

**WHEELCHAIR OBSTACLE AVOIDANCE USING ULTRASONIC SENSOR  
&  
PIC MICROCONTROLLER**

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**This report is submitted in partial fulfilment of the requirements for the award of  
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

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ULTRASONIC SENSOR & PIC MICROCONTROLLER

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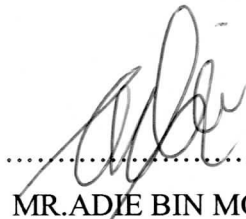
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Special dedication to my beloved family, my dearest friends and my supervisor, Mr.  
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## ABSTRACT

This project is about an electronic wheelchair which capable to take necessary autonomous reaction to avoid obstacle during the operation. This project of electronic wheelchair consists of combination of 4 project circuits to become a main project circuit. To make success of this project, it requires a system which needs to be programmed with the PIC controller. This project involves a combination of software and hardware. Ultrasonic sensor was used to determine whether there exists obstacle at the wheelchair's path. In case of, there exist obstacle at the path, the wheelchair will take necessary action, which determined by pre-programmed PIC microcontroller to take alternative path in order to arrive at specified destination. Through this project it is hoped that the handicapped person who using this wheelchair can move around more safely.

## ABSTRAK

Projek ini adalah tentang sebuah kerusi roda elektronik yang mampu untuk memuat reaksi autonomi yang diperlukan untuk mengelakkan halangan selama operasi. Projek kerusi roda elektronik ini terdiri daripada gabungan litar 4 projek untuk menjadi litar projek utama. Untuk menjayakan projek ini, diperlukan satu sistem yang perlu diprogram dengan PIC controller. Projek ini melibatkan gabungan perisian dan perkakasan. Sensor ultrasonik digunakan untuk menentukan sama ada terdapat halangan di bahagian sisi kerusi roda. Dalam satu kes sekiranya terdapat halangan di bahagian sisinya, kerusi roda akan mengambil tindakan yang diperlukan, yang ditentukan oleh mikrokontroler PIC yang telah diprogramkan untuk memilih laluan alternatif untuk mencapai tujuan tertentu. Melalui projek ini diharapkan bahawa orang cacat yang menggunakan kerusi roda ini boleh bergerak dengan lebih selamat.



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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Project Background**

This project focuses on the programming of microcontrollers using a high-level language. The PIC family of microcontrollers is chosen as the target microcontroller because of the low power consumption which made this microcontroller popular in portable application.

This project is a subpart of the main project, to complete a voice control operated wheelchair for handicapped person, where for this part, requirement is needed to complete an obstacle avoidance system for wheelchair, so that it can take necessary autonomous reaction to avoid obstacle during operation.

Ultrasonis sensor is being used as method of obstacle sensing and PIC microcontroller is used to configure the necessary action should the wheelchair take, so that it can move to the objective location by avoiding all the obstacle.

There are several part of circuit for this project, which involved a PIC control circuit as the main part, motor driver circuit, sensing circuit and other. For the situation



that the wheelchair will face during sense an obstacle, a command of program will be added into, to make the wheelchair can avoid the obstacle. So, an autonomous avoidance system will be designed for the wheelchair with the Ultrasonic sensor as an input for the PIC Microcontroller, and the PIC as the main component to control the output for the Wheelchair so that it can get work.

## **1.2 Project Objectives**

The main aim's of this project is to:

- i. Design an intelligent wheelchair system that can avoid obstacle, using a system of Obstacle Avoidance.
- ii. Produce a program for a system that can navigate the wheelchair to avoid the obstacle.
- iii. Design several part of circuits that involved as the hardware to complete the function of Wheelchair Obstacle Avoidance.
- iv. Simulate and fabricate the circuits.

## **1.3 Problem Statements**

Currently, there have a wheelchair that have been designed before which it was controlled by human voice. Technically, it also designed for handicapped person, using electronic concept. A system have been programmed to the wheelchair so that it can move by a command from human voice. But, when the wheelchair was succed, realized that there are still have some short of problem, when imagined if the handicapped person who use the wheelchair is also a blind person, cannot see their location at that time, and don't know the direction to go, such as to go to the dining room. This problem will be

more aggravate them and maybe perforce to use a voice from other people that are present nearby, might be more complicated for them. The person's voice recognition also become a problem, where it maybe had to program first before can be used by the mean handicapped person. And that become a problem when the voice is not programmed first, the wheelchair will be listen to the anybody command and execute the instruction without any confirmation. It will make the user be in unsafe. So, here the improvement of the wheelchair will be designed so that it can be an intelligent assistant prototype to the blind handicapped person which can help them move autonomously by the sensing that have been programmed into. The policy of the wheelchair that can avoid the obstacles also will make the user are in safe condition when moving anywhere. This improvement of the wheelchair will be executed by the scope and methodology that will be covered in the PSM to ensure this project to success.

#### **1.4 Scope of The Project**

All projects have their own scope or limitation as a guideline throughout the completion of the project. This project of Wheelchair Obstacle Avoidance Using Ultrasonic Sensor and PIC Microcontroller is a project that consists two major parts which are the hardware and software parts. So, the scope for implementation of this project is:

i. Study and Research

Find information for this project, which come from books, internet, journal, and supervisor and also from products that are already in the market so that more knowledge can be obtained, especially for Research study on the Programmable Intelligence Computer, PIC16F877A microcontroller and the control system of the circuit.

ii. Program design and compilation using computer

The simulation of the circuit using related software, will be done first before any installation of the component is made on the PCB board.

iii. Installation for the hardware

The project consist of several electronic circuit such as Ultrasonic Sensor Circuit, Control Circuit, and Motor Driver Circuit, which all of these will be designed fabricate, and installs on the wheelchair for fully function.

## 1.5 Report Structure

This report divides to five chapters where Chapter 1 is an introduction of this report which explains briefly about Wheelchair Obstacle Avoidance Using Ultrasonic Sensor & PIC Microcontroller. This chapter includes the project introduction, project objective, problem statements, scopes of work, report structure and the project flow.

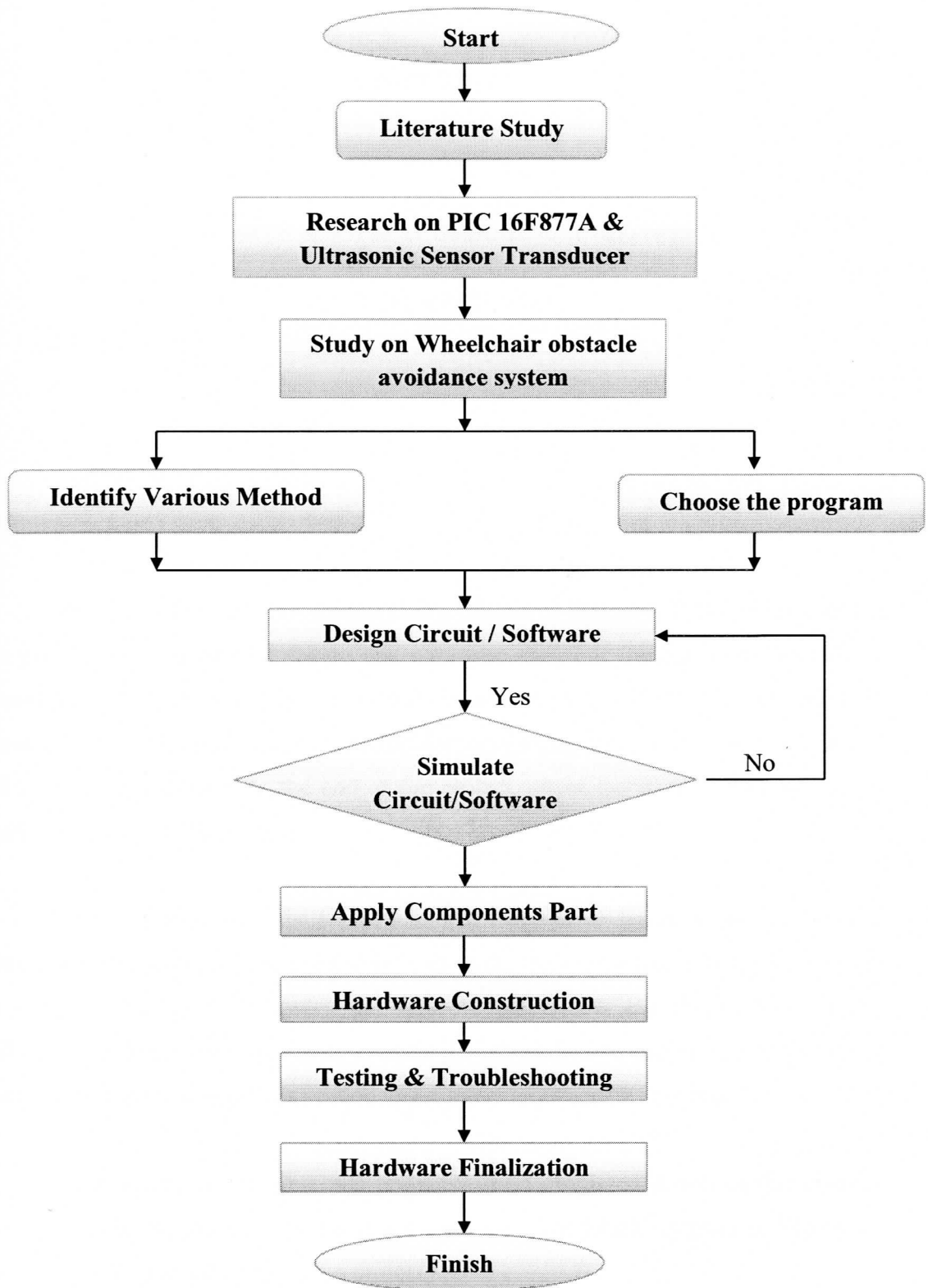
Chapter 2 is the literature review. The background study, which was explanation details about the research of this project, and the devices that used for this project, such as PIC Microcontroller, Ultrasonic sensor, motor driver, also the other theories relate for this project.

Chapter 3 will explain a project methodology which explains the procedures about the whole method being used for this project. This chapter contains the methods used which involve the software, the hardware process techniques, analyzing of data and the flowchart.

Chapter 4 will show the results of the project's progress and the completion of the project that have been done and ready to present during the Project's Seminar.

Chapter 5 states the discussion and conclusion of this project. Any suggestion regarding of this project will be cover in this chapter.

## 1.6 Project Flow



## CHAPTER 2

### LITERATURE REVIEW

#### 2.0 Introduction

Wheelchair Obstacle Avoidance Using Ultrasonic Sensor & PIC microcontroller is a project that consist of software and hardware part. For the hardware, it involves several part of circuit, which were a control circuit using PIC 16F877A as the main part, motor driver circuit, and Ultrasonic Sensor as the sensing circuit. Each part can be test and work independently. At the end of the project, all of the parts will be connected together to complete the system.

For the situation that the wheelchair will face during sense an obstacle, several command of program will be created into, to make the wheelchair can get move from the obstacle. That case is shows the software part which use the PICC Compiler Software to compile the program as to make the wheelchair be programed so that it can takes the necessary autonomous reation to get move anywhere, as needed.

An approach to complete this project will be discussed details in this chapter, which involves the hardware part and software part. The block diagram of Figure 2.1 shows the executive summary of the project.



## 2.1 Block Diagram

Figure 2.1 explains about the overview function of the Wheelchair Obstacle Avoidance Using Ultrasonic Sensor & PIC Microcontroller system. As shown in Figure 2.1, the input for the system is come from the sensor part, which Ultrasonic Sensor used as the sensing circuit. The result from the Ultrasonic Sensor then become an input for the PIC microcontroller which was use the PIC 16F877A. The PIC will process the signal input as which has been programmed into it to control the output for the motor driver. Since the motor driver was controlled by the PIC, it can makes the motor to take several actions such as forward, reverse and stop, as to make the wheelchair avoid the obstacles.

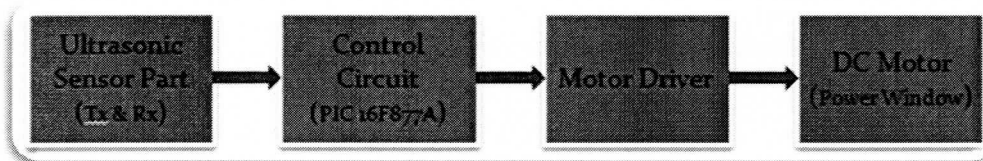


Figure 2.1 Block Diagram of the Wheelchair Obstacle Avoidance Using Ultrasonic Sensor & PIC Microcontroller

## 2.2 Ultrasonic Sensor

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. This technology is suitable to be used for measuring and direction

Normally, the Ultrasonic sensors are industrial control devices that use sound waves above 20,000 Hz, beyond the range of human hearing. It also capable to generate

the ultrasound, which in range of 40 kHz-50 kHz, which used in this project for that range. It then converts the sound waves into electrical energy which can be measured. Shown below is the Ultrasonic Transducer

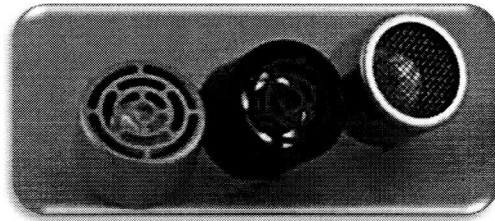


Figure 2.2: Ultrasonic Sensor Transducer

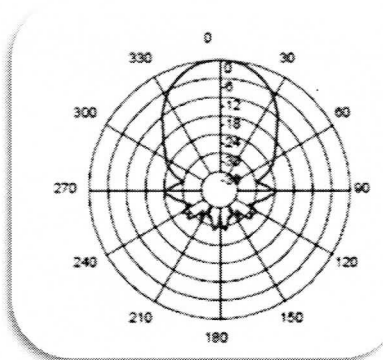


Figure 2.3: The Beam angle tested 40.0 kHz frequency

From the Figure 2.3 of angle beam tested for the Ultrasonic sensor frequency, can be explained that the rebound angle of the frequency transmitted by the Ultrasonic transmitter that can be received by the Ultrasonic receiver is at  $55^{\circ}$  (-6dB).

## 2.3 PIC Microcontroller

PIC initially referred to "Programmable Interface Controller", but shortly thereafter was renamed "Programmable Intelligent Computer". PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1640 originally developed by General Instrument's Microelectronics Division.

Figure 2.4 shows a single chip that contains the processor (the CPU), nonvolatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit. Also called a "computer on a chip," billions of microcontroller units (MCUs) are embedded each year in a myriad of products from toys to appliances to automobiles. For example, a single vehicle can use up to 70 or more microcontrollers.

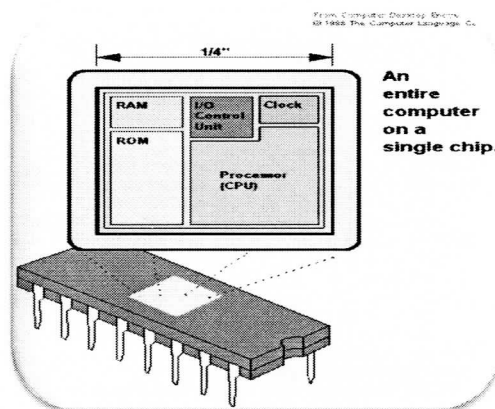


Figure 2.4: Single Chip PIC

### 2.3.1 PIC 16F877A

In this project, the PIC16F877A microcontroller is chosen to be used as the brain of the circuit. The microcontroller was chosen because it is common used and it provides more input and output ports to support more functions.