DESIGN AND EVALUATE THE PERFORMANCE OF MY 2ND EYE BY USING ULTRASONIC SENSOR

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Bachelor of Mechatronics Engineering
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" I hereby declare that I have read through this report entitle "*DESIGN AND EVALUATE THE PERFORMANCE OF MY 2nd EYE BY USING ULTRASONIC SENSOR*" 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
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

YEAR 2012

I declare that this report entitle "*Design And Evaluate The Performance Of My 2ND Eye By Using Ultrasonic Sensor*" 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.

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ABSTRACT

Nowadays, there are a lot of new technologies which have been developed in order to assist visually impaired people. Nevertheless, they are still using the white stick for their guidance purpose because it is the lowest price tool and easy to be used. However, the white stick is still has some problems which is, it has the limitation to be used and only can manually used. Hence, an obstacle detection system by using ultrasonic sensor is proposed in order to solve this problem. This system is developed to detect the obstacle from different directions within a range by sonar sensor for static and moving obstacles. This project will be begin with some experiments in laboratory in order to detect the obstacles indoor before proceed to the outdoor field test. The result expected is the sonar sensor can detect the obstacle within 1.0 to 1.5 meters form four different direction accurately for static obstacle.

ABSTRAK

Pada zaman kini, pelbagai teknologi baru telah dibangunkan bagi membantu orang yang kurang upaya dalam penglihatan. Tetapi, mereka masih menggunakan tongkat putih bagi tujuan bimbingan kerana alat ini murah dari segi harga dan mudah digunakan. Walaubagaimanapun, tongkat putih mempunyai banyak masalah kerana pengunaan tongkat putih mempunyai hadnya and ia perlu digunakan secara manual. Oleh itu, sebuah sistem pengesanan halangan dengan menggunkan pengesan ultrasonik telah dikemukan bagi tujuan menyelesaikan masalah tersebut. Sistem ini dibangunkan untuk mengesan halangan dari arah yang berbeza dalam satu julat jarak dengan menggunakan pengesan ultrasonik bagi halangan statik dan bergerak. Projek ini akan dimulakan dengan uji kaji dalam makmal untuk mengesan halangan dalam bangunan sebelum meneruskan uji kaji lapangan di luar bangunan. Keputusan yang dijangkakan ialah pengesan ultrasonik dapat mengesan halangan statik dengan tepat dalam lingkungan 1.0 hingga 1.5 meter dari empat arah yang berbeza.

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θ- Angle of the bottom sensor

IR sensor- Infrared sensor

CHAPTER 1

INTRODUCTION

1.1 Project Background

According to 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 year 2010 [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. By seen this statistic, the percentage of visually impaired person and blind person is not so much. However, based on the 2010 population Census, total resident of Malaysia achieved 28.3 million peoples, which means Malaysia had 0.69 million visions impaired peoples and 56.6 thousand blind people [2]. These results show that this amount of people needs more support and care from the community. This phenomenon gave birth to 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 in year 2011. However, there is still some space to improve the performance of this system. One of the improvements can be made is to replace the IR sensor on the white stick. It is because the shorter range of detection and influence from object's colour and reflectance of IR sensor have limited the performance of the system. Therefore, the proposed solution is to replace the IR sensor by ultrasonic sensor in this project. By this way, the system can detect obstacle in larger area and the accuracy and the stability of the system will not be influenced by the characteristic of the material.

1.2 Problem Statement

There are several problem need to be solved along this project. First of all, we need to carry out some experiment to compare the characteristic of infrared sensor and ultrasonic sensor. After that, a new method should to be applied in order to replace the infrared sensor used in previous version of My 2nd Eye with ultrasonic sensor. Then, a new casing needs to be designed to place the ultrasonic sensor. Thus, there are several aspect need to be considered in the design to make has an aesthetic value:

- Accuracy of ultrasonic sensor within 1.0 to 1.5 meter.
- Number of ultrasonic sensor has to be used.
- The size of new designed casing for ultrasonic sensor that can make the design has an aesthetic value.

1.3 Objective

The objective of this project is to improve the performance of the previous My 2nd Eye by using ultrasonic sensor as the system's input.

1) To design and develop the obstacle detection system by using ultrasonic distance sensor and PIC microcontroller.
2) To analyze the efficiency of ultrasonic sensor for obstacle detection.
3) To determine the effect of the voltage drop on the accuracy of the ultrasonic sensor.

1.4 Scope

Design an obstacle detection system by using four ultrasonic sensors that are able to detect the obstacle within 1.5 meter in four directions (front, down, left and right) for static obstacle in order to replace the IR sensor on the previous version My 2nd Eye white stick. However, since the ultrasonic sensor used is not waterproof, the performance of the system in raining day or in the wet condition will not be considered.

CHAPTER 2

LITERATURE REVIEW

In this chapter, a review of several previous research project journals which are related with this project's purpose and objective will be discussed. Then, a comparison will be made between the previous projects and this project and the result will be displayed in table.

2.1 GuideCane

The GuideCane is actually same like white cane because the user needs to hold the cane in front of them while walking. Although it is consider heavier than the white cane, but it rolls on wheels that support the GuideCane's weight during regular operation. A servomotor is controlled by the built-in computer to steer the wheels left and right relative to the cane. Both wheels are equipped with encoders to determine their relative motion. The GuideCane is equipped with ten ultrasonic sensors in order to detect obstacle. To specify a desired direction of motion, the user operates a mini joystick located at the handle. Based on the user input and the sensor data from its sonar and encoders, the computer decides where to head next and turns the wheels accordingly.

While travelling, the ultrasonic sensors can detect any obstacle in a 120° wide sector ahead of the user (Step 1 in Figure 2.1). The sensors data will be received by the built-in computer and determine an appropriate direction of travel instantaneously. If an obstacle blocks the desired travel direction, then the obstacle avoidance algorithm prescribes an alternative direction to avoid the obstacle and then resumes in the desired direction (Step 2 in Figure 2.1). Once the wheels begin to steer sideways to avoid the obstacle, the user feels the resulting horizontal rotation of the cane (Step 3 in Figure 2.1).

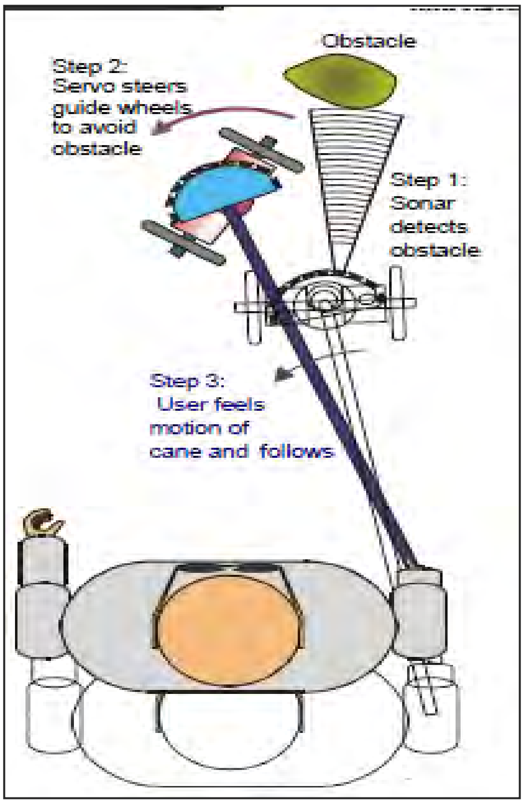

Figure 2.1: The User Avoid Obstacles

The user's trajectory is very close to the GuideCane's trajectory because it handle is short. After the obstacle is cleared, the wheels steer back to the original desired direction of travel immediately, although the new line of travel will be offset from the original line of travel[3].

The GuideCane can provide an accurate direction guideline to the user since the built-in computer can determine an appropriate direction of travel instantaneously after receive the sensor data. The servomotor acts as a robotic guide-dog to lead the user to the correct direction by turning the wheels to left or right. But, the size of the GuideCane is slightly larger and this will make the user inconvenient when walking to the street with many people. The placement of the ultrasonic sensor is slightly lower will cause the detection range of the ultrasonic sensor slightly drop as the sensor cannot detect the obstacles which just slightly higher. The use of ten ultrasonic sensors will cost a lot of money.

2.2 An Ultrasonic Navigation System for Blind People

In this paper, an ultrasonic guidance system for blind people is developed without white cane by using microcontroller. This system consists of a microcontroller, an accelerometer, a footswitch, a speech synthesizer, a hexadecimal keypad, a mode switch, two ultrasonic sensors, two vibrators and a power switch. Figure 2.2 shows the block diagram of the system.

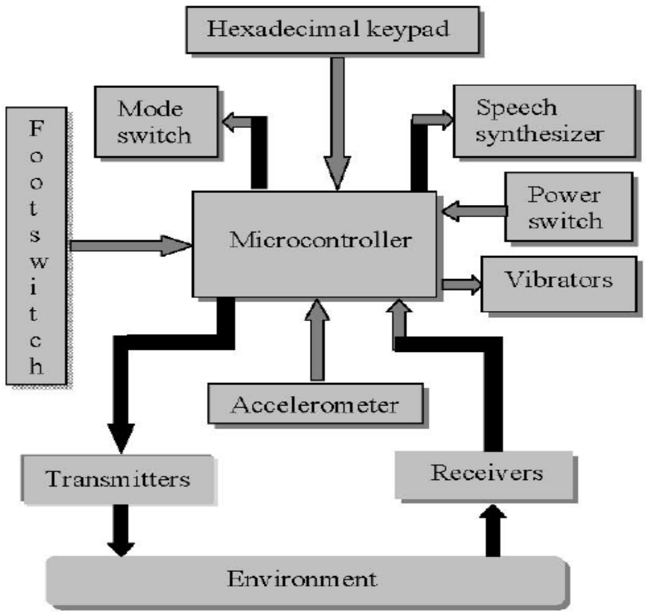

Figure 2.2: The Block Diagram Of The System

Basically this system has several functions. First of all is the obstacle detection function. This system detects the obstacle by using two ultrasonic sensors and gives direction instruction to the user by vibration. For example, if left ultrasonic sensor detects obstacle, then the left vibrator will vibrate. The vibration will increase if the distance between the user and the obstacle decrease and the vibration will decrease if the distance increases.

Next, this system also acts as a 'Micromap', which means that the system can record and playback the direction instruction of a journey. In record mode, user walks the route of interest, and the aid measures the distance travelled by the user. When user reaches a decision point, for instance a point at which the route takes a left turn, the user presses a key on the aid coded with a left turn instruction. Then, the distance travelled will be stored in the memory in microcontroller. User repeats this step for the next decision point until reach the destination. User can make any of this decision: turn left, turn right, cross road, cross road junction, pedestrian crossing, steps, pause, and stop.

In the playback mode, there are forward and reverse directions. The aid measures again the distance travelled by the user. When this is equal to that stored in the memory for that particular section of the route, a corresponding decision word generated by the synthesizer is given to the user. The audible signal indicates what action the user should take at this point, for instance turn left. In the reverse direction, the procedure is exactly the same except that the route information stored in the memory is used in reverse order, and that right and left are interchanged [4].

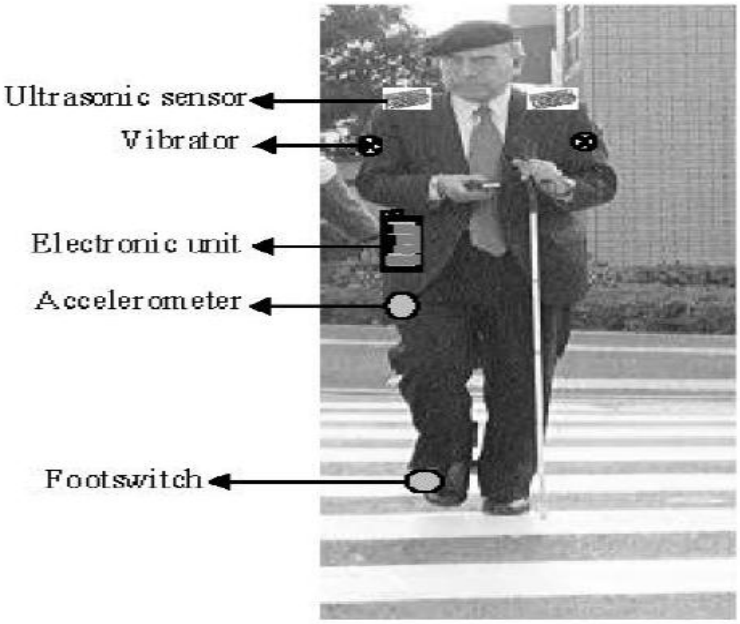

Figure 2.3: The Navigation Aid Worn By The Blind

This system is very user friendly as the system consists of multifunction. However, the placement of ultrasonic sensors at the shoulder of the user is too high will cause the ultrasonic sensors cannot detect the obstacle at lower level. If the user does not hold a white cane, this will very dangerous to the user.

2.3 A Low Cost Artificial Vision System for Visually Impaired People

This system uses ultrasonic sensors are used to calculate distance of the obstacles around the blind person to guide the user towards the available path. Output is in the form of voice which the blind person can hear e.g., right, left etc. In its advance mode, the system will be able to recognize objects using image processing algorithms. The system block diagram is shown in figure. From figure, we can see that the system consists of microcontroller, camera, ear speaker, ultrasonic sensors, EEPROM, digital to analog converter. The system can function in two modes, WALK mode and CAM mode. In WALK mode, the system uses ultrasonic sensors to detect obstacle and the voice command will guide the user to the right direction via ear speaker. In CAM mode, the vision camera is used to help the blind people in recognizing objects and text. Figure shows hardware setup of the system [5]. Figure 2.4 shows the system block diagram and Figure 2.5 shows the hardware setup of the system.

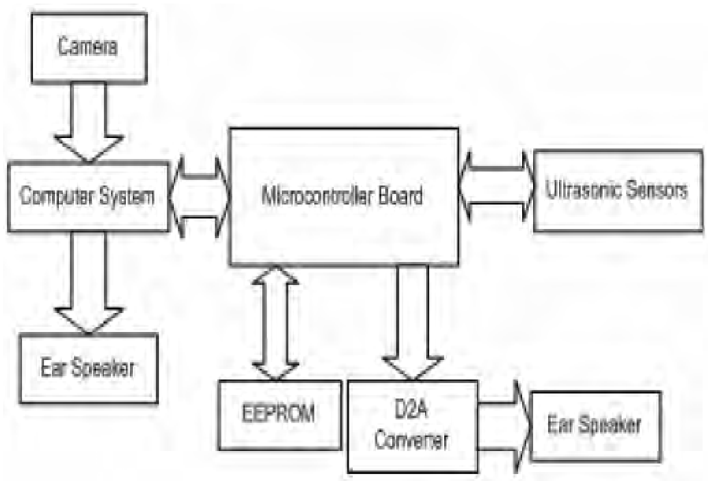

Figure 2.4 The System Block Diagram

Figure 2.5 Hardware Setup

This system can give the direction guidance accurately as the ultrasonic sensors are placed with angle so that the sensors can detect the obstacle from many directions, including the dig. However, this system cannot determine the distance between the obstacle and user and give an instruction on it. Since this system did not involve white cane, this will very dangerous to the user.

2.5 Product Comparison

The table shows the distribution of particular design and proposed design. They will be compared in several criteria: accuracy, cost, user friendly, safety, and energy consumption. With this comparison, we can detect the strength and weakness of each product.

Table 2.1 Pair Wise Comparison Table of the Product's Criteria

		A	B	C	D	E	TOTAL	WEIGHT
accuracy	A		A	A	D	A	3	0.3
cost	B			B	D	E	1	0.1
user friendly	C				D	C	1	0.1
safety	D					D	4	0.4
energy consumption	E						1	0.1

In the Table 2.1, we display all the important criteria which should be included in a product and weighted all of it. Next, we can arrange the importance of the particular criteria according it's weight after compare with other entire criteria. From the Table 2.1, we found that safety (weight= 0.4) is the most important criteria to the product, follow by the accuracy (weight= 0.3). This means that we need to concentrate both of these criteria in the product designing.

Table 2.2: Weighted Objective Table For The Products

W	Wish
R	Requirement

W/R	Criteria	Description Values	Weight	Artificial Vision System	Guide cane	Ultrasonic Navigation System	My 2nd Eye
R	accuracy	highest	0.3	4	2	2	`5
W	Cost	lowest	0.1	2	2	3	5
W	User friendly	highest	0.1	5	4	5	3
R	Safety	highest	0.4	2	4	2	4
W	Energy consumption	lowest	0.1	3	1	4	5
			Total (weight x point)	3	2.9	2.6	4.4

Table 2.3 Point Explanation

Very Low	Low	Moderate	High	Very High
1	2	3	4	5

Table 2.2 shows the result gained by compare the important criteria among the review product by using weighted objective method. The purpose of using this method is to compare the products according the importance of the criteria so that in the end, we can choose the most suitable product. From Table 2.2, we found that My 2nd Eye gains the highest total point of 4.4. Hence, it is the most suitable product of obstacle detection for visually impaired people.

2.6 Sensor Comparison

In this section, we will discuss the specification of 3 types of sensor: IR sensor, sonar sensor and laser sensor and compare their specification based on some criteria. Hence, we can choose the most suitable sensor for our system.

2.6.1 PING)))™ Ultrasonic Distance Sensor (#28015) (Ultrasonic sensor)

Figure 2.6: Ultrasonic Distance Sensor

Ultrasonic sensor works by transmitting an ultrasonic (well above human hearing range) burst and providing an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated. Table 2.4 display all the technical specification of the PING)))™ Ultrasonic Distance Sensor (#28015).

Table 2.4: Technical Specifications Of Ultrasonic Distance Sensor

No	Specification	Value
1	Supply voltage	5 Vdc
2	Supply current	33 mA – 35mA
3	Measuring distance range	2 cm – 300cm
4	Temperature	0°Cto 70°C
5	Size	22mm x46mm x16 mm
6	Weight	9g

[6]