**DESIGN AND DEVELOP WIRELESS TYPE TO CONTROL
THE VIBRATION MOTOR FOR MY 2ND EYE EXTENDED**

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**Bachelor of Mechatronics Engineering
June 2012**

"I hereby declare that I have read through this report entitle "*DESIGN AND DEVELOP WIRELESS TYPE TO CONTROL THE VIBRATION MOTOR FOR MY 2ND EYE EXTENDED*" and
found that it has comply the partial fulfilment for awarding the degree of *Bachelor of Mechatronics Engineering*".

Signature   :   ....

Supervisor's Name   :   ....

Date   :   ....

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A report submitted in partial fulfilment of the requirements for the degree of Bachelor of Mechatronics Engineering

Faculty of Electrical Engineering
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YEAR 2012

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I declare that this report entitle "*Design and Develop Wireless Type to Control the Vibration Motor for MY 2ND EYE Extended*" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature   :   ....

Name   :   ....

Date   :   ....

I dedicate this research work to my supervisor, Mr. Anuar bin Mohamed Kassim who teach and guide me, to my family who supports me in everything and to my friends who helped me finished this project.

ACKNOWLEDGEMENT

I wish to express my sincere thanks to my supervisor, Mr. Anuar Bin Mohamed Kassim for corrected various documents and guiding me to lead this project success.
Next, I would like to thanks my friends for help me a lot in this project.

I would also thank University Teknikal Malaysia Melaka (UTeM) and Faculty Of Electrical Engineering (FKE). Without them, this project would not be realized successfully.

ABSTRACT

Nowadays, Malaysia had 0.69 million visions impaired peoples and 56.6 thousand blind peoples. Normally, a visually impaired or blind person is very hard or near to impossible to notice where the obstacles are existed. Therefore, a travel aid device called My 2nd Eye has been designed in order to give warning signal to the user about the location of obstacle by using vibration motor in a glove. However, the existing My 2nd Eye is lack of flexibility because of the gloves must be connected to the stick plus, the glove also not comfortable for some users. In order to solve the problem, wireless communication must be applied and has been proposed in this project. In this project, a communication module such as XBEE as the module to connect main controller and vibration motor has been selected. By using XBEE modules, the vibration motor can be mounted anywhere without causing any trouble to user. That means the gloves can be replaced by some better design and more aesthetic value design. Then, the performance of the designed system like power consumption and reflection time of user would be tested to ensure the product can function properly. From the experiment, power consumption of normal usage would be 0.4742 Watts and Configuration 1 would be the best configuration of total six designs. As recommendation, more samples should be tested to confirm the reflection time of user. Besides that, the wristband can be replaced by something more aesthetic, for example, belt.

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LIST OF ABBREVIATIONS

CDMA – Code Division Multiple Access

GSM - Global System For Mobile Communication

IEEE - The Institute of Electrical and Electronics Engineers, Inc

MAC - Media access control, data link of OSI layer

OSI - Open Systems Interconnection model

PHY - Physical layer of the OSI model

SMS – Short Message Service

TDMA - Time Division Multiple Access

Wi-Fi - IEEE 802.11 WLAN

WLAN - Wireless Local Area Network

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CHAPTER 1

INTRODUCTION

1.1 Project Background

In early 2010, the organization of the United Nations (UN) has been released the statistic that people with disabilities (PWDs) in the world are 10% percent of the total population. In addition, 80 percent of the disabled are located in developing countries from the calculated number [1]. The population of visually impaired person in Malaysia is 2.44% of total population of Malaysia. Besides that, the number of blind people in Malaysia is 0.2% of total resident [2]. By seen this statistic, percentage of visually impaired person and blind person is not so much. However, based on the 2010 population Census, total resident of Malaysia are 28.3 million peoples [3]. This means Malaysia had 0.69 million visions impaired peoples and 56.6 thousand blind peoples. Therefore, the research and development of equipment and device in order to help the visually impaired person and blind person is recommended. In 2010, the first researched and developed device for the visually impaired person which is called My 2nd Eye had been developed by Mr. Anuar Bin Mohamed Kassim and his final year students under his guidance. My 2nd Eye consists of four sensors placed on a stick. Each of the sensors detects the obstacle in one direction. The directions covered were left, right, front and down. There were also four vibration motors build in a glove which were represent these four directions. When these sensors detected obstacle, the vibration motors build in a gloves will vibrating respectively. However, there were still some weakness appeared on My 2nd Eye. One of the weaknesses of My 2nd Eye was the connection between glove and the stick was too nuisance for blind people. It is because the connection fixed to user's hand with the stick. Therefore, the proposed system to overcome this problem by using wireless control the vibration motor through XBEE in this project. As the consequent, the vibrator no need to fix in the glove

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and can be mounted on anywhere better places for give vibration alert signal to the visually impaired person while travelling.

1.2 Problem Statement

As the previous version of My 2nd Eye, it has a lot wired connection from the PIC main controller on the middle of the stick and the glove at the top of the stick. In addition, the wires of the vibrators which are mounted in the gloves are very sensitive and easily break. Besides, the warning system in the glove is also not so comfortable to some users and has low of aesthetic value. By applying wireless control, more option can be developed and improved the conventional method. The power consumption must be as low as possible to allow the warning system working for long time. Besides that, the warning system will be mounted on a wristband. The position of the vibration motors placed should allow user to distinct easily.

1.3 Objective

1. To design and develop a wireless communication for My 2nd Eye which can connect vibration motor with the main controller without physical connection by using XBEE modules.

2. To check the power consumption of the warning system which included an XBEE module as receiver and four vibration motors as warning part.

3. To determine the reflection time needed by user to differentiate the direction of obstacle.

4. To determine optimum position of vibration motor in wristband.

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1.4 Scopes

The scope of this project is research and develops a wireless communication in order to connect the vibration motor which is used to indicate the position of obstacles with main controller by using XBEE modules. The position to mount the vibrators and the places which can be mounted also should be decided in order to obtain very comfortable and aesthetic design. The vibration motor will be mounted in a wristband in this research. The power consumption and reflection time of user should be determined. The design of the walking stick also can be adjusted due to the requirement from the Society of Blind Malaysia which need the device must be compact and carry easily.

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CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

There are many kind of wireless control method which are available in the market such as Bluetooth, ZigBee, Wi-Fi, GSM and many more. In this chapter, the previous research which applied wireless control system would be discussed in order to find a suitable wireless control method for My 2nd Eye Extended.

2.2   ZigBee

The ZigBee specification has two implementation options or feature sets: ZigBee and ZigBee PRO. The ZigBee Feature Set is designed to support smaller networks with hundreds of devices in a single network. The ZigBee PRO Feature Set is the most popular choice of developers and the specification used for most Alliance developed standards. It maximizes all the capabilities of the ZigBee Feature Set, plus facilitates ease-of-use and advanced support for larger networks comprised of thousands of devices. Both Feature Sets are designed to interoperate with each other, ensuring long-term use and stability. The ZigBee specification enhances the IEEE 802.15.4 standard by adding network and security layers and an application framework [**4**].

The pros of ZigBee are support multi-node networking (up to 64,000 nodes in a network) [**4**], reliable communication, and very low energy consumption that PHY and MAC implementation using the IEEE 802.15.4 standard provides. The cons of Zigbee are short range (up to 100m) and low data rate [**5**].

The company that provide ZigBee modules are Atmel, Ember, MaxStream, Microchip, Renesas Technology and etc. XBee ZNet 2.5 is one of ZigBee modules produced by MaxStream.

Table 1: Specification of XBee ZNet 2.5

| Specification	XBee ZNet 2.5	XBee ZNet PRO 2.5
Indoor/ Urban Range	Up to 40m	Up to 100m
Outdoor RF line-of-sight Range	Up to 120m	Up to 1.6km
RF Data Rate	250kbps	250kbps
Supply Voltage	2.1-3.6V	3.0-3.4V
Operating current (transmit, max output power)	40mA @ 3.3V	295mA@3.3V
Operating current (Receive)	40mA @ 3.3V	45mA @ 3.3V

[6]

2.3   Global System For Mobile Communication (GSM)

GSM is a digital mobile telephone system that is widely used in many parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1,800 MHz frequency band [7]. GSM supports voice calls and data transfer speeds of up to 9.6kbit/s, together with the transmission of SMS (Short Message Service) [8]. However, GSM is not suitable in this project due to its cost too high compared with others.

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Figure 1: Siemens TC35i GSM Modem

[**9**]
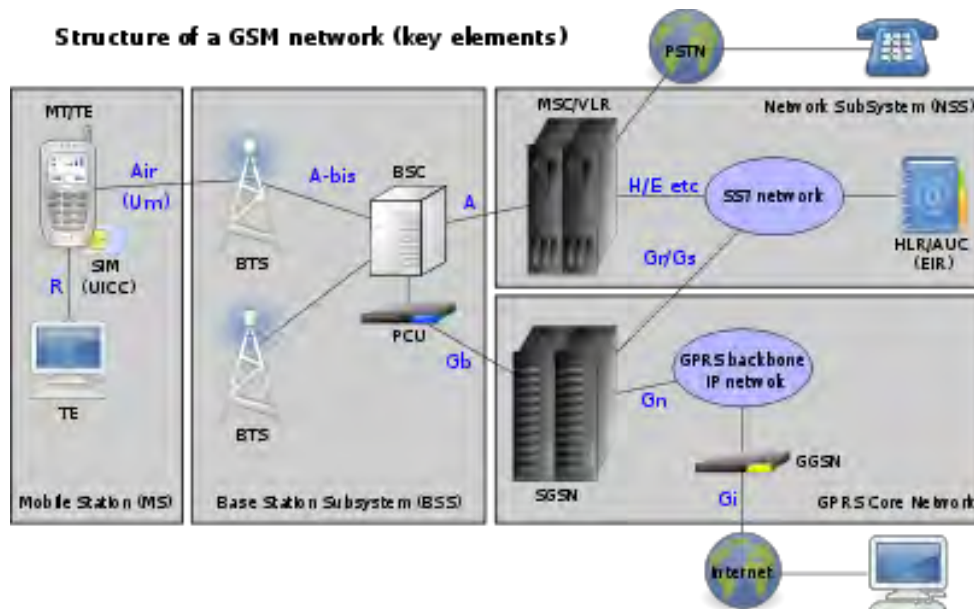
Figure 2: The Structure Of GSM Network

2.4 Bluetooth

The Bluetooth wireless technology was created to solve a simple problem: replace the cables used on mobile devices with radio frequency waves. The technology encompasses a simple low-cost, low-power, global radio system for integration into mobile devices [**10**].

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The range of Bluetooth depends on class of radio implement.

- Class 3 radios – have a range of up to 1 meter or 3 feet
- Class 2 radios – most commonly found in mobile devices – have a range of 10 meters or 33 feet
- Class 1 radios – used primarily in industrial use cases – have a range of 100 meters or 300 feet [11]

Figure 3: Bluetooth Bee

Table 2: Specification Of Bluetooth Bee

Specification	
Operating Frequency	2.4~2.48GHz unlicensed ISM band
Modulation	Gaussian Frequency Shift Keying
Transmit Power	≤ 4dBm, Class 2
Transmission distance	20 ~ 30m in free space
Transfer Rate	Asynchronous: 2.1Mbps (Max) / 160 kbps; Synchronous: 1Mbps/1Mbps
Input Voltage	+3.3 DC/50mA

[12]

2.5 Wi-Fi (IEEE 802.11 WLAN)

IEEE defined 3 major WLAN types in 802.11a, 802.11b, and 802.11g. 802.11b and g operate in 2.4GHz frequency band where 802.11a operates in 5GHz band. The 2.4-GHz frequency band used for 802.11 is the band between 2.4 and 2.485 GHz for a total bandwidth of 85 MHz, with 3 separate non-overlapping 20-MHz channels. In the 5-GHz band, there are a total of 12 channels in 3 separate subbands—5.15 to 5.25 GHz (100 MHz), 5.25 to 5.35 GHz (100 MHz), and 5.725 to 5.825 GHz (100 MHz). Wi-Fi usually used in infrastructure mode, where the station communicates with other wireless station and wired network through an access point. However, there is another mode called ad-hoc mode, where the stations can communicate directly with each other without the need for an access point [**13**].
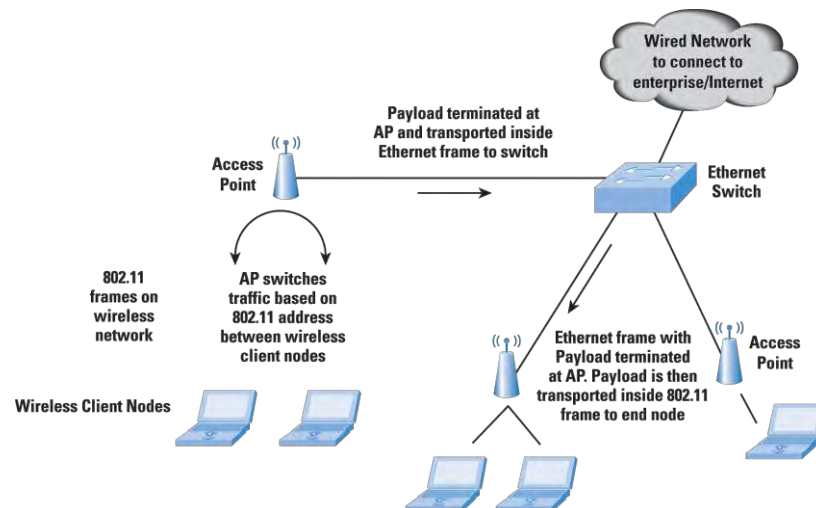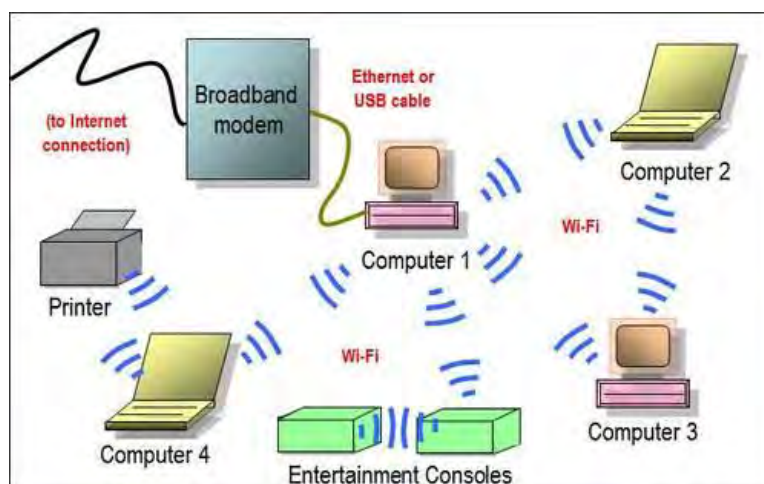

Figure 4: Infrastructure Mode Wi-Fi

Figure 5: Ad-hoc Mode Wi-Fi

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2.6 Discussion On Literature Review

In order to compare each of the wireless control method above, a pair-wise comparison table had been made to determine the weight of each criterion. Then, weighted objective method had been used to get a highest mark wireless control method.

2.6.1 Pair-wise Comparison Table

Table 3: Pair-wise Comparison

		A	B	C	D	E
Range	A		B	C	AD	E
Power Consumption	B			B	B	B
Cost	C				C	E
Speed	D					E
Ease of use	E					

A= Range

B= power Consumption

C= Cost

D= Speed

E= Ease of use

Calculation of weight:

Weight of Range = 1/11= 0.09091

Weight of Power Consumption = 4/11= 0.3636

Weight of Cost = 2/11= 0. 1818

Weight of Speed = 1/11= 0. 09091

Weight of Ease Of Use = 3/11= 0. 2727

From the weight, we can clearly see that the most important criteria in this system is power consumption which weight is 0.3636. This is because the system had to operate

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for long time, if the power consumption too high, more battery needed to support long time operation. This will ramp up size of the system.

2.6.2   Weighted Objective Method

1 =worst

10=best

Table 4: Weighted Objective Method

Criteria	Weight	ZigBee	Bluetooth	Wi-Fi	GSM
Range	0.09091	5	6	7	10
Power Consumption	0.3636	8	4	2	4
Cost	0.1818	8	7	5	3
Speed	0.09091	6	7	10	10
Ease of use	0.2727	8	6	6	4
Total	1	7.545	5.545	4.818	3.901

(Adapted and edited from Table 1 [**5**])

2.6.3   Conclusion On Literature Review

According to the results of the weighted objective method, ZigBee had the highest rating. This means ZigBee is more suitable in this application than other does. This is because this application doesn't require high speed, the data rate in this application only used to control 4 vibration motors. This application also does not require far range because the transmitter and receiver are placed very near, their distance should be less than 2 meters. Therefore, the criteria had to be concerned are power consumption, cost and ease of use. Low power consumption can increase the battery life; low cost can minimize the cost of My 2nd Eye and ease of use can made the My 2nd Eye design simpler. ZigBee had won others wireless control methods in these three criteria. So, ZigBee had been chosen to be used in this application. The XBEE module is the most popular ZigBee modules. The

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XBEE Series 2 provides an extra advantage which is unique 64 bit address. This can avoid interfere between 2 My 2nd Eye. Therefore XBEE Series 2 had been chosen in this project.