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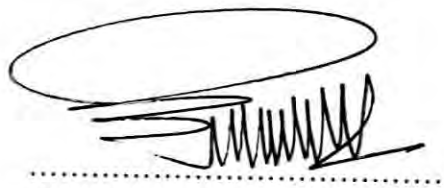

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INFRARED ROBOTIC BY USING MICROCONTROLLER

AHMAD RASHIDI BIN AHMAD FAUZY

This report was submitted in partial Fulfillment of Requirement for The Bachelor Degree of Electronic Engineering.

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
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I would like to dedicate this thesis to my family and someone special, whose encouragement and support was a great help in completing it.
For friends and lecture in Faculty of Electronic and Computer Engineering University Teknikal Malaysia Melaka (UTEM)
for the all of the knowledge given

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ABSTRAK

The project '*Infrared Robotic Using Microcontroller*' is to produce robot which will avoid when see the obstacles in front. It's like a small wheel robot that avoids obstacles which it senses with its active infrared sensors. Each rear wheel has its own motor; the single front wheel is not powered. The robot steers "like a tank" by rotating the rear wheels in opposite direction. These robots are controlled using PIC16F84A Microcontroller. The behaviors of the robot are searching an object in front. The three wheels of the robot were in a triangular configuration. This robot is able to move forward, turn left and turn right. This project deals with the design and construction of robot structure and also the related circuits. The sensors are built with infrared LEDs which are running at 36 kHz and two 36 kHz remote control receiver modules. When the 36 kHz infrared light from the LEDs is reflected by an object, one of the receiver modules will be triggered and the PIC16F84 microcontroller will steer the robot away from the objects by reversing one of the motors. One unit of Cytron servo motor C36S is used as determines direction for the robot. The DC Servo motor is used to move robot forwards and back. PIC16F84A microcontroller is programmed using PIC Basic PRO programming. MPLAB and PICshell software are used to assemble and download machine code into the microcontroller.

ABSTRAK

Projek '*Tortoise robot*' adalah bagi menghasilkan sebuah robot yang akan mengelak halangan apabila melihat sesuatu objek dihadapan. Ia menyerupai sebuah robot roda kecil yang akan mengelak halangan apabila pengesan infra merah diaktifkan. Robot ini adalah dikawal menggunakan mikropengawal PIC16F84A. Sifat robot adalah mengesan objek dihadapan. Tiga buah roda robot berada di satu konfigurasi segitiga. Robot ini boleh bergerak ke hadapan, belok ke kiri dan kanan. Projek ini berhadapan dengan rekabentuk dan pembinaan robot struktur dan juga litar-litar yang berkaitan. Pengesan dibina dari infra merah dimana berfungsi dalam pancaran 36kHz dan dua kawalan jauh 36kHz sebagai modul penerima. Apabila 36kHz inframerah daripada LEDs dipantulkan oleh suatu objek, satu modul penerima akan dicetuskan dan mikropengawal PIC16F84 akan memandu robot jauh daripada benda-benda oleh dengan menggerakkan satu motor secara mengundur. Satu unit Cytro servo motor C380 digunakan untuk menentukan arah pada robot. Servo motor arus terus juga digunakan untuk mengerakakan robot kehadapan dan kebelakang.PIC16F84A mikropengawal diprogramkan menggunakan pemprogram PIC Basic PRO. Perisian MPLAB dan perisian PICshell digunakan untuk benukar dan memuat turun mesin kod ke dalam mikropengawal.

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CHAPTER I

INTRODUCTION

1.1 Infrared Robotic Using Microcontroller

Nowadays robots can be found in mostly industries which perform routines, and redundant tasks that are cannot be performed by human labor such as task that was too difficult or too dangerous and to critical to be done by a human. Furthermore recent technologic advances have made it possible to use robotic devices to provide safe and intensive rehabilitation to persons. Robots are usually controlled by computer; computers are nothing more than simple adding machines (they just add incredibly fast). In order for the computer to operate the robot, they must be programmed, but they also need to be able to sense the environment and provide that sensory information to the program so that pre-programmed decisions and movements can be sent to the robot in response [1].

Robotics is about building systems. Controller(s), sensors, a power source, and motors are a few of the many subsystems that make up a robot. There are many different kinds of robots – robotic arms, analog insect- like robots and digital (microprocessor based) robots [2]. While a microcontroller according to Levine, a microcontroller is essentially an inexpensive single chip computer which means the

entire computer system lies within the confines of a sliver of silicon encapsulated inside the plastic housing of an integrated circuit [3].

Since robotics is about building a system with a microcontroller inside, an *Infrared Robotic by Using Microcontroller* had been developed to create a robotic system that can avoid when see the obstacle. This Robot controlled using PIC Microcontroller. PIC Microcontroller are device that can perform the basic of a stand-alone electronic applications through perform a variety of programmed functions.

It's like a small three robot that avoids obstacles which it senses with its active infrared sensors. Each rear wheel has its own motor; the single front wheel is not powered. The robot steers "like a tank" by rotating the rear wheels in opposite direction.

The sensors are built with infrared LEDs which are running at 36 kHz and two 36 kHz remote control receiver modules. When the 36 kHz infrared light from the LEDs is reflected by an object, one of the receiver modules will be triggered and the PIC16F84 microcontroller will steer the robot away from the objects by reversing one of the motors.

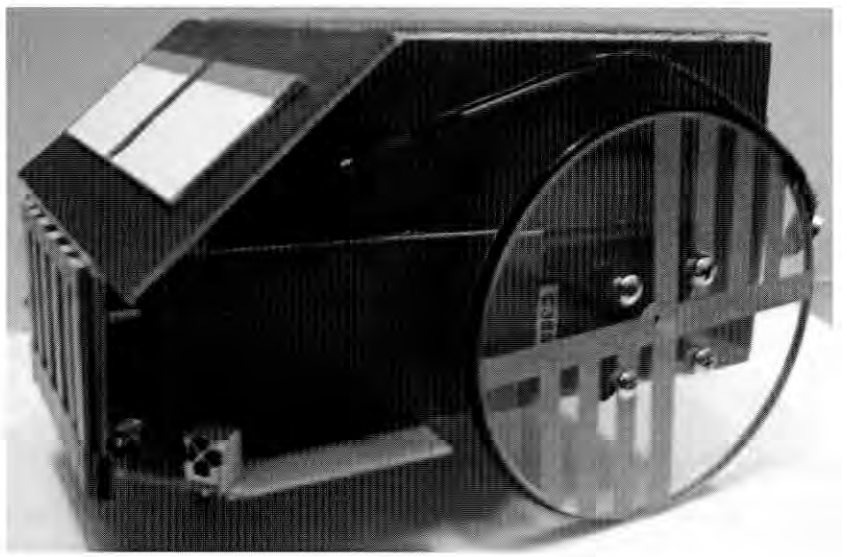


Figure 1.1: Infrared Robotic Using Microcontroller

1.2 Problem Statement

With the increasing of technology in robotic area, there are so many researches that had been done to replace human works. Current research in robotic tends to be in two main areas that is in artificial intelligence and related field of machine vision [4]. According to Selig, a typical artificial intelligence problem in robotics might be to find a clear path for a robot through a cluttered environment; however most of research in this area is towards making intelligent machines [4].

There are so many robotic that had been designed to used either in industries or for research education. In many previous works, a wide range of sensors and various methods for detecting and avoiding obstacles for mobile robot purpose have been proposed. Good references related to the developed sensor systems and proposed detection and avoidance algorithms can be found in [5] [6] 7] [8].

Generally, this project was also a solution to obstacle avoidance, but this project was a low cost solution, using a PIC application and infrared LEDs which are running at 36 kHz and two 36 kHz remote control receiver modules as a sensor. There was a previous project that also a low cost solution to obstacle avoidance for a mobile robot had been designed but it was using a single ultrasonic sensor panning an angle of 180± [5].

This *Infrared Robotic by Using Microcontroller* can be divided into two parts, robot structural construction (hardware) and robotic control system construction (software). This project is also focuses on construction of robot structure that able to move smoothly and stable in all condition and possesses terrific strength to be moved freely that can avoid obstacles. The construction involves the skills of attaching components onto circuits, programming the micro controller and installation of sensors to the robot to drive it into specific movement. The final step is to combine both software and hardware specifications and manipulates controlling system to control the movement of the robot.

1.3 Project Objectives

In developing this project, objectives was the main concern to make sure that all the this project will successfully done. The objectives of this Infrared Robotic by Using Microcontroller project was:

i. To build the Infrared Robotic by Using Microcontroller.
ii. To know and understood about microcontroller (PIC) theory
iii. To learn PIC (peripheral interface controller) characteristic and programming.
iv. To implement the PIC on the robots circuit.
v. To ensure that robot will avoid when hit the obstacle.

1.4 Scope of Work

The scope of work for this Infrared Robotic by Using Microcontroller project was:

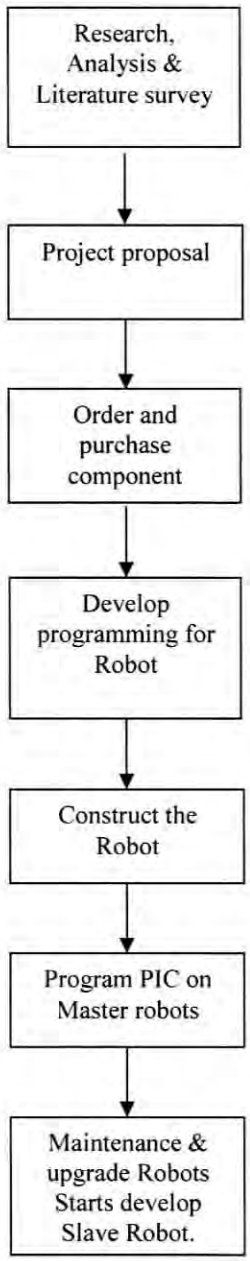
i. Build a mechanical structure and motor placement for a device that can perform a basic of stand-alone electronic applications through perform a function that will avoid when hit any obstacle.

ii. Build a mechanical structure and motor placement for a device that can sense any obstacle within 10 centimeters using infrared sensors.

iii. Controlled the Infrared Robotic using PIC program that fed with input from sensors and drive the motors base on specific command as programmed.

iv. Wrote a suitable programming for PIC microcontroller to control the robot's movement to ensure the smooth movement of the robot and able to respond sensitively to the sensor

1.5 Project Flow



CHAPTER 2

LITERATURE REVIEW

2.1 OVERVIEW

A robot is a mechanical or virtual, artificial agent. A robot is usually an electro-mechanical system, which, by its appearance or movements, conveys a sense that it has intent or agency of its own. The word robot can refer to both physical robots and virtual software agents, but the latter are often referred to as bots [1] [2]. A typical robot must have several, but not all of the following properties:

- Is not 'natural' / has been artificially created.
- Can sense its environment.
- Can manipulate things in its environment.
- Has some degree of intelligence or ability to make choices based on the environment or automatic control / preprogrammed sequence.
- Is programmable.
- Can move with one or more axes of rotation or translation.
- Can make dexterous coordinated movements.
- Appears to have intent or agency (reification, anthropomorphisation or pathetic fallacy [7]).

There is no one definition of robot which satisfies everybody, and many people have written their own. For example, International standard ISO 8373 defines a "robot" as:

"An automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications. [9]"

Joseph Engelberger, a pioneer in industrial robotics, once remarked

"I can't define a robot, but I know one when I see one."[10]"

The Cambridge Online Dictionary defines robot as:

"A machine used to perform jobs automatically, which is controlled by a computer [11]"

Robots are indispensable in many manufacturing industries. The reason is that the cost per hour to operate a robot is a fraction of the cost of the human labor needed to perform the same function. More than this, once programmed, robots repeatedly perform functions with a high accuracy that surpasses that of the most experienced human operator. Human operators are, however, far more versatile. Humans can switch job tasks easily. Robots are built and programmed to be job specific.

Today's most advanced industrial robots will soon become "dinosaurs." Robots are in the infancy stage of their evolution. As robots evolve, they will become more versatile, emulating the human capacity and ability to switch job tasks easily. Robots are good for such tasks because the tasks can be accurately defined and must be performed the same every time, with little need for feedback to control the exact process being performed. Industrial robots can be manufactured in a wide range of sizes and so can handle more tasks requiring heavy lifting than a human could.

They are also useful in environments which are unpleasant or dangerous for humans to work in, for example bomb disposal, and work in space (example Canadarm2) or underwater, in mining, and for the cleaning of toxic waste. Robots are also used for patrolling these toxic areas.

While the personal computer has made an indelible mark on society, the personal robot hasn't made an appearance. Obviously there's more to a personal robot than a personal computer. Robots require a combination of elements to be effective: sophistication of intelligence, movement, mobility, navigation, and purpose.

2.2 GENERAL COMPARISSON

Generally, *Infrared Robotic by Using Microcontroller* is a one small robot with three wheels that avoid obstacles which it senses with its active infrared sensors. Each rear wheel has its own motor that the single front wheel is not powered. Compare to another robot, the same concepts of sensing principle is applied in this project but the different is in location of the infrared sensors where that will be placed horizontal in the rear of the Infrared Robotic robot.

The robot steers "like a tank" by rotating the rear wheels in opposite direction. The sensors are built with infrared LEDs which are running at 36 kHz and two 36 kHz remote control receiver modules. When the 36 kHz infrared light from the LEDs is reflected by an object, one of the receiver modules will be triggered and the PIC16F84 microcontroller will steer the robot away from the objects by reversing one of the motors.

In this project, the robot will be programmed to move backwards as the sensors for obstacles avoidance (pin6 and pin7) which are located at the rear part of the Infrared Robotic robot. A like our eyes, both IR sensors will keep on sensing obstacles while the robot is moving. Infrared transmitter will emit infrared in a straight line. If the

infrared light hits an object, it will reflect and the infrared receiver will detect the infrared light. If this occurs, the robot will take some actions to avoid that obstacle. Since the IR sensor using is a short distance sensor, the maximum sensing distance is limited to 3cm. Any obstacles that appear outside the sensing distance will not be detected.

The rotation speed of the motors is reduced by the "worm-wheel" of the motor axes which drive the cogs of the wheel axes. The circuit behind this robot can be divided in 3 parts:

1) A double motor drive to drive two small electric motors forward/ reverse/ full stop.
2) Two infrared emitters and receivers to sense objects.
3) A "brain" which is a PIC 16F84A microcontroller which will drive the motors in reaction to the sensor readings.

The **Figure 2.1** will show the robot will be avoid when the sensor detecting obstacles in the front. When any of the infrared receivers detects reflected infrared lights, the robot will move in the inverse direction and make a turn avoiding the obstacle.

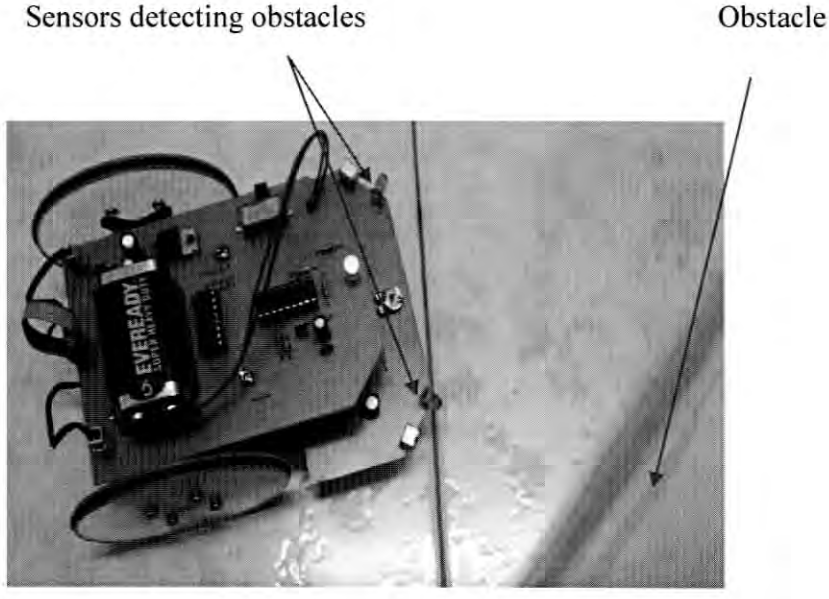


Figure 2.1: Obstacle Avoidance Robot