

# PROSIDING

## PERSIDANGAN KEBANGSAAN TEKNOLOGI KEJURUTERAAN 2013

*2<sup>nd</sup> National Conference on Engineering Technology (NCET) 2013*

*'Knowledge Application Generates Transformation'*

1 – 2 Julai 2013

Setia City Convention Centre, Setia Alam, Selangor

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## ~Pra-kata~

2nd National Conference on Engineering Technology, NCET 2013 adalah aktiviti ilmiah yang bermatlamatkan untuk menggalakkan penyelidikan, pembangunan dan inovasi di kalangan pensyarah, pengajar dan kakitangan melalui pembentangan kajian penyelesaian masalah dalam bidang kejuruteraan dan teknologi. Persidangan anjuran Jabatan Tenaga Manusia ini dijalankan pada setiap dua tahun bermula pada tahun 2011. Bagi tahun 2013 persidangan ini telah diteruskan lagi dengan tema '*Knowledge Application Generates Transformation*'. NCET 2013 juga menggalak dan menambah penerbitan teknikal oleh mana-mana institusi pengajian tinggi dan institusi latihan yang berteraskan teknologi dan kemahiran. Pensyarah, tenaga pengajar dan kakitangan dapat berkongsi pengetahuan, kemahiran dan kepakaran melalui pembentangan kertas kerja persidangan.

Pada NCET 2013 yang telahpun diadakan di Setia City Convention Centre (SCCC), Setia Alam, Selangor pada 1 dan 2 Julai 2013 dengan pembentangan sebanyak 67 kertas persidangan. Sebanyak 51 kertas persidangan telahpun dibentangkan secara *oral presentation* dan sebanyak 16 kertas persidangan turut dibentangkan secara *poster presentation*. Kesemua kertas persidangan yang telah dibentangkan adalah dalam bidang Teknologi Kejuruteraan Elektrikal / Elektronik / Telekomunikasi, Teknologi Kejuruteraan Mekanikal, Teknologi Kejuruteraan Sivil, Teknologi Kejuruteraan Komputer / Teknologi Maklumat, Teknologi Kejuruteraan Bukan Logam / Percetakan / Hal Ehwal Latihan Teknik-Vokasional.

2nd National Conference on Engineering Technology anjuran Jabatan Tenaga Manusia pada tahun ini turut mendapat penyertaan daripada, Universiti Kebangsaan Malaysia, Universiti Teknikal Malaysia Melaka, Universiti Tun Hussein Onn Malaysia, Universiti Selangor, Pusat Latihan Pengajar Dan Kemahiran Lanjutan (CIAST), Jabatan Pembangunan Kemahiran selain daripada penyertaan Institusi Latihan Jabatan Tenaga Manusia (ADTEC dan ILP) sendiri.

Persidangan ini telahpun berjalan dengan jayanya dengan kerjasama pelbagai pihak. Adalah diharapkan agar persidangan seterusnya akan mendapat penyertaan daripada lebih banyak institusi pengajian tinggi dan institusi latihan kemahiran (awam dan swasta) dan juga sektor lain yang berkaitan demi untuk memartabatkan pendidikan dan latihan dalam bidang teknologi dan kemahiran vokasional di Malaysia ini.

## *~ Kata-Kata Aluan ~*

**YBhg Dato' Haji Romli Bin Haji Hassan**

**Prosiding  
National Conference On Engineering Technology (NCET) 2013**

Assalamualaikum Warahmatullahi Wabarakaatuh, Salam Sejahtera dan Salam 1 Malaysia.

Alhamdulillah, dengan izin Allah, *National Conference on Engineering Technology* (NCET) 2013 yang berkonsepkan perkongsian pengetahuan melalui pengembangan pemikiran teknologis yang diterjemahkan kepada hasil kreativiti dan inovasi teknologi dapat terus kita jayakan lagi.

Kesinambungan penganjuran persidangan lalu telah membawa cetusan kepada percambahan minda yang seterusnya menghasilkan versi baru dalam persembahan melalui kepelbagaian aktiviti penyelidikan dan pengembangan idea terhadap inovasi di kalangan para pensyarah kemahiran di Malaysia. Manfaatkanlah kesempatan yang bermakna ini untuk bersama-sama secara berterusan saling belajar untuk meningkatkan pengetahuan, kemahiran dan kepakaran agar dapat menyumbang lebih banyak lagi idea dan penerbitan berunsur teknikal yang berkualiti dan canggih di masa akan datang.

Perkongsian pengalaman dalam bidang kepakaran teknikal dan kemahiran di kalangan pensyarah dilihat akan memperkasakan lagi kelangsungan pengembangan tenaga kerja berdaya saing. Ini seiring dengan usaha kerajaan untuk mengarus perdanakan dan memperluaskan Pendidikan Teknikal dan Latihan Vokasional atau TVET sebagai pilihan tepat dalam pembangunan laluan kerjaya dan kesejahteraan rakyat sebagaimana direncanakan dalam strategi Rancangan Malaysia Kesepuluh (RMK10). Kejayaan usaha murni ini juga adalah hasil sokongan Kementerian melalui galakan penganjuran program-program berkaitan sains dan teknologi oleh ILJTM yang secara langsung akan memangkin peningkatan dalam pencapaian ekonomi berpendapatan tinggi di bawah Model Baru Ekonomi (MBE). Persidangan akan terus menjadi salah satu medan membuktikan kepada semua betapa peranan pensyarah-pensyarah kemahiran sentiasa relevan dan memberi sumbangan yang cukup besar dalam arus pembangunan negara.

Penglibatan berterusan pensyarah kemahiran dalam menonjolkan kemampuan kreativiti, inovasi dan reka cipta secara berterusan akan disokong tidak sekadar untuk tatapan ilmiah semata malah sebagai pengenalan kepada produk baru di peringkat kebangsaan mahupun di mata dunia. Kelangsungan NCET yang diusahakan oleh JTM ini diharap akan memartabatkan JTM dalam meneraju pembangunan sumber tenaga kerja berdaya saing melalui sokongan dan galakan yang tidak berbelah bagi terhadap usaha-usaha penyelidikan, pembangunan, kreativiti dan inovasi serta peningkatan penerbitan bahan teknologi dan kejuruteraan di kalangan pensyarah kemahiran. Oleh itu, adalah diharapkan agar penerbitan prosiding NCET 2013 boleh dimanfaatkan bersama oleh semua pihak.

Sekian, terima kasih.

**(DATO' HAJI ROMLI BIN HAJI HASSAN)  
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# Ucaptama 1:

## Tajuk : Knowledge Application Generates Transformation

Oleh: Yang Berbahagia Profesor Dato Ir. Dr. Badhrulhisham bin Abdul Aziz  
Timbalan Naib Canselor (Akademik & Antarabangsa)  
Jabatan Hal Ehwal Akademik & Antarabangsa  
Universiti Malaysia Pahang (UMP)

- Road To 2020

1 Malaysia ó preservation and enhancement of unity in diversity, April 2009  
Government Transformation Programme (GTP), January 2010  
Economic Transformation Programme, 2010  
10<sup>th</sup> Malaysian Plan, June 2010

- Coherent -big push to boost transformation and growth:

Enablers :

- ✚ Break logjam of vested interests through political will and leadership
- ✚ Prepare people for change

Strategic Reform Initiatives:

- ✚ Re-energising the private sector
- ✚ Developing quality workforce, reducing dependence on foreign labour
- ✚ Creating a competitive domestic economy
- ✚ Strengthening the public sector
- ✚ Transparent and market friendly affirmative action
- ✚ Building the knowledge base infrastructure
- ✚ Enhancing the source of growth
- ✚ Ensuring sustainability of growth

Outcome :

- ✚ High income
- ✚ Inclusiveness
- ✚ Sustainability

- TVET is critical in the 10<sup>th</sup> Malaysia Plan

Policy Guidelines From The 10th Malaysian Plan:

Improving the Perception of TVET and Attracting More Trainees

í a national media campaign will be developed and rolled-outí

- ✚ 69 out of 88 technical schools will be converted into vocational schools í six new vocational schools will be established by 2015 ...

Upgrading and Harmonising TVET Curriculum Quality in Line with Industry Requirements

- ✚ í standardize TVET curriculum...

- ✚ Recognizing and equating various levels of Malaysian Skills Certificate with certifications issued by TVET providers
- ✚ í a Board of Technologists Malaysia will be established
- ✚ Malaysia-Japan International Institute of Technology will be established as an independent institute

#### Developing Highly Effective Instructors

- ✚ Highly experienced industry personnelí to become instructors ...
- ✚ part-time working arrangements will be expanded
- ✚ í Centre for Instructor and Advanced Skills Training (CIAST) will be expanded..
- ✚ A new centre for instructor skills training will be developed to add a further training capacity of 800 instructors each year

#### Streamlining Delivery of TVET

- ✚ The current funding approach of TVET will be reviewedí provide financial assistance to students to study at Malaysian Skills Certificate Level 3
- ✚ The performance rating of TVET institutions will be utilized when making decisions for buying placesí in private TVET institutions
- ✚ A total of RM 150 million will be set aside to train 20,000 school dropouts during the Plan period

- The Establishment of Malaysia Board of Technologists (MBOT)

To elevate the standing and recognition of Technologists and Technicians

To increase the pool of skilled workforce required to attain a high income economy

To improve public perception of TEVT and attract more students

To protect public safety and health through

\* In order to distinguish between engineering and engineering technology, a technological spectrum is used to illustrate the differences. Generally, in an organization, engineers would most likely work in the design and development fields while technologists, technicians and craftsmen would be more inclined to work in manufacturing and production line. The engineers role are more towards the left of the spectrum while the technologists are more towards the right of the spectrum although the main activities of both engineers and technologist are in the center of the spectrum.

## Ucaptama 2 :

### Tajuk : IP Protection Towards Developed Nations (Patent)

Oleh: Pn. Fatimah Rohada Dahalan,  
Director Of Patent Examination Section (Engineering),  
Intellectual Property Corporation Of Malaysia (MyIPO)

- Patents - An exclusive right granted for a new invention, which is a product or a process
- Industrial Designs - The ornamental or aesthetic aspect of an article
- Geographical Indications - an indication which identifies any goods as originating in a country or territory
- A patent is an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem .
- Procedure :
  - application
  - preliminary examination
  - application laid open for public inspection
  - substantive or modified substantive examination
  - grant or refusal
  - period of protection
- 1.47% increase (2011 vs. 2010)
- Foreign applications outnumbered locals (locals 17%)
- Importance Of Strong Patent Protection
  - Encourage Transfer Of Technology and creation of knowledge and information through publication
  - exclusive rights vs. publications
  - Incentive to Invest in R & D ó researchers and investor will recover cost due to exclusivity for the limited time period
  - Attract Foreign Direct Investment ó Increase confidence of MNCs to invest in R & D facilities and manufacturing
  - Promotes investment in commercialization of new products for publicø benefit ó enforcement of protection to empower owners to fight infringement

# **E1 - Sistem Pengesan Penceroboh Melalui SMS untuk Motosikal (Intruder Alert System via SMS for Motorcycle)**

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## **Abstrak**

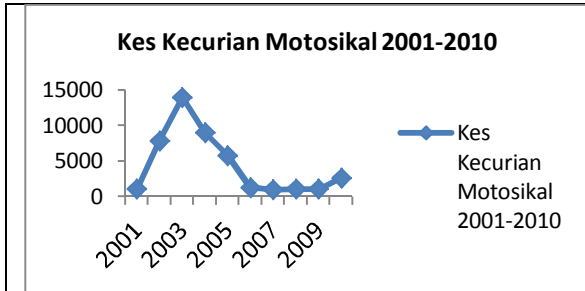
*Kes kecurian motosikal merupakan kes kecurian kenderaan paling tinggi saban tahun, justeru Sistem Pengesan Penceroboh melalui SMS untuk Motosikal (Intruder Alert System via SMS for Motorcycle) di cipta bagi menangani masalah ini. Selain itu juga ia merupakan satu perkembangan teknologi dalam bidang automotif. Satu sistem penghantaran data/mesej ke telefon bimbit (handphone) melalui modul transmitter dan modul receiver dapat dilaksanakan dengan bantuan Mikropengawal PIC. Untuk melaksanakan sistem ini, beberapa litar elektrik digunakan supaya penghantaran data dapat dilakukan melalui transmitter, receiver ke telefon bimbit dengan hanya menekan suis "LOCK" pada remote kawalan jauh maka sistem dalam keadaan diaktifkan, kemudian apabila suis "UNLOCK" pada kawalan jauh ditekan, maka ia akan mematikan semua sistem. Jika terdapat gangguan pada motosikal sensor akan mengaktifkan penggera serta sistem akan menghantar pesanan ringkas pada pengguna dan pada masa yang sama gear akan dikunci. Sistem Pengesan Penceroboh melalui SMS untuk Motosikal boleh diaplikasikan ke atas semua jenis motosikal yang ada dipasaran.*

**Kata kunci:** Mikropengawal PIC, pesanan ringkas, vibrator sensor.

## **1.0 Pengenalan**

Industri Automotif telah berkembang dengan begitu pesat kerana merupakan keperluan yang penting dalam kehidupan manusia, perkembangan industri ini adalah seiring dengan perkembangan teknologi telekomunikasi. Pembangunan Sistem ini bertujuan untuk mengurangkan kadar kecurian motosikal yang meningkat setiap tahun. Berdasarkan kajian sumber yang telah dibuat ada banyak sistem yang telah direka namun ianya mempunyai banyak perbezaan jika dibandingkan dengan sistem ini, antara perbezaan yang dikenal pasti adalah dari segi kos dan pengoperasian sistem yang sedia ada dipasaran seperti *electronic lock*, *solex lock* dan *motorcycle alarm*, namun kecurian motosikal masih lagi meningkat khususnya di negara kita Malaysia. Mengikut statistik[1] yang dikeluarkan oleh PDRM, jumlah kecurian motosikal di seluruh Malaysia dari tahun 1997 hingga tahun 2010 iaitu sebanyak 78,119 tidak termasuk kes yang tidak dilaporkan. Motosikal juga merupakan jenis kenderaan paling tinggi kes kecuriannya[2]. Selain itu, faktor kos peralatan (produk sedia ada) dipasaran juga diambil kira bagi penggunaan sistem penggera pada motosikal bagi menentukan ianya berpatutan atau sebaliknya. Ini adalah disebabkan harga dipasaran produk sedia ada seperti sistem penggera motosikal nilainya terlalu mahal. Oleh itu, ianya menyebabkan kesukaran bagi pemilik kenderaan motosikal ini untuk memiliki peralatan yang berteknologi ini. Dengan itu, satu pengubahsuaian rekabentuk sistem penggera motosikal ini perlu dilakukan di mana fungsi sistem adalah sama dengan sistem produk yang sedia ada tetapi terdapat beberapa penambahbaikan yang mungkin dapat membantu pengguna motosikal. Ia merupakan satu sistem yang telah diperbaharui dari segi keselamatan, iaitu motosikal tidak dapat dihidupkan walaupun kunci utama telah dicerobohi. Sistem ini juga

menggunakan sistem mikropengawal 16F84A dimana mengawal keseluruhan sistem. Selain itu sistem ini juga mempunyai bekalan kuasa tambahan dimana ianya dapat mengawal semua sistem jika pencuri cuba memutuskan bekalan kuasa dari bateri.



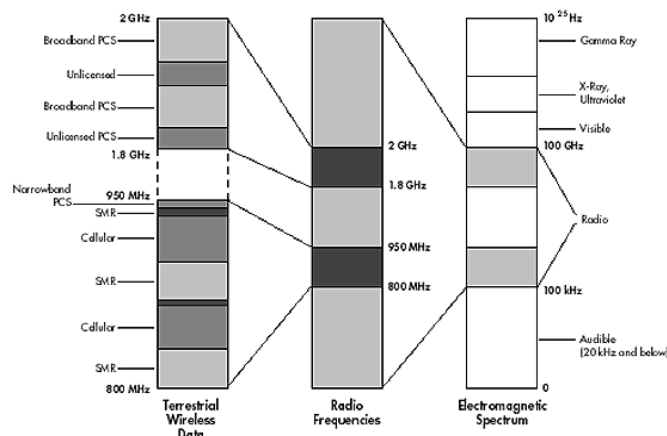
**Gambarajah 1:** Kes Kecurian Motosikal 2001-2010

JENAYAH HARTA BENDA	2005		2006		2007 (Jan-Feb)	
	Jumlah Kes	Selesai Kes	Jumlah Kes	Selesai Kes	Jumlah Kes	Selesai Kes
CURI	34,317	19,626	37,128	20,099	6,580	3,249
CURI VAN/LORI/JENTERA BERAT	5,507	1,667	6,328	587	938	161
CURI MOTOKAR	9,711	4,532	11,101	2,935	1,862	459
CURI MOTOSIKAL	51,709	22,448	64,858	10,330	11,637	3,126

**Gambarajah 2:** Statistik Kehilangan motosikal

## 2.0 Latar Belakang

Sistem ini menggunakan isyarat RF (radio frekuensi) sebagai medium penghantar dan penerimaan data dalam bentuk gelombang berfrekuensi melalui ruang udara. Isyarat yang dipancarkan adalah dalam garis lurus tanpa halangan diantara dua medium ini. Untuk perhubungan sehala, satu pemancar (*transmitter*) dan satu penerima (*receiver*) diperlukan. Apabila pemancar menghantar data melalui medium yang dikongsi, maka semua penerima yang berada di dalam lingkungannya akan menerima isyarat tersebut. Proses mengkod (di dalam pemancar) akan memasukkan kod-kod tertentu di dalam isyarat yang dihantar. Apabila penerima menerima isyarat tersebut, ia akan menyahkod bagi mengenalpasti dan memproses data yang dihantar untuk dirinya sahaja dan mengabaikan data yang dihantar untuk penerima lain, penghantaran dan penerimaan isyarat adalah dalam lingkungan 100-1000 meter sahaja. Gambarajah di bawah menunjukkan julat dalam radio frekuensi.

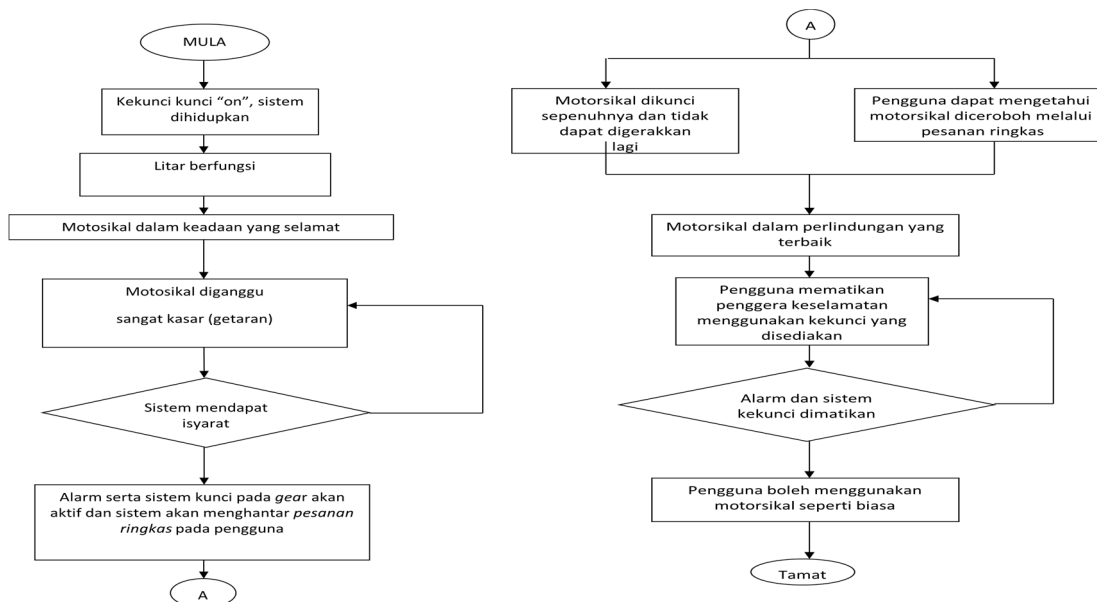


**Gambarajah 3:** Julat dalam Radio Frekuensi

### 3.0 Metadologi Projek

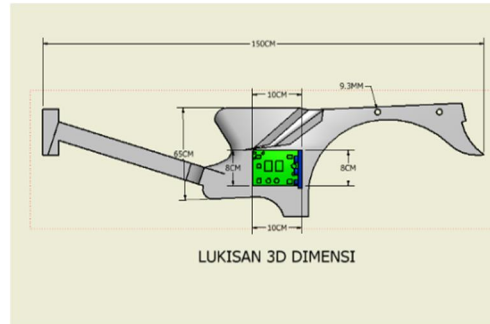
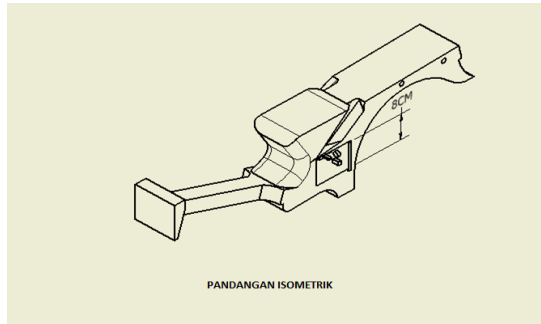
Sistem ini berfungsi melalui antaramuka (*interface*) antara mikropengawal 16F84A sebagai litar kawalan dan perhubungan melalui telefon bimbit pengguna untuk menghantar pesanan ringkas apabila terdapat gangguan pada motosikal pengguna melalui isyarat pemancar dan penerima data. Fungsi sistem ini adalah sebagai kunci tambahan bagi sistem keselamatan motosikal pengguna. penambahan ciri-ciri keselamatan bagi mengurangkan kadar kecurian motosikal di negara ini. Sistem berfungsi apabila butang “*LOCK*” pada *remote butang kawalan jauh* ditekan maka sistem dalam keadaan diaktifkan, Kemudian Apabila butang “*UNLOCK*” pada *butang kawalan jauh* ditekan, maka ia akan mematikan semua sistem. Jika terdapat gangguan pada motosikal, *penggera* akan sentiasa berbunyi serta sistem akan menghantar *pesanan ringkas* pada pengguna dan pada masa yang sama gear akan dikunci. Penggunaan kunci sentral (*central lock*) digunakan sebagai peranti yang mengunci pergerakan pada sporket rantai motosikal.

#### 3.0.1 Carta Alir Kefungsian Sistem



#### 3.0.2 Rekabentuk

AutoCAD adalah perisian '*computer aided design*' yang khusus untuk lukisan teknikal seperti lukisan '*architectural*', '*mechanical*' atau '*electrical*' sehingga lukisan umum. Sistem Pengesan Penceroboh Melalui SMS untuk Motosikal menggunakan perisian AutoCAD 2007 bagi merekabentuk model yang lebih kompleks dan ukuran (8cm x 10cm ) yang tepat serta bersesuaian dengan saiz yang boleh diaplikasikan pada semua jenis motosikal yang ada di pasaran. Sistem ini biasanya akan di pasang pada bahagian dalam atau pun di bawah tempat duduk penunggang, ianya sukar dikesan kerana kedudukan sistem ini tersembunyi dan tidak dapat dilihat dari luar melainkan ia dibuka atau dipecahkan. Gambarajah 4 dan 5 menunjukkan dua sudut pandangan iaitu tiga dimensi dan isometrik.

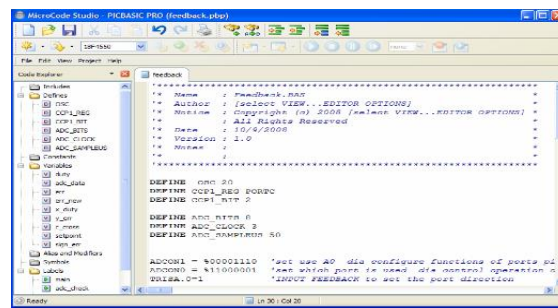


Gambarajah 4: Lukisan 3D

Gambarajah 5: Pandangan Isometri

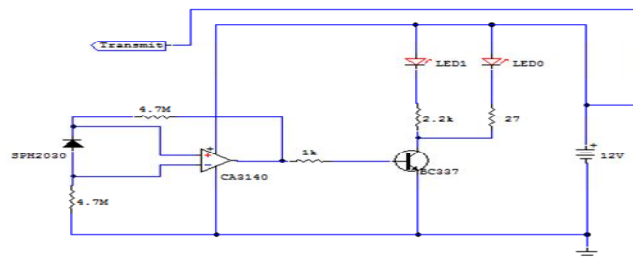
### 3.0.3 Aplikasi Perisian

Sebuah perisian perlu digunakan untuk mengawal keseluruhan sistem ini, perisian *Microcode Studio* adalah perisian yang telah digunakan bagi sistem ini, ia merupakan *Integrated Development Environment (IDE)* direka bersama pengkompil PICBASIC PRO[7]. Perisian ini adalah mudah untuk membangunkan aturcara, mengenalpasti kesalahan penulisan aturcara dan bersifat *user friendly*.



Gambarajah 6: Perisian MicroCode Studio

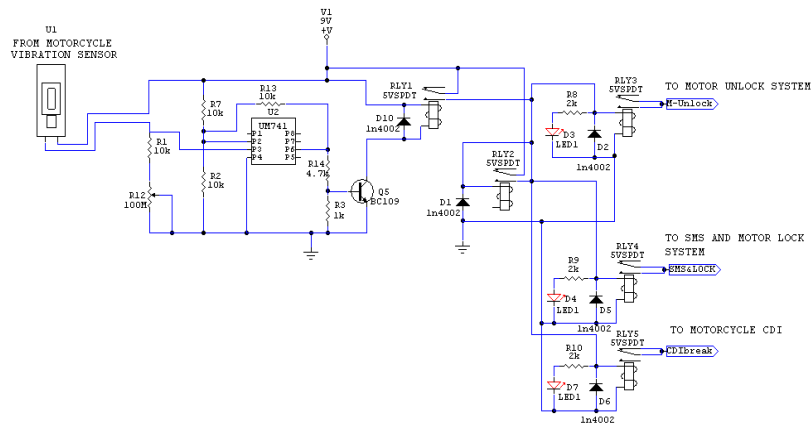
### 3.0.4 Litar Elektrik



Gambarajah 7: Litar Pemancar

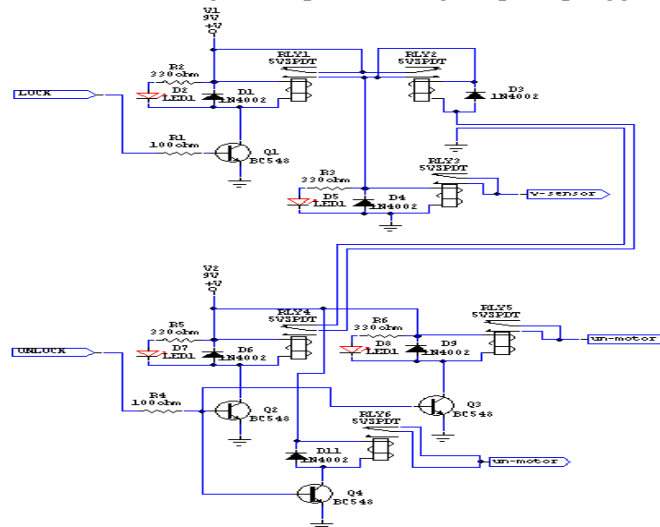
Gambarajah 7 merupakan Litar pemancar yang berfungsi untuk menghantar isyarat kepada litar penerima untuk menghidupkan sistem keselamatan motorsikal melalui alat kawalan jauh sebagai pengantara isyarat.





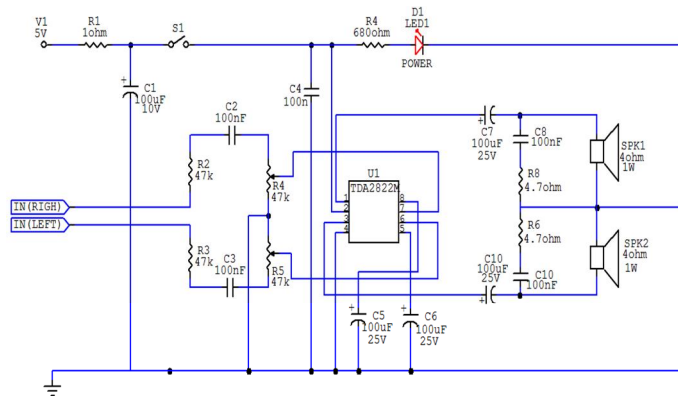
**Gambarajah 8:** Litar Pengesan Getaran

Gambarajah 8 merupakan Litar pengesan getaran ialah satu litar yang direka untuk mengesan sebarang gangguan dan getaran pada suis. Ia berfungsi apabila terdapat getaran pada suis dan akan menghantar isyarat kepada sistem PIC kemudian isyarat akan dihantar kepada litar utama seterusnya Buzzer akan berbunyi selama 24 saat kemudian sistem akan menghantar pesanan ringkas pada pengguna.



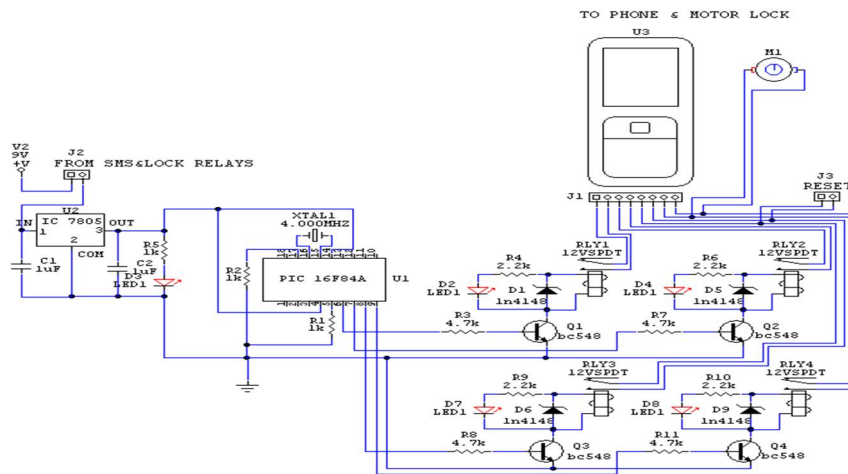
**Gambarajah 9:** litar sistem kawalan kunci dan nyah-aktif

Gambarajah 9 merupakan litar sistem kawalan kunci dan nyah-aktif yang berfungsi mengaktifkan dan menyah-aktifkan sistem kawalan.



**Gambarajah 10: Litar Pembesar Suara**

Gambarajah 10 merupakan Litar Pembesar suara yang berfungsi untuk menghasilkan bunyi yang lantang jika berlaku pencerobohan pada motosikal.



**Gambarajah 11: Litar SMS & Kekunci Gear**

Gambarajah 11 merupakan Litar SMS & KEKUNCI GEAR, Mikropengawal 16F84A ini berfungsi untuk mengawal keseluruhan sistem. Litar ini juga mengawal fungsi suis dan pengesan. Ia juga mengawal dan memberi isyarat kepada sistem *penggera*. Apabila berlaku kecurian sistem ini akan menghantar isyarat kepada *penggera* seterusnya *buzzer* akan berbunyi dan pengguna akan mendapat pesanan ringkas (SMS). Manakala *litar kunci* berfungsi untuk mengunci *gear* supaya motosikal tidak dapat di bergerak. Litar ini berfungsi apabila litar *pengesan gegaran* mengesan gegaran ataupun hentakan.

#### 4.0 Keputusan Dan Perbincangan

Berdasarkan kepada jadual 1 dibawah, Pengujian ini telah dijalankan pada lima jenis motosikal pelajar dan didapati sistem ini telah beroperasi dengan lancar. Jadual 2 pula merujuk kepada data yang boleh diterima mengikut jarak yang di uji. Hasil daripada

pengujian tersebut, terdapat beberapa perkara yang perlu dibaiki pada masa kan datang, contohnya menggunakan sistem GSM sebagai medium penghantar data dan membuat panggilan. Empat gelombang GSM digunakan iaitu 850MHz, 900Mhz, 1800Mhz dan 1900Mhz, namun dua gelombang paling terkenal dan digunakan di Malaysia iaitu 900 dan 1800MHZ[7].

MASUKAN (INPUT)	KELUARAN (OUTPUT)
Suis "kunci" ditekan	Litar penggera aktif
Gangguan pada motor	Siren berbunyi
	Litar SMS akan aktif dan SMS dihantar kepada pengguna motosikal
	Motosikal tidak dapat digerakkan kerana sporket telah dikunci
Suis "penyah-aktif" ditekan	Litar penggera dinyah-aktifkan dan siren dimatikan

**Jadual 1:** Keputusan Pengoperasian Sistem

Jarak (meter)	Data
50-350	Terima
350-500	Terima
500>	Tiada

**Jadual 2:** Jarak Penghantaran data

## 5.0 Kesimpulan

Sistem Pengesan Penceroboh untuk kenderaan menjadi perkara yang penting untuk menjamin keselamatan harta peribadi. Dengan terhasilnya "Sistem Pengesan Penceroboh Melalui SMS untuk Motosikal" ia dapat mengurangkan kes kecurian motosikal yang semakin meningkat. Rekabentuknya yang mudah dan kecil adalah salah satu daya tarikan kepada pengguna. Di samping itu, dari segi kefungsiannya sistem ini. "Sistem Pengesan Penceroboh Melalui SMS untuk Motosikal" boleh diaplikasikan ke atas semua jenis motosikal yang ada dipasaran. Walaubagaimanapun RF isyarat yang dihantar mestilah di dalam kawasan lingkungannya dan ia amat terhad. Bagi mendapatkan isyarat penerimaan dan penghantaran data dan panggilan telefon yang lebih cekap dan jarak yang jauh tanpa sebarang gangguan GSM 'Global System for Mobile Communication' adalah lebih sesuai untuk penambahbaikan pada masa akan datang.

## 6.0 Rujukan

- [1] <http://www.jurnalmalaysia.com/index.php/berita-terkini/422-statistik-10-tahun-kenderaan-di-malaysia>
- [2] [www.pmo.gov.my/dokumenattached/BM\\_GTP2012\\_AR\\_Full.pdf](http://www.pmo.gov.my/dokumenattached/BM_GTP2012_AR_Full.pdf)
- [3] <http://www.postel.go.id/content/ID/regulasi/frekuensi/kepmen/101106%20white-paper%20bwa.pdf>
- [4] [http://www.motorcyclistonline.com/gearbox/122\\_0901\\_motorcycle\\_security\\_systems/](http://www.motorcyclistonline.com/gearbox/122_0901_motorcycle_security_systems/)
- [5] <http://www.internationaljournalsrg.org>
- [6] Beyda, W.J., 1996. Data Communications from Basics to Broadband. Ed. Ke-2. Prentice Hall Inc, New Jersey.
- [7] Linacre, Jordan h., 2006. PIC Basic Project 30 Project Using PIC basic and PIC BASIC PRO. Microchip Technology Inc, Great Britain.
- [8] Elia Nadira, Sabudin, Siti Zarina Mohd Muji, Mohd. Helmy Abd Wahab, Ayob Johari, Norazman Bin Ghani, "GSM-based Notification Speed Detection for Monitoring Purposes", IEEE, Department of Computer Engineering, University Tun Hussein Onn Malaysia in 2008.

## E2 - Sistem Penjejak Solar Bagi Meningkatkan Keluaran Kuasa Maksimum

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### **Abstrak**

*Permintaan kepada tenaga elektrik telah meningkat setiap tahun akibat daripada pembangunan setempat dan pertambahan penduduk di Malaysia. Ia merangkumi kilang, kawasan perumahan, bangunan dan aktiviti harian. Salah satu sumber alternatif adalah tenaga matahari. Tenaga ini merupakan tenaga yang murah dan tenaga yang boleh diperbaharui. Oleh kerana matahari bergerak dari timur ke barat, penggunaan panel solar yang statik tidak boleh bergerak mengiringi matahari, ia akan menghasilkan kuasa keluaran yang minimum. Bagi mendapatkan kuasa keluaran yang maksimum, panel solar perlu sentiasa menghadap matahari secara konsisten. Kajian ini bertujuan untuk merekabentuk sistem penjejak solar satu paksi yang boleh bergerak menghadap matahari secara konsisten dari timur ke barat, menggunakan penderia cahaya dan motor arus terus yang dikawal oleh mikropengawal akan dibentangkan.*

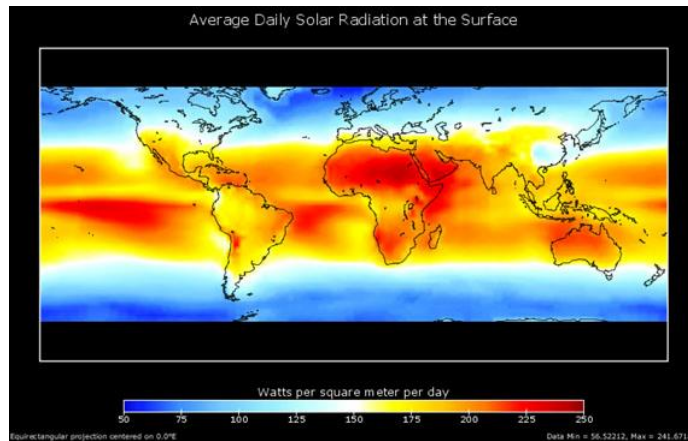
**Kata Kunci :** *Penjejak Solar, Mikropengawal, Penderia cahaya*

### **1.0 Pengenalan**

Di Malaysia cahaya matahari tidak dipengaruhi oleh musim. Dianggarkan sehari mendapat 175~200 watt meter persegi. Sila rujuk Gambarajah 1. Sumber fosil sebenarnya adalah sumber yang terhad dan untuk mengatasi masalah ini, penggunaan tenaga alternatif seperti tenaga suria telah diperkenalkan. Matahari boleh dianggap sebagai sebuah badan hitam yang mempunyai fluks tenaga yang ia mengeluarkan suhu dan berkadar terus dengan pemalar Stephan-Boltzmann. Oleh kerana matahari mempunyai suhu lebih kurang 5770K, menyebabkan tenaga fluks (per unit luas) ialah: [1]

$$E_{\text{matahari}} = T^4 = 6.28 \times 10^7 \text{ W/m}^2 \quad \text{Dimana pemalar Stephan-Boltzmann,}$$
$$= 5.67 \times 10^{-8} \text{ W/m}^2\text{K}$$

$$T_{\text{matahari}} = \sim 5770\text{K} = \text{suhu permukaan matahari}$$



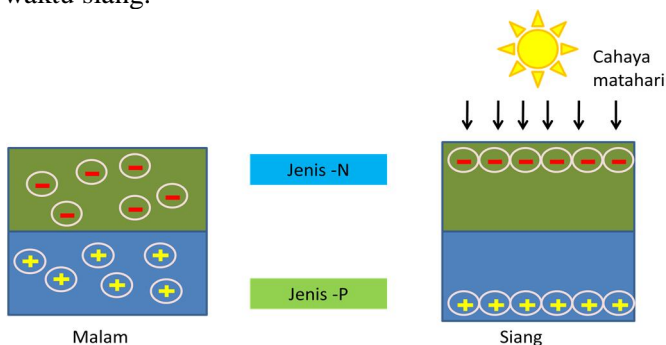
**Gambarajah 1: Purata Pancaran Matahari Di Bumi**

## 2.0 Kajian Latar Belakang

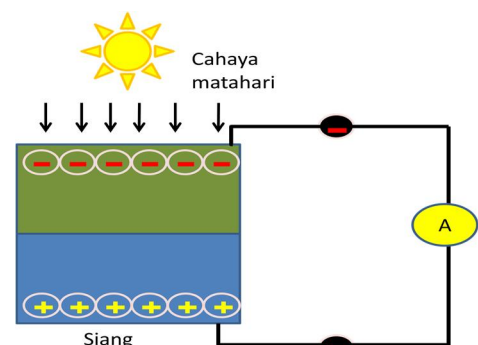
Kuasa solar atau matahari telah lama dipraktikkan oleh masyarakat nenek moyang kita dahulu secara tradisional seperti mengeringkan pakaian dan makanan, masyarakat yang menetap di kawasan terpencil serta saintis aeroangkasa ataupun *National Aeronautics and Space Administration* (NASA) seperti kapal angkasa dan satelit. Kesan fotoelektrik yang pertama dinyatakan oleh seorang ahli fizik Perancis Edmund Bequerel pada tahun 1839. Beliau mendapati bahawa bahan-bahan tertentu akan menghasilkan jumlah arus elektrik apabila terdedah kepada cahaya. Pada tahun 1905, Albert Einstein pula menyifatkan sifat cahaya dan kesan fotoelektrik berdasarkan teknologi *photovoltaic* serta memenangi hadiah Nobel dalam fizik. [2]

### 2.1 Teknologi *Photovoltaic* (PV)

Panel solar adalah elemen semulajadi iaitu apabila didedahkan kepada cahaya matahari ia akan menghasilkan tenaga elektrik. Ia diperbuat daripada bahan separuh pengalir yang mempunyai sebelah positif dan sebelah lagi negatif. Apabila tenaga matahari memancar di atas panel solar, ia akan menyerap atau memantul semula. Tenaga matahari yang diserap oleh panel solar ini akan menghasilkan arus elektrik. PV mempunyai dua jenis sel iaitu jenis-N dan jenis-P. Apabila litar terbuka dan mendapat cahaya, pembawa akan bertambah dan bercantum antara satu sama lain. Manakala litar tertutup dan mendapat cahaya, ia akan menghasilkan arus elektrik. Gambarajah 2 dan 3 menunjukkan operasi PV ketika waktu malam dan ketika waktu siang.



**Gambarajah 2: Litar Terbuka**

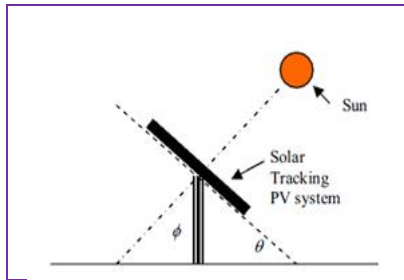


**Gambarajah 3: Litar Tertutup**

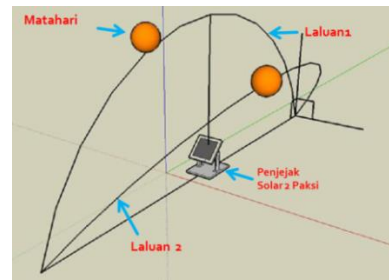
## 2.2 Penjejak Solar

Penjejak solar adalah alat bagi mengawal panel solar bergerak dari timur ke barat menghadap matahari. Terdapat dua jenis penjejak solar iaitu:

- i. **Penjejak solar satu paksi.** Mendapat hampir 30% kuasa keluaran tambahan berbanding panel solar statik. Pergerakan panel solar dari timur ke barat pada satu laluan matahari sahaja. Sila rujuk Gambarajah 4.
- ii. **Penjejak solar dua paksi.** Kuasa keluaran hanya mendapat tambahan 6% berbanding penjejak solar 1 paksi. Panel solar ini bergerak dari timur ke barat melalui dua laluan matahari. Sila rujuk Gambarajah 5. [3]



Gambarajah 4: Penjejak Solar Satu Paksi

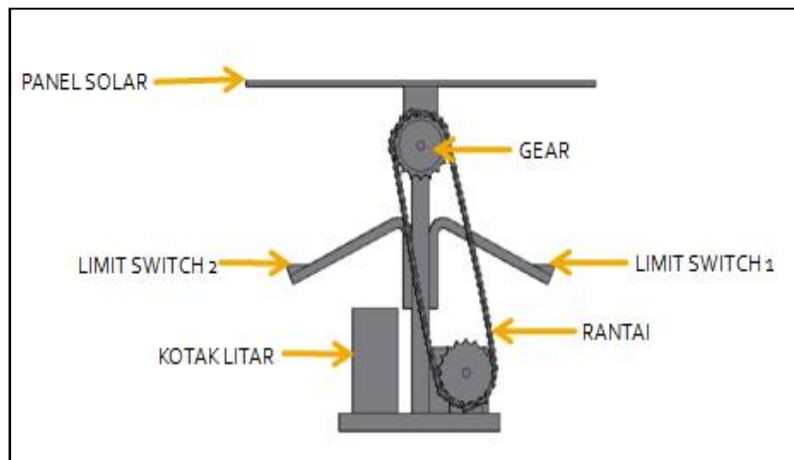


Gambarajah 5: Penjejak Solar Dua Paksi

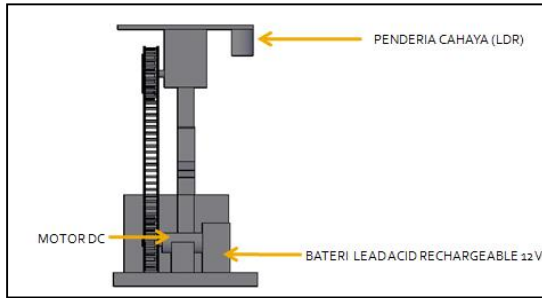
## 3.0 Rekabentuk

### 3.1 Rekabentuk Mekanikal

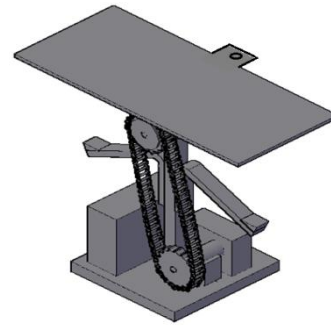
Gabungan daripada semua komponen akan menghasilkan satu rekabentuk sistem penjejak solar yang terbaik. Ia dilukis dalam pandangan hadapan, pandangan sisi kanan dan pandangan 3 dimensi menggunakan perisian AUTOCAD 2010. Sila rujuk Gambarajah 6, 7 dan 8. Manakala projek sebenar boleh dirujuk Gambarajah 9.



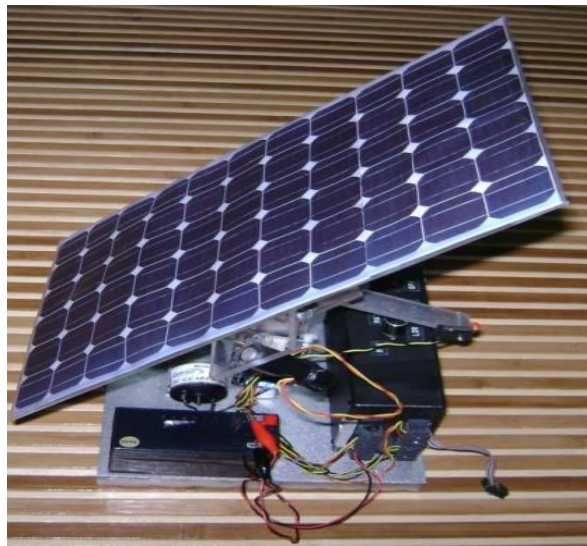
Gambarajah 6: Pandangan Hadapan



**Gambarajah 7:** Pandangan Sisi Kanan



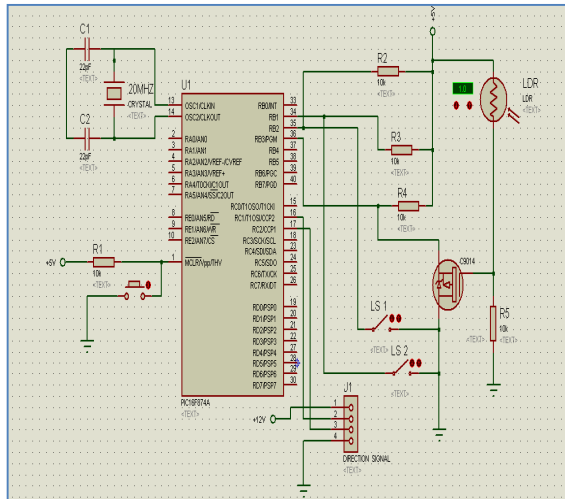
**Gambarajah 8:** Pandangan 3D



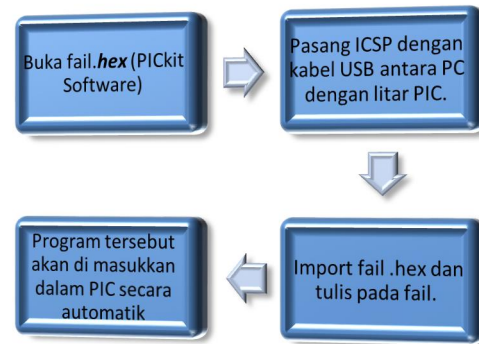
**Gambarajah 9:** Projek Sebenar

### 3.2 Rekabentuk Elektrikal

Oleh kerana projek ini mempunyai dua bekalan voltan yang berbeza, satu untuk litar mikropengawal (5V) dan satu lagi untuk litar pemacu motor arus terus (12V). Maka satu litar pengatur voltan perlu dibuat untuk mendapatkan voltan (5V) manakala bekalan kuasa 12V boleh diambilkan terus pada bateri *Lead Acid Rechargeable*. Sistem penjejak solar ini menggunakan mikropengawal 16F877A untuk mengawal keseluruhan sistem penjejak ini. Ia meliputi dua bahagian input iaitu, penukaran voltan analog daripada litar penderia cahaya untuk mengesan kedudukan cahaya matahari dan sebuah *potentiometer* untuk melaras input penderia cahaya supaya pergerakan panel konsisten seiring pergerakan matahari. Manakala bahagian keluaran pula adalah untuk mengawal motor arus terus bagi menggerakkan panel solar. Mikropengawal merupakan otak kepada projek ini, dimana setiap komponen yang digunakan dikawal oleh mikropengawal ini. Sila rujuk Gambarajah 10. Litar pengayun digunakan pada litar mikropengawal ini bagi menghasilkan denyut masa yang stabil dan tepat. Jarak denyut masa yang digunakan diantara kilohertz (kHz) kepada megahertz (MHz). Dua kapasitor 22pF telah digunakan untuk menapis hingar dari luar litar mikropengawal tersebut.



**Gambarajah 10:** Litar skematik bagi litar mikropengawal 16F877A



**Gambarajah 11:** Cara Memasukkan Aturcara Ke Dalam PIC

Penderia cahaya adalah jenis penderia yang selalu digunakan dalam litar elektronik. Penderia cahaya yang paling mudah ialah *Light Dependent Sensor (LDR)*. Sebuah LDR akan digunakan sebagai penderia cahaya dalam sistem penjejak ini. Penderia cahaya ini adalah input bagi mikropengawal. Apabila LDR mendapat cahaya terang, rintangan pada LDR akan menurun dan voltan input mikropengawal akan tinggi. Manakala apabila LDR tidak mendapat cahaya (gelap), rintangan pada LDR akan meningkat dan voltan input mikropengawal akan rendah. Sila rujuk jadual 1 dan 2.

Keadaan Cahaya Pada LDR	Mikropengawal
Terang	Memberi isyarat pada motor berhenti.
Gelap	Memberi isyarat pada motor bergerak ke barat sehingga mendapat cahaya terang semula.

**Jadual 1:** Kendalian LDR

	LDR	Motor
Keadaan Cahaya	Gelap	Bergerak ke barat
	Terang	Berhenti

**Jadual 2:** Operasi Motor Arus Terus

Sebuah tiub PVC (*Polyvinyl Chloride*) yang mempunyai ketinggian 6cm digunakan bagi meletakkan penderia cahaya untuk meningkatkan kepekaan penderia cahaya tersebut. Penggunaan motor arus terus digunakan untuk menggerakkan panel solar. Apabila motor berputar, ia akan menggerakkan panel solar dan akan menggerakkan juga penderia cahaya (LDR) kepada kedudukan baru. Penderia ini akan menghantar isyarat kepada mikropengawal untuk memproses data tersebut bagi mengawal putaran motor kepada kedudukan seterusnya. Pemacu Motor Arus Terus digunakan untuk mengawal 2 arah motor arus terus. Ia berfungsi dalam keadaan voltan motor diantara 3V hingga 25 V. Pemacu jenis ini mempunyai kelajuan tindakbalas yang laju dan arus maksimum ialah 10A berterusan dan 15A maksimum (10 saat). Paras logik antara 3.3V-5V. Ia juga bertindak sebagai pengawal kelajuan frekuensi PWM sehingga 10 Khz. Pengaturcaraan merupakan bahagian yang paling rumit dijalankan.



Sila rujuk Gambarajah 11. Ia merangkumi dua bahasa aturcara iaitu bahasa C dan bahasa himpunan. Bahasa C lebih senang difahami berbanding bahasa himpunan. Untuk bahasa C, perisian microCode Studio untuk Mikropengawal (PIC) digunakan.

## 4.0 Keputusan dan Analisis

### 4.1 Hasil Ujian Dalaman

Berdasarkan hasil ujian dalaman pada Jadual 3 didapati bahawa apabila lampu suluh dipancarkan pada Penerima Cahaya (LDR), motor tidak bergerak. Manakala apabila LDR tidak mendapat cahaya, motor bergerak ke barat. Jika Suis Limit 1 maksimum ke timur, motor akan berhenti dan mula berfungsi apabila mendapat cahaya pertama. Jika Suis Limit 2 maksimum di barat, motor akan berhenti selama 10 saat dan selepas itu bergerak ke timur.

	LDR	Pin 32 (V)	Motor
Keadaan Cahaya	Gelap	0.7	Bergerak ke barat
	Terang	3.5	Berhenti

Suis Limit	Motor Arus Terus
LS1 (Maksimum di Timur)	Berhenti dan mula berfungsi apabila mendapat cahaya pertama
LS2 (Maksimum di Barat)	Berhenti 10 saat , selepas itu bergerak ke timur

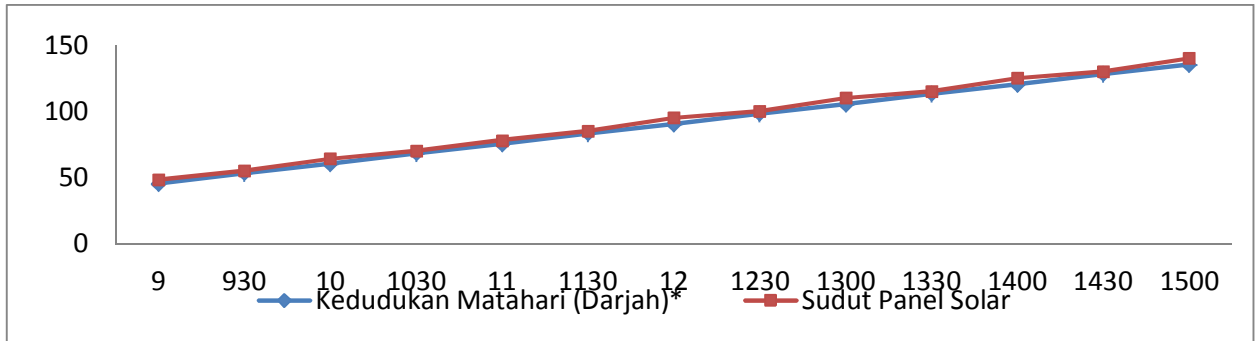
**Jadual 3 :** Keputusan Ujian Dalaman Menggunakan Lampu Suluh

### 4.2 Hasil Ujian Luaran

Ujian luaran dilaksanakan dalam masa 3 hari bermula 4 April 2011, 5 April 2011 dan 6 April 2011. Jika Suis Limit 1 maksimum ke timur, motor akan berhenti dan mula berfungsi apabila mendapat cahaya pertama berhenti 20 minit. Setelah 20 minit motor bergerak semula ke barat dan seterusnya. Jika Suis Limit 2 maksimum di barat, motor akan berhenti selama 13 jam dan selepas itu bergerak ke timur. Daripada hari pertama hasil ujian ini didapati bahawa projek ini telah berfungsi dengan baiknya kerana keadaan matahari yang bersinar secara konsisten dari arah timur ke arah barat pada hari pertama. Sedikit masalah berlaku ketika sebelah petang pada hari kedua dan ketiga.

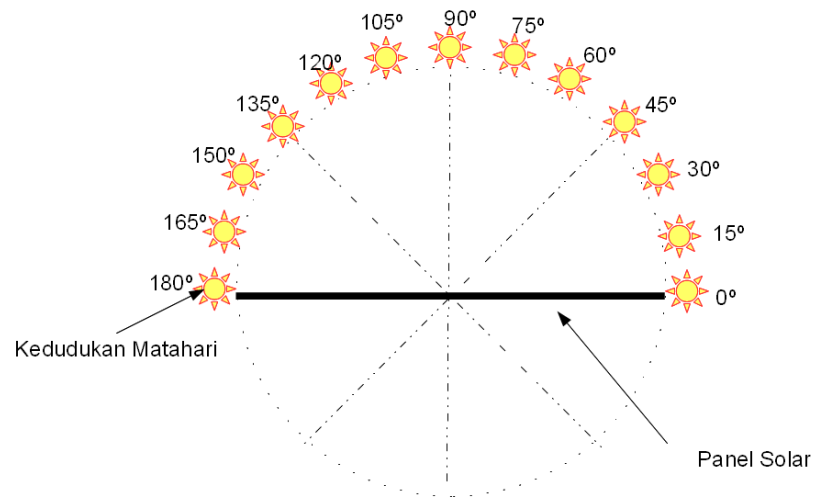
Hasil Ujian Luaran 1: Hari Pertama (4 April 2011)

Masa	900	930	1000	1030	1100	1130	1200	1230	1300	1330	1400	1430	1500
Kedudukan Matahari(Darjah)*	45	53	60	68	75	83	90	98	105	113	120	128	135
Sudut Panel Solar	45	55	64	70	78	85	95	100	110	115	125	130	135



**Gambarajah 12:** Analisis Luaran (Carta Garisan) Pada 4 April 2011.

## 5.0 Perbincangan



**Gambarajah 13:** Kedudukan Matahari Dengan Panel Solar

Berdasarkan Gambarajah 13, posisi matahari telah dibahagikan kepada 12 kedudukan. Jika panel solar di tempatkan pada kedudukan statik pada  $45^\circ$  ataupun  $135^\circ$  maka panel hanya mendapat 9 daripada 12 posisi matahari. Oleh itu jika panel solar dapat mengadap matahari secara konsisten dari timur ke barat maka panel solar tersebut akan mendapat 3 posisi tambahan ataupun 25% tambahan berbanding panel solar statik. Sila rujuk Gambarajah 12.

Ujian dan analisis dibuat untuk menguji kefungsiian dan pencapaian bagi sistem penjejak ini. Kedua-dua ujian mempunyai objektif yang berbeza. Ujian dalaman adalah untuk mengesahkan kefungsiian sistem kepada cahaya. Sumber cahaya ialah cahaya lampu suluh dan pergerakan motor diperhati. Manakala ujian luaran adalah untuk menguji kefungsiian kepada kedudukan matahari. Kedudukan matahari diambil berdasarkan perbezaan kedudukan matahari dan kedudukan panel solar.

## 6.0 Kesimpulan

Secara keseluruhan objektif projek ini telah tercapai. Sistem Penjejak Solar Bagi Meningkatkan Keluaran Kuasa Maksimum telah dibangunkan dengan jayanya iaitu solar panel yang boleh bergerak menghadap cahaya matahari secara konsisten dari timur ke barat, menggunakan motor arus terus yang dikawal oleh mikropengawal. Ia telah menunjukkan bahawa sistem penjejak solar boleh mengumpul tenaga melebihi 20% daripada solar panel statik.

### 6.1 Cadangan Penambahbaikan

Bagi meningkatkan lagi kecekapan sistem penjejak solar satu paksi adalah dengan mengaplikasikan penjejak solar dua paksi. Motor Arus Terus juga haruslah dikawal dengan lebih perlahan memandangkan pergerakan matahari yang amat perlahan. Penambahbaikan lagi adalah dengan menggunakan satu lagi tambahan penderia yang boleh mengesan jika berlakunya hujan. Oleh itu, panel solar ini akan lebih sensitif kepada alam sekeliling dengan memberi tindakbalas kepada mikropengawal.

## 7.0 Rujukan

- [1] <http://mcensustainableenergy.pbworks.com/w/page/20638192/The%20Solar%20> Resource
- [2] <http://science1.nasa.gov/science-news/science-at-nasa/2002/solarcells>
- [3] Elliot Larard (1998), Research of Tracking Solar Array System, University of Queensland

## E3 - Permodelan dan Simulasi Kawasan Liputan Pengenalpastian Frekuensi Radio (RFID)

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### Abstrak

*Pengenalpastian Frekuensi Radio (Radio Frequency Identification, RFID) merupakan teknologi tanpa wayar jarak dekat yang boleh menjejaki sesuatu objek bergerak dan berkomunikasi melalui frekuensi radio tertentu. Sistem RFID mengandungi dua komponen utama iaitu Penanda RFID (RFID Tag) atau Transponder dan juga pembaca RFID (RFID Reader). Prinsip gangguan Pembaca RFID kepada Pembaca RFID adalah gangguan frekuensi, dua atau lebih komunikasi Pembaca RFID yang menggunakan frekuensi dan masa yang sama. Objektif kajian ini adalah untuk membangunkan satu perisian bagi meramal liputan dan gangguan sistem RFID berdasarkan model perambatan kehilangan lorong. Kajian dilakukan menggunakan perisian Matlab. Graf kontor diperolehi dan gangguan serta liputan sistem akan dianalisis dan prestasi liputan akan dipertingkatkan dengan jarak yang optimum mengikut parameter kuasa (EIRP) yang digunakan serta topologi Pembaca RFID. Hasil dari kajian ini mendapati topologi optimum bagi Pembaca RFID Omni arah adalah topologi enam belas Pembaca RFID tersusun kerana telah mencapai nilai kuasa ambang pada  $PR > -100\text{dB}$  dengan peningkatan nilai EIRP dan Pembaca Uni arah telah mencapai peratus liputan 100% dengan peningkatan EIRP sebanyak  $-5\text{DB}$  pada topologi enam pembaca tersusun. Model terbaik yang digunakan bagi Pembaca RFID bagi mendapatkan prestasi kawasan liputan yang baik serta mengalami pengurangan gangguan adalah model antenna 6 Pembaca RFID Uni arah.*

**Keywords:** Pembaca RFID, Penanda RFID, EIRP, Omni arah, Uni arah

### 1. Pengenalan

Pengenalpastian Frekuensi Radio (*Radio Frequency Identification*, RFID) adalah suatu teknologi tanpa wayar yang beroperasi untuk menjejaki kawasan ataupun objek yang bergerak dengan menggunakan sistem penghantaran frekuensi radio. Pelbagai jalur frekuensi yang digunakan diseluruh dunia mengikut spesifikasi yang ditentukan oleh sesebuah negara. RFID mengandungi dua komponen utama iaitu Penanda RFID (*Tag*) dan rangkaian Pembaca RFID (*reader*) sebagai antenna pemancar [1]. Pembaca RFID berfungsi sebagai pengesan atau mengaktifkan Penanda RFID dengan membaca dan menerima semula maklumat yang dihantar oleh Penanda RFID dan kemudian memproses maklumat dan menghantar semula kepada Penanda RFID. Penghantaran data antara dua antenna adalah berasaskan pengaruh duaan (*inductive coupling*). Antenna Pembaca RFID menjanakan medan magnetik dan berganding dengan antenna pada Penanda RFID. Penanda RFID terdiri daripada cantuman antara litar-litar elektronik dan antenna. Sistem RFID direkabentuk untuk mengenali dan mengesan objek dengan melekatkan Penanda RFID menyimpan maklumat tentang suatu objek dan boleh membaca maklumat dan juga memberi tindak balas dengan menghantar maklumat kepada Pembaca RFID. Julat jarak bacaan antara Penanda RFID dengan Pembaca RFID adalah dari beberapa inci sehingga seratus kaki [2].

## 2. Pengenalpastian Masalah

Semua Pembaca RFID mempunyai ruang tak terhingga di sekelilingnya dan berkomunikasi dengan Penanda RFID. Ruang ini dikenali sebagai Zon Pemisitan Pembaca RFID (*Reader Interrogator Zone*). Antara masalah yang timbul bagi Pembaca RFID dalam ruang Zon Pemisitan Pembaca RFID adalah :

1. Pertindihan frekuensi diruang Zon Pemisitan Pembaca RFID.
2. Penghantaran isyarat Pembaca-Pembaca RFID yang bersilang akan mengalami gangguan antara satu sama lain.

Gangguan yang dikesan oleh satu Pembaca RFID dan disebabkan oleh Pembaca RFID yang lain dikenali sebagai Perlanggaran Pembaca (*reader collision*). Bagi meminimumkan gangguan komunikasi bagi penanda dalam sistem RFID, Perlanggaran Pembaca perlu diminimumkan dalam satu rekabentuk Sistem RFID. Pelbagai cara bagi meminimumkan Perlanggaran pembaca, antaranya mengimbangi frekuensi melebihi masa bagi Pembaca RFID dalam sistem RFID [3].

## 3. Model Perambatan dalam ruang bebas

Model perambatan gelombang dalam ruang bebas digunakan untuk meramal kekuatan isyarat penerima tanpa halangan antara penghantar dan penerima. Kuasa penerima bagi ruang bebas bergantung kepada kuasa antenna penerima yang dipisahkan dari antenna pemancar dengan jarak  $d$  :

$$P_r(d) = \frac{P_t G_t \lambda^2}{(4\pi)^2 d^2 L} \quad (1)$$

Dimana  $L$  = faktor kehilangan sistem ( $L \times 1$ )  
 $\lambda$  = panjang gelombang dalam meter  
 $G_t$  = Gandaan bagi antenna pemancar  
 $G_r$  = Gandaan bagi antenna penerima

Gandaan bagi antenna bergantung kepada kecekapan keluasan kemasukan udara,  $A_e$

$$G = \frac{4\pi A_e}{\lambda^2}$$

Dimana  $\lambda$  bergantung kepada nilai frekuensi pembawa : (2)

$$\lambda = \frac{c}{f} = \frac{2\pi c}{\omega_c}$$

Kehilangan ruang bebas diwakili oleh pelemahan isyarat sebagai pengukuran kuantiti positif dalam dB yang ditakrifkan sebagai perbezaan (dalam DB) antara kecekapan kuasa pemancar dan kuasa penerima dan mengandungi gandaan antenna. Model kehilangan ruang bebas diberi sebagai:

$$PL(\text{dB}) = 10 \log \frac{P_t}{P_r} = -10 \log \left[ \frac{\lambda^2}{(4\pi)^2 d^2} \right] \quad (3)$$

Dimana  $P_r$  = Kuasa antenna penerima  
 $P_t$  = Kuasa pemancar antenna

### 3.1 Kehilangan Dalam Bangunan

Kehilangan dalam bangunan merupakan situasi dimana isyarat yang diterima oleh penerima dari penghantar mengalami pelemahan dan bergantung kepada nilai perambatan ruang bebas. Perambatan ruang bebas digunakan untuk meramal kekuatan isyarat penerima tanpa halangan antara penghantar dan penerima. Model kehilangan dalam bangunan dapat diterbitkan dari model kehilangan log jarak:

$$\overline{PL}(d) = \overline{PL}(d_0) + 10n \log\left(\frac{d}{d_0}\right) \quad \text{Dimana } \begin{array}{l} d_0 = \text{jarak rujukan} \\ d = \text{jarak pemisah antara} \\ \text{penghantar dan penerima} \end{array} \quad (4)$$

Model kehilangan dalam bangunan diperolehi dari model kehilangan log jarak diberikan sebagai:

$$PL(\text{dB}) = \begin{array}{l} PL(d_0) + 10n_1 \log\left(\frac{d}{d_0}\right) \quad 0 \leq d < 8\text{m} \text{ atau} \\ PL(d_0) + 10n_2 \log\left(\frac{d}{d_0}\right) \quad 0 > 8\text{m} \end{array} \quad (5)$$

### 3.2 Kuasa Pemancar Isotropik (EIRP)

Kuasa pemancar Isotropik (EIRP) adalah jumlah gandaan antenna yang diukur dalam unit desibel (dB) dan jumlah kuasa yang dihasilkan diukur dalam unit (dBW)

$$EIRP(\text{w}) = \frac{P' G^t}{4\pi R^2} \quad (\text{w/m}^2) \quad \text{atau} \quad EIRP(\text{dB}) = 10x \log 10 \left( \frac{P' G^t}{4\pi R^2} \right) \quad (6)$$

### 3.3 Kuasa Penerima

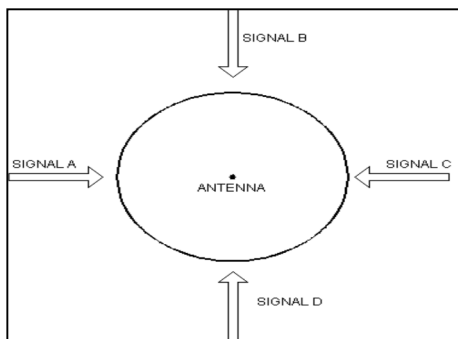
Kuasa penerima di antenna penerima dapat diperolehi dari beza antara kuasa antenna pemancar (EIRP) dengan kehilangan alam medium perambatan. [4]

Kuasa di Penerima:

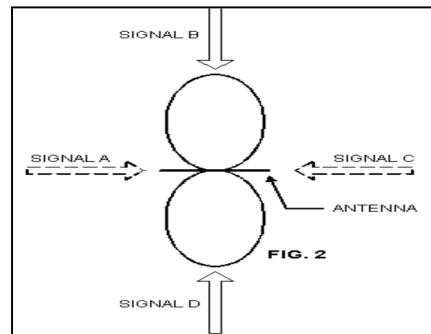
$$P_{\text{rec}} = EIRP - PL(\text{dB}) \quad (7)$$

## 4. Antena

Antena merupakan peranti pasif yang menentukan arah dan menghapuskan kehilangan. Dalam sistem RFID, antenna digunakan sebagai agen komunikasi antara Penanda RFID dan pembaca RFID. Antena yang diletakkan akan memainkan peranan penting dalam menentukan kawasan liputan suatu kawasan [5].



Rajah 1: Antena Omni-arah



Rajah 2: Antena Uni-arah

#### 4.1 Piawaian Nilai kuasa penerima ambang

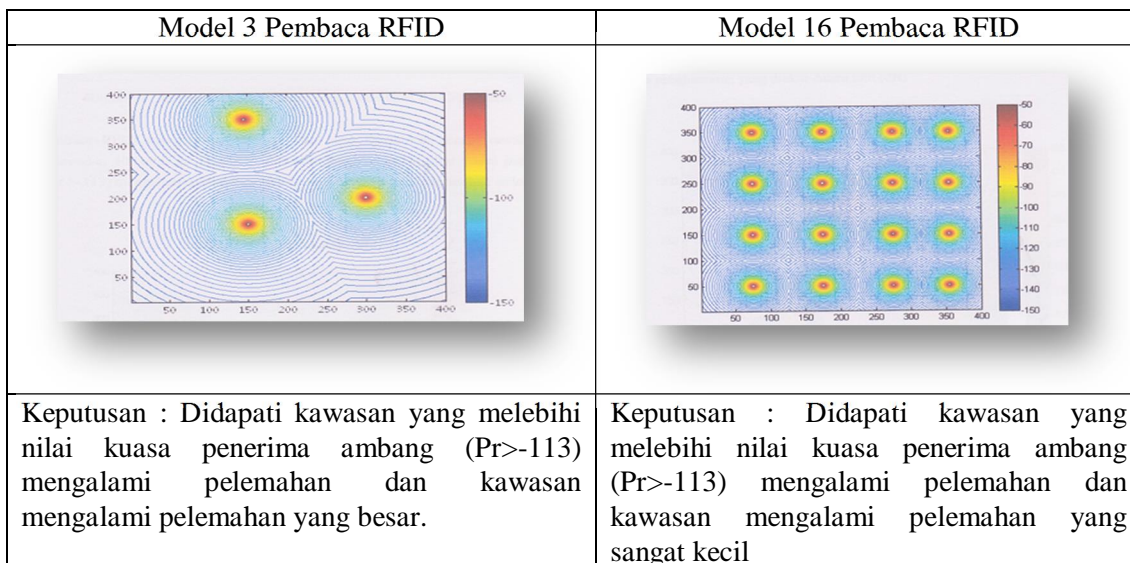
Kuasa penerima ambang adalah had kuasa yang boleh menerima isyarat dengan baik dan tidak mengalami pelemahan. Jadual dibawah menunjukkan nilai piawai bagi kuasa penerima ambang pembaca RFID

ERP/W	ERP/dBW	Nilai ambang (ERP)/dBW	Kehilangan Lorong/ dB	Jarak/m
Lebih dari 0.1	Lebih dari -10	-113	103	193.1
0.1 hingga 0.5	-10 hingga -3	-120	117	485.0
0.5 hingga 2.0	-3 hingga 3	-126	129	1068.0

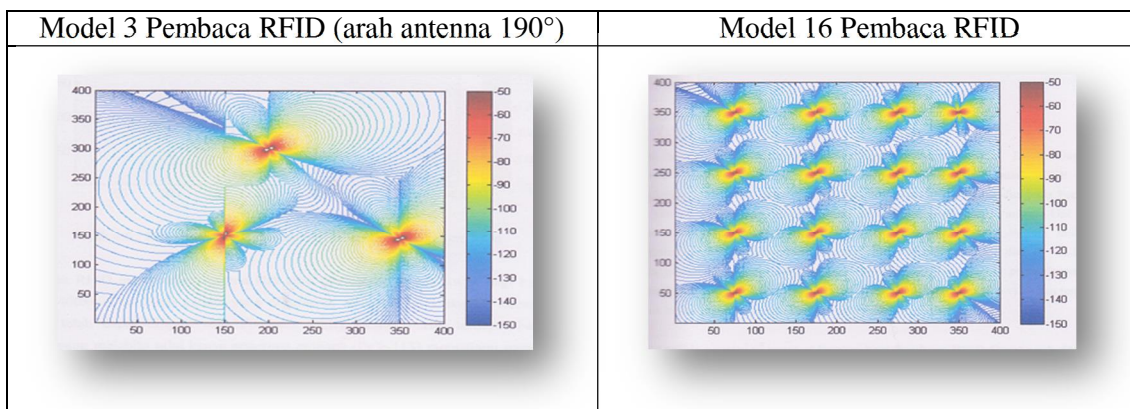
**Jadual 1:** Jadual Nilai piawai bagi kuasa penerima ambang Pembaca RFID

#### 5. Keputusan dan analisis

Hasil dari simulasi yang telah dilakukan dengan menggunakan perisian MATLAB, terdapat perbezaan isyarat kuasa penerima ambang bagi setiap topologi Pembaca RFID yang berbeza, penggunaan jenis antenna dan keluasan kawasan. Isyarat yang berada diluar kawasan isyarat kuasa penerima ambang akan mengalami pelemahan isyarat.



**Rajah 3:** Model Omni arah (keluasan kawasan : 400x400meter)

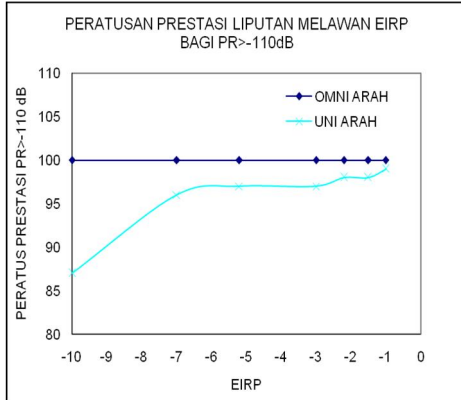


Keputusan : Didapati kebanyakan kawasan telah dapat diliputi oleh Pembaca RFID namun masih terdapat beberapa kawasan yang melebihi nilai kuasa penerima ambang ( $Pr > -113$ ) mengalami pelemahan kecil.

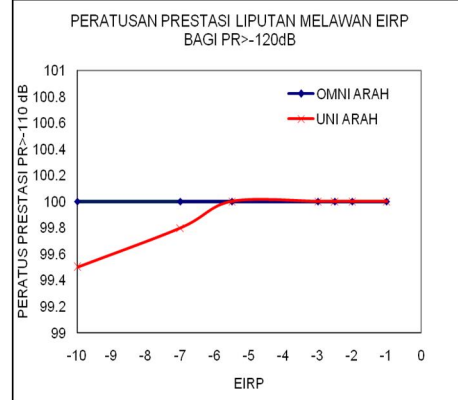
Keputusan : Didapati kebanyakan kawasan telah dapat diliputi oleh Pembaca RFID namun masih terdapat beberapa kawasan yang melebihi nilai kuasa penerima ambang ( $Pr > -113$ ) mengalami pelemahan dan pertindihan isyarat banyak berlaku.

**Rajah 4:** Model Uni arah (keluasan kawasan : 400x400meter)

### 5.1 Analisis peratusan prestasi liputan bagi Pembaca RFID Omni arah dan Uni arah dengan peningkatan nilai EIRP



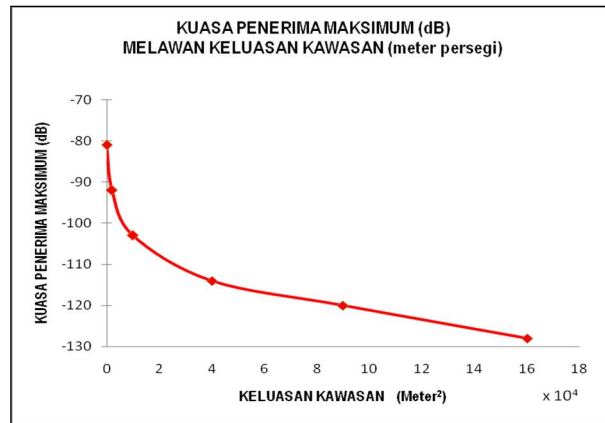
**Rajah 5:** Peratusan Prestasi Liputan Melawan EIRP bagi PR > -



**Rajah 6:** Peratusan Prestasi Liputan Melawan EIRP bagi PR > -

Dari graf diatas, didapati peratusan prestasi liputan diperolehi dari nilai kiraan peratus kuasa penerima melebihi kuasa ambang bagi dua keadaan iaitu  $Pr > -110\text{dB}$  dan  $Pr > -120\text{dB}$ . Terdapat perbezaan antara peratusan liputan antenna uni arah dan omni arah. Dari persamaan (7), pertambahan nilai EIRP dibandingkan dengan peratus prestasi kuasa penerima mengikut dua keadaan yang telah dinyatakan. Perbandingan dengan piawaian dibuat dan didapati pada nilai  $-3\text{dB} \times \text{EIRP} \times 3\text{dB}$  nilai kuasa ambang adalah  $-126\text{dB}$  dan nilai simulasi peratusan prestasi liputan berada dalam julat piawaian.

### 5.2 Analisis isyarat kuasa penerima ambang (dB) bagi keluasan kawasan yang berbeza



**Rajah 7:** Graf kuasa penerima maksimum (dB) melawan keluasan kawasan



Dari rajah dapat dilihat pengurangan kuasa penerima maksimum terhadap peningkatan keluasan kawasan. Bagi keluasan  $25 \times 25 \text{m}^2$ , kuasa penerima maksimum adalah 80dB, ini menunjukkan prestasi isyarat penerimaan bagi kawasan berkeluasan adalah sangat baik kerana kurang mengalami pelemahan isyarat dan memudahkan Pembaca RFID berkomunikasi dengan Penanda RFID. Manakala kawasan yang berkeluasan  $400 \times 400 \text{m}$ , kuasa penerima maksimumnya adalah -125dB dan mengalami pelemahan isyarat yang besar. Sekiranya terdapat Penanda RFID disekitar kawasan pelemahan, berlaku masalah bagi kedua-dua Penanda dan Pembaca RFID untuk berkomunikasi.

## 6. Perbincangan

Setelah membuat simulasi model kawasan liputan bagi Pembaca RFID dalam satu kawasan berkeluasan  $400 \times 400 \text{m}$ , analisis dilakukan bagi dua keadaan Pembaca RFID untuk mendapatkan nilai ambang prestasi liputan terhadap peningkatan nilai kuasa EIRP Pembaca RFID yang menggunakan antenna Omni-arah dan Uni-arah. Menilai peratusan prestasi liputan terbaik terhadap topologi Pembaca RFID yang menggunakan antenna Omni-arah dan Uni-arah untuk menialai kuasa maksima terhadap keluasan kawasan topologi Pembaca RFID. Daripada analisis yang dilakukan didapati penggunaan peranti RFID lebih baik digunakan dikawasan yang berkeluasan kecil kerana dalam kawasan yang kecil, prestasi kekuatan isyarat kuasa penerima adalah lebih baik berbanding prestasi kekuatan isyarat berkeluasan besar. Penggunaan antenna Uni-arah pula merupakan cara yang paling berkesan bagi mendapat keluasan kawasan liputan yang optimal dan megelakkan pertindihan isyarat berlaku. Hasil dari simulasi mendapati model topologi optimum bagi Pembaca RFID yang menggunakan antenna Omni arah adalah model 16 Pembaca RFID tersusun. Model ini sangat menjimatkan dan mengurangkan kos kerana memerlukan bilangan pembaca yang kecil bagi keluasan yang besar.

## 7. Kesimpulan

Daripada keseluruhan kajian ini, semua objektif telah berjaya dicapai. Gangguan terhadap isyarat RFID dan cara mengatasi isyarat telah dikaji. Ramalan kawasan liputan dan gangguan sistem RFID telah dibangunkan berdasarkan model perambatan sedia ada (*path loss model*) dengan parameter-parameter seperti (EIRP), topologi Pembaca RFID dan keluasan kawasan yang terlibat serta membangunkan perisian bagi mengurangkan gangguan terhadap sistem RFID. Gangguan dan liputan sistem dianalisis dan prestasi liputan dipertingkatkan dengan jarak optimum mengikut parameter kuasa (EIRP) yang digunakan serta topologi Pembaca RFID. Perbandingan dibuat berdasarkan peratusan prestasi liputan terhadap peningkatan nilai EIRP dan peratusan prestasi liputan terhadap topologi. Pembaca RFID serta keluasan kawasan yang terlibat menggunakan antenna uni-arah dan antenna omni-arah.

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## **E4 - Rekabentuk dan Pembangunan Model Mesin Lipatan dan Pra-Pembungkusan Produk Tekstil**

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### **Abstrak**

*Dalam dunia menuju ke arah globalisasi, manusia memerlukan peralatan yang dapat digunakan bagi membantu melaksanakan sesuatu pekerjaan dengan mudah, cepat dan berkesan. Idea Produk "Folding,Packing and Sealing Machine" adalah daripada pengusahaan sebuah kilang tempatan yang berada di Tampoi, Johor yang menyatakan pelbagai kelemahan dan kekurangan dalam penghasilan produk tekstil. Antara kelemahan yang dihadapi ialah jumlah pengeluaran produk yang tidak konsisten, pekerja harus dilatih untuk melipat baju sebelum bekerja dan penggunaan tenaga buruh yang ramai.Selain itu,bahagian penglipatan kain dan pra-pembungkusan baju merupakan bahagian proses yang tidak selesa dan menjemukan kepada para pekerja dan kualiti kerja juga tidak terjamin. Sebagai menyahut seruan ini, terhasillah satu mekanisme lipatan untuk melipat T-Shirt pelbagai saiz dan tekstil yang lain bersesuaian untuk perusahaan tekstil, pengusaha dobi dan lain-lain bagi menjimatkan masa dan penggunaan tenaga manusia. Mesin yang direka hasil daripada kajian dan penyelidikan yang dibuat dapat memudahkan lagi proses lipatan T-Shirt dan pra-pembungkusan berbanding dengan kaedah yang terdahulu. Segala aspek alat penghantar seperti flip-flop, gear, aci syaf, PIC controller,PLC,silinder dan motor elektrik dikaji bagi memastikan proses pemilihan projek ini dapat dilaksanakan dengan lancar dan teratur. Ketelitian dan ketelusan pengetahuan di dalam bidang mekanikal amat diperlukan bagi menjadikan mesin ini satu realiti. Dengan terciptanya mesin ini diharapkan pengusaha tekstil dapat meningkatkan hasil pengeluaran produk dan tidak membebankan pekerja dalam proses lipatan dan pra-pembungkusan. Penggunaan mesin ini juga diharap dapat menambahkan lagi pendapatan pengusaha tekstil di Malaysia.*

**Katakunci:** *T-Shirt, Folding, Mesin, Ekonomi, Tekstil,Tenaga Buruh,*

### **1.0 Pengenalan**

Industri tekstil dan pakaian dianggap sebagai industri *sunset* terutama sekali dengan kemasukan China sebagai ahli Pertubuhan Perdagangan Antarabangsa serta persaingan yang sengit dalam persekitaran bebas kuota sejak awal 2005. Industri pakaian merupakan tulang belakang kepada sektor tekstil di Malaysia dan sekaligus menjadi tunggak kepada pembangunan pesat ekonomi Negara ini. Pembangunan pesat industri pakaian dapat dilihat daripada peningkatan hasil eksport pakaian dalam jadual 1.1 bagi tahun 2007 iaitu sebanyak RM 10.3 billion meningkat kepada RM 10.81 billion pada tahun 2011.Selain itu, peningkatan eksport tekstil ke luar Negara juga bertambah daripada RM 9.3 billion pada tahun 2010 kepada RM 10.8 billion pada tahun 2012 atau lebih jelas pertumbuhan sebanyak 1.6 peratus dalam dua tahun.Perusahaan tekstil menduduki tempat ke-9 dalam Malaysia's Major Export by Sector (2008-2011). Malaysia adalah Negara mengekspot utama tekstil kepada USA sebanyak 20.1%,Japan sebanyak 8.1%,Singapura 5.4%,Mexico sebanyak 5.2%,China sebanyak 4.6%,Turkey sebanyak 4.5% dan sebagainya [12].Pertambahan sektor perindustrian

tekstil ini berikutan penerokaan oleh syarikat-syarikat besar, IKS,perusahaan kecil dan perusahaan skim kerajaan.Pertambahan ini memberi tekanan terhadap permintaan tenaga buruh yang semakin meruncing sekarang. Kekurangan tenaga buruh memberi impak negative dalam industri tekstil,serba sedikit mengurangkan produktivitinya secara optimum.Pertambahan tenaga buruh asing adalah akibat daripada penyerapan tenaga buruh tempatan ke sektor pembuatan dan perkhidmatan [3].Pelbagai pendekatan telah dilakukan untuk mengatasi masalah ini, salah satu ialah pengenalan terhadap penggunaan mekanisasi di perusahaan tekstil.Teknologi mekanisasi ini secara tidak langsung mengurangkan kebergantungan tenaga buruh asing [5].Penggunaan mekanisasi di tekstil di Malaysia dilihat semakin menjadi keutamaan.Selain daripada mengurangkan kebergantungan tenaga buruh asing, mekanisasi juga meningkatkan produktiviti buruh,mengurangkan kos produktiviti dan meningkatkan kualiti pengeluaran [6].Kajian ini memfokuskan serta membincangkan amalan-amalan pengimplimentasian mekanisasi dan masalah-masalah yang dihadapi oleh perusahaan tekstil.Perusahaan tekstil semakin pesat membangun kebelakangan ini.Oleh sebab itu,keperluan tenaga buruh asing di dalam sektor ini akan bertambah.Dalam jangka masa yang panjang, mekanisasi adalah suatu jalan penyelesaian yang terbaik bagi meningkatkan daya saing. Setiap syarikat dalam industri ini harus memainkan peranan yang penting di dalam pengurangan kos melalui kebergantungan terhadap tenaga buruh.Amalan penggunaan mekanisasi harus diteruskan bagi menarik minat pekerja tempatan selain dari meningkatkan produktiviti tekstil dan menghadkan penggunaan tenaga buruh asing.

## 2.0 Kaedah Konvensional Dan Terbaru

Mesin yang dicipta ini ialah sebuah mesin yang agak ringkas tetapi ia memainkan peranan yang amat penting pada manusia dan alam sekitar. “Folding,Packing and Sealing Machine” (FPSM) ini merupakan satu mesin yang berunsurkan sistem kawalan automatik.Mesin ini direkacipta dan diaturcara untuk melakukan proses melipat kain dan pra-pembungkusan spesimen seperti saiz “T-shirt” S,M,L dan XL dalam sektor industri tekstil. Oleh sebab masalah yang dihadapi oleh pengusaha dan juga kekurangan buruh untuk melipat dan proses pra-pembungkusan maka sebuah mesin baru telah direka bentuk oleh kami untuk proses tersebut. Rajah 2.0 (di Apendiks) menunjukkan “Malaysia Knitting Manufactures Association” telah memberi pengiktirafan terhadap produk yang dibangunkan dan ia boleh dikembangkan lagi dalam perusahaan tersebut.Manakala Rajah 2.1 (Di Apendiks) menunjukkan kaedah tradisional yang diamalkan oleh pengusaha dengan menggunakan tenaga buruh telah menyekat produktiviti.



Rajah 2.2 : Model Mesin Lipatan Baju

## 2.1 Kaedah Terbaru T-Shirt Folding

Terdapat dua *push button* A dan B. *push button* A adalah untuk *t-shirt* bersaiz S dan M manakala *push button* B pula adalah untuk *t-shirt* bersaiz L, XL dan XXL. Cara penggunaannya ialah letakkan "*T-shirt*" pada *platform* dan tekan *push button* untuk mulakan proses lipatan baju. Motor (A) akan memusing flip-flop 160° hingga 175° "*forward*" dan apabila flip-flop A dikesan oleh sensor 1, motor (A) akan berpusing "*reverse*", flip-flop A akan kembali kedudukan asal. Seterusnya sensor 1 akan aktif dan mengaktifkan motor (B) untuk berpusing flip-flop "*forward*". Flip-flop B akan mengesan sensor 2, dan motor (B) akan "*reverse*", flip-flop B kembali kedudukan asal dan operasi motor (C) beroperasi. Akhirnya, motor (D) akan berpusing "*forward*" bagi memindahkan *t-shirt* ke atas "*conveyor*" dan setelah flip-flop D kembali ke kedudukan asal "*conveyor*" akan membawa *t-shirt* ke proses *bagging*, dan *sealing*. Rajah 2.2 menunjukkan model mesin lipatan baju.

## 2.2 T-Shirt Packing dan Sealing Machine

"T-Shirt Packing and Sealing Machine" merupakan sebuah mesin pra-pembungkusan baju secara automatik yang direkabentuk dalam rajah 2.3 dan rajah 2.4 bagi penghasilan membungkus baju yang telah dilipat dalam kuantiti yang banyak dalam setiap pengoperasian. Pemilihan sistem kawalan yang sesuai seperti kaedah secara elektro-mekanikal atau elektro-pneumatik juga ditekankan untuk mengawal pergerakan paksinya. Selain itu, jenis-jenis pengesan dan pencengkam yang sesuai juga dipilih berdasarkan saiz dan jenis produk demi menjamin kawalan kualitinya dan tidak menimbulkan sebarang kerosakan ke atas produk. Penekanan dilakukan terhadap penggunaan komponen-komponen seperti sensor, DC motor dan peranti elektro-pneumatik. Rodless silinder akan extend apabila baju akan dikesan oleh sensor 4. Apabila sensor 5 mengesan, rodless silinder mengangkat baju lalu bergerak ke bahagian pra-pembungkusan untuk masukan baju ke dalam bag t-shirt. Bag t-shirt akan disusun dalam tray yang disambung dengan double acting silinder. Kemudian axial fan akan berfungsi mengikut masa yang ditetapkan dan ia akan membuka bag t-shirt. Baju akan diangkat oleh silinder lalu menolak masuk ke dalam beg t-shirt. Seterusnya silinder penahan baju mula extend dan proses *sealing* akan berlaku. Akhirnya, bag t-shirt akan masuk ke dalam kotak yang disediakan dan pembungkusan baju akan berulang-ulang secara automatik.



Rajah 2.3 : Proses Pra-Pembungkusan T-Shirt











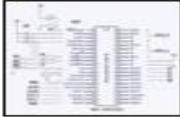










Rajah 2.4: Proses *Sealing* T-Shirt

## 2.3 Rekabentuk Rangka Mesin

Proses seterusnya merupakan proses penghasilan konsep atau idea untuk menyelesaikan masalah yang dihadapi. Pada peringkat ini daya pemikiran kreatif dan inovatif diperlukan untuk menghasilkan konsep yang baik [9]. Dalam projek ini, pereka akan menghasilkan konsep dan idea yang dapat memenuhi kriteria reka bentuk sebuah mesin "*FBSM*" yang akan memudahkan pengguna. Sebelum pembinaan sesebuah mesin, rangkanya terlebih dahulu dibina. Pembinaan rangka pula mengikut kesesuaian komponen-komponen yang akan dibina

di atas rangka mesin tersebut. Jadual 2.1 menunjukkan perincian pemilihan reka bentuk mesin  $\phi$ FPSMö. Terdapat tujuh komponen utama yang terlibat dalam pemilihan tersebut seperti rangka mesin, flip-flop, syaf dan aci, perkakasan, motor dan *Rotary Actuator*. Jadual 2.1 juga telah menunjukkan idea-idea yang dipilih berdasarkan kesesuaian dan kegunaan mesin.

Bil	Idea 1	Idea 2	Idea 3	Idea Pilihan
1	Rangka Flip-Flop 			Idea 3 - Stabil - Lebih kukuh - Ruang lebih besar untuk pelbagai saiz baju S,M,L,XL
2	Rangka Folding Mesin 			Idea 3 - Gerakan pantas - Lipatan kemas - Gunakan kuasa elektrik - Mudah sir - Bergam untuk pekerjaan rutin
3	Rangka Syaf dan Motor 			Idea 3 - Sambungan aci pada motor kuat - Cengkaman syaf kuat - Putaran aci yang baik 180°
4	Perisian PLC 	PLC 		Idea 2 - Software PIC sesuai (memerah) - Pergerakan flip-flop dikawal - Sudut putaran boleh dikawal - Kelajuan boleh laras
5	Pra-Pembungkusan 			Idea 2 & 3 - Exos fan membuka bag t-shirt dengan kesempurnaan. - Silinder bawa masuk T-Shirt dengan ketepatan
6				-Proses sealing dapat dilakukan dengan tepat dan sempurna -Gunakan silinder untuk press tagging gun/tag tagging
7				-Bentuknya lebih sesuai dengan rangka mesin. -Stabil -Lebih kukuh -Ruang lebih besar untuk conveyor dan rodles silinder

Jadual 2.1: Pemilihan Rupa Bentuk Komponen Mesin

### 3.0 Keputusan Eksperimen Dan Analisis

Pengujian mesin ialah proses yang dilakukan untuk mengukur kualiti mesin ataupun kualiti setiap komponen yang telah dibangunkan ini. Kualiti akan diuji dari segi kuantiti baju, tempoh masa, bilangan pekerja dan kos buruh yang ditampung oleh syarikat.

#### 3.1 Pengujian Hasil

Dalam pengujian hasil, penyelidik telah menjalankan 3 kaedah pengujian iaitu tempoh masa, bilangan pekerja dan kos pengeluaran. Sampel “FBSM” dan manual dibandingkan untuk melihat perbezaan diantara kedua-duanya. Jadual 3.1 dan 3.2 menunjukkan nilai sifat untuk mengukur kuantiti atau kualiti mesin dibandingkan dengan kaedah manual. Nilai sifat tersebut adalah berdasarkan lima faktor yang telah dipilih iaitu kuantiti baju, saiz baju, tempoh masa, bilangan tenaga buruh diperlukan dan kos buruh.

Sampel T-Shirt Saiz S,M	Kuantiti T-Shirt	Tempoh Masa (jam)	Bilangan Tenaga Buruh Diperlukan	Kos Buruh Diperlukan (RM)	Nisbah
Lipatan Mesin	1200	8 ½	1	3590	1 : 1200
Lipatan Manual	1200	15	5	10,150	1 : 240

1<sup>st</sup> T-Shirt = 35 saat (mesin)

2<sup>nd</sup> T-Shirt = 25 saat (mesin)

**Jadual 3.1** :Pengukuran Kualiti mesin dibanding dengan kaedah manual (Saiz S dan M)

Sampel T-Shirt Saiz L,XL	Kuantiti T-Shirt	Tempoh Masa (jam)	Bilangan Tenaga Buruh	Kos Buruh (RM)	Nisbah
Mesin	1200	10	1	3590	1 : 1200
Manual	1200	17	8	19,120,00	1 : 150

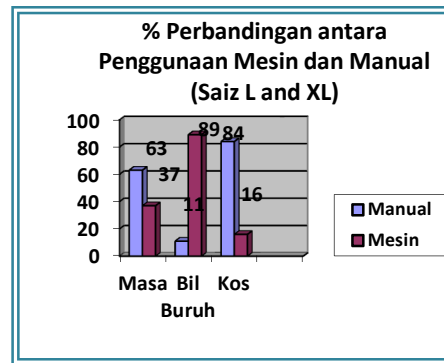
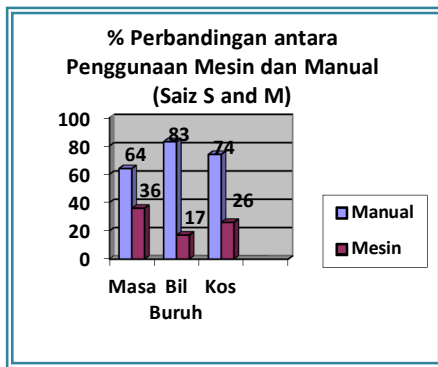
1<sup>st</sup> T-Shirt = 40 saat (mesin)

1<sup>nd</sup> T-Shirt = 25 saat (mesin)

**Jadual 3.2** :Pengukuran Kualiti mesin dibanding dengan kaedah manual (Saiz L dan XL)

### 4.0 Perbincangan

Dalam jadual 3.1, sampel T-Shirt lipatan dan pra-pembungkusan mesin mempunyai kadar tempoh masa yang singkat jika dibandingkan dengan sampel lipatan manual. Kadar tempoh yang diperlukan untuk proses “*folding, bagging and sealing*” hanya memerlukan 8 ½ jam bagi 1200 helai *öt-shirtö* yang bersaiz S dan M. Tambahan pula, pihak pengurusan hanya memerlukan seorang operator sahaja untuk menyiapkan ketiga-tiga proses. Manakala, kaedah manual perlu menggunakan seramai 5 pekerja memerlukan 15 jam dan menelan perbelanjaan yang agak tinggi sebanyak RM 10,150.00 berbanding dengan kaedah mekanisasi dimana ia hanya memerlukan sebanyak RM 3590.00. Faedah yang diperolehi oleh seseorang pengusaha tekstil dalam penggunaan *öFPSMö* ialah dapat menjimatkan RM 6560 sebulan bagi satu mesin. Jika penyelidik mengambil kira sebanyak 20 syarikat sebagai sampel maka dapat menjimatkan sebanyak RM 131,200.00 sebulan.



**Rajah 4.1 :** Peratus Perbandingan Penggunaan Mesin dan Manual Mengikut Saiz T-Shirt

Dalam jadual 3.2, kadar tempoh yang diperlukan untuk proses “*Folding, Packing and Sealing*” hanya 10 jam bagi 1200 sehalai t-shirt yang bersaiz L dan XL. Tambahan pula, pihak pengurusan hanya memerlukan seorang operator untuk menyiapkan ketiga-tiga proses iaitu “*Folding, Packing and Sealing*”. Manakala, kaedah manual perlu menggunakan seramai 8 pekerja yang akan menelan belanjawan yang tinggi sebanyak RM 19,120.00 berbanding dengan kaedah mekanisasi dimana ia hanya memerlukan sebanyak RM 3590.00 sebulan. Faedah yang diperolehi oleh seseorang pengusaha tekstil akibat penggunaan mesin T-Shirt ialah dapat menjimatkan sebanyak RM 15,530 sebulan bagi satu mesin. Jika penyelidik mengambil sebanyak 20 syarikat sebagai sampel maka dapat menjimatkan sebanyak RM 310,600.00 sebulan. Penggunaan mesin ini dapat meningkatkan produktiviti dan mengurangkan kos pengeluaran.

	Manual	Mesin	Saving
<b>Total worker</b>	8	1	7
<b>Total House @ Room</b>	2 (house)	1 (room)	-
<b>Housing Cost (RM/yr) RM 500 @ RM 250</b>	12,000	3000	9,000
<b>Electrical &amp; Water Bill per year (RM/yr)</b>	2400	-	2400
<b>Medical bill per year (RM/yr)</b>	400	50	350
<b>Levi@RM540/person/yr</b>	4320	540	3780
<b>Total RM/yr</b>	<b>19,120.00</b>	<b>3590</b>	<b>15,530.00</b>

**Jadual 4.1 :** Faedah yang diperolehi oleh syarikat akibat penggunaan mesin

Jadual 4.1 menunjukkan perbezaan ketara apabila menggunakan mesin berbanding dengan kaedah manual. Melalui kajian, dapat dibuktikan bahawa penggunaan mesin dapat menjimatkan RM 15,530 sebulan dan RM 186,360.00 bagi setahun. Jika hipotesis kajian sebanyak 20 syarikat sebagai sampel maka dapat menjimatkan sebanyak RM 3,727,200.00 bagi setahun. Penggunaan mesin ini dapat meningkatkan produktiviti dan mengurangkan kos pengeluaran.

## 5.0 Kesimpulan

Daripada keseluruhan kajian ini, semua objektif telah berjaya dicapai. Dengan terhasilnya mesin ini diharap dapat memberikan pulangan lumayan kepada usahawan produk tekstil di

negara kita. Selain produk dijual di negara kita sendiri, produk tekstil kita juga akan di eksport ke negara luar. Semua itu akan terhasil jika sistem perusahaan tekstil negara kita menggabungkan kaedah lama dengan teknologi terkini. Penggunaan mesin canggih dan dapat mempercepatkan produktiviti pengeluaran tekstil serta meningkatkan lagi produktiviti akan merencanakan lagi aktiviti produk tekstil di negara kita. Mesin atau mekanisasi ini adalah amat penting kerana jika kadar tempoh yang singkat ianya akan menyebabkan produktiviti turut meningkat. Menurut Luke [1], kesan positif penggunaan automasi dalam tekstil industri terdapat dalam empat kategori, iaitu pengeluaran, operator, produk dan keuntungan. Mesin FBSM yang direka ini akan menimbangkan kepada tujuan untuk mengatasi masalah kekurangan tenaga buruh serta permintaan hasil tekstil seperti t-shirt, baju jaket dan sebagainya yang semakin tinggi di dalam dan luar negara. Masalah kekurangan tenaga buruh juga boleh diatasi jika melalui usaha-usaha bagi mempertingkatkan penggunaan sistem pengeluaran intensif berautomasi dan mekanisasi serta mengurangkan perusahaan-perusahaan tekstil yang berintensif buruh. Penggunaan mesin dalam sektor tekstil dapat mengatasi masalah kekurangan buruh.

### 5.1 Faktor-faktor penting dalam kajian

Sektor tekstil adalah terlalu penting bagi kita, faktor ini sumber utama pengeluar pakaian kita. Oleh itu, kita perlu berusaha untuk mendapatkan hasil yang banyak dengan mengerjakan tenunan secara intensif supaya mendapat hasil yang banyak. Bagi mencapai tujuan tersebut, kaedah pemprosesan pakaian dan teknik tekstil moden perlu diusahakan. Dengan kaedah penggunaan mesin yang lebih baik, ini akan dapat menjimatkan kos dan seterusnya menambahkan keuntungan. Oleh itu aspek penting dalam revolusi tekstil adalah perlaksanaan kaedah dan ciptaan baru alat-alat tekstil bagi mengurangkan penggunaan tenaga manusia, meringankan kerja dan meningkatkan hasil pengeluaran. Sebelum revolusi, kebanyakan kerja-kerja lipat, pra-pembungkusan dilakukan oleh manusia. Cara ini sangat rumit, membebankan dan memakan masa yang panjang. Rajah 5.0 dan rajah 5.1 menunjukkan mesin FBSM yang telah dibangunkan ini dapat menggantikan cara lama yang dibuat secara manual dan melambatkan proses pengeluaran tekstil. Dengan terciptanya mesin ini diharapkan pengusaha tekstil dapat meningkatkan hasil pengeluaran produk dan tidak membebankan pekerja dalam proses lipatan dan pra-pembungkusan. Penggunaan mesin ini juga diharap dapat menambahkan lagi pendapatan pengusaha tekstil di Malaysia.

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## APENDIKS

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**DECLARATION LETTER**

KANTAN A/L P. SAMNATAHN (013-7742524)  
PUSAT LATIHAN TEKNOLOGI TINGGI (ADTEC) BATU PAHAT  
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JOHOR DARUL TAKZIM 30 OCTOBER 2012

PROJECT TITLE	AUTOMATIC FOLDING, BAGGING AND SEALING MACHINE 2.0
RESEARCHER AND DEPARTMENT	KANTAN A/L P. SAMNATAHN MECHATRONICS TECHNOLOGY DEPARTMENT ADTEC BATU PAHAT
INDUSTRIAL PARTNER	MALAYSIAN KNITTING MANUFACTURERS ASSOCIATION (MKMA)

The undersigned hereby declare that:

1. The Automatic Folding, Bagging and Sealing Machine 2.0 is ownership by Mechatronics Technology Department ADTEC Batu Pahat
2. The Automatic Folding, Bagging and Sealing Machine 2.0 is a user-friendly machine that uses less manpower for textile manufacturing industry.
3. The Automatic Folding, Bagging and Sealing Machine 2.0 has a commercial value due to no others textile manufacturing industry using the technology before.
4. The Automatic Folding, Bagging and Sealing Machine 2.0 using the first upgrading textile manufacturing technology in Malaysia.
5. The Automatic Folding, Bagging and Sealing Machine 2.0 facilitate work in Textile Manufacturing Industry.
6. The Automatic Folding, Bagging and Sealing Machine 2.0 uses 3 main concepts. They are:
  - i. Automatic Folding Machine
  - ii. Automatic bagging Machine
  - iii. Automatic Sealing machine with Tape

Designer of Project (Name in Print) \_\_\_\_\_ Designer of Project (Signature) \_\_\_\_\_  
*Chiang, Ek Chie* \_\_\_\_\_  
Industry Representative (Name in Print) \_\_\_\_\_ Industry Representative (Signature) \_\_\_\_\_  
Executive Director



Rajah 2.0 : Declaration Letter From Malaysian Knitting Manufactures Association



Rajah 2.1 : Kaedah Konvensional Melipat Baju

## E5 - Gesture Controlled Robot

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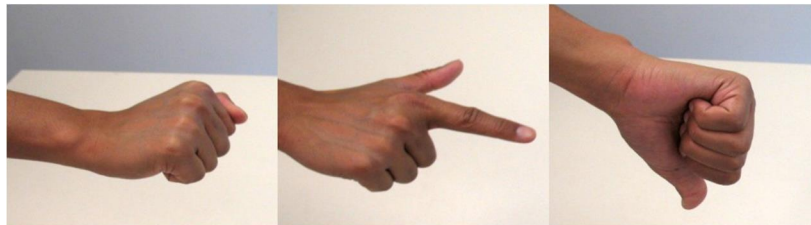
### *Abstract*

*Interaction between humans and robots should be as simple as possible. Gestures, one of the oldest know means of communicating and very understandable all around the world, could take us further in this relationship. As gesture control is becoming more and more popular these days, robots should be able to recognize and understand simple gestures and translate them into commands. As for that, means to capture these gestures is needed. The gesture will be capture and the data will then be analyzed and translated into commands understandable by a robot. In this project data is been captured and the data received is been analyzed by a computer software which will translate it into commands. These commands will then be sent to a robot using various methods for example via Network. The system was tested and positive results were obtained, though further development is needed to improve the system especially the accuracy, and reliability.*

**Keywords:** *Gesture Capture, Interpretation, and Translation. Commanding a robot*

### 1. Introduction

Since human walk the earth, they have been interacting with one another in order to exchange or share information, things, or even feelings. It has become one of the basic needs for us. Interaction or communication can come in different ways for example by words or writing which are familiar nowadays or even in a more primitive ways such as using sound, gesture, picture, and many more. As humans develop further, the means of communicating have become more advanced and complex. Nowadays information can travel across continents or into space in just a blink of an eye. This is made possible with various technologies for example the telephone, the internet, Wi-Fi and much more. And as human move forward into the future, the need to interact not only among ourselves but also with other beings or things for example animals or our daily appliances becomes more important. What humans don't realize is that this interaction has been occurring in our daily life on a regular basis. For example we turn on the coffee machine each morning which in other word means telling it to make coffee or we program a robot to do a movement which in other word means teaching it to do something and the list goes on and on. It cannot be denied, that humans are getting more and more dependent on these technologies and gadgets. And as we grow, these gadgets are getting more complex, more multifunctional and more intelligent.



**Figure 1.2 :** Some example of simple gestures

## 2. Objective

Here are the objectives of this project in an abridged version:

- To investigate the usage of gesture as a way to control a robot and develop an affordable system therefore.
- To capture and identify a gesture using a data glove that is already in disposal.
- To create gestures or set of gestures that will correspond to different commands to control the system or a robot.
- To create a user interface that controls the system.
- To create a universal system that is easy to configure according to the user and that is not limited to only one robot.

## 3. Project Fundamental And Approach

### 3.1 Means to Capture a Gesture

There are actually many methods available today in order to capture a gesture. One of the examples is using a controller with various sensors. It can utilize the usage of various sensors for example an optical sensor or a movement sensor or a bend sensor to capture the movement of our fingers. The figure 3.1 shows a Wii remote which is used to capture gestures and translate them into commands that will control a game or interact with the system. The Wii remote uses an infrared camera to detect infrared light sources to calculate the position based on which light is detected and its intensity. Another way to capture data is by using acceleration sensors or a gyro sensor to detect the movement of the hand. With these sensors, it is able to calculate the speed and acceleration of the hand and also the rotation of the hand. To capture the bend state of the fingers, bend sensors for example a piezoelectric sensor can be used. These sensors will detect change in strain and turn it into an electrical signal.



Figure 3.1 : The Wii remote [4].

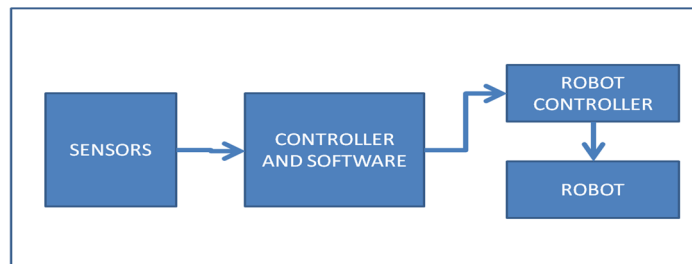


Figure 3.2 : Overall system diagram.

Another example is by using an image recognition system. It uses a camera to detect image movement. For that, powerful image recognition software is needed to recognize a movement or a pattern thus identifying it as a gesture. Nowadays there are many image recognition software that can be used to recognize movement or pattern.

### 3.2 System Architecture

#### 3.2.1 Overall System

The system consists of a few hardware and software parts. The figure 3.2 shows the overall system and how it is connected to one another. The program or software and controller which is the main focus of the development plays a vital role in the whole system.

It will display data it received from the sensors and in the same time compare the data with a pre-programmed data pattern to see whether a gesture is detected. When it detects or recognizes gesture, it will then check what command corresponds to the gesture. The program will then send the command if permitted to a robot server. A robot server that has already existed will be used. The server will interpret the command it received and then send a signal to the robot to carry out the command.

### 3.2.2 Hardware Used

In developing this system, various hardware was used. The main hardware of this system is the computer which is where the program is developed and run. A normal computer with average processing capabilities and without any modification was used during the development of this project.

Another main component and the most important hardware of the system is the data glove that is used to capture the hand gesture data. No modification was made to the glove. Only some parameters for example the filter mode and the units need to be set or configured. The last component is the robot that actually could be any robot that a user wants to control. For this, the user needs to know how to give command to the robot via an interface that is connected to the computer.

#### 3.2.2.1 Data Glove



**Figure 3.3 :** The P5 Data Glove.

The Figure 3.3 shows the data glove used in this project. The data glove which is called the P5 Glove is used to capture the movement of the hand and also used to interact with the system. It was created mainly as a gaming controller. The P5 glove uses the USB interface to communicate and come with a very easy plug and play setup.

The receiver tower is usually the static part. It has a connection to the computer USB port and also to the glove via SVHS cable. On the front, there is a dark glass and behind this glass there are two Infrared sensors unit. Each sensor unit consists of four photodiodes that will detect light from LEDs that are mounted on various positions on the glove. There are eight LEDs altogether. The sensors will detect normally four LEDs that are the brightest from those eight that are available and determine the location and the movement of the glove.

It is connected to the receiver tower. There is a rubber band used to strap the hand on to it and also five rings, one on each finger which is adjustable. As said above it has eight LEDs position all over the glove. These LEDs will transmit invisible light. It also have five independent bend sensors one for each fingers. These sensors will measure the change of resistance when the fingers is bent thus determining and calculating the bend state of the fingers. There are also four buttons on the glove that can be used for various purposes. The D button on the glove is used to turn on or turn off the glove.

All of the data will then be sent to the PC via USB. The optimal distance between the receiver tower and the glove should be about 25 cm to 40 cm. The glove should not be so far away as this will affect the ability of the sensor units to detect light from the LEDs. Furthermore background light and also reflections may also affect the readings. The glove is not the most advanced of its class. The accuracy is not that good and the reading is not very reliable especially for the rotation data. The table 3.1 shows the glove's specifications.

The glove can track movement with six degree of freedom. This means that the glove can track six different movements. This includes the normal three principle Cartesian axes which are X, Y, and Z and also the three aircraft principal axes which are Yaw, Pitch, and Roll. The figure 3.4 shows how the three principle Cartesian Axes are organized. The X-axis represents the horizontal coordinate. The Y-axis will represent the vertical coordinate and lastly the Z-axis will represent the in screen coordinate. The X and Y coordinates can be determine directly whereas the Z coordinates is calculated using the two sensor units.

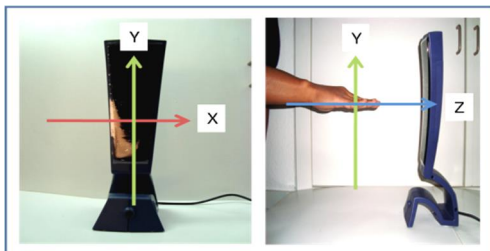
The figure 3.5 shows how the three aircraft principle axes are organized. The Yaw movement represents the movement around the Y-axis. The Pitch movement represents the movement around the X-axis and the Roll movement represents the movement around the Z-axis.

### 3.2.2.2 Robot

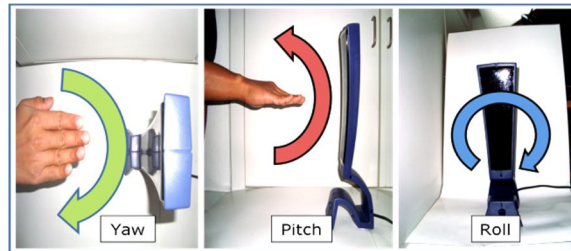
One of the main objectives of this project is to control a robot. For this project no modification on the robot is necessary. The important thing to know for this project is how a robot works, its commands and try to implement it in the system. The system is designed so that a user can control any kind of robot. Therefore it is made so that it is easy to change between robots. This program will recognize a command it has received and then send a command in robot language to the robot. Normally the command that needs to be sent to this program is already simplified.

Specification	Descriptions
Finger Sensor Specs	<ul style="list-style-type: none"> <li>• 5 independent bend sensors on each finger</li> <li>• 5 degree resolution (0 - 90 degree range)</li> <li>• 60 Hz refresh rate</li> </ul>
Tracking System Specs	<ul style="list-style-type: none"> <li>• Patent pending optical tracking system</li> <li>• 90 ó 120 cm range between receiver and glove</li> <li>• 45 Hz refresh rate</li> <li>• 6 degrees of freedom (x, y, z, yaw, pitch, and roll)</li> </ul>
X, Y, and Z Specs	<ul style="list-style-type: none"> <li>• 0.125 inch (0.32 cm) resolution</li> <li>• 0.5 inch (1.27 cm)</li> </ul>
Yaw, Pitch, and Roll Specs	<ul style="list-style-type: none"> <li>• 3 degree resolution</li> <li>• 3 degree accuracy</li> </ul>
USB System Specs	<ul style="list-style-type: none"> <li>• USB 1.1 compliant</li> <li>• HID Specification compliant</li> <li>• 2 USB Interfaces provided - Native P5 Mode, and Standard Mouse /Joystick Mode</li> </ul>
Supported Platforms	<ul style="list-style-type: none"> <li>• Windows 98 and also Mac 9 and below.</li> </ul>
Weight of glove	<ul style="list-style-type: none"> <li>• 4.5 oz (128 gram)</li> </ul>

**Table 3.1 :** The glove's technical specifications



**Figure 3.4 :** The XYZ axes



**Figure 3.5 :** The Rotation axes

### 3.2.3 Software Used

In order to complete this project, software was used and plays an important part in the

development. The main software used for this project is the Qt Software and Microsoft Visual C++ (MSVC). Using these software a functional program and its interface was created.

### **3.2.3.1 QT Software**

The Qt Software is a software used to write and create an application and its UI framework. It is compatible with most of the existing platform today which among others are Windows, Mac OS, Linux and Symbian. It is also easy to change between those platforms once an application in one of the above mentioned platform is created. It is based mainly on the C++ programming language. It features a C++ class library with many functions that will enable the user to create an advanced and complex application together with its graphical user interface [9]. The current version is the Qt 4.5.

### **3.2.3.2 P5 Driver and SDK**

The P5 Driver is the driver needed operate and to communicate with the data glove. The company that built the data glove released an SDK for the glove after receiving many request from the consumers. This has enabled the developers to use the data glove for many other uses. With this SDK, the user can retrieve various data from the glove for example the position and rotation of the glove and used it in any application they are developing. There were many other private developers that enhanced the driver and the SDK making it better than the official one. The driver was made compatible to various operating systems

### **3.2.3.3 OpenGL**

For the main 3D display, OpenGL (Open Graphics Library) is used to create a virtual hand model and generate the movement of this model. OpenGL is an Application Programming Interface (API) used to generate 2D and 3D computer graphics. It was developed by Silicon Graphics Inc. in 1992 and now used for various applications such as CAD and computer games. It is a powerful graphic generator tool. The current version is the OpenGL 3.2 [29].

## **4. Implementation**

### **4.1 Data Usage**

Some of the data received from the glove is not used directly. When the *Start* button is pressed, the program will read and save the current position of the glove. This will be the zero point or origin. The program will then read the glove position at a regular interval. For the position data (X, Y, Z), each time during these intervals, the program will subtract the origin data from the current position data and this will give the position of the glove relative to the origin. This data is displayed and used to recognize a gesture. For the rotation data, it is also displayed and used as relative rotation. The calculations are done internally by the data glove. Upon pressing the *Start* button the program will read and save the current rotation angle. It will then send the data to the data glove. As said in chapter three the data is shown as

### **4.2 Communication between the Glove and the Program**

There are many call functions available to read data from the glove. This function enables the program to retrieve much useful data for example the position data, rotation data, fingers bend state, buttons state, speed, acceleration, LED position and many more. One only needs to know which command to use to get the data.

### **4.3 Gestures**

Based on the position of the glove, rotation of the glove, and bend value of the fingers, the program will detect a certain pattern and recognize it as a gesture. This gesture

will be representing a command that gives further instruction to the program or as a command to control a robot in which it will be sent to the robot .

## 5. Test And Validation

At the end of the project, the complete system was tested. The testing process can be divided into two parts which are offline testing and online testing. Offline testing means that the system is tested without connecting the program to the robot and online testing on the other hand means that the program is connected to the robot. After some intensive testing, it is found that this project has the potential and should be developed further.

### 5.1 Offline Testing

Most of the testing is done offline. This is to ensure that the system is fully functional before it is connected to the robot so that there will be no problems with the robot. First, tests were conducted to find the best setting for the glove. Different sets of parameters were tested and the data were analyzed until a good reading was obtained from the glove. A Good result was obtained for the position data of the glove though for the rotation data no better solution was found.

The next step is to test the functionality of the program itself. This is done to ensure that the program is running smoothly and that the program will not crash while it is running. The functionality of the program was tested by testing each function in the program. Tests were conducted by running the functions over and over again and seeing whether it is running the way it is suppose to run. Most of the time during the test, the program runs smoothly. Though if used in a hectic manner, it is found that sometimes the program would crash. It is also found that after a while, some of the program's functions will stop functioning for example the status display which will stop displaying the status of the program or sometime the program will not display the data. The origin of this problem is unknown and therefore these problems could not be solved.

A repeatability test was also conducted to see whether the result is reproducible. In this test each gesture was done ten times and it was noted how many times the program managed to detect the intended gesture. The result was very promising as most of the times the program managed to detect the gestures at an average of more than nine times out of ten. The chart 5.1 shows the result of the test.

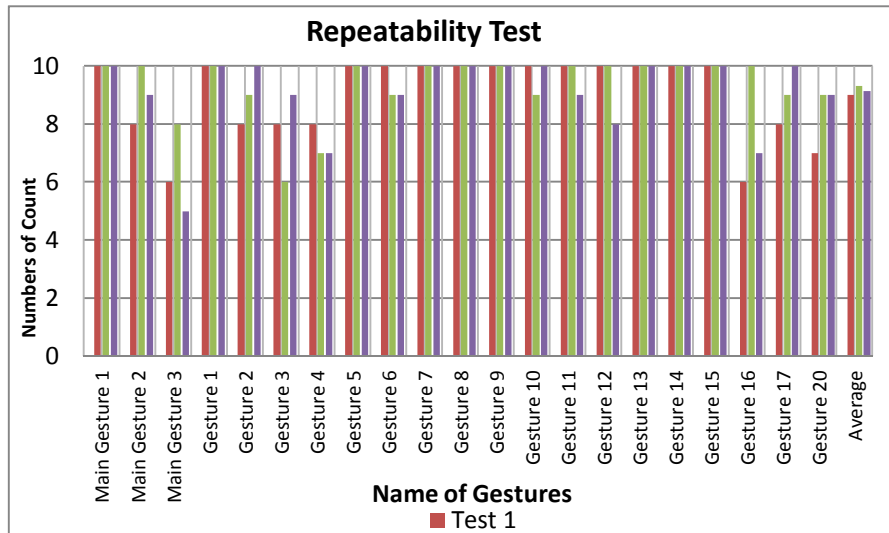


Chart 5.1 Repeatability test result.

## 6. Conclusion And Future Prospects

First of all is the usage of gesture to control a robot. It can be concluded that this is a very simple method to command a robot to do something. This is provided that the robot can recognize a gesture. One does not need any special knowledge in order to do a gesture as these gestures are usually simple and intuitive. As it is a universal language understandable by everyone, it makes it easier to be implemented. Gesture based platform has proven to be popular nowadays. An example is the sale of the Wii game console that is based on gesture recognition surpasses the sales of Play Station 3 and Xbox 360[28].

Gestures can be captured or identify using various methods. It can be concluded from this project that the usage of optical sensors is a good solution but still not the best. One of the problems is that background light could severely interfere with the reading. The sensors cannot distinguish between light coming from the data glove and light coming from the background. This could give a different reading which is not good as the result is not constant. One of the solutions is to combine various tracking method in order to recognize a gesture for example using an acceleration sensor to track the rotation.

One of the unique features of this program is that it can theoretically be used to control not just one specific robot but several. This is a good idea, as it will be a universal program that is able to control any robot. From the test that was conducted, it was able to control the Gantry and Motoman robot. The user just needs to write a robot dictionary in a text file. The good thing is that this does not interfere with the program's source code.

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## **E6 - Penilaian Prestasi Penggunaan Bahan Pendingin *Hydrocarbon* dengan HCFC R22 Pada Sistem Penyamanan Udara Domestik**

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### ***Abstrak***

*Bahan pendingin HCFC R22 yang digantikan terus dengan bahan pendingin hydrocarbon merupakan alternatif yang berkesan bagi menangani penggunaan bahan pendingin dari kumpulan CFC/HCFC pada sistem penyamanan udara dan penyejukan. Namun begitu penggantian dari HCFC kepada hydrocarbon pada penyamanan udara domestik masih belum meluas digunakan di Malaysia. Untuk tujuan itu satu kerja ujian perlu dilakukan bagi menilai prestasi menggunakan, bahan pendingin dari hydrocarbon dengan HCFC R22, untuk mendapatkan perbandingan dari segi keberkesanan pada Total Cooling Capacity dan kadar penggunaan kuasa elektrik. Satu tempat pengujian yang sesuai akan dibangunkan untuk mendapatkan keputusan ujian yang tepat dan boleh dipercayai.*

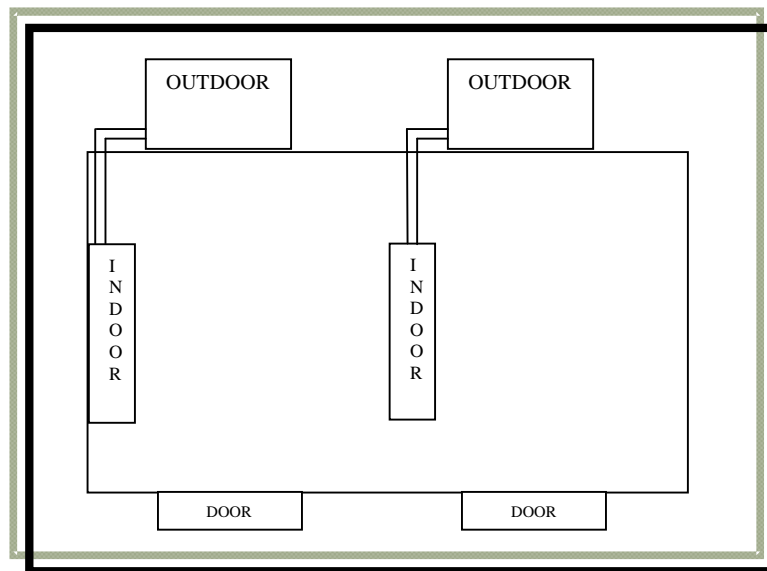
***Kata kunci:*** *Hydrocarbon, HCFC R22, penyamanan udara, kerja ujian (work test)*

### **1.0 Pengenalan**

Terdapat banyak jenis bahan pendingin yang digunakan untuk system penyejukan dan penyamanan udara di pasaran kini. Mulai tahun 2010, Jabatan Alam Sekitar Malaysia telah melaksanakan Protokol Montreal 1994 iaitu di mana gas-gas bahan pendingin berunsurkan kloroflokarbon dijumpukan penjualan dan pengimportan menjelang tahun 2010. Penggunaan gas dalam bahan pendinginan alat penyaman udara boleh-pisah secara berleluasa ialah gas R-22 yang berunsurkan hidroflorokarbon (HCFC) yang mempunyai kesan negatif terhadap atmosfera. Penggunaan HCFC mempercepatkan penghakisan lapisan ozon di atmosfera dan penambahan suhu global. Alternatif yang digunakan sekarang adalah gas R-410. Gas ini juga mempunyai Indeks Pemanasan Global yang tinggi. Untuk mengatasi masalah ini gas bahan pendingin berunsurkan hidrokarbon digunakan. Gas HCR-22a (campuran 50% Butanadan 50% Isopropena) merupakan alternatif yang mempunyai nilai Indeks Pemanasan Global dan Keupayaan Penghakisan Ozon yang rendah. Masalah utama yang wujud dalam penggunaan gas bahan pendingin HCR-22a ialah kemudahbakarannya (*flammability*). Penggunaan gas bahan pendingin HCR-22a mempunyai kelebihan dari segi kecekapan penggunaan tenaga dan kecekapan prestasi pemampat. Satu kajian dijalankan untuk menilai kecekapan penggunaan gas pendingin HCR-22a. Kajian ini dijalankan dengan membuat perbandingan dengan kecekapan gas R-22. Kecekapan sesuatu sistem penyaman udara dinilai dengan mengukur parameter :-keupayaan penyejukan dan kecekapan kuasa elektrik. Satu eksperimen direkabentuk dan dijalankan untuk menguji kecekapan penggunaan gas bahan pendingin. Kerja ujian dilakukan untuk menentukan kecekapan unit hawa dingin yang menggunakan bahan pendingin hydrocarbon (HCR-22a) yang digantikan secara terus setelah membuat tebusguna (reclaim) bahan pendingin asal iaitu R22 (HCFC) terhadap sistem yang siap terpasang dibilik pensyarah bahagian Teknologi Penyejukan dan Penyamanan udara. Ujian ini akan menentukan kebolehan produk dari segi kecekapan penyejukan (cooling efficiency) dan penjimatan tenaga elektrik (electric consumption).

## 2.0 Rekabentuk Kajian

Prestasi kecekapan bahan pendingin dinilai dengan menyediakan *testbed* atau tapak pengujian. Dua alat penyaman udara yang sama kapasiti dan sama jenis dipasang di dalam dua bilik pengujian yang berukuran sama saiz secara berasingan. Beban haba didalam setiap bilik pengujian diseragamkan dengan diletakkan 8 buah mentol 100 Watt. Lampu mentol ini berfungsi sebagai beban haba yang seragam. Beban ini menyebabkan sistem pemampat berfungsi.



**Rajah 1:** Gambarajah Blok Pengujian Unit

### Kaedah ujian

Ujian kendalian unit dilakukan dengan menggunakan bahan pendingin asal R22 dan bahan pendingin hydrocarbon HCR-22a ke atas sistem yang sama dengan mengikut tempoh masa yang sama iaitu selama 15 jam dan bacaan ujian pertama diambil setelah 9 jam kemudiannya dan bacaan ujian seterusnya diambil 1 jam sekali. Bahan pendingin dimasukkan ke dalam setiap alat penyaman udara.

### Langkah Ujian

- Unit yang dihidupkan disambung dengan meter KWH.
- Suhu ditetapkan dengan melaraskan suhu thermostat kepada 20°C.
- Bacaan arus (amp) diambil.
- Bacaan suhu ambient diambil.
- Bacaan tekanan sistem diambil.

- f) Bacaan suhu udara masuk dan keluar unit indoor diambil.
- g) Bacaan jumlah kuasa elektrik KWH diambil.

### **Spesifikasi unit**

Jenama : ACSON  
Jenis : Split Unit Wall Mounted  
Keupayaan Penyejukan : 9000 BTU/hr  
Running current : 4.0 amp  
Supply voltage : 220 ó 240 volt/1Ph/ 50Hz

Peralatan Pengujian ( test equipment )

Alatan pengujian yang digunakan adalah seperti berikut ;

1. KWH meter 1 phase TIF KW-220-1
2. Sling psychrometer
3. Pressure gauge
4. Psychometric chart
5. Psychometric software
6. Thermometer.
7. Clamp meter

Tempat ujian : Bengkel Teknologi penyejukan dan penyaman udara

Keluasan bilik : 68.44 sq. Ft

Anggaran Beban pendinginan dalam bilik : 5133 BTU/hr  
Kapasiti penyejukan alat penyaman udara: 9000 BTU/hr ( 1 HP)

Suhu ambient : Sekitar 29°C DB dan 25 WB

Larasan Thermostat : 20°C

Kelajuan motor kipas Medium

Tempoh kendalian unit alat penyaman udara : 8 jam ( 9 am ó 4.00 pm)  
Beban haba yang digunakan adalah 8 (lapan) biji mentol : 800 watt

### **3.0 Keputusan dan Analisa**

1. Perbandingan cas bahan pendingin diantara sistem yang menggunakan bahan pendingin R22 (HCFC) dan Hydrocarbon (HC). Konsep cas bahan pendingin menggunakan kaedah berat bahan pendingin. Bagi sistem hydrocarbon ianya bergantung pada berat bahan pendingin dengan berpandu tekanan sistem.

Sistem bahan pendingin R22	Sistem bahan pendingin hydrocarbon	Perbezaan
0.525 kg	0.357 kg	0.168 kg

Perbezaan sebanyak 32 %

2. Tekanan yang dikenakan pada sistem penyamanan udara tersebut ;

Perkara	Tekanan (PSI)	Perbezaan Tekanan	Arus larian	Perbezaan Arus
Sistem bahan pendingin R22	60 psi	1 psi	3.2 amp	0.3 amp
Sistem bahan pendingin hydrocarbon	59 psi		2.9 amp	

3. Ujian cooling capacity sistem berdasarkan dari analisa psychometric chart keatas sistem menggunakan bahan pendingin R22 (HCFC) dan hydrocorban (HC) seperti dibawah ;

Perkara	Ambient temperature	Supply air (Air Off) temperature	Return air (Air On) temperature	Air volume (Fan speed tip)
Sistem bahan pendingin R22	31 °C DB	16°C DB	22°C DB	97 L/S
		14 °C WB	18°C WB	
		10 g/kg	9.0 g/kg Absolute Humidity	
Sistem bahan pendingin hydrocarbon	24 °C WB	16°C DB	21°C DB	99 L/S
		14°C WB	16°C WB	
		9.1 g/kg	9.3 g/kg Absolute Humidity	

Perkara	Total sensible heat	Total latent heat	Total heat
Sistem bahan pendingin R22	$Q_s = 1.23 \times L/S \times t$ $Q_s = 1.23 \times 97L/S \times (22^\circ C - 16^\circ C)$ $Q_s = 715.86$	$Q_L = 3.0 \times L/S \times w$ $= 3.0 \times 97 \times 1=291$	$Q_L + Q_s = 291 + 715.86$ $= 1006.86 \text{ Watt}$
Sistem bahan pendingin hydrocarbon	$Q_s = 1.23 \times L/S \times t$ $Q_s = 1.23 \times 99L/S \times (21^\circ C - 16^\circ C)$ $Q_s = 730.62$	$Q_L = 3.0 \times L/S \times w$ $= 3 \times 99 \times 0.2=59.4$	$Q_L + Q_s = 59.4 + 730.62$ $= 790 \text{ Watt}$

4. Penggunaan Tenaga Elektrik oleh system yang menggunakan bahan pendingin R 22(HCFC) dan HCR 22-a :-

Refrigerant R 22 HCFC

Power per day KWH	No of day use	Electric rate RM/kwhr (commercial tariff)	Electric bill per 20 days
19.44 kilowatt	30 April 2013 ó 1Mei 2013 1 day	0.312 19.44 x 0.312 =RM6.10	RM122.00
Running ampere : 3.2			

## HCR-22a

Power per day KWH	No of day use	Electric rate RM/ kw hr (commercial tariff)	Electric bill per 20 days
15 kilowatt	30 April 2013 ó 1Mei 2013 1 day	15 X 0.31.2 = RM4.70	RM94.00
Running ampere : 2.9			

## 4.0 Kesimpulan

Daripada hasil pengujian system yang dijalankan, terdapat penjimatan penggunaan elektrik sebanyak 23 %. Kecekapan pemampat bertambah dengan penggunaan gas bahan pendingin hidrokarbon. Perbezaan isipadu gas bahan pendingin hidrokarbon HCR-22a berbanding kepada gas bahan pendingin R 22 ialah sebanyak 32%. Ini menunjukkan bahawa isipadu hidrokarbon yang rendah dari gas R 22 diperlukan untuk menyejukkan system yang sama. Justeru itu menjimatkan kos dan meningkatkan kecekapan pemampat. Isipadu gas yang kurang meringankan beban di pemampat. Tapak pengujian atau *testbed* yang disediakan adalah ringkas dan dapat menguji kecekapan system gas bahan pendingin.

## 5.0 Rujukan

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# E7 - 30 Km/h Velocity Detector

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## Abstrak

Projek '30 Km/h Velocity Detector' ini merupakan satu sistem yang memberitahu pemandu samaada memandu dalam keadaan berhemah atau tidak berhemah. Ia dereka bagi mengawal lalu lintas di hadapan sekolah iaitu 30KM/J. Projek ini berfungsi dengan menggunakan PIC16F877A. Pada siang hari, panel solar akan beroperasi dengan mengecas bateri yang terdapat dalam kotak yang telah sediakan. Pada waktu malam lampu pada papan tanda peringatan akan dinyalakan, bagi memudahkan pemandu melihat papan tanda peringatan tersebut. Apabila kenderaan melalui barisan limit switch satu, mikropengawal akan memulakan pengiraan sehingga kenderaan melalui barisan limit switch kedua. Jika masa yang di rekodkan kurang dari yang sepatutnya LED merah akan menyala dan sebaliknya LED hijau akan menyala. Masa yang ditetapkan dari limit swith satu ke limit swith dua ialah sekurang-kurangnya 2 saat. Program-program ini tulis dengan menggunakan software MPLAB dan memindahkan ke litar PIC dengan menggunakan PIC KIT 2. Secara keseluruhannya, projek ini dikhaskan di kawasan halaju 30 km/j.

**Keywords:** PIC16F877A, Limit Switch, LED, 30 KM/J.

## 1. Pengenalan

Malaysia merupakan sebuah negara yang semakin pesat membangun. Majoriti rakyat malaysia mempunyai kenderaan sendiri, yang digunakan untuk ke tempat kerja, pusat membeli belah, balik kampung, menghantar anak-anak ke sekolah dan lain-lain lagi. Statistik merupakan jumlah kemalangan jalan raya semakin meningkat setiap tahun.

Projek ini mendapat ilham daripada kes kemalangan jalan raya yang sering berlaku di hadapan sekolah semasa pelajar datang atau pulang ke sekolah. Kanak-kanak sekolah yang belum mahir melintasi jalan raya sering menjadi mangsa kemalangan.

Hal ini disebabkan oleh, kenderaan-kenderaan yang melalui jalan raya di hadapan sekolah tidak mematuhi halaju yang ditetapkan. Halaju bagi jalan raya di hadapan sekolah adalah 30km/j, bagi kemalangan yang melebihi 30km/j boleh menyebabkan kecederaan yang serius hingga boleh membawa maut. Bagi mengelakan perkara ini berlaku, sebuah projek perlu dicipta bagi mengingatkan para pengguna jalan raya tentang kelajuan kenderaan mereka. Sama ada mematuhi atau melanggar halaju yang ditetapkan.



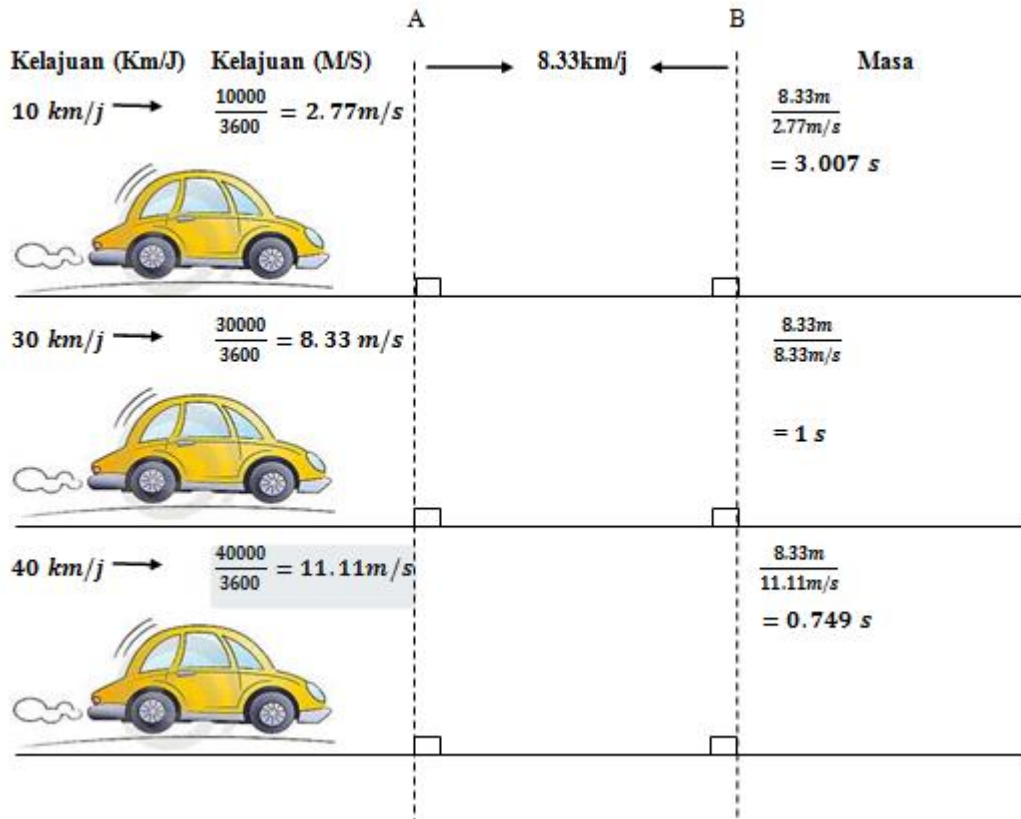
$$\begin{array}{r} 22 \quad 22 \\ \hline 2 \end{array} \quad \begin{array}{r} 222222 \\ \hline 22 \quad 2 \quad 22 \quad 2 \end{array}$$

$$\begin{array}{r} 222222 \\ \hline 2222 \quad 2 \end{array}$$

$$= 2.777 / 2$$

**Rajah 1:** Papan tanda 30km/j dan kiraan dalam m/s

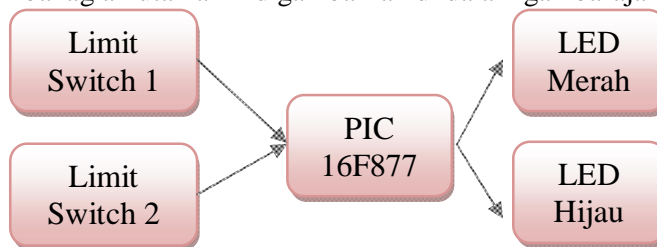
Andai jarak bagi 2 barisan sensor pengesanan hadlaju ditetapkan kepada 8.33km/j, jika kenderaan yang melintasi kedua-dua barisan sensor dalam masa 1 saat, maka kelajuan kereta tersebut ialah 30km/j. Jika kereta tersebut melalui kedua-dua barisan sensor dalam masa melebihi 1 saat, maka kelajuan kenderaan tersebut ialah kurang dari 30km/j. Pengiraan bagi kelajuan- kelajuan tertentu seperti gambarajah dibawah.



**Rajah 2:** Kelajuan dan jarak yang ditetapkan

## 2. Rekabentuk Elektronik

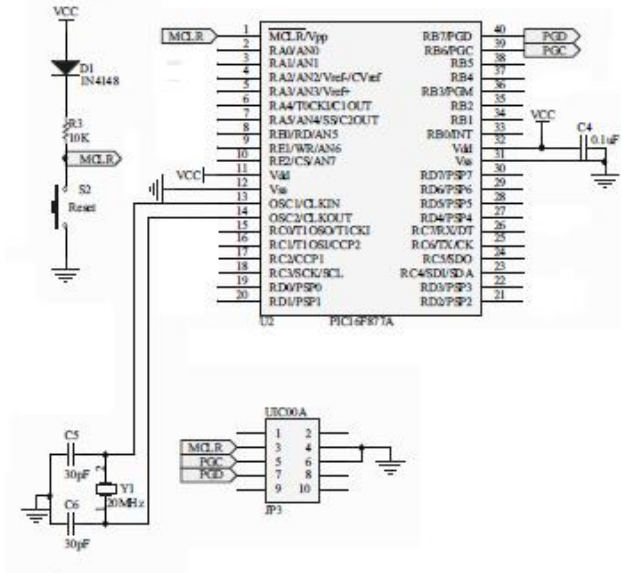
Sistem '30 Km/h Velocity Detector' terdiri daripada beberapa bahagian elektronik yang utama. Bahagian-bahagian utama ini digambarkan di dalam gambarajah blok seperti Rajah 3.



**Rajah 3:** Blok Diagram Sistem Elektronik 30 Km/h Velocity Detector

## 2.1. Microcontroller (PIC 16F877A)

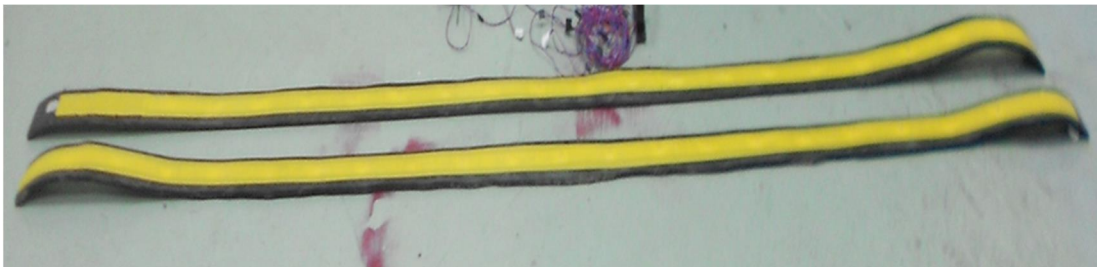
Projek ini menggunakan mikrocontroller jenis PIC 16F877A. PIC 16F877A diprogram menggunakan bahasa C. Bahasa C dipilih kerana lebih mudah difahami dan lebih fleksibel untuk dimanipulasi. Program ditulis menggunakan perisian MPLAB IDE v8.30. Compiler yang digunakan untuk menukar bahasa C kepada bahasa mesin ialah HITECH C PRO. Bahasa C ditulis dalam file `source.c` akan ditukar kepada bahasa mesin dalam file `source.hex`. Program yang dimuat turun ke dalam PIC 16F877A adalah file `source.hex`. File `source.hex` ini kemudian dimuat turun kepada PIC 16F877A dengan menggunakan perisian PICkit2. Litar PIC 16F877A dihubungkan dengan komputer dengan menggunakan kabel USB ICSP PIC programmer UIC00A. Litar asas bagi memuat turun program adalah seperti Rajah 4.



Rajah 4: Litar Asas PIC 16F877A

## 2.2. Limit Switch

Sensor limit switch ini digunakan untuk mengesan tayar kereta yang melalui jalan yang ingin dikesan. Limit switch ini di samabungkan secara selari dengan jarak antara setiap satunya telah ditetapkan supaya semua jenis kenderaan dapat dikesan. Rajah 5 menunjukkan barisan limit switch yang telah di sambung dan tutup dengan pita pelekat.



Rajah 5: Barisan Limit Switch 1 dan Limit Switch 2



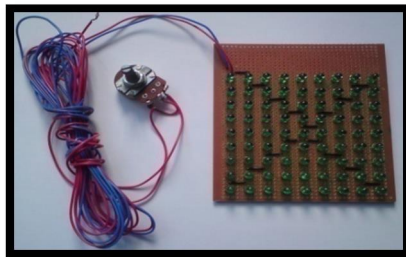
### 2.3. Paparan LED

Paparan LED ini digunakan bagi memberi amaran kepada pemandu yang melalui jalan di hadapan sekolah supaya berwaspada dengan kelajuan kenderaan mereka. LED hijau menandakan kelajuan kenderaan kurang dari 30 KM/J bermakna masih selamat jika ada pelajar sekolah yang melintas. Manakala LED merah menandakan kelajuan kenderaan melebihi 30 KM/J bermakna kelajuan tidak selamat di kawasan pelajar melintas.

**Rajah 6:** Paparan LED

### 2.4. Solar Panel

Solar Panel digunakan bagi mengecas bateri '30 Km/h Velocity Detector'. Ini bermakna '30 Km/h Velocity Detector' tidak perlu bekalan tenaga dari luar atau pun bateri yang perlu diganti kerana solar panel mampu menjana tenaga harian yang diperlukan.



**Rajah 7 :** Solar Panel

### 3. Pengaturcaraan

Seperti diterangkan di atas program bagi projek ini ditulis menggunakan bahasa C. Isyarat Limit switch pertama menandakan tayar kereta telah kena pada limit switch 1. PIC 16F877A akan mula mengira masa sehingga limit switch kedua kena pada tayar kereta. Disebabkan oleh jarak antara kedua-dua limit switch telah ditetapkan kepada 8.33m. Maka kelajuan kenderaraan dapat dikira dengan membahagikan jarak dengan masa. Teknik memprogramkan projek ini adalah inspirasi daripada fungsi Tachymeter yang terdapat pada sesetengah jam tangan seperti Rajah 8.



**Rajah 8** : Gambaran Bukan Pada Tirai

## 4. Keputusan

Setelah semua analisis dan kajian yang telah dilakukan untuk projek ini, keputusan yang diperolehi ialah projek ini dapat berfungsi dengan baik dan sesuai untuk di pasang pada jalan di hadapan sekolah. Pengguna jalan akan lebih waspada tentang kelajuan kenderaan mereka. Rajah 9 menunjukkan projek '30 Km/h Velocity Detector' yang telah siap.



Rajah 9 : Gambarajah Projek

## 5. Kesimpulan

Berdasarkan projek yang dihasilkan ini, masalah untuk mengesan kelajuan kenderaan menggunakan konsep tachymeter berjaya diselesaikan. '30 Km/h Velocity Detector' berjaya membezakan kelajuan samada kurang atau lebih dari 30 KM/J . Kajian yang lebih lanjut perlu dibuat bagi membandingkan penggunaan kuasa pada projek ini.

## 6. Rujukan

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# **E8 - Exploitation Of Renewable Energy For Highway Lighting System.**

Rustam bin Sulaiman

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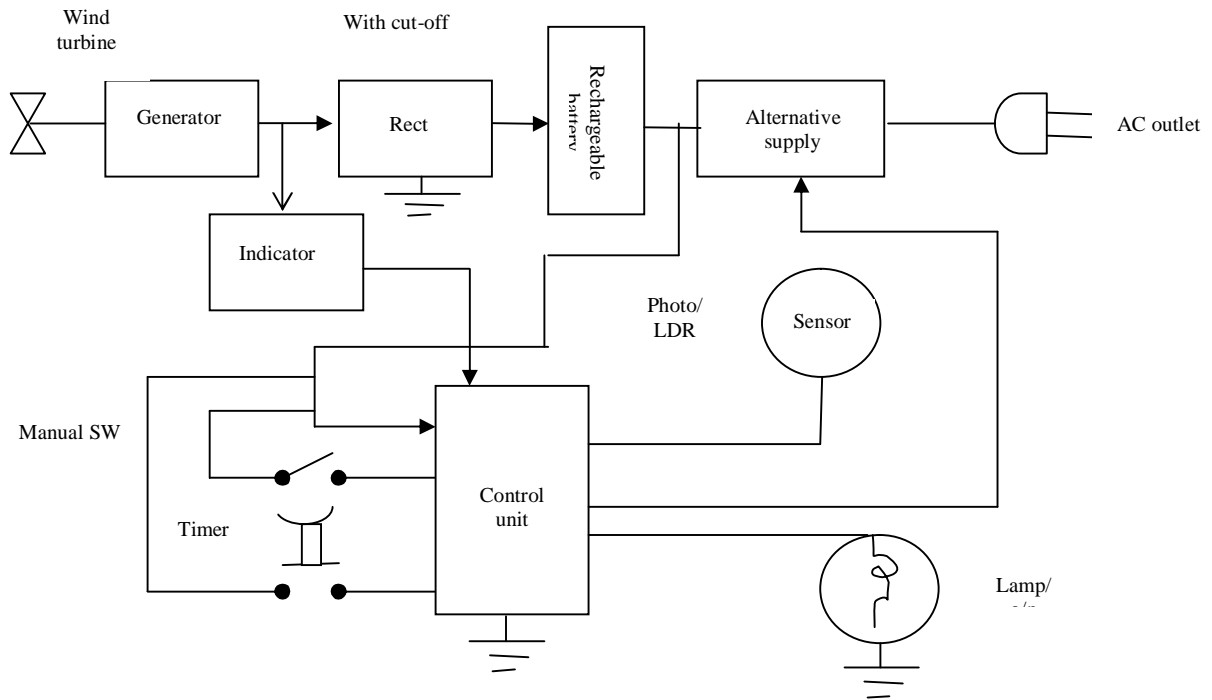
## ***Abstract***

*The purpose of this paper is to exploit this renewable energy to use in highway lighting system. This system consists of 3 functions, which are (i) generate free energy from wind turbine, (ii) store the energy into rechargeable battery and (iii) switching the lighting system when required. Third function will be activated when the light from the sun not reached to the light sensor. This project was focused on free energy from wind turbine as source of energy, analog and digital circuit consist of active and passive component as a controller and street light as an output. Light dependent resistor and toggle switch and generator indicator as input sensor in developing this system. The voltage and current have been measured by the voltmeter and Ammeter. The reading shows that the ammeter from generator rises up when charging process and 0 ampere when battery is full charge. Same as when the LDR is energies and not energies will give the same reading at generator. The movement of Ammeter and Voltmeter shows the heart beat of the system. The conclusion shows that the output can trigger the DC or AC voltage depends on the requirement of the project itself. The control circuit is the combination of digital IC and analog transistor which is the big current has been controlled by small current. The electromechanical component such as relay is a medium to switch ON the big power or small power at the power stage of the system. The storage voltage depends on how big is the turbine and the generator.*

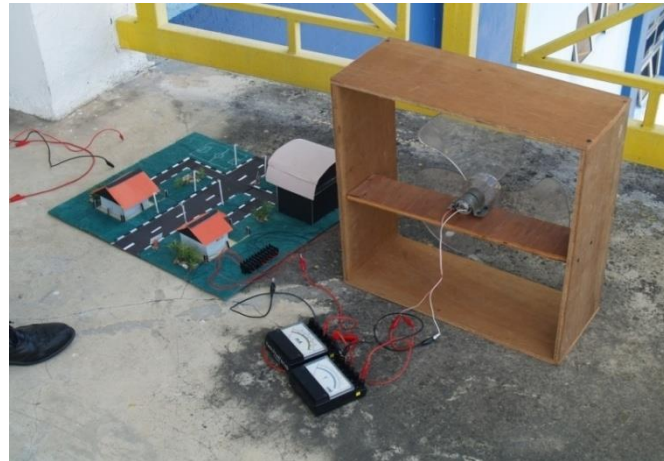
***Keywords:*** *Generator, Storage energy, control system, sensor system, power supply circuit.*

## **1. Introduction.**

This project was named Exploitation of renewable energy for highway lighting system. This system consist of 3 function, which are (i) generate free energy from wind turbine, (ii) store the energy into rechargeable battery and (iii) switching the lighting system when required. Third function will be activated when the light from the sun not reached to the light sensor. This project was focused on free energy from wind turbine as source of energy, analog and digital circuit consist of active and passive component as a controller and street light as an output. Light dependent resistor and toggle switch and generator indicator as input sensor in developing this system.



**Figure 1:** Block diagram of the system



**Figure 2:** Wind turbine model

The turbine will sense the speed of wind and spin the generator as well. The moving of generator will induce the emf and pass through the rectifier circuit in term of one way current flow otherwise the current will return to the generator. When the generator is fully charged, the cut-off circuit will cut off the flow of current until the storage voltage fall down again.

When the LDR sense the absent of light the controller will switch ON the system and storage voltage will flow to the lamp until the storage voltage fall at the point of cut-off circuit energise again and the storage voltage charge up again.

## 2.0 Material And Method.

The TTL IC 7432 and Electrical drive 2N3055 have been used manipulate the system and pick-up the small signal from TTL IC to the base Transistor to allowed the high current from emitter to the collector and switch ON the Relay coil. When the relay coil has been energise the NO contact will connecting the source of the high voltage to the load. The sensitivity of the LDR can be controlled by the voltage divider concept at the input of control circuit. The alternative supply and the manual switch is an option in case of the malfunction of the storage system and the inconsistent of whether.

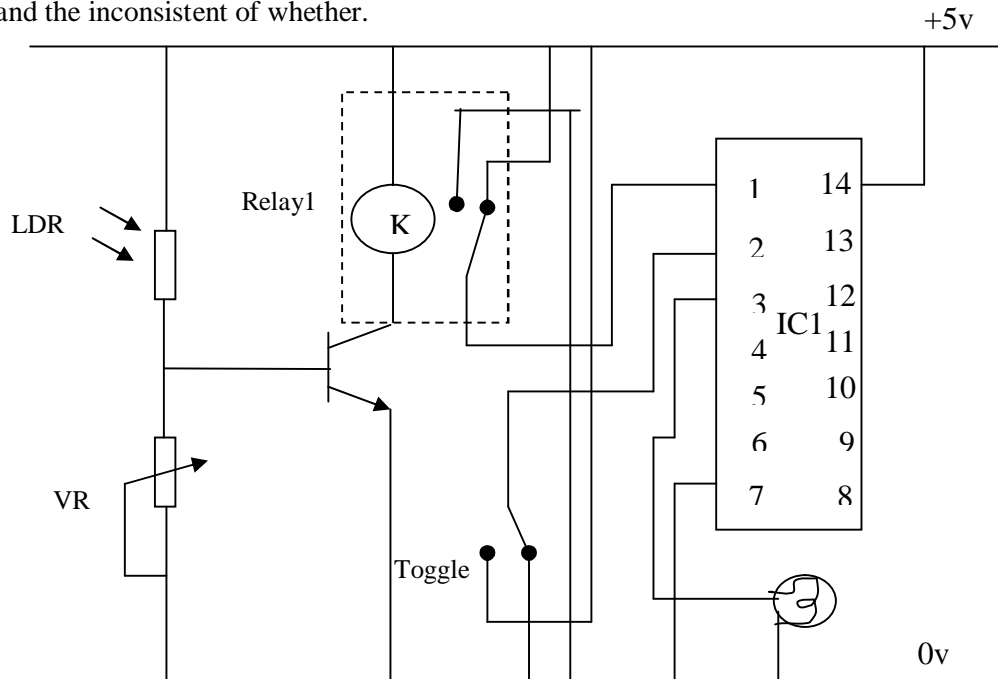


Figure 3: Control circuit

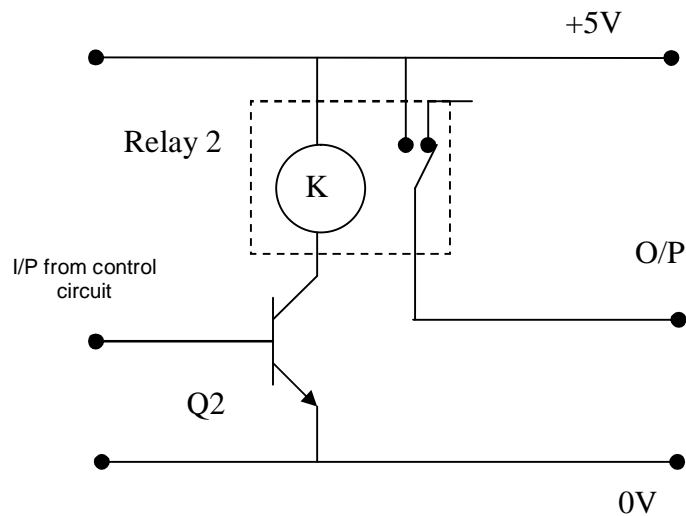
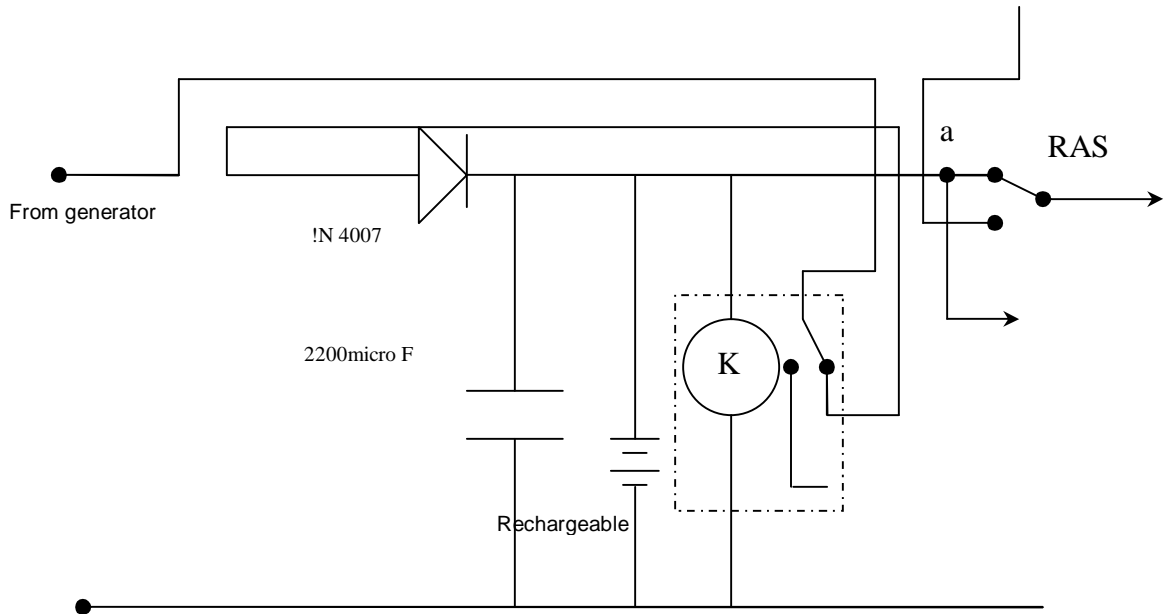
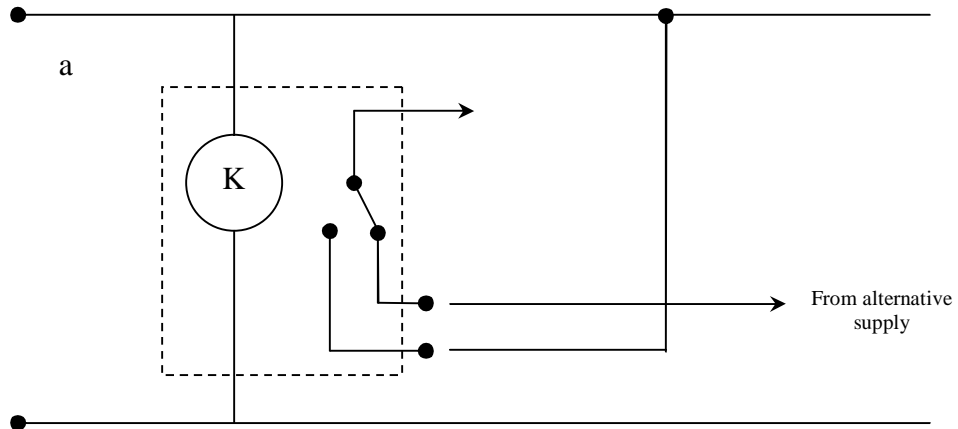


Figure 4: Power circuit.



**Figure 5 :** Power supply circuit



**Figure 6:** Alternative supply circuit

SPEED (rpm)	I (mA)	V (V)	POWER (W)
0.0	0.0	0.0	0.0000
21.6	0.1	1.0	0.0001
46.6	18.0	2.0	0.0360
53.4	20.0	2.2	0.0440
141.0	40.0	2.4	0.0960
232.0	60.0	2.6	0.1560
288.0	70.0	3.0	0.2100

**Table1:** Analysis of Turbine Power Output with Load

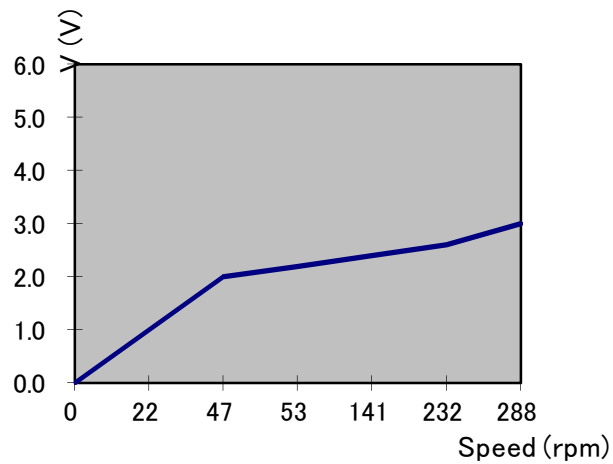


Chart 1

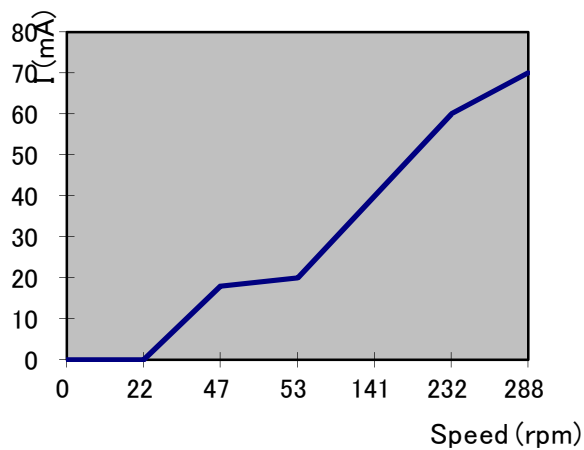


Chart 2



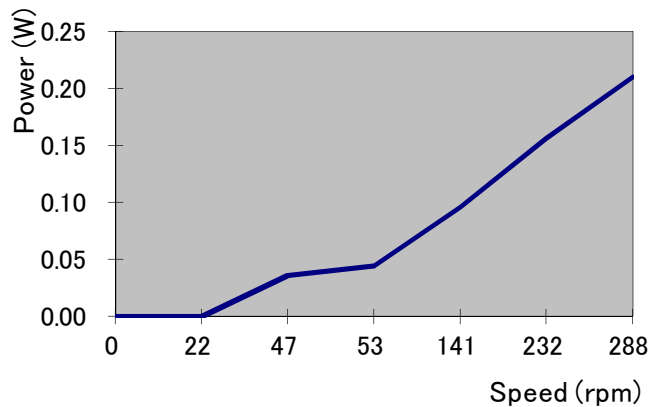


Chart 3

### 3.0 Results and discussion

The voltage output depends on the performance of generator. The result has been displayed by the voltmeter and Ammeter. The voltmeter has been connected parallel with the storage energy and DC generator. The Ammeter has been connected series with generator to the rechargeable battery and rechargeable battery to the load. The reading shows that the ammeter from generator rises up when charging process and 0 ampere when battery is full charge. Same as when the LDR is energies and not energies will give the same reading at generator. The movement of Ammeter and Voltmeter shows the heart beat of the system.

### 4.0 Conclusion

The result of this project examining the voltage output comes from different types of fundamental energy such as wind which is kinetic, heat, solar, hydro, and nuclear and etc. This paper focus on wind energy which is the easiest way to get the energy. The output can trigger the DC or AC voltage depends on the requirement of the project itself. The control circuit shows that the combination of digital IC and analog transistor which is the big current has been controlled by small current. The electromechanical component such as relay is a medium to switch ON the big power or small power at the power stage of the system. The storage voltage depends on how big is the turbine and the generator. The higher the speed of turbine the higher power will be produce.

### 5.0 References

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# E9 - Optimization of Transfer Molding Parameters for IC Packaging Quality Improvement

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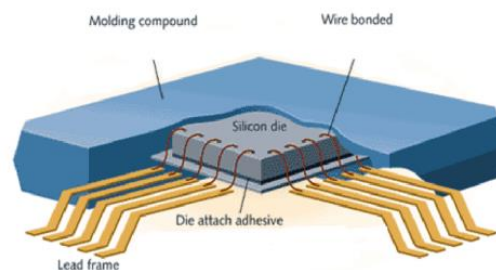
## Abstract

Over the years, semiconductor manufacturing industry has seen drastic advancement in Integrated Circuit (IC) design and fabrication technology. In order to be competitive in this industry, IC assembly companies need to adopt reliable processes with high yield. IC chips assembly has crucial influence on its overall electrical performance and product reliability. Defects on IC packages such as hole, vein, crack, and floss often occurred during molding process of IC assembly. The purpose of molding process is to protect the chips from environmental harmful factors such as heat, humidity, dust, etc. This research focuses only on the molding process where Taguchi method was applied to acquire the most appropriate molding parameters with multiple quality characteristics. Results show that the optimized molding process parameters have significantly reduced defects on molded lead frames and consequently improved the quality of IC packages.

**Keywords:** Microelectronics, IC assembly, and transfer molding

## 1.0 Introduction

Encapsulation is a crucial step in the assembly of semiconductors where ICs are encased in protective packages. Figure 1 below shows an anatomy of a typical IC package which has already been encapsulated. Two types of encapsulation techniques which normally implemented for IC packages are transfer molding and potting or glob topping [1]. However, a majority of encapsulating processes in IC packaging are transfer molded. Transfer molding is the method of choice for mass production because it produces higher quality IC packages [2].

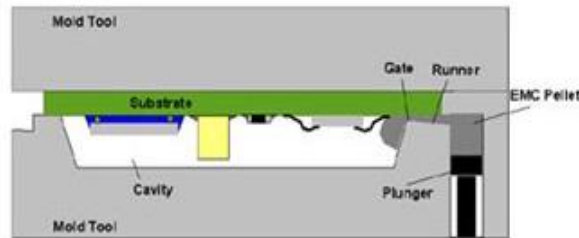


**Figure 1:** A typical IC package structure

## 1.1 Transfer Molding Process Description

Transfer molding equipment for ICs consists of a press equipped with top and bottom platens. The bottom platen is where leadframe with IC chips is placed at the beginning of molding process. This platen also contains a chamber known as a pot at the middle of its body, where the molding compound is placed and liquified by a combination of pressure and

heat. By lifting up a plunger or piston, pressure is applied to transfer the melt material via channels known as runners into the mold which contains a series of cavities. Each cavity which is for each package has vents that allow air to exit the cavity as the molding compound is forced in. The typical temperature of the molding process is around 175 °C and the pressure ranges from 3 to 100 bar [3]. Lastly, both platens are clamped together to apply force needed for compound curing process. Figure 2 shows a diagram of a transfer molding process description.



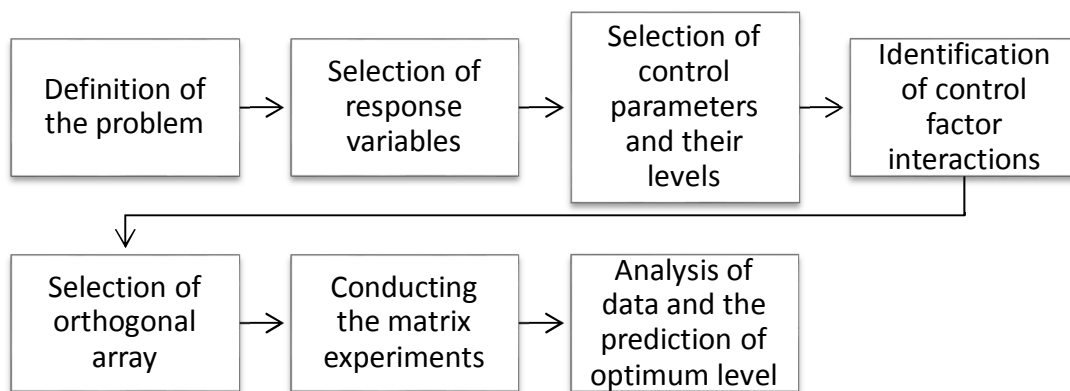
**Figure 2 :** Transfer molding process diagram

## 2.0 Materials And Methods

In many circumstances, process parameters setup is normally taken from machine vendor's recommendations or process engineers based on their experiences. In this study, a systematic approach which applies Taguchi method to design experiments parameters and followed by conducts of experiments was implemented.

### 2.1 Taguchi Method-Based Parameter Design

Taguchi method is one of the most useful problem analysis tools to design and improve process parameters [4-5]. This method applies orthogonal array to set up the experiments for the advantages of less count of experiment and optimizes the process parameters through analysis of signal to noise (S/N) ratio [6]. Taguchi method-based design of experiments involves a series of steps as described in Figure 3.



**Figure 3:** Design of experiments by Taguchi Method

Design of experiment is conducted to reduce defects on IC packages that occur during molding process and to simultaneously validate the best parameter configuration for transfer molding process. Normally, IC packages defects such as incomplete mold, void, fail

vertical offset, flashes and flake surface often occurred during molding process [7]. However, quality characteristics which are used as response variables for this study are incomplete mold fill, hole and surface roughness only. Three control factors with three corresponding levels as shown in Table 1 were selected to optimize the molding process. These control factors were chosen as suitable configurations to be utilized in this study according to findings from literature review [8-10] and vendor's experience.

**Table 1: Process Control Factors and Their Levels**

CONTROL PARAMETERS	LEVELS		
	1	2	3
A : Transfer Pressure (kg/cm <sup>2</sup> )	80	95	110
B : Curing Time (sec)	180	300	90
C: Filling Speed (mm/sec)	4	8	10

## 2.2 Experimental Conduct

Table 2 depicted the orthogonal array of control factors and their corresponding levels selected for experimental conduct. By using this array coordination as reference, 9 experiments were carried out on an auto molding equipment available in ADTEC Taiping (ASM IDEALab). For the experiments, the following conditions are applied:

- The surrounding environment is assumed to be constant
- Other molding process parameters are assumed constant
- The experiments are conducted on dummy leadframe (without die)

**Table 2: L9 Orthogonal Array**

Experiments	Control Parameters		
	A	B	C
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

## 3.0 Results And Analysis

### 3.1. Incomplete Mold Fill and Hole

IC packages were inspected with Scanning Electron Microscopes (SEM) for incomplete mold fill as well as hole and the images of defects were collected. It is found that only the process output of Experiment No. 2 has incomplete mold fill defects as shown in Figure 4 (a) while other experiments produce complete mold fills as shown in Figure 4(b). However, holes are spotted on the IC packages from almost all experiments as shown in

Figure 4 (c) except for Experiment No. 2 and Experiment No. 8. For yield improvement, parameters configuration from Experiment No. 8 is thereby recommended because it produces least number of defects.

### 3.2. Surface Roughness

As for surface roughness analysis, inspection of IC packages were done by measuring the average roughness (Ra) of surface and the data collected were recorded for S/N ratios well as mean value calculations. From the analysis result depicted in Table 3, we obtained the optimal parameter configuration from Experiment No. 4. The S/N ratio and mean values for each factor are summarized in Figure 5. It can be seen that filling speed has the largest effect on surface roughness quality and curing time has the least effect on the surface roughness quality. Figure 4 (d), Figure 4 (e) and Figure 4 (f) shows surface profile images of process output from Experiment No. 8.

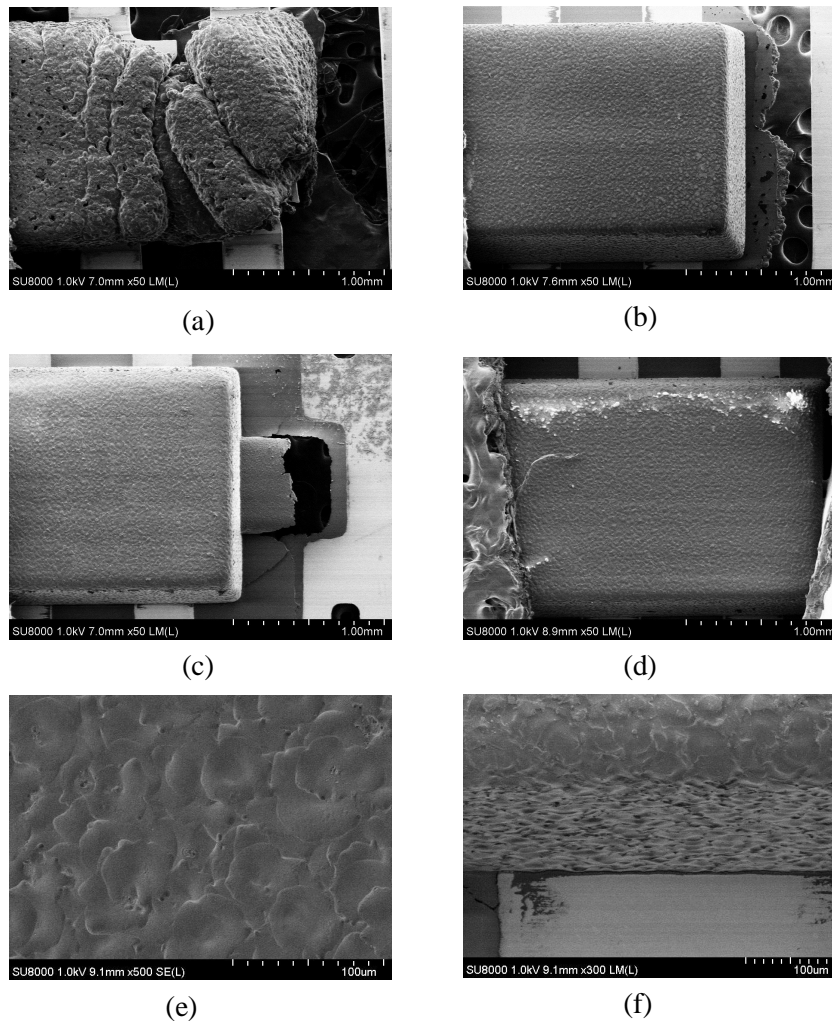
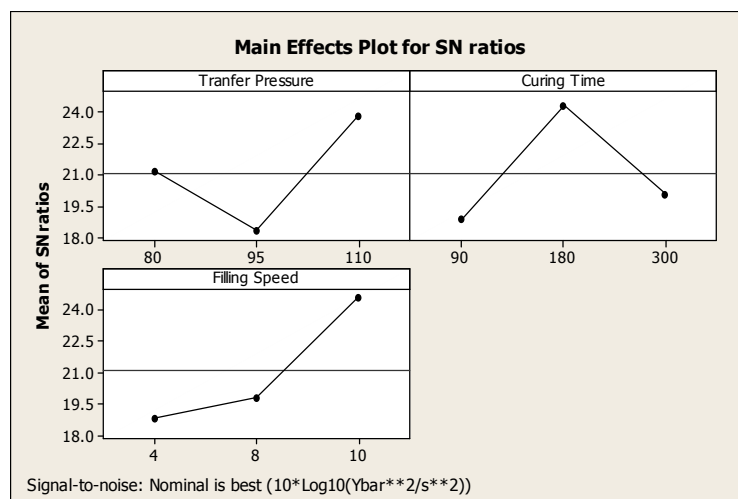


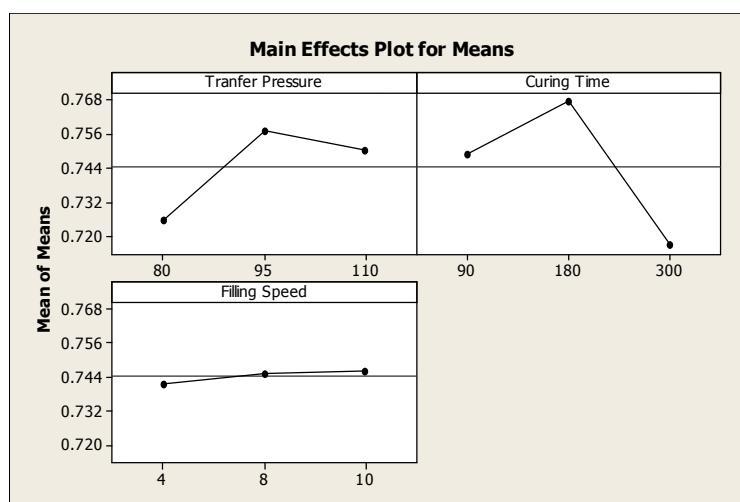
Figure 4: SEM images of molded IC packages

**Table 3:** Analysis result of surface roughness for each control factors

Experiments	Sample 1	Sample 2	Sample 3	S/N	MEAN
1	0.694	0.752	0.764	25.880	0.737
2	0.709	0.74	0.879	18.661	0.776
3	0.747	0.6	0.645	18.905	0.664
4	0.633	0.831	0.677	16.732	0.714
5	0.679	0.723	0.764	24.601	0.722
6	0.809	1.02	0.679	13.729	0.836
7	0.852	0.878	0.826	30.309	0.852
8	0.545	0.706	0.707	16.901	0.653
9	0.709	0.732	0.798	24.166	0.746



(a)



(b)

**Figure 5:** (a) Means and (b) S/N ratios of surface roughness for each control factors

## 4.0 Conclusion

This study focuses on the transfer molding process of IC packages and its purpose is to improve the IC packages quality by reducing three types of defects caused by the process. The experimental results validated that using the best parameter configuration obtained from Taguchi method can produce the least number of defects. Therefore, it can be concluded that Taguchi method has successfully identified the more critical factor of the molding process and can be effectively implemented to improve the quality of IC packages.

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# E10 - Development of Door Access System Using Communication Devices

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## Abstract

*Key is the most important locking device used to ensure one's safety at any premises. Some of us tend to forget to lock home door before as they rush for work, while some feel uncertain whether they have lock the door or not. Some people spend a lot of time searching for home keys in their fully loaded handbag. Worst case, some kids are forced to wait for hours before their parents reached home to open the door when their parents stuck in traffic jam. The product developed in this project tries to overcome the above mentioned problems by just a phone call. Cellular phone nowadays is a must have gadget for everyone. How nice if mobile phones can be used as a key to access the door. So the door can be accessed anywhere. By using Dual-Tone Multi Frequency (DTMF) coding system readily available in smart phones, locking instruction could be done through phone call. Locking instructions sent via phone will be coded and recoded to moves the actuator installed in the door. Further improvement could be done to increase the aesthetic value and functions of the automated locking system.*

**Keywords:** *DTMF, door lock, door control, phone access*

## 1 Introduction

The research and innovation concentrating on home security is getting more significant recently [1]. Door locking system is the main focus for home security. Das, et al.[1] stated that current trend on door locking system focuses on imaging and mobile controlling. Product development varies from motion tracking for intrusion detection [2], to alarm system [3] as well as enhance security system [4] and energy saving locking mechanism [5].

The technological advancement and globalization tsunami have created high mobility lifestyle that requires one to move from one place to the other frequently. A lot of tasks need to be done fast, on the go and remotely [6-7]. Other than the need to keep property safe, remote controlling feature also increases property value by making it a Smart Home [8]. Controlling all the system available in a house through smart phone is an advantage and preferred especially in to the technology savvy generation.

### 1.1 Door Locking System

Door access is controlled by managing the person allowed to enter, time duration accessible and how the access is made [9]. The identity of the person allowed to enter could be recognized via thumb print [10], facial images [11], or eye pupil [12]. Access time is controlled by determining the  $\delta$ Time Zone [9] whereas the access control is varied by combining few mechanical and electrical mechanisms [13].

Common door use a door knob to open and close the door, while electrical door available in the market mainly uses magnetic mechanism to latch [13]. These locking systems are integrated and were designed as a unit. Therefore, the installation of the locking system



requires one to disassemble the currently used door knob and change the whole unit of the locking system with the new one. It is costly, time consuming and might cause damage to the door leaves. An electrically powered door locking system which does not need major modification to existing locking system is currently unavailable but in demand.

### **1.2 Mobile Control**

The technology of remote control was developed on few bases such as infra red [14], electro-magnetic [15], radio frequency [16] and recently many researchers turn to telecommunication technology using mobile and smart phone to transfer data and signals [8]. With the advancement of information, computer, and telecommunication technology (ICT), the usage of mobile phone has increased dramatically. Almost everyone owns at least a mobile phone. Smart phones are equipped with many applications that are able to help people in many ways. Dual-Tone Multi Frequency (DTMF) function for example, enable user to program task by inputting instructions and performs task remotely [8].

## **2 Locking Concept**

This experiment tried to design and develops a prototype door locking system which converts the normal manual door knob locking system into an automated electrical door locking system. Other than locking and unlocking the door manually using a key, it is also desired to control the door locking system remotely using mobile phone. It is desired to combine the potential of the DTMF to the normal door knob locking system to create and automated door locking system using Smart phone as input access device.

Common door use a door knob to access the door, while electrical door available in the market uses magnetic mechanism to latch. But the door designed in this paper modified a manual door knob and connects it to 12V actuator as the locking mechanism. Among the advantage of this design is that the existing door knob can still be used and no waste is created. Furthermore, the existing manual locking system using a key to access is still usable besides the automated option.

This concept also conserves energy since less electrical energy is needed to operate the system compared to the conventional magnetic door lock. Magnetic lock needs continuous power supply to lock the door and required Uninterruptible Power Supply (UPS) to prevent any locking failure during when there is power supply interruption. UPS needs regular maintenance which will add extra operating cost beside bigger space [17].

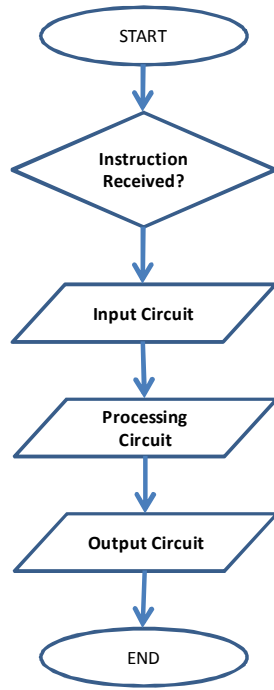
Using embedded 12V actuator requires no extra maintenance and less space especially for battery backup system. It also do not need continuous power supply and still can be use even there is no power connected.

## **3 Methodology**

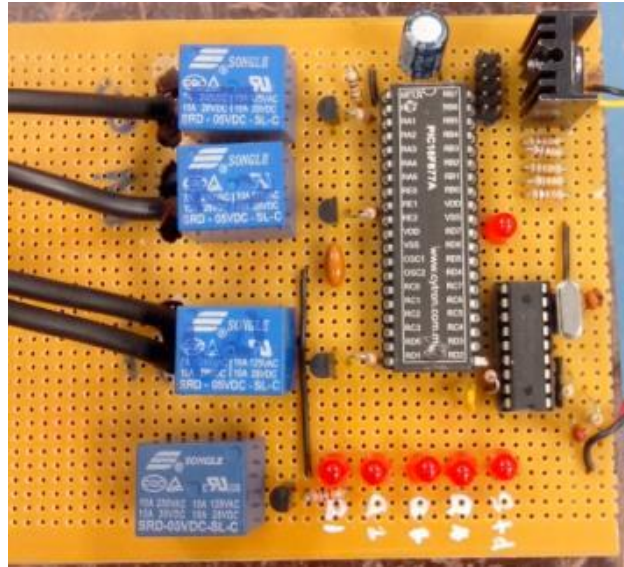
### **3.1 Electronics Circuit**

The system comprises of three different circuits that interacts with each other namely the Input, Process and Output circuits as shown in Figure 1. The input circuit receives instruction from user and decode them to DTMF coding [18]. The signal from input circuit is then feed to the process circuit where the analysis, checking, and verifying of signal received were done. Finally, the signal from processing circuit will trigger the output circuit and moves the actuator installed accordingly.

The circuits developed for this project is shown in figure 2. The major components that are used are DTMF decoder IC (MT8870), PIC16F887, and 5V SPDT Relay. This circuit requires some sort of programming and used C language as the instructions.



**Figure 1:** Process Flow Chart



**Figure 2:** Project circuitry

Figure 3 shows the basic design of magnetic door installation while figure 4 shows the door locking system designed in this project.

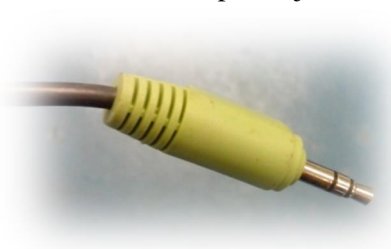


**Figure 3:** Normal magnetic door lock.

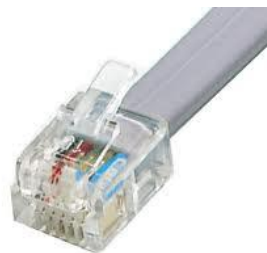


**Figure 4:** Door lock using actuator.

The signal can be received through two methods. First choice is using the home fix line and the other is using mobile phone. Therefore, there are two interfaces used in this system to receive signal from phone namely earphone and RJ11. If fixed line is used, the input at the receiver should be connected to the RJ11 jack; but, if mobile phone was used, the input at the receiver should be earphone jack.



**Figure 5:** Earphone jack



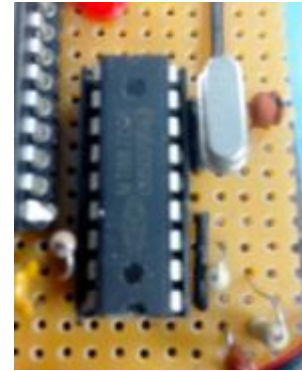
**Figure 6:** RJ11 socket

### 3.2 Receiver Circuit

In the receiver circuit, the main component used is the DTMF Decoder IC (MT8870). Pin 2 of this IC receives DTMF codes and converts it to binary output. The binary output then sent to the processing circuit to be analyzed. The possible outputs are shown as in table 1 below.

**Table 1:** Output result from receiver IC

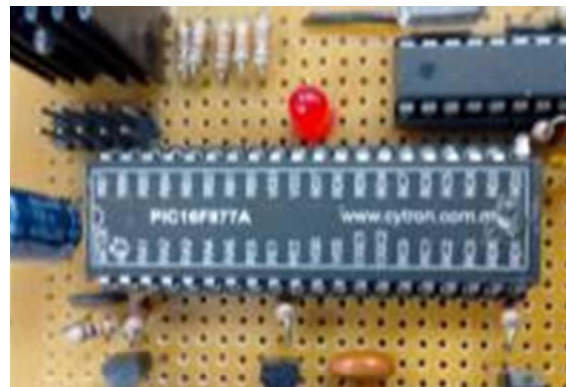
DTMF Input (Pin 2)	Output			
	Pin 11	Pin 12	Pin 13	Pin 14
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	1	0	1	0
*	1	0	1	1
#	1	1	0	0



**Figure 7:** MT8870 DTMF Decoder (receiver IC)

### 3.3 Processing Circuit

In the processing circuit, the signal from the receiver unit is received and analyzed by MT8870. Since the circuit uses 4MHz resonator as a clock, it consumes less power to operates and require less energy [19]. Pin 11 to Pin 14 from the decoder IC are connected to PIC16F887 at RB0 to RB3 and set as a digital input. This PIC will analyse the combination code from the decoder. The output of the process is set at PORT C and PORT D which were set as digital output. The possible of input and output combinations are shown in table 2:



**Figure 8:** PIC16F887 (Processor)

**Table 2:** Output result from processor to controller

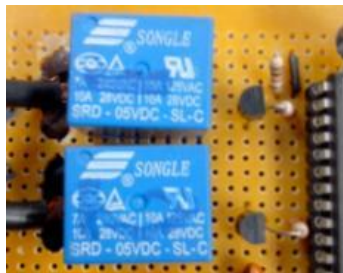
Combination	Signal Sequence	Input				Analyse	Output
		RB0	RB1	RB2	RB3		
1	1	0	1	0	1	L	Actuator to push the rod and lock the door
	2	0	1	1	0	O	
	3	0	0	1	0	C	
	4	0	1	0	1	K	
2	1	0	1	1	0	O	Actuator to pull the rod and unlock the door
	2	0	1	1	1	P	
	3	0	0	1	1	E	
	4	0	1	1	0	N	
3	1	0	1	1	0	L	Relay to switch on porch lamp
	2	0	1	1	1	A	
	3	0	0	1	1	M	
	4	0	1	1	0	P	

After the processing circuit identified the instruction received, the PIC will activates PORT C as digital output to generate input for the output circuit.

### 3.4 Output Circuit

There is no programming in the output circuit because it is only build up from a relay circuit to controls 5V output of the PIC and converts it to 12V DC to controls the actuator.

This relay receives a discreet pulse signal from the PIC to push or pull the actuating rod to close or open the door. The actuator receives reversible polarity to be in either extend or

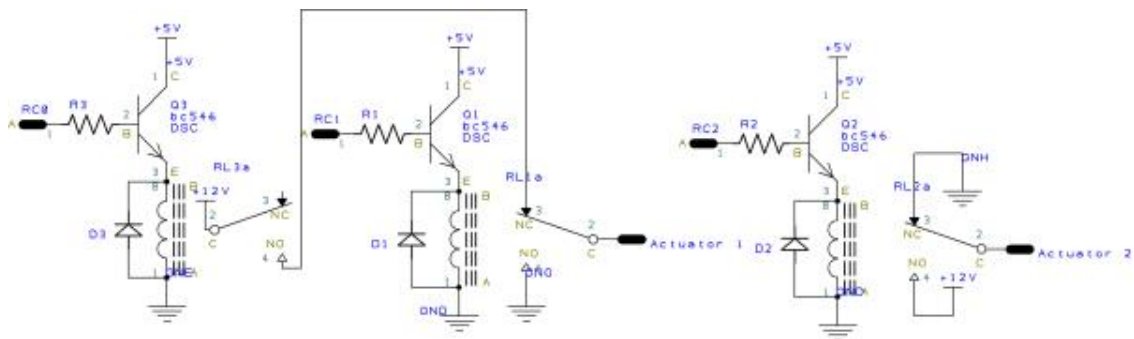


**Figure 9:** 5V SPDT Relay



**Figure 10:** Actuator connects to door knob

retract position. So three relay need to be use to control it. The connections is shows as in figure 11 below:



**Figure 11:** Controller circuit diagram

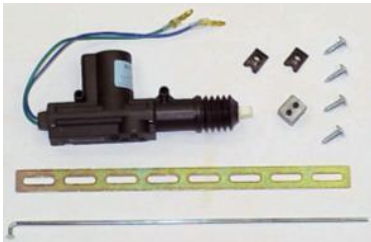
The combination of output at the PORTC was determined as table 3 below :

**Table 3:** Operation of pull and push for the actuator

Input			Output		Result
RC0	RC1	RC2	Actuator Pin 1	Actuator Pin 2	
0	0	0	NC	Gnd	No Operation
1	0	0	+12V	Gnd	Actuator Attract
0	1	1	Gnd	+12V	Actuator Retract

### 3.5 Mechanical Lock

The mechanical components of this project are shown in figure 12. The actuator used as the locking mechanism was mounted inside (concealed) the door. It functions as the locking mechanism depending on the voltage received. If +12V is received, the actuator will extend and if -12V is received, the actuator will retract. The bar inside the locking mechanism was extended to make sure it can use both control automatically and manually.



**Figure 12:** 12V actuator



**Figure 13:** 12V actuator mounted inside the door

## 4 Results and Discussions

Based on the performance and load of the circuit used in this project, it is suggested that smaller microprocessor can be use for such application such as PIC16F84A because it has less input and output terminal. The advantage will be less cost to manufacture and operates the system. However, since in this project, PIC16F887 was used, there are extra inputs and outputs port available. Therefore, this project could be expands further by adding more functions and accessories to increase its commercial value.

In receiver circuit, more precise programming needs to be done to make sure the system runs smoothly without any hangover loop. At least three main problems were identified. It was found that during phone call, sometime the DTMF received was not clear and resulting in improper signal recoding. Such error causes the processor could not determine the correct input and therefore, forcing the program to run continuously and create infinite loop.

The receiver IC could operates in two modes which are latch output and discrete output. This project use latch output to keep the receiver continuously sending codes to the processor. The watch-dog timer needs to be use while the programming enter infinite loop. But if there are input during Watch-dog timer runs, the system will have double hangover and Watch-dog timer need to run for second time. This will make the user failed to realise whether thier input has been coded or not.

Meanwhile, in the controller circuit, 10 Amp relay was used to make sure the actuator performs maximum torque by supplying 10 Amp current to the actuator. Alternatively, motor driver IC (L293D) could be used to control the actuator but the motor driver cannot support that much current. Lower current about 1Amp can be used to operate the actuator but there will be less torque for the actuator to pull and push the rod. If home fix line is desired to be used as signal carrier, auto answer or recordable phone need to be used. If mobile phone is

used, the mobile phone needs to be in auto answer mode. To mount the actuator inside the door, whole set of the door knob need to change to modified door knob to make sure this modification done can fit nicely in the door without failure. Finally, modification to the door is restricted and not all doors can do this modification. Further testing need to done on solid wood door and fire rated door for safety purposes.

## 5 Conclusion

This project was successfully built with working prototype and functions correctly. In the future, improvement can be done on the circuitary and hardware control by using proper fabrication on circuit and hardware. In this prototype, it only control the door and cannot add another output to control. But another output can be produce if you want to control any other output like lamp or fan. Since this is the prototype, it only focus to produce one output to control the door.

The actuator need high amp of current because the door knob used high torque to twist it. For the actuator, RC servo motor can be use to pull and push the door knob but in costing, 12V actuator is more economic to use. Internationally, there are a electrified door knob in market [20] which was widely use in hotels, hospitals and high security building. In the future this electrified door knob can be use for solid wood door and fire rated door to be controlled by phone but need to consider the cost and control circuit should be modified. As an skill developement institution, we successfully reach our goal to produce skilled and proactive student by doing this project. The student that joined and doing this project together having higher softskill and having more experience in doing a job. It is target that out student will have more employability in the market.

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# E11 - Autostarts Car System By GSM Control And Monitoring With Android Operating Application

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## **Abstract**

*This project focuses on the design, development and hardware implementation to control the car system. The suggested solution is by using microcontroller PIC16F887 with GSM frequency MD720-3 modem as an interface. This interface application is able to control the engine system, air conditioning system and security system. These systems can be monitored by GSM frequency which can be sent directly to user via hand phone. This engine system and air conditioning system have been innovated by activating it easily using hand phone. User are able to monitor the thermal comfort before entering the car where the temperature control is set between 23°C to 28°C with relative humidity in around 50% to 80%. Next, the security systems have been innovated which is the car alarm will be activated automatically if any interference occurs and the information will be sent through SMS to the user. In addition, the engine will turn off immediately by sending a security message to the system. With this innovation project, it will help the user to use an alternative application to control the car system with low cost and this prototype is expected to become popular among car users.*

**Keywords** : microcontroller PIC16F887, GSM/GPRS modem, mobile phone, thermal comfort, control car system,

## **1.0 Introduction**

Automotive field is one of the fields which are getting importance in growth today while determining the extension of a progression country's level in the engineering technology. As Malaysians, we should be proud that Malaysia was first known as car exporter in the international arena. There are various new models produced by two local automobile companies, there are Proton and Perodua which successfully appear in the market for public choices. In addition, various technologies were developed in parallel with the development of new models. The technologies developed included the current needs which the inventor must ensure the aspects in terms of design, technology and long-term effects, especially the impact on the financial and environmental costs.

## **2.0 Research Background**

There are various models with the design and implementation technologies which were combined to fulfill the needs of the market. Thus, this creativity and innovation projects were developed based on the current view which shows that the polar users tend to get friendly vehicles and environmentally friendly with an efficient security system. This project is based on main aspects included safety and comfort. For the user's comfort aspect, this project was emphasized to achieve thermal comfort (thermal comfort zone) for the car.

i) Thermal comfort zone

ASHRAE defined that human thermal comfort is the state of mind reflect that satisfaction with the environment [1]. Moreover, the range of temperature and humidity for the comfort zone should be in between 23 ° C to 28 ° C with air relative humidity is in between 50% to 80% [2]. Thermal comfort is influenced by two factors; there are general factors and personal factors. General factors included temperature and relative humidity, while personal factors such as health, psychology, sociology or daily activity based on situation factors [3]. For a car, a combination of high temperature and high relative humidity caused a decreasing in thermal comfort and air quality in the car [4].

ii) Car Security Systems

Through the availability of car security systems, user feels more confidence to park their cars in public area. The security features innovated in this project is:

If the existing security is violated, the security system will be activated and signals will be sending to the vehicle owner's mobile phone and the owners can blocked the engine by sending special security code via short messaging system (SMS) to the vehicle.

### 3.0 Research Objectives And Methodology

For this particular creativity and innovation projects, there are three main objectives that we are aiming in for included:

i). Turning on the car engine by using mobile phone's application technology through G.S.M. (Global System for Mobile Communication) frequency.

This research is innovated to control the car systems such as controlling car engine, controlling air-conditioning system and to enhance the existing security systems. All these processes are using the microcontroller PIC16F887 and GSM modem as interfaces. Applications GSM modem is used as an alternative way to replace the existing remote which works as engine system starter and car ventilation system.

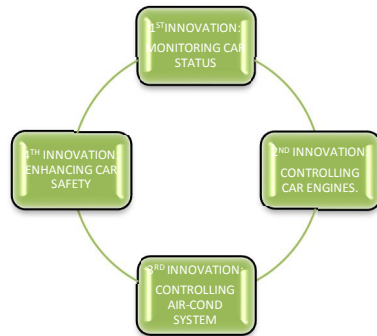
ii). Controlling thermal comfort (thermal comfort zone) inside the car compartment by controlling the setting temperature between 23°C to 28°C with air relative humidity around 50% to 80% which then the set data will be sending via short message service (SMS) to user. Heat temperature which trapped in the car will be issued until it reaches below 40°C. At the same time, the three passengers' window will be opened automatically for 4cm and hot air from the car will be released excitation by the blower. If the temperature in the car reached 39.9°C, air-conditioning system will be fully functioned. Thermal comfort in the car can be monitored from time to time only by using a short messaging service (SMS) which sent to users mobile. When the thermal comfort status has been achieved, relevant feedback will be sent immediately to inform the user that the car is ready to drive.

iii). Improving car safety monitoring when the security system is violated.

To ensure the car is in safe condition, innovated car security system with monitoring also be made periodically to the user. As an improvement if the car is stolen, the car engine system will be blocked by simply sending a special message security service.

Based on this 3 objectives , 4 innovated system are identify as shown in Figure 1 and Figure 2 (attached in Appendix I) are illustrated the schematic diagram of the system that had been developed to achieve the objectives.

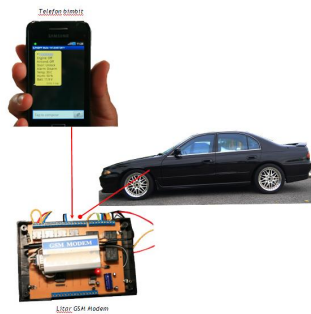




**Figure 1:** Identified of innovated system

#### 4.0 Experimental And Results

Communication occurs when monitoring message on the car sent by mobile phone to GSM modem which was installed in the car compartment. SIM card inserted in the GSM modem acts as a receiver at the same time also serves to send back the car status report in the form of a message to the users' mobile phone as illustrated in Figure 3 and Figure 4 (attached in Appendix II) is shown the process flow chart of the developed system.

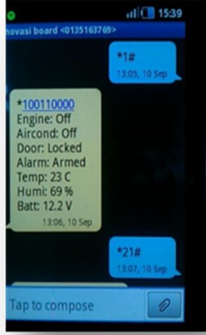
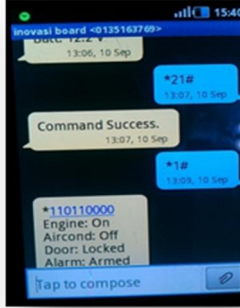


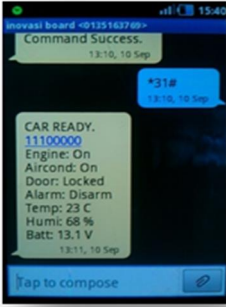

**Figure 3:** Communication between mobile phone and GSM

The procedures to test and trial run process of 4 innovated systems based on 5 situations are attached at the Appendix (Appendix III)

Table 1 is indicated the results of 4 innovated system that had been tested and compared to the existing system to ensure the system is works properly as a needed to achieve the objectives.

**Table 1: Experimental results**

Innovation 1: Monitoring Car Status		
Existing	Innovation	Results
Users need to Monitor and study manually (visual inspection)	Users need to get current information status as simple as sending the code set. (*1#)	
Innovation 2: Car engine control		
Existing	Innovation	Results
Users need to turn on and turn off manually using the key	Users need to send the code by phone to the car in order to turn on and turn off the engine and then monitor the vehicle status. (*21#-ON Engine) (*20#-OFF Engine)	
Innovation 3: Car Air Conditioning Control		
Existing	Innovation	Results

<p>First, users need to turn on the engine and air conditioning manually.</p>	<p>Users only need to send the code by phone to the car in order to turn on air-conditioning automatically.</p>	
<p><b>Innovation 4: Enhance the Existing Car Security System</b></p>		
<p><b>Existing</b></p>	<p><b>Innovation</b></p>	<p><b>Results</b></p>
<p>There is no feedback to user when car security system is violated.</p>	<p>Feedback will be sent to users' mobile phone immediately</p>	

## 5.0 Discussions

The system that has been developed with unique features such as the following:

- i. Developing engine control systems and wireless car ventilation

This project uses mobile phone which functioned to control the engine and car ventilation system. Similar characteristics and android operating compatibility system allows two (2) way communications between GSM modem with user in a simple, fast and efficient. Signal transmitted through short messaging service (SMS), will help to guide the car to start or to turn off wirelessly. At the same time, the signal also serves to control the car ventilation system (blower).

- ii. Turning on the car air conditioning systems and thermal comfort control wirelessly

The car engine and air conditioning systems will be switched on automatically to the internal state of the car to achieve thermal comfort. In order to achieve thermal comfort, the ideal temperature needed is between the range of 23 °C to 28 °C, and the ideal relative humidity ranges is from 50% to 80%. Consequently, a simple feedback of thermal comfort will be sent to users via short messaging service (SMS).

- iii. Wireless vehicle security monitoring

The existing security system was upgraded with monitoring that can be done periodically through short messaging service (SMS). Unique security features was enhanced security in two (2) situations:

- The first situation is if the car is violated

For the first situation, car owners will find out if the car was invaded through short message service (SMS). If there is any interference occurs to car safety, the alarm will ring automatically and SMS will be sent to users instantly.

- The second situation is if the vehicle is taken away.

For the second situation, if the vehicle runs, the system will tracked especially when the car engine is switched on. A special safety message will be sent to immobilize the car engine system immediately.

After testing and analysis, this project has a potential to be developed and commercialized to the community and users in Malaysia. The final products was developed by combining three (3) types of innovation and give advantages to the environmentally friendly, user-friendly and low cost implications. This project was developed to control three (3) car systems such as controlling engine car, the air conditioner and to monitor existing car security systems. In addition, this project focuses on thermal comfort for the vehicle user.

Several advantages of this project are:

i. Energy and time saving

- With the remote control method (wireless) through users' mobile phone, the product was developed help to reduce its energy (fuel consumption) and time use to start the engine and air conditioning in the vehicle.

ii. Increased the rate of User Vehicle Security

- Security can be enhanced and can be controlled through the signal displays on the phone users.

iii. Marketability and Multiused Openfunction

With simple and inexpensive installation cost, the product is applicable to all categories of vehicle users.

iv. Green Technology Applications

Users can enjoy and ensure the fresh air and thermal comfort in a vehicle environment before and while driving.

## 6.0 Conclusion

The prototype which named as 'Car Autostarts by GSM Control and Monitoring System' has been developed using expert lecturers in ILP. This prototype is a 'project based' set by the institute to be developed with students and it became a policy in order to produce students who can be marketed in also to increase skills and knowledge to those students involved.

The advantages of this prototype are, the components used are easily available, the simple circuit and zero maintenance. While the development meets the objectives set it

is also expected to win users heart due to unique features such as user-friendly and environmentally friendly. It gives the users an alternative way to monitor and to know thermal comfort before entering the car. Besides that, existence systems which using 'remote' control still can be used, even car safety monitoring is also innovated and enhanced.

With the development costs is not expensive, this prototype is suitable for affordable cars and will be expected to have a place for users who require additional facilities in upgrading existing systems to approach the system on luxury cars. This prototype is expected to reduce production costs of the development costs when it is commercialized.

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# Appendix I

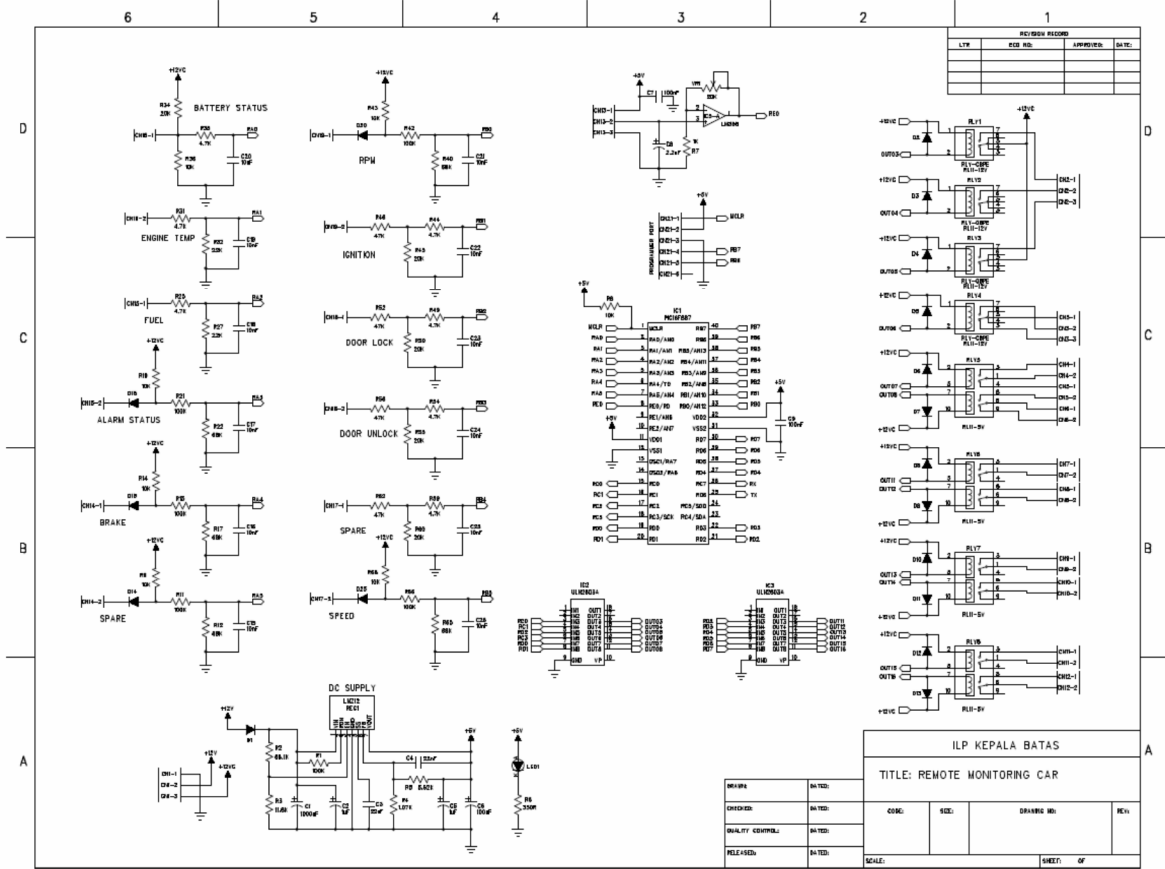


Figure 2: GSM Controller board schematic diagram

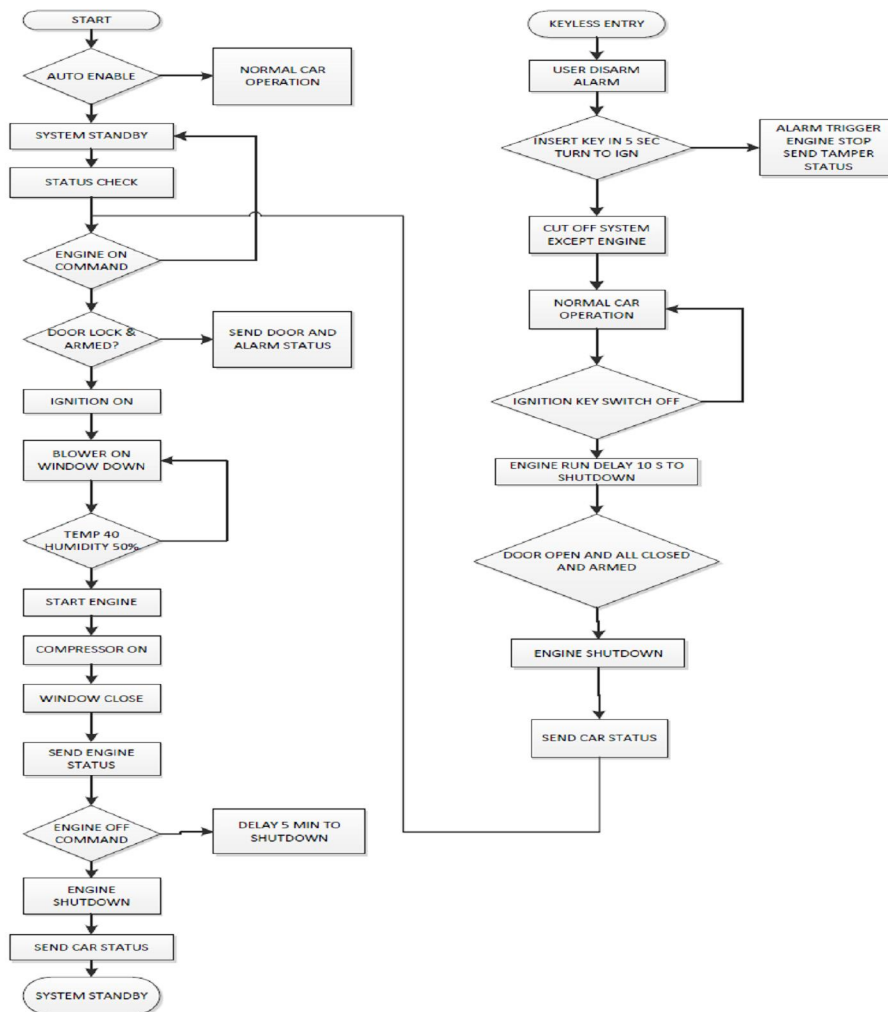


Figure 4: Process flow chart of the system

i. Monitor the status of the car

Step 1: Type the code \* 1 # and send to 013-xxxxxx

Step 2: Receive car status feedback based on the following:

ÉEngine status(OFF / ON)

ÉAir conditioning status (OFF / ON)

ÉDoor status (LOCK / UNLOCK)

ÉAlarm (DISARMED / ARMED)

ÉTemperature

ÉHumidity

ÉBattery

ii. Turn ON the engine

Step 1: Type the code \* 21 # and send to 013-xxxxxx

Step 2: Receive feedback

COMMON SUCCESS / COMMON FAIL

iii. Turn OFF the car

Step 1: Type the code \* 20 # and send to 013-xxxxxx

Step 2: Receive feedback

COMMON SUCCESS / COMMON FAIL

iv. Turn ON the air-conditioning system

Step 1: Type the code \* 31 # and send to 013-xxxxxx

Step 2: Receive feedback CAR READY for the following:

ÉEngine status (OFF / ON)

ÉAir conditioning status (OFF / ON)

ÉDoor status (LOCK / UNLOCK)

ÉAlarm (DISARMED / Armed)

ÉTemperature

ÉHumidity

ÉBattery

The CAR READY message is indicated the thermal comfort zones are achieved.

v. Increasing car safety monitoring when the security system is violated.

If the car is violated, feedback in the form of short message will be received by the users through the command as follows:

Alarm Triggered



## E12 - Performance of BioTROP in Confine and Open Field

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### **Abstract**

*Generally, the sensor node can be deployed in any possible applications such as environmental monitoring, industrial sensing, infrastructure protection, and battlefield awareness. In developing the reliable transmission and low power consumption, Wireless Underground Sensor Network (WUSN) challenges any routing protocols to achieve all of these requirements. This paper presents on the performance of Biological Tunnel Routing Protocol (BioTROP) in WUSN particularly on the tunnel environment compared to free-space in real-testbed deployment. Three challenging conditions were set up in experimental process such as low power transmission, all nodes appear as source nodes concurrently and faster transmission rate. The BioTROP protocol is deployed using 6 TelosB nodes at a predetermined distance. Final findings show the performance evaluation of BioTROP in Tunnel Wireless Sensor Network (TWSN) successfully manipulates the signal interference and attenuation that occurred in a tunnel environment when increase up to 20 percent of Packet Reception Rate (PRR) compared to the free space result.*

**Keywords:** routing protocol, tunnel wireless sensor network, ant colony optimization

### **1.0 Introduction**

There are several types of wireless communication in WSN such as Wireless Underground Sensor Networks (WUSN) and Underwater Wireless Sensor Network (UWSN). In WUSN, devices are either buried completely under dense soil, or placed within a bounded open underground space, such as mines and road / subway tunnels [1]. Thus, Tunnel Wireless Sensor Network (TWSN) is under WUSN category as shown in Figure A.1. In TWSN, although the signal propagates through the air, the propagation characteristics of EM waves are significantly different from those of the terrestrial wireless channels. This is due to confined space caused by the structures of the mines and road or subway tunnels [1].

Basically, there are several general challenging for multi-hop routing in WSN where originally the sensor nodes are manufactured to be low processing powered, low data reliability and need low energy consumption with limited computational capabilities and limited coverage. These basic limitations have already challenged the implementation of sensor nodes in any area such as confined space and open field. Compared to the free - space environment, the relevant factors that occur extremely in underground tunnel environments are extreme path loss, reflection/refraction, and multi-path fading. The tunnel lining may contain various materials including sodium silicate, lime, silica fume, cement, and bentonite [2]. Therefore, the composition of each material can contribute more path loss due to material absorption, a major concern when using EM waves.

Otherwise, underground path losses are highly dependent on the soil type and water content. In tunnel environment, the soil-wall interface introduces reflection and refraction because of the different attenuation characteristics of soil and air. The reflected signal may improve or impair the communication performance depending on the distance between nodes. Furthermore, broadcasting waves at medium transitions will be partially transmitted and partially reflected, then also cause multi-path fading phenomenon. On certain condition that involves the transmission of data from underground tunnel to ground surface, multi-path fading effect will especially be pronounced for sensors deployed near the wall surface, where the wave is close to the soil-air interface.

In maintaining a multi-hop communication, the ideal routing protocol must have nature awareness, reliable in heavy source node, effective in ad hoc situations and faster transmission rate with lower power consumption. Hence, this paper introduces the Biological Tunnel Routing Protocol (BioTROP), a practical ad-hoc protocol for tunnel environment. This protocol is inspired by an ant colony feature in finding food. Further discussion will be done as follows: Section II introduces the biological inspired technique was introduced in the WSN area as generally. This is followed by the detail explanation of BioTROP in Section III. Section IV views the experiment test bed at two areas and continues with result analysis in Section V. Finally, Section VI draws the conclusions of this project.

## **2.0 Biological Inspired Techniques**

In discussing the routing protocol in TWSN, certain techniques have valid solutions, a specific topology and characteristics of certain scenarios as a design basis. However, the drastic change phenomenon is a critical issue in the dynamic topology of the network. Hence, a group of algorithms or routing protocols called biological inspired are introduced because these consists of being adaptable, biological principles are capable of overcoming the several adaptability problems such as multihop routing and dynamically environmental changes. The area of biological model has some approaches, such as swarm intelligence, Artificial Immune System (AIS) and intercellular information exchange [3-6]. Swarm intelligence inspired by swarming activities of groups of organisms such as ant, bee and bird [7]. Meanwhile AIS imitates the finer properties of the biological immune system [8]. The intercellular information exchange approach is similar to molecular biology.

Ant Colony Optimization (ACO) inspired by the behavior of ant during searching its food. In a certain ant colony, there are many army ants assigned to find the path to go to the food area. Each army ant communicates to each other using chemical scent known as pheromones during the searching process. Compare the challenging environment with a simple and unsophisticated creature, an ant able to find the shortest path to target food area and share the information with other ants through stigmergy. Therefore, the implementation of an ant agent in the routing protocol area attracted many researchers in early nineties when it was proposed by Marco Dorigo in his doctoral dissertation in 1992. The ACO is grouped under Swarm Intelligence which is clustered under the Biological Models [9]. Biological Models are one of the Self-Organizing Protocol under hierarchical topology as shown detailed.

However in reality, the finding process will take a lot of time due to the slow movement of ants and the unknown food location. However, certain ant colony has many army ants to facilitate the finding process. Therefore, this paper implements a certain technique of ant finding food to minimize searching time without overlook the limitation of

multi-hop communication in a confined space like a tunnel. One of the critical issues that appeared is traffic management of signal transmitted by many source nodes. So, this project only uses the concept of three agents in an ant food finding process which are Forward Ant, Backward Ant and Data Ant to develop the simpler algorithm and light weights computational.

### 3.0 Structures of BioTROP

This section presents the general framework and design of a novel routing algorithm for TWSN defined as Biological Tunnel Routing Protocol (BioTROP). BioTROP is a routing protocol that was raised from the behavior of ant. In BioTROP, the Ant Colony Optimization (ACO) is adapted to perform autonomous routing in TWSN [11,12]. It is inspired from the basic structure in implementing ACO in Telosb nodes by M. Ariff [9] and optimal forwarding progress in RTLD concept by Ahmed on WSN routing [13]. The proposed routing protocol consists of two functional modules that include routing management and neighbour management. Both functions cooperate and coordinate with each other to provide self-optimized routing capability.

The flow chart of the proposed BioTROP protocol is shown in Figure A.2. The process begins when the data packet ready to send or forward. First, the algorithm checks the surrounding environment to analyze available node by broadcasts the Request to Reply (RTR) message. If a certain node received RTR message, it will send the parameter of LQI, Packet Reception Rate (PRR) and remain battery voltage to sender node. Each node will update the optimal forwarding (OF) table when received three needed parameter mentioned above from surrounding nodes. Calculations of the maximum parameter of optimal forwarding progress will determine the next node to forward data packet. This stage implements the concept of forward progress in RTLD indirectly.

Furthermore, the searching method invoked for every hop before Forward Ant (FA) agent record the best hop neighbour in neighbour table agent. Backward Ant (BA) agent invoked when FA arrive at a base station node. It will pass through the recorded trail in neighbour table agent. Therefore, the possibility of the data to reach the source becomes higher and assured. If the sender node not received the BA agent in a certain time, it will rebroadcast the RTR message to analyze the best node again. At the final stage, the Data Ant (DA) agent will invoke when BA reaches its sender node. The source will send the data from DA agent straightforwardly through the recorded route. This process repeats continuously each time the source sets to send the data to base station.

### 3.1 Routing Management Module (RMM)

Routing management is the main module in BioTROP. It collaborates with neighbourhood modules and optimizes the routing process in order to accomplish the BioTROP routing protocol. Figure A.3 shows the state machine diagram of BioTROP. The routing management sends request to the neighbourhood management to resolve the discovery process of neighbour nodes. Each time the neighbour discovery invoked, the list of newly discovered nodes is saved in the neighbour table. All available neighbour nodes will be calculated their conditions parameter in the optimal forwarding equation as shows in Equation 1. Therefore, the determination of optimal location was made at this stage. Whenever the routing management sends packet to its neighbour, ants table will stores the trail or neighbour node first to re-check the path by opposite direction at BA stage.

$$P_{\text{total}} = \max(P_{\text{tx}} \times P_{\text{rx}}) + (P_{\text{tx}} \times P_{\text{rx}}) + P_{\text{tx}} + P_{\text{rx}} \quad (1)$$

$$P_{\text{tx}} + P_{\text{rx}} = 1$$

$$P_{\text{tx}} = 0.4, P_{\text{rx}} = 0.3, P_{\text{total}} = 0.3$$

$$P_{\text{total}} = P_{\text{tx}} + P_{\text{rx}} + P_{\text{tx}} \times P_{\text{rx}}$$

### 3.2 Neighbourhood Management Module (NMM)

The objective of the neighbourhood management module is to discover a subset of forwarding candidate nodes and to maintain a neighbour table of the forwarding candidate nodes. Although the sensor node has limited memory, the neighbour table is provided to all of forwarding candidates that occurs in this project. The neighbour table format contains source node ID, next node ID, type of action (receive or reply), remaining power, PRR and LQI as shown in Figure A.4. The proposed system manages up to a maximum store of 6 sensor node information in the neighbour table. Figure A.5 shows the state machine diagram of the functional process of the neighbourhood management as an overall.

### 4.0 Experiment Test Bed

The tests were conducted using a simple network topology in two different environments at Industrial Training Institute (ITI) Marang, Terengganu, Malaysia as shown in Figure A.6, A.7, A.8 and A.9 in Appendix section. These configurations were used to test the percentage of delivery ratio, the percentage of packets dropped and the packet received rate at the base station. Each node will send out a data packet every 1000 milliseconds. Thus, that makes the rate of data sent equals to 1 packet per second, which is double with suggestion rate. According to TelosBs manufacturer, the optimum rate should be 0.5 packets per second, because higher rates can lead to congestion [14]. Hence, from this experiment, we can see the performance of BioTROP under a quite similar condition of tunnel environment and also in an open field. The data rate was set to send at a constant rate of 1 packet per second and the distance between the nodes,  $d$ , was varied from two meters to eight meters. The transmission power was set to -25dBm and -15dBm. Node 0 was set as the base station meanwhile Node 1 to 6 runs as source node as well as the intermediate node between them concurrently.

### 5.0 Results and Discussions

This section discusses the experimental results of the implementation of BioTROP in TWSN. The BioTROP are embedded into 6 TelosB nodes. TelosB mote uses CC2420 component as transceiver in its module. Therefore, there are 8 power settings transmission that are allowed as specified in Figure A.10. In this paper, the TWSN testbed are experimenting with two different power transmissions which are -25 dBm and -15 dBm, where these are the two lowest settings in TelosB mote. In each experiment there are 4 positions setup which is  $d= 2, 4, 6$  and 8 meters. The performance will be in term of Packet Reception Rate (PRR). This performance will be observed at the base station in 5 minutes. Furthermore, the proposed protocol is analyzed also in free space condition with same power transmission, period and distances. Hence, the analyzing of result between tunnel environment and free-space condition were done on PRR performance. Finally, this chapter discusses the significant test for all experimental results.

Refer to the performance of closest distance in Figure A.11, both power transmission setups showed similar result in both environments. The slight difference occurred due to the

obstacle surface (confined space) in the tunnel compared to in a free area. Meanwhile the results at 4 meters showed the BioTROP gives 15 percent greater in tunnel compared to free-space. On the other hand, an obvious dissimilarity is happening on lowest power transmission at 6 meters. However at 8 meters the PRR was unstable in the free - space area for both power setups. As overall, a better performance showed in tunnel condition for node 1. Node 2 located on opposite sides of node 1. So, similar pattern and changes are observed in the graph in Figure A.12. However, the difference at 8 meters using -15 dBm power transmission is not obvious compared to node 1. The reading just differ 20 percent compared to more than 50 percents at node 1 with the same power transmission. Generally, node 2 also shows the BioTROP have good performance in tunnel condition compared to free-space area.

Node 3 shows more consistent result in both situations. Refer to Figure A.13, the PRR of node 3 is gradually decreased at -25 dBm power transmission in tunnel condition. The drastic changes only obtained at 2 conditions in free-space implementation. Firstly, the reading recorded at 6 meters with -25 dBm and secondly at 4 meter with -15 dBm power transmission. Overall, the graph is quite stable in tunnel condition and showed better implementation compared to in the free-space area. It proves at 8 meters with -15 dBm power transmission when more 25 percent differential was recorded. In Figure A.14, the different performance is read on tunnel condition for node 4. If node 3 was decreasing consistently, there is increasing and decreasing result on node 4 performance at -25 dBm power transmission. As overall, the performance of node 4 in free-space area is decreased when the distance increased. The drastic descent only happens at 6 meter with lowest power transmission. However, the comparison of result between both areas can be observed clearly at 8 meter with -15 dBm power transmission. The BioTROP was successfully implemented in tunnel condition more than 45 percent contrast to free-space area.

The Figure A.15 shows the PRR performance of node 5. As can be observed, no obvious differential can be detected compared to others node. The drastic dropped also happen at 6 meters in the free-space area using lowest power transmission. When power transmission increased, the result does not change intermediately in tunnel condition. Although almost data packets fail to deliver in farthest distance using lowest power transmission in both areas, more than 70 percent was read on tunnel condition compared to only 28 percent in free space area when the power increased. Node 6 has showed its PRR performance in Figure A.16. As happens at others node, the graph drops drastically at 6 meters in free-space area. However, it gets down slightly at 8 meters. When the power transmission increased, the throughput gradually declines from 2 meters to 8 meters. Overall, node 6 was delivered its data packets confidently in tunnel condition compared to free-space area. BioTROP successful increased of 27 percent PRR at node 6 contrast to 44 percent who successfully rose at node 5.

As a whole, this paper analyzes the proposed routing protocol in real test bed only without running it at specific simulator. Thus, the result obtained for two setups of power transmission in each node complements to each other and support one another. This is because the result in lowest power transmission at distance of 6 meter and 8 meter show the enhancement throughput as can be seen at the same distance in -15dBm power transmission. Hence, the proposed routing protocol able to operate in tunnel environment as long as the node sets with match power transmission. Furthermore, the BioTROP successfully manipulate the reflection of signal symptom in increasing the delivery of data when more than 20 percent improvements are recorded in a tunnel environment compared to free-space condition.

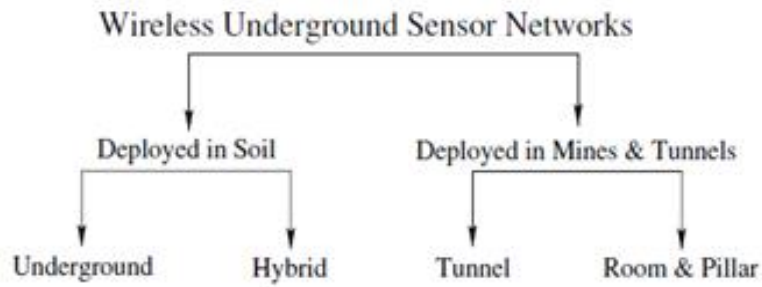
## 6.0 Conclusion

From two setups of power transmission, the result recorded can be analyzed to test BioTROP performance. Therefore, the conclusions were made as follows; Firstly, the practical model of routing protocol in a tunnel environment based on capability of TelosB motes in TinyOs 1. x have been successfully designed, model and experiment based on ant colony optimization technique. Secondly, the concept of optimal forwarding decision that suite in tunnel condition was adapted with considered parameters. By emphasizing the parameter of PRR and LQI as a signal consideration in metric calculation, the weightage of selection in heavy signal more effective. Finally, the ACO method was implemented by using Forward Ant, Backward Ant and Data Ant agent to improve the probability of data packets delivered. Although the ant agents will increase the traffic of signal, most of node successfully delivered its data packet to base station more than half of data packet sent. Otherwise, the BIOTROP successfully manipulate the reflection of signal symptom in increasing the delivery of data when more than 20 percent improvements are recorded in a tunnel environment compared to free-space condition.

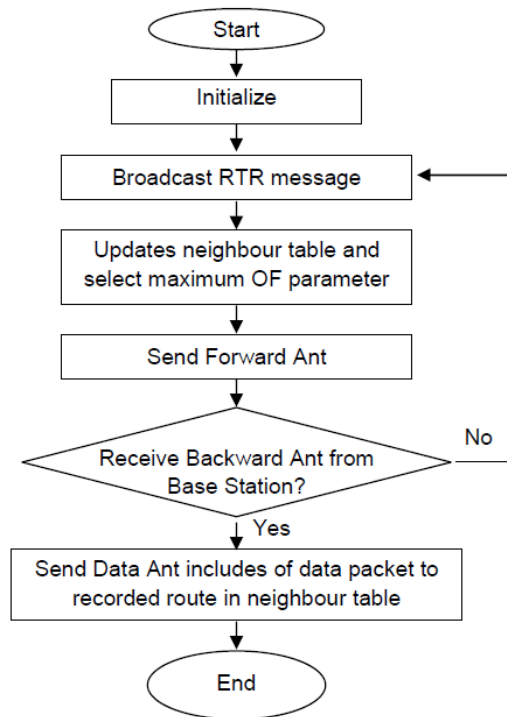
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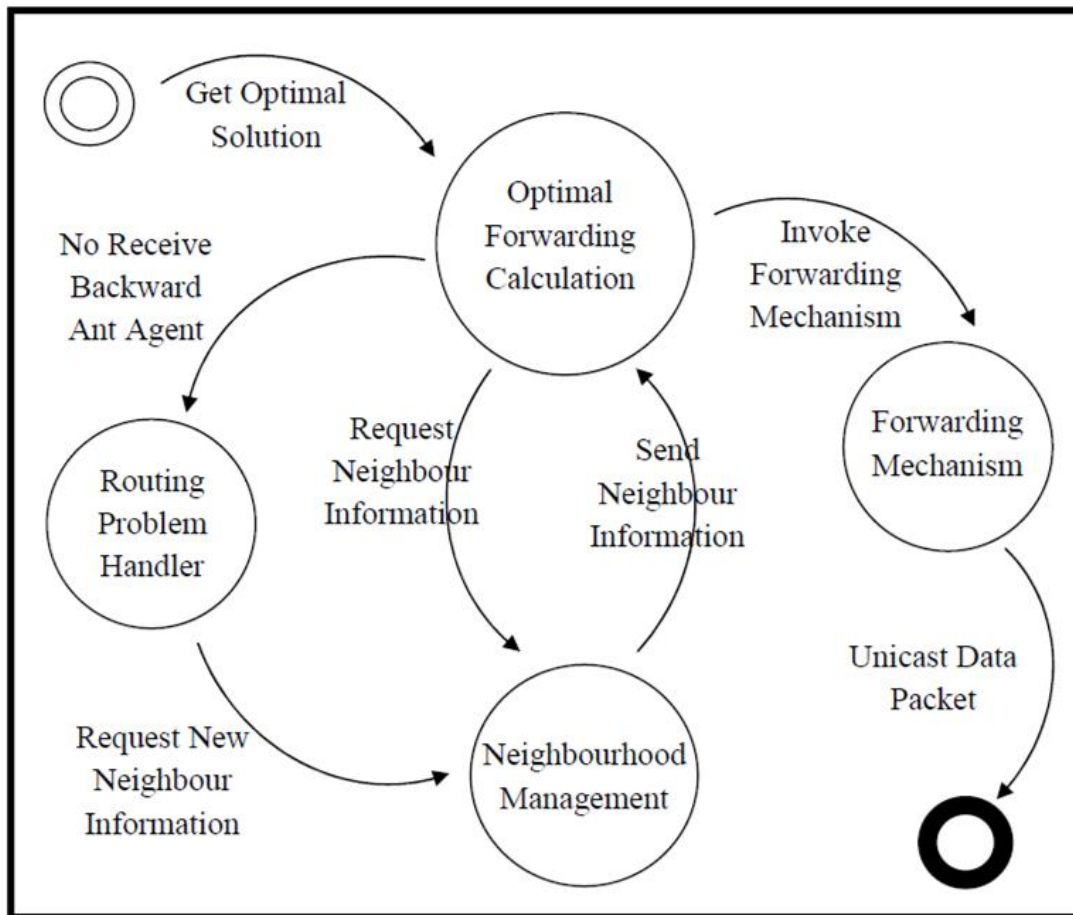
## Appendix



**Figure A.1:** Overview of WUSN architectures [1]



**Figure A.2:** Proposed BioTROP design approach

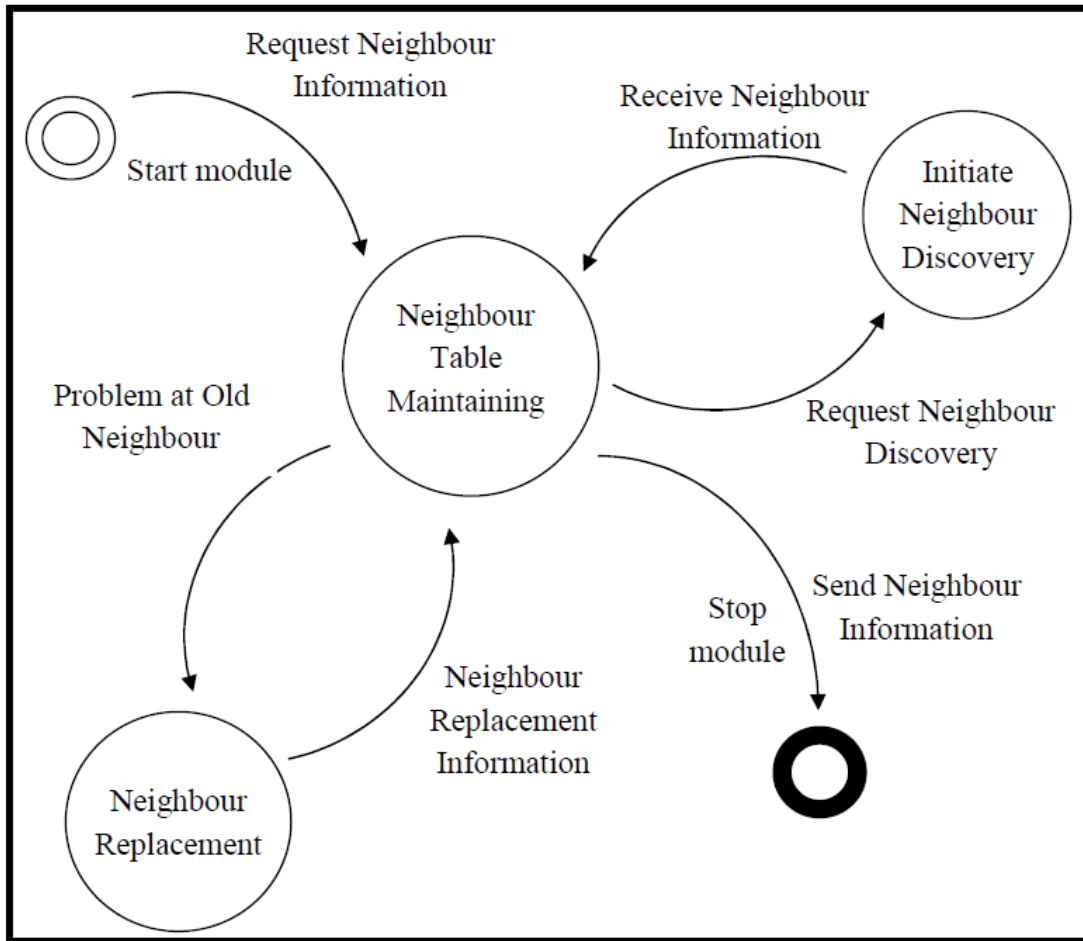


**Figure A.3:** State Machine Diagram of RMM

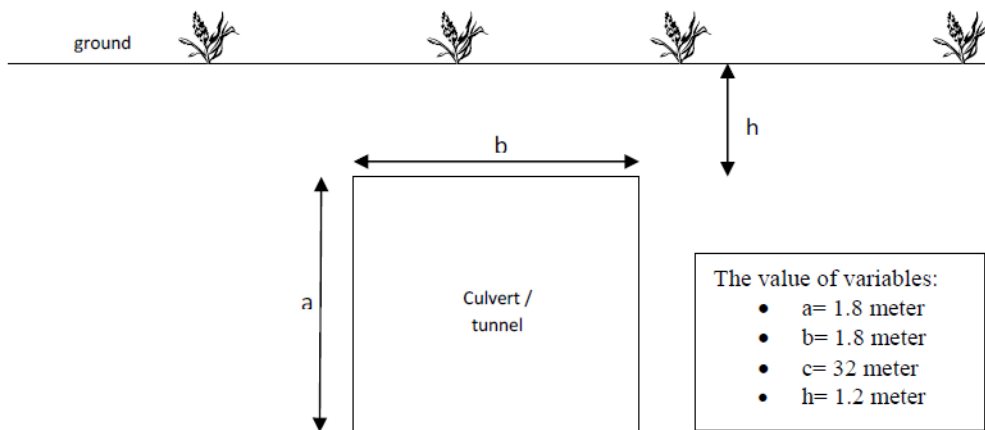
<i>source node</i>	<i>next node</i>	<i>Action</i>	<i>PRR</i>	<i>LQI</i>	<i>battery level</i>
2 byte	2 byte	2 byte	2 byte	2 byte	2 byte

**Figure A.4:** Neighbour table format

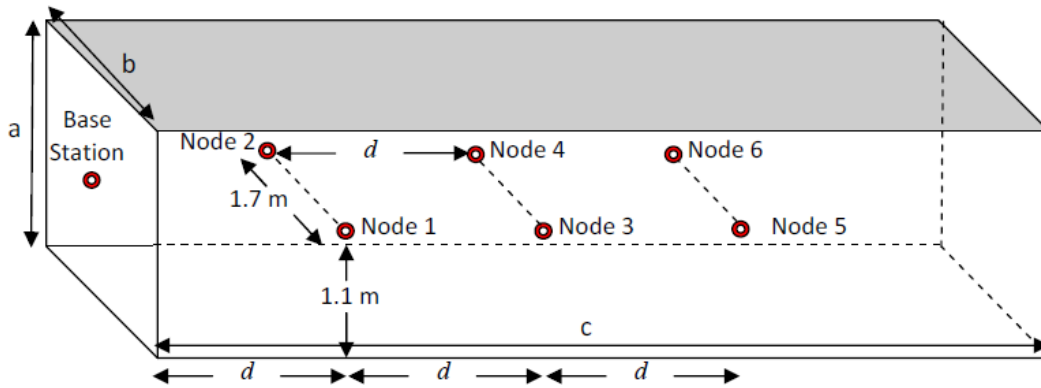




**Figure A.5:** State Machine Diagram of NMM



**Figure A.6:** Front view of culvert



**Figure A.7:** The side view of experiment setup



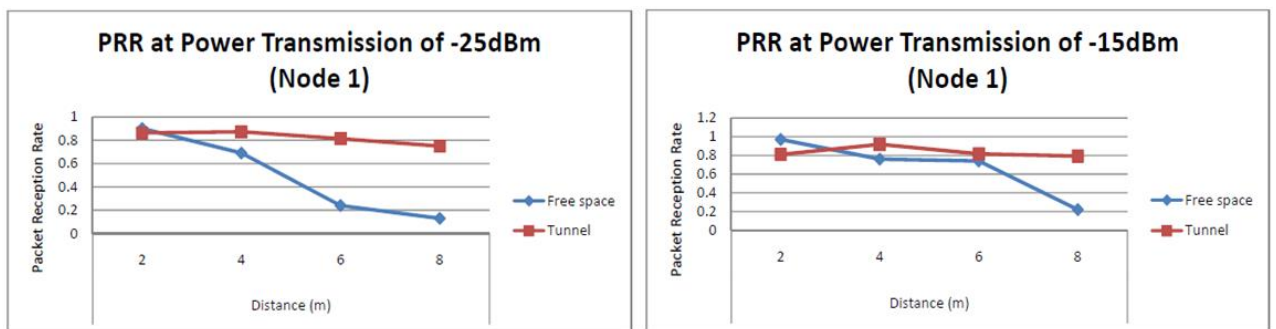
**Figure A.8:** Wireless motes deployment in tunnel model



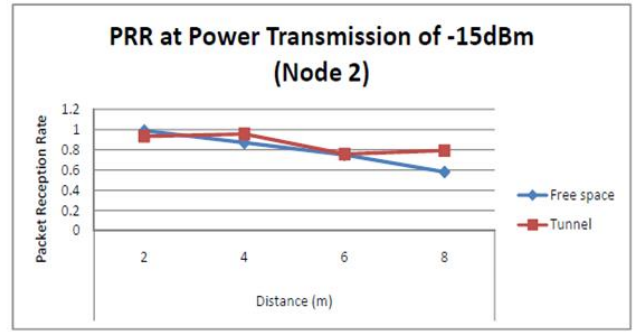
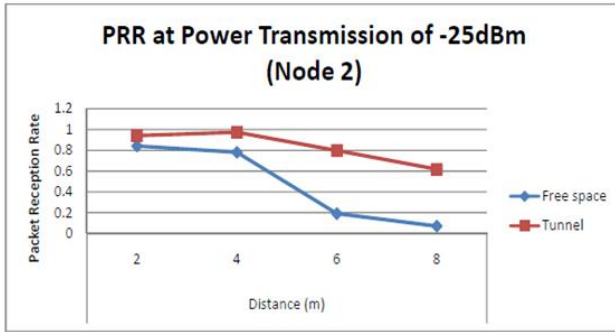
**Figure A.9:** Wireless motes deployment in open field

PA_LEVEL	TXCTRL register	Output Power [dBm]	Current Consumption [mA]
31	0xA0FF	0	17.4
27	0xA0FB	-1	16.5
23	0xA0F7	-3	15.2
19	0xA0F3	-5	13.9
15	0xA0EF	-7	12.5
11	0xA0EB	-10	11.2
7	0xA0E7	-15	9.9
3	0xA0E3	-25	8.5

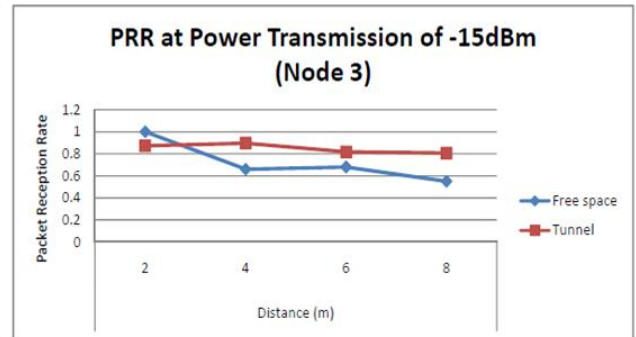
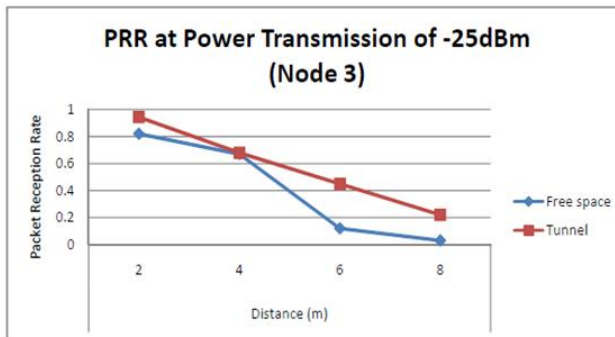
**Figure A.10:** Output Power Settings and Typical Current Consumption for TelosB node



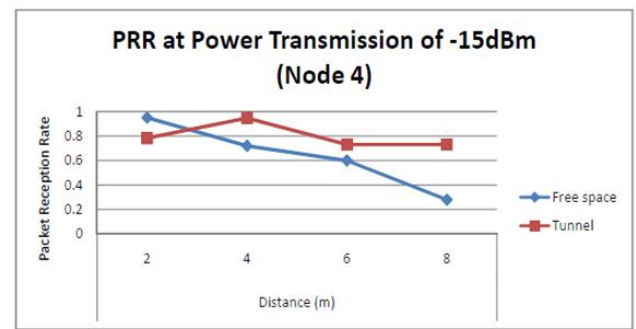
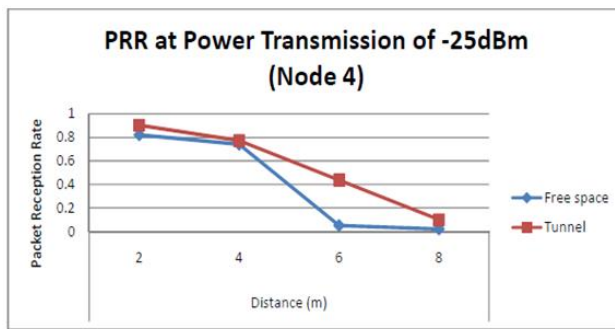
**Figure A.11:** The PRR of node 1 at two different areas with -25 dBm power transmission and -15 dBm power transmission



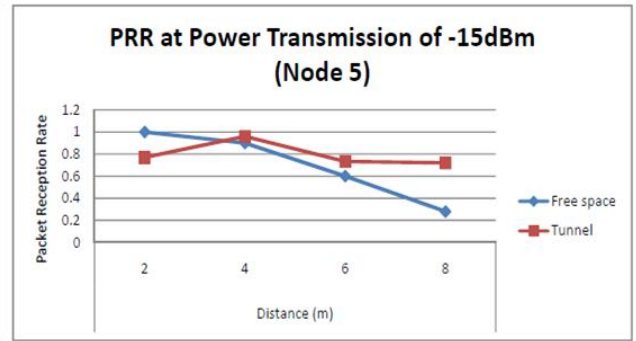
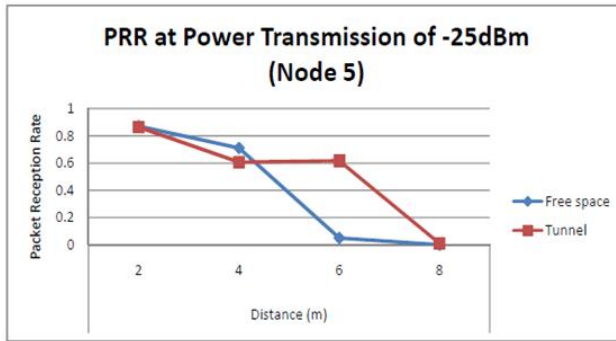
**Figure A.12:** The PRR of node 2 at two different areas with -25 dBm power transmission and -15 dBm power transmission



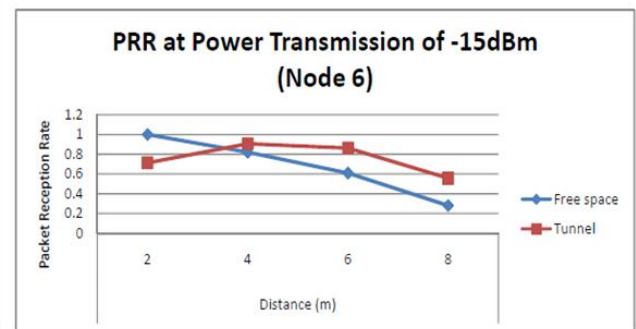
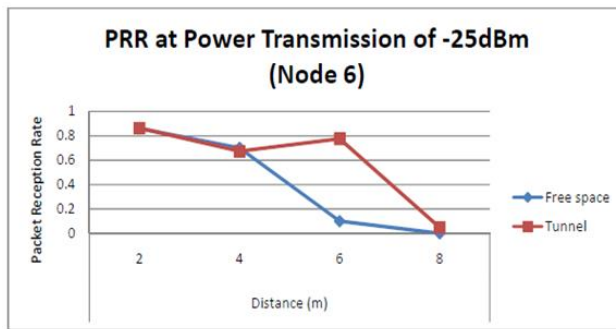
**Figure A.13:** The PRR of node 3 at two different areas with -25 dBm power transmission and -15 dBm power transmission



**Figure A.14:** The PRR of node 4 at two different areas with -25 dBm power transmission and -15 dBm power transmission



**Figure A.15:** The PRR of node 5 at two different areas with -25 dBm power transmission and -15 dBm power transmission



**Figure A.16:** The PRR of node 6 at two different areas with -25 dBm power transmission and -15 dBm power transmission

# E13 - Automatic Dirt Content Detection Using Human Machine Interface

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## *Abstract*

*Everyday new technology is being developed to help improve the manufacturing industry. Proper planning and integration of technology can create an efficient, quality controlled and cost effective production line. Almost all manufacturing industries require a production line free of dirt and debris. Through careful research and design, a dirt detection system was developed with the use of programmable logic controllers, sensors, conveyor and the widely accepted touch screen interface. This system can drastically help to improve the amount of rejected products that requires dirt detection in the bottling industry (i.e mineral water, ketchup, sauce etc) thus resulting in a more cost effective production line. The system is adaptable to an existing production line within small medium industries. The automatic dirt detection system was successfully developed utilising a programmable logic controller (PLC) and a human machine interface (HMI). The HMI provides a simple user interface for operating the system. A manual mode is also available for maintenance and troubleshooting. The system uses a sensor which returns the level of dirt detected measured in volts. A clean bottle would return a reading of about 4 volts. This figure would significantly reduce as more dirt is detected. With the completed system, further research could be pursued to make the system more scalable. A supervisory control and data acquisition (SCADA) system could be integrated with the system to cater for larger industries.*

**Key - Words:** Programmable Logic Controller, Human Machine Interface, Industrial Control, Sensor, Conveyor

## 1.0 Introduction

Many bottling industries face the problem of detecting dirt and debris in their production line. Often, the check is done manually and randomly by a quality control (QC) operator. This method is time consuming and unreliable. The system developed in this paper is to address the above problem by incorporating an automatic dirt content detection system within the production line. This will help to reduce the amount of rejected products, improve quality of the products and create a more cost effective production line.

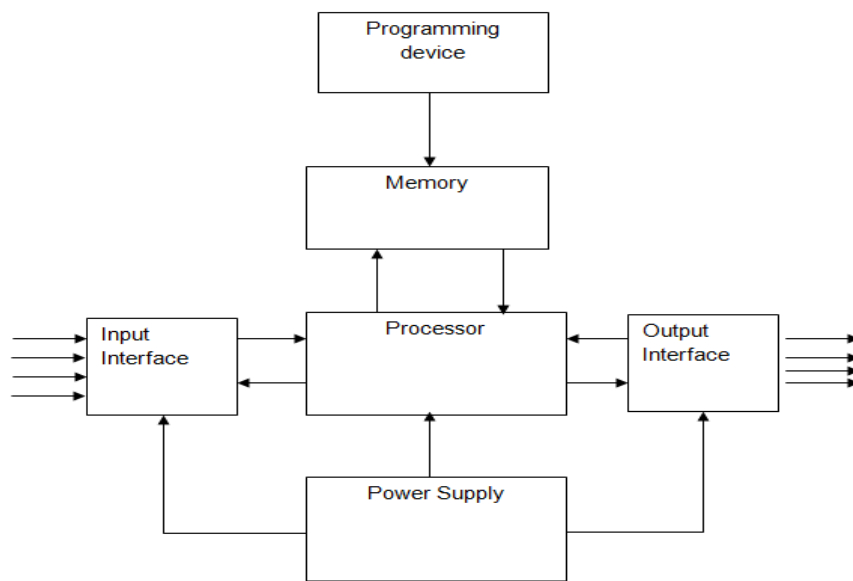
Sensor studies have utilised the PLC for the purpose of automation and detection. One of the most prominent studies on PLCs was conducted by Noh et. al in [1]. In this study, a Tank Level Control System was developed using a PID. Other studies related to control systems has also been addressed in [1], [4-6]. This paper presents an automatic dirt content detection system with a human-machine interface. In this study, the dirt contents are detected through a system and its output are translated into voltage reading. The user interface display is in the form of a graphical user interface (GUI). From the interface, the user can select if the system is to operate in manual or automatic mode. The dirt content detection system has been developed and tested and is fully operational.

A programmable logic controller (PLC) or programmable controller is a [digital computer](#) used for the [automation](#) of [electromechanical](#) processes such as the control of machinery on factory [assembly lines](#), amusement rides and lighting fixtures. PLCs are used in

many industries and machines. Unlike general-purpose computers, the PLC is designed for multiple input and output arrangements, extended temperature ranges, immune to electrical noise and resistant to vibration and impact. The programs which controls a machine's operations are typically stored in battery-backed or [non-volatile memory](#). A PLC is an example of a [real time](#) system since the output parameters must be produced in response to the input conditions within a specific time, which would otherwise cause an unintended operation. A PLC can also interface with a human-machine interface (HMI) in order to supervise the system.

## 2.0 Programmable Logic Controller Systems

PLC programs are typically written in a special application on a personal computer, then downloaded by a direct-connection cable or over a network to the PLC. The program is stored in the PLC either in a battery-backed-up [RAM](#) or some other non-volatile [flash memory](#). Often, a single PLC can be programmed to replace thousands of [relays](#). Figure 1 illustrates the block diagram for a general PLC system.



**Figure 1: The PLC System**

PLCs can be programmed using standards-based programming languages. A graphical programming notation called [Sequential Function Charts](#) is available on certain programmable controllers. Most PLCs utilise a Ladder Logic Diagram Programming, a model which emulated an electromechanical control panel device (such as the contact and coils of relays-which PLCs eventually replaced). This model remains the most common today.

IEC 61131-3 currently defines five programming languages for programmable control systems: FBD ([Function block diagram](#)), LD ([Ladder diagram](#)), ST ([Structured text](#), similar to the [Pascal programming language](#)), IL ([Instruction list](#), similar to [assembly language](#)) and SFC ([Sequential function chart](#)). These techniques emphasise logical organisation of operations.

While the fundamental concepts of PLC programming are common to all manufacturers, differences in I/O addressing, memory organisation and instruction sets means that PLC programs are never perfectly interchangeable. Even within the same product line of a single manufacturer, different models PLCs may not be directly compatible.

### 3.0 Human Machine Interface

A Human Machine Interface (HMI) is a modification of the original term MMI (man-machine interface). The term user interface is often used in the context of computer systems and electronic devices. The user interface of a mechanical system, a vehicle or an industrial installation is sometimes referred to as the human-machine interface (HMI).



Figure 2: MyTek Human Machine Interface

### 4.0 Research Methodology & Process

The objective of this project is to develop an automated dirt content detection system by integrating a PLC with an HMI. This project consists of two main parts: Installation of hardware and the configuration of software.

#### 4.1 Installation of Hardware

##### 4.1.1 Installation:

Firstly, all the required components have to be assembled. Once this is completed, the control panel and boxes have to be installed. Finally, the wires and cables have to be installed.

##### 4.1.2 Testing and commissioning of wiring and relay logic:

Once the installation above is completed, the wiring has to be tested to ensure the specific requirements are met. The insulation resistance between phases, phases to neutral, phases to earth and neutral to earth have to be less than 1 M Ohm when tested at 500V dc with an insulation resistance checker.

After that, the polarity of the socket outlet, switches and circuit breakers have to be checked. The wiring is then checked based on the power and control circuit diagram. Finally, the testing and commissioning have to be conducted; checking the faults identified and rectifying them, live testing with a power supply, ensure that the system is fully functional according to the specifications.

##### 4.1.3 PLC installation and Input / Output Wiring:

The PLC and wiring is mounted within a control box as specified in the wiring diagram. The HMI is installed on the outside of the control box. Then, the input and output wiring is linked to the conveyor, bottle testing section and water tank system. The power then has to be segregated to the analogue and digital input/output components of the system.

##### 4.1.3 Testing and commissioning of Input and Output wiring and PLC program.

The communication between the PLC and the HMI has to be tested and configured via a PC. Once this is completed, the system is then tested. The input and output wiring has to be in accordance with the addresses assigned. A ladder logic testing and commissioning is then conducted.



## 4.2 PLC Programming and Interfacing

In this study NO, NC, coils, timers, counters were used as the main optimization technique to fulfill the objective of this project. Once the installation of the hardware was completed, the HMI interface was configured. Below is a brief summary of the system:

The system's default setting is set to automatic mode with a stable PLC algorithm. The user has the option to switch to manual mode for maintenance purposes or should any faults occur with the system. In manual mode, the user can control the inlet and outlet valve manually to get closer to the bottle and also move the conveyor for maintenance purposes.

A PLC is used to control the input components (sensors, push button) and the output components (valve, motor, conveyor, motor pump, indicator lamp).

Two induction motors are used in the system. The first is a three phase induction motor with delta connection which is used to control the frequency of the frequency converter to move the conveyor. The second is a three phase motor with a star and delta connection to pump the water. The HMI is installed to monitor and control the input and output of the system.

The research framework is shown in Figure 3 below. The study involved the following:-

- Knowledge acquisition
- Development system set-up
- Ladder diagram development
- Prototype development
- Experimentation and data collection

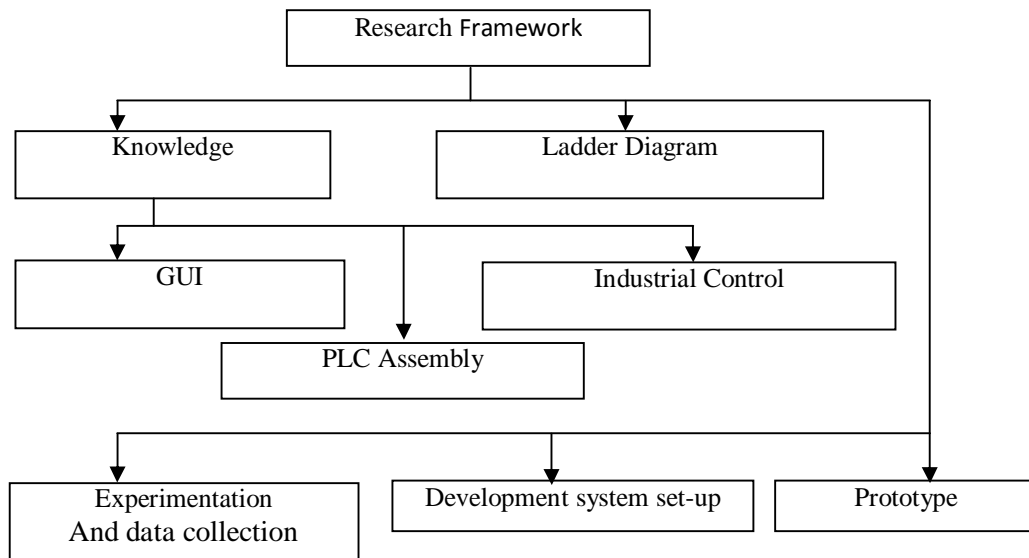


Figure 3: Research Methodology

## 5.0 Results & Discussion

The automatic dirt detection system was successfully developed utilizing a PLC. The GUI unit was developed using an HMI which is shown in figure 4. From the figure below, we can

see the entire automation system displayed on the main screen. The system can be set to manual or automatic mode by selecting the corresponding button on the display screen. The system is equipped with four sensors; a sensor to detect the movement of the bottles, a laser sensor to detect the dirt content within a bottle, a high and low water level sensor to detect the amount of water in the tank-- a high level sensor will cause the water pump as the water tank is full to stop and a low level sensor will activate the water pump to refill the tank with water.

Figure 5 shows the display screen for the automatic mode and figure 6 shows the display screen for the manual mode. In automatic mode the PLC will run the system using input from the sensors while in manual mode any of the operations can be performed by pressing the corresponding buttons. Figure 7 shows the display screen for the status of the equipment (on and off).

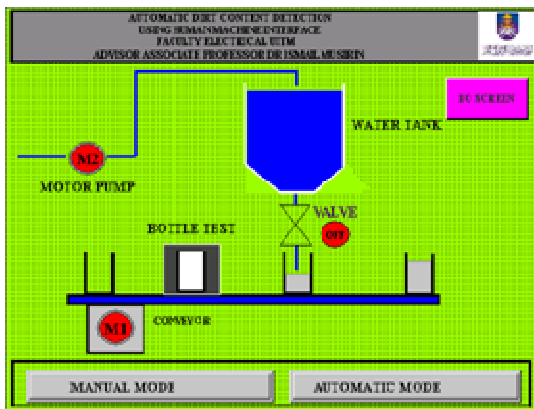


Figure 4: GUI of Virtual HMI Main Screen

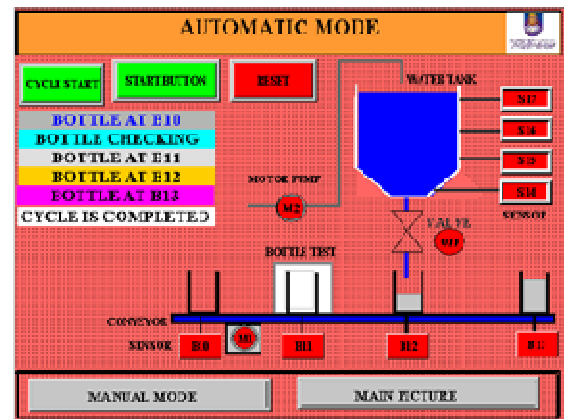


Figure 5: GUI of Virtual HMI Automatic Mode

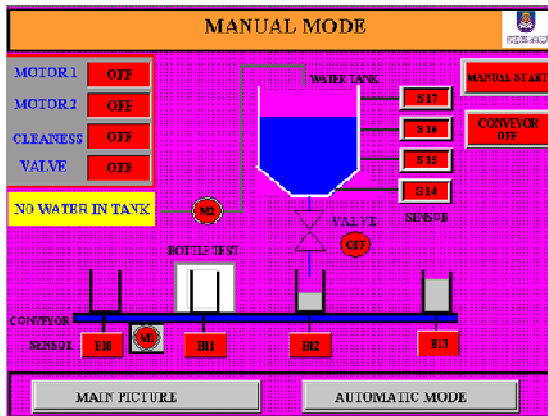


Figure 6: GUI of Virtual HMI Manual Mode

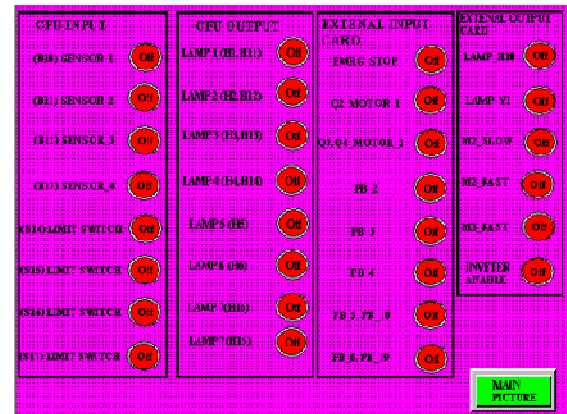
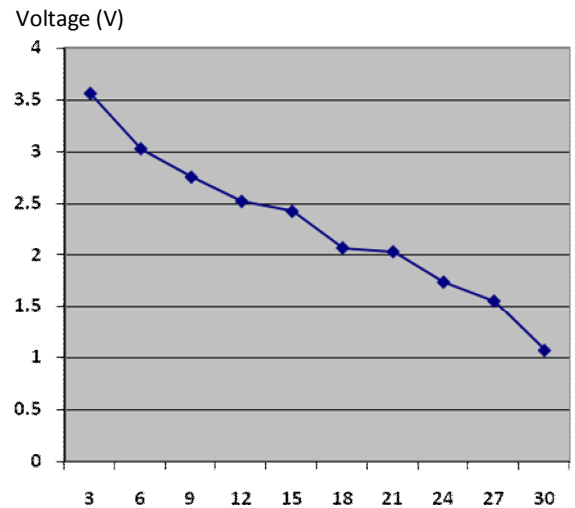


Figure 7: GUI of Virtual HMI Input and Output

Table 1 shows the dirt level data collected from the system with respect to the voltage level. The highest dirt level will correspond to the lowest voltage level and vice versa. This indicates that the dirt level and the voltage level are reciprocal of each other. Figure 8 shows the profile for the dirt level with respect to the voltage level. The voltage level is measured by using a Keyence LV-300 sensor which consists of a transmitter and receiver. When there is no dirt present in a bottle, the transmitted laser will give a reading of about 4 volts. Any dirt in the bottle will cause a voltage drop or an interrupted reading.

**Table 1:** Level of dirt in the bottle

DIRT LEVEL (MM)	VOLTAGE (V)
3	3.557
6	3.025
9	2.752
12	2.519
15	2.422
18	2.071



**Figure 8:** Voltage and Dirt Level profile for bottle

To work the system user has to be able to control and assess the state of the system. <sup>Dirt level (MM)</sup> PLCs are well-adapted for a range of automation tasks. The Keyence KV 1000 PLC can successfully interface with a MyTek HMI. A HMI is a modification of the original term MMI (man-machine interface) and is user friendly, simple and easily interfaces with the PLC. Currently, a PIC and PID cannot interface with HMI system.

## 6.0 Conclusion

This paper has presented Automatic Dirt Content Detection Using a Human Machine Interface. The successfully developed system implemented a dirt detection system using a PLC and an HMI. The data collected from testing the system can be seen in figure 8. The developed system can be further enhanced for larger applications. Incorporation of a supervisory control and data acquisition (SCADA) system can be a future scope of research. SCADA is normally found in centralised systems which monitors and control entire sites or complexes which are spread out over large areas (anything between an industrial plant and a country). Most control actions are performed automatically by Remote Terminal Units (RTUs) or by Programmable Logic Controllers (PLCs). The advantages of a SCADA system may allow operators to change the set points for the flow and enable alarm conditions, such as loss of flow and high temperature to be displayed and recorded.

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# E14 - MoLEACH: Modified LEACH Algorithm for Network Lifetime Improvement

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## Abstract

*Wireless sensor networks (WSNs) composed from a large number of sensor nodes with the ability to sense and process data in the physical world in a timely manner. The sensor nodes contain a battery constraint which limit the network lifetime. Due to energy constraints, the deployment of WSNs will required advance techniques to maintain the network lifetime. A clustering based routing algorithm called Low-Energy Adaptive Clustering Hierarchy (LEACH) was proposed as a solution for low power consumption. During this study, LEACH algorithm shows some drawbacks that need an improvement to overcome it as to improve the performance. Then, the Modified LEACH (MoLEACH) algorithm was proposed where the improvement was done in cluster head selection based on LEACH. In cluster head selection, MoLEACH taking into account the residual energy of each node for calculation of the threshold value for next round. Meanwhile in LEACH, the cluster head selection was based on distributed algorithm. Both of these protocols were implemented in network simulator to compare the performance. This study shows that there was a better performance achieved by MoLEACH based on the results obtained.*

**Keywords:** WSNs, LEACH, network lifetime, power consumption

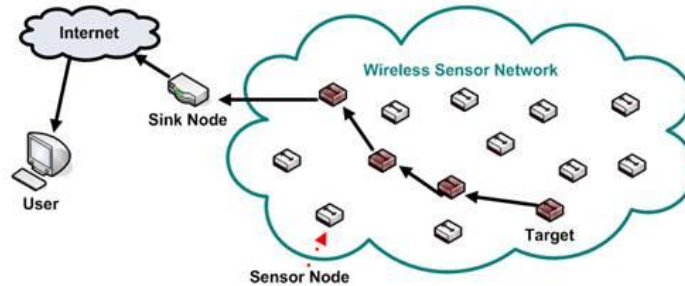
## 1.0 Introduction

WSNs consist of a set of many sensors with sensing, wireless communication and computation capabilities. These sensors are scattered in the preserved environment and located far from users. The architecture of WSNs includes three entities as in [1]. There are:

- i. **Sensors:** which make up the network: its function is based on taking local measures through a discrete system, creating a wireless network in an unattended environment, gathering data and sending them to the final user through the base station.
- ii. **Base station or gateway node:** it is located near the sensor field. The data or information gathered by the sensor field is sent to the base station through a multihop infrastructureless architecture, which communicates with the user via Internet or satellite communication.
- iii. **User:** it is the entity interested in obtaining the information about a specific phenomenon by means of measuring or monitoring the environment.

Wireless Sensor Network (WSN) is widely used to create a smart environment that relies on sensory data from real world. The application of wireless sensor network has fulfill nowadays needs by providing a facilities to monitor a physical and environmental conditions, such as temperature, sound, vibration, pressure, motion and pollutants. A smart environments is relies on sensor network to gathering an information, whether in building, shipboard,

transportation system automation, habitat monitoring, healthcare monitoring, home automation, traffic control, or elsewhere[2] [3]. A smart sensor used in WSN is a combination of sensing, processing and communication technologies.



**Figure 1:** Wireless sensor network architecture

The study done by [4] stated that network lifetime is a key characteristic to evaluate a performance of sensor network. The effectiveness of WSNs is depending on the sensor in the network. If the sensor node considered "alive" it then can perform a duty to sense, communicate and process information (temperature, humidity etc), but not after that. There are two major factors that affect the network lifetime: how much energy it consumes over time and how much energy available for its use. The proposed technique to deal with network lifetime called clustering is an important method, and a good performance WSNs is highly dependent on energy-efficient clustering routing algorithm[5]. The development of a clustering-based hierarchy protocol that optimizes the energy-efficiency in WSNs is called Low-Energy Adaptive Clustering Hierarchy (LEACH) [6]. This research proposed an improved scheme of LEACH about using energy efficiently.

## 2.0 Modified LEACH (MoLEACH) Algorithm

### 2.1 Overview

The original LEACH uses a distributed algorithm for the formation of the cluster head node, each node make decision by itself without a central control. In this case, the cluster head is selected randomly and nodes become the cluster head in turn when cluster heads have the same initial energy. The reference indicator is the number of times for each node to become the cluster head. However, after several rounds, the distribution of energy in the network will be uneven and cluster head selection will become unreasonable[7]. In this proposed modified LEACH algorithm, we improved the cluster head selection process by taking into account the residual energy in each member node after each rounds while the steady-state is identical with LEACH. Different from LEACH, we have three phases in this proposed algorithm which include set-up phase, steady-state phase and pre set-up phase.

### 2.2 Modified LEACH Description

#### 2.2.1 Cluster head selection

To increase the lifetime of the networks, the proposed algorithm uses a probability function while considering the use of node residual energy for cluster configuration; whereas LEACH only utilizes a probability function. In the case of the nodes do not have the same amount of energy (for second round and afterward), the nodes with higher residual energy will become a Cluster Head (CH) more often than nodes that have less energy to ensure that all nodes die approximately at the same time. This can be achieved by setting the probability of becoming a CH as a function of a node's energy level relative to the aggregate energy remaining in the network, rather than purely as a function of the number of times the node has been cluster head, thus

$$p_i = \frac{p}{\sum_{i \in G} p_i} \cdot \frac{E_{residual}(i)}{\sum_{i \in G} E_{residual}(i)} \quad i \in G \quad (2)$$

where  $p$  is the desired percentage of cluster heads,  $r$  is the current round number,  $G$  is the set of nodes that have not been CHs in the last  $\frac{p}{p}$  rounds,  $E_{residual}$  is the current residual energy of node and

$$E_{total} = E_1 + E_2 + \dots + E_n \quad (3)$$

where  $E_{total}$  is the total energy of entire network. Using these probabilities, the nodes with higher energy will become cluster heads rather than nodes with less energy.

### 2.2.2 Set-up phase

Each node generates a random probability ( $p_n$ ) at the beginning of a new round and computes the threshold value  $T(n)$  by using equation 2. If  $r = 1$  (i.e. the first round) and  $E_{residual}$  for each node are same. In case of  $p_n < p$ , the node is selected as a CH. A selected CH broadcasts an advertised message over neighbor nodes. The neighbor nodes collect advertised messages during a given time interval and then send a "join REQ" message to the nearest CH. The cluster head receives the "join-REQ" messages and builds a cluster member list and a TDMA schedule. Then broadcast them over neighbor nodes. The member node receives and save the message for data transfer.

### 3.2.3 Steady-state phase

In LEACH, the steady-state operation divided into frames. Main activities in this phase are sensing and transmission of sensed data. Each sensor nodes senses and transmits the sensed data to its cluster head according to Time Division Multiple Access (TDMA) table. In addition, for next round that going to occur it is required for the cluster node to transmit together their current energy and their ID's. When data and energy status has been received, the CH performs data fusion and aggregation in order to reduce the amount of data. Finally, each CH transmits data to BS along the CH-to-CH routing path which have been formed during setup phase.

### 3.2.4 Pre set-up phase

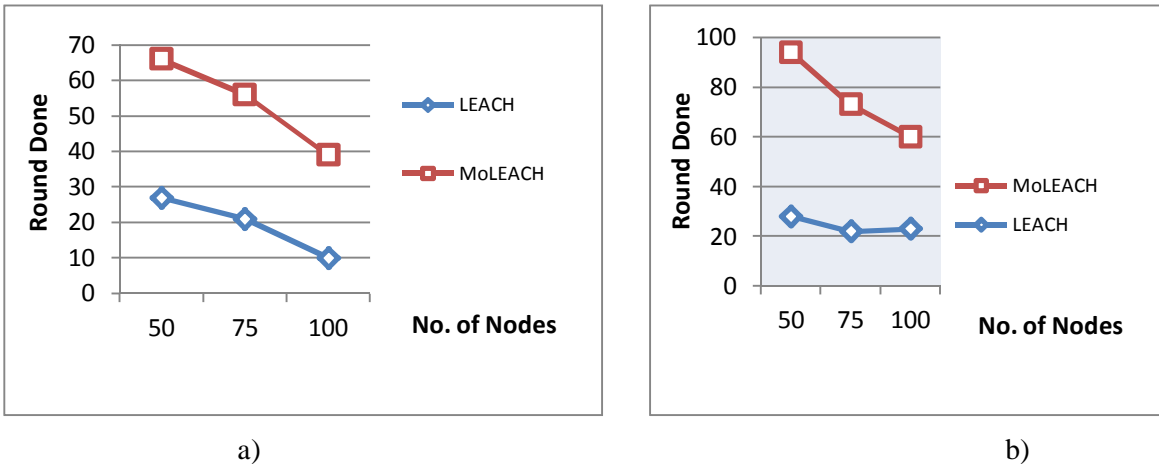
Before the last frame of a round completes, the CH sends Base Station (BS) the residual energy value of each nodes that belong to its own cluster. BS collects all residual energy values from CHs, finds the total residual energy value ( $E_{total}$ ) of the network, and distributes  $E_{total}$  back to CHs. The CH broadcasts  $E_{total}$  over cluster nodes. Each nodes save the value of  $E_{total}$  for the next computation of  $T(n)$  and the current round is terminated.

## 4.0 Results and Analysis

In this simulation, the network lifetime will be analyzed by analyzing the first node dead (FND) and half node dead (HND) of the network. Lifetime is traditionally defined as the amount of time between the start of dataflow in the network and the time a certain percentage of nodes have run out of energy. For the purpose of simulation, the different number of nodes was tested which are 50, 75 and 100 nodes being implemented in  $500 \times 500 \text{ m}^2$  and  $1000 \times 100 \text{ m}^2$  network size where the size of TDMA frames and BS distance is fixed.

### 4.1 First Node Dead (FND)

In the case of a small area network the MoLEACH gets better results, which achieves even more than 2 times the lifetime of the LEACH as is shown in Figure 2. The consideration of node residual energy during cluster head selection processing can maintain the balanced energy consumption of the sensor network. It is also can be seen that when the number of nodes increases, the network lifetime decrease for both protocols. For larger number of nodes and bigger network size, the network lifetime closer to each other but there is still an improvement shows by modified LEACH.

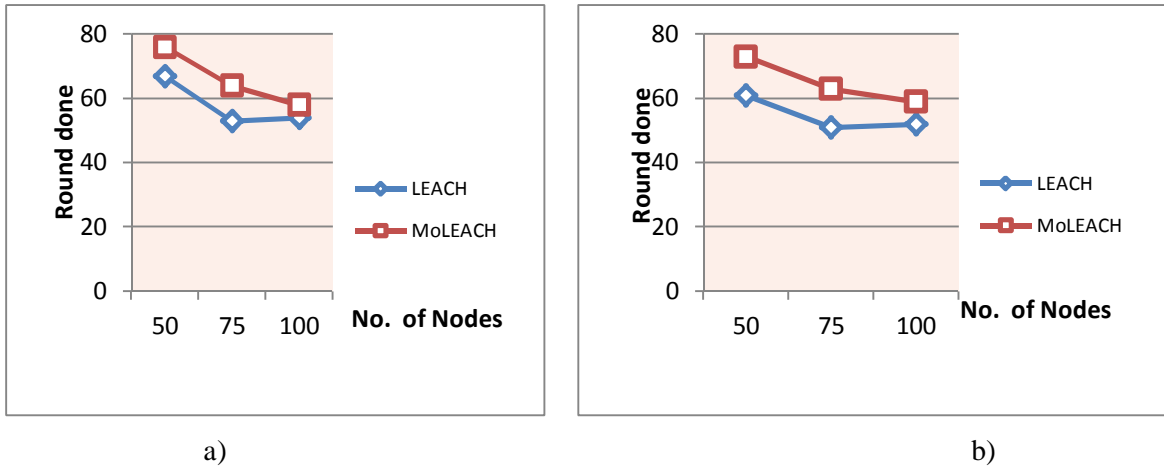


**Figure 2:** FND results for different nodes implemented in different network size

a)  $500 \times 500 \text{ m}^2$  b)  $1000 \times 1000 \text{ m}^2$

### 4.3 Half node dead (HND)

Following is presented a comparison among all the protocols of the rounds achieved until half of the nodes are already dead. From Figure 3, it depicts a half node dead for both protocols decrease with the increment of number of nodes.



**Figure 3:** Half node dead results for different nodes implemented in different network size a) 500 x 500 m<sup>2</sup> b) 1000 x 1000 m<sup>2</sup> and

From the simulation results, the distribution of energy in LEACH algorithm is uneven between the node and the CH become unreasonable. The proposed MoLEACH has encountered this problem by taking into account the nodes residual energy in selecting the CH. In LEACH, there is a different amount of energy for cluster formation at the beginning of each round, as the total energy will depend on the number of nodes that elect themselves to be CH and their locations within the network. A larger number of Cluster Head nodes imply more energy dissipated in the network. Overall, the MoLEACH shows more energy-efficient than LEACH where it can determine better cluster than distributed algorithm used in LEACH.

## 8.0 Conclusion

The implementation of WSNs architecture in a simulation environment has been carried out in this research. This implementation will evaluate different simulation scenarios of large scope clustered-type networks. The purpose of the implementation consists on the research and the obtaining of power consumption and an improvement of original LEACH. The search of the power consumption and improvement is performed through the analysis of the network behavior. The network behavior will be obtained by means of simulation executions after the variation of values of specific parameters of the WSNs operation. The improvements of LEACH otherwise known as "Modified-LEACH" has solved a drawback in LEACH by introduce a technique in cluster head selection. This technique improve the cluster head selection by introduce a new threshold calculation by taking into account the



residual energy of each node to become cluster head in next round.. It is shows that results are better when the number of nodes is smaller as well as the network size. As increment of number of nodes and network size, the network lifetime is worse. But still, the performance of MoLEACH compared to LEACH in term of network lifetime, MoLEACH shows improvements. Therefore, it can be determined that the WSNs architecture implemented perform the obtaining of desired results during the development of this project, and could serve as base implementation for future versions of the developed work.

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## E15 - Simulating Power Quality Problems: Voltage Sag (Dip)

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### **Abstract**

*Power quality is used to describe the degree of consistency of electrical energy expected from generation source to point of use. The term power quality refers to a wide variety of electromagnetic phenomena that characterize the voltage and current at a given time and at a given location on the power system. Power quality problems can be defined as problem that results in failure of customer equipments, which manifests itself as an economic burden to users, or produces negative impacts on the environment. Voltage stability, power factor, harmonics pollution, reactive power and load unbalance are some of the factors that affect the consistency or the quality level. This research proposal proposes to investigate and analyze the causes and effects of power quality to homes and industries in Sarawak. The increasing application of electronics equipment used in the industries and homes has caused a big impact on the power quality. Many electrical devices are now interconnected to the power network and it can be observed that if the power quality of the network is good, then any loads connected to it will run smoothly and efficiently. On the other hand, if the power quality of the network is bad, then loads connected to it will fail or may cause damage to the equipments and reduced its lifetime. The outcome of this research will enable better and novel solutions of poor power quality to small industries and reduce damage of electrical devices and products in the industries.*

**Keywords:** *Power Quality, Voltage Dip, Power Network*

### **1.0 Introduction**

In recent years, there has been an increased emphasis and concern for the quality power delivered to factories, commercial establishments and residences. Much of the equipment in use today is susceptible to damage or service interruptions during poor power quality events [1]. There has been a proliferation of non linear loads in electrical installations due to the great development of electronic equipment. As widely known, everyone using computer whether at home or office has experienced a computer shutdown and reboot, due to power outage which result in loss of working hours. This is caused by the poor power quality on the 240V line. Quality of Electricity is very essential for modern industry. Almost all offices and industrial equipment depend on electricity in some form or the other. Heavy industrial equipments like non-linear variable speed drives powered through power electronic converters may cause power disturbances. Due to this, power quality is becoming a mounting concern in the electric power industry. Power quality problems encompass a wide range of disturbances and conditions on the power system. They include everything from very fast voltage transients to long duration outages. It also includes steady state phenomena such as flicker and noisy waveforms. The power system can also experience momentary interruptions like voltage sag and swell. These problems are sometimes unpredictable, because it is

difficult to predict when and where it might happen. Poor electric power quality basically was limited to interruptions in the energy supply, however currently many other factors influence the quality of energy, since the number of sensitive loads is increasing at the same time that the non-linear current consumption augments the voltage waveform distortion. The Institute of Electrical and Electronics Engineers (IEEE) has attempted to address this problem by developing a standard that includes definitions of power disturbances. This standard, IEEE Standard 1159-1995, IEEE Recommended Practice for Monitoring Electrical Power Quality, defines disturbances as: interruptions, sags and swells, long duration variations, impulsive transients, oscillatory transients, harmonic distortion, voltage fluctuations, and noise. Therefore the power quality monitoring standard is very effective to prevent future problems that might cause damage of equipments or premature aging of the installation components like transformers, circuit breakers. The electrical wiring might also be affected. Monitoring of electrical power quality is perhaps the most important, step in identifying and solving power problems [2].

## **2.0 Problems Statements**

The widespread use of electronics devices ranging from equipment at home to the control of huge and costly industrial processes has raised the awareness of power quality issues and concerns over the last few years. Low power quality issue has seriously affected the small industry and resulted in financial loss due to the stop of production and wasted electrical power distributed to homes, especially the non-linear characteristics of various offices and industrial equipments connected to the power grid which might cause electrical disturbances. Some electronic equipment, beyond consuming distorted currents, also requires rigorous parameters of electric energy, meaning that a small disturbance may cause malfunction or even in the most extreme cases, cause serious damage. Circuit Breakers tripping for no apparent reason, computer malfunction, communication failure, conductor failure of heating, electronic equipment shutting down, flickering of fluorescent lights, fuse blowing, motor failures and overheating are some of the effect due to poor power quality. All this phenomena potentially lead to inefficient running of installations, system down time and reduced equipment life and consequently high installation running costs. Study needs to be carried out to investigate the causes of the poor power quality so that solutions can be designed. It also aims to give readers a better insight in the benefits that may be gained by having good Power Quality in installations.

## **3.0 Objectives**

This proposed paper aims to simulate the power quality phenomena using an analytical tool, Power System Computer Aided Design (PSCAD) conducted at one of the substation at small industry and the impacts they may present to power quality. It also attempts to study the power quality problem such as voltage sag on a power line that may be caused by typical loads using computer models paving the way to identify the source of the problem. Reliability of supply and voltage quality is to be studied by using method of monitoring the power waveform. Power quality monitoring is an essential service many utilities perform for their industrial and other key commercial customers. The results of this study will contribute knowledge for researchers to design a more efficient power to reduce power waste either as a result of reactive or capacitive losses, harmonic distortion and other losses such as load imbalance. Other than that, it also contributes to overcome problems such as energy loss and malfunction of electrical equipment due to the poor power quality.

## 4.0 Literature Review

Harmonic distortion is one of the main factors that contributes to poor power quality and was observed when the sinusoidal voltages or currents have frequencies that are integer multiples of the fundamental frequency being supplied. This distortion is continuous and the most common result is unwanted heating in the electrical system. It is interesting to note that some of the equipment that is sensitive to power quality disturbances is often equipment that generates harmonics. Equipment such as adjustable speed drives, computer power supplies, UPS equipment and other power electronics create harmonic currents. Harmonic currents generate harmonic voltages as they pass through the system impedance. In addition to power electronics, arcing equipment such as arc furnaces and welders are also major contributors in the harmonic arena [3].

The monitoring of Electric Power Quality is an important tool to detect problems that may be affecting the equipment or the electrical installation. An effective Power Quality Monitoring may also prevent future problems that might cause damage of equipments or premature aging of the installation components like transformers, circuit breakers even the electrical wiring can be affected. Power Quality Monitor prototype was developed at Energy and Power Electronics laboratory of the University of Minho. This prototype is assembled in a strong plastic case with easy to connect plugs for power and sensors and a built-in 14 inch TFT monitor. To allow the Electric Power Quality Monitor to record the consequences of the failure and also the consequences of the return of the electric power, the prototype was equipped with a backup battery, so, it continues working in the occurrence of power outages. The software of the Electric Power Quality Monitor is constituted by several applications and is based in *Lab View*. The developed applications allow the equipment to function like a digital oscilloscope, analyze harmonic contents, detect and record voltage distortions (sags, swells, interruptions, wave shapes), measure energy, power, voltage and current unbalance, power factor, record and watch strip charts and generate reports [4].

Harmonic field measurement is done to verify the degree of severity of harmonic distortion due to domestic non-linear loads in the distribution system [5]. There are number of solid state controlled non-linear equipments are used for domestic application such as electronic fan regulator, personnel computer, printer, etc. These non-linear loads inject harmonic currents in the network thus distorting supply voltage. In carrying out harmonic measurement, six types of domestic application were selected. All the measurements are made at 230 V using Yokogawa make clamp on type Power Analyzer. Harmonic spectrum for each load is plotted showing magnitude of each harmonic frequency that makes up a distorted waveform. The magnitude of each harmonic frequency can be expressed as a percentage of fundamental. Total harmonic distortion is defined from harmonic spectrum as the ratio of the RMS sum of all harmonic frequencies to the RMS value of the fundamental [6].

There is no single algorithm that can detect the variety of power quality anomalies. Instead, a set of algorithms is need, where each one is responsible for detection of a set of disturbances. The IT group expertise in analog to digital converters (ADCs) testing/characterization and in digital signal processing algorithms will be used in the development of power quality analyzers. The use of ADCs and digital signal processing algorithms will enable the development and implementation of instruments with great versatility which can be easily adapted to the anomalies that degrade power quality [7].

The power consumption in Brazil is constantly increasing; all electrical equipments connected to an electric power system are designed to work in a particular nominal voltage. The efficiency of industrial processes is directly related to the Power Quality (PQ) delivered to customers, since most of the equipments that compose these processes have different levels

of vulnerability in relation to disturbances in the Power Quality [9]. The recent standard PRODIST forces all utilities to meet the requirements. An analysis regarding the power quality parameters covered by Prodist are steady state voltage magnitude, power factor, voltage harmonics, voltage unbalance, voltage fluctuation (flicker), voltage variation and frequency variation. The goal is to present aspects to be observed in the measurement of each parameter indicating the standard in which the measurement is based, technical characteristics, measurement methodology and criteria accuracy that must be observed [10].

Power quality becomes an emphasis of related researches. The functions of QCC are expanded and its basic types and structures are defined based on the detailed study on QCC (Quality Control Center) of the FRIENDS. The technological core of FRIENDS is called the electric power QCC (Quality Control Center), which can realize the power supply of different kinds of qualities and different kinds of electric energy forms, moreover it has the functions of information processing and control center. The supply of many kinds of electric energy qualities includes: premium quality power supply, high quality power supply and normal quality power supply. The supply of different kinds of electric energy forms includes: AC power supply and dc power supply. Thus high flexibility, high reliability, and intelligence of power supply can be achieved by QCC. The conventional distribution system with QCC is called flexible distribution system. A profound research on QCC and its key part UPQC has been present [8].

## **5.0 Research Methodology**

This research proposes a study on the power quality phenomena (voltage dip) in small industries. It will be carried out in several stages: as below:

Stage 1:

Surveys and interviews with engineers in small industries, record data and information.

Stage 2:

Modeling one of the substation systems in the small industry. The load data collected from industry will be used to carry out simulation using PSCAD or any other appropriate simulation tools. It will be simulated by using suitable parameters on the non-linear loads.

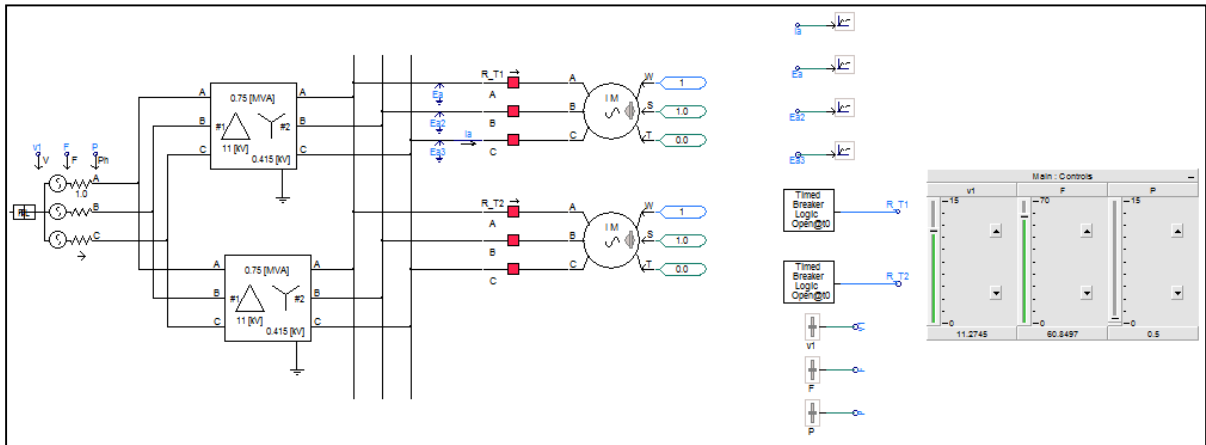
Stage 3:

The simulation results will be used to design or recommend a solution to improve and overcome the issue of power quality in small industries.

## **6.0 Voltage Sag Cause by Large Induction Motor Starting**

According to IEEE standard 1159-1995, a voltage sag is defined as a decrease in RMS voltage down to 90% to 10% of nominal voltage for a time greater than 0.5 cycles of the power frequency but less than or equal to one minute. By referring to the previous research, there are two main causes of voltage sag; starting of large loads either on the affected site or by a consumer on the same circuit or faults on other branches of the network. Voltage sag can be created within an industrial complex without any influence from the utility system. These sag typically caused by starting large motors or by electrical faults inside the facility. A model of the power system at Substation No.5 in small industry will be constructed to simulate and analyze power quality problems. High starting current of the motor often lead to unwelcome voltage drops to an unacceptable value in the supply network and the high starting torque put the mechanical elements under considerable strain. Every power and source has their own impedance. When there is heavy loads at starting, voltage sag was

happens on the feeders due to the large impedance. The currents for the large induction motor sometimes can be several times higher than the rated load currents due to the heavy loads. This higher currents can be represents a very high load across the electrical system. The presence of the voltage sags has the effect of causing motor to draw more currents and results in trip of the electrical network. Figure 6.1 illustrate a simple model of substation No.5 with two induction motor connects to the distribution feeder in simulation of voltage sag. They are supplied through two transformers with ratings of 0.75MVA, 11KV/415V. The voltage sag caused by the large induction motor starting at the Chiller pump room will be examined. An overlay graph with signal was measure in the feeder of the system.



**Figure 6.1:** Simple Large Induction Motor Starting at Substation No.5

Table I shows the computed values from the survey result to be used to present the load components and Table II shows the transformer information. Since October 2012, its experience 16 numbers of voltage sag conditions which causing electrical equipments to trip suddenly and consequently stop the electrical supply from substation 5.

**Table I:** Data of Load Components

Load Components (Chiller Pump Room)	Rated RMS phase Voltage/kV	Power Drawn (A)	Base Angular Frequency (rad/sec)	Horse Power
Induction Motor 1	0.25	660	314.16	221
Induction Motor 2	0.25	950	314.16	319

**Table II:** Transformer T1 and T2

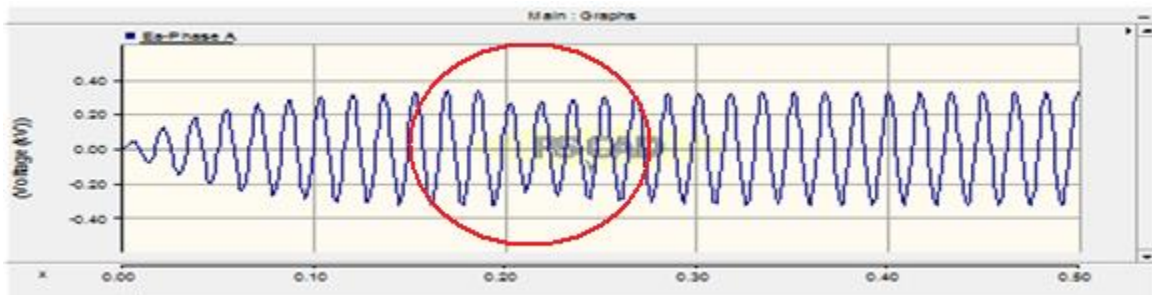
Transformer Information	
Transformer T1 & T2	0.75MVA,11kV/0.415KV,60Hz
Efficiency	98.55%
Voltage Regulation	1.38
Width (m)	2100
Depth (m)	1850
Height (m)	2100

**Table III:** Voltage Sag count based on the record data

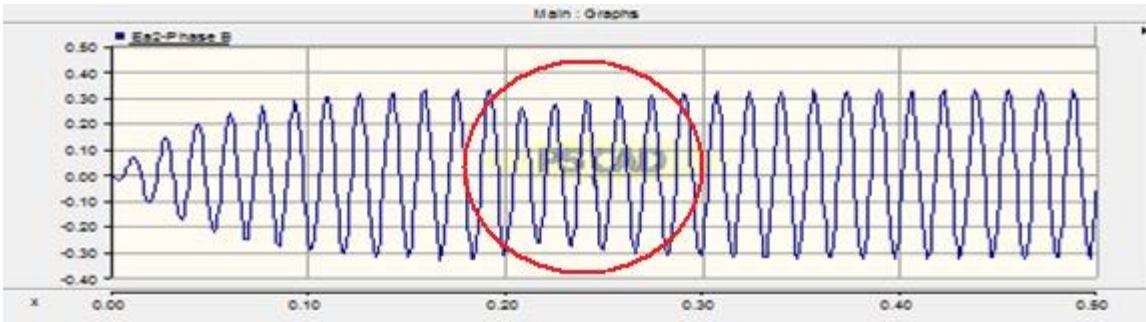
Month		Voltage Sag Count
Year 2012	Oct	3
	Nov	2
	Dec	2
Year 2013	Jan	4
	Feb	2
	Mar	3

## 7.0 Result and Analysis

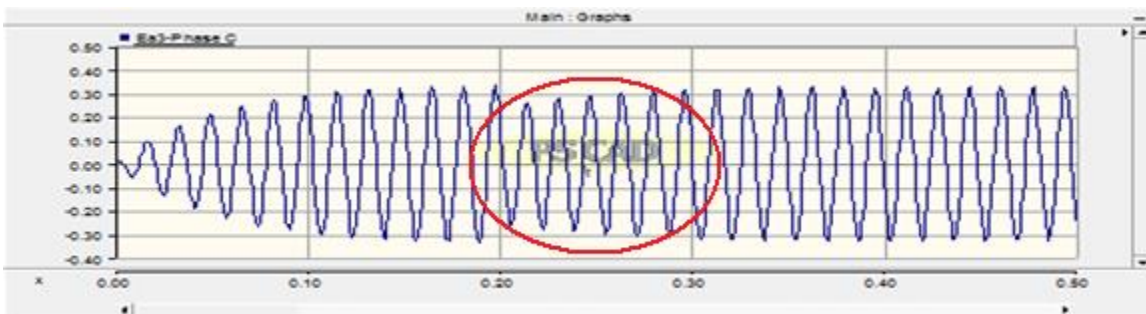
Phase A:



Phase B:



Phase C:



**Figure 7.1** Voltage Sag effect that Cause by Large Induction Motor

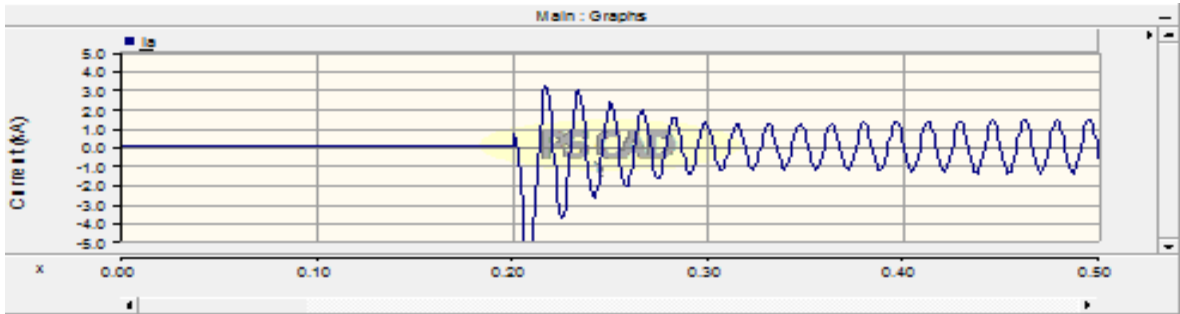
Figure 7.1 shows the effect of voltage magnitude during starting of large induction motors on phase A, phase B and phase C. At the initial state, all the switches are opened and the induction motor is off. Once the switch is closed at 0.2s, the induction motor draw approximately seven times higher than the rated load current and the voltage is immediately

decrease to 60 %. Voltage Sag is happens start from 0.2s and will remain until it reached the nominal speed. When heavy loads are introduced at starting, there is voltage sag experience on the distribution feeder or even on the motor loads. The magnitude of the voltage sag is reduced below 90% for 0.5-60 cycles. Normally the duration of the voltage sag will be stay for several seconds. Sag magnitude maybe different depending on the network impedance and the motor power ratings. The results obtained have illustrated the effect of power quality during the starting of large induction motor. Table III shows the result of the voltage sag magnitude in p.u.

**Table III:** Voltage Sag Magnitude due to large induction motors

Voltage Sag Magnitude (in p.u)	Phase A	0.809
	Phase B	0.672
	Phase C	0.746

As seen in Figure 7.2, there is no current drawn from 0 sec to 0.2sec from the induction motor. At the moment of starting large induction motor, its exhibits an instant inrush of current which is approximately seven times then it rated current. The large inrush current can cause voltage sag in the local and adjacent area even if the utility line voltage remains at a constant nominal value.



**Figure 7.2** Effect of current during starting of large induction motor at Chiller pump room.

## 8.0 Conclusion

Voltage sags are becoming an increasing concern of industrial plants due to increasing automation. Automated facilities are more difficult to restart, and the electronic controllers used are sometimes more sensitive to voltage sags than other loads. The sensitivity of industrial equipment to voltage sags varies greatly. The more sensitive equipment widens a plant's area of vulnerability to disruptive voltage sags. Simulation of voltage sag by using computer aided tools PSCAD in the power distribution system has been carry out as part of this research. Voltage sag in this research is concentrate on one of the substation in the small industry. The purpose is to find out the low power quality due to the voltage sag. The results obtained were realistic if compare with the previous research. The loading effect on the starting was causing the high starting current and leading to the voltage sag. Decreasing of the voltage magnitude on 0.2s shows that the poor power quality in the power system. Normally the sag will remain until the motor have reached their nominal speed. The results of the simulation will assist in the future study and development in the power system network. Therefore more works should be carrying out in this area so that to improve the power quality problems.



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# M1 - Advanced Manufacturing: Technology Review On The Fabrication Of An Aircraft Component (Fish-Head)

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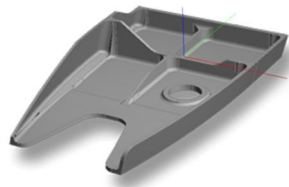
## Abstract

*In general, an aircraft component fish-head is machined using a 5-axis Computerized Numerical Control (CNC) milling machine and it requires tremendous effort in programming and capital investment due to the fish-head features complexity. This paper is to demonstrate alternative methods which are investigated by integrating reverse engineering and rapid prototyping processes; that are vacuum casting (VC), fused deposition modeling (FDM) and three dimensional (3D) printing. The fish-head is digitized using a 3D laser scanner and edited using a surface modeling software to generate the Standard Triangulation Language (STL) model. The STL data file is used in FDM and 3DP whereas the master pattern is used for VC. The quality of the prototypes is evaluated for dimensional accuracy, surface roughness and time to produce. The prototypes dimensional accuracy error is less than 5%. The prototypes can be manufactured in less than 24 hours through all reviewed processes.*

**Keywords:** Advance manufacturing processes, reverse engineering, rapid prototyping

## 1.0 Introduction

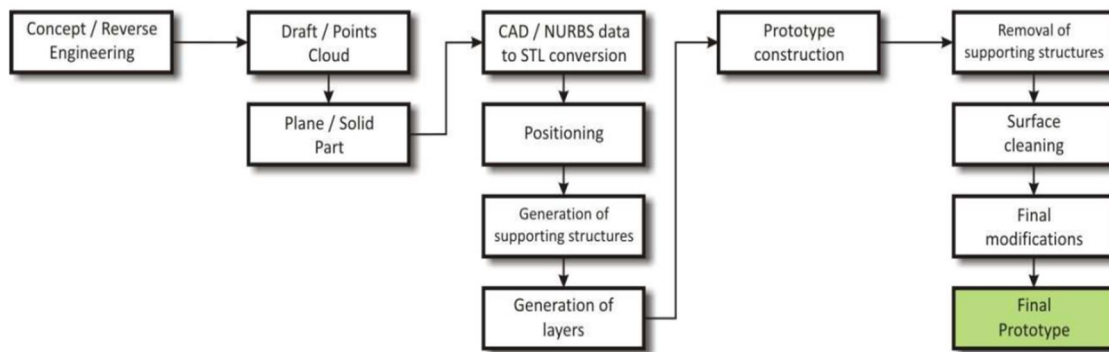
In general, an aircraft component fish-head (Figure 1) is machined using a 5-axis Computerized Numerical Control (CNC) milling machine and it requires tremendous effort in programming and investment due to the fish-head features complexity. However, a disadvantage often associated with machining is the lead time needed to prepare the required tooling before carrying out the machining operation (David, 2003). Additionally, CNC machining is limited in its capabilities to machine geometrically complex surfaces or structures (Minhat, 2009). Other alternative methods which are more economical and easy to manufacture are sought to overcome such problems. New perspectives of advanced manufacturing processes that are considered are Fused Deposition Modeling (FDM), Vacuum Casting (VC) and 3D printing (3DP).



**Figure 1:** Airbus Fish-head (STEP Tools, 2012)

The objectives of this project are to manufacture and review the prototype of a fish-head component through advanced manufacturing method namely FDM, VC and 3DP. The scope

of this research is to produce a prototype of the fish-head aircraft component from advanced manufacturing processes through the identified advance manufacturing processes by means of Reverse Engineering (RE) and Rapid Prototyping (RP). Furthermore, special attention of this work is given to applications of rapid prototyping in the fabrication of aerospace parts or components. In this study, a reverse engineering (RE) system based reconstructing approach has been proposed and developed for the nominal geometry reconstruction of a fish-head. RE is mainly used to re-engineer a component to get its CAD model data (Boppana et al., 2011) for RP or rapid manufacturing (RM) and the majority of RE applications has been focused on surface modeling to suit CAD/CAM systems for the purpose of product design, replica, manufacture or inspection. This research gives the manufacturer an alternative to the CNC machining that can produce a near net shape prototype as good as the CNC machining but at a lower cost and at a faster time. Thus allowing more complex parts to be produced using this manner, in term of reverse engineering. The integration of RE and RP comes in the form of the CAD model developed through RE process can be built into physical prototype using RP methods. Both RE and RP are technologies that have led to reduction of product development lead times. Integration of the two processes, RE and RP has the potential to drastically reduce the product development times further. Figure 2 shows the typical relationship of RE and RP.



**Figure 2:** The relationships of reverse engineering and rapid prototyping (Michal & Stefan, 2012)

FDM is a rapid prototyping technology that extrudes semi molten filament material through a robotically controlled nozzle. FDM is commonly used for modeling, prototyping and product applications. FDM is an additive manufacturing that built products through layer by layer. In particular to FDM, poor surface finish affects the function of RP produced parts, depending on the geometry of the enclosing surface, the building strategy, layer thickness and orientation of the part; these disadvantages significantly outweigh the advantages of RP parts especially FDM (Pandey et al., 2007). However parts fabricated through FDM are usually undergoes a secondary machining to improve the surface quality. A study (Vinesh et al., 2006) shows that FDM is capable of producing good quality aerospace component as in the case of GKN Westland helicopter oiljet.

VC is an advanced manufacturing method that is using vacuum during the processes of mould fabrication and the casting of parts. It is normally employed for producing parts where the amounts of trapped air must be kept to an absolute minimum. VC is an indirect tooling process because the process requires a master pattern before a mould tooling can be formed and soften because a typical silicone rubber is used for building the mould which can only support castings in small batches before worn out. The advantages of VC include good surface finish, void-free interior structure, and clarity or colour if desired and close tolerance to a pre-determined size (Chabra & Singh, 2011). The close dimensional tolerance and

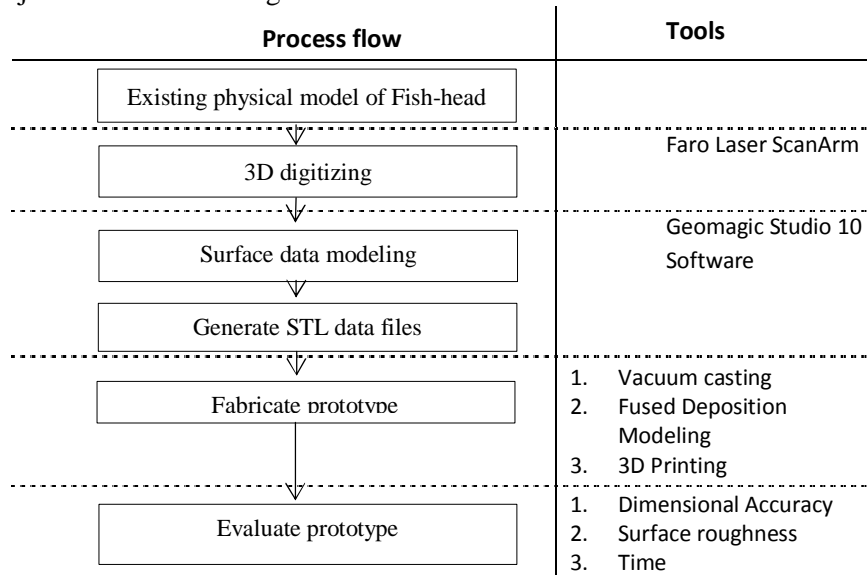
absence of voids also result in parts with physical properties similar to those expected from production runs of injection moulded thermoplastic shapes.

In 3DP manufacturing of components, a layer of powder is spread over a platform. Starch, plaster, ceramics, and metals are commonly used materials for 3DP (Dimitrov et al., 2006). The particles are bonded together selectively by a liquid adhesive or binder solution. The liquid adhesive is deposited in a two-dimensional pattern by a multichannel jetting head. As the current layer is completed, the platform is lowered down by a thickness of a layer, so that a new fresh layer can be spread again. However, the surface finish is poor compared to other RP processes (Ippolito et al., 1995). The surface finish in 3DP fabricated parts can be improved by using very fine powders as they allow the use of thinner layers and also provide improved surface finish within each layer (Andre et al., 2012).

Compared to other RP processes, 3DP with its latest drop-on-bed (DoB) version in particular is considered as the fastest RP manufacturing method available but it is not very accurate (Chabra & Singh, 2011 and Dimitrov et al., 2006).

## 2.0 Theoretical framework

The main objective of this project is to produce a prototype of a fish-head component through advanced manufacturing methods i.e. VC, FDM and 3DP. The schematic flow of the overall project is as shown in Figure 3 below.



**Figure 3:** Schematic flowchart of the overall project

The fish-head master pattern need to be digitized by using FARO Laser ScanArm, a non-contact coordinate measuring machine (CMM) and later converted into STL data file, which can be used for FDM and 3DP. The input for the 3D laser line scanning is the fish-master pattern and the surface colour as this will influence the quality of the digitized fish-head point clouds. The point clouds are later edited through GEOMAGIC Studio 10. It is expected that the finished STL data files will influence the quality of the fish-head prototype fabricated through FDM and 3DP, as both processes relies heavily on the STL data files.

In vacuum casting the parameter that could affect the quality of the fish-head prototype is the pressure difference and the pressure time. Quality issues related to vacuum castings are shrinkage marks; insufficient filling, flash and gas pocket (Xu et al., 2012). The pressure difference happens inside the vacuum chamber during the degassing stage prior to the flow of the casting material. In the degassing process, the speed of liquid dropping down funnel and the speed of the mixed material filling into mould cavity are determined by the speed of gas

pressure without considering the action of gravity. The faster the pressurized gas exits the chamber, the faster the speed of filling of silicone mould cavity. Another parameter that could affect the quality of the prototype is the pressure time. The pressure time is proportional to the filling speed of the mould cavity. Therefore it is important to control the pressure time in order to obtain a good casted prototype

The input for FDM process is the raster angle and the layer thickness as this directly influence the output quality. For this work, the raster angle is set at 45 degree, as it will minimize the staircase effect and significantly reduce the surface roughness (Luis Pérez, 2002 and Fatimatuzahraa et al., 2011). The layer thickness is set at the minimum value of 0.127 millimeter (Armilotta, 2006) as this is the lowest feasible value achievable by the machine.

The input parameter for 3D Printing process, such as powder particle size and printing layer thickness play an important role in the strength and surface quality of the 3D printing process. By adjusting the above parameter, it is expected that the surface quality and dimensional accuracy (Vaezi & Chua, 2011) is on par with the fish-head master pattern. This due to smaller particle size produced higher green strength and surface quality (Lu et al., 2009). To achieve the desired dimensional accuracy the layer thickness need to be 0.1 millimeter accuracy (Vaezi & Chua, 2011) therefore the layer thickness is set at 0.1016 millimeter as this is the minimum achievable by the machine.

The final products through Vacuum casting, Fused Deposition Modeling and 3D Printing are then evaluated for dimensional accuracy, surface roughness and time to produce single prototype. For dimensional accuracy the COORD3 EOS544 CMM is used. The CMM utilizes Renishaw PH10M motorized indexing heads, and Renishaw TP2 probe head with the uni-directional repeatability accuracy of 0.35 micrometer ( $\mu\text{m}$ ). For the surface roughness evaluation, a Mitutoyo SurfTest SV-400 is used. For the surface roughness evaluation, an evaluation length of 0.25 millimeter (mm) is used with the stylus speed of 0.1 mm/s is used throughout the measurement. In this work the arithmetic mean surface roughness or Ra is used for all the surface roughness measurements.

### 3.0 Results and Discussions

The results and discussions are separated into 3 rapid prototyping processes, VC, 3DP and FDM respectively.

#### 3.1 Vacuum Casting (VC)

The geometrical accuracy comparison between the fish-head master pattern and the ABS fish-head prototype is measured using a CMM. As far as the 3D fish-head profile is concerned, the dimensions of the master pattern has been precisely copied to the ABS fish-head prototype, with average dimensions deviating less than 5% of the corresponding master dimensions. Shrinkage of the prototypes is observed in some of the measured location. This is caused primarily by heat from resin solidification process (Dan-Yang et al., 2012). Therefore, a satisfactory replication accuracy of fish-head is achieved by using the vacuum casting method. The fish-head prototype has a good sharpness and surface finish, as well as a high replication to the cavity dimensions. Surface milling is performed to remove flash material.

It is found that the average surface roughness of the fish-head master pattern and the prototype is at 1.57 micrometer ( $\mu\text{m}$ ). Even though the average surface roughness for all the surfaces are equal, the deviation from the master pattern is extreme, with the maximum surface roughness is at 56.35%. Therefore in order to get the similar surface roughness as the master pattern, the prototype needs to go for a secondary surface machining such as surface milling, and this is normal to most RP manufacturing processes (Vaezi & Chua, 2011). The average time to complete one prototype is 20 hours.

### 3.2 3 Dimensional Printing (3DP)

The dimensional accuracy of the fish-head fabricated through 3DP is found deviating by less than 5% on average as compared to the master pattern. This finding coincides with Mahesh et al. (2004) saying that the 3DP process is capable of producing prototype with less than 5% error deviation. There are also shrinkage observed on few dimensions such as the length, width, arc radius and the slope angle. This is normal on 3DP as this is due to the drying shrinkage of the powder-binder (Utela et al., 2008). The shrinkage put the liquid under tension. This tension results in the movement of the build medium as it dries. 3DP builds parts layer-by-layer, shrinkage not only affects the final dimensions but also the integrity and strength (Suwanprateeb, 2006) of the built prototype. The shrinkage in 3DP, can lead to effects such as distortion and delamination between successive layers of the part. Therefore upon manufacturing through 3DP processes, a tolerance of maximum 5% is required to compensate for the shrinkage.

In order to increase the dimensional accuracy of the prototype, Dimitrov et al. (2006) suggested that reducing the number of layers used will improve the part dimensional accuracy. Therefore for this work there are 275 layers of powder and binder involved. Based on the simulation, the fish-head prototype is orientated in to obtain the shortest vertically to minimize layer displacement (Dimitrov et al., 2006) as to increase the dimensional accuracy.

The surface roughness of the prototype fabricated through 3DP, performed poorly as the values are higher compared to the master pattern surface roughness. The average surface roughness for 3D printing is at 7.946  $\mu\text{m}$  compared to 1.574  $\mu\text{m}$  for the master pattern. This is due to the fact that the powder material ZP130 is dry type powder with mean particle size diameter of 20.79  $\mu\text{m}$  (Z-Corporation, 2012).

The particle size affects design parameters of both the printing process and the final part surface roughness. Fine powders have the ability to produce lower surface roughness, smaller minimum features, and thinner layers (Dimitrov et al., 2006). Whereas larger particles are easier to spread, have lower surface area per volume and the larger pores facilitate fluid migration through the bed to aid in the production of more homogeneous parts (Michele & Emanuel, 2003). Physical examination shows that the fish-prototype from 3D printing appears to be porous which is not observable in vacuum casting and FDM prototypes. Both the geometric and surface finish in 3DP printed parts can be greatly improved by using very fine powders as they allow the use of thinner layers and also provide improved finish within each layer (Utela et al., 2008). But these powders have to be processed or deposited by the slurry method (Utela et al., 2008) because the fine powders with particle size 2 micrometer ( $\mu\text{m}$ ) or less cannot be spread dry. This wet process is more complex and slower than the dry process. However, a larger powder particle size such as the ZP130 is preferred for the physical and thermal properties for some applications (Z-Corporation, 2012).

The time required to complete fabricate is 38 minutes and, the entire fish-head prototype build depth is approximately 21.94 mm, and 26.8 ml of ZB58 powder binder.

### 3.3 Fused Deposition Modeling (FDM)

The dimensional accuracy for the fish-head prototype fabricated through FDM, it is found that the deviation for the outer dimension such as the length, width and arc radius is less than 5%, as per stated by Mahesh et al. (2004) that FDM process is capable of producing prototypes with less than 5% error. To achieve this accuracy, the raster angle of the FDM is set at 45 degree (Luis Pérez, 2002) using the INSIGHT software. Physical examination on the cylindrical profile of the prototype shows a slight distortion of the round shape and the inner wall. However based on measurements the deviation is less than 5% for both the inner and outer diameter. This is due to the residual stress as described by Zhang and Chou (2008). There are three factors that contributed to the residual stress arise in FDM: thermal gradient, speed of deposition and part geometry (Sun et al., 2008). In FDM, the heating and rapid

cooling cycles of the materials result in non-uniform thermal gradients which cause a stress built-up that leads to distortions.

The prototype average surface roughness is 4.83  $\mu\text{m}$  as compared to 1.57  $\mu\text{m}$  for the fish-head master pattern or 207.6 % higher when compared to the master pattern. This is due to the clearly visible the stair-steps profile on the surface of the prototype. This is because the FDM technologies utilize a layering process or stacking layers, the stair-steps profiles inevitably occur on the surface of the fabricated parts. Due to the small dimensions of the prototype, the defects due to the stair-steps effects are visible, thus the surface quality of the processed parts is insufficient to meet general industrial purposes. The surface quality of objects fabricated using FDM is generally inferior to that of general NC-machined parts due to the stair stepping effect (Lee et al., 2007), which results from stacking layers with some level of thickness. A secondary machining or surface finishing is required to achieve the desired surface roughness.

Based on the simulation conducted using INSIGHT software, the prototype requires 2.883 cubic inch or 47.243 cubic centimeter of ABS-M30 built material and 0.394 cubic inch or 6.456 cubic centimeter of SR-20 support material. The whole built time is estimated at 2 hours 44 minutes. The finished prototype is then soaked into a solution to remove the water soluble support for another 10 hours. Therefore the total time to manufacture one prototype is 12 hours 44 minutes.

#### 4.0 Conclusions

The geometrical accuracy and the surface roughness of the prototypes are compared with the fish-head master pattern. It is found that all three advance manufacturing process is capable of producing the prototype with error less than 5% as per suggested by Mahesh et al. (2004). However, for the surface finish none of the advance manufacturing process is capable of producing the exact same surface roughness as per fish-head master pattern. This shows that a secondary surface finish machining is required in order to achieve the desired surface finish. As for the time required to produce a single prototype, 3DP is the fastest processing time in producing one prototype, followed by FDM and VC respectively. Table 1 shows the overall summary for this particular project.

**Table 1: Project Summary**

	<b>Vacuum casting</b>	<b>Fused Deposition Modeling</b>	<b>Three Dimensional Printing</b>
Dimensional Accuracy	< 5% error	< 5% error	< 5% error
Surface Roughness	Requires secondary surface machining	Requires secondary surface machining	Requires secondary surface machining
Time to produce single prototype	20 hours	12 hours 44 minutes	2 hours 38 minutes

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## M2 - Perbandingan Kaedah Pembuatan Radius Menggunakan Alat Pembuat Jejari (Lathe Radius Attachment) Dan Kaedah Manual Bagi Mesin Larik Konvensional

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### Abstrak

'Lathe Radius Attachment' berfungsi untuk membuat radius pada benda kerja yang berbentuk silinder yang menggunakan mesin larik konvensional. Objektif kajian adalah untuk merekabentuk dan menghasilkan sebuah 'attachment' bagi memudahkan proses pemesinan dalam membentuk 'fillet'. Lakaran awal menggunakan perisian 'Autodesk Inventor 2012'. 'Attachment' ini mudah dikendalikan berbanding menggunakan kekesot gabung dan kekesot lintang. Projek ini tidak memerlukan tenaga mahir untuk mengendalikannya berbanding menggunakan kekesot gabung dan kekesot lintang. Lathe radius attachment (LRA) berkeupayaan membuat radius  $\varnothing 5\text{mm}$ -  $\varnothing 25\text{mm}$  dengan ketepatan sehingga  $\pm 0.05 - 0.1\text{mm}$ . Radius attachment ini juga menggunakan 'stopper' yang menggunakan teknik separa bulatan iaitu  $135^\circ$ . Dua belas sampel dengan purata ukuran jejari fillet yang dihasilkan adalah  $10.005\text{ mm}$ . Di samping itu, ia juga dapat menjimatkan masa pemesinan iaitu 10 minit (3 produk / jam) berbanding yang asal iaitu 20 minit. Projek ini juga lebih selamat digunakan boleh diguna pakai dalam sektor pembuatan dan amat berguna dalam memudahkan kerja operator yang terlibat.

**Katakunci:** Attachment, Larik (Lathe), radius

### 1.0 Pengenalan

Untuk mengurangkan pembiayaan pengeluaran, peningkatan efisiensi proses pemesinan suatu produk sangat berpengaruh terutama dengan menurunkan waktu proses pemesinan [1]. Peralatan tambahan seperti pemegang bendakerja (*workholder*) dan attachment memainkan peranan yang sangat penting dalam proses pemesinan produk terutama bila melibatkan pengeluaran besar (bertujuan mengurangkan unit kos) dan kebolehtukuran (memudahkan proses pemasangan) [2].

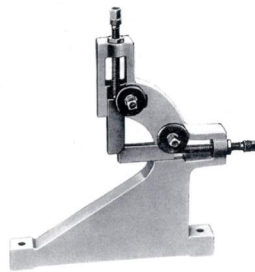
*Workholder* dan *Attachment* adalah dua alat yang berbeza. *Workholder* adalah menyeluruh dari segi definisi iaitu semua alat yang digunakan untuk memegang, *grip* atau *chuck* bendakerja dalam keadaan tertentu untuk membolehkan kerja pemesinan dijalankan [3]. *Workholder* yang dimaksudkan termasuk semua jenis *vices*, *clamps* dan *abutments*, *chucks*, *collets*, *centres*, *mandrel* dan *face plates*. Bagi memenuhi kehendak dalam proses pemesinan dan pemasangan pemegang bendakerja khas dikenali sebagai alat penepat (*jigs and fixtures*) digunakan.

*Attachment* pula tidak berfungsi untuk seperti *workholder* iaitu dengan memegang bendakerja tetapi lebih kepada membantu dalam mendapatkan perisian yang diperlukan dalam sesuatu produk. Walaubagaimanapun ketiga-tiga alatan ini mempunyai tujuan utama yang sama

iaitu mengurangkan kos pemesinan dan penggandaan produk dapat dibuat secara tepat [4] dan tidak memerlukan pekerja mahir untuk menggunakan alatan tersebut.

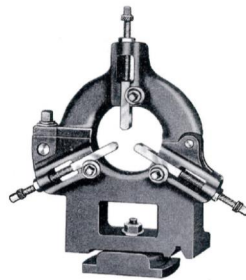
## 2.0 Attachment bagi Proses Larik

*Attachment* bagi proses larik terbahagi kepada dua kelas iaitu: (1) Bertujuan meningkatkan kelajuan dan ketepatan bagi proses larik. (2) Mesin larik yang digunakan untuk melakukan proses pemesinan yang melibatkan proses canai dan kisar. *Follower Rest* (Rajah 1) merupakan sejenis attachment yang digunakan untuk menyokong bendakerja yang panjang yang terletak antara dua *center*. Dua rahang (*jaw*) yang boleh ubah bertujuan memegang bendakerja pada kedudukan yang kukuh dan mengelakkan bendakerja tersasar dari mata alat semasa proses pemesinan [5]. Rahang perlu ditempatkan dengan tepat atas bendakerja namun bendakerja masih boleh berpusing. Semasa proses pemesinan dijalankan *lubricant* digunakan pada titik di antara bendakerja dan rahang.



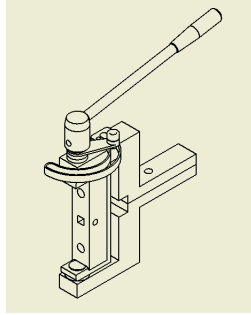
Rajah 1

*Steady test* (Rajah 2) digunakan untuk menyokong benda kerja silinder yang panjang semasa proses larik, *boring* dan *threading*. Dua rahang bawah diubah dahulu bila bendakerja dimasukkan dan rahang atas diubah kemudian mengikat diameter bendakerja yang diproses. *Scoring* pada mata alat berlaku bila rahang atas diikat terlalu ketat atau kekurangan minyak/*lubricant* manakala chatter (gegaran) pada bendakerja berlaku bila rahang atas terlalu longgar.



Rajah 2

**Rajah 4** menunjukkan Lathe Radius Attachment (LRA) yang dihasilkan bagi kajian projek ini. Dihasilkan dengan tujuan untuk menghasilkan produk dengan *Radius*, *Fillet* and *Ball Radius* yang dikehendaki dengan ketepatan dan hasil produk yang lebih kemas.

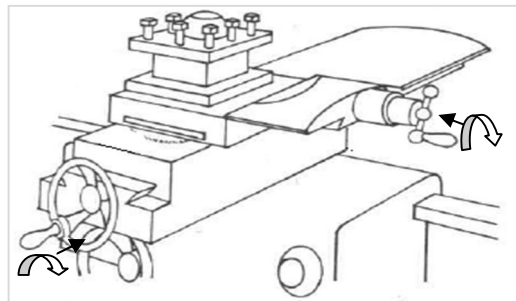


Rajah 4

Kesimpulannya, *attachment* adalah peralatan khas yang direka dan dibina untuk membantu mempercepatkan proses dan ketepatan hasil.

### 3.0 Kaedah Lama Dalam Membuat Jejari

Kekesot lintang, tiang mata alat dipasang pada kekesot bergabung (Rajah 3). Kekesot bergabung pula dipasang di atas kekesot lintang dengan dua *bolt*. Apabila kedua-dua *bolt* ini dilonggarkan kekesot bergabung boleh dikilaskan pada sudut yang dikehendaki. Dengan cara ini penirusan tajam tetapi pendek boleh dilarik. Pada hujung kekesot lintang dan kekesot bergabung dilengkapi dengan relang yang ditanda jitu supaya kedalaman pemotongan dapat dilaraskan dengan tepat.



Rajah 3

Cara yang digunakan ini memerlukan kemahiran yang tinggi kerana radius yang ingin dibentuk perlulah sama dengan tolok yang telah diselaraskan. Untuk membuat radius dengan cara ini, ianya perlulah menggerakkan kekesot bergabung dan kekesot lintang perlulah digerakkan seperti dalam **Rajah 3**.

### 4.0 Bahan dan Kaedah

Kajian melalui pemerhatian yang merupakan salah satu cabang yang terletak antara kategori '*survey*' dan kategori *æthnografikø* boleh digunakan samada bagi kajian berbentuk

kualitatif dan juga kuantitatif [6]. Bagi kajian kualitatif, pengkaji akan menterjemahkan hasil kajian dalam bentuk penerangan berbanding nombor/nilai atau ukuran [7]. Pendapat ini juga disokong bahawa banyak perkara tidak dapat dijelaskan hanya dengan merujuk pada data numerika sebaliknya memerlukan data-data kualitatif yang dipungut melalui kaedah temubual atau pemerhatian yang teliti secara mendalam [8]. Kajian bagi projek ini bersandar kepada pemerhatian dan survey dari responden khusus pelajar bahagian pembuatan (pemesinan) di ADTEC Batu Pahat.

Dari kajian yang dijalankan, 43% pelajar menyatakan bahawa agak sukar untuk membuat radius dengan menggunakan mesin larik konvensional. Manakala 24% pula menyatakan bahawa radius yang dihasilkan adalah kurang kemas. 9% pelajar mengatakan faktor masa yang lama jika menggunakan kaedah kekesot. 100% responden bersetuju kaedah kekesot merupakan kaedah yang sukar dan kurang sesuai digunakan dalam membuat radius.

Menurut [asfas], *jigs* dan *fixtures* selalunya diperbuat daripada pelbagai bahan yang boleh ditempa untuk mengatasi kerosakan. Bahan yang digunakan dalam kajian ini adalah *Mild Steel* dan *Aluminium*. *Mild Steel* digunakan kerana ia merupakan bahan yang murah dan digunakan secara meluas sebagai pemegang bendakerja. Dengan kandungan karbon kurang dari 0.3% ia adalah bahan yang ekonomi dalam fabrikasi yang tidak terdedah kepada kerosakan yg kritikal. *Aluminium* pula digunakan hanya sebagai pemegang dan *stopper*.

Lukisan terperinci dihasilkan dengan menggunakan  $\phi$ Autodesk Inventor 2010 $\phi$ . Begitu juga bagi tujuan menghasilkan lukisan 2D, 3D, pemasangan dan juga ceraian.

## 5.0 Keputusan dan Perbincangan

*Lathe Radius Attachment* direka dan diuji untuk mendapatkan hasil yang dikehendaki. *Attachment* ini juga boleh digunakan untuk membuat *Radius*, *Fillet* and *Ball Radius* dimesin larik konvensional bagi mendapatkan ketepatan dan keberkesanan yang diinginkan. Dalam kajian ini, *fillet* dengan radius 10mm adalah hasil yang dikehendaki dan *Lathe Radius Attachment* digunakan untuk mendapatkan hasil tersebut. Duabelas (12) bendakerja digunakan dan purata hasil dinyatakan. Hasilnya yang didapati adalah seperti dalam Jadual 1.

**Jadual 1.** Perbandingan Hasil Melalui Dua Kaedah.

Proses dan Kaedah	Kekesot Lintang dan Gabung	Lathe Radius Attachment
Fillet dengan radius R10 mm	R10.047 mm	R10.005 mm
Masa membuat fillet R10 mm	30 ó 45 minit	15 ó 20 minit
Produktiviti	1 bendakerja / jam	3 bendakerja / jam

Hasil yang ditetapkan adalah dengan merujuk kepada  $\phi$ fillet $\phi$  dengan jejari 10mm. Secara purata, bagi cara lama hasilnya adalah dalam lingkungan 10.047 mm manakala dengan menggunakan alat baru ini fillet yg dihasilkan adalah dengan jejari 10.005 mm. Perbezaan masa yang ketara wujud antara dua kaedah ini. Masa selama 45 minit diperlukan untuk kaedah lama yang menghasilkan 1 sahaja bendakerja manakala 20 minit diperlukan untuk kaedah baru yang menghasilkan 3 bendakerja dalam masa 1 jam.

## 6.0 Kesimpulan

Lathe Radius Attachment adalah alatan baru yang boleh digunakan dalam mendapatkan hasil yang tepat serta menjimatkan masa bagi penggunaan suatu mesin larik secara konvensional. Dengan tujuan bagi mengurangkan pembiayaan pengeluaran , peningkatan efisiensi bagi proses pemesinan suatu produk penggunaan LRA sangat mempengaruhi terutamanya dalam menurunkan waktu proses pemesinan dan penggandaan produk dapat dibuat secara tepat dan tidak memerlukan pekerja mahir untuk menggunakan alatan tersebut.

## 7.0 Rujukan

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## M3 - Rekabentuk Dan Fabrikasi Mesin Gril Satay

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### Abstrak

*Inovasi Mesin Gril Satay Grill yang dinamakan 'Satay Port' merupakan penciptaan alat gril satay automatik tanpa asap. Satay Port terdiri dari sistem penghantar yang dipasang bersebelahan dengan elemen pemanasan dengan pelbagai peranti lain. Setiap peranti yang dipasang di gunakan untuk memegang satay semasa proses menggril berlaku. Kadar suhu elemen pemanas telah di tetapkan terlebih dahulu. Satay yang siap digril akan jatuh sendiri kedalam bekas tersedia dibantu oleh daya tarikan graviti. Mesin yang berat 17kg ini boleh beroperasi sehingga 8 jam tanpa henti dan mampu menggril sehingga 760 cucuk satay dalam 1 jam tanpa karbon dan asap serta boleh beroperasi di tempat tertutup atau tempat berhawa dingin. Inovasi terbaru yang direka ini, menggunakan kuasa letrik 240 Volt dan di perbuat daripada keluli tahan karat "Stainless Steel" sesuai untuk produk berasaskan makanan yang berkonsepkan makanan segera. Ia sangat sesuai bagi pengusaha Restoran, Hyper Market, Kiosk dan Hotel.*

**Keyword :** *Mesin Gril Satay, Makanan Segera, Gril Satay, elem Pemanas.*

### 1.0 Pengenalan.

Satay adalah makanan paling terkenal di Malaysia. Kebiasaannya satay ini di makan dengan kuah kacang, ketupat, timun dan bawang. Terdapat pelbagai jenis satay iaitu satay ayam, satay kambing, satay lembu, satay rusa, satay arnab satay perut dan pelbagai jenis lagi. Pemakanan satay di Malaysia telah berkembang di seluruh negara dan di gemari oleh pelbagai kaum. Dari segi pemasarannya, ia boleh didapati di pasar-pasar malam, di kedai-kedai makan dan di restoran yang khusus penjualan satay seperti Satay Kajang. Satay ini di gril melalui kaedah tradisional dengan menggunakan arang kayu sebagai bahan pembakar, terdapat pelbagai masalah yang di hadapi antaranya ialah:-

- i. Tempat menggril satay sangat kompleks dan sukar untuk mengekalkan suhu dan sukar untuk mengekalkan kebersihan satay yang di gril.
- ii. Melalui kaedah menggril tradisional menggunakan api arang, satay perlu di terbalikkan secara manual untuk mengelakkan menggril tidak sekata.
- iii. Keadaan tidak bersih daripada asap dan abu dari bara api yang terbang ke daging satay ketika pengendali menyemarakkan api dengan kipas tangan untuk membuat arang dibakar lebih kuat dan memberi kesan bahang panas kepada individu yang terlibat.
- iv. Kaedah ini tidak sesuai untuk premis perkhidmatan makanan tertutup kerana asap yang berlebihan dikeluarkan dari proses menggril.
- v. Satay yang di dihasilkan akan terbakar dan terdapat kesan karbon (arang) pada satay dan boleh menjejaskan kesihatan

Jika di perhalusi konsep gril satay secara tradisional (Gambar 1) mendatangkan beberapa masalah antaranya asap yang banyak semasa operasi yang mana sangat tidak sesuai untuk

beroperasi di tempat yang tertutup selain memerlukan kemahiran untuk menggril bagi memastikan satay di gril dengan sempurna. Masalah kebersihan juga amat ketara apabila menggril satay dengan cara tradisional kerana di gril di atas tempat yang tercemar dengan kotoran dan kebarangkalian berlakunya keracunan makanan di samping kesan karbon pada satay yang di bakar akan membawa kepada masalah kanser. Kemungkinan kemalangan boleh berlaku yang menyebabkan berlakunya kecederaan contohnya melecur dan terbakar di sebabkan bahang yang panas semasa menggril satay (Gambar 2).



**Gambar 1:** Menggril satay dengan kaedah tradisional



**Gambar 2 :** Nyalaan api yang terlalu kuat menyebabkan bahang kepada orang yang menggril satay

## 1.1 Kajian Lapangan

Dalam usaha menambahbaik pendekatan penyediaan satay kaedah tradisi, usaha untuk mencipta dan merekabentuk sebuah mesin pembakar satay separa automatik yang selamat dan mudah di gunakan telah di laksanakan . Pemerhatian di lokasi peniaga satay telah di lakukan untuk mengkaji aspek keselamatan, kebersihan (hygiene), mengenalpasti tempoh optima menggril pelbagai jenis satay dan menganalisa kos bahan bakar. Carian keratan akhbar (Gambar 3), dokumen paten dilakukan dan sebahagian dokumen paten berkaitan proses menggril [1],[2],[3],[4], [5], [6] dianalisa untuk dikenalpasti kesesuaian berkaitan kebaikan dan kekurangan rekacipta berkenaan seperti Jadual 1 dan Jadual 2. Hasil dari pemerhatian di lokasi peniaga satay serta analisa dokumen paten, satu rekabentuk Mesin Pembakar Satay telah dibuat dengan bermatlamat mengatasi masalah yang timbul dari pendekatan penyediaan satay kaedah tradisi.

### 1.1.1 Ciri teknikal Mesin Gril Satay.

Mesin yang di reka khas ini (Gambar 4,Gambar 11, Gambar 12), mengandungi komponen tapak dan rangka utama berbentuk bersegi tiga dimana terdapat ruang untuk memuatkan satay ke peranti pemegang (Gambar 6)dan ruang memunggah keluar di lokasi bertentangan. Elemen pemanas berkuasa letrik dipasang bersebelahdengan rangka berbentuk bersegi tiga. Semasa satay dibawa menggunakan sistem penghantar (Gambar 5) melalui ruang pemanas, ia bergerak dengan operasi tanpa perlu membalikkan satay. Satay tidak berputar semasa proses menggril berterusan kerana mesin ini di lengkapi elemen pemanas di kedua-dua bahagian atas

dan bawah. Satay akan melalui laluan pemanasan dalam menyerong ke atas dan kemudian turun secara menegak ke bawah, selepas itu, satay secara automatik terlepas dari peranti pemegang jatuh pada pelongsor untuk terus ke dalam dulang disebabkan oleh daya graviti (Gambar 7). Mesin di lengkapi dengan elemen pemanas dalam keadaan seragam yang di kawal oleh termostat untuk mengelakkan elemen menjadi panas melampau. Tahap yang dikehendaki bagi kemasakan di tentukan oleh kelajuan sistem penghantar atau keamatan cara pemanasan. Mudah alih dan menggunakan bekalan kuasa satu fasa, 240V 50Hz seperti Jadual 3. Kapasiti menggril bagi mesin ini adalah 760 satay setiap satu jam. Mesin Gril Satay telah di patenkan [7] bagi memberi perlindungan harta intelek.

### 1.1.2 Penyelesaian Masalah

Dengan adanya mesin ini, ia dapat memudahkan kepada peniaga dan pengusaha restoran menggunakannya kerana hasil rekaan mesin ini mampu mengatasi permasalahan yang di kenal pasti seperti Jadual 4 :-

- i. Masalah asap dan abu dari bara api tidak lagi ujud kerana mesin yang di rekabentuk ini menggunakan pemanas (heater) berkuasa letrik dan mengaplikasikan konsep *Green Technology*.
- ii. Kebersihan satay yang di bakar diutamakan kerana keseluruhan mesin ini di buat daripada keluli tahan karat iaitu *food grade stainless steel 304* berbanding dengan kaedah tradisional menggunakan bekas yang boleh karat dan terdedah kepada pencemaran.
- iii. Masalah kemahiran menggril satay juga dapat di atasi, dimana pengguna tidak perlu untuk memantau tahap kemasakan satay tersebut. Mesin ini menampilkan larasan suhu dan tempoh satay berada didalam ruang pemanggangan dimana satay masak sepenuhnya ketika sampai keruang pemunggahan ('unloading') dan ianya jatuh tanpa memerlukan pemerhatian khusus.
- iv. Aspek keselamatan kesukaran seperti berhadapan dengan bahang panas juga dapat di atasi kerana ruang pemanggangan pada mesin ini direkabentuk secara tertutup dan selamat.
- v. Aktiviti gril satay secara *out door* dapat diubah ke aktiviti *indoor* (Gambar 9, Gambar 10). Dengan adanya mesin ini, aktiviti menggril dapat di lakukan di tempat tertutup malah di ruang berhawa dingin kerana ia tidak mengeluarkan asap.
- vi. Mesin ini amat mesra pengguna kerana struktur nya di bina bersaiz kecil dengan hanya 17 kg .
- vii. Sumber kuasa letrik yang rendah berbanding dengan penggunaan arang kayu dengan kos RM 14.00 untuk 2 bag setiap kali beroperasi selama 8 jam, berbanding kos penggunaan letrik jika takrif TNB adalah sebanyak RM 0.25. adalah RM 5.00/hari atau RM 0.65 /jam.

Pengiraan:-

Kadar Penggunaan Elektrik Mesin Menggril Satay:

$$\begin{aligned}
 &= \text{Power (kW)} \times \text{Jam} \times \text{Kuantiti} \times \text{Takrif TNB} \\
 &= 2.5\text{kw} \times 8 \text{ jam} \times 1\text{unit} \times \text{Rm } 0.25 \\
 &= \underline{\text{RM } 5.00} \\
 &\quad \quad \quad 8 \text{ jam} \\
 &= \text{RM } \underline{0.65 \text{ sen/jam}}
 \end{aligned}$$



### 3.0 Keputusan dan Analisis

Ujian kebolehgunaan adalah satu proses penilaian prestasi keatas produk yang dihasilkan. Ujian ini adalah penting dimana kita akan mengetahui samada produk dihasilkan itu berfungsi dengan baik atau sebaliknya. Bagi produk yang telah berjaya di hasilkan, didapati tiada masalah yang timbul serta berfungsi dengan baik dan memuaskan. Antara ujian yang telah di lakukan ialah :-

#### 3.1 Ujian pembakaran



**Gambar 8 :** Ujian pembakaran

Kajian terhadap masa yang dicatat semasa proses pembakaran satay bergantung kepada kualiti dan kuantiti satay yang di hasilkan seperti Jadual 5

### 4.0 Perbincangan

Berdasarkan kepada hasil ujian yang di lakukan maka dapat di rumuskan bahawa dengan kadar suhu 220 °C maka AC Motor 240v 4 watt dan 4/5 rpm adalah yang paling sesuai di gunakan ini adalah kerana hasil satay yang di bakar telah masak secukupnya dengan penghasilan sebanyak 760/jam bagi satay ayam dan 600/jam bagi satay daging.

Selain daripada itu ujian yang di lakukan di tempat tertutup membuktikan bahawa tiada gangguan asap semasa menggril kerana smooke deteector tidak mengesan sebarang asap yang keluar sebaliknya wap kabus yang terhasil daripada kesan lemak daging yang menitik di atas heater namun tiada memberikan kesan sampingan. Oleh yang demikian perbandingan dapat di kesan dengan jelas apabila di buat perbandingan dengan kaedah tradisional seperti Jadual 4.

#### 4.2 Faedah yang di perolehi daripada mesin

- i. Sesuai untuk dalaman cawangan perkhidmatan makanan seperti mahkamah makanan, hotel dan restoran.
- ii. Sesuai untuk pendekatan layan diri
- iii. Mudah alih, ia boleh digerakkan untuk fungsi luar.
- iv. Mudah dalam operasi dan penyelenggaraan
- v. Menggril satay secara berterusan dengan suhu yang dikehendaki bagi menentukan kadar kemasakan kelajuan penghantar .

## 5.0 Kesimpulan

Kesimpulan penghasilan projek ini adalah berjaya dan mencapai objektif yang di sasarkan dan di dapati bahawa setiap penghasilan produk perlu menitik beratkan beberapa aspek seperti kebersihan,keselamatan,pengeluaran,mesra alam dan mesra pengguna serta mampu mengubah konsep perniagaan satay kepada konsep santai.

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## M4 - Design And Fabricate Progressive Die for Labeling Holder

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### *Abstrak*

*Produk Labeling holder dihasilkan bertujuan untuk memegang kertas tanda nama bersaiz 80mm X 51mm X 3mm. Idea timbul setelah melihat kesukaran tanda nama dilekat atau dipasang pada bahagian almari, laci, rak dan sebagainya. Ia dihasilkan melalui proses tekan (stamping process) jenis progresif dimana bahannya adalah keluli tahan karat (stainless steel). Rekabentuk produk dan alat tekan dihasilkan menggunakan perisian CAD sebelum proses pembuatan dilakukan. Penggunaan peralatan terkini merangkumi CNC, CAM, CAE perlu dalam menghasilkan alat tekan jenis progresif ini dimana kualiti alat tekan dan produk yang dihasilkan dengan sempurna serta berketepatan tinggi dapat dihasilkan dengan menitikberatkan pemilihan bahan, proses pemesinan yang digunakan dan parameter pemrosesan. Proses rawatan haba dilakukan bagi mendapatkan tahap kekerasan HRC pada alat tekan tersebut terutamanya bahagian die plate dan punch. Proses uji cuba alat tekan dilakukan dan beberapa perkara dinilai pada produk yang terhasil seperti keselamatan, ketahanan dan aestetik. Kriteria ini dianalisa kemudian diperbaiki demi menjamin kualiti produk. Dapat disimpulkan produk ini dapat membantu dan memudahkan pengguna untuk meletakkan tanda nama sebagai rujukan bagi peralatan serta dapat mejimatkan masa tanpa perlu menggunakan pelekat dan kebersihan lebih terjamin.*

**Kata Kunci :** Tanda nama, Alat tekan progresif, CAD, rawatan haba, keluli tahan karat.

### 1. Pengenalan

Alat tekan (*press tool*) merupakan peralatan yang digunakan untuk menghasilkan sesuatu komponen produk dengan kuantiti yang banyak serta spesifikasi bentuk produk yang sama dimensinya [1]. Terdapat beberapa jenis *press tool* yang biasa digunakan dalam industri pengeluaran seperti *single die*, *compound die* dan *progressive die*. Antara produk yang dihasilkan daripada alat tekan adalah produk berasaskan *ferrous metal* atau *non-ferrous metal*. Antara *ferrous metal* adalah seperti steel, mild steel, stainless steel, cast iron dan iron. Manakala *non-ferrous metal* pula adalah seperti copper, brass, zinc, aluminium dan aloi.

Menurut Jim Szumera, James A. Szumera (2003) [2], Progressive Die merupakan gabungan beberapa stesyen proses dimana setiap proses adalah berlainan semasa proses tekan dilakukan. Progressive die merupakan alatan yang mempunyai beberapa perhentian yang diletakkan dalam satu barisan. Kepingan logam (*strip*) akan disuapkan masuk kepada alatan *Progressive Die* dengan melalui beberapa perhentian yang sekata dan setiap kali perhentian, bentuk mata pemotong (*punch*) akan membentuk pada kepingan logam (*strip*) dan kemudian ia akan disuap keperhentian yang lain untuk proses pembentukan seterusnya. Kebiasaanya, ianya dikawal secara automatik dengan menggunakan mesin suapan automatik (*auto feeder*). Ia boleh menghasilkan produk yang banyak dalam jangka masa yang singkat dengan hanya menggunakan satu alatan sahaja.

Melabel merupakan proses memberi nama sesuatu tempat atau perkara [3]. Proses ini menggunakan tanda nama dan biasanya akan dilekatkan pada sesuatu itu menggunakan pita pelekat. Masalah timbul apabila tanda nama tersebut ini ditukar kerana sisa pelekat perlu dibersihkan menggunakan bahan kimia lain dan kerja ini agak merumitkan. Perkara ini sering

dihadapi oleh pengguna apabila ingin melabelkan sesuatu tempat atau menyatakan kegunaan pada tempat tersebut seperti almari, rak dan sebagainya. Antara masalah yang dapat dikenalpasti pada produk sedia ada di pasaran adalah ruang untuk memasukkan *labeling paper* pada produk terhad, penggunaan pita pekat untuk melekatkan *labeling holder* menyukarkan pengguna dan rekabentuk kurang selamat.

Fokus kajian kepada penggunaan *labeling holder* yang lebih mesra pengguna dan selamat dimana ciri-ciri produk yang akan dihasilkan mestilah mempunyai kriteria tertentu. Kajian juga merangkumi proses pembuatan dan penghasilan *progressive die*. Ia termasuk pemilihan bahan yang sesuai seperti aluminium, stainless steel, copper dan mild steel dan proses-proses pembuatan yang terlibat..

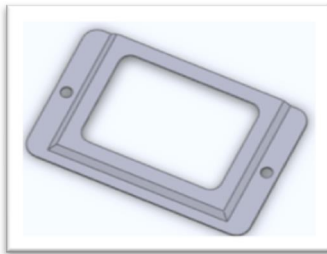
## 2. Kaedah

### Rekabentuk Labeling Holder

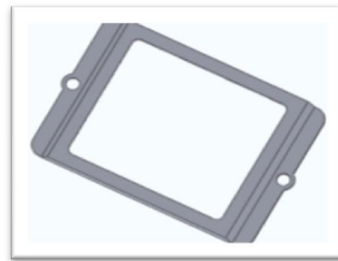
Pemilihan rekabentuk *labeling holder* ini berdasarkan kriteria yang ditetapkan iaitu prestasi, ergonomik, estetik, saiz dan kos. Rekabentuk dihasilkan menggunakan perisian CAD dan saiz serta bahan yang digunakan dapat ditetapkan. Terdapat tiga rekabentuk yang dibuat perbandingan dan pemilihan adalah reka bentuk 3 berdasarkan skor tertinggi melalui penilaian spesifikasi rekabentuk produk (PDS).



**Rajah 1 :** Rekabentuk 1



**Rajah 2 :** Rekabentuk 2

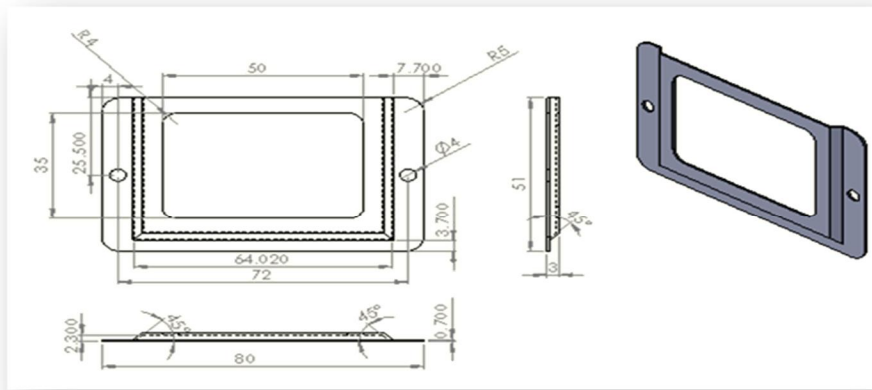


**Rajah 3 :** Rekabentuk 3

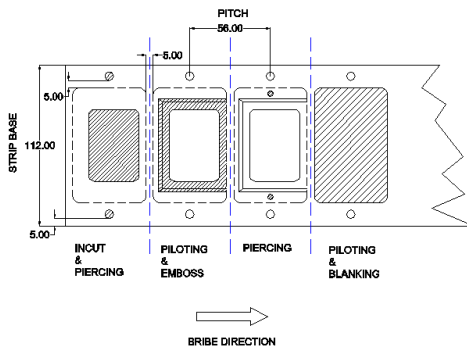
Rekabentuk 2 dipilih kerana fungsi seperti dinyatakan pada rajah di atas dan rekabentuk yang ringkas tetapi mengekalkan ciri-ciri yang telah ditetapkan dan kos yang terlibat juga dijangka lebih rendah berbanding rekabentuk 1 dan 3.

### Pembuatan Progressive Die

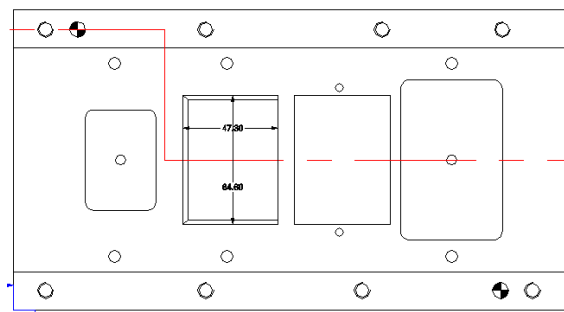
Proses pembuatan *Progressive die* menggunakan mesin *Computer Numerical Control (CNC)* dan *CAM* serta *CAE* untuk menghasilkan kod program serta menganalisis die tersebut. Proses pengerasan dilakukan keatas beberapa bahagian plat (*die plate, punch*) untuk menjaga kualiti produk yang terhasil. Antara plat yang terlibat ialah *top plate*, *Progressive Die* tersebut dihasilkan berdasarkan lukisan terperinci serta *strip layout* seperti **Rajah 4**, **Rajah 5** dan **Rajah 6** di bawah.



**Rajah 4:** Lukisan terperinci labeling holder



**Rajah 5 :** Strip Layout



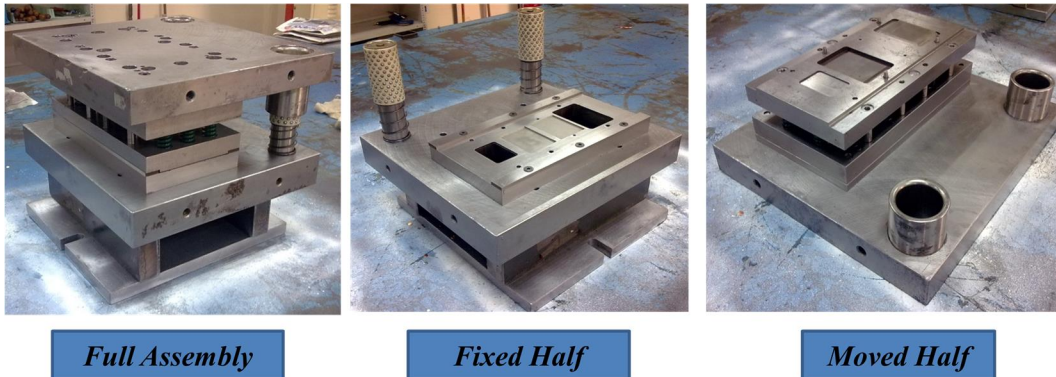
**Rajah 6 :** Die Plate

Proses yang terlibat dalam menghasilkan labeling holder seperti rajah strip layout di atas. Terdapat 4 stesyen iaitu stesyen 1 incut dan piercing, stesyen 2 piloting dan emboss, stesyen 3 piercing dan stesyen 4 piloting dan blanking. Keempat ó empat stesyen ini akan menghasilkan 1 produk siap labeling holder dimana strip akan melalui stesyen 1 hingga stesyen 4 untuk melengkapkan satu kitaran.

### Pengiraan Progressive Die

- |                      |  |                        |                |
|----------------------|--|------------------------|----------------|
| 1. Scrap Bridge      | = 2T   | = 2 x 0.7mm            | = 1.4mm        |
| 2. Cutting Clearance | = C x Sç Tmax  | = 0.01x0.7ç 40         | = 0.044mm/side |
| 3. Cutting Force     | = L x S x Tmax   | = 544 x 0.7 x 40       | = 15232 kg =   |
| 15.3 tone            |  |                        |                |
| 4. Tebal Die, H      | = <sup>3</sup> ç C.F (kg)  | = <sup>3</sup> ç 15232 | = 24.8mm =     |
| 25 mm                |  |                        |                |
| 5. Spring Pressure   | = 10% of Cutting Force   | = 15232 x 10%          | = 1523kgf(N)   |
| 6. Faktor Ekonomi    | = $\frac{\text{Luas Produk} \times \text{Bilangan Baris}}{\text{Lebar Strip} \times \text{Pitch Produk}} \times 100\%$ |                        |                |
|                      | = $\frac{2297.1415 \times 1}{112 \times 56} \times 100\%$  |                        |                |
|                      | = 36.63%   |                        |                |

### 3. Keputusan Dan Perbincangan



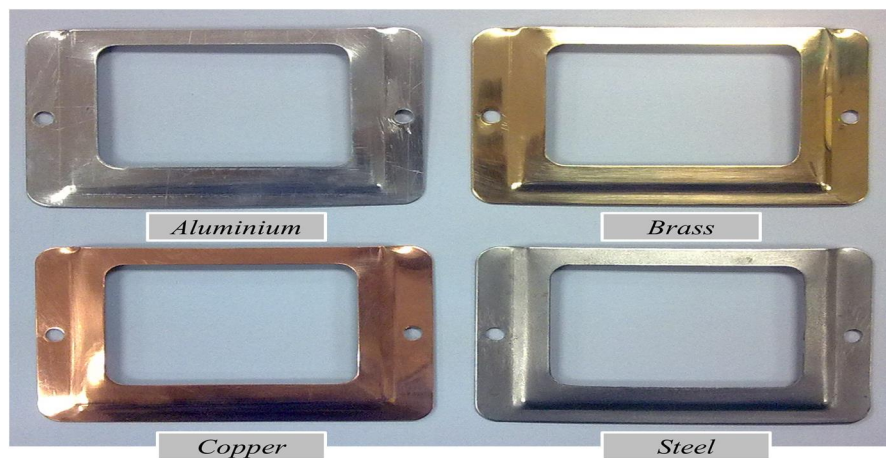
Rajah 7: Rekabentuk progressive die yang dihasilkan

Rajah 7 di atas menunjukkan progressive die yang telah siap dihasilkan dan telah ditambahbaik setelah beberapa masalah dan penyelesaian dilakukan ke atasnya. Masa kitaran untuk satu produk siap adalah kurang 35 saat kerana *strip feeding* dilakukan secara manual. Stamping Maching yang digunakan dalam kajian ini ialah LI CHIN LUP 80 berkapasiti 80 tan.

Terdapat 4 jenis bahan yang digunakan sebagai *strip* kerana bahan tersebut merupakan bahan yang biasa digunakan secara meluas (Rajah 8). Ketebalan strip yang digunakan ialah 1mm dan keempat-empat bahan tersebut memberi pelbagai hasil penyudahan. Bahan aluminium menunjukkan permukaan yang tidak rata (bergelombang) dan terdapat kesan koyakan kecil terutamanya pada bahagian yang diemboss. Ini berlaku disebabkan sifat bahan yang lembut tetapi liat dan menyebabkan produk melekat pada *die plate*.

Bahan kedua (brass) dan ketiga (copper) menunjukkan permukaan yang tidak rata dan bucu-bucu yang bergerigis. Ini disebabkan permukaan strip terlalu licin menyebabkan proses tekan berlaku mengakibatkan *strip* bergerak.

Bahan keempat (stainless steel) menunjukkan permukaan rata dan licin. Bucu-bucu juga tidak bergerigis dan hasil yang baik berbanding ketiga-tiga bahan strip yang lain. Ini bermakna, stainless steel yang bersifat keras tetapi rapuh dipilih sebagai bahan untuk strip.



Rajah 8 : Contoh Produk siap

### **Troubleshooting**

Progressive die yang dihasilkan mempunyai beberapa masalah terutamanya melibatkan bahagian punch dan die plate. Ini kerana ujian yang dijalankan terhadap 4 jenis bahan strip secara manual feeding. Auto feeding tidak dilakukan dalam kajian ini kerana peralatan yang terhad. Kebiasaannya alat tekan yang dihasilkan akan mengalami masalah sama ada ketika proses penghasilan alat tekan atau selepas proses penghasilan produk. Rujuk **Jadual 1**.

Bil	Masalah	Punca	Penyelesaian
1	<b>Produk bergerigis (Burr)</b>	<ul style="list-style-type: none"><li>- Bahagian pada mata pemotong (<i>punch</i>) tumpul.</li><li>- Ruang kelegaan pada <i>Die Plate</i> terlalu besar dan tidak mengikut <i>Cutting Clearance</i> yang sebenar.</li></ul>	<ul style="list-style-type: none"><li>- Tajamkan mata pemotong (<i>punch</i>) dengan menggunakan mesin <i>grinding</i>.</li><li>- Hasilkan <i>Die plate</i> yang baru mengikut kelegaan (<i>Cutting Clearance</i>) yang ditetapkan.</li><li>- Penggunaan <i>strip</i> yang sesuai mengikut jenis bahan dan ketebalan <i>strip</i>.</li></ul>
2	<b>Strip melekat bersama <i>piloting punch</i> semasa proses <i>Stamping</i></b>	<ul style="list-style-type: none"><li>- Sudut (<i>Angle</i>) pada <i>piloting punch</i> tidak cukup panjang.</li></ul>	<ul style="list-style-type: none"><li>- Tambah kepanjangan sudut (<i>Angle</i>) <i>piloting punch</i> agar <i>strip</i> tidak melekat pada <i>piloting punch</i>.</li></ul>

**Jadual 1:** Masalah dan penyelesaian pada *Progressive Die*

Ujian secara pemerhatian terhadap penggunaan produk mendapati pengguna mudah menggunakannya. Walaubagaimanapun, sebelum pengguna boleh meletakkan tanda nama, mereka perlu melekatkan labeling holder secara kekal menggunakan rivet atau skru. Kerja ini memerlukan masa dan alatan tambahan lain yang sesuai seperti riverter dan screwdriver. Namun kebanyakan mereka menyatakan perkara tersebut mudah dan meletakkan tanda nama pada labeling holder lebih mudah dan bersih berbanding melekatkan tanda nama menggunakan pita pelekat.

## **4. Kesimpulan**

Labeling holder dihasilkan bagi memudahkan pengguna melabel sesuatu tanpa perlu melekatkan label tersebut. Ia bertujuan memudahkan pengguna melabel dan membuang label dengan mudah dan selamat. Hasil pemerhatian mendapati labeling holder ini dapat memudahkan pengguna dan permukaan yang dilabel tidak mempunyai kesan pelekat. Ini bermakna labeling holder ini dapat memberi kemudahan dan tahap kebersihan yang lebih berbanding menggunakan pita pelekat.

Progressive die yang dihasilkan menunjukkan kualiti dan rekabentuk produk yang baik dan masa kitaran untuk mengeluarkan produk siap menggunakan kaedah manual feeding kurang 30 saat menunjukkan alat tekan ini berupaya menghasilkan produk kurang 15 saat sekiranya menggunakan auto feeding.

Antara faktor penting yang diambil kira semasa menghasilkan labeling holder ini ialah bahan yang bersesuaian (stainless steel), rekabentuk yang selamat dan mesra pengguna,

## 5. Rujukan

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# M5 - Turbulence Study of Simple Circular Pipe

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## Abstract

*A turbulent flow exhibits small-scale fluctuations in time. It is usually not possible to resolve these fluctuations in a CFD calculation. So the flow variables such as velocity, pressure, etc. are time-averaged. Unfortunately, the time-averaged governing equations are not closed i.e. they contain fluctuating quantities which need to be modeled using a turbulence model. No turbulence model is currently available that is valid for all types of flows and so it is necessary to choose and fine-tune a model for particular classes of flows. So, we use k-ε model to predict and discuss about the turbulence in the circular pipe. The k-ε models consist of two differential equations: one each for the turbulent kinetic energy k and turbulent dissipation ε. These two equations have to be solved along with the time-averaged continuity, momentum and energy equations. So turbulent flow calculations are much more difficult and time-consuming than laminar flow calculations.*

**Keywords:** FLUENT 5/6, Reynolds stress model, k-ε model, turbulent dissipation, Reynolds number, Iterations, Convergence

## 1.0 Introduction

In our daily life, all fluids flow that we are facing is turbulent. Some typical examples are air movement in our room, flow in our car, surrounding our house, around buildings and airplanes as well. We can encounter the turbulent in rooms when the air flows from wall to wall are formed. Beside that, the flows in internal combustion engines are highly turbulent in piston engines, combustors and gas turbines.

Many scientists or engineers are study about turbulence modelling after solve the Navier Stokes equation for the laminar flows. They can compute the fluid flow using computer program as an external module to get the turbulence modeling. Generally, the main ingredients to built a good Navier-Stokes solver are known; this includes tools like mixed approximations for the velocity, u and pressure, p to avoid checker board oscillations and also upwinding to damp high Reynolds number oscillations. However the problem is still happen while implementing a turbulence model because these models have not been studied much theoretically.

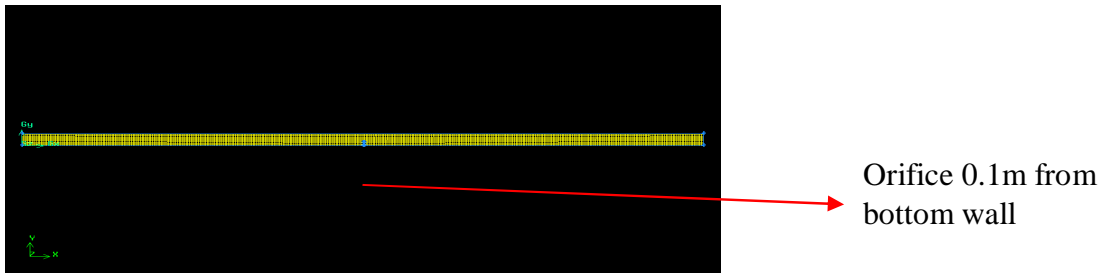
In this paper, the most commonly used turbulence models seem to be discussed are:-

- a) **k-ε** model
- b) Reynolds stress model

## 2.0 Background

As known, we observed and reviewed the differences the fluid flow problem in **k-ε model**. Then we come out with the good solution using **Reynolds stress** model to solve the above turbulence problem in simple circular pipe. The Reynolds number is same as given which is  $Re= 5000$  at orifice portion and change to  $Re= 10,000$  at normal pipe.

When  $Re$  is sufficiently lower, the flow is symmetric and steady. When  $Re$  is higher than the critical value, the flow becomes unstable and changes the flow become turbulence. As known, we create the geometry and mesh in gambit and then read the mesh into FLUENT 5/6 and predict the turbulence model. So, we use **Reynolds stress** model to discuss and improve the existing model in the circular pipe. The **k-ε** model gives a very poor result in term of normal stresses. So in non-isotropic effects often are important are flows with the strong curvature, swirling flows, flow with strong acceleration and retardation. We can see the differences of model between **Reynolds stress** and **k-ε**.



**Figure 1:** mesh for *Reynolds stress* model in circular Pipe

The pipe flow in figure 1 are given inlet velocity is 1 m/s, the fluid exhausts into the ambient atmosphere and density is  $1 \text{ kg/m}^3$ . For  $\mu = 2 \times 10^{-5} \text{ kg/(ms)}$ , the pipe diameter is 0.2m, pipe length is 8m, and average velocity at the inlet is 1 m/s and the Reynolds no. based on below equation,  $Re = \rho D/\mu$ , where  $\bar{U}_z$  is the average velocity at the inlet, which is 1 m/s in this case.

## 3.0 Modeling – size, mesh and grid

The mesh size of model is  $100 \times 30$  which are 100 divisions in the axial direction and 30 divisions in the radial direction. The grid size is very important to get refine mesh model and the finest one could be less of number of converges of the model. The grid size calculated in the software is (3858 8114 4257). Below are some difference results by running the fluent 5/6 for both models.

No.	<i>k-ε model</i>	<b>Reynolds stress model</b>
1	The shape is same for circular pipe with $L=8\text{m}, \mu = 2 \times 10^{-5} \text{ kg/(ms)}, u=1 \text{ m/s}, \rho=1 \text{ kg/m}^3, \text{Ø}=0.2\text{m}$	circular pipe with $L=8\text{m}, \mu = 2 \times 10^{-5} \text{ kg/(ms)}, u=1 \text{ m/s}, \rho=1 \text{ kg/m}^3, \text{Ø}=0.2\text{m}$
2	Mesh size = $100 \times 30$ and grid=(3858 8114 4257).	Mesh size = $100 \times 30$ and grid=(3858 8114 4257).
3	Number of iterations=1116 (for converged)	Number of iterations=191( for converged)

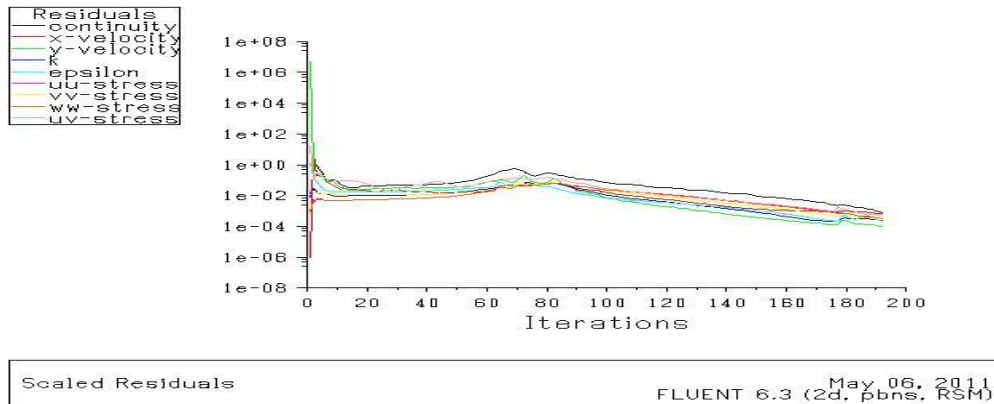
4	-Value of $k=5.7556e-4$ and $\epsilon=9.9944e-4$ (for converged)  -No stress value	-Value of $k=2.5406e-4$ and $\epsilon=2.4886e-4$ (for converged)  - stresses value: uu stress= $3.3378e-4$ , vv stress= $3.1068e-4$ , ww stress= $3.452e-4$ & uv= $6.0125e-4$
5	$Re = \rho D/\mu$ , $Re= 5000$ (orifice), $Re= 10,000$	$Re = \rho D/\mu$ , $Re= 5000$ (orifice), $Re= 10,000$
6	Reattachment line from bottom wall (orifice)=0.1m	Reattachment line from bottom wall (orifice)=0.1m

**Table 1 :** Differences between existing *k-ε* model and **Reynolds stress** model

#### 4.0 Result and Discussion

##### *i- Iterate the model until convergence*

We do iterate the model until getting the number of iterations for convergence. Then, we start to analyze the flow to get the velocity, turbulence and Reynolds stress in uu,vv,ww & uv.



**Figure 1 :** Model **Reynolds stress** converge in a total of 191 iterations

##### *ii- Centerline and wall Y-Plus Plots*

We can see for both turbulence models, the wall  $y^+$  value is at centerline and between 2.5 and -2.5 for *k-ε model* and for **Reynolds stress**, the wall  $y^+$  value is between  $1e+2$  and  $-1e+1$  and start changes at 4m position ( orifice).

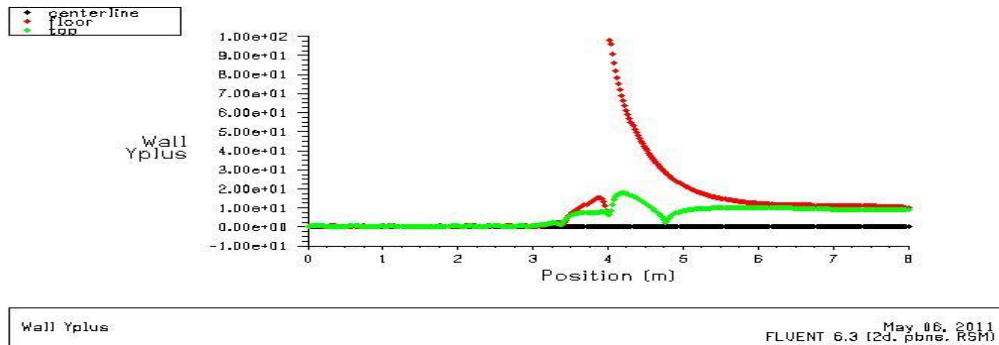


Figure 2 : Model Reynolds stress wall Yplus plot

iii) Skin friction coefficient Plots

The skin friction coefficient for **Reynolds stress** is between  $5e-2$  and  $0.00$  and start changes at  $4m$  position ( orifice).

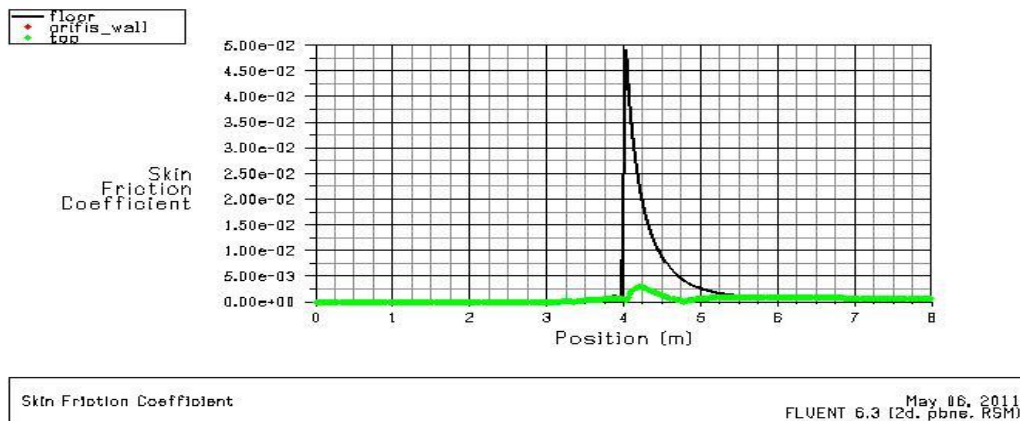


Figure 3 : Model Reynolds stress skin friction coefficient

iv) Velocity plot

The radial velocity for **Reynolds stress** is laminar shape ( we can see at  $0.2m/s$ ) and start changes at  $4m$  position ( orifice) become be turbulence ( see point node in green color for below figure).

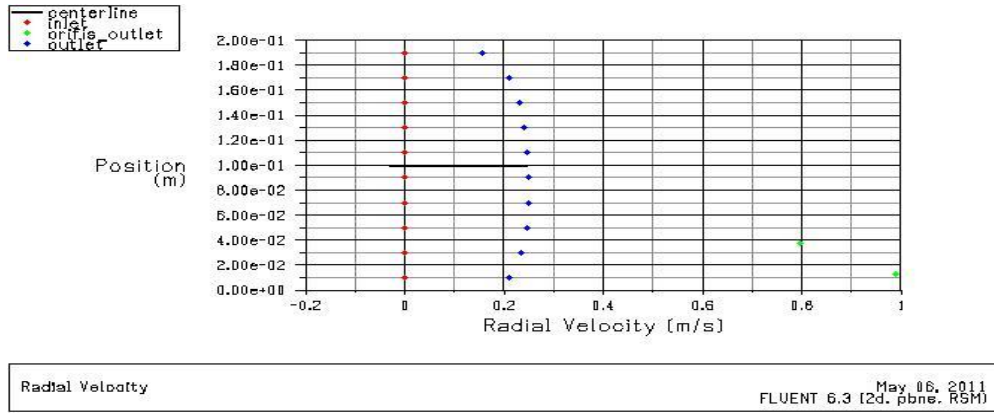


Figure 4 : Model Reynolds stress radial velocity shape

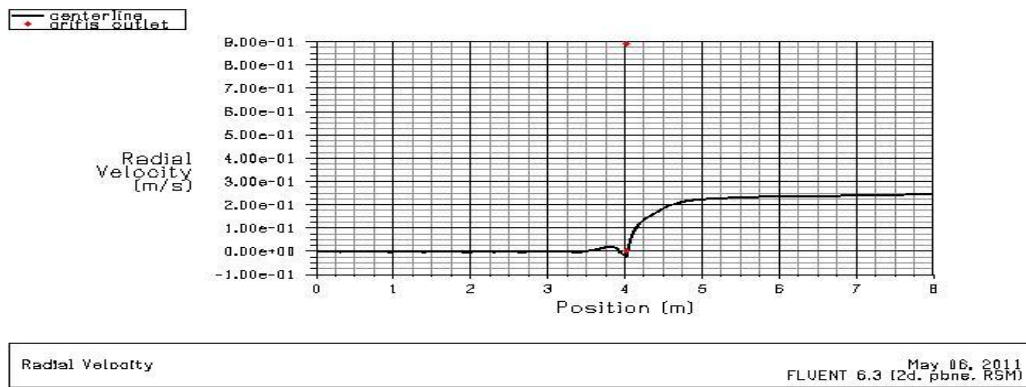


Figure 5 : Model Reynolds stress radial velocity at orifice outlet

Based on the result above, we can discuss about the fluid flow as following:

No.	<i>k-ε model</i>	<b>Reynolds stress model</b>
1	The converged value is higher due to very far to iterate and reach orifice portion. At the same time there is no effect on wall.	The converged value is quickly to get and not so long to iterate due to all portion effect the flow especially stress at wall.
2	The wall Y-plus is look centralize and straight line at center ( zero point) for turbulence plot due to the minimum effect at wall and very far from orifice outlet.	The wall $y^+$ value is between $1e+2$ and $-1e+1$ and start changes at 4m position (orifice). Its due to very high effect at wall and high changes after orifice outlet.
3	The skin friction coefficient also straight line at center (zero point) for turbulence plot due to the minimum effect at wall.	The skin friction coefficient for <b>Reynolds stress</b> is between $5e-2$ and $0.00$ and start changes at 4m position ( orifice). ). Its due to very high effect at wall.
4	The radial velocity plus is look centralize and straight line at center ( zero point). There is no shape effect from graph.	The radial velocity for <b>Reynolds stress</b> is laminar shape at $0.2m/s$ and start changes after orifice to be a turbulence shape.

5	The $k-\epsilon$ model is isotropic and thus not good in predicting normal stresses. Its unable to account for curvature effects	The Reynolds model can selectively augment or damp the stresses due to curvature effects, acceleration, buoyancy and swirling flow
6	Its simple and work reasonable for a large number of engineering works. Its also has disadvantage which cannot account for irrotational strains.	Its complex and difficult to implement but the result is very good for non-isotropic effects.

**Table2:** Differences result between existing  $k-\epsilon$  model and **Reynolds stress** model

## 5.0 Conclusion and Improvement

As conclusion, the fluent physical model can analyzed the fluid flow problem for both model. From the model analysis, we can improve the result by:

- 1- The  $k-\epsilon$  model need to size and grid parallel with the orifice size. So, its can converge very fast compare the existing that need to iterate so long.
- 2- The  $k-\epsilon$  model also depend on the mesh of models which is the finest model will be less number of iteration and converge as well.
- 3- The axial velocity for  $k-\epsilon$  model cannot be seen because of the velocity is based on the orifice outlet position. So we need to reposition the orifice outlet and see whether the orifice size give a big effect or not to the total diameter size.
- 4- We need to change the model if we use an-isotropic to **Reynolds stress** model.
- 5- We need to change the model if want to get the effect of stresses at wall from  $k-\epsilon$  to **Reynolds stress** model.
- 6- We can get the good shape of turbulence by refine the model with put reference value and wall treatment setting of the viscous model.

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## M6 - Steering Wheel Alignment Jig

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### *Abstrak*

*Di dalam proses pembuatan automotif ataupun pusat servis kenderaan, kebiasaannya alat yang digunakan bagi memudahkan proses kerja berjalan dengan lancar ialah dengan menggunakan jig. Ini kerana, ia dapat menstabilkan penahanan sesetengah peralatan yang memerlukan peralatan untuk dipegang. Jig yang baik adalah jig yang mampu memegang dan menahan peralatan dengan sempurna. Oleh itu, satu steering wheel alignment jig telah dihasilkan bagi tujuan memegang stereng kereta bagi tujuan mengimbangi kedudukan stereng supaya ianya benar – benar lurus dan rata dari sudut pandangan pemilik kereta. Oleh yang demikian rungutan tentang masalah kedudukan stereng senget selepas ini diharapkan dapat diselesaikan dengan wujudnya steering wheel alignment jig ini.*

**Kata kunci** : pembuatan automotif, pusat servis kenderaan, stereng senget, jig.

### 1.0 Pengenalan

Hampir 70% daripada penduduk Malaysia memiliki kereta. Tidak kiralah bagi yang berpendapatan rendah mahupun berpendapatan tinggi, semestinya mereka perlu memiliki sebuah kereta. Semasa mereka membeli kereta, perkara pertama yang mereka lakukan ialah mereka akan memasuki ruang kabin kereta dan seterusnya mereka akan memegang roda stereng terlebih dahulu. Oleh yang demikian, persepsi pelanggan yang pertama dalam menentukan tahap kualiti kebagusan sesebuah kereta ialah kedudukan roda stereng. Selain itu, kebiasaannya untuk menjamin keselamatan kereta itu sentiasa bagus, seorang pemilik kereta pasti akan menghantar kereta mereka ke pusat servis untuk melakukan pengimbangan roda ( *wheel balancing* ) dan seterusnya melakukan penjajaran roda ( *wheel alignment* ). Akhirnya, selepas petugas pusat servis menyerahkan kunci, perkara pertama yang dilakukan oleh pelanggan ialah memastikan kedudukan stereng adalah dalam keadaan tegak terlebih dahulu.

Masalahnya, bagi sebuah kereta yang baru diterima dari pusat jualan kereta ataupun pusat servis tayar ialah pelanggan tidak berpuas hati dengan kedudukan roda stereng yang mungkin akan senget sedikit dari pandangan mata walaupun keretanya itu bergerak lurus. Apakah fenomena ini biasa bagi sesebuah kenderaan yang mempunyai tayar baru? Apakah para pekerja pusat jualan atau servis tidak memeriksa terlebih dahulu kedudukan stereng kereta sebelum kuncinya diserahkan kepada pelanggan? Berapakah sudut kecondongan stereng yang biasa berlaku selepas proses penjajaran dilakukan?

Bagi menjawab semua persoalan tersebut, maka kami dari Bahagian Proses Pembuatan Automotif telah mencipta sebuah alat yang dapat digunakan di pusat jualan ataupun pusat servis tayar kereta bagi mengurangkan kecacatan yang barangkali kita rasa ianya minoriti sahaja tetapi boleh menjejaskan reputasi sesebuah syarikat jualan atau pusat servis.

### 2.0 Objektif Rekacipta

Objektif utama projek rekacipta ini dijalankan ialah :

- i. Memastikan kedudukan roda stereng berada dalam kedudukan tegak selepas operasi pemasangan kenderaan dijalankan. Pihak kualiti dalam syarikat dapat mengeluarkan data kecondongan untuk mereka melakukan kaizen semasa proses pemasangan roda stereng sekiranya masalah ini sentiasa berulang.
- ii. Menetapkan kedudukan roda stereng supaya ia berada dalam kedudukan tegak selepas operasi servis dan penjajaran tayar kereta dilakukan di pusat servis. Ini bagi memastikan kepuasan pelanggan dapat dijaga kerana selepas keluar dari pusat servis tersebut, perkara pertama yang dilakukan pelanggan ialah memastikan kedudukan stereng tegak sejajar dengan pergerakan kereta yang lurus.
- iii. Dapat memberi maklumat kepada pekerja pusat servis atau pemasangan kereta bahawa penjajaran tayar kereta adalah dalam keadaan baik. Ini dapat diuji dengan melihat berapakah kecondongan kenderaan semasa ia bergerak sebelum nat penjajar diselaraskan dengan mesin penjajar tayar.

### **3.0 Kelebihan**

Antara kelebihan produk ini ialah, ia dipasang pada roda stereng dengan bantuan alat penimbang digital. Oleh yang demikian, ketika kenderaan bergerak dan stereng dilepaskan bebas ketika pemanduan stereng akan condong mengikut kepada arah roda condong. Jadi, kita akan dapat mengesan banyak mana kecondongan dan arah kecondongan supaya kita dapat membuat penjajaran kepada tayar yang yang boleh menyebabkan kecondongan itu berlaku.

### **4.0 Ciri-Ciri Utama**

Ianya dapat dipasang hampir pada semua jenis stereng asal kenderaan ataupun stereng sport yang bersaiz asal. Ini kerana stereng kecil tidak sesuai dipasang bagi kereta keluarga kerana ia tidak mempunyai ciri keselamatan. Oleh yang demikian, produk ini lebih bercirikan kereta biasa bagi tujuan biasa bukan untuk stereng perlumbaan.

### **5.0 Keunikan**

Apa yang unik bagi produk ini ialah, ianya mudah alih dan mudah dipasang oleh sesiapa sahaja. Data kecondongan juga dapat diketahui dengan memasang penimbang digital ataupun telefon pintar yang mempunyai sistem penimbang digital. Selain itu, bagi mereka yang kurang berkemampuan, mereka boleh sahaja memasangnya dengan penimbang air. Cuma datanya sahaja tidak dapat diketahui.

### **6.0 Keaslian**

Produk ini masih belum dibangunkan oleh mana ó mana pihak dipasaran di dalam negara kita. Ini dapat dipastikan dengan lawatan ke bengkel ó bengkel servis mahupun kilang pemasangan kenderaan. Oleh yang demikian boleh dikatakan, kesempatan ini kami ambil supaya masalah ó masalah aduan yang berkaitan tentang stereng ini akan dapat diatasi kelak.



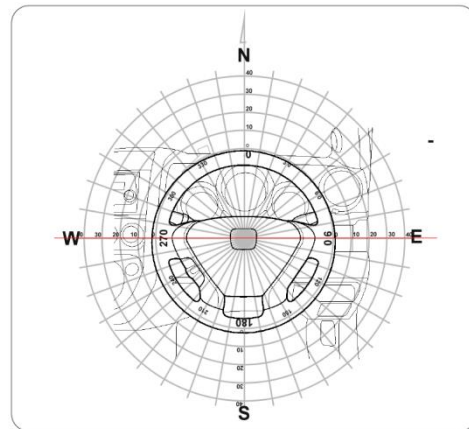
## 7.0 Potensi Komersil

Produk ini disasarkan bukan sahaja untuk dipasang di roda stereng kereta sahaja, malah ia juga boleh dipasang di roda stereng yang lebih besar seperti bas dan lori yang mana penggunaannya adalah sama. Jadi potensi kebolehpasarannya juga dijangka bakal meluas. Bukan setakat untuk syarikat pengeluar kenderaan sahaja malah boleh juga dipasarkan ke pusat servis komersil ataupun pusat servis kereta pokok ceri.



### DATA TEKNIKAL

1. Saiz dimensi produk :  
390 mm X 111 mm X 35 mm.  
Saiz maksimum diameter dalam stereng  $\varnothing$  325mm.
2. Berat keseluruhan : 1.35 kg.
3. Spesifikasi penimbang digital:  
Keluasan pengukuran :  $4 \times 90^\circ$  sukuan ( $360^\circ$ )  
Had suhu terima :  $+ 5^\circ\text{C}$  sehingga  $+ 40^\circ\text{C}$ .  
Had kelembapan :  $\leq 85\%$  RH  
Resolusi :  $0.1^\circ$   
Ketepatan :  $0^\circ$  dan  $90^\circ \leq 0.1^\circ$  dan selebihnya  $\leq 0.2^\circ$   
Sumber kuasa : Bateri Lithium CR2032 3V



## 8.0 Kesimpulan

Posisi roda stereng yang sebelum ini condong selepas proses pemasangan kereta ataupun selepas operasi penjajaran roda di pusat ó pusat servis tayar akan selesai dengan terhasilnya produk ini. Ia bukan sahaja mudah dikendalikan, malah ia lebih mesra pengguna. Selain itu, kos penyenggaraan dan kos kalibrasi juga amat rendah. Pengguna yang terdiri dari pekerja kilang pemasangan kereta dan pusat servis kereta hanya perlu menukarkan bateri dan laras tetapkan kedudukan produk ini di meja granite bagi memastikan produk ini boleh digunakan dan dapat memberikan data yang tepat.

## M7 - Automatic Poultry Feeder

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### **Abstract**

Malaysia merupakan sebuah negara membangun yang mementingkan teknologi dalam setiap bidang ekonomi. Kerajaan ketika ini menyarankan supaya inovasi diterapkan ke dalam setiap bidang pengeluaran terutama dalam bidang pengeluaran. Menyahut cabaran dan wawasan kerajaan tersebut, Bahagian Teknologi Pembuatan, ADTEC Shah Alam telah menghasilkan sebuah mesin yang mampu memberi makan kepada ternakan unggas dalam skala sederhana dengan kos yang mampu milik oleh semua lapisan masyarakat. Produk yang dimaksudkan kini dikenali sebagai Automatic Poultry Feeder (APF). Antara objektif penghasilan APF adalah memudahkan pengurusan ternakan kepada para penternak skala kecil dan sederhana. Dengan kebolehan mengeluarkan makanan dari tangki simpanan berkadaran dengan masa yang boleh dilaras, ia menjadikan kerja-kerja pemberian makanan sangat mudah dan teratur. Ia dapat mengelakkan pembaziran makanan dan ini akan menyumbang kepada pengoptimuman kos ternakan. Taraf hidup rakyat Malaysia kini telah meningkat di mana kuasa membeli turut bergerak seiring. Unggas hiasan menjadi topik hangat beberapa tahun kebelakangan ini. Dengan harga yang mencecah ribuan malah puluhan ribu ringgit untuk sepasang unggas, menjadikan kerja-kerja memberi makan wajib dijalankan dengan teratur. Oleh itu, fokus utama penghasilan APF adalah untuk para penternak yang mengusahakan unggas eksotik seperti merak, pelbagai jenis merpati, parrot, parakeet, lorikeet, pelbagai jenis ayam seperti serama, rosecomb, cochin, brahma, sebright, polish serta banyak lagi spesies unggas yang sedang berkembang biak di Malaysia bagi tujuan hiasan. Namun begitu, APF juga boleh digunakan secara meluas untuk tujuan pemberian makanan kepada haiwan selain yang disebutkan memandangkan prinsip operasinya yang direkabentuk sedemikian.

**Keywords :** *Automatic Poultry Feeder, ternakan, ayam, burung, itik, unggas, penternak, makanan ternakan, eksotik, hiasan, serama, cochin, rosecomb, parrot, polish, sebright.*

### **1.0 Pengenalan**

Usaha dalam menjadikan kerja-kerja pemberian makanan ternakan lebih mudah telah difikirkan berabad yang lalu. Namun begitu, bukan semua idea yang diketengahkan dapat direalisasikan dengan jayanya disebabkan pelbagai faktor seperti perkembangan produk-produk yang boleh dijadikan komponen kepada mesin masih belum terhasil. Kebanyakan komponen-komponen elektronik pada masa itu tidak sesuai bagi menghasilkan sebuah mesin yang memerlukan ketetapan masa yang baik. Oleh itu, tenaga manusia sering menjadi sumber mudah untuk digunakan dalam hampir semua tugas. Kelemahan manusia seperti yang kita sedia maklum adalah akan lesu, perlu rehat, ada kalanya jatuh sakit yang memakan masa untuk rawatan, perlu latihan yang khusus, kemahiran yang berbeza dan pelbagai lagi faktor yang mempengaruhi kualiti kerjanya. Dengan itu, setiap mesin yang direka perlulah mempunyai ciri-ciri yang dapat mengatasi hampir semua kelemahan yang ditunjukkan oleh manusia. Namun begitu, terhasilnya APF bukanlah untuk mengambil alih tugas manusia atau

pekerja secara 100% tetapi adalah bagi memudahkan dan menambahkan kadar produktiviti dan kualiti produk dalam kerja-kerja pemberian makanan ternakan.

Sehubungan dengan itu, seiring dengan teknologi yang ada pada abad ini, satu rekabentuk mesin pemberi makan ternakan dihasilkan dengan tujuan utama memberi makan kepada haiwan ternakan mengikut ketetapan pemasaan yang telah dilaraskan. Beberapa kriteria perlu dititik beratkan dalam merekabentuk mesin ini memandangkan terdapat pelbagai kemungkinan yang berlaku apabila mesin ini benar-benar digunakan dalam lokasi atau ladang ternakan. Situasi di mana mesin diberikan tugas berterusan sepanjang hari, digunakan untuk lokasi yang berkelabapan tinggi dan dioperasikan oleh pekerja yang kurang mahir menjadikan langkah merekabentuk mesin ini perlu dinilai dan dianalisa dengan teliti. Kriteria seperti kebolehharian, kecekapan, ketahanan, kekuatan, rintang karat dan sebagainya perlu diukur dan dinyatakan dengan jelas.



**Rajah 1:** Prototaip *Automatic Poultry Feeder (APF)*

Dengan mengambilkira semua faktor yang mungkin dalam kerja-kerja atau operasi mesin ini, satu rekabentuk mesin telah dihasilkan dan di ketengahkan sebagai satu produk prototaip yang bakal diuji dan ditambahbaik dari semasa ke semasa. Semua langkah di atas perlu diambil bagi merealisasikan *APF* supaya bukan sahaja mampu melaksanakan tugasnya tetapi juga mampu bertahan dan mengekalkan kualiti hasil kerjanya dalam tempoh yang lama.

## **2.0 Penerangan Projek**

Selain kebolehfungsiannya, *APF* juga direkabentuk dengan menekankan aspek keteguhan dari segi binaan fizikal, komponen elektronik berserta pendawaiannya. Oleh itu, mesin ini telah dilengkapi dengan komponen dan bahan binaan dipilih khas bagi membolehkan ianya berfungsi tanpa ada masalah sepanjang operasinya. Bentuknya dibina seakan sebuah kotak bagi memudahkan ia ditempatkan di lokasi-lokasi seperti di sudut atau di tengah ladang ternakan. *APF* telah dibina supaya berupaya mengeluarkan makanan ternakan

pada masa yang telah ditetapkan bagi membolehkan semua haiwan ternakan mendapat bekalan yang cukup. Dengan kelajuan putaran *feeder roller* selaju 2.5 pusingan per minit menjadikannya sebuah mesin yang efektif dari segi keselamatan, penggunaan tenaga dan keberkesanan dalam operasi. Sebuah motor elektrik digunakan sebagai punca kuasa mekanikal yang ditukarkan dari bekalan elektrik 240 volt yang mana bekalan tersebut dengan mudah boleh didapati dari hampir semua premis yang berkenaan. Daya putaran motor elektrik dengan kelajuan 2.5 rpm tersebut telah disalurkan ke set gear dan menggerakkan *feeder roller* bagi mengeluarkan makanan ternakan ke takungan makanan.

*APF* adalah direkabentuk bagi kegunaan ladang kecil dan sederhana dalam memantapkan aliran operasi kerja. Sebagai contoh ia sangat berkesan jika diaplikasikan di ladang-ladang ternakan unggas eksotik, ladang berskala kecil dan sederhana. Penggunaan tenaga manusia dalam kerja-kerja memberi makan ternakan unggas sangat membebankan jika melibatkan kekerapan yang tinggi, oleh itu *APF* direka supaya mampu menyediakan servis yang lebih berkesan dalam jangka masa panjang sekiranya digunapakai.



**Foto 1 : Padi**



**Foto 2 : Dedak**



**Foto 3 : Jagung**



**Foto 4 : Campuran**



**Foto 5 : Gandum**



**Foto 6 : Sambau/Kambu**

Foto 1 hingga 6 adalah mewakili jenis-jenis makanan unggas yang biasa diperolehi dan boleh digunakan bersama *APF*. Jika perhatikan pada senario penghasilan makanan ternakan di Malaysia, kebanyakan makanan ternakan yang dihasilkan adalah dalam bentuk kering samada bahan makanan dalam bentuk asli seperti gandum dan padi mahupun bahan makanan yang telah diproses seperti yang dikeluarkan dalam bentuk *pellet*.

Analisa pasaran yang dijalankan ke atas *APF* menunjukkan bahawa mesin ini sangat diperlukan di ladang-ladang ternakan unggas di sekitar Shah Alam dan Klang. Terdapat beberapa permintaan telah diutarakan oleh pemilik-pemilik ladang ini yang memohon supaya pihak ADTEC mengeluarkan beberapa buah mesin ini untuk dimiliki oleh mereka. Dengan permintaan yang sedemikian, pihak kami percaya bahawa *APF* adalah menjadi salah satu mesin yang diperlukan dalam industri ternakan di Malaysia.

### 3.0 Analisa Produk

*APF* mampu memuatkan 8 liter makanan ternakan ke dalam tangkinya. Muatan ini boleh ditambah sekiranya diperlukan memandangkan mesin yang pertama ini adalah prototaip. Pekerja ladang biasanya akan memberi makan haiwan ternakan 2 kali dalam sehari iaitu pada pagi dan petang. Jumlah makanan yang diberikan pula adalah secara maksima untuk mengelakkan unggas kelaparan pada waktu di antara pagi dan petang tersebut. Namun begitu, kaedah ini tidak disarankan ke atas unggas yang diternak bagi tujuan pembakaan kerana makanan yang diberi secara longgokan akan menjadikan induk unggas gemuk dan menghadapi masalah dalam aktiviti pembakaan. Seeloknya, makanan perlu diberikan secara sedikit demi sedikit tetapi kerap. Kaedah makanan yang dilonggok juga menyebabkan ia terdedah kepada udara sekitar yang mana jika tidak disentuh pada waktu yang lama akan menyebabkan kulat dan keracunan. Berbeza dengan *APF* yang mengekalkan kualiti makanan ternakan yang berada di dalam tangkinya apabila hanya makanan yang dikeluarkan mengikut pemsasaan sahaja yang akan terdedah kepada udara sekitar. Tindakan ini sudah tentu akan mengelakkan sebarang keracunan pada haiwan ternakan. Pemsasaan *APF* adalah dari 1 sehingga 96 kali sehari iaitu dalam tempoh 24 jam, namun begitu adalah mustahil untuk unggas makan pada waktu malam, jadi pelarasan pemsasaan boleh dilakukan hanya pada siang hari seawal jam 7 pagi hingga 6 petang yang melibatkan 1 hingga 44 kali pemberian makanan. Setelah diambilkira kebiasaan jadual pemberian makanan unggas, kekerapan optimum dalam pemberian makanan menggunakan *APF* adalah sebanyak 5-6 kali dalam tempoh tersebut.

### 4.0 Perbincangan

Setiap produk yang dihasilkan akan melalui proses ujikaji dan kebanyakannya akan memerlukan penambahbaikan hasil daripada maklumat keperluan dari pelanggan dan sebagainya. *APF* tidak terkecuali dalam hal ini, hasil daripada ujikaji penggunaannya, beberapa penambahbaikan dikenalpasti dan boleh dilakukan sekiranya *APF* ingin diketengahkan ke dalam laluan pasaran Negara.

*APF* telah dihasilkan dengan jayanya dan dapat beroperasi dengan sempurna dalam mencapai objektifnya. Namun begitu, seiring dengan perkembangan zaman serba kompak ini, *APF* perlu tampil dengan saiz yang lebih kecil tetapi mempunyai tangki yang lebih besar untuk dipasarkan. Ini adalah tidak mustahil kerana rekabentuk perumah *APF* masih mempunyai ruang kosong yang boleh dielakkan untuk penambahbaikan kelak. Buat masa ini saiz *APF* adalah 490 mm panjang x 520 mm lebar x 500 mm tinggi, yang mana agak besar di mana tangki berada di dalam perumahannya sendiri. Penambahbaikan boleh dilakukan dengan

meletakkan tangki simpanan di atasnya seterusnya menambahkan saiz tangki bagi memaksimumkan penggunaannya. Dalam usaha penambahbaikan ini, penilaian dan kajian semula perlu dilakukan sekali lagi menggunakan bahan dan saiz yang berbeza bagi mendapatkan perbandingan yang jelas berkenaan kelebihan rekabentuk baru berbanding dengan yang lama.

Perkara kedua yang perlu diberi perhatian adalah dari segi berat mesin itu sendiri, berat *APF* mungkin perlu dikurangkan dengan optima mengikut keperluannya di sektor industri dan sebagainya. Mesin yang terlalu berat akan menyukarkan kerja-kerja mengangkut dan menyelenggara. Oleh itu, adalah tidak mustahil *APF* yang pada asalnya seberat ~12 kg akan dapat dikurangkan kepada hanya ~5 kg sahaja tidak termasuk tangkinya.

## 5.0 Kesimpulan

Secara langsung, *APF* telah berupaya mengurangkan kos upah pekerja di mana jika dikira dari jumlah jam bekerja, manusia biasa hanya mampu bekerja 12 jam sehari dengan menggunakan tenaga sendiri dan agak mustahil untuk mengupah hanya seorang pekerja bagi menjaga makan dan minum untuk beratus ekor unggas. Namun begitu *APF* dapat bekerja 24 jam sehari jika diperlukan dengan perkadaran yang tetap dan stabil serta selamat. Keseragaman hasil kerja juga dapat ditetapkan dengan baik. *APF* juga dapat menyumbang kepada penjimatan makanan ternakan dan kos upah pekerja.

Keperluan *APF* terbukti apabila kebanyakan ladang unggas masih belum mempunyai sebuah mesin seumpamanya yang mampu menjalankan kerja-kerja pemberian makanan ternakan dengan berkesan. *APF* telah berada pada tahap sempurna dalam mencapai objektifnya.

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## M8 - Can Crusher Machine

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### **Abstract**

*Malaysia merupakan sebuah negara membangun yang mementingkan teknologi dalam setiap bidang ekonomi. Kerajaan ketika ini menyarankan supaya inovasi diterapkan ke dalam setiap bidang pengeluaran terutama dalam bidang pengeluaran. Menyahut cabaran dan wawasan kerajaan tersebut, Bahagian Teknologi Pembuatan, ADTEC Shah Alam telah menghasilkan sebuah mesin yang mampu menjalankan tugas memampatkan tin minuman dalam skala sederhana dengan kos yang mampu milik oleh individu atau organisasi yang memerlukan. Produk yang dimaksudkan kini dikenali sebagai Can Crusher Machine (CCM). Antara objektif penghasilan CCM adalah memudahkan kerja-kerja memampatkan tin minuman dalam skala kecil dan sederhana. Kebolehannya dalam memampatkan tin minuman dengan seragam dan cekap dapat membantu meringankan dan mempercepatkan pengurusan sisa buangan terutama sekali bagi tin-tin minuman. Di mana masa yang diperlukan untuk kerja-kerja memampat boleh digunakan untuk menjalankan kerja-kerja lain yang lebih memerlukan perhatian. Ketahanan mesin ini juga telah diuji dan kekukuhan serta kelasakannya dalam menjalankan tugas tidak dapat dinafikan walaupun beroperasi dalam keadaan terbeban. CCM dalam erti kata lain dapat memenuhi keperluan pusat-pusat kitar semula serta GO atau NGO yang mengutamakan pemuliharaan alam sekitar dalam setiap operasi organisasinya.*

**Keywords :** *can crusher machine, pemampat tin minuman, sisa buangan, pusat kitar semula*

## **1 Pengenalan**

Usaha dalam menjadikan kerja-kerja pelupusan lebih mudah telah difikirkan berabad yang lalu. Namun begitu, bukan semua idea yang diketengahkan dapat direalisasikan dengan jayanya disebabkan pelbagai faktor seperti perkembangan produk-produk yang boleh dijadikan komponen kepada mesin masih belum terhasil. Kebanyakan komponen-komponen elektronik pada masa itu tidak sesuai bagi menghasilkan sebuah mesin yang memerlukan daya kilas yang tinggi dan seragam. Oleh itu, tenaga manusia sering menjadi sumber mudah untuk digunakan dalam hampir semua tugas. Kelemahan manusia seperti yang kita sedia maklum adalah akan lesu, perlu rehat, ada kalanya jatuh sakit yang memakan masa untuk rawatan, perlu latihan yang khusus, kemahiran yang berbeza dan pelbagai lagi faktor yang mempengaruhi kualiti kerjanya. Dengan itu, setiap mesin yang direka perlulah mempunyai ciri-ciri yang dapat mengatasi hampir semua kelemahan yang ditunjukkan oleh manusia. Namun begitu, terhasilnya CCM bukanlah untuk mengambil alih tugas manusia atau pekerja secara 100% tetapi adalah bagi memudahkan dan menambahkan kadar produktiviti dan kualiti produk dalam kerja-kerja memampatkan tin minuman.

Sehubungan dengan itu, seiring dengan teknologi yang ada pada abad ini, satu rekabentuk mesin pemampat tin minuman dihasilkan dengan tujuan utama memampatkan tin minuman kepada ketebalan yang paling nipis dan seragam untuk memudahkan usaha pelupusan. Beberapa kriteria perlu dititik beratkan dalam merekabentuk mesin ini

memandangkan terdapat pelbagai kemungkinan yang berlaku apabila mesin ini benar-benar digunakan dalam industri pengurusan sisa buangan. Situasi di mana mesin diberikan tugas berterusan sepanjang hari, digunakan untuk tujuan memampat tin-tin yang khas dan keras dan dioperasikan oleh pekerja yang kurang mahir menjadikan langkah merekabentuk mesin ini perlu dinilai dan dianalisa dengan teliti. Kriteria seperti kebolehharapan, kecekapan, ketahanan, kekuatan tekanan dan sebagainya perlu diukur dan dinyatakan dengan jelas.



**Rajah 1:** Prototaip *Can Crusher Machine (CCM)*

Dengan mengambilkira semua faktor yang mungkin dalam kerja-kerja atau operasi mesin ini, satu rekabentuk mesin telah dihasilkan dan di ketengahkan sebagai satu produk prototaip yang bakal diuji dan ditambahbaik dari semasa ke semasa. Semua langkah di atas perlu diambil bagi merealisasikan *CCM* supaya bukan sahaja mampu melaksanakan tugasnya tetapi juga mampu bertahan dan mengekalkan kualiti hasil kerjanya dalam tempoh yang lama.

## 2 Penerangan Projek

Selain kebolehfungsiannya, *CCM* juga direkabentuk dengan menekankan aspek keteguhan dari segi binaan fizikal, komponen elektronik berserta pendawaiannya. Oleh itu, mesin ini telah dilengkapi dengan komponen dan bahan binaan dipilih khas bagi membolehkan ianya berfungsi tanpa ada masalah sepanjang operasinya. Bentuknya dibina seakan sebuah kotak bagi memudahkan ia ditempatkan di lokasi-lokasi seperti di sudut bangunan atau di tepi laluan orang ramai. *CCM* telah dibina supaya berupaya memampatkan tin-tin minuman dan makan yang diperbuat daripada bahan plastik, aluminium dan logam lembut lain. Dengan kelajuan memampat sebanyak 75 tin per minit menjadikannya sebuah mesin yang efektif dari segi keselamatan, penggunaan tenaga dan keberkesanan dalam operasi. Sebuah motor elektrik digunakan sebagai punca kuasa mekanikal yang ditukarkan dari bekalan elektrik 240 volt yang mana bekalan tersebut dengan mudah boleh didapati dari hampir semua premis yang berkenaan. Daya kilas yang lemah dari motor elektrik dengan kelajuan 1420 rpm tersebut telah ditambahbaik dengan menyalurkan gerakan putaran ke sebuah kotak gear dengan nisbah 60:1 menjadikan daya kilas meningkat kepada hampir 1kNm dan mampu menggerakkan piston pemampat untuk melengkapkan kerja memampatkan tin minuman dengan berkesan.

*CCM* adalah direkabentuk bagi kegunaan industri kecil dan sederhana dalam memantapkan aliran operasi kerja. Sebagai contoh ia sangat berkesan jika diaplikasikan di pusat kitar semula yang mana tugas mudah tetapi melesukan adalah tidak relevan dengan



pekerja yang ada. Penggunaan tenaga manusia dalam kerja-kerja memampatkan tin minuman sangat tidak praktikal jika dilihat dari segi keselamatan dan kesihatan pekerja itu sendiri, oleh itu *CCM* direka supaya mampu menyediakan servis yang lebih berkesan dalam jangka masa panjang sekiranya digunakan.



**Foto 1 :** Saiz tin sebelum dimampat



**Foto 2:** Saiz tin selepas dimampat menggunakan alat tangan



**Foto 3:** Saiz tin selepas dimampat menggunakan *CCM*

Foto 1 di atas mewakili saiz tin normal sebelum dimampatkan, seperti yang kita sedia maklum, saiz tin yang sebegini sangat memakan ruang jika disimpan dalam kuantiti yang banyak. Kebanyakan pusat kitar semula faham akan masalah ini dan cuba menyelesaikannya dengan cara memampatkan tin tersebut kepada kepingan nipis. Buat masa ini, hampir semua pusat kitar semula menggunakan tenaga manusia dalam kerja-kerja memampatkan tin-tin minuman tersebut iaitu dengan menggunakan bantuan alat tangan seperti tukul atau gandin kayu dan sebagainya bagi mencapai tujuan mereka. Namun begitu kaedah ini akan menghasilkan bentuk mampatan yang tidak seragam seperti yang dapat kita lihat pada Foto 2. *CCM* cuba menghapuskan masalah ini dengan mengeluarkan hasil mampatan yang seragam dan ini memudahkan kerja-kerja penyimpanan yang mana ia selamat dan mudah diurus selain kemas. Foto 3 mewakili bentuk dan saiz tin minuman yang dimampat oleh *CCM*.

Analisa pasaran yang dijalankan ke atas *CCM* menunjukkan bahawa mesin ini sangat diperlukan di pusat-pusat kitar semula sekitar Shah Alam dan Klang. Terdapat beberapa permintaan telah diutarakan oleh pemilik-pemilik syarikat kitar semula ini yang memohon supaya pihak ADTEC mengeluarkan beberapa buah mesin ini untuk dimiliki oleh mereka. Dengan permintaan yang sedemikian, pihak kami percaya bahawa *CCM* adalah menjadi salah satu mesin yang diperlukan dalam industri kitar semula bahan buangan di Malaysia.

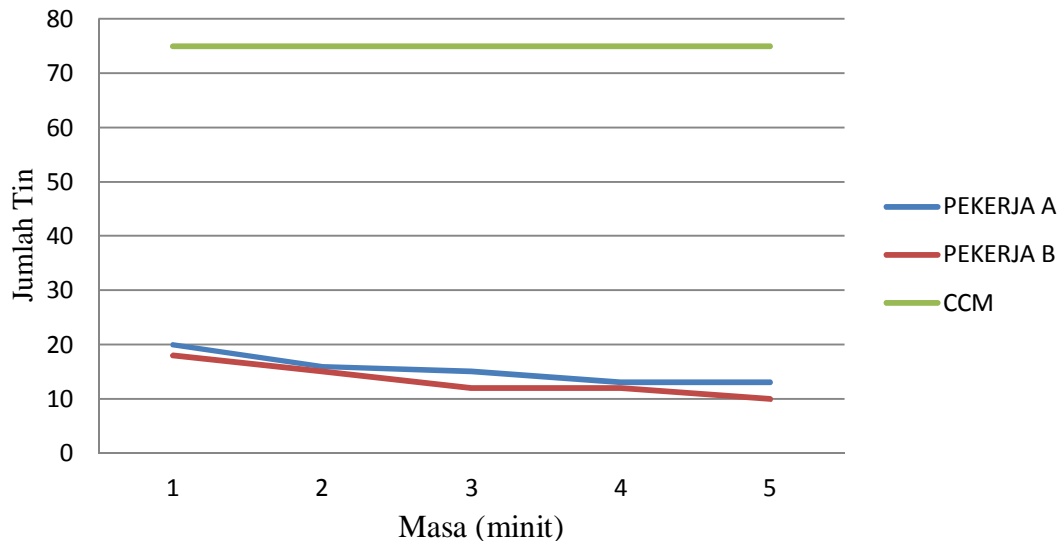
### 3 Analisa Produk

*CCM* mampu memampatkan 75 tin dalam masa seminit jika digunakan secara berterusan memandangkan. Tenaga manusia biasa hanya mampu memampatkan paling banyak 20 tin dalam masa seminit dengan menggunakan alat tangan seperti penukul atau pemampat mudah. Jika dikira dari segi kelesuan, jumlah 20 tin minuman seminit akan dengan cepat menjadikan pekerja tersebut kepenatan dan lesu serta sukar meneruskan kerjanya secara berterusan dengan hasil yang seragam. Satu jadual telah dibinakan daripada hasil ujikaji yang dijalankan kepada dua pekerja dan sebuah *CCM*. Jadual 1 di bawah adalah mewakili hasil ujikaji tersebut.

OBJEK KAJIAN	BIL. TIN MINUMAN YANG TELAH DIMAMPATKAN PER MINIT				
	UJIAN 1 Minit 1	UJIAN 2 Minit 2	UJIAN 3 Minit 3	UJIAN 4 Minit 4	UJIAN 5 Minit 5
PEKERJA A	20	16	15	13	13
PEKERJA B	18	15	12	12	10
CCM	75	75	75	75	75

**Jadual 1 :** Data Perbandingan Prestasi Kerja Memampat Tin Oleh Tenaga Manusia dan CCM

**Graf 1 :** Perbandingan Prestasi Kerja Memampat Tin Oleh Tenaga Manusia dan CCM



Daripada Jadual 1, ia menunjukkan keupayaan manusia adalah berbeza dari satu individu kepada individu yang lain. Selain itu juga, manusia iaitu pekerja akan menghasilkan kesan yang berbeza dari segi kuantiti dan kualiti produk apabila masa meningkat akibat dari keletihan dan kelesuan. Namun begitu, CCM tidak akan langsung terpengaruh dengan semua faktor tersebut.

Graf 1 adalah mewakili Jadual 1 yang mana setiap garisan mewakili 3 objek kajian yang berbeza, data diambil dari 2 orang pekerja bagi menjamin ketepatannya. CCM juga diuji dalam masa yang sama bagi mendapatkan perbandingan yang jelas dalam setiap minit yang diambil kira. Dengan data-data yang diperolehi maka terbukti bahawa CCM dapat menandingi kebolehan manusia dalam masa yang singkat memandangkan manusia mudah mengalami kelesuan dan kurang tenaga apabila mereka menjalankan kerja secara berterusan. Berbeza dengan CCM apabila ia mampu mengekalkan prestasinya hingga ke akhir ujikaji.

## 4 Perbincangan

Setiap produk yang dihasilkan akan melalui proses ujikaji dan kebanyakannya akan memerlukan penambahbaikan hasil daripada maklumat keperluan dari pelanggan dan sebagainya. *CCM* tidak terkecuali dalam hal ini, hasil daripada ujikaji penggunaannya, beberapa penambahbaikan dikenalpasti dan boleh dilakukan sekiranya *CCM* ingin diketengahkan ke dalam laluan pasaran Negara.

*CCM* telah dihasilkan dengan jayanya dan dapat beroperasi dengan sempurna dalam mencapai objektifnya. Namun begitu, seiring dengan perkembangan zaman serba kompak ini, *CCM* perlu tampil dengan saiz yang lebih kecil untuk dipasarkan. Ini adalah tidak mustahil kerana rekabentuk perumah *CCM* masih mempunyai ruang kosong yang boleh dielakkan untuk penambahbaikan kelak. Buat masa ini saiz *CCM* adalah 1170 mm panjang x 310 mm lebar x 2250 mm tinggi, yang mana agak besar tetapi masih sesuai untuk industri. Dalam usaha penambahbaikan ini, penilaian dan kajian semula perlu dilakukan sekali lagi menggunakan bahan dan saiz yang berbeza bagi mendapatkan perbandingan yang jelas berkenaan kelebihan rekabentuk baru berbanding dengan yang lama.

Perkara kedua yang perlu diberi perhatian adalah dari segi berat mesin itu sendiri, berat *CCM* mungkin perlu dikurangkan dengan optima mengikut keperluannya di sektor industri dan sebagainya. Mesin yang terlalu berat akan menyukarkan kerja-kerja mengangkut dan menyelenggara. Oleh itu, adalah tidak mustahil *CCM* yang pada asalnya seberat ~44 kg akan dapat dikurangkan kepada hanya ~20 kg sahaja.

## 5 Kesimpulan

Secara langsung, *CCM* telah berupaya mengurangkan kos upah pekerja di mana jika dikira dari jumlah jam bekerja, manusia biasa hanya mampu bekerja 12 jam sehari dengan menggunakan tenaga sendiri dan perkadaran keluaran hasil yang tidak tetap, namun begitu *CCM* dapat bekerja 24 jam sehari jika diperlukan dengan perkadaran yang tetap dan stabil serta selamat. Keseragaman hasil kerja juga dapat ditetapkan dengan baik. *CCM* juga dapat menyumbang kepada penjimatan ruang simpanan dalam masa yang singkat kerana tin-tin yang telah padat boleh disimpan di tempat yang lebih kecil saiznya.

Keperluan *CCM* terbukti apabila kebanyakan pusat kitar semula masih belum mempunyai sebuah mesin seumpamanya yang mampu menjalankan kerja-kerja memampatkan tin minuman dengan berkesan. *CCM* telah berada pada tahap sempurna dalam mencapai objektifnya.

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# M9 - Study on Contribution and Effect Analysis of Coolant on Roundness in Cylindrical Grinding Machine

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## *Abstract*

*The purpose of this report is to study the contribution and effect of coolant to machined surface integrity in term of roundness. The process of grinding was done by Universal Cylindrical Grinder Model OD 820 S with variable speed table and full CNC wheel head indeed manufactured by SHARP Precision Machine Tools. The parameters involved in this analysis include depth of cut; work head speed and traverse speed are set as followed to previous parameter analysis based on the design of experiment (DOE). All other parameters are constant such as coolant which is Pretech Cool Syn 3000 Green with three difference brix concentration and abrasive wheel speed which is 1960 rpm. The roundness test will be performing using the CNC roundness at the Metrology Lab and method that used to determine the roundness of each sample is Least Square Circle Method. The result analysis was done based on roundness value from CNC roundness tester.*

## **1.0 Introduction**

Most grinding machines are equipped with coolant systems. The coolant is directed over the point of contact between the grinding wheel and the work. This prevents distortion of the work piece due to uneven temperatures caused by the cutting action. In addition, coolant keeps the chips washed away from the grinding wheel and point of contact, thus permitting free cutting. Clear water may be used as a coolant, but various compounds containing alkali are usually added to improve its lubricating quality and prevent rusting of the machine and work piece. An in expensive coolant often used for all metals, except aluminum, consists of a solution of approximately 1/4 pound of sodium carbonate (sal soda) dissolved in 1 gallon of water. Another good coolant is made by dissolving soluble cutting oil in water. For grinding aluminum and its alloys, a clear water coolant will produce fairly good results (Knapp B.R, 1998).

There are many factor that effect on roundness to cylindrical grinding such as type of coolant used, cutting parameter, vibrations, machining tool (cutting tool and fixture) and material of work piece. Hence, this project is mainly purpose to cover the study of performance of new coolant with different viscosity by using cylindrical grinding in machine shop laboratory. This study also determine the 3 sets of viscosity of a new coolant in term of producing high accuracy and precision, the highly smooth surface finish that can influence the roundness of the finish product.

## **2.0 Methodology**

### **2.1 Material Selection**

In selecting the proper material for the machining operation for this study, there is the consideration to give attention such as:

- i. Appropriate material for the grinding wheel grade that we used for machining
- ii. Good machinability to ensure the good surface finish
- iii. Material availability.

The material that selected for this study must be not too soft and not to hard because the wheel that used for this machining is the medium grade grinding wheel. The material that selected also must be having good machinability characteristic to ensure the machining may perform well and produce a good result. So, Stainless steel SUS 304 are selected for perform machining operation because of its appropriateness to the grinding wheel, good machinability characteristic and the availability. (Refer figure 2.1)



**Figure 2.1:** Stainless steel SUS 304

## 2.2 Machining setup parameters

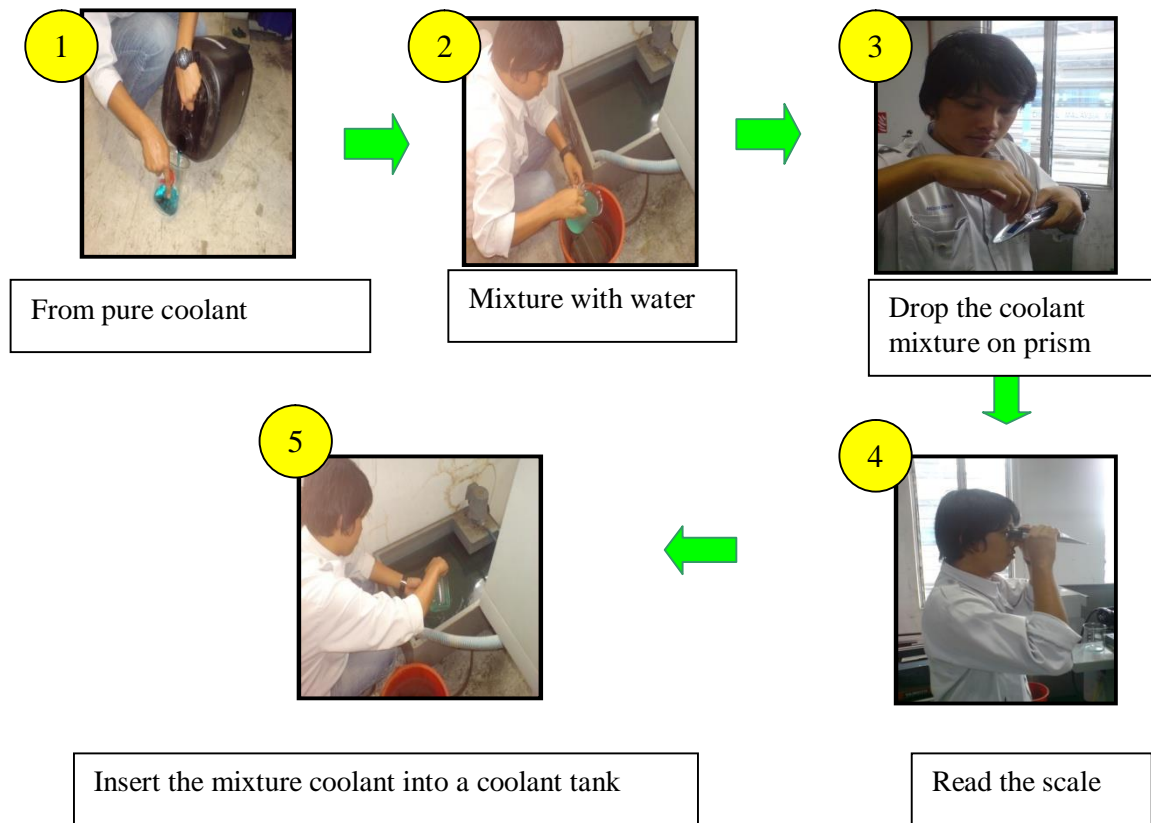
The parameters value is set up in high and low value. The experimental setup of Cylindrical Grinding process parameter will be followed from previously studies. The parameters in term of roundness value of work piece for Stainless Steel SUS 304 are selected. The parameters that involve in this study are work head speed, traverse speed, depth of cut. The high and low value will determine by refer to machine manual of the cylindrical grinding machine.

Parameter	Low	High	Units
Workhead speed	150	280	rpm
Traverse speed	4	8	In/min
Depth of cut	0.0025	0.005	mm

**Table 2.1:** The high and low value set up in the table

## 2.3 Coolants setup parameters

The parameters of the coolant will be setup based on coolants concentration using Refractometer. The coolants parameters were divided in three percent concentration category which are 3%, 6% and 9% brix using semi-synthetic coolant type Pretech Cool Syn 3000 Green. The semi-synthetic coolant type Pretech Cool Syn 3000 Green is mixed together with water according to coolant concentration for this study. Mixed with more coolant compare then water will gave high concentration of coolant. To determine the concentration of the coolant, just place a few drops of coolant on the prism and hold the unit up to a light source. Look into the eyepiece and read the scale. To calibrate, just make sure the prism is clean and place a few drops of tap water on the prism. The separation line should be on zero. If not, turn the adjustment screw until it is. The process diagram below has shown the procedure to setup coolant parameters.



## 2.4 Machining Samples

24 samples have been selected for this study. Before starting the machining process, the raw material need to be cut according to dimension needed. The dimension size of the samples for this study is length 100mm x diameter 30mm. The samples were divided into two machining processes. The first process is preparation before machining and includes a material preparation using band saw machine to cut the raw material and turning process to remove the carbon and oxidation on the wok piece surface. The second process is machining procedure using Cylindrical grinding machine.

Next, using the lathe machine, a rough turning and facing is applied to the workpiece to remove the carbon and oxidation on the workpiece surface.

## 2.5 Machining Workpiece Using Cylindrical Grinding Machine

After done with cutting the raw material and oxidation removal, it is important to planning the process before start the project including the calculation and the measurement used in the project has be prepared. Then, make sure the surrounding of the machine is safe and the machine is in good condition. Student have to make sure themselves are also safe to do the project such as by wearing a suitable cloth, shoes and all the safety precaution to be use during the work. Safety rule is important before working on this project.

First steps is check the machine alignment using the test bar and dial indicator to make sure there is no offset that may affect the surface finish. The chuck or spindle is important to be alignment before start machining in order to get good result. Then the coolant brix concentration is checked using the refractometer for proper machining. The coolant concentration is setup at 3% ,6% and 9% followed from coolant setup parameters from this study. Next, the workpiece will setup to the head stock and tail stock. Make sure the tailstock support the work piece end to avoid vibration or offset when the spindle running.

Before start run the wheel, the trip dog for table traverse setup to a proper range. This is to make sure the wheel cut the entire surface and avoid the wheel crash into the tailstock or spindle. The wheel is run from slow speed to the full speed of turning bit by bit. This is for avoiding the wheel offset because the wheel surfaces absorb the coolant and make the wheel heavier. Diamond tool were used to Dressing the wheel to make sure the surface of abrasive wheel is smooth and removes the wear or grooving parts. This operation is to change the cutting action of wheel or recondition the grinding surface.

After that, the spindle is set to run and set the value of the parameters on the control panel which is spindle speed and traverse speed referred to the data table. The wheel bring closer to the workpiece surface slowly moved until see the spark out. Set the hand wheel for infeed to initial reading (Feed rate = 0mm). After that, the value of infeed is set referred to the data table and start machining until reach to the dimension that stated



**Figure 2.2:** Universal Cylindrical Grinding Machine model OD-618 H/S

## 2.6 Roundness Measurement

All of the samples from the machining operation next will be test the roundness using the roundness tester machine. This machine capable to test the roundness, straightness, flatness of the work piece using various method analyses. The roundness test for each sample will be performing as soon as machining process finish. This is to ensure that the work piece surface affected by the oxidation or scratches while handling it. The CNC Roundness ó Formtester MMQ44 manufactured by Mahr at the Metrology Laboratory will be used to test the roundness of each sample. (Refer Figure 2.3)



**Figure 2.3:** The CNC Roundness ó Formtester MMQ44 manufactured by Mahr at the Metrology Laboratory

### 3.0 Results

All the resulting data collected were analyzed by using Microsoft Excel software. This software will evaluate the result from graph that produce. The study of effect coolant in term of roundness can be determine by using CNC Roundness tester (Formtester MMQ44). This tester able to represent all roundness value with different type of coolant that been used. The data for this study were collected from the experiment, where 24 specimens have been analyzed in term of roundness. The roundness reading was recorded with different length of specimens that is 60mm, 90mm and 120mm. The data from the experiment will be determined and analyzed using Hypothesis test from Microsoft Excel software. Then, the data were key in into Microsoft Excel software. The obtained result generated a graph and the results analysis automatically. The discussions were done according to the result.

#### 3.1 Findings and Result of Roundness

The table below represents the results of roundness value for 3 sets of coolant by using material type stainless steel SUS 304.

Sample	Workhead Speed	Traverse Speed	Depth of cut	R1 (µm)	R2 (µm)	R3 (µm)	Roundness average
1	150	8	0.0025	4.62	3.24	2.69	3.517
2	280	8	0.0025	3.51	2.97	6.37	4.283
3	280	4	0.005	4.7	6.48	7.71	6.29
4	280	4	0.0025	1.74	1.91	1.87	1.84
5	280	8	0.005	3.31	3.01	2.72	3.013
6	150	4	0.005	4.79	4.51	2.78	4.027
7	150	4	0.0025	4.6	2.41	2.89	3.3
8	150	8	0.005	3.63	1.97	3.04	2.88

**Table 3.1:** Experimental Results on Roundness using 3% brix coolant concentration



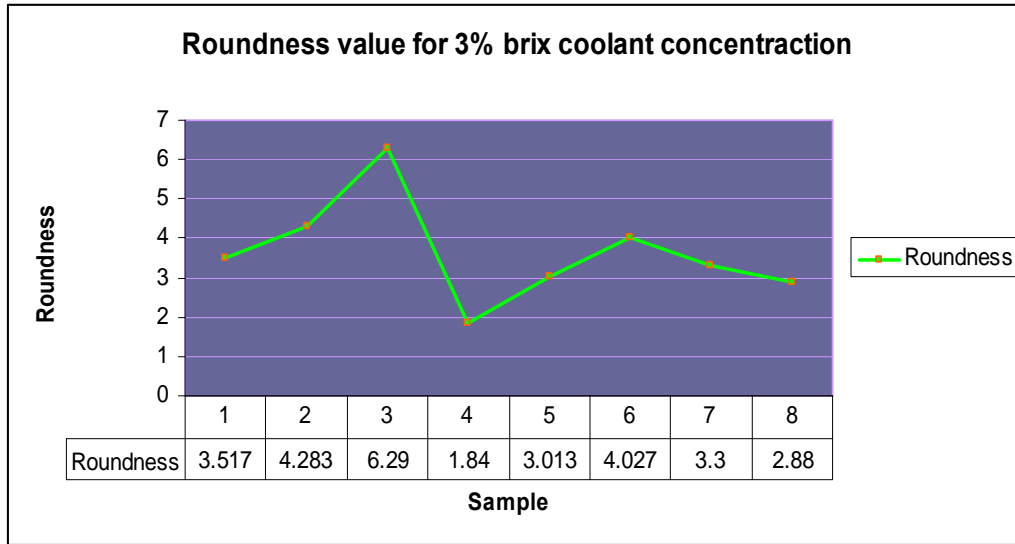
- The best or minimum roundness value
- The worst or maximum roundness value

**Result observation;**

Minimum value of R: 1.84 m

Maximum value of R: 6.29 m

Total Roundness Average: 3.644 m



**Figure 3.1:** The Graph of Roundness for 3% brix coolant concentration.

From the Figure 3.1, it is clearly shown that the maximum value of roundness for Coolant 3% brix is 6.29 m from the sample 3 while the best or maximum value of roundness is 1.84 m from the sample 4.

Sample	Workhead Speed	Traverse Speed	Depth of cut	R1 (µm)	R2 (µm)	R3 (µm)	Roundness average
1	150	8	0.0025	1.55	3.61	1.32	2.16
2	280	8	0.0025	3.65	3.55	4.29	3.83
3	280	4	0.005	3.67	6.58	7.7	5.983
4	280	4	0.0025	1.8	1.79	1.33	1.64
5	280	8	0.005	2.32	4.72	3.32	2.443
6	150	4	0.005	4.67	4.84	2.46	3.99
7	150	4	0.0025	3.07	1.6	2.65	2.44
8	150	8	0.005	3.42	1.96	2.8	2.73

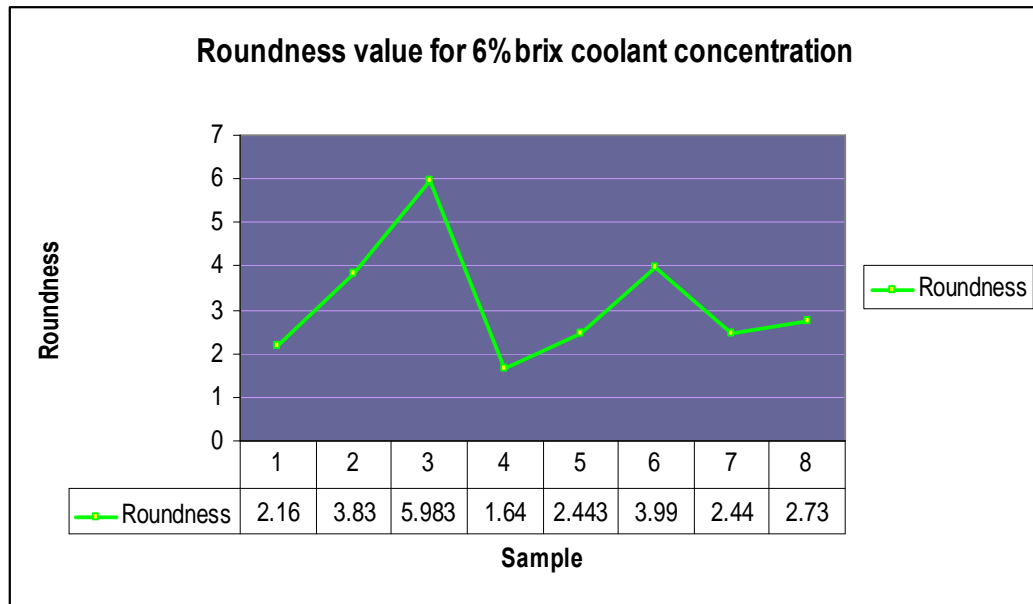
**Table 3.2:** Experimental Results on Roundness using 6% brix coolant concentration

**Result observation;**

Minimum value of R: 1.64 m

Maximum value of R: 5.983 m

Total Roundness Average: 3.152 m



**Figure 3.2:** The Graph of Roundness for 6% brix coolant concentration.

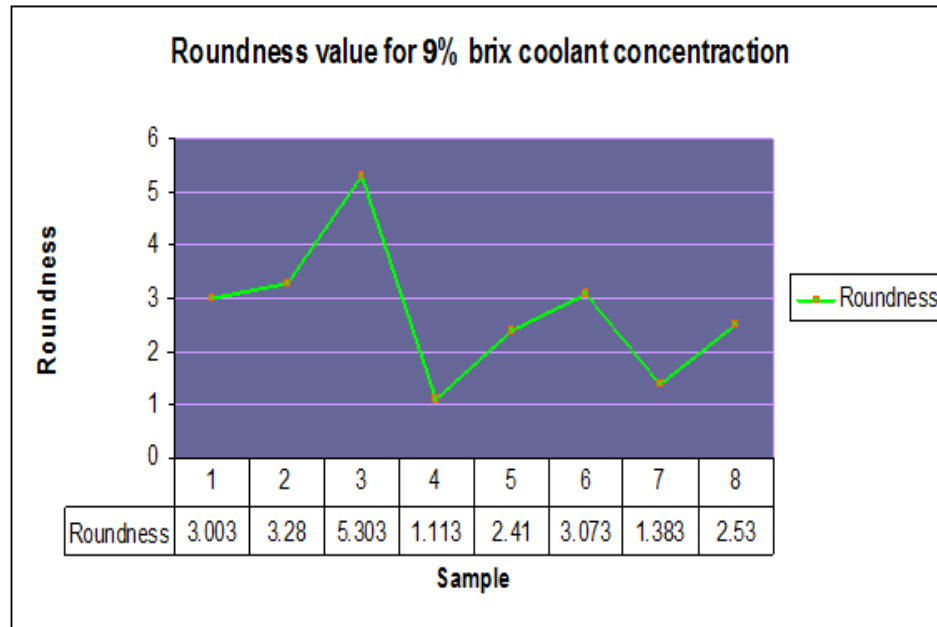
From the Figure 3.2, it is clearly shown that the maximum value of roundness for Coolant 6% brix is 5.983  $\mu\text{m}$  from sample 3 while the minimum value of roundness is 1.64  $\mu\text{m}$  from sample 4.

Sample	Workhead Speed	Traverse Speed	Depth of cut	R1 ( $\mu\text{m}$ )	R2 ( $\mu\text{m}$ )	R3 ( $\mu\text{m}$ )	Roundness average
1	150	8	0.0025	1.56	2.95	4.5	3.003
2	280	8	0.0025	3.88	2.21	3.75	3.28
3	280	4	0.005	5.58	4.47	5.86	5.303
4	280	4	0.0025	0.96	0.63	1.75	1.113
5	280	8	0.005	1.99	3.06	2.18	2.41
6	150	4	0.005	2.01	3.62	3.59	3.073
7	150	4	0.0025	1.74	0.96	1.45	1.383
8	150	8	0.005	3.17	1.92	2.5	2.53

**Table 3.3:** Experimental Results on Roundness using 9% brix coolant concentration

**Result observation;**

Minimum value of R: 1.113  $\mu\text{m}$   
 Maximum value of R: 5.303  $\mu\text{m}$   
 Total Roundness Average: 2.7618  $\mu\text{m}$

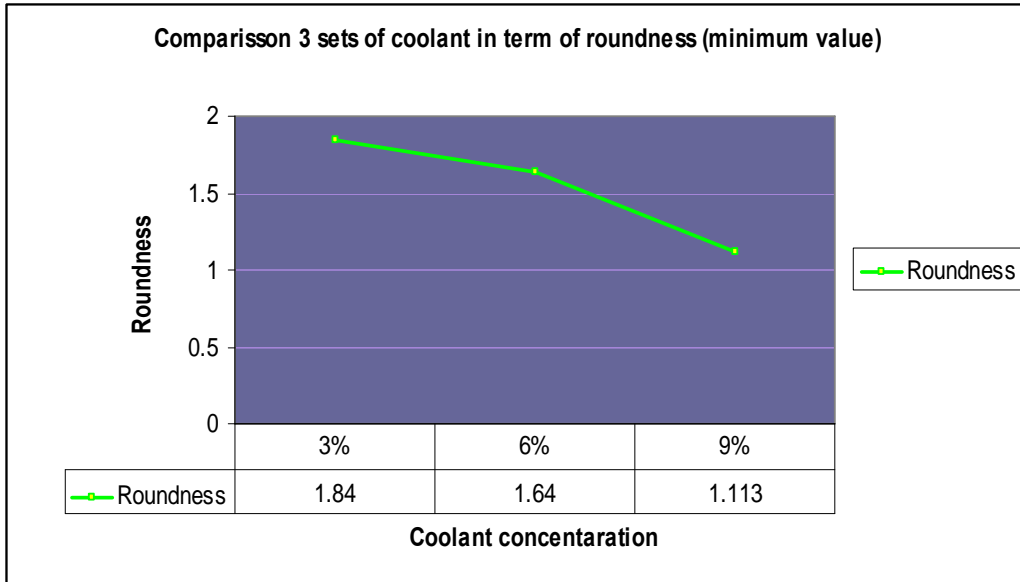


**Figure 3.3:** The Graph of Roundness for 6% brix coolant concentration.

From the Figure 3.3, it is clearly shown that the maximum value of roundness for coolant 9% brix is 5.303  $\mu\text{m}$  for the sample 3 while the minimum value of roundness is 1.113  $\mu\text{m}$  for the sample 4.

Coolant concentration (Brix)	Workhead Speed	Traverse Speed	Depth of cut	R1 ( $\mu\text{m}$ )	R2 ( $\mu\text{m}$ )	R3 ( $\mu\text{m}$ )	Roundness average
3%	280	4	0.0025	1.74	1.91	1.87	1.84
6%	280	4	0.0025	1.8	1.79	1.33	1.64
9%	280	4	0.0025	0.96	0.63	1.75	1.113

**Table 3.4:** Experimental Results for the minimum roundness value

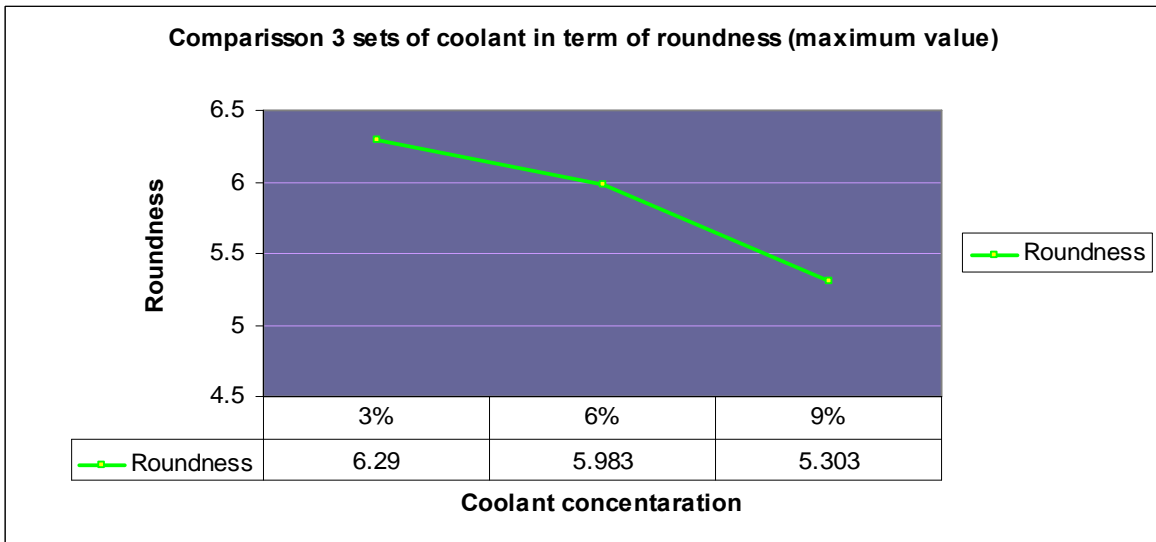


**Figure 3.4:** Comparison 3 types of coolant in term of roundness (minimum value)

Figure 3.4 shown the minimum value or the best roundness value of coolant which is 3%, 6% and 9% with different concentration. Coolant 3% represents 1.84  $\mu$ m of roundness value while the coolant 6% gave a 1.64  $\mu$ m. The best roundness value gets from coolant 9% brix concentration and represents 1.113  $\mu$ m of roundness value.

Coolant concentration (Brix)	Workhead Speed	Traverse Speed	Depth of cut	R1 ( $\mu$ m)	R2 ( $\mu$ m)	R3 ( $\mu$ m)	Roundness average
3%	280	4	0.005	4.7	6.48	7.71	6.29
6%	280	4	0.005	3.67	6.58	7.7	5.983
9%	280	4	0.005	5.58	4.47	5.86	5.303

**Table 3.5:** Experimental Results for the maximum roundness value

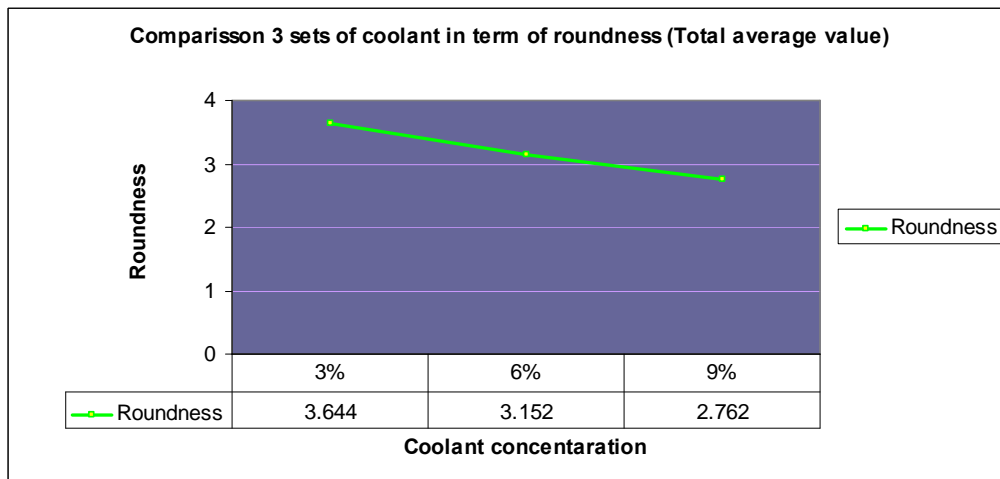


**Figure 3.5:** Comparison 3 types of coolant in term of roundness (maximum value)

Figure 3.5 shown the maximum value or the worst roundness value of coolant which is 3%, 6% and 9% with different concentration. Coolants 3% represent 6.29  $\mu\text{m}$  of roundness value while the coolant 6% gave a 5.983  $\mu\text{m}$ . The worst roundness value gets from coolant 9% brix concentration and represents 5.303  $\mu\text{m}$  of roundness value.

Coolant concentration (Brix)	Total roundness average ( $\mu\text{m}$ )
3%	3.644
6%	3.152
9%	2.762

**Table 3.6:** Experimental Results for total roundness average



**Figure 3.6:** Comparison 3 types of coolant in term of roundness (Total average value)

Figure 3.6 shown the total roundness average value for coolant 3%,6% and 9% with different concentration .Coolant 3% represent 3.644  $\mu\text{m}$  of roundness value while the coolant 6% gave a 3.152  $\mu\text{m}$ . The best total average roundness value gets from coolant 9% brix concentration and represents 2.762  $\mu\text{m}$  of roundness value.

## 4.0 Discussion

From the results that achieved , the roundness value present a different results due to the used of different concentration of coolant.The total roundness average at 3%, 6% and 9% concentration of coolant is 3.664 $\mu\text{m}$ , 3.157 $\mu\text{m}$  and 2.7618 $\mu\text{m}$ . From the results it is clearly shown that the minimum or the best roundness average is 2.7618  $\mu\text{m}$  by using coolant 9% concentration while between 3% and 6% of concentration gave a worst or maximum roundness value.

According to Iowa, (2003), low coolant concentrations may result in poor lubricity, shorter tool life, increased biological activity, and an increased risk of rust formation on newly machined surfaces. This is been supported by Alves,S.M. (1999) study and the low lubricity is found as a cause of an increase of friction chips and the bond and leads to the increase of roundness values.

Due to the above factor, the concentration of coolant will influence the coolant lubricity and it will not only give effect in term of roundness value but it also effect to material removal rate, grinding forces, grinding temperature, and on grinding wheel wear.

## 5.0 Conclusion

The contribution and effect of coolant concentration on work piece roundness in the cylindrical grinding machine can be derived from the study. The effect of coolant on the roundness values by cylindrical grinding machine have been investigated experimentally. The machining has been done by using materials Stainless Steel SUS 304. From the result experiment, itø found the concentration of the semi-synthetic coolant which is 3%brix, 6%brix and 9% brix just gave small contribution and effect on roundness value because the mean value of 3 sets of coolant does no show major difference.

Even though, the usage of different percent brix concentration did not give a major effect to the roundness value, the higher value percent brix concentration still have effect to roundness value and give the best results from this study. After the experimental identification the model result will be used to define the better and suitable coolant concentration of cylindrical grinding process.

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# M10 - Study On Mechanical And Chemical Properties Of High Carbon Steel Boride Layer

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## **Abstract**

*Boronizing of high carbon steel is a thermochemical treatment in which boron atoms are diffused into the surface of high carbon steel substrate to form boride layer. Boronizing on high carbon steel has long been used to improve the surface properties of dies and tools because boride layer has high hardness, good wear resistance, and good corrosion and oxidation resistance. The aim of this study is to observe the mechanical and chemical properties of boronized high carbon steels. The high carbon steel substrate plate was sectioned to a rectangular shape with nominal dimensions of  $10 \times 10 \times 5 \text{ mm}^3$  and then polished progressively up to 600-grit emery paper to obtain desired surface condition. Then, ground specimens were embedded with boronizing agent in a stainless steel container produced. Boronizing processes were performed in a tube furnace at  $850^\circ\text{C}$ ,  $950^\circ\text{C}$  and  $1050^\circ\text{C}$  for 2, 4 and 6 hours. The boronized high carbon steel specimens were characterized by using optical microscopy, X-ray diffraction (XRD) analysis and Vickers hardness testing. The results show that boride layer formed has tooth-shaped structure and the structure is homogeneously distributed over the surface. Boride layer thicknesses formed on the boronized high carbon steels were ranged from 12 to  $110 \mu\text{m}$  depending on the process temperature and treatment time. The hardness of borides formed on the samples changes between 1234.667 and 2192.333  $\text{HV}_{0.1}$  depends on the treatment time and temperature. Also the hardness of boronized high carbon steel is 6 times harder than as-received high carbon steel.*

**Keyword:** *Boronizing, High Carbon Steel, Boride Layer.*

## **1.0 Introduction**

For many years, surface treatment is an important heat treatment in metallurgy. Boronizing and related thermochemical heat treatment has become widely accepted as selective surface treatments where atoms are transferred to the surface of the steel at elevated temperature.

Boronizing is a thermochemical diffusion surface treatment in which boron atoms are diffused into the surface of the workpiece to form hard borides with the base material [1]. It can be applied to a wide range of steels including carbon, low alloy, tool and stainless steel, and also some super alloys as boron atoms can diffuse easily into the surface of metallic material due to their relatively small size and very mobile nature. The formation of the metal boride will provide the excellent surface properties in terms of high hardness, corrosion resistance, high temperature oxidation resistance up to  $850^\circ\text{C}$ , and the length of service life up to 3-10 times [2]. In industry, boronizing has long been used to improve the surface properties of dies e.g. injection moulding dies, hot forming dies, extrusion dies and also in tools because



of boride have high hardness, good wear resistance, and good corrosion and also oxidation resistance.

Boronizing on high carbon steel is commonly used nowadays to protect the surfaces of tool components and also dies. With this technique, it can improve components life up to several times. Many of industries have preferred this kind of technique on high carbon steel-based components such as pins, bolts, punches, clamping, valve components and fittings because no voids are produced at diffusion zone (more stronger), can be uniformly applied to irregular shapes and also cost effective for large or small parts. To control the boronizing processes in automatic installations, knowledge of kinetic parameters is important. It is very important to establish the variables that affect the boronizing kinetics process to control automated procedures and obtain desirable properties. In this study, the influence of kinetic parameters such as temperature and time in boronizing process on high carbon steel was observed.

## 2.0 Experimental Procedure

In this study, high carbon steel plate with chemical compositions is shown in the table was used as the boronizing substrate.

**Table 2.1:** Chemical composition of the as-received steel

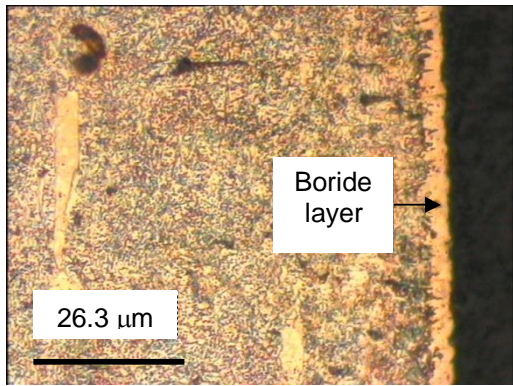
Material	Chemical composition (% , by weight)							
	C	Cr	Mn	Ni	Si	Mo	W	P
HCS	1.26	8.184	0.594	0.148	1.376	2.498	0.072	0.046

Firstly, the as-received High Carbon Steel plate was cut into 12 specimens with dimension of 10 mm length, 10 mm width and 5 mm height. After that, the specimens were ground from 120 up to 600 grit emery papers to get desired surface finish. Silica gels were used to avoid the specimens from corrodes after grinding process. So after grinding, the specimens were quickly stored in a container that contains silica gels. The specimens were then placed into a container produced and embedded with boronizing agent. The boronizing agent that was used in this study are Ekabor 2. The thickness of the boronizing agent around the specimen was set to 15 mm [3]. After that, the specimens along with the boronizing agent were sealed in a container produced. Then, the container was placed into a furnace for boronizing process. Boronizing process is carried out by holding the specimen in an argon atmosphere. Argon gas was supplied into the tube furnace to avoid oxygen from affecting the boronizing process. Boronizing process was done at temperature of 850°C, 950°C and 1050°C for 3 holding times which are 2 hours, 4 hours, and 6 hours. After boronizing process was completed, the container was cooled in room temperature and then the specimens were removed. After that, the specimens were characterized by using X-Ray Diffraction (XRD), Optical Microscope and Vickers Micro Hardness.

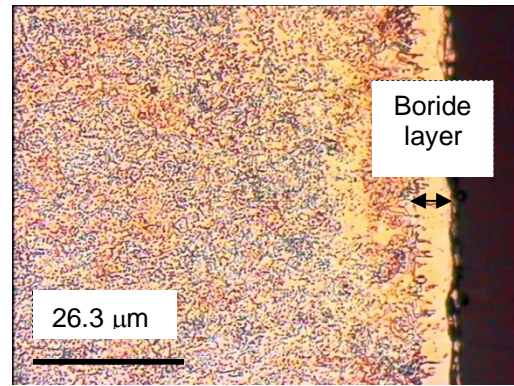
### 3.0 Result and Discussion

#### 3.1 Microstructure of Boride Layer

Optical microscope examination on the microstructures of the boride layer that was formed during boronizing at various temperatures and times are shown in Figures 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8 and 3.9. Figure 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8 and 3.9 shown in Annex A.



**Figure 3.1:** Boronized high carbon steel at 850°C for 2 hr (500X)



**Figure 3.2:** Boronized high carbon steel at 850°C for 4 hr (500X)

As a result of optical microscope investigation on boronized high carbon steel specimens, it is indicated that all the boride layers that were formed on the surface of the high carbon steel specimens have a tooth-shape structure and these structures were homogeneously distributed over the surface of the high carbon steel specimens. From these microstructures of boride layer, the thickness of boride layers for various temperatures and time were calculated and the values were summarized at Table 3.1 below.

Temperature, T (K)	Time, t (hr)	Boride layer, d ( $\mu\text{m} \pm 1\mu\text{m}$ )
850°C (1123K)	2	12
	4	14
	6	22
950°C (1223K)	2	24
	4	36
	6	54
1050°C (1323K)	2	63
	4	97
	6	110

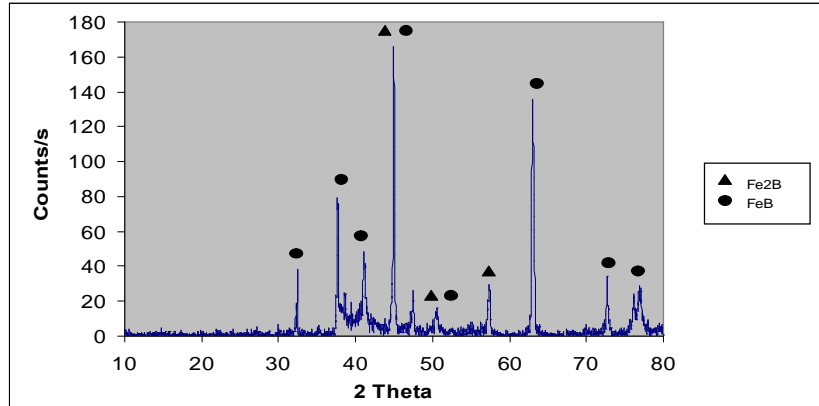
**Table 3.1:** The thickness of the boride layer at different boronizing temperature and time

From Table 3.1, it is shown that the thickness of boride layer on boronized high carbon steel specimens were ranged from ( $12 \mu\text{m} \pm 1 \mu\text{m}$ ) to ( $110 \mu\text{m} \pm 1 \mu\text{m}$ ). From the results shows, it is indicated that the thickness of boride layer was increased with increasing process temperature and treatment time. This is because boron atoms that were introduced into the surface of the high carbon steel substrate were through diffusion process. Since it is a diffusion process, the parameters that are playing a major role in diffusion process are treatment temperature and path of diffusion process. Higher temperature will gives higher

energy than low temperature. Thus, boronizing at high temperature will give high energy to the boron atoms to diffuse into the substrate surface. With a certain time of period, boron atoms can diffuse deeper to the steel substrate to form hard boride layer.

### 3.2 X-Ray Diffraction (XRD)

The present of borides ( $\text{FeB} + \text{Fe}_2\text{B}$ ) formed on the surface of steel substrate was confirmed by x-ray diffraction analysis (XRD) [4] shown in Figure 3.10 below.



**Figure 3.10:** X-ray diffraction pattern observed from the surface of the boronized high carbon steel at 950°C for 4 hr

### 3.3 Vickers Microhardness Test

The Vickers micro hardness (HV) values of boronized high carbon steel at 850°C, 950°C and 1050°C for 2, 4 and 6 hr were summarized in Table 3.2 below. The hardness of the boronized high carbon steel was measured by using a digital micro hardness tester fitted with a Vickers indenter under loads of 100 g.

**Table 3.2:** Vickers micro hardness values of boronized high carbon steel for different times and temperatures

Temperature, T (K)	Time, t (s)	Hardness Vickers Number (VHN <sub>0.1</sub> )			
		D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>average</sub> (±15)
As-received HCS	-	211	215	208	211
850°C (1123K)	2hr	1220	1245	1239	1235
	4hr	1524	1527	1517	1523
	6hr	1588	1595	1650	1611
950°C (1223K)	2hr	1669	1675	1635	1660
	4h	1700	1763	1723	1729
	6hr	1859	1822	1875	1852
1050°C (1323K)	2hr	1993	1955	1925	1958
	4hr	2115	2138	2079	2111
	6hr	2187	2200	2190	2192

The maximum microhardness values in boronized high carbon steel reached (2192 ± 15) HV when boronized at 1050°C for 6hr while the minimum value is (1235 ± 15) HV when boronized at 850°C for 2hr. The micro hardness value of high carbon steel substrate was also

measured as  $(211 \pm 15)$  HV. Thus, surface hardness values were increased 9610 times by the boronizing process.

The case depth microhardness of the boronized high carbon steel was measured by using a digital micro hardness tester fitted with a Vickers indenter under loads of 100 g. The variation of hardness of boronized high carbon steel for different temperatures and times from surface into matrix were summarized in Table 3.3, 3.4 and 3.5. Table 3.4 and 3.5 are shown in Annex B.

**Table 3.3:** Case depth microhardness of boronized high carbon steel at 850°C for 2, 4 and 6 hr

Distance, $\mu\text{m}$	Vickers Microhardness Number (VHN <sub>0.1</sub> )		
	2 Hour	4 Hour	6 Hour
5	1214	1580	1599
10	1012	1480	1550
15	548	990	1498
20	376	667	1441
25	243	250	269

From the Table 3.3, 3.4 and 3.5 above, we can see that the hardness values of boronized high carbon steel from the surface into the substrate of the high carbon steel were gradually decreased. The hardness value of boride layer for case depth hardness is likely same with surface hardness measurement. There are no obvious changes of the hardness value at the boride layer but after the boride layer, the hardness values were decreased suddenly. This is because the presence of hard FeB and Fe<sub>2</sub>B phases in boride layer, which give much higher hardness than that of the high carbon steel substrate.

#### 4.0 Conclusion

In this study, boronizing process was successfully conducted on high carbon steel plate. The data obtained were compared with varies boronizing temperature and time conducted. The results are summarized as follows:

1. The Optical Microscope cross section examinations on the boride layers that are formed on boronized high carbon steels substrate have a tooth-shaped structure and this structure is homogeneously distributed over the surface. The thickness of the boride layer is range from 11.842 to 109.211 $\mu\text{m}$  and these boride layer thickness are depends on treatment time and temperature. The longer boronizing time and higher temperature results in the thicker boride layer.
2. The presence of FeB and Fe<sub>2</sub>B phases in the boronized high carbon steel were confirmed by XRD analysis.
3. The hardness of borides formed on boronized steels were varied from 1234.667 up to 2192.333 HV<sub>0.1</sub>. These hardness values depend on the treatment time and temperature. As temperature and treatment time increases, the specimens become harder.

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# M11 - Indoor Thermal Condition In The Air-Conditioned Mosque Building: A Case Study During Friday Prayer In Malaysia

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## *Abstract*

*Mosque is the most important public building for Islamic religious practices. In order for the various religious activities, such as the Friday prayer to be carried out satisfactorily, the indoor condition of the mosque has to be comfortable. In Malaysia, it has become common that the mosques are installed with air conditioning system to ensure this satisfactory condition. The characteristics of indoor thermal condition and indoor air quality (IAQ) are not often studied to gauge the level of satisfaction. This paper presents the findings from such a study in hot and humid country of Malaysia, involving an air-conditioned qariah level mosque known as Masjid At- Taqwa, in Kepala Batas, Penang. Ambient temperature ( $T_a$ ) increased correspondingly with peak the time of Friday prayer due to increasing heat gain/load produced from the worshippers. Similar pattern was displayed by air velocity movement where at peak time of Friday prayer, air velocity becomes weak at range 0.05 to 0.15 m/s. A PMV and PPD value was found to be 1.76 and 64%, respectively. Comparing the operative temperature (OT) to comfort zone specified by ASHRAE Standard 55 (2004) showed that the physical condition in the Mosque AC system was not within the comfort zone boundaries. A very poor IAQ was observed in main prayer hall where carbon dioxide ( $CO_2$ ) reached to maximum value of 3035.75 ppm when Friday prayer time ended.*

**Keywords:** Thermal condition, Air Conditioning, Mosque, Friday Prayer.

## 1.0 Introduction

Indoor thermal comfort is an important issue in building industry. In hot and humid climate countries, mechanical ventilation such as air conditioning system (A/C) is one of the most common ways to maintain the desired comfort level. A lot of studies have been carried out to improve the indoor thermal comfort especially in buildings. Al-ajmi & Loveday, (2010) reported the thermal comfort for occupants in air conditioned building office in Kuwait, Kwok & Chun (2003) reported the thermal comfort and acceptance level of students in the Japanese school with different cooling techniques and Hwang *et al.*, (2007) reported the patient thermal comfort satisfaction in the hospital ward in Taiwan. Moreover, international standard such as ASHRAE Standard 55, (2004) has been developed as reference and guidance in evaluation of thermal environment specifically for Heating, Ventilating and Air Conditioning (HVAC) system. The ISO 7730, (2005) is another international standard that is commonly used as a reference by HVAC designers. This standard was developed in parallel with ASHRAE Standard, (2004), which specifies methods for measuring and evaluating the moderate and extreme thermal environments of in which human beings are exposed. A human beings thermal sensation related to thermal balance is influenced by the

physical activity, clothing and also the environmental parameters such as air temperature, mean radiant temperature, air velocity and air humidity. Therefore when these factors have been measured or determined, thermal sensation can be predicted by calculating the Predicted Mean Vote (PMV). To extend the thermal discomfort or thermal dissatisfaction, Predicted Percent Dissatisfied (PPD) obtained from PMV can provide the information about percentages of people likely to feel too cool or too warm. Another side issue is when people exposed to air-conditioned environment, the indoor air quality (IAQ) always come into picture. This awareness is due to some of health complaints as IAQ affect the health, comfort and productivity of the office workers (Sekhar & Lim, 2003 ; Kamaruzaman et al.,2009).

Malaysia is located within the Latitude and Longitude of 1° - 7° -North and 100° - 119° -East, which has hot and humid climate throughout the year (Zulkifli H., 1999). The mean air temperature is about 26.4 °C, relative humidity range between 72% to 90%, and wind velocity is between 0.3 m/s and 1.5 m/s. Nonetheless, the outdoor temperature during daytime may reach as high as 38.4 °C, which can cause high radiant temperature in the building space, thus gives discomfort to the occupants.

In Malaysia, the official religion is Islam due to the majority Muslim. A unique building known as Mosque or in Arabic words *Masjid* is a very important building to the Muslim community. *Masjid* is categorised under public building where religious practices take place such as performing daily prayers, Friday prayer, *Idul Fitri* and *Idul Adha* prayers, intermittently base on solar time. Usually, the religious practice is conducted in the main prayer hall of the mosque either in a group or individually. The prayer that is performed in a group is led by an *Imam*. Whereas the worshippers, who perform the prayer, will stand, bowing, prostrating and sitting behind the *Imam*, with alignment in row (*saf*) and closed contact to each other. In this situation, all of them are facing to Mecca-*qibla* direction. In addition, the main prayer hall of the mosque also is used for other activities; religious lecture or preaching sessions by the *Imam* or *-Ustaz'* in the evening, and sometimes for wedding ceremonies to declare the *-akad'*. Every Friday noon, all the male Muslims must perform the Friday prayer at the mosque. The duration takes about an hour to complete, consisting of two modes, Friday preaching or *khutba* mode and Friday prayer mode. When the Friday prayer time arrived, the Friday preaching or *khutba* mode will be delivered first by the *Imam*. Meanwhile all worshippers in main prayer hall are seated on the floor and listening to the *khutba*. At this stage, the mosque will be fully occupied with worshippers especially in the main prayer hall. After about 45 minutes, the *khutba* is end and Friday prayer will be performed led by an *Imam*.

It is a challenge to achieve the satisfaction level of thermal comfort in the mosque during major prayer modes such as the Friday prayer. Therefore, it has become common that mosques in Malaysia are installed with air conditioning systems to provide cooling and better thermal comfort to the worshippers. However, there is limited research report on thermal comfort in the air conditioned mosque buildings. Thus, the objective of this study is to characterize the indoor thermal condition for an air conditioned mosque during the Friday prayer in Penang, Malaysia.

## 2.0 Methods

Indoor thermal condition is evaluated in main prayer hall of one air conditioned mosque during Friday prayer in November 30, 2012. Measurements of indoor microclimatic conditions were made with a mobile meteorological station known as Multi Station Thermal Comfort Real Time Monitoring System (MSTCRTMS). The MSTCRTMS station

includes sensors for the measurement of dry-bulb air temperature ( $T_a$  ; °C), globe temperature ( $T_g$  ; °C) wind speed/air velocity ( $V$ ; m/s), relative humidity (RH ; %) and also carbon dioxide ( $CO_2$  ; ppm) representing the IAQ condition. Air velocity, air temperature and relative humidity are measured using function probe of KIMO CTV100-ANA300. Globe temperature was measured using globe thermometer consisting of thermocouple wire held at the middle of the 230 mm-black globe ball. Carbon dioxide was measured using infrared gas sensor. All measurements were connected to ADAM View Software Version 4.30.004, the thermal data logging system. All physical data was recorded at 10 minutes intervals, starting time at 12.00 noon and lasting till 15.00 PM in the evening, synchronized with Malaysian standard time. All equipment set-ups have been tested and calibrated before evaluation started. The MSTCRTMS station was installed at a height of 1.1 m above from floor level and located at fixed position in main prayer hall (between *saf* 6 & 7). The height level proposed by ASHRAE Standard 55 (2004) for light activity-standing/sitting, is almost suitable condition to worshippers during Friday prayer activity. The metabolic rate value used in this study was estimated to be 1.3 met as recommended by ISO 7730 (2005), for near sedentary physical activity. The cloth assemblies for worshippers were observed to be variaties during the Friday prayer. Thus, the clo value for worshippers were estimated base on cloth assemblies references in ISO 7730 (2005). Indoor climate data will be used to determine the mean radiant temperature (MRT) and operative temperature (OT) using standard equation (Mc Quiston F.C, Parker, J.D & Splitler, J.D., 2005). Furthermore, PMV and PPD values are determined using software CBE Thermal comfort tools for ASHRAE-55 (Hoyt Tyler et al., 2012). The  $CO_2$  level will be compared with IAQ Code of Practice, Department Occupational Safety & Health Malaysia (2005).

### 3.0 Sample And Descriptions

An air conditioned mosque building, namely Masjid AT-Taqwa, Kepala Batas, Penang Malaysia was selected in this study. The GPS reference coordinate is at Latitude 5.5170 °North and Longitude 100.2600 °East. The mosque was built in year 2004 and was constructed based on square plan. The total built-up area of main prayer hall is 640.1 m<sup>2</sup> and wall height is 6 metre (Table 1). In general, there are 4 basic external walls. Each wall has an area of 151.8 m<sup>2</sup>. One of the walls (Westward-facing), is oriented toward the direction of holy city, Mecca, Saudi Arabia. This wall is basically a solid wall and described as a *qibla* wall. This wall, contains the *mihrab* where the *Imam* is located during prayers. Adjacent to the *mihrab* is the *mimbar*, located at the right side and elevated 1.5 metres above floor, where the *Imam* delivers the Friday *Khutba*. The wall facing Northward, is built with two sliding doors for entrance and six windows. The wall facing Southward, is built with two sliding doors for entrance and three windows. The wall facing Eastward, is built with four sliding doors for entrance and also with three windows. The door dimension is 1.83m x 2.2m each. For windows, it has a frame dimension of 2.2m x 1.6m and built in with four sliding leaf. All the windows are installed for ventilation purposes. The mosque has a roof that is constructed together with one big dome, located at center of the main prayer hall. The main prayer hall can be occupied by approximately 800 worshippers at one time. The floor area is finished with carpet that has built in a pattern for the *saf*, parallel to the *qibla* wall (Westward). The distance between of each *saf* is about 1.06 metres. Figure 1 illustrates the external view of the mosque, the MSTCRTMS position and the worshippers with their assembly cloth condition in main prayer hall of Mosque AC building.





**Figure 1:** View of mosque & worshippers with their assembly cloth in main prayer hall

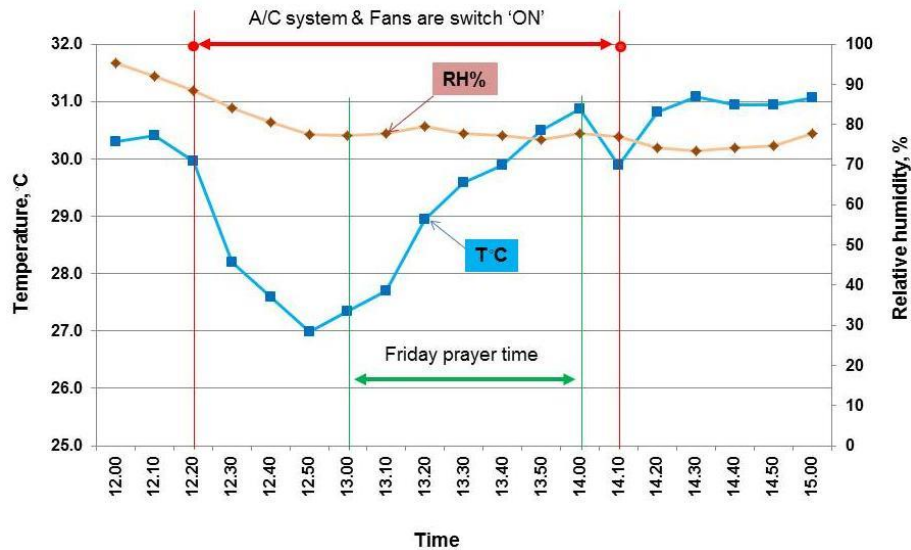
The mosque has been installed with 32 horse power air conditioning systems (split unit type-ceiling exposed model) and supported by 15 units of wall fans to distribute cooled air into the surrounding spaces. The temperature of the air conditioning units were set at 21 °C and fan motor speed running at maximum level. During the operation of the mechanicals system, all windows and doors were fully closed. The mechanicals system estimated operation time is about 110 minutes to provide the cooling and comfort to worshippers. The cloth assemblies for worshippers were observed to be of variety. The most common cloth worn by the worshippers were similar to western cloth such as normal shirts and trousers. Another cloth type observed is the Malay traditional dress cloth assemblies (consistings of malay shirt, with *kain pelikat*) and Arabic *dishdisha* (overall long sleeve cloth) with *kain pelikat*. During Friday prayer, the overall clo value were estimate in between 0.420 to 0.890 and mean value is 0.553 clo. All the information as indicated in Table 1 below.

**Table 1: Sample A/C Mosque physical data**

Built year	Dimension (m) LxWxH (Area, m <sup>2</sup> )	Occupants Capacity	Clo value	Air conditioning & Ventilation system, Number of units, types, power	ON/OFF Time
2004	25.3 x 25.3 x 6 (640.1 m <sup>2</sup> )	800	min = 0.420 max = 0.890 mean = 0.553 SD = 0.149	10 Ceiling exposed A/C Units, 3 HP-each 1 Wall-mounted Splits Unit, 2 HP 15 Wall fans, 199 W/fan	12.20 PM - 14.10 PM

## 4.0 Results And Discussions

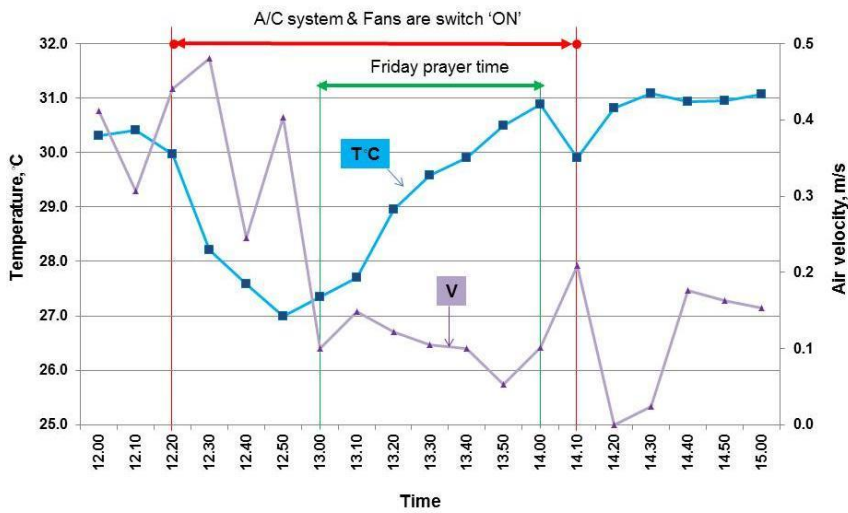
The yearly (2003-2012) mean outdoor temperature ( $T_o$ ) and relative humidity (RH) for Butterworth Meteorology Station is 27.65 °C (min=27.1 °C; max=28.2 °C) and 80.8% (min=78.3%; max=81.3%), as reported by the Meteorological Department, (2012). Figure 2 shows the results of ambient temperature ( $T_a$ ) against RH in main prayer hall during Friday prayer for location AC. 30 minutes before the Friday prayer begin,  $T_a$  and RH were slightly reduced to 26.9 °C and 77.2 %, respectively. When Friday prayer started (13.00 PM),  $T_a$  slowly increased up to 30.9 °C until Friday prayer time ended. However, the RH remained at level of 77%. The rise in temperature was due to the heat gain/load produced by the worshippers occupying the main prayer hall.



**Figure 2: Indoor ambient temperature VS Relative humidity during Friday prayer**

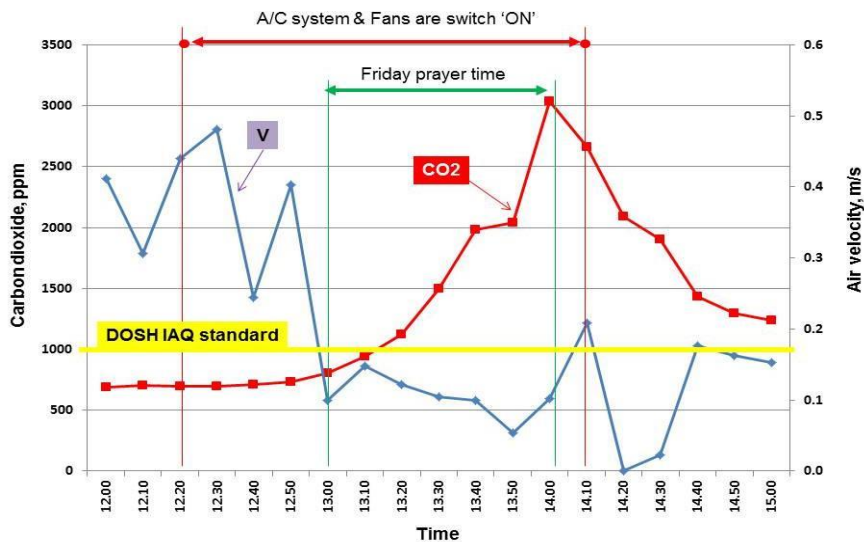
Figure 3 shows the  $T_a$  against air velocity ( $V$ ). At the beginning, the main prayer hall was effectively cooled as  $T_a$  was reduced and had good air movement. When Friday prayer started at

13.00 PM, the air velocity become weak ranges from 0.1 to 0.15 m/s only.  $T_a$  on the other hand, began rise and caused the main prayer get warmer. It was observed that worshippers started to fill up the main prayer hall slowly according to the *saf* while waiting for the Friday prayer to start. When the prayer time was almost in sight, the main prayer hall was fully occupied. The packed main prayer hall caused the ambient temperature to rise.



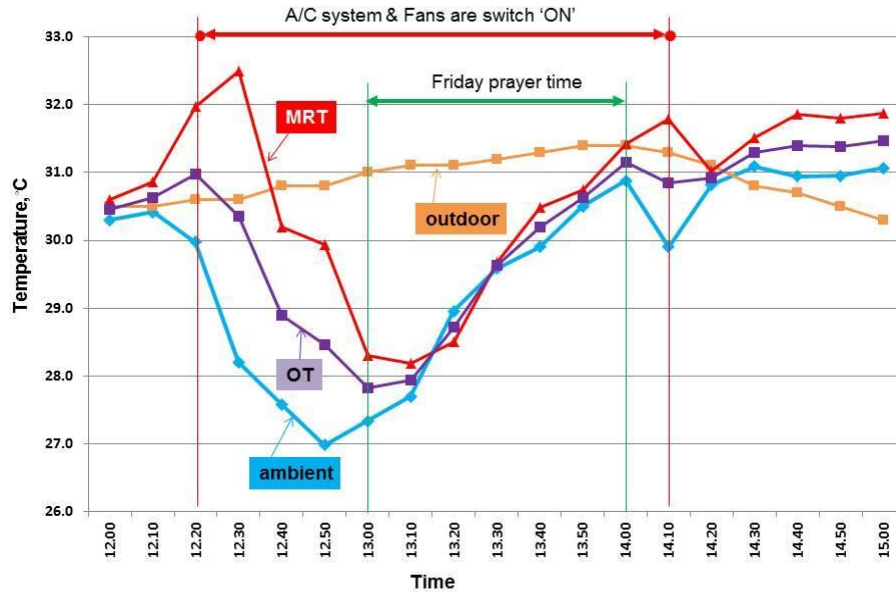
**Figure 3:** Indoor ambient temperature VS Air velocity movement during Friday prayer

The average of CO<sub>2</sub> level in the main prayer hall is shown in Figure 4. At the beginning of A/C systems and fans operation, the CO<sub>2</sub> level was within the range as suggested by DOSH-IAQ standard (2005). Starting at 13.00 PM-14.00 PM, the CO<sub>2</sub> increased up to 3,000 ppm; while the air velocity was becoming weaker. This condition showed that the increasing occupation of the main prayer hall affected air movement at the measurement level, while the increasing number of people increased the CO<sub>2</sub> production within the hall. One of the factors contributing to this situation was the fully-closed windows and doors.



**Figure 4:** Average carbon dioxide VS air velocity movement during Friday prayer

The pattern of indoor climate is presented in Figure 5. At the beginning stage of A/C system and fans operations, MRT was slightly higher compared to operative and ambient temperature. When Friday prayer started, all the temperature readings were observed to have almost similar pattern, rising slowly until prayer ended. This is also due to the increasing outdoor thermal conditions.



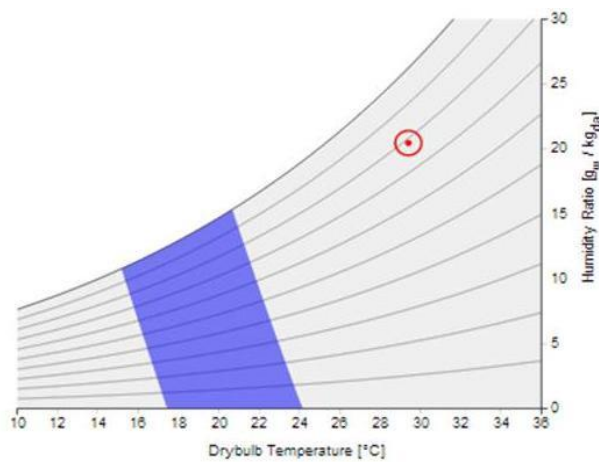
**Figure 5:** Average ambient air, outdoor air, mean radiant (MRT) and operative temperature (OT) in the AC Mosque during Friday prayer

A summary of all the parameters measured during Friday prayer time using A/C system and fans observed from 13.00 PM-14.10 PM are given in Table 2. The average indoor air temperature and relative humidity were 28.96 °C and 79.3 %, respectively. The air velocity in the main prayer hall was 0.21 m/s, mean radiant temperature (MRT) and operative temperature (OT) calculation values is 30.31 °C and is 29.63 °C, respectively. The acceptance of indoor climate from PMV and PPD view is only 1.76 and 0.64. The CO<sub>2</sub> level is observed with average of 1,410.6 ppm which is almost 45 % over the DOSH limit.

**Table 2:** Summary indoor climate during Friday prayer time-with A/C system & Fans (13.00 PM-14.00 PM)

Indoor climate	Mean	Min	Max	S.D
Ambient temperature, $T_a$ ( $^{\circ}\text{C}$ )	28.96	26.99	30.88	1.34
Relative humidity, RH (%)	79.30	76.37	88.48	3.59
Air velocity, $V$ (m/s)	0.21	0.05	0.48	0.15
MRT ( $^{\circ}\text{C}$ )	30.31	28.19	32.50	1.46
Operative Temperature ( $^{\circ}\text{C}$ )	29.63	27.82	31.15	1.22
PMV	1.76	1.17	2.27	0.37
PPD	0.64	0.39	0.87	0.17
CO2	1410.60	693.55	3035.75	829.87

Comparing the OT to comfort zone specified by ASHRAE Standard 55, shows that the thermal condition in the A/C Mosque was not within the comfort zone boundaries (Figure 6). The PMV value is found to be 1.76 and PPD is 64 % which implies that the condition in the main prayer hall during Friday prayer time was warm.



**Figure 6:** Operative temperature on ASHRAE Standard-55, comfort zone boundary using software CBE Thermal comfort tools for ASHRAE-55 (Proposed by : Hoyt Tyler et al., 2012).

The ASHRAE Standard 55, comfort zone boundary is considered not suitable to be applied for Malaysian people due to different climatic condition (Nicol, 2004). Therefore, Abdul Malek Abdul Rahman, (2000) has adjusted the comfort temperature range to suit the Malaysian people and their climate. Using the later to compare the results, it is found that the main prayer hall fall within the comfort zone boundaries for Malaysian people.

The findings of this study is in conformity with the findings by Al-Homoud *et al.*, (2010) for an A/C Mosque in Saudi Arabia. Worshippers presence is considered as an internal heat load. Observation showed that the main prayer hall of the A/C Mosque was fully occupied especially when Friday prayer started. When worshippers were sitting/standing too close to

the MSTCRTMS station, the surrounding temperature will rise due to heat from the human body and reduction of the air movement. Additionally the A/C system with capacity of 32 horsepower and supported by 15 wall fans to provide comfort was insufficient to produce the cooling load demands.

## 5.0 Conclusion

Based on the finding from objective measurement for A/C Mosque indoor thermal condition, it can be concluded that indoor thermal condition in this A/C Mosque building did not fall within the comfort zone of ASHRAE Standard 55 but did fall slightly in comfort zone for Malaysian people in terms of mean  $T_a$  and RH values, only. Poor IAQ in the main prayer hall was caused by carbon dioxide which exceeded acceptable level. Further study is needed to evaluate and determine the actual thermal sensation of worshippers in A/C Mosque during Friday prayer.

## 6.0 Acknowledgement

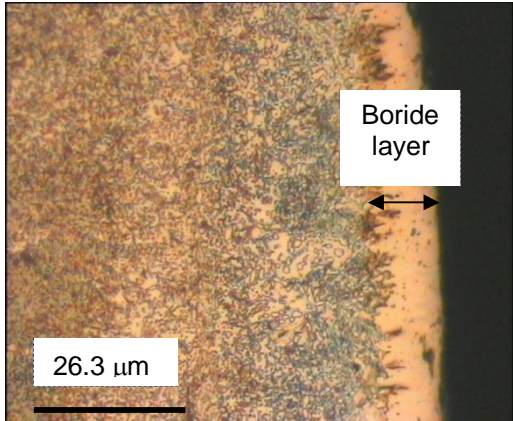
We are gratefully acknowledgement to Tuan Haji Abdul Rahman, Tuan Haji Ir. Ahmad Zakiyuddin, committee members and worshippers (*Jemaah Muslim*) from Masjid At-Taqwa, Bertam Indah Kepala Batas and Tuan Haji Mohd Sukimi bin Mat Salleh, Director of ILP Kepala Batas for their continuous supports and permission during conducted the research.

## 7.0 References

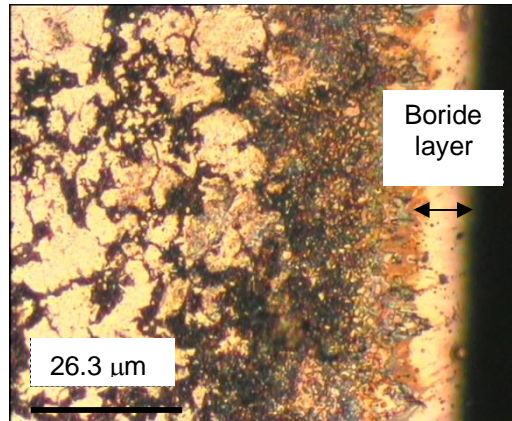
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## Annex A

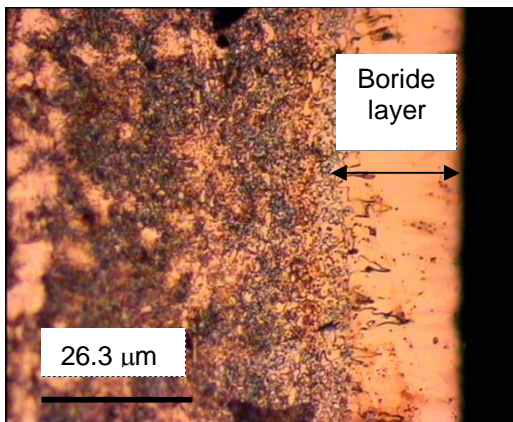
### Optical Microscope



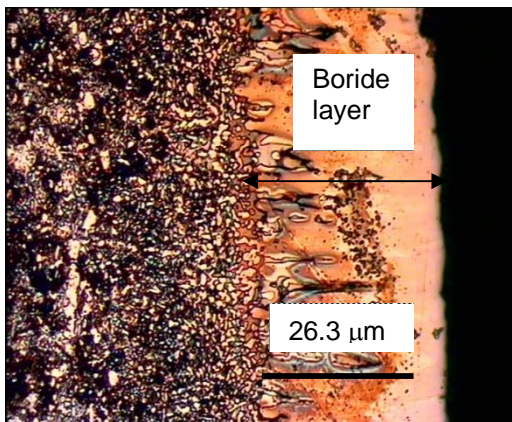
**Figure 3.3:** Boronized high carbon steel at 850°C for 6 hr (500X)



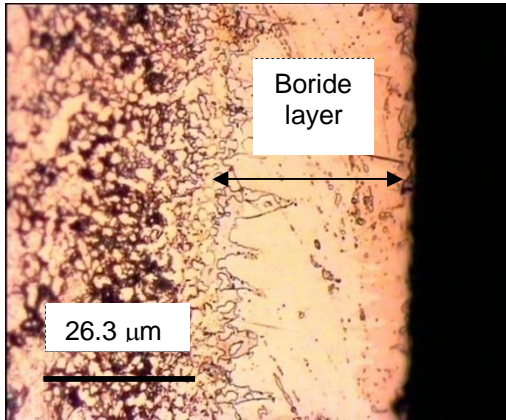
**Figure 3.4:** Boronized high carbon steel at 950°C for 2 hr (500X)



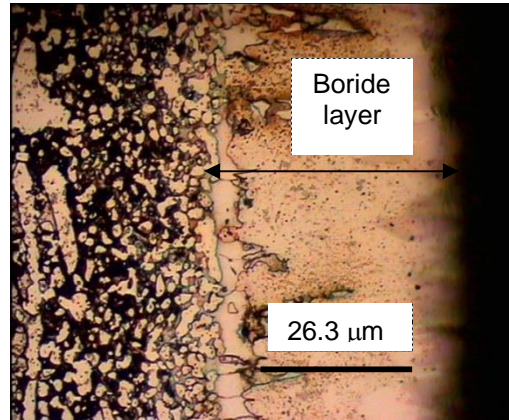
**Figure 3.5:** Boronized high carbon steel at 950°C for 4 hr (500X)



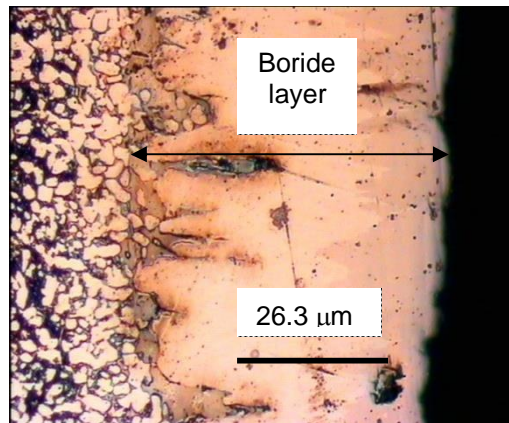
**Figure 3.6:** Boronized high carbon steel at 950°C for 6 hr (500X)



**Figure 3.7:** Boronized high carbon steel at 1050°C for 2 hr (500X)



**Figure 3.8:** Boronized high carbon steel at 1050°C for 4 hr (500X)



**Figure 3.9:** Boronized high carbon steel at 1050°C for 6 hr (500X)



## Annex B

### Case Depth Microhardness

**Table 3.4:** Case depth microhardness of boronized high carbon steel at 950°C for 2, 4 and 6 hr

Distance, $\mu\text{m}$	Vickers Microhardness Number ( $\text{VHN}_{0.1}$ )		
	2 Hour	4 Hour	6 Hour
15	1649	1713	1824
30	1630	1700	1800
45	534	731.1	1790
60	451	512.7	731.1
75	300	312	324

**Table 3.5:** Case depth microhardness of boronized high carbon steel at 1050°C for 2, 4 and 6 hr

Distance, $\mu\text{m}$	Vickers Microhardness Number ( $\text{VHN}_{0.1}$ )		
	2 Hour	4 Hour	6 Hour
25	1900	2100	2180
50	1875	2030	2175
75	760	1975	2074
100	543	870	1998
125	350	368	387

# **M12 - Kesan Penggunaan Semula Minyak Masak Terpakai Terhadap Kesihatan Manusia dan Alam Sekitar Serta Kajian Penghasilan Biodiesel Menggunakan Minyak Masak Terpakai**

Suaibunaha Bin Jusoh<sup>1</sup>, Nor Arniza Binti Jamil<sup>2</sup>, Shahril Azli Bin Yahya<sup>3</sup>, Wan Mustaffa Bin Wan Mohamed Zain<sup>4</sup>, Suriani binti Hasan<sup>5</sup> : Jabatan Mekanikal Institut Latihan Perindustrian Pasir Gudang, Johor

## ***Abstrak***

*Minyak masak terpakai boleh dijadikan sumber utama penghasilan Biodiesel kerana ia tidak sesuai digunakan berulang kali selain mudah didapati dengan percuma. Fokus kajian adalah penghasilan Biodiesel menggunakan minyak masak terpakai, kaitannya dengan beberapa isu alam sekitar dan penyakit kronik manusia serta kajian penentuan prestasi paling optimum. Pendekatan kajian terdahulu, kaji selidik dan ujikaji teknikal menggunakan enjin dynamometer dapat membuktikan prestasi Biodiesel menggunakan minyak masak terpakai adalah setanding dengan diesel fosil. Pengusaha IKS, kafeteria, dewan makan ILPPG dan surirumah merupakan sumber mendapatkan minyak masak terpakai berikutan populasinya meluas dan cenderung kepada penggunaan semula minyak masak terpakai. Bagi penentuan campuran optimum, B0, B10, B20, B30, B50 dan B100 diuji dengan membandingkan faktor prestasi tork enjin, kuasa dikeluarkan, kadar penggunaan bahan api dan emisi. Hasil ujikaji menunjukkan prestasi B20 adalah paling optimum dan sekiranya minyak masak terpakai digunakan secara meluas dalam industri Biodiesel, beberapa isu alam sekitar dan penyakit kronik dapat dikurangkan.*

***Kata Kunci:*** Biodiesel, alam sekitar, penyakit, minyak masak sawit terpakai, prestasi

## **1.0 Pengenalan**

Penggunaan biodiesel yang dihasilkan daripada minyak sawit dan lemak haiwan berpotensi menggantikan diesel sebagai bahan api pada masa depan[1]. Kebimbangan terhadap pencemaran alam sekitar dan peningkatan penyakit kronik pada masa kini yang berpunca daripada pembuangan minyak masak terpakai ke dalam sinki dan longkang telah menyebabkan saluran air tersumbat dan menggalakkan pembiakan nyamuk serta kehadiran tikus dan lipas. Kajian menunjukkan sejenis toksin yang dipanggil 4-hydrox-trans-2-nonenal (HNE) akan dihasilkan apabila minyak masak dipanaskan semula di mana pengambilan makanan yang mengandungi toksin HNE (daripada minyak masak) boleh menyebabkan risiko penyakit-penyakit seperti Kanser, Penyakit Kardiovaskular (penyakit berkaitan jantung dan salur darah), Strok, Alzheimers dan Parkinson [2]. Kesedaran yang tinggi berkaitan risiko penyakit kronik ini membawa kepada kajian penggunaan semula minyak masak terpakai sebagai bahan api alternatif Biodiesel menggantikan Diesel bagi mengelak guna semula minyak masak terpakai dan secara tidak langsung mengurangkan pencemaran udara akibat perlepasan gas hidrokarbon daripada bahan api Diesel.

Kajian ini bermatlamat untuk mengkaji potensi minyak masak terpakai sebagai sumber utama penghasilan bahan api alternatif Biodiesel, kajian pembuktian prestasinya serta penentuan komposisi nisbah campuran optimum yang sesuai. Skop khusus kajian adalah menentukan komposisi nisbah campuran optimum Biodiesel-Diesel dengan melakukan kajian terhadap nisbah campuran B0, B10, B20, B30, B50 dan B100 yang dihasilkan melalui proses

transesterifikasi [3], menganalisa kadar emisi setiap nisbah campuran, prestasi tork enjin dan kuasa dikeluarkan bagi setiap nisbah campuran serta kadar penggunaan bahan api bagi setiap nisbah campuran.

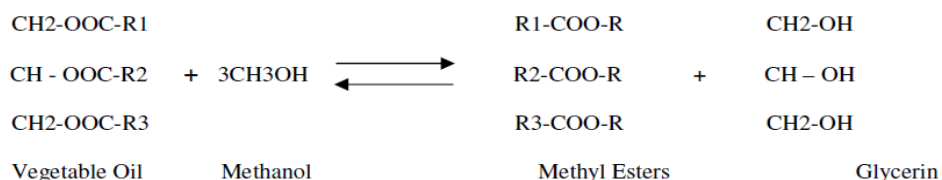
## 2.0 Kajian terdahulu

Biodiesel daripada campuran minyak masak terpakai berjaya dihasilkan dalam menyelesaikan isu alam sekitar bagi rantau Campinas (negeri São Paulo, Brazil). Minyak masak terpakai yang dikumpul daripada penduduk di Campinas telah dicampur dengan etanol pada nisbah 7:01 dan ditransesterifikasi pada suhu 60 ° C selama satu jam dengan NaOH sebagai pemangkin. Keputusan analisis kimia fizik menunjukkan bahawa biodiesel memiliki ciri-ciri yang dekat dengan piawaian yang diperlukan oleh Diesel di Brazil. Kajian terbaru yang dijalankan di bandar Campinas mendedahkan bahawa pemastautin yang tidak prihatin telah meningkatkan kesan alam sekitar dan kos ekologi di rantau itu di mana pelupusan minyak masak yang digunakan telah dibuang ke dalam pembentung dan tanah. Tindakan segera diambil bagi meningkatkan kesedaran di kalangan penduduk dan pelaksanaan dasar untuk menentukan penyimpanan, koleksi berkala dan menggunakan minyak masak untuk pengeluaran biodiesel. Bahan api ini akan digunakan untuk bas, lori dan mesin atau dijual kepada pengedar bahan api, seterusnya menawarkan penjimatan sebanyak AS \$ 0,8-4,5 juta kos baikpulih saluran pembentungan dan tanah [4].

## 3.0 Metodologi kajian

Kaedah kajian dilakukan menggunakan dua kaedah iaitu **kajian serta analisis dan kajiselidik**. **Kaedah pertama** adalah melalui kajian telah dilakukan di Bengkel Teknologi Automotif ILP Pasir Gudang dengan mengambil **faktor jangka panjang** serta **faktor jangka pendek** setiap nisbah. Faktor jangka pendek telah dikaji dengan mengulangi 3 kali bacaan bagi setiap nisbah campuran dalam mendapatkan bacaan yang lebih jitu. Manakala bagi faktor jangka panjang, kajian memperuntukkan selama 6 bulan sebelum keputusan diambil.

Proses pertama kajian adalah penyediaan komposisi nisbah campuran Biodiesel-Diesel melalui proses **transesterifikasi**. Proses ini adalah untuk menghasilkan campuran Biodiesel di mana sebanyak 21 liter minyak masak terpakai telah diperolehi melalui kutipan daripada Pengusaha IKS, kafeteria, dewan makan ILPPG dan surirumah. Minyak masak ini kemudian ditapis dan dibersihkan terlebih dahulu dengan melakukan semburan air dan dibiarkan termendap semalaman. Selepas itu, sebatian Potassium Hidroksida dan Methanol dicampurkan dan dilarutkan selama lima minit sebelum dicampurkan dan dikacau ke dalam minyak masak tadi selama 10 minit (transesterifikasi) [2]. Campuran kemudian dibiarkan selama 8 jam bagi menghasilkan Metil Ester iaitu Biodiesel, B100 dan gliserin (tidak diperlukan). Metil Ester B100 sekali lagi dibersihkan menggunakan air bagi memastikan B100 yang bersih sahaja digunakan (bagi mengelakkan penapis bahan api dan nozel tersumbat oleh bendasing) [5]. Persamaan di bawah menerangkan tindakbalas kimia yang berlaku dalam penghasilan Biodiesel [6].



Proses kedua adalah penyediaan komposisi nisbah campuran **B0, B10, B20, B30, B50** dan B100 di mana 10 liter campuran Biodiesel telah disediakan bagi setiap campuran seperti **Jadual 1**.

**Jadual 1.** Nisbah komposisi setiap campuran

<b>Bxx</b>	<b>B0 (Diesel tulen)</b>	<b>B10</b>	<b>B20</b>	<b>B30</b>	<b>B50</b>	<b>B100 (Biodiesel Tulen)</b>
<b>Biodiesel, ltr</b>	0	1	2	3	5	10
<b>Diesel, ltr</b>	10	9	8	7	5	0

Proses ketiga pula adalah **analisis** penentuan prestasi, emisi dan kadar penggunaan bahan api komposisi nisbah campuran B0, B10, B20, B30, B50 dan B100 menggunakan Enjin Dynamometer dan *Gas Analyzer*. Analisis prestasi tork dan kuasa yang dihasilkan telah ditetapkan dengan menetapkan beban dengan variasi kelajuan 1500rpm ó 4500rpm dengan selang kelajuan sebanyak 500rpm setiap 5 saat menggunakan enjin Dynamometer dengan bukaan injap penuh (*full throttle*) yang disambungkan dengan enjin Diesel jenis Mitsubishi 4 silinder dan 4 lejang. Manakala *Gas Analyzer* digunakan bagi menilai parameter kadar emisi yang dihasilkan iaitu SO<sub>2</sub>, HC, CO dan NO<sub>x</sub>. Manakala kadar penggunaan bahan api telah diukur menggunakan pita pengukur baki setiap bahan api yang tertinggal setiap kali analisis dijalankan.

Sebagai inisiatif ke arah meningkatkan pemahaman dan kesedaran kesan penggunaan Biodiesel serta gunasemula minyak masak terpakai dalam masakan atau pembuangan sisanya kepada alam sekitar dan kesihatan manusia, satu Seminar Teknologi Biodiesel telah dijalankan di institut ini pada 13 September 2012 kepada kakitangan dan pelajar JTM serta wakil komuniti dan industri sekitar Pasir Gudang seramai 300 orang. Selepas seminar dijalankan, **kaedah kajian kedua** dilakukan iaitu dengan mengedarkan **borang kaji selidik** (rujuk lampiran) terhadap pemahaman dan kesedaran Biodiesel ke atas alam sekitar dan kesihatan manusia. Kaji selidik telah dilakukan kepada 60 orang pelajar dan 30 orang kakitangan dikalangan warga ILPPG yang menyertai seminar tersebut.

#### 4.0 Keputusan dan perbincangan

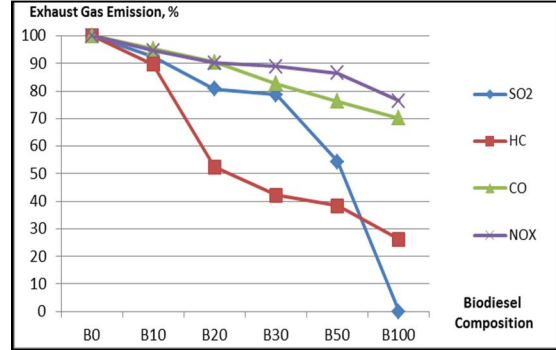
Sebelum keputusan perbandingan antara nisbah campuran teknikal dijalankan, standard kualiti Biodiesel yang terhasil haruslah menepati paling dekat dengan piawaian Biodiesel ASTM 6751 bagi memastikan ia beroperasi dengan baik dan sesuai dengan piawaian Diesel IS 1460 (**Jadual 2**). *Engine Manufacturing Association* dari Amerika telah mengusulkan standard campuran Biodiesel-Diesel B20 yang sesuai dan menghampiri standard Diesel IS1460 [1] . Tetapi masih tiada lagi kajian spesifikasi dilakukan untuk campuran >B20.

Hasil ujikaji yang dijalankan selama 6 bulan yang mengambilkira **faktor jangka panjang** pada enjin Diesel atas *stand* menunjukkan penggunaan campuran lebih 20% (B20) akan memberi kesan negatif di mana pembentukan gel akan mudah terbentuk pada suhu rendah dan akan mengakibatkan penapis dan nozel pemancit tersumbat berikutan titik kabus dan viskositi Biodiesel yang semakin meningkat dengan penurunan suhu dan ini menunjukkan campuran >B20 menghampiri sifat Biodiesel murni (B100). Selain itu, penggunaan campuran >B20 akan secara berterusan akan merosakkan beberapa jenis bahan elastomer dan campuran getah enjin seperti paip getah/saluran bahan api dan *seal* pam bahan api. Kajian menunjukkan penggantian kerap perlu dilakukan bagi mengganti komponen yang rosak akibat tindakbalas kimia yang berlaku.

Kajian mengambilkira faktor jangka pendek mendapati penggunaan Biodiesel telah menghasilkan **kadar emisi** (SO<sub>2</sub>, HC, CO dan NO<sub>x</sub>) yang lebih rendah berbanding Diesel

disebabkan sifat Biodiesel yang berasaskan tumbuhan di mana kajian mendapati semakin besar kandungan Biodiesel BXX maka semakin rendah kadar emisi yang dihasilkan (**Rajah 1**). Kajian mendapati emisi Biodiesel menurun daripada B10 ke B100. Ini menunjukkan penggunaan Biodiesel bukan sahaja mesra alam malah boleh membantu pengurangan pelepasan gas rumah hijau.

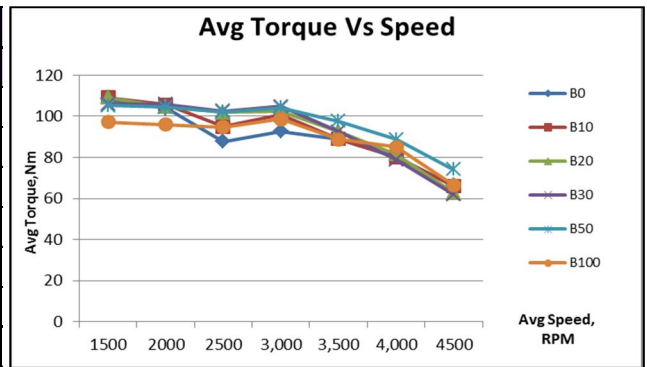
Biodiesel Composition	Exhaust Gas Emission, %			
	SO <sub>2</sub>	HC	CO	NO <sub>x</sub>
B0	100	100	100	100
B10	92.5	89.6	95.2	94.6
B20	80.7	52.4	90.4	96.8
B30	78.6	42.2	82.6	88.8
B50	54.3	38.3	76.3	86.4
B100	0	26.2	70.1	76.4



**Rajah 1.** Keputusan emisi setiap nisbah campuran

Parameter **tork** sangat penting pada permulaan gerakan kenderaan. Tork yang tinggi akan memudahkan pergerakan kenderaan dan sebaliknya. Penilaian parameter tork ditunjukkan dalam **Rajah 2**. Kajian menunjukkan penambahan nilai BXX dalam campuran akan meningkatkan nilai tork pada permulaan penyalaan bagi B10, B20 dan B30 dengan nilai menghampiri Diesel, B0. Manakala campuran B50 dan B100 menghasilkan tork yang lebih rendah daripada B0 pada permulaan kelajuan. Ini bermakna B50 dan B100 tidak praktikal untuk digunakan disebabkan tork rendah yang dihasilkan pada permulaan kelajuan untuk menggerakkan kenderaan yang pegun.

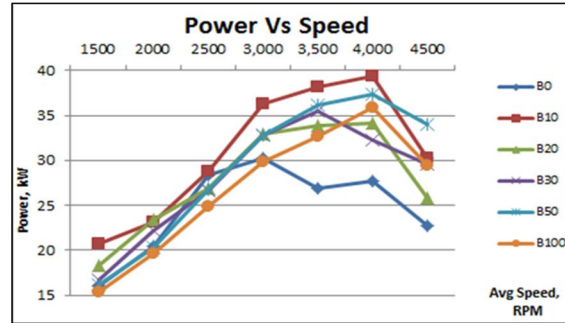
Avg Speed, RPM	Avg Torque, Nm					
	B0	B10	B20	B30	B50	B100
1500	108.3	109.2	109.2	106.1	105.2	97.1
2000	104	105.6	104.6	105.9	104.4	95.95
2500	87.75	94.85	102	102.5	102.2	94.8
3,000	93	101	102	105	104	99
3,500	89	89	93	92	98	89
4,000	80	80	82	79	89	85
4500	66.25	66	62.9	61.9	74.05	66.5



**Rajah 2.** Keputusan prestasi bagi tork yang dihasilkan

**Kuasa** adalah kadar kerja yang boleh dilakukan dalam suatu jarak masa. Hasil kajian sebagaimana ditunjukkan dalam **Rajah 3** mendapati nilai kuasa yang dihasilkan semakin berkurangan dengan pertambahan campuran Biodiesel. Ini adalah disebabkan oleh penurunan *calorific value* campuran Biodiesel.

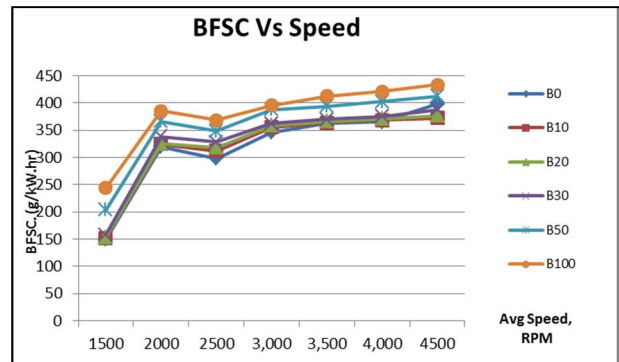
Avg Speed,RPM	Power, kW					
	B0	B10	B20	B30	B50	B100
1500	16.1	20.8	18.3	16.7	16.2	15.4
2000	20.4	23.1	23.4	22.2	20.3	19.6
2500	28.4	28.8	26.9	26.7	26.8	24.9
3,000	30	36	33	33	33	30
3,500	27	38	34	36	36	33
4,000	28	39	34	32	37	36
4500	22.7	30.2	25.8	29.6	34	29.4



Rajah 3. Keputusan prestasi bagi kuasa yang dihasilkan

**Kadar penggunaan bahan api** adalah kadar alir jisim bahan api per unit kuasa yang dihasilkan. Hasil ujikaji mendapati kadar penggunaan bahan api meningkat dengan peningkatan campuran Biodiesel seperti ditunjukkan dalam **Rajah 4** disebabkan nilai *flash point* dan nombor setana yang turut meningkat.

Avg Speed,RPM	BFSC, g/kW.hr					
	B0	B10	B20	B30	B50	B100
1500	150	152	154	158	204	244
2000	320	324	325	338	366	385
2500	298	312	318	328	348	368
3,000	346	355	358	362	388	395
3,500	362	364	366	370	394	412
4,000	365	368	371	375	402	421
4500	398	372	377	388	412	433

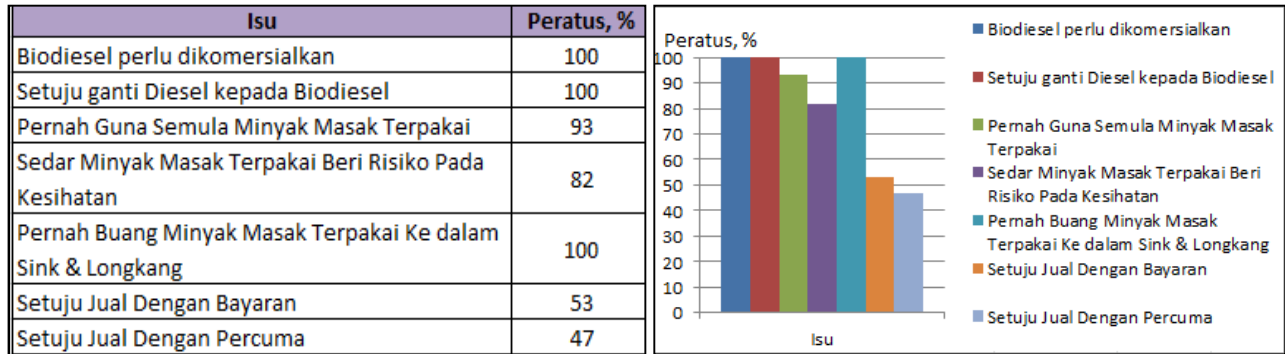


Rajah 4. Keputusan Kadar Penggunaan Bahan Api

Setelah mengambil semua faktor ujikaji, B50 dan B100 paling tidak sesuai digunakan kerana nilai kuasa dihasilkan lebih rendah berbanding B0. Sementara itu, walaupun B30, B50 dan B100 lebih mesra alam tetapi faktor jangka panjangnya yang akan merosakkan komponen enjin menjadi faktor utama kegagalan malah kajian daripada *Engine Manufacturers Association* (EMA) menyarankan penggunaan campuran Biodiesel melebihi 20% dalam jangka panjang memerlukan modifikasi bahan komponen dan penyelenggaraan enjin yang khusus. Perbandingan di antara B10 dan B20 pula mendapati, walaupun tork dan kuasa yang dihasilkan B10 lebih tinggi berbanding B20, tetapi faktor alam sekitar menjadi penentu utama penentuan campuran Biodiesel yang optimum kerana B20 memberikan emisi yang lebih rendah. Oleh itu B20 diputuskan sebagai campuran paling optimum berdasarkan pertimbangan beberapa faktor tersebut.

Hasil kajiselidik yang diperolehi mendapati walaupun 82% peserta sedar bahaya gunasemula minyak dalam masakan namun, 93% peserta masih menggunakannya manakala 100% peserta pernah membuang sisa baki minyak masak terpakai ke dalam sinki dan longkang. Secara umumnya, ini menunjukkan bahawa kesedaran terhadap penggunaan semula minyak masak terpakai dalam masakan masih rendah dan mula meningkat selepas

penganjuran seminar, namun ia telah menjadi budaya rakyat Malaysia yang sukar dikikis. Oleh itu, tindakan peningkatan kesedaran harus diambil segera bagi menangani isu kesihatan dan alam sekitar oleh kerajaan mahupun pihak swasta dengan menubuhkan badan-badan yang mengutip sisa minyak masak terpakai secara percuma atau pembelian dengan harga rendah bagi mengelakkan penggunaan semula serta pembuangan minyak masak yang tidak teratur. Kempen dan seminar perlu diperbanyakkan bagi memperkenalkan Biodiesel sebagai bahan api alternatif yang boleh dihasilkan menggunakan minyak masak terpakai. Keputusan lain yang boleh diperolehi daripada kaji selidik yang dijalankan turut ditunjukkan dalam **Rajah 5**.



**Rajah 5.** Keputusan Kaji Selidik

## 5.0 Kesimpulan

Kajian ini telah membuktikan bahawa Biodiesel boleh dijadikan bahan api alternatif menggantikan bahan api Diesel kerana sifatnya yang lebih bersih dan hampir menyamai prestasi Diesel murni. Prestasi Biodiesel terhadap enjin Diesel telah dibuat perbandingan melalui faktor jangka panjang dan faktor jangka pendek. Daripada hasil kajian, dapat disimpulkan B20 merupakan campuran yang optimum dan sesuai digunakan pada enjin Diesel tanpa sebarang modifikasi. Di ILPPG, Biodiesel telah digunakan sebagai bahan api menggantikan Diesel dalam sesi latihan. Satu kertas kerja telah dimajukan ke Ibu Pejabat JTM bagi memasukkan modul Biodiesel di dalam Silibus Pembelajaran Tahap 3 Automotif di seluruh ILJTM bagi tujuan pendedahan dan aplikasi teknologi bahan api alternatif. Semoga dengan langkah kecil ini, ilmu pengetahuan dan teknologi terkini dapat diaplikasikan dalam kehidupan seharian masyarakat ke arah kualiti hidup dan persekitaran yang lebih baik demi generasi masa hadapan. Kajian mendapati, keupayaan memperolehi sumber minyak masak terpakai masih lagi rendah disebabkan kesedaran terhadap kesan penggunaannya yang masih lemah. Diharap kajian ini juga akan mengelakkan orang ramai untuk menggunasemula minyak masak terpakai bagi mengelakkan penyakit kronik dan membuka minda masyarakat tentang alternatif lain yang boleh dilakukan terhadap minyak masak terpakai selain mengguna semula atau membuangnya di tempat yang tidak sepatutnya dengan penubuhan badan-badan yang membeli semula minyak masak terpakai bagi tujuan penghasilan Biodiesel secara komersial menggunakan minyak masak terpakai.

## 6.0 Rujukan

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**Jadual 2** : Standard Diesel IS 1460 dan Biodiesel ASTM 6751

PROPERTIES	Diesel IS 1460 Specification	Biodiesel ASTM 6751 Specification	Proposed BIS Specifications (B100)	DATA B5	DATA B20	DATA (B100)
Density (g/cm <sup>3</sup> )	820 to 870	NA	860-900	834.2	854.7	885.7
Carbon Residue (100%) % mass	Max. 0.3	Max 0.05	Max 0.05	0.04	0.01	0.01
Sulphated Ash, % mass	Max. 0.01	Max 0.020	Max 0.02	0.002	0.002	0.001
Total Sulfur, % mass	Max. 0.25	Max 0.05	Max 0.005	0.02	0.04	NIL
Cetane Number	Min. 48	Min 47	Min 51	50.4	54.6	56.6
Flash Point, °C	Min. 35	Min 100	Min 120	39.5	77	103
Copper Corrosion	Max. 1	No. 3b max	Max 1	1	1	1
Viscosity, 40 °C(cSt)	2.0 to 5.0	1.9-6.0	2.5-6.0	2.497	3.25	4.10
Neutralization Value (mg)	Max. 0.2	Max 0.8	Max 0.50	0.1	0.2	0.04
Free Glycerin,% mass	N/A	Max 0.02	Max 0.02	NA	NIL	0.01
Total Glycerin,% mass	N/A	Max 0.24	Max. 0.25	NA	0.05	0.22
CFPP, (°C)	Max. 6(W)	NA	NA	0.0	-1	0.0
Pour Point deg C	3 °C	NA	NA	-6	-3	NA
Water and sediments, (% mass)	NA	0.01	NA	0.05	0.04	<0.01

**BORANG SOAL SELIDIK – SEMINAR TEKNOLOGI BIODIESEL**

1. Kategori :  

Pengajar	Pelajar
----------	---------
2. Jantina :  

Lelaki	Perempuan
--------	-----------
3. Pada pendapat anda adakah teknologi Biodiesel di Malaysia perlu dikomersialkan?  

Ya	Tidak
----	-------
4. Adakah anda bersedia menggantikan Biodiesel sebagai bahan api kenderaan anda?  

Ya	Tidak
----	-------
5. Adakah anda pernah mengguna semula minyak masak terpakai dalam masakan anda?  

Ya	Tidak
----	-------
6. Adakah anda sedar penggunaan semula minyak masak terpakai boleh mendatangkan risiko penyakit kronik seperti tekanan darah tinggi, lemah jantung dan strok?  

Ya	Tidak
----	-------
7. Pernahkah anda membuang sisa minyak masak terpakai yang tidak digunakan ke dalam sinki, longkang atau saliran air yang lain?  

Ya	Tidak
----	-------
8. Adakah anda setuju jika wujudnya badan-badan tertentu yang bersetuju membeli kembali minyak masak terpakai ini atau badan-badan yang mengambil secara percuma minyak masak daripada anda?  

Beli semula	
Beri secara percuma	
9. Penghasilan bahan api biodiesel melalui pengumpulan minyak masak terpakai boleh membantu masyarakat mengurangkan risiko penyakit di samping menjadikan alam sekitar bebas daripada pencemaran. Adakah anda sedar dan akan menyokong program pengumpulan minyak masak terpakai jika program tersebut dilakukan di ILPPG?  

Ya	Tidak
----	-------
10. Apakah yang anda pertimbangkan bagi pemilihan bahan api kenderaan anda:  

Harga	Kadar penggunaan bahan api
Kecekapan	Mesra alam
Lain- lain sila nyatakan _____	
11. Jika ada bahan api yang mampu mengurangkan pengeluaran sehingga 60% CO<sub>2</sub>, adakah anda sanggup membayar harga lebih tinggi jika dibandingkan dengan diesel fosil sedia ada?  

Ya, RM _____	Tidak
--------------	-------
12. Adakah anda rasa Seminar Biodiesel ini memberi manfaat dan pengetahuan kepada anda tentang bahaya mengguna semula minyak masak terpakai, kesan buruk pembuangan yang tidak teratur minyak masak terpakai dan faedah minyak masak terpakai sebagai bahan api alternative?  

Ya	Tidak
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TERIMA KASIH

# M13 - The Perforation Of Plastic Materials Under Dynamic Loads Based On Experimental And Numerical Simulation Method

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## Abstract

*When a rigid object perforation collides with a plastic material at a specific kinetic energy, definitely the rigid object will penetrate the surface of plastic material. The plastic target will be perforated if the plastic's object energy provided was sufficient. This research has been focused on the deformation of ductile plastic target during perforation process of the rigid projectile based on the experimental and numerical simulation methods. An experimental approach mainly investigates the perforation process, and observes the tearing appearance of the plastic materials. Moreover, this approach can provide data on how well material can withstand penetration forces. Accurate assessment for yielding and the redistribution of stress- strain that occurs in a component as a result of plastic deformation can be obtained. At the same time a numerical simulation based on finite element method will be conducted. This can be a prospective analysis tool for future impact response predictions without conducting expensive experimental studies. At the end of the research, characteristics of specific plastic materials under dynamic impact loads can be obtained, and a validation of FEM numerical simulation can be concluded. The comparison between experimental and simulation works provide valuable information on both of the characteristics and behavior of plastic materials, supported by existing facts.*

**Keywords:** Plastic, Numerical Simulation, Impact Test, Penetration

## 1.0 Introduction

Due to their high strength, high stiffness, and low weight, plastic materials have been considered for various applications such as in housing, packaging industry and building industry, for the past decades or so. Moreover, the plastic material proved ability to fulfill demands in automotive sectors, electronics devices, aircraft, and military applications. It is because, plastic materials not only have good structural characteristic but also well in penetration and perforation resistance and structural integrity after impact [1].

Common plastic materials classified according to their thermal characteristics and the method of fabrication [2]. Therefore, the selection of plastic material should be taking into account the properties of materials such as impact strength, tensile strength, and hardness to indicate the suitability for selection [3]. For example, ductile plastic materials have superiority over brittle plastics, metals, wood, glass and paper due to moldability, ruggedness and low cost [4]

The analysis of plastic structures in terms of impact penetration and perforation by dynamic loads in many fields of engineering activities whether partially penetrated or completely perforated has attracted a great deal of attention. Comprehensive reviews of the relevant investigation and discussion can be found in the studies by [5][6][7][8][9][10][11][12][13][14][15][16][17] and [18].

## 2.0 Literature Review

There have numerous of comprehensive study and discussion on the impact and perforation [6][19]. Several assumptions also presented by a few researchers can be made as guidance, For example,[20][21][22] have presented a detailed numerical solution to the following idealized penetration problem.

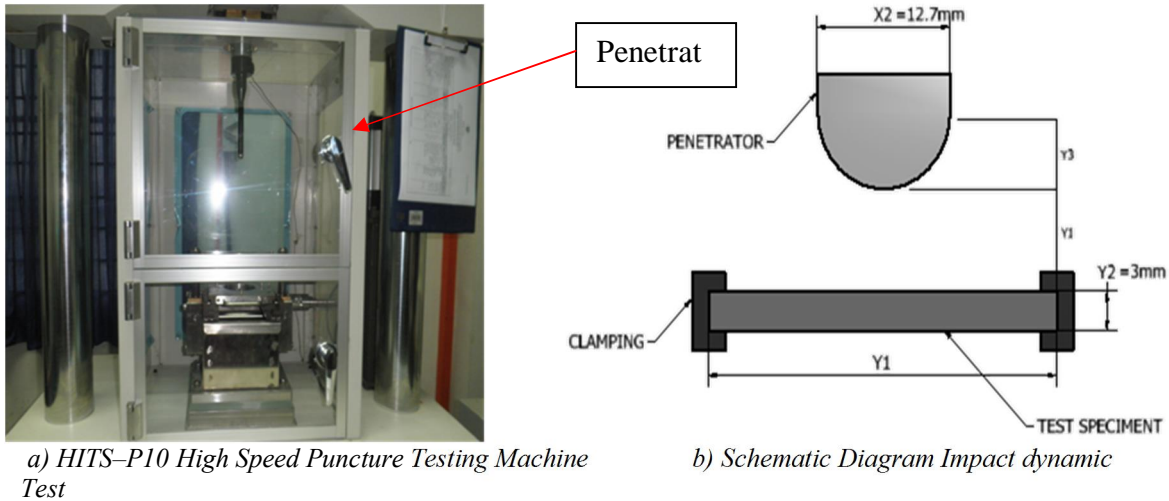
In Impact Mechanics, empirical method, analytical model and simulation used to perform the study of impact and perforation. The empirical method used due to their simplicity and good correlation with test results, which enables a quick first approximation and comparison to other methods. The early version of empirical formula for normal penetration and perforation mechanics was developed by [6].

The conservation and balance laws, and comprised of mathematical relationship can be determined by analytical approach. For example, it used to determine the resultant force applied on the projectile nose through resistance function based on dynamic cavity expansion theory.

The behavior of structures can also be reduced to a set of linear equations that can easily be solved using numerical simulation [23]. For example, it can be used to analyze impact problems and high speed metal-forming processes [24]. Another application for nonlinear problem in impact is also perform in dynamic-explicit finite element method [25]. In perforation mechanics, mesh less method can also be implemented [26]. The geometrical structure is described mesh-less functions that concludes a solution to predict the perforation process. In the present research, dynamic-explicit FEM is used as the analysis core to observe the Polyethylene in impact dynamic load simulation.

## 3.0 Experimental Setup

In the present research, plastic materials are tested using two different approaches. One is based on finite element method approach by using dynamic-explicit Impact Finite Element program suite, and the second one is based on experiment approach by using an impact machine of HITS óP10 High Speed Puncture Testing Machine as shown in Fig.1 (a). The penetrator tip diameter is 12.7 mm (ASTM 3763) and the specimen holding follows the penetrator. For the plastic puncture experiment, the specimen dimension for this clamping system should be 100mm x 100mm with the material thickness of 2 mm. It can be seen in schematic diagram of Fig.1 (b).



**Figure 1:** The HITS6P10 High Speed Puncture Testing Machine and Schematic Diagram for Impact Dynamic Load Test

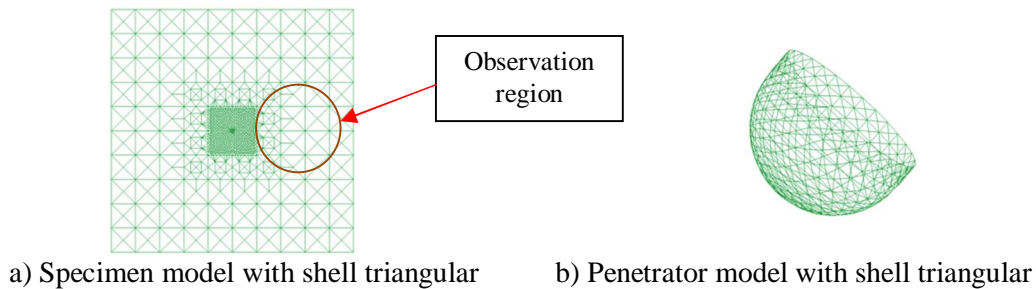
The plate material will be rigidly clamped except the unsupported in the middle (diameter 75 mm). The Penetrator strikes at the center of this unsupported region. The experiment is conducted in constant 20 ms of velocity.

#### 4.0 Finite Element Modeling

The finite element analysis is conducted in Impact Finite Element Program suite. There are four main steps to do the simulation: creating geometrical modeling, developing finite element meshing and defining Impact test scenario, running Impact solver and analyzing the results using the Impact post-processor.

The geometrical model and finite element meshing are done in pre-processor GiD. The preparation of Impact input file performed within GiD environment using a special module GiD to Impact interface provided by IMPACT. IMPACT solver is employed to simulate the perforation simulation process. To model the plastic plate with the thickness of 2 mm, deformable triangular elements are used. Local meshing refinement in the area of (20mm x 20mm) at the center of plate has been done to enable the detail observation of tearing process on impact as shown in fig. 2(a). The meshing illustration of the plate and penetrator can be seen in Fig. 2.

While, for the penetrator, only the tip of the penetrator is considered. This surface is modeled as triangular rigid surface is show in fig. 2(b) with a contact friction coefficient of 0.25 assumed.

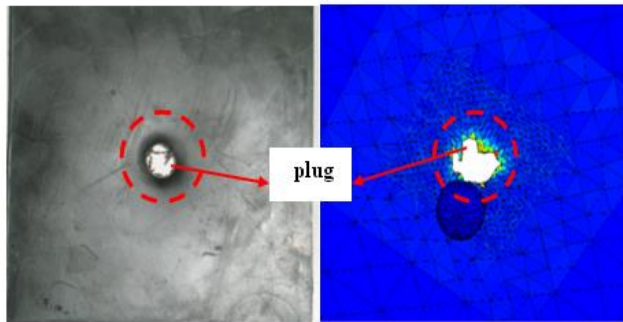


**Figure 2:** Specimen and Penetrator Modeling

The plastic polypropylene material has an isotropic modulus elasticity  $E=0.8\text{GPa}$ , Poisson's ratio 0.42, yield stress 35MPa, and failure strain 0.35. This failure strain 0.35 means when any element reaches the total strain of 0.25 the element will be released from the analysis. In Impact, this will simulate the splitting of the elements or releasing elements from the structure. The velocity simulation is a constant velocity set in 20 m/s (72 km/h).

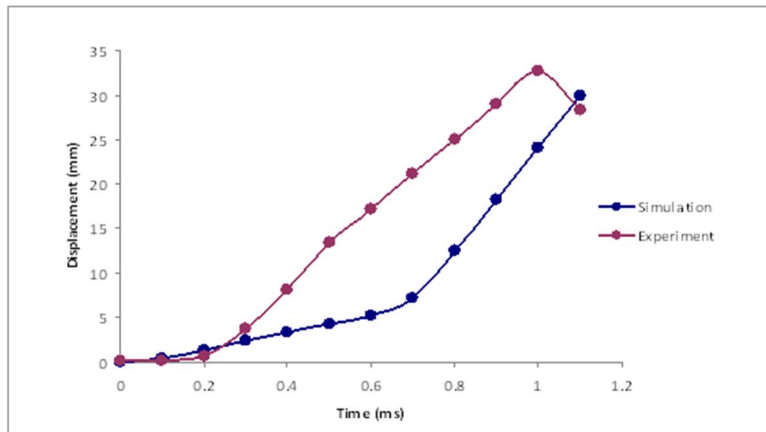
## 5.0 Results

The perforation sequence can be seen obviously after the analysis successfully conducted. The initial stage, the plastic strain starts to accumulate in the region of the middle of specimen. Caused by the sufficient energy, velocity and strain continues, some element starts splitting and followed by increasing the tearing process. Finally the penetrator completely through the plate and the plugs emerge around the hole after the perforation process. The illustration of the penetration stages are shown in Fig. 4.

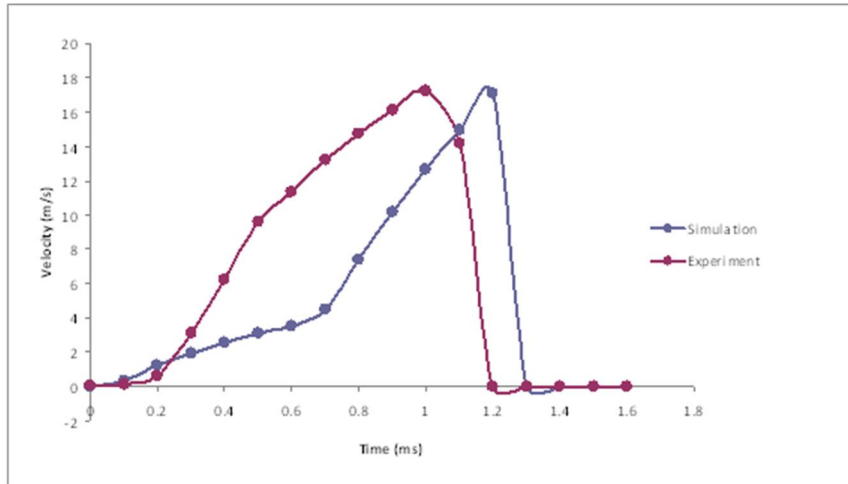


**Figure 4:** The comparison of perforation of Polypropylene specimen by experiment and simulation approaches

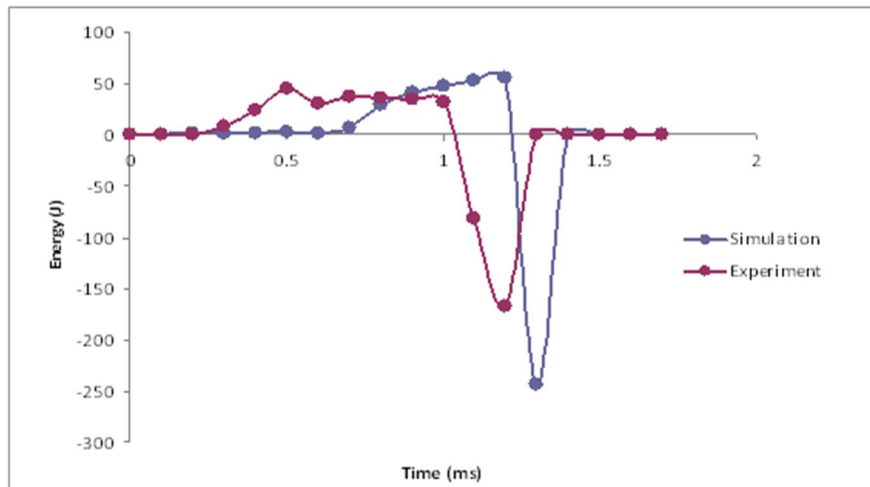
The displacement, velocity and kinetic energy history for plastic specimen is plotted and shown in Fig.5-Fig.7. The results obtained between experiments and are not much differ to one another. Observing the displacement, starting perforation is quite regular but then it become irregular due to condition of the sample at the ambient temperature. When the penetrator moves at high velocity (20 m/s), the hardness for penetration dramatically decreases until it discontinued due to it moves downward freely without load. During the perforation process, the kinetic energy is transferred to the plate. Plastic material (Polypropylene) are capable to absorbing much larger quantities of energy before failure.



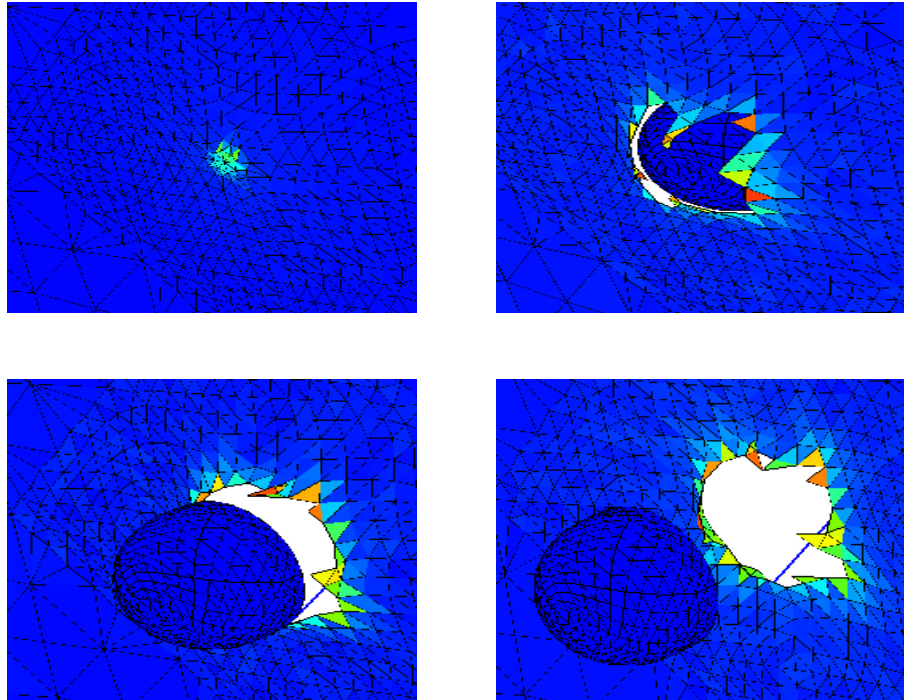
**Figure 5:** The displacement vs. Time graph for the polyethylene specimen



**Figure 6:** The velocity vs. Time graph for the polyethylene specimen



**Figure 7:** The Kinetic Energy vs. Time graph for the polyethylene specimen



**Figure 8 :** The perforation distribution of Polypropylene specimen by simulation approaches

## 6. Conclusion

When the numerical results were compared with the experimental data, excellent agreement was found. The overall physical behavior of the target plate during impact was very well described. In this analysis, the results obtained either by experiment or simulation test show that there were no large variations in the form of graphs produced. Although the result obtained in this research mostly are satisfied within the accuracy expected, the validity is still doubtful and endangers. The validity of the corresponding results which can be repeatedly checked by elaborate experiments beyond the scope of this work. It includes penetration of the applicable regulations, changes in the structure and dimensional changes of plastic.

## 7. References

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## M14 - Influence of Electrical Discharge Machining Parameters on Machining Characteristics of Beryllium Copper

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### Abstract

*The influence of electrical discharge machining parameters on machining characteristic of Beryllium Copper (BeCu) was studied. Electrical Discharge Machining (EDM) is one of the important non-traditional machining processes and it is widely accepted as a standard machining process in the manufacturing of forming tools to produce mould and die. The appropriate parameters were selected to study the influence of operating parameters of BeCu on machining characteristic, i.e., material removal rate. Electrolytic copper is selected as electrode with positive polarity. The experiment was done using SODICK AQ35L EDM machine. Two level approach of Full Factorial Design of Experiment (DOE) was applied to design the experimental and the data was analyzed by using ANOVA analysis and the optimal combinations of the process parameters were predicted. It was found that peak current was the most significant factor affecting the EDM machining characteristics. Further, pulse on time and pulse off time it must be combined with other factors in order to influence the machining characteristics. Finally, machine voltage was the less significant factor for this EDM process on BeCu.*

**Keywords:** *Electrical Discharge Machining, Full Factorial, EDM parameters, Design of Experiment (DOE), Beryllium Copper*

## 2.0 Introduction

Electrical Discharge Machining (EDM) is one of the most popular non-traditional material removal processes and has become a basic machining method for the manufacturing industries especially in mould and die making. In critical area such as deep slot, micro hole and sharp edge in pocketing, EDM is the most preferred method rather than using conventional machining [1,2]. It was known that Beryllium Copper (BeCu) is used in mould and die making for its high strength as well as good electrical and thermal conductivity. According report by Sagar [3], BeCu alloys usually used as an insert in mould to remove heat from the plastic as quickly as possible. The faster the mould can transfer heat out of the molten plastic and solidify it, the faster the mould can be run. It will reduce the cycle time which equates to reduced manufacturing cost

Since BeCu has a great function in mould making, the best combination of machine parameters should be studied to produce an optimum result on the EDM machining process. It was noticed that various machining parameters influence material characteristics such as material removal rate, electrode wear rate and surface roughness. The setting possible combination of those parameters was difficult to produce optimum surface quality [4]. Therefore, a comprehensive study of the effect of EDM parameters such as peak current, machine voltage, pulse duration and interval time on the machining characteristic is greatly significant and could be necessity [5].

In this study, the effect of machining parameters on machining characteristics of BeCu alloys in EDM die-sinking is studied. Thus, the design of experiment using Full Factorial was used to investigate the influence of EDM parameters on machining characteristic of BeCu.

### 3.0 Experimental Method

BeCu was used as a workpiece material for this study and electrolytic copper with size 12 mm (width) x 12 mm (length) x 32 mm (height) was selected as electrode. Bridge Port milling machine having maximum speed 4200 rpm was used to prepare the electrode and workpiece samples. The size of BeCu workpiece was 50 mm (width) x 50 mm (length) x 5 mm (height). SODICK AQ35L EDM machine was selected with peak current, machine voltage, pulse on time, and pulse off time as the parameters. Kerosene oil is used as dielectric fluid while machining characteristic to be investigated is material removal rate (MRR) and surface appearance. Mitutoyo weighing scale was used to get the calculation of MRR. Further, Surface crater was captured by Mitutoyo Digital Imaging Microscope. With the help of Design Expert software to analyze the result, Full Factorial design was selected and Analysis of Variance (ANOVA) is employed to evaluate the data.

**Table 1:** Parameters and levels selected for the experiment

Factors	Machine Parameters	Level	
		Low (-1)	High (+1)
A	Peak Current (A)	5	30
B	Machine Voltage (V)	10	45
C	Pulse On Time (µs)	5	200
D	Pulse Off Time (µs)	10	300

Table 1 shows the parameters used in this study and working level of design factor in Full Factorial method. Four factors and two levels were used in this experiment. There are 16 running processes and 2 centre points were performed from the equation of Full Factorial design. The Full Factorial design can be stated as below:

$$\text{Full Factorial Equation} = 2^k \text{ ----- (1)}$$

Where k denotes as the number of factors, i.e., peak current, machine voltage, pulse on time, and pulse off time, being investigated in this experiment and 2 is the level of experiment, i.e., low (-1) and high (+1). The analysis of ANOVA is employed in order to indicate the mathematical models of EDM machining characteristic using Design Expert software version 6.

### 4.0 Experimental Result

Table 2 shows the summarization of the data that was collected for this experiment. The measurements of weight were taken by using weight scale while the time of processes were taken from the monitor screen of machine after each machining. It is found that sample 14 shows the highest MRR while sample 12 shows less MRR. Sample 1 and 14 are the centre points of combination parameters. The calculation of MRR is taken from Equation 2.

$$MRR = \frac{W_b - W_a}{tm} \text{ (g/min)} \text{ ----- (2)}$$

Where:

$W_b$  = material weight before machining

$W_a$  = material weight after machining

$tm$  = machining time

**Table 2:** Experimental MRR results

Run	Factor A	Factor B	Factor C	Factor D	MRR (g/min)
	Peak Current (A)	Machine Voltage (V)	Pulse On Time ( $\mu$ s)	Pulse Off Time ( $\mu$ s)	
1	17.5	27.5	102.5	155	0.1549
2	5	10	200	10	0.0293
3	30	10	5	10	0.1250
4	17.5	27.5	102.5	155	0.1493
5	5	10	5	10	0.0063
6	30	10	5	300	0.1463
7	5	10	200	300	0.0185
8	30	45	200	300	0.1431
9	30	45	200	10	0.1347
10	30	10	200	300	0.1141
11	30	45	5	300	0.1538
12	5	45	200	10	0.0129
13	30	45	5	10	0.1565
14	30	10	200	10	0.1613
15	5	45	5	300	0.0136
16	5	10	5	300	0.0160
17	5	45	5	10	0.0387
18	5	45	200	300	0.0331

## 5.0 Analysis of Variance

The Analysis of Variance (ANOVA) is to be carried out to examine the influence of process parameters on the machining characteristic of BeCu. Based on ANOVA analysis of MRR in Table 3, it can be seen that the model is significant with probability, Prob>F value between 0.0001 to 0.0478 less than 0.05. It shows that the main Factor A and Factor B, interaction between Factor BC, ACD and BCD are significant at 99 percent.

Figure 1 is clearly support the ANOVA analysis identified the significant factor where Factor A peak current is the most far away from normal plot following by Factor B machine voltage. From the analysis, it shows that the most significant parameter in EDM die-sinking process of BeCu is peak current rather than the machine voltage.

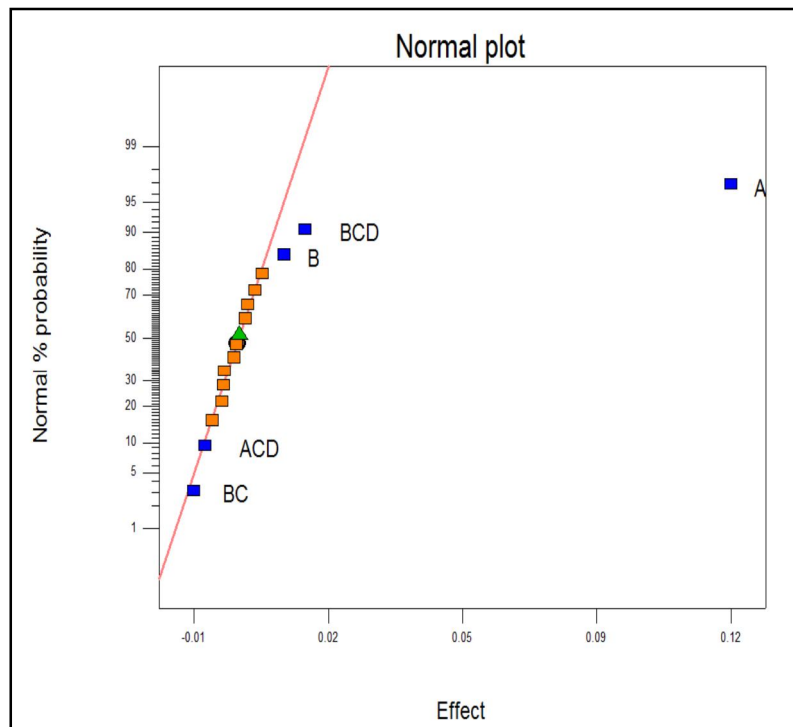
**Table 3: ANOVA table for MRR**

Response: MRR

ANOVA for Selected Factorial Model

Analysis of variance table [Partial sum of squares]

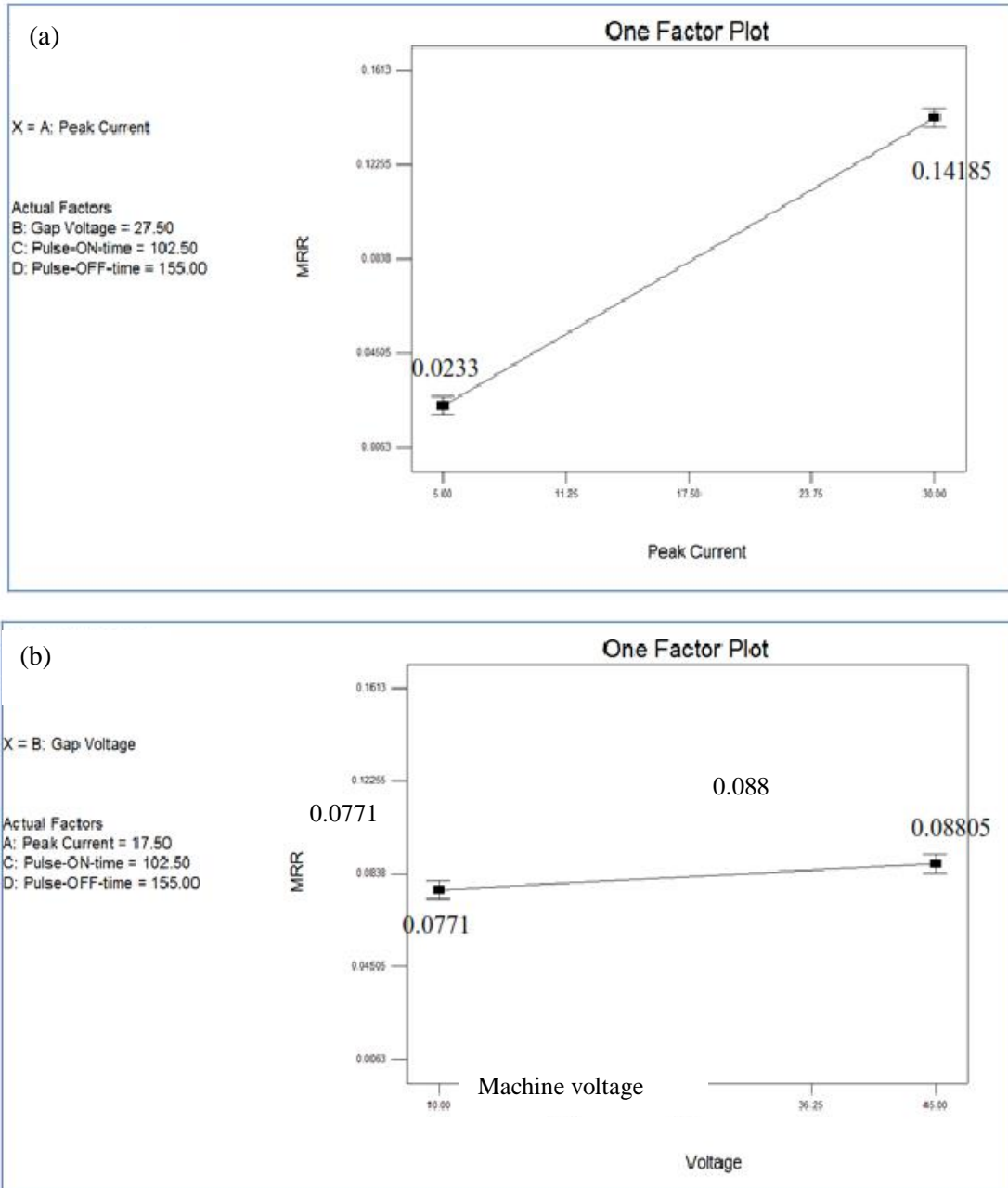
Source	Sum of Squares	DF	Mean Square	F Value	Prob > F	
Model	0.058	5	0.012	225.04	< 0.0001	significant
A	0.056	1	0.056	1082.48	< 0.0001	
B	4.796E-004	1	4.796E-004	9.24	0.0113	
BC	4.666E-004	1	4.666E-004	8.98	0.0121	
ACD	2.576E-004	1	2.576E-004	4.96	0.0478	
BCD	1.014E-003	1	1.014E-003	19.53	0.0010	
Curvature	8.593E-003	1	8.593E-003	165.47	< 0.0001	significant
Residual	5.713E-004	11	5.193E-005			
Lack of Fit	5.556E-004	10	5.556E-005	3.54	0.3932	not significant
Pure Error	1.568E-005	1	1.568E-005			
Cor Total	0.068	17				



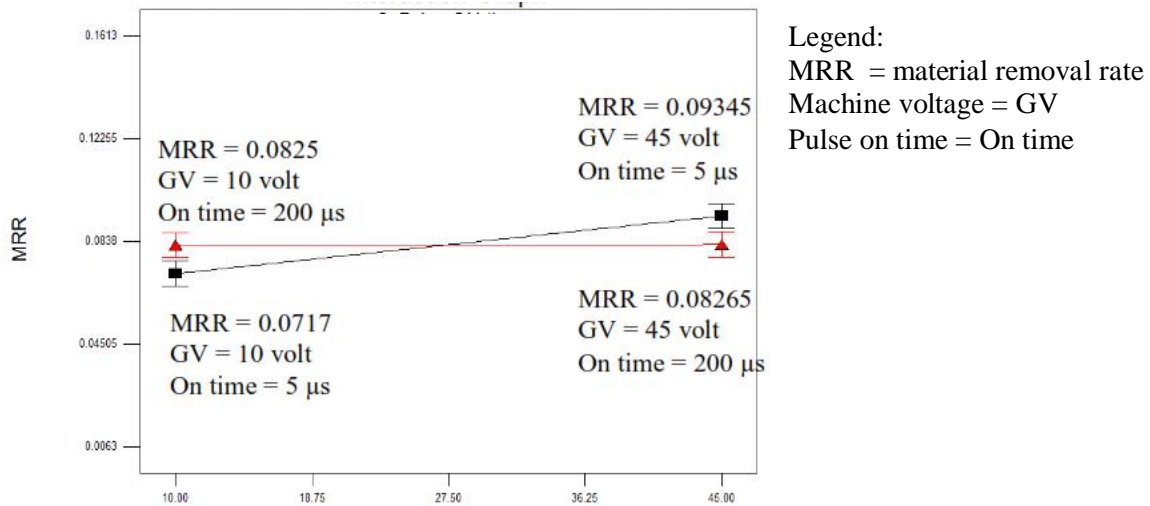
**Figure 1: Normal probability plot for MRR**

Factor C pulse on time and Factor D pulse off time must be combined with Factor A peak current and Factor B machine voltage to influence the MRR as shown in Figure 1. It shows that Factor C pulse on time and D pulse off time cannot stand alone as compare to Factor A peak current and Factor B machine voltage.

Figure 2 shows one factor plot with centre point parameters; Factor A peak current 17.5 A, Factor B machine voltage 27.50 V, Factor C pulse on time 102.50  $\mu$ s and Factor D pulse off time 155  $\mu$ s. Based on main effects for MRR, it shows that when peak current increases the value of MRR is also increased dramatically. Meanwhile, the increasing of value MRR in machine voltage is almost flat. It means that peak current is the most significant factor for MRR.



**Figure 2:** One factor plot (a) Factor A peak current and (b) Factor B machine voltage dependence of MRR



**Figure 3:** Interaction graph of Factor BC for MRR

Based on Figure 3, interaction between Factor B machine voltage and Factor C pulse on time is significant with respect to MRR. In order to get a maximum value of MRR which is 0.09345 g/min, the Factor B machine voltage is set at high level 45 V and Factor C pulse on time is set at low level 5  $\mu$ s. Meanwhile, for minimum value of MRR which is 0.0717 g/min, both Factor B machine voltage and Factor C pulse on time is set at low level value which is 10 V and 5  $\mu$ s respectively.

## 6.0 Conclusion

In this study, the influence of EDM parameters on machining characteristic of Beryllium Copper was investigated. The machine voltage is the less significant factor, while peak current is the most significant factor. The higher value MRR can be obtained with combination of high level setting of peak current and pulse on time. The changes of peak current and pulse on time have contributed to a great influence of MRR. It can be concluded that a storage spark with higher energy is produced when increasing peak current, subsequently; more heat is generated and substantial quantity of heat utilized in material removal.

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# M15 - Effects of Hot Dip Galvanizing (HDG) Coating Modes on the Mechanical Properties of A36 Mild Steel

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## ***Abstract***

*This paper presents the results of a research on the effects of HDG coating modes on the mechanical properties of A36 mild steel. Three different coating modes were conducted on the specimens, namely Mode 1: specimens were cut to a standard dimension, followed by galvanizing; Mode 2: specimens were galvanized before the cutting process and the uncoated surfaces were covered by cold galvanizing; and Mode 3: specimens were galvanized before the cutting process, without cold galvanizing. Tensile, hardness, and impact tests were performed to determine the mechanical properties of the galvanized specimens. Analysis of the results showed that Mode 1 produced the best mechanical properties in all tests.*

**Keywords:** *Hot Dip Galvanizing, Mechanical Properties, Coating Modes*

## **1.0 Introduction**

Hot Dip Galvanizing (HDG) is the process of applying a protective zinc coating to steel, to prevent rusting. The HDG process involves passing the metal through a molten bath of zinc, at a temperature in the range 445 to 460°C. When exposed to the atmosphere, the pure zinc reacts with oxygen (O<sub>2</sub>) to form zinc oxide (ZnO), which further reacts with carbon dioxide (CO<sub>2</sub>), to form zinc carbonate (ZnCO<sub>3</sub>). Zinc carbonate is usually a dull grey, fairly strong material, which in many circumstances stops further corrosion and protects the steel below it. Galvanized steel, which is identified by the crystallization patterning on the surface, is widely used in applications where rust resistance is needed [1].

The four processes of galvanization are surface preparation, pre-fluxing, galvanizing, and finishing. Surface preparation consists of cleaning and pickling operations that free the surface from dirt, grease, rust, and scale. Pre-flux serves to dissolve any oxide that may have formed on the steel's surface after pickling and prevents further rust from forming. Clean, oxide-free work, is galvanized by immersion into molten zinc. Finishing includes quenching, removing excess zinc, and inspection [2].

Only a few previous studies, which have addressed the mechanical properties of galvanized steel, were available. Furthermore, no researches have studied the effects of HDG coating modes on the mechanical properties of tested materials. This study will focus on the effects hot dip galvanizing with different coating modes on the mechanical properties of mild steel, in order to determine the best protective coating modes.

## **2.0 Material and Methodology**

A36 mild steel was used as the main material in this research. A36 steel is a low carbon mild steel, used primarily as a structural material. The percentage level of carbon results by



increment in the strength and hardness of the steel. The mechanical properties of A36 mild steel, galvanized using three different modes, were examined. A36 mild steel was prepared using three different coating modes, and included a control specimen. All the specimens were prepared as described and illustrated in Figure 1:

**i. Controlled Specimen (C0)**

A controlled specimen was prepared from an A36 mild steel bar, according to the standard dimensions for each test. This specimen was tested to gain actual data for the A36 mild steel.

**ii. Mode 1 (C1)**

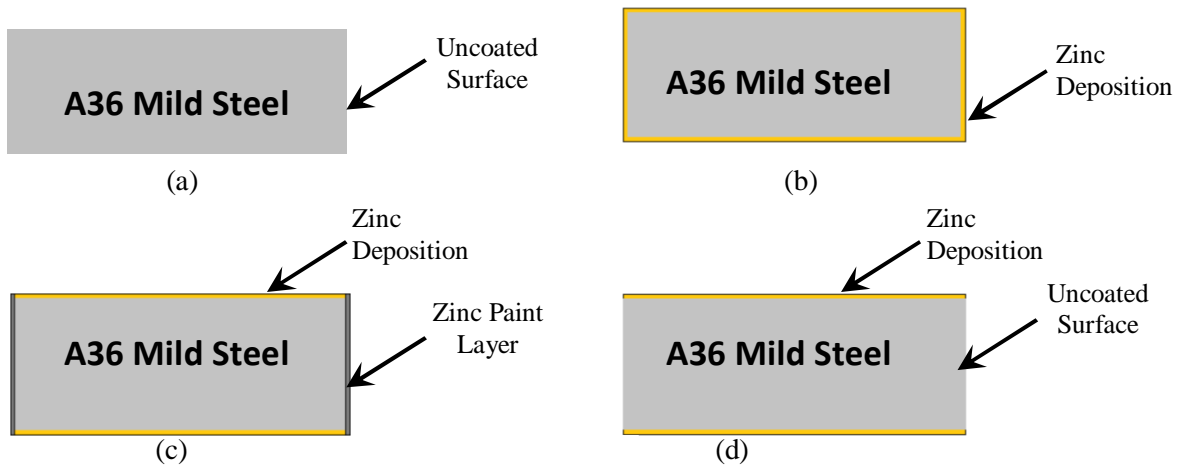
For Mode 1, A36 mild steel specimens were cut according to the standard dimensions for each test, followed by the galvanizing process. After the galvanizing process, all specimen surfaces were fully covered and protected with the zinc coating.

**iii. Mode 2 (C2)**

For Mode 2, an A36 mild steel bar was galvanized before the cutting process, according to the required dimensions. After the cutting process, some surfaces were not covered with the zinc. These uncovered areas were coated by cold galvanizing, which is a zinc paint application used on uncoated surfaces. In summary, specimens were coated using HDG before the cutting process and finished with cold galvanizing. As a result, all surfaces were coated with zinc using two different galvanizing processes.

**iv. Mode 3 (C3)**

The Mode 3 process was similar to Mode 2; however, the specimens did not undergo the final process of cold galvanizing. For these specimens, all surfaces were not fully coated with zinc. Therefore, the cut surfaces remained uncoated.



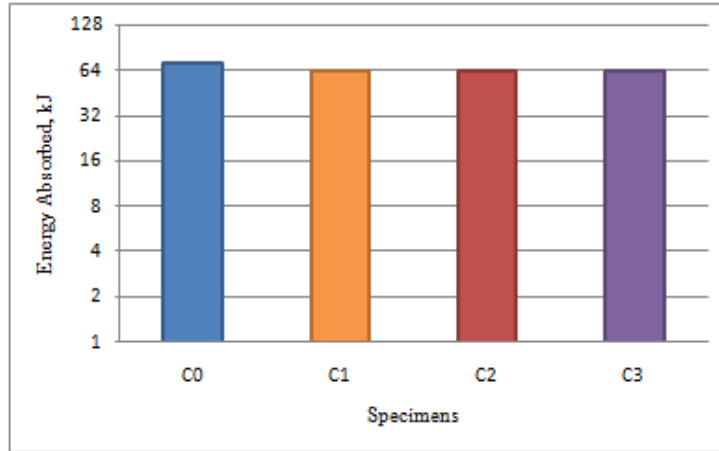
**Figure 1:** Illustration of the prepared specimens (a) Controlled, (b) Mode 1, (c) Mode 2, and (d) Mode 3.

After all specimens were prepared, tests were conducted to obtain their mechanical properties. Impact tests were carried out at room temperature using a Charpy Izod Impact Tester 300J to determine the energy absorbed by the specimens. Tensile tests were conducted using a Comotech Testing Machine, model QC-505A. The speed rate for the test was set at 50 mm/minute. Finally, Rockwell hardness tests were performed using an Affri 250 MRS hardness testing machine. In this test, RB -  $\frac{1}{16}$  in. hardened steel ball indenters were used. The indenter was forced into the samples under a minimum load of 100kg.

### 3.0 Results and Discussions

#### 3.1 Charpy Impact Test

Figure 2 shows the results of the Charpy impact test. The maximum energy absorbed by the C0 specimen was 71.84 kJ. The next highest value was the C3 specimen, with 64.48 kJ, followed by C1 and C2, with 64.17 kJ and 64.07 kJ, respectively. The energy absorbed by these galvanized specimens decreased by around 10%, compared to the C0 specimen. These results show that the C0 specimen had highest toughness value, compared to the galvanized specimen.



**Figure 2:** Energy absorbed results of A36 mild steel with different coating modes

Mater [3] states that the presence of a zinc bonding layer gives a sliding decrease in the toughness value of the steel. The toughness drop for galvanized specimens C1, C2, and C3, was caused by the zinc layer that was bonded to the A36 mild steel. Pure zinc has low toughness. The impact will be absorbed by the zinc layer first, when the specimen absorbs the impact. This condition affects the toughness value of the mild steel underneath the zinc layer. Moreover, the results of the C1, C2, and C3 specimens were insignificant. The different coating modes did not produce any major effect amongst all of the galvanized specimens.

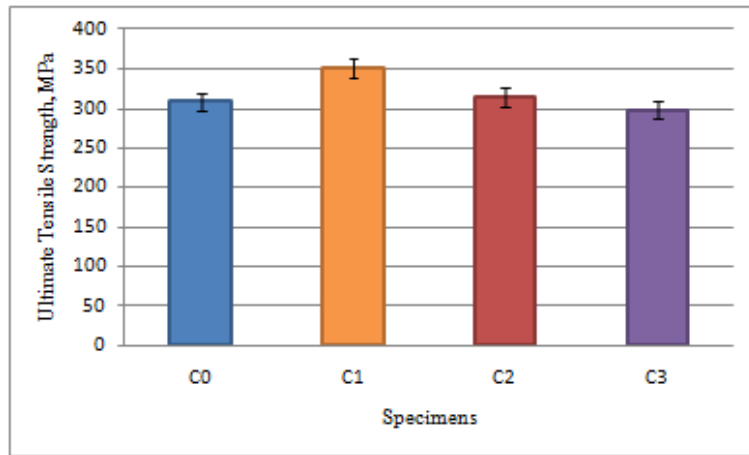
Besides that, the galvanizing method's quenching process was also a solid reason for the drop in energy absorbed. According to Sunil et al. [4], the surface contact of a metal in the quenching process will affect the result. If the surface's contact to the quenching medium is uneven, it will reduce the toughness of the surface differently, for all areas of the metal. When steel undergoes a sudden temperature drop, the steel's surface will react by producing micro sized fractures.

#### 3.2 Tensile Test

Figure 3 shows the ultimate tensile strength results. The maximum value was gained by the C1 specimen, with a value of 351.07 MPa, and followed by the C2 specimen with a 314.21 MPa value, C0 specimen with a 308.04 MPa value, and finally the C3 specimen, with a value of 297.75 MPa. It can be seen from Figure 3 that the existence of the zinc coating on the surface of the A36 mild steel increased the tensile strength of the specimen [5]. However, the C3 specimen's value was similar to that of the controlled specimen. This was due to the

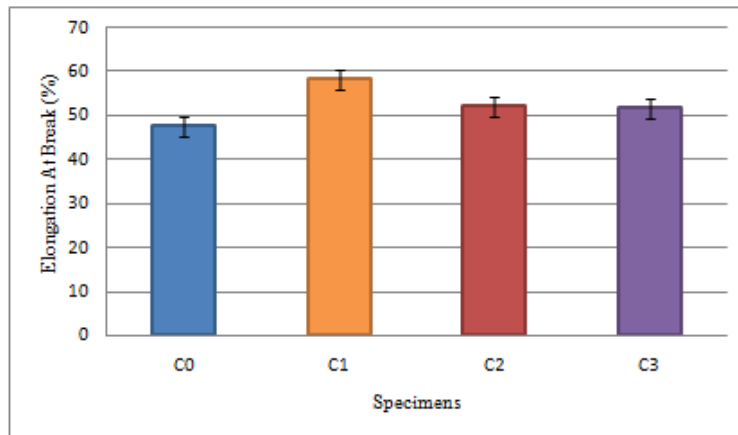
uncoated surface of the specimen. The side surface of the gauge area in the C3 specimen was not coated, either by hot dip galvanizing or cold galvanizing (zinc paint). Therefore, the tensile strength was similar to that of the C0 specimen.

The zinc layer acted on the stretch force, before reaching the A36 mild steel's surface. From observation, necking occurred on the zinc first, before taking place on the mild steel's surface. Overall, the ultimate tensile strength for the fully galvanized specimen was higher than that of the controlled steel specimen. Therefore, the galvanizing coating increases the tensile strength of the material.



**Figure 3:** Ultimate tensile strength of A36 mild steel with different coating modes

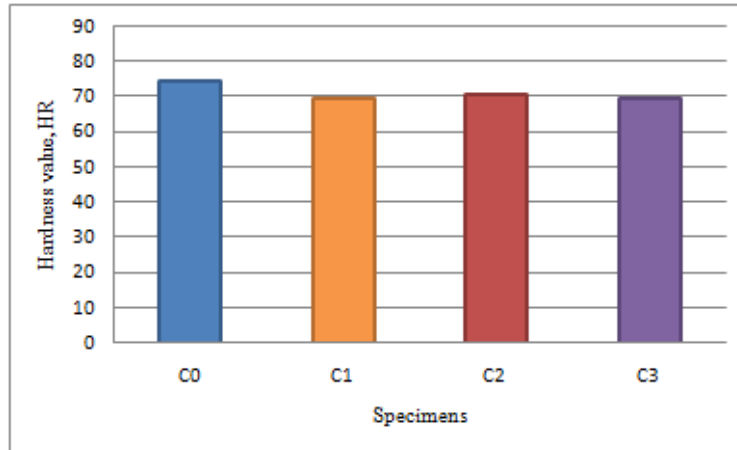
Figure 5 shows the elongation at break. The results show that all coated specimens had high ductility, compare to uncoated specimens. The C1 specimen showed the highest elongation at the break, at 58.42%. Ductility increased to about 18.5% for the C1 specimen, compared to the C0 specimen. This was followed by the C2 specimen with 52.09%, and the C3 specimen with 51.73%. The presence of the zinc layer on top of the mild steel increased the ductility of the material. According to Htun *et al.* [6], the zinc layer, which is bonded to the mild steel, increases the elongation value. The graph proves this statement; as all values of elongation at the break for galvanized steel, are higher than that of the controlled specimen.



**Figure 5:** Elongation at break of A36 mild steel with different coating modes

### 3.3 Rockwell Hardness Test

The Rockwell hardness value (HRB) results are shown in Figure 6. The graph shows that the C0 specimen had the highest value of 74.73 HR, followed by the C2 specimen with 70.93 HR, and C1 and C3 specimens, with 69.36 HR and 69.49 HR, respectively. The hardness value of the galvanized specimen dropped around 7%. The HR value of the C0 specimen was higher, because the surface of the mild steel was not coated with either hot dip galvanizing or zinc paint. Thus, the indenter only penetrated the solid A36 mild steel's surface, which is harder than a zinc layer. The hardness values varied typically with the ductility of the materials.



**Figure 6:** Hardness value results of A36 mild steel with different coating modes

The graph clearly shows that galvanized specimens had low hardness compared to that of the C0 specimen. All coated specimens showed insignificant differences. The drop of hardness values in all coated specimens were mainly caused by the zinc coating. There was an intermolecular change when the mild steel was hot dip galvanized. Therefore, the material's surface properties were different from that of the C0 specimen; because zinc was bonded to all of the coated specimens. As a result, the indenter penetrated the zinc coating first before reaching the A36 mild steel's surface. Because zinc is classified as a soft steel (compared to A36 mild steel), it influences the HR result. Furthermore, the quenching process was another vital reason why the hardness value dropped; as discussed previously in Section 3.1.

### 4.0 Conclusion

Based on the results obtained, and observations made during the testing, it is concluded that insignificant changes to the mechanical properties were observed in all coated specimens. It is clearly proven that the galvanizing process affects the material properties of A36 mild steel. This is caused by the zinc material bonded on the A36 mild steel and the temperature change of the material during the galvanizing process. The material properties of zinc influence the material properties of A36 mild steel beneath it. The best coating condition is concluded to be C1, where the specimen is fully galvanized using zinc deposition.

## 5.0 Acknowledgement

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# M16 - Effects of Painting, Hot Dip Galvanizing (HDG), and Duplex Coating, on the Mechanical Properties of A36 Mild Steel

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## **Abstract**

*The purpose of this work is to investigate the influence of painting, hot dip galvanizing, and duplex coating, on the mechanical properties of A36 mild steel. Tensile, Charpy impact, and Rockwell hardness tests were performed to examine tensile strength, yield strength toughness, and hardness, respectively. The result obtained from the controlled specimen was used as the reference value. It was found that hardness and toughness properties dropped, when compared to the controlled specimen; while strength and ductility showed an increment. Duplex coating showed the best mechanical properties, when compared to both painting and HDG.*

**Keywords:** *Hot dip galvanizing, Painting, Duplex, Mechanical properties*

## **1.0 Introduction**

The most common and easy method used to prevent corrosion, is painting. This method is widely used, because it is easy and low cost, right from the start. For example, in the case of billboards; painted billboards have to undergo extreme Malaysian equatorial weather conditions, where they are exposed to heat and humidity throughout the year. They can easily rust after only a few years; or in the worst conditions, in just a year, due to perfect rusting conditions, which includes moisture and oxides [1]. Many manufacturers are unaware that there are other methods available to prevent corrosion, which are Hot Dip Galvanizing (HDG) and Duplex. Hot dip galvanizing uses zinc and zinc alloy coatings, and is one of the most commercially important and oldest methods used to protect steel from corrosive media. Hot dip galvanizing is the process of coating iron or steel with a layer of zinc, by passing the steel through a molten bath of zinc, at a temperature of around 460°C [2,3]. If hot dip galvanized steel is painted, the duplex system provides a more sophisticated method of corrosion protection. The galvanized coating protects the base steel by providing both cathodic and barrier protections. The paint coating acts as a barrier for the hot dip galvanized coating, and significantly reduces the corrosion rate of the zinc [3, 4]. Even though this method is not commonly used (due to higher initial costs than painting), it is able to provide many years of maintenance-free protection. This paper seeks to identify the best protective coating (according to its mechanical properties), of painting, HDG and Duplex.

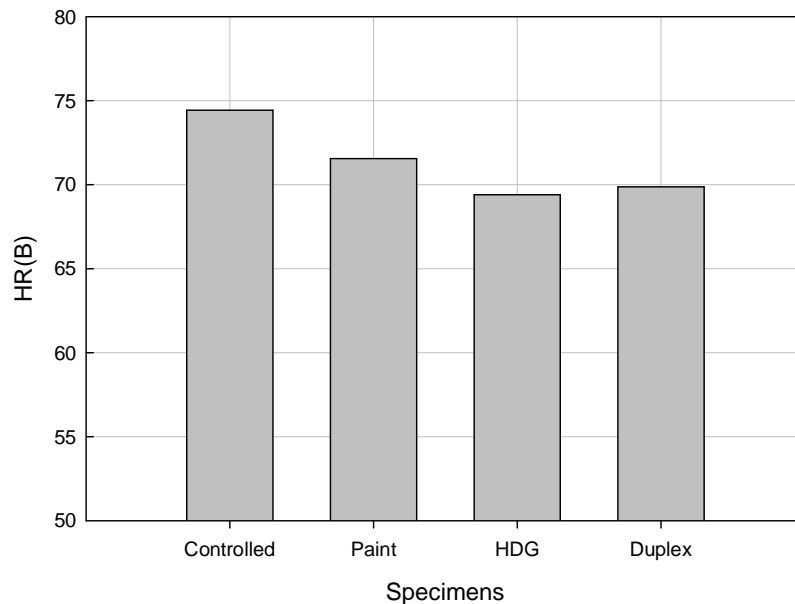
## **2.0 Materials and Methodology**

A36 mild steel plates were used as specimens for the evaluation of mechanical properties of the different types of coating methods. First, A36 mild steel was prepared and cut according to ASTM (American Society for Testing and Materials) standards for each test. Next, specimens were cleaned and coated using three different coating methods, namely painting, HDG, and Duplex. Mechanical tests were then conducted to obtain the mechanical

properties of each specimen. A Hardness test machine (Affri 250 MRS), Universal Material Tensile Machine (Cometech Testing Machine, QC-505A), and Charpy Izod Impact Tester 300J, were used to investigate the mechanical properties of A36 mild steel.

### 3.0 Results and Discussion

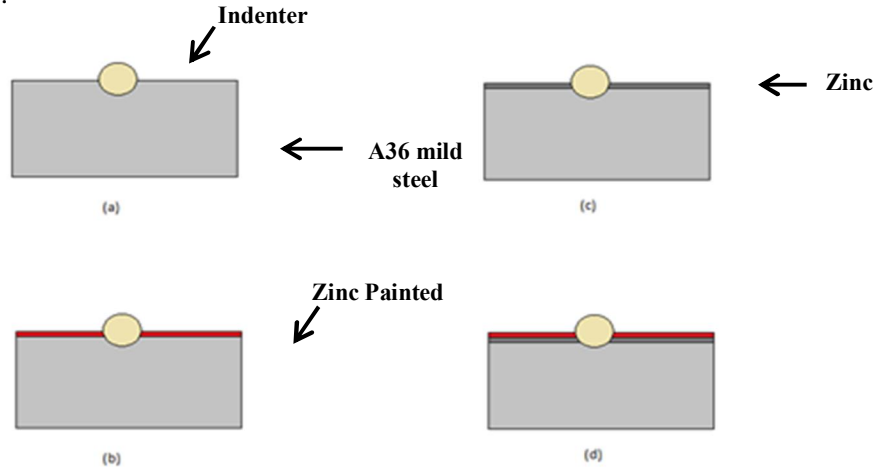
Figure 1 shows the results of the hardness tests using specimens with different types of coatings. It can be seen that the controlled specimen had the highest value of hardness, at 74.43 HR, whilst the lowest was achieved by HDG (at 69.4 HR). This was because the surface of the controlled specimen was uncoated. Therefore, the indenter directly penetrated the solid A36 mild steel hardened surface, as shown in Figure 2(a). The hardness values varied typically according to the ductility of the material. The different values of hardness occurred due to the zinc coating. An intermolecular change occurred when the A36 mild steel was coated with zinc using the HDG method. Therefore, the material's surface properties were different compared to the controlled specimen, because zinc was deposited onto the surface. Furthermore, the quenching effects of HDG also influenced the hardness. Quenching is performed to prevent ferrite or pearlite formations, and allow bainite or martensite to be formed. Transformation in the solid state can be obtained using heat treatment procedures that cause changes in the microstructure, thus resulting in materials with a wide range of hardness and mechanical properties [5].



**Figure 1:** Hardness results for A36 mild steel with different types of coatings

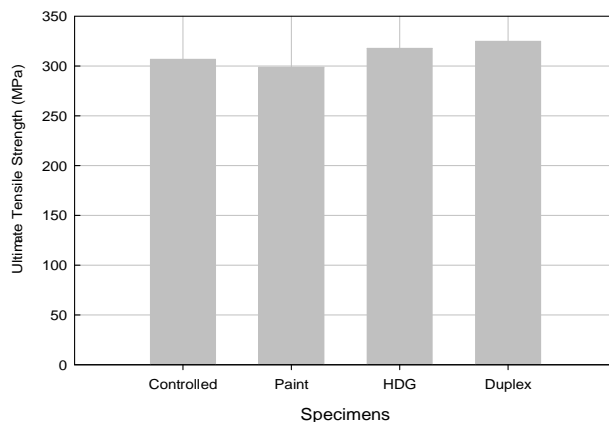
Nevertheless, the indenter penetrated the zinc coating before it reached the A36 material surface (as shown in Figure 2 (b)). The zinc was classified as soft steel compared to A36; and therefore, it influenced the HR result. The paint coating stuck to the surface and was not bonded with steel, like HDG (as shown in Figure 2 (c)). The HR value for the Duplex specimen was low. The combination of paint and HDG coatings was penetrated by the indenter; and therefore, the HR value was varied because the protective layer reduced the depth to reach the A36 surface (as shown in Figure 2 (d)). If the coating was thicker, it may have become brittle and susceptible to applied stresses. This may have separated the galvanized coating from the steel underneath [2]. In conclusion, when the coatings were applied to the material, the HR values changed. Furthermore, the type of coating also

influenced these changes. The existence of a coating eventually reduces localized plastic deformation [6].



**Figure 2:** Illustration of the Rockwell Hardness Test (a) Controlled specimen, (b) Painted specimen, (c) HDG specimen, and (d) Duplex specimen.

In order to further study the effects of different coating methods on the mechanical properties of A36 mild steel, a tensile test was conducted to evaluate ultimate tensile and yield strengths. Figure 3 shows the ultimate tensile strength and the maximum stress that A36 could withstand using different coating types; while being stretched before necking occurred. The Duplex specimen had the highest ultimate tensile strength (at 324.79 MPa), followed by HDG (317.68 MPa), controlled (300.66 MPa), and painted (298.68 MPa). The provided paint and HDG coatings, helped to distribute and absorb parts of the stress, when the specimens were stretched. Therefore, there was a difference in the Duplex specimen, compared to the controlled specimen. Meanwhile, for the painted specimen, the tensile strength had no significant change compared to the controlled specimen. Finally, for the HDG specimen, it was clear that the existence of the zinc coating increased the ultimate tensile strength. This was for the same reason as the Duplex specimen, whereby the zinc acted on the stretched force, before it reached the A36 mild steel's surface. As observed, necking occurred on the zinc first, before taking place on the A36 mild steel's surface. In conclusion, the zinc coating improved the ultimate tensile strength.

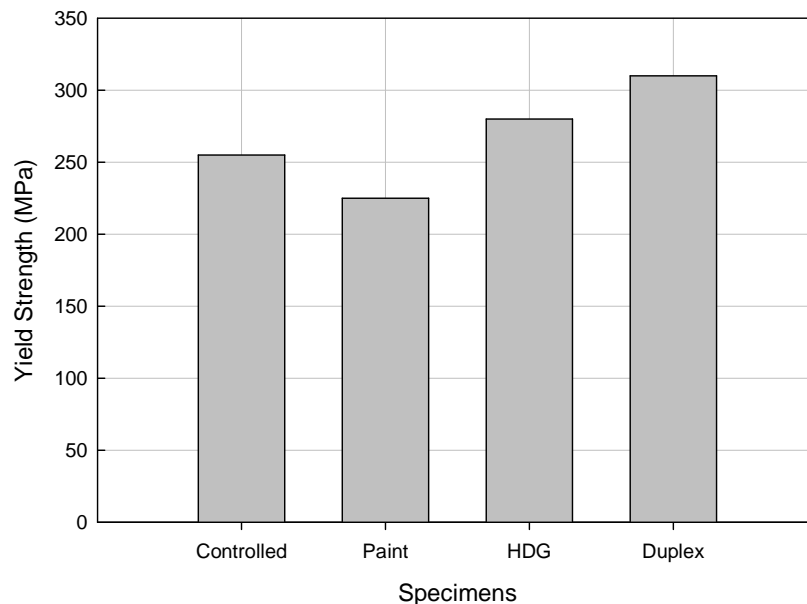


**Figure 3:** Ultimate tensile strength (or maximum stress) results of the A36 mild steel coated with different types of coating.

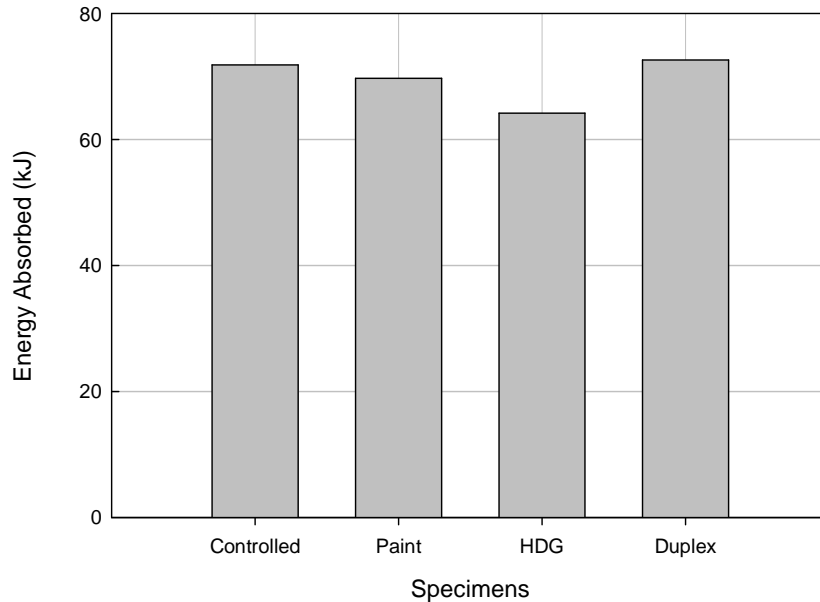


Figure 4 shows the yield strength obtained for A36 mild steel using different types of protective coatings. The standard yield strength for A36 mild steel is 250 MPa (American Galvanizer Association, 2012). The Duplex system had the highest yield strength (310 MPa), followed by HDG (280 MPa), controlled (255 MPa), and painted (225 MPa). The main factor attributing to this is that the two layers used in the Duplex coating interrupts the plastic deformation, when zinc and paint are present as a coating on the mild steel's surface. Therefore, the yield strength increases. Meanwhile, the HDG specimen's yield strength increased, the control specimen was close to the standard data, and the painted specimen's yield strength decreased. This was because the surface's peeling paint when being stretched did not affect the plastic deformation process. The paint was only stuck to the surface, and not bonded like the zinc was. In conclusion, the existence of a protective zinc layer increased the yield strength of the A36 mild steel.

Finally, the impact test results' trend shows that the Duplex specimen had the highest energy absorption value (72.6 kJ), followed by controlled (71.84 kJ), painted (69.7 kJ), and HDG (64.17 kJ); as shown in Figure 5. The Duplex coating, consisting of paint and zinc, slightly influences the difference obtained from the energy absorption of the controlled specimen. Therefore, the double layer provides an equal protection to that of the control specimen. There were no significant changes in the Duplex and controlled specimen's energy absorption. Meanwhile, for the HDG and painted specimens, the energy absorption values dropped from that of the controlled specimen. The lower the energy absorbed is normally classified as a brittle material, while the higher the energy absorbed is classified as ductile or tough materials. Zinc, as a low toughness material, influences the energy absorbed when the impact occurs. From the results, the HDG specimen was considered as a low toughness material; while the Duplex, controlled, and painted specimens, were considered as higher toughness material.



**Figure 4:** Yield strength results of A36 mild steel coated with different types of coating



**Figure 5:** Energy absorbed results of A36 mild steel coated with different types of coatings

#### 4.0 Conclusion

Insignificant mechanical property changes were observed from all results obtained. Overall, in certain conditions, there were slight increases and decreases in mechanical properties. It can therefore be concluded that the Duplex system gives the best protective coating compared to painting and HDG.

#### 5.0 Acknowledgment

The authors acknowledge Universiti Selangor for their financial support through UNISEL BESTARI Grant Research GPB-UNISEL13/ST-004 and Super Galvanising (M) Sdn Bhd for their outstanding continuous support.

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# M17 - The Influence Of Cutting Parameter On Heat Generation In High-Speed Milling Inconel 718 Under MQL Condition

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## Abstract

*The paper is extended result from a comprehensive series of experiment on the effect of operating variable parameter; cutting speed, feed rate, depth of cut and width of cut on heat generation when end milling under MQL condition. The response surface methodology (RSM) was employed in the experiment, and a Box–Behnken design was used to determine the cause and effect of the relationship between the control input variables and response. The investigated milling parameters were cutting speed (100 - 140 m/min), feed rate (0.1 - 0.2 mm/tooth), depth of cut (0.5-1.0 mm) and width of cut (0.2 -1.8 mm). Result of this study show ball nose end milling generates low temperature ranging from 69°C to 359°C. Experimental data and statistical analysis showed that heat generation was dominated by radial depth of cut, followed by axial depth of cut. Feed rate and cutting speed were found statistically not significant. The responses of various factors were plotted using a model graph. The linear models were developed with a 92% confidence level. The optimum condition required for minimum heat generated include cutting speed of 117 m/min, feed rate of 0.19 mm/rev, axial depth of cut of 0.52 mm, and radial depth of cut of 0.24 mm. With this optimum condition, a minimum heat generated of 68°C was obtained.*

**Keywords:** Inconel 718, end mill, high-speed machining, heat, response surface methodology, minimum quality lubrication

## 1.0 Introduction

The concern towards green manufacturing has attract many manufacturers to implement a Minimum Quantity Lubrication (MQL) with biodegradable lubricant on their manufacturing activities [1]. MQL is an alternative approach to reduce temperature during machining as well as improving surface finish [2,3]. This cooling technique require a small amounts of high-quality mist form lubricant and apply directly to the cutting tool/work piece interface instead of using traditional flood coolants [4]. The advantage of MQL (air-lubrication mixture ) is its capability to penetrate cutting zone to reduce friction on tool-chip interface by lubricating this vicinity region. The temperature generated during cutting process was majorly dissipated through chip and mist evaporation [5,6,7]. Ueda et al. [3] in their research, investigate the effects of MQL on the major cutting operation (turning, drilling and milling) and conclude that MQL assisted cutting process capable to reduce heat between 60°C -100°C compare to dry cutting. The temperature generated during milling with 600 m/min was 580°C compare to 660°C in dry milling.

## 2.0 Experiment details

The workpiece material used was a rectangular block of Inconel 718. The block was age hardened ( $42 \pm 2$  HRC). The chemical composition of the workpiece material confirms the following attribute (wt.%): 0.49 Al; 0.004 B; 0.051 C; 5.0Cb; 18.30 Cr; 0.04 Cu; 0.23 Mn; 3.05 Mo; 53.0 Ni;  $< 0.005$  P;  $< 0.002$  S; 0.08 Si; 1.05 Ti and balance Fe.



**Fig.1:** CNC milling machine DMC 635 V eco.

The cutting parameters were set as the finishing process as shown in Table 2. The insert was a 16 mm diameter ball nose end mill with the following features: WC-10% Co with PVD coating of multilayer TiAlN/AlCrN; relief angle  $11^\circ$ ; radial rake angle  $0^\circ$  axial rake angle  $-3^\circ$ . The milling operations were carried out on the DMC 635 V Eco CNC milling machine. As suggested by ISO 8688-2-1989, the tests were stopped when uniform tool wear ( $VB_1$ ) reached 0.3 mm or localized flank wear reached 0.5 mm ( $VB_3$ ).

**Table 2.** Experiment cutting condition.

Cutting speed, $V_c$	100-140 m/min
Feed rate, $f_z$	0.1-0.2 mm/tooth
Axial depth of cut, $a_p$	0.5-1.0 mm
Radial depth of cut, $a_e$	0.2-1.8 mm
Run out	10 $\mu\text{m}$ (radial) and 5 $\mu\text{m}$ (axial)
Overhang length	30 mm
Cutting configuration	Down milling
Lubricant	MQL with flow rate of 50 ml/h

As shown in Fig.2, the MQL nozzles were positioned so that the mist can be jetted out to the rake and flank face of cutting tool. According to a study by López de Lacalle et al. [6], nozzle angle position of  $130^\circ$  is better than  $45^\circ$ . The distance between the nozzle and the tool is 30mm. The flowrate of MQL were set at 50 ml/hr. The medium of lubrication is biodegradable Coolube<sup>®</sup> 2210EP, an advanced metal cutting lubricant based on composition of natural esters which are formulated from renewable plant-based oils [4].



**Fig.2.** MQL experiment setup

NEC Thermo GEAR Thermography infrared camera with 2 megapixel was used. This camera capable to capture temperature of moving object by triggering maximum temperature inside the spectrum image. Emissivity range between 0.1-1.0 and varied according to material to be captured. Emissivity value for inconel was set at 0.19 [8]. Validation the captured temperature value was done by comparing the value of thermography camera and infrared thermometer at room temperature.



Maximum temperature 25.4°C

Emissivity value 0.19

**Fig.3** validation emissivity value before experiment.

## 2.1. Developing the multiple regression model

In this work, mathematical models have been developed using RSM based on the experiment data. Situations where the curvature in the normal operating ranges is inadequately modeled by the first-order function that can be represented by the following equation [9]:

$$\hat{Y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_{12} x_1 x_2 + \beta_{13} x_1 x_3 + \beta_{14} x_1 x_4 + \beta_{23} x_2 x_3 + \beta_{24} x_2 x_4 + \beta_{34} x_3 x_4 + \beta_{123} x_1 x_2 x_3 + \beta_{124} x_1 x_2 x_4 + \beta_{134} x_1 x_3 x_4 + \beta_{234} x_2 x_3 x_4 + \beta_{1234} x_1 x_2 x_3 x_4 + e \quad (1)$$

where  $\hat{Y}$  is the predictive Ra value;  $x_1$ ,  $x_2$ ,  $x_3$ , and  $x_4$  are the coded values of  $V_c$ ,  $f_z$ ,  $a_p$ , and  $a_e$ , respectively;  $e$  is the experimental error; and  $\beta_0$ ,  $\beta_1$ ,  $\beta_2$ , and  $\beta_4$  are the model parameters to be estimated using the experimental data. The accuracy of the model will be compared with the experimented value as:

$$\% \text{ deviation} = \frac{|R_a - R_{a_{exp}}|}{R_{a_{exp}}} \times 100 \% \quad (3)$$

where;  $\%$  : percentage deviation of predicted value from single experiment data  
 $R_{a_{exp}}$  : Measured  $R_a$

$R_{a_{cal}}$  : Calculated  $R_a$

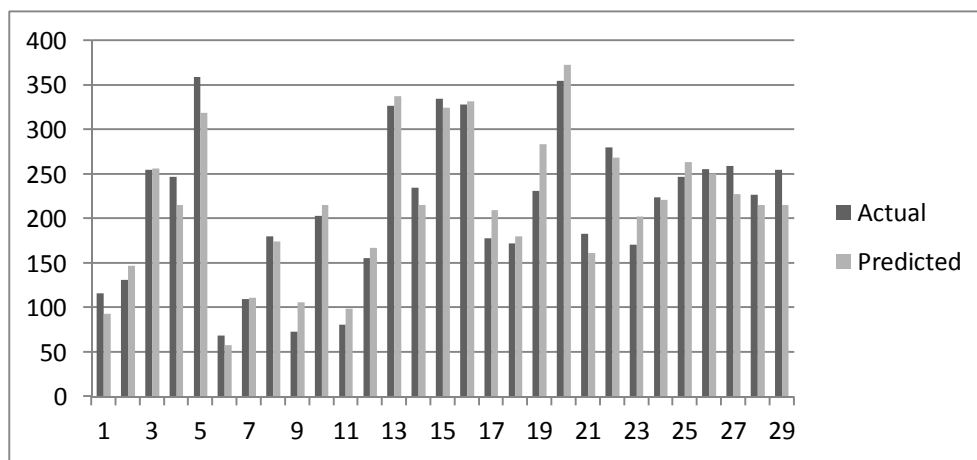
The average whole deviation value was determined by:

$$\bar{e} = \frac{\sum_{i=1}^n \frac{|Q_i - \bar{Q}|}{Q_i}}{n} \quad (4)$$

where  $\bar{e}$  : average percentage error within data set  
 $n$  : number of samples

### 3.0 Experiment results and discussion

The experiment results showed that end milling under MQL condition can achieve low heat generation. The achieved heat ranged from 70°C to 360°C. Details on the collected experimental data and the data calculated by mathematical modeling (Equation 1) are shown in Fig.4.



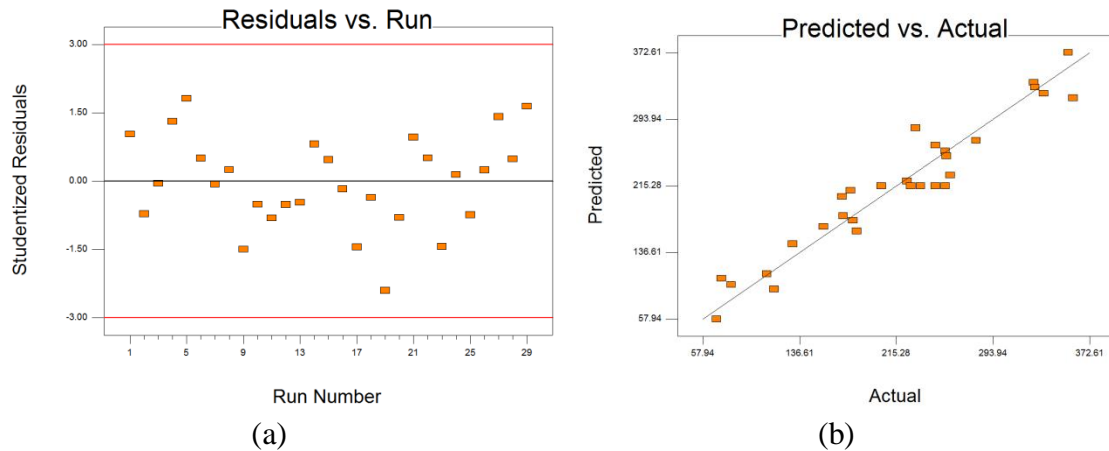
**Fig.4** Experiment and calculation comparison with average error of 10%.

The analysis of variance (ANOVA) was used to check the adequacy of model and significant contributing factors (Table 3). From ANOVA, the model F-Value of 73.36095 indicates the model is significant. It was supported by the lack of fit value of 0.3508 implies the model is significant. The linear Box-Behnken model shows that radial depth of cut the highest effect on heat generation followed by feed rate while cutting speed and feed rate were not significant toward heat generation.

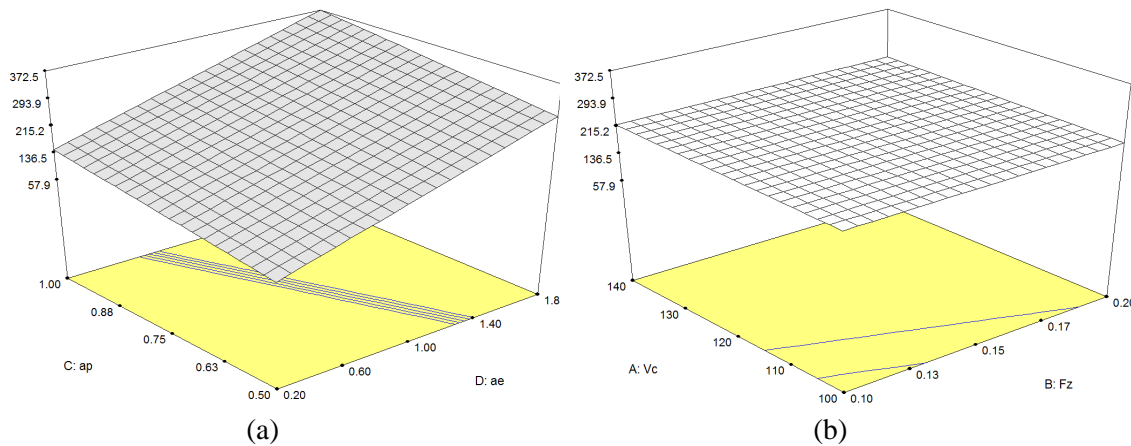
**Table 3** ANOVA for response surface linear model

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Model	177820.3	4	44455.08	73.36095	< 0.0001	significant
A-Vc	990.0833	1	990.0833	1.633862	0.2134	
B-Fz	154.0833	1	154.0833	0.254272	0.6187	
C-ap	23674.08	1	23674.08	39.0676	< 0.0001	
D-ae	153002.1	1	153002.1	252.4881	< 0.0001	
Residual	14543.46	24	605.9775			
Lack of Fit	12924.26	20	646.213	1.596376	0.3508	not significant

Fig.5a shows the diagnostic graphs consist of residual versus run and predicted versus actual graph. The purpose of diagnostic is to check for lurking variables that may have influenced the response during the experiment. The plot show a random scatter trend indicates a time-related variable lurking in the background. Fig.5b is a graph of the actual response values versus the predicted response values. It helps you detect a outlier value, that are predicted by the model. The data points should be split evenly by the 45 degree line. It shows the correct transformation and fit model. The effect of cutting parameters are shown in Fig.6. Generally, lower cutting temperature,  $T_c$  should be achieved when machining at the lower point of cutting speed,  $V_c$ , feed rate,  $f_z$ , axial depth of cut,  $ap$  and radial depth of cut,  $ae$ . The cutting temperature reduces dramatically as  $ap$  and  $ae$  decreases (Fig. 6a). However,  $V_c$  and  $f_z$  exhibit small changing of  $T_c$  with decreasing parameter value (Fig. 6b).



**Fig.5** Residual vs Run and Predicted Vs Actual plot.

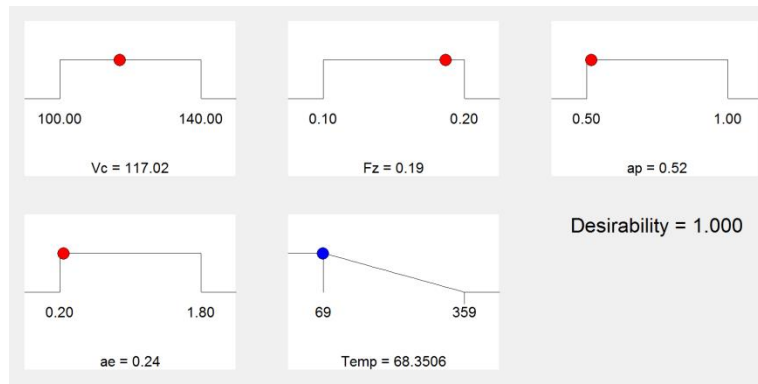


**Fig.6** Model graph for cutting condition

**Model Equation**

The first order model was developed to describe the relationship between cutting parameter (input) and heat generated (output). Hence the cutting temperature,  $T_c$  was found to be:

$$T_c = -124.37 + 0.4542 V_c + 71.67 F_z + 177.67 + 141.15 ap \tag{5}$$



**Fig.7** Ramp graph showing the condition of optimized temperature.

This model depends only on cutting parameter. A comparison of the predicted value and experiment is graphically illustrated by Fig.4. The average error was 10% since the factor of determination,  $R^2$  and adjusted  $R^2$  of 92.4% and 91.2 % respectively. Process optimization has been done by setting the lowest temperature generated as objective. It was found that the minimum temperature predicted is 68.35°C by the combination of  $V_c$ 117.02 m/min ,  $f_z$ 0.19 mm/tooth,  $a_p$ 0.52 mm and  $a_e$ 0.24 mm. **Fig.7** shows the position of optimised parameter setting within specified range.

#### 4.0 Conclusion

This paper shows the relationship between cutting parameter and cutting temperature during end milling. A mathematical model has successfully developed base on RSM method with 29 series of experiments. This study shows the high speed machining can reduce heat generated during machining with radial depth of cut is the dominating factors. The experiment shows the MQL application able to reduce cutting temperature as low as 70°C. The lowest cutting temperature can be achieved when cutting at  $V_c$  117.02 m/min ,  $f_z$  0.19 mm/tooth  $a_p$  0.52 mm and  $a_e$  0.24 mm.

#### 5.0 Acknowledgments

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# M18 - Proses Penyahikatan Bahan Pengikat Daripada Komponen Suntik Dengan Menggunakan Kaedah Pelarut Dan Haba

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## Abstrak

Proses penyahikatan bahan pengikat merupakan elemen penting di dalam menjayakan pengacuan suntikan seramik. Kegagalan proses ini akan menyebabkan berlakunya keherotan, keretakan dan pencemaran pada komponen suntik. Justeru itu, kajian ini difokuskan untuk mengenal pasti proses penyahikatan yang paling optimum berdasarkan kepada kadar penyingkiran bahan pengikat dan keadaan rupa bentuk jasad. Bahan suapan yang digunakan adalah serbuk seramik alumina-zirkonia bersama bahan pengikat yang terdiri daripada polietilena berketumpatan tinggi (HDPE), lilin parafin (PW) dan asid stearik (SA). Pada peringkat pertama, komponen suntik direndam dalam larutan *n*-heptana pada suhu 50°C, 60°C serta 65°C untuk menyingkirkan PW dan SA. Manakala bagi peringkat kedua, HDPE disingkirkan melalui kaedah penyahikatan haba. Keputusan ujikaji menunjukkan pada suhu 60°C dengan tempoh rendaman selama 16 jam adalah paling optimum. Kehilangan berat bahan pengikat mencapai 82.3% serta bebas daripada sebarang kecacatan. Bahan pengikat terurai hampir sepenuhnya pada suhu 550°C semasa proses penyahikatan haba. Kadar pemanasan yang rendah (1-2°C/min) membantu mengelakkan berlakunya kecacatan pada komponen suntik.

**Kata Kunci:** Alumina-zirkonia, pengacuan suntikan seramik, penyahikatan haba dan pelarut

## 1.0 Pengenalan

Proses pengacuan suntikan seramik (CIM) telah meluas digunakan dalam industri pembuatan untuk penghasilan pelbagai produk seperti komponen elektronik, automotif, perkakasan pemesinan dan telekomunikasi [1]. Proses CIM melibatkan beberapa peringkat iaitu proses pengadunan bahan suapan, pengacuan suntikan, penyahikatan dan pensinteran. Penyahikatan adalah suatu proses untuk menyingkirkan bahan pengikat daripada komponen suntik. Bahan pengikat dalam proses CIM boleh ditafsirkan sebagai suatu medium sementara yang memegang zarah-zarah serbuk seramik supaya berada dalam bentuk yang dikehendaki sebelum ianya disingkirkan semasa proses penyahikatan [2]. Proses penyahikatan perlu dilakukan dengan teliti bagi mengelakkan berlakunya sebarang masalah seperti keherotan, keretakan dan pencemaran kepada komponen suntik sehingga boleh menjejaskan kualitinya.

Proses penyahikatan memerlukan masa pemrosesan yang lama. Oleh yang demikian pelbagai kaedah telah dibangunkan seperti kaedah penyahikatan pelarut, haba, aliran kapilari, agen pemangkin dan kombinasi di antaranya [3]. Kombinasi kaedah penyahikatan pelarut dan haba telah terbukti berjaya memendekkan tempoh penyahikatan serta dapat mengelakkan kecacatan kepada komponen suntik [3,4]. Walau bagaimanapun, proses penyahikatan yang melibatkan penggunaan serbuk seramik alumina-zirkonia bersama bahan pengikat yang terdiri daripada polietilena berketumpatan tinggi (HDPE), lilin parafin (PW) dan asid stearik (SA) masih belum dibincangkan secara meluas oleh penyelidik terdahulu. Melalui ujikaji

yang dijalankan, larutan *n*-heptana telah digunakan bagi melarutkan PW dan SA pada peringkat pertama proses penyahikatan. Pada peringkat yang kedua pula, HDPE disingkirkan melalui kaedah penyahikatan haba berdasarkan kepada analisis termogravimetri. Justeru itu, penyelidikan ini difokuskan untuk menentukan proses penyahikatan yang paling optimum berdasarkan kepada kadar penyingkiran bahan pengikat dan keadaan jasad yang bebas daripada sebarang kecacatan.

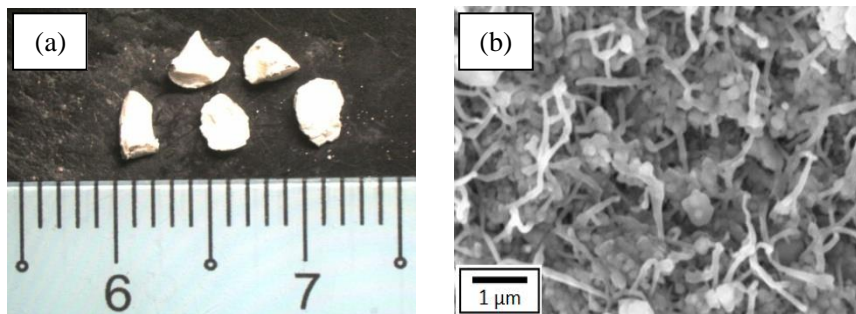
## 2.0 Penerangan Projek

Bahan suapan yang digunakan adalah kombinasi serbuk alumina dengan zirkonia serta bahan pengikat yang terdiri daripada polietilena berketumpatan tinggi (HDPE), lilin parafin (PW) dan asid stearik (SA). Campuran komposisi serbuk alumina dengan zirkonia masing-masing adalah pada kadar 80% dan 20% berat. Serbuk alumina (AL-160SG-1) dibekalkan oleh Showa Denko. Manakala serbuk zirkonia (KZ-3YF) dibekalkan oleh KCM Corporation. Saiz dan ketumpatan purata serbuk alumina-zirkonia selepas proses pencampuran adalah 0.31  $\mu\text{m}$  dan 4.46  $\text{g}/\text{cm}^3$ .

Serbuk alumina-zirkonia tersebut, kemudian diadunkan bersama bahan pengikat dengan menggunakan mesin pencampur dalaman (Brabender W 50 EHT). Kadar pembebanan serbuk alumina-zirkonia yang digunakan adalah pada 57% isipadu. Manakala komposisi bahan pengikat yang digunakan pula adalah 50% HDPE, 46% PW dan 4% SA berat. Pencirian bagi bahan pengikat yang digunakan adalah seperti yang ditunjukkan dalam Jadual 1. Proses pencampuran bahan dilakukan pada suhu 140°C dengan halaju 20 rpm selama 30 minit. Seterusnya, proses pembutiran bahan suapan dilakukan dengan menggunakan mesin penghancur (Strong Crusher TSC-5JP) sehingga membentuk butiran-butiran kecil. Gambar dan imej mikroskop elektron imbasan (SEM) (Zeiss Leo 1450) bagi bahan suapan selepas proses pembutiran adalah seperti yang ditunjukkan dalam Rajah 1. Kemudian bahan suapan akan disuntik ke dalam rongga acuan yang berbentuk silinder ( $\text{Ø}15\text{mm} \times 21\text{mm}$ ) dengan menggunakan mesin suntikan jenis skru (Battenfeld BA 250 CDC). Parameter bagi setiap proses pengacuan suntikan seramik telah dioptimumkan.

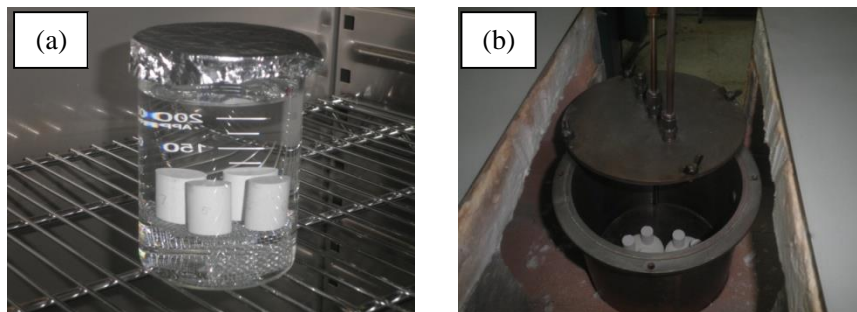
**Jadual 1:** Pencirian komponen bahan pengikat

Bahan pengikat	Pembekal	Ketumpatan ( $\text{g}/\text{cm}^3$ )	Suhu lebur ( $^{\circ}\text{C}$ )	Suhu penguraian ( $^{\circ}\text{C}$ )
HDPE	Titan Petchem	0.96	131.2	420-550
PW	Emercy Oleochemicals	0.89	57.5	200-400
SA	Emercy Oleochemicals	0.88	68.3	180-380



**Rajah 1:** (a) Gambar dan (b) imej SEM bagi bahan suapan selepas proses pembutiran

Proses penyahikatan dua peringkat (pelarut dan haba) telah digunakan untuk menyingkirkan bahan pengikat daripada komponen suntik. Proses penyahikatan pelarut dilakukan dengan merendam komponen suntik ke dalam larutan *n*-heptana (Merck 104379) pada suhu 50°C, 60°C dan 65°C untuk menyingkirkan PW dan SA. Masa rendaman adalah setiap 2 jam, dengan tempoh keseluruhan masa rendaman adalah selama 18 jam. Komponen suntik dikeringkan sebelum diambil bacaan beratnya bagi mendapatkan peratusan pengurangan berat bahan pengikat. Komponen suntik yang bebas daripada sebarang kecacatan dengan peratusan pengurangan berat bahan pengikat yang optimum seterusnya digunakan untuk proses penyahikatan haba. Proses penyahikatan haba dilakukan di dalam relau (Maju Saintifik RS800/200/200) yang dialirkan gas argon untuk menyingkirkan HDPE serta saki-baki PW dan SA. Jadual penyahikatan haba direkabentuk berdasarkan kepada analisis termogravimetri (Netzsch STA 449 F3) yang dilakukan ke atas bahan pengikat. Proses penyahikatan pelarut dan haba adalah seperti yang ditunjukkan dalam Rajah 2. Kecacatan dan pencirian morfologi bagi komponen suntik selepas proses penyahikatan dianalisis dengan menggunakan mikroskop (Olympus SZ6) dan SEM (Zeiss Evo MA10). Seterusnya penganalisis CHN (Finnigan Flash EA 1112) digunakan untuk mengukur kandungan karbon dan hidrogen di dalam komponen suntik bagi menilai keberkesanan proses penyahikatan.



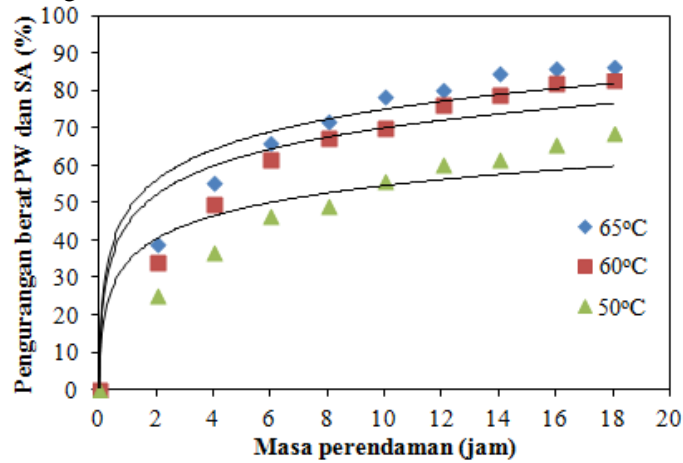
**Rajah 2:** Proses penyahikatan (a) pelarut dan (b) haba

### 3.0 Keputusan dan Perbincangan

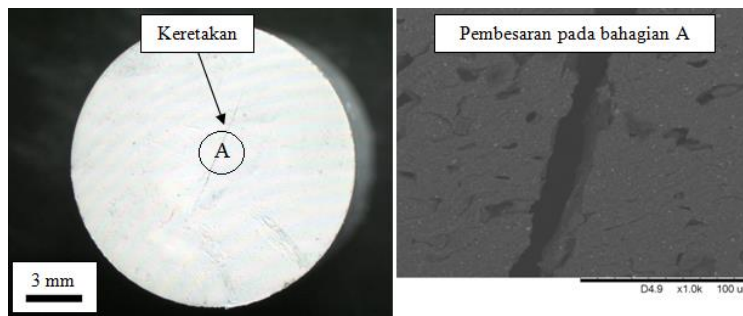
#### 3.1 Penyahikatan Pelarut

Rajah 3 menunjukkan kesan suhu pelarut dan masa rendaman ke atas peratusan pengurangan berat bahan pengikat. Kadar penyahikatan adalah lebih cepat pada peringkat awal proses sebelum ia mencapai keadaan mendatar selepas 16 jam. Hal yang demikian kerana pada peringkat awal bahan pengikat bersentuhan secara langsung dengan pelarut. Kemudian pelarut perlu meresap jauh ke dalam komponen suntik sebelum dapat melarutkan bahan pengikat. Pada suhu rendaman 65°C didapati berlaku keretakan pada sampel. Keretakan berlaku selepas 2 jam tempoh rendaman seperti yang ditunjukkan dalam Rajah 4. Pada suhu yang tinggi, semakin banyak bahan pengikat yang terurai dan seterusnya terdesak untuk keluar daripada struktur jasad dengan cepat [5]. Keadaan ini menyebabkan berlakunya keretakan pada komponen suntik. Rajah 5 menunjukkan mikrostruktur SEM bagi komponen suntik selepas direndam pada suhu 60°C dengan masa perendaman yang berbeza. Peningkatan masa perendaman menyebabkan semakin banyak PW dan SA tersingkir sehingga membentuk struktur yang lebih porous. Justeru itu pada suhu rendaman 60°C dipercayai paling optimum untuk proses penyahikatan pelarut. Bagi tempoh rendaman selama 16 jam, kadar peratus

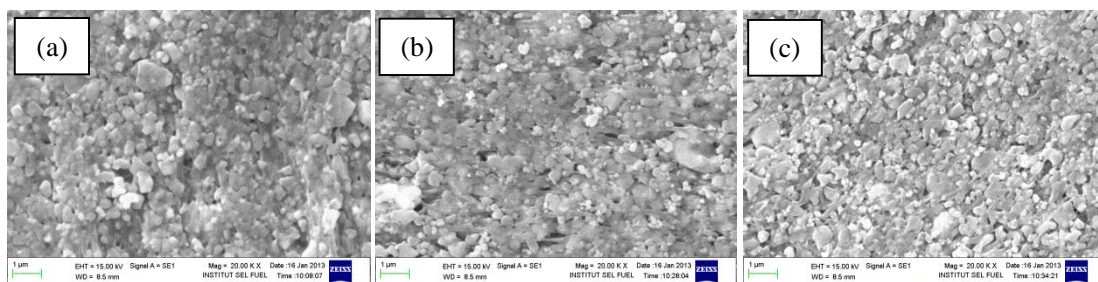
pengurangan berat bahan pengikat mencecah sehingga 82.3% dan pada masa yang sama ianya bebas daripada sebarang kecacatan.



**Rajah 3:** Kesan suhu pelarut dan masa perendaman ke atas peratusan pengurangan berat bahan pengikat



**Rajah 4:** Keretakan pada komponen suntik pada suhu rendaman 65°C

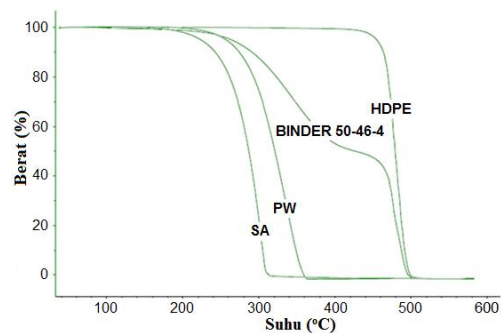


**Rajah 5:** Imej SEM bagi komponen suntik selepas proses penyahikatan pelarut pada suhu 60°C dengan masa perendaman (a) 0 jam, (b) 2 jam dan (c) 16 jam

### 3.2 Penyahikatan Haba

Seterusnya proses penyahikatan haba dilakukan bagi menyingkirkan HDPE serta saki baki PW dan SA. Rajah 6 menunjukkan analisis termogravimetri bagi bahan pengikat pada julat suhu di antara 30°C hingga 600°C. Didapati ke semua bahan pengikat terurai hampir

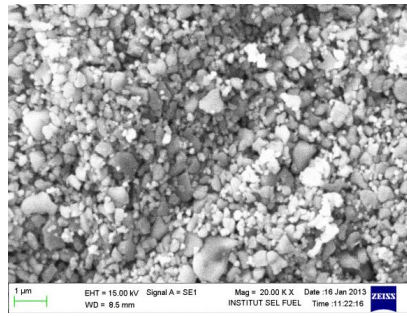
sepenuhnya pada suhu 550°C. Seterusnya jadual bagi proses penyahikatan haba telah di optimum berdasarkan kepada analisis termogravimetri tersebut. Jadual penyahikatan haba yang telah dioptimumkan adalah seperti yang ditunjukkan dalam Jadual 2. Pada peringkat pertama penyahikatan haba, saki baki PW dan SA akan tersingkir sepenuhnya. Kemudian daripada suhu 420°C hingga 550°C kadar pemanasan yang lebih perlahan dikenakan kerana pada ketika ini HDPE mula mengurai. Gas-gas penguraian akan keluar melalui struktur jasad yang porous. Kadar pemanasan yang tinggi akan menyebabkan kecerunan suhu dan pembentukan tekanan dalaman kepada komponen suntik [4]. Hal yang demikian boleh mendatangkan kecacatan kepada komponen suntik seperti keretakan dan melepuh. Pada peringkat kedua, masa menahan dilanjutkan selama 3 jam memandangkan saiz komponen suntik yang agak besar. Rajah 7 menunjukkan imej SEM bagi komponen suntik selepas proses penyahikatan haba. Ia menunjukkan hampir keseluruhan daripada bahan pengikat telah tersingkir.



**Rajah 6:** Analisis termogravimetri bagi bahan pengikat pada kadar pemanasan 10°C/min

**Jadual 2:** Jadual penyahikatan haba yang optimum

Peringkat	Kadar Pemanasan (°C/min)	Suhu penyahikatan (°C)	Masa menahan(min)
1	2	420	60
2	1	550	180
3	5	30	0



**Rajah 7:** Imej SEM bagi komponen suntik selepas proses penyahikatan haba

### 3.3 Analisis Kandungan Karbon dan Hidrogen

Analisis CHN telah dilakukan bagi mengukur kandungan karbon dan hidrogen di dalam komponen suntik. Hal yang demikian disebabkan sebahagian besar daripada bahan pengikat terdiri daripada unsur karbon dan hidrogen. Jadual 3 menunjukkan kandungan karbon dan hidrogen yang terdapat di dalam komponen suntik. Sebelum proses penyahikatan didapati kandungan karbon dan hidrogen masing-masing adalah pada kadar 12.780 dan 4.214% berat. Nilai ini mewakili 43% daripada keseluruhan bahan suapan pada pembebanan serbuk 57% isipadu. Setelah melalui proses penyahikatan pelarut selama 2 hingga 16 jam pada suhu 60°C kandungan karbon dan hidrogen terus menyusut. Pada ketika ini hampir 80% daripada PW dan SA telah tersingkir. Seterusnya hampir keseluruhan daripada bahan pengikat telah terurai selepas melalui proses penyahikatan haba. Didapati kandungan karbon dan hidrogen di dalam komponen suntik hanya berbaki 0.073 dan 0.069% berat. Justeru itu, ujikaji ini menunjukkan bahawa proses penyahikatan telah berjaya dilakukan. Saki-baki bahan pengikat akan tersingkir sepenuhnya setelah melalui proses pensinteran.

**Jadual 3:** Analisis kandungan karbon dan hidrogen dalam komponen suntik

Kandungan / Peringkat	Sebelum proses penyahikatan	Penyahikatan pelarut (60°C, 2 jam)	Penyahikatan pelarut (60°C, 16 jam)	Penyahikatan haba
Karbon (% berat)	12.780	8.975	8.182	0.073
Hidrogen (% berat)	4.214	2.185	1.797	0.069

## 4.0 Kesimpulan

Proses penyahikatan pelarut dan haba telah dilakukan bagi mendapatkan proses penyahikatan yang paling optimum. Hasil ujikaji menunjukkan suhu pelarut dan masa rendaman memberi kesan ke atas kadar penyahikatan bahan pengikat. Pada suhu rendaman 60°C dengan tempoh rendaman selama 16 jam dipercayai paling optimum untuk proses penyahikatan pelarut. Data yang diperolehi daripada analisis termogravimetri pula membantu mendapatkan jadual penyahikatan haba yang optimum. Kadar pemanasan yang rendah

dengan masa menahan yang panjang membolehkan bahan pengikat meresap keluar. Secara keseluruhannya, kombinasi kaedah penyahikatan pelarut dan haba berjaya menyingkirkan bahan pengikat daripada komponen suntik dan pada masa yang sama komponen suntik bebas daripada sebarang kecacatan.

## 5.0 Rujukan

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# M19 - Improving Mechanical Properties of Rice Husk / Polypropylene Composites Using Sodium Hydroxide

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## Abstract

*Polypropylene (PP) is a thermoplastic that is produced from petroleum, while rice husk (RH) is mostly agricultural waste burned openly outside the factory. The purpose of this study is to improve the mechanical properties of composite matrix mixture of rice husk with Polypropylene (PP) by using a sodium hydroxide (NaOH). The granular sizes of rice husk were boiled before it is placed into a 2% concentration Sodium Hydroxide (NaOH). 50 rounds per minutes are set on the internal mixer machine to mix PP/RH at 175 ° C for 10 minutes. Four different composites compositions (90/10, 80/20, 70/30 & 60/40) with sodium hydroxide (NaOH) treated RH and without sodium hydroxide (NaOH) was studies. Experimental samples produced by molds 200 x 200 x 2 mm with a temperature of 175 ° C under a pressure of 20 Tan for 8 minutes. The specimens were analyzed by different techniques such as Tensile Test (ASTM D638), Hardness Test (ASTM E-384), Impact test (ASTM D6110) and Scanning Electron Microscopy (SEM). This research has shown that the presence of NaOH indicates higher young modulus and hardness test value compared to untreated RH. While for the impact strength and tensile strength value shows both treated and untreated PP/RH composite decreased when fiber loading increased. The morphology analysis was conducted to determine the effects of natural fiber bonding between the matrix materials after NaOH treatments for broken specimens after mechanical testing.*

**Keywords:** Polypropylene, Rice Husk, treatment, sodium hydroxide, composite.

## 1.0 Introduction

Natural fibers provide over conventional reinforcement materials, in term of the cost, biodegradability, renewability, low specific gravity, abundancy, high specific strength and nonabrasiveness [1]. One of natural fibers with high availability is rice husk, a residue of the agricultural by-product material. It constitutes about 20% of the weight of rice. It contains about 35% cellulose, 25% hemicellulose, 20% lignin, and 17% of ash (94% silica) by weight [2]. The utilization of rice husk ash as a reinforcement of a polymeric material is provides several advantages, such as improved strength and durability properties, reduced materials costs, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions.[3,4,5,6, & 7].

The matrix selected in this research was Polypropylene (PP). Polypropylene is one of the most extensively used packaging material, because of its easy availability, process-ability, flexibility and seal strength, however it has inherited weakness of nondegradability. The combination of two or more materials to achieve properties those are superior to those of their constituents [8,9,10,11 &12].

A polymer composite is a two or more materials combination at atomic level. Nowadays development of new materials by using natural fiber has accelerated. The properties of various natural fibers and their composites have been evaluated to determine

their potential to replace glass fiber-reinforced plastic composites in some applications [13]. Anyway a notable disadvantage of natural fibers is their polarity which makes it incompatible with hydrophobic matrix.

The hydrophilic natural fibers need to be treated appropriately to make them more compatible with hydrophobic thermosets or thermoplastics prior to processing of biocomposite. The presence of hydroxyl and other polar groups on the surface and all over natural fiber may cause poor and weak bonding between fiber and the matrix [14]. However, the performance and properties of composite materials depend on the properties of the individual components and their interfacial compatibility.

The main action of NaOH on the fiber is to remove the lignin binder of the cellulosic material [15]. This research was based on two concepts one by using untreated RH and PP to produce a composite material with various composition and the other is by treating the RH with NaOH.

## 2.0 Experiment

### 2.1 Material

This research use Polypropylene (PP) as the matrix material in the form of pallet with a density 0.9 g/cm and melting temperature at 230<sup>o</sup>C had been obtained for this research. This compound consists of carbon, hydrogen and some additives designed for general purpose applications. The rice husk fiber was obtained from the rice field Alor Star, Kedah, (Malaysia). Its moisture content is 13 wt. % where the granular sizes ranged are from 500 to 1000  $\mu$ m.

### 2.2 Materials preparation

For untreated RH, firstly the raw material was sun-dried for three days before they were fed into a blender to obtain short fibers at lower than 1000  $\mu$ m in length. However the treated RH has a different preparation method, firstly the 120 grams of untreated RH is washed and boiled in the boiling water with the 100<sup>o</sup>C temperature for about 1 hour. Second, they are forwarded to soaking process for 2 hours with 2 % concentration of Sodium Hydroxide (NaOH) then the compound was stirred. The compound was left in the environmental chamber for 3 hours followed by cleaning process using normal pipe water. The washing process was repeated for 4 times to ensure no more NaOH residual at Rice husk. The next process is drying the rice husk under sunlight for 24 hours, for three days.

### 2.3 Composite Fabrication

The Polypropylene and rice husk is weighed according to Table 1. A thermal mixing process was carried out using a Thermo Haake Rheomix 600 OS internal mixer at a temperature of 175<sup>o</sup>C and a rotor speed of 50 rpm for 10 minutes. Through this process, the mixture of substances will be found better and more uniform overall, after that the material goes to crusher machine to produce a standard particle size 2 mm x 2 mm. The final stage of the composite preparation process in this research is the hot pressing. Hot pressing was carried out at a temperature of 175<sup>o</sup>C for 8 minutes, and the mixture was then cooled under room temperature. The final products were in the form of plates with dimensions of 200 mm x 200 mm x 2 mm and prepared for cut into ASTM standard and conduct mechanical testing.

### 2.4 Tensile Testing and Characterization

Sample cutter has been used to cut the sample in dog-bone shaped. Five samples of PP/RH composition treated and untreated with dimension of samples 125 mm x 12.7 mm x 2

mm were tested according to ASTM standard D638. The tests were performed at  $25\pm 3^{\circ}\text{C}$  with 50 % of humidity and failure under tension at a cross head speed of 5 mm/min using Shimadzu Universal Testing Machine. Tensile strength and modulus were recorded. Here, the morphology of the cracked surface is observed by using scanning electron microscopy (SEM) at three types of magnifications that are 22X, 100X and 500X, which consists of topographical, morphological and composition pictures.

### 2.5 Hardness Testing

The hardness tests were performed according to ASTM E-384. The Micro Hardness Vickers is used to measure the depth of penetration of a loaded indenter into the material. The tests were performed at  $25\pm 3^{\circ}\text{C}$  with 50% of humidity. Average of eight point has been taken from each composition.

### 2.6 Impact Testing

The impact resistance test was carried out by using the "Pendulum Impact Tester Model: LS 22006-2" complete with hammer 25 J impact force and the operating conditions at  $23 \pm 2^{\circ}\text{C}$  with 50% humidity. The test conducted in accordance to ASTM D6110 in order to determine the values of Charpy Impact Strength ( $\text{J} / \text{mm}^2$ ). The five specimens were placed horizontally on a sample holder, and then will be broken by the swinging pendulum. Before the experiment, the width and thickness of the sample is measured by using the "digital vernier caliper" in which the average values are recorded.

### 2.7 Morphological Observation of Fractured Surfaces through SEM

Scanning Electron Microscope observation was performed using Philips XL 30 ESEM operated at 20 to 30 kV. The fractured samples from the tensile test were first dried and coated with the gold using Sputter Coater Polaron E-5100 system. Dispersion state of rice husk fiber and the fracture mode of composites under the tensile loading were determined.

**Table 1:** Composition ratio of PP/RH

No. of sample	Composition (wt %)		
	Polypropylene (PP)	Rice husk (RH) (Untreated)	Rice Husk (RH) (Treated)
1	90	10	/
2	80	20	/
3	70	30	/
4	60	40	/
5	90	/	10
6	80	/	20
7	70	/	30
8	60	/	40

## 3.0 Results and Discussion

### 3.1 Tensile Properties

Figure 1 and 2 shows the effect of filler loading on tensile strength and tensile modulus. From the Figure 1, it can be seen that the tensile strength of PP/ RH decreased with increasing of rice husk. It was happen because when filler loading increase the effective matrix cross-section reduction and stress concentration increase. When the percentage of the matrix lessens, the fibers do not have any place to reinforce, making it easy for them to slip

off and failure if stress is applied [3,4,5,6 & 7]. Figure 2 is tensile modulus of PP/ RH composite increased with increasing filler loading. Tensile modulus of the treated PP/RH higher compared to untreated composites.

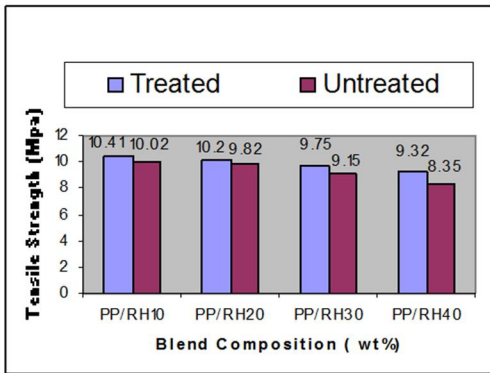


Figure 1: Chart of Tensile Strength against percentage of Composition PP & Rice Husk.

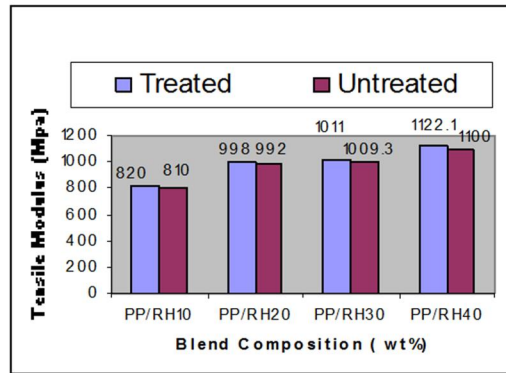


Figure 2: Chart of Tensile Modulus against percentage of Composition PP & Rice Husk.

### 3.2 Hardness Properties

Figure 3 demonstrates the effect of adding Sodium Hydroxide on the hardness property of PP/RH composite. It can be seen from the result obtained that hardness of treated composite of PP/RH is better than untreated composite. This result proved that reaction between Sodium Hydroxide (NaOH) in PP/RH system increases the stiffness property of composite. The highest hardness value of PP/RH untreated composition with 40 wt. % RH is 11 and meanwhile the highest value for treated with same composition is 12 value. Generally, fibers that increase the moduli of composites increase the hardness of the thermoplastic [3]. The significant difference in the value shows that the percentage of RH composition will increase the hardness of the material as the bonding between the molecules. The addition of lower ratio of treated RH in to PP/RH composition increases hardness value. In general, results showed that hardness of the composites is significantly enhanced with the addition of natural fiber.

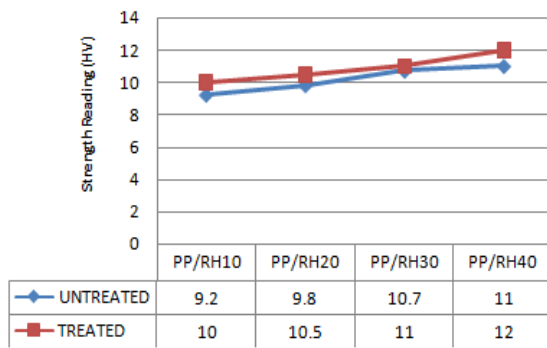


Figure 3: Graph of Microvickers Strength against percentage Composition of PP & Rice Husk

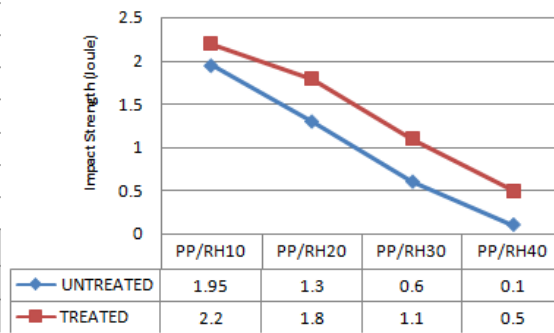


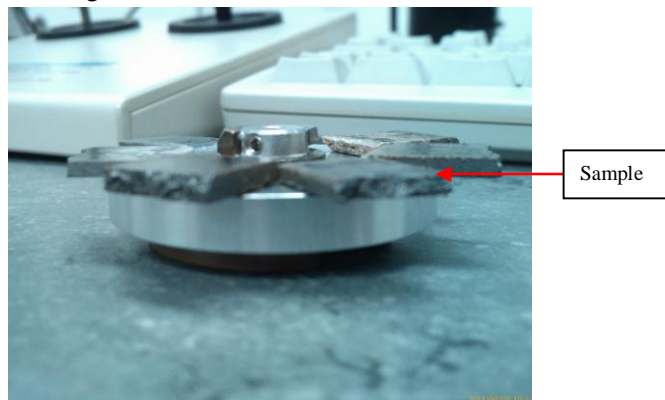
Figure 4: Graph of Impact strength against percentage Composition of PP & Rice Husk

### 3.3 Impact Properties

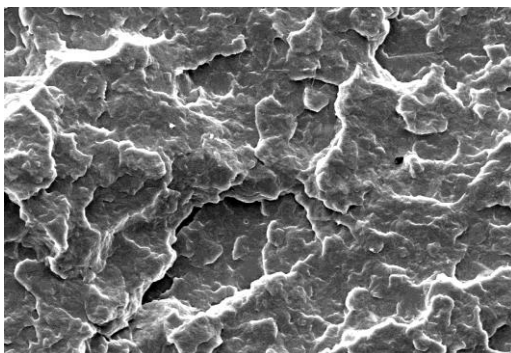
Figure 4 demonstrates the effect of adding Sodium Hydroxide on the impact property of PP/RH composite. It can be seen from the result obtained that both treated and untreated composite of PP/RH is decreases when fiber loading increased. This result proved that reaction between Sodium Hydroxide (NaOH) in PP/RH system decreases the impact strength property of composite. The highest impact value of PP/RH untreated composition with 10 wt. % RH is 1.95 and meanwhile the highest value for treated with same composition is 2.2 value. The addition of natural fiber composite generally decreased the impact value [5].

### 3.4 Morphological Properties

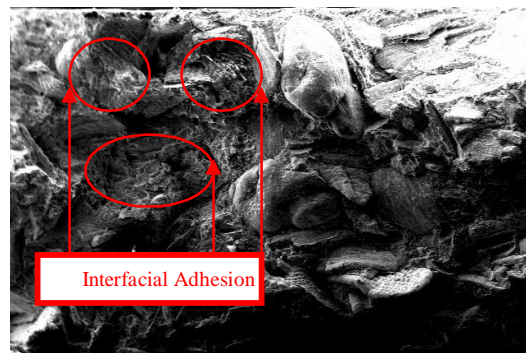
Alkali treatment reduces the lignin and hemicellulose content in biomass, increases the surface area, allowing penetration of water molecules to the inner layers, and breaks the bonds between hemicellulose and lignin-carbohydrate [4]. In morphology properties, it can be seen that the effect of filler loading with the addition sodium hydroxide on the treated sample. Figure 5 show the scanning electron microscope (SEM) sample analysis of PP/RH. Figure 6 and 7 shows the tensile fracture surface micrograph on pure PP and PP/RH (60/40) composite. From the SEM photos, the rice husk treated fibers in Figure 7 look well contacted in the PP matrix with adhesive characteristics, which proportional with the result of the tensile strength as shown in Figure 1.



**Figure 5:** Sample of SEM Analysis



**Figure 6:** Magnification of Pure Polypropylene



**Figure 7:** Magnification of Boiled and Treated Rice Husk at Mixture of 60 wt % PP & 40 wt. % rice husk

## 4.0 Conclusion

Based on the mechanical properties results, filling of treated and untreated RH in a polymer matrix composite degrade the different rates of mechanical testing result. The presence of treated RH increases the effective of tensile modulus and hardness value result between fiber and matrix. While for tensile strength and impact strength both treated and untreated RH loading decreased the composite properties.

## 5.0 Acknowledgment

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# M20 - Analysis of Material Selection for Air Compressor Tanks

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## *Abstract*

*This paper provides the guidelines for the selection of a material for air compressor tanks in order to develop a low cost, lightweight material with high material strength. In order to improve the functionality and to reduce the total mass, the best mechanical properties are investigated for material selection via the Cambridge Engineering Selector (CES) software. A comparative study is carried out on the materials that are used in order to choose a suitable material for air compressor tanks. Three groups of materials comprising 14 materials have been selected for further analysis. The research results show that low alloy steel can reduce the total mass and hence increase the toughness capability and lower the cost.*

**Keywords:** Material Selection, Compressor, Mechanical Properties

## 1.0 Introduction

A compressor is equipment that is used to increase the pressure of a compressible fluid. It can be used in a variety of ways to alter the chemical composition, as in the case of making fertilizers. Besides, it can be used for industrial purposes, such as in production line manufacturing processes. Perhaps the most well-known use of air compressors is in the case of pneumatic tools such as air powered nail guns, staplers, sanders, spray guns and ratchet wrenches[1].

The aim of materials selection is to identify materials, with regard to their dimensions and shape, and manufacturing processes in order to produce a functional product at a low cost. Accordingly, Sapuan[2] highlighted the Knowledge Based System as a tool in material selection with the guidelines of a computerized system. The material selection approach by Ashby is applied in this area. The system uses a material selection chart that presents the material and performance indices.[3]

## 2.0 Background

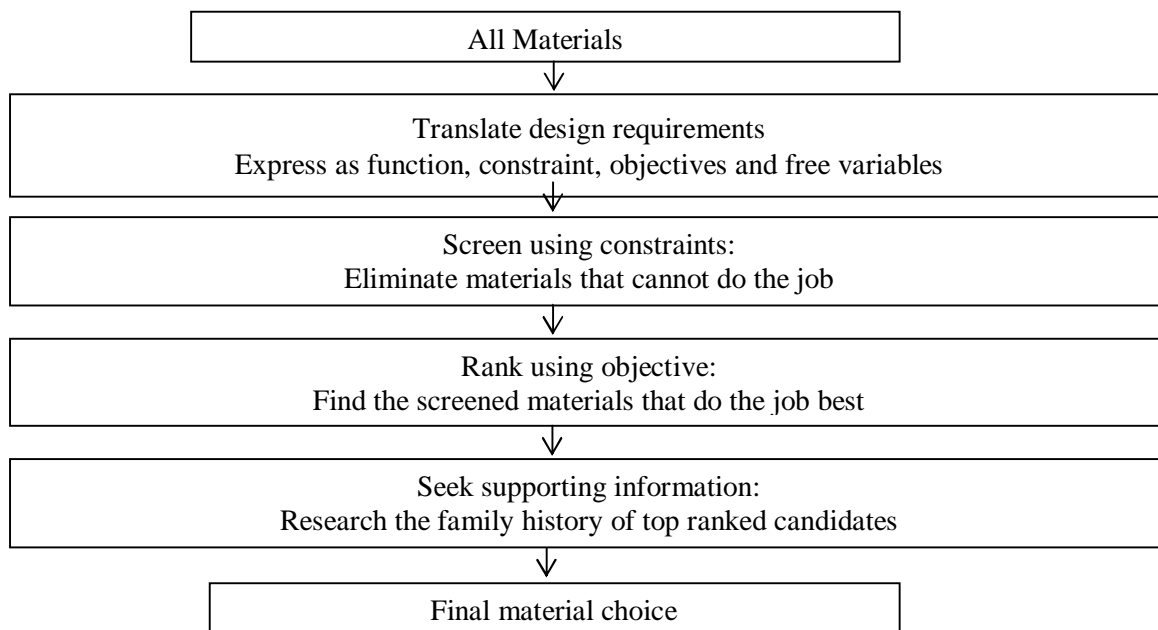
Air compressors have been around well over 100 years and have as many uses as there are tools that use air. One reason for their popularity is because air is a resource that is safe, flexible, clean, and convenient. Nowadays, most users will choose air compressors which are generally faster, lighter, and more powerful. Portability is a key factor when choosing an air compressor. Portable air compressor tanks are available in a variety of shapes, sizes, and materials.

The material used also affects the weight of the air compressor tank. This is because different types of materials have their own mechanical properties, advantages, and disadvantages.

### 3.0 Methodology

This study includes the process in the selection of materials, an analysis of their selected mechanical properties and recommends the best material for the air compressor tank. A systematic approach to the material, based on size and shape, is according to the material selection chart as developed by Ashby, 2005. It begins as a conceptual design by using primary constraints, due to the performance index and optimized choice of materials. The selection of the material, based on the characteristics and properties of the material in terms of hardness, fracture toughness, fatigue, thermal properties, elastic properties, and strength will be conducted via the Cambridge Engineering Selector (CES) software. CES is a specialist tool to support material selection that allows all constraint and objective for all extensive property data.

The analysis began with a selection strategy and was followed by the selection with the Cambridge Engineering Selector (CES) software. According to Ashby[4], four main steps are needed for early material selection, and these are translation, screening and ranking, followed by supporting information as shown in Figure 1



**Figure 1:** The strategy for materials selection

### 4.0 Results and Discussions

Air compressor tanks are used to compress air in storage and are recommended for all compressed air systems. The objective is to reduce the mass and to analyse the material selection. The weight of the air compressor tank depends on the material used.

In the Ashby approach to the material selection and function was used to describe the performance of the element. The function has the form



$$p = f(F,G,M)$$

where F<G and M express the functional requirements, geometric parameters and material indices, respectively.

The function,constraints,objective, and free variables are listed in Figure 2

Function :	to compress air storage.
Objectives:	to minimize the mass of the tank
Constraints:	Must be lightweight, high fatigue stress and adequate strength.
Free variables:	Choice of material

**Figure 2:** Design Requirements

There are three stages that have to be considered when producing an air compressor tank:

- i. Stage 1: Yield Strength vs. Density
- ii. Stage 2: Young Modulus vs. Density
- iii. Stage 3: Fracture of Toughness vs. Density

After developing design function requirement, the process is done using the required performance indices. Maximizing the mass and the stiffness as  $m = \frac{\sigma_f^2}{\rho}$ ,  $m = \frac{\rho}{E^{1/3}}$  and  $m = \frac{K_{IC}}{\rho}$  respectively for tank material. Therefore, from the CES software,14 candidates materials were passed through the three stages as in Table 1.

**Table 1:** List of materials passed through all the stages

Material	Group of material	Comment
Age-hardening wrought Al-alloys		
Cast Al-alloys		
Commercially pure titanium	Non-Ferrous Metal	Not suitable
Nickel-based super alloys		
Titanium alloys		
Wrought magnesium alloys		
Zinc die-casting alloys		
Cast iron		
High carbon steel		
Low alloy steel	Ferrous Metal	Suitable
Medium carbon steel		
Stainless steel		
CFRP, epoxy matrix	Composite	Not suitable
Aluminium/Siliconcarbide composite		

Non-ferrous metals are not suitable compared to ferrous metals. Even though the materials are lightweight, they have limited strength capabilities. Non-ferrous metals either contain no iron or only insignificant amounts that are used as an alloy. Non-ferrous metals have a number of disadvantages. They are costly and have limited strength capability. They are extremely high in cost and the price can vary according to the ferrous metal and can raise production costs for companies. The strength of the material is lost when it is heated above the solution treatment temperature by welding and this happens to age-hardening wrought Al-alloy materials. Besides, some of the materials have lower strength, such as cast Al-alloys, commercially pure titanium, and titanium alloys. The strength of the material is very important because it is the ability of a metal to resist being pulled apart by opposing forces acting on the material of the tank. The detailed disadvantages for each non-ferrous metal are discussed in Table 2.

**Table 2:** Disadvantages of non-ferrous metals

Material	Disadvantages
Age-hardening wrought Al-alloys	- If it is heated above the solution treatment temperature by welding, the strength of the material is lost.
Cast Al-alloys	- Have lower ductility and strength than the wrought age-hardening alloys.
Commercially pure titanium	- Expensive material. - Requires vacuum processing to prevent intake of oxygen which makes it brittle.
Nickel-based super alloys	- Expensive - Hard to forge and roll - Typical uses: blades, disks, jet engines
Titanium alloys	- Expensive material. - Have limited ductility. - Low impact strength.
Wrought magnesium alloys	- Higher corrosion rates than cast alloys. - Subjected to mechanical working by processes such as rolling, extrusion, and forging.
Zinc die-casting alloys	- Can be formed by methods normally used for polymers - vacuum forming, compression moulding - Typical uses: automotive parts and tools.

After eliminating non-ferrous metals from the list for material selection, there are two materials left, i.e. ferrous metals and composites, which have passed through all the stages. However, each group of materials has their own mechanical properties, advantages, and disadvantages

Cast iron is any iron alloy containing greater than 2% carbon. Cast iron has a high compressive strength and good wear resistance. However, it lacks ductility, malleability, and impact strength, and is quite brittle. High carbon steel is harder, more brittle, and stronger than medium carbon steel. This material is difficult to weld because of the hardening effect of

heat at the welding joint. Low alloy steels generally contain up to 3 - 4% of one or more alloying element for the purpose of increasing the strength, toughness, and hardenability of the metal alloy. Besides, it is more resistant to corrosion. Medium carbon steels have low hardenability, high strength and are stronger than low carbon steels. They can be successfully heat treated only in very thin sections and rapidly. Stainless steels are highly resistant to corrosion in a variety of environments, especially in ambient atmospheres. Stainless steel is exploited for its high strength and high costs. Low alloy steels have the unique characteristics of materials which have high strength, toughness, hardenability and are more resistant to corrosion. The mechanical properties of each ferrous metal are shown in Table 3.

**Table 3:** Comparison of mechanical properties for each ferrous metal

A composite material can be defined as a combination of two or more materials that results in better properties than those of the individual components used separately. The main advantages of composite materials are their strength and stiffness, combined with low density, when compared with bulk materials, allowing for a weight reduction in the finished part. The other advantages of composites are:

- i. A higher performance for a given weight leading to fuel savings. Excellent strength to weight and stiffness to weight ratios can be achieved by composite materials. This is usually expressed as strength divided by density, and stiffness divided by density.
- ii. Production cost is reduced. Composites may be made by a wide range of processes.
- iii. Composites offer excellent resistance to corrosion, chemical attack, and outdoor weathering. However, some chemicals are damaging to composites (e.g., paint strippers), and new types of paint and strippers are being developed to deal with this.

Two materials passed through all three stages, i.e. CFRP, epoxy matrix, and Aluminium/Silicon carbide composite. They are better than any of their individual components with regard to their properties like strength, stiffness, heat resistance, etc. The detailed mechanical properties are shown in Table 4.

**Table 4:** Comparison of mechanical properties for each material composite

<b>Material</b>	<b>Density</b> <i>kg / m<sup>3</sup></i>	<b>Yield strength</b> <i>Mpa</i>	<b>Fracture toughness</b> <i>Mpa.m<sup>1/2</sup></i>	<b>Tensile strength</b> <i>Mpa</i>	<b>Price</b> <i>MYR / kg</i>
Cast iron	7050 - 7250	250 - 790	22 - 54	410 ó 830	1.44 - 2.87
High carbon steel	7800 - 7900	400 - 1155	27 - 92	550 ó 1640	1.79 - 3.22
Low alloy steel	7800 - 7900	400 - 1500	14 - 200	550 ó 1760	1.79 - 4.66
Medium carbon steel	800 - 7900	305 - 900	12 - 92	410 ó 1200	10.76 - 43.04
Stainless steel	7600 - 8100	170 - 1000	62 - 150	4800 ó 2240	10.76 - 43.04

<b>Material</b>	<b>Density</b> <i>kg / m<sup>3</sup></i>	<b>Yield strength</b> <i>Mpa</i>	<b>Fracture toughness</b> <i>Mpa.m<sup>1/2</sup></i>	<b>Tensile strength</b> <i>Mpa</i>	<b>Price</b> <i>MYR / kg</i>
Aluminium/Silicon	2660 - 2900	280 - 324	15 - 24	290 - 365	17.93- 35.87
CFRP	1500 - 1600	550 - 1050	6.12 - 20	550 - 1050	215.2- 358.7

Silicon carbide composite is a good high temperature structural material due to its excellent oxidation, corrosion, and creep resistance. However, it has poor fracture toughness. CFRP (carbon fibre reinforced polymer) has a low density, high modulus, and strength. According to Rahman,[5] from the study of the machinability of CFRP, thermosets (CFRP) are more brittle and possess less capability for plastic deformation than thermoplastics (PEEK/Carbon), which tend to fracture and damage earlier. However, they are expensive because they must be processed directly to shape by laying partially cured layers of material and then hot pressing. Carbon fibre is extremely conductive. This means that thermal energy or heat can move through a material. Although the cost of CFRP still remains high, new technological advancements in manufacturing are continuing to allow the production of more cost effective products.

In this study, low alloy steels are a more suitable material for air compressor tanks than CFRP, epoxy matrix. Table 5 below gives a comparison of the mechanical properties of low alloy steel and CFRP.

**Table 5:** Comparison of the mechanical properties of low alloy steel and CFRP

<b>Material</b>	<b>Density</b> <i>kg / m<sup>3</sup></i>	<b>Yield strength</b> <i>Mpa</i>	<b>Fracture toughness</b> <i>Mpa.m<sup>1/2</sup></i>	<b>Tensile strength</b> <i>Mpa</i>	<b>Price</b> <i>MYR / kg</i>
Low alloy steel	7800 - 7900	400 - 1500	14 - 200	550 - 1760	1.79 - 4.66
CFRP	1500 - 1600	550 - 1050	6.12 - 20	550 - 1050	215.2- 358.7

Some of the mechanical properties of CFRP do not fulfil the requirements for the performance of the material. In terms of mechanical properties, CFRP has a lower density (1500 to 1600 MPa) than low alloy steels. However, the material performance requirements for air compressor tanks are high fracture toughness, high yield strength, and good corrosion resistance. The fracture toughness of low alloy steels (14 to 200  $Mpa.m^{1/2}$ ) is higher than CFRP (6.12 to 20  $Mpa.m^{1/2}$ ). High fracture toughness is very important to prevent cracks. If the material of the tank has high fracture toughness it will probably undergo ductile fracture.

Low alloy steels are suitable materials for the pressure vessel industry, which requires an adequate amount of strength and toughness. It contains micro alloying elements which are used to ensure the amount of hardenability required to obtain bainitic steels [6]. Besides, the yield strength for low alloy steel (400 to 1500  $Mpa$ ) is higher than CFRP and fulfils the requirements for the tank material. The impact properties of low alloy steel displayed much

higher resistance to ductile fractures at high test temperatures and resistance to brittle fractures at low test temperatures [6] to support a functionality of air compressors during use. If the yield strength is low, as in CFRP materials (6.12 to 20 Mpa), the air compressor tank should be large enough so that the applied force produces a stress that is below the yield strength. In most cases, the cost of the raw material accounts for about 50% of the finished cost. Obviously, the cost of the material is a major factor influencing the choice of the material or the process. From Table 4.4, CFRP (215.2- 358.7 MYR / kg ) is more expensive than low alloy steels (1.79 - 4.66 MYR / kg ).

## 5.0 Conclusion

From the study, two materials have passed through three stages of the performance indices. The materials are low alloy steels and CFRP, epoxy matrix. The low alloy steel has been suggested as a material that is suitable for air compressor tanks. The selection of the material was based on the factors that affect the material, such as the mechanical properties and the cost of the material. Low alloy steel has a higher strength which can support the force of an air compressor during use and it is less brittle. The density of low alloy steels is 7800 - 7900 kg / m<sup>3</sup> and the fracture toughness of 14 to 200 Mpa.m<sup>1/2</sup> is higher than that of the other materials, thus meeting the performance requirements for air compressor tanks. The yield strength for low alloy steel (400 ó 1500 Mpa) is higher than CFRP materials. Besides, the cost of the material is a major factor influencing the choice of the material or process. The cost of low alloy steel (1.79 - 4.66 MYR / kg ) is cheaper than that of carbon fibre reinforced polymer (215.2- 358.7 MYR / kg ). Process selection for fabrication is highly recommended for the next analysis.

## 6.0 Acknowledgement

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# **C1 - Kesan Pengurusan Sistem Acuan Kepada Penggunaannya Secara Optimum Dalam Pembinaan Bangunan Berkonsepkan Sistem Berindustri (IBS)**

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## **Abstrak**

*Selepas lewat 90-an, adalah satu kebiasaan bagi pembinaan pangsapuri menerima Industrialised Building System (IBS) sebagai satu kaedah pembinaan yang cepat dan menjimatkan kos dengan kelebihan penggunaan sistem acuan yang diperkenalkan. Sistem acuan ini mempunyai kualiti penuangan konkrit yang baik, pemasangan yang cepat dan peningkatan kekerapan penggunaan berulang kali berbanding acuan konvensional. Seminar peningkatan pengetahuan dan kemahiran telah banyak dijalankan oleh penggiat IBS untuk mewujudkan kesedaran terhadap kelebihan penggunaan sistem ini. Satu elemen penting yang kurang diberi penekanan adalah pengurusan Sistem Acuan IBS, di mana ianya amat penting untuk penggiat IBS terutamanya kontraktor dapat mengoptimumkan penggunaan Sistem Acuan yang dimiliki untuk mendapatkan pulangan yang lebih besar setelah membuat pelaburan awal yang tinggi. Kajian soal selidik ini dilakukan bagi mengkaji kesan pengurusan Sistem Acuan terhadap penggunaan acuan secara optimum dalam pembinaan berkonsepkan IBS. Penemuan kajian menunjukkan bahawa acuan yang diuruskan dengan baik dapat mengoptimumkan penggunaan dan jangka hayat acuan IBS seterusnya menjimatkan kos dengan lebih efektif.*

**Kata Kunci:** *Industrialised Building System (IBS), Sistem Acuan IBS, Pengurusan Sistem Acuan.*

## **1.0 Pengenalan**

Keadaan industri pembinaan tempatan, dengan kualiti, produktiviti dan tahap keselamatan yang rendah, terlalu bergantung kepada pekerja asing tidak mahir adalah tidak mampan dan tidak selaras dengan pembangunan di Malaysia untuk masa yang akan datang. Dalam usaha untuk mengekalkan persaingan dalam industri pembinaan terutama dalam era globalisasi ini, kerajaan Malaysia telah melancarkan pelan tindakan yang dikenali sebagai *IBS Roadmap 2003-2010* untuk menggalakkan penggunaan IBS dalam industri pembinaan tempatan.

Industri pembinaan telah menjadi penyebab kepada masalah alam sekitar kerana penggunaan sumber global yang berlebihan untuk pembinaan dan juga operasi bangunan itu sendiri. Industri pembinaan akan menjadi lebih mesra alam jika penggunaan sumber dapat dikurangkan, penggunaan sumber tenaga yang efisien, pengurangan kadar pembaziran dan pengurangan kadar pencemaran. Sebagai contoh, dengan pengurangan penggunaan acuan terutamanya acuan kayu akan mengekalkan sumber alam semulajadi dan mengurangkan aktiviti penebangan hutan yang boleh menyebabkan pemanasan global. Bagi mengatasi masalah-masalah tersebut, Sistem Acuan IBS diperkenalkan sebagai salah satu kluster sistem IBS. Dengan penggunaan Sistem Acuan IBS ini telah menggalakkan pembangunan secara mampan samada secara langsung atau tidak langsung. Tambahan lagi, penggunaan IBS ini telah mengurangkan pencemaran udara yang disebabkan oleh debu-debu ke tahap yang minima di tapak pembinaan. Di samping itu, pencemaran bunyi yang terhasil daripada kerja-

kerja pemasangan acuan juga dapat dikurangkan. Selain itu, sistem Acuan IBS ini juga boleh mengurangkan tempoh masa bagi melakukan kerja-kerja sementara dalam pembinaan kerana bilangan acuan yang digunakan dalam sistem ini dapat dikurangkan.

## 2.0 Sistem Acuan IBS

Sistem ini menjalankan proses pembinaan menggunakan suatu cara yang sistematik dan berasaskan mekanikal. Kerja-kerja pemasangan, pengubahsuaian dan penanggalan acuan perlu dilakukan oleh pekerja yang berkemahiran dan diselia oleh seorang penyelia yang bertauliah. Acuan yang dipasang perlu dibuat pemeriksaan terlebih dahulu sebelum kerja-kerja penuangan konkrit dilakukan. Penggunaan panel acuan jenis ini dapat mempertingkatkan pembinaan konkrit in-situ. Hal ini sekaligus dapat meninggikan kelajuan pembinaan. Antara jenis-jenis acuan yang digunakan adalah seperti berikut:

- a) Acuan piawai
- b) Acuan fleksibel
- c) Acuan bateri
- d) Acuan terhad
- e) Acuan “one-off”

### 2.1 Acuan Piawai

Acuan piawai biasanya diperbuat dari besi keluli, aluminium, *glassfibre reinforced polymer (GRP)*, konkrit atau kombinasinya. Acuan ini diperlukan untuk kerja-kerja konkrit bertetulang. Acuan ini juga dibuat untuk tahan lasak, senang dicuci, dibuka, dan pasang semula tanpa merosakkan permukaan. Pada lazimnya, acuan besi keluli jauh lebih tahan daripada acuan GRP atau konkrit yang banyak bergantung pada cara pemakainya.

### 2.2 Acuan Fleksibel

Acuan fleksibel digunakan bila sebahagian dari ukuran komponen ini tidak berubah.

### 2.3 Acuan Bateri

Acuan bateri biasanya diperbuat dari besi dan digunakan *casting* tegak. Iaitu konkrit dimasukkan dari tepi. Cara ini berguna untuk komponen-komponen nipis, panel dinding, tiang dan sebagainya.

### 2.4 Acuan Terhad

Acuan terhad digunakan untuk komponen-komponen terhad seperti parapet, arches dan komponen-komponen bukan piawai

### 2.5 Acuan “One-Off”

Acuan *one-off* digunakan untuk elemen-elemen istimewa seperti tulisan, skulptur dan sebagainya.

(Sumber: Surat Pekeliling Bil. 7 Perbendaharaan Tahun 2008, Kementerian Kewangan Malaysia)

### 3.0 Metodologi Kajian

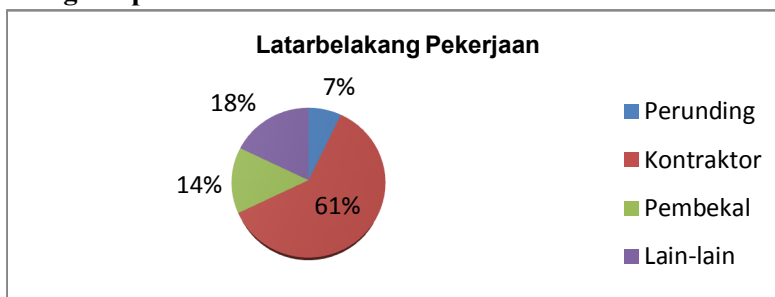
Data dalam kajian telah dikumpulkan melalui borang soal selidik yang telah diedarkan dengan serahan tangan kepada mereka yang terlibat dengan projek pembinaan di tapak bina, syarikat perunding, agensi kerajaan yang berkaitan dan pembekal di sekitar Kuala Terengganu dan juga melalui email kepada syarikat yang berdaftar dengan Pusat IBS CIDB. Pendekatan yang diambil ini adalah dengan mengambilkira saiz sampel, masa, kos dan usaha. Borang soal selidik telah direkabentuk dan dibangunkan dalam dua fasa. Fasa pertama merangkumi soalan soal selidik berdasarkan pembacaan awalan dari kajian literatur yang dibuat fokus kepada artikel mengenai IBS yang telah dibangunkan serta kajian awal berdasarkan lawatan ke tapak bina dan sesi temubual bersama pengurus projek yang berpengalaman menggunakan Sistem Acuan IBS lebih dari 5 tahun. Pra ujian soal selidik telah dijalankan terlebih dahulu dengan memilih syarikat pembekal dalam Sistem Acuan IBS ini sebagai sampel responden untuk pra ujian soal selidik bagi memastikan soalan yang dibangunkan tidak menimbulkan sebarang kekeliruan dan wujudnya soalan yang berulang kehendak maksudnya di dalam borang soal selidik yang telah direkabentuk. Borang soal selidik seterusnya diperbaiki setelah meneliti maklum balas awal berdasarkan pra ujian yang dibuat.

Borang soal selidik yang dibangunkan mengandungi 15 soalan yang merangkumi maklumat latar belakang responden seperti pekerjaan, tahap pengetahuan mengenai Sistem Acuan IBS dan tahun pengalaman. Soalan seterusnya fokus kepada Sistem Acuan IBS yang digunakan dari segi material, kekerapan atau jangkahayat penggunaan dan pengurusan acuan. Seterusnya soalan kaji selidik lebih berkisarkan masalah yang dihadapi dalam penggunaan Sistem Acuan IBS dan langkah yang diambil dalam menyelesaikan masalah tersebut. Selain itu soalan kaji selidik juga meliputi kepada kaedah pengurusan acuan yang tidak digunakan untuk tempoh tertentu dan bagaimana untuk memastikan acuan tahan lebih lama dan pendapat terhadap penggunaan Sistem Acuan IBS ini dari sudut pembaziran. Sebanyak 100 borang kaji selidik telah diedarkan dan bilangan yang respon adalah sebanyak 32 yang terdiri dari latar belakang yang berbeza. Data yang telah diperolehi dalam kajian ini diproses dan dianalisis.

### 4.0 Penemuan Kajian Dan Perbincangan

Sebelum data pengurusan Sistem Acuan IBS dianalisa, profil responden dilihat untuk mengukuhkan data yang diperolehi. Tiga kriteria penting mengenai latar belakang responden yang menjadi asas kajian adalah meliputi pekerjaan atau perniagaan responden, tahap pengetahuan responden terhadap IBS dan pengalaman responden dalam projek berkonsepkan IBS.

#### 4.1 Latarbelakang Responden

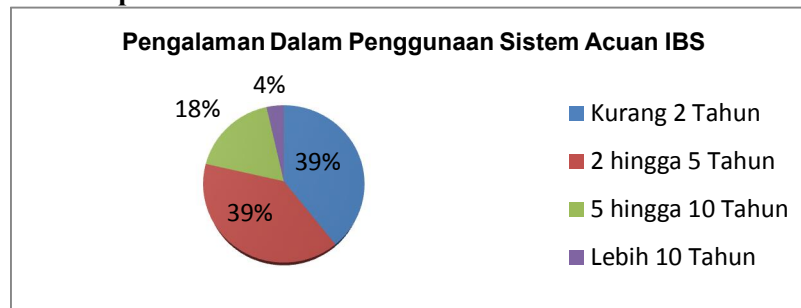


Rajah 1: Peratusan Responden Berdasarkan Latarbelakang Pekerjaan



Maklum balas telah dikumpulkan melalui edaran borang soal selidik meliputi 100 responden dengan 32 darinya dikembalikan. Dari 40 responden, 7 % adalah dari perunding, 61% kontraktor, 14% pula pembekal dan 22% adalah lain-lain di mana ianya adalah terdiri daripada tenaga pengajar yang mempunyai pengalaman di dalam IBS dan juga pegawai CIDB. Peratusan pekerjaan/perniagaan responden dapat diterjemahkan seperti Rajah 1 di atas. Kontraktor merupakan kumpulan majoriti responden bagi kajian yang dijalankan. Tumpuan kaji selidik ini lebih cenderung kepada kumpulan kontraktor kerana maklumat yang lebih dipercayai boleh diperolehi disebabkan mereka adalah kumpulan yang menggunakan dan menguruskan Sistem Acuan IBS ini. Kumpulan responden yang lain merupakan kumpulan sasaran bagi menyokong data dan analisis yang dibuat.

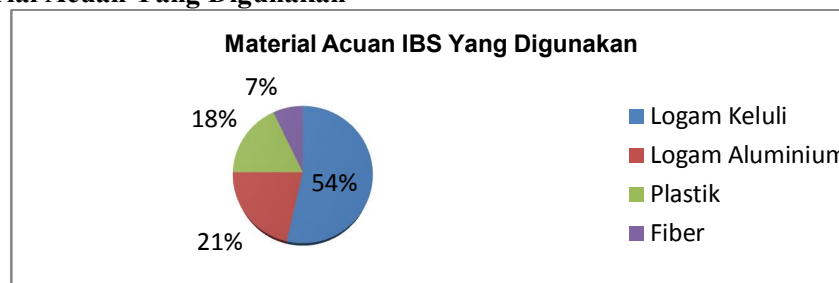
#### 4.2 Pengalaman Responden



**Rajah 2:** Peratusan Pengalaman Responden Dalam Penggunaan Sistem acuan IBS

Berdasarkan Rajah 2, responden mempunyai pengalaman dalam penggunaan sistem acuan IBS kurang dari 5 tahun iaitu sebanyak 39% kurang 2 tahun dan 39% juga untuk 2 hingga 5 tahun berbanding hanya 18% untuk 5 hingga 10 tahun dan 4% yang mempunyai pengalaman lebih daripada 10 tahun. Untuk membantu kajian mendapatkan data yang kukuh, pengalaman responden ini dipecahkan kepada bilangan projek yang terlibat mengikut kategori tahun pengalaman responden. Di mana responden yang mempunyai pengalaman kurang daripada 5 tahun pernah terlibat dalam 1 hingga 6 projek pembinaan bangunan berkonsepkan IBS.

#### 4.3 Material Acuan Yang Digunakan

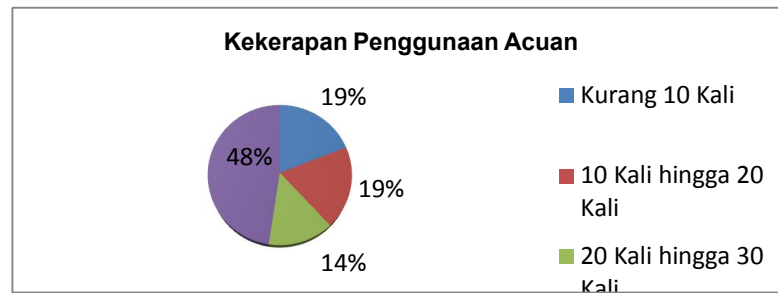


**Rajah 3:** Peratusan Material Acuan IBS Yang Digunakan

Rajah 3 menunjukkan material acuan yang digunakan atau dimiliki oleh responden. Acuan logam keluli merupakan acuan yang paling banyak digunakan dengan peratusan 54%. Manakala acuan jenis fiber merupakan jenis acuan yang paling sedikit peratusan penggunaannya iaitu sebanyak 7%. Logam keluli adalah acuan jenis piawai di mana ianya lebih menjadi pilihan kerana ia lebih tahan lama serta ekonomik berbanding acuan jenis lain. Walau bagaimanapun, ketahanan sistem acuan keluli ini juga dipengaruhi oleh cara pengurusannya.

#### 4.4 Kekerapan Penggunaan

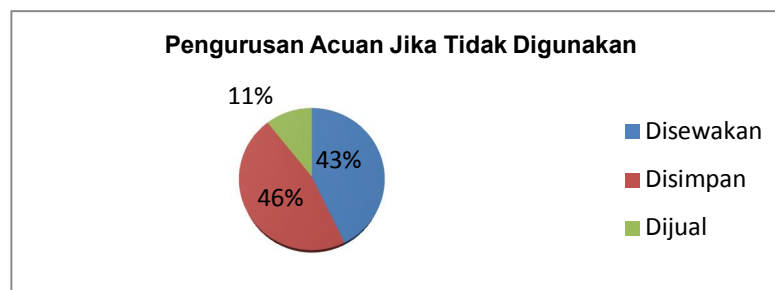
Peratusan kekerapan penggunaan acuan IBS menunjukkan penggunaan acuan melebihi 30 kali adalah peratusan yang tertinggi iaitu 48%. Peratusan kekerapan ini dapat dikaitkan dengan dominasi penggunaan acuan jenis logam keluli sebagaimana penemuan data di atas. Pandangan responden juga telah diambil dan 35% responden berpendapat bahawa dengan membersihkan acuan serta menyapu bahan anti karat juga penyimpanan yang baik adalah merupakan langkah yang sepatutnya bagi memastikan jangka hayat penggunaan acuan lebih lama.



Rajah 4: Peratusan Kekerapan Penggunaan Acuan

#### 4.5 Pengurusan Acuan

Satu pengurusan acuan perlu difikirkan oleh pihak kontraktor untuk memastikan pelaburan awal terhadap pembelian acuan ini memberi pulangan yang menguntungkan selari dengan konsep projek pembinaan menggunakan sistem IBS yang menjimatkan kos dan mengurangkan pembaziran. Pengurusan acuan menjadi kritikal kepada kontraktor apabila tiada kesinambungan projek menggunakan kaedah atau sistem yang sama. Oleh itu, data bagaimana responden menguruskan acuan jika ianya tidak digunakan dalam tempoh tertentu telah dikumpulkan. Rajah 5 menunjukkan 46% responden menyimpan acuan yang ditempat yang sesuai dan selamat. Manakala 43% responden menyewakan acuan tersebut kepada kontraktor yang lain dan selebihnya acuan tersebut dijual.



Rajah 5: Peratusan Kaedah Pengurusan Acuan Jika Tidak Digunakan

#### 5.0 Kesimpulan dan Cadangan

Berdasarkan maklum balas responden dalam kajian ini menunjukkan bahawa pengurusan yang baik sangat memberi impak kepada kekerapan dan jangka hayat acuan IBS yang digunakan dalam projek pembinaan bangunan berkonsepkan IBS. Satu garis panduan yang betul harus dibangunkan kepada pihak yang terlibat dengan penggunaan Sistem Acuan IBS bagi memastikan setiap individu yang terlibat dalam pengurusan Sistem Acuan ini

mempunyai pengetahuan dan kemahiran yang mencukupi. Kekerapan penggunaan acuan secara optimum dapat menjamin penjimatan kos yang lebih efektif. Acuan yang dibeli ataupun yang direkabentuk khas memerlukan kos perbelanjaan yang tinggi dan seharusnya ianya dijaga dengan sempurna dan dijadikan sebahagian daripada aset syarikat berkenaan yang perlu kepada pengurusan aset yang baik.

## 6.0 Rujukan

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## I1 - PC Akuarium

Azhari bin Salleh, Rusidin bin Mustapha, Mohd Zahirruddin bin Mohamad,  
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### **Abstrak**

*Projek ini adalah kajian mengenai “PC Akuarium” untuk menaiktaraf sistem penyejukan bagi sebuah komputer. Minyak Sunflower yang berasaskan Mineral Oil digunakan sebagai medium penyejukan utama bagi pemproses (CPU) dan komponen-komponen utama komputer yang lain, khususnya yang menghasilkan haba dan banyak melibatkan pemprosesan data. Projek ini juga banyak melibatkan perbandingan sistem penyejukan komputer yang sedia ada dengan sistem yang telah kami bina untuk meminimumkan suhu komputer semasa penggunaan dan pemprosesan data yang tinggi. Sistem ini juga adalah bertujuan untuk menstabilkan suhu dan memastikan sistem komputer berjalan dengan baik tanpa sebarang masalah yang melibatkan suhu yang tinggi yang boleh mengancam perjalanan pemprosesan data dan komponen di dalamnya.*

**Keywords:** *PC Akuarium, Mineral Oil, sistem / medium penyejukan, menstabilkan suhu.*

### **1.0 Pengenalan Projek**

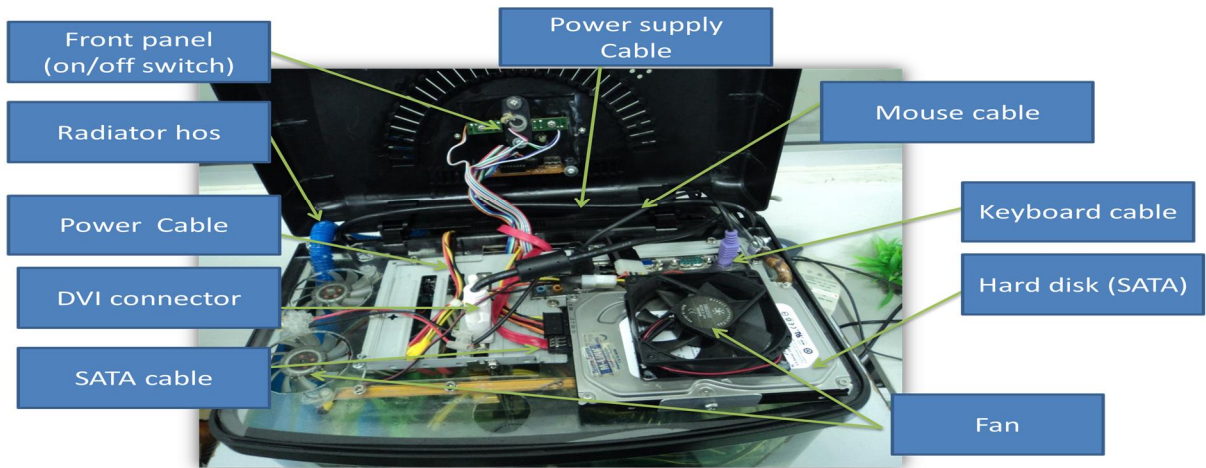
Selama ini sistem komputer hanya bergantung kepada kipas untuk menyingkirkan haba terutamanya pada prosesor dan kad grafik. Prosesor yang panas akan menyebabkan komputer menjadi lembab memproses data sehingga boleh merosakkan komponen tersebut. Penggunaan kipas yang sedia ada tidak dapat menyingkirkan haba secara berkesan terutamanya semasa mengendalikan proses *Processor/CPU* dan *Graphical Processor Unit/GPU* memproses data yang tinggi seperti bermain permainan komputer.

Oleh yang demikian, satu alternatif baru dalam sistem penyejukan komputer yang lebih efisien akan dihasilkan melalui projek ini. Melalui penggunaan minyak Sunflower sebagai medium penyejukan, kami ingin membina sebuah komputer yang seakan-akan akuarium ikan hiasan. Penggunaanya yang bersifat mesra pengguna diharap akan dapat memenuhi permintaan yang dicadangkan. Ia juga diharap akan dapat menjadi titik tolak dalam meningkatkan produktiviti dan proses menaiktaraf sistem komputer yang sedia ada pada masa hadapan.

Penggunaan komputer yang maksimum seperti bermain permainan video, drawing dan multimedia editing akan melibatkan pemprosesan data yang besar dan menyebabkan *CPU* berkerja keras sehingga meningkatkan lagi haba yang terhasil. Faktor habuk adalah salah satu faktor yang boleh menjadi penyebab yang merosakkan perkakasan di sebabkan itu perkakasan yang diseliputi habuk akan menyukarkan kipas *CPU* berfungsi dengan baik. Oleh itu, kajian, pengumpulan data dan ujikaji telah dijalankan untuk mencipta perkakasan yang boleh mengurangkan kepanasan dan habuk yang menjadi masalah kepada setiap pengguna yang memiliki komputer peribadi tersebut.

## 2.0 Rekabentuk Model:

### Pandangan atas



Rajah 1



Rajah 2

## 2.1 Pembangunan projek

### LANGKAH 1 (Fasa Pengujian)

- Mengkaji minyak yang digunakan ke atas komponen komputer.
- Menyediakan *power supply* dan menengelmkannya bersama minyak.

- c) Aspek-aspek keselamatan amatlah dititik beratkan semasa pengujian ini kerana letupan atau kebakaran kecil mungkin berlaku. Penyediaan *Fire Extinghuiser* semasa pengujian amat dititikberatkan bagi mengelakkan sebarang kejadian tidak diingini.

#### LANGKAH 2 (Fasa Pemasangan)

- a) Fasa pemasangan melibatkan pemotongan *casing* dan juga *acrylic panel*.
- b) Ukuran yang tepat memainkan peranan yang sangat penting dalam fasa ini bagi menonjolkan kekemasan hasil kerja.
- c) Pemotongan melibatkan penggunaan mesin-mesin seperti *jigsaw*, *handrill* dan juga *grainder*.
- d) Aspek keselamatan dan bahaya penggunaan mesin juga dititikberatkan semasa membuat proses pemotongan seperti aspek pemakaian dan juga peralatan keselamatan seperti goggles.

#### LANGKAH 3 ( Fasa Monitoring)

- a) Fasa ini melibatkan perbandingan suhu antara Pc biasa dan Pc akuarium yang telah dibina.
- b) Pengujian dilakukan dengan penggunaan perisian *õSpeecyö* bagi mengambil bacaan suhu *CPU, GPU, HDD* dan *motherboard*
- c) Suhu minyak dan suhu bilik juga di ambil dan disokong kesahihanya dengan ,menggunakan alat *Thermometer digital*.

### 3.0 Ciri-Ciri dan Keupayaan Projek

PC Akuarium mempunyai ciri-ciri dan keupayaan seperti berikut :

- a) Projek ini boleh digunakan oleh sesiapa sahaja.
- b) Projek ini boleh membantu pengguna untuk memanjangkan jangka hayat komputer.
- c) Mengelakkan peningkatan suhu yang melampau.
- d) Mencegah kebakaran yang kecil pada komponen komputer sekiranya suhu terlalu panas atau mengalami litar pintas.
- e) Menjimatkan kos penyelenggaraan.

#### 3.1 Faedah dan aplikasi rekacipta.

- a) Pengurangan suhu prosesor sekitar 30% sehingga 40% dari komputer biasa.
- b) Suhu prosesor yang hampir seragam mengikut masa penggunaan komputer.
- c) Mengatasi masalah habuk pada komponen komputer sehingga 90%.
- d) Haba yang terhasil diserap lebih berkesan oleh minyak berbanding udara.
- e) Masalah ~~hanging~~ dapat dikurangkan sehingga 80% mengikut masa dan penggunaan aplikasi komputer.
- f) Mengharumkan ruang bilik atau premis.
- g) Menjadi alat hiasan ruang (menyerikan suasana bilik).
- h) Mencegah kebakaran kecil jika berlaku litar pintas pada komponen komputer.

#### 4.0 Analisa Persembahan (*Performance Analysis*)

- Analisa persembahan menggunakan perisian seperti berikut:

Software	Kategori	Kegunaan
Windows 7 Ultimate	Operasi sistem	Pengoperasian komputer
Speccy	Aplikasi	Memaparkan suhu komponen komputer
Call of duty-Black ops	Permainan	Ujikaji suhu.

- Ujian suhu keatas projek dan komputer biasa yang mempunyai spesifikasi yang sama pada tahap penggunaan *ekstrem*.

##### a) Komputer biasa.

Suhu rehat/ c					
CPU	GPU	MB	HD	catatan	
46	46	44	43		
Aktiviti : Permainan komputer bergrafik tinggi					
Masa : 5 jam					
Masa/jam	Suhu/ c				
	CPU	GPU	MB	HD	
1	88	79	91	41	
2	85	78	87	41	
3	86	78	85	42	
4	87	81	85	41	
5	85	81	87	41	
Purata	86.2	79.4	87	41.2	

Jadual 1

##### b) PC Akuarium

Suhu rehat/ c					
CPU	GPU	MB	HD	catatan	
39	40	32	37		
Aktiviti : Permainan computer bergrafik tinggi					
Masa : 5 jam					
Masa/jam	Suhu/ c				
	CPU	GPU	MB	HD	Minyak
1	53	52	46	41	41.6
2	60	58	55	42	46.3
3	59	60	55	43	49.4
4	63	56	51	39	44.7
5	57	56	51	38	45.3
Purata	58.4	56.4	51.6	20.3	45.46

Jadual 2

##### Panduan:

CPU : Processor  
HD : Hard Disk

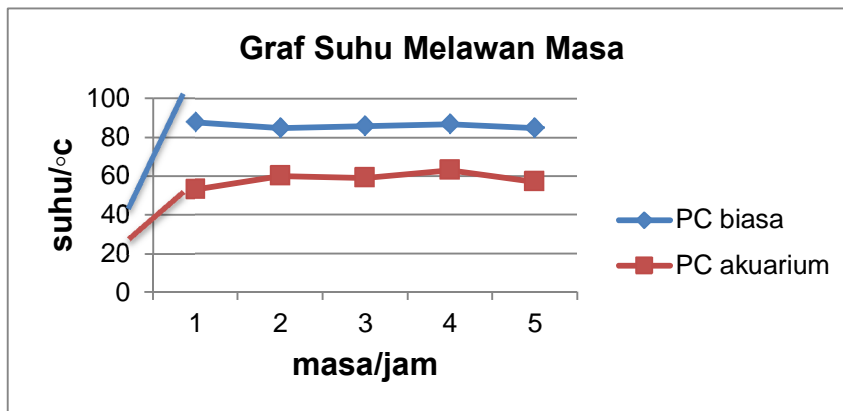
MB : Motherboard  
GPU : Kad grafik

c) Kadar penurunan suhu/ c

Komputer	Komponen computer			
	CPU	GPU	MB	HD
Biasa	86.2	79.4	87	41.2
PC akuarium	58.4	56.4	51.6	20.3
Beza suhu	27.8	23	35.4	20.9
% penurunan	32.25	28.9	40.6	50.7

Jadual 3

d) Graf perbandingan suhu bagi CPU.



Rajah 3

Rumusan dari analisa yang dilakukan:

Dari rajah 3 (Graf Peningkatan Suhu vs Masa) dapat disimpulkan bahawa PC Akuarium mempunyai kenaikan suhu yang lebih rendah berbanding PC biasa yang mempunyai spesifikasi yang sama. Ini secara tidak langsung memenuhi objektif projek ini iaitu untuk menaiktaraf sistem penyejukan bagi sebuah komputer bertujuan meminimumkan suhu komponen komputer semasa penggunaan dan pemprosesan data yang tinggi. Sistem yang telah kami bina ini juga berjaya untuk menstabilkan suhu dan memastikan sistem komputer berjalan dengan baik tanpa sebarang masalah yang melibatkan suhu yang tinggi yang boleh mengancam perjalanan pemprosesan data dan komponen di dalamnya. Secara amnya, komputer serta perkakasan merupakan suatu perkakasan yang memerlukan penjagaan yang baik bagi memastikan jangka hayat serta kualitinya berada didalam keadaan baik. Komputer merupakan alat elektronik yang mempunyai peranti-peranti yang menghasilkan haba yang menyebabkan kepanasan terhasil daripada penggunaan aplikasinya.

Melalui konteks penjagaan ini, aspek yang perlu dititikberatkan ialah keadaan suhu sekeliling. Komputer memerlukan penjagaan yang baik daripada pengguna itu sendiri jika pengguna itu mahukan jangka hayat komputer tersebut lebih lama dan memastikan sistem sentiasa berada di dalam keadaan baik. Oleh yang demikian, suatu peranti atau mesin perlulah dibina. Antaranya beberapa pendekatan yang di ambil dalam penyelesaian masalah ialah:



•Mencipta perkakasan yang dapat menyejukkan perkakasan komputer dengan membuat pengubahsuaian perkakasan komputer dengan menyambungkan Radiator ke dalam akuarium yang berisi minyak.ö

## 5.0 Cadangan penambahbaikan

Beberapa penambahbaikan yang boleh dilakukan terhadap projek ini, antaranya adalah seperti berikut:

- i. Menggantikan minyak Sun Flower dengan mineral oil yang lebih berkualiti pada masa akan datang.
- ii. Membuat program automatik untuk menghidupkan sistem radiator secara automatik mengikut peningkatan suhu minyak.
- iii. Mengemaskan lagi pemasangan bahagian atas komputer akuarium untuk tujuan tarikan dan nilai komersial di masa akan datang.
- iv. Penggunaan perkakasan komputer yang mempunyai spesifikasi tertinggi (Processor dan Memori) bagi menjalankan fungsi pemproses yang lebih laju dan lancar bagi tujuan benchmarking keupayaan sesebuah computer berprestasi tinggi.

## 6.0 Pengiktiran Rekacipta

Projek ini telah memenangi anugerah pingat Perak (kategori IT/Perkakasan) di dalam Pertandingan Kreativiti dan Teknologi Inovasi (CITEC) 2013 anjuran Jabatan Tenaga Manusia (JTM) di ILP Ledang Johor.

## 7.0 Kesimpulan

Projek PC Akuarium yang merupakan salah satu usaha kami menetengahkan inovasi yang baru untuk sistem penyejukan dan penjagaan komponen komputer. Minyak Sunflower sebagai medium utama kami yang juga merupakan faktor penyejukan dan penyebaran haba yang baik. Dari segi kajian yang dilakukan minyak merupakan salah satu bahan yang muatan habanya lebih besar daripada air. Minyak juga memendam haba yang bermaksud, sejumlah haba diserap atau dibebaskan oleh sesebuah bahan kimia sewaktu pertukaran fasa tanpa mengubah suhunya.

Minyak juga adalah salah satu bahan penyingkir haba yang baik berbanding udara dan cecair. •PC Akuariumö yang telah kami bina ini juga mampu menangani suhu yang ekstrem dan pemprosesan data yang lebih besar dalam satu-satu masa tanpa mengalami masalah ölaggingö atau öShutdownö dengan sendirinya.

Projek ini merupakan suatu inovasi sistem penyejukan yang efisien bagi sistem komputer. Sasaran penggunaan sistem ini adalah bagi para penggemar permainan video bergrafik tinggi ,jurutera dan para pekerja multimedia yang kerja mereka memerlukan sejumlah pemprosesan data yang besar dalam satu-satu masa.

## 6.0 Rujukan

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## **I2 - Category 6 UTP Cable Health Check for Performance Evaluation**

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### ***Abstract***

*Network Health Check on the Local Area Network is very important to ensure that the network is always in good condition and functions as expected. In the field of computer networking, there are several categories of health check which can be carried out. For instance network equipment's health, system and configuration health as well as security system health. This research is carried out to evaluate the Category-6 UTP cable performance prior to 7 years of usage on a local area network. The performance evaluation is performed by determining the amount of changes occurred on each UTP cable parameter. Then, the values of each cable parameter will be analysed to determine the relationship between the condition of the cables with the performance deterioration occurred on the network. In order to obtain accurate results, the study will be carried out on two separate environments which are active network points and inactive network points. The results obtained will be compared with the data obtained at the beginning of the installation process (7 years ago).*

**Keywords :** Network Health Check, Category-6 UTP Cable, active and inactive network points.

### **1.0 Introduction**

IT infrastructure such as Local Area Network (LAN) is very important to an organisation. It is an important and sometimes critical tool in assisting the business or service organisation to carry out their daily functions and then achieving their global goal in business. Therefore, it is necessary for an organisation to monitor the condition, functionality and the effectiveness of their LAN by carrying out the network health check regularly.

Health checks in networking can be categorised into several categories such as network equipment health, system and configuration health and also in network security health [1]. However, most of the network administrators are only interested in doing a health check on the equipment such as switches, routers and servers. It is very rare to see the network administrators carrying out the health check on transmission medium called UTP cable. As we know, UTP cable is a very important component in a computer network where it is used to connect an equipment to another equipment in a network to enable data processing and to provide communication facilities across the organisation. In the event of any malfunction/s to the UTP cables, the network would not function as expected by the users and the organisation itself. So, it is very important for us to conduct regular health checks on UTP cables to ensure that the cables are always in good condition.

## 2.0 Category 6 UTP Cable

Category 6 is standard for sixth generation Ethernet cable defined by the Telecommunications Industry Association and Electronic Industries Association (TIA/EIA) [2]. The cable contains four pairs of copper wire like the previous generation Category 5 as shown in Figure 1.0. Unlike Category 5, Category 6 UTP fully utilises all 4 pairs in order to support up to 1 Gigabit Ethernet speeds. The recommended length is limited to 328 feet (100 meters) only.

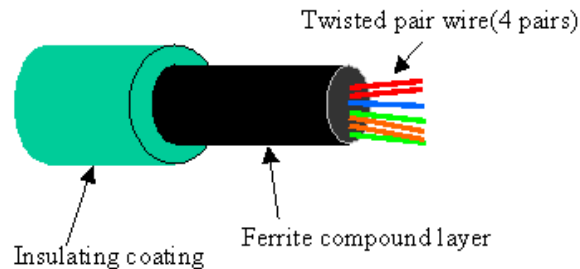


Figure 1.0: Category 6 UTP Cable Structure

### 2.1 Internal Cable Parametre

Internal channel testing for Category 6 cabling system includes measuring at swept frequencies up to 350MHz for familiar electrical parametre. ANSI/TIA/EIA-568-B.2 has produced a guideline that listed a number of important parametre need to be tested during the installation process in order to make sure that all the cable installed meet the requirement standard [2]. The parametre are:-

#### 2.1.1 The Wire map

Wire map is used to identify the possibilities of errors during the wiring installation. The Wiring map will check:

- Condition of pin termination at each end
- Continuity each pair to the remote end
- Shorts between any two or more conductors
- Transposed pairs
- Crossed pairs
- Reversed pairs
- Shorted pairs
- Any other mis-wiring

#### 2.1.2 Cable Length

The physical length of the cable is the actual length derived from measurement of the cable between the two end points. In Category 6 UTP cable, the maximum physical length for the permanent link, measuring from one node to another node is 90 metres. The maximum physical length of the channel link is up to 100 metres (90 metres permanent link + 10 metres patch cord cable).

### **2.1.3 Insertion Loss (Attenuation)**

Insertion Loss or previously called as attenuation is the reduction in signal strength over the distance the signal is transmitted and is usually expressed in dB per unit length; example:2 dB/1000 feet. It is a measure of how much the signal amplitude will reduce or deteriorate as it travels down a cable. It is an important parameter in deciding the available bandwidth used in Gigabit Ethernet cable. In the copper cable technology, the insulation and conductor are the major contributors to cable attenuation, while the jacket composition makes a minor contribution to attenuation in UTP cable designs. Attenuation increases with distance and frequency. In other words, we can say that the higher the signal frequency or the greater the length of the cable, the greater the attenuation. When we are measuring the attenuation in a UTP cable, lower dB values indicate better performance and less signal loss (Category 6 Consortium, 2002).

### **2.1.4 Near-end Crosstalk (NEXT)**

When a current flows through a wire, it will produce an electromagnetic field. This electromagnetic field can interfere with the other signal on the adjacent wires. As frequency increases, this effect becomes stronger. Each pair is twisted because this allows opposing fields in the wire pair to cancel each other. The tighter the twist, the more effective the cancellation and the higher the data rate can be supported by the cable. Maintaining this twist ratio is a very critical factor for a successful installation. If the wires are not tightly twisted, the result is Near End Crosstalk (NEXT). NEXT occurs when a strong signal on one pair of wires is picked up by an adjacent pair of wires. The higher NEXT, the better performance of the cable, (Category 6 Consortium, 2002).

### **2.1.5 Power Sum NEXT (PS-NEXT)**

Power Sum NEXT or PS-NEXT is not a measurement and it is just a calculation. PS-NEXT is derived from the summation of the individual NEXT effects on each pair by the other three pairs. Since PS-NEXT is a measure of difference in signal strength between disturbing pairs and a disturbed pair, a larger number (less crosstalk) is more desirable than a smaller number (more crosstalk) [6]. Since PS-NEXT varies significantly with frequency, it is important to measure it across a range of frequencies which varies depending on the wiring standard used. Typically, PS-NEXT results are around 3 dB lower than the worst-case NEXT result at each end of the link.

### **2.1.6 ACR-F (Attenuation to Crosstalk Ratio – Far End)**

ACR-F (previously called ELFEXT- Equal Level Far End Cross Talk) is the crosstalk at the far end and is decreased by the attenuation. ACR-F corresponds much better to the actual situation during data transfer than FEXT. It is caused by the crosstalk inside the cable decreases as the attenuation increases. ACR-F is not a measured value but is only a calculated value. The higher ACR-F, the better cable performance (Category 6 Consortium, 2002).

### **2.1.7 PS ACR-F (Power Sum ACR-F)**

PSACR-F is calculated from the ACR-F value. Just like PS-NEXT, this parameter is important for protocols that use all four pairs for signal transfer. PS-ACR-F expresses how much signal in the same cable gets from three pairs to the remaining fourth pair. The source of the signal and measurement of crosstalk takes place at the opposite ends of the cable.

### **2.1.8 ACR-N (Attenuation to Crosstalk Ratio – Near End)**

ACR-N (previously called as ACR) is not a measurement. It is deduced from two previously measured values which show the margin between NEXT and attenuation values. If the level of attenuation meets or approaches the level of near end crosstalk, the transmitted signal will be lost. The gap between NEXT and attenuation must be at least 10 dB. As the ACR-N parameter is dependent on NEXT as well as attenuation values, an improvement of these two parameters will influence the resulting ACR-N values. The higher ACR-N, the better cable performance.

### **2.1.9 PS- ACR-N**

Power sum attenuation to crosstalk ratio (PS ACR-N) is defined as the difference between PS NEXT and attenuation:

$$\text{PS ACR-N} = \text{PSNEXT} - \text{Attenuation (dB)}$$

### **2.1.10 Return Loss**

The return loss measures the amount of signal returned back to the transmitter due to the impedance mismatch between the cable and the connecting hardware in a structured cabling system. Usually it is caused by poor cable terminations. Poor terminations between cables and connectors will produce a high level of signal reflections that affects the power transfer between the transmitter and the receiver in a communication system. The higher return loss, the better cable performance, (Category 6 Consortium, 2002).

### **2.1.10 Propagation Delay**

Propagation delay is a measure of the time required (in nanoseconds) for a signal to propagate from the transmitter to the receiver [3]. Delay is the principle reason for a length limitation in LAN cabling system. Typical delay for category 6 UTP cable is a bit less than 5 ns/m while the worst case allowed is 5.7 ns/m (Bryan Philips).

### **2.1.11 Delay Skew**

Even more critical than the Propagation Delay is the Delay Skew. Delay Skew is the difference in time (nanoseconds) between the fastest and the slowest pairs each signal takes to arrive on all 4 pairs [3]. For 10/100BaseT transmission this is not as critical since only 2 of the 4 pairs are being used for transmission. But in Category 6 technology, Delay Skew becomes one of the most important parameter because all 4 pairs will be used at the same time for signal transmission. For optimal

performance, the signals should arrive to the receiver at the nearest time possible. The standard time allowed is up to 45ns in delay between the fastest and slowest pairs.

### 3.0 Network Point Measurement

In this research, we will measure the performance parameter on *Brand Rex (H) Millenium C60 4 Pair 235 AWG UTP IEC332-1 Category 6 C 2500 MHz* cable by using DTX-1200 cable analyzer. This cable installed as horizontal cable (connection from patch panel to the wall outlet) for all network points. Considering there are high number of network points which is around 2200, only 340 samples will be taken which is 177 samples for active network points and 163 samples for inactive network points. Measurements are made only for the Channel Link. Channel link connection includes connection from the network patch panel to the wall outlet as depicted in figure 2.0 below.

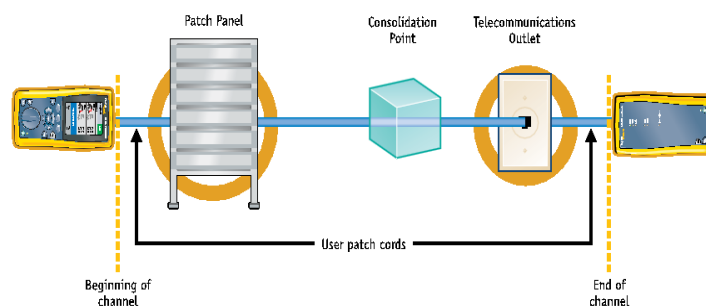


Figure 2.0: Channel Link Connection Model

### 4.0 Results and Discussions

Comparison BEFORE and AFTER for each parameter for both environments will be made to identify the possible cable parameter that contributes to the network performance deterioration. As each cable produces a different value for each cable parameter, so we will only select the average values to represent the other cables for detail discussion. Table 1.0 shows the average values for each parameter for both active and inactive ports.

Table 1.0: Average Parameter Values for Active and Inactive Ports

		Insertion Loss (IL)	NEXT	PS-NEXT	ACR-N	PS-ACR-N	ACR-F	PS-ACR-F	RL	Prop Delay	Delay Skew
Active	Before	26.7	6.2	7.7	12.6	13.3	9.9	10.8	3.8	112.3	5.9
	After	28.3	-1.5	0.8	7.4	9.0	12.8	14.0	3.2	101.3	5.4
Inactive	Before	26.8	6.5	7.9	13.6	14.3	10.4	11.1	3.1	108.0	5.5
	After	27.8	-1.8	0.5	6.5	8.2	13.4	14.3	2.8	94.3	5.9

Although a total of important UTP cable parameters involved in the measurements as described before, only 10 important parameters that closely related to the network performance will be discussed in this section which is :-

#### **4.1 Insertion Loss**

According to the values in the table 1 above, we notice that there is only a small increment of insertion loss which is respectively +1.6 and +1.0 for both active and inactive network points even after 7 years since the cable used. The result also shows that the active network port produced a higher insertion loss compared to the inactive port. Theoretically, the attenuation for coax cables increases over a period of time for a number of reasons such as flexing and moisture entry into the cable.

#### **4.2 NEXT and PS-NEXT**

According to the values shown in Table 1, we notice that there is very high decrement in the NEXT which is 7.7 dB for active and 8.3dB for inactive port. NEXT values means smaller received crosstalk signal from the adjacent pair. The negative value shows that the crosstalk signal is very high and test will generate a FAIL result. The increment in crosstalk signal will reduce the Signal to Noise Ratio (SNR) in the cable itself. The decrement of SNR will finally increase the Bit Error Rate and reduce the cable performance. So we can say that NEXT is influenced by the age of cable.

PS-NEXT is a sum of crosstalk signal from the other three pairs on the same Category 6 UTP cable. When the NEXT values on every pair of the cables increase, the amount of PS-NEXT also will be increased.

#### **4.3 ACR-N and PS ACR-N**

According to the values in the table above, the ACR-N values decrease 5.2 dB for an active port and 7.1 dB for inactive port in 7 years used. Both conditions show the ACR-N values fall below the standard specified by TIA which is at least 10 dB.

As we notice, the PS-ACR-N is a sum of ACR-N for the other three pairs in the cables. So, when the ACR-N values on every pair of the cables increase, the amount of PS-ACR-N also will be increased as stated in the table 6 above.

#### **4.4 ACR-F and PS-ACR-F**

Based on the values measured in the table above, there is a small increment for ACR-F for both active and inactive network points which are respectively 2.9 and 3.0 dB after cable being used for 7 years.

The same thing happened to PS-ACR-F, as it is the sum of Attenuation to Crosstalk Ratio at Far End for the other three pairs, when the value for the ACR-F increase, the value of PS-ACR-F will also increase.

#### **4.5 Return Loss**

Based on the values measured on Table 1, there is a small decrement in Return Loss for both active and inactive network points which is -0.6 and -0.3 dB after cable being used for 7 years.

#### **4.6 Propagation Delay**

Delay measurements are relatively straightforward. Most structured wiring standards expect a maximum horizontal delay of 548 ns. Based on the results, we notice that the Propagation Delay for the cables are far below the maximum limit for Category 6 UTP categories which is good. The surprise here is, after the UTP cable used for 7 years, Propagation Delay value decreases around 11 to 14 ns for both active and inactive network points which is better than the previous result. So, we can conclude that the Propagation Delay is not affected by the cables' age.

#### 4.7 Delay Skew

According to the TIA standard, well-constructed and properly installed structured cabling should have a skew less than 50 ns over a 100-meter link. Lower skew is better and anything under 25 ns is excellent. Skew between 45 and 50 nanoseconds is marginally acceptable. Referring to the table above, we notice that the delay skew for the cables is excellent which is below 6 ns for both conditions. The surprise here is, as Propagation Delay, Delay Skew value also decreases about 2-3 ns which is better than the previous result. As a conclusion, we can say that the Delay Skew is not affected by the cables' age.

## 5.0 Conclusion

This research was carried out to determine the effect of current Category 6 UTP cables used to the Local Area Network performance deterioration. In order to get better findings of this research, we have chosen two different environments involving 340 network points of the data sampling process. Half for the active network points and the other half for the inactive network points. Active network points are used to determine if the deterioration in performance for the UTP cables is caused by the frequency being used while the inactive points are used to determine if the deterioration in performance is due to the cables' age itself.

Referring to the measurement result, firstly we found that both network environments gave quite a similar result. This result shows us that the performance parameter for the Category 6 UTP cables installed in the building are not affected by the frequency being used, but they are only affected by the age of the cables. There was a slight reduction in performance for certain cable parameters after being used for 7 years. The most affected cable parameters due to the age of the cable were NEXT, PS-NEXT, ACR-N and PS-ACR-N. This is because the old UTP Cable will produce a higher crosstalk signal than the new cable. Secondly, of the total 340 network points measured in this research, more than 85 % points produce FAIL results and did not comply with the standard specified by EIA/TIA. The FAIL results generated because the old cables produced a very high Near End Crosstalk which exceeded the minimum margin specified by EIA/TIA.

Based on the findings, we can conclude that the UTP cables condition had also been a contributing factor in Local Area Network performance deterioration. Older UTP cables will produce a higher crosstalk compared with the new cables. The crosstalk value can be presented by cable parameters such as NEXT, PS-NEXT, ACR-N, PS-ACR-N. The increment of crosstalk will reduce the Signal to Noise Ratio (SNR) in the cables and then reduce the cables' performance. However, there are still some weaknesses in this research that need to be highlighted in the future research which as follows :-



- This research was carried out only after the cables have been used for 7 years. To obtain a more accurate result of performance deterioration rate, the measurements should be carried out annually.
- This research does not take into account the type of environment where cables were installed. As we notice, the different environments will have different temperatures. Room and floor temperature play an important role in determining the performance of a cable. Therefore, to obtain better result, research must be categorised according to the type of premises and environmental conditions.

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## I3 - Store Management System II (SMS II)

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### Abstrak

*Pengurusan stor adalah salah satu aspek pengurusan kewangan yang sangat penting kerana barang-barang di dalam stor merupakan modal kerajaan yang tersimpan bagi memberikan perkhidmatan kepada pelanggan pada kos yang minimum. Pengurusan stor yang lemah, tidak teratur dan tidak cekap boleh menyebabkan kerajaan mengalami kerugian yang besar akibat pembaziran modal yang terikat dalam bentuk stok, keusangan dan kesusutan nilai barang-barang tersimpan. Store Management System II (SMS II) merupakan satu sistem yang memudahkan proses pengurusan stor, ia boleh dicapai secara atas talian (on-line) dan merupakan sistem pengurusan stok dan bahan gunahabis bagi semua stor agensi kerajaan dan kementerian yang bertujuan untuk menjadikan pengurusan stor lebih teratur dan efektif. SMS II dibangunkan menggunakan perisian sumber terbuka seperti **Apache II Web Server**, **PHP: Hypertext Preprocessor** dan **MySQL Database** sebagai perisian induk. Sistem ini juga dibangunkan bersama dengan format skrip tambahan seperti **Javascript**, **Cascading Style Sheet (CSS)** dan **TCPDF** supaya sistem berfungsi dengan lebih interaktif dengan pengguna. SMS II 100% menepati dan memenuhi kehendak Pekeliling Perbendaharaan Bil. 5 Tahun 2009 – Tatacara Pengurusan Stor Kerajaan Malaysia. Kesemua 22 jenis borang / laporan bermula KEW. PS-1 hingga KEW. PS-22, setiap satunya dapat dijana dalam tempoh masa yang singkat. Penghasilan setiap borang adalah kurang daripada 5 minit walaupun bilangan stok mencecah 800 item.*

**Katakunci:** pengurusan stor, stok, bahan gunahabis, stor agensi kerajaan

### 1.0 Pengenalan

Store Management System II (SMS II) ini dibangunkan pada bulan Disember tahun 2009 bagi memenuhi dan menepati kehendak [1]Pekeliling Perbendaharaan Bil. 5 Tahun 2009 - Tatacara Pengurusan Stor Kerajaan dan mula diperkenalkan di ILP Mersing mulai awal tahun 2010. Sistem pengurusan stor ini boleh dicapai secara atas talian (on-line) dan merupakan sistem pengurusan stok dan bahan gunahabis bagi semua stor agensi kerajaan dan kementerian yang bertujuan untuk menjadikan pengurusan stor lebih teratur dan efektif. Selain itu, sistem ini dikemaskini secara berterusan bagi memenuhi kehendak dan keperluan semasa penyelia stor ILP Mersing. Antara objektif pembangunan sistem pengurusan stor ini adalah seperti berikut :

- a) Memudahkan pengurusan stor di bengkel dan mengurangkan beban serta masa tenaga pengajar untuk menguruskan stor.
- b) Memudahkan pengisian setiap borang dan laporan
- c) Dapat mengetahui dengan lebih terperinci mengenai data-data yang berkaitan dengan bahan di stor dari segi jenis item, lokasi, kuantiti atau harga.

Store Management System II (SMS II) ini juga telah diistiharkan sebagai karya sastera semasa proses Permohonan Pemberitahuan Sukarela Hak Cipta kepada Perbadanan Harta Intelek Malaysia (MyIPO) yang telah dilaksanakan pada bulan Julai 2012 yang lalu.

## 2.0 Kaedah Pembangunan dan Implementasi Sistem

### 2.1 Rekabentuk Sistem

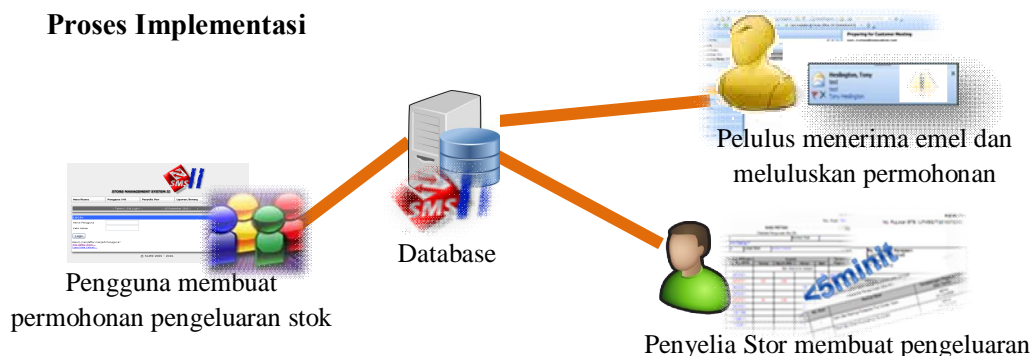
Rekabentuk Sistem Pengurusan stor ini terbahagi kepada dua komponen utama iaitu :

- a) **Perkakasan (hardware) :**  
Perkakasan yang diperlukan terdiri daripada dua buah pelayan (server) yang bertindak sebagai *Master Server* dan *Slave Server* serta satu atau lebih komputer pengguna (client) untuk tujuan capaian ke atas sistem. Pelayan (server) memerlukan sekurang-kurangnya 400 Mhz bagi kelajuan pemrosesan, 512 MB memori dan kapasiti hardisk sebesar 1.5 GB untuk membolehkan proses instalasi SMS II dilaksanakan. Selain itu, dua *network card* diperlukan bagi setiap server bagi membolehkan proses capaian ke atas sistem dan proses replikasi dapat dilaksanakan secara serentak. Keperluan bagi komputer penggunaan (client) pula adalah memadai dengan menggunakan komputer peribadi yang mempunyai spesifikasi yang minima sahaja serta dilengkapi dengan *network card*.
- b) **Perisian (software) :**  
Sistem ini dibangunkan menggunakan perisian sumber terbuka seperti *Apache II Web Server*, *PHP: Hypertext Preprocessor* dan *MySQL Database* sebagai perisian induk. Sistem ini juga dibangunkan bersama dengan format skrip tambahan seperti *Javascript*, *Cascading Style Sheet (CSS)* dan *TCPDF* supaya sistem berfungsi dengan lebih interaktif dengan pengguna. Perisian yang perlu dibuat instalasi bagi komputer pengguna (client) hanya satu perisian sahaja iaitu Adobe Acrobat Reader. Web browser tidak memerlukan proses instalasi kerana setiap sistem pengoperasian bagi komputer peribadi yang ada pada masa kini telah dilengkapi dengan web browser yang tersendiri.

### 2.2 Proses Pembangunan

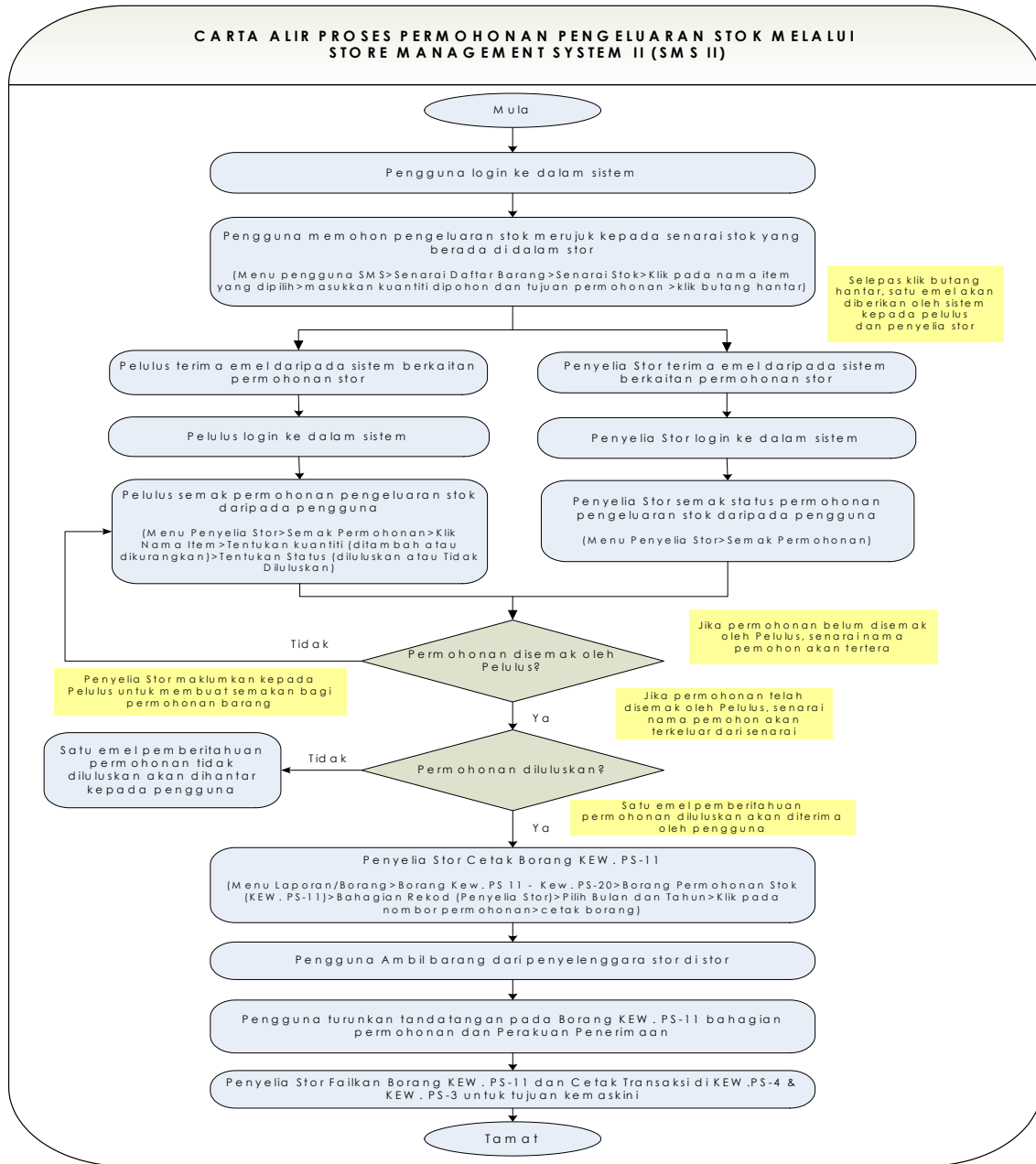
Proses pembangunan sistem ini terbahagi kepada 2 fasa. Fasa pertama lebih tertumpu kepada pembangunan pangkalan data (database) menggunakan perisian MySQL manakala Fasa kedua adalah fasa pembangunan antaramuka (interface) dengan menggunakan perisian PHP.

### 2.3 Proses Implementasi



**Rajah 2.1 :** Rajah Proses Implementasi Store Management System II (SMS II)

Proses Implementasi SMS II adalah bergantung kepada tahap capaian pengguna mengikut bidang tugas serta kebolehan sistem menjana laporan sepertimana yang ditetapkan di dalam [1] Pekeliling Perbendaharaan Bil. 5 Tahun 2009. Tahap Capaian Pengguna terbahagi kepada tiga kumpulan iaitu Pengguna, Pelulus (Ketua Bahagian) dan Penyelia Stor. Kesemua 22 borang iaitu bermula dari KEW. PS-1 sehingga KEW. PS-22 sepertimana yang terkandung di dalam [1] Pekeliling Perbendaharaan Bil. 5 Tahun 2009 - Tatacara Pengurusan Stor Kerajaan setiap satunya boleh dijana secara automatik dalam tempoh kurang daripada 5 minit.



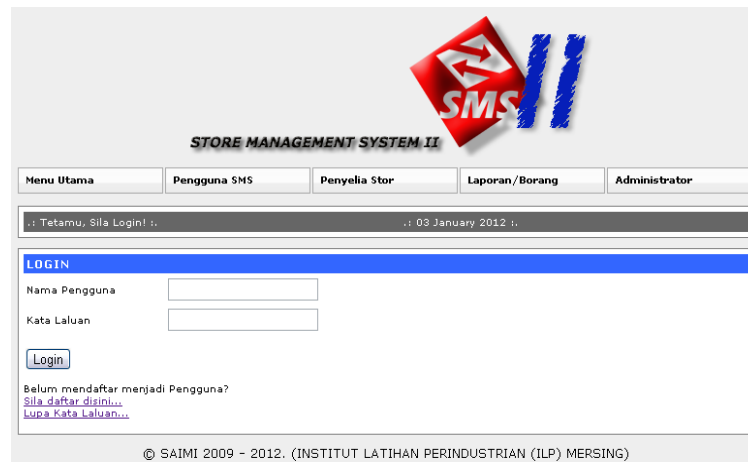
**Carta 2.1 :** Carta Alir Proses Permohonan Pengeluaran Stok

Ketepatan maklumat dan masa capaian yang singkat juga merupakan ciri-ciri tambahan kepada projek inovasi ini di dalam menyelesaikan masalah-masalah semasa proses pengurusan stor dilaksanakan

## 2.4 Gambarajah Projek

Sistem ini juga menitikberatkan penyelesaian bagi penyelia stor mahupun pengguna ketika berurusan menggunakan sistem ini dengan memasukkan beberapa ciri yang tidak terdapat di dalam sistem lain. Antaranya:

- i. Penggunaan antaramuka (*Graphical User Interface*) yang menarik dan mudah difahami serta boleh diubahsuai mengikut keperluan.
- ii. Kemudahan indikator melalui emel (*email alert*), dimana pelulus dan penyelia stor akan dimaklumkan melalui emel sekiranya terdapat pemohonan stok dari pengguna dan pengguna akan dimaklumkan juga melalui emel sekiranya permohonan pengeluaran stok diluluskan.
- iii. Manual dan video penggunaan disediakan di dalam sistem ini sebagai rujukan pengguna yang baru mengakses sistem ini.



Rajah 2.2 : Gambarajah Paparan Menu Store Management System II (SMS II)

## 3.0 Keputusan dan Analisis

### 3.1 Penjimatan

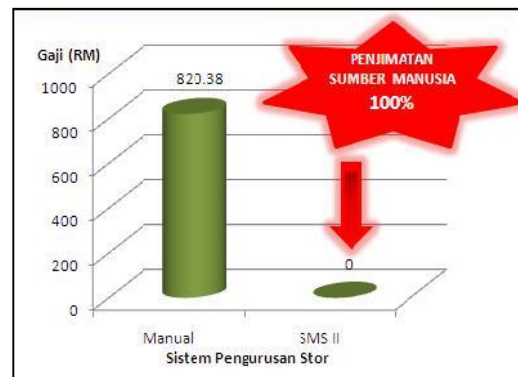
Salah satu aspek utama dalam penghasilan sesuatu hasil inovasi adalah kos. Tidak dapat dinafikan kos memainkan peranan besar yang mempengaruhi kejayaan sesebuah produk atau perkhidmatan. Kos ini meliputi kos pembangunan, operasi, peralatan, bahan gunahabis dan penyelenggaraan.

- a) Peratus Penjimatan Perbelanjaan
  - i. Dapat menjimatkan kos perbelanjaan sebanyak 100% kerana SMS II dibangunkan sendiri oleh kakitangan ILP Mersing tanpa sebarang bayaran dan perkhidmatan konsultansi dari syarikat swasta.
  - ii. Pengguna Sistem Manual memerlukan seorang penyelia stor (secara sepenuh masa) untuk menguruskan semua borang / laporan. Tetapi dengan penggunaan SMS II, penyelia stor dilantik di kalangan tenaga pengajar. Walaupun tidak menguruskan stor secara sepenuh masa, pengurusan stor di bengkel tetap dapat diuruskan dengan efisien, kemas dan teratur.
  - iii. Oleh yang demikian, penjimatan perbelanjaan dari segi kos operasi bulanan bagi jabatan dapat dikurangkan sebanyak RM820.38 (gaji untuk seorang penyelia stor) iaitu sebanyak 100% penjimatan.

- b) Penjimatan Sumber Manusia :
- i. Penggunaan SMS II telah memberi penjimatan dari segi penggunaan sumber tenaga manusia dimana terdapat beberapa proses pengiraan yang dahulunya memerlukan komitmen 100% daripada penyelia stor kini telah diambil alih sepenuhnya oleh sistem dan semua hasil pengiraan akan terjana secara automatik.
  - ii. Proses-proses pengiraan yang tidak memerlukan penggunaan sumber tenaga manusia ialah:
    - ✓ Proses pengiraan kadar pusing stok bagi empat suku tahun (KEW. PS-13).
    - ✓ Proses pengiraan baki stok selepas proses penerimaan stok dan pengeluaran stok (KEW. PS-3 dan KEW. PS-4).
    - ✓ Proses pengisian borang-borang dan laporan, terutamanya laporan yang memerlukan pengisian item satu persatu seperti KEW. PS-14.
- c) Penjimatan Kos Peralatan, Perisian & Penyelenggaraan
- i. Pembangunan SMS II tidak melibatkan sebarang pertambahan kos peralatan kerana pelaksanaan sistem ini hanya menggunakan *Server* dan *LAN* yang sedia ada di institut.
  - ii. Tiada kos perisian diperlukan untuk sistem ini kerana semua perisian menggunakan Perisian Sumber Terbuka (*Open Source Software*).
  - iii. Kos penyelenggaraan adalah di tahap yang minima kerana kerja-kerja penyelenggaraan SMS II ini dilakukan sendiri oleh pegawai yang membangunkan sistem ini.
- d) Penjimatan Masa
- Melalui amalan biasa dengan menggunakan sistem manual, masa yang diperlukan untuk menyediakan dan menghasilkan laporan bagi 800 item yang terdapat di stor akan mengambil masa 2 hari bekerja. Berbeza dengan menggunakan sistem SMS II masa yang diperlukan hanyalah kurang daripada 5 minit. Oleh yang demikian penjimatan masa sebanyak 15.92 jam dapat dioptimasikan dengan peratus penjimatan adalah setinggi 99.5%.



**Rajah 3.1** : Graf Perbandingan Penjimatan Perbelanjaan



**Rajah 3.2** : Graf Perbandingan Penjimatan Masa

## 4.0 Perbincangan

### 4.1 Impak Terhadap Organisasi

Merujuk kepada keputusan dan analisis, penggunaan sistem SMS II ini telah banyak membantu meningkatkan kecekapan sistem pengurusan stor dan produktiviti di Institut.

- a) Peningkatan yang dapat dikecapi oleh ILP Mersing selepas menggunakan SMS II sebagai sistem pengurusan stor ialah :
  - i. Verifikasi stok dapat dilaksanakan pada bila-bila masa kerana setiap rekod di stor dikemaskini dalam tempoh kurang daripada 5 minit.
  - ii. Setiap laporan dapat disiapkan mengikut masa yang ditetapkan atau lebih awal daripada tempoh yang ditetapkan.
  - iii. Tiada rungutan daripada pengguna, penyelia stor mahupun pegawai luar yang bertindak sebagai pemverifikasi stok di institut ini.
  - iv. Sasaran kesilapan sifar dapat dicapai semasa proses penyediaan rekod dan laporan yang melibatkan pengurusan stor kerajaan.
- b) Sistem ini dijamin mampu meningkatkan *Star Rating* organisasi. Ini dapat dilihat dari kualiti kerja yang bertambah baik, pengurusan masa yang lebih efisien, pengurangan dari segi kos pengendalian dan seterusnya menggalakan persaingan sihat diantara agensi-agensi sektor awam dalam mengamalkan pengurusan organisasi dan penyampaian perkhidmatan dengan lebih berkesan. Ini semestinya mengubah kakitangan perkhidmatan sektor awam ke arah *Minda Kelas Pertama*
- c) Kesan Kepada Persekitaran  
SMS II ini tidak memberi kesan terhadap persekitaran mahupun ekosistem kerana sistem ini dibangunkan tidak menggunakan sebarang bahan kimia atau melibatkan sebarang aktiviti yang membawa kepada pelepasan toksin.
- d) Potensi Komersil / Pemasaran  
SMS II ini telah diiktiraf untuk digunapakai di semua Institut Latihan Jabatan Tenaga Manusia (ILJTM). Selain itu, sistem ini mendapat perhatian dari agensi kerajaan merangkumi jabatan dan kementerian untuk dijadikan sebagai penanda aras di dalam pengurusan stor kerajaan. Pengubahsuaian terhadap sistem juga boleh dilakukan demi memenuhi dan mengikut kehendak badan-badan berkanun.

## 5.0 Kesimpulan

Berdasarkan analisis keputusan dan perbincangan, dapat disimpulkan bahawa Store Management System II (SMS II) adalah satu sistem pengurusan stor yang dapat memudahkan pengurusan stor kerana sistem ini boleh diakses secara atas talian (on-line) serta menjadikan pengurusan stor lebih efisien dan teratur walaupun diuruskan oleh tenaga pengajar. Selain itu, pengurusan stor menggunakan SMS II adalah menjimatkan masa dan tenaga kerja berbanding pengurusan stor secara manual. Masalah maklumat yang diterima tidak tepat dan memerlukan masa yang panjang untuk proses pengurusan stor dan penyediaan dokumen audit / verifikasi dapat dikurangkan.

## 6.0 Rujukan:

[1] Pekeliling Perbendaharaan Bil. 5 Tahun 2009 6 Tatacara Pengurusan Stor

## I4 - Animasi Gerak Henti Tanah Liat Huruf (*Alphabet*)

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### **Abstrak**

*Penggunaan kad imbas dalam pembelajaran awal kanak-kanak kadangkala membosankan dan sukar bagi mereka untuk memberikan tumpuan. Dengan perkembangan teknologi masa kini, penggunaan video animasi dilihat lebih menarik perhatian kanak-kanak untuk belajar. Animasi gerak henti atau gerak pegun (stop motion) ialah satu teknik animasi untuk membuatkan suatu objek yang dimanipulasi secara fizikal kelihatan bergerak dengan sendirinya. Ia dilakukan dalam 3 Dimensi dengan bantuan penggunaan tanah liat, kamera, dan mounting board. Kesemua objek di dalam video dibentuk menggunakan tanah liat pelbagai warna. Beberapa siri gambar diambil, disusun dan disunting mengikut pergerakan yang diinginkan bagi menghasilkan satu animasi. Video animasi ini dapat membantu para pendidik seperti guru pra-sekolah dan juga ibu bapa dalam membantu kanak-kanak mengenal huruf dengan lebih cepat. Pembelajaran dalam bentuk animasi lebih mudah difahami oleh kanak-kanak dan penggunaannya lebih menyeronokkan berbanding penggunaan kad imbas yang perlu diperkenalkan secara manual. Video animasi ini dipercayai dapat membantu pembelajaran awal kanak-kanak yang berusia 4 hingga 6 tahun.*

**Kata Kunci** : Animasi Gerak Henti, Tanah Liat, Kamera, 3 Dimensi.

### **1. Pengenalan**

Pada masa kini, penggunaan video animasi sebagai alat bantuan mengajar bukan lagi sesuatu yang baru bagi kanak-kanak kerana ianya mampu memberikan suasana belajar yang lebih menyeronokkan dengan bantuan pelbagai karakter serta warna yang menarik. Lambakan pelbagai program pembelajaran yang menggunakan konsep animasi di pasaran menunjukkan ianya semakin mendapat tempat di kalangan masyarakat. Penggunaannya lebih menyeronokkan berbanding penggunaan kad imbas yang perlu diperkenalkan secara manual. Animasi Gerak Henti Tanah Liat Huruf adalah video animasi yang memaparkan 26 huruf iaitu A hingga Z dengan durasi selama 12 minit. Dengan menggunakan Bahasa Inggeris sebagai bahasa perantaraan, video ini memperkenalkan sebutan huruf bagi huruf besar dan huruf kecil, bentuk huruf dan juga perkataan yang bermula dengan huruf tersebut.

Tujuan utama projek ini dibangunkan adalah untuk digunakan sebagai alat bantu mengajar bagi guru pra-sekolah, ibu bapa atau penjaga dalam memberi pendedahan awal kepada proses pembelajaran sekolah mahupun di rumah. Selain itu, video ini juga dibangunkan untuk :

- i. Memperkenalkan 26 huruf iaitu A hingga Z dari segi sebutan, bentuk, perbezaan di antara huruf besar dan huruf kecil serta objek yang pangkalnya bermula dengan huruf tersebut.
- ii. Memudahkan proses pengajaran guru pra-sekolah untuk mengajar golongan kanak-kanak berusia 4-6 tahun.
- iii. Sebagai alternatif kepada rancangan televisyen serta memudahkan pemantauan ke atas anak-anak oleh ibu bapa atau di rumah.

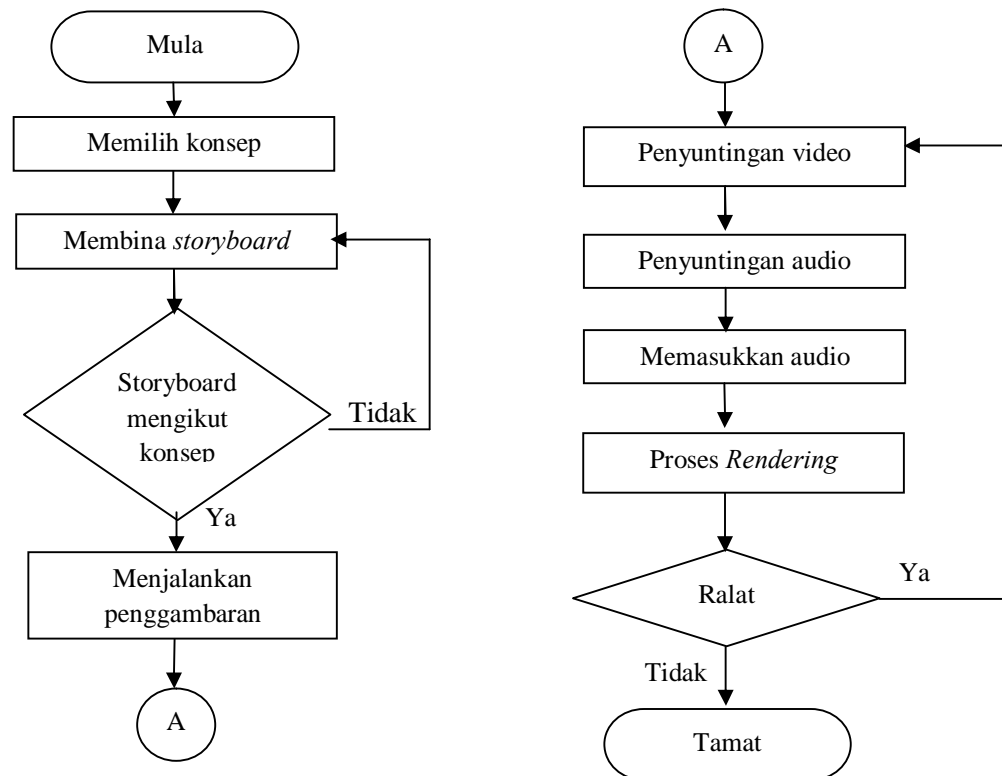


- iv. Menggalakkan pemikiran kreatif dan imaginasi di kalangan kanak-kanak dengan penggunaan tanah liat yang terdiri daripada pelbagai warna serta bentuk yang menarik.

## 2. Pembangunan Projek

Dalam proses pembangunan projek ini, objek dibentuk sepenuhnya menggunakan tanah liat di samping bantuan peralatan perisian. Antara peralatan yang digunakan di ialah kamera DSLR Canon EOS 600D, *tripod*, *SD memory card*, komputer riba, *mounting board*, tanah liat (*Play Doh*) dan peralatan untuk membentuk tanah liat. Adobe Photoshop CS5 dan Adobe Illustrator CS5 digunakan untuk penyuntingan gambar manakala Adobe Flash CS5 digunakan untuk menghasilkan antaramuka bagi pengguna membuat pilihan samada untuk memainkan video dari awal hingga akhir atau bermula dari *scene* yang tertentu. Sony Vegas Pro 11.0 digunakan untuk membuat suntingan video serta memasukkan kesan bunyi, audio dan juga teks bagi mendapatkan hasil yang berkualiti. Sony Sound Forge adalah perisian yang digunakan untuk merakam suara latar bagi video ini.

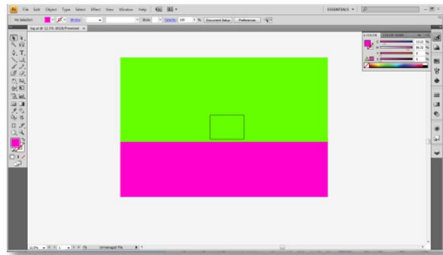
### 2.1 Carta Aliran Kerja



**Rajah 2.1** : Carta Aliran Proses Pembangunan Projek

### 2.2 Proses Penyuntingan

Proses penyuntingan gambar dan video dilakukan dengan teliti dan memakan masa yang agak lama bagi menghasilkan video animasi yang berkualiti. Gambarajah di bawah menunjukkan proses penyuntingan yang dilakukan.



**Rajah 2.2** : Latar belakang yang dicipta menggunakan Adobe Illustrator



**Rajah 2.3**: Gambar asal objek dan latar belakang (*mounting board*)



**Rajah 2.4** : Objek yang disunting menggunakan Adobe Photoshop



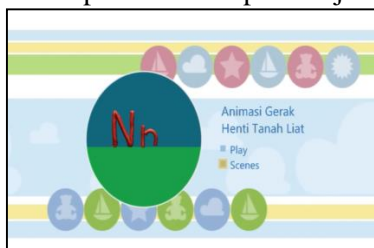
**Rajah 2.5** : Objek dan latar belakang disunting menggunakan Adobe Photoshop

Gambar yang telah siap disunting disusun menggunakan perisian Sony Vegas Pro 11.0. Proses *rendering* dilakukan untuk menghasilkan video animasi. Setelah selesai penyuntingan gambar, fail audio pula dimasukkan. Video Animasi ini menggunakan 3284 keping gambar yang disusun secara bersiri bagi menghasilkan animasi.

### 3. Keputusan

#### 3.1 Rekabentuk Perisian

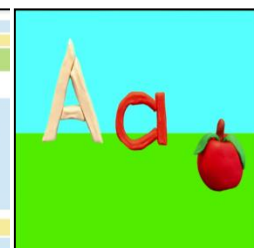
Video ini menyediakan antaramuka untuk pengguna membuat pilihan sama ada memainkan video secara berterusan dari awal hingga akhir atau memilih *scene* tertentu untuk dimainkan. Pemilihan *scene* tertentu dapat menjimatkan masa bagi pengguna untuk meneruskan video bagi huruf yang dikehendaki tanpa menunggu huruf lain dimainkan. Video animasi ini akan menunjukkan pergerakan tanah liat bagi membentuk sesuatu huruf. Setiap objek akan dibesarkan seiring dengan sebutan suara untuk memberi penekanan kepada objek tersebut.



**Rajah 3.1** : Antaramuka bagi pengguna membuat pilihan



**Rajah 3.2** : Pilihan *Scene*

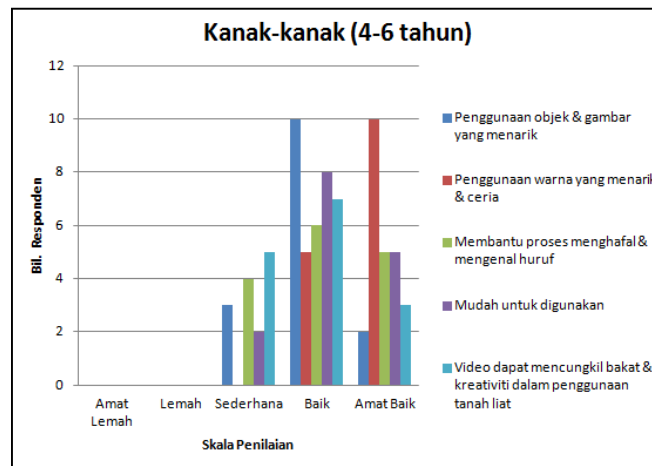


**Rajah 3.3** : Animasi bagi huruf Aa

### 3.2 Analisis Hasil Projek

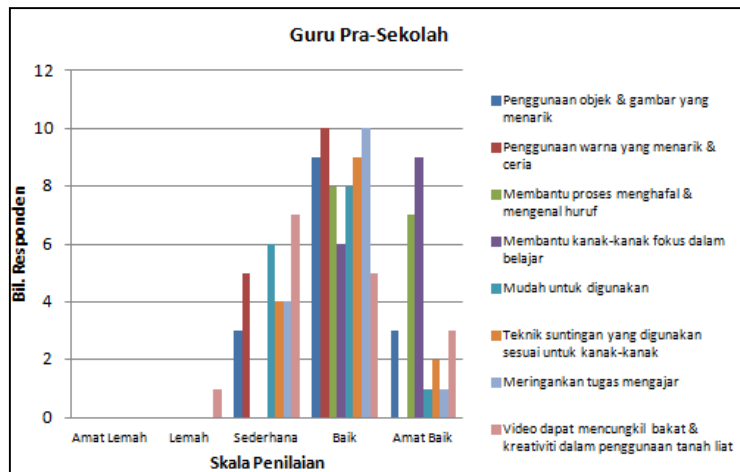
Kajian soal selidik telah dijalankan kepada kumpulan sasaran seramai 45 orang di mana 15 orang terdiri daripada kanak-kanak (4-6 tahun), 15 orang guru pra-sekolah dan 15 orang ibu bapa serta penjaga yang tinggal di sekitar Institut Latihan Perindustrian (ILP) Kuala Langat. Kajian soal selidik ini dijalankan secara lisan ke atas kanak-kanak memandangkan mereka masih tidak mahir dalam membaca dan menulis. Hasil data dari analisis borang soal selidik dan juga input dari maklumbalas yang diberikan oleh kanak-kanak akan dipersembahkan dalam bentuk carta.

Carta bagi Rajah 3.4(a) menunjukkan hasil keputusan yang diperolehi daripada *responden* yang terdiri dari kanak-kanak berusia 4 hingga 6 tahun. Terdapat 5 soalan yang dikemukakan kepada responden.

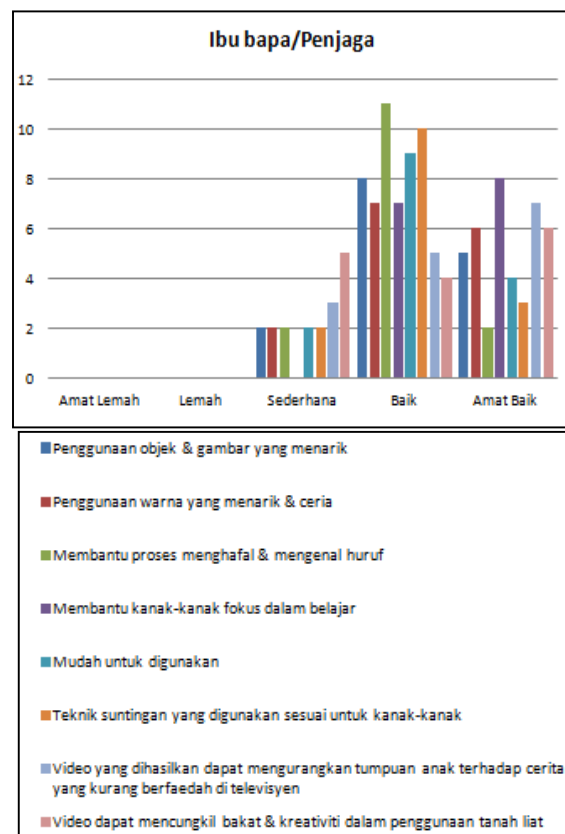


**Rajah 3.4(a):** Carta Jumlah *Responden* kanak-kanak berusia 4-6 tahun kepada soalan

Carta bagi Rajah 3.4(b) di bawah adalah keputusan jumlah *responden* bagi soalan yang dikemukakan kepada golongan guru pra-sekolah. Bahagian ini mempunyai 8 soalan ringkas yang menjurus kepada kesan video animasi ini ke atas kanak-kanak dan juga guru itu sendiri.



**Rajah 3.4(b):** Carta Jumlah *Responden* guru pra-sekolah kepada soalan Carta bagi Rajah 3.4(c) di bawah pula adalah keputusan jumlah *responden* bagi soalan yang dikemukakan kepada ibu bapa dan penjaga. Bahagian ini mempunyai 8 soalan yang juga menjurus kepada kesan video ke atas kanak-kanak serta ke atas ibu bapa.



**Rajah 3.4(c):** Carta Jumlah *Responden* ibu bapa/penjaga kepada soalan

#### 4. Perbincangan & Cadangan

Hasil daripada analisis keputusan yang diperolehi, secara kasarnya dapat diperhatikan bahawa video animasi yang dihasilkan dapat menarik minat kanak-kanak untuk belajar

mengenai huruf dan membantu mereka mengenal huruf dengan lebih cepat. Ia juga dapat membantu meringankan tugas para guru pra-sekolah dalam sesi pengajaran kerana ianya tidak memerlukan tenaga yang banyak lebih-lebih lagi jika pengajaran yang sama perlu dilakukan berulang kali. Ibu bapa dan penjaga juga memberikan maklumbalas yang positif ke atas video yang dihasilkan dan mendapati ianya dapat membantu anak mereka untuk lebih fokus semasa belajar. Ia juga dapat dijadikan alternatif kepada cerita-cerita yang disiarkan di kaca televisyen yang mana lebih banyak mendatangkan keburukan daripada kebaikan. Namun begitu, daripada analisis yang dibuat masih terdapat beberapa kelemahan yang perlu diperbaiki pada video tersebut. Pengguna lebih menyukai jika video ini dapat dimainkan melalui pemain CD/Video (*CD/Video Player*) kerana video yang dihasilkan ini hanya dapat dimainkan melalui komputer. Selain itu, pengguna tidak dapat membuat pilihan *scene* lain semasa sesuatu *scene* sedang dimainkan dan perkara ini agak menyukarkan pengguna untuk terus ke *scene* yang dikehendaki jika tersalah membuat pilihan pada awalnya.

Dari hasil perbincangan, masalah yang didapati adalah satu masalah yang minor dan ianya boleh diperbaiki dengan melakukan beberapa penambahbaikan. Masalah ini dapat diselesaikan sekiranya ia melibatkan masa tambahan untuk membuat suntingan video dan menghasilkan video dalam format yang boleh dimainkan secara terus melalui pemain CD/Video. Beberapa butang seperti *'Back'* boleh ditambah pada antaramuka untuk membuat pilihan kepada pengguna bagi memilih *scene* yang dikehendaki tanpa menunggu ia dimainkan sehingga tamat. Selain itu, pergerakan objek boleh dilancarkan lagi dengan menambah lebih banyak gambar bersiri. Setelah penambahbaikan dibuat, video animasi ini dipercayai dapat memberikan kebaikan serta menepati kehendak pengguna sasaran.

## 6. Kesimpulan

Secara keseluruhannya, walaupun projek ini mempunyai beberapa kelemahan terutamanya dari segi kelancaran pergerakan objek dan penggunaan video, projek ini dapat membantu kanak-kanak dalam usaha mengenal huruf dalam sesi pembelajaran yang lebih menyeronokkan. Projek ini boleh dikatakan menepati objektif yang telah ditetapkan iaitu dapat memperkenalkan 26 huruf iaitu A hingga Z dari segi sebutan, bentuk, perbezaan di antara huruf besar dan huruf kecil serta objek yang pangkalnya bermula dengan huruf tersebut. Video animasi ini juga terbukti dapat membantu serta memudahkan proses pengajaran guru pra-sekolah untuk mengajar golongan kanak-kanak berusia 4-6 tahun. Selain itu, ibu bapa yang kekurangan masa untuk memantau aktiviti pembelajaran anak-anak dapat menggunakannya sebagai alternatif kepada rancangan televisyen. Di samping itu juga, pergerakan objek yang pelbagai bentuk, rupa dan warna secara tidak langsung dapat menggalakkan pemikiran kreatif dan imaginasi di kalangan kanak-kanak. Oleh itu, dengan adanya video Animasi Gerak Henti Huruf ini, ianya dapat memberikan kesan yang positif ke atas pembelajaran awal kanak-kanak yang disasarkan. Penggunaan alat bantu mengajar yang menarik, menyeronokkan dan tidak membosankan dapat menarik minat kanak-kanak seterusnya secara tidak langsung dapat memupuk minat mereka untuk belajar di masa akan datang.

## 7. Rujukan

- [1] Hello abc Nursery English Books 1 & 2, Penerbitan Pelangi Sdn Bhd
- [2] Let's Practice Abc Capital and Small Letters, Penerbit Edukid Distributors Sdn Bhd.
- [3] <http://cikguani.blogspot.com/2010/06/teori-jean-piaget.html>, 20 Januari 2013, 10.05am
- [4] <http://www.slideshare.net/ISMAILMAMAT/ict-dan-multimedia-kanak-kanak-prasekolah>, 24 Januari 2013, 08.45am
- [5] [http://ms.wikipedia.org/wiki/Gerak\\_henti](http://ms.wikipedia.org/wiki/Gerak_henti), 24 Januari 2013, 09.00am

# O1 - Kesediaan Industri Dalam Penerimaan Graduan Diploma Teknologi Komputer Rangkaian Berdasarkan Tahap Kemahiran Kebolehpasaran

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## Abstrak

*Kajian ini bertujuan untuk mengenalpasti tahap kesediaan industri terhadap graduan Diploma Teknologi Komputer Rangkaian berdasarkan tahap kemahiran kebolehpasaran pelajar. Objektif kajian ini adalah untuk mengenalpasti tahap kesediaan industri dalam penerimaan graduan Diploma Teknologi Komputer Rangkaian berdasarkan tahap kemahiran kebolehpasaran graduan, mengenalpasti tahap kemahiran kebolehpasaran graduan dan mengenalpasti terdapatnya hubungan antara tahap kesediaan industri dan tahap kemahiran kebolehpasaran graduan. Kajian tinjauan deskriptif kuantitatif ini menggunakan borang soal selidik sebagai instrument kajian yang melibatkan 150 orang graduan Program Diploma Teknologi Komputer Rangkaian di Institut Latihan Perindustrian (ILP). Nilai Alfa yang akan digunakan bagi soalan di dalam soal selidik ini ditetapkan perlu melebihi 0.6 bagi menunjukkan kebolehpercayaan soalan yang dibangunkan. Data akan dianalisis bagi mendapatkan frekuensi, peratus dan min dalam bentuk jadual. Hasil kajian ini diharapkan dapat membantu pensyarah di ILP dalam membangunkan kurikulum pembelajaran serta menerapkan elemen kemahiran kebolehpasaran di kalangan pelajar.*

**Kata kunci:** tahap kemahiran kebolehpasaran, graduan Diploma Teknologi Komputer Rangkaian, kesediaan industri

## 1.0 Pendahuluan

Menjelang tahun 2020, Malaysia mensasarkan pertambahan 50 peratus tenaga mahir negara bagi mencapai taraf negara maju dan pendapatan berkapita tinggi. Pelbagai usaha dijalankan oleh pihak kerajaan termasuk usaha melalui Pelan Transformasi Negara (ETP) yang akan mewujudkan 3.3 juta peluang pekerjaan (Utusan Malaysia, 2011). Keperluan tenaga mahir negara iaitu untuk menghasilkan sekurang-kurangnya 3.3 juta pekerja mahir dalam tempoh 10 tahun akan datang bagi memenuhi keperluan industri tempatan cuba direalisasikan melalui Rancangan Malaysia Ke Sepuluh iaitu mengarusperdanakan Pendidikan Teknikal dan Latihan Vokasional. Hal ini melibatkan peranan yang dinamik iaitu daripada agensi-agensi pendidikan atau latihan teknikal dan vokasional (Tan Sri Muhyiddin, 2012)

Laporan Penyiasatan Tenaga Buruh yang dikeluarkan oleh Jabatan Perangkaan, bagi suku tahun ketiga 2011 menyatakan kadar pengangguran adalah pada kadar 3.1%. Berdasarkan Kajian Pengesanan Graduan yang dilaksanakan oleh Kementerian Pengajian Tinggi (KPT), seramai 40,000 siswazah Institut Pengajian Tinggi (IPT) di seluruh negara masih mencari pekerjaan. Omar Abdul Rahman (2012) menyatakan bahawa angka itu melibatkan siswazah yang gagal mendapat pekerjaan tetap meskipun selepas enam bulan tamat pengajian. Menurut beliau lagi, antara faktor penyumbang kepada siswazah tidak mendapatkan pekerjaan ialah kerana mereka ingin menyambung pengajian ke peringkat lebih

tinggi, kelulusan siswazah tidak mengikut kehendak industri serta industri tidak memberi peluang kepada mereka (*Sabah Daily*, 23 September 2012).

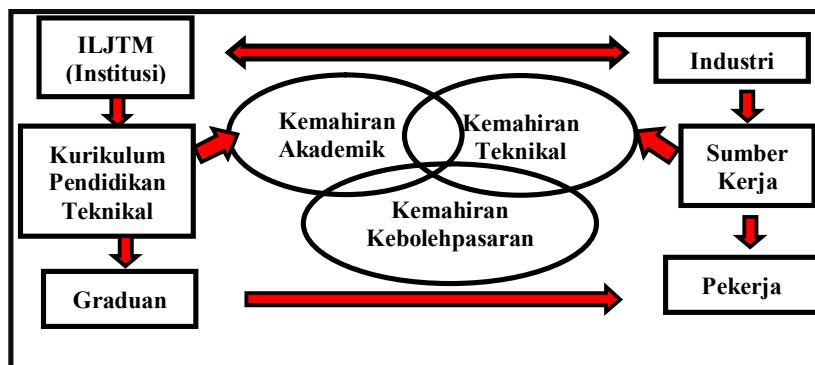
## 2.0 Pernyataan Belakang

Kebolehpasaran graduan adalah penting dan peranan Institut latihan Jabatan Tenaga Manusia (ILJTM) adalah memastikan graduan tidak menganggur dan sentiasa mendapat tempat di industri termasuklah program Diploma Teknologi Komputer Rangkaian dalam kajian ini. Menurut Mohamed A., Mohd Isa F.L dan Shafii H.(2007), masalah pengangguran graduan dikaitkan dengan isu kekurangan dan kelemahan graduan sesuatu institusi itu sendiri dari segi kurangnya kemahiran menyelesaikan masalah, tidak berfikiran kritis, kurang kemahiran komunikasi dan kerja kumpulan, lemah Bahasa Inggeris, kurang etika dan sebagainya. Menurut Quek (2005), tenaga kerja perlu dibentuk supaya berkeupayaan menguasai pelbagai kemahiran *multiskil* dan fleksibel selari dengan perkembangan ilmu pengetahuan.

Hasil kajian Ahmad (2005) juga membuktikan bahawa terdapat 80,000 lulusan teknikal yang masih menganggur, dan untuk mendapat pekerjaan lulusan didapati banyak bergantung kepada kelayakan akademik untuk mendapat pekerjaan. Lulusan juga didapati kurang kompetensi kemahiran *nontechnical* atau kemahiran kebolehpasaran yang diperlukan majikan. Isu graduan menganggur masih lagi wujud pada masa kini dan merungsingkan pelbagai pihak. Mohd Safarin (2005) berpendapat antara punca graduan masih menganggur disebabkan oleh graduan yang dihasilkan masih tidak dapat memenuhi kehendak majikan pada masa kini. Masalah atau faktor pengangguran ini bukanlah semata-mata disebabkan masalah kekurangan pekerjaan tetapi adalah disebabkan wujudnya ketidaksepadanan antara kemahiran yang diperlukan oleh pasaran buruh dengan kemahiran yang dimiliki oleh lulusan teknikal (*skill mismatch*).

## 3.0 Sorotan Kajian

Fugate (2004) menyatakan kemahiran kebolehpasaran sebagai kebolehan seseorang untk mengenalpasti serta menyedari peluang pekerjaan. Kajian ini telah menggunakan kerangka konsep seperti yang ditunjukkan pada Rajah 1, sebagai panduan. Kerangka konsep ini adalah diubahsuai dan gabungan daripada Model Hubungan Antara Institut Teknikal Dan Industri (1998) dan Model hubungan kemahiran-kemahiran yang perlu diterapkan di institusi (1995) yang menghasilkan kerangka konsep kajian dalam pembangunan kemahiran kebolehpasaran graduan.



**Rajah 1:** Kerangka konsep kajian dalam pembangunan kemahiran kebolehpasaran graduan (sumber : Universiti Council of Ontario. 1998)

Berdasarkan kerangka konsep kajian dapat inputnya adalah institusi yang merujuk kepada pensyarah-pensyarah ILJTM yang mengajar program kemahiran berdasarkan kurikulum latihan kemahiran. Kandungan kurikulum latihan yang diajar sewajarnya merangkumi tiga elemen kemahiran iaitu kemahiran akademik, kemahiran teknikal dan kemahiran kebolehpasaran yang akan melahirkan graduan yang mempunyai tahap kemahiran kebolehpasaran yang diperlukan oleh pihak industri. Dalam kertas kajian ini, kemahiran kebolehpasaran yang diberi tumpuan merupakan kemahiran komunikasi, kemahiran kritis dan menyelesaikan masalah, kerja berpasukan, pembelajaran berterusan dan pengurusan maklumat, keusahawanan, etika dan moral profesional, kemahiran kepimpinan

#### 4.0 Aspek-Aspek Kemahiran Yang Diperlukan Oleh Majikan

Menurut Buck dan Barrick (1987), pihak institusi kurang tumpuan kepada pembangunan insaniah yang diperlukan oleh majikan dalam pengajaran. Elemen kemahiran yang diperlukan oleh majikan terhadap graduan ialah (i) pekerja dapat mempamerkan tanggungjawab, mempunyai disiplin diri, maruah, kerjasama dan minat (ii) pekerja mempunyai semangat untuk belajar dan menyelesaikan masalah. Model SCAN (2001) yang didapati merangkumi kesemua aspek kemahiran bagi menentukan tahap kemahiran generik pelajar dan graduan kerana merangkumi tujuh kompetensi utama iaitu (1) kemahiran asas, (2) kemahiran berfikir, (3) kemahiran sumber, (4) kemahiran informasional, (5) kemahiran interpersonal, (6) kemahiran sistem dan teknologi dan (7) kualiti personal. Lankard (1995) melalui kajiannya pula telah mengenalpasti tujuh kategori bagi kemahiran kebolehpasaran melalui modul-modul latihan iaitu (1) mempamerkan imej positif (2) menonjolkan tingkah laku kerja yang positif (3) mengamalkan tabiat kerja yang baik (4) Mengamalkan sikap beretika (5) Berkomunikasi secara efektif (6) Menerima tanggungjawab (7) Bekerjasama

**Jadual 1** : Ringkasan kriteria kemahiran kebolehpasaran kerja ( NCVET, 2003)

<b>Jenis Kemahiran</b>	<b>Sumbangan</b>
K1 : Kemahiran Berkomunikasi	Menyumbang kepada idea serta maklumbalas yang berkesan dan produktif
K2:Kemahiran Kritis & Menyelesaikan Masalah	Menyumbang kepada idea dan penyelesaian alternatif untuk hasil produktif
K3 : Kemahiran Kerja Berpasukan	Menyumbang kepada hubungan kerja yang baik untuk mencapai objektif dan hasil produktif
K4 : Pembelajaran Berterusan & Pengurusan Maklumat	- Menyumbang kepada pengembangan kerjaya pekerja, operasi syarikat dan hasil - Menyumbang kepada pelaksanaan tugas dan hasil yang lebih efektif
K5 : Kemahiran Keusahawanan	Menyumbang kepada hasil inovatif
K6 : Etika & Moral Profesional	Menyumbang kepada amalan profesional yang produktif
K7 : Kemahiran Kepimpinan	Menyumbang kepada kemahiran perancangan strategik jangka pendek dan panjang

Jadual 1 di atas menunjukkan sumbangan graduan yang boleh diberikan kepada organisasi melalui penerapan kemahiran-kemahiran kebolehpasaran dalam diri.



## 5.0 Metodologi

Kajian ini adalah berbentuk deskriptif kuantitatif berasaskan soal selidik berkaitan dengan tahap kemahiran kebolehpasaran graduan ILP lepasan program Diploma Teknologi Komputer Rangkaian. Populasi kajian ini terdiri daripada graduan ILJTM yang mewakili 5 institusi yang menawarkan program Diploma Teknologi Komputer Rangkaian di Semenanjung Malaysia. 4 Institut Latihan Perindustrian (ILP) ialah ILP Mersing, ILP Ledang, ILP Selandar dan ILP Kuala Langat. Hanya satu institut peringkat Pusat Latihan Teknologi Tinggi (ADTEC) yang menawarkan program peringkat diploma ini iaitu ADTEC Batu Pahat. Walaubagaimanapun hanya 4 institusi yang akan dipilih sebagai sampel kajian yang keseluruhannya daripada ILP manakala graduan daripada ADTEC Batu Pahat adalah sebagai kajian rintis.

Populasi kajian adalah terdiri daripada graduan yang baru menamatkan program diploma. Kajian ini menggunakan set borang soal selidik untuk responden yang terdiri daripada pihak majikan atau industri serta graduan daripada popuasi yang ditetapkan. Polpulasi graduan program ini dianggarkan 150 orang. Mengikut Jadual Krejcie dan Morgan (1970), saiz sampel yang diperlukan dalam kajian ini ialah 108 responden. Kajian rintis merupakan kajian awal yang dijalankan sebelum pelaksanaan kajian sebenar bagi menguji kebolehpercayaan instrument iaitu borang soal selidik yang dihasilkan. Kajian rintis akan dijalankan ke atas 35 orang graduan daripada ADTEC Batu Pahat, Johor bagi bidang yang sama iaitu Program Diploma Teknologi Komputer Rangkaian. Instrumen kajian ini ialah set borang soal selidik yang menggunakan skala Likert dengan lima pilihan jawapan iaitu Sangat Tidak Setuju (STS), Tidak Setuju (TS), Tidak Pasti (TP), Setuju (S) dan Sangat Setuju (SS).

## 6.0 Analisis Data

Analisis data akan dijalankan menggunakan SPSS Versi 20 bagi tujuan menerangkan statistik sampel terhadap peratusan kesediaan industri dan tahap kemahiran kebolehpasaran graduan seperti di jadual 2.

**Jadual 2:** Senarai Soal Selidik

Bahagian	Responden
<b>i) Graduan</b>	
<b>A</b>	Maklumat Demografik
<b>B</b>	7 Item Kemahiran Kebolehpasaran
<b>ii) Majikan</b>	
<b>C</b>	Maklumat Demografik
<b>D</b>	7 Item Kemahiran Kebolehpasaran

Bahagian A dan C iaitu Demografik Respondan terdiri daripada maklumat diri yang mewakili item umur, jantina, jawatan, jabatan dan tempoh berkhidmat. Kajian ini menggunakan skala nominal dan skala sela untuk mengukur maklumbalas responden. Data-data akan dianalisis menggunakan bentuk kekerapan dan peratusan data. Bahagian B dan D digunakan untuk melihat tahap kesediaan majikan atau pihak industri terhadap kemahiran kebolehpasaran graduan tahap kemahiran kebolehpasaran graduan yang akan dianalisis menggunakan skor min.

## 7.0 Perbincangan dan Cadangan

ILJTM telah meletakkan sasaran sekurang-kurangnya 80% graduan akan memperolehi pekerjaan yang sesuai dengan kelayakannya dalam tempoh 6 bulan setelah menamatkan pengajian supaya dapat memenuhi keperluan industri atau swasta. Walaubagaimanapun graduan berpeluang untuk menceburi sektor kerajaan ataupun bidang perniagaan iaitu bekerja sendiri. Laporan Kaji Selidik Pengesanan Graduan ILJTM (Tracer Study) Tahun 2010, langkah proaktif perlu diambil untuk memasarkan graduan yang dikeluarkan supaya memenuhi kehendak industri.

**Jadual 3:** Taburan Bilangan Graduan Mengikut Sesi Latihan

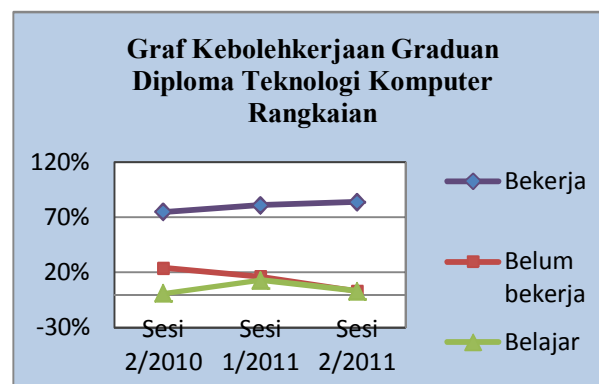
Graduan	Sesi 2/2010		Sesi 1/2011		Sesi 2/2011	
	Bilangan	Peratus	Bilangan	Peratus	Bilangan	Peratus
Diploma Teknologi Komputer Rangkaian	74	30%	75	26.13%	75	24.11%
<b>Jumlah Graduan ADTEC Batu Pahat</b>	<b>247</b>		<b>287</b>		<b>311</b>	

Jadual 3 di atas menunjukkan peratusan graduan Diploma Teknologi Komputer Rangkaian sebanyak 30% daripada keseluruhan 247 graduan ADTEC pada sesi 2/2010, diikuti dengan 26.13% daripada 287 graduan pada sesi 1/2011 dan sebanyak 24.11% daripada 311 graduan pada sesi 2/2011.

**Jadual 4:** Taburan Kebolehkeraan Pelajar Diploma Kejuruteraan Komputer Rangkaian Mengikut Jantina

Sesi Latihan	Bekerja		Belum Bekerja		Belajar	
	Lelaki	Perempuan	Lelaki	Perempuan	Lelaki	Perempuan
Sesi 2/2010	21	36	2	7	0	2
Sesi 1/2011	22	33	3	8	0	2
Sesi 2/2011	21	29	5	11	0	1
<b>Jumlah</b>	<b>64</b>	<b>98</b>	<b>12</b>	<b>26</b>	<b>0</b>	<b>5</b>

Jadual 4 di atas menunjukkan taburan kebolehkeraan pelajar pada sesi 2/2010, 1/2011 dan 2/2012 mengikut jantina



**Rajah 2:** Graf Kebolehkeraan Pelajar Diploma Teknologi Komputer Rangkaian

**Jadual 5:** Taburan Kebolehkeraan Graduan Diploma Teknologi Komputer Rangkaian

<b>Kebolehkeraan pelajar</b>	<b>Sesi 2/2010</b>	<b>Sesi 1/2011</b>	<b>Sesi 2/2011</b>
Bekerja	75%	81%	84%
Belum bekerja	24%	16%	13%
Belajar	1%	3%	3%
Jumlah	100%	100%	100%

Rajah 2 merupakan graf yang dihasikan daripada Jadual 5 dan menunjukkan statistik kebolehkeraan graduan dalam program Diploma Teknologi Komputer Rangkaian berdasarkan tiga sesi. Didapati terdapat peningkatan graduan yang bekerja setelah tamat pengajian dalam tempoh 6 bulan. Kadar peratusan graduan yang belum bekerja menurun pada sesi 2/2011. Peratusan graduan yang menyambung pengajian selepas tamat latihan pula meningkat daripada 1% kepada 3%. Berdasarkan peningkatan graf pelajar yang bekerja selepas tamat pengajian memberi satu petunjuk positif dalam penerimaan majikan terhadap graduan program ini untuk bekerja.

Pelbagai aktiviti dicadangkan perlu dipergiatkan lagi di peringkat institusi supaya pelajar-pelajar dapat menguasai kemahiran kebolehpasaran. Antara aktiviti yang membentuk kemahiran tersebut adalah melalui program-program kerjaya, keusahawanan dan sebagainya sebagai nilai tambah untuk mempromosikan diri pelajar supaya diterima bekerja. Kemahiran kebolehpasaran ini perlu diterapkan secara berterusan dan diharapkan dapat mengurangkan lagi kadar pengangguran negara. Menurut Callan (2003), pelajar berminat untuk memahami dan melibatkan diri dalam pembelajaran sekiranya pendekatan pembelajaran yang diberikan adalah bersesuaian dengan mereka. Pendekatan kemahiran generik ini boleh diterapkan secara terperinci melalui sukatan kurikulum, pendekatan serta penilaian yang bersesuaian untuk pembangunan kemahiran kebolehpasaran tersebut.

## **8.0 Kesimpulan**

ILJTM berperanan melahirkan graduan yang bukan sahaja memiliki kemahiran akademik dan kemahiran teknikal, bahkan memiliki kemahiran kebolehpasaran sebagai nilai tambah untuk menjadikan mereka graduan yang berdaya saing. Elemen kemahiran kebolehpasaran didapati sangat berguna kepada graduan apabila memasuki alam pekerjaan. Sekiranya pelajar hanya memiliki elemen kemahiran akademik dan teknikal sahaja, ianya masih belum mencukupi dan belum memenuhi kehendak industri. Kesemua elemen kemahiran iaitu kemahiran akademik, kemahiran teknikal dan kemahiran kebolehpasaran saling berkait antara satu sama lain dan pihak industri amat memerlukan lepasan pelajar yang mempunyai kesemua kemahiran tersebut. Dengan ini perhatian harus diberikan kepada pembangunan kurikulum supaya pelajar dapat menguasai kesemua elemen kemahiran tersebut. Kesedaran pelajar juga sangat perlu supaya dapat menguasai kesemua kemahiran tersebut melalui program-program tertentu dan diharapkan kemahiran insaniah secara diamalkan secara berterusan oleh setiap pelajar sehingga menceburi bidang pekerjaan.

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## O2 - Kajian Kes Bagi Kolaborasi ADTEC Batu Pahat dan Cisco Networking Accademy: Kerangka Penilaian Keberkesanan Program

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### Abstrak

Kajian kes ini mengemukakan kerangka penilaian bagi elemen pengajaran dan pembelajaran (PNP) serta pengurusan program kolaborasi Cisco Networking Academy yang dilaksanakan di ADTEC Batu Pahat. Ia adalah penyelesaian kepada permasalahan ketiadaan kriteria dan indikator rujukan bagi melaksanakan penilaian keberkesanan program yang dijalankan. Program yang ditawarkan oleh Cisco Networking Academy di ADTEC Batu Pahat meliputi Cisco Certified Network Associates (CCNA) merupakan program tambahnilai kepada graduan yang mengikuti pengajian di ADTEC Batu Pahat serta peningkatan kompetensi bagi pekerja industri. Kerangka penilaian dibangunkan dengan mengenalpasti indikator bagi pengukuran keberkesanan program kolaborasi pintar yang dijalankan. Pembangunan kerangka penilaian adalah berdasarkan kajian literature serta maklumbalas yang dikumpul daripada pensyarah yang terlibat melalui soal selidik. Dapatan daripada hasil penilaian keberkesanan tersebut akan dimanfaatkan dalam penambahbaikan proses PNP serta pengurusan program kolaborasi Cisco Networking Academy di ADTEC Batu Pahat.

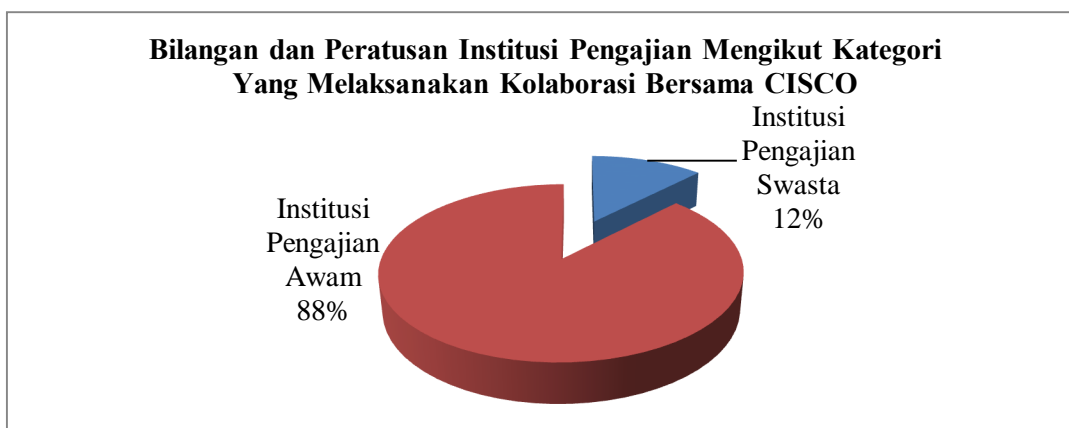
**Kata kunci :** Cisco Networking Academy, kolaborasi, pengajaran dan pembelajaran (PNP), kerangka penilaian dan indikator.

### 1.0 Pengenalan

Kolaborasi antara CISCO Networking Academy dengan ADTEC Batu Pahat telah bermula mulai tahun 2010 dengan pentauliah ADTEC Batu Pahat sebagai *Local Academy*. ADTEC Batu Pahat telah mengendalikan program CCNA bagi pekerja industri, individu persendirian serta para pelajar yang mengikuti pengajian peringkat Diploma dalam bidang Komputer Rangkaian. Seramai 343 peserta telah mengikut program CCNA dari Oktober 2010 hingga Ogos 2012 (Website Netacad, 2012, <http://www.http://cisco.netacad>).

Struktur program CISCO Networking Academy yang ditawarkan memberi kelebihan kepada peserta kerana ia menggunakan kurikulum berasaskan keperluan dan aplikasi industri sebenar serta penerimaannya secara global. Selain itu program yang ditawarkan ini juga merupakan platform untuk melayakkan personel untuk persijilan professional antarabangsa iaitu Cisco Certified Network Associates (CCNA).

Trend menunjukkan kecenderungan institusi pengajian awam di negara ini menyertai program kolaborasi bersama industri. Jumlah keseluruhan institusi pengajian di Malaysia yang melaksanakan kolaborasi dengan CISCO International sehingga 1 Mac 2013 adalah berjumlah 106 institusi (Website Cisco, 2013). Pecahan bilangan penyertaan institusi pengajian mengikut kategori awam dan swasta di Malaysia adalah seperti Carta 1.



**Carta 1:** Peratusan Institusi Pengajian Mengikut Kategori Awam dan Swasta Yang Melaksanakan program CISCO Academy. (Sumber: <http://www.cisco.com/web/learning/netacad/academy/index.html>, Website Cisco International, 2013)

Kolaborasi ini banyak ditawarkan oleh organisasi besar dunia khususnya dalam industri berkaitan teknologi komputer antaranya Cisco, Microsoft, Juniper dan banyak lagi. Ia merupakan sebahagian daripada tanggungjawab sosial industri dalam memperkasa generasi pelapis yang seterusnya melengkapkan kitaran keseimbangan antara industri dan tenaga kerja. Sehubungan itu, kolaborasi ini memberi manfaat kepada semua pihak terutamanya institusi pengajian dalam meningkatkan kompetensi graduan yang dihasilkan sejajar dengan keperluan industri semasa dalam Negara mahupun di peringkat global.

Walaubagaimanapun tiada kerangka penilaian keberkesanan yang khusus bagi menilai keberkesanan program yang dilaksanakan dari aspek pengurusan program serta pembelajaran dan pengajaran. Sehubungan itu, kajian kes ini menyediakan satu kerangka penilaian keberkesanan program kolaborasi khusus bagi ADTEC Batu Pahat. Hasil penilaian keberkesanan tersebut akan membantu penambahbaikan kepada pengurusan program serta proses pengajaran dan pembelajaran yang dilaksanakan.

## 2.0 Kajian Lapangan

Kolaborasi membawa maksud suatu gaya untuk berinteraksi secara langsung yang melibatkan diri secara sukarela dalam perkongsian membuat keputusan sekurang-kurangnya antara dua pihak yang sama untuk satu matlamat yang sama (Barth, 2006; Pugach & Johnson, 2002)

Perkataan Kolaborasi telah menjadi satu istilah popular dalam pendidikan. Ia merupakan pendekatan yang popular dan boleh diadaptasikan mengikut situasi yang pelbagai. Pengetua disarankan supaya menggunakan gaya kepimpinan kolaborasi (Burello, Lashley & Beatty, 2001; Krajewski, 2005) dan guru digalakkan menggunakan kolaborasi untuk meningkatkan pencapaian pelajar (Levine & Marcus, 2007).

Oleh itu, kolaborasi yang dilaksanakan bersama industri membolehkan sesebuah organisasi mempelajari serta memperolehi kemahiran, pengetahuan, produk serta perkembangan teknologi yang mana ia memberi manfaat kepada kedua-dua belah pihak sama ada pihak industri mahupun institusi pengajian.

Seterusnya organisasi boleh mengenalpasti pendekatan bagi menilai keberkesanan kolaborasi yang dijalinan antara institusi pengajian dan industry. Terdapat kepelbagaian model bagi kerangka penilaian yang digunapakai seluruh dunia. Merujuk Sadegh (2012), tiga

model bagi kerangka penilaian bagi pemindahan teknologi iaitu model AUTM (Association Of Universities Technology Managers), HEFCE ( Higher Education Funding Council For England) dan UNICO Technology Transfer Associates.

Menurut Mattessich (2001), sejumlah dua puluh faktor telah dikenal pasti mempengaruhi kejayaan kolaborasi dan ianya dikelaskan kepada enam kategori iaitu Persekitaran, Perilaku Ahli, Proses dan Struktur, Komunikasi, Matlamat dan Sumber. Selain itu, faktor utama kejayaan bagi kolaborasi istitusi pengajian dan industri dibahagikan kepada 2 komponen utama iaitu faktor organisasi dan faktor proses. Faktor organisasi terdiri dari elemen komitmen organisasi dan penyediaan sumber. Faktor proses pula merangkumi pengurusan projek dan komunikasi (Thune, 2010).

Merujuk kajian lapangan tersebut, model kerangka penilaian yang bersesuaian adalah model yang dibangunkan oleh UNICO Technology Transfer Associates kerana ia pendekatan bagi kerangka penilaian tersebut mencakupi pelbagai dimensi aktiviti kolaborasi melalui penentuan indikator berkaitan. Kerangka yang dibangunkan ini mengariskan indikator bagi menilai keberkesanan aktiviti program kolaborasi dari perspektif institusi pengajian iaitu ADTEC Batu Pahat. Sehubungan itu, berikut adalah kriteria dan indikator bagi penilaian keberkesanan pelaksanaan kolaborasi program *CISCO Networking Academy* di ADTEC Batu Pahat. Perincian indikator merujuk kepada kriteria bagi skop pengurusan program dan proses PNP adalah seperti di bawah.

## **2.1 Pengurusan Program**

Pengurusan program meliputi aktiviti dari penyediaan sumber iaitu tenaga pengajar, peralatan dan infrastruktur serta pengambilan peserta program. Pengurusan juga adalah pendekatan untuk mengendali teras utama yang melibatkan perancangan pemikiran aktiviti seharian, perkembangan berterusan organisasi (Hairuddin & M. Bustaman, 2009). Program *CISCO Networking Academy* hanya boleh dikendalikan oleh pensyarah yang telah ditauliah sebagai *CISCO Certified Instructor (CCAI)*. Selain itu pengetahuan dan kompetensi dalam pengendalian peralatan amat diperlukan (Mary, 2006). Program ini juga merupakan *web based learning* yang memerlukan kepada capaian internet bagi membolehkan akses kepada laman sesawang *CISCO Networking Academy* sama ada oleh *administrator* yang dilantik, pengajar dan juga peserta program. Maka indikator yang dicadangkan bagi penilaian keberkesanan pengurusan program adalah seperti jumlah pengajar, program peningkatan kompetensi pengajar, kelengkapan dan peralatan serta infrastruktur latihan.

## **2.2 Proses Pembelajaran dan Pengajaran (PNP)**

PNP adalah aktiviti utama dalam pelaksanaan program. Perkembangan teknologi dalam pendidikan banyak membantu proses PNP lebih berkesan khususnya kepada guru, murid dan pentadbiran (Norasiah, 2009). Aktiviti PNP bermula dengan pendaftaran serta pembukaan akaun unik bagi setiap peserta di laman sesawang yang dikendalikan oleh pengajar yang telah dilantik. Pembangunan dan penyediaan silibus program serta bahan pengajaran adalah dibawah pengendalian sepenuh *CISCO International*. Iadikemaskini secara berkala merujuk perubahan teknologi dan keperluan pasaran kerja. Kaedah pengajaran akan diolah oleh pengajar mengikut kesesuaian silibus. Penilaian dan latihan juga adalah secara atastalian. Indikator yang dicadangkan bagi penilaian keberkesanan proses PNP adalah seperti teknik penyampaian PNP, tempoh program, kaedah penilaian dan kadar kelulusan peserta.

### **2.3 Kepuasan Pelanggan**

Kepuasan pelanggan mencerminkan persepsi peserta hasil daripada program yang diikuti berbanding sasaran pada awal program. Ia juga memberi gambaran penerimaan oleh peserta. Ia boleh dilihat melalui indikator yang mencerminkan pencapaian objektif program, kefahaman pengetahuan dan keupayaan teknikal peserta program, kompetensi dan pengetahuan pengajar, skor kesesuaian peralatan dan kemudahan yang disediakan berkaitan program serta bilangan aduan daripada peserta.

### **2.4 Komunikasi Pelanggan**

Penyampaian maklumat kepada bakal peserta mahupun peserta yang sedang mengikuti program adalah penting dalam menyokong proses utama iaitu PNP. Komunikasi dengan bakal peserta meliputi hebahan berkaitan program yang ditawarkan. Manakala komunikasi dalaman kepada peserta lebih memfokuskan penyampaian maklumat aktiviti, informasi, perubahan yang berlaku semasa program berlangsung. Komunikasi ini wujud dalam bentuk perbincangan dalam laman sesawang, email antara pengajar dan pelajar serta *administrator* dengan pelajar atau sebaliknya. Indikator yang berkaitan meliputi pelaksanaan aktiviti promosi, penganjuran taklimat /seminar, penerbitan bahan promosi pamphlet/ poster/ bulletin dan medium komunikasi yang digunakan bagi penyampaian maklumat di antara peserta dan pengajar.

## **3.0 Kaedah Kajian**

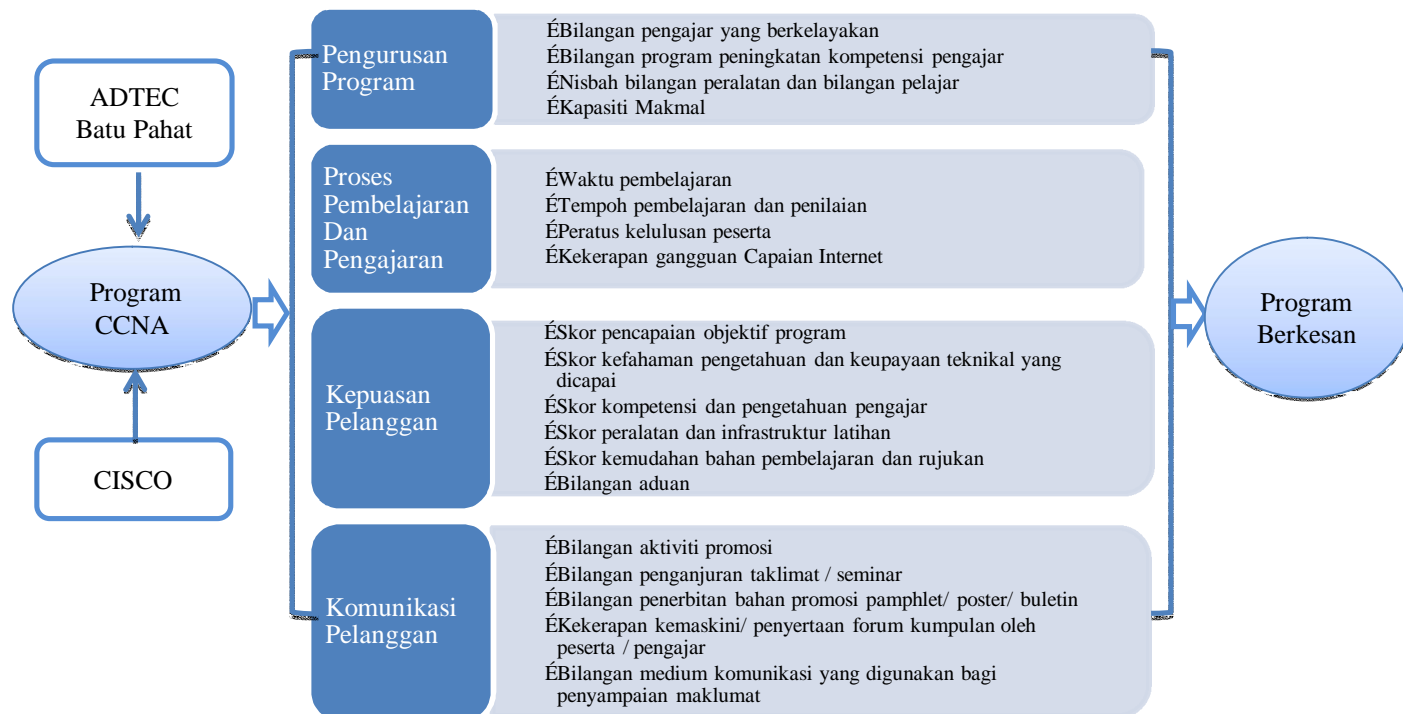
Kaedah utama bagi kajian ini adalah soalselidik dan juga kajian lapangan. Kajian lapangan digunapakai bagi penentuan kandungan kerangka penilaian meliputi skop dan indikator penilaian. Manakala soal selidik dilaksanakan bagi mendapatkan maklumbalas daripada para pensyarah di ADTEC Batu Pahat dalam menentukan kesesuaian indikator yang telah dikenalpasti melalui kajian lapangan yang terdahulu.

Skop responden difokuskan kepada tenaga pengajar dari 6 bidang teknikal yang terdapat di ADTEC Batu Pahat. Jumlah keseluruhan responden yang terlibat dalam soal selidik ini adalah 70 peratus daripada bilangan keseluruhan tenaga pengajar iaitu seramai 50 orang. Maklumbalas bagi setiap soalan di dalam soalselidik diukur menggunakan skala likert iaitu sangat tidak sesuai, tidak sesuai, sesuai dan sangat sesuai. Indikator yang disenaraikan adalah indikator yang mendapat markah purata melebihi 50 markah dan ke atas iaitu dalam julat sesuai dan sangat sesuai.

## **5.0 Hasil Kajian**

Tumpuan bagi pembentukan kerangka penilaian menjuruskan kepada indikator dalaman organisasi iaitu diperingkat institusi pengajian. Rajah 1 menunjukkan indikator utama bagi pembentukan kerangka penilaian keberkesanan program kolaborasi yang dijalankan.





**Rajah 1:** Kerangka penilaian dan indikator bagi pengukuran keberkesanan program kolaborasi

Merujuk Rajah 1, penilaian keberkesanan program kolaborasi yang dijalankan di antara ADTEC Batu Pahat dan CISCO iaitu program CCNA meliputi empat (4) kriteria utama iaitu Pengurusan Program, Proses Pembelajaran dan Pengajaran (PNP), Kepuasan Pelanggan dan Komunikasi Pelanggan. Setiap kriteria tersebut merangkumi indikator- indikator seperti di bawah.

- a) Indikator bagi Pengurusan Program
  - i) Bilangan pengajar yang berkelayakan
  - ii) Bilangan program peningkatan kompetensi pengajar
  - iii) Nisbah bilangan peralatan dan bilangan pelajar
  - iv) Kapasiti Makmal
  
- b) Indikator bagi Proses Pembelajaran dan Pengajaran (PNP)
  - i) Teknik penyampaian PNP
  - ii) Tempoh PNP dan penilaian
  - iii) Peratus kelulusan peserta
  - iv) Kekerapan gangguan Capaian Internet
  
- c) Indikator bagi Kepuasan Pelanggan
  - i) Skor pencapaian objektif program
  - ii) Skor kefahaman pengetahuan dan keupayaan teknikal yang dicapai
  - iii) Skor kompetensi dan pengetahuan pengajar
  - iv) Skor peralatan dan infrastruktur latihan

- v) Skor kemudahan bahan pembelajaran dan rujukan
  - vi) Bilangan aduan
- d) Indikator bagi Komunikasi Pelanggan
- i) Bilangan aktiviti promosi
  - ii) Bilangan penganjuran taklimat / seminar
  - iii) Bilangan penerbitan bahan promosi pamphlet/ poster/ buletin
  - iv) Kekekapan kemaskini/ penyertaan forum kumpulan oleh peserta/ pengajar
  - v) Bilangan medium komunikasi yang digunakan bagi penyampaian maklumat

## 6.0 Kesimpulan

Kajian ini mengemukakan kerangka penilaian bagi pengukuran keberkesanan program kolaborasi antara institusi pengajian (ADTEC Batu Pahat) dan industri (CISCO International) dari perspektif tenaga pengajar. Model kerangka penilaian bagi program kolaborasi yang dibangunkan dalam kajian terdahulu membantu dalam penyediaan kerangka penilaian ini. Ia boleh digunakan oleh ADTEC Batu Pahat. Penentuan kriteria dan indikator ini membantu institusi pengajian memperkasakan program yang dilaksanakan di masa akan datang melalui penambahbaikan secara berterusan.

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## O3 - Impak Pelaksanaan Amalan 5S Di Institut Teknikal Jepun Malaysia

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### *Abstrak*

*5S adalah akronim kepada lima perkataan Jepun iaitu Seiri, Seiton, Seisou, Seiketsu dan Shistuke yang membawa maksud sisih, susun, sapu, seragam dan sentiasa amal. Kajian ini bertujuan untuk mengkaji impak amalan pelaksanaan 5S dalam kalangan kakitangan Japan Malaysia Technical Institut. Fokus kajian adalah kecekapan capaian dokumen, kecekapan capaian peralatan, penggunaan ruang alat tulis peribadi dan penggunaan ruang kerja kakitangan. Kajian dibuat di Bahagian dan Jabatan berkaitan di JMTI melibatkan kakitangan dan pelajar yang terlibat secara langsung dengan minimum data 15 orang dalam tempoh tiga bulan pemerhatian mulai Januari hingga Mac 2013. Peratus kecekapan capaian dokumen adalah 69.37% lebih baik jika dibandingkan masa sebelum persijilan dan 44.66% lebih baik dengan masa capaian piawai MPC. Kecekapan capaian peralatan pula adalah 76.58% lebih baik berbanding masa sebelum persijilan dan 77.71% lebih baik dengan masa capaian piawai yang ditetapkan MPC. Berdasarkan keputusan penggunaan ruang alat tulis peribadi dan juga penggunaan ruang kerja kakitangan, didapati keberkesanan penjimatan ruang adalah rendah kerana nilai keberkesanan penggunaan ruang alat tulis individu adalah 4.5% manakala keberkesanan penggunaan ruang kerja keseluruhan individu pula ialah 1.49% sahaja. Faktor utama yang menyumbang kepada kejayaan dan kegagalan Amalan 5S adalah Pengurusan, Persekitaran, Peribadi dan Kewangan. Keputusan daripada kajian ini boleh dijadikan panduan kepada kakitangan dan pelajar JMTI khususnya dan JTM amnya berkaitan impak daripada perlaksanaan Amalan 5S boleh membantu meningkatkan produktiviti sesuatu kerja.*

**Keywords:** *Amalan 5S, Kecekapan, Keberkesanan, Faktor Kejayaan, Faktor Kegagalan.*

### **1.0 Pengenalan**

Pada masa kini prinsip 5S telah diterima sebagai salah satu konsep utama dalam model Pengurusan Kejut (*Lean Management*) dan juga model Pembuatan Bertaraf Dunia (*World Class Manufacturing*) [1]. Prinsip ini digunakan untuk meningkatkan lagi produktiviti kerja.

Institut Teknikal Jepun Malaysia (JMTI) merupakan sebuah Institusi Latihan Kemahiran di bawah Jabatan Tenaga Manusia (JTM), Kementerian Sumber Manusia (KSM). Institut ini telah ditubuhkan pada 7 Oktober 1997 melalui termeterainya '*Record of Discussion*' (ROD) di antara Kerajaan Malaysia dan Kerajaan Jepun. JMTI menawarkan empat program latihan khusus iaitu dalam bidang Teknologi Kejuruteraan Komputer, Teknologi Kejuruteraan Elektronik, Teknologi Kejuruteraan Mekatronik dan Teknologi Kejuruteraan Pembuatan. Sehingga kini JMTI telah mengeluarkan seramai 13,392 orang graduan dengan peratusan keboleherjaannya melebihi 75% selepas pelajarnya menamatkan pengajian. Kecemerlangan pengendalian sistem pengurusan dan sistem latihannya disokong oleh pengiktirafan agensi dan organisasi tertentu seperti Pengiktirafan Program Latihan oleh Jabatan Perkhidmatan Awam (JPA) mulai tahun 2002, Pengiktirafan Sistem Persijilan MS ISO 9001:2008 mulai tahun 2006 dan Pengiktirafan Amalan Persekitaran Berkualiti (5S) mulai 13 Jun 2012.

Tujuan kajian ini adalah bagi mengenalpasti faktor keberkesanan atau impak pelaksanaan Amalan 5S yang telah dilaksanakan di JMTI. Secara khususnya, objektif kajian ini adalah:

- i. Menganalisa kecekapan masa capaian dokumen dan peralatan di kalangan kakitangan dan pelajar di JMTI selepas Persijilan Amalan 5S.
- ii. Menganalisa keberkesanan penjimatan ruang kerja di kalangan kakitangan JMTI selepas Persijilan Amalan 5S.
- iii. Mengenalpasti faktor-faktor yang menyumbang kepada kejayaan dan kegagalan Pelaksanaan Amalan 5S di JMTI.

Skop kajian tertumpu kepada tiga perkara seperti berikut:

- i. Penentuan kecekapan masa capaian dokumen dan peralatan akan dilakukan di Bilik Fail Unit Pentadbiran bagi penentuan masa capaian dokumen manakala penentuan masa capaian peralatan akan tertumpu kepada ruang peralatan tangan di Jabatan Teknologi Kejuruteraan Pembuatan. Data akan diperolehi daripada 15 orang kakitangan dan pelajar JMTI pada satu-satu masa di antara bulan Januari hingga Mac 2013 minimum dua kali sebulan.
- ii. Penentuan keberkesanan penjimatan ruang kerja pula akan dilaksanakan terhadap kakitangan JMTI di Unit Pentadbiran sahaja. Data akan diperolehi daripada 15 orang kakitangan JMTI pada satu-satu masa di antara bulan Januari hingga Mac 2013 minimum dua kali sebulan. Ruang yang dikaji tertumpu kepada ruang simpanan alat tulis dan penggunaan ruang kerja keseluruhan peribadi kakitangan sahaja.
- iii. Penentuan faktor-faktor kejayaan atau kegagalan pelaksanaan Amalan 5S pula akan diperolehi melalui maklumat daripada Borang Maklum Balas (Borang A dan Borang B) yang diedarkan kepada kakitangan dan pelajar JMTI minimum 30 orang.

## 2.0 Kajian Literatur

5S adalah akronim kepada lima perkataan Jepun iaitu *Seiri, Seiton, Seisou, Seiketsu* dan *Shistuke* [2]. Amalan 5S adalah penting untuk memberikan kesedaran khususnya kepada warga kerja organisasi perkhidmatan awam untuk menghasilkan satu persekitaran kerja yang berkualiti dan efektif [3]. Selain itu, hasil daripada perlaksanaannya juga membolehkan pihak organisasi mengambil langkah sewajarnya bagi meningkatkan kualiti pengurusan sistem organisasi mereka [4].

5S merupakan satu kaedah yang boleh meningkatkan komunikasi dan membantu pekerja untuk meningkatkan prestasi kerja mereka bagi mengurangkan *downtime*, masa menunggu, lebihan atau kekurangan inventori, kecacatan produk, kecederaan pekerja dan peningkatan kos pengeluaran. Hasil pelaksanaan 5S menunjukkan bahawa teknik 5S adalah satu cara yang berkesan untuk meningkatkan piawai kesihatan dan keselamatan pekerjaan, prestasi persekitaran kerja dan kekemasan [5]. 5S juga merupakan satu kaedah untuk membangunkan prestasi syarikat, perubahan sistem kerja dan latihan kakitangan berkaitan pelbagai amalan di industri [6]. Salah satu kajian mendapati pengurangan masa sebanyak 16.6% serta penggunaan ruang dapat dikurangkan sebanyak 22.2% selepas pelaksanaan 5S di sebuah organisasi yang dikaji [7].

Masyarakat Jepun mengutamakan kecemerlangan organisasi dan mengamalkan 5S pada setiap masa sama ada di rumah mahupun di tempat kerja. Hal ini berbeza dengan pelaksanaan 5S di negara-negara barat seperti United Kingdom dan Amerika yang mana Amalan 5S dilihat sebagai satu sistem dan digunakan sebagai alat untuk menyelesaikan masalah (dilaksana di tempat kerja sahaja)[8]. Di Malaysia, pelaksanaan di sektor industri telah lama bermula. Pelaksanaan Amalan 5S di sektor awam hanya bermula apabila Pekeliling Kemajuan Perkhidmatan Awam (PKPA) bilangan 4 tahun 1991 dikeluarkan.

Semenjak itu, pelbagai pihak dan organisasi telah melaksanakan Amalan 5S. Namun impak pelaksanaannya tidak ketara kerana Amalan 5S dilakukan secara paksaan ataupun arahan oleh pihak atasan[9],[10].

Kesan-kesan pelaksanaan Amalan 5S dapat dipecahkan kepada empat kategori utama iaitu [11],[12],[13];

- i. Menjadikan persekitaran yang kondusif, berkualiti dan selamat.
- ii. Mempercepatkan sesuatu tugas.
- iii. Mengurangkan pembaziran.
- iv. Penghasilan kakitangan dan pelajar berkualiti, kreatif dan cemerlang.

### **3.0 Metodologi Kajian**

#### **3.1 Kaedah Pengumpulan Dan Analisa Data Objektif I**

Data rujukan iaitu masa (dalam unit saat) capaian dokumen dan peralatan sebelum persijilan akan diperolehi daripada Jawatankuasa Pelaksanaan Amalan 5S JMTI manakala masa capaian piawai akan diperolehi daripada MPC. Data selepas persijilan pula akan dikumpul melalui pengukuran masa capaian dokumen dan masa capaian peralatan oleh pengguna mulai daripada permintaan sehingga terimaan (tiga kali bagi setiap pemerhatian dan dua kali dalam tempoh sebulan mulai Januari hingga Mac 2013) dengan menggunakan jam digital.

Maklumat masa capaian dokumen dan peralatan direkod dan dikumpulkan di dalam jadual yang bersesuaian. Seterusnya purata (*mean*) bagi masa capaian dokumen dan purata bagi masa capaian peralatan akan dikira.

#### **3.2 Kaedah Pengumpulan Dan Analisa Data Objektif II**

Data saiz ruang penyimpanan alat tulis peribadi dan saiz penggunaan ruang kerja dibandingkan dengan saiz ruang yang dihadkan bagi aktiviti selepas persijilan 5S akan diukur melalui pengukuran yang dibuat dengan menggunakan pita pengukur dengan mengambil kira keluasan luas. Pengumpulan data dihadkan kepada kawasan kerja kakitangan Bahagian Pentadbiran sahaja memandangkan kawasan pekerja adalah terkumpul dan saiz bagi setiap ruang atau kawasan adalah hampir sama.

Maklumat Keluasan Kawasan Simpanan Alat Tulis Peribadi Kakitangan dan Keluasan Penggunaan Ruang Keseluruhan Peribadi Kakitangan JMTI selepas persijilan yang diperolehi melalui kajian akan dikumpul dan dimasukkan ke dalam jadual yang bersesuaian. Seterusnya purata keluasan penggunaan ruang bagi setiap individu dan keseluruhan serta keberkesanan penjimatan ruang terhadap keluasan yang ditetapkan akan dikira.

#### **3.3 Kaedah Pengumpulan Dan Analisa Data Objektif III**

Data berkaitan maklumat faktor-faktor penentu kejayaan dan kegagalan pelaksanaan Amalan 5S di JMTI akan diperolehi melalui Borang Soal selidik yang diedarkan kepada kakitangan dan pelajar yang terlibat secara langsung dengan kajian. Soalan adalah berbentuk subjektif yang mana penerangan akan diberikan sebelum kakitangan dan pelajar memberikan idea mereka

Maklumat faktor-faktor penentu kejayaan dan kegagalan pelaksanaan Amalan 5S di JMTI yang diperolehi daripada pemerhatian kajian akan diteliti dan disenaraikan mengikut turutan kekerapan faktor terbanyak diberikan pandangan atau pendapat oleh kakitangan dan pelajar seterusnya disusun di dalam jadual penyusunan. Seterusnya faktor-faktor akan diringkaskan maksudnya dan dikelaskan kepada beberapa faktor utama seperti Faktor

Peribadi, Faktor Persekitaran, Faktor Pengurusan, Faktor Kewangan dan lain-lain faktor yang berkaitan sebelum dipindahkan maklumat ke dalam Graf Histogram dan Gambarajah Ishikawa sebagai ringkasan penemuan.

## 4.0 Keputusan Dan Perbincangan

### 4.1 Keputusan Dan Perbincangan Objektif I

i. Kecekapan masa purata keseluruhan capaian dokumen 16.60 saat dibandingkan dengan masa capaian sebelum persijilan ialah 54.2 saat adalah,

$$\%_{kd1} = (\mu_1 - \mu_{d2}) / (\mu_1) \times 100\%, = \frac{54.2 - 16.6}{54.2} \times 100\% = 69.37\%,$$

Atau pun 69.37% lebih baik daripada masa capaian sebelum persijilan.

ii. Kecekapan masa purata keseluruhan capaian dokumen 16.60 saat dibandingkan dengan masa capaian piawai MPC ialah 30 saat,

$$\%_{kd2} = (\mu_2 - \mu_{d2}) / (\mu_2) \times 100\%, = \frac{30 - 16.6}{30} \times 100\% = 44.66\%$$

Atau pun 44.66% lebih baik daripada masa yang ditetapkan oleh MPC.

iii. Kecekapan masa purata keseluruhan capaian peralatan 13.37 saat dibandingkan dengan masa capaian sebelum persijilan ialah 57.1saat,

$$\%_{kp1} = (\mu_3 - \mu_{p2}) / (\mu_3) \times 100\%, \frac{57.1 - 13.37}{57.1} \times 100\% = 76.58\%,$$

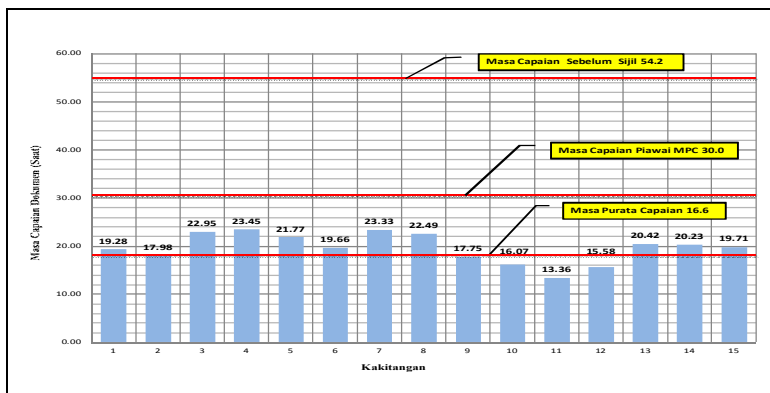
Atau pun 76.58% lebih baik daripada masa capaian sebelum persijilan.

iv. Kecekapan masa purata keseluruhan capaian peralatan 13.37 saat dibandingkan dengan masa capaian piawai MPC ialah 60 saat,

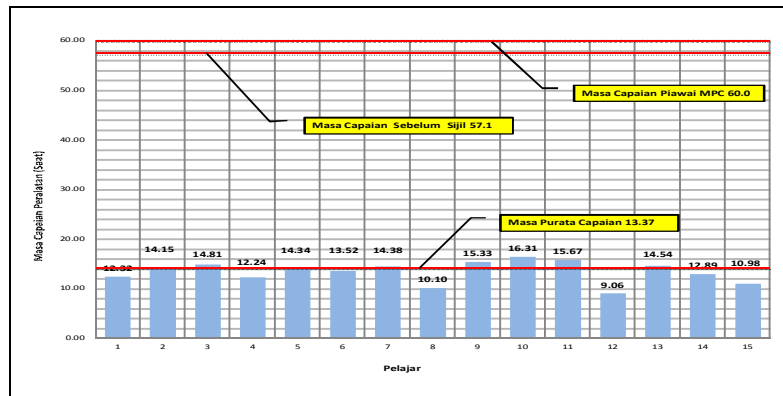
$$\%_{kp2} = (\mu_4 - \mu_{p2}) / (\mu_4) \times 100\% , \frac{60 - 13.37}{60} \times 100\% = 77.71\%$$

Atau pun 77.71% lebih baik daripada masa yang ditetapkan oleh MPC.

Rajah 1 menunjukkan Keputusan Masa Capaian Dokumen Kakitangan JMTI dibandingkan dengan masa capaian sebelum persijilan dan juga masa capaian piawai MPC. Rajah 2 pula menunjukkan Keputusan Masa Capaian Peralatan Pelajar JMTI dibandingkan dengan masa capaian sebelum persijilan dan juga masa capaian piawai MPC.



Rajah 1: Keputusan Masa Capaian Dokumen Kakitangan JMTI



**Rajah 2:** Keputusan Masa Capaian Peralatan Pelajar JM TI

Berdasarkan keputusan yang diperolehi daripada kajian terhadap masa capaian dokumen selepas persijilan oleh kakitangan JM TI didapati masa purata capaian dokumen kesemua 15 orang kakitangan adalah di paras yang ditetapkan dengan nilai minimum 13.36 saat dan nilai maksimum 23.45 saat dengan nilai purata keseluruhan 16.60 saat. Nilai kecekapan capaian dokumen pula adalah 69.37% lebih baik jika dibandingkan dengan masa sebelum persijilan dan 44.66% lebih baik dengan masa capaian piawai MPC. Bagi masa capaian peralatan oleh 15 orang pelajar JM TI pula, nilai minimum masa capaian individu pula adalah 9.06 saat manakala yang paling maksimum ialah 16.31 saat dengan nilai purata masa capaian 13.37 saat setiap orang. Kecekapan capaian peralatan pula adalah 76.58% lebih baik berbanding masa sebelum persijilan dan 77.71% dengan masa capaian piawai yang ditetapkan oleh MPC.

#### 4.2 Keputusan Dan Perbincangan Objektif II

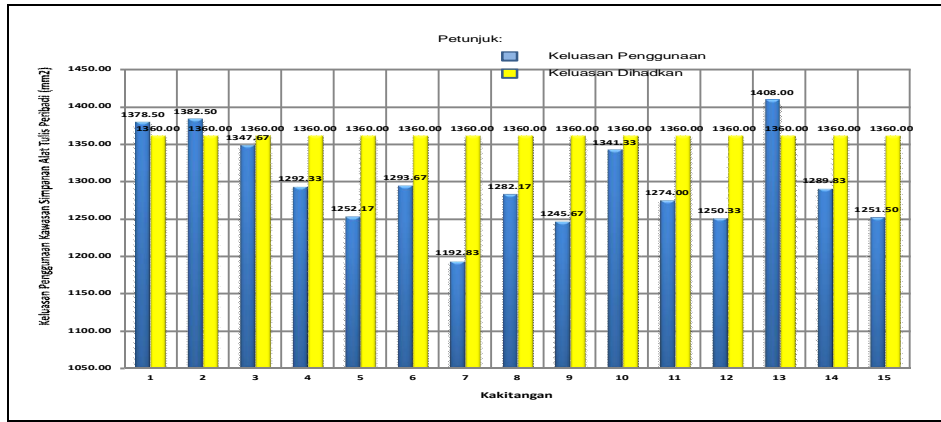
Jumlah luas penggunaan ruang alat tulis peribadi individu keseluruhan adalah,

$$\hat{U}_{A_{tik}} = \hat{U}_{\mu_{A_{ti}}} = 19,482.5 \text{ mm}^2$$

Jumlah luas yang dihadkan,  $\hat{U}_{A_{ktih}}$  adalah 20,400 mm<sup>2</sup>. Oleh yang demikian, keberkesanan luas penjimatan ruang kawasan simpanan alat tulis peribadi keseluruhan individu dibandingkan dengan luas keseluruhan ruang simpanan alat tulis yang dihadkan ialah,

$$\begin{aligned} K_{tsi} &= ((\hat{U}_{A_{ktih}}) \text{ ó } (\hat{U}_{A_{tik}})) / (\hat{U}_{A_{ktih}}) \times 100\% \\ &= (20,400 \text{ ó } 19,482.5) / (20,400) \times 100\% \\ &= 4.50\% \end{aligned}$$

Rajah 3 menunjukkan Keputusan Taburan Keluasan Penggunaan Kawasan Simpanan Alat Tulis Peribadi Dibandingkan dengan Keluasan Dihadkan.



**Rajah 3:** Keputusan Taburan Keluasan Penggunaan Kawasan Simpanan Alat Tulis Peribadi Dibandingkan dengan Keluasan Dihakkan

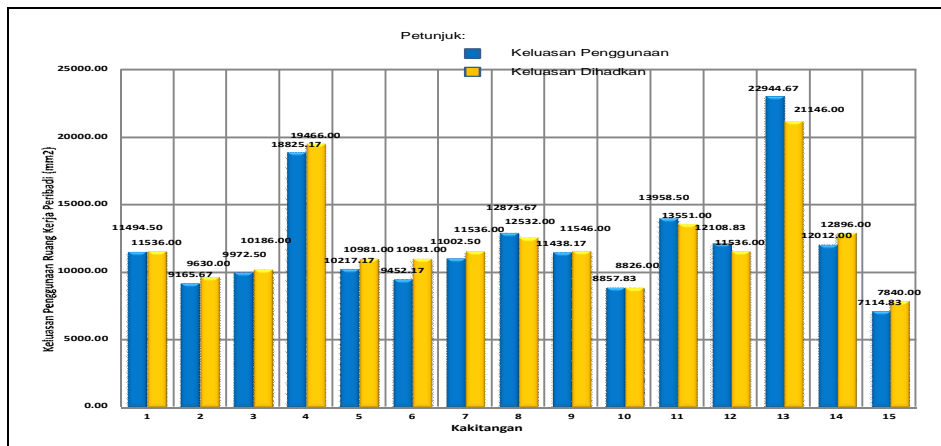
Jumlah luas penggunaan ruang ruang kerja peribadi keseluruhan individu adalah,

$$\hat{U}_{Apik} = \hat{U}_{\mu Apik} = 181,438.17 \text{ mm}^2$$

Jumlah luas yang dihadkan,  $\hat{U}_{Akrkih}$  adalah 184,189.00 mm<sup>2</sup>. Oleh yang demikian, keberkesanan luas penjimatan penggunaan ruang kerja peribadi keseluruhan individu dibandingkan dengan luas keseluruhan ruang kerja peribadi yang dihadkan ialah,

$$\begin{aligned} K_{rksi} &= ((\hat{U}_{Akrkih} \text{ ó } \hat{U}_{Apik}) / (\hat{U}_{Akrkih})) \times 100\% \\ &= (184,189.00 \text{ ó } 181,438.17) / (184,189.00) \times 100\% \\ &= 1.49\% \end{aligned}$$

Rajah 4 menunjukkan Keputusan Taburan Keluasan Penggunaan Ruang Kerja Peribadi Keseluruhan Individu Dibandingkan dengan Keluasan Dihakkan.



**Rajah 4:** Keputusan Taburan Keluasan Penggunaan Ruang Kerja Peribadi Keseluruhan Individu Dibandingkan dengan Keluasan Dihakkan.

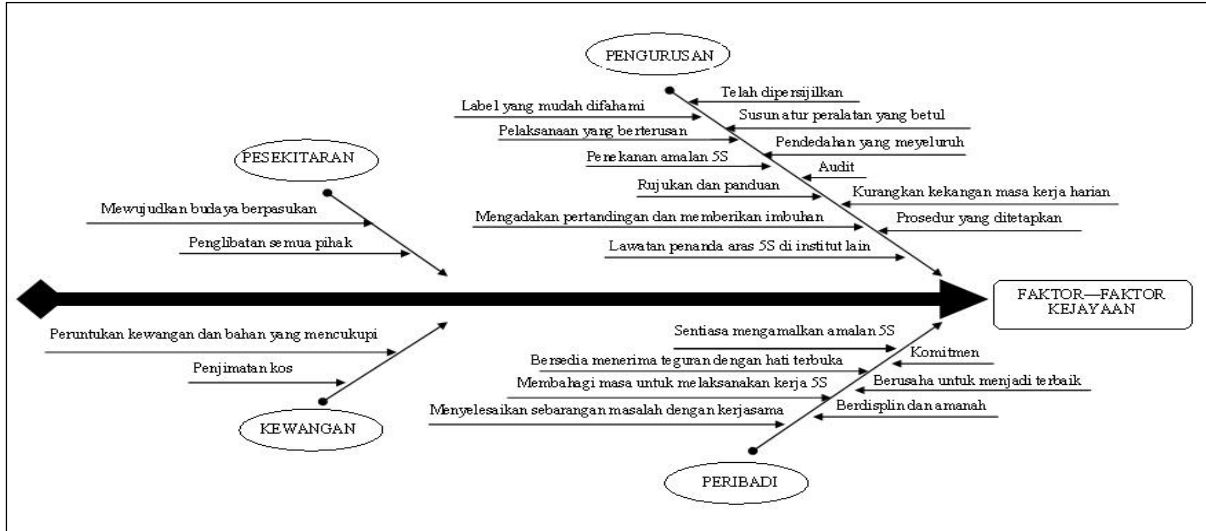
Berdasarkan keputusan yang diperolehi, penggunaan ruang alat tulis peribadi dan juga penggunaan ruang kerja kakitangan adalah terlalu rendah keberkesanan penjimatan ruang kerana nilai keberkesanan penggunaan ruang alat tulis individu adalah 4.5% manakala keberkesanan penggunaan ruang kerja keseluruhan individu pula ialah 1.49% sahaja. Bagi ruang alat tulis dan ruang kerja individu, berdasarkan data yang diperolehi, kakitangan tidak terlalu terlalu produktif untuk meningkatkan keberkesanan penjimatan ruang kerana



kebanyakkan ruang digunakan hampir sepenuhnya pada tempoh pemerhatian dan sesetengah individu menambah ruang simpanan sendiri kerana ruang yang dihadkan tidak mencukupi.

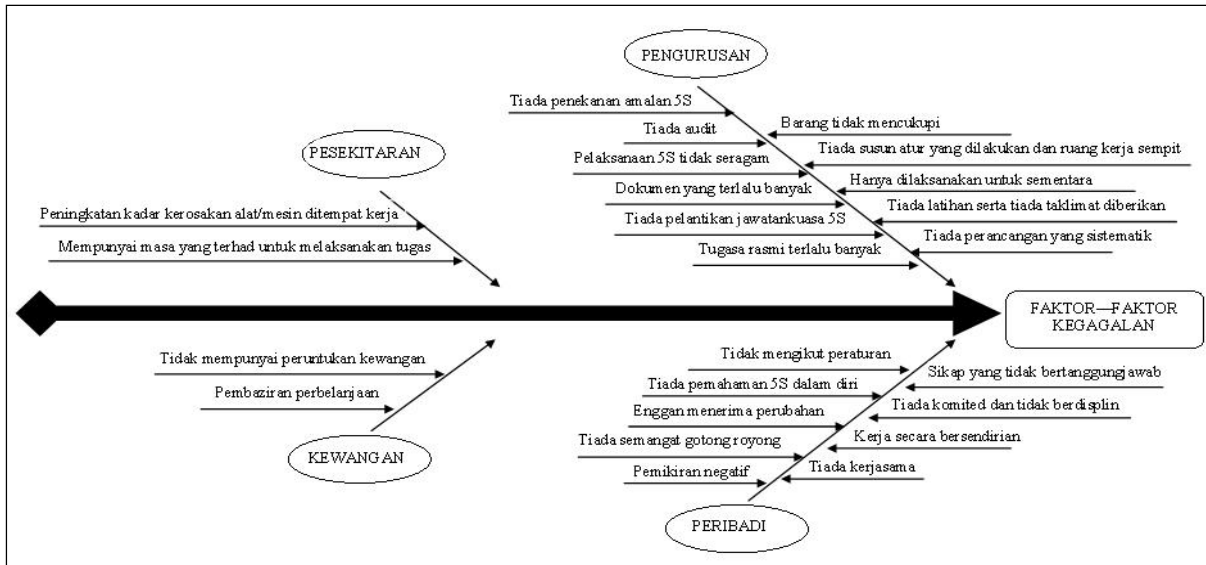
### 4.3 Keputusan Dan Perbincangan Objektif III

Faktor-faktor Penentu Kejayaan Pelaksanaan Amalan 5S yang diperolehi daripada kajian diringkaskan mengikut pengkelasan samada Pengurusan, Persekitaran, Kewangan atau pun Peribadi dalam bentuk Gambarajah Ishikawa seperti Rajah 5.



Rajah 5: Faktor Penentu Kejayaan Pelaksanaan Amalan 5S Di JMTI

Berikut pula merupakan Faktor-faktor Penentu Kegagalan Pelaksanaan Amalan 5S yang diperolehi daripada kajian diringkaskan mengikut pengkelasan samada Pengurusan, Persekitaran, Kewangan atau pun Peribadi dalam bentuk Gambarajah Ishikawa seperti Rajah 6 dibawah.



Rajah 6: Faktor Penentu Kegagalan Pelaksanaan Amalan 5S Di JMTI

Berdasarkan keputusan yang diperolehi didapati Faktor Utama yang menyumbang kepada kejayaan pelaksanaan Amalan 5S di JMTI adalah Pengurusan (47.23%) dengan 12 faktor, Persekitaran (26.39%) dengan 2 faktor, Peribadi (22.22%) dengan 7 faktor dan Kewangan (4.16%) dengan 2 faktor. Faktor Utama yang menyumbang kepada kegagalan pelaksanaan pula adalah Peribadi (63.41%) dengan 9 faktor, Pengurusan (31.35%) dengan 11 faktor, Persekitaran (3.74%) dengan 2 faktor dan akhir sekali Kewangan (1.5%) dengan dua faktor. Berdasarkan keputusan juga didapati faktor kewangan bukanlah faktor yang paling penting bagi menentukan kejayaan dan kegagalan pelaksanaan Amalan 5S di institut.

## 5.0 Kesimpulan

Secara keseluruhannya, kajian ini telah mencapai objektifnya. Hasil penemuan dan analisa kajian, boleh disimpulkan bahawa peratus kecekapan capaian dokumen adalah 69.37% lebih baik jika dibandingkan dengan masa sebelum persijilan dan 44.66% lebih baik jika dibandingkan masa capaian piawai MPC. Kecekapan capaian peralatan pula adalah 76.58% lebih baik terhadap masa sebelum persijilan dan 77.71% lebih baik dengan masa capaian piawai yang ditetapkan oleh MPC. Berdasarkan keputusan penggunaan ruang alat tulis peribadi dan juga penggunaan ruang kerja kakitangan, didapati keberkesanan penjimatan ruang adalah rendah kerana nilai keberkesanan penggunaan ruang alat tulis individu adalah 4.5% manakala keberkesanan penggunaan ruang kerja keseluruhan individu pula ialah 1.49% sahaja. Faktor utama yang menyumbang kepada kejayaan adalah Pengurusan, diikuti oleh Persekitaran, Peribadi dan akhir sekali Kewangan. Faktor utama kegagalan pula adalah Peribadi, diikuti dengan Pengurusan, Persekitaran dan akhir sekali Kewangan. Diharapkan penemuan hasil kajian ini dapat menjadi rujukan kepada semua institusi latihan amnya dan JMTI khususnya.

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# O4- Effect of Fiber Orientation on Tensile Properties of Glass Fiber Reinforced Composites (GFRC)

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## Abstract

In this research, the GFRC made with hand lay-up process technique were studied. The effects of fiber orientation have been investigated to determine the tensile properties of GFRC composites. The specimens were cut and tested according to tensile test standard by using UTM machine. This research indicates that tensile properties are depending on fiber orientation of GFRC composites. Finally, the fracture specimens of GFRC composites were discussed.

**Keywords:** GFRC, UD, Composites

## 1.0 Introduction

Polymer composites are the most common materials to be used for lightweight structure such as aircraft and automobile [1]. Fiber reinforced composites provide improved strength, modulus and stiffness. Many factors must be considered when designing fiber-reinforced composites such as length, diameter, **orientation** and properties of fiber and matrix. Unidirectional (UD) arrangements of fibers produce anisotropic properties, with particularly good strength and stiffness parallel to the fibers as shown in Figure 1 (a). The fiber are designed as  $0^0$  plies, indicating all fiber are aligned to direction of applied stress as shown in Figure 1 (b). More complicated arrangement such as  $0^0/\pm 45^0/90^0$  provides reinforcement in multiple directions. The effects of fiber orientation have been studied by Prashanth [2] and Hossain [3].

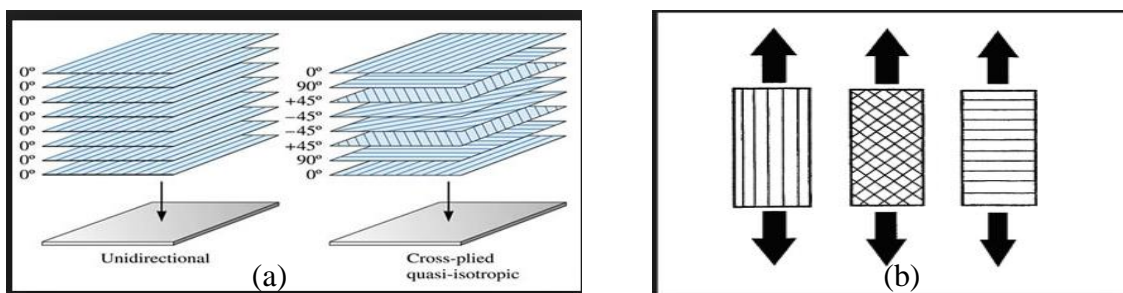
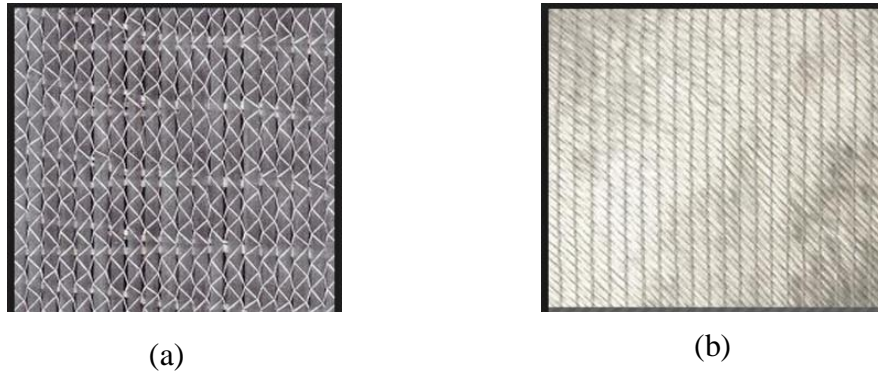


Figure 1: (a) Unidirectional and Cross-plyed Quasi-isotropic (b) Direction of load

## 2.0 Experimental

### 2.1 Materials

The raw materials to be used in this study are unsaturated polyester with 1% catalyst and two types of glass fiber as shown in Figure 2.

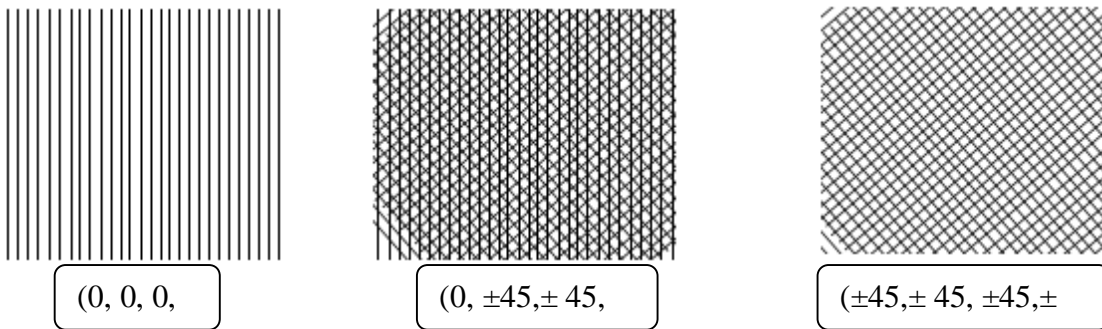


**Figure 2:** (a) Uni-directional Stitched Glass ( $0^{\circ}$ ) (b) Biaxial Stitched Glass ( $\pm 45^{\circ}$ ).

## 2.2 Sample preparation

The samples were prepared by using wet lay-up process. The desired laminates were containing four (4) layer of fiberglass. The fiber is positioned on the mould by hand. The resin is poured over the fiber and brushed or rolled to ensure complete wetting of fiber and removal of air bubbles. The combinations of fiber and resin are known as composites and this composite should be cured at room temperature for 24 hours.

Sample specimens are prepared after the composite laminated are ready. The geometry of specimens is set by referring to ASTM standard D3039. The proper design of specimens is mentioned in this standard. The dimension of the test specimens are 25mm x 250mm. There are total three categories of specimens prepared for testing purpose. The fiber direction of the composite laminates was shown in Figure 3. The specimen is then cut out by using cutter machine. Grinding process was done by sand belt grinding machine as finishing purpose. Specimens are labeled according to different fiber orientation. Six test specimens were prepared for each category.



**Figure 3:** Orientation of fiber.

## 2.3 Tensile test

The tensile test is done to measure the tensile strength and tensile modulus of the composite laminate specimens. The machine was used in this experiment is Universal Testing Machine Instron 5582 100kN. After tensile test, the fracture specimens were observed to study the orientation of the fracture.



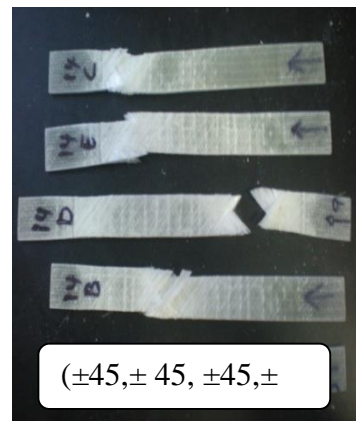
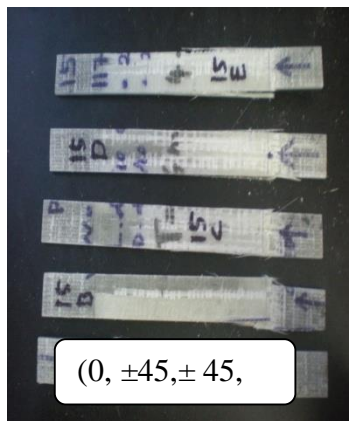
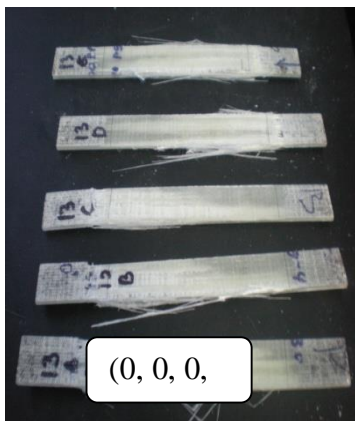
Figure 4: UTM Machine

### 3.0 Results and Discussion

The experimental results were obtained by carried out tensile test. The results for specimens are shown in Table 1.

Table 1: Tensile properties of glassfiber reinforced Composites.

Fiber orientation	Tensile Strength (MPa)	Tensile Modulus (GPa)	Elongation
(0,0,0,0)	511.09	6.06	11.24
(0, ±45, ±45,0)	278.71	3.95	9.44
(±45,±45,±45,±45)	68.08	1.48	22.06



### Figure 5: Fracture Specimens

When FGRC are designed, the fibers are always oriented in load direction. The study results shows that the properties of FGRS are depending on the fiber orientation as explain below.

- i) From the results, it clearly shows that the fiber orientation with (0,0,0,0) have a superior value in tensile strength compared to sample (0, ±45, ±45,0) and (±45, ±45,±45,±45).
- ii) Elongation of sample with direction (±45,±45,±45,±45) shows higher value than the others.
- iii) The fracture specimen shows that the sample (±45,±45,±45,±45) is break in 45 degree direction.

## 4.0 Conclusions

The experimental study used for analysis of tensile properties of FGRC lead to the following conclusions.

- i) The presence of UD stitched glass increased the tensile properties of the FGRC.
- ii) More load is required to fracture the specimen (0,0,0,0).

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## O5 - Formation of Porous Anodic Oxide Films for Structured Nanocatalysts System

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### **Abstract**

*The main aim of this project is to synthesize the porous nanostructure of alumina to be used as catalyst support for ammonia production. The porous alumina nanostructures were obtained by electrochemical anodization process. The electrochemical anodization is done using 0.5 M oxalic acid electrolyte with various anodization time at 10, 20, 30 and 60 min respectively. The aluminum (Al) foil will be anodized in a standard two electrode bath. Voltage, pH and temperature at 5°C are controlled to ensure the optimum formation of porous alumina nanostructures is achieved. Field emission scanning electron microscope (FESEM) reveals the porous alumina nanostructures are formed. X-ray diffraction (XRD) pattern shows the amorphous structure of formed alumina.*

**Keywords:** *Anodic aluminum oxide, porous alumina*

### **1.0 Introduction**

Among porous materials, anodic aluminum oxide (AAO) grown on aluminum in certain electrolytes has been of increasing interest as it possesses a unique, self-organized, nano-sized, high aspect ratio, highly ordered structures, tuneable porous structure suitable for creating different kinds of oriented fields [1,2] as a key material for fabrication of devices on a nanometer scale, such as electronic and photoelectronic devices, and for application to micro and ultrafiltration [3]. Furthermore, the dimensions of pores in anodic alumina templates, such as diameter, length and density can be controlled by varying the anodizing conditions [4].

Usually for AAO synthesis via anodisation process, the electrolyte usually keeps at very low working temperature, 0-5°C. The reason is to reduce the dissolution rate of alumina during anodisation process [5]. As reported by Shakhshiri [6], if anodisation process is done at low temperature between -5°C to 5°C, a hard oxide coating is formed and its getting softer if anodize take place at a higher temperature between 20°C to 30°C. Other reasons to keep the temperature lower such as lower than room temperature are to prevent oxide structure from being dissolved in acidic electrolytes and to avoid a local heating at the bottom of the pores during course of anodization. Local heating can cause inhomogeneous electric field distribution at the bottom and leads to local electrical breakdown of the oxide. So, without temperature control, the oxide films will be cracked or burst.

Common electrolytes that used to anodize aluminum were sulfuric acid, oxalic acid and phosphoric acid. But the most stable electrolyte was oxalic acid because it easy to control with moderate voltage of ~ 40 V at wide temperature ranges of 0 to 24 °C [7]. A highly

ordered nanostructures [8] and thin layer formation of dense aluminum oxide can be obtained with carefully controlled anode of aluminum in an acidic electrolyte [9]. As reported by Choi et al. [10], in some cases, oxalic acid solutions were used instead of phosphoric acid since it is more acidic.

In this study, we investigated the formation of porous alumina in oxalic acid electrolyte at low temperature, 5°C, with constant potential at 40 V. The effect of anodization time was investigated in order to determine the length of porous oxide layer formation. The transition from a barrier type film to porous oxide occurs easily as anodizing time is a key factor responsible for the development of porous oxide structure on previously formed barrier type film.

## 2.0 Experimental Work

Aluminum foils (purity 99.85%) with dimension of 10 mm x 50 mm and thickness of 0.3 mm (Shanghai Mingbao Metal Materials Company) were cleaned by sonication in acetone, ethanol and rinsed with deionized water for pre cleaning process.

The aluminum foils as working electrode was anodized in electrolytes, 0.5 M oxalic acid solution under the constant potential of 40 V applied to the foils. The anodization process was carried out at various time, 10, 20, 30 and 60 min. The platinum electrode was used as the counter electrode. The distance between working and counter electrodes was kept at 40 mm. The temperature of electrolyte was kept at low temperature at 5°C by putting the biquer into a basin contain ice cubes. The magnetic stirrer was used to ensure the homogeneity of the electrolyte and to control the working temperature. Reported by Song et al. [11], highly ordered porous anodic alumina films assisted by pretexturing were mostly formed in oxalic solutions at potentials of 40-80 V. It is because oxalic acid is used for medium potential ranges. The sweep rate was kept at 0.1 V/s. Then, the anodized sample will be cleaned immediately with ethanol and followed by rinse with DI water.

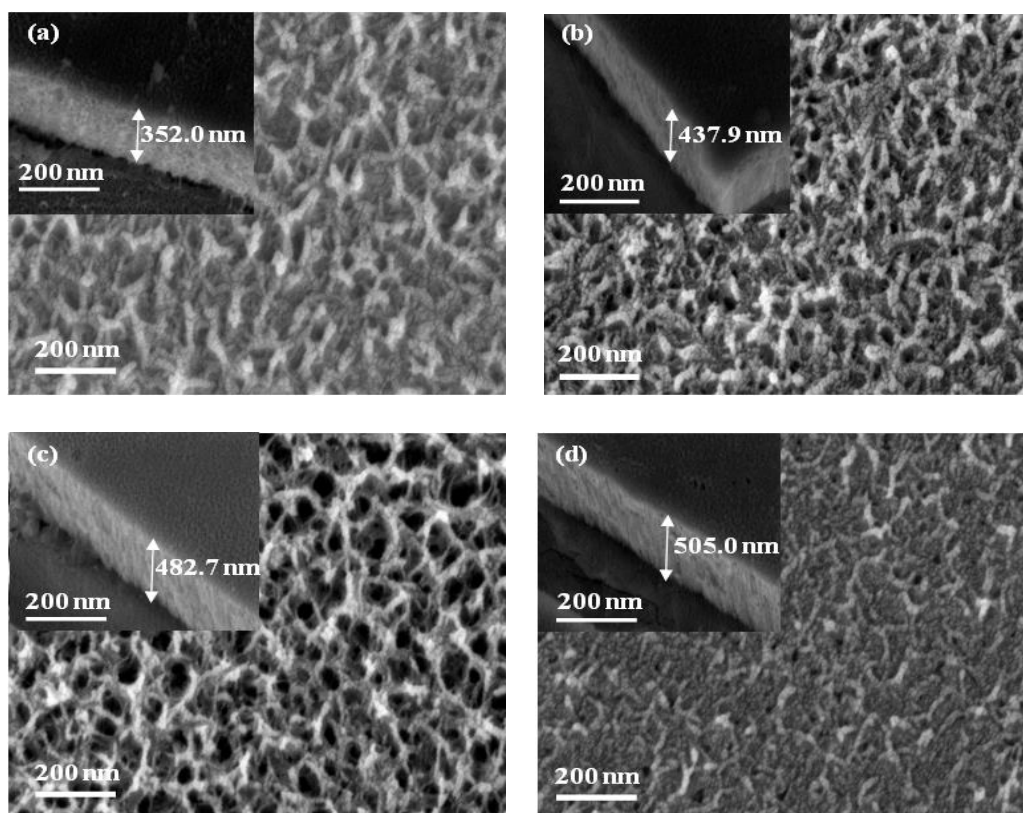
The morphology of anodized samples was observed using a field emission scanning electron microscope (FESEM), Variable Pressure Zeiss Supra 35. The films were characterized by X-ray diffraction (Bruker AXS D8 Advanced) using monochromatic Cu-K radiation.

## 3.0 Result & Discussion

### 3.1 Morphology Analysis

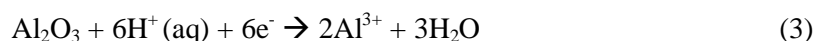
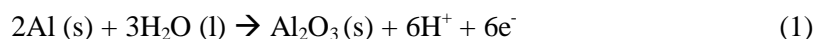
Figure 1 shows FESEM images of porous alumina with different anodization time. At the beginning 10 minutes of anodization, the porous oxide layer is still short or too thin, but the pattern of porous structure still can be seen as shown in Figure 1 (a). The similar pattern also remains to Figure 1 (b). At 30 minutes of anodization, the porous structure is seen as shown in Figure 1(c). But, when the duration is increased up to 60 minutes of anodization, the FESEM image was unclear as shown in Figure 1(d). It is anticipated that, if the porous oxide layer is too long, it will be peel off or crack at certain location due to electrochemical etching at the bottom part. So, an oxidation is continuously occur which produce H<sup>+</sup> contents. The excessive production of H<sup>+</sup> contents, leads to local acidification which cause porous oxide layer to collapse.





**Figure 1:** Surface morphologies of anodized aluminum in 0.5 M oxalic acid solution with voltage of 40V at low temperature, 5°C with different anodization time (a) 10 minutes; (b) 20 minutes; (c) 30 minutes; and (d) 60 minutes. Insets are the cross-sectional morphologies of the similar sample.

As expected, the length of the oxide layer increased as the time of anodization process is increased. The initial length at 10 minutes of anodization was 352.0 nm. It increased to 437.9 nm at 20 minutes to 482.7 nm at 30 minutes to 505.0 nm at 60 minutes. As reported by other authors, the growth of oxide layer takes place at the metal/oxide interface at the pore bottoms. It involves the conversion of a preexisting, naturally occurring film on the surface into the barrier type film and further into a porous oxide layer. During the growth of porous oxide, a thin and compact barrier layer at the pore bottom/electrolyte interface is continuously dissolved by locally increased field. Due to this, a new barrier layer at the metal/oxide interface is rebuilt. The oxide growth at the anode electrode (reaction 1) and hydrogen evolves at the cathode (reaction 2) in electrochemical anodization can be explained as below:

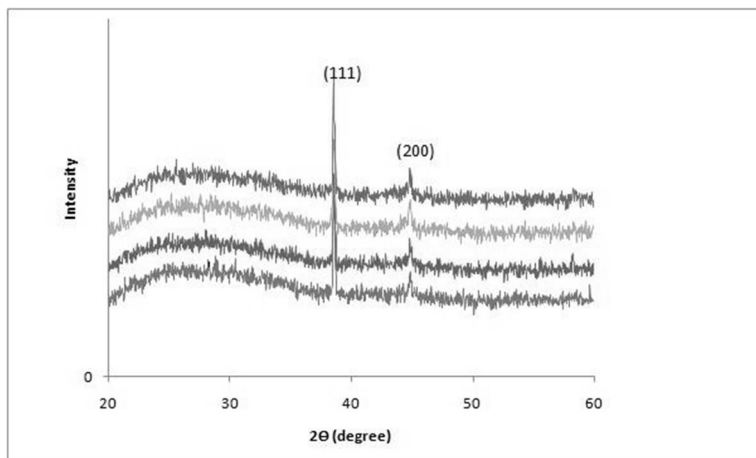


According to reaction (1), as anodization occurs, the alumina will be formed together with the formation of  $\text{H}^+$ . As reported by Li, pore growth may be due to a field-assisted hydrogen ion attack on the oxide layer, so the hydrogen ion attack must be fundamental to

pores nucleation and development [12]. The increase in the  $H^+$  would reduce the pH locally inside the pores, accelerating the chemical dissolution process (reaction 3). The chemical dissolution process will produce  $2Al^{3+}$ .

For pores formation mechanism, the barrier film which consists of non-conductive oxide covers the entire surface of the aluminum at the beginning of the anodization process. The electric field is focused locally on fluctuations of the surface and leads to field enhanced dissolution in the formed oxide, hence to the pores growth.

### 3.2 X-ray Diffraction Spectra



**Figure 2:** XRD pattern of anodized aluminum at varying anodization time (a) 10 min; (b) 20 min; (c) 30 min and (d) 60 min. All samples were anodized at 40 V in 0.05 M oxalic acid with pH ~2.

The X-ray diffraction spectra of anodized aluminium at 40 V in 0.05 M oxalic acid with temperature of 5°C are illustrated in Figure 2. As seen in the diffraction pattern in Figure 2, anodized aluminum foils are amorphous at 111 and 200 plane which corresponds to 39° and 45° on the  $2\theta$  scale. The patterns produced are similar to all the templates fabricated at various time of anodization.

### 4.0 Conclusion

The porous alumina has been successfully prepared in the oxalic acid electrolyte. The surface morphology and cross section appearances of the porous alumina were characterized by using field emission scanning electron microscope (FESEM). The FESEM results indicate that, the length of porous oxide layer/ tubes increased as the time of anodisation process increased.

### 5.0 Acknowledgement

The author would like to acknowledge Advanced Technology Training Centre (ADTEC) Taiping for his study leave concession, Jabatan Perkhidmatan Awam for Hadiah Latihan Persekutuan (HLP) scholarship support, Universiti Sains Malaysia for all the facilities and research support, his PhD supervisor, Assoc. Prof. Dr. Zainovia Lockman for never-ending continues support and all the GeMs research group members.

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## **O6- Kesan Dakwat Cetakan Ke Atas Kertas Jenis *Uncoated, Opaque Coated* dan *Glossy Coated***

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### ***Abstract***

*Dakwat adalah komponen penting dalam melaksanakan dan menghasilkan cetakan yang berkualiti. Terdapat 4 warna asas dalam percetakan Offset Lithography iaitu C-Cyan, M-Magenta, Y-Kuning dan K-Hitam. Dalam percetakan Offset Lithography ini, dakwat akan dicetak ke atas medium yang dipanggil substrate. Substrate merupakan bahan yang digunapakai sebagai tempat imej dicetak. Antara substrate yang digunapakai dalam proses cetakan adalah plastik, kain, filem serta pelbagai jenis kertas. Bagi penulisan kertas persidangan ini, cetakan akan dihasilkan menggunakan kertas, mesin cetak dan dakwat CMYK. Kertas yang akan digunakan adalah berbeza-beza manakala mesin cetak dan dakwat CMYK adalah dari jenis yang sama. Kelainan kertas-kertas yang digunakan adalah berdasarkan kelainan permukaannya sama ada bersalut atau tidak dan sebagainya. Memandangkan penggunaan berlainan jenis kertas membawa kepada kelainan hasil cetakan secara visual dalam kerja-kerja cetakan seharian, ianya telah memberi kami ilham untuk mengkaji kesan penggunaan kertas-kertas ini. Projek ini mengkaji kesan berlainan jenis kertas dalam percetakan Offset Lithography dan kajian dilakukan dengan menggunakan rekabentuk grafik yang sama dan dicetak menggunakan mesin cetak yang sama. Analisis dilakukan pada hasil kerja cetakan mesin dari segi ketumpatan dakwat, pertindihan dakwat dan kesan turutan warna. Alat yang akan digunakan dalam proses analisa adalah Densitometer untuk memastikan data yang diperolehi adalah tepat. Kesimpulan dari kesan penggunaan berlainan kertas dalam cetakan di atas, hasil cetakan menghasilkan kualiti cetakan yang berlainan dari segi pertindihan warna, ketumpatan warna kecerahan warna dan kelekatan warna.*

**Keywords:** *Offset Lithography, substrate, CMYK, Densitometer.*

### **1.0 Pengenalan**

Satu faktor penting yang mempengaruhi kualiti imej untuk percetakan *offset* adalah kuantiti dakwat pada kertas percetakan. Kuantiti dakwat adalah bergantung kepada kombinasi kertas percetakan-mesin percetakan-dakwat.

Kaedah utama dalam analisa dan kawalan dakwat iaitu kaedah berlandaskan *colourimetry*, memperolehi kadar warna untuk C, M, Y dan K berpandukan kualiti ditetapkan di dalam ISO 12647-2: *Offset Lithographic Process*. Ketumpatan dakwat lebih tepat untuk ditentukan bagi sesuatu proses di mana mesin, dakwat dan kertas adalah sama. Walaubagaimanapun, pada umumnya, ketumpatan sesuatu dakwat tidak menentukan ketepatan sesuatu warna. Oleh demikian, tujuan ISO 12647-2 kadar pantulan ketumpatan dakwat adalah kaedah yang paling sesuai dalam menentukan sesuatu ton warna. Berpandukan

ISO 13656, hasil pengeluaran oleh seorang operator mesin akan dinilai berdasarkan cetakan warna. Bacaan ketumpatan warna *solid* akan diambil sebagai helaian 'OK'. Kemudian ketumpatan ini akan dijadikan rujukan untuk mengawal kualiti pengeluaran. Berdasarkan ISO 12647-2, faktor utama untuk menentukan dakwat ialah *colourmetry*, dan pengukuran ketumpatan menggunakan densitometer dijadikan sebagai informasi untuk rujukan sahaja.

## 2.0 Objektif dan Metodologi

Objektif utama kajian ini adalah untuk kenalpasti dan membuat perbandingan kesan dakwat Cyan, Magenta, Kuning dan Hitam ke atas kertas jenis *uncoated*, *opaque coated* dan *glossy coated*.

Ketiga-tiga jenis kertas ini adalah kertas yang biasanya digunapakai dalam percetakan.

### 1) Sifat Kertas

Kertas yang digunakan bagi tujuan cetakan mempunyai pelbagai jenis. Bagi kertas *uncoated*, *opaque coated* dan *glossy coated*, masing-masing ditentukan berdasarkan rata permukaannya. Bagi kertas yang mempunyai permukaan yang rata, ia mempunyai permukaan yang seragam. Bagi kertas yang mempunyai permukaan yang kasar, sifatnya adalah tidak rata. Semakin rata permukaan kertas, hasil cetakan akan lebih baik. Bagi menambah atau mengurangkan sifat rata permukaan kertas dua cara diaplikasikan iaitu melalui kemasan mekanikal (melicin) dan kemasan lapisan kertas (*coating*). Bagi sesetengah kertas, ada yang mempunyai sifat tidak serap dakwat cetakan. Atas sebab sifat yang terdapat pada permukaannya menyebabkan ia perlu diberi perhatian yang lebih ketika kerja-kerja cetakan dilakukan. Antara kertas yang tidak serap dakwat cetakan adalah kertas stiker, *polymer* dan *coated paper*. *Tracing paper*, *chromo coated paper* dan *parchment paper* juga mempunyai sifat yang sama.

Dua kriteria penting yang mempengaruhi sifat cetakan adalah sifat semula jadi kertas, bergantung kepada sifat permukaan dan liang yang terdapat pada permukaan kertas tersebut. Liang yang terdapat pada permukaan kertas membantu sifat kebolehcetakan. Liang-liang ini yang menentukan jumlah serapan dakwat dan terbahagi kepada dua sifat iaitu saiz liang dan bilangan liang. Semakin besar dan semakin banyak liang yang terdapat atas kertas, kebolehan kertas tersebut untuk menyerap dakwat cetakan akan bertambah. Ini seterusnya memudahkan dakwat untuk kering dengan cepat bagi setiap cetakan.

### 2) *Tone Value Increase (TVI)* dan *Density*

*Tone Value Increase (TVI)* ditarifkan sebagai peningkatan dalam diameter dot tengah semasa pra-cetak dan proses percetakan. Jumlah dapatan dot dan perbezaan antara saiz dot pada filem negatif dan sama saiz dot bahan cetak. Sebagai contoh, corak dot yang meliputi 30% daripada kawasan imej di dalam filem, tetapi meliputi 50% apabila dicetak, inilah menunjukkan peningkatan dot sebanyak 20%. Walau bagaimanapun, dengan sistem pengimejan komputer ke plat hari ini, di mana filem sudah tidak digunakan lagi, dot pada filem tidak lagi menjadi rujukan. Oleh itu, perbandingan jumlah dapatan dot kini diukur sebagai dot digital dengan dot pada hasil cetakan.

*Density* adalah ketumpatan dakwat yang dipengaruhi oleh pewarna yang terdapat dalam dakwat. Ketumpatan sesuatu dakwat akan menghasilkan warna yang berbeza.

**Jadual 1:** *Typical Values* dalam *Offset Press Densitometers (Polarization Filter)*

<b>Colour</b>	<b>Types of Paper</b>	<b>Solid Density</b>	<b>Dot Gain (70%)</b>
Cyan (C)	<i>Uncoated</i>	1.20 ± 0.05	16 ± 3
	<i>Opaque Coated</i>	1.35 ± 0.05	
	<i>Glossy Coated</i>	1.45 ± 0.05	12 ± 3
			10 ± 3
Magenta (M)	<i>Uncoated</i>	1.15 ± 0.05	16 ± 3
	<i>Opaque Coated</i>	1.30 ± 0.05	
	<i>Glossy Coated</i>	1.40 ± 0.05	12 ± 3
			10 ± 3
Yellow (Y)	<i>Uncoated</i>	1.10 ± 0.05	16 ± 3
	<i>Opaque Coated</i>	1.25 ± 0.05	
	<i>Glossy Coated</i>	1.35 ± 0.05	12 ± 3
			10 ± 3
Black (K)	<i>Uncoated</i>	1.60 ± 0.10	16 ± 3
	<i>Opaque Coated</i>	1.75 ± 0.10	
	<i>Glossy Coated</i>	1.80 ± 0.10	13 ± 3
			11 ± 3

### 3.0 Ujikaji dan keputusan

Eskperimen ini telah dijalankan di ILPAPNT iaitu di bengkel percetakan. Ia melibatkan mesin Speedmaster 102-4 iaitu mesin cetak 4 warna. Plat yang digunakan untuk eksperimen ini adalah dihasilkan menggunakan mesin komputer ke plat iaitu Heidelberg Suprasetter. Jenis plat adalah *thermal* plat yang bersaiz 790mm x 1090mm mempunyai ketebalan 0.3mm. Jenama plat adalah Kodak Sword Ultra.

Jenis-jenis kertas yang digunakan dalam eksperimen ini adalah kertas *uncoated* iaitu simili 80gsm, *opaque coated* iaitu *matt coated* 100 gsm dan *glossy coated* iaitu *glossy coated* 100gsm. Jenis dakwat yang digunakan dalam eksperimen ini adalah jenis DIC iaitu dakwat proses untuk 4 warna : Cyan (C), Magenta (M), Kuning (Y) dan Hitam (K).

Alat pengukuran untuk mendapatkan keputusan eksperimen adalah Densitometer jenama Xrite model Superdot 528.

**Jadual 2:** Alatan dan Bahan Eksperimen.

BIL	BAHAN/ALATAN	SPESIFIKASI
1	Dakwat CMYK	Jenama DIC, Dakwat proses.
2	<i>Plate</i>	Saiz: 790 mm x 1090 mm, Ketebalan 0.3 mm, Kodak Sword Ultra, CTP Suprasetter
3	Kertas <i>Uncoated</i>	80 gsm, Simili
4	Kertas <i>Opaque Coated</i>	100 gsm, <i>Matt Coated</i>
5	Kertas <i>Glossy Coated</i>	100 gsm, <i>Glossy Coated</i>
6	Mesin 4 Warna	Speedmaster 102
7	Densitometer	Xrite, Superdot 528

Prosedur yang dilaksanakan adalah seperti berikut:

- i) Memilih objek atau imej yang bersesuaian untuk mencetak.
- ii) Imej yang dipilih dibuat penambahbaikan sebelum plat dihasilkan. Proses pecahan warna kepada CMYK adalah amat penting supaya dot yang dihasilkan pada plat adalah tepat.
- iii) Plat dihasilkan menggunakan mesin Suprasetter menggunakan sistem komputer ke plat.
- iv) Sebanyak 4 plat iaitu C,M,Y dan K dihasilkan untuk cetakan.
- v) Kerja mencetak imej dilaksanakan dengan menggunakan kertas jenis *glossy coated* 100 gsm, *opaque coated* 100 gsm dan *uncoated* simili 80 gsm.
- vi) Kuantiti untuk setiap jenis kertas adalah sebanyak 1000 keping.
- vii) Kadar dakwat cetakan untuk setiap jenis kertas adalah sama dan menggunakan plat yang sama.

Keputusan yang diperolehi dari hasil cetakan adalah seperti jadual di bawah:

1) Ketumpatan

**Jadual 3:** Keputusan ketumpatan dakwat

	<b>Cyan (C)</b>	<b>Magenta (M)</b>	<b>Yellow (Y)</b>	<b>Black (K)</b>
<i>Uncoated</i>	0.78	0.78	0.57	1.05
<i>Opaque Coated</i>	1.33	1.23	0.83	1.51
<i>Glossy Coated</i>	1.40	1.27	0.84	1.66

2) *Tone Value Increase (TVI)*

**Jadual 4:** Keputusan *Tone Value Increase (TVI)*

	<b>Cyan (C)</b>	<b>Magenta (M)</b>	<b>Yellow (Y)</b>	<b>Black (K)</b>
<i>Uncoated</i>	15%	14%	13%	19%
<i>Coated Matt</i>	14%	13%	9%	14%
<i>Coated Glossy</i>	12%	11%	10%	14%

## 4.0 Perbincangan

1) Kertas '*Uncoated*'

Kertas '*uncoated*' sesuai untuk mencetak teks panjang, kemudahbacaan yang baik kerana jumlah cahaya yang dibiaskan adalah kurang. Ia menyerap dakwat lebih daripada kertas '*opaque coated*', menyebabkan nilai '*print contrast*' yang rendah dan hasil percetakan untuk penerbitan yang mempunyai banyak kesan grafik. Secara amnya kos kertas '*uncoated*' adalah murah berbanding kertas '*opaque coated*'.

2) Kertas '*Opaque Coated*'

Bahan percetakan seperti majalah, laporan, kad ucapan dan dokumen yang banyak mempunyai imej grafik sesuai menggunakan kertas '*Opaque Coated*'. Intensiti '*color reproduction*' pada jenis kertas ini agak kurang namun begitu kesan '*smudge*' kurang berbanding '*glossy*'. Cahaya yang dibiaskan masih rendah menyebabkan kebolehbacaan yang baik.



### 3) Kertas 'Gloss'

Kertas percetakan 'glossy' sesuai untuk penerbitan majalah fotografi atau majalah fesyen berprestij. Bahan-bahan dengan kandungan yang sangat visual, atau banyak gambar-gambar resolusi tinggi. Permukaan adalah sangat berkilat dan sangat reflektif, yang memerlukan kawasan yang lebih kecil teks atau pilihan jenis huruf besar (dikenali sebagai fon). Kekurangan kertas percetakan berkilat termasuk *smudges*.

## 5.0 Kesimpulan

Kesan berbeza ke atas menjadikan pemilihan kertas faktor yang penting untuk sesuatu penerbitan. Hasil yang dapat dilihat secara visual mahupun pengukuran. Faktor penting seperti 'tone value' dan 'tone values increase' bukan sahaja membantu, malahan amat penting bagi menghasilkan cetakan yang sempurna. Pilihan jenis substrat sama ada 'uncoated', 'opaque coated' atau pun 'glossy' memberi kesan berbeza ke atas penerbitan seperti risalah, brosur, kad perniagaan dan lain-lain penerbitan. Selain dari faktor kemasan yang disebutkan di atas pilihan lain seperti jenis substrat kertas bajet atau 'eco-friendly' saiz dan berat yang diukur dalam *grammage* meter persegi (gsm) turut menyumbang dalam sesuatu percetakan.

## 6.0 Rujukan

- [1] Handbook of Print Media, Technologies and Production Methods, Helmut Kipphan (Ed.)
- [2] ISO 12647-2:2004E Graphics technology 6Process control for the production halftone colour separations, proof and production prints.

## **O7 - Kesan Pembelajaran Berasaskan Masalah, Contoh, dan Contoh-Masalah Terhadap Pemerolehan Pengetahuan, Prestasi Pindahan, dan Pelaburan Usaha Mental Pelajar Teknologi Elektrik**

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### **Abstrak**

*Kertas konsep ini bertujuan untuk mencadangkan kajian bagi menentukan kesan-kesan pembelajaran melalui tiga pendekatan yang berbeza; iaitu Pembelajaran Berasaskan Masalah (PBM), Pembelajaran Berasaskan Contoh (PBC) dan Pembelajaran Berasaskan Contoh-Masalah (PBCM) terhadap prestasi akademik pelajar di dalam domain Teori Litar. Secara khusus, kajian ini menumpukan perbandingan kesan-kesan pembelajaran terhadap pemerolehan pengetahuan, prestasi pindahan dekat dan pindahan jauh, dan kecekapan pembelajaran yang berkait dengan hubungan pencapaian pembelajaran dan jumlah usaha mental yang dilaburkan. Peserta yang terpilih akan diagihkan secara rawak kepada tiga kumpulan eksperimen, iaitu, kumpulan PBM, kumpulan PBC dan kumpulan PBCM. Ujian pra-pos pula akan dijalankan untuk mengukur hasil pembelajaran. Usaha mental pula akan diukur sebaik sahaja pelajar selesai fasa pembelajaran dan fasa ujian dengan menggunakan indeks beban tugas multidimensi NASA-TLX. Adalah dijangkakan bahawa kumpulan PBCM akan lebih menerima manfaat terhadap hasil pembelajaran (kecekapan positif) berbanding kumpulan PBM dan PBC, di mana peningkatan pengetahuan dapat dicapai hanya dengan menggunakan usaha mental yang sedikit.*

**Katakunci:** Strategi pembelajaran, teori beban kognitif, kecekapan pembelajaran.

### **1.0 Pendahuluan**

Kebanyakan pensyarah atau pengajar berasa selesa menggunakan kaedah tradisional yang berasaskan õkuliah-latihan-ujianö dalam kebanyakan domain pendidikan tinggi (Brooks, 2009), termasuk dalam TVET. Mereka menganggap pelajar akan dapat memperoleh pengetahuan dan kemahiran penyelesaian masalah, dan seterusnya, menggunakan kemahiran tersebut semasa aktiviti-aktiviti pindahan seperti ujian. Hakikatnya, beberapa penyelidik berjaya membuktikan anggapan tersebut tidak tepat. Kaedah tradisional, di mana pengajar dan buku teks memainkan peranan aktif dalam mempersembahkan dan menerangkan bahan yang hendak dipelajari (Zhu & Simon, 1987), telah dikenalpasti oleh sebagai punca yang menyebabkan pelajar cepat bosan dan hilang minat dalam pembelajaran. Kaedah tersebut juga dipercayai kurang menumpukan kepada pembangunan skema yang menyebabkan pembelajaran menjadi tidak berkesan (Darabi *et al.*, 2006). Pembangunan skema sangat penting kerana skema merupakan struktur pengetahuan dalam ingatan jangka panjang yang membolehkan pelajar mengenal pasti masalah dan menentukan langkah paling sesuai untuk menyelesaikannya (Kalyuga *et al.*, 2001). Tambahan pula, pengajaran dan pembelajaran

(P&P) dalam teknologi dan kejuruteraan melibatkan banyak kemahiran proses sains dan manipulatif, memerlukan daya pemikiran, kreativiti dan kefahaman konsep yang tinggi.

## 2.0 Latar Belakang Kajian

Hasil kajian yang dijalankan oleh Awang *et al.*, (2007) ke atas program kemahiran pendawaian elektrik di salah sebuah ILP mendapati kaedah P&P tradisional kurang berkesan dalam mencapai objektif menyediakan tenaga kerja yang memenuhi kehendak pasaran. Dapatan ini disokong oleh maklum balas yang diberikan oleh pelajar-pelajar ADTEC, yang mendapati isu berkaitan dengan pembelajaran menyumbang kepada kegagalan menguasai kemahiran dan teori sesuatu subjek (JTM, 2006). Salah satu punca mengapa tiada peningkatan yang tinggi terhadap pengetahuan dan kemahiran pelajar ADTEC adalah disebabkan oleh teknik penyampaian pembelajaran yang lemah (JTM, 2006).

Situasi ini menjadi lebih kritikal dengan keupayaan pelajar aliran kemahiran yang biasanya dikaitkan dengan pencapaian akademik yang lemah. Menurut Stark (2004), pelajar aliran kemahiran mempunyai masalah dalam mengaplikasikan konsep formal dalam domain yang melibatkan pengiraan kepada situasi yang sebenar. Walaupun dalam domain pengiraan yang agak mudah dan berstruktur, pelajar aliran kemahiran tetap sukar untuk memahami maksud pemboleh ubah dan prinsip-prinsip yang berkaitan (Stark, 2004). Sebagai peneraju utama dalam latihan kemahiran, perkara tersebut tentunya menjadi satu cabaran yang paling besar buat ADTEC dalam misinya menjadi penyumbang tenaga kerja yang berdaya saing negara. Berdasarkan kepada faktor-faktor tersebut, ADTEC perlu berusaha untuk mempertingkatkan imej dan kualiti perkhidmatan latihan kemahiran bagi memenuhi keperluan tenaga kerja mahir negara (JTM, 2009). Anjakan paradigma P&P dari kaedah tradisional kepada gaya pembelajaran yang lebih inovatif sangat perlu terutama dalam pendidikan teknologi dan kejuruteraan yang merupakan kunci kepada transformasi dalam melahirkan tenaga kerja mahir yang kompeten.

Beberapa penyelidik mencadangkan Pembelajaran Berasaskan Masalah (PBM) sebagai strategi yang berkesan dalam membangunkan pemerolehan pengetahuan pelajar dari segi konsep dan prinsip (Bilgin, Senocak, & Sozbilir, 2009). Walaupun demikian, PBM bukan sentiasa menjadi penyelesaian yang terbaik, terutama kepada pelajar yang tiada pengetahuan dalam domain (Lewis, 2008). Tambahan pula, Berkson (1993) merumuskan tiada bukti yang menyakinkan bahawa PBM mampu meningkatkan pencapaian pelajar berbanding kaedah tradisional. Rumusan tersebut adalah selari dengan beberapa kajian, yang mendapati tiada perbezaan yang signifikan di antara kaedah PBM dan tradisional terhadap pencapaian pelajar (Khan *et al.*, 2007). Dengan bukti-bukti empirikal dari kajian PBM tersebut, ia tidak menunjukkan kesimpulan yang kukuh tentang keberkesanannya.

PBM mengandungi banyak elemen-elemen penyelesaian masalah (contohnya seperti, formula matematik dan teori litar elektrik) menyebabkan kandungan maklumat yang perlu dipelajari menjadi sukar dan mendorong kepada beban kognitif *intrinsic* kepada pelajar novis. Kesukaran (sifat intrinsik) ini memungkinkan pelajar novis untuk cenderung menggunakan strategi yang lemah, seperti *means-ends-analysis* (van Gog, Paas, & van Merriënboer, 2004). Menurut Teori Beban Kognitif (Sweller, 1988), *means-ends-analysis* melibatkan interaksi antara maklumat yang banyak. Interaksi dengan cebisan-cebisan maklumat yang banyak mendorong kepada beban kognitif *extraneous* yang tinggi. Van Gog *et al.*, (2004) menerangkan bahawa beban kognitif *extraneous* merupakan beban yang tidak berkesan terhadap pembelajaran (pembinaan skema) disebabkan oleh pendekatan pembelajaran yang lemah (Sweller, 1994). Situasi ini akan mengakibatkan terlalu banyak elemen yang perlu diproses oleh pelajar novis dalam satu masa sehingga memerlukan usaha mental (*mental effort*) yang tinggi terhadap sistem kognitif (van Gog *et al.*, 2004).

Di atas sebab itu, pelajar novis perlu dibimbing sepenuhnya terutama semasa fasa awal pembelajaran (van Gog, Paas, & van Merriënboer, 2008). Paas, Renkl, dan Sweller (2003) mencadangkan Pembelajaran Berasaskan Contoh (PBC) kerana kaedah ini dijangka mampu mengurangkan beban kognitif *extraneous* yang tidak berkesan semasa pembelajaran. Menurut Renkl dan Atkinson (2003), PBC merupakan model penyelesaian masalah yang dibangunkan oleh pakar terdiri daripada tiga komponen: pertama, pernyataan masalah; kedua, langkah-langkah penyelesaian, dan kemudian; ketiga, penyelesaian akhir bagi masalah tersebut. Kelebihan utama PBC adalah ia mengelakkan pelajar dari proses mencari maklumat yang tidak relevan dan membantu mereka untuk menumpukan perhatian mengkaji langkah-langkah penyelesaian masalah yang disediakan, seterusnya menyokong mereka membina skema penyelesaian masalah (Wittwer & Renkl, 2010) dalam ingatan jangka panjang.

Bagaimanapun, kesan positif PBC akan hilang apabila pelajar telah mempunyai pengetahuan dan kemahiran dalam domain yang mencukupi. Terdapat kesan pembalikan ke atas pelajar tersebut sekiranya mereka terus didedahkan dengan strategi PBC, dan fenomena ini dikenali sebagai kesan pembalikan-kepakaran (*expertise-reversal effect*) (Kalyuga, Ayres, Chandler, & Sweller, 2003). Peningkatan kepakaran pelajar akan menyebabkan beban *intrinsic* yang dikenakan terhadap tugas atau masalah yang perlu diselesaikan adalah lebih rendah, sekali gus meninggalkan ruang kognitif yang lebih kepada proses maklumat yang berkaitan dengan tugas atau masalah tersebut. Pelajar pakar mungkin mengetahui maklumat yang diberikan dalam contoh kerja tetapi tidak berusaha ke arah pemahaman yang lebih mendalam menggalakkan proses pembelajaran menjadi pasif (Atkinson & Renkl, 2007). Justeru, Atkinson dan Renkl (2007) menjelaskan bahawa pelajar pakar tidak lagi memerlukan bimbingan seperti yang disediakan melalui PBC, kerana maklumat tersebut dianggap sebagai berulang (*redundant*). Akibatnya, PBC bukan sahaja tidak memberi kesan yang positif dalam pembelajaran, malahan boleh memudaratkan pelajar pakar (Van Gog, Kester, & Paas, 2011).

Kedua-dua strategi PBC dan PBM mempunyai kesan yang positif terhadap hasil pembelajaran apabila dipraktikkan kepada kumpulan pelajar yang bersesuaian (di mana, PBC untuk pelajar novis dan PBM untuk pelajar pakar). Secara teorinya, gandingan PBC dan PBM (PBCM) mungkin akan memberikan kesan yang lebih baik terhadap pembelajaran, terutama dalam topik yang kompleks seperti Teori Litar. Pada peringkat awal pemerolehan kemahiran dan pengetahuan, pelajar novis, mungkin mendapat lebih manfaat daripada PBC, manakala apabila sampai peringkat pakar, pelajar mungkin mendapat manfaat daripada PBM (Reisslein *et al.*, 2006).

### 3.0 Pernyataan Masalah

Teknik penyampaian P&P yang lemah dikenal pasti sebagai punca kegagalan pelajar ADTEC dalam menguasai teori dan kemahiran penyelesaian masalah. Untuk menangani kelemahan tersebut, ramai pendidik mencadangkan pembelajaran aktif seperti PBM. Namun, ada kalanya PBM yang dirasakan sesuai masih tidak mampu meningkatkan prestasi pencapaian kesemua pelajar. Begitu juga keberkesanan PBC yang pada hakikatnya tidak menyeluruh kepada segenap lapisan pelajar. Gabungan PBC dan PBM (PBCM) pula, walaupun secara teorinya mungkin mendatangkan kesan yang positif terhadap pembelajaran, namun secara praktiknya konsep sebegini masih belum diterokai oleh penyelidik. Justeru, tujuan kajian ini adalah untuk membandingkan kesan PBC, PBM, dan PBCM kepada pelajar ADTEC dalam domain Teori Litar terhadap pemerolehan pengetahuan, prestasi pemindahan, pelaburan usaha mental, dan seterusnya, menentukan kecekapan pembelajaran.

## 4.0 Objektif Kajian

- (i) Mengenal pasti kesan PBC, PBM dan PBCM terhadap pemerolehan pengetahuan, prestasi pemindahan dan usaha mental pelajar.
- (ii) Membandingkan kesan antara PBC, PBM dan PBCM terhadap pemerolehan pengetahuan, prestasi pemindahan dan usaha mental pelajar.
- (iii) Membandingkan kesan antara PBC, PBM dan PBCM terhadap kecekapan pembelajaran pelajar.
- (iv) Mencadangkan model pembelajaran yang sesuai bagi modul Teori Litar.

## 5.0 Reka Bentuk Kajian

Kajian akan menggunakan terminologi Campbell dan Stanley seperti yang digambarkan pada Jadual 1 di bawah.

**Jadual 1:** Reka bentuk kajian

E1	O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>
E2	O <sub>3</sub>	X <sub>2</sub>	O <sub>4</sub>
E3	O <sub>5</sub>	X <sub>3</sub>	O <sub>6</sub>

(Adaptasi dari sumber: Campbell & Stanley, 1963)

Petunjuk:- E1, E2, E3 = Kumpulan Eksperimen ; X<sub>1</sub>, X<sub>2</sub>, X<sub>3</sub> = Rawatan ;  
O<sub>1</sub>, O<sub>3</sub>, O<sub>5</sub> = Ujian Pra; O<sub>2</sub>, O<sub>4</sub>, O<sub>6</sub> = Ujian Pasca

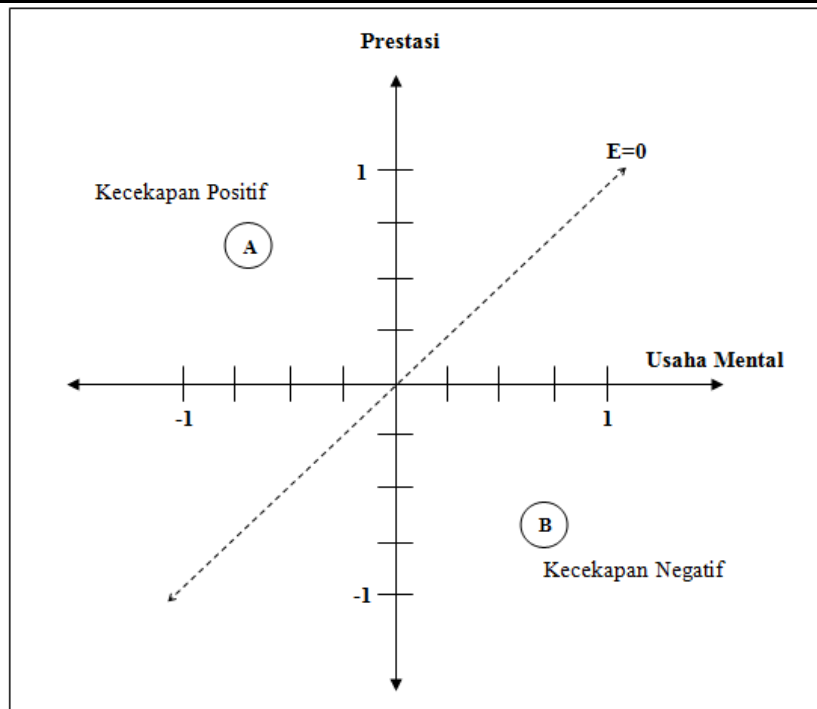
## 6.0 Pengukuran

Untuk mengukur pemboleh ubah-pemboleh ubah kajian, pelbagai sumber dicadangkan dan ringkasan adalah seperti yang ditunjukkan di Jadual 2. Ujian pra dan pasca akan dibangunkan untuk mengukur hasil pembelajaran, manakala usaha kognitif akan diukur menggunakan indeks beban tugas NASA (NASA-TLX) yang dibangunkan oleh Hart dan Staveland (1988). Kecekapan pembelajaran pula ditentukan dengan menggunakan formula yang dicadangkan oleh Paas dan van Merriënboer (1993). Menurut mereka, sekiranya skor prestasi dan skor usaha mental adalah sama, kecekapan adalah sifar. Skor di atas garisan asas di sudut atas kiri graf (kawasan A) ditakrifkan pula sebagai mempunyai kecekapan positif kerana menunjukkan prestasi yang lebih baik dengan usaha mental yang sedikit. Sebaliknya, di sudut bawah kanan graf (kawasan B) mempunyai kecekapan negatif kerana ia menunjukkan prestasi yang rendah dengan usaha mental yang tinggi (lihat, Rajah 1).

**Jadual 2:** Bentuk pengukuran

Pemboleh Ubah	Instrumen/Kaedah	Sumber
Pemerolehan Pengetahuan	Ujian Soalan Aneka Pilihan (Konsep, Prinsip dan Prosedur)	Dibangunkan oleh penyelidik
Prestasi Pemindahan	Ujian Prestasi Pemindahan (Dekat dan Jauh)	Dibangunkan oleh penyelidik
Pelaburan Usaha	Indeks beban tugas	Adaptasi dari Hart dan

Mental	(NASA-TLX)	Staveland (1988)
Kecekapan Pembelajaran	Ukuran relatif kecekapan pembelajaran	Adaptasi dari Paas dan Van Merriënboer (1993); dan Paas <i>et al.</i> (2003)



(Adaptasi dari sumber: Paas *et al.*, 2003)

**Rajah 1:** Graf kecekapan pembelajaran

## 7.0 Kesimpulan

Adalah dijangkakan bahawa PBCM lebih memberi manfaat (kecekapan positif) berbanding pembelajaran hanya dengan PBM sahaja atau PBC sahaja kepada pelajar ADTEC dalam domain Teori Litar. Ini disebabkan kaedah PBCM dapat membantu pelajar untuk menguasai skema penyelesaian masalah dan pada masa yang sama kaedah tersebut dapat mengurangkan beban kognitif, terutamanya beban kognitif *extraneous* yang tidak mendatangkan faedah terhadap peningkatan pencapaian akademik pelajar.

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## O8 - Kajian Kesalahan Disiplin Pelajar Politeknik Merlimau

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### **Abstrak**

*Kajian ini dijalankan adalah untuk mengesan satu paten kesalahan disiplin dan jenis kesalahan yang sering dilakukan oleh pelajar bagi merancang dalam meningkatkan tahap dan mutu disiplin pelajar dengan lebih berkesan. Data kajian ini diperolehi daripada data disiplin dan sahsiah rupa diri pelajar yang diperolehi daripada Jabatan Hal Ehwal dan Pembangunan Pelajar, JHEPP dari tahun 2009 hingga 2012. Hasil dapatan telah dianalisis menggunakan perisian Statistical Package for the Social Sciences (SPSS) 17.0 bagi mendapatkan kekerapan, peratusan dan min data. Dapatan data dipersembahkan dalam bentuk jadual dan grafik dengan menggunakan perisian Microsoft Excel. Dapatan kajian mendapati pada tahun 2009 menunjukkan 5.9% pelajar melakukan salah laku disiplin berbanding enrolmen pelajar pada tahun tersebut, meningkat kepada 9.4% pada tahun 2010, dan 13.4% pada tahun 2011 dan penurunan kepada 11.3% pada tahun 2012. Selain daripada itu, dapatan kajian juga menunjukkan bahawa paten yang terhasil adalah dipengaruhi jumlah kesalahan dan tindakan yang di ambil pada tahun sebelumnya kecuali bagi Jabatan Kejuruteraan Elektrik yang menunjukkan peningkatan secara konsisten melainkan pada tahun terakhir kajian. Secara keseluruhan kajian ini telah berjaya mengesan paten yang terhasil di mana ia membantu Jawatankuasa Disiplin Politeknik dalam merancang wacana pengurusan dan perlaksanaan dalam mengatasi permasalahan ini dengan mempertingkatkan pembentukan modal insan melalui kokurikulum AR101 polibridged dan penubuhan Jawatankuasa khas iaitu Jemaah Nazir bagi Politeknik Malaysia dalam mencapai prinsip global.*

**Katakunci :** *disiplin, analisis, notis denda dan saman*

### **1.0 Pengenalan**

Berdasarkan Rekod Notis Denda Kesalahan Hukuman Tatatertib Terus dan Borang Aduan Disiplin Pelajar (Borang KD-1) menunjukkan peningkatan kesalahan disiplin setiap tahun. Kesalahan ini lazimnya dikategorikan kepada dua kesalahan utama iaitu disiplin dan sahsiah rupa diri yang melibatkan masalah disiplin rambut (panjang/ terbiar/ mewarna dll), Kad Pelajar (tidak dipamirkan/palsu dll), Pakaian (tidak berkolar/ ketat/ bertampal dll), Kasut (sandal/selipar dll) Aksesori (rantai/ gelang bagi pelajar lelaki dll) Kesalahan Lain-Lain / Luar Biasa (kesalahan melibat pihak luar/dalam di bawah akta 174). Peningkatan ini telah menimbulkan satu persepsi atau andaian tanpa usul periksa dan boleh mencemaskan pensyarah pada masa akan datang jika tidak ditangani dengan baik dan seterusnya bakal merosakkan Sistem Pengurusan Disiplin Pelajar Politeknik Merlimau kelak. Kajian ini boleh digunakan untuk mengambil langkah-langkah yang perlu bagi memperbaiki program-



program pembentukan sahsiah diri agar sistem pengajian politeknik akan dapat memberi sumbangan yang lebih berkesan dalam meningkatkan mutu modal insan pelajar.

## 2.0 Objektif Kajian

Mengesan satu bentuk paten kesalahan disiplin yang kerap dilakukan oleh pelajar Politeknik Merlimau. Bentuk paten kesalahan ini penting untuk menilai kesan terhadap kesalahan disiplin yang dilakukan sebagai satu landasan kepada Jawatankuasa Disiplin Politeknik Merlimau, JKDP dalam menilai keberkesanan program dan aktiviti disiplin yang telah dilaksanakan serta merancang program dan aktiviti disiplin yang lebih relevan pada masa akan datang.

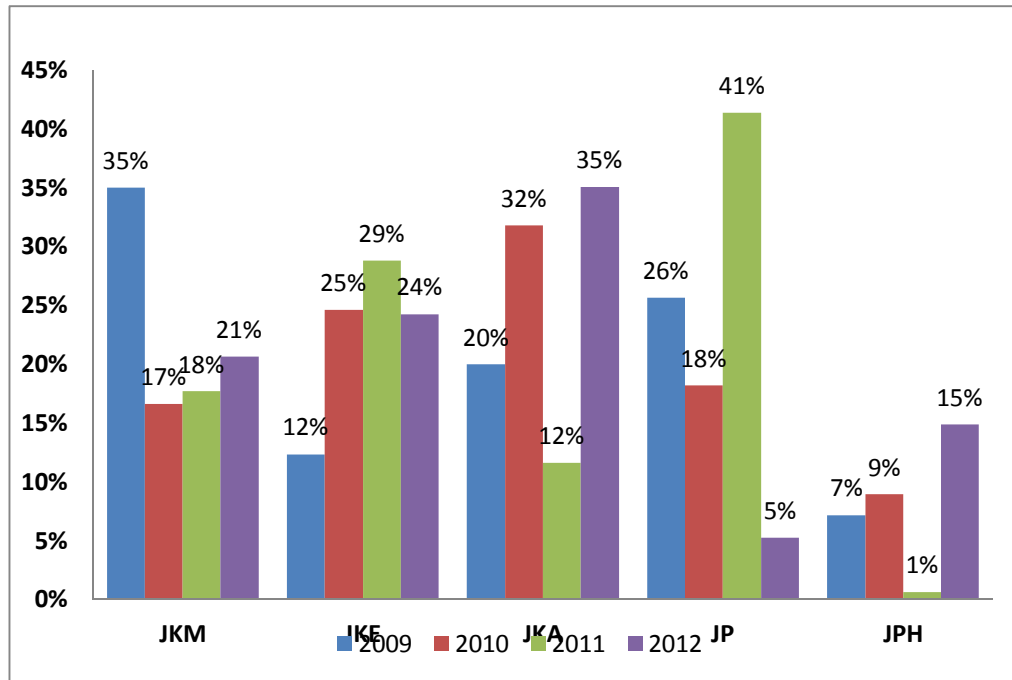
## 3.0 Metodologi

Populasi kajian terdiri daripada data-data sekunder rekod kesalahan disiplin Politeknik Merlimau dari tahun 2009 hingga 2012. Kajian ini meliputi beberapa aktiviti disiplin seperti pemeriksaan mengejut disiplin dan sahsiah rupadiri pelajar sebanyak 4 kali setahun, pemantauan bulanan secara berkala, borang aduan salah laku disiplin pelajar dan aktiviti-aktiviti pemantauan secara *ad hoc* dengan melibatkan lebih 6000 pelajar. Beberapa item dalam notis denda kesalahan disiplin (Kaedah 26A) dan kesalahan lalulintas seperti klasifikasi jabatan dan kesalahan diisi menggunakan kod. Laporan keputusan hasil kajian yang telah dianalisis adalah merujuk kepada item-item di dalam notis denda kesalahan dan mengikut format yang ditetapkan. Perbincangan yang dibuat di akhir kajian ini merangkumi pelbagai aspek melibatkan jangkaan tingkahlaku pelajar yang bakal tamat pengajian pada tahun-tahun ke hadapan. Hasil kajian ini diharapkan dapat membantu Politeknik Merlimau untuk membuat penilaian satu bentuk '*patten*' kesalahan disiplin yang kerap di lakukan oleh pelajar pada masa akan datang, seterusnya merancang ke arah meningkatkan kualiti modal insan dalam sektor pendidikan politeknik dibawah Kementerian Pengajian Tinggi Malaysia. Kajian ini dilaksanakan dengan bantuan perisian *Statistical Package for the Social Sciences (SPSS 17.0)* dalam mendapatkan analisa yang dan *Microsoft Excel* juga digunakan dalam penyediaan laporan dan grafik yang diperlukan.

## 4.0 Analisis Dapatan

### Bahagian A: Analisis Bilangan Kesalahan Disiplin

Secara keseluruhannya kebanyakan peningkatan peratusan kesalahan pelajar Politeknik Merlimau berlaku di Jabatan Kejuruteraan seperti Jabatan Kejuruteraan Mekanikal, Jabatan Kejuruteraan Elektrik dan Jabatan Kejuruteraan Awam. Ketiga-tiga Jabatan Kejuruteraan berkenaan menyumbang 58% hingga 80% kesalahan disiplin di Politeknik Merlimau setiap tahun berkenaan. Namun begitu jika dilihat melalui peningkatan kesalahan yang dilakukan dari tahun ke tahun menunjukkan bahawa terdapat satu paten yang ketara bagi kesemua jabatan akademik iaitu jika pada tahun pertama terdapat kesalahan yang banyak maka tahun berikutnya akan mengurang. Ini jelas dapat dilihat daripada rajah 1 yang menunjukkan paten kesalahan pelajar dipengaruhi oleh jumlah saman yang telah dikeluarkan atau pun operasi disiplin yang telah dijalankan. Begitu juga sebaliknya, jika saman atau operasi kurang maka akan berlaku peningkatan kesalahan pada tahun berikutnya.

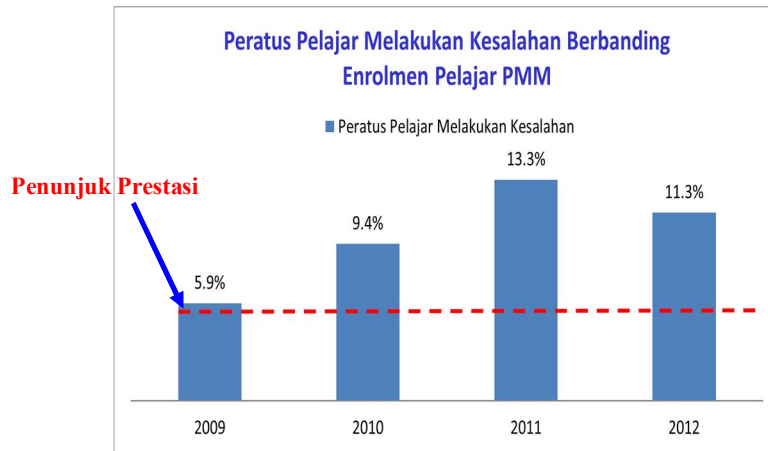


**Rajah 1:** Peratusan Kesalahan Disiplin Jabatan Mengikut Tahun

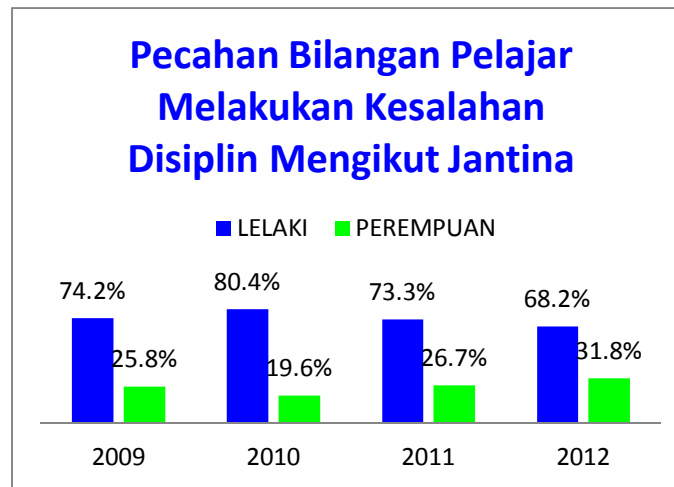
Selain itu, tindakan seperti pelajar yang tidak mematuhi ketetapan disiplin semasa pemantauan kali pertama dicadangkan diberi tindakan Nasihat dan Amaran dan butiran pelajar dicatatkan, manakala semasa pemantauan kali kedua boleh dicadangkan tindakan berlemah lembut seperti mengeluarkan notis denda kesalahan disiplin dengan kadar yang paling minimum dan mewajibkan hadir aktiviti gotong-royong dan amalan-amalan murni yang lain juga penyumbang kesan paten yang terbentuk.

**Bahagian B: Analisis Bilangan Pelajar Melakukan Kesalahan Disiplin Berbanding Enrolmen Pelajar Politeknik**

Merujuk kepada rajah 2, pada tahun 2009 sebanyak 5.9% kesalahan disiplin pelajar direkodkan daripada 5,958 pelajar manakala pada tahun 2010 sebanyak 9.4% melakukan kesalahan disiplin pelajar direkodkan daripada 5,367 pelajar seterusnya pada tahun 2011 sebanyak 13.3% kesalahan disiplin pelajar direkodkan daripada 5,360 pelajar dan pada tahun 2012 sebanyak 11.3% kesalahan disiplin pelajar direkodkan daripada 6,068 pelajar. Kesalahan ini ini sentiasa melebihi petunjuk prestasi yang dikehendaki iaitu bilangan pelajar yang terlibat dengan salahlaku disiplin adalah tidak melebihi 05% daripada bilangan enrolmen politeknik. Malah apa yang amat dibimbangkan ialah peningkatan peratusan pelajar yang terlibat dengan salahlaku disiplin ini semakin ketara saban tahun sehingga tahun 2011, diharapkan pada tahun akan datang melalui program dan pemantapan pengurusan disiplin secara berkesan akan mengurangkan bilangan pelajar yang terlibat dengan salahlaku disiplin kepada bawah petunjuk prestasi 05% daripada bilangan enrolmen Politeknik Merlimau.



**Rajah 2:** Peratusan Pelajar Melakukan Kesalahan Disiplin Berbanding Enrolmen Pelajar PMM



**Rajah 3:** Peratusan Pelajar Melakukan Kesalahan Disiplin Berbanding Enrolmen Pelajar PMM Mengikut Jantina

Merujuk kepada rajah 3, graf pecahan pelajar melakukan kesalahan disiplin mengikut jantina pada 3 tahun terakhir iaitu 2012, 2011 dan 2010 menunjukkan penurunan kesalahan disiplin yang dilakukan oleh pelajar lelaki dimana pada tahun 2010 sebanyak 80.4% bilangan kesalahan disiplin dilakukan oleh pelajar lelaki, 73.3% pada tahun 2011 dan 68.2% pada tahun 2012. Seiring dengan data tersebut juga ianya menunjukkan peningkatan bilangan pelajar perempuan yang melakukan kesalahan disiplin dimana pada tahun 2010 sebanyak 19.6% bilangan kesalahan dilakukan oleh pelajar perempuan, manakala pada tahun 2011 peningkatan kepada 26.7% bilangan kesalahan dan pada tahun 2012 sebanyak 31.8% bilangan kesalahan dilakukan oleh pelajar perempuan.

Selain daripada itu, pada tahun 2009 seramai 231 berbanding dengan 349 pelajar secara keseluruhan yang melakukan kesalahan disiplin, jumlah ini mewakili 66% bilangan pelajar yang melakukan kesalahan disiplin, manakala pada tahun 2010 seramai 311 pelajar berbanding dengan 506 pelajar secara keseluruhan yang melakukan kesalahan disiplin, jumlah ini mewakili 61% bilangan pelajar yang melakukan kesalahan disiplin, manakala pada

tahun 2011 seramai 481 pelajar berbanding dengan 712 pelajar secara keseluruhan yang melakukan kesalahan disiplin, jumlah ini mewakili 68% bilangan pelajar yang melakukan kesalahan disiplin dan pada tahun 2012 seramai 430 pelajar berbanding dengan 686 pelajar secara keseluruhan yang melakukan kesalahan disiplin, jumlah ini mewakili 63% bilangan pelajar yang melakukan kesalahan disiplin.

## 5.0 Kesimpulan

Kajian Kesalahan Pelajar Politeknik Merlimau dari tahun 2009 hingga 2012 yang telah dijalankan untuk menganalisa perkembangan modal insan pelajar yang lazimnya terdiri daripada aliran sekolah. Rasionalnya, institusi bukan seharusnya memberikan ilmu dan ketrampilan sahaja tetapi perubahan sikap, mentaliti dan tingkah laku. Kejayaan pelajar terletak kepada pencapaian akademik, sikap, ilmu dan kemahiran. Ilmu dan kemahiran penting bagi mengisi peluang pekerjaan, tetapi sikap, mentaliti dan tingkah laku penting supaya kualiti diri mereka menjadi pemangkin ke arah proses kemajuan, pendorong kepada keluarga dan agen perubahan kepada masyarakat. Pelajar bukan sahaja harus muncul dengan idea baru, semangat yang kental serta pelbagai kemahiran tambahan agar negara boleh berdiri gah setanding dengan negara-negara maju yang lain tetapi haruslah berupaya menangani gelombang perkembangan dan perubahan masa kini sebagai satu benteng sendiri sejajar dengan slogan yang pernah dilafazkan oleh Perdana Menteri kita Datoø Sri Najib bin Tun Abdul Razak iaitu istilah Glokal di mana setiap rakyat Malaysia mempunyai nilai dan asas pegangan ketimuran yang kukuh, jati diri yang kuat menentang arus pengaruh negatif dari luar. Huraian analisis diatas didapati peratusan pelajar melakukan kesalahan bermula dari tahun 2009 sehingga 2012 sentiasa melebihi peratus petunjuk prestasi yang dikehendaki iaitu bilangan pelajar yang terlibat dengan salahlaku disiplin adalah tidak melebihi **05%** daripada bilangan enrolmen politeknik. Malah apa yang amat dibimbangkan ialah peningkatan peratusan pelajar yang terlibat dengan salahlaku disiplin ini semakin ketara saban tahun, sebagai contoh pada tahun 2009 hanya 5.9%, pada tahun 2010 meningkat kepada 9.4%, manakala pada tahun 2011 angka ini terus meningkat kepada 13.4% dan sedikit penurunan pada tahun 2012 kepada 11.3%. Secara keseluruhan kajian ini telah berjaya mengesan paten yang terhasil di mana ia membantu Jawatankuasa Disiplin Politeknik dalam merancang wacana pengurusan dan perlaksanaan dalam mengatasi permasalahan ini dengan mempertingkatkan pembentukan modal insan melalui kokurikulum AR101 polibriged dan penubuhan Jawatankuasa khas iaitu Jemaah Nazir bagi Politeknik Malaysia dalam mencapai prinsip glokal.

## 6.0 Rujukan

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## O9 - Kesedaran dan Penerimaan Pihak Industri Dalam Pengambilan Pekerja Golongan OKU Cacat Pendengaran Lepas PTV di Malaysia

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### Abstrak

Tujuan kajian ini adalah untuk mengkaji sama ada terdapat hubungkait antara kesedaran dan penerimaan pengambilan pekerja golongan Cacat Pendengaran Lepas Pendidikan Teknik dan Vokasional dalam sektor industri perkhidmatan di Malaysia. Kajian ini telah melibatkan seramai 55 orang responden daripada industri perkhidmatan di sekitar Batu Pahat, Johor dan juga Melaka serta 50 orang guru-guru khas dari SMPK(V) Shah Alam Selangor, SMPK(V) Indahpura Johor dan juga SMT Batu Pahat Johor. Kajian ini merupakan kajian kuantitatif dimana maklumat dikumpulkan melalui dua set soal selidik, set A dan Set B. Set A adalah untuk industri perkhidmatan manakala Set B adalah untuk guru-guru khas SMPK(V). Semua data telah dianalisis menggunakan perisian SPSS versi 11. Bagi mengkaji sama terdapat perkaitan antara kesedaran dan penerimaan dalam kalangan industri terhadap pengambilan pekerja golongan Cacat Pendengaran, pekali korelasi Pearson,  $r$  telah digunakan. Hasil analisis menunjukkan bahawa tiga faktor penerimaan industri dalam pengambilan pekerja golongan Cacat Pendengaran iaitu tanggapan terhadap golongan Cacat Pendengaran, kemahiran yang perlu dimiliki oleh golongan Cacat Pendengaran serta kekangan yang dihadapi oleh majikan sekiranya mereka mengambil golongan ini. Justeru itu, terlalu sedikit industri perkhidmatan yang mempunyai polisi dalam pengambilan golongan OKU. Ini menyebabkan kadar peratusan pengambilan golongan Cacat Pendengaran sangat rendah. Melalui perbandingan antara kemahiran yang diperolehi oleh pelajar Cacat Pendengaran setelah tamat pengajian di SMPK(V) dengan kemahiran yang dikehendaki oleh pihak industri, dapat disimpulkan bahawa pelaksanaan reka bentuk kurikulum di SMPK(V) untuk pelajar Cacat Pendengaran adalah bersesuaian dengan pasaran kerja. Hasil analisis kajian ini juga menunjukkan bahawa terdapat perkaitan lemah yang signifikan antara kesedaran dan penerimaan pihak industri terhadap pengambilan pekerja golongan Cacat Pendengaran.

**Kata Kunci:** Kesedaran, penerimaan, industri perkhidmatan, OKU cacat pendengaran, PTV

### 1.0 Pengenalan

Pekerjaan adalah satu hala tuju penting dalam kehidupan seseorang individu dan tidak terkecuali golongan OKU. Setiap tahun ramai pelajar berkeperluan khas ini meninggalkan alam persekolahan dan memasuki alam kedewasaan tanpa mempunyai kemahiran kerja dan terpaksa berdepan dengan pelbagai kesukaran hidup. Kajian mendapati bahawa 50 peratus hingga 70 peratus OKU di Amerika tidak mempunyai pekerjaan dan menerima pendapatan minimum[1]. Selain itu, hasil kajian juga mendapati bahawa sumbangan tenaga kerja OKU tidak mempengaruhi kadar pertumbuhan ekonomi di Amerika. Ini mungkin disebabkan kebanyakan OKU di Amerika lebih cenderung untuk bekerja

separuh masa dan mendapat gaji yang rendah berbanding pekerja normal[2]. Namun begitu, terdapat perbezaan hasil kajian yang diperolehi menunjukkan bahawa tidak terdapat perbezaan yang signifikan antara golongan OKU atau pekerja normal di Amerika yang mana kedua-duanya berperanan penting dan harus bekerjasama berganding bahu dalam menjana ekonomi negara[3]. Kesimpulannya, setiap individu tidak kira golongan OKU atau normal bersama-sama memainkan peranan penting dalam pembangunan negara.

## **2.0 Latar Belakang Masalah**

Sehingga kini, golongan OKU di Malaysia juga masih belum dapat diterima sepenuhnya dalam pasaran kerja secara terbuka. Majikan seolah-olah takut hendak mengambil mereka bekerja padahal mereka juga sama seperti manusia biasa, cuma kurang dalam beberapa segi sahaja. Tetapi jika dilatih dengan cara yang betul, mereka pasti dapat melakukan pekerjaan malah menampilkan komitmen yang lebih tinggi dan tekun. Walaupun secara umumnya, sikap masyarakat pada OKU adalah positif namun pihak majikan masih keberatan hendak mengambil OKU bekerja dengan mereka. Sikap majikan pada OKU belum lagi terbuka dan belum bersedia memberi peluang bagi mendapatkan kerja di tempat mereka. Meskipun kebanyakan golongan OKU di Malaysia telah mendapat pendidikan khas dan pendidikan vokasional di pusat-pusat latihan kerajaan dan swasta, mereka masih sukar menempatkan diri sebagai pekerja di sektor awam mahupun swasta akibat daripada kekurangan fizikal. Keadaan ini telah mendorong sesetengah individu kurang upaya menceburkan diri dalam bidang perniagaan dan keusahawanan. Melihat kepada produktiviti, kapasiti dan kreativiti golongan OKU yang berjaya dalam lapangan kerjaya dan penggajian mereka mampu menjadi pemangkin dan motivasi kepada golongan OKU lain di Malaysia. Golongan OKU tidak lagi boleh dianaktirikan, dipandang sambil lewa atau hanya layak berada di kaki lima sahaja[4].

## **3.0 Pernyataan Masalah**

Pengambilan pekerja dalam kalangan OKU Cacat Pendengaran di Malaysia adalah tidak memberangsangkan. Majoriti majikan pada hari ini kurang berminat atau tidak ingin mengambil pekerja daripada golongan OKU ini untuk bekerja di syarikat mereka. Majikan akan memberi pelbagai sebab mengapa tidak mengambil OKU ini bekerja tetapi kadang kala alasan mereka tidak munasabah. Apakah mereka ini tidak boleh menghasilkan produktiviti yang baik? Padahal, jika golongan ini dilatih dengan cara yang betul, mereka pasti dapat melakukan pekerjaan malah menampilkan komitmen yang lebih tinggi dan tekun [4]. Oleh itu, sesuatu harus dilakukan supaya masalah pemasaran pekerjaan bagi golongan OKU di Malaysia dapat diatasi. Justeru itu, kajian ini mengkaji sama ada terdapat hubung kait antara kesedaran dan penerimaan dalam kalangan industri terhadap pengambilan pekerja golongan Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional di Malaysia.

## **4.0 Matlamat Kajian**

Matlamat kajian ini adalah untuk menentukan permasalahan kebolehpasaran pekerja Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional dalam sektor industri perkhidmatan di Malaysia.

## **5.0 Objektif Kajian**

- (i) Mengenal pasti faktor penerimaan industri dalam pengambilan pekerja golongan Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional di Malaysia.

- (ii) Menentukan sama ada terdapat polisi yang jelas di industri dalam pengambilan pekerja OKU.
- (iii) Menentukan sama ada terdapat kesesuaian antara reka bentuk kurikulum Pendidikan Teknik dan Vokasional bagi golongan Cacat Pendengaran dengan kehendak pasaran kerja dalam sektor industri perkhidmatan.

## 6.0 Persoalan Kajian

- (i) Apakah faktor penerimaan industri dalam pengambilan pekerja golongan Cacat Pendengaran Lepas Pendidikan Teknik dan Vokasional di Malaysia?
- (ii) Apakah polisi pihak industri dalam pengambilan pekerja OKU?
- (iii) Adakah reka bentuk kurikulum Pendidikan Teknik dan Vokasional bagi golongan Cacat Pendengaran di Malaysia sesuai dengan pasaran kerja dalam sektor industri perkhidmatan?

## 7.0 Skop Kajian

Kajian ini mengkaji sama ada terdapat hubungkait antara kesedaran dan penerimaan pengambilan pekerja golongan Cacat Pendengaran Lepas Pendidikan Teknik dan Vokasional dalam sektor industri perkhidmatan di Malaysia. Kajian ditumpukan kepada elemen-elemen untuk mendapatkan sama ada terdapat perkaitan antara kesedaran dan penerimaan industri terhadap pengambilan pekerja golongan Cacat Pendengaran. Antara elemen-elemen yang ditekankan dalam kajian ini ialah faktor penerimaan industri terhadap golongan Cacat Pendengaran, sama ada ada terdapat polisi yang jelas di industri dalam pengambilan pekerja OKU serta sama ada terdapat atau tidak kesesuaian antara reka bentuk kurikulum Pendidikan Teknik dan Vokasional bagi golongan Cacat Pendengaran dengan kehendak pasaran kerja. Selain itu, faktor penerimaan industri merangkumi tanggapan terhadap golongan Cacat Pendengaran, kemahiran yang perlu dimiliki oleh golongan Cacat Pendengaran serta kekangan yang dihadapi oleh majikan sekiranya mereka mengambil pekerja OKU ini.

## 8.0 Metodologi Kajian

**Jadual 1: Ringkasan Metodologi Kajian**

Rekabentuk Kajian	Kajian kuantitatif
Lokasi Kajian	-Industri Perkhidmatan di sekitar Batu Pahat, Johor & Melaka -SMPK(V) Shah Alam, SMPK(V) Indahpura, SMT BP
Populasi	Pihak yang terlibat sama ada secara langsung dan tidak langsung dengan golongan Cacat Pendengaran Lepas PTV di Malaysia. Ia terdiri daripada sektor industri serta guru-guru di Sekolah Menengah Pendidikan Khas di Malaysia.
Sampel Kajian	-Sektor industri berasaskan perkhidmatan di sekitar Batu Pahat, Johor serta Melaka -Guru-guru khas yang berkelayakan mengajar apa jua mata pelajaran yang berkaitan pelajar Cacat Pendengaran di 3 buah sekolah SMPK(V) yang terpilih.
Kaedah Persampelan	-Kaedah persampelan secara bertujuan
Instrumen Kajian -Soal selidik, -jenis item.	2 set soal selidik -Set A: Industri Perkhidmatan -Set B: Guru-guru khas SMPK(V) Guna skala item skala Thurstone, item skala Likert.
Pengesahan pakar (pensyarah Fakulti Pendidikan Teknikal, UTHM)	Tatabahasa: Dr. Hj. Baharom Kandungan & Kriteria: Pm. Mahmad Amir b. Radzali & Tn. Hj Shamsudin Husin Analisis Statistik: Prof. Dr. Sulaiman b. Yamin

Kajian Rintis	Nilai Alpha Cronbach: -Set A: 0.9657 -Set B: 0.9736
Analisis Data	Perisian statistik berkomputer SPSS versi 11.0: Analisis kesemua data kajian Analisis Kolerasi Pearson, r: Mendapatkan hubung kait antara kedua-dua pemboleh ubah pada persoalan utama bagi kajian ini.

Jadual 1 menunjukkan ringkasan metodologi yang digunakan dalam kajian ini. Terdapat beberapa peringkat yang perlu dilakukan bagi mendapatkan hasil kajian yang memuaskan bagi menjawab setiap persoalan kajian yang telah ditetapkan dan seterusnya objektif kajian dapat dicapai.

## 9.0 Dapatan Kajian

### Persoalan Kajian 1:

#### Apakah faktor penerimaan pihak industri terhadap pengambilan pekerja Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional di Malaysia?

Persoalan kajian ini adalah untuk menguji tahap kesedaran dan penerimaan pihak industri perkhidmatan terhadap pekerja Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional. Jadual 2 menunjukkan Tahap Skor Min Bagi Kesedaran dan Penerimaan Industri. Berdasarkan kepada analisis yang telah dibuat, didapati purata skor min bagi kesedaran dan penerimaan industri perkhidmatan ialah 3.65 dan berada pada tahap sederhana.

**Jadual 2:** Tahap Skor Min Bagi Kesedaran dan Penerimaan Industri

Item	Skor Min	Tafsiran Tahap Kesedaran dan Penerimaan.
Tanggapan Terhadap Pekerja Cacat Pendengaran	3.73	Tinggi
Pendapat Terhadap Kemahiran Yang Perlu Dimiliki Oleh Pekerja Cacat Pendengaran	4.03	Tinggi
Kekangan Yang Dihadapi Oleh Majikan	3.41	Sederhana
Pendapat Terhadap Kerja Yang Sesuai Untuk Pekerja Cacat Pendengaran	3.44	Sederhana
<b>Purata Skor Min</b>	<b>3.65</b>	<b>Sederhana</b>

Jadual 3 menunjukkan kemahiran yang perlu dimiliki oleh pelajar Cacat Pendengaran. Merujuk kepada jadual tersebut, pihak industri perkhidmatan sangat mengkehendaki agar pekerja Cacat Pendengaran mempunyai kemahiran akademik yang tinggi diikuti oleh kemahiran pekerjaan serta kemahiran interpersonal. Jumlah purata skor min ialah bersamaan dengan 4.03 menunjukkan responden bersetuju dengan ketiga-tiga kategori kemahiran tersebut.

**Jadual 3:** Kemahiran yang perlu dimiliki oleh Pelajar Cacat Pendengaran

Kemahiran	Item	Skor Min	Interpretasi Min
Akademik	C13, C14, C15, C17, C18, C22	4.17	Setuju
Pekerjaan	C16, C20, C21, C23, C27, C29, C30, C32, C33	3.98	Setuju



Interpersonal	C19, C24, C25, C26, C28, C31	3.95	Setuju
<b>Purata Skor Min</b>	<b>21 item</b>	<b>4.03</b>	<b>Setuju</b>

### Persoalan Kajian 2:

#### Apakah polisi pihak industri dalam pengambilan pekerja OKU?

Data ini telah diuji pada bahagian B bagi soal selidik set A dan akan menjelaskan persoalan kajian seperti yang dinyatakan berikut. Data yang diperolehi akan digunakan untuk mengukur tahap pengambilan pihak industri terhadap pekerja Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional. Selain itu, penyelidik telah membangunkan data soal selidik berbentuk data skala Thurstone. Merujuk kepada Jadual 4, purata skor min bagi pengambilan pekerja Cacat Pendengaran ialah 1.68. Ini menunjukkan bahawa tahap pengambilan pekerja Cacat Pendengaran adalah sangat rendah.

**Jadual 4:** Tahap Skor Min Bagi Pengambilan Pekerja Cacat Pendengaran

Item	Skor Min	Tafsiran Tahap Pengambilan Pekerja Cacat Pendengaran
Menggaji Cacat Pendengaran	1.71	Rendah
Ada polisi	1.76	Rendah
Bercadang mengambil pekerja Cacat Pendengaran	1.58	Rendah
<b>Purata Skor Min</b>	<b>1.68</b>	<b>Rendah</b>

### Persoalan Kajian 3:

#### Adakah reka bentuk kurikulum Pendidikan Teknik dan Vokasional bagi golongan OKU di Malaysia sesuai dengan pasaran kerja dalam sektor industri perkhidmatan?

Persoalan kajian ini bertujuan untuk menguji sama ada reka bentuk kurikulum Pendidikan Teknik dan Vokasional bagi golongan OKU di Malaysia sesuai dengan pasaran kerja. Data ini telah diperolehi daripada item-item Bahagian B bagi borang soal selidik untuk guru-guru khas SMPK(V). Sebanyak 34 item telah dibangunkan oleh penyelidik bagi menjelaskan persoalan ini. Ia merangkumi penekanan dalam reka bentuk kurikulum untuk SMPK(V) serta kemahiran yang ditekankan kepada pelajar Cacat Pendengaran. Merujuk kepada Jadual 5, skor min antara ketiga-tiga kemahiran tidak jauh berbeza satu sama lain. Skor min tertinggi ialah 3.75 bagi kemahiran interpersonal, diikuti oleh kemahiran pekerjaan (3.71) manakala kemahiran akademik (3.70). Oleh kerana perbezaan min adalah kecil maka dapat disimpulkan bahawa pelajar Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional mempunyai kemahiran yang sama rata bagi kemahiran akademik, kemahiran pekerjaan dan juga kemahiran interpersonal.

**Jadual 5:** Kemahiran yang dimiliki oleh Pelajar Cacat Pendengaran Setelah Tamat Pengajian di SMPK(V)

Kemahiran	Item	Skor Min	Interpretasi Min
Akademik	B14, B15, B16, B18, B19	3.70	Setuju
Pekerjaan	B17, B21, B22, B23, 24, B28, B30, B31, B33, B34	3.71	Setuju
Interpersonal	B20, B25, B26, B27, B29, B32	3.75	Setuju
<b>Purata Skor Min</b>	<b>21 item</b>	<b>3.72</b>	<b>Setuju</b>

### **Sama ada Terdapat Hubungkait antara Kesedaran dan Penerimaan Pihak Industri Terhadap Pengambilan Pekerja OKU Cacat Pendengaran Lepas PTV di Malaysia**

Analisis korelasi digunakan untuk melihat kekuatan hubungan antara pemboleh ubah yang diuji. Penyelidik memilih pemboleh ubah bebas ialah kesedaran dan penerimaan industri perkhidmatan manakala pemboleh ubah bersandar ialah pengambilan pekerja OKU Cacat Pendengaran. Hasil kajian pada Jadual 6 menunjukkan nilai pekali korelasi ialah -0.421 dan signifikan pada aras keertian 0.01 (2-tailed). Merujuk pada Jadual 7, nilai pekali korelasi ini menjelaskan bahawa terdapat perkaitan signifikan yang lemah di antara kedua-dua pemboleh ubah yang diuji. Hal ini membuktikan bahawa hubungan yang wujud tidak berlaku secara kebetulan. Nilai-nilai pekali korelasi yang rendah diperolehi dalam kajian ini sering berlaku dalam kajian-kajian pendidikan, psikologi atau sosial lain [5]. Namun begitu, dapatan daripada kajian ini menjadi titik tolak dan berupaya menyumbang kepada penemuan kajian yang penting dan boleh digunakan untuk membina teori[6].

**Jadual 6:** Perkaitan Antara Kesedaran dan Penerimaan Industri Perkhidmatan Terhadap Pengambilan Pekerja OKU Cacat Pendengaran.

Item	Pekali Korelasi	Nilai-p	Keputusan
Kesedaran dan penerimaan industri perkhidmatan	<b>-0.421</b>	<b>0.001*</b>	<b>Signifikan</b>
Pengambilan pekerja OKU Cacat Pendengaran	<b>-0.421</b>	<b>0.001*</b>	<b>Signifikan</b>

\*Signifikan pada aras keertian 0.01(2-tailed)

**Jadual 7:** Kekuatan Nilai Pekali Korelasi (Sumber: Chua, 2006)

Saiz Pekali Korelasi (r)	Kekuatan Korelasi
0.31 hingga 0.50 atau -0.31 hingga -0.50	<b>Lemah</b>

## **10.0 Perbincangan**

### **10.1 Kesedaran dan Penerimaan Pihak Industri**

Dapatan kajian menunjukkan bahawa tahap kesedaran dan penerimaan pihak industri adalah sederhana. Ini menunjukkan bahawa pihak industri mempunyai persepsi yang positif terhadap pekerja OKU Cacat Pendengaran Lepas Pendidikan Teknik dan Vokasional di

Malaysia. Selain itu, terdapat tiga faktor keperluan industri dalam pengambilan pekerja Cacat Pendengaran iaitu tanggapan terhadap pekerja Cacat Pendengaran, kemahiran yang perlu dimiliki oleh pekerja Cacat Pendengaran serta kekangan yang dihadapi oleh majikan sekiranya mereka mengambil pekerja OKU ini. Analisis kajian menunjukkan bahawa pihak industri mempunyai tanggapan yang tinggi terhadap golongan Cacat Pendengaran. Ini bermakna, pihak industri amat yakin dengan kebolehan serta kemahiran yang dimiliki oleh golongan istimewa ini. Pihak industri juga mengkehendaki supaya pekerja Cacat Pendengaran mempunyai kemahiran yang tinggi. Hasil analisis mendapati bahawa pihak industri lebih mengutamakan kemahiran akademik, diikuti oleh kemahiran pekerjaan dan seterusnya ialah kemahiran interpersonal. Analisis juga mendapati bahawa majoriti majikan kurang setuju dengan faktor kekangan yang dikemukakan oleh penyelidik di dalam borang soal selidik. Ini mungkin disebabkan oleh data kajian yang diperolehi daripada borang soal selidik telah didominasi oleh syarikat-syarikat yang tidak pernah mengambil pekerja Cacat Pendengaran serta tidak mempunyai polisi dalam pengambilan pekerja OKU. Ketiadaan pengalaman bekerja bersama-sama dengan pekerja OKU ini menyebabkan pihak industri tidak dapat memberi gambaran yang sebenar persepsi atau tanggapan mereka terhadap golongan istimewa ini.

## **10.2 Pengambilan Pekerja Cacat Pendengaran**

Berdasarkan hasil dapatan, penyelidik mendapati bahawa kadar peratusan pengambilan pekerja Cacat Pendengaran adalah rendah. Ini kerana terlalu sedikit peratusan pihak industri yang mempunyai polisi dalam pengambilan pekerja OKU. Ketiadaan polisi menyebabkan pihak majikan kurang berminat untuk mengambil pekerja dalam kalangan Cacat Pendengaran. Walaupun secara umumnya, sikap masyarakat pada golongan minoriti ini adalah positif namun pihak majikan masih keberatan hendak mengambil pekerja OKU untuk bekerja di syarikat mereka. Sikap majikan pada OKU belum lagi terbuka dan belum bersedia untuk memberi peluang bagi mendapatkan kerja di tempat mereka.

## **10.3 Reka bentuk Kurikulum SMPK(V)**

Melalui perbandingan antara kemahiran yang diperolehi oleh pelajar Cacat Pendengaran setelah tamat pengajian di SMPK(V) dengan kemahiran yang dikehendaki oleh pihak industri, penyelidik menyimpulkan bahawa pelaksanaan reka bentuk kurikulum di SMPK(V) untuk pelajar Cacat Pendengaran adalah bersesuaian dengan pasaran kerja masa kini. Ini kerana penyelidik mendapati bahawa pelajar Cacat Pendengaran yang pernah mengikuti pengajian di sekolah menengah khas kemahiran vokasional mempunyai kemahiran akademik, pekerjaan dan juga interpersonal yang tinggi. Di samping itu, hasil analisis mendapati bahawa pihak industri lebih mengutamakan kemahiran akademik, diikuti oleh kemahiran pekerjaan dan seterusnya ialah kemahiran interpersonal.

## **11.0 Kesimpulan**

Merujuk kepada hasil dapatan kajian yang diperolehi, menunjukkan bahawa terdapat perkaitan lemah yang signifikan antara kesedaran dan penerimaan pihak industri terhadap pengambilan pekerja OKU Cacat Pendengaran Lulusan Pendidikan Teknik dan Vokasional di Malaysia. Pihak industri mempunyai tanggapan yang tinggi terhadap golongan OKU ini serta yakin mereka berkebolehan dan berkemahiran sekiranya diberi bimbingan yang baik. Namun begitu, hasil kajian tidak memperolehi gambaran sebenar sikap majikan memandangkan terlalu sedikit majikan yang sanggup mengambil pekerja OKU Cacat Pendengaran. Penguasaan kemahiran akademik, pekerjaan dan interpersonal yang tinggi dapat memberikan

peluang yang cerah untuk mendapatkan sesuatu pekerjaan. Justeru itu, ketiadaan polisi dalam pengambilan pekerja OKU menyebabkan pihak industri kurang berminat atau tidak mahu mengambil pekerja OKU Cacat Pendengaran untuk bekerja dengan mereka. Hasil kajian juga mendapati bahawa pelajar yang pernah mengikuti pengajian di sekolah menengah khas kemahiran vokasioanl mempunyai kemahiran akademik, pekerjaan dan interpersonal yang tinggi. Ini membuktikan bahawa pelaksanaan reka bentuk kurikulum SMPK(V) untuk pelajar OKU Cacat Pendengarn adalah bersesuaian dengan pasaran kerja masa kini.

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# O10 - Issues and Challenges of Technical and Vocational Education & Training in Malaysia for Knowledge Worker Driven

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## *Abstract*

*Many Asian countries are fast adopting the new and emerging technologies in industry and agriculture including Malaysia. The new technologies, in general, need a higher knowledge based system and would require enormous technical skills. This has a profound effect on the employment, education and training of technical manpower as well as in the training of TVET. To move up the value chain to become a high-income economy, skilled workforce is vital in achieving this goal. As a result, it is important to increase the enrolment in TVET (Technical and Vocational Education & Training) and raise the overall training quality. This paper will discuss the overview and the course of TVET in Malaysia. The main thrust of this paper is to highlight the challenges that overlay the implementation of TVET in Malaysia. Hence, the development of Knowledge Worker (K-worker) will be realized.*

**Keywords:** Knowledge and Technical Skills, Technical and Vocational Education & Training, TVET Challenges, K-Worker.

## **1.0 Introduction**

Malaysia is one of the fastest growing modern countries in the world that has successfully achieved a balance between industrial growth and traditional values and is poised to become a fully developed nation by the year 2020. Conventionally, labor demand and supply have been growing annually at 2%. With the introduction of the National Key Economic Areas (NKEAs), demand is expected to outgrow supply. By 2020, up to an additional 3.3 million jobs will be created, of which 1.3 million will be TEVT-related. However, based on historical trends, it may be challenging for the current TEVT sector to meet the demands of a high-income economy. Malaysia aspires to move up the value chain to become a high-income economy, with a Gross National Income (GNI) per capita of approximately USD 15,000 by 2020 [1]. To realize this ambitious goal, the Malaysian GDP will have to grow at an average rate of 6% per annum until 2020. Malaysia will need to have a workforce that is equipped with the necessary skills and knowledge to support and drive the economy. The economy will require a larger workforce. While labor demand and supply have been growing annually at 2%, the twelve National Key Economic Areas (NKEAs) are expected to create up to an additional 3.3 million jobs by 2020. Approximately 1.3 million (40%) will be TVET-related [2].

## **2.0 Background and Problem**

It is important to ensure the economy has suitably-skilled human capital. While the twelve NKEA sectors project a need for 1.3 million TEVT graduates, 1.6 million TEVT graduates are required by 2020. Current capacity of TEVT institutes reveals that it is insufficient to meet the needs of the economic transformation. Concluding from current rates of graduation, of the 1.6 million required TEVT graduates, institutes are able to fulfill 1.2

million. This leaves a supply-demand gap of 400,000 graduates until 2020. The number of students that chose TVET in Malaysia keeps increasing by years. Based on data from Manpower Department [4], the total of intake in Malaysian Public Skills Training Institutes is increasing since 2001 although there are a slight drop in a few years [4]. But still, the graph shows the positive increments in student participation.

Malaysian Advanced Technology Training Center (ADTEC) currently offers Diploma and Advanced Diploma. Entrance into Malaysian ADTEC requires a minimum of pass in Sijil Pelajaran Malaysia (SPM) with 3 credits. It is equivalent to Malaysian Skills Certification at Level 4 and 5. At the end of the program, the students are required to complete an industrial project based which determine their qualification for Diploma or Advanced Diploma Degree. It is coherent with Level 4 and level 5 for Malaysian Skills Qualification (MSQ) that merely required a trainer to complete an industrial based project as one of the competency assessment. During this process, the students find difficulties in many aspects for every project stage. They need support and guidance especially from their supervisor, their closest reference.

Meanwhile, the number of certificates awarded has declined or leveled off across the board. Moreover, the number of graduates at higher levels (Levels 4 and 5) is low, with only 1,444 graduates in 2009 [3]. At this rate, the 10th Malaysia Plan's target of achieving 50% highly-skilled workforce by 2020 and the Economic Transformation Program (ETP) requirement of 1.3 million TVET graduates will be difficult to meet, severely hampering the nation's ambitions of becoming a high-income economy. At this rate, the 10th Malaysia Plan's target of achieving 50% highly-skilled workforce by 2020 and the ETP's requirement of 1.3 million TVET graduates will be difficult to meet, severely hampering the nation's ambitions of becoming a high-income economy [2].

### **3.0 Objective and Methodology**

The objective of this paper is to discuss the major problems that arise in TVET implementation in Malaysia. This issue is repeatedly reported in many platforms but infrequently done in academic manner [18]. By improving the quality and overcoming the problems, K-Workers can be produced effectively. The methodology used to accumulate the issues in this paper was through analysis and thorough reading from reports, papers, journals and articles by previous authors and researchers.

### **4.0 Literature Review and Discussion**

Malaysia is developing rapidly and in a dire demand for technical and engineering manpower at the various levels especially in the technology and engineering discipline. The demand for engineers and engineering assistants keeps increasing from 153,000 in the year 1994 to 500,000 in the year 2008 [5]. In the year 2010 the country will need more than 500,000 engineering technicians and engineers [6]. This figure keeps increasing by years. Currently, Malaysia has a workforce of about 12 million, of which only about 28 percent are highly-skilled, whilst 60 percent are employed in small and medium-sized enterprises [7]. To meet the needs of this manpower, the government has put in place a lot of emphasis on technical and vocational education and training to produce more Knowledge workers (K-workers).

Synchronizing with the development of K-workers, institution of Technical and Vocational Education Training (TVET) is providing effective training to develop people in the professions. Coherence from this issue, government is can create a pool of skilled workers that can handle the rapidly changing world of work. Issue of skilled workers has become vital and widely debated across the countries. The global changes in technology and particularly in

the Malaysian industries have created a major need for skilled workforce and comprehensive training. A holistic skills training and technical training program to train K-worker should encompass not only technical competences but also learning and methodology competences [8]. This can be achieved through supervision process during their training and practical in Public Skills Training Institute (ILKA) and industries as well. The quality supervision has been described as an invaluable learning activity for beginners as well as experienced practitioners such as teachers, administrators, trainers and other professionals.

## **5.0 Overview of TVET System in Malaysia**

TVET seems new to certain people in Malaysia since the exposure related to this system is still under proper explained. The effort to promote TVET is highly increase for the past years after our Prime Minister has put the skills training as one of the main agenda in Malaysian Budget 2011 and 2012. However the idea of providing tor TVET in Malaysia could be traced back since late 1890s where there were already discussions on setting up trade schools to prepare Malay boys to work as mechanics and fitters on the railways [9]. However, in practice, much of the early initiatives catered mainly for traditional arts and crafts as seen in 1900 when the government of Selangor engaged several local craftsmen comprising of a wood-carver, a silversmith, a blacksmith and a tailor, to teach their crafts to Malay students residing in the Malay Settlement on the outskirts of Kuala Lumpur [10].

Currently, the TVET in Malaysia are based on National Occupational Skill Standard (NOSS) [11]. To be certified for Malaysian Skill Certification, they should encompass the minimum requirement in National Occupational Skill Standard (NOSS). NOSS can be defined as a specification of the competencies expected of a skill worker who is gainfully employed in Malaysia for an occupational area, level and the pathway to achieve the competencies. In general, TVET provision in Malaysia is still largely concentrated on lower-level skills qualification whereby more than 70 percent of graduates are at Malaysian Skills Certificates, Levels 1 and 2 [12]. Although TVET Institutions are running at high operating levels, many are not yet operating at full capacity. The overall funding structure also does not fully support quality and performance of TVET providers. There are many TVET providers in Malaysia either from public or private institutions. Most of the higher level of skills qualification (Level 4 and 5) is being conducted by Public Institutions that are being supported by the Government. The institutions under the Ministry of Human Resource and Development for instance are providing 5 active institutions currently for conducting these higher levels namely Advanced Technology Training Center (ADTEC) and Japanese Malaysia Technical Institutes (JMTI) across the country.

## **6.0 Findings - Current issues with TVET in Malaysia**

Technical and Vocational Education and Training (TVET) in Malaysia has took place in our education system for years. While Malaysian government propelling for a dire transformation in economic towards vision 2020, the demands for K-Workers is increased. This goal can be achieved by developing human capital by providing TVET provision. Nevertheless, the challenge exists because of lack participation in technical and vocational streams. Consequently, there is a huge opportunity for TVET providers to attract school-leavers to take up TVET. In addition, more than 100,000 school-leavers join the labour market annually, after 11 years of formal schooling without pursuing further education or training [12]. Recently, the focus is to improve the value proposition and attractiveness of TVET to prospective students, providers and industry. A national media campaign is being rolled-out to improve public awareness and perception of TVET as well as to re-brand TVET as an attractive career option.

TVET in Malaysia seems to be the last resort for less qualified students for academic option. As reported by Pang [12], this perception has been aggravated by the lower academic requirements stipulated for admission into TVET programs and the limited prospects for further educational and professional development of TVET graduates. The societal stigma of TVET has also been created by the impression that the primary objective of vocational education and training is to cater for school drop-outs, rather than as an important strategy to train skilled workers for the employment market and for sustainable livelihoods. In addition, TVET-based qualifications and careers are still poorly perceived and recognized in the workplace. Many employers do not recognize the certification due to the highly fragmented landscape, with many ministries and agencies issuing certifications.

**Table 2:** Main Streams of the Education and Training System in Malaysia [13]

Stream or Pathway	Institutions	Workforce Preparation
1. Higher education	Universities and other institutions of higher learning, both public and private	Professional and managerial personnel such as engineers, architects, and surveyors.
2. Technical and vocational education	Polytechnics, technical colleges and (more recently) community colleges	Supervisory personnel such as technical assistants and supervisors.
3. Vocational skills training	Skills training institutions, public and private	Skilled and semi-skilled workers.

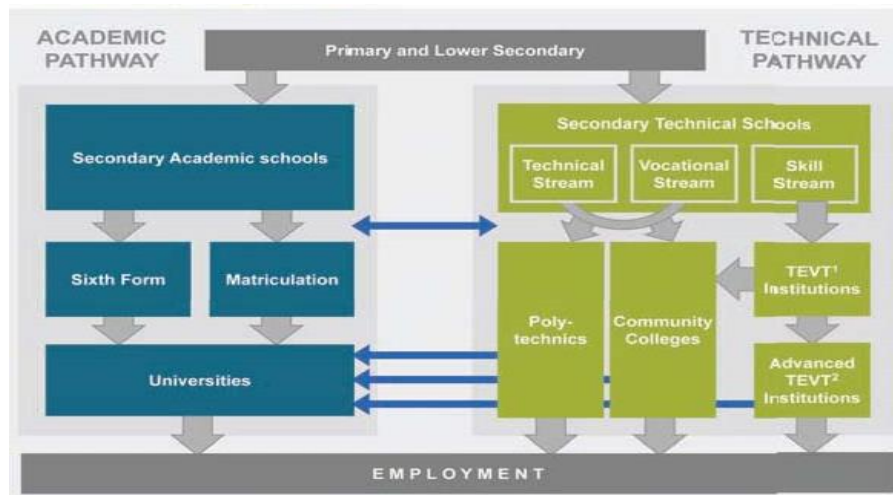
As being explained before, TVET provider in Malaysia is conducted by many different ministries, agencies and organizations, both public and private. The various TVET providers often operate as silos and do not taking into account program offerings in the broader context, resulting in overlapping courses and institutions as well as creating confusion for students and employers. This situation has implications for the standardization of training and qualification, cost-effectiveness, quality assurance, recognition of prior learning, and the further education of TVET graduates. The current governance structure still lacks effective coordination, sharing of resources, and articulation within the overall system. There is also no single oversight body to provide overview of TVET landscape. The diverse TVET management structures and the sharing of supervisory responsibilities by various government bodies and ministries account for some of the inefficiencies in the system like duplication and segmentation of training, and the absence of a common platform for developing coherent policies and joint initiatives.

The main issue reported from the industries are the lacking of product quality and skills possessed by the students. Although the system fundamentally designed to meet observed or projected labor market demands, the current TVET programs in Malaysia are largely supply-driven and still lack giving emphasis to match training to available jobs. Training institutions also seldom track the employment destination of their graduates. Consequently, the institutions have not taken advantage feedback from past trainees on the quality of the training they have received to improve their curricula and training packages. In short, the implementation of outcome evaluation and tracer studies that can improve the market responsiveness of training programs is still lacking. The overall funding structure also does not fully support quality and performance of TVET providers [12].

To understand Malaysia's approach of TVET, we can refer to the Tenth Malaysia Plan [7]. The main thrust of the National Mission is for the nation to embark upon a new phase of development towards realizing its aspiration upon becoming a developed nation by 2020. The most critical element in the achievement of the National Mission is the quality of



the human capital. Similarly, there are an estimated 100,000 or 22% of Malaysian students in 2009 that enter the workforce directly upon completion of only 11 years of schooling, after achieving a SPM. This group of students may be more technically inclined and therefore offers significant opportunity to improve their skills in the technical fields. Given the rapid pace at which Malaysia will need to develop its human capital to achieve high income nation status, it is necessary to radically raise the skills of Malaysians to increase their employability by focusing on the following: (1) Mainstreaming and broadening access to quality technical education and vocational training; and (2) Enhancing the competencies of tertiary graduates to prepare them for entering the labor market [14].



**Figure 5:** Mainstreaming TVET: Dual-pathway to Employment [14]

Higher Institution has to manage their resources and maneuver their project and innovation. One of the measures taken by the Ministry of Human Resources to set the quality in higher education is to designate and upgrade certain key centers. Center of Excellence (COE) has been granted to certain center such as Welding Technology and Computer Network Technology for ADTEC Batu Pahat. It is very clear that it plays a dominant role in skills creation and the dissemination of knowledge, which are crucial for the development of human capital. The aims of these centers are to develop creative and innovative human resource, develop globally competitive new technological products for the industries of tomorrow and to be the engine of growth, particularly for the fields of science and technology. The similar challenges in TVET reported were regarding the mindset and public perception [12, 16]. The public especially the parents does not have confident in TVET future and profession. Pang [12] and Zain [16] also discussed about the various TVET provider that comes to the issue of certification and demand supply-mismatch. Other important challenges are related to curriculum [15] and the quality of TVET providers [12].

**Table 3:** Summary of Issues and Challenges in Malaysia TVET (Source: Majumdar [15]; Pang [12]; Zain [16])

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*Curriculum and multiplicity of provision, certification, standard.*

*Mindset change and poor perception & recognition of TVET.*  
*Shortage of technical teaching staff.*  
*TVET lecturers' scheme of service.*  
*High cost of technical education.*  
*Employability of graduates.*  
*Flexible access to TVET throughout life.*  
*Enculturation of life-long learning.*

*Weak monitoring & evaluation and Demand-Supply Mismatch*  
*Lacking in efficiency and quality.*

*Non-Homogeneous Participation of Ethnic Groups*  
*Attrition and Completion issue*

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## 7.0 Conclusion

Although the issues relating to TVET are always being discussed, they are nevertheless complex and may require more than just fundamental approach. A holistic and wide approach needs to be tackle effectively as well as in the planning process and should be put together before any strategic solution can be considered. The impact of globalization and the uncertainties of the world economy will greatly affect the long-term strategy to initiate any necessary plans that will be made. The challenges that arise can be overcome by certain practical manners and through the innovation and enhancement of the system. One of the instance points is through the National Dual Training System (NDTS) that was implemented since 2005 to expose apprentices to actual situations in the industry. Apart from technical competencies, the NDTS also emphasizes human and social competencies. The Human Resource Development Fund was introduced in 1993 that aims to provide accelerated industrial training and offer enormous opportunities and avenues for companies, industry associations and public/private industrial training institutions to contribute to more responsive and relevant skill development. The TVET system is also transforming based on models from developed country such as Germany, the polytechnic university system in Hong Kong and Japan, and a few others. The mutual ground for these models is that of the major weight on practical-oriented approach. Hence, the inspiration to develop K-Worker will definitely accomplish. It is hoped that the issues discussed will throw some light on the efforts to make TVET more relevant in our particular environment.

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## O11 - Kajian Tahap Penerimaan Pekerja Lulusan Sistem Latihan Dual Nasional (SLDN) di Alam Pekerjaan

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### Abstrak

Sejajar dengan pembangunan negara yang semakin pesat telah mendorong peningkatan terhadap keperluan tenaga kerja mahir yang kompeten dan berdaya saing. Pelaksanaan Sistem Latihan Dual Nasional (SLDN) yang mula diperkenalkan sejak tahun 2005 telah menjadi satu platform bagi sektor pekerjaan dalam menjanakan tenaga kerja yang bukan sahaja mempunyai kemahiran teknikal, malahan juga nilai tambah dari segi sikap, pengetahuan kerja dan kemahiran sosial serta mampu meningkatkan produktiviti kerja. Tujuan kajian ini adalah, untuk melihat sejauh mana penerimaan pekerja lulusan SLDN di alam pekerjaan, dari aspek kebolehkerjaan dan kebolehpasaran. Kajian ini menggunakan pendekatan kualitatif dan kuantitatif dengan penggunaan survey questionnaire, semi-structured interviews dan focus group discussion (FGD). Penganalisaan kajian ini adalah berbentuk deskriptif dan inferensi. Tahap kebolehkerjaan dan kebolehpasaran dinilai berdasarkan penilaian persepsi majikan dan juga pekerja lulusan SLDN dan disokong dengan data kualitatif yang diperolehi menerusi temuduga dan sesi FGD. Penilaian keseluruhan mengikut tahap persepsi menunjukkan majikan dan pekerja mempunyai persepsi yang sangat positif terhadap kebolehkerjaan dengan nilai skor min sebanyak 4.2907 (majikan) dan 4.4270 (pekerja). Majikan dan pekerja juga didapati telah memberikan persepsi yang sangat positif terhadap kebolehpasaran pekerja lulusan SLDN dengan nilai skor min sebanyak 4.3962 (majikan) dan 4.5054 (pekerja). Manakala hasil analisa regresi pula menunjukkan bahawa 73 peratus faktor-faktor yang dikaji di dalam kebolehkerjaan (seperti sikap, kemahiran teknikal, kemahiran sosial dan pengetahuan kerja) memberi pengaruh terhadap kebolehpasaran (produktiviti kerja dan penerimaan program) pekerja lulusan SLDN, dari perspektif majikan. Kesimpulan kajian ini menunjukkan bahawa faktor kemahiran sosial adalah penyumbang utama dalam meningkatkan kebolehpasaran pekerja lulusan SLDN.

**Kata Kunci:** Kemahiran Teknikal, Pengetahuan Kerja, Kemahiran Sosial, Sikap, Kebolehpasaran.

### 1.0 Pengenalan

Berdasarkan Rancangan Malaysia Kesepuluh, enrolmen dalam pendidikan teknikal dan latihan vokasional (TEVT) perlu ditambah baik dan kualiti latihan secara keseluruhan perlu dipertingkatkan sejajar dengan tahap kemahiran tenaga kerja. Kerajaan telah menetapkan usaha mengarusperdana latihan kemahiran sebagai bidang keberhasilan utama (*key result area*) selaras dengan Teras Keempat dalam RM Ke-10 iaitu membangun dan mengekalkan modal insan bertaraf dunia untuk melahirkan komposisi pekerja berkemahiran tinggi daripada 28% kepada 33% menjelang 2015 dan 50% menjelang tahun 2020 (EPU, 2010). Rancangan Malaysia Kesepuluh (RM Ke-10).

Menurut laporan yang dikeluarkan oleh Jabatan Pembangunan Kemahiran (JPK) pada tahun 2010, didapati bahawa 72.7% graduan lulusan SLDN telah memperolehi pekerjaan

berbanding 494 orang responden yang terlibat dalam kajian tersebut (JPK, 2010). Kajian tersebut juga mendapati hanya 70.1% graduan telah mendapat pekerjaan dalam tempoh kurang daripada 6 bulan selepas menamatkan latihan.

Kajian ini turut memberi gambaran sebenar iaitu samada lulusan SLDN berjaya memperoleh pekerjaan melalui Sijil Kemahiran Malaysia (SKM). Fokus persoalan utama kajian adalah: Adakah pekerja lulusan SLDN menepati keperluan kebolehkeraan di industri dari segi kemahiran teknikal, pengetahuan kerja, sikap dan kemahiran sosial?. Kajian ini tertumpu kepada skop kebolehkeraan dan kebolehpasaran lulusan SLDN di seluruh Malaysia yang mana terdiri daripada lima sektor utama iaitu perkhidmatan, pembuatan, pertanian, perlombongan dan pembinaan. Kajian ini juga hanya melibatkan pekerja lulusan SLDN yang bekerja di syarikat bertaraf *Government Linked Company* (GLC), *Multi-national Corporation* (MNC) dan Perusahaan Kecil dan Sederhana (SME), yang dibahagikan dalam enam zon kawasan di seluruh Malaysia.

## **2.0 Kepentingan Kajian**

Hasil dapatan kajian dapat memberikan gambaran yang jelas kepada penyelidik terhadap persepsi majikan dari aspek kebolehkeraan pekerja lulusan SLDN di sektor pekerjaan. Disamping itu juga, pekerja lulusan SLDN diberi peluang untuk menilai sendiri tahap kebolehkeraan mereka mengikut persepsi sendiri. Menurut Lindzey dan Aronson (1985), persepsi mencakupi konteks kehidupan sosial, sehingga dikenali persepsi sosial. Tahap kebolehpasaran graduan yang dinilai dalam kajian ini juga akan dapat memberikan petunjuk tentang tahap penerimaan majikan lulusan SLDN dari segi mobiliti, tawaran gaji dan bilangan yang ditawarkan pekerjaan oleh majikan mengikut bidang-bidang kemahiran yang diperlukan. Kajian ini juga diharapkan dapat memberi indikator kepada pihak yang bertanggungjawab supaya polisi yang berkaitan dengan perancangan dan pelaksanaan program SLDN dipertingkatkan lagi.

## **3.0 Definisi Kebolehkeraan**

Secara komprehensif, kebolehkeraan boleh ditakrifkan sebagai kualiti yang diperlukan oleh seseorang individu dalam melakukan kerja hariannya, kompeten dengan tugasnya, dan sekiranya perlu, dia juga mampu melakukan sebarang perubahan dalam kerja jika wujud perubahan dalaman dan luaran di organisasinya (Xiaoling dan Long, 2011). Bagi seseorang individu, kebolehkeraan merangkumi set kemahiran, pengetahuan dan sikap yang dia perlu miliki, sebagai aset untuk dipersembahkan kepada bakal majikan mahupun majikan sedia ada. Menurut Hillage dan Pollard (1998), kebolehkeraan bermaksud keupayaan seseorang untuk melaksanakan pekerjaannya, terus melaksanakan pekerjaan sedia ada dan mendapatkan pekerjaan baru sekiranya perlu. De Vos et al. (2011) mentafsirkan kebolehkeraan sebagai memenuhi, memperoleh dan mewujudkan kerja secara berterusan kearah mencapai penggunaan kebolehan yang optimum. Pada dasarnya, ia juga merujuk kepada keupayaan individu untuk mendapatkan dan mengekalkan pekerjaan atau untuk mendapatkan pekerjaan lain jika seseorang itu ingin menukar atau telah diberhentikan kerja. Definisi ini juga telah dipetik daripada istilah mendapat pekerjaan yang biasa digunakan oleh Pertubuhan Buruh Antarabangsa (ILO, 2008).

## **3.0 Kebolehpasaran Dari Sudut Ekonomi**

Struktur ekonomi dan sosial sesebuah Negara adalah bergantung pada trend pasaran buruh yang mana ianya juga memberi kesan terhadap pembentukan institusi, kandungan pembelajaran dan pendidikan yang ditawarkan. Akibatnya, pendidikan vokasional tidak lagi

semata-mata dijangka menyediakan peluang pembelajaran untuk pembangunan kemahiran awal tetapi juga untuk membolehkan pekerja membuktikan kemampuan diri mereka di alam pekerjaan (Gonon et. al, 2010). Hasil kajian De Vos et al. (2011) menunjukkan kejayaan kerjaya seseorang individu mempunyai hubungkait yang positif dengan kebolehpasaran yang dimilikinya. Shephard (1989) turut menjelaskan, pekerjaan mempunyai potensi untuk memenuhi bukan sahaja ekonomi seseorang juga memberikan atau memenuhi keperluan sosial dan peribadi seseorang. Individu yang mempunyai kemahiran adalah lebih mudah untuk diterima kerja oleh majikan dan mempunyai potensi untuk memajukan syarikat (Harvey, 2001). Menurut Juhdi et al. (2010), dalam kajiannya mentakrifkan kebolehpasaran sebagai *... a person is able to remain in his or her job that eventually could help him or her climb the career ladder...* Secara dasarnya, kebolehpasaran bermakna seseorang yang berupaya mengekalkan pekerjaan beliau yang akhirnya boleh membantu dirinya mengembangkan kerjayanya di peringkat yang lebih tinggi dan kompetatif. Dari sudut ekonomi, Juhdi et al. (2010), menjelaskan bahawa *...employees have to stay marketable given the uncertain economic condition...* Kenyataan ini menjadi panduan kepada penyelidik dalam mengukur tahap kebolehpasaran pekerja lulusan SLDN.

#### 4.0 Metodologi Kajian

Menurut Gajendra (1981), kajian deskriptif membekalkan data-data yang penting untuk penyelidikan dan membolehkan penerangan dilakukan terhadap sesuatu fenomena dengan menganalisis data-data yang diperolehi dari soal selidik. Selain itu, pendekatan kualitatif turut digunakan dalam kajian ini, supaya penyelidik dapat memberikan fokus yang lebih intensif terhadap fenomena yang dikaji (Gall et al., 2003). Kajian kualitatif yang dipilih adalah *semi-structured interviews* untuk majikan dan pekerja lulusan SLDN manakala perbincangan kumpulan terfokus diadakan untuk majikan bagi mendapatkan idea dan maklum balas mereka dalam kajian ini.

Populasi sasaran bagi kajian ini adalah terdiri daripada dua strata responden iaitu majikan dan pekerja lulusan SLDN. Majikan merupakan orang atau syarikat yang terlibat secara langsung dengan pekerja lulusan SLDN. Seramai 10,451 graduan dan majikan daripada 1,160 syarikat telah dikenalpasti sebagai responden untuk kajian ini (Q-Fact SLDN & MOSQ, JPK, 2011). Daripada jumlah ini juga, 71.94% graduan telah berjaya memperoleh tahap 1 dan 2, 26.45% SKM tahap 3 dan 1.61% bagi tahap 4, pada tahun 2011. Kajian ini menggunakan pendekatan kaedah persampelan kluster, rawak berstrata dan peratus perkadaran. Memandangkan populasi kajian melibatkan pekerja lulusan SLDN, pengkaji telah memikirkan beberapa kekangan yang mungkin dihadapi semasa mendapatkan akses kepada pekerja terbabit, antaranya maklumat perhubungan seperti alamat terkini, nombor telefon dan alamat tempat bekerja. Oleh yang demikian, peratus perkadaran telah digunakan bagi mengira bilangan sampel yang sesuai mengikut negeri-negeri yang diklusterkan mengikut enam zon kawasan. Dengan menggunakan jadual penentuan saiz sampel berdasarkan populasi (Krejcie & Morgan, 1970), didapati bahawa nilai sampel yang diperlukan dalam kajian ini adalah 291 untuk responden majikan manakala 370 orang untuk responden pekerja lulusan SLDN.

Penganalisan data dalam kajian dilakukan dengan menggunakan dua kaedah iaitu analisa deskriptif dan inferensi. Analisa deskriptif digunakan bagi tujuan menggambarkan taburan data secara kecenderungan memusat, dimana data dapat dijelaskan dengan menggunakan sama ada taburan kekerapan, peratusan, mod, median atau min. Manakala kaedah inferensi digunakan bagi tujuan melihat perhubungan yang mungkin wujud di antara pembolehubah-pembolehubah yang hendak dikaji. Data-data yang diperolehi daripada kajian kuantitatif adalah berbentuk data kekerapan dan analisis data dilakukan dengan menggunakan perisian *Statistical Package for the social Science* (SPSS versi 17.0). Bagi analisa kualitatif,

data temuduga dan FGD ditranskripsikan kemudian ditaip bagi tujuan pengekodan data. Transkripsi dibaca dan tema-tema dikenal pasti kemudian dikodkan. Proses pengekodan dijalankan sehingga tamat satu transkripsi temuduga bagi seorang peserta kajian. Hasil analisis data temuduga boleh juga dipersembahkan dalam bentuk memerihalkan semula atau menggunakan kekerapan tema yang diperolehi melalui transkripsi temuduga. Kesemua jenis temuduga boleh dianalisis mengikut proses yang sama iaitu dengan menghasilkan tema-tema atau dipersembahkan dalam bentuk petikan percakapan peserta kajian. Penganalisan data-data kualitatif ini dilakukan dengan menggunakan perisian QSR NVivo 9.

## **5.0 Dapatan Kajian**

Berdasarkan kajian kuantitatif yang telah dijalankan, daripada 400 borang soal selidik yang telah diedarkan kepada pekerja lulusan SLDN di 6 zon kawasan seluruh Malaysia, hanya 372 borang sahaja yang dikembalikan dan dijawab (Kadar respons adalah 93.0%). Namun begitu, bilangan respons ini telah mencapai sasaran jumlah sampel responden pekerja yang diperlukan dalam kajian (370 orang). Manakala, sebanyak 350 borang soal selidik majikan telah diedarkan, dan hanya 315 borang sahaja yang telah diisi dan dikembalikan (dengan kadar respons 90.0%), yang mana juga telah mencapai sasaran jumlah yang diperlukan dalam kajian ini (291 majikan). Hasil daripada kutipan data yang telah dijalankan, kebanyakkan taburan responden tertumpu pada kategori SME iaitu 92.7% dari kalangan majikan dan 56.2% adalah pekerja. Responden yang berada dalam kategori MNC adalah 3.8% majikan dan 41.1% adalah pekerja. Bagi kategori GLC, hanya sebilangan kecil sahaja majikan dan pekerja terlibat dalam kajian ini. Mengikut zon kawasan, didapati zon tengah mempunyai responden yang paling tinggi berbanding zon-zon yang lain iaitu sebanyak 39.0% majikan dan 54.0% pekerja lulusan SLDN.

## **6.0 Persepsi Terhadap Kebolehkeraan**

Berdasarkan analisa yang dijalankan, menunjukkan bahawa tahap kebolehkeraan pekerja lulusan SLDN secara keseluruhannya dari persepsi majikan dan pekerja lulusan SLDN adalah berada di tahap persepsi positif. Ini berdasarkan kepada nilai skor min keseluruhan yang tinggi iaitu 4.0740 bagi majikan dan 4.2302 bagi pekerja. Hasil dapatan ini juga menunjukkan 88.5% majikan memberikan persepsi yang positif terhadap tahap kebolehkeraan pekerja lulusan SLDN. Manakala, seramai 93.0% pekerja lulusan SLDN turut memberikan persepsi yang positif terhadap kebolehkeraan mereka di alam pekerjaan. Hasil analisa tahap persepsi secara keseluruhan, didapati tahap kebolehkeraan dari persepsi majikan dan pekerja adalah positif. Ini menunjukkan bahawa majikan menganggap pekerja lulusan SLDN telah memenuhi keperluan kebolehkeraan yang terdiri daripada faktor-faktor kemahiran teknikal, pengetahuan kerja, sikap dan kemahiran sosial. Hasil kajian juga menunjukkan pekerja turut memberikan persepsi yang sama terhadap tahap kebolehkeraan mereka.

## **7.0 Persepsi Terhadap Kebolehpasaran**

Hasil kajian terhadap pekerja lulusan SLDN menunjukkan 93.6% daripada mereka boleh mendapatkan pekerjaan dalam tempoh kurang daripada 6 bulan setelah menamatkan latihan. Dapatan kajian juga menunjukkan kemampuan lulusan SLDN ini memperolehi pekerjaan adalah lebih baik daripada yang ditunjukkan dalam kajian terdahulu (JPK, 2010). Menurut kajian yang dijalankan oleh ibu pejabat JPK, menunjukkan hanya 62.6% daripada lulusan SLDN boleh mendapatkan pekerjaan dalam tempoh 6 bulan selepas tamat latihan. Sebaliknya, kajian ini mendapati hanya sebilangan kecil lulusan SLDN terpaksa menunggu

lebih 6 bulan untuk mendapatkan pekerjaan pertama mereka iaitu sebanyak 6.4% sahaja. Perbandingan diantara kajian ini dan kajian terdahulu (JPK, 2010) menunjukkan terdapatnya peningkatan graduan lulusan SLDN yang memperolehi pekerjaan dalam tempoh kurang daripada 6 bulan. Ini juga menunjukkan bahawa pekerja lulusan SLDN semakin mendapat sambutan daripada pihak majikan khususnya di sektor industri kecil dan sederhana. Dapatan analisa juga disokong dengan kenyataan majikan yang menyatakan bahawa permintaan terhadap pekerja lulusan SLDN adalah tinggi dan sentiasa diperlukan di pasaran kerja. Dari hasil analisa tahap persepsi, didapati bahawa majikan dan pekerja juga telah memberi persepsi positif terhadap elemen ini.

## **8.0 Hubungan Kebolehkerjaan dan Kebolehpasaran**

Hasil kajian menunjukkan bahawa setiap faktor yang dikaji mempunyai hubungan diantara satu sama lain, sama ada mempunyai hubungan yang sederhana mahupun kuat. Penyelidik juga mengesan hubungan diantara kebolehkerjaan dan kebolehpasaran berada di tahap kuat, dari persepsi majikan dan pekerja. Disebabkan analisa ini tidak dapat menjelaskan sejauh mana kebolehkerjaan mempengaruhi kebolehpasaran pekerja lulusan SLDN di alam pekerjaan, penyelidik telah menggunakan analisa regresi bagi mengesan sejauh mana faktor-faktor yang dikaji dalam kebolehkerjaan mempengaruhi tahap kebolehpasaran pekerja-pekerja ini dari persepsi majikan. Hasil analisa mendapati bahawa, hanya ada tiga faktor sahaja mempunyai hubungan yang signifikan terhadap kebolehpasaran pekerja lulusan SLDN dari persepsi majikan iaitu, kemahiran teknikal, sikap dan kemahiran sosial. Manakala faktor pemalar dan pengetahuan kerja tidak mempunyai hubungan yang signifikan dengan kebolehpasaran pekerja pada aras keertian 1 peratus. Walaupun faktor pengetahuan kerja tidak mempunyai hubungan yang signifikan, namun ianya masih memberi sumbangan sebanyak 0.092 dalam persamaan regresi kebolehpasaran. Hasil analisa turut memberi gambaran bahawa majikan sangat mementingkan faktor kemahiran sosial dalam menentukan kebolehpasaran pekerja lulusan SLDN. Antara kemahiran sosial yang menjadi perhatian majikan adalah seperti kemahiran komunikasi, disiplin diri, kemahiran pembelajaran dan kemahiran konseptual (kemahiran membuat keputusan). Namun begitu, berdasarkan analisa yang dijalankan juga, didapati hanya 73.0% sahaja faktor-faktor yang diuji memberi sumbangan kepada kebolehpasaran pekerja lulusan SLDN ini. Ini menunjukkan bahawa terdapat kewujudan faktor-faktor lain yang mungkin juga memberi kesan keatas kebolehpasaran pekerja-pekerja ini. Untuk memahami keadaan ini lebih mendalam, satu kajian lain perlu dilakukan bagi mengenalpasti faktor-faktor tersebut, yang mana didapati turut memberi sumbangan dalam meningkatkan kebolehpasaran pekerja lulusan SLDN di alam pekerjaan.

## **9.0 Cadangan Dan Kesimpulan**

Hasil daripada kajian ini diyakini dapat memberikan gambaran sebenar terhadap tahap kebolehkerjaan dan kebolehpasaran pekerja lulusan SLDN. Secara keseluruhannya, majoriti responden yang terlibat dalam kajian ini menyokong program latihan SLDN ini agar diteruskan dan dimantapkan lagi pelaksanaannya di masa-masa depan. Sokongan dan bimbingan yang berterusan daripada pihak pengurusan JPK sangat diperlukan untuk memastikan sasaran pencapaian pekerja yang berdaya saing tercapai dan memenuhi keperluannya menjelang tahun 2020. Pendedahan yang lebih efektif perlu diperkenalkan bagi meningkatkan enrolmen perantis SLDN di sektor pekerjaan, di samping menambah kesedaran orang awam tentang peri pentingnya peranan pekerja berkemahiran dalam mencapai taraf Negara maju.



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# P1 - Development Of Teaching Method For PLCMikro

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## **Abstrak**

*PLCMIKRO (PLC & microcontroller) merupakan gabungan antara PLC (Programmable Logic Controller) dengan PIC (Peripheral Interface Controller). PLCmikro training kit ini dibina dengan tujuan untuk memperkenalkan sistem kawalan yang dapat berfungsi seperti PLC. PLCmikro ini terdiri dari sistem minimum mikro pengawal PIC16F877A (32 I/O), rangkaian input yang terdiri daripada rangkaian suis, deep switch, potensiometer dan sensor. Manakala rangkaian output pula terdiri daripada rangkaian solenoid valve, 7 segment, Lampu dan contactor. Software LDmicro digunakan sepenuhnya bagi membina ladder diagram dalam menulis program yang dikehendaki. Bagi membuktikan PLCmikro ini boleh berfungsi dalam sistem automasi, sistem asas pneumatic dibina pada training kit. Buku kerja (Workbook) juga turut disertakan bersama PLCmicro training kit ini bagi memudahkan pelajar mengulang-kaji penggunaan training kit ini.*

**Keywords:**PLCmikro, sensor, pneumatik, PIC16F877A, LDmicro

## **1. Pengenalan**

Kemajuan ilmu pengetahuan dan teknologi telah mendorong manusia untuk berusaha mengatasi segala permasalahan yang timbul di sekitarnya serta meringankan pekerjaan yang ada. Salah satunya dunia perindustrian yang tidak hanya berperanan dalam satu bidang sahaja, melainkan disegenap bidang kehidupan manusia. Banyak perkara yang mungkin ketika ini memerlukan penyelesaian permasalahan dimana ianya mengkehendaki perbelanjaan wang, waktu, tenaga yang amat banyak untuk menyelesaikannya. Dengan adanya kemajuan teknologi pada masa ini, permasalahan tersebut dapat dikurangkan seminiimum mungkin. Salah satu contohnya pada alat PLC yang dapat dibina dengan sesederhana mungkin dengan memanfaatkan mikro pengawal sebagai komponen utamanya.

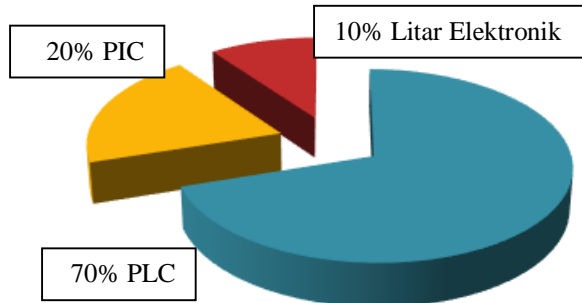
### **1.1 Latar Belakang**

Di antara faktor awal yang mewujudkan rekaan dan pembangunan sistem kawalan PLCmikro adalah seperti berikut :

- 1.1.1 Keperluan kos yang rendah
- 1.1.2 Mudah diaturcarakan
- 1.1.3 Pengawal yang mudah dikawal
- 1.1.4 Sistem pendawaian yang ringkas dan mudah
- 1.1.5 Lebih kecil, murah dan keboleharapan yang tinggi
- 1.1.6 Binaannya ringkas dan penyelenggaraanya murah

## 1.2 Kajian Lapangan

Hasil penelitian yang dijalankan dari tahun 2010 hingga 2012 kebanyakan pelajar lebih gemar menggunakan PLC sebagai peranti pengawal pada projek akhir mereka. Kajian menunjukkan;



- 70% pelajar memilih PLC (PLC Nais, Omron, dan lain-lain)
- 20% pelajar memilih mikro pengawal (PIC16F877, Arduino dan lain-lain)
- 10% pelajar memilih sistem elektronik (litar pengawal, papan litar ganti dan sebagainya)

Ini kerana PLC mempunyai kelebihan seperti;

- É Mudah dibuat pengubahsuaian aturcaranya.
- É Rekabentuk sistem kawalan mudah diubah dengan menggunakan perisian.
- É Aplikasi kawalan yang meluas.
- É Kebolehharapannya tinggi.
- É Ketahanan kepada masalah persekitaran proses( suhu, lembapan, ketidakstabilan voltan dan hingar ) yang baik.

Manakala PIC mempunyai kelebihan seperti;

- É Kos pembuatan yang murah
- É Kecekapan untuk menjalankan arahan atau program yang telah diprogramkan.
- É Kemudahan untuk menaiktaraf pengawal mikro dan perisian.
- É Senang diperolehi jika berlaku kerosakan bagi tujuan pembaikan dan penggantian IC
- É Jumlah masukan/keluaran (I/O) yang banyak dan flexible.
- É Kebolehan pengawal mikro untuk kegunaan aplikasi analog dan digital.

## 1.3 Penyataan Masalah

Walaupun PLC lebih gemar digunakan oleh pelajar, tetapi kos untuk membeli PLC adalah lebih mahal jika dibandingkan dengan PIC. Sebagai contoh; PLC jenis Nais dengan 32 I/O berharga lebih kurang RM1070 manakala PIC SK40C dengan 32 I/O berharga lebih kurang RM100. Perbezaan kos melebihi 10 kali ganda.

Permasalahan lain yang dihadapi apabila jumlah input melebihi jumlah output ataupun sebaliknya. Contohnya jika nilai input dikehendaki 17 manakala output yang diperlukan hanya 2 port sedangkan PLC tersebut mempunyai 32 I/O iaitu 16 Input dan 16 Output. 1 unit PLC expansion diperlukan lagi bagi mengisi 1 port input yang tidak mencukupi sedangkan terdapat 14 output yang masih tidak digunakan. Harga 1 unit PLC expansion biasanya menyamai harga sebuah primary PLC.

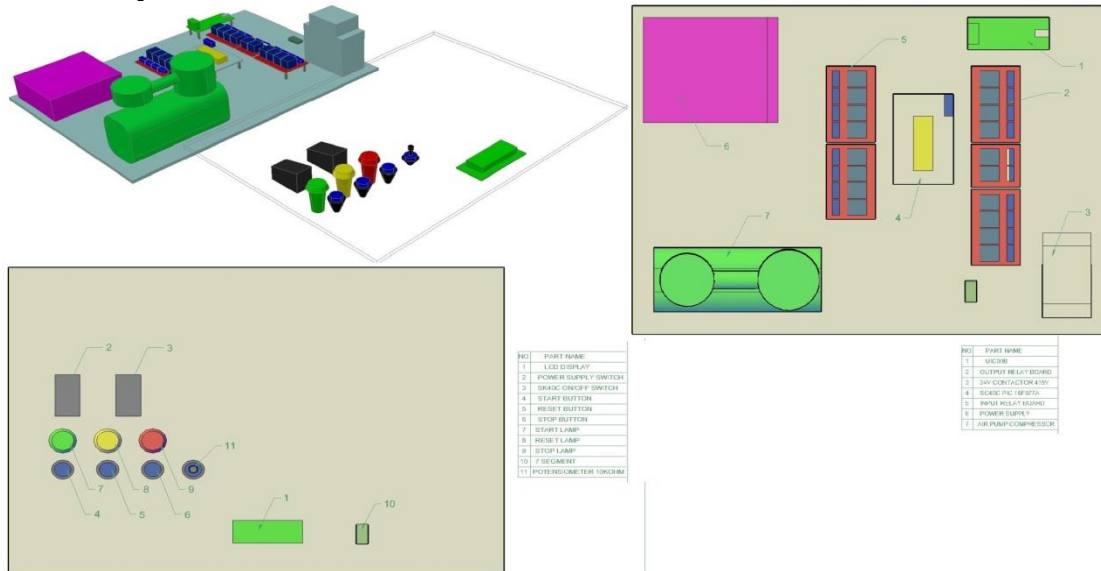
## 2. Kaedah Pembelajaran

Kaedah pembelajaran secara konvensional pelajar perlu mempelajari subjek-subjek seperti PLC, Microcontroller, pengaturcaraan C atau C++, elektronik, electro-pneumatik dan sebagainya. Pembelajaran ini dijalankan dari peringkat sijil hinggalah ke ijazah. Kemampuan pelajar untuk menggunakan microcontroller menjadi sukar kerana tidak ke semua subjek

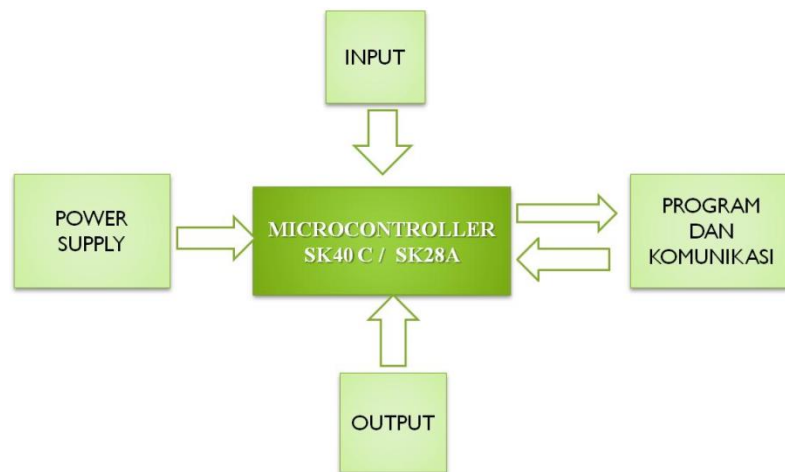
tersebut diajar diperingkat sijil lagi. Kelemahan paling ketara ialah subjek-subjek tersebut diajar secara berasingan dan tidak dikaitkan secara terus antara setiap subjek. Kos penyediaan peralatan pengajaran juga tinggi kerana pihak institute perlu menyediakan makmal-makmal tertentu.

Kaedah pembelajaran PLC mikro ini membolehkan pelajar mempelajari PLC dan microcontroller pada masa yang sama. Ianya membolehkan microcontroller di programkan menggunakan ladder diagram, di mana pelajar tidak perlu mengetahui pengaturcaraan C dan C++. Ini akan membolehkan pelajar mempelajari penggunaan microcontroller di peringkat awal (sijil) lagi.

### 3. Keputusan Dan Analisis



Rajah 1: Rekabentuk PLC mikro Training Kit

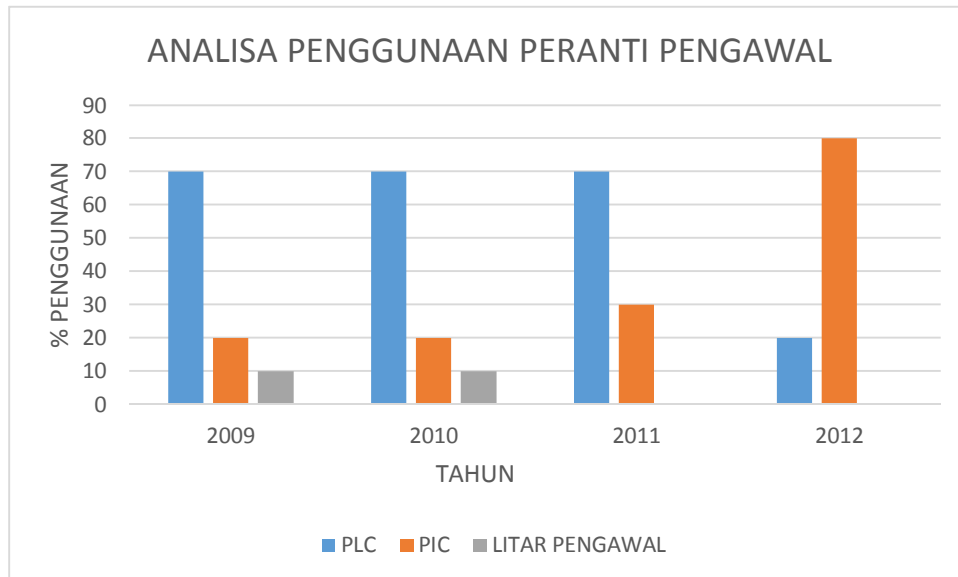


Rajah 2: Blok Diagram Asas PLC mikro

Hasil dari maklum balas dan cadangan yang diberikan oleh peserta satu training kit berserta dengan buku panduan telah dibangunkan. Training kit module ini mempunyai kelebihan-kelebihan berikut;

- (1) Kos membina training kit yang murah

- (2) Mempelbagaikan bekalan kuasa 5v, 12v dan 24v. Training kit PLCmikro ini hanya perlu dibekalkan dengan bekalan kuasa 240V untuk berfungsi sepenuhnya. Ini menjadikan system ini amat mudah alih.
- (3) Menggunakan papan geganti (relay board) untuk menerima isyarat masukan atau menghantar isyarat keluaran. Relay board ini juga berfungsi sebagai penukar (switching) voltan/arus masukan 24v kepada 5v dan voltan/arus keluaran dari 5v kepada 12v atau 24v.
- (4) Menggunakan SK40C sebagai peranti pengawal.
- (5) Menggunakan perisian LDmicro bagi menulis program ke dalam PIC16F877A.
- (6) Portable compressor digunakan bagi membekalkan angin termampat pada sistem pneumatik.
- (7) Contactor dengan coil 24v digunakan bagi membolehkan motor 3 phase, 240V atau 415V dikawal menggunakan PLCmikro.
- (8) Potentiometer 10kohm digunakan bagi menunjukkan bahawa PLCmikro boleh menerima isyarat dalam bentuk analog.
- (9) UIC00B disambungkan secara terus dengan SK40C bagi membolehkan program terus di muatnaik (upload) ke dalam PIC.
- (10) Motor berkuasa 5V di sambung kepada PLCmikro bagi menunjukkan isyarat analog sebagai isyarat keluaran (PWM).



**Rajah 3:** Kadar penggunaan peranti kawalan di ADTECBP



## 4. Kesimpulan

PLCmikro boleh digunakan sebagai alat pengajaran dalam pembelajaran teknologi kejuruteraan mekatronik secara khusus. Di dalamnya terkandung kejuruteraan mekanikal seperti sistem pneumatik, kejuruteraan elektrik/elektronik seperti system litar geganti input dan output, kejuruteraan perisian seperti penggunaan perisian LDmicro, dan kejuruteraan automasi seperti sistem kawalan electro-pneumatik.

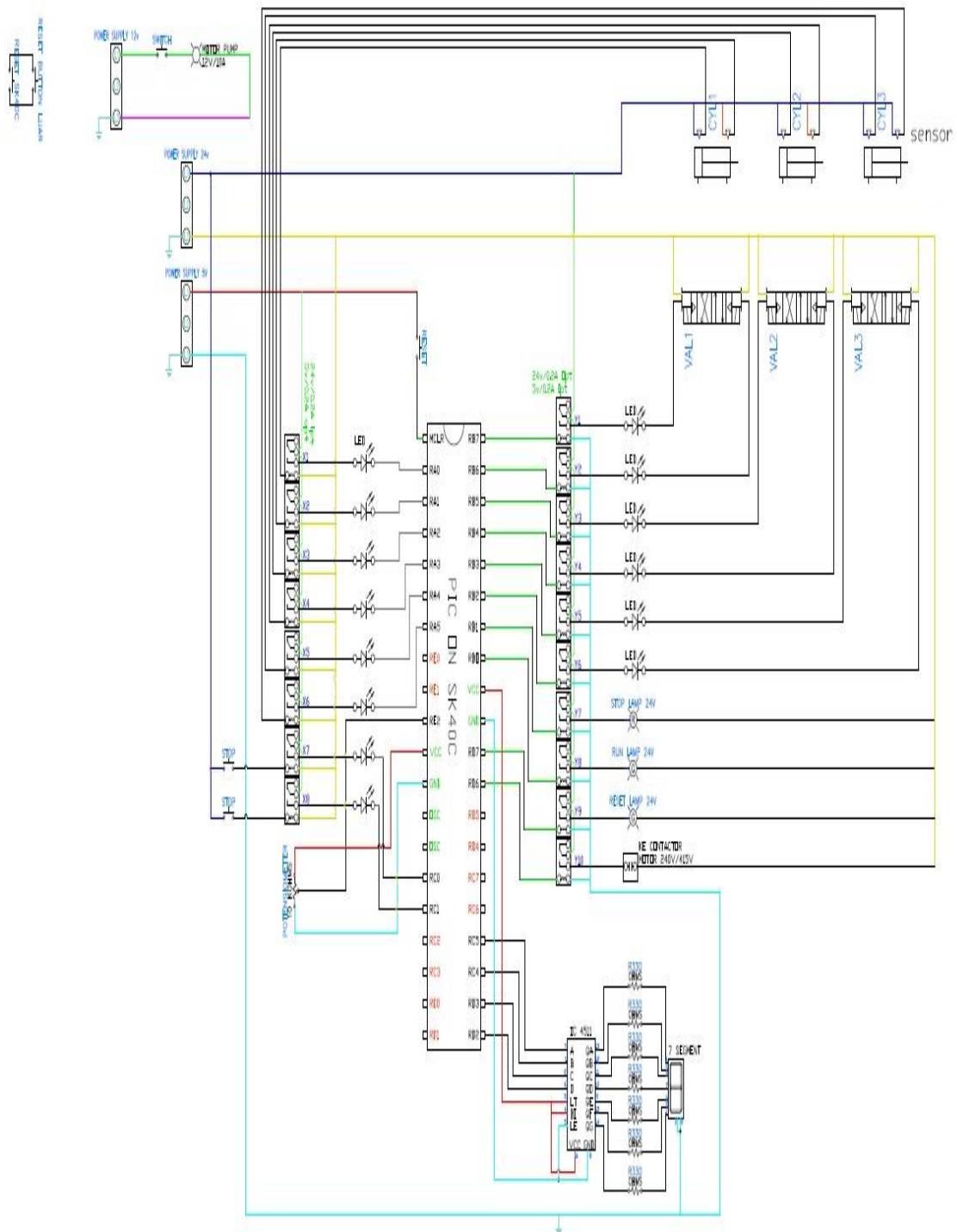
Kajian juga menunjukkan peningkatan minat dikalangan pelajar peringkat rendah bermula dari kolej vokasional (tingkatan 4&5) hinggalah ke peringkat diploma untuk menggunakan PIC sebagai peranti kawalan.

Pengembangan sistem PLCmikro ini bukan sahaja membolehkan pelajar mempelajari asas kefungsiian PLC tetapi pada masa yang sama pelajar juga dapat mempelajari kefungsiian PIC. Ianya juga merupakan langkah pertama dalam usaha untuk menghasilkan PLC buatan Malaysia.

## 5. Rujukan

- [1] Karl-Heinz John, Michael Tiegelkamp, *IEC 61131-3: Programming Industrial Automation Systems*, 2nd Edition, 2010.
- [2] Chuck Hellebuyck, *Programming PIC Microcontrollers with PicBasic*, 2003.
- [3] Microchip, *PIC16F87XA Data Sheet, 28/40/44-Pin Enhanced Flash Microcontrollers*, 2003.
- [4] Cytron Technologies, *SK40C, Enhanced 40 Pins PIC Start-Up Kit, User's Manual V1.2*, Dec 2010

## APENDIKS



**Rajah 6: Litar asas PLCmikro**



## P2 - Integrated Intelligent Home Management System

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### Abstrak

*Tempat kediaman merupakan salah satu keperluan asas bagi manusia. Kediaman yang selesa mampu menjamin kualiti hidup yang baik dan mampu membawa kepada keharmonian serta peningkatan dalam produktiviti kerja seharian. Projek ini berkisar mengenai membina sebuah prototaip rumah pintar terintegrasi untuk keselesaan, kemudahan dan keselamatan semua penghuninya. Rumah pintar bukanlah suatu yang baru tetapi buat masa ini, sistem seperti ini memakan kos dan kepakaran yang tinggi. Ia juga masih belum mendapat tempat sebagai keperluan hidup. Oleh itu, prototaip ini menerokai teknologi rumah pintar menggunakan kawalan microcontroller yang murah yang merangkumi sistem keselamatan, kemudahan dan keselesaan penghuninya. Buat masa ini, microcontroller yang digunakan adalah dari siri arduino yang merupakan open Source platform. Projek ini dibangunkan secara modular yang bermaksud beberapa modul individu dibangunkan dan kemudiannya diintegrasikan dalam sistem kawalan utama. Pengguna boleh memilih modul yang dikehendaki yang kemudiannya ia akan diintegrasikan dengan sistem mengikut pilihan. Perkhidmatan yang disediakan adalah khidmat rundingan, penjualan komponen-komponen dan khidmat pengaturcaraan. Selain itu, pihak kami juga menyediakan khidmat pemasangan jika perlu. Jika tidak, pengguna boleh memilih untuk memasangnya secara sendiri atau DIY. Memandangkan sistem rumah pintar masih belum diterokai sepenuhnya serta mempunyai pasaran yang sangat luas, hasil dari prototaip ini mendapati ia boleh digunakan dan dibangunkan serta boleh dikembangkan bukan sahaja untuk pengurusan rumah, malah untuk kegunaan pengurusan sistem di pejabat, hotel, kedai, dan kawasan perusahaan seperti kawasan penternakan dan pertanian.*

### 1.0 Pengenalan

Tempat kediaman merupakan salah satu keperluan asas bagi manusia. Kediaman yang selesa mampu menjamin kualiti hidup yang baik dan mampu membawa kepada keharmonian serta peningkatan dalam produktiviti kerja seharian. Selain itu, kemajuan dalam bidang sains dan teknologi memungkinkan pelbagai ciptaan baru yang berteraskan kepada sistem automasi direka dan diguna pakai dalam kehidupan seharian bagi member lebih keselesaan.

I2HoMeS merupakan satu projek inovasi berkisar mengenai membina sebuah prototaip rumah pintar terintegrasi untuk keselesaan, kemudahan, pemantauan dan keselamatan semua penghuninya. Prototaip ini menumpukan kepada penggunaan controller mikro yang lebih murah yang sedia ada dipasaran. Ia diintegrasikan ke dalam satu sistem bersepadu untuk kawalan sistem dirumah seperti suhu dan lampu disamping memantau rumah terutamanya ketika tiada orang di rumah. Ia melibatkan pembangunan dan integrasi sistem kawalan, pembangunan perisian dan sistem komunikasi antara semua sistem.

Oleh kerana sistem rumah pintar masih belum diterokai sepenuhnya dan mempunyai pasaran yang sangat luas, prototaip ini diharap dapat merintis jalan kepada penghasilan suatu produk inovasi untuk semua. Selain itu, aplikasi yang sama mampu dikembangkan bukan sahaja untuk pengurusan rumah, malah untuk kegunaan pengurusan sistem di pejabat, hotel,

kedai, dan kawasan perusahaan seperti kawasan penternakan dan pertanian.

## 2.0 Latarbelakang

Rumah pintar bukanlah suatu yang baru tetapi buat masa ini, sistem seperti ini memakan kos puluhan ribuan ringgit. Rumah merupakan keperluan asas manusia yang mana hak untuk mendapat rumah yang selesa dan selamat merupakan hak semua individu.

Oleh itu, prototaip ini menerokai teknologi rumah pintar menggunakan kawalan kontroler mikro yang lebih murah. Dengan itu, pelbagai sensor dan komponen elektronik yang menggunakan arus terus (DC) boleh digunakan. Pelbagai sensor yang kecil dan murah boleh di integrasi kedalam sistem ini sebagai contoh sensor cahaya dan sensor suhu. Ia juga boleh mengawal alat lektrik berarus ulang-alik (AC) 240 V dengan menggunakan Solid State Relay yang lebih efisien. Dengan itu sistem sedia ada rumah seperti TV dan lampu masih boleh dikawal oleh sistem ini.

Dengan ini, sistem ini tidak memerlukan kos yang terlalu tinggi serta tidak memerlukan kepakaran yang tinggi untuk dipasang. Ia lebih berkosep *DIY* dan *Plug and Play* serta dibangunkan atau boleh diselaraskan mengikut keperluan.

## 3.0 Penerangan Projek

Seperti yang telah dinyatakan, rumah pintar ini akan dikawal oleh controller mikro berdasarkan produk keluaran Arduino yang banyak terdapat dipasaran. Komponen utamanya adalah sistem kawalan utama. Dalam projek ini, Arduino Mega 2560 digunakan sebagai kawalan utama. Kawalan utama ini merupakan komponen wajib yang perlu ada jika pengguna ingin memasang sistem ini dirumah. Selepas itu, pengguna hanya perlu memilih modul-modul yang perlu mengikut keperluan. Nasihat rundingan akan diberikan kepada pengguna dan seterusnya komponen-komponen yang perlu dibeli akan dinyatakan.

Selain itu, terdapat juga kawalan sekunder bagi sistem ini. Di sini, projek ini menggunakan Arduino nano sebagai kawalan sekunder. Kawalan sekunder adalah penting tetapi tidak wajib. Ini bagi memudahkan pendawaian dan pengaturcaraan. Kawalan utama akan diletakkan di dalam rumah yang mengawal segala data dari dalam sistem atau dari kawalan sekunder dan juga mengawal hubungan dengan dunia luar. Kawalan sekunder pula boleh digunakan sebagai kawalan setempat sebagai contoh kawalan untuk tingakat atas, atau kawalan peranti luar rumah.

Komunikasi antara sistem kawalan ini boleh dilakukan secara tanpa wayar menggunakan Bluetooth atau radio frekuenz atau dengan wayar menggunakan komunikasi serial, I<sup>2</sup>C atau Power line Communication. Projek ini mengaplikasikan komunikasi secara radio frekuenz, I<sup>2</sup>C dan komunikasi serial untuk diagnostic.

Selain itu, rumah pintar ini mampu berkomunikasi dengan dunia luar jika modul komunikasi dipilih. Dengan itu, sistem dapat berhubung dengan pengguna jika perlu sebagai contoh untuk memberitahu bahawa rumah telah dimasuki. Ia juga pintu kepada komunikasi luar sebagai contoh telefon pintar. Terdapat dua jenis modul komunikasi yang sedang dibangunkan iaitu sistem menggunakan GSM dan juga menggunakan internet.

Sistem rumah pintar ini dibangunkan mengikut modul-modul tertentu. Pelanggan boleh memilih modul-modul yang dikehendaki, dan ia akan dikonfigurasi mengikut kehendak pelanggan. Ia mempunyai sistem kawalan utama dan ia boleh disambungkan dengan sistem kawalan sekunder yang mengawal sebahagian kawalan rumah. Sistem akan memantau rumah dan melakukan beberapa perkara yang telah ditugaskan secara automatik. Sebagai contoh mengangkat kain jika hujan. Modul-modul yang akan dibangunkan akan diterangkan dibawah

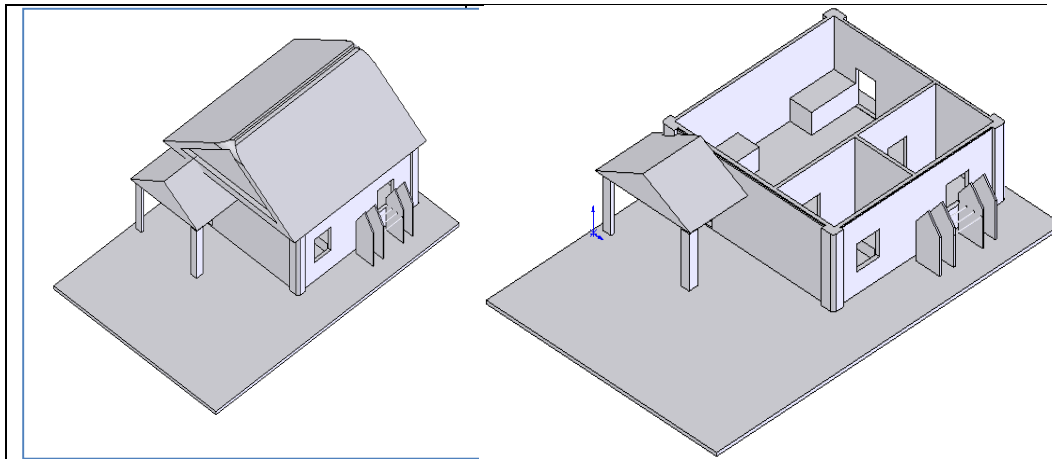
Pun begitu, penghuni masih boleh memantau dan mengawal keseluruhan sistem secara manual jika perlu selain memberi kemudahan dan keselesaan kepada penghuninya. Dengan ini penghuni akan berasa lebih selesa dan tenang tinggal di rumah kediaman sendiri.

### 3.1 Modul-Modul Sistem

Antara sistem-sistem yang akan diintegrasikan ke dalam sistem rumah pintar ini adalah seperti berikut.

- Modul kawalan utama dan sekunder
- Modul komunikasi luar (GSM atau internet)
- Modul perhubungan dalaman ( wireless atau wayar atau Power line communication)
- Modul kawalan keluar masuk menggunakan sistem RFID dan juga kata laluan
- Modul pengesanan gas
- Modul pengesanan api
- Modul ampaian automatik
- Modul penyiraman automatik
- Modul pengesanan siang dan malam
- Modul kawalan jauh (IR)
- Modul pengesanan pergerakan (mengesan pencuri)
- Modul pengesanan pintu atau tingkap terbuka atau tidak
- Modul pengawalan suhu
- Modul pengecas Solar

### 3.2 Lakaran Projek



### 3.3 Kreativiti dan Inovasi

Antara inovasi projek ini ialah penggunaan sistem kawalan mikro yang murah dan sedia ada untuk mengawal operasi rumah pintar ini. Komponen yang digunakan adalah komponen standard dan *Open Source* pada kos yang lebih efektif. Perisiannya juga adalah percuma.

Selain itu, sistem ini adalah sistem menyeluruh dan tidak terhad kepada kawalan

keselamatan sahaja. Sistem ini dibangunkan untuk lebih fleksibel dengan keperluan pengguna yang pelbagai ragam. Pengguna boleh memilih modul-modul yang dikehendaki sahaja mengikut keperluan yang diperlukan. Ini memberi lebih fleksibiliti kepada pengguna. Rumah pintar ini dibangunkan menggunakan sistem-sistem ringkas dan mudah agar pengguna boleh memasangnya sendiri.

Inovasi lain adalah sistem komunikasi dengan dunia luar yang memberi kemudahan kepada pengguna untuk memantau keadaan rumah ketika keluar menggunakan telefon pintar atau komputer. Dari segi kreativiti pula, sistem ini menggabungkan pelbagai sistem kecil yang banyak cipta menjadi satu projek besar terintegrasi. Selain itu, komponen-komponen yang digunakan adalah komponen standard, mudah dicari dan kos efektif.

## 4.0 Kelebihan dan Potensi Komersial

Sistem ini merupakan sistem menyeluruh dan terintegrasi yang memberi pelbagai kemungkinan kepada pelanggan. Sistem rumah pintar ini dibangunkan mengikut modul-modul tertentu. Pelanggan boleh memilih modul-modul yang dikehendaki, dan ia akan dikonfigurasi mengikut kehendak pelanggan. Oleh itu, ia lebih fleksibel dan pelanggan boleh memilih modul-modul yang dikehendaki mengikut keperluan masing-masing.

Rumah pintar ini juga mampu berkomunikasi dengan dunia luar jika modul komunikasi dipilih. Dengan itu, sistem dapat memaklumkan status rumah dan pengguna boleh menghidupkan atau mematikan peralatan elektrik di rumah hanya dengan menghantar SMS kepada sistem.

Pun begitu, penghuni masih boleh memantau dan mengawal keseluruhan sistem secara manual jika perlu selain member kemudahan dan keselesaan kepada penghuninya. Dengan ini penghuni akan berasa lebih selesa dan tenang tinggal di rumah kediaman sendiri.

### 4.1 Kelebihan

Berikut adalah antara kelebihan khusus rumah pintar ini.

- Memberi keselesaan kepada penghuni
- Mengautomatiskan beberapa sistem dalam rumah
- Rumah kediaman lebih selamat dari bahaya seperti kebakaran dan juga pencuri
- Rumah sentiasa dipantau oleh sistem
- Lebih mudah untuk mengawal peralatan dirumah

Selain itu kelebihan lain sistem ini adalah

- Sistem pada harga efektif
- Mudah diselenggara
- Menggunakan komponen standard yang mudah diganti
- Konsep *DIY* dan *Plug dan Play*
- Komponen dan perisian terbuka (open source)

### 4.2 Kesan Kepada Alam Sekitar

Tujuan rumah pintar ini antara lainnya adalah untuk membantu menjimatkan penggunaan tenaga serta mengawal sumber. Kadang-kadang dek kesibukan bekerja, kita mungkin terlupa untuk menutup lampu atau peranti elektrik. Oleh itu, sistem rumah pintar ini dilengkapi sensor yang mampu mengawal peranti-peranti ini. Sebagai contoh, sistem pencahayaan luar bergantung kepada sensor cahaya. Jika siang, lampu akan terpadam dengan

sendirinya dan jika malam, lampu akan hidup secara automatic.

Pengguna juga boleh menggunakan alat kawalan jauh untuk menutup kesemua peranti sebelum keluar kerja hanya dengan menggunakan satu butang sahaja.

Selain itu, sistem ini tidak menghasilkan sebarang bahan buangan atau mengeluarkan bahan toksik yang boleh mencemarkan alam. Peranti elektronik yang digunakan boleh dikar semuala.

### **4.3 Kesan Ergonomik**

Secara ergonomichnya pula, sistem ini menyenangkan pengguna dimana ia direka untuk member keselesaan kepada pengguna. Ia mampu memudahkan kerja seharian. Sebagai contoh, sistem penyidai automatic dimana pengguna tidak perlu mengangkat baju ketika hujan dan menyidainya semula selepas hujan berhenti. Dengan itu, pengguna dapat mengurangkan kerja-kerja tidak perlu seperti mengangkat baju.

Selain itu, sistem ini memang sangat sesuai untuk membantu pesakit-pesakit atau orang kelainan upaya. Sebagai contoh, denga alat kawalan jauh, pengguna dapat mengawal pelbagai peranti elektrik seperti Tv, lampu dan kipas tanpa perlu bergerak.

### **4.4 Potensi Komersial**

Sasaran utama projek ini adalah untuk kediaman. Oleh kerana kediaman merupakan keperluan asas manusia, ia mempunyai pasaran yang sangat luas untuk diterokai. Hari ini, masih belum ada sistem yang murah dan berkesan. Oleh itu, pasarannya masih cair, terbuka luar, global dan ia mampu dibangunkan untuk dipasarkan dan dikomersilkan. Ini kerana terdapat berbillion penduduk dunia dan banyak tempat kediaman yang boleh dilengkapi dengan sistem ini.

Selain itu, ia mampu dikembangkan kepada pasaran atau segmen lain seperti kawalan pejabat, hotel, kedai dan kawasan perusahaan. Ini mengembangkan lagi potensinya. Dengan menggunakan sistem yang sama, ia boleh disesuaikan dengan tempat seperti hotel dan pejabat. Sebagai contoh, di hotel, modul kawalan keluar masuk bilik, boleh menggunakan sistem ini.

Rumah ini direka cipta untuk bersifat global. Ini bermakna ia boleh disesuaikan dan digunakan diseluruh dunia dan idak terhad kepada pasaran tempatan sahaja. Ia ditambah dengan kos yang rendah dan menggunakan bahan yang telah sedia ada dipasaran.

## **5.0 Keputusan dan Perbincangan**

Beberapa siri ujian telah dilakukan untuk menguji dan melihat kefungsiian prototaip ini. Hasil daripada ujian yang telah dijalankan, adalah didapati hamper kesemua sistem berfungsi dengan baik.

Ujian pertama tertumpu kepada kefungsiian setiap modul secara sendirian. Ujian dilakukan dengan mengambil data daripada sensor yang berkenaan. Data ini kemudiannya diproses oleh sistem dan digunakan unutk menggerakkan sesuatu. Hasil ujian ini menunjukkan keputusan yang baik, dimana setiap sub sistem boleh beroperasi dengan baik. Selain itu, ujian komunikasi antara dua pengawal mikro telah dilakukan dan didapati bahawa ia boleh berkomunikasi dengan baik.

Setelah itu, ujian adalah tertumpu kepada mengujian modul-modul yang telah diintegrasikan kepada sistem kawalan utama. Ini bagi menguji keserasian dan melihat jika ada apa-apa masalah timbul apabila ia diintegrasikan bersama. Hasil ujian mendapati, hamper kesemua sub sistem boleh berfungsi dengan baik. Terdapat beberapa masalah yang dihadapi ketika integrasi iaitu dengan sistem komunikasi dimana komunikasi tidak dapat berfungsi

dengan baik. Selain itu, terdapat masalah dari segi bekalan kuasa, dimana sistem akan tiba-tiba terpadam apabila bekalan kuasa tidak mencukupi.

Secara keseluruhannya, sistem berfungsi dengan baik. Ia telah memenuhi objektifnya dimana hampir kesemua modul yang dibangunkan berfungsi mengikut apa yang dikehendaki.

## 5.1 Cadangan Penambahbaikan

Antara cadangan penambahbaikan yang dicadangkan adalah seperti berikut.

- Menukar bekalan kuasa kepada yang lebih tinggi.
- Menggunakan *solid state relay* bagi menggantikan gantinya biasa
- Menggunakan sistem komunikasi yang lebih efisien.
- Membangunkan lebih banyak modul-modul
- Membangunkan satu perisian yang boleh digunakan untuk memantau dan mengawal selia sistem
- Menambah kamera litar tertutup untuk menambahkan ciri-ciri keselamatan.
- Membangunkan aplikasi telefon pintar untuk memantau dan mengawal sistem.

## 6.0 Kesimpulan

Dengan lebih 6 billion penduduk dunia yang menghuni ribuan juta tempat kediaman, sistem ini dilihat mampu dipasarkan dengan mudah kerana kosnya yang murah dan menggunakan komponen yang sedia ada dipasaran disamping memberi pulangan yang lumayan. Pasaran rumah pintar masih lagi cair, dimana belum ada sistem yang murah, ringkas dan berkesan. Oleh itu, prototaip ini mampu merintis kepada pembangun rumah pintar berskala besar.

Sistem rumah pintar ini direka untuk lebih fleksibiliti agar pengguna dapat memilih modul-modul yang diperlukan sahaja. Ia juga sangat mudah dipasang dan berkonsepkan DIY dimana pengguna boleh memilih modul yang dikehendaki dan kemudiannya memasangnya sendiri di rumah.

Selain itu, aplikasi yang sama mampu dikembangkan bukan sahaja untuk pengurusan rumah, malah untuk kegunaan pengurusan sistem di pejabat, hotel, kedai, dan kawasan perusahaan seperti kawasan penternakan dan pertanian.

Hasil ujian menunjukkan keputusan yang positif, dimana hampir kesemua modul-modul yang dibangunkan dapat berfungsi dengan baik dan dapat diintegrasikan ke dalam sistem kawalan utama. Kajian mendapati, terdapat beberapa penambahbaikan yang boleh dilakukan bagi meningkatkan lagi keberkesanan sistem.

Akhir sekali, adalah didapati projek ini mempunyai potensi untuk dimajukan dengan lebih lanjut dengan mengambil kira penambahbaikan yang perlu dilakukan dan boleh dibangunkan pada skala sebenar.

## 7.0 Rujukan

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# P3 - SAJ Mobile Water Bill Calculator On Android Smartphone

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## **Abstract**

*With the development of the Android platform, more and more tasks can be done using portable devices. Especially, in this smartphone era, everything is done using our smartphone or tablets. With this limitless advantage of Android smartphone, it is a waste of technology if we do not utilize the Android smartphone to help us in doing daily routine. Calculating water bill without knowing the tariff and formula is not a pleasant task to do. Currently, people can calculate their water bill using water company website but user need to have internet to do so. In this paper, we describe how we use the Android smartphone to help user in calculating water bill on their smartphone without any internet connection. The tariff that we use is based on tariff provided by Syarikat Air Johor (SAJ) Holdings that provides the water in Johor. The objective of this application is to develop a tool to calculate water bill on our smartphone without any internet connection. SAJ already has their online calculator. Based on their online calculator, we applied the same concept to Android smartphone application. The graphical user interface (GUI) of the mobile water bill calculator is designed using XML while the main programming of the calculator is written using JAVA language. As the result, we completed the calculator on the Android emulator based on the Android 2.2 Froyo. The reason for using such an old version of Android for the application is because older version application can operate in later version smartphone but later version application might not work in older version smartphone.*

**Keywords:** *Android, Smartphone, water bill calculator*

## **1.0 Introduction**

The mobile phones have become an indispensable and inseparable object in human life. There are 3.3 billion active mobile phones in the world [1]. It is common for individuals to own more than one. The increasing dependency upon mobile phone to perform a lot of functions more capability than conventional handsets make mobile phone itself has evolved into an entirely new device that we know as smartphone.

The conception of the Android platform is attracting more and more programmers in mobile computing fields. The growth of the smartphone industry has led these devices to keep improving their function such as high resolution camera with flash, bigger screens and support the thousands of application. Since the Open Handset Alliance released the Google Android Software Development Kit (SDK) on November 12, 2007 (OHA), the conception of the Android platform is attracting more programmers to develop Android application [2]. Android application developers also prefer to interface built-in device such as sensors, Wi-Fi, Bluetooth, camera and others into their application.

In this paper, we define how we use the Android smartphone to help user in calculating water bill. The architecture of Android system [3], similar to other operating systems, use a hierarchical structure. The tariff that we use is based on tariff provided by SAJ Holdings [4]. One of the reasons for choosing SAJ is because it already has online calculator. Based on their online calculator, we applied the same concept to Android smartphone. The graphical

user interface (GUI) of the mobile water bill calculator is designed using XML while the main programming of the calculator is written using JAVA language. As the result, we completed the calculator on the Android emulator based on the Android 2.2 Froyo Application Programming Interface (API) with SDK 8 [5]. The reason for using such an old version of Android for the application is because older version application can operate in later version smartphone but later version application might not work in older version smartphone.

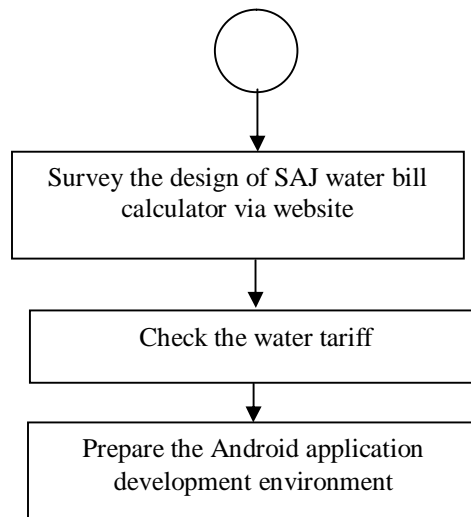
This document is organized as follows. In section 2 Methodology, the details of our work is discussed. Section 3 Results illustrates the results obtained and the analysis performed. Finally, conclusions are presented in last section of this paper.

## 2.0 Methodology

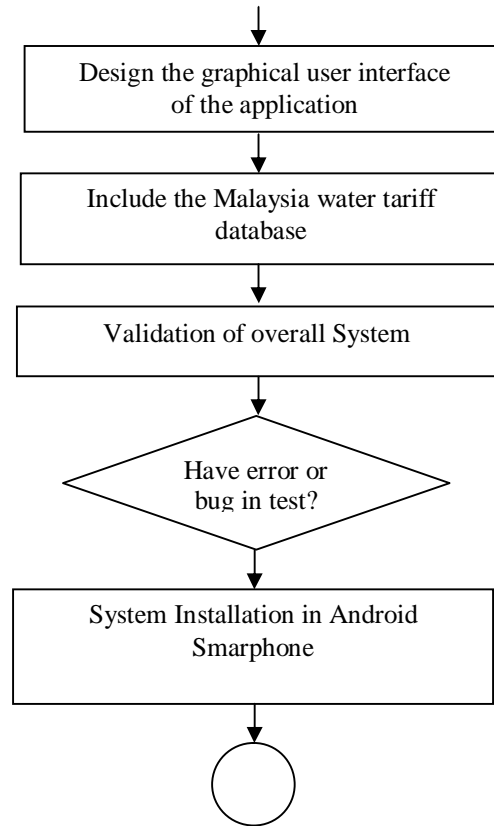
The main flow of the development of SAJ water bill application is shown in Figure 1. First we need to survey and study the SAJ water bill calculator at the SAJ website. Next check the water tariff and verify the water bill calculation based on the tariff. The next step is to prepare the environment to develop Android application. The integrated development environment (IDE) that we use to develop the mobile water bill calculator application is Eclipse 10 Indigo. One of the advantage of Eclipse is it a freeware that supports Android API and SDK. It also supports multiple computer languages such as C, C++, JAVA, C#, and XML. The example of the Eclipse IDE that is used to develop this application is shown in Figure 2.

Then we need to download the Android development package through the Eclipse update. After that, you can create Android project from the updated Eclipse menu. The Android project divides the source code into two languages which are JAVA and XML. The JAVA language is used to program the main program including the algorithm and the application main flow while the XML is used to program the application setting through Android manifest and to program the graphical user interface of the application. The image in Figure 2 shows the interface design window where the main user interface is developed. The XML basic code for the GUI is shown in Table 1 (a). From the code we can see that the interface that we use is button and spinner

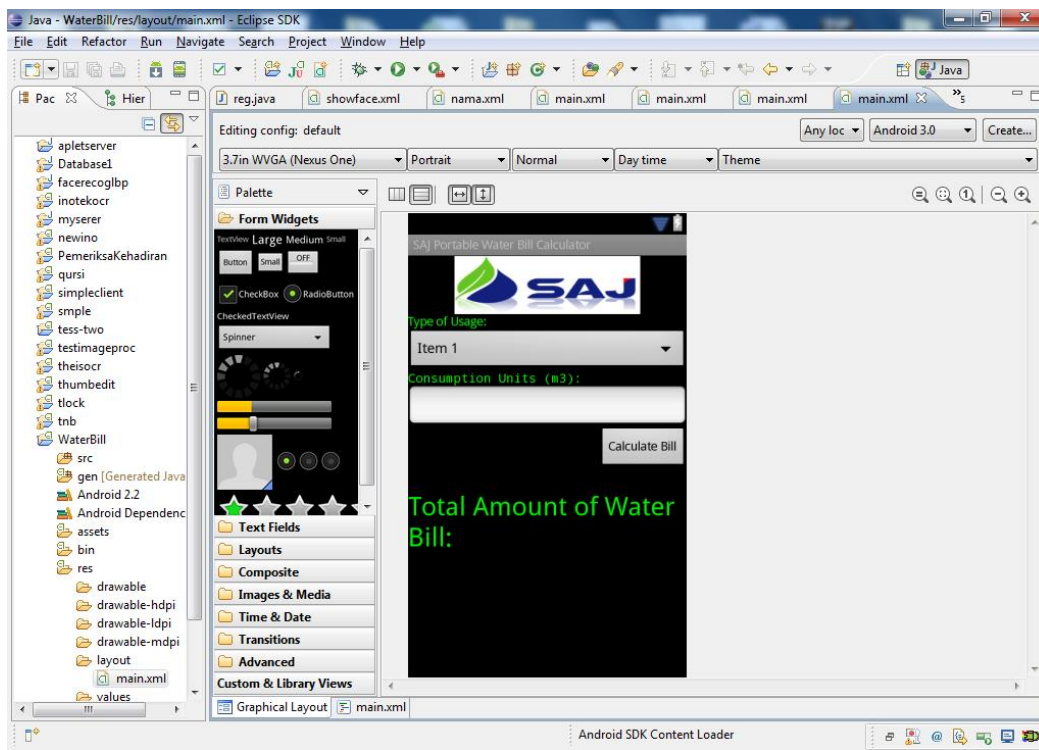
After completing the interface, the main program is written using JAVA in the main project source. In this part we include the water tariff in the codes using the JAVA arrays. The sample of the JAVA class that we use in SAJ application is shown in Table 1 (b). The codes show the type of layout that we use which is the Linear Layout. After finishing the program the simulation of the application is executed in order to check any error or bugs. If no bugs or errors are detected, we export the program to a Android smartphone.







**Figure 1:** The flow chart of the application development



**Figure 2:** The Eclipse IDE

**Table 1:** The sample codes of the SAJ water bill application

(a)
<pre>package com.waterbill; import android.app.Activity; import android.os.Bundle; import android.view.View; import android.widget.AdapterView; import android.widget.AdapterView.OnItemClickListener; import android.widget.ArrayAdapter; import android.widget.Button; import android.widget.EditText; import android.widget.Spinner; import android.widget.TextView; public class WaterBillActivity extends Activity {     @Override     public void onCreate(Bundle savedInstanceState) {         super.onCreate(savedInstanceState);         setContentView(R.layout.main);         Spinner spinner = (Spinner) findViewById(R.id.spinner1);         spinner.setAdapter(adapter);     } }</pre>
(b)
<pre>&lt;?xml version="1.0" encoding="utf-8" ?&gt; &lt;LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"     android:orientation="vertical"     android:layout_width="fill_parent"     android:layout_height="fill_parent"&gt; &lt;/LinearLayout&gt;</pre>

Not let we focus more on the application development. Through the main.xml file of the project, we can include images and GUI to the application. The sample of the GUI of the main.xml is shown in Figure 3. As you can see, we are using three type of GUI in the main layout of the application. The GUIs are the edit box, selective menu and button. The edit box is use for inserting the amount of water that we had consumes. The selective menu is used to select the type of premises we are living. This menu is essential because different premises has different tariff. The last GUI is the button where is used as the executer of calculator. By touching or clicking the button, it will calculate the amount of you water bill.



**Figure 3:** The sample of the main layout of the water bill application

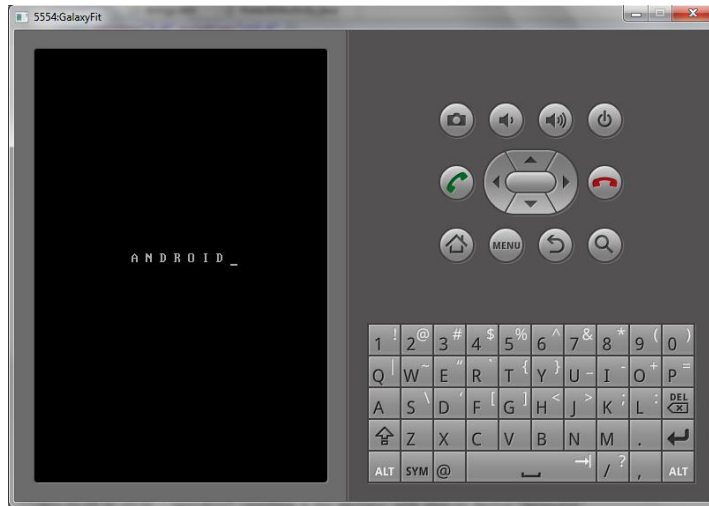
Instead of having different tariff based on the premises, the tariff is also different according to blocks. According to SAJ, there are three blocks are used in the tariff. The first one is for water usage below 21 meter square. The second block is for water usage between 21 and 35 meter square and the last block is for water usage more than 35 meter square. The detail of the tariff based on premises and blocks is shown in Table2. As you can see, the tariff is divided into six premises and the cheapest rate in the 1<sup>st</sup> block is domestic usage.

**Table 2:** The tariff based on premises and blocks

Premises	Domestic	Commercial	Government	Shipping	Estate	Apartment/Flat
<b>1<sup>st</sup> block</b>	RM0.60	RM2.60	RM2.80	RM7.00	RM1.15	RM1.35
<b>2<sup>nd</sup> block</b>	RM1.65	RM2.96	-	-	-	-
<b>3<sup>rd</sup> block</b>	RM2.96	-	-	-	-	-

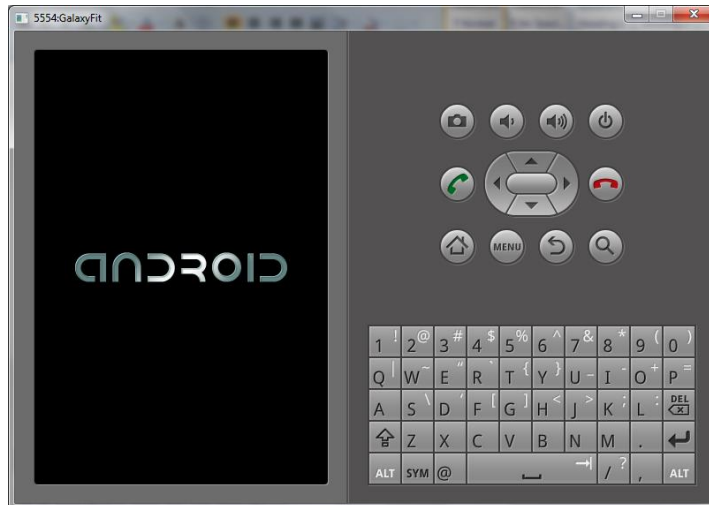
Because there are six different premises, the selective menu must also have six selections. The calculation in terms of block condition is embedded in the programming depend on the amount of water used. For example if the water used in domestic resident is 34 meter squares, the calculation of the resulting bill is  $20 \times RM0.60 + 14 \times RM1.65$ . For the layout programming using the XML, there are no much algorithm to be used since it is just controlling the function of the GUI and the appearance of the application. On the other hand, for the JAVA programming, a little algorithm is used to calculate the tariff according to their premises and blocks. The algorithms involve conditional operator and some mathematical equation.

### 3.0 Results



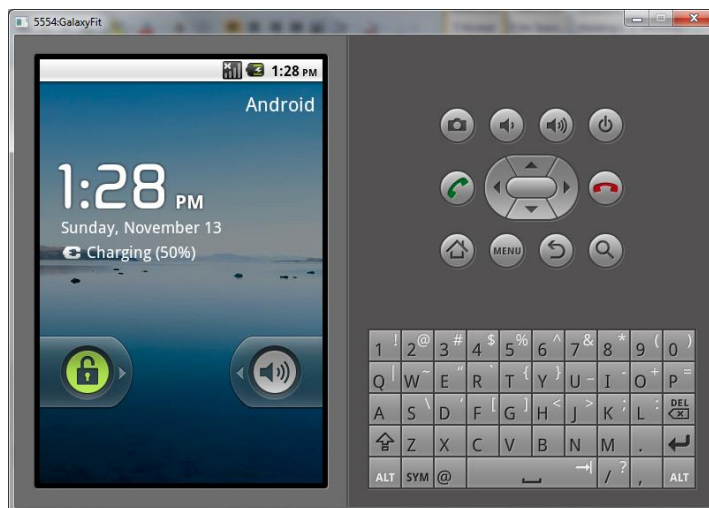
**Figure 4:** The booting page of Android

In order to evaluate the programmed codes, we emulate the Android project on Android emulator. An emulator is a replication of the smartphone in software form. The computer environment for the emulation is a standard desktop computer powered by Window 7 Professional, 2.8 GHz AMD Phenom IIX4 B93 Processor and 2GB RAM. The results of the emulation can be viewed from Figure 4 to Figure 17. Figures 4 to 5 is the booting page of the Android smartphone. It is similar to booting up our smartphone. After all of the booting completed, we will arrive at our locked main page of the smartphone. It is the same as our smartphone main screen. This main screen is shown in Figure 6. The next thing to do is to unlock the lock by sliding the lock button.

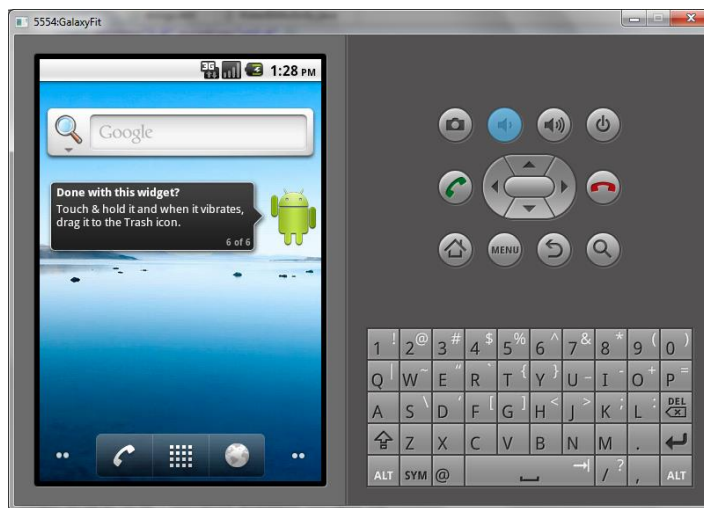


**Figure 5:** The introduction page of android

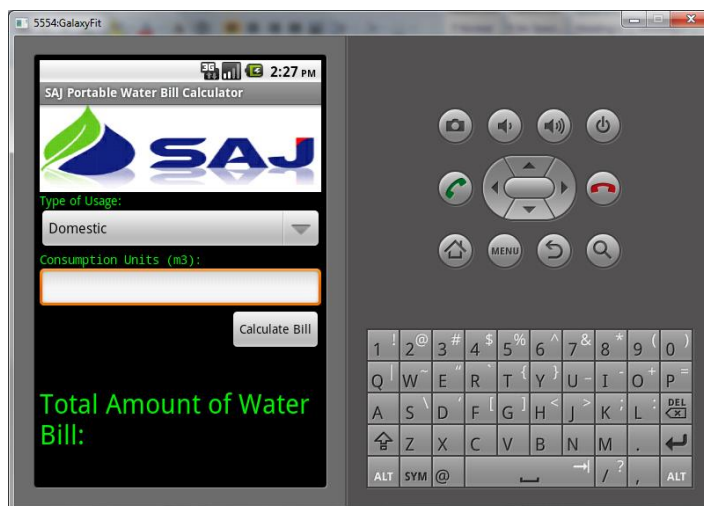
After sliding the lock button, we can now arrive to the active main page in Figure 7 where we can run any application. Because it is an emulator, the program will automatically run the water bill calculator application. After loading the application the main page of our application will appear as shown in Figure 8.



**Figure 6:** The locked main page of the smartphone emulator

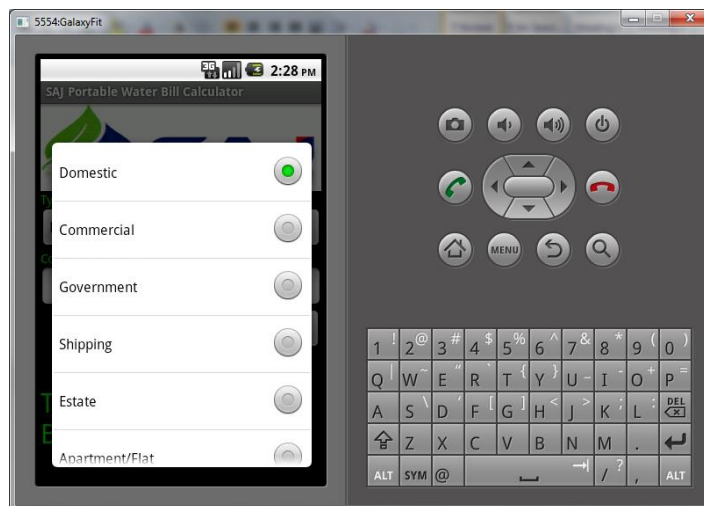


**Figure 7:** The active main page



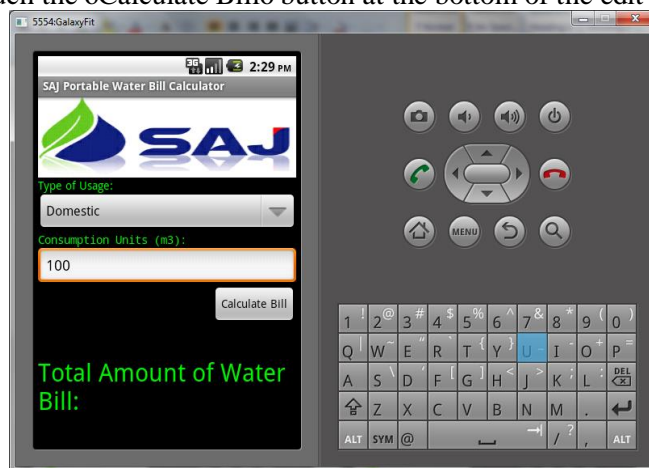
**Figure 8:** The main page of the water bill calculator application

The first thing that we need to be done once we run the application is selecting the type of premises. By clicking the "Type of usage" selective menu, a pop up will appear as shown in Figure 9. To select the type of premise, you just need to click the circle at the end of each type of premises. For example, we select the domestic as our premise. Note that this emulation is running on a computer so the interface we are using is clicking. But for smartphone, you can replace the clicking by touching the buttons.



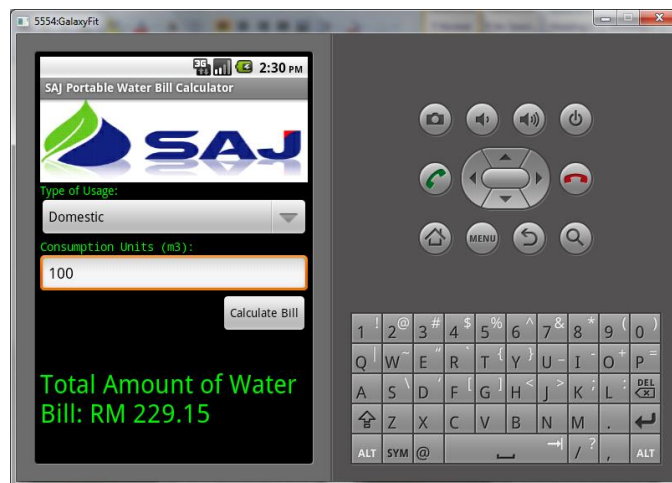
**Figure 9:** The pop up of the selective menu

After select the type of premise, we can do the next step which is inputting the amount water that we had consumed. For example, we input 100 meter square in the water consumption box as shown in the Figure10. To acquire the amount of our water bill, we just need to click or touch the "Calculate Bill" button at the bottom of the edit box.

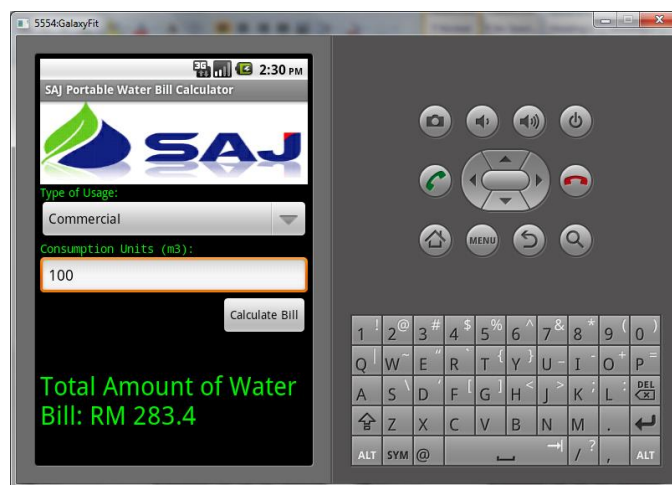


**Figure 10:** Inputting the amount of water consumed

The result after clicking the button is shown in Figure 11. As you can see, the total amount of the water bill will appear in the lowest part of the screen. The number we can see that the amount of bill of consuming 100 meters squares for domestic use is RM 229.15.

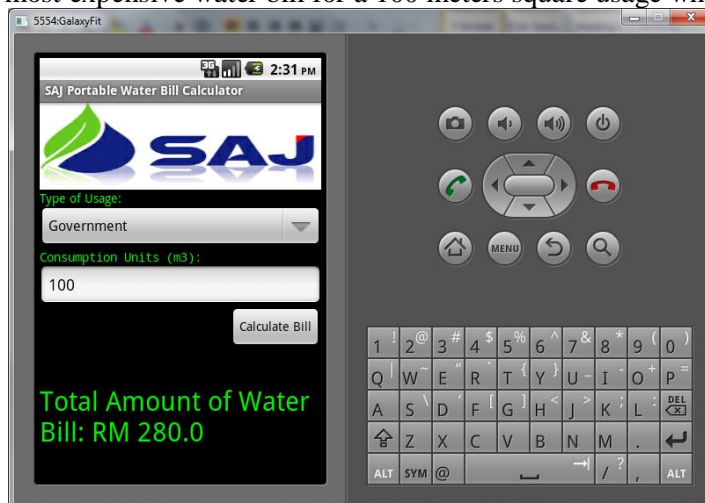


**Figure 11:** The total bill for 100 meters square of domestic water usage



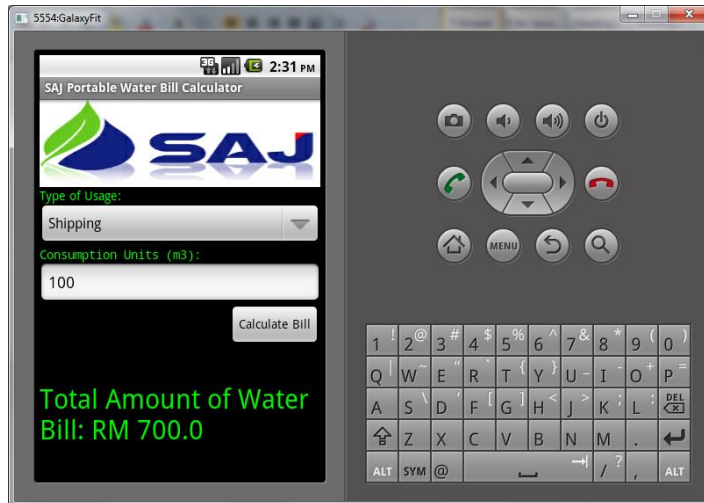
**Figure 12:** The total bill for 100 meters square of commercial water usage

For different premise, we will have different total amount of bill. The result for calculating the total amounts of water bill for other premises which are the commercial, government, estate, shipping and flat are shown in Figures 13 to 16. As we can see, the shipping premise needs to pay the most expensive water bill for a 100 meters square usage which is RM700.



**Figure 13:** The total bill for 100 meters square of government water usage

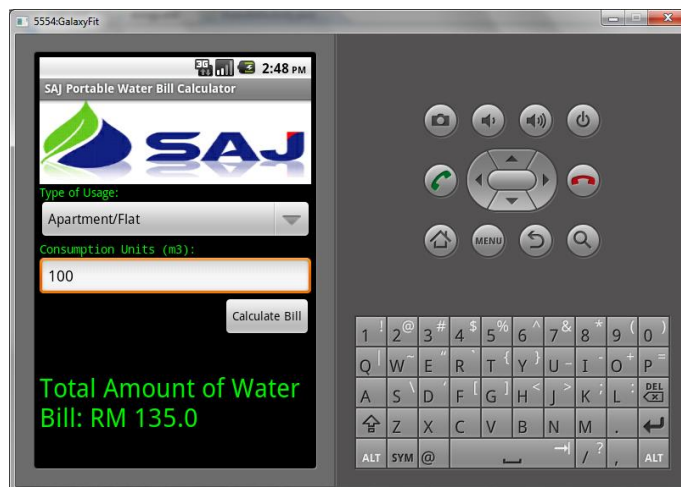




**Figure 14:** The total bill for 100 meters square of shipping water usage



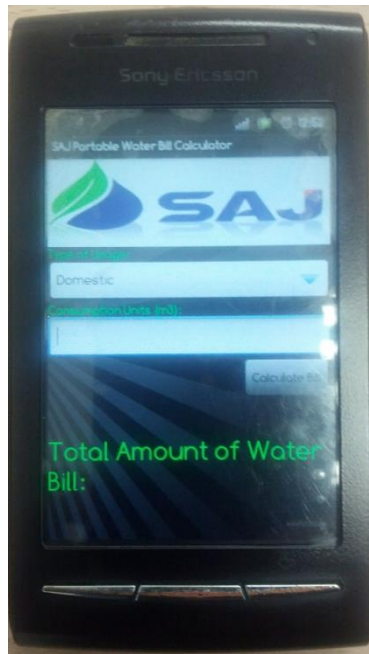
**Figure 15:** The total bill for 100 meters square of estate water usage



**Figure 16:** The total bill for 100 meters square of apartment water usage

After completely evaluated the application using the emulator, we uploaded the

application installer file to the smartphone and test is on the real smartphone environment. The result of the application in the real smartphone is shown in Figure 15. The usage of the application is the same as the emulator. The only different is now we only need to touch instead of click.



**Figure 17:** The mobile water bill calculator application in a smartphone

## 4.0 Discussions

In this paper, we have developed and validated an Android application to calculate the water bill. As we can see in the result, the simulation do not causes any bugs that crash the application. The next stage in our development is to test in application in an actual smartphone. The phone that we tested is Sony Xperia X3 phone. The installation on X3 is also a successful without problems. During the usage of the application i.e., changing the spinner and writing the number also produce no hardware-based error and executed smoothly. There is no need to measure the time performance as the result appears on the spot without any significant delay. It is because the computation that is used in this application is so simple that could not affect the CPU overhead.

## 5.0 Conclusions

In this paper, we developed an Android application for Android smartphone called mobile water bill calculator. It is a simple and easy to use application that can be used by anyone. From this project, we have learned about JAVA and XML programming and interfacing the project to an emulator and smartphone. From what we experienced, the development of Android application is not that difficult if we are familiar with the computer language used in development. As for future works, we would like to develop more application for the Android smartphone.

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## P4 - Analyze Wifi Signal using Android Application for Improving the Wifi Connectivity

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### Abstract

This paper is elaborate on experiment channel selection of wireless network for standard 802.11g. The objectives of this paper are studying the effect of Wi-Fi channel to signal strength and the throughput of the Wi-Fi. The methodology used is measure the signal strength using freeware application via android and measure the throughput from client by using freeware application via laptop. As the result, the performance of Wi-Fi will be affected by the selection of channel number.

**Keyword:** Wi-Fi channel, signal strength, throughput

### 1.0 Background

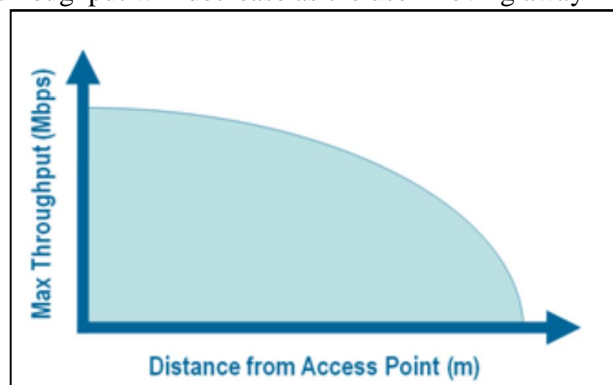
The family standards of IEEE 802.11 are well known for home network and enterprise. This standard is available in variety version.

Version	Released	Bandwidth (MHz)	Frequency	Theoretical PHY Rate
802.11	1997	20	2.4GHz	2Mbps
802.11a	1999	20	5GHz	54Mbps
802.11b	1999	20	2.4GHz	11Mbps
802.11g	2003	20	2.4GHz	54Mbps
802.11n	2009	20, 40	2.4GHz, 5GHz	600Mbps

**Table 1 :** Family of IEEE 802.11

This standard widely used in wireless networking or known as wireless fidelity (Wi-Fi) as the frequency 2.4GHz is unlicensed frequency band and the frequency modulation used are frequency-hopping spread spectrum (FHSS) and direct-sequence spread spectrum (DSSS).

The Performance of wireless network depends on the throughput and the signal strength. The throughput and signal strength will be affected by the distance of access point. Figure 1 shown the throughput will decrease as the user moving away from access point.



**Figure 1 :** Throughput Vs Distance From Access Point

Besides, the throughput of wireless network also affected by channel number as the interference in the same channel number from two or more Wi-Fi networks. There are three non overlapping channels that use by Wi-Fi 802.11 and totally fourteen channels are available for 2.4GHz ISM band. Not all the channels are used in all countries where 11 channels are allowed in North American domain and 13 channels are allowed in Europe as Table 2. The standard bandwidth for each channel is 22MHz and channel separation is 5MHz except for channel 14, as in Table 3. Channel 14 does not use in any country except Japan that is only allowed for standard 802.11b.

**Table 2 :** Channels that Recognized by Communications Bodies [5].

Channel Number	Europe (ETSI)	North America (FCC)	Japan
1	√	√	√
2	√	√	√
3	√	√	√
4	√	√	√
5	√	√	√
6	√	√	√
7	√	√	√
8	√	√	√
9	√	√	√
10	√	√	√
11	√	√	√
12	√	No	√
13	√	No	√
14	No	No	802.11b only

**Table 3:** List of Channels Frequency

Channel Number	Lower frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	2401	2412	2423
2	2406	2417	2428
3	2411	2422	2433
4	2416	2427	2438
5	2421	2432	2443
6	2426	2437	2448
7	2431	2442	2453
8	2436	2447	2458
9	2441	2452	2463
10	2446	2457	2468
11	2451	2462	2473
12	2456	2467	2478
13	2461	2472	2483
14	2473	2484	2495

The best channel selection by choosing the non-overlap channel that is channel 1, 6 and 11 as illustrate in Figure 2.

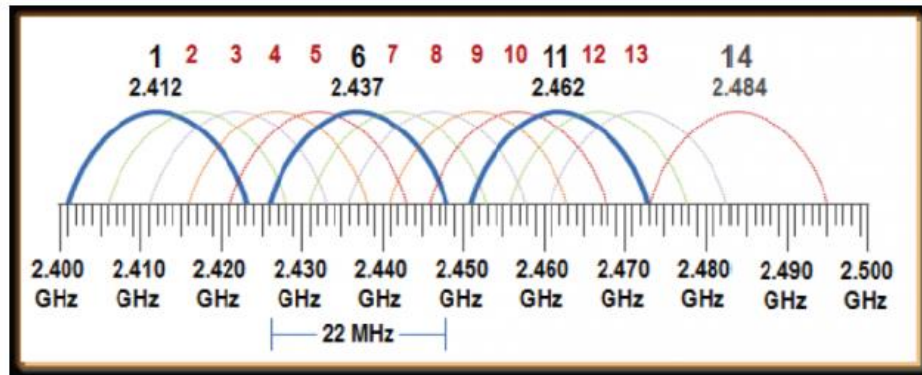


Figure 2 : 802.11g Channels [7]

## 2.0 Methodology

There are two steps to analyze the performance of Wi-Fi to determine the best channel selection that is measure the signal strength for different Wi-Fi with same channel and vice versa. Second step is measure the throughput of signal for different Wi-Fi with same channel and vice versa.

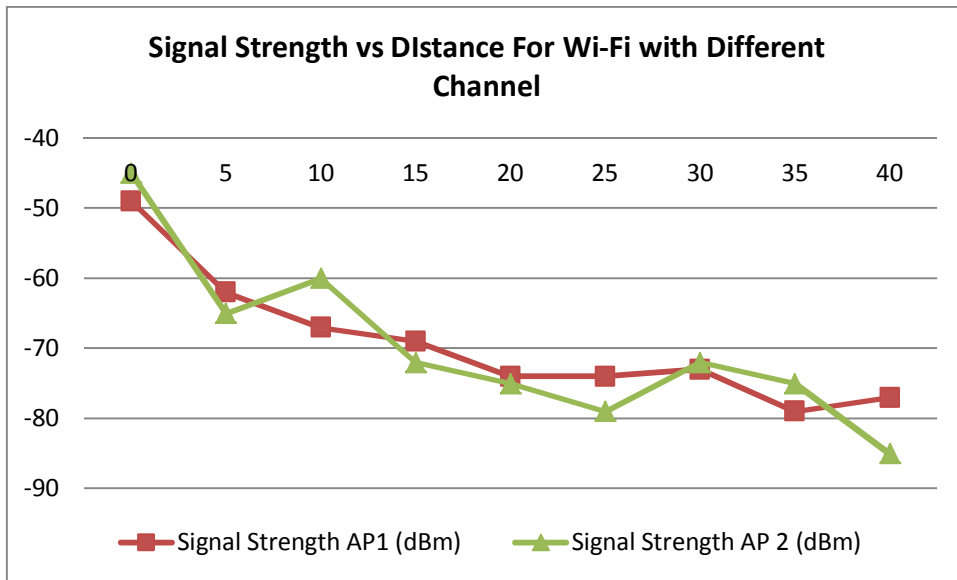
List of software that used in this paper are Wi-Fi analyzer for android and TamoSoft Throughput Test. The software Wi-Fi analyzer used to measure the signal strength that used with android, while TamoSoft used to measure the throughput of Wi-Fi client. Both of the software is freeware.

There are two Access Points that use in this experiment as described in Table 4:

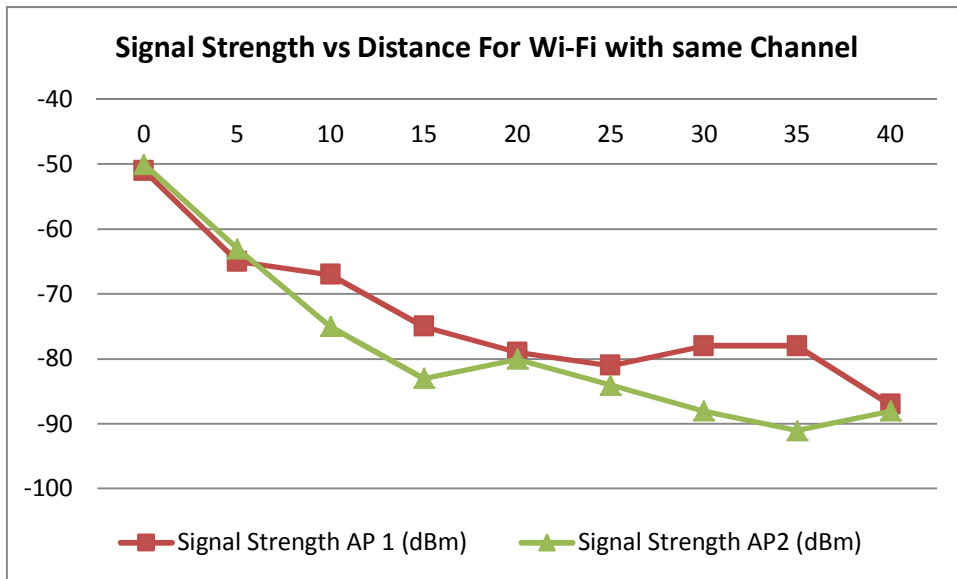
Table 4: Model of Access Point

Access Point	Model	Mac Address	Channel
1	DWL-2100	001B1113A50D	6
2	DSL-2640B	84C9B2BF96C9	1 or 6

### 3.0 Results and Discussions



**Graph 1:** Signal Strength Vs Distance For Wi-Fi with Different Channel



**Graph 2:** Signal Strength Vs Distance For Wi-Fi with Same Channel

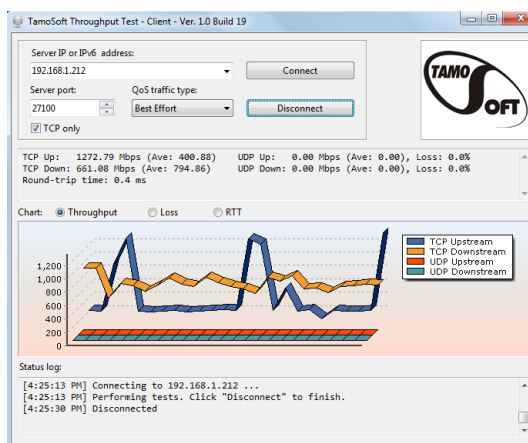


Figure 2

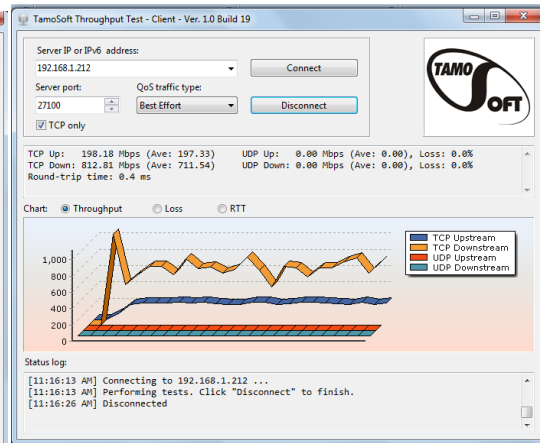


Figure 3

Figure 2 and Figure 3 is comparison throughput of client by using AP 1 and AP 2. The channel selection for AP1 is channel 6 and AP2 using channel 1.

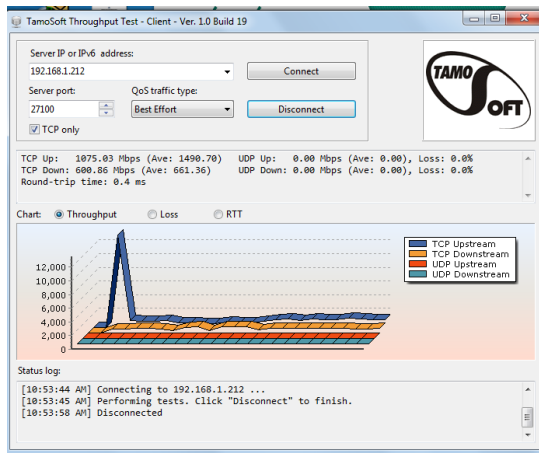


Figure 4

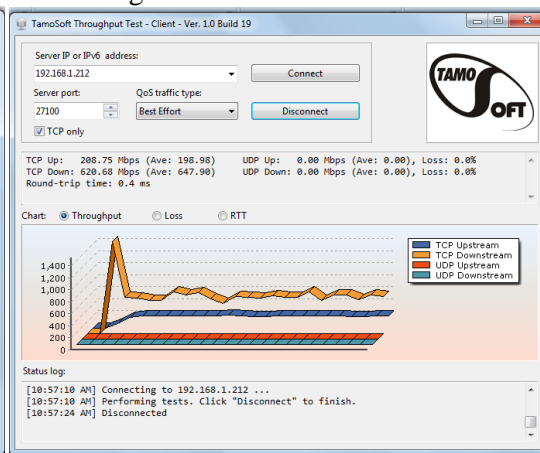


Figure 5

Figure 4 and Figure 5 is comparison throughput of client by using AP 1 and AP 2 that using same channel. The channel selection for AP1 and AP2 is channel 6.

From the observation, the signal strength of Wi-Fi will decrease as the client far away from the access point as shown in graph 1 and graph 2. As in graph 1, the signal strength of access point at distance zero are different which is using different channel for both access point, where at distance zero the signal strength for AP2 is -45dBm which is using channel 1 compare to signal strength of AP1 is -50dBm which is using channel 6.

Meanwhile from Figure 2 and Figure 3, the throughput are higher as the channel selection are different where the AP1 using channel 6 and AP2 using channel 1. The throughput of both access points that using same channel contributes low signal strength.

## 4.0 Conclusion

The objective of this experiment is to compare the performance of Wi-Fi using Wi-Fi analyzer via android. As the result, two or more access points in same area should using different channel which is channel 1, 6 or 11, therefore the connectivity of Wi-Fi will increased.



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# P5 - Low Voltage (LV) Power System Monitoring via GSM Network

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## *Abstract*

*Power supply breakdown contribute the major problem to consumer especially small and medium industry where the power supply breakdown monitored by maintenance people manually in conventional power system. The Low Voltage (LV) Power System Monitoring via GSM Network has been developed to monitor power flow through SMS using the PIC16F877A microcontroller automatically. The microcontroller performs all the functions of the system. The microcontroller sends commands using a mobile phone when receive signal from power flow sensor to responsible maintenance people. The water tank system has two sensors, the first sensor acting as Blackout Sensor and the second sensor acting as Power Failure Sensor. The responsible maintenance people will be received two different messages from the monitoring system, the first message showing the power supply blackout level cause of power supply breakdown from utility or out site power failure then the second message showing the internal power failure. From the result obtain, the system is working successfully to minimize the power supply breakdown to consumers and successfully sense the power flow without any interruption.*

**Keywords:** power system monitoring

## 1.0 Introduction

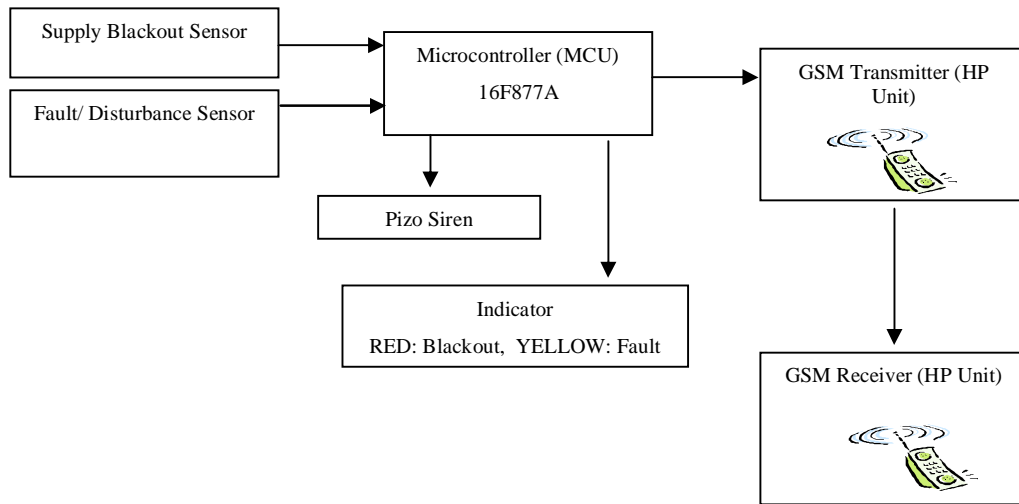
Mobile phones have become one of the most popular communication devices among most of the people around the world, and Short Message Service (SMS) is popular among mobile phone users as a cheap and convenient method of communicating. Therefore, SMS technology is a common feature with all mobile network service providers. They provide many information and services via SMS such as latest news updates, stock information, and various entertaining applications stuffs. Some common examples are send and receive confidential information of bank accounts, enhance security in households and vehicles, monitoring physical quantities remotely, transfer data between remote locations, alerting method and information distributing system.

The conventional power system is that an assigned maintenance person to monitor power supply breakdown or power failure manually. This manual process can become very time consuming and tiresome. The recent advances in the field of information technology have made the exchange of information fast, secured and accurate. The digital revolution caused rapid drop of cost of digital devices such as computers and telecommunication devices. Communication networks like the internet, GSM networks etc. are available in almost all the countries of the world. Also, unwanted weather conditions like heavy snow, rain, storm, etc. will not hamper on collecting data as long as the GSM networks are stable.

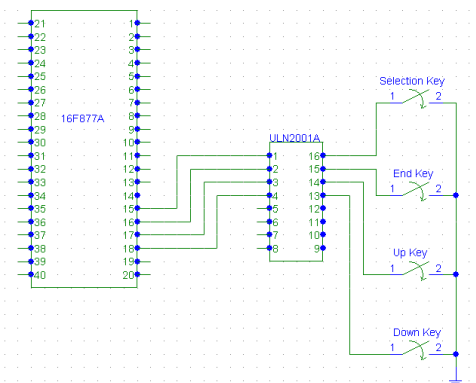
The main core of this project is to minimize power supply breakdown in term of time to consumer and sense the power failure status by sending trough Short Massaging Service (SMS). In order to achieve the objective of the project, there are several scope had been outlined. The scope of this project includes using MPLAB IDE to program microcontroller PIC 16F877A, build hardware for the system and observe performance of the system.

## 2.0 Methodology

Microcontroller acting as the brain of the system, it is control and commanding the GSM transmitter and PIZO Siren & Indicator when receiving sensing signal from the sensors. Figure 1 shows the block diagram of the system. In this section will be discussed about hardware of the Power System Monitoring via GSM Network such as GSM Transmitter, PIC16F877A, sensor, indicator and siren. Nokia 1200 keypad connect to the digital I/O pin of PIC16F877A, microcontroller pin 15 (RC0) connected to Selection Key, pin 16 (RC1) connected to End Key, pin 17 (RC2) connected to Up Key and pin 18 (RC3) connected to Down Key through ULN2001A buffer IC. Figure 2 shows the connection between Nokia 1200 keypad and PIC16F877A.



**Figure 1:** Block Diagram of Power System Monitoring via GSM Network



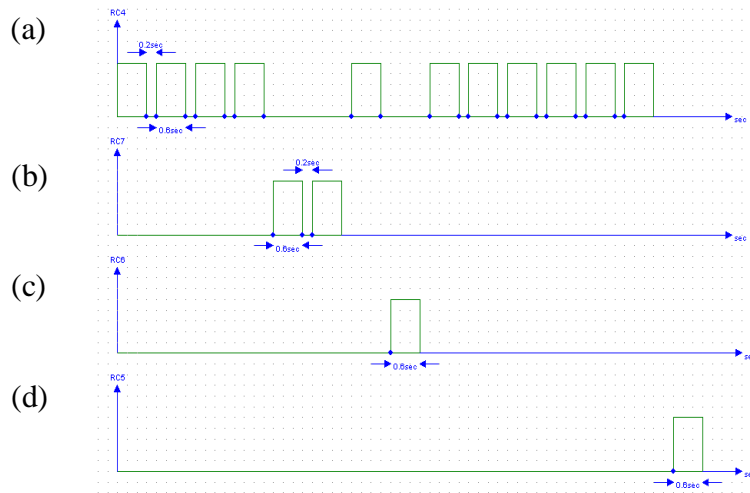
**Figure 2:** Connection between Nokia 1200 and PIC16F877A microcontroller

When the microcontroller receives the sense signal from level sensor it will send the timing pulse signal to Nokia 1200 keypad. Figure 3 shows the timing pulse signal from PIC16F877A to Nokia 1200. The purpose of timing pulse signal is to operate Nokia 1200 as follows:

1. Nokia 1200 operation when microcontroller receive sense signal from Low Power Blackout Sensor; Select **Menu** > Select **Message** > Select **Option** > Press **Down Key** > Select **Insert Option** > Press **Down Button** > Select **Insert Template** > Use

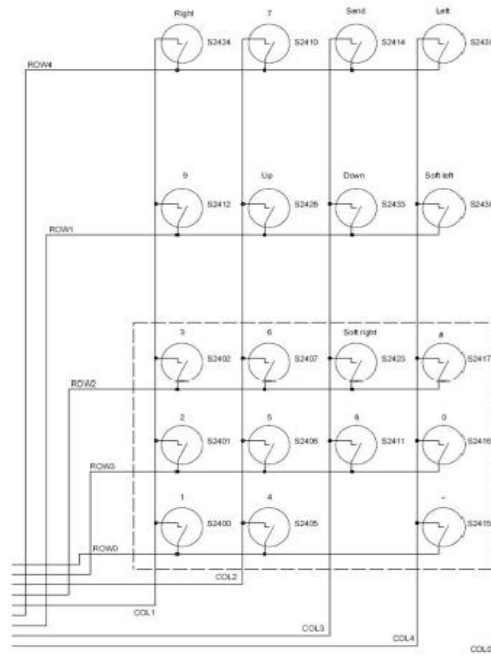
**Warning, Power Blackout** > Select **Option** > Select **Send** > Select Search > Select **OK** > Select **OK** > Press **END Key**

2. Nokia 1200 operation when microcontroller receive sense signal from Power Failure Sensor; Select **Menu** > Select **Message** > Select **Option** > Press **Down Key** > Select **Insert Option** > Press **Down Button** > Select **Insert Template** > Use **Warning, Power Failure** > Select **Option** > Select **Send** > Select Search > Select **OK** > Select **OK** > Press **END Key**



**Figure 3:** Timing pulse signal from PIC16F877A I/O pin to Nokia 1200 keypad  
(a) RC0 to Selection Key  
(b) RC3 to Down Key  
(c) RC2 to Up Key  
(d) RC1 to End Key

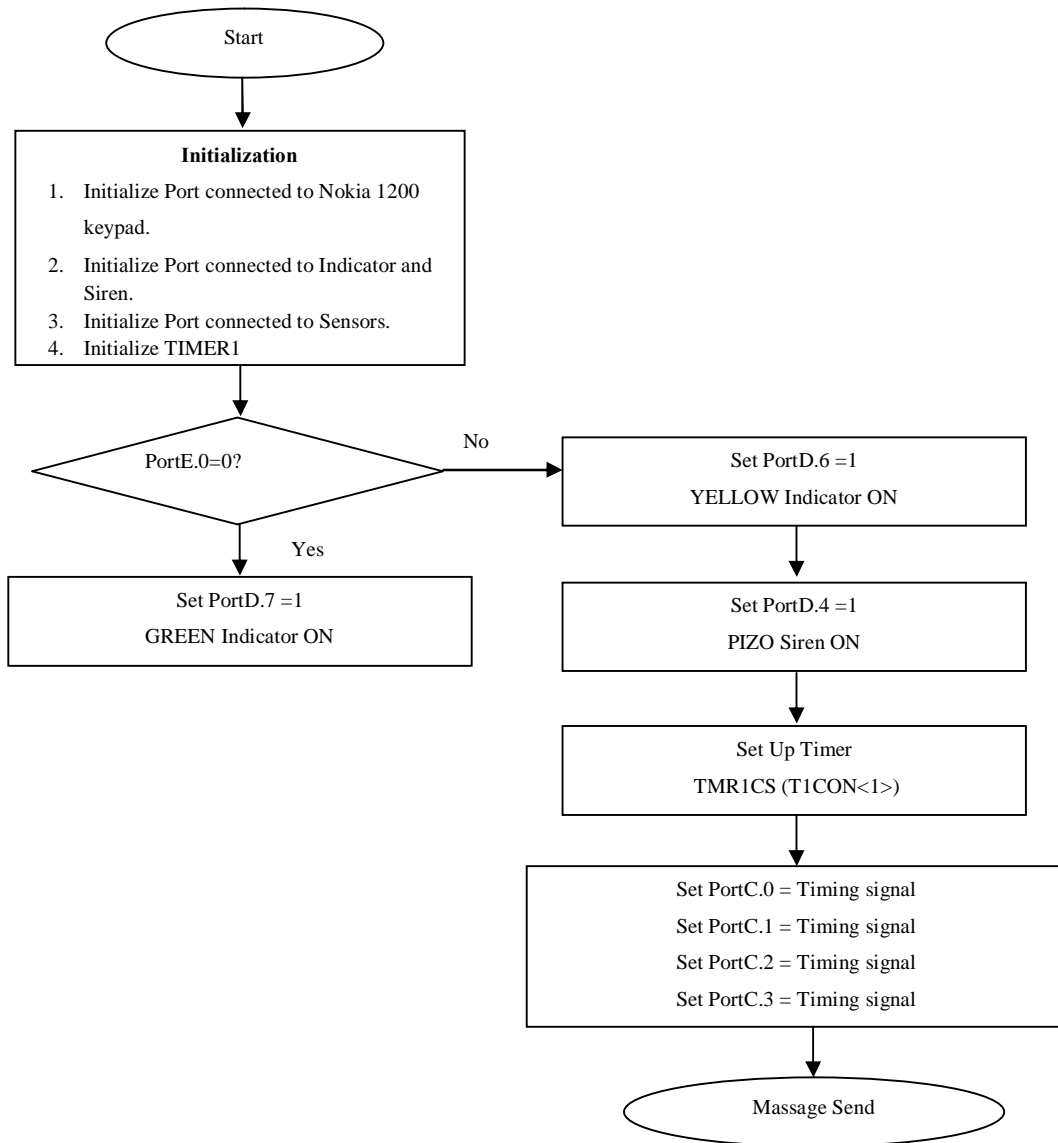
Figure 4 shows the schematic diagram of Nokia 1200 keypad, it is a push to ON switch system. The switch activate by push the keypad or giving a pulse signal and sending a signal to Nokia 1200 processor unit.



**Figure 4 :** Wiring diagram of Nokia 1200 keypad

Microcontroller acts as brain of the whole Power System Monitoring via GSM. It will receive the sense signal from level sensors and sending timing pulse signal to Nokia 1200 keypad and activate the indicator and PIZO siren. Then, Nokia 1200 sending a message to pointed maintenance number such as Power Blackout at Low Level and Power Supply Failure.

An algorithm has to be developed to make the microcontroller to read the input and respond accordingly. Therefore, the algorithm is established and represented by a flowchart in Figure 5. These flowcharts are then translated into assembly language and compiled using MPLAB, the PIC16F877A software development tool.



**Figure 5:** Flowchart of power system monitoring when sensor activate.

### 3.0 Results

The result of power system monitoring shows that its work properly when Blackout Sensor and Failure Sensor are activated where PIC16F877F microcontroller receive a sense signal from sensor then triggering Nokia 1200 keypad and light-up the YELLOW or RED Indicator and power system monitoring alert maintenance person trough SMS automatically

## 4.0 Conclusion

The problems of conventional power system usually classified into two where there is power supply breakdown and power failure due to weak monitoring by maintenance person. This problems cause of the power system need assigned maintenance person to monitor water supply breakdown power failure manually. Power System Monitoring via GSM was successfully developed to minimize the problems of power supply breakdown and power failure. The power system alert maintenance person trough SMS automatically. The system also succeeds light-up the indicator and sounding the siren to indicate a status of the system. The GSM information technology has made the exchange of information fast, secured and accurate. Also, unwanted weather conditions like heavy snow, rain, storm, etc. will not hamper on collecting data as long as the GSM networks are stable cannot interrupts the system.

## 5.0 Recommendation

The systems have problems to sending more than one pointed number to maintenance person in one time cause of Nokia 1200 cannot support this type of features. The Nokia 1200 only support one pointed number in same time. I am recommend to using GSM Module, there are can sending more than one pointed number to maintenance person. But some modification needs to study and analyze such as RS232C ports, software modification and hardware modification.

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G. Darvini, P. Salandin and L. Da Deppo

## P6 - Development of Cable Tracker for Wire Tracking

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### **Abstrak**

*Dalam membuat pendawaian, ujian keterusan perlu dijalankan bagi memastikan penyambungan dan pemasangan dipasang dengan betul. Pendawaian domestik sama ada pendawaian tersembunyi atau pendawaian permukaan memerlukan ketelitian dalam pemasangan bagi mengelakkan terjadinya litar pintas atau kerosakan peralatan. Kebiasaannya pendawai akan menggunakan multimeter untuk menjalankan ujian keterusan. Namun kekangan yang dihadapi ialah apabila pendawaian tersebut melibatkan kabel yang panjang. Maka, “Cable Tracker” atau Alat Pengesan Kabel direka khas untuk memudahkan pengujian keterusan dijalankan. Cable Tracker ini adalah alat pengujian tanpa kekutuban yang boleh mengenalpasti keterusan dua hingga lima penyambungan dalam satu-satu masa. Menggunakan program kawalan PIC (Peripheral Interface Controller), alat ini sangat membantu pendawai dalam menyempurnakan kerja-kerja pendawaian. Selain itu, alat ini juga mudah dibawa dan digunakan.*

*“Cable Tracker” merupakan kombinasi dua alat yang terdiri daripada penghantar (transmitter) dan penerima (receiver) berfungsi sebagai pengesan keterusan sesuatu penyambungan dengan memasang kedua-dua alat ini pada setiap kabel yang hendak diuji (output dan input). Penghantar memaparkan nombor “1” dan “2” menggunakan LED (Light Emitting Diode) manakala penerima akan memaparkan keputusan pengujian melalui paparan ruas 7 dengan mempamerkan nombor “1” dan “2” mengikut kabel yang diuji..*

**Kata Kunci:** kabel, ujian keterusan, PIC, paparan ruas 7, LED

### **1.0 Pengenalan**

Sebelum bekalan elektrik dimasukkan kepada sesuatu pemasangan atau pendawaian, ujian keterusan dan ujian kekutuban perlu dijalankan terlebih dahulu bagi memastikan litar yang telah dipasang selamat digunakan. Kegagalan melaksanakan pengujian ini boleh menyebabkan berlakunya litar pintas atau kebocoran arus sekaligus boleh mendatangkan bahaya kepada pengendali dan boleh menyebabkan kerosakan peralatan atau perkakasan elektrik.

Single Phase Wiring System ( Sistem Pendawaian Fasa Tunggal; Kod: B01-01-03) dan Single Phase Domestic Wiring (Pendawaian Domestik Fasa Tunggal, Kod: B01-01-06) merupakan modul pengajaran bagi Semester 1 Kursus Teknologi Elektrik yang memerlukan pelajar membuat pendawaian sama ada pendawaian permukaan, pendawaian tersembunyi, sesalur dan pembuluh. Pelajar ditentusahkan sebagai terampil sekiranya apabila litar atau pendawaian berfungsi dengan baik. Pendawaian atau penyambungan yang betul adalah aspek utama untuk memastikan sesuatu litar tersebut berfungsi.



## 2.0 Pernyataan Masalah

Kebiasaannya semasa proses pengajaran dan pembelajaran, alat pengujian seperti multimeter analog ataupun digital digunakan bagi menguji keterusan sesuatu litar sebelum kabel pada suis atau soket alur keluar dipasang. Proses penilaian menjadi rumit dan memakan masa yang lama khususnya apabila penyambungan melibatkan pendawaian yang panjang. Hal ini disebabkan oleh kekangan rekabentuk alat pengujian yang digunakan seperti multimeter. Selain multimeter, terdapat beberapa alat pengujian yang digunakan bagi mengesahkan keterusan dan kekutuban pendawaian yang menggunakan konsep aruhan magnet serta sonar. Akan tetapi, gangguan isyarat yang terhasil daripada interfeferen dua atau lebih kabel menyebabkan maklumat kekutuban tidak dapat dikenalpasti dengan baik.

Oleh itu, satu peralatan pengujian yang mudah dikendalikan, mempunyai tahap kebolehpercayaan yang tinggi serta mampu menjimatkan masa pengujian diperlukan bagi meningkatkan produktiviti dan keberkesanan latihan. Hal ini penting agar proses pengajaran dan pembelajaran tidak tergendala dan dapat diselesaikan dalam tempoh masa yang ditetapkan selain memberi lebih masa kepada pelajar untuk melakukan latihan amali

Biasanya pelajar menggunakan analog multimeter atau digital multimeter untuk menjalankan pengujian keterusan pada sesuatu litar sebelum kabel pada suis atau soket alur keluar dipasang. Namun, masalah timbul apabila melibatkan pemasangan kabel yang panjang. Dengan menggunakan "*Cable Tracker*" ini, pelajar dapat menjimatkan masa dan memudahkan pengujian kerana alat ini berfungsi tanpa menggunakan wayar pengantara yang menghubungkan antara alat penghantar dan alat penerima.

## 3.0 Latar Belakang

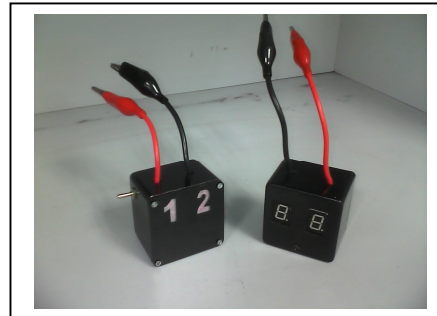
Kajian literatur mendapati alat pengujian keterusan komersial dapat diklasifikasikan mengikut beberapa konsep teknologi asas yang digunakan untuk mengesan keterusan litar. Antara yang kerap digunakan adalah teknologi elektromagnetik yang mengesan aruhan magnet (Ortiz, Simó, dan Oliver, 2002) dan teknologi sonar yang mengesan frekuensi (Future Sky Equipment Co., 2013). Alat pengujian yang menggunakan teknologi magnet didapati terdedah kepada gangguan (*noise*) isyarat yang mungkin memberikan dapatan pengujian yang salah (Hughes, 2009).

*Cable Tracker* yang dihasilkan berfungsi menggunakan konsep asas pengaliran elektrik diantara penghantar dan penerima isyarat. *Cable Tracker* mempunyai dua komponen utama iaitu bahagian pengantar dan penerima yang direkacipta tanpa perlu menggunakan wayar pengantara sebagaimana alat pengesan sedia ada di pasaran. Hal ini menjadikan proses pengujian keterusan dan kekutuban lebih mudah selain menjimatkan masa.

Gambarajah 1 menunjukkan alat pengujian yang biasa digunakan manakala Gambarajah 2 menunjukkan *Cable Tracker* yang lebih ringkas dan mudah dikendalikan. Perbandingan spesifikasi adalah seperti di Jadual 1.



**Gambarajah 1:** Multimeter yang biasa digunakan



**Gambarajah 2 :** Cable Tracker

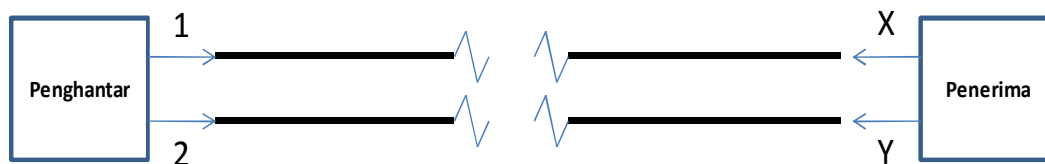
**Jadual 1:** Perbandingan spesifikasi alat pengujian keterusan litar

	Multimeter	Cable Tracker
<b>Teknologi</b>	Electromagnetik	PIC
<b>Berat</b>	400 g	200 g
<b>Gangguan Isyarat</b>	Ada	Tiada

#### 4.0 Metodologi

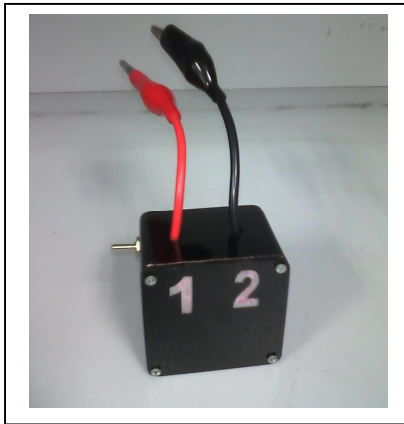
Dalam membangunkan projek ini, beberapa kajian rintis dan rujukan telah dilakukan bagi mencapai objektif penghasilan projek.

Cable Tracker terdiri daripada dua komponen iaitu bahagian penghantar dan penerima. Kedua-dua bahagian menggunakan litar kawalan menggunakan *Peripheral Interface Controller (PIC)*. Gambarajah 3 menunjukkan bagaimana penyambungan pada kabel dilakukan.

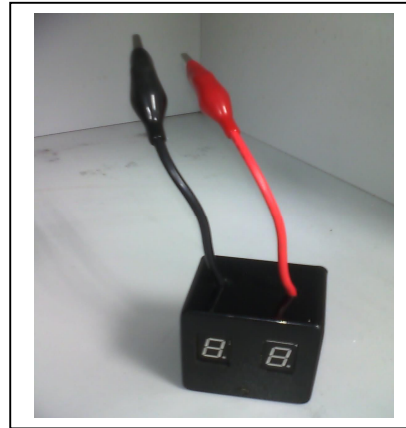


**Gambarajah 3:** Kaedah penyambungan Cable Tracker pada kabel

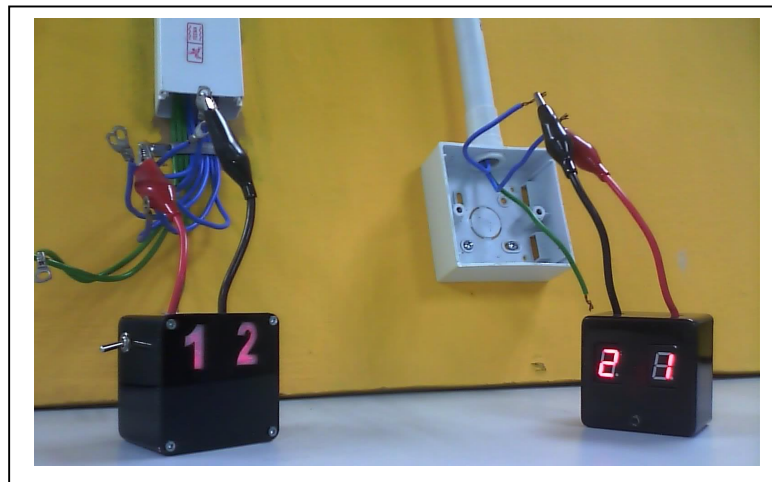
Bahagian penghantar (gambarajah 4) bertindak sebagai penanda dilengkapi dengan paparan *Light Emitting Diode (LED)* yang akan melabel kabel sebagai  $\delta 1\delta$  ataupun  $\delta 2\delta$ . Kabel dilekatkan kepada Cable Tracker menggunakan klip buaya (merah untuk kabel 1 manakala hitam bagi kabel 2). Bahagian penerima (Gambarajah 5) mempunyai struktur dan rekabentuk yang sama kecuali papan paparan menggunakan paparan ruas 7. Bahagian penerima akan dipasang pada penghujung kabel yang ingin ditentukan keterusan dan keketubannya. Papan ruas 7 akan mempamerkan sama ada nombor  $\delta 1\delta$  dan  $\delta 2\delta$  pada paparan ruas 7; X ataupun Y berdasarkan isyarat yang diterima daripada kabel yang telah dipasangkan kepada bahagian penghantar.



**Gambarajah 4:** Alat Penghantar

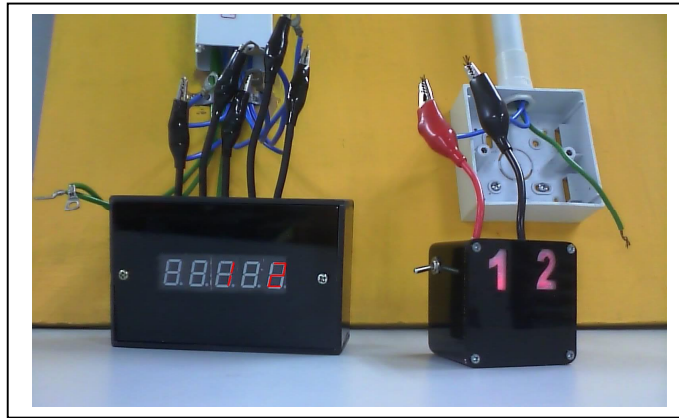


**Gambarajah 5:** Alat Penerima 2 input



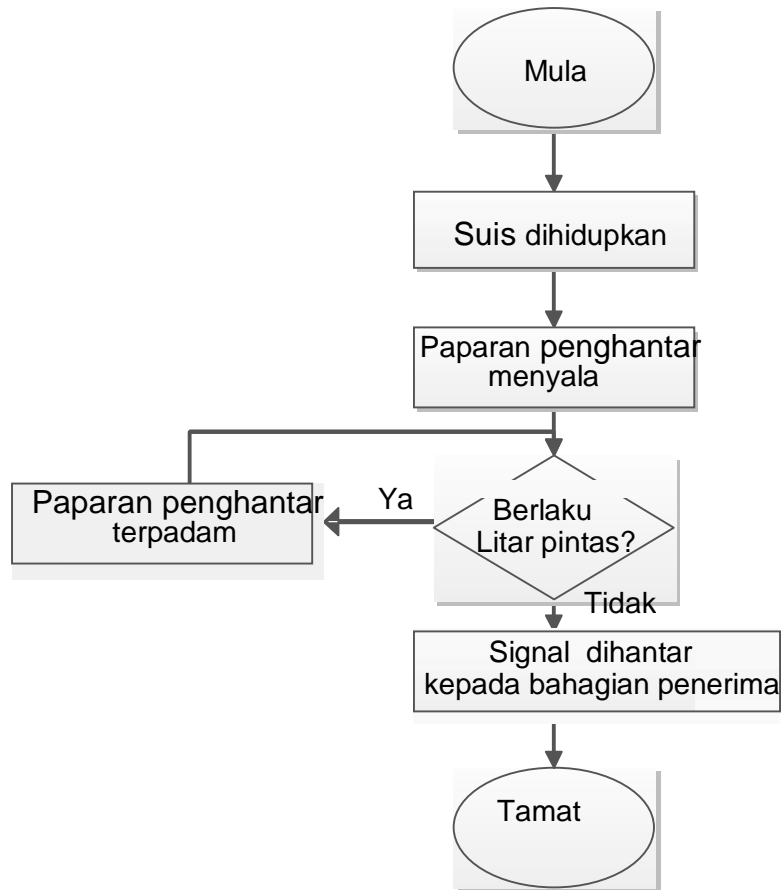
**Gambarajah 6:** Penggunaan Cable Tracker

Gambarajah 6 menunjukkan bagaimana Cable Tracer berfungsi dan digunakan untuk membuat pengujian bagi pendawaian dua kabel. Suis pada alat penghantar dihidupkan dan disambung pada kabel masukan manakala alat penerima disambungkan pada kabel keluaran yang mana merupakan kabel penamat pada suis atau soket alur keluar. Alat penerima akan memaparkan keluaran secara automatik mengikut label pada kabel masukan

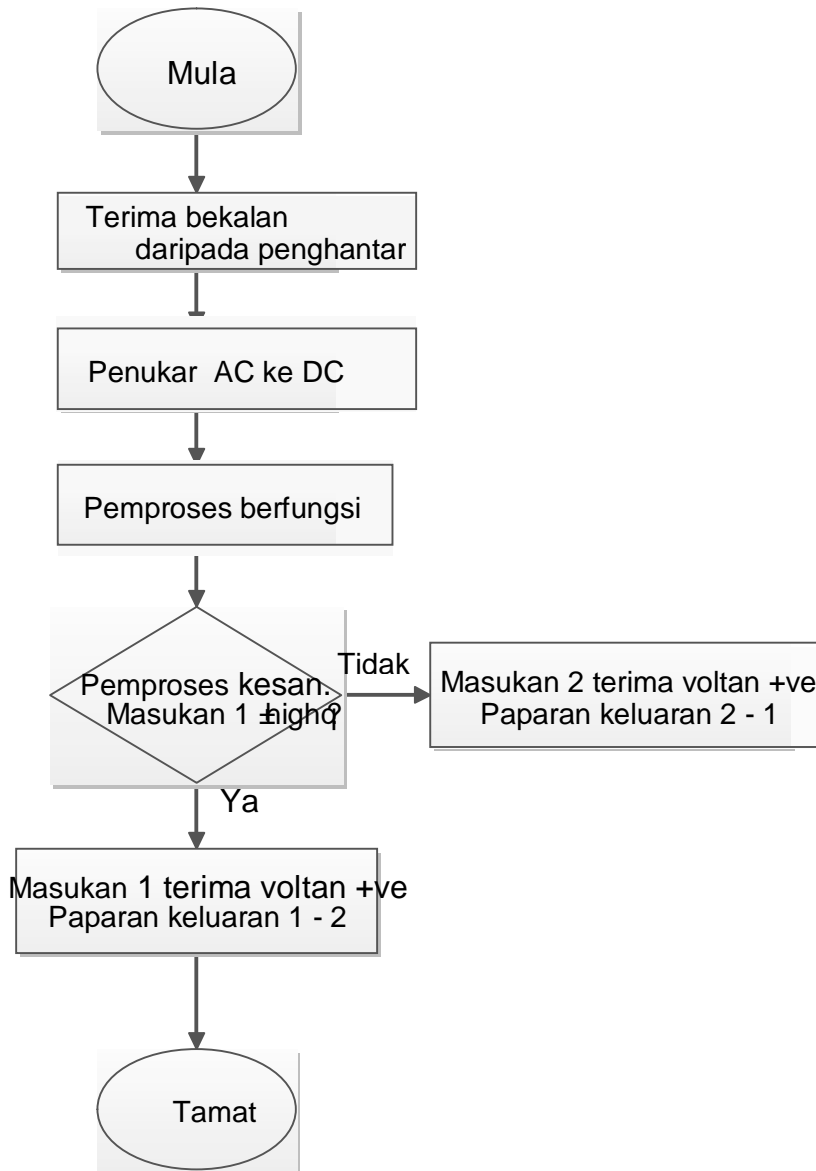


**Gambarajah 7:** Penggunaan Cable Tracer 5 Kabel

Penggunaan Cable Tracker boleh diperluaskan kepada pengujian pendawaian yang melibatkan lebih daripada dua kabel. Kajian rintis turut telah dilakukan terhadap pendawaian 5 kabel seperti ditunjukkan di dalam Gambarajah 7. Antara aplikasi yang boleh dilakukan adalah dengan memasang alat penghantar pada kabel penamat suis atau soket alur keluar, manakala alat penerima dipasangkan pada kabel masukan seperti kabel utama daripada Papan Agihan. Cable Tracker berfungsi seperti dalam Gambarajah 8 dan Gambarajah 9.



**Gambarajah 8 :** Carta Alir Fungsi Bahagian Penghantar



**Gambarajah 9 :** Carta Alir Fungsi Bahagian Penerima

## 5.0 Perbincangan

Pengujian dilakukan untuk memastikan 'Cable Tracker' ini dapat berfungsi dan mencapai objektif projek iaitu memudahkan pelajar atau pengguna menjalankan ujian keterusan dan mengelakkan masalah litar pintas berlaku.. Idea ini tercetus apabila para pengajar mendapati pelajar mengalami masalah sewaktu membuat penyambungan dan pelajar membuat kesilapan sehingga menyebabkan litar atau pendawaian yang dipasang tidak dapat berfungsi dengan baik.

Kajian mendapati pengujian keterusan dan kekutuban menggunakan Cable Tracker adalah dapat menjimatkan masa sebanyak 60 % berbanding menggunakan kaedah multimeter. Jadual 2 menunjukkan masa yang dicatat untuk melakukan pengujian menggunakan multimeter dan Cable Tracker.

**Jadual 2:** Perbandingan masa pengujian

Alat Pengujian	Jarak Pendawaian			
	10 meter	50 meter	100 meter	200 meter
Multimeter	50 saat	100 saat	180 saat	300 saat
Cable Tracker	30 saat	60 saat	100 saat	150 saat

Jumlah masa yang dapat diijamatkan meningkat dengan peningkatan jarak pendawaian. Selain dapat digunakan untuk menguji keterusan dan kekutuban kabel semasa latihan amali di dalam pengajaran dan pembelajaran, alat Cable Tracker dilihat berpotensi untuk digunakan oleh sesiapa sahaja yang terlibat di dalam kerja-kerja pemasangan elektrik.

## 6.0 Kesimpulan

Cable Tracker dapat membantu dan memudahkan pengguna untuk membuat pemasangan dan pendawaian. Ia juga mempunyai nilai komersil untuk dikembangkan dan dipasarkan. Selain mudah digunakan, Cable Tracker juga mudah dibawa, mampu meningkatkan produktiviti serta motivasi untuk bekerja. Penambahbaikan boleh dilakukan bagi mengurangkan gangguan kepada isyarat. Rekabentuk yang lebih ergonomik serta luwes mampu meningkatkan nilai estetik serta daya tahan terhadap hentakan.

Cable Tracker ini amat sesuai bagi pelajar atau pengguna yang baru menceburi bidang pendawaian elektrik memandangkan penggunaannya yang amat mudah, efisien dan pantas. Penggunaan alat pengukuran sedia ada seperti multimeter memerlukan kemahiran serta kecekapan yang tinggi serta perlu mempelajari teknik penggunaan yang betul dalam mengendalikan alat tersebut bagi mengelakkan berlakunya ralat atau sebarang kejadian yang tidak diingini.

Sebagai pusat latihan kemahiran, projek ini mencapai sasaran untuk melahirkan tenaga mahir dan berdaya saing yang tinggi sekaligus menyahut seruan kerajaan untuk mengurus perdanakan program-program kemahiran dan meningkatkan pengeluaran produk-produk baru berasaskan idea kreatif dan inovasi. Pelajar-pelajar yang melibatkan diri dalam projek ini telah mendapat pengalaman baru dan membuka minda mereka agar lebih kreatif dan berani mencipta sesuatu yang baru.

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## P7 - Mesin Basuh Mudah Alih

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### **Abstrak**

*Projek ini adalah fokus kepada merekabentuk, memasang dan menguji lari mesin basuh mudah alih. Idea untuk menjalankan projek ini adalah setelah meneliti di pasaran tiada mesin basuh mudah alih yang boleh di bawa kemana-mana oleh pengguna yang menggunakan sumber kuasa selain dari kuasa elektrik di rumah. Ini adalah kerana rakyat Malaysia sekarang sudah semakin banyak menjalankan aktiviti-aktiviti luar tidak kira dikalangan pelajar atau yang sudah berkeluarga. Aktiviti perkhemahan yang melibatkan beberapa hari atau yang melibatkan kerja-kerja lapangan yang agak lama di tempat tempat yang agak jauh dari kemudahan asas sangat memerlukan peralatan mudah alih dan sebagainya. Projek mesin basuh mudah alih ini menggunakan satu motor DC untuk menggerakkan kipas basuhan dan dikawal menggunakan motor driver dan mikrokontroller PIC16F887 untuk mengendali dan mengawal keseluruhan proses membasuh. Dibekalkan dengan bateri asid Plumbun 2100 mAH. Sistem pengecas AC-DC juga di lengkapkan pada model ini untuk memastikan bateri dapat di cas di mana-mana palam 3 pin dengan bekalan satu fasa 240V. Sistem pengecas ini juga boleh berfungsi untuk mengecas bateri terus dari solar panel yang mana ini sangat membantu penggunaan di tempat yang jauh dari kemudahan asas bekalan elektrik. Mesin basuh mudah alih ini akan berfungsi dengan dua mod iaitu mod Normal dan mod Agresif, di mana putaran pada mod Agresif masa penukaran motor dari mengikut arah jam dan melawan arah jam lebih pendek. Ini akan memastikan basuhan akan mendapat impak lebih dari pusingan tersebut dan akan lebih memberi geseran pakaian pada air dan seterusnya menyebabkan basuhan bertambah bersih. Pengguna juga dapat membuat pilihan masa membasuh secara manual iaitu dengan pilihan 5 minit, 10 minit dan 15 minit. Masa tersebut adalah masa keseluruhan proses membasuh oleh mesin ini. Jika pengguna rasakan pakaian tersebut terlalu kotor maka pilihan masa lebih lama perlu di pilih, lebih lama masa basuhan maka lebih bersih lah pakaian tersebut. Walaubagaimana pun ia akan menggunakan lebih kuasa dari bateri.*

**Keywords :** *microcontroller PIC16F887, mudah alih, mobile, mesin basuh, pengecas AC-DC, bateri asid Plumbun, solar powered, solar panel, aktiviti luar, berkhemah.*

### **1. Pengenalan**

Perkembangan teknologi yang tiada had dan peningkatan aktiviti manusia dalam semua lapangan menuntut kepada keperluan peralatan yang lebih kecil, ringan, mudah alih, mudah di kendali dan yang seperti dengannya. Pada zaman teknologi ini manusia sangat bergantung kepada peralatan untuk membantu apa saja aktiviti yang mereka jalankan. Tanpa

peralatan atau gajet tersebut manusia mungkin lumpuh dalam melaksanakan aktiviti dalam kehidupan. Dari keperluan manusia kepada bantuan peralatan dan gajet inilah yang membuka ruang kepada ahli-ahli kreativiti dan inovasi untuk sentiasa berfikir dan berkerja untuk mencari idea yang boleh membantu segala aktiviti manusia tersebut.

Projek ini adalah salah satu idea yang di ketengahkan untuk menghasilkan suatu peralatan atau produk yang boleh membantu manusia dalam usaha menjayakan apa saja aktiviti luar yang mereka jalankan. Peralatan ini akan membantu dalam aktiviti lapangan yang agak lama atau aktiviti yang selalu bergerak dari satu tempat ke tempat lain dan tempat-tempat tersebut adalah remot dari kemudahan asas bekalan elektrik.

## **2. Kajian Ilmiah**

Pelbagai rekabentuk mesin basuh telah ada di pasaran dengan pelbagai fungsi dan kebolehan, juga di lengkapi dengan ciri-ciri keselamatan, ciri-ciri penjimatan elektrik, penjimatan air dan tidak ketinggalan dari rekabentuk yang futuristik dan sebagainya. Walau bagaimana pun fokus utama dalam rekabentuk yang akan dilaksanakan dalam projek ini adalah merangkumi beberapa perkara iaitu saiz yang kecil, ringan, menggunakan tenaga yang sedikit, menggunakan lebih dari satu punca tenaga dan yang paling penting ia tidak mengurangi fungsi utama peralatan iaitu membasuh pakaian.

Saiz yang kecil di perlukan untuk memenuhi kriteria mudah alih, lebih kecil pasti akan kurang ruang yang di perlukan untuk di pindahkan dari satu tempat ke tempat yang lain. Untuk tujuan ini, saiz kecil yang di maksudkan adalah ia dapat dikendalikan oleh seorang sahaja dalam proses mengalih atau memindahkan peralatan tersebut.

Peralatan yang ringan dengan objektif yang sama iaitu dapat dikendalikan oleh hanya satu orang pasti menepati kriteria rekabentuk utama iaitu mudah alih. Saiz dan berat memainkan peranan yang penting untuk menentukan peralatan tersebut boleh di kategorikan dalam kategori peralatan mudah alih.

Apabila sesuatu peralatan itu adalah mudah alih bererti peralatan tersebut akan beroperasi atau berfungsi tanpa bekalan tenaga yang tetap, pasti ia akan mempunyai punca tenaga yang mudah alih juga iaitu bateri. Dalam merekabentuk peralatan seperti ini, untuk memastikan peralatan tersebut dapat digunakan dalam jangka waktu yang lebih lama maka peralatan tersebut perlulah di rekabentuk untuk tidak menggunakan tenaga yang banyak disamping menggunakan sistem bateri yang baik.

Seperkara lagi yang amat penting dalam rekabentuk adalah untuk memastikan penggunaan peralatan tersebut tidak terhad atau bergantung kepada satu cara sumber tenaga sahaja. Ini adalah kerana dengan keadaan mudah alih, sumber tenaga yang terhad akan menghadkan penggunaan peralatan tersebut. Oleh sebab itu rekabentuk perlu lah menitik beratkan supaya peralatan boleh menggunakan lebih dari satu sumber tenaga. Pada rekabentuk mesin basuh mudah alih ini tenaga elektrik dari sumber kuasa talian tetap 240V juga boleh digunakan, pada masa yang sama bateri dapat dicas dan dapat menggunakan tenaga dari bateri dan seterusnya boleh menggunakan solar panel untuk mengecas bateri dan seterusnya boleh di gunakan untuk peralatan tersebut.

## **3. Objektif Kajian dan Metodologi Rekabentuk**

Matlamat utama projek ini adalah untuk menghasilkan satu produk iaitu sebuah mesin basuh mudah alih yang menepati keperluan pengguna.

Dalam usaha mencapai objektif tersebut apa yang di utamakan adalah memastikan



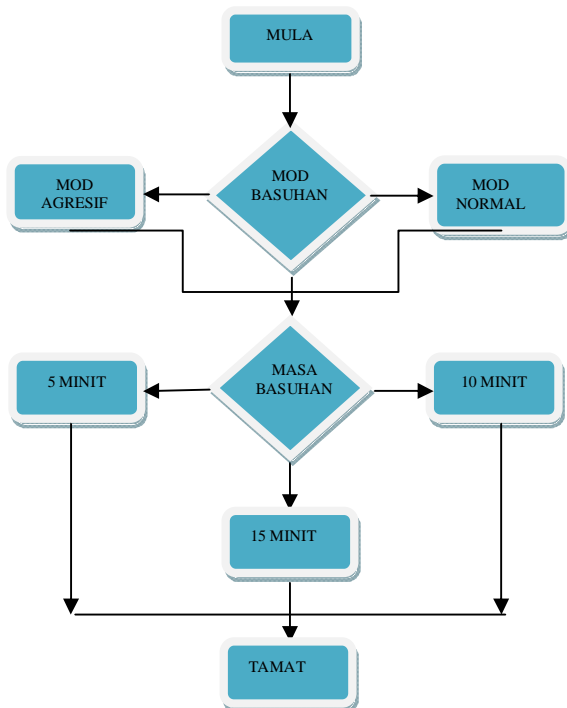
produk itu mudah alih. Untuk tujuan tersebut reka bentuk telah di tetapkan supaya boleh di pisahkan antara unit tempat basuhan dan unit kawalan. Unit-unit tersebut itu juga senang digantikan jika berlaku kerosakan dan tidak menggunakan ruang yang besar semasa proses mobiliti. Motor yang digunakan adalah motor DC yang mempunyai daya kilas (tork) yang tinggi pada kelajuan rendah. Dengan pusingan mengikut jam dan melawan jam secara berterusan semasa beroperasi motor tidak sesuai berfungsi dengan kelajuan tinggi kerana akan mempercepatkan kerosakan motor kerana kerap membrek dengan tekanan yang kuat semasa menukar arah pusingan. Proses membasuh memerlukan daya kilas yang kuat untuk memastikan basuhan itu berkesan mencuci pakaian yang dibasuh. Litar Kawalan Motor khas telah digunakan untuk mengawal motor tersebut berasingan dari litar utama.

Unit kawalan mestilah di reka bentuk supaya kalis air semasa di satukan dengan unit basuhan untuk memastikan semasa proses basuhan tiada air akan terkena unit kawalan yang mungkin boleh merosakkan unit kawalan tersebut. PIC16F887 digunakan dalam unit kawalan, di mana kawalan pusingan motor, arah pusingan motor, pemasa pusingan dan sebagainya di programkan di dalam PIC tersebut dengan bahasa C.

Di dalam unit kawalan ada satu unit pengecas, unit yang akan mengecas bateri yang akan membekalkan tenaga kepada *Mesin Basuh Mudah Alih* tersebut. Unit pengecas tersebut akan menggunakan bekalan 240V dari bekalan kuasa untuk mengecas bateri, IC Comparator antara yang digunakan didalam litar tersebut. Unit pengecas dapat member bekalan kepada motor dan pada masa yang sama mengecas bateri tersebut. Jika di tempat remot tetapi boleh menggunakan sumber sahaya matahari, *solar panel* dan *solar charge controller* dapat digunakan untuk mengecas bateri tersebut dan mengoperasi *Mesin Basuh Mudah Alih* tersebut.

#### 4. Ujikaji dan Keputusan

Carta alir proses basuhan adalah seperti di Rajah 1 di bawah.

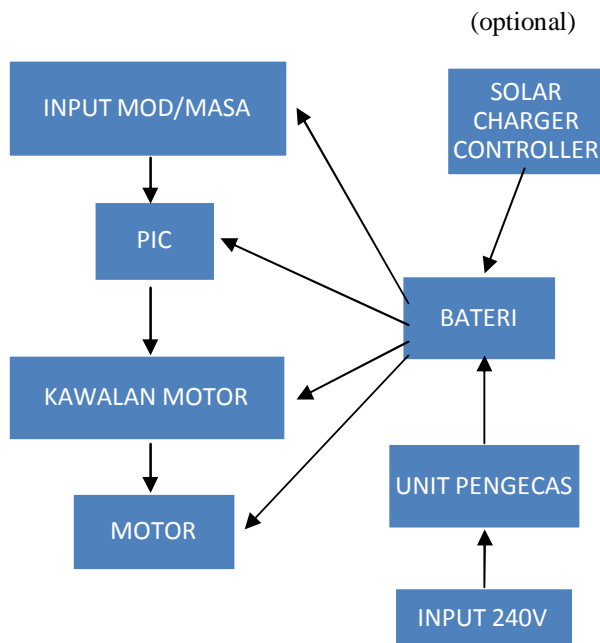


**Rajah 1:** Carta alir Proses basuhan

Rajah 1 di atas menunjukkan blok diagram proses basuhan di unit kawalan. Mod pilihan agresif telah di programkan untuk menukar putaran dari cw ke ccw dalam masa 4 saat manakala dalam mod normal masa putaran cw ke ccw adalah dalam masa 8 saat. Mod agresif menggunakan lebih kuasa dari bateri kerana motor brek dan daya kilas mula motor di setiap cw dan ccw menggunakan lebih kuasa elektrik.

Selepas pengguna memilih mod basuhan, pengguna di beri pilihan untuk memilih masa membasuh keseluruhannya di antara 5 minit, 10 minit dan 15 minit. Lebih degil kotoran pakaian memerlukan lebih masa basuhan dan pasti akan mengguna lebih tenaga elektrik, Untuk basuhan yang ringan seperti stoking dan pakaian dalam mungkin hanya perlu dengan mod normal dan masa basuhan hanya 5 minit.



Semua proses diatas adalah di kawal di unit kawalan utama menggunakan program yang telah di tulis di dalam PIC16F887. Blok diagram untuk keseluruhan sistem dan unit kawalan adalah seperti di Rajah 2 di sebelah.



**Rajah 2 :** Blok Diagram keseluruhan sistem dalam Mesin Basuh Mudah Alih

Rajah 2 di atas menunjukkan blok diagram keseluruhan sistem elektrik dan elektronik dalam Mesin Basuh Mudah Alih. Walau bagaimana pun *Solar Charger Controller* adalah unit tambahan yang di perlukan jika ingin menggunakan solar panel sebagai sumber tenaga utama. Unit tersebut boleh dibeli di kedai-kedai berkaitan solar. Litar Unit Pengecas, Litar Kawalan Motor dan Litar Utama yang menempatkan PIC adalah 3 litar berasingan yang berganding antara satu sama lain untuk menyempurnakan fungsi dan operasi Mesin Basuh Mudah Alih ini.

Gambar-gambar di bawah menunjukkan komponen-komponen yang telah di gunakan untuk melaksanakan projek ini.

Bearing	Shaft dan pulley	Propeller dan shaft	Nut / washer
			
Pulley	Belting	Spring / washer	Bolt / Nut
			
Motor	Motor housing	Long bolt	Basin basuhan
			
Penutup	Unit Kawalan	Top cover	Complete product
			

Gambar-gambar di atas menunjukkan komponen utama yang digunakan untuk menjayakan projek ini. Oleh kerana projek ini adalah projek *prototype*, semua proses rekabentuk dan pemasangan adalah menggunakan peralatan biasa di bengkel dengan menggunakan tangan. Walau bagaimana pun fungsi dan operasi berjalan lancar seperti yang di rancang pada peringkat awal.

## 5. Perbincangan

Keseluruhan projek berfungsi dan beroperasi seperti di rancang. Dari peringkat rekabentuk, matlamat utama rekacipta untuk menghasilkan produk mudah alih adalah fokus utama. Unit Kawalan dan unit basin basuhan boleh di pisahkan sangat memudahkan dalam mobility kerana ia tidak menggunakan ruang yang besar. Keseluruhan unit kawalan juga telah di rekabentuk tidak akan di masuki air dengan menggunakan silikon di semua lubang dan ruang ada di antara unit kawalan dan unit basuhan.

Berat produk akhir yang tidak melebihi 7.2 kg adalah sangat ideal dan masih dalam

kategori boleh di angkat dan di bawa ke mana-mana. Jika unit kawalan utama dan unit basin basuhan di pisahkan akan mengurangkan lagi berat semasa mobilisasi. Saiz produk akhir juga tidak besar kerana ia adalah sama dengan saiz baldi besar biasa yang ada di pasaran. Dari segi keseluruhan produk akhir ia sangat menepati konsep mudah alih yang menjadi fokus utama rekabentuk produk.

Komponen mekanikal yang agak tidak tepat dari segi ukuran menyebabkan pusingan motor yang tidak stabil pada shaft. Keadaan ini menyebabkan sesekali propeler basuhan terlanggar pada dinding basin basuhan. Keadaan ini dapat di atasi jika setiap komponen mekanikal di rekabentuk lebih teliti dan di hantar untuk fabrikasi dengan mesin khas bukan dengan peralatan yang ada bengkel seperti projek kali ini. Sebahagian dari komponen yang digunakan dalam projek ini menggunakan bahan-bahan kitar semula yang mungkin ada unsur unsur *ware and tare* yang juga mungkin punca kes tersebut terjadi. Keadaan ini tidak terlalu kritikal untuk projek *prototype* seperti ini.

Dari segi sumber kuasa, bateri yang lebih baik mungkin boleh di gunakan untuk memastikan mesin boleh beroperasi lebih lama. Bateri kapasiti lebih besar akan menambahkan berat produk, jenis bateri yang lebih ringan perlu di fikirkan untuk memastikan mesin dapat menepati kehendak mudah alih dalam fokus rekabentuk tetapi dapat beroperasi dengan lebih lama. Bateri LiPo mungkin lebih ringan tetapi bateri tersebut memerlukan sistem mengecas yang agak komplikated dan lebih besar yang mungkin tidak selari dengan fokus utama rekabentuk kerana menambahkan berat produk jika di gunakan.

## 6. Kesimpulan

Mesin Basuh Mudah Alih ini telah berjaya di rekabentuk, di pasang dan telah di ujilari dengan keputusan yang amat baik. Dengan hanya menggunakan peralatan yang minima satu inovasi mesin basuh telah Berjaya di hasilkan. Produk yang sama di pasaran yang kecil dengan kapasiti basuhan 3 kg dan berat 6kg tetapi hanya menggunakan satu sumber tenaga sahaja iaitu bekalan elektrik di rumah. Menunjukkan ia hanya mesin basuh mini tapi tidak menepati mudah alih. Satu lagi rekabentuk mudah alih di pasaran memerlukan pengguna memutar satu handel untuk membasuh, ini menunjukkan basuhan adalah secara manual, ia tidak memerlukan bekalan tenaga elektrik atau bateri.

Jika produk ini hendak di ketengahkan lagi ke peringkat yang boleh di komersialkan, bahan atau material yang lebih sesuai untuk basin basuhan mestilah di rekabentuk dengan lebih tepat dengan material yang sesuai. Motor juga perlu di kaji untuk mendapatkan motor yang betul-betul ringan tetapi mempunyai daya kilas yang kuat pada rpm rendah. Dan seterusnya sistem bateri mestilah di pilih bateri yang lebih ringan tetapi berkapasiti tinggi. Rekabentuk ruang dalam unit kawalan mestilah di rekabentuk supaya semua litar dan komponen dapat di susun dengan lebih sistematik yang menjurus kepada tidak menggunakan ruang yang banyak untk mengurangkan lagi saiz dan berat *Mesin Basuh Mudah Alih* ini. Secara keseluruhannya rekabentuk sistem dan operasi produk ini adalah memuaskan, dapat beroperasi dengan baik dengan prestasi yang baik.

Penambahbaikan yang boleh difikirkan pada masa hadapan adalah untuk menambahkan fungsi *spinning* iaitu fungsi berputar laju untuk membuang air yang ada pada pakaian yang di basuh. Untuk meralisasikan operasi tersebut rekabentuk mekanikal perlu di perkemaskan untuk memastikan sistem motor, bearing, shaf , *motor holder* dan propeler dapat berfungsi tanpa getaran pada kelajuan tinggi. Kesemua itu dapat di selesaikan dengan membuat rekabentuk tepat dengan CAD dan seterusnya hantar untuk proses fabrikasi.

Dengan kos yang sangat minima dapat dihasilkan *prototype* produk sebegini, jika di usahakan untuk di komersialkan ia pasti akan lebih minima dari segi kos. Dari merujuk

kepada *prototype* ini kerja-kerja mengkomersialkan produk ini akan lebih mudah dan akan membantu lagi dalam pengurangan kos pembuatan. Dengan kegiatan luar manusia yang semakin bertambah permintaan kepada produk mudah alih seperti ini pasti meningkat.

## 7. Rujukan

- [1] <http://tinyhouseblog.com/tiny-furnishings/tiny-washing-machine/>.
- [2] <http://www.microchip.com>
- [3] <http://www.cytron.com.my/>
- [4] <http://www.freepatentsonline.com>

## **P8 - Smart Automation System In Residential (Sistem Keselamatan Peralatan Elektrik di Kediaman)**

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### ***Abstract***

*This system is mainly designed for user to access household appliances switches using mobile communication (GSM). During early in the morning, when the householder leave the house for work or outstation, always forgot to switch off the electrical appliance. Since the householder cannot switch off the electrical appliances, it will cause the electrical bill charge higher than usual usage. By using this system, the mentioned problem can be overcome. Besidesthat, it can also be used at industrial factory or plant. The person in charge for the machines can switch ON or OFF the machines at time without his presence at the premises. This system also will be focusing on users to control their home appliances using remote and cell phone based interface. To access the control unit, the user should send an authentication code (DTMF) along with the required to home control system through Global System for Mobile communication (GSM). Upon being properly authenticated, the cell phone-based interface at home (control unit) would able the relay to operate and commands the microcontroller so it can perform the required function and action. In the end, a complete function in term of code will be return to the source of the original command (user's cell phone).*

**Keywords:** *Microcontroller AT89S52, DTMF module, Optocoupler, relay*

### **Introduction**

Nowadays people are looking for the methods to improve life conditions, comfort and at the same time the simplicity of handling with domestic electric appliances. The proposed of the system is to develop a cost effective solution that will provide controlling of home appliances . The system provides availability due to development of a low cost system. The home appliances control system with a reasonable cost was thought to should be mobile provides remote access to the appliances and allowing control the switch. Though devices connected as home appliances consume electrical power.

These devices should be controlled as well as turn -ONø or -OFFø if required. Most of the times it was done manually. Now it is a necessity to control devices more effectively and efficiently at any time from anywhere. In this system, we are going to develop a cellular phone based home appliance controller . This system is designed for controlling switch devices such as light,aircond and others. For active the cellular phone on the system a call is to be made and as the call is answered, a four digit password to access the system to control devices. As the caller press the specific password, it results in turning -ONø or -OFFø specific device. The device switching is achieved by relays . Security preserved by owner home.

## 1.0 Background

The problems arise early in the morning when residents are rushing to go to work and forgotten OFF the lights, fans, air-conditioning, and iron. When we forgotten to close the switch such as iron, it is likely that will happen such as fire and electrical wastage. This system is suitable for solving this problem through the telephone control switch. With the using DTMF circuit, microcontroller system, line telephone input, relay output control is used to detect ON or OFF switch devices.

This system is designed for controlling ON and OFF the switch for electrical devices. The cellular phone unit on the system will be activated, when a call is to be made and the call is answered, it will response the user with enter a four digit password to access the system to control ON or OFF electrical device. Besides that this system can reduce electricity bill.

This system is focused on power supply, line telephone input, DTMF circuit, microcontroller circuit and relay output. There are parts of TCS to be developed which the control switch ON or OFF. The part of software from microcontroller circuit using IC AT89S52 and do the programming data in IC through software 8051IDE. The purpose design the system for this project is to solve the problem forgetting to switch OFF the electrical devices by using telephone cell, which it can switch the remote terminal ON or OFF without anybody being present at the location. This project is achieved by using TCS (Telephone Controlled Switch) [5].

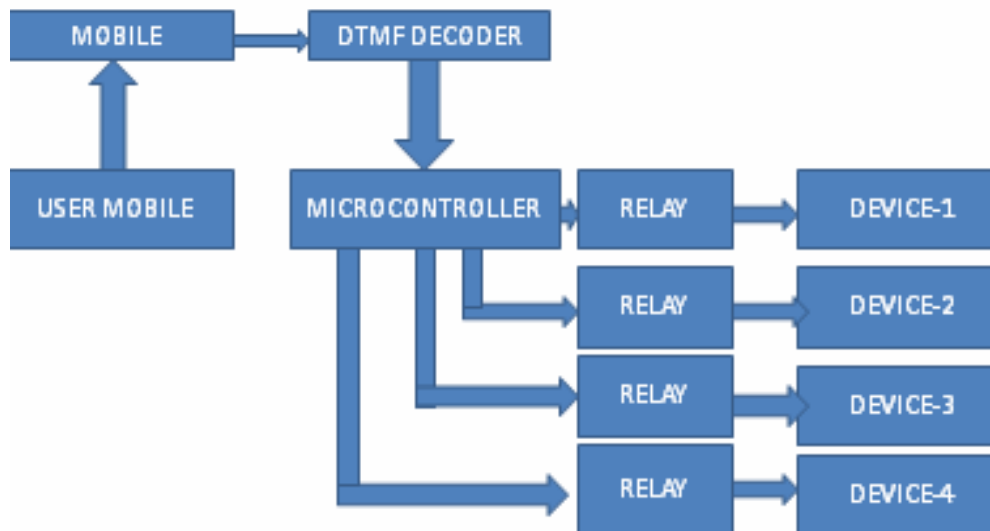


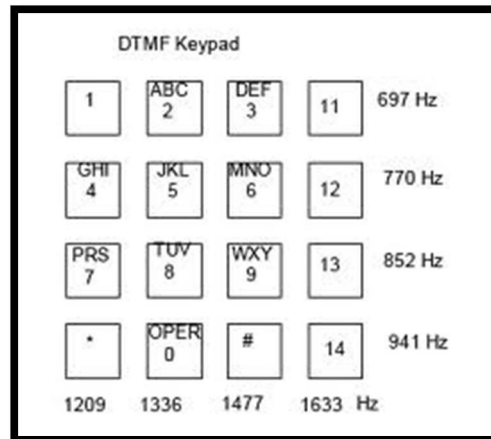
Figure 1: Block Diagram the system

## 2.0 Data Transmission

In this system, we used DTMF as one of data transmission. DTMF (Dual Tone Multi frequency) is the system used by touch-tone telephones. DTMF assigns specific frequency (consisting of two separate tones) to each key so that it can easily be identified by a microprocessor[2]. DTMF generation is a composite audio signal of two tones between the frequency of 697Hz and 1633Hz[2]. The DTMF keypad is set such that each row will have its own unique tone frequency and also each column will have its own unique tone. The figure 2 is a representation of the typical DTMF keypad and the associated row and column frequencies. The tone frequencies were selected such that harmonics and intermodulation products will not cause an unreliable signal. This circuit detects the dial tone from a telephone

line and decodes the keypad pressed on the telephone. The dial tone are heard when we pick up the phone set is call Dual Tone Multi-Frequency, DTMF in short.

The name was given because the tone that we heard over the phone is actually makes up of two distinct frequency tone means that it is dual tone. The DTMF tone is a form of one way communication between the dialer and the telephone. A complete communication consists of the tone generator and the tone decoder. For my project use the IC MT8870BE, the main component to decode the input dial tone to 4 digital outputs[3]. These digital bits can be interface to microcontroller for application such as phone line transfer operation.

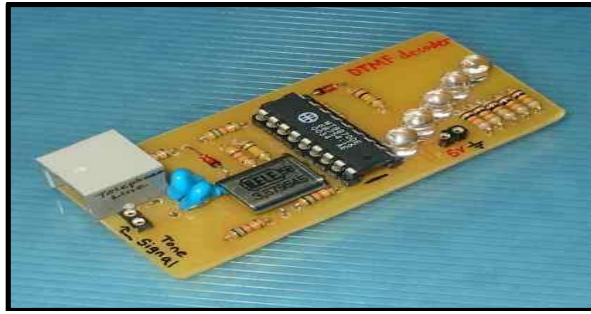


**Figure 2 : DTMF Keypad**

As technology matures, pulse and dial tone technique was inverted for telephony communication. It uses electronics and computer to assist in the phone line connection. Basically on the caller side, it is a dial tone generator. When a key is being pressed on the matrix keypad, it generates a unique tone consisting of two audible tone frequencies.

For example, when key 1 is pressed, the tone is actually consists of a 697 Hz and 1209 Hz sine signal[5]. Otherwise, key 8 will generate the tone form by 852 Hz and 1336 Hz[5]. The frequency use in the dial tone system is of audible range suitable for transmission over the telephone cable. On the telephone exchange side, it has a decoder circuit to decode the tone to digital code. For example, the tone of 941 Hz + 1336 Hz will be decoded as binary 1010 as the output[6]. This digital output will can see through LED, which will then act as a operator to connect the caller's telephone line to the designated phone line. The telephone exchange center will generate a high voltage signal to the receiving telephone, so as to ring the telephone bell, to notify the receiving user that there is an incoming call. This project focuses on a simple DTMF (dual tone multi-frequency) decoder circuit.





**Figure 3 : DTMF Circuit**

### **3.0 SASIR Performance**

This system used microcontroller as a main control unit, optocoupler to control the switch ON or OFF. The microcontroller AT89C52 used in this system because it is a low power, high performance CMOS 8-bit microcomputer with 8K bytes of flash programmable and erasable read only memory (PEROM)[4]. The device is manufactured by Atmel which high density non-volatile memory technology and is compatible with the industry standard for 80C52 instruction set and pin out[4]. The on chip Flash allows the program memory to be reprogrammed in system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications[4].

The standard features for the AT89C52 is 8K bytes of flash, 256 bytes of RAM, 32 input output lines, three 16 bit timer and counters, a six vector two level interrupt architecture, a full-duplex serial port, on chip oscillator, and clock circuitry. Besides that, the AT89C52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer and counters, serial port, and interrupts system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next hardware reset.

The main circuit of this system is the microcontroller unit using IC AT89S52 for programming assembly language for instruction for all circuits(refer figure 4). The section shows the relation between a telephone interface circuits and Relay output. An integrated DTMF decoder type MT8870BE decodes the tone dialing code receives through telephone line.

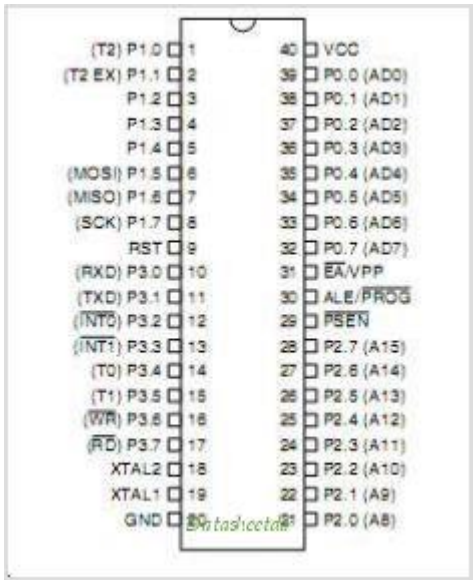


Figure 4 : AT89S52 Pinout

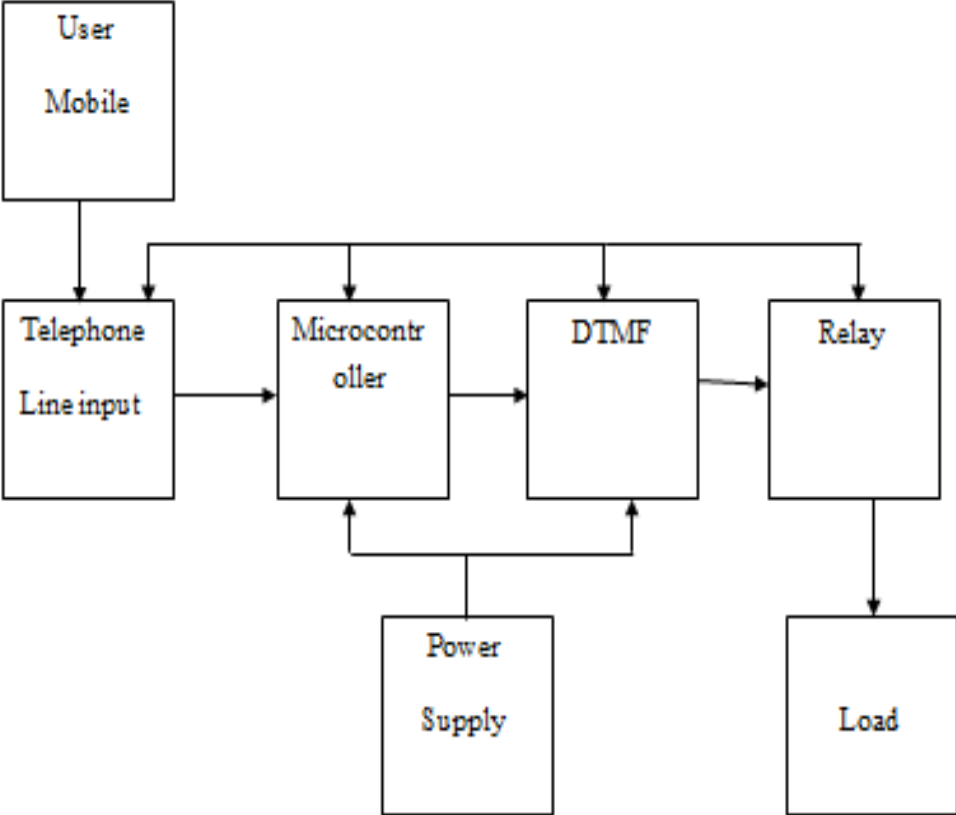


Figure 4 : Block diagram of SASIR

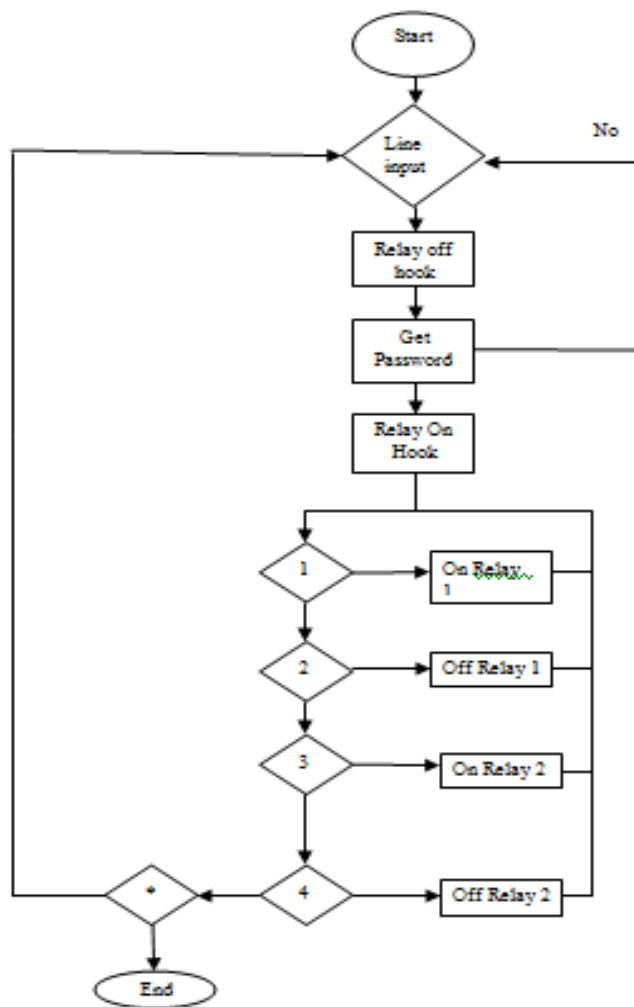
Figure 4 above show the block diagram of this project that consist of Microcontroller as a main circuit, DTMF circuit, Relay circuit and optocoupler circuit. This system will be function when user made one call and the system will detect ring signal to receive and

transmit data through the telephone line. Initially, relay is in turn off condition, so telephone line is connected to ringing section through relay contact. Due to this, ringing signal of 120V A.C. is rectified by diode full wave bridge rectifier circuit and D.C. is available across C4. The ringing signal detector is relatively simple. A bridge rectifier, D1 ó D4 connected to the telephone lines turns the ringing signal into pulsating direct voltage, which is smoothed by C4 and limited to 15 V with the aid of Zener diode D. The direct voltage across diode D supplies the LED in optocoupler IC. During the ringing signal, the collector of phototransistor in optocoupler (pin 5) is at ground potential. The micro controller IC interrogates the state of optocoupler output signal. Port line p 3.3 and microcontroller counts time delay stored in software (about 15 to 25 sec.). In that time delay, if any one picks up the handset micro controller stops its working and telephone set can be used as normal way. Otherwise, after the completion of time delay microcontroller turns on relay by setting bit P3.7.

#### 4.0 Results and Discussions

Figure 4 show the flow of the system operate. When a user dials a phone number, ring tone sound rings. When the relay ATX209 contact normally close at ring detector unit, the ring tone sound is off and the user must enter a password to activate the controls relay to switch on or off control load. In microcontroller, button 1 used to ON relay 1 and button 3 used to OFF relay function. Button 2 is used to operate relay 2 and button 4 used to OFF relay 2. This project using Super LED as a load, led lights indicate when the load is in a state of life, otherwise it shows the switch is OFF. During this period the relay remain OFF until the incoming call is detected by the ring detector unit

When the call is detected, the ring detector unit gives the microcontroller unit a logic low pulse. As per the time delay specified in the microcontroller programming, microcontroller waits for about 15-20 seconds. For the period of if anyone pick up the hand set of telephone set, microcontroller stops working and telephone set can be used in usual way. If no one picks up hand set then microcontroller unit gives the logic high pulse to the switching unit, thus the relay in the switching unit is made on and thus the incoming telephone line is connected to the DTMF decoder. The DTMF recorder receives the signals from the line and converts it into equivalent 4 bit code. These codes are given to the microcontroller unit. The microcontroller unit uses these codes to perform required operation using the software from the memory unit. When a line on the port 2 goes low the driver transistor is switched OFF and thus the corresponding relay and the load. If the line on Port 2 is made logic high, the corresponding driver transistor is switched ON and thus the relay and the load.



**Figure 4** : Process Flow of SASIR

## 5.0 Conclusion

Smart Automation System in Residential is a new system coding that uses microcontroller as a main unit control. This project targets to solve problem such as forgetting switch OFF the electric device, reduce the electricity bill, reduce the wastage of power. Mobile phones have become an important part of our life. This system uses a controller and a cellular phone for its operations. The systems can be used as a telephone line for any application that requires on and off switching based applications. This system controlled home appliances in the comforts of any environment will improve our way of living with rapidly developing technology. Controlling appliances remotely by a hand phone will become a reality. Smart automation home appliance might become a standard system in the new homes in the future.

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## P9 - Multi Purpose Machine ( MPM)

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### **Abstrak**

*Satu mesin rekaan terkini yang menggabungkan tiga proses kerja dalam satu mesin. Dengan terhasilnya mesin yang canggih dan berteknologi tinggi ianya dapat mempercepatkan kerja-kerja yang dilakukan seharian. Objektif penghasilan mesin MPM ini adalah untuk mengurangkan masalah kekurangan tempat penyimpanan dan kos mengangkut mesin ke tempat perniagaan. Mesin MPM yang berkeupayaan tinggi ini menggunakan kuasa elektrik dan komponen mekanikal yang telah diubahsuai mengikut kefungsiannya yang diinginkan. Penggunaan mesin ini diaplikasikan kepada pengusaha usahawan menjual air tebu, kelapa yang telah dimesinkan serta jagung rebus yang telah dilerai dari batangnya. Gabungan pelbagai fungsi dalam satu mesin dapat mengurangkan masalah kekurangan tempat penyimpanan dan kerja mengangkut mesin yang terhad di tempat perniagaan. Dengan hanya menukar mata pemotong kerja-kerja memesis, melerai dan memerah dapat dilakukan dengan cepat. Secara keseluruhannya dengan terciptanya mesin ini ia mudah dikendalikan dan kerja menyimpan serta mengangkut mesin ini menjadi mudah.*

**Keyword :** mesin, gabungan, tebu, kelapa, jagung, kuasa elektrik, mudah

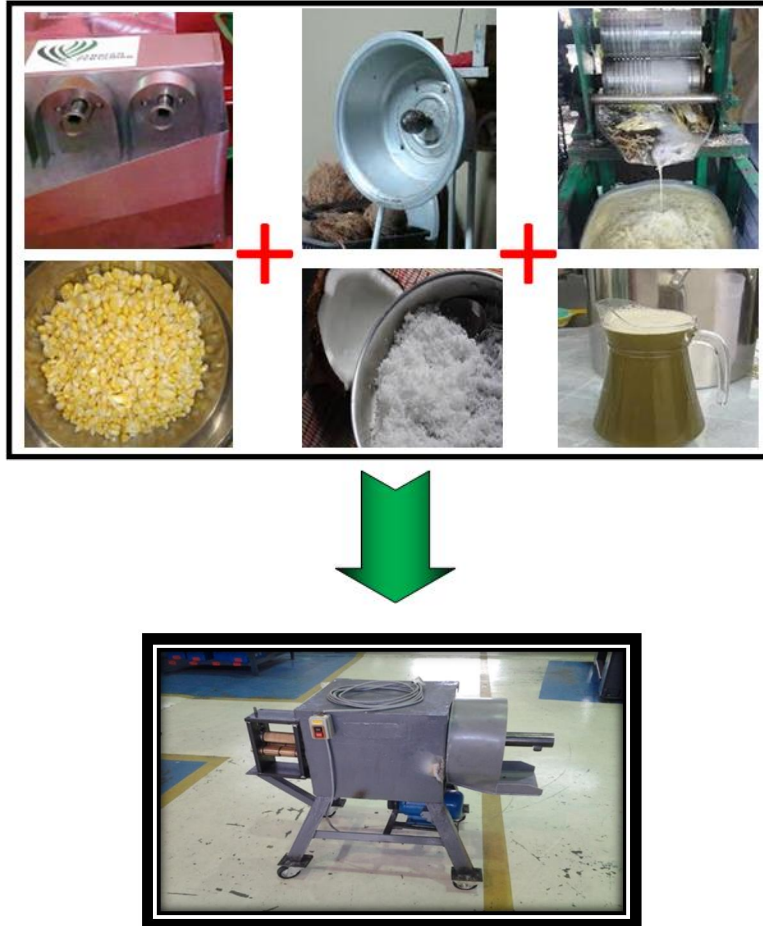
### **1.0 Pengenalan**

Seiring dengan zaman yang serba canggih dan moden ini, idea kreatif serta inovasi amat penting dalam menghasilkan sesebuah mesin yang mampu memberi impak tinggi kepada pengguna sekaligus menjana pendapatan kepada yang lebih baik. Di pasaran kini hanya terdapat satu mesin untuk satu fungsi sahaja. Untuk peniaga yang ingin menjual jagung yang dilerai, kelapa yang dimesinkan serta memesis tebu untuk mendapatkan airnya terpaksa mendapatkan ketiga-tiga mesin ini. Oleh itu sebuah mesin yang menggabungkan tiga jenis mesin bagi menjimatkan ruang penyimpanan, masa, kos dan produktiviti di mana memberi impak pendapatan yang tinggi kepada usahawan kecil dan sederhana telah dihasilkan dengan hanya menggunakan satu motor. Mesin ini menggabungkan tiga proses berbeza iaitu mesin kelapa, mesin pelerai jagung dan mesin tebu dimana mesin ini disatukan dan diberi nama mesin MPM. Dari pada kajian yang dilakukan terhadap peniaga di pasar-pasar tani dan pasar malam mereka terpaksa mengangkut mesin-mesin tersebut dan ruang di tapak perniagaan menjadi sempit. Fokus utama penghasilan mesin ini bertujuan meningkatkan nilai hasil pendapatan usahawan dengan mempelbagaikan cabang perniagaan sedia ada serta menjimatkan ruang simpanan mesin dan mesin MPM mudah diselenggara kerana ianya menggunakan bahagian asas mekanikal sahaja. Kajian terhadap pasaran menunjukkan satu mesin untuk satu proses di mana ianya melibatkan kos modal yang tinggi untuk membeli tiga mesin sekali gus serta tempat simpanan mesin yang terhad. Hatta dengan terhasilnya mesin MPM ianya dapat menjimatkan tiga kali ganda kos modal serta memberi nilai pulangan yang lebih besar serta mempunyai nilai kormesial yang lebih tinggi dan paling penting menjimatkan ruang simpanan mesin. Bagi mengatasi halangan tersebut maka tercetuslah idea untuk menghasilkan sebuah mesin yang mempunyai nilai pulangan yang tinggi supaya kos

menjalankan perniagaan dapat dikurangkan dan menarik minat belia menceburi bidang perniagaan.

## 2.0 Kaedah Dan Bahan

### 2.1 - Rekabentuk model



**Rajah 1** : Projek mesin MPM

Projek ini menggabungkan mesin kelapa, mesin tebu dan mesin peleraai jagung dengan menggunakan motor satu fasa di bawah satu kerangka yang dibina khas bagi menampung kesemua fungsi yang ada. Mesin ini menggunakan motor satu fasa yang mempunyai 220-230 voltan dengan pusingan kelajuan 1600 pusingan seminit. Ianya mampu menjalankan dua proses serentak samaada proses memesis kelapa dengan melerai jagung atau proses memesis tebu dengan memesis kelapa dengan hanya menekan suis *on*.

- *Product features and capabilities (ciri produk & keupayaan)*

Mesin yang direka khas ini menggabungkan tiga proses yang merangkumi proses menghasilkan kelapa parut, jagung lerai dan air tebu. Gabungan mesin ini mengutamakan tahap keselamatan yang tinggi serta mesra pengguna dengan sasaran pasaran kepada golongan peniaga, industri kecil dan individu seperti suri rumah. Mesin ini berkonsepkan

mudah alih dengan roda bagi memudahkan pergerakan serta menjimatkan masa iaitu peniaga hanya perlu mengeluarkan modal untuk membeli mesin MPM yang telah menggabungkan tiga proses sekaligus tanpa perlu membeli tiga mesin yang berlainan. Mesin ini boleh dibawa ke mana sahaja serta ianya mempunyai nilai kebolehpasaran tinggi kerana permintaan jagung lerai, kelapa parut dan air tebu semakin meningkat. Bercirikan mesra pengguna iaitu untuk menjalankan mesin hanya perlu menekan satu butang *on* serta direka menggunakan komponen mekanikal yang mudah didapati dan paling penting pemilik dapat melakukan penyelenggaraan sendiri kerana alat ganti senang dibuka, murah dan mudah didapati.

- Faedah dan aplikasi

Meningkatkan nilai hasil kepada pengusaha kecil dan sederhana iaitu nilai tambah yang ada pada mesin MPM iaitu satu mesin tiga fungsi yang digabungkan bertepatan dengan ciri ó ciri keselamatan yang tinggi dan peniaga dapat menaikkan jumlah pendapatan kepada tahap yang lebih baik. Sebagai contoh jika seorang pengusaha menggunakan mesin MPM ianya dapat mengembangkan perniagaan dengan menjual kelapa parut, air tebu dan paling mendapat permintaan yang tinggi ialah jagung lerai sejuk beku.

- Kebolehpasaran

Harga yang berpatutan dan memberi nilai impak yang tinggi kepada pengguna mesin MPM kerana peniaga dapat mengembangkan perniagaan daripada satu bidang kepada tiga bidang kerana mesin ini menggabungkan tiga proses sekaligus membolehkan peniaga meningkatkan taraf pendapatan dan daya saing yang sihat di kalangan peniaga. Penjimatan kos modal juga lebih tiga kali ganda berbanding membeli tiga jenis mesin sekaligus dan ini membuatkan mesin MPM ini mampu menembusi pasaran tempatan kerana ianya menjanjikan pulangan yang lumayan kepada peniaga.

## 2.2 Kajian Literatur (Analisis)

Melalui kajian analisis yang pertama iaitu kajian melalui pemerhatian yang dilakukan ialah didapati mesin kelapa, mesin menghasilkan dan air tebu yang berada dipasaran dan juga harganya yang mahal untuk dimiliki oleh pengusaha-pengusaha berskala sederhana dan kecil. Tambahan pula mesin- mesin ini dijual dalam bentuk yang berasingan. Pengusaha harus mengeluarkan modal yang lebih besar untuk memiliki kesemua mesin ó mesin ini. Selain itu sesetengah mesin-mesin tersebut terlalu besar dan kadang ókadang tidak ekonomik untuk dimiliki oleh pengusaha-pengusaha kecil, yang mana mesin tersebut sukar di bawa dengan kenderaan yang kecil berbanding dengan jumlah mesin yang banyak

Kajian analisis yang kedua iaitu kajian terhadap *pengguna* berdasarkan temubual dengan peniaga kecil dan perseorangan, mereka memang mempunyai keinginan untuk memiliki mesin kelapa dan mesin tebu tetapi faktor kos pembelian mesin menjadi penghalang utama. Jadi berdasarkan cadangan dan kehendak dan ciri-ciri yang pengguna mahu telah diadaptasikan penciptaan projek MPM buatan tempatan dengan kos yang berpatutan dan mampu dimiliki.



Antara Jenis bahan yang digunakan untuk menghasilkan mesin MPM.



Motor Elektrik Satu Fasa

Pulley V Belt

#### 4.0 Analisa Persembahan

Wujudnya mesin MPM ianya meringankan kos modal iaitu jika sebelum ini peniaga terpaksa membeli sebuah mesin kelapa yang berharga RM150, mesin tebu RM1650 dan mesin peleraai jagung dengan harga RM500, tetapi dengan mesin MPM kos modal bagi menghasilkan mesin ini hanyalah RM700 iaitu penjimatan sehingga tiga kali ganda sekaligus menaikkan hasil jualan dan pendapatan peniaga. Peniaga juga tidak perlu memikirkan ruang penyimpanan yang besar kerana mesin ini hanya bersaiz 105cm x 60cm x 86cm dan mudah alih serta bagi peniaga pasar tani ianya boleh dibawa ke mana sahaja.

##### 4.1 Analisa Kos

Mesin Sedia Ada	RM	JUMLAH	Multi Purpose Machine (MPM)	RM 700.00	PENJIMATAN
Mesin Kelapa	150.00	RM 2300.00			
Mesin Tebu	1650.00				
Mesin Jagung	500.00				

**Jadual 1** : Jadual menunjukkan kos asal ketiga-tiga mesin dapat dikurangkan sebanyak RM1,600.00



**Rajah 3 :** Proses memesis kelapa



**Rajah 4 :** Proses melerai jagung



**Rajah 5 :** Proses memesis tebu

## 5.0 Perbincangan

Setelah berjaya menggabungkan tiga proses menjadi satu mesin dengan harga modal yang lebih rendah dan memudahkan peniaga serta menjimatkan masa bagi menghasilkan kelapa parut, jagung lerai, air tebu dan yang paling penting kos modal untuk membeli mesin dapat dikurangkan iaitu beli dengan harga sebuah mesin tetapi mendapat tiga proses yang berbeza. Namun beberapa penambahbaikan perlu dibuat dari segi bahan asas menghasilkan kerangka

mesin, saiz penggunaan rod serta motor dan rekabentuk yang dihasilkan perlu lebih ergonomik dan efisien dari segi teknikal.

## 6.0 Kesimpulan

Sebagai kesimpulan dengan terdapatnya mesin MPM ini dipasaran secara tidak langsung peniaga dapat menjana pendapatan yang lebih kerana mesin ini mempunyai tiga fungsi yang dapat dilakukan. Oleh yang demikian peniaga dapat melakukan ketiga-tiga kerja dalam satu mesin sahaja. Namun mesin MPM ia juga terdapat kekurangannya iaitu mesin ini tidak dapat melakukan ketiga-tiga kerja dalam masa yang serentak. Dengan adanya mesin ini peniaga-peniaga dapat mengurangkan ruang tempat penyimpanan dan kos mengangkut mesin ke tempat perniagaan. Mesin MPM ini mempunyai nilai potensi yang amat besar untuk diperluaskan lagi dipasaran dengan melakukan penambahbaikan selaras dengan teknologi terkini kerana ianya mampu mengubah pendapatan dan mewujudkan daya saing yang lebih sihat dikalangan peniaga. Penghasilan mesin MPM ini dapat memenuhi faktor-faktor penting dalam kajian penghasilan mesin ini iaitu peniaga-peniaga dapat melakukan proses kerja dalam satu mesin dan kos untuk membeli mesin-mesin untuk kerja-kerja meleraikan jaging, memesis kelapa dan meleraikan jagung dapat dikurangkan.

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# P10 - Spectrum Project

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## Abstract

*What is Autism. Autism is a lifelong developmental disability that blocks the learning, language communication, emotional and social development of a child. It is a disorder with a wide range of symptoms sometimes so mild that a child can function in a regular classroom with special services and at other times so severe that a child is mute and institutionalised. Autism is a severely incapacitating life-long disability which typically manifests itself during the first 30 months of life. Autism varies from child to child and time to time in severity and manner. Other common symptoms include sleeping, feeding and toileting problems, self-injurious behaviour, repetitive and self-stimulatory behaviour. However, people with autism may have a wide range of intellectual ability. Often, they can show extraordinary abilities in mathematical or mechanical skills, or in music, rote, memory, etc. Statistics show that one in every 150 children born today has a typical autism. The number of children with autism has increased by a staggering 30% over the last three years.*

**Keywords :** *Autism , intellectual ability , extraordinary ability*

## 1. Introduction

Project Spectrum concerns the development of a sensory environment for children on the autistic spectrum. The approach taken is a user centred one, taking the needs of the children as a starting point. The environment addresses the children's sensory requirements and provides a tailorable experience that can accommodate the needs and preferences of a wide range of children. Following a design research methodology, work on the project can be broken down into three stages of, understand the problem, propose and realize a solution, and evaluate the solution. Taking a user centred approach to the design has necessitated most of the work being focused on the requirements of children with autistic spectrum disorders (ASD) and these needs can be addressed through the design of an appropriate environment. As children with ASD are so variable, such an environment has to be extremely flexible and tailorable.

Additionally the project looked at the requirements of other stakeholders of parents/carers who bring the children into the environment and help them engage with it, and teachers. Although the primary deliverable is a highly configurable environment for use in schools (and other centres), the design and development process undertaken is just as important as this will help us to understand how digital technology can be used to support the engagement and psychological development of autistic children.

Therefore the major deliverables are a set of user requirements for the design of future environments and an evaluation methodology, both of which are based on the needs of the children.

## 2. Method and material

People with autism tend to be unusually strong visual and spatial thinkers, and it became clear that SketchUp plays to those strengths. With that bit of information, the Project Spectrum was launched with a single goal: connecting the autism community with SketchUp. For some children on the (autism) spectrum, especially those who are nonverbal, SketchUp serves as a way to communicate allowing them to share their thoughts through images. Other kids learn life skills that help them to achieve educational and career goals they might not have even aspired to before SketchUp. It seems SketchUp builds self-esteem since these children are able to model circles (and squares) around their neurotypical peers."

Project Spectrum was created to give people with autism the opportunity to express their creativity and develop a life skill using ,Google SketchUp 3D modeling software, has come to be recognized as a powerful tool in the autism and Aspergers communities, enabling individuals to design, communicate, and collaborate in fun and interesting ways. Designing with SketchUp can help increase success in school and even improve social skills like figure 1 below.

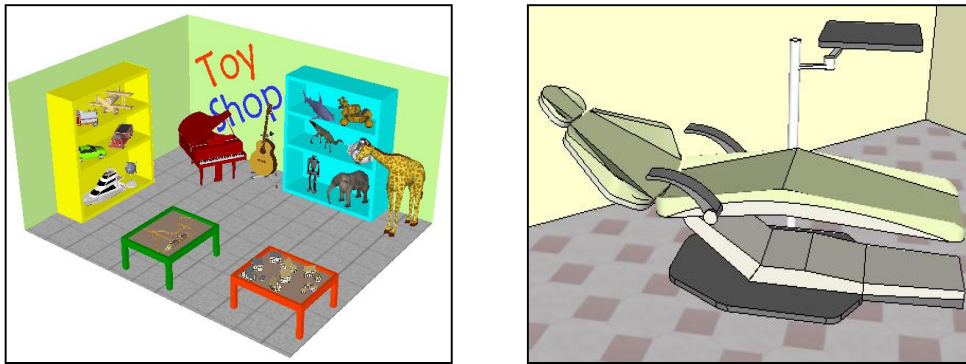


Figure 1

## 3. Result and discussion

### Building friendships, confidence

Parents enrolled their children in the sketch-up activity with a bit of skepticism. they had experienced prior failures and had found few activities their sons enjoyed. The parents soon noticed that these activity were different than other extracurricular activities, and seemed to be more aligned with their son's interests.

In turn, the success of the activity led to greater self-confidence in parents, who began to rethink what they expected of their parenting ability and began to feel more effective.

They also noticed their sons' sincere concern about friends in the activity ó something that hadn't happened in other social interactions. The parents and grandparents who noticed these changes began to feel optimistic that the boys would be able to develop genuine relationships with children and adults in the future.

A second-grader who attended the activity and who had struggled on a daily basis with attention issues and self-esteem problems was asked about his presentation and he said simply, "It went great. I was awesome."

### Building bridges

Just as an engineer might use SketchUp to design a bridge from one side of a canyon to another, SketchUp sessions were building bridges between generations within a family.

There were different types of intergenerational relationships that the researchers were able to analyze: parent-to-child, grandparent-to-grandchild, and grandparent-to-adult-child. In addition, the sibling relationships of the boys were studied.

## 4. Summary

Spectrum project is a happy marriage of talent and technology. A high proportion of people with autism have spectacular visual and computer talents, often invisible if you haven't managed to tap into them, The goal was always to reach children nationally and beyond.

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## P11 - DFL (Darby Float + Spirit Level)

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### Abstrak

*Kerja-kerja kemas dinding dan lantai merupakan antara kerja akhir yang sangat penting dalam proses pembinaan sesuatu bangunan. Ini kerana hasil kerja lepa dan penjubinan yang bermutu tinggi menggambarkan tahap kemahiran yang dimiliki oleh seseorang tukang bangunan. Oleh itu, semasa kerja melep dan pemasangan jubin dinding dan lantai pelbagai alatan pertukangan diperlukan oleh seorang tukang mahir seperti laying trowel@steel trowel, skimming float, devil float, felt float, gauging trowel, darby float, hawk, internal angle, external angle, straight edge, scupper, jointer, stainless steel straight edge angel dan spirit level.[1] Setiap kali kerja melep dan pemasangan jubin dilakukan, setiap kali itu juga, tukang bangunan perlu membawa alatan yang banyak. Oleh itu, menyedari pemasalahan ini kami mencari inisiatif bagi mengurangkan beban tukang bangunan daripada membawa barang tukang yang banyak semasa kerja melep dan menjubin. Alatan yang direka khas ini adalah gabungan Darby float + spirit level (DFL) dimana, kebiasaannya semasa kerja melep simen permukaan lantai dan dinding. Kedua-dua alatan ini di gunakan secara berasingan, iaitu menggunakan Darby float untuk meratakan simen pada permukaan dinding atau lantai dan untuk mendapatkan ketegakan dan kerataan menggunakan spirit level. Ia melengahkan masa tukang untuk menyiapkan kerja melep kerana terpaksa menggunakan peralatan ini secara bergilir-gilir. Namun, dengan Darby float + spirit level (DFL) kerja lebih mudah kerana hanya menggunakan satu alat sahaja untuk meratakan simen pada permukaan dinding atau lantai dan mendapatkan ketegakan dan kerataan yang optima.*

**Kata kunci:** Kemas Dinding, Pemasangan Jubin, Melep dan Meratakan Simen.

### 1.0 Pengenalan

Industri pembinaan kian berkembang, pelbagai alatan dan jentera binaan mengalami tranformasi rupa dan bentuk agar lebih efektif dan memudahkan kerja. Kesannya sesuatu kerja yang dulunya memerlukan masa yang lama, kini boleh disiapkan dengan cepat.

Oleh yang demikian, bagi memudahkan kerja lepaan lantai dan dinding. Kami menggabungkan 2 alatan binaan iaitu *darby float* dan *spirit level(DFL)*. Ia direka khas tanpa mengubah fungsi asal alat. DFL diperbuat dari material kayu dengan saiz fizikal iaitu lebar: 62mm-112mm dan panjang : 1m-2m. DFL berfungsi untuk meratakan simen pada permukaan dinding atau lantai dan sekaligus boleh mendapatkan ketegakan dan kerataan yang dikehendaki.

### 2.0 Perancangan Rekabentuk

Semasa melakukan sesuatu kerja kita sering menghadapi masalah, masalah yang timbul akan menyebabkan kita berfikir bagaimana cara terbaik melakukan kerja agar masalah tersebut tidak berulang dan sekaligus kerja dapat dilakukan dengan baik. Oleh yang demikian, bagi proses merekabentuk DFL, masalah yang berkaitan perlu dikenalpasti, melalui pemerhatian kami, semasa kerja melep simen permukaan lantai dan dinding. Tukang binaan

perlu membawa banyak alatan termasuklah *darby float* dan *spirit level*. Ini membebankan tukang binaan. Selain itu, kedua-dua alatan ini juga digunakan secara berasingan, iaitu menggunakan *darby float* untuk meratakan simen pada permukaan dinding atau lantai dan untuk mendapatkan ketegakan dan kerataan menggunakan *spirit level*. Ia melengahkan masa tukang untuk menyiapkan kerja melega kerana terpaksa menggunakan peralatan ini secara bergilir-gilir.

Selepas masalah dikenalpasti, kita perlu mendapat banyak maklumat mengenai alatan *darby float* dan *spirit level*. Ia diperolehi dari rujukan bacaan perpustakaan dan internet. Dari maklumat-maklumat tersebut, membantu dalam mendapatkan cetusan idea rekabentuk alat yang bersesuaian untuk menyelesaikan masalah yang dihadapi. Dalam proses cetusan idea rekabentuk, kita akan memperolehi pelbagai jenis rekabentuk agar kita mempunyai banyak pilihan. Seterusnya dengan pilihan yang pelbagai ini, kita dapat memilih idea rekabentuk yang terbaik.

Selain itu, kita perlu membuat perancangan keseluruhan bagi membina prototip dari idea yang telah dipilih. Ia meliputi pemilihan bahan, keada rekabentuk, kaedah pembuatan, kos keseluruhan projek, jangka masa pembuatan, faktor keselamatan serta kengkangan ó kengkangan yang mungkin berlaku.

Setelah perancangan teliti telah dilakukan, Pembinaan prototip dilakukan sehingga siap dan disusuli dengan pengujian prototip. Proses pengubahsuaian dilakukan terhadap prototip jika terdapat masalah-masalah tertentu. Kemudian peringkat terakhir jika semua pengujian mencapai tahap yang dikehendaki, kita perlu mendokumentasikan projek rekabentuk yang dibuat.

### 3.0 Metodologi projek

Kaedah yang digunakan bagi rekabentuk DFL adalah 90% menggunakan cara manual iaitu kerja tangan dan 10% menggunakan mesin contohnya menebuk lubang dan lain-lain. Peringkat pemulaan dalam pembinaan DFL adalah sangat penting bagi pemilihan bahan projek yang tepat.

Material yang digunakan adalah pemark kayu panjang (*darby float*) [3] yang berukuran 1050 cm x 16 cm dari jenis kayu meranti gred A dan *Spirit level*. [2] Setelah bahan disediakan, lukisan rekabentuk DFL yang ingin dibuat perlulah dirujuk semasa kerja dijalankan. Langkah pertama adalah membuat penandaan pada pemegang *darby float*. Penandaan ini adalah untuk memastikan tempat bagi meletakkan *spirit level* adalah betul. Pengukuran haruslah tepat seperti dalam lukisan rekabentuk. Penandaan dilakukan menggunakan pen mengikut saiz *spirit level* yang digunakan.

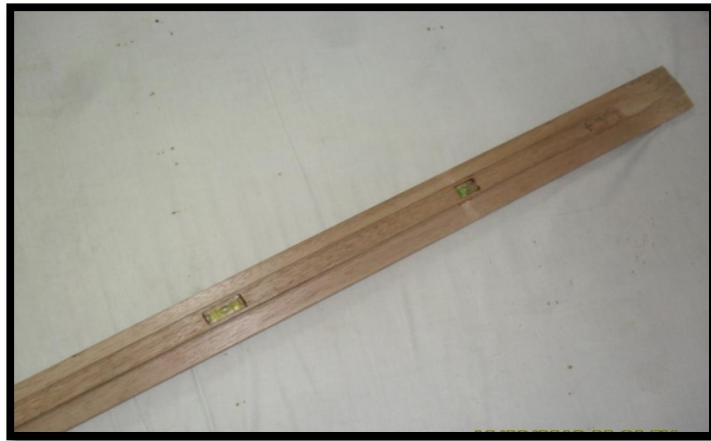
Setelah penandaan dibuat, Proses seterusnya adalah menebuk lubang pada pemegang *darby float*. Pemegang *darby float* hendaklah ditebuk mengikut saiz *spirit level* menggunakan gerudi. Kemudian diratakan dengan menggunakan pahat. Kemudian gosok lubang yang telah dirata dengan pahat menggunakan kertas pasir kasar dan halus. Ini penting bagi memastikan lubang yang ditebuk adalah cantik dan licin. Pastikan lubang yang ditebuk berada pada tengah-tengah bagi *spirit level* mendatar dan bagi *spirit level* menegak kedudukannya adalah disebelah kanan.

Setelah lubang pada pemegang *darby float* siap. Langkah seterusnya adalah memasukkan *spirit level* pada lubang yang telah ditebuk. Sebelum itu, masukan gam kayu



didalam lubang agar menguatkan cantuman antara *spirit level* dan pemegang *darby float* . Kemudian barulah *spirit level* dimasukkan dalam keadaan mendatar pada bahagian tengah pemegang *darby float* dan dalam keadaan tegak pada bahagian kanan pemegang *darby float*.

Langkah terakhir dalam pembinaan DFL ini adalah kerja kemasan . DFL yang dihasilkan dibersihkan menggunakan berus bulu untuk menghilangkan habuk-habuk. Setelah semuanya selesai. Barulah DFL diujiguna, dimana kita perlu menguji kerataan dan ketegakan *spirit level* pada DFL menggunakan *spirit level* pengukur. DFL yang telah siap seperti dalam Rajah 1 dibawah.



**Rajah 1:** DFL yang telah siap

#### **4.0 Kefungsian Projek**

DFL merupakan salah satu alatan binaan yang ditambahbaik fungsinya.Oleh itu, mungkin terdapat sedikit sebanyak kelemahan pada rekabentuknya. Untuk mengatasi kelemahan tersebut kami telah menguji kefungsian alat ini dengan dua cara.

Cara pertama, semasa menguji ketepatan *spirit level* yang diletakkan pada pemegang *darby float* pada bahagian tengah untuk menguji aras mendatar dan disebelah kanan.bagi menguji aras menegak. Kami akan memastikan lantai dan dinding adalah dalam keadaan yang betul-betul rata dan tegak. Disamping itu juga, *spirit level* penguji dipastikan dalam keadaan yang baik.

Cara kedua, untuk menguji kebolehgunaan alat DFL ini, kami telah membuat kaji selidik secara rawak dengan kaedah ujiguna alat DFL ini di tapak binaan yang sebenar selama seminggu. Hasil kaji selidik ini, kebanyakan tukang ditapak menunjukan respon positif dimana rata-rata berpendapat DFL memudahkan kerja melepai dinding dan lantai. Rajah 2 dan Rajah 3 dibawah menunjukan alat DFL sedang diujiguna ditapak bina.



**Rajah 2** : kerja memaras dan meratakan lantai



**Rajah 3** : kerja memaras dan meratakan dinding

## 5.0 Inovasi dan Keistimewaan Projek

Projek DFL ini menghasilkan inovasi dengan menambahbaik fungsi alat *darby float* kepada boleh memaras dan meratakan permukaan lantai dan dinding. Oleh yang demikian, kerja melepai bagi meratakan simen pada permukaan dinding atau lantai dan mendapatkan ketegakan dan kerataan boleh menggunakan satu alat sahaja

Selain itu, DFL agak mudah dan selesa digunakan kerana fungsi asal *darby float* dan cara penggunaannya adalah sama. Ini memudahkan tukang kerana telah mahir dengan cara kerja yang biasa dilakukan untuk melepai dan tidak perlu belajar cara baru.

DFL juga mempunyai harga yang berpatutan dan mampu milik. Ini akan menggalakan orang persendirian dan syarikat binaan untuk mendapatkannya.

## 6.0 Potensi Komersial

DFL sangat berpotensi untuk dikomersialkan kerana harga yang berpatutan dan murah, disamping produk ini tidak jauh beza dengan produk asal iaitu *darby float*. Ia cuma penambahbaikan produk lama dan diberi dwifungsi dalam satu alat. Oleh yang demikian, individu ataupun syarikat binaan telah biasa dengan alat lama dan mungkin teruja dengan penambahbaikan yang dibuat untuk alat DFL ini.

Oleh itu, fokus pasaran bagi alat DFL ini adalah orang perseorangan dirumah serta pengiat industri binaan dari syarikat kecil dan besar.

## 7.0 Perbincangan dan Kesimpulan

Melalui projek DFL ini, kami dapat melihat bahawa kesan dari penambahbaikan yang dibuat menyumbang kepada memudahkan kerja melepa simen pada dinding dan lantai kerana hanya menggunakan satu alatan saja bagi memaras dan meratakan simen. Berbanding cara lama, iaitu perlu menggunakan *darby float* untuk memaras dan bagi menguji kerataan terpaksa menggunakan *spirit level*.

Selain itu, ia juga dapat mengurangkan beban tukang daripada membawa alatan yang banyak. Ini kerana tukang binaan dapat mengurangkan bilangan alatan kerja melepa yang dibawa ke tapak binaan.

DFL juga mempunyai keistimewaannya tersendiri kerana alatan yang hampir sama dengan yang asal (*darby float*) tetapi dilengkapi dengan *spirit level* bagi memudahkan menentuukur kerataan dan ketegahkan. Oleh yang demikian, tukang binaan telah biasa menggunakan alat ini dan ia akan menyumbang kepada peningkatan kemahiran tukang binaan disamping kerja yang lebih efektif dan berkualiti.

Selain itu, fokus pasaran produk yang menyeluruh memberi nilai tambah kepada penerimaan pelanggan kepada alat DFL ini. Dimana, DFL bukan saja untuk tukang disyarikat binaan yang besar dan kecil tetapi ia juga boleh digunakan oleh orang perseorangan dirumah.

Kesimpulannya, diharapkan agar pengiat industri binaan negara boleh menerima alatan DFL bagi memudahkan kerja melepa simen lantai dan dinding. Ini kerana ia mendorong kepada rekaan yang lebih baik dimasa hadapan. Oleh itu, setiap masalah mesti ada penyelesaian, namun ia bergantung pada kita, bagaimana kita menghadapi masalah? Adakah dengan menjadikan masalah itu satu masalah ataupun menjadikan masalah itu sebagai cabaran untuk lebih maju.

## 8.0 Rujukan

[1] TAN BOON TONG *õ*Teknologi Binaan Bangunan, cetakan keempat 2000

[2] <http://talesofonecity.wordpress.com/tag/melchisedech-thevenot/>

[3] [http://www.lmcc.com/q\\_and\\_a/concrete-finishing-terms.asp](http://www.lmcc.com/q_and_a/concrete-finishing-terms.asp)

## P12 - Smart Desktop PC

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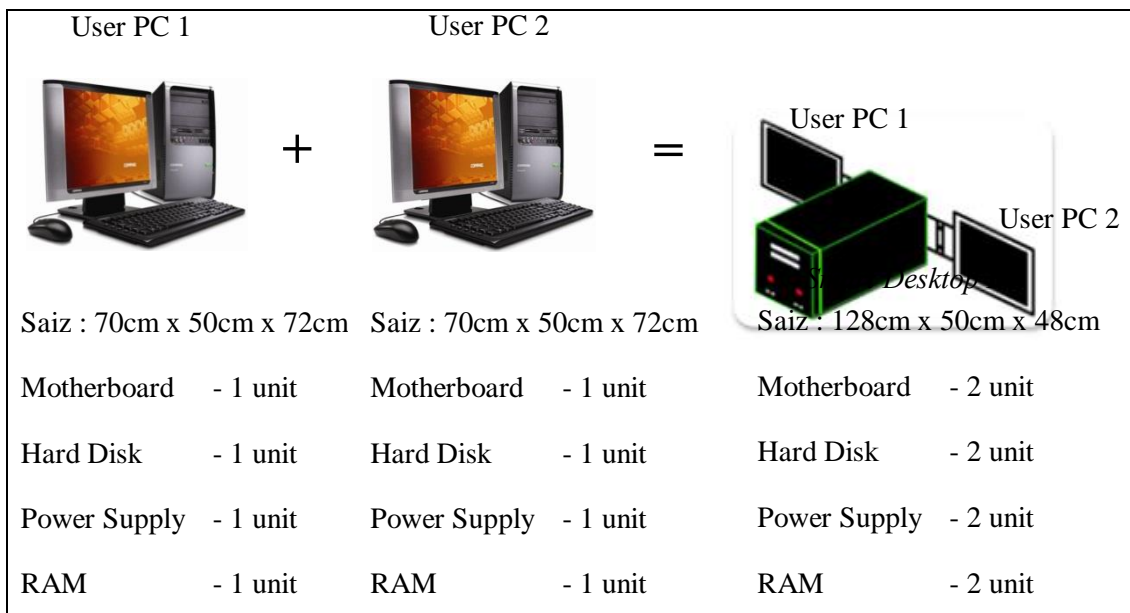
### Abstrak

Komputer desktop ini merupakan komputer generasi keempat yang merangkumi sekurang-kurangnya monitor, Central Processing Unit (CPU), keyboard dan mouse serta mempunyai dimensi 41cm x 17.5cm x 39cm. Oleh yang demikian desktop ini, memudahkan pengguna untuk menggunakannya kerana ia boleh menjimatkan ruang yang sedia ada. Ia amat bersesuaian digunakan di sekolah-sekolah dan institut-institut. Dengan Smart Desktop PC ini hanya memerlukan sebuah meja komputer pelajar yang sama saiz tetapi mampu untuk menampung dua (2) orang pengguna untuk menggunakan komputer pada masa yang sama tetapi platform sistem operasi yang berbeza iaitu Windows 7 dan Fedora. Projek ini dibangunkan dengan menggunakan material terpakai dan sedia ada di bengkel latihan bagi mengurangkan kos pembangunan projek. Dan ia juga bertujuan untuk menjimatkan ruang tetapi masih mengekalkan jaminan keselesaan dan keselamatan pengguna.

**Katakunci :** Smart Desktop PC

### 9.0 Pengenalan

Smart Desktop PC merupakan dua (2) buah komputer desktop lengkap yang telah diubahsuai menjadi satu (1) buah komputer desktop tetapi dapat digunakan oleh dua (2) orang pengguna dalam pada masa yang sama. Rujuk **Rajah 1** untuk ilustrasi yang lebih jelas.



**Rajah 1**

Projek ini dapat menjimatkan ruang dan boleh dilipat di bahagian kedua-dua monitor. Kedua-dua pengguna berupaya untuk menggunakan komputer *desktop* tersebut di platform yang berbeza (Windows 7 dan Fedora) serta perisian aplikasi yang berlainan tetapi pada masa yang sama. Produk ini sesuai untuk digunakan di dalam sesi pembelajaran di makmal komputer kerana selain dari menjimatkan ruang kerja, ia juga menjamin keselesaan dan keselamatan pengguna sendiri.

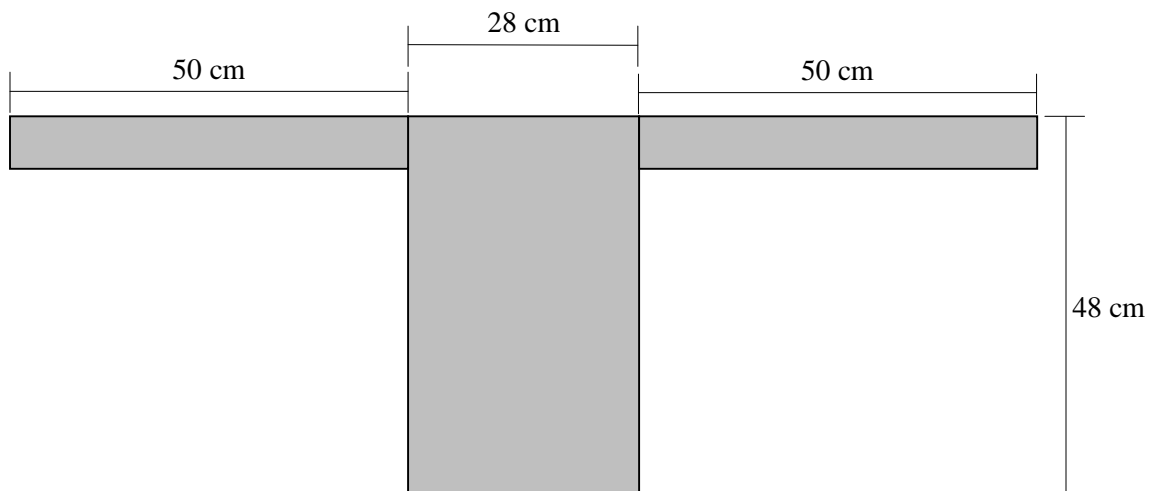
Objektif projek ini adalah seperti berikut :-

- a. Menjimatkan ruang kerja penggunaan komputer *desktop* di dalam makmal.
- b. Memastikan keselesaan dan keselamatan pengguna produk.
- c. Memanfaatkan material sedia ada di bengkel latihan untuk dijadikan projek inovasi yang mampu memberi manfaat kepada orang ramai.
- d. Membuat perbandingan keupayaan dua (2) sistem operasi dan perisian aplikasi yang berbeza pada masa yang sama.

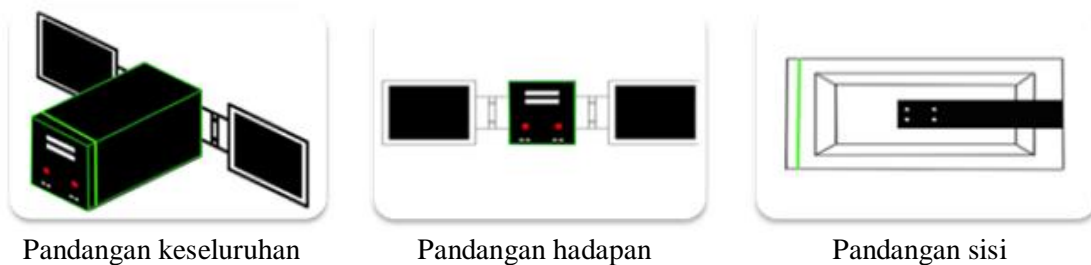
## 10.0 Penerangan Projek

### 10.1 Rekabentuk Model

Pembangunan projek *Smart Desktop PC* ini menggunakan material seperti yang dinyatakan di dalam **Rajah 1**. Bagi *CPU casing*, ia menggunakan besi holo yang dipotong mengikut rekaan yang telah dibincangkan mengikut kesesuaian pengguna. **Rajah 2** dan **Rajah 3** berikut merupakan rajah dimensi dan rajah pandangan keseluruhan, hadapan dan sisi projek tersebut :-



**Rajah 2**



**Rajah 3**

## 10.2 Ciri-Ciri, Keupayaan & Faedah Produk

Ciri-ciri utama *Smart Desktop PC* ini adalah untuk menjimatkan ruang pengguna tetapi mengekalkan keselesaan dan keselamatan sebagai aspek yang perlu dipenuhi. Situasi di dalam makmal biasanya akan mengandungi 30 unit meja bagi menampung 30 unit komputer untuk pengguna maksima 30 orang pengguna. Tetapi dengan adanya *Smart Desktop PC* akan mengurangkan penggunaan meja komputer kepada 15 unit sahaja. Sekaligus menjimatkan kos pembelian inventori.

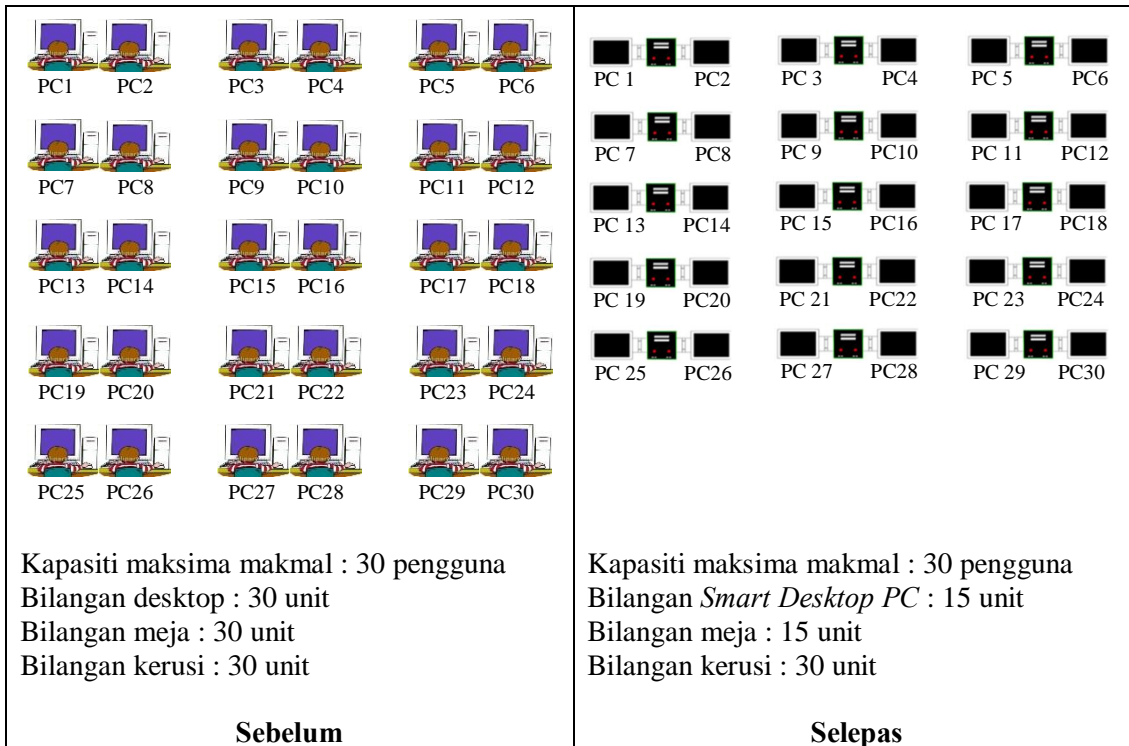
Ia juga berkait rapat dengan kaizen dan amalan 5S yang dapat memastikan penggunaan komputer dan kekemasan ruang kerja di mana *Smart Desktop PC* boleh dilipat di bahagian kedua-dua belah monitor seterusnya menghasilkan suasana dalam makmal yang kemas dan lapang. *Smart Desktop PC* ini juga mempunyai dua (2) sistem operasi iaitu Windows 7 dan Fedora. Oleh yang demikian, pengguna boleh menggunakan komputer dengan sistem operasi yang berbeza dan perisian aplikasi yang berlainan pada masa yang sama.

Senario yang biasa berlaku di dalam pelaksanaan latihan dalam makmal di mana peminjaman monitor atau CPU ke lokasi lain untuk jangka masa pendek atau panjang yang menyebabkan kehilangan atau isu terlepas pandang. Dengan adanya *Smart Desktop PC* ini tiada lagi wujud masalah tersebut. Selain daripada itu projek ini juga menggunakan kos dan masa yang minima di mana material yang digunakan adalah material sedia ada dan terpakai yang terdapat di bengkel latihan. Ia dapat memupuk daya kreativiti dan inovatif di kalangan pelajar dan pensyarah di dalam pembangunan projek yang berkualiti dengan kos yang minima.

## 11.0 Analisa Persembahan

Kualiti *Smart Desktop PC* dari segi aspek prestasi operasi sistem adalah baik kerana kedua-dua operasi sistem (Windows 7 dan Fedora) dapat dihidupkan serentak tanpa masalah. Secara tidak langsung, penggunaan perisian aplikasi yang berlainan pada masa yang sama juga tiada masalah. Selain daripada itu, haba yang dibebaskan di dalam CPU juga dapat dikawal dengan baik dan tidak menyebabkan sebarang *overheating*.

**Rajah 4** berikut menunjukkan keadaan makmal komputer bagi sebelum dan selepas penggunaan *Smart Desktop PC* yang memuatkan maksima 30 pengguna. Jelas sekali menunjukkan penjimatan ruang dan kos pembelian inventori.



**Rajah 4**

Terdapat dua (2) kategori masalah yang timbul semasa pembangunan projek iaitu masalah aplikasi luaran dan masalah aplikasi dalaman. Permasalahan yang timbul pada aplikasi luaran adalah penggunaan komputer dalam menyelesaikan tugas dalam lingkungan yang minima. Oleh itu dengan penghasilan projek ini akan perolehi keputusan yang berbeza dalam menjimatkan ruang, masa dan kepelbagaian jenis operasi di dalam penggunaan satu unit komputer.

Permasalahan yang timbul pada aplikasi dalaman pula dapat diperhatikan adalah seperti berikut :-

- a. Mengambil masa untuk pemasangan (*assemble & installation*) dan penetapan (*setting*).
- b. Memerlukan *casing* komputer yang lebih kukuh dan kuat.
- c. Pemilihan jenis kimpalan pada penyambungan *casing* komputer.
- d. Pemilihan jenis besi dan aluminium untuk penambahbaikan *casing* komputer supaya dapat menampung dua (2) unit monitor.
- e. Penggunaan bahan terpakai atau baru seperti unit perkakasan komputer dan *casing* komputer.
- f. Pemilihan antara menggunakan jenis monitor iaitu jenis LCD yang bersesuaian dengan berat dan ketahanan *casing* komputer.

**Rajah 5** berikut merupakan beberapa masalah yang dihadapi dan bagaimana masalah tersebut diselesaikan :-

Bil	Masalah	Punca	Penyelesaian
1.	<i>Casing</i> komputer Tidak Kukuh	Bahan yang ditempah tidak kukuh	Membina <i>casing</i> baru dengan menggunakan besi holo
2.	<i>Power supply</i> tidak sesuai	Saiz yang standard tidak sesuai	Menggunakan <i>power supply</i> mini ATX
3.	Tapak <i>hard disk</i> tidak sesuai	Saiz tapak tidak sama dengan <i>hard disk</i> yang ditempah	Melakukan modifikasi pada tapak <i>hard disk</i>
4.	<i>Front panel</i> tidak mencukupi	Memerlukan dua (2) <i>front panel</i>	Menggunakan <i>front panel</i> terpakai

**Rajah 5**

## 12.0 Perbincangan

Tujuan utama pembangunan *Smart Desktop PC* ini adalah untuk melakukan sesuatu pembaharuan dan memberi keselesaan pada pengguna. Selain daripada itu, ia menjimatkan ruang makmal. Walaupun terdapat beberapa masalah yang dihadapi dalam pembangunan projek, output amat bernilai untuk diaplikasikan di institusi latihan, sekolah dan syarikat.

Aspek utama yang perlu dititikberatkan dalam menyelesaikan masalah yang dihadapi ialah dengan memastikan pemilihan besi dan aluminium untuk penyambungan *casing* dan dua (2) monitor. Tahap keselamatan pada penyambungan *casing* perlu diteliti semasa mengimpal besi tersebut.

## 13.0 Kesimpulan

Secara keseluruhannya, *Smart Desktop PC* berjaya dibangunkan dan mencapai semua objektif yang telah ditetapkan. Projek tersebut juga mampu beroperasi sebagaimana yang dirancang. Walaubagaimanapun, untuk mempertingkatkan lagi kualiti projek, disarankan agar penggunaan satu (1) unit *power supply* sahaja tetapi masih mengekalkan kawalan haba di dalam CPU.

## 14.0 Rujukan

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[3] *Head to Head Linux vs Windows 7*,

<http://www.techradar.com/news/software/operating-systems/head-to-head-linux-vs-windows-7-626655#articleContent>



# **P13 - Model Integration Store Management Using AJAX Technology Japan-Malaysia Technical Institute (JMTI)**

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## ***Abstract***

*The model is developed to combine management stores from four different departments in Japan-Malaysia Technical Institute (JMTI). The departments are Department of Computer Engineering (TKK), Department of Electronic Engineering (TKE), Department of Mechatronic Engineering (TKM) and Department of Manufacturing Engineering (TKP). The idea to integrate the stores is meant to help improve its governance process and at the same time to manage stores in proper way. Model will be designed to suit with the environment of JMTI which will translate into prototype to test the function. It will use web-based platform with AJAX technology on the interface of the system. The modeling starts from use case diagram to collaboration diagram and developer uses PHP as a programming language, SQL database to develop the system as well as web hosting to expose on the real environment.*

***Keywords:*** department, model, store, AJAX, prototype

## **1.0 Introduction**

Store management is one part of the system that is important to manage the stock and cash flow. All ministries, departments, agencies and units must have store management either manual or online to ensure that they can purchase and store items to be used for their operations. The critical part is to manage the item so that it will be within the budget, being used efficiently and effectively with minimal wastage, as well as to ensure that the records figure is matched and accurate for the purpose of reporting. Ministry of Finance (MOF) stated that the impact of poor, disorganized and inefficient inventory management can cause the government to suffer losses as a result from waste capital tied up in stock, obsolescence, shrinkage and theft of goods stored (Treasury Circular Bills 5 Year 2009 Ministry Of Finance). The off-the-shelf store management system might not be suitable for an organization because each organization is unique with its own store management processes and environments. Basically, logic process for store management would be the same, but to make a centralized system from different departments is the critical part. The author has studied the problem that JMTI faced when managing the store and come out with a system that can be used to manage every department.

From 1997 to 2013, JMTI didn't have any system to manage store for all departments. Every department manages its system manually using file and form to request and buy item. Management receives the report separately between every department and combines together to discuss about budget allocation. Each department has its own process to manage and there is no integration and collaboration with each other. The author must analyze requirements of the system and study environments behavior in JMTI so that the

requirements and design will fit with the surroundings. Therefore the system would help to increase the productivity and allow the department to organize and handle store operations smoothly.

## **2.0 Methodology**

The system development using methodology for implementation to make sure all project activities are carried out without problem and any shortcut. Developer can use traditional methods like System Development Life Cycles (SDLC), Object Oriented System Analysis & Design (OOSAD) and agile methods [2]. The process is very important to ensure system development from start to finish that involves procedures, technique, documentation, methodology and tool along the process. At the same time, the step by step process can help developer to identify problem throughout the development by identifying block where the problem occurs.

In this research, general methodology is used because it helps researcher's ability to understanding, conducting, evaluating and publishing design research with information using technique that common researcher used like identify problem, document sampling, using internet and observation. There are five stages in general methodology of design research used by researcher and already accepted by other researcher as guidance to conduct the research [3].

## **3.0 AJAX Technology**

AJAX (Asynchronous JavaScript and XML) is a standard based technique for web application developers to create user interface for the applications deploy on the server. Using AJAX software, developers write the JavaScript code in addition to the standard HTML and create reach interactive user interface. With AJAX, web applications can send data to and retrieve data from a server asynchronously (in the background) without interfering with the display and behavior of the existing page. Data can be retrieved using the XMLHttpRequest object.

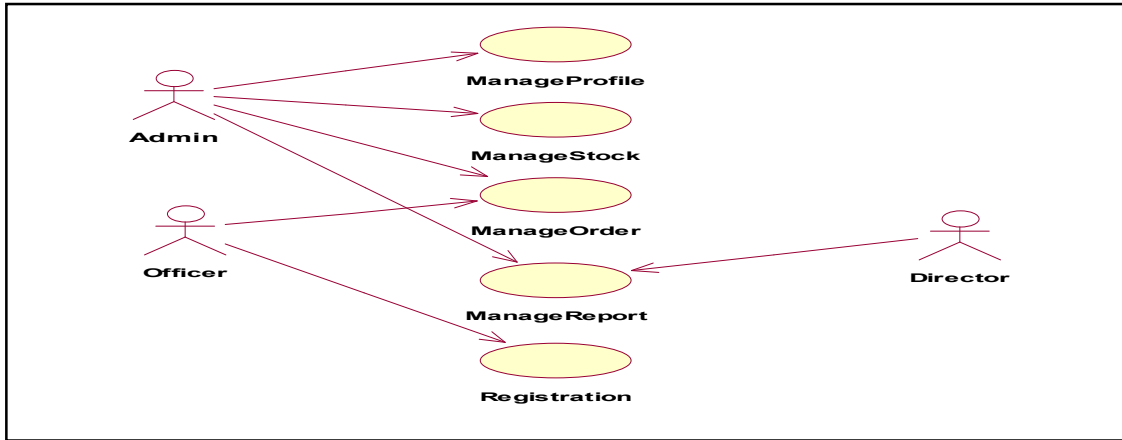
## **4.0 Modeling System**

First stage of the system development is getting information about the requirement and come out with the model. Model depicts the overview of the process that involved use case, sub use case, activity diagram, sequence diagram, collaboration diagram, functional requirement and class diagram.

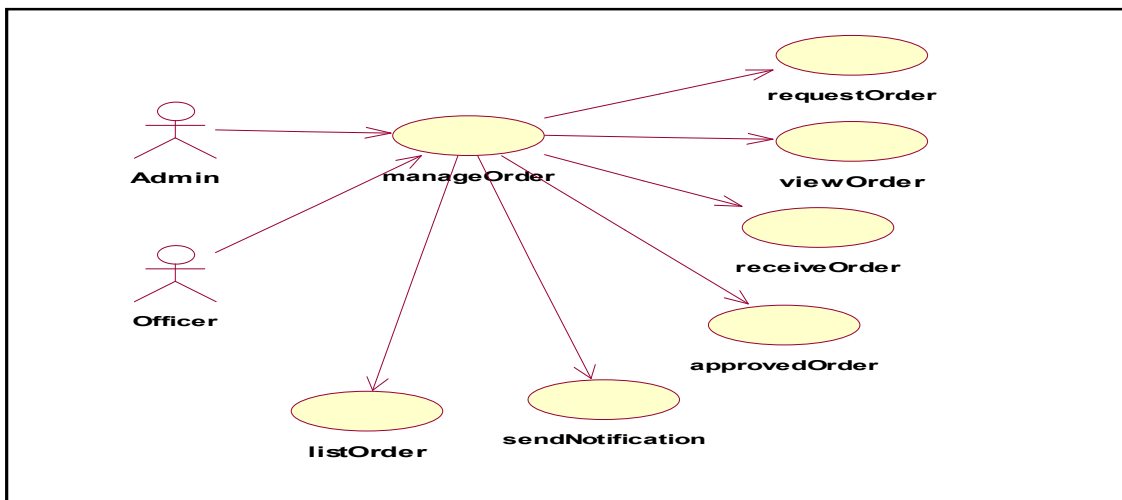
Every process will detail on model so that developer from development system can code and build based on the model [4]. This section describes modeling using Unified Modeling Language (UML) tools and Rational Rose as a software. The design starts from use case, sub use case, class diagram, activity diagram, sequence diagram and collaboration diagram for every process involved on store management system.

### **4.1 Use Case Design**

Use case design represents the overview of the system. The system used use case to highlight object that is needed by user and what they expect from the system. The main use case shows the interaction between the system and entities external from the system. To detail the use case, sub use case is used to depict from the main use case. Five main use case views are Manage Profile, Manage Stock, Manage Order, Manage Report and Registration. Figure 1 shows main use case view with one of the sub use case view on Figure 2.



**Figure 1 :Main Use Case View**



**Figure 2 : Sub Use Case**

## 4.2 Class Diagram

The class diagram shows the building blocks of any object-oriented system. Class diagram views the model with every box represents class of the system. Class diagram has attributes that can be translated into database and operation that show function of the class. It presents objects oriented method and everything that involved with the system [5].

Class diagram must tail with use case, sub use case, use case specification, sequence and collaboration diagram; and any changes to class diagram will affect the other model. Figure 3 shows class diagram with eight classes that represent the system. They are Profile, Order, Stock, Report, Approved, New Request, Vendor and allocate with attribute and operation. Connection for each class determines on database with one to one, one to many, many to many and others as a reference to database administrator.

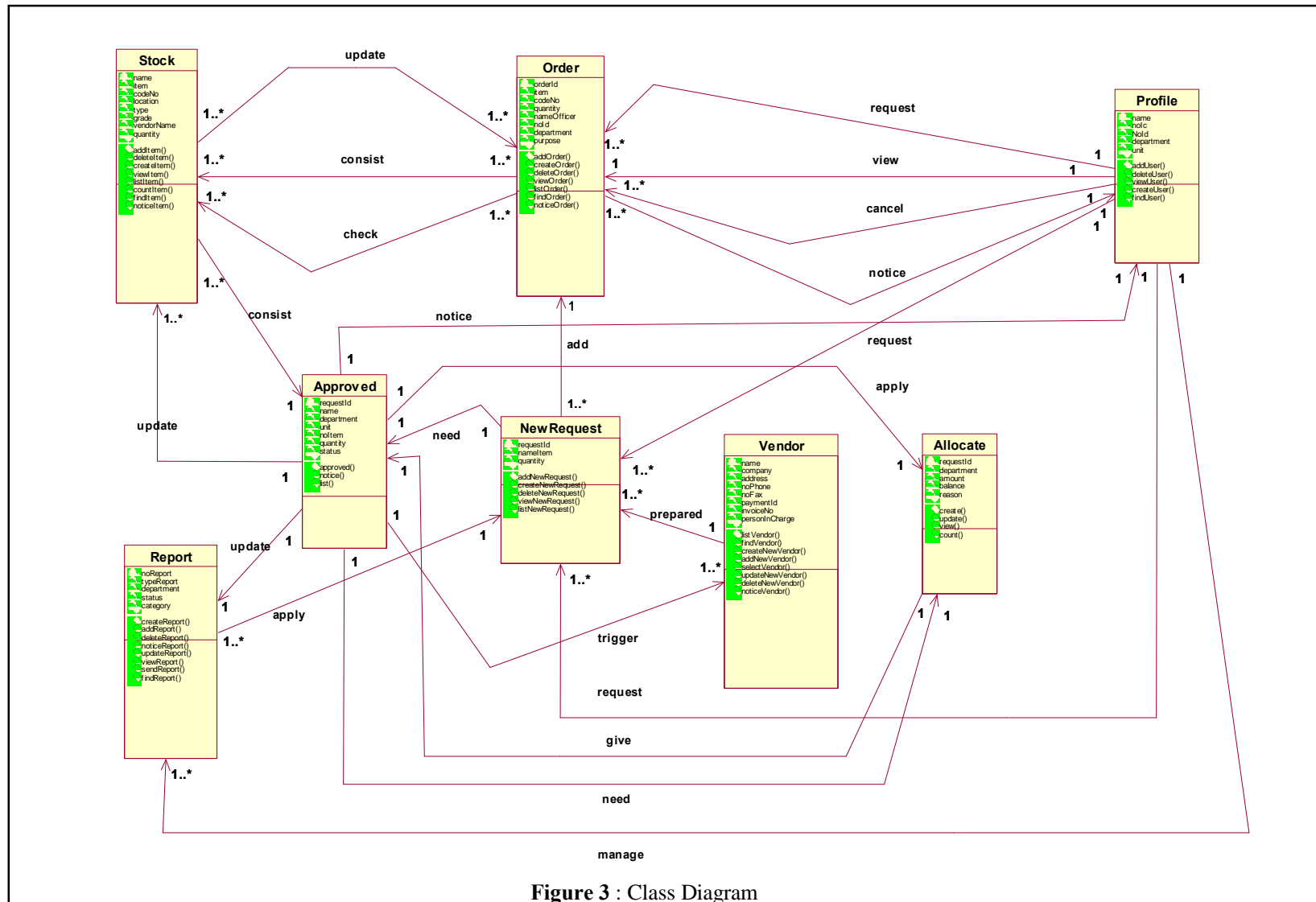


Figure 3 : Class Diagram

### 4.3 Sequence Diagram

Sequence diagram shows a detailed step by step process which user supposedly do on system and object involved. For example, objects like user login, view interface, choose list of vendor, controller and refer to database will translate into system that developer understands.

The process flow refers to sequence diagram because it shows details from step by step for one process. Sequence diagram shows process on horizontal view and not the same with activity diagram because activity diagram shows activities for the process and sequence diagram detailed for each activity.

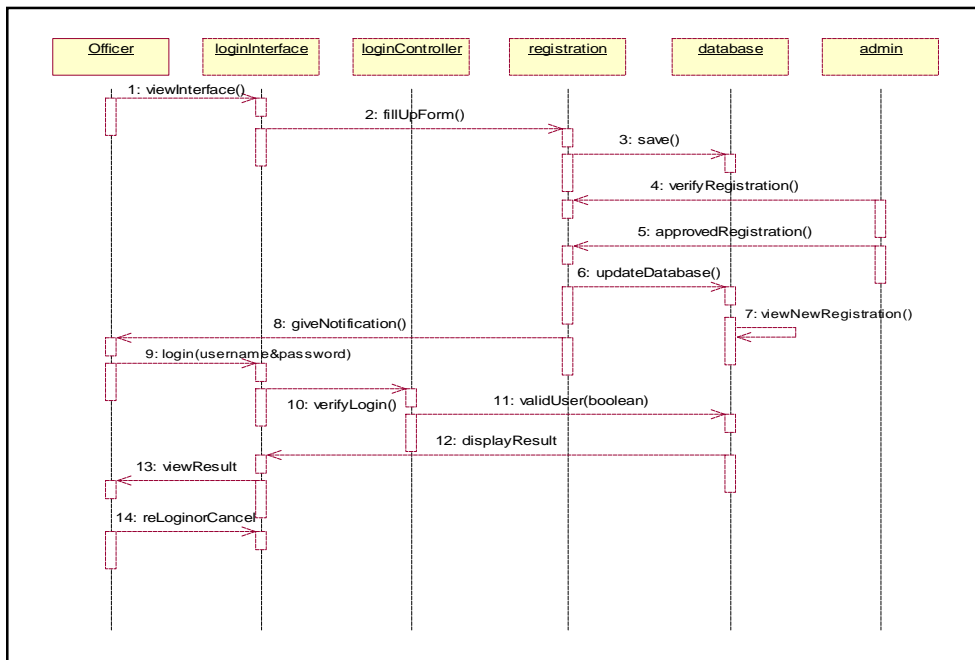


Figure 4 : Sequence Diagram for Registration

### 4.4 Collaboration Diagram

Collaboration diagram shows the connection between each object translates from sequence diagram. The process is the same but it shows on vertical view that objects are connected to each other.

### 5.0 Prototype

Figure 5 shows the login interface whereby each category of the user has to successfully login the system before the other menu/module can be accessed as shown in Figure 5.



Figure 5: Login Interface

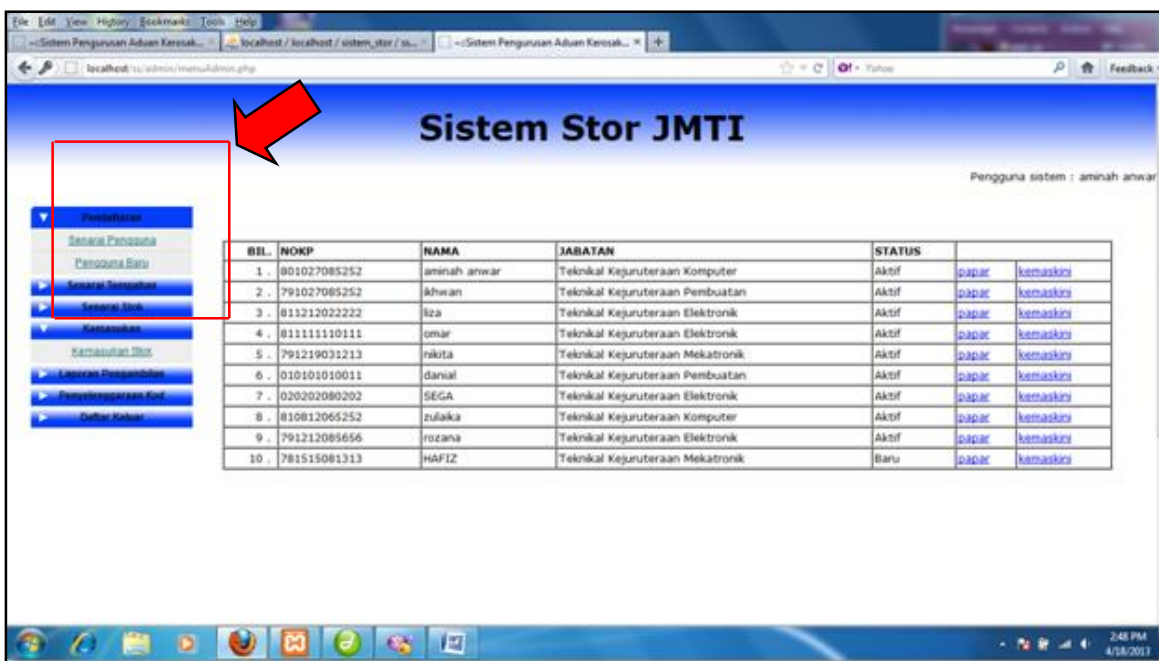


Figure 6 : Module System

After the system has authenticated the user during login session, five choices of modules will be displayed to the users depending on their roles. Users need to define what they want to do on system and determine where to go next until log-out from the system. The system has seven modules which are Registration, Booking List, Stock List, Stock Entry, Acquisition Report, Maintenance Code and Log-Out.

## 6.0 Discussion

Overall, the main objective of this study which originally to design and develop the system by using the prototype methodologies has been achieved. This project used UML, a standard technology for modeling and PHP supporting with Ajax as tools for developing; therefore the requirement and prototype model could be easily be understood and referred to by other developers as well as researchers. As this model only caters the process of managing store for every department so that the system only viable to captured some certain information to present the system requirement.

This is the first model develop to depict overall process of managing store and some prototype to proved the model. Since it a first model develops by JMTI, it can be expand to other model like Supply Chain Management (SCM) model that involves re-order process, inventory model, delivery model, buying model, tender model and so on.

## 7.0 Conclusion

Model integrated store management is designed to give overview on requirement of system before developing the system. Starting from use case to collaboration diagram and translated into a prototype, user knows the process on how system works. The model shows on software engineering methodology so that documentation is completed step by step. Using the object-oriented concept, each item must be detailed and changing the item will affect the overall process starting from use case to collaboration diagram.

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# P14 - Production Line Upgrade Simulation Using WITNESS

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## ***Abstract***

*WITNESS is among the software used by Manufacturing Engineers to simulate process and forecast the production output. Most of manufacturing companies are still using orthodox yet low-cost method in determining the plant process by using normal calculation, process flowchart or visual stream mapping. By using WITNESS, engineer able to plan and simulate any expansion, additional machine, manning and related equipment based on capital expenditure (Capex) provided by the company as investment for more output and thus reduce the waste and rejects. The purpose of this paper is to simulate the three proposals suggested for modernization of a production line consists of various process producing valves and analyze the best proposal for the company. In the simulation, Capex provided by the company for the modernization the production line is RM 100,000 and the challenge of the engineer is to present the best proposal that fit accordingly within the budget.*

**Keyword :** *WITNESS, manufacturing, simulation, Capital Expenditure*

## **1. Introduction**

This simulation is primarily concerned with the number of valve output that BUZZ Manufacturing Company can produce. In general, the antiquated machinery and poor planning of the company is the major contribution of the less productivity of the company. Nowadays, with technology, we can analyze the production of the company using computer modeling and simulation. Modeling the plant layout in Witness 2000 software can show the output that the machine can produce. With this method, estimation can be more precise and several alternatives can be attempt on the system without wasting time and money to do trials on the actual machine and system. Basically, the process of the manufacturing of the valves in the plant is start when the stock arrived; undergo processes of sawing, coating, hardening, grinding and cleaning.

## **2. Objective**

The objective of simulation is modernization of BUZZ Valve Manufacturing Company, so that the company can increase the current output manufactured within the capex provided.

## **3. Scope of Simulation**

The scope of simulation can be divided into three main parts. The first part is to model the machining process by using Witness 2000 Software. Based on plan layout give and explanation of existing system, the initial production plan created.

The second part is to adjust the based model (initial system of the company) with new equipment, system or planning to get the highest output within the budget provided.

The third part is to prepare a report that analyzed the proposal, and choose the best proposal to be proposed to the company management.



## **4. Methodology**

The production facility of BUZZ Valve Manufacturing Co. was modeled using Witness 2000. With the operating time frame constrained to 46 hours (2760 minutes), which includes 8 hours of warm-up period without production, the production model was simulated to obtain the current production output value. The output value is recorded and used as the reference value for total throughput improvement.

Three different approaches were implemented to achieve the objective of increasing the throughput of the manufacturing line. Each of these approaches contributes to a proposal. The three proposals will be compared at the end of the report to obtain a best solution to increase the total throughput of the company with the minimum investment possible.

## **5. Generating Proposal**

### **5.1 Proposal 1**

The first approach was to use trial and error method to improve the output of the model. Modifications were randomly implemented to the model and the new output value was compared with the original output. Once the modification shows improvement in the new output value, the modification is kept, and a new round of trial and error of modification was carried out. The iterations of experimenting result of modifications were continued until the budget of \$100,000 is spent.

### **5.2 Proposal 2**

The methodology used was to minimize bottleneck of the production line. The original production model was simulated and the report of the model was obtained. The value of the percent blocked of each station in the production line was studied. The machine with highest value of percent blocked is the bottleneck of the production line. In this approach, attempts are made to reduce the blockage of the production. After each attempt, the model is simulated and the new report of the model was studied. The iteration was repeated with changes made to the production line until the budget finishes.

### **5.3 Proposal 3**

The last approach to the problem was to systematically consider the outcome of all the possible changes. For this approach, all the available changes were simulated one by one to the original model, and the modification with the highest increment was implemented. Then, another round of simulations was carried out using the new model. All the available changes are tested with the new model, and the option which results in the highest increment was selected. The iteration continues until the budget runs out or no more significant increment in the production output is achievable.

### **5.4 Comparison Parameter**

After the three proposals were generated, the proposals were compared to determine the best solution to the problem. A comparison parameter is used to compare the outcome of each proposal. The comparison parameter used was the ratio of increment in throughput (unit or percent) over the money invested (thousand dollars). The objective of the problem is to come out with a solution which gives highest increment in throughput with the lowest investment. Thus, the proposal with highest comparison parameter was selected.

## 6. Result

### 6.1 Base Model

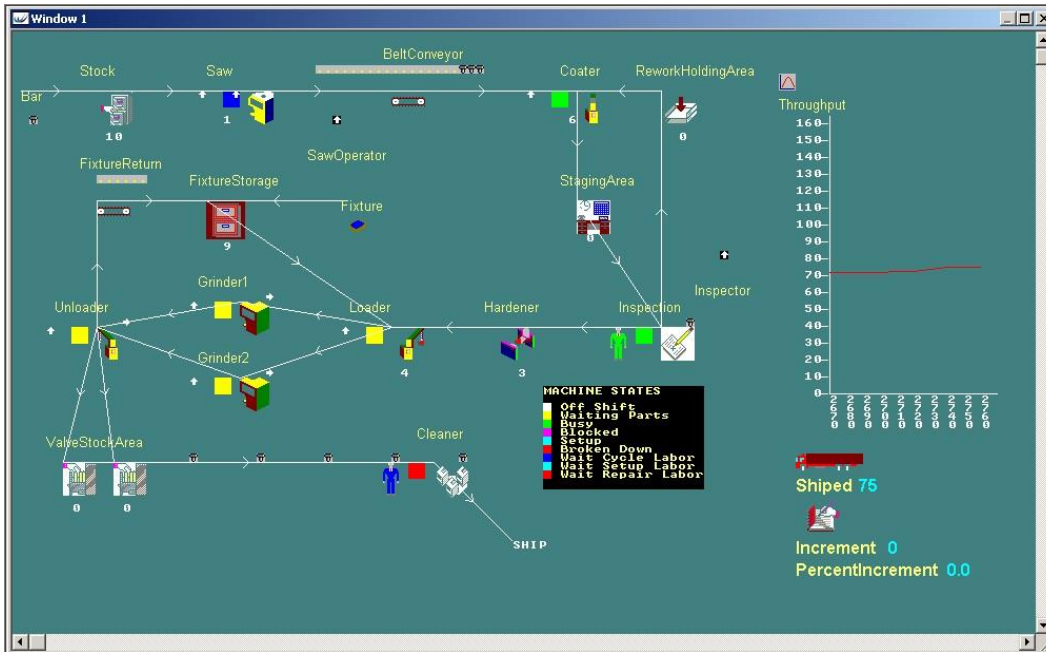


Figure 1: Base Model Production Line

### 6.1 Proposal 1

No.	Item	Quantity	Cost (\$)
1.	New inspector and machine	1	30, 000
2.	Convert belt conveyor to roller	1	10, 000
3.	Coater batch capacity increase	1	10, 000
4.	Hardener Reduce cycle time	20%	40, 000
5.	Cleaner decrease cycle time	10%	10, 000
<b>Total</b>			<b>100,000</b>
	New output	131 units	
	Throughput Increment	56 units	
	Increment percentage	74.7%	
	Ratio of increment per thousand \$	0.56	
	Ratio of % increment per thousand \$	0.74	

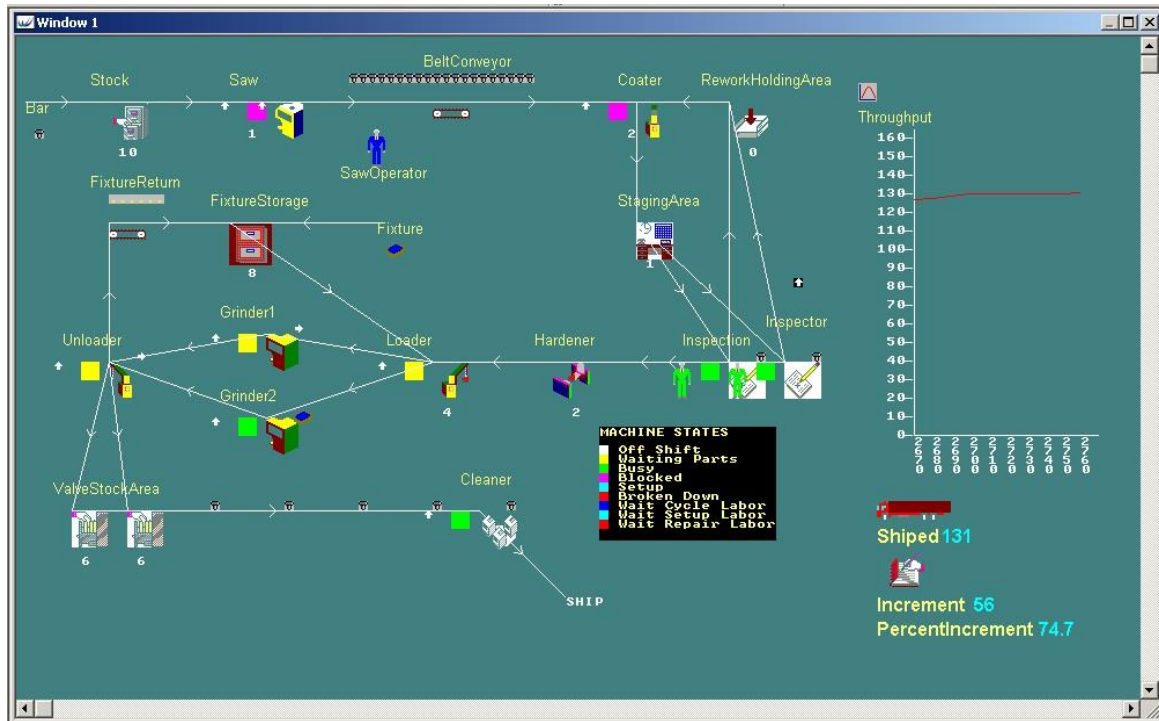


Figure 2: Proposal 1 Production Line

## 6.2 Proposal 2

No.	Item	Quantity	Cost (\$)
1.	New inspector and machine	1	30,000
2.	Staging area capacity	4	400
3.	Coater cycle time decrease	10%	6,500
4.	Belt conveyor to roller	1	10,000
5.	Reduce inspector cycle time	2 X 10%	20,000
6.	New cleaner	1	16,500
7.	Decrease grinder cycle time	10%	12,500
	<b>Total</b>		<b>95,900</b>
	New output	167 units	
	Throughput Increment	92 units	
	Increment percentage	122.7%	
	Ratio of increment per thousand \$	0.96	
	Ratio of % increment per thousand \$	1.28	

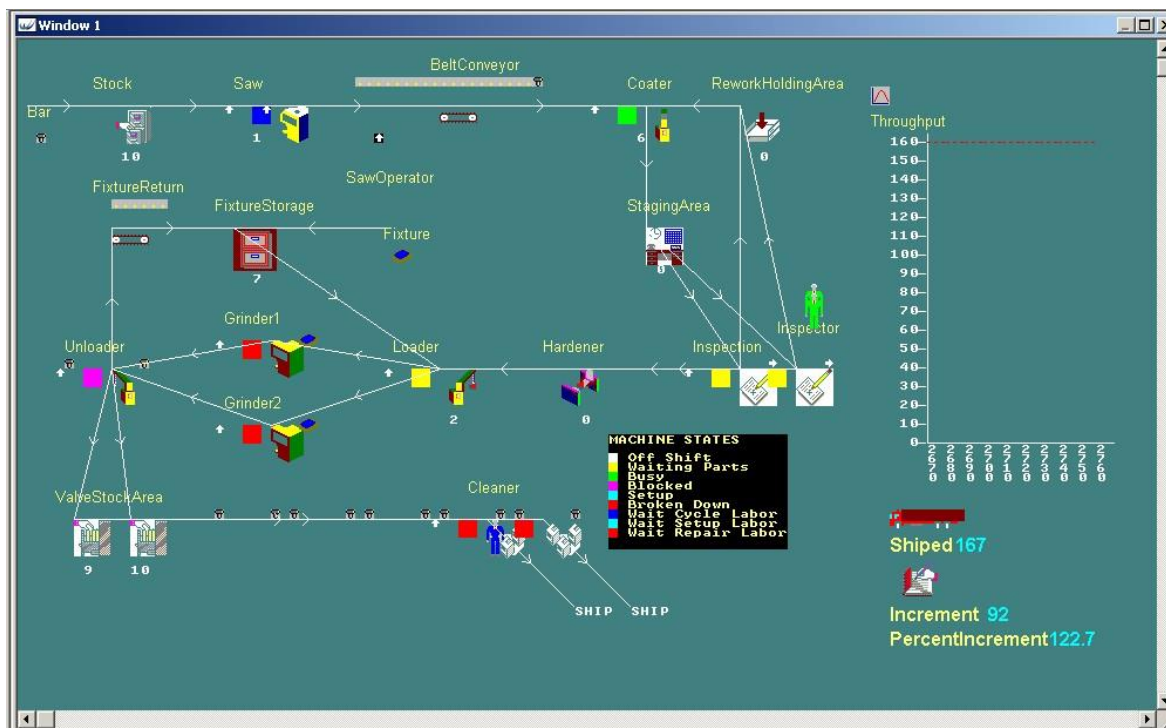


Figure 3: Proposal 2 Production Line

### 6.3 Proposal 3

No.	Item	Quantity	Cost (\$)
1.	New inspector and machine	1	30,000
2.	Convert belt conveyor to roller	1	10,000
3.	Increase staging area per part capacity	1	100
4.	Additional cleaner	1	16,500
<b>Total</b>			<b>56,600</b>
	New output	152 units	
	Throughput Increment	77 units	
	Increment percentage	102.7%	
	Ratio of increment per thousand \$	1.36	
	Ratio of % increment per thousand \$	1.81	

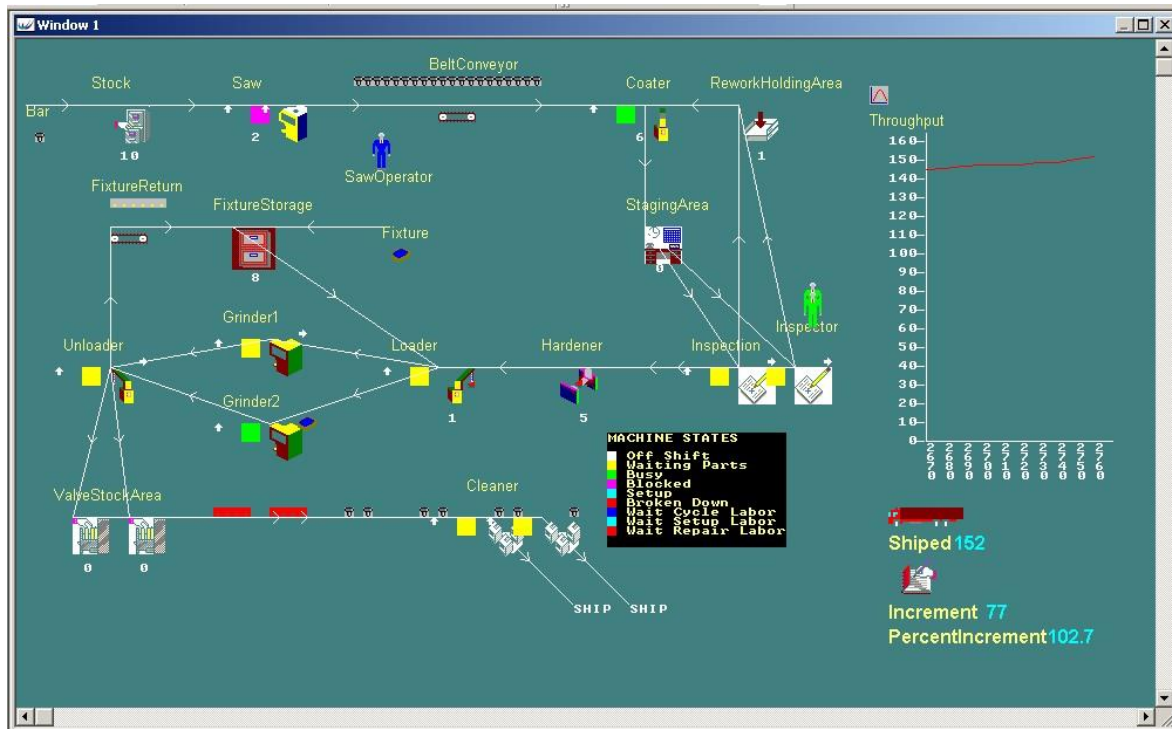


Figure 4: Proposal 3 Production Line

## 7. Conclusion

Based on the simulations, Proposal 2 is the best option for BUZZ Valve Manufacturing Company. A high investment will give high and more output or products for the company to market. With proposal 2, the bottleneck will be reduce, thus increase the utilization of the other machines.

The objectives to modernize the company and to increase the company will be achieve with Proposal 2 with the increment output of 92 units and 122.7 % from the current system in the production line.

# P15 - Rubber Tapping Knife

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*ADTEC Kulim*

## ***Abstract***

*More than 90% of all rubber is produced in Peninsular Malaysia. Rubber tapping is still as a labor for small plantations owned by families or individuals and it still in great demand worldwide. The rubber tapping knife is design for usage on rubber estate. This product is used for tapping the rubber to ooze the latex to flow downward where cup is placed to catch the sap. The scope of this project focuses on the rubber tappers in Malaysia in commercial agricultural activities. Plantation agricultural activities requires tools that allow easy and safe to work again as to increase production, save time and reduce labor costs. This project is based on developing and improving the existing model of the rubber tapping equipment which can be used by a rubber tapper. The innovation that have been apply to the rubber tapping knife are adjusted ergonomic handling which is can be fit in varying length, easy to storage because it have a hook as well as this rubber tapping was attachable with ultrasonic insect repellent. Besides that, this product comes with knife cover for protection. This rubber tapping knife can help many rubber tappers to do their job easily and it is safe to use.*

**Keywords:** *rubber tapper, rubber tapping knife, ergonomic, insect repellent*

## **1.0 Introduction**

Peninsular Malaysia is among the world's most important rubber growing areas. Rubber (pokok getah) is also grown in the Malaysian states of Sabah and Sarawak on the island of Borneo. Together the 14 states produce almost 20% of world's natural rubber on 1.3 million hectares of land with declining due to planting of other crops, especially oil palm. Eighty percent of this rubber comes from thousands of privately owned plots of land (small holders), usually less than 2.5 hectares [1]. Since 2001, Malaysia's rubber production has been increasing. Malaysia has earned a good reputation around the world for its high quality and well priced rubber products [2]. Rubber manufacturers in Malaysia supply several different rubber products such as medical gloves, components for automobiles, belts and hoses to several different countries such as USA, Japan and many countries in Europe.

### **1.1 Rubber Tree (*Hevea Brasiliensis* [3])**

In the wild, the tree can reach a height of up to 100 feet (30 m). The white or yellow latex occurs in latex vessels in the bark, mostly outside the phloem. These vessels spiral up the tree in a right-handed helix which forms an angle of about 30 degrees with the horizontal, and can grow as high as 45 ft. In plantations, the trees are kept smaller, up to 78 feet (24 m) tall. The tree requires a climate with heavy rainfall and without frost.

Rubber tapping is still as a labor for small plantations owned by families or individuals, on many larger plantations. The basic idea behind rubber tapping has not changed. However, it continues to be the basis for the production of all natural rubber, which is still in great demand worldwide, even with the invention of synthetic rubber compounds and other alternatives.

## **1.2 Rubber Tappers Work Process**

Rubber tapping is the process of extraction of latex from the rubber trees [4]. Latex is a white or slightly yellowish liquid composed of rubber, protein, sugar, water etc. this latex is concentrated, compounded and then used in different forms for the manufacture of various goods like the commonly seen rubber bands gloves, conditions, foam beds, tires etc. Workers on rubber tree plantations use a special knife to cut a thin strip from the outer bark of the rubber tree. It is done by making a cut at between one and a half meters from the ground at an angle of about 30 degree or 45 degree to the horizontal and it slopes downward. The cut is about 2 mm deep. It is made in such a way as to sever the latex tube but not to damage cambium. This cut causes the tree to ooze the latex rich sap and also acts as a channel for it to flow downward where a cup, bag, or other container is placed to catch the sap.

Tapping work is done generally by hand. It is very laborious job and requires considerable skill. There are several tapping system practiced in Malaysia, but the most popular is a "Sloping Cut" made half way round the circumference of the tree. The cuts are made each night or in the early morning hours before dawn, which increases the yield from each cut as the tree begins to heal the wound quickly and the collection of latex is completely before noon. The flow of sap typically tapers off and ceases before the end of the day. The following day, a cut is made along the same line as the cut from the previous day. This maximizes the yield and useful lifetime of a particular tree. After one side of a tree has been used for harvesting the rubber sap for a certain amount of time, that side of the tree is left to heal and the other side of the tree is used. By alternating areas of the trunk on opposite sides of the tree, called panels, a skilled rubber tapper may keep a particular tree productive for years at a time. The age of the tree, bark thickness and other features of any given tree have to be considered, experience and personal skill of the tapper play an important role.

## **1.3 Rubber Tapping Knife**

Rubber tapping knife was found during the early years which required skills for cutting the tree to extract the latex [5]. The design of the knife and cutting pattern varies from one place to other. The existing tapping knife for rubber tree is made from steel and suitable for all kind trees. It is very practical use from many workers. It uses to enhance latex. This knife is 34 cm length. From this knife, it need to redesign some of the part, which is need to have a suitable length for height tree and in the same time it suitable for lowest tree. Others, need to consider is handle part, from this product it doesn't have a handle grip and it design with fully steel and this can cause of slippery factor while doing the taper job. This is not suitable for worker because it can hurt the hand.

Kampung Raja, Dungun Kuala Terengganu is our case study area. To fulfill the objectives of this research, questionnaires have been done to get some information and idea on the case study about rubber tapper knife. From the research studies, rubber tapping worker have to work on early morning which is in a dark places and it need lighting

source to carry with [6]. They also have to work in estate, which is exposed to the dangerous insects. For safety, workers have to bring their own safety insect repellent. On the other case, from the research the types of knife usually use the same type because that shape is the most suitable, practically and also easy to use. In this study, we redesign the rubber knife to be easily and comfortably, as well as the rubber blade has a system that helps employees to do rubber tappers work more easily.

The following statements are the problems associated with the problem of rubber tappers in Malaysia now:

- i. The first problem is before starting the work, should provide a long piece of wood to be used for tall trees.
- ii. Requires high energy using rubber wood used to be.
- iii. No proper grips for the knife. And chances of accidents are more.
- iv. The probability is high for sore eyes caused by dust that fell from the rubber tree.
- v. Equipment which is sometimes very difficult because the rubber tappers need a lot of preparation tools such as mosquito coils, pieces of wood, pesticides, and others.
- vi. To be careful with the sharp tip of the knife.

So from here the existing knife should be redesign for more suitable, comfort, easy way and safe to be used.

## 2.0 Methodology

After the researches have been done, we come out with a new design criterion for the rubber tapping knife. The criteria are adjustable in varying length, safety insect repellent, easy maintenance, easy storage and carrier as well as comfortable grip with elastomeric system.

Firstly, the research is based on the data collection by the standard patents, books and internet. Secondly, by using the data analysis and survey of the rubber tappers that leads product design specification. Product design specifications that have been considered are:

- i. The equipment must be easy to handle
- ii. The product has to be designed in such a way that it can be easily repaired.
- iii. The size of the product should be minimum in size
- iv. The product can be remodeled by giving good aesthetics and appearance.
- v. The materials can be used are stainless steel and thermoplastic elastomeric (TPE) for handle grips
- vi. The common buyers would be rubber tappers and for a common man.
- vii. The mechanism should be easy to develop and shouldn't affect the tapping function.

Third, it then leads to concepts generation by problem solving methods, sketching concepts and technical drawing using Solidworks software. Ergonomic factor, safety, size and appearance have been considered in sketching development.

Ergonomics is the study of designing equipment and devices that fit the human body, its movements, and its cognitive abilities [7]. Ergonomics is employed to fulfill the two goals of health and productivity. It is relevant in the design of such things as safe furniture and easy-to-use interfaces to machines and equipment. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.

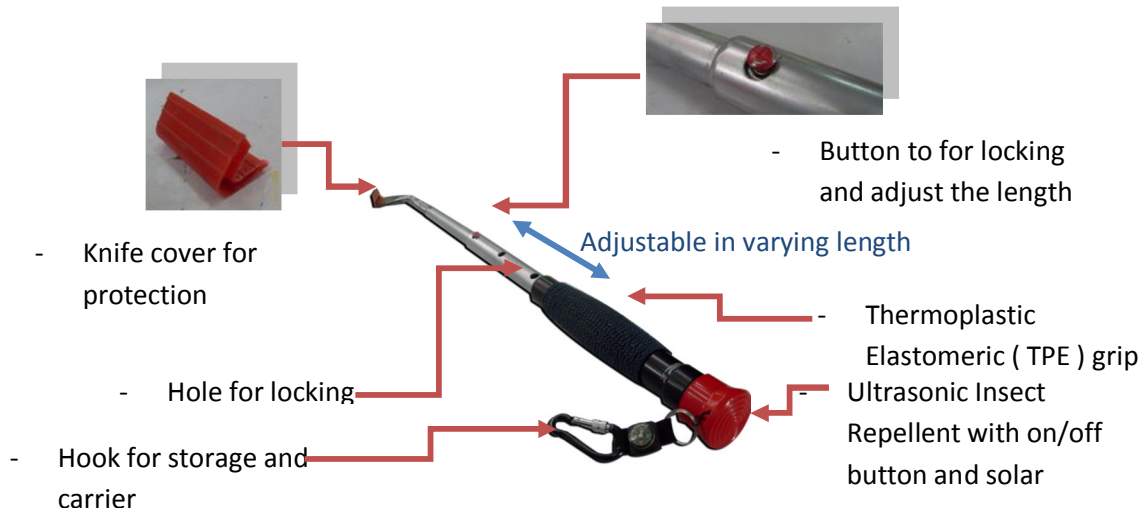


## 2.1 Material

### 2.1.1 Stainless Steel

Stainless steel resistance to corrosion and staining, low maintenance and familiar luster make it an ideal material for many applications. The alloy is milled into coils, sheets, plates, bars, wire, and tubing to be used in cookware, cutlery, hardware, surgical instruments, major appliances, industrial equipment and as an automotive and aerospace structural alloy and construction material in large buildings. There are a few reasons for us to choose stainless steel material for our product. There are:

- i. Durability- Stainless steel can resist very hot and very cold temperatures. This makes the material ideal for appliances. Stainless steel does not break easily, even if dropped.
- ii. Rust Resistance- Stainless steel is resistant to rust.
- iii. Cleaning- Cleaning stainless steel appliances is very easy.
- iv. Appearance- Stainless steel, as it is a neutral color, is easy to match with just about any places. These appliances usually come in a high-shine, mirror finish or a less bright, brushed stainless steel finish.
- v. Price- cost effective, the price of a stainless steel is more cheaper than other materials. Stainless steel itself will last a long time, which may save money in the long run.
- vi. Low maintenance.



**Figure 1:** New design of Rubber Tapping Knife

## 3.0 Result and Discussion

From the finding there have some problem for rubber taper worker, which is it need to consider some of safety factor, ergonomic handling, comfortable for any work situation even for height tree.



From the observation at Kampung Raja, Terengganu, we have found that existing knife is not suitable for high tree and it occur a problem to the user to do their job well. The criteria from the product is adjustable handling which is it can fit in varying length. This can help the worker to tapping for height tree. And it is safer because the workers no need to use stair anymore.

Others problem is safety factors which is worker have to work in the estate and they also have to work early in the morning that might have insect or pest. They need to bring their own safety insect repellent. Why do tappers go early in the morning for tapping? This is because of the amount of water content is more, temperature for the latex to flow as well as atmospheric pressure. An insect repellent is a substance applied to skin, clothing, or other surfaces which discourages insects from landing or climbing on that surface [8]. They are environmentally friendly and do not cause any health risk to users. They do not contain any chemicals and do not have to be cleaned. This insect repellent gets rid of insect with ultrasonic waves undetectable by human ear. Because humans cannot hear ultrasonic frequencies, ultrasonic pest resellers do not disturb nearby users in any way. It is also safe for children or pets. Ultrasonic insect repellent has a wide band frequency ó from 22,000 to 28,000 Hz, which eliminates even mosquitoes resistant to ultrasound with constant frequency and which is the maximum limit of human hearing. The specifications of the insect repellent is completely powered by solar energy complied with environmental. It uses rechargeable battery. This device use rechargeable battery with solar energy for 8 hour in bright sunlight. Its variable frequency of insect is 21- 32 kHz, distance around 1-3 meters. Thus, this product was design attachable with ultra sonic insect repellent.

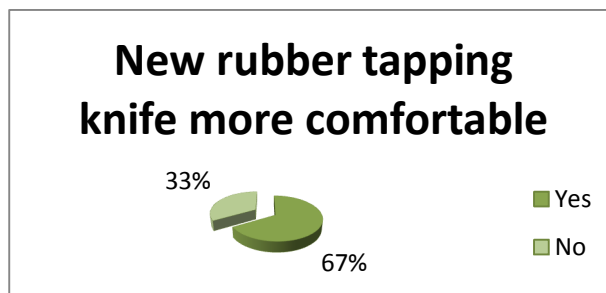
For the handle it design for ergonomic handling, which is it use elastomeric system material as the handle grip. Thermoplastic elastomeric (TPE) grips. These soft-touch grips are invariably described as "ergonomic" provided a solution by creating ergonomic handles to make the task of cutting more bearable and enjoyable. Good handle design is important at work and in all kinds of daily activities for items that are efficient to use, safe, and attractive. A change the diameter of the handle to fit the user's hand, and a soft rubber coating adds to the comfort. Less hand fatigue and can work longer. Thus, it can give comfortable grip for the worker to do their work more easy and fun without feel fatigue. This rubber knife can help many workers to do their job more easy and safe.

This rubber tapping knife also easy for storage because it has a hook to store on the wall and it also was design in a compact size. The hook also designs for easy carrier for the worker. It is also safe to bring because this product comes with knife cover for protection from sharp knife. The others consideration in design this product is it easy maintenance which is user can change the knife if it doesn't work or blunt.



**Chart 1:** Response from the rubber tappers about new rubber tapping knife.

After done questionnaire to the respondent, we got the result of the product. Fifteen respondents (rubber tapper workers) have been interviewed by us. From 15 respondents, only five workers didn't feel comfortable with our product.



**Chart 2:** Workers are comfortable using new rubber tapping knife.

This type of rubber knife can help the worker do their work with no worry and more enjoyable. The purpose of this instrument design is based on the notion that there is a problem that has been said in the statement of the problem, as well as the continuing decline in the agricultural sector's contribution. In addition, this tool is also designed to facilitate the work of farming in the preparation of the growing medium at the same time reducing labor and help to save costs. Materials made is sure the quality is better in terms of a simple mixture will become more refined and quality. In addition, it is also to enhance the contribution of agriculture to economic growth.

#### 4.0 Conclusion and Future Work

The design we have produce is rubber tapping knife. This product is design for both men and women (28-50) or illiterate user age category based on the analysis from questionnaire and suitable for any rubber estate plantation. This design was produce to fulfill the user need and from the problem solving that we have analysis before. From there we redesign the rubber knife to be easier for the worker.

In this case study, we have achieved the objectives of our project. But for future work, this rubber tapper knife can be improved by market specification in five main factors. Firstly, plantation management would buy the tools at 50% above the current tool price if it safer and allows workers to be more productive. Second is the tool must increase employer profitability by either increasing productivity or by lower labor costs

in allowing skilled labor to tap. The availability of potential of potential laborers including women chooses not to work as rubber tappers because it involves lot of hard work. Other factors are the tools must last for 5 years and the tools must be maintained with only basic sharpening of tools.

The conclusion, this product using the simple technology which is, it is safe and easy to use.

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# **P16 - Padanan Sistem Pendidikan Teknik dan Vokasional Bersama Sistem Pengajian Akademik : Kajian Penambahbaikan Kurikulum Institut Latihan Jabatan Tenaga Manusia Bagi Memenuhi Keperluan Pengajian Akademik dan Industri Elektronik**

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## **Abstrak**

*Kajian kes ini adalah berdasarkan kepada peranan Institusi Latihan Jabatan Tenaga Manusia (ILJTM), Kementerian Sumber Manusia dalam melahirkan tenaga mahir negara. Objektif utama kajian adalah untuk menentukan keberkesanan kurikulum latihan kemahiran yang dibangunkan oleh ILJTM dalam melahirkan graduan ini dapat menyambung pelajaran ke peringkat yang lebih tinggi dan untuk memenuhi keperluan industri. Sampel kajian dilakukan terhadap pelajar yang sedang menyambung pelajaran di peringkat Ijazah Sarjana Muda / Diploma Lanjutan serta mengikuti Latihan Dalam Loji. Dalam kajian ini ia melibatkan pelajar, penyelia universiti dan penyelia industri dengan menggunakan soal selidik. Data Kualitatif diperoleh melalui temubual dan pemerhatian berkala. Dapatan dari kajian menunjukkan bahawa penyelia universiti berpuas hati dengan prestasi pelajar dalam bidang elektronik. Dalam tempoh kajian, beberapa kelemahan dalam kurikulum telah di kenalpasti dan perlu dibuat penambahbaikan berterusan. Sehubungan dengan itu beberapa langkah-langkah penambahbaikan kurikulum telah dicadangkan dalam kajian ini bagi memenuhi keperluan pihak universiti dan industri elektronik yang mana ini merupakan penentuan kejayaan negara dalam mentransformasikan beberapa keberhasilan yang telah ditetapkan. Sehubungan dengan itu kajian ini adalah penting bagi mewujudkan kolaborasi antara latihan kemahiran bersama pengajian akademik terus dilaksanakan agar melahirkan tenaga kerja yang dapat menguasai secara teori dan amali supaya memberi peluang kedua kepada graduan institut latihan kemahiran menyambung pelajaran ke peringkat yang lebih tinggi.*

**Kata Kunci :** *Kurikulum : skop dan isi kandungan ; Kolaborasi : kerjasama atau usaha sama*

## **1.0 Pengenalan**

Kerajaan akan menambah jumlah penuntut serta kualiti latihan pendidikan teknikal dan latihan vokasional (TEVT) dalam Rancangan Malaysia Kesepuluh (RMKe-10) bagi meningkatkan lagi kemahiran tenaga kerja tempatan. Penambahan itu dilakukan dengan matlamat meningkatkan ekonomi dalam rangkaian nilai untuk menjadi ekonomi berpendapatan tinggi (Rancangan Malaysia Kesepuluh (RMKe-10, 2010). Kini usaha untuk memperkasa tenaga kerja terutama di bidang teknikal semakin giat diusahakan dengan semakin hampirnya

tahun 2020. Pada masa ini, hanya 28% daripada jumlah tenaga kerja di Malaysia bekerja dalam pekerjaan berkemahiran tinggi.

Seperti yang dirumus dalam RMK-10, kerajaan menasaskan 33% tenaga kerja dalam kategori pekerjaan berkemahiran tinggi menjelang tahun 2015, dan 40% menjelang tahun 2020. Sehubungan itu jelas sekali bahawa keluaran latihan kemahiran dalam pasaran tenaga kerja amat berpotensi di masa hadapan. Untuk mencapai sasaran ini pelbagai strategi pembangunan latihan kemahiran sedang pesat dilaksanakan.

Selain daripada infrastruktur yang sedia ada pelbagai inisiatif dan program-program peningkatan yang dinamis akan diperkenalkan. Arus globalisasi telah merubah senario sektor perindustrian dunia dengan ledakan teknologi inovatif dalam bidang kejuruteraan elektrik dan elektronik, teknologi maklumat, rekabentuk industri, bioteknologi dan banyak lagi. Dari aspek kerjaya matlamat yang disasarkan adalah untuk menampilkan bidang kemahiran sebagai pilihan utama dan bukan sebagai alternatif atas kegagalan akademik.

Persepsi masyarakat harus berubah, untuk itu ibu bapa harus sedar bahawa kerjaya kolar biru mempunyai status yang boleh dibanggakan pada masa depan justeru turut mengalakkan anak-anak mereka menceburi bidang ini secara serius apatah lagi bagi anak yang menunjukkan minat dalam bidang ini. Bagi mengurus perdanakan latihan kemahiran maka perspektif pelatih/pelajar perlu diubah, dan salah satu caranya dengan mewujudkan kolaborasi antara latihan kemahiran dengan pengajian akademik supaya pelatih / pelajar yang telah mengikuti latihan kemahiran dapat menyambung pelajaran di peringkat yang lebih tinggi kelak.

Graduan dengan kelulusan akademik yang baik, ataupun memiliki tahap pencapaian akademik tinggi adalah lebih mudah diterima bekerja di industri. Ini terbukti apabila mereka dibayar dengan gaji yang tinggi berbanding mereka yang mempunyai kelayakan atau pun pencapaian rendah. Dengan erti kata lain, graduan dengan tahap kelayakan akademik yang tinggi atau pun pencapaian akademik baik memenuhi keperluan majikan dan industri (Junaidah et al 2006).

Bagaimanapun, evolusi industri telah mengubah pengertian terhadap keperluan industri, struktur tenaga kerja dan bidang pendidikan. Kurikulum pembelajaran yang selama ini hanya tertumpu semata-mata kepada penerapan pengetahuan secara teori terhadap graduan. Kini tidak semestinya dipandang lagi oleh pihak industri (Ahmad Jais & Suhariri 2005). Graduan yang berpotensi untuk memenuhi keperluan industri bukan sahaja mesti memiliki kelayakan akademik tetapi mereka juga harus mempunyai kemahiran kreatif, inovatif, semangat berpasukan dan keusahawanan (Pether 2000).

Oleh itu, mereka perlu dilengkapi dengan pengetahuan dan kemahiran yang memenuhi keperluan majikan (Che Puteh 2006). Bagi tujuan ini, latihan yang berkesan perlu disediakan bagi membekalkan kemahiran spesifik kepada tenaga kerja supaya mereka kekal relevan dengan keperluan industri (Hashim 2005).

Padanan Sistem Pengajian merupakan satu aktiviti atau program untuk membina kerjasama dengan sektor awam dan swasta dalam bidang pendidikan dan latihan teknikal. Di

dalam kajian ini menulis menerangkan mengenai padanan yang dilakukan antara Pusat Latihan Teknologi Tinggi (ADTEC) Kulim bersama Universiti Malaysia Perlis (UniMAP) , dimana kedua-dua institusi pendidikan ini menjalin hubungan bersama dengan matlamat untuk meletakkan bidang pendidikan ini menjadi agenda kerajaan yang perlu dilakukan untuk membuat tranformasi yang lebih baik.

Di dalam padanan ini dimana, bagi pelajar diploma teknologi dari Pusat Latihan Teknologi Tinggi (ADTEC) kulim, di terima untuk menyambung pelajaran di peringkat Sarjana Muda dengan mana semua subjek yang telah di pelajari di peringkat diploma dapat di pindahkan kredit dengan ini tempoh belajar di Universiti Malaysia Perlis (UniMAP) hanyalah 3 tahun sahaja. Dengan padanan ini pelajar dari ADTEC kulim dapat pindahan kredit sebanyak 23 kredit. Dan ini bermaksud lulusan ADTEC Kulim mendapat kemudahan pindahan kredit sama dengan lulusan Politeknik.

Dengan padanan ini menunjukkan bahawa sistem pembelajaran yang menggunakan kurikulum yang dibangunkan oleh Jabatan Pembangunan Kemahiran iaitu NOSS dengan adanya penambahan daripada Jawatan Kuasa Kurikulum Jabatan Tenaga Manusia iaitu dalam sistem pembelajaran kemahiran dapat di terima oleh institusi pengajian awam seperti Universiti Malaysia Perlis (UniMAP).

## **2.0 Latarbelakang**

Dalam tempoh kajian, beberapa kelemahan dalam kurikulum telah di kenalpasti dan perlu dibuat penambahbaikan berterusan. Sehubungan dengan itu beberapa langkah-langkah penambahbaikan kurikulum telah dicadangkan dalam kajian ini bagi memenuhi keperluan pihak universiti dan industri elektronik yang mana ini merupakan penentuan kejayaan negara dalam mentransformasikan beberapa keberhasilan yang telah ditetapkan. Sehubungan dengan itu kajian ini adalah penting bagi mewujudkan kolaborasi antara latihan kemahiran bersama pengajian akademik terus dilaksanakan agar melahirkan tenaga kerja yang dapat menguasai secara teori dan amali supaya memberi peluang kedua kepada graduan institut latihan kemahiran menyambung pelajaran ke peringkat yang lebih tinggi.

## **3.0 Skop Kajian**

Sampel kajian dilakukan terhadap pelajar yang sedang menyambung pelajaran di peringkat Ijazah Sarjana Muda / Diploma Lanjutan serta mengikuti Latihan Dalam Loji. Dalam kajian ini ia melibatkan pelajar, penyelia universiti dan penyelia industri dengan menggunakan soal selidik. Data Kualitatif diperoleh melalui temubual dan pemerhatian berkala. Dapatan dari kajian menunjukkan bahawa penyelia universiti berpuas hati dengan prestasi pelajar dalam bidang elektronik.

## **4.0 Subjek Kajian**

Subjek kajian adalah terdiri daripada graduan-graduan Diploma Teknologi Elektronik bagi sesi/kohort 1/2006 dan 2/2006 yang telah menamatkan pengajian mereka pada tahun 2008. Penulis telah memilih ke semua graduan tersebut dari dua kumpulan atau pun -cohortø

pelajar sesi akademik berkenaan yang telah bekerja atau pun sedang menyambung pelajaran sebagai subjek kajian seperti yang ditunjukkan dalam Jadual 1.1 & 1.2.

Dalam kajian kes ini, jumlah keseluruhan graduan tersebut, penulis telah mengenalpasti dan memilih hanya pelajar yang menyambung pelajaran (UniMAP/ UTEM, CIAST dan JMTI) sahaja sebagai subjek utama kajian yang berjumlah 18 orang sahaja seperti yang ditunjukkan dalam Jadual 1.3.

Bersesuaian dengan Falsafah Pendidikan Negara, pendidikan yang bercorak menyeluruh perlu diterapkan demi menjamin modal insan yang berguna, Modal insan yang di perlukan adalah meliputi berorientasikan kepada pendidikan akademik ataupun pendidikan teknik dan vokasional (Norhasni Zainal Abidin 2009) digunapakai oleh penulis sebagai asas rujukan untuk menentukan padanan pendidikan akademik bersama latihan kemahiran dapat dilakukan maka asas kepada pencapaian diperingkat Sijil Pelajaran Malaysia masih digunapakai bagi membolehkan seseorang pelajar yang ingin menyambung pelajaran di peringkat Ijazah Sarjana Muda diterima. Jadi disini penulis mendapatkan data-data setiap graduan yang menyambung pelajaran di ambil keputusan SPM mereka sebagai membuktikan bahawa mereka dapat diterima untuk menyambung pelajaran di peringkat Ijazah Sarjana Muda. Jadual 3.4 menunjukkan keputusan Sijil Pelajaran Malaysia bagi graduan Diploma Teknologi Elektronik yang menyambung pelajaran di peringkat ijazah sarjana muda di Universiti (UniMAP dan UTEM).

## **5.0 Sampel Kajian**

Sampel kajian dan sumber data adalah terdiri daripada tiga pihak terlibat secara langsung dalam program kalaborasi iaitu graduan, penyelia institut dan penyelia industri. Penyelia institut iaitu terdiri daripada pegawai unit CESS akan mendapatkan maklum balas daripada graduan ADTEC kulim bagi setiap semester sistem pengajian universiti, bagi mengetahui prestasi bekas graduan ADTEC Kulim yang mana ia bertujuan untuk meninjau, memantau menilai kemajuan graduan yang terbabit. Semasa proses ini input yang diambil ialah mengetahui CGPA pelajar tersebut dan apakah masalah yang di hadapi oleh pelajar sepanjang tempoh pengajaran dan pembelajaran di Universiti terbabit.

Jadual 1.4 menunjukkan sumber data dan sampel dalam kajian ini bagi keputusan peperiksaan pada semester 1 (Disember 2008), semester 2 (Julai 2009), semester tiga (Disember 2009) dan semester 4 (Julai 2010).

## **6.0 Keputusan dan Analisis**

Kajian kes ini dilakukan terhadap graduan-graduan Pusat Latihan Teknologi Tinggi (ADTEC) Kulim bagi lulusan Diploma Teknologi Elektronik Industri) yang sedang menyambung pelajaran di peringkat Ijazah Sarjana Muda (Elektronik Industri) di Universiti Malaysia Perlis (UniMAP) dan Universiti Teknikal Melaka (UTEM). Sampel kajian adalah 100% melibatkan kesemua populasi berjumlah 60 orang tetapi dalam kajian ini iaitu yang lebih spesifik untuk mengetahui mengenai keberhasilan padanan ini, hanya dilakukan kepada 6 orang responden sahaja.



Dalam kajian ini, data kuantitatif dikumpul menggunakan soal selidik, manakala data kualitatif diperoleh secara triangulasi melalui temubual dan pemerhatian digunakan untuk menyokong data kuantitatif. Sementara itu penganalisaan data kuantitatif dilakukan secara ujian statistik deskriptif, manakala kaedah statistik kuasi digunakan untuk membuat analisa data kualitatif. Data kuantitatif dan kualitatif yang dikumpul, kemudiannya di proses menggunakan perisian untuk mendapatkan kekerapan dan peratusan tertentu.

## **7.0 Perbincangan**

Berdasarkan kepada kajian ini secara keseluruhannya penilaian penyelia universiti kepada pelajar-pelajar ADTEC Kulim menunjukkan bahawa mereka boleh menguasai sistem pembelajaran di universiti walaupun sebelum ini mereka ini menjalani pembelajaran yang berorientasikan kepada latihan kemahiran sahaja. Maklum balas dari pelajar ini membuktikan bahawa pengajaran sistem latihan kemahiran yang dijalankan di Pusat Latihan Teknologi Tinggi (ADTEC) Kulim khasnya dan ILJTM yang lain amnya adalah berkesan bagi seseorang pelajar itu untuk menyambung pelajaran di peringkat yang lebih tinggi dan mereka juga sesuai bekerja di industri yang berteknologi tinggi.

Namun begitu, masih terdapat banyak perkara yang perlu dilihat semula dan diambil kira dalam usaha melahirkan graduan yang berkemahiran serta mempunyai penguasaan ilmu teori yang baik. Jadi adalah menjadi harapan penulis dengan berdasarkan kepada kajian ini supaya cadangan akan diambil kira supaya ia mampu meningkatkan kemahiran dan penguasaan ilmu teori dapat diperbaiki agar masa hadapan graduan bidang kemahiran ini akan lebih terjamin, yang mana pembelajaran di dalam bidang kemahiran bukanlah menunjukkan bahawa mereka ini hanya mampu belajar di peringkat diploma sahaja yang mana diperingkat ini mereka hanya akan bekerja di peringkat pertengahan sahaja. Namun jika dilihat daripada hasil padanan ini dengan berdasarkan kepada kajian, menunjukkan mereka ini boleh pergi lebih baik.

## **8.0 Kesimpulan**

Dalam konteks yang lebih luas sistem pendidikan TEVT iaitu yang berorientasikan latihan kemahiran diyakini sebagai salah satu faktor penting dalam perkembangan ekonomi dan kestabilan sosial sesuatu negara, samada negara itu yang sedang membangun ataupun negara maju yang berasaskan kepada perindustrian sebagai bidang ekonomi utama. Banyak negara yakin dengan memperkemas sistem pendidikan TEVT dengan baik dan boleh mengeluarkan pekerja yang mahir, akan menjadi elemen penting dalam strategi pengembangan dan pertumbuhan ekonomi negara. Di sini ingin penulis mengambil pandangan Bennet (2003), bahawa persaingan ekonomi sesuatu negara adalah bersandarkan kepada kemahiran dan kemampuan tenaga kerjanya, dan kemahiran yang dimiliki itu akan bersandar pula kepada kualiti sistem TEVT yang terdapat di negara tersebut. Selari dengan pandangan ini, Wikkins (2001) mengatakan bahawa paradigma sosial sistem TEVT adalah ekonomi iaitu sistem ini mempunyai sumbangan penting dalam usaha memodenkan industri

dan meningkatkan kualiti hidup masyarakat serta pada masa yang sama akan meningkatkan pertumbuhan ekonomi negara.

Dalam ingin meletakkan pendidikan TEVT ini mempunyai terbaik penulis berpendapat bahawa pendidikan TEVT ini harus diurus perdanakan seperti mana yang telah digariskan dalam budget 2011 yang telah dibentangkan oleh YAB Perdana Menteri kita pada Oktober 2011. Bagi mengurus perdanakan pendidikan TEVT ini ia perlu diangkat setanding dengan bidang pendidikan akademik yang mana selama ini menjadi pilihan bagi setiap pelajar yang cemerlang.

Berdasarkan kepada kajian penulis menunjukkan bahawa graduan dari institut latihan kemahiran ini, yang mana pencapaian mereka adalah agak sederhana di peringkat SPM , namun apabila mereka diberi peluang kedua iaitu dengan menyambung pelajaran di institut kemahiran ini yang mana dianggap sebagai pilihan terakhir, namun sudah mampu mencapai kejayaan menyambung pelajaran di Universiti yang dianggap impian setiap pelajar.

Mudahan dengan padanan ini yang bermaksud graduan dari ADTEC Kulim khasnya dan ILJTM amnya dapat menyambung pelajaran di Universiti dengan dibenarkan membuat pindahan kredit seperti dengan matlamat program padanan ini tercapai. Sebagai bukti penulis telah mengemukakan beberapa data-data kualitatif dan kuantitatif yang boleh dijadikan penanda aras yang menunjukkan bahawa padanan ini berjaya seperti yang dicadangkan.

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**Jadual 1.1** Jumlah Graduan Diploma Teknologi Elektronik

No	Kumpulan atau -Cohort/UTEM	Bilangan Graduan (status)				
		UniMAP/ UTEM	CIAST	JMTI	Bekerja	Lain-lain
1	1/2006 30	4	5	1	19	1
2	2/2006 30	2	4	2	22	0
<b>JUMLAH</b>		<b>6</b>	<b>9</b>	<b>3</b>	<b>41</b>	<b>1</b>

Sumber : ADTEC Kulim ó CESS (2009)

**Jadual 1.2** Jumlah Graduan Menyambung Pelajaran di Universiti / Institusi  
(CIAST dan JMTI)

Bilangan Graduan di Universiti / Institusi					
No	Kumpulan atau 'cohort'	UniMAP / UTEM	CIAST	JMTI	Jumlah
1	1/2006	4	5	1	10
2	2/2006	2	4	2	8
<b>Jumlah</b>		<b>6</b>	<b>9</b>	<b>3</b>	<b>18</b>

Sumber : ADTEC (2009)

**Jadual 1.3** Prestasi SPM bagi graduan ADTEC di UniMAP dan UTEM

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	A1	A2	C3	C4	C5	C6	D7	D8	F9
Bahasa Melayu	0	0	0	0	2	3	1	0	0
Bahasa Inggeris	0	0	0	0	0	3	2	1	0
Matematik	0	0	0	0	0	5	1	0	0
Matematik Tambahan	0	0	0	0	0	0	4	0	0
Sains Am	0	0	0	0	1	2	3	0	0
Teknikal									

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Sumber : ADTEC (2009)

**Jadual 1.4** Keputusan Peperiksaan Sampel Kajian

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No	IPTA Diploma	Sem 1	Sem 2	Sem 3	Sem 4
1	UniMAP	2.71	2.68	2.86	2.50
2	UniMAP	2.82	2.91	3.00	2.54
3	UTEM	2.69	2.56	2.84	2.89
4	UniMAP	2.70	2.52	2.84	2.98
5	UniMAP	2.52	2.67	3.12	2.71
6	UniMAP	2.91	2.82	3.00	2.52

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