

Smart Casing for Desktop Personal Computer

N. M. Z. Hashim¹, A. F. Jaafar², Z. Zakaria³, A. Salleh⁴, R. A. Hamzah⁵

^{1,2,3,4} Faculty of Electronics & Computer Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka Malaysia.

⁵ Faculty of Engineering Technology, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka Malaysia.

nikzarifie@utem.edu.my¹
a_farid99@yahoo.com²
zahriladha@utem.edu.my³
azahari@utem.edu.my⁴
rostamaffendi@utem.edu.my⁵

Abstract: *Computer cooling is the process of removing the heat from computer components. Since a computer system's components produce large amounts of heat during operation, this heat must be dissipated in order to keep these components within their safe operating temperature. In addition to maintain normal function, varied cooling methods are introduced to either achieve greater processor performance, or else to reduce the noise pollution caused by typical This project is proposed as to develop a system that can detect the temperature from the hardware system. This project is a standalone temperature and fan monitoring and control unit for the Personal Computer (PC). The main objective of this project is to overcome the problem that occurs when the system is running for a long time and temperature of the hardware is increase. The ability of this project is this project can control and maintain the value of temperature. This project will turn off the main power if the temperature is overheating. LM35S sensors are used to capture two different temperatures and detect if there are any increases in the temperatures. The main control of this circuit is the Peripheral Interface Controller (PIC) 16F876A to control Direct Current (DC) fans and Light Emitting Diode (LED) when certain temperature was detected. The results showed the system was working successfully as the aim in the objectives. For further improvement in the future, this project can be applied in industrial sector e.g. as temperature controllers in industry include plastic extrusion and injection molding machines and thermo-forming machines.*

Keywords: LM35S sensor, Overheat, PIC 16F876A, Printed Circuit Board (PCB), Sensor

1. Introduction

Computer cooling is the process of removing the heat from computer components. Because a computer system's components produce large amounts of heat during operation, this heat must be dissipated in order to keep these components within their safe operating temperatures. In addition to maintaining normative function, varied cooling methods are used to either achieve greater processor performance (over clocking), or else to reduce the noise pollution caused by typical e.g. cooling fans.

Components which produce heat and susceptible to performance loss and damage include the integrated circuits such as Central Processing Unit (CPU)s, chipset and graphics cards along with hard drives. Overheated parts generally exhibit a shorter maximum life-span and may give sporadic problems resulting in system freezes or crashes. In this project there are two materials that will be used to build this casing. Firstly, Alloy is good material to build the base for the hardware like CPU, hard disk, graphic cad and sound cad. This is good materials that can absorb heat temperature from the hardware. Secondly this material looks more stylish. The transparent casing also can protect our hardware from current leaking.

In project use PIC16F876A is used to control NPN power transistor further drive Direct Current (DC) brushless fans and relay when certain temperature was detected. The value of temperature always display on LCD screen. In this project, two LM35 are used to capture two different temperatures. The main control of this circuit is the PIC16f876A and it is used to activate the LEDs and fan according to their desired temperature.

Two LM35s are used as the sensor to detect the temperature that connected with the main circuit controller. This sensor is used to compare the value of the temperature. For example the first condition, temperature is to set at 50 °C and 80 °C. It means when the temperature reaches 50 °C, the fan will be switched on and switch off when the temperature is below 50 °C. When the temperature increases up to 80 °C, the main power automatically will be switched off.

Proteus software is used to design a program a specific data is early keyed in so that no device will be used to feed the data to the program. This project has In Circuit Serial Programming (ICSP) that is used for loading program. ICSP gives the user a convenience way to load program into PIC microcontroller without removing the PIC from the circuit board. The program can be modified for the desired temperatures to activate the LEDs, fans and buzzer.

In this project, several study been conducted as to gain

appropriate knowledge. M. F. Yahya reported in the Low cost Cooling Home System that in order to accurately control process temperature without extensive operator involvement, a temperature control system relies upon a controller, which accepts a temperature sensor such as a thermocouple or Resistance Temperature Detector (RTD) as input. It compares the actual temperature to the desired control temperature, or set point, and provides an output to a control element [1]. The controller is one part of the entire control system, and the whole system should be analyzed in selecting the proper controller. The element should be considered during the controller selection are type of input sensor (thermocouple, RTD) and temperature range, type of output required (electromechanical relay, SSR, analog output), control algorithm needed (on/off, proportional, Proportional-Integral-Derivative (PID) and the number and type of outputs (heat, cool, alarm, limit).

Sihan Goi and Edward Loi reported that their project is a standalone temperature, fan monitoring and control unit for the PC [2]. It used the temperature readings to adjust fan speeds in order to regulate temperature and noise. The system was flexible in that it can be configured to be either completely autonomous, or set up to be configurable. It was highly configurable in the setting up of the features and parameters. The entire unit is controlled by the 2 Atmel Mega32 Micro Controller Unit (MCU)s, 1 for the main control unit and 1 for the Radio Frequency (RF) remote control, with inputs to the Analogue Digital Converter (ADC) (for thermal sensors), port pins, RS232 serial connection and output to the LCD, port pins and RS232 serial connection [3]. The RF remote control controls specific settings of the unit. The main unit was powered off a standard 4-pin PC Molex power connector while the remote control is powered off a 9V battery. The objectives of this project are to create a system that can stabilize the temperature in a PC and to design a suitable casing for the PC with a good air flow.

2. Methodology

The project is conducted as the flow chart in Figure 1 below.

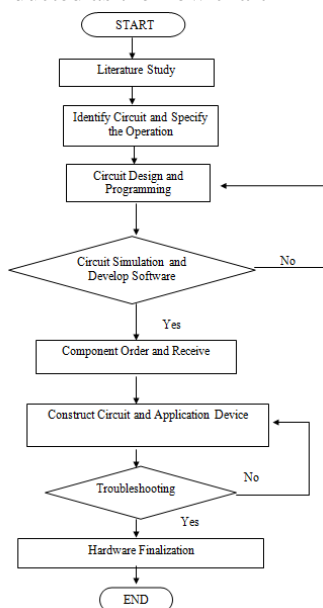


Figure 1: Project Flow Chart

2.1. Circuit Design

Circuit for the project is designed with the used of the electronic circuit and connected the temperature sensor into the PIC microcontroller. Schematic and Printed Circuit Board (PCB) is designed by using the Protel software.

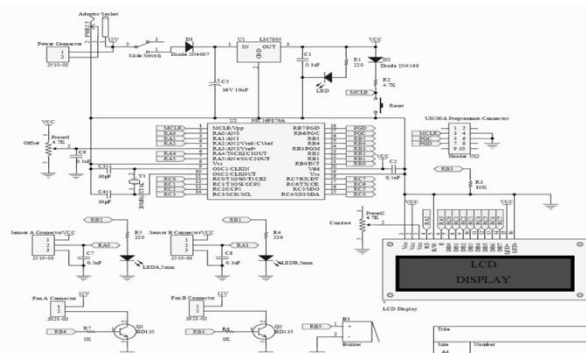


Figure 2: Schematic Circuit using Protel

After all components are connected, PCB layout is designed before the etching process. By using the option provided by the software, routed automatic can be selected and then adjustment of the connected point will be made in order to make sure the circuit work properly.

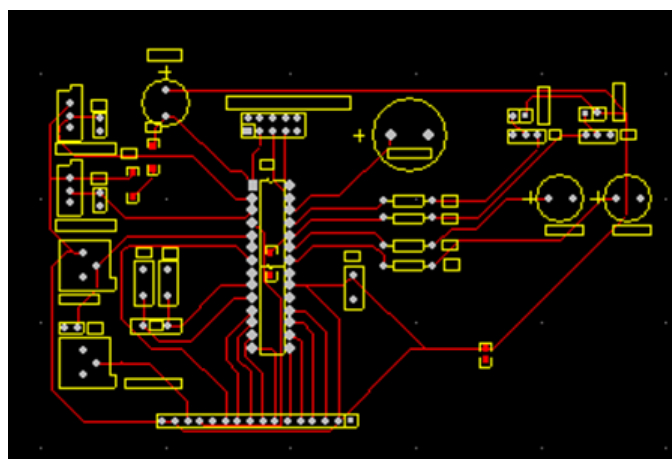


Figure 3: PCB Layout

2.2. Making the PCB

Based on the schematic circuits, PCB will be made with computer aided software. The design of the PCB will be used during etching process. In the etching process, acid is used to drop all the unnecessary copper from the board. In order to develop the electronic circuit and the connection to parallel port, it is necessary to use equipment or tool e.g. soldering iron, leads soldering, sucker and paste and also use the screw driver.

2.3. Circuit Simulation and Software Development

After Circuit Design and Programming, the circuit are designed and programmed. The circuit will be designed by using PROTEL, PROTEUS and MULTISIM software. The next stage would be simulation for the circuit. Laboratory experiments are the way to verify the overall designed are fully operation. Besides that, Mp lab software will be used as compiler in programming.

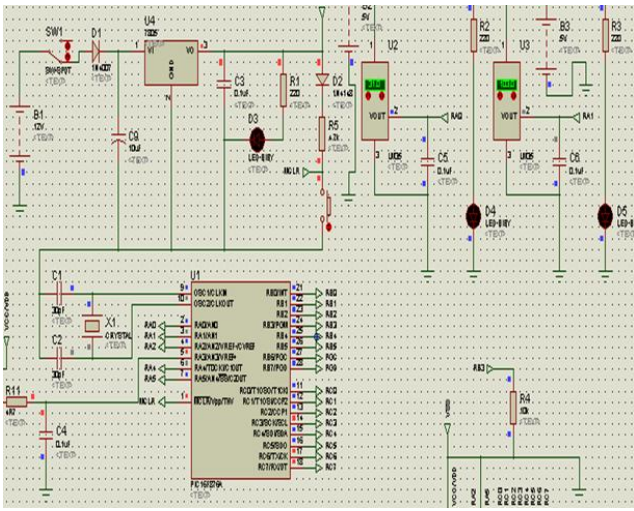


Figure 4: Circuit Simulation Using Proteus

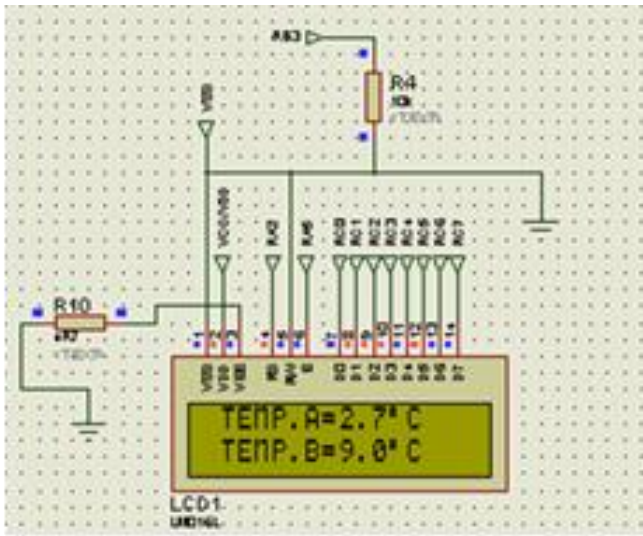


Figure 5: Outputs from Proteus Simulation

2.4. Programming Develop Software

After constructing the schematic circuits, the coding for the PIC 16F876A is designed by using the programmer software such as PIC C Compiler or MPLAB IDE. For this project, PIC C Compiler is used to build the HEX file before downloaded it into PIC [4], [5], [6], [7], and [9].

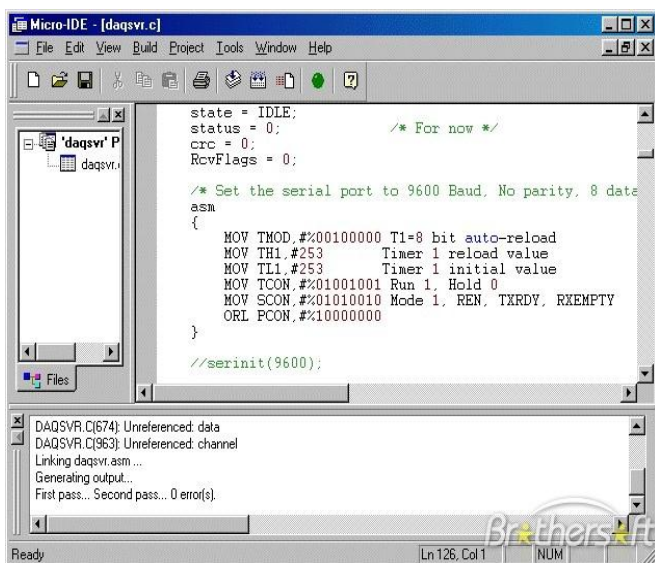


Figure 6: Window interface in PIC C Compiler for Making Source Code [10], [11]

2.5. Interface the Programming into Model

Interface programming will transfer the program or the construction to generate the system that made by Proteus into a model via parallel port.

2.6. Troubleshooting

Testing and evaluation for this project can be divided into two types of testing. There is simulation testing by using software based and simulation testing by using model or electronic circuit. Simulation testing by using software is a testing about after the programming running the entire temperature sensor whether it can collect the reading of temperature from the hardware or not. While, for simulation testing by using model or circuit electronic is about what to check interaction the system with parallel port to transmit the reading temperature.

Output that produce by using Proteus from the model of temperature sensor and the software simulation will be analysed either it is follow the project requirement or not. This project was successful if the testing result shows good result, but if the result is not satisfy or out if the system failed to deliver the intended result, troubleshooting activities and redevelopment might be carried.

3. Results and Discussions

There are few tests have been done to find the result for this project. The first test is compatibility test of the PIC and the LCD display developed algorithm. The second test is compatibility test on the temperature sensor and the comparator circuit. Finally, the final test is compatibility test on the combination of the two circuits of the temperature sensor and the microcontroller circuit. The third test is done before the combination circuits will be put together inside the PC casing and the fourth test will be conducted when all the combination circuits were inside the PC casing.

3.1 CPU Computer Temperatures Suitability

By using CPUID HARDWARE MONITOR software, it can determine the suitable temperature for computer CPU as shown in Figure 7 [8]. Normal temperature for the computer CPU, ACPI and hard disk can be checked by using this software. There are 6 CPUs have been used to get the different value temperature for every computer. From observation, the entire computer has the almost same temperature value.

Sensor	Value	Min	Max
AFM81			
ACPI			
Temperatures			
TZ50	43 °C (109 °F)	43 °C (109 °F)	43 °C (109 °F)
TZ51	50 °C (121 °F)	50 °C (121 °F)	51 °C (123 °F)
Intel Core Duo T2350			
Temperatures			
Core #0	39 °C (102 °F)	39 °C (102 °F)	41 °C (105 °F)
Core #1	43 °C (109 °F)	42 °C (107 °F)	44 °C (111 °F)
Hitachi HT5541680J95A00			
Temperatures			
HDD	52 °C (125 °F)	52 °C (125 °F)	52 °C (125 °F)

Figure 7: CPUID Hardware Monitor

3.2 Testing

3.2.1. Test 1: Algorithm Test with Proteus Software

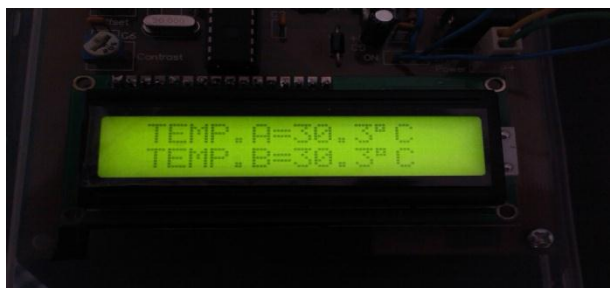


Figure 8: LCD Monitor

Table 1: The Result for Test 1

No.	Method	Observation
1	After the PIC16F84A was installed to IC socket.	Some lines of LEDs on LCD display could not function. The wording of the “TEMP-1 and TEMP-2” had not been displayed while the LCD display shows the light.
2	Troubleshooting the circuit and algorithm for PIC.	The LCD display was functioned. The wording of the “TEMP-1 and TEMP-2” had been displayed correctly as the expected result, but the value of the “TEMP-1 and TEMP-2” was not correct.

From observation, due to the coding error, the LCD display only display the light after the PIC16F876A had been installed to IC socket. As the improvement, the coding must be rechecked. After a while, finally the suitable coding has been found and error can be removed.

3.2.2. Test 2: LM35DZ temperature sensor and LCD display

The LM35DZ temperature sensor is factory-calibrated in the Celsius scale with a linear Degree to Volt conversion function. The output voltage (at pin 2) changes linearly with temperature from 0V (0°C to 1000mV (100°C). This greatly simplifies that the designed circuit need to be provided with a precision voltage reference (TL431) and an accurate comparator (A1 of LM358) in order to construct a complete thermal-controlled switch.

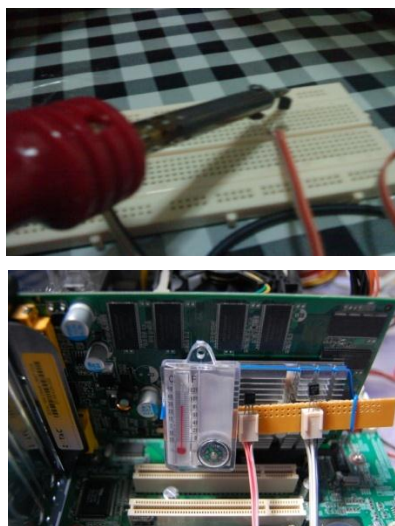


Figure 9: Testing LM35DZ sensors

3.2.3. Test 3: Combination Circuits Test

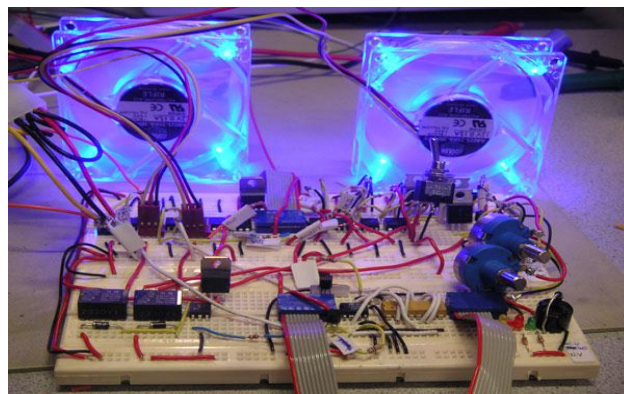


Figure 10: Combination Circuits Test

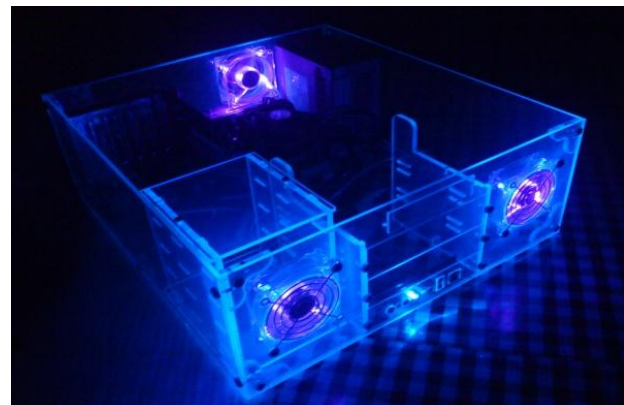


Figure 11: Testing Casing without Temperature Circuit 1

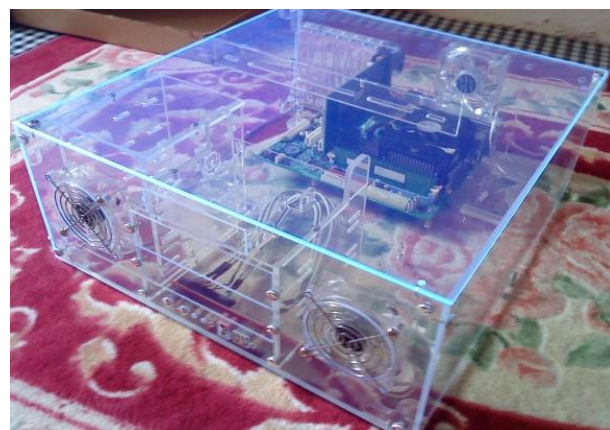


Figure 12: Testing Casing without Temperature Circuit 2

3.2.4. Combination Circuits Test

Table 2: Observation Table

Test	Methods	Observation
1	Before the sensor was put near to the computer hardware (graphic card).	The LCD displays always show normal temperature 35°C.
	After the sensor was put near to the computer hardware (graphic card).	The LCD displays show normal temperature increase after a few second.
2	Put solder iron near to sensor 1	The temperature increase until 50°C and after that the led and fan is running. The led and stop working after the temperature below 50°C.
	Put solder iron near to sensor 2	The temperature increase until 80°C and after that the led turn on and the supply cut off.



Figure 13: Testing Casing with Temperature Circuit

The result showed the tests were successful. After the combination circuits were put inside the casing, the sensor can sense various temperatures from the environment and the relay can function perfectly.

4. Conclusions

As the conclusion, the development of a smart casing was fully functional based on the objectives which are targeted before started this project. Finally all the combination circuits and the sensor were embedded in the PC casing to be used in the real case. This project gives an idea on how to combine all the circuits, sensors and electronic components together in one whole system. As a future improvement, replacement of 9V battery with a power supply from the main computer is recommended as to be applied in the real PC casing. This project also can apply in industrial sector as to manage manufacturing processes or operations e.g. industry that includes plastic extrusion and injection molding machines, thermo-forming machines, packaging machines, food processing, food storage, and blood banks.

5. Acknowledgement

We are grateful to thank Universiti Teknikal Malaysia Melaka (UTeM) for their kind help for supplying the electronic components and giving their laboratory facilities to complete this study.

References

- [1] M. F. Yahya, "Low Cost Cooling Home System", Bachelor Degree Thesis, UTeM, 2008.
- [2] M. Mahmud, "Line Following Robot", Bachelor Degree Thesis, UTHM, 2008.
- [3] (2013) PC Temperature Monitoring and Control Unit, [Available]. http://courses.cit.cornell.edu/ee476/FinalProjects/s2005/s_g348_ek125/html/software.html, 2005.
- [4] Ibrahim, D, "Microcontroller-Based Temperature Monitoring and Control". Oxford England: Newnes. 453 – 469 2002.
- [5] N. M. Z. Hashim, A. S. Jaafar, N. A. Ali, L. Salahuddin, N. R. Mohamad, "Traffic Light Control System for Emergency Vehicles Using Radio Frequency", IOSR Journal of Engineering (IOSRJEN) Volume 3 Issue 7, pp. 43-52, 2013.
- [6] N. M. Z. Hashim, N. A. Ali, A. S. Jaafar, N. R. Mohamad, L. Salahuddin, N. A. Ishak, "Smart Ordering System via Bluetooth", International Journal of

Computer Trends and Technology (IJCTT) Volume 4 Issue 7, pp. 2253-2256, 2013.

- [7] N. M. Z. Hashim, M. S. Sizali, "Wireless Patient Monitoring System", International Journal of Science and Research (IJSR) Volume 2 Issue 8, pp 250-255, 2013.
- [8] F. Jaafar, "Computer and Software", Industrial Training Report, 2009.
- [9] N. M. Z. Hashim, S. H. Husin, A. S. Ja'afar, N. A. A. Hamid, "Smart Wiper Control System", International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 2 Issue 7, pp. 409-415, 2013.
- [10] N. M. Z. Hashim, S. N. K. S. Mohamed, "Development of Student Information System", International Journal of Science and Research (IJSR) Volume 2 Issue 8, pp 256-260, 2013.
- [11] N. M. Z. Hashim, N. A. M. M. Arifin, "Laboratory Inventory System", International Journal of Science and Research (IJSR) Volume 2 Issue 8, pp 261-264, 2013.

Author Profile



N.M.Z Hashim received the B.Eng. and M.Eng. degree in Electrical and Electronics Engineering from University of Fukui, Japan in 2006 and 2008, respectively. From 2008, he worked as Lecturer in Faculty of Electronics and Computer Engineering, Universiti Teknikal Malaysia Melaka (UTeM), Malaysia. He is acting the Head of Department of Computer Engineering. His works are in Signal and Image Processing, Wavelet Transformation, Communication and Electronic Engineering. He joined Institute of Electrical and Electronic Engineers (IEEE), Board of Engineering Malaysia (BEM), Institute of Engineering Malaysia (IEM), Society of Photo-Optical Instrumentation Engineers (SPIE), International Association of Computer Science and Information Technology (IACSIT) and International Association of Engineers (IAENG) as member. (Email: nikzarifie@utem.edu.my).

A. F. Jaafar received his B. Eng in Electronic Engineering (Computer Engineering) from Universiti Teknikal Malaysia Melaka, Malaysia. Currently he is a Lecturer in Politeknik Sultan Haji Ahmad Shah Kuantan, Pahang, Malaysia. (Email: a_farid99@yahoo.com).



Z. Zakaria, PhD, MIEEE, BEM, Grad IEM - was born in Malaysia in 1975. He received the B. Eng. and M. Eng. in Electrical and Electronic Engineering from the Universiti Teknologi Malaysia in 1998 and 2004 respectively. He obtained his Doctorate from The University of Leeds in 2010 in the field of Microwave Engineering. From 1998 to 2002, he was with STMicroelectronics, based in Malaysia where he worked as Product Engineer. He is currently a Senior Lecturer and also the Deputy Dean (Academic) at the Faculty of Electronic and Computer Engineering, University Teknikal Malaysia Melaka, where he teaches Electronics, Microwave Engineering and Signal Processing. His research interests include a variety of microwave device developments such as planar and non-planar microwave filters, amplifiers and antennas. He also investigates radiowave propagation as well as energy harvesting for wireless sensor networks and signal processing. (Email: zahriladha@utem.edu.my).



A. Salleh graduated from Universiti Teknologi Malaysia, Malaysia with Bachelor of Electrical Engineering (Telecommunication) in 2003 and Master of Electrical Engineering (Electronics & Telecommunications) in 2008. He is acting the Head of Department of Telecommunication Engineering Department. Currently he works as Lecturer in Faculty of Electronics and Computer Engineering,

Universiti Teknikal Malaysia Melaka (UTeM). He is the member of Board of Engineering Malaysia (B.E.M) and Institute of Electrical and Electronics Engineers (IEEE). (Email: azahari@utem.edu.my).



R. A. Hamzah was graduated from University Technology of Malaysia (UTM) in B.Eng Electrical & Electronics and M.Sc Electronic System Design from University Science of Malaysia (USM). Currently he works as a lecturer at Department of Electronic & Computer Engineering Technology, UTeM. His research interests are signal & image processing, stereo vision and embedded system. Before joining an academician, he worked as an engineer at Electronic Department, Naval Shipping

Dockyard for almost 5 years. He also member of Institute of Electrical and Electronic Engineer (IEEE), Board of Engineer Malaysia (BEM) and International Association of Computer Science and Information Technology (IACSIT). (Email: rostamaffendi@utem.edu.my).