SYSTEM DETECTION FOR VEHICLE MOVEMENT

MOHAMAD KHAIRUDDIN BIN SAID

INFORMATION COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNOLOGI PETRONAS
DECEMBER 2005

SYSTEM DETECTION FOR VEHICLE MOVEMENT

By

Mohamad Khairuddin Bin Said

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
(Information Communication Technology)

DECEMBER 2005

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

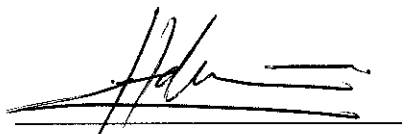
System Detection for Vehicle Movement

By

Mohamad Khairuddin Bin Said

A project dissertation submitted to the
Information Technology Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirements for the
BACHELOR OF TECHNOLOGY (Hons)
(INFORMATION COMMUNICATION TECHNOLOGY)

Approved by,

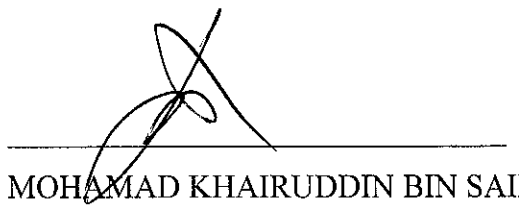


(Mr. Helmi Mohd Rais)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
December 2005

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or person.



MOHAMAD KHAIRUDDIN BIN SAID

ABSTRACT

The main objective for this project is to develop an intelligent robot which can detect an obstacle object that blocking the main road. Besides the system also develop to create one robot system that can follow certain path to be use in moving or transport industries. Then security aspect also has been applied in this project by providing surveillance camera which able to monitor certain activity at one place by transmitting data or image recorded by it to security center.

This research is on artificial intelligence knowledge which related to knowledge and intelligence that has been applied to robot system in order to implement the task which is similar or more human can do. All the task are done using latest technology in order to produce the greatest system that can be use by all sides and give benefit to all.

From the finish product, I hope this robot can be use for the broad purpose and contribute to the big research of robotic development. From my research, Malaysia is still new with robot development, and with that I hope robot industry can become wider.

ACKNOWLEDGEMENT

First and foremost, gratitude goes to Mr. Helmi Mohd Rais, Project Supervisor. Thank you for his constructive comments and guidance throughout the project implementation.

Indebted gratitude goes to all individuals who provide technical assistance in this project development includes Mr Roslan from DataCom Lab, Miss Hawa From EE Lab,Mr Isa from EE Department , Mr. Muhamad Hanis Hashim,Miss Norhafiza Kamarudin and Miss Sharifah Zuraidah for their support and motivation..

Finally, warmest gratitude goes to my family and friends who gave me moral support to accomplish this project. Last but not least, to all those people who assisted me in accomplishing this project.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF PROJECT

In order to implement the human being thinking concept with the idea to help and create one environment that able to generalize big impact over society and modernity, artificial intelligence concept has been applied into robotic development industry. By target that there is enough information provided for the robot to be more powerful and intelligent, it needs to be reprogrammed based on good theory and knowledge that give to the robot, where the idea is more intelligent give to the robot, it will make the robot become more powerful.

System Detection for Vehicle Movement is the topic that has been choosing as my Final Year Project title. This project is about system that being research and planned to be develop to help people that having difficulty during drive the vehicle and to help factory industry that use transport to move their things from one place to another places. Besides that, it will help a security system by providing camera surveillance and act as spy camera by becoming an eye for security department to guide certain area.

Then this system will lead to safer driving mode by providing a sensor that can avoid any obstacle object and follow the right path along the road. The detector system refer to one unit sensor installed to detect obstacle object using infrared signal and two units sensor that can detect the black line with three diameters length on a white surface. It also refer to one video camera that installed on the vehicle or robot body which is

implementing surveillance activities by transmitting any image of recording session to one computer .

The process of understanding the physical part of the robot is important before moving to programming part since the task for designing a robot together with combination of the effective element to improve the intelligence, movement, mobility, navigation, purpose within controlling and monitoring surveillance activities. Basically there are two type of system detection. The first one is obstacle detector and the second one is line follower. The bonus function on this system is surveillance camera. With use of PIC chip that has been coded and programmed with C programming, the robot will able to do both task during moving on the road. Besides, at the same time, the camera surveillance activities still occur where the communication wireless is use for this part.

The obstacle detector will respond to signal that pass by infrared on the LED when it detect obstacle. The signal that received by microcontroller will led to execution program that stored in the server .The server motor will reverse the tires for 3 cm and move right in order to find new way of direction point. The same situation will occur if the infrared still detect an obstacle and it will only stop and move forward when successfully find new direction.

For line follower detector, basically it will respond for any 3 cm diameter of black line on white surface. The infrared use is left and right LED. So, when the left LED detect a black line, it will tell second LED to respond and start to follow the diameters of the black line.

The usage of wireless communication is proof in implementation of camera surveillance communication between programs on computer with the video camera that attach on robot body. Beside, the surveillance activity also occurs in order to achieve

security degree level for monitoring activity. The video will be control by a system that installed in computer by using one program that specially design using Visual Basic 6. All the element and component are being integrated together in order to produce good robotic system where the previous main task before integrated the components is, we need to study and analyze the research that has been done in order to get deep understanding of it. The microcontroller is a main CPU for the robot and can be said act as a brain by keep program and compile it all the time. This show, all the intelligence would lies on robot microcontroller which is famous as highly integrated chip including one or more part need for a controller.

1.2 PROBLEM STATEMENT

Nowadays, new car with high engineering technology made does not provided a good safety protection which is absolutely important for the drivers and passenger. This has been proof by the case where lot of small accident occurs because the vehicle itself fails to detect an object that located either at the back or in front of the car. As example, when driver reverse his car, the possibility for him to hit obstacle object that located in front or behind the car is high. So with no sensor that can detect the obstacle, the car will easily hit the obstacle. This proof that good sensor detection system can help us to avoid from hit the obstacle object.

Many labors and energy use for the task of moving material or things from one location to another location since the labor involved are workers who will bring the goods and the person that will drive the vehicle .This situation actually led to several problems such as high cost and expensive expenses. So by having a robot that can able to move itself from one venue to another venue, the problem face regarding the movement goods activities, are solved where just one worker a need to control the vehicle for moving goods from one place to another place.

By having line follower sensor, the car can go and back from one location by only following the line or road that has been planned. So the vehicle that already installed a sensor will only go along the path and not use wrong path. As we know, the efficiency of work doing by human could be less in some time of working hours by getting tired or bored, but robot will continuously do job with no feeling of tired or bored. Next, one robot could do 10 times human job, thus save cost and labor use.

The surveillance camera that attach on this robot show the current problem that face by people from the perspective of security issues, where it could realize all environment safety monitoring by let the robot move all the way, and one person will monitor any event or activity transmit by the camera video , by using wireless communication with computer server. This authorized person can snap the image that recorded by the camera. One more the cost and labor use could be save and give lot of benefit for the owner of the robot. Before this, one CCTV is put at one place and not able to move 360 degree to record all activities. But using one robot, we can keep an eye of one big area. Let say if one security guard walking around, if any thief come, it will notice the guard and bad things could happen, but the robot have less possibility to be notice by surrounding people. So we also could save one life where have risk to damage the robot if damaged by thief.

The last problem identified is problem of using assembly language to program the robot. Assembly language is first language introduced and use in robot development. However it has limitation with the algorithm, sub module and instruction. First things we must do before use assembly language is to understand how memories work since it will be use and uniquely identified in programming part. Then if any error or bugs occur, we need to have long time before detect the mistake. The period of assemble programming development also longer than time expected just because of its "jumps" and sub modules.

1.3 OBJECTIVES AND SCOPE OF STUDY

- To define accuracy of system detection.

  -The accuracy of the system will be increased so the sensor will able to detect any object in appropriate distance.

- To create system that able to detect obstacle object and avoid accident and hit object during car reverse.

  -The system able to sense obstacle object and avoid from hit it.

- To create system that able to follow black line and be use for any task that involved moving material

  -The robot will follow the setting path and will not use wrong direction

- To implement surveillance activity by give task to robot to become spy agent especially for security purpose

  -The security aspect is improved and can save cost to hire more person as guard

1.4 **RELEVANT OF THE PROJECT**

System Detection for Vehicle Movement, are designed to solve problem regarding failure to sense obstacle object that located behind or in front of the vehicle. The sensor will detect and give signal to microprocessor to execute task to reverse and find new direction.

This system can encourage people to drive more confident without worried about any obstacle object that block their way since they have a sensor that will tell them when it is detect by sensor. The accident case could be minimized at the same time it also can reduce the trauma that face by people who involved in accident.

This product can be marketable and valued product for the good characteristic that attach on it. This system can contributed to business opportunities and are relevant for many industries. This project actually will lead to continuous research on robot industry in Malaysia and create one field of working area where many people will start to do research about robot and will produce lot of useful product.

Sometimes people are love to play intelligent game or robot, so for this statement, we can also apply the system into a game to children where it is more on skill of controlling by children , similar to car control but with more advanced technology and advanced exploration for gaming issue.

Finally, the enhancement on security issue where the use of surveillance camera can give benefit to all side by monitoring big area of certain places but at the same time can save the cost and human energy.

1.5 BENEFITS OF SYSTEM

System Detection for Vehicle Movement gives various benefits that suit for multipurpose application. It is unique system compare to other system detection since it created to detect and sense the obstacle and follow black. It also able to view any activities occurs during the robot movement and act as spy camera for surveillance activity.

The accuracy detection also increases to enable the sensor to detect the object at the good distance. When the sensor detects an object, robot will stop and move to other way. It means that the vehicle have the ability to move through the circuit even meet the blocking point by choose other direction. Some term showed the uniqueness of this system as below:

- Multipurpose -Can use for many ways
- PIC Chip -Multipurpose chip that have various usage
- Accuracy -Good and accurate system
- Monitoring -Interact with screen to show activities occur.

1.6 FEASIBILITY OF THE PROJECT WITHIN SCOPE AND TIME FRAME

With 4 months of time development given, lack of equipment and facilities such as software and hardware, beside have to study new thing to build the robot are major limitation face by me. Some integration of hardware and software need to be done to build this robot since all the tools available at Electrical Lab and the process to get the facilities is quite difficult since different department and less experience working with EE lab.

All tools available are located at EE Building and be used throughout the project. Actual times are needed to develop the completed robot a more longer than given but with time have, I will try to do the best and complete as lot as I could. More time will be needed to program a more functional robot that line follower and obstacle avoidance,

Using available tools and source that found in library and outside after doing research make the project seem feasible to done. Research and studies are done in the early of phase development. All the research done by other people are study and tools that need to use have to be learned. Same with EE component, I also have to study and understanding how it working.

CHAPTER TWO

LITERATURE REVIEW

2.1 ROBOTIC AND TECHNOLOGIES

Robot is an agent that has intelligent embedded inside its own memory or physical, which is led robot to do any task or job without human assist, either manually or automatically. As stated in Dictionary.LlaborLawTalk.Com, " In practical usage, a robot is a mechanical device which performs automated tasks, either according to direct human supervision, a pre-defined program or, a set of general guidelines, using artificial intelligence techniques. These tasks either replace or enhance human work, such as in manufacturing, construction or manipulation of heavy or hazardous materials". This show and proof that robot is an intelligent technology that can do multiple task and job following the surrounding environment.

Robot can understand and follow any instruction or command that instruct it to do the action as required, such as helping human in doing the hard and difficult work .However to produce robot, we need to do lot of works with high level skills and research. Robot only can work with combination of software, hardware and mechanical system together.

A robot may include a feedback-driven connection between sense and action, not under direct human control. The action may take the form of electro-magnetic motors or actuators (also called effectors) that move an arm, open and close grips, or propel the robot. The step by step control and feedback is provided by a computer program run on either an external or embedded computer or a microcontroller. By this definition, a robot may include nearly all automated devices.

Two basic ways of using effectors are to move the robot around (locomotion) or to move other object around (manipulation). These divide robotics into two mostly separate categories: mobile robotics (moving) and manipulator robotics (grabbing). Joints connect parts of manipulators.

A parallel robot is one whose arms (primary axes) have three concurrent prismatic joints or both prismatic and rotary joints. Degrees Of Freedom (DOF) means axes of movement. The human arm has 7 DOF. A 6 DOF is highly flexible. Proprioceptive sensors sense the robot's actuators (e.g., shaft encoders, joint angle sensors). Proprioception is one of the most important senses of the human body.

Alternately, robot has been used as the general term for a mechanical man, or an automaton resembling an animal, either real or imaginary. It has come to be applied to many machines which directly replace a human or animal in work or play. In this way, a robot can be seen as a form of biomimicry. Lack of anthropomorphism is perhaps what makes us reluctant to refer to the highly complex modern washer-dryer as a robot.

However, in modern understanding, the term implies a degree of autonomy that would exclude many automatic machine tools from being called robots. It is the search for ever more highly autonomous robots which is the major focus of robotics research and which drives much work in artificial intelligence.

Though we tend to think of robots as tremendously sophisticated, thanks typically to their anthropomorphic physical design and our excess of indoctrination to the robots of 1960s television, the fundamental elements are very simple. Motion is achieved by motors controlled by digital circuits that incorporate a key power semiconductor switching element called a thyristor or silicon-controlled rectifier (SCR). The robot

turns when only one of two parallel motors is actuated: for example, stopping the left motor while running the right motor causes the dummy to turn left.

Digital signals fed to the motor control circuitry determine which motors move at which times. The problem can range from very simple (e.g., turning left or right) to very complex (e.g., controlling an elbow and wrist to move an item from a conveyor belt to a shelf). The signals can be sent by an outside element (e.g., a human operator) or by internal circuitry that makes "decisions" based upon observations of the robot's environment and may alter these decisions based upon whether the motion is preceding satisfactorily.

Underlying simplicities notwithstanding, combinations of various computer systems and electromechanical subsystems can produce the appearance of profound sophistication, e.g., a "chess-playing robot" that really should be viewed as two discrete systems: (1) chess-playing software that has nothing to do with robotics; and (2) a robot that interacts with the chess board. The latter requires the abilities to [a] locate a chessman on the board based upon its expected coordinates, [b] lift the man, [c] remove any captured man from the board, and [d] reposition the first man--all without breaking or knocking down chess pieces or committing other environmental faux pas.

A research Perspective by RJ Green and IB Bahrain (1993) [8] " A robot is a general purpose machine system that , is an analogous way to a human can perform a variety of different task under condition which may not be known I advance".

Another statement by Chairman of Board Kyungchul Shin, Korea Association of Robotics in http://www.robotics.or.kr/english/company_info/01.htm, says that KAR(Korea Association of Robotics) with the objective of an industrial growth and a

development of Robot and Robot-related industries by solving technical problems through sharing information lively in close cooperation one another, was established on June 29, 1999 and started its business officially on November 3, 1999 after it was authorized by the Ministry of Science and Technology. Robotics has been a critical field in the Mechatronics and Electronics, and recently has been the most important industry in the knowledge-based industries harmonizing with Information Technology.

Most of the countries have confirmed the possibility and the effect of Robot Technology, and above all, developed countries like United States and Japan that lead Robot Technology, don't hesitate to support Robot Industry as an enterprise of national importance. Recently, Industries place more weight on Robot Technology rapidly recognizing the importance of Robot Technology to enforce national power, and there are many active experiments of Robot for the high degree application. KAR will put every effort to make the Robot Industry a key national industry with international competitiveness by leading development of advanced intelligent robot and localization of capital goods infrastructure with our members, professors, government and allied organizations.

One of key development trends in the growth of IT In Malaysia was the rise of robot technologies which integrated with latest knowledge in Mechatronics and electronic study. However, many phases of development module and experiment type need to do from time to time in order to ensure that the product created are at the best level so we can use the robot not only for special purpose but with wider area of scope. As example, the vehicle with system detection will help human to increase the accuracy of sensor remote system and avoid accident or prevent car from hit blocking object.

2.2 ROBOTICS IN INDUSTRIES

Su, Chao-Ton, C Alec Chang, and Fang-Chih Tien. (November 1995). Neural networks for precise measurement in computer vision systems. Computers and Robotics in Industry. 27(3): 225-236.

Although both systems have been successfully applied to some inspection tasks, they are generally not considered as precise measurement tools due to dimensional distortion and errors. A procedure is presented to correct these errors for precise measurement. The first step is to formulate calibration models for image coordinate systems using neural networks. Then neural networks to model dimensional errors from the initial measurement are structured in a learning stage using standard parts. Finally, these models are used to correct measurement errors in measurement tasks. These proposed procedures are implemented as an example.

We need robot in industries since it has been proof that robot could manage to do the difficult work that cannot do or hard to do by human. In other word, robot has capability to do 7 times task more than human in the same time. For robot which can move or have arm installed on it, the possibility to do task perform by human is higher.

A statement by US Food and Drug Administration (FDA)-approved robotic arm that covered a review of literature during the last ten years, beginning in 1987 and ending in October 1997 state that "The robotic device consists of two main parts: the computer controller and the positioned of arm. The computer chassis weighs approximately 140 pounds, requires its own cart, and is connected by cable to the positioner. The positioner attaches directly to the machine, weighs approximately 40 pounds, has 14 inches of vertical movement with a 27-inch reach, has a maximum speed of three inches per second, and can both store and retrieve two separate machine processing fields of view.

The robotic arm has been used in multiple machine control procedures, including machine repair, packaging, and production and processing.

As the project focus on system detection, The vehicle will help industries in provide good accuracy detection to prevent accident during working in factory. The material or any product can be transfer using vehicle that can be controlled by one staff. After that, the vehicle will be able to detect which way it must use in order to transfer the material from one place to another place.

Like in Proton factory and Matshusita also, they use vehicle that installed with system detection to do work such as transfer spare part or car accessories from one department to other department. As we know, the car component is heavy and just can be transfer by more humans. However, one vehicle can move the component. For other work procedure, they also use Robotic with Arm to do installation of car components. This proof on how robot can help industries.

Manufacturing field use robots in their industries to assist various section of department on different job task such as combine the heavy part of car component. The interrelationship between human and robot can be said as having same consistent high level of output, power, and quality and cannot be achieved with human and simple mechanism. In other word, if the labor eliminated, a strong case can still made for automating with robot and other flexible automation

2.3 ROBOTIC INDUSTRY IN JAPAN DEVELOPMENT

Japanese manufacturing firms have been quick to adapt computers, artificial sensors, and automatic control processes for industry. Though initially they contributed little to

modern control theory, artificial intelligence, neural nets, and so forth, at the theoretical level, they were eager to understand from the Western literature that these ideas could be adapted to manufacturing. The Japanese were among the first to move forward in "Mechatronics," wherein computer chips and electromagnetic sensors and actuators are closely integrated with precision machinery.

Japan had academic departments and subjects of instruction in Mechatronics in its technical universities before the United States did. All the evidence the JTEC team saw indicates that Japan is continuing this preeminence in the application of computers to manufacturing and other industrial applications.

Robotics is a special and very important type of human-computer interaction -- an interaction that involves not only the computer but also mechanical actuators and sensors. Japan is in love with robots. From the beginning, Japan has sought to apply robots to industrial and other tasks. Japan seems to have as many robot exhibitions, conferences, and articles in popular magazines and newspapers, video programs, and so forth, as the United States; on a per-capita basis, Japan has many more.

MITI's Mechanical Engineering and Electrotechnical Labs in Tsukuba industrial city have had ongoing robot research for many years. What the Japanese seem to call basic research is really engineering development of devices for walking, climbing walls, and manipulating at smaller and smaller scale, for example. Their robot research is very device-oriented.

2.4 TYPES OF ROBOTS

It is important to distinguish between industrial robots, service robots, telerobots, and medical robots. An industrial robot is a machine that can be programmed to perform a well-defined task with high autonomy in a carefully controlled environment on a repeated basis. It usually is installed in a factory on a production line.

A service robot, by contrast, is a device programmed or controlled more or less continuously by a human to perform what is usually a continually changing, not repeatable, task in a minimally controlled and unpredictable environment. Examples are robots used for cleaning windows and floors of buildings, placing and retrieving packages in warehouses, and delivering mail.

A telerobots is a subclass of service robot that operates in an environment remote from the human operator and typically hazardous to humans. Examples are telerobotic manipulators on space vehicles, planetary rovers, deep ocean exploration vehicles and manipulators, and similar devices for operating inside radioactive or chemically toxic environments.

2.4.1 Industrial robots

Japan initially bought and installed U.S. (e.g., Unimate, Cincinnati Milacron) and European (e.g., ASEA) industrial robots for welding, paint spraying, and simple assembly operations. The Japanese quickly learned how to make their own, and in many cases bought the U.S. and European robot companies. Today, Japan appears to be the largest user of industrial robots. When queried about the attitude of the production workers toward the use of robots, Japanese managers are quick to point out the differences between Japanese and U.S. workers.

In Japan, the company has obligations to the worker for life, and the workers have a great deal of influence over how the robots are used. Furthermore, the workers are not ignorant of the mathematics and engineering of how the robots work and how to program them; Japanese workers have better technical education than their U.S. counterparts. Finally, robots are much more accepted in Japanese culture than in the United States.

2.4.2 Service Robots

Japan seems to be developing service robots at about the same pace as is the United States, but presumably because the robots require continual human reprogramming and keyboard communication is difficult for the Japanese, one is not so likely to see the same number of computer graphic interfaces for robots. Further, because the U.S. space program and undersea robotic activities got a head start, the United States is somewhat ahead in these areas.

The Japanese, however, now have an active space robotics program, originally intended to operate from a special Japanese module on the U.S. Space Station Freedom; under current political circumstances, the module may be slated to be launched by Japanese boosters several years later than the original schedule. The future of Japanese space robotics is not currently clear, primarily because the U.S. program is unreliable.

2.4.3 Medical robots

Endoscopic surgery (e.g., laparoscopic removal of gall bladders, arthroscopic repair of knee and shoulder joints, colonoscopy removal of polyps, and neurosurgical removal of brain tumors) has much in common with telerobotic, as does use of programmed robots

for orthopedic machining of bone during hip replacements. Robotic ideas have been used since the 1960s in designing prosthetic arms and legs and powered orthoses (braces fitted around existing but nonfunctioning limbs). In combination, these latter three have become a new class called medical robots.

Only the industrial robots tend to operate autonomously for significant periods of time. All the others tend to be intimately coupled to human operators. The degree of sophistication of the computer involvement can range from the simplest functions of reading shaft encoders or providing simple feedback control, through matrix inversion as part of kinematics transformations, to the most exotic AI or neural net operations for perception, decision making, or learning.

As part of the JTEC survey, the writer attended the International Workshop on Biorobotics and Human-Robot Symbiosis at Tsukuba on May 18-19, 1995. Papers were presented on service robots, telerobots, and medical robots. The Japanese have made extensive contributions to robot conferences internationally for many years, particularly in clever sensor and device design. Therefore what were not surprising at this conference were the continuing Japanese reports on projects to build robot devices that are smaller and smarter. What was more interesting was the great variety of Japanese papers on robots and related subjects: robots to assist the elderly, social robots, robots that "mimic gentle animal-like action," the Bridgestone (tire company) "soft arm" robot, a code of conduct for human-robot coexistence, artificial will, and the like all demonstrating a keen interest in creating soft, gentle, flexible, adaptable interaction between robots and humans. This seemed to echo the emphasis that the JTEC panel saw in Japanese developments in human-computer interaction.

2.5 EXAMPLES OF ROBOTIC USING SYSTEM DETECTION

The objective of the Robotic using system detection is to research and develop intelligent, flexible robotics. The goal is to enhance productivity and flexibility especially in the applications, which are harmful and monotonous to humans and which cannot be robotized so far. The ultimate goal is to develop systems capable of producing lot size one in cost-effective way. The Robotic using system detection is co-operating with system developers and end-users to gain synergy and knowledge on both technology and applications which leads to the best possible solutions.

2.5.1 Competencies

2.5.1.1 Interactive robotics

Using the on-line sensor feedback during the path execution, robot system becomes more flexible and robust. This enables also applications requiring e.g. force control or precise positioning. Interactive technologies enable managing and monitoring of the robot on-site or remotely e.g. using internet.

- Force–controlled industrial robot
- Rapid and safe use of robots
- Holonic manufacturing systems
- Coordinated control of heavy manipulators

2.5.1.2 Off-line programming

Using off-line programming, production capacity increases because robot is not frequently reserved for the manual teaching. Many new applications especially

treatment of complex surfaces requires off-line programming and path optimization to achieve quality requirements.

- Optimization of robot movement
- 5 axis machining of sand moulds

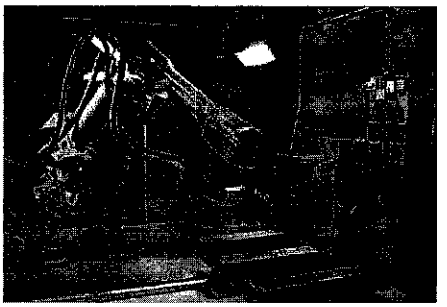


Figure 1: Interactive Robotics

Figure 2: Off-Line programming

2.5.1.3 Measurement Modeling and spatial estimation

Off-line programming and applications with high accuracy requirements need calibration of robot and work cell. Spatial models enable planning of optimal measurements and robot movements using accuracy as an optimization criterion.

- Sensing planning of calibration

- Estimation of accuracy of the robot

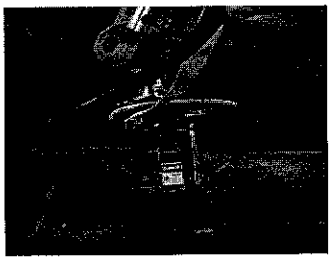


Figure 3: Measurement Modeling and spatial estimation

2.6 ROBOT APPLICATIONS

Building new robot applications successfully requires knowledge on both robot technology and the technology involved in the application itself. The team has long term experience on robotics and several application technologies.

- Robotic debarring, grinding, cleaning and polishing
- Robotic machining
- 3D Measurement]

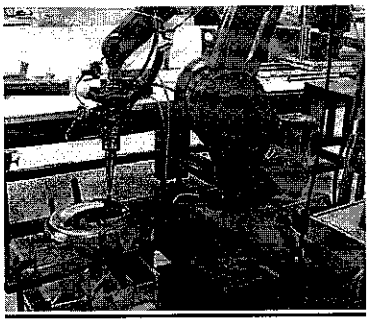
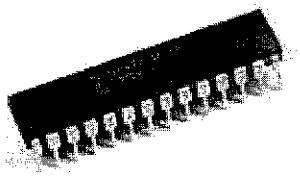


Figure 4: Robotic Application

2.7 MICROELECTRONICS, MICROCONTROLLERS AND TECHNOLOGY PROGRAMMING



2.7.1 Chips in Use

Many of the chips that will be use will have 18 pins. Some of these include the PIC16C52. PIC16C54, PIC16C58, and PIC16F84 (see *Figure 1.1).* Incidentally, the PIC16F84 contains an Electrically Erasable and Programmable Read Only Memory (EEPROM) that can be changed without UV erasure. This allows for the "program on the fly" approach and is a feature that we will learn to love.

Examples of 28-pin PICMICRO® MCUs are the PIC16C56. PIC16C57, PIC16C62, PIC16C72, PIC16C76, and PIC14COOO. This last one is used extensively in battery charging and maintaining. The PIC12C508 is an 8-pin device, while the PIC16C505 has 14 pins. The PIC16C64. PIC16C74, PIC16F874, and PIC17C44 are all 40-pin.

This section will cover the basics regarding the struc-ire used in the PICMICRO® MCU line. In the computer jalm, they like to call this the "architecture," but what will be literature is the style of construction employed.

As have been expecting, there have been a multitude of ap-roaches used over the years. However, the Microchip election is one that has a proven record.

2.7.2 Reduced Instruction Set Computing

As has been previously pointed out, the PICMICRO® ICUs use 35 instructions to perform their magic. Trust le, this is a small number of instructions as compared to any other microprocessor types. As the microprocessor devices, with the PIC16C923 using 64 pins. The PIC17C752 and PIC17C756 are 68-pin chips and the PIC17C162 and PIC17C766 have 84 contacts.

So, that gives a small picture of the Microchip line of PIC®microcontrollers. Each of the above ICs has its own features and characteristics, but that is part of what makes using fun. Now, this part wills literature about the structure or architecture of these devices.

2.8 INTELLIGENCE IN ROBOTICS APPLICATIONS

As robotic are close and like human, it need an intelligent system just like human already have. A journal by Green B.J. and Bahrain I. B. [8] stated that "An intelligent robotics system consists of a mechanism for acting on and within the environment in which it operates."

An intelligent computer system can go a long way in reducing human labor. But if such a system can be provided with a method of actually interacting with the physical world, its usefulness is greatly increased. Robotics gives the means to exhibit real-world intelligence by directly manipulating their environment. That is, robotics gives the artificial mind a body.

An essential component of robotics has to do with sensory systems in general, and vision in particular. While it is true that robotics systems exist (including many successful industrial robots) that have no sensory equipment (or very limited sensors) they tend to be very brittle systems. They need to have their work area perfectly lit, with no shadows or mess. They must have the parts needed in precisely the right position and orientation, and if they are moved to a new location, they may require hours of recalibration.

If a system could be developed that could make sense out of a visual scene it would greatly enhance the potential for robotics applications. It is therefore not surprising that the study of artificial vision and robotics go hand-in-hand. The one proof that robotic is intelligent is it can interpret the environment into what kind of actions it need to do. Therefore Green B.J. and Baharin I. B. [8] stated that " Robot comprises several subsystems, namely: a sensor system, which capable of obtaining knowledge about the state of the mechanism and the environment, a controller and drivers, to guide the mechanism and the sensors in a desired manner, and a planning and control system that decides on the actions and sensing in the environment. A smart or intelligent robot should be able to think, sense, move, and manipulate material, parts, tools or specialized devices through variable programmed motion for the performance of variety of tasks." These had shown a very good overview on intelligence implemented in robotics.

CHAPTER 3
METHODOLOGY

3.1 PROJECT IDENTIFICATION

For my project, I have used a methodology to develop this system, known as the Waterfall model. This methodology model called Waterfall model because of cascading effect from one phase to another phase. The effect cascading is shown as in Figure 3.1. In this model, each phase is well defined at the starting and ending point, with identifiable deliveries to the next phase. There are four phases involved in this model such as:

1. Requirement definition,
2. System and software design
3. Implementation and unit testing
4. System testing.

For the first phase, which is named as requirement definition phase, I have study and analyze on the problem statement. After the problem was identified. I conduct a research to help me in decision making. This work has being done in order to define the problem statement. With enough information, the problem statement defines.

Next, the statement for previous problem will solve when the objective of the project is defined. Another research will be conduct again to identify the requirement that will be needs for the system development. The requirement for all hardware and software type will be listed and jot down in order to start purchase and search session. Then, the software that could suit with hardware use will be decided for purchase or usage

purpose. All these two types of hardware and software will be use to satisfy the objective during system development

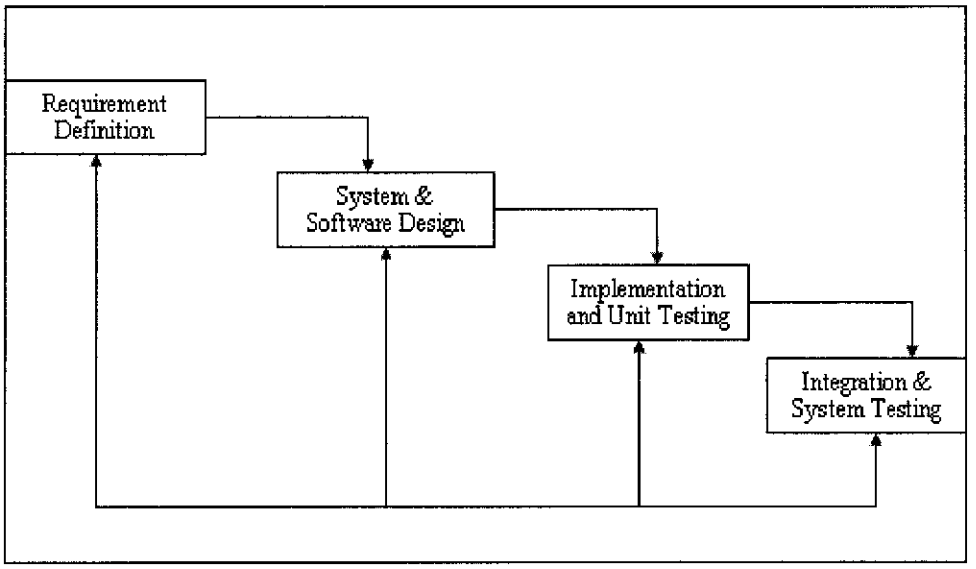


Figure 3.1: Waterfall Model

For the second phase, system and software design phase, all component of robot/car control will be assembling. Next, I will conduct a research to study on their algorithm of the software .This research are very important since the module that need during system development, will be identify by all possible algorithm. Another important thing is, the body of the robot should be assembled in this phase before I move to next level. The mini camera also will be installed on car component and tested either work or not.

Next schedule is programming part. After the coding finish, it will be compiled into PIC controller and burned into Microcontroller. The third phase is related to video installation. The process of install the video on vehicle and setting the port that need to be use for communicate with the vehicle using wireless technology are something new that need to be learn. All the software and hardware needed are provided by the

Electrical and Electronics Department of University Technologies PETRONAS. All the thing need to do is make new research and learn how to use them.

Then, in implementation and unit testing phase, the process of testing and checking all component that assembled in previous phase are done to ensure whether they are working or not . After each testing process done and complete, each module that was laid out to build this system were programmed and tested individually .These purpose of individually tested are to ensure that it each module is working and to avoid any major errors.

During this phase, all the modules will be combining together in order to perform the algorithm which is has been laid out in phase two. All algorithms such as object detection, camera viewing and color detection with object avoidance are combining together. After that, the system will through testing phase and check for any bugs and error. If any errors occurred, bugs needed to be identified and corrected.

As the conclusion, by help from Mr. Roslan and Miss Hawa, two technicians that expertise in networking and electrical field and also the availability tools in the university would make this project feasible in this four months period .Even UTP give Internet access to student, but all of it do not give any benefit since we just get the connection but not the accessibility. For future generation of final year project, I hope that same thing would not happen so they could do their project with no difficulties. However, thank to Allah since UTP has a good library where all the research and materials can be find in the library and there are many sources of these research materials available.

3.2 TOOLS REQUIRED

The hardware and software required to build the system are as below:

3.2.1 Hardware

- Pliers
- Multimeter
- Solders
- Glues
- Plastics
- Screwdrivers
- Scissors
- Car control
- Mini Video camera
- Warp 13A Burner (use to burn the compiled program into PIC chip)
- PIC Chip
- EE Lab facilities

3.1.2 Software

- Microsoft Office 2003
- Microsoft Project
- PIC C Compiler
- Microsoft Visual Studio
- Warp 13 A Programmer Software

CHAPTER 4:

RESULTS AND DISCUSSIONS

In this chapter, the focus is on discussion on the result and discussion based on the observation and analysis done to the robot. First part of this chapter will include about robot components and structure while second part is about the robot brain, which is PIC16F876 microcontroller. Lastly, the third part will be the robot's sub modules and lastly is about the robot algorithm.

4.1 ROBOT COMPONENTS AND STRUCTURE

4.1.1 Assembling Components

To build on complete robot body, we need to know what things and material that needs to be use and how to do the assembling. To build a robot body, first thing that needs to consider are board circuit and component material that made from good quality material to have the strong body. Then the components from the robot has been bought and collected separately. Then the components for the robot will be soldered to connect the wire between certain parts to another part in board circuit diagram.

Then the design that has been analyzed for the circuit movement and understanding are solder onto the PCB .After that, the design that has been soldered will be tested using multimeter in order to guarantee that all the connection between each components are correct and to avoid short-circuit. Figure 4.1 to Figure 4.6 is the image of the robot that has been assembled together with all components.

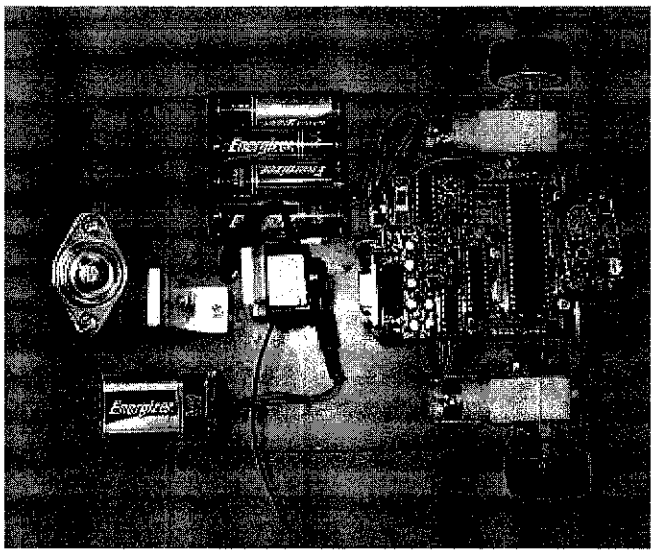


Figure 4.1: Bird View

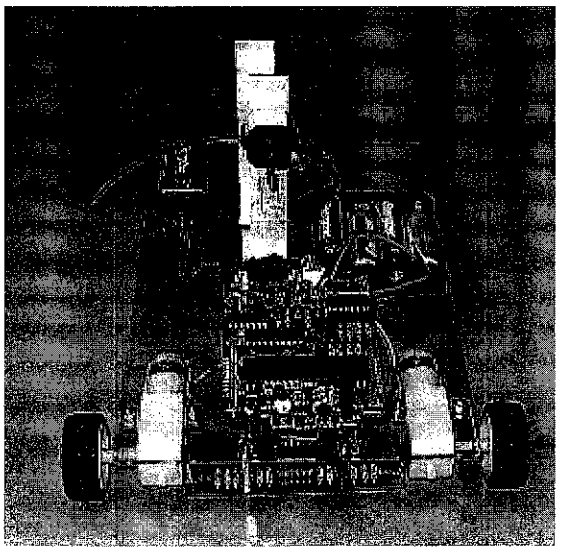


Figure 4.2: Front View

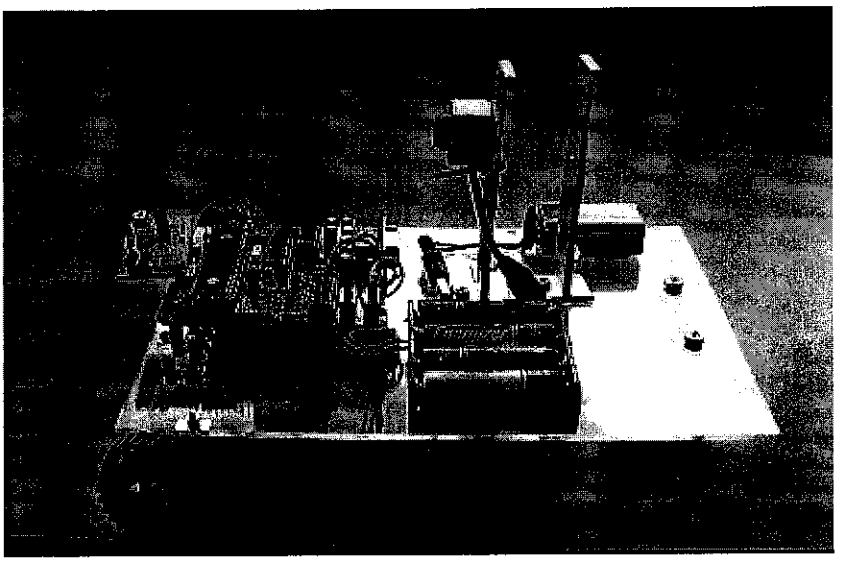


Figure 4.3: Left View

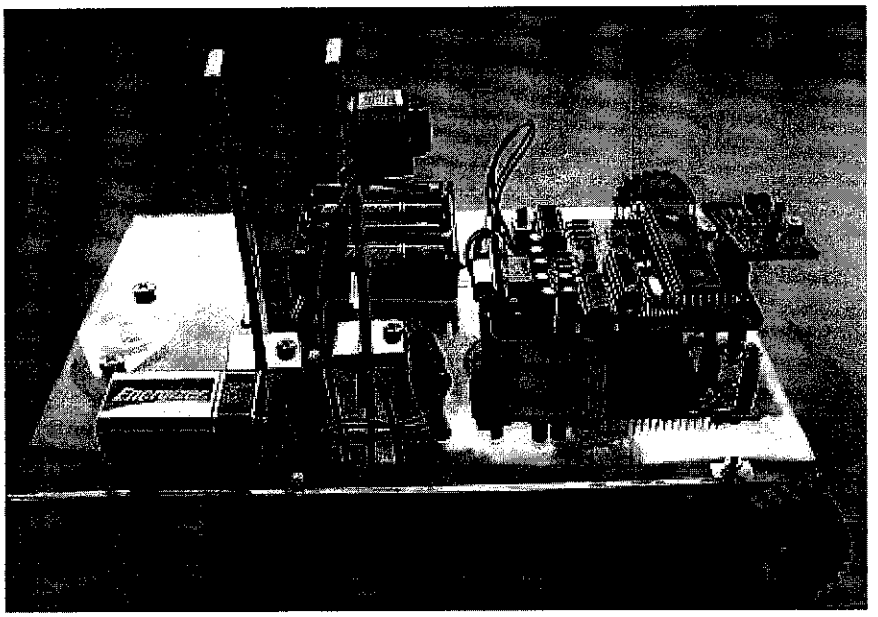


Figure 4.4: Right View

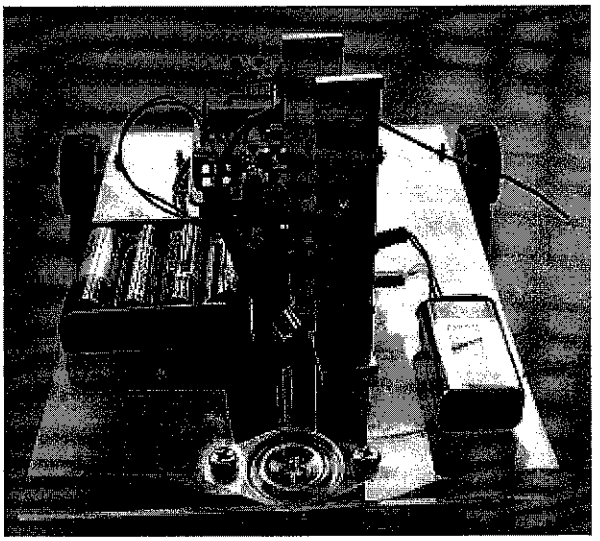


Figure 4.5: Back View

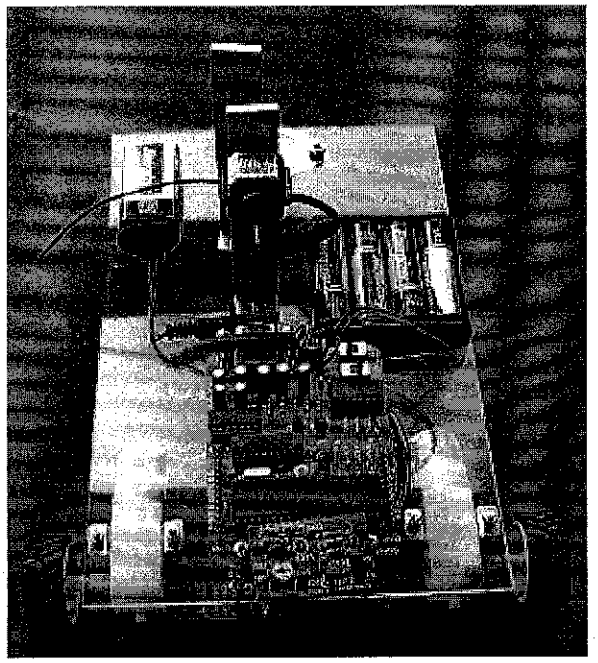


Figure 4.6: Full View

When all testing part finish, PCB now will connected to robot body by using two supporters. Then, the PCB was connected to the robot body with two supporters. Steps

on building are robot as in Figure 4.7 has been analyzed and implement in phase by phase development. For the list of components that use in this project, it is attach and listed in the Appendices. Then, the image below show the robot before it is assembled with components.

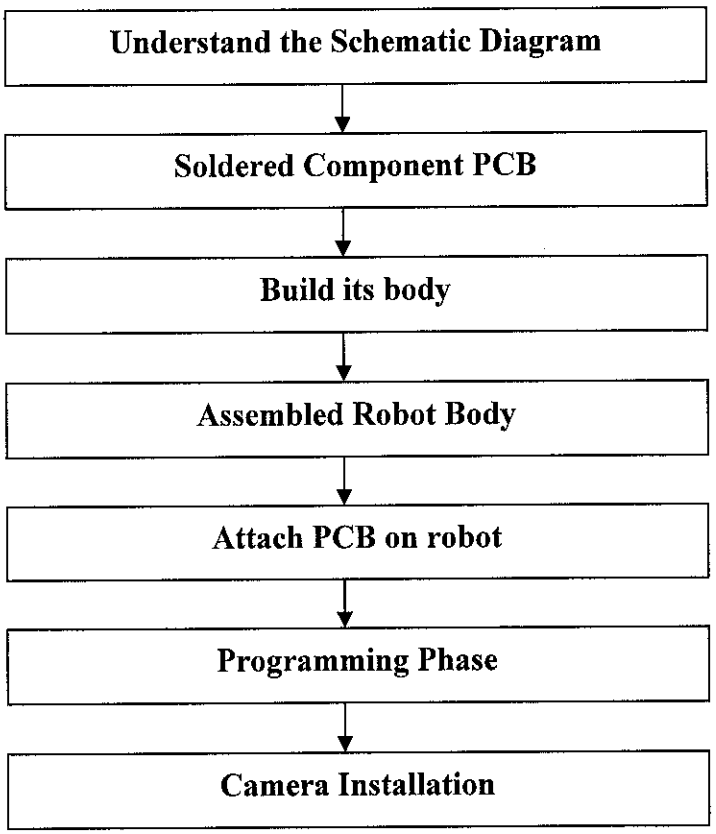


Figure 4.7: Steps on building the robot body

Before soldering all electronic device and components onto Printed Circuit Board (PCB), we must first need to be design and all the connection on the PCB will be printed out. Then after that only the component and electronic device can be soldered onto PCB .The main function for PCB is being a motherboard for this robot body and its functioning is to hold the PIC16F876. There are two switches use on robot which can be use the mode of the robot, first is to detect obstacle with reverse system and to detect

the road which is made of line that distinguish black and white color. The soldered components on the PCB are shown in Figure 4.8.

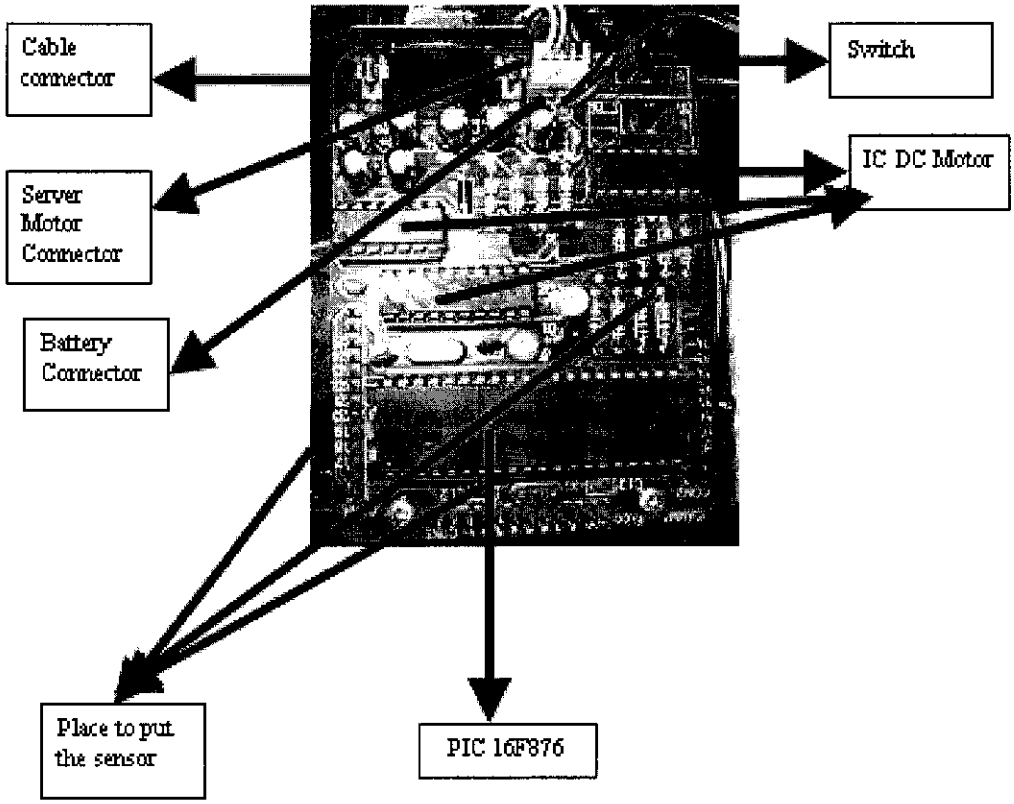


Figure 4.8: The soldered component

4.1.2 Robot Structure

The body of the robot is made of from plastic frame material that is specially developed to be use as platform for placing the board circuit. Then the robot body has two tires attached on left and right side, follow by one single moveable tire at the back .The front tires are controlled by server motor and accept and instruction from microcontroller to do movement such as go forward and backward.

Then the single tire at the back is use to make the robot easy to reverse when it detect an obstacle object. At the middle of the plastic frame, is the location for the mother board. Next to it are place for battery box position. After that at the back near the single tire, there will be position for video camera to be installed on robot body. The glue will be use to attach the robot with certain component that cannot be use since no drill done to put the screw on it. The purpose of use plastic and paper is to make the weight is less so it could move accurately. In Table 4.1 below, we can see the specification of the robot

Width	**8.5cm**
Length	**13 cm**
Height	**10.5cm**
Material	**Plastic**

Table 4.1: Specification of the structure

4.2 MICROCONTROLLER

Microcontroller is one component that can be able to upload, store and run program in a single chip computer. Being produced by Microchip with interesting characteristic, microcontroller can be use for many types of electrical applications.

It has few advantages and benefit for use it such as the cost of microcontroller is cheap, and easy to programmed and be use with good function of capable to store and run program. However there are various types of microcontroller and each type has its own functionality.

PIC16F876 is used for this project just because of some function such as:

- PIC16F876 Path Width Modulator (PWM) which can use to control the speed of the tires.

- PIC16F876 able to convert analog input from Infrared to digital values since it has functionality and attach with analog to digital (ADC) converter.

- There are three types of input and output ports available in PIC16F876 and this will be sufficient to build a desired robot system. Figure 4.9 illustrates the PIC16F876 along with the port name.

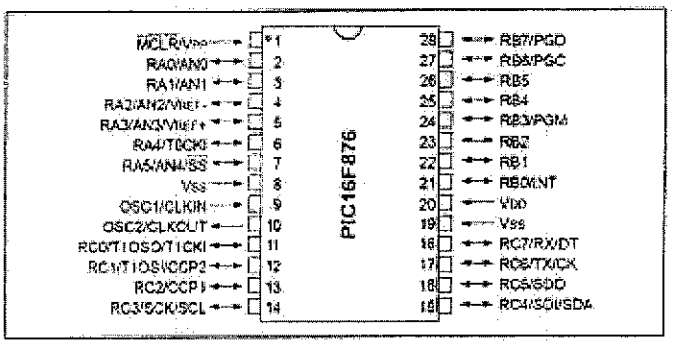


Figure 4.9 PIC16F876

4.2.1 C Programming

C programming is language that only can be use with the microcontroller. C is a high programming language and is easier to learn and use to program this microcontroller. There are many advantages using C such as:

- In C programming, no requirement is needed to program each memory allocation.
- C programming contain header file (16F876.h) which able to hide all those underlying microcontroller hardware details.
- C programming is easier to debug and to be use.

4.2.2 Programming The PIC16F876 Microcontroller

By using C Compiler, C programming code will be write down and testing either success or not. The reason of using C Compiler is it has certain built in functionality which is important to be use in order to load the programming into PIC. Each code line will be compiled to check if there is any error and make easy to be modified.

Once no error and program debug succeed, a hex file will be created. After that, WarplSA software and WarplSA Burner is being use to burned the previous hex file into PIC. Figure 4.2 shows the flow chart on how to program a microcontroller.

The other things is the code can be compiled using cable connected by PCB to computer , this method is more easier since the code can be compiled into PIC directly without need to take it out and burn many times.

For each pin use it will be connected with a component. Schematic diagram is very important before building the system. Good programming skills and result are produce from good understanding about schematic program.

During write the programming code, by refer to schematic diagram, each pin is defined from the schematic then we can know what value will on or off each component. For example, either a high value will lights up the LED or will off the LED.

4.2.3 WARP 13A PIC Programmer

The file that has been converting into hex file will be burned using this software into PIC. To program it, Warp 13A burner is use as shown in Figure 4.10. The PIC16F876 will be placed at the PIC slot and the hex file will be transferred into the PIC by using the Warp ISA PIC Programmer Software.

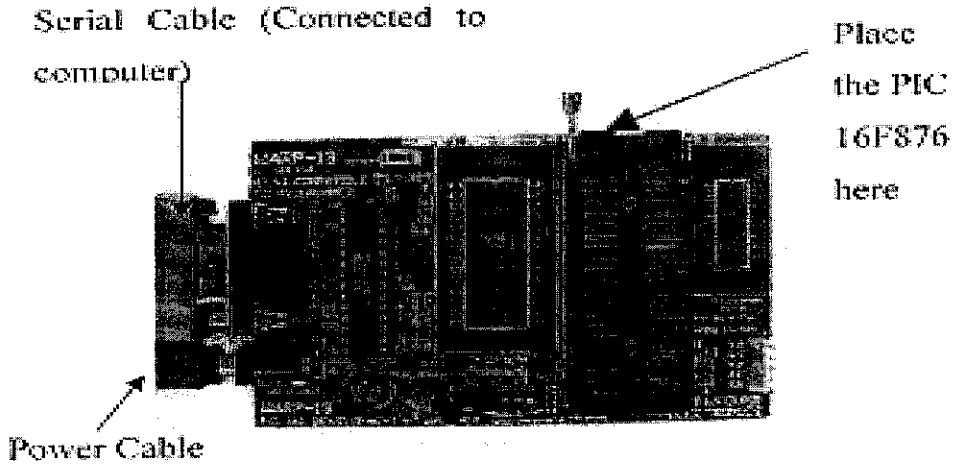


Figure 4.10: WARP 13A PIC Programmer

4.2.4 Microcontroller Pin Mapping

The program will depend on which pin is out and input By identify what components that connected to it, we can mapping listed output all the pins connection between PIC16F876 Microcontroller and its components.

To mapping the pins connection, we need to check back schematic diagram of microcontroller connections. The algorithm of the program and the status of each port can be decided by using mapping. So, the result is each components connected to each pin will function accordingly to the program given.

Table 4.2 shows the mapping for each pin with the port name and some descriptions on what does it means.

Pin	Pin Name	Connect to	Descriptions
1	*MCLR*	*MCLR*	Master Clear (Reset) input or programming voltage input. This pin is an active low RESET to the device.
2	RAO	Left AD	Connected to Analog to Digital Converter, where the analog
3	RA1	Center AD	Left, center, right and front will be digitized to binary value. This will then use to help
4	RA2	Right AD	the robot make decisions.
5	RA3	Front AD	
6	RA4	Buzzer	This will on/off the buzzer.
7	RA5	-	
8	Vss	Vss	Ground reference for logic and I/O pins.
9	OSC1/ CLKIN	OSC1	Oscillator crystal input/external clock source input.
10	OSC2/ CLKOUT	OSC2	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode.

11	RCO	RMIn2	This is connected to the right motor.
12	RC1	RMInl	This connects to right motor but have the function of PWM2 output. PWM will control the speed of the motor.
13	RC2	LMIn 1	This connects to right motor but have the function of PWM 1 output.
14	RC3	LMIn2	This is connected to the left motor.
15	RC4	Front LED	This connected to the front LED.
16	RC5	Right LED	This connected to the right LED.
17	RC6	Center LED	This connected to the center LED.
18	RC7	Left LED	This connected to the left LED.
19	Vss	Vss	Ground reference for logic and I/O pins.
20	Vdd	Vdd	Positive supply for logic and I/O pins.
21	RBO	Switch SI	Connected to slide switch.
22	RB1	J Switch	Connected to the jumper switch.
23	RB2	Front IR	Connected to front Infrared
24	RB3	Right IR	Connected to right Infrared
25	RB4	Center IR	Connected to center Infrared
26	RB5	LeftIR	Connected to left Infrared
27	RB6	PGC	Interrupt-on-change pin or In-Circuit Debugger pin. Serial programming clock.
28	RB7	PGD	Interrupt-on-change pin or In-Circuit Debugger pin. Serial programming data.

Table 4.2: Robot Microcontroller Pin Mapping

4.3 ROBOT SUBMODULES

4.3.1 Server Motor Attach With Tire

PIC chip that being use in this project has led it to being an inexpensive "smart chip" speed controller for server motors because PIC is high speed, low cost, and low power requirements that had led. The method use in the robot to control the speed of DC Motors is known as Server Motor. The amount of power that been supplied will determine the turning speed of Server motor. The voltage given to the Server Motor need to be varies in order to control the amount of power. With this method, it will turn the motor on and off quickly, with a fixed amount of voltage supplied. The amount of voltage supplied can be determined in percentage.

The compares of using different source power of voltage are shown in Figure 4.11 and Figure 4.12 by showing the example of providing full voltage and 50% voltage to the motor. Full voltage that supplied for both motors will give a full power to the tires. This enables the robot to move forward with a maximum speed. But for a 50% voltage, half of the power is supplied to the tire which let the robot to move with half the speed. Server Motor is used to determined its speed and also needed to change the direction of the robot, such as when turning right or left.

For example, by giving a 100% voltage to right tire and 50% voltage to left tire will give a different speed at both tires. Since the right tire have a higher speed than the left tire, the robot will turn to the left. Same concept goes when turning to the right. Therefore, by having PWM, a robot will be able to control its speed and control the direction its going.

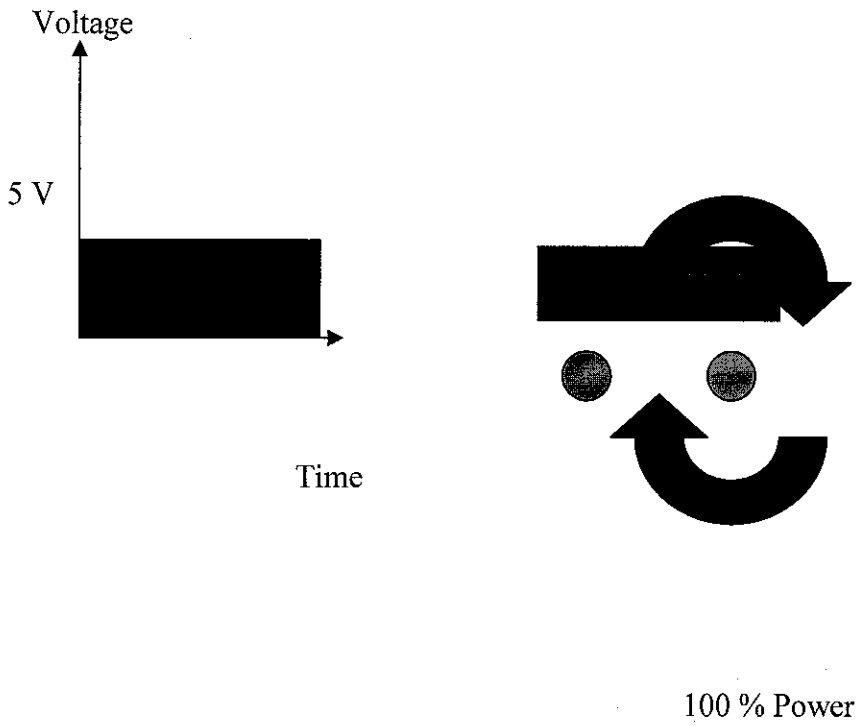


Figure 4.11: Maximum voltan will give 100% power to the motor and tire

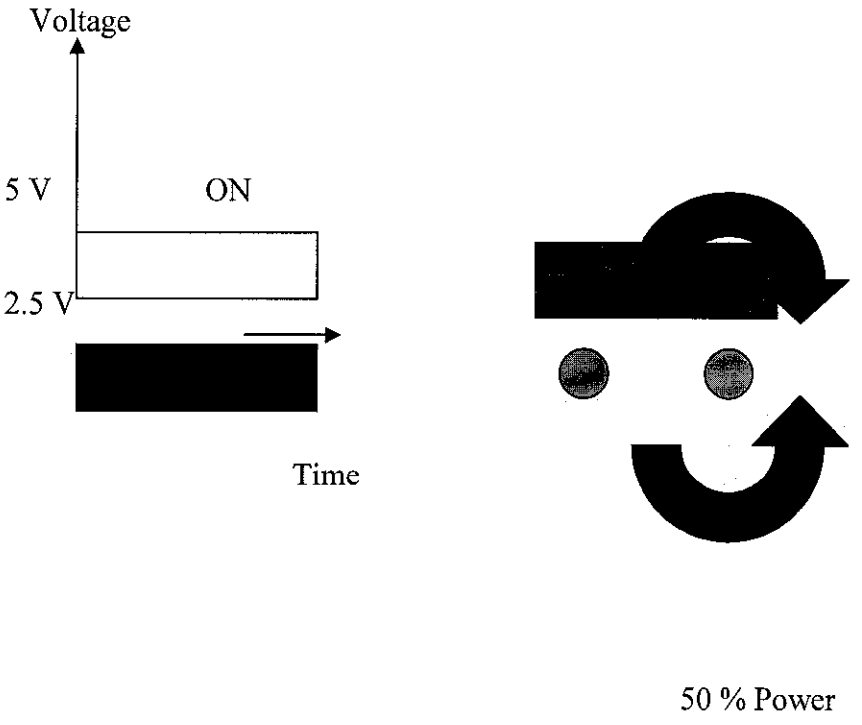


Figure 4.12: Maximum voltan will give 50% power to the motor and tire

4.3.2 Infrared Sensors

The functioning of Infrared is to sending out Infrared light from the Infrared LED in a fairly narrow beam. The light then will be captured by the Infrared receiver. Infrared sensors working and functioning as the eyes for the robot and this make the infrared sensors became the most important component for the robot.

The infrared also functioning as communication path for the follow and move by lead the robot to the right path in order make the decision of which line should be follow. Also to detect what things blocked its movement and to avoid hit any obstacle avoidance in front it. The infrared sensors have two functions, which are to detect black line and to detect obstacle in front of it. In Figure 4.13 shows the placement of the infrared transmitter and receiver for obstacle avoidance and line follower, while in Figure 4.14 shows the schematic diagram for both sensor infrared.

Infrared sensor are soldered with head facing in front and attach to under plastic of front robot as shown In Figure 4.14, the infrared sensors were soldered with the head facing the floor. This will be easier for the infrared sensors to detect black surface and to detect obstacle. The both infrared sensor put under robot and in front of robot.

The Infrared Sensors will transmit infrared and the emitters will receive it and read the value. The capacitors were placed between the sensors and emitters to prevent light from the Infrared LED interfering with the sensor.

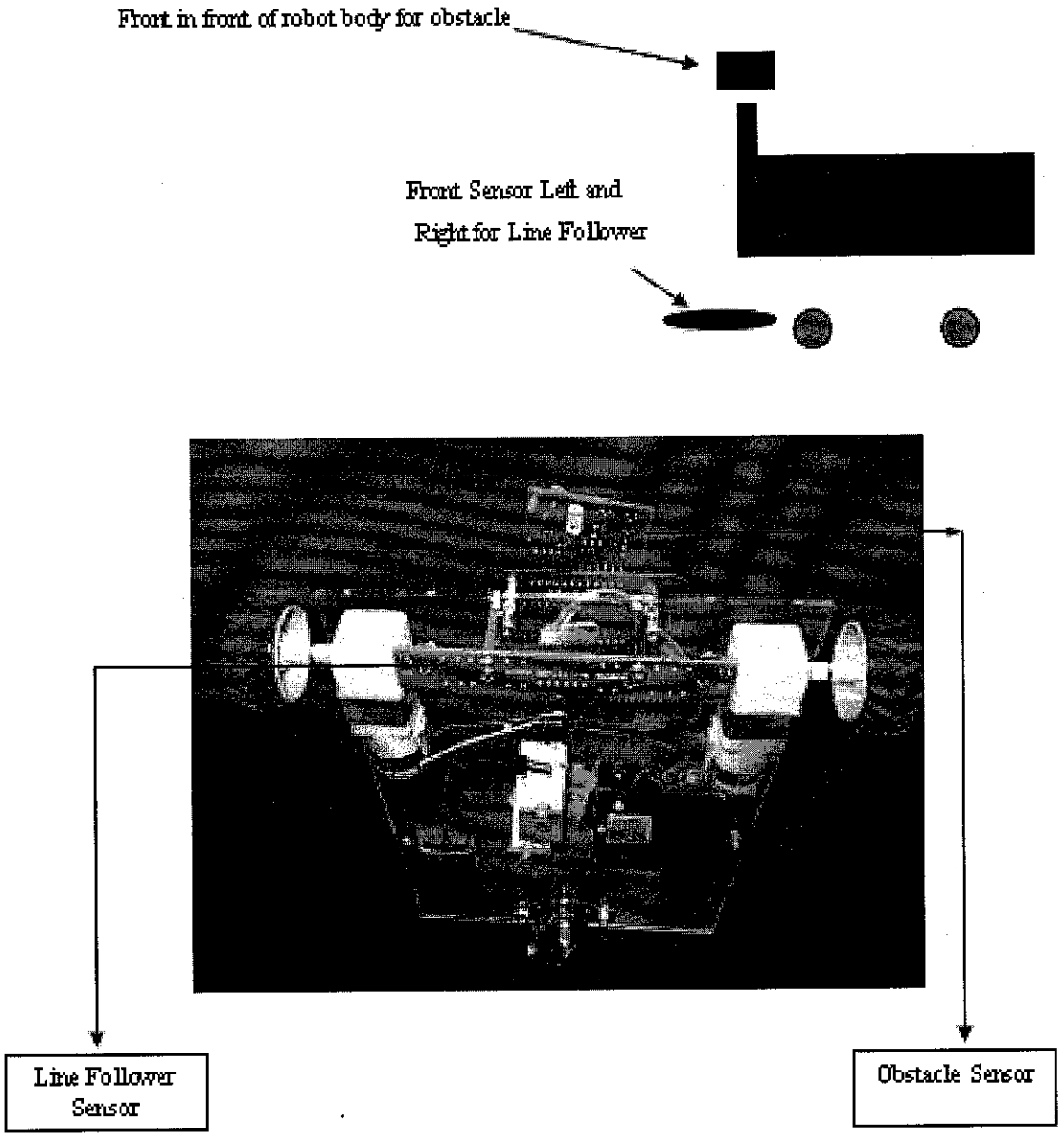


Figure 4.13: Location of Sensor

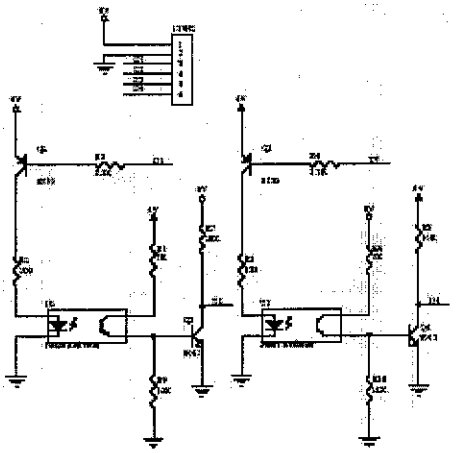


Figure 4.14 Schematic Diagrams for Line Follower IR

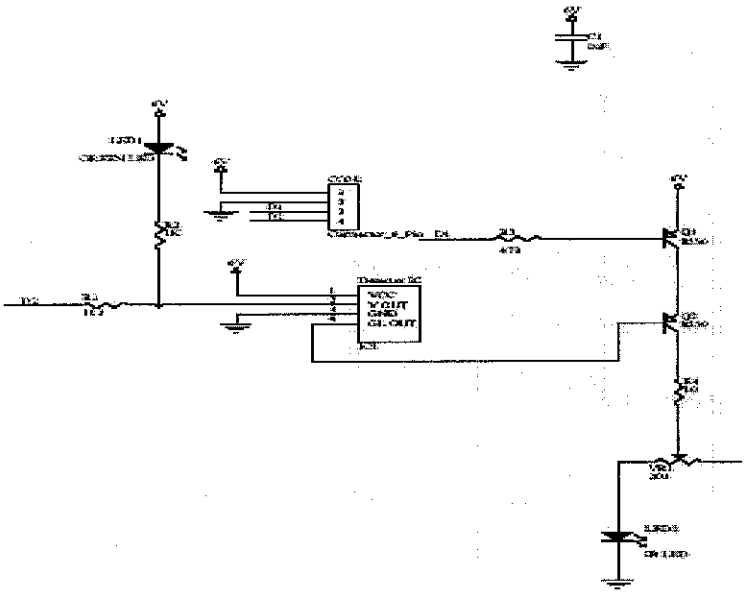


Figure 4.15 Schematic Diagram Obstacles IR

4.3.2.1 Programming The Infrared Sensors In PIC C

An analog and wavelength from the Infrared LED will be received by infrared receiver or emitter and it will set the value for it. Port B2 until Port B6 was set to receive values for PIC16F876 Microcontroller. The entire of Infrared need to on first before we can reading the value sense by the Infrared Then the value will be convert from analog to digital value. The conversion of analog to digital value will be explained more in the next subtopic, Analog to Digital Converter (ADC).

4.3.3 Analog To Digital Converter (ADC)

Microcontroller cannot understand value of analog signal which is continuously. The example of analogue sine wave is shown Figure 4.16 shows example of an analogue sine wave. Any value between 1 and 0 is the value for analogue value and it cannot be understood by microcontroller. The wave that can be understand is digital value which is discrete value and located in the range of no 1 and 0 without fractional values such as shown Figure 4.17.

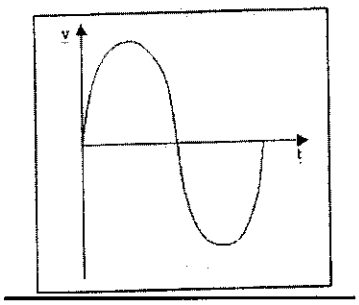


Figure 4.16: Analog waveform

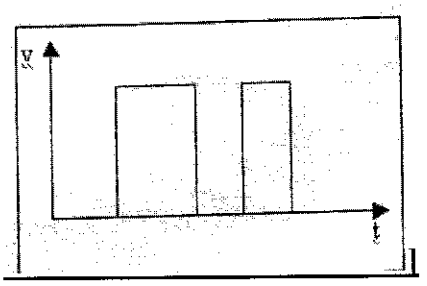


Figure 4.17 Digital Waveform

Analog Digital Converter is use by microcontroller in order to digitize the value since the infrared sensor sends value in analog. The function of Analog to Digital Converter is to convert analog value from Infrared Sensors into digital value, which can be understood by a microcontroller. The conversion analog to digital by an ADC task is done by function that have in the microcontroller This function is responsible for converting analog value to a binary number, which can be understood by the microcontroller.

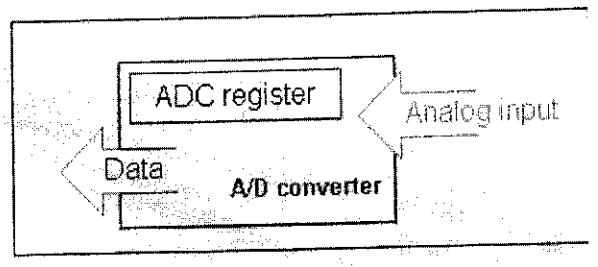


Figure 4.18: Function converts AS to DS

4.3.4 LED

This robot use Led which is capable to lights up when electricity is passed through it LED is abbreviation of Light Emitting Diode. Each LED responses to its corresponding infrared values. Left and right LED both will lights up when their Infrared detect black line. Then for the front LED, once infrared detect obstacle, it will make the LED light up. Therefore, these LED's work as an indicator for the infrared.

For Front LED and Front Infrared Sensor, when the Front Infrared Sensor detects an obstacle, it will give a high value (1) and lights up the Front LED.

4.3.5 Video Camera

A video camera is installed on robot body and functioning for surveillance activities where it communicate using wireless connectivity with program installed on computer . The camera will send and transmit data from its recording session to be view by computer and the image can be captured using the system. The system that use is developed using Visual Basic 6. It is functioning to detect the output and input view by camera. It also can captured any image transmit by the camera and saved in computer as *.bmp. Figure 4.19 show the position of the camera on the robot body structure.

Mini video camera will be installed on robot in order to let the screen view activities happen in PIC during detection process and other events. The type of video camera is still on survey phase.

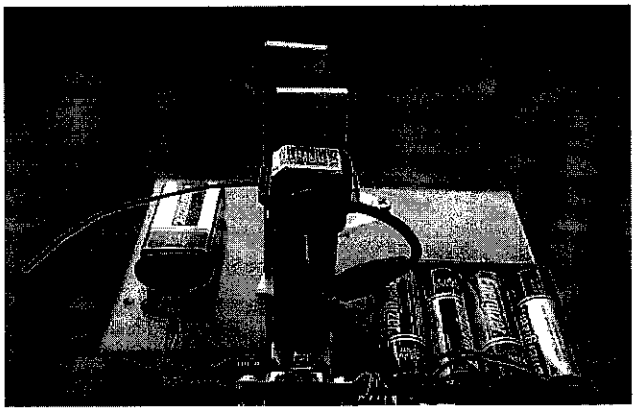


Figure 4.19: Position of Video Camera

4.3.6 Modes

For this robot, it has two modes that functions for this project .The first is function that will follow the white surface line by detect using infrared installed under robot body. Then the second mode is detecting obstacle avoidance and finds other way to move hen the infrared send data to reverse the tire.

4.4 ALGORITHM

4.4.1 Obstacle Avoidance

The line follower mode will only follow black surface line with 3 diameters only. During moving, it also capable to detect obstacle avoidance by received signal from infrared and instruct server motor to do things as programs. The object will be detected within three meters by robot in order to ensure that collision can be prevented.

IR will be use to detect the obstacle by give signal to tell that it found obstacle to the microcontroller, so this thing will give order to server motor to reverse and find another way.

The flow chart for obstacle avoidance module is implemented in this robot. Firstly, before the robot start move it will read the initial value from the infrared that placed in front of robot which should be zero (0). During move all the ways, the infrared will shot to forward direction and for any 3 meters object detected, it will tell the server.

When the signal received by server, it will let tire to reverse and find another direction. Sam thing keep goes for any obstacle detection process. The fronts LED will be on to show that the robot still detect an obstacle in front of it. Every 1ms the sensor will refresh to check whether the obstacle had been moved. Robot can only detect obstacle in front of it since there is an infrared attached in front of the robot body.

4.4.2 Line Follower

The line detector will follow a black line with 3 diameters on a white surface. This process involved in detects the left and right sensor. This sensor placed under robot body between the front right and left tire.

The sensor will become an eye for this robot because it will follow the line according to the sensors value. When the first U1 detect a black surface with 3 diameters, it will give signal to U2 to respond for the process. Then when both starts give signal, the microprocessor will read the signal and implement the stored task by follow the line all the ways. The infrared initial value is zero (0). When the infrared detects a black line it will return a high value or 1 and it will light up the corresponding LED.

Value 0 is return when light surfaced detected, and for black surface it give 0 values. For one bit value, it is present for one infrared. Therefore when any of the infrared detects black line, it will give a high value (1).The robot will move according to the infrared values. The value for Server Motor at both motors will be set (1) according to the Infrared values. Both tires of the robot will move forward when the power of Server Motor given to both motors is the same and when the left motor have a low speed because the left infrared has a high value, the robot will turn to the left because of the different in speed at both motors. This happen because the right tire will rotate faster than the left tire. Same goes for the right turn.

4.4.3 PIC Chip

PIC chip is main chip that going to be use in this project. It is multipurpose chip which can be used for any purpose. It is selected as chip to use in this project because several factors:

- The chip can be burn to load the script inside and if error occur, it can be use many time by burning again until the right scrip loaded.

- These chips are more users friendly where it can be manipulated using 32 steps of instruction in order to achieve multiple ways of usage.

- PIC easily can be get, where it quality is same with the expensive cheap. Since the budget approved for this project is limited, so the best selection is PIC.

4.5 FEASIBILITY OF THE PROJECT WITHIN SCOPE AND TIME FRAME

With 4 months of time development given, lack of equipment and facilities such as software and hardware, beside have to study new thing to build the robot are major limitation face by me. Some integration of hardware and software need to be done to build this robot since all the tools available at Electrical Lab and the process to get the facilities is quite difficult since different department and less experience working with EE lab.

All tools available are located at EE Building and be used throughout the project. Actual times are needed to develop the completed robot a more longer than given but with time have, I will try to do the best and complete as lot as I could. More time will be needed to program a more functional robot that line follower and obstacle avoidance,

Using available tools and source that found in library and outside after doing research make the project seem feasible to done. Research and studies are done in the early of phase development. All the research done by other people are study and tools that need to use have to be learned. Same with EE component, I also have to study and understanding how it working.

New things have been learned such as Solder Techniques, Schematic Drawing and all EE related knowledge. There are many expertise in this that are helpful and this could save time compared to studying it alone.

Then the second phase in general development schedule is programming part. After the coding finish, it will be compiled into PIC controller and burned into Microcontroller. The third phase is related to video installation. The process of install the video on

vehicle and setting the port that need to be use for communicate with the vehicle using wireless technology are something new that need to be learn. All the software and hardware needed are provided by the Electrical and Electronics Department of University Technologies PETRONAS. All the thing need to do is make new research and learn how to use them.

As the conclusion, by help from Mr. Roslan and Miss Hawa, two technicians that expertise in networking and electrical field and also the availability tools in the university would make this project feasible in this four months period .Even UTP give Internet access to student, but all of it do not give any benefit since we just get the connection but not the accessibility. For future generation of final year project, I hope that same thing would not happen so they could do their project with no difficulties. However, thank to Allah since UTP has a good library where all the research and materials can be find in the library and there are many sources of these research materials available.

4.6 TESTING AND SYSTEM CHECKING

System testing and product checking has been done for three times in order to ensure that the final product is be able and fully ready to be released. The testing has covered all aspect such as accuracy, security, decision making, direction selection and time taken to travel. All the system testing done in Data Communication Lab UTP.

In accuracy testing, the robot has been monitoring for its performance in detecting the obstacle object. The robot is placed into one small area of circuit provided with box that act as obstacle avoidance .Then the server motor will on, and the robot will let to move around within the circuit area. For any obstacle found by the sensor, it will respond to microprocessor and one execution task will be send by microcontroller to server motor

to stop the robot and reverse the tire in the specific range of distance before it hit the obstacle object.

For the result, robot basically will sensor the obstacle from 4 meters distance and the process of transmit the signal to microprocessor and respond by server motor will take 1 second. It means totally 4 second is needed to complete the process of obstacle detection. For distance range, the robot able to avoid any object that located at least 4 meters from its front side. So, within 4 meters, the robot will reverse and start to move in new direction.

Once the robot detects the obstacle, the program will execute a program to instruct the server motor to reverse for 3 meters and go forward again but go to right side. That means, after reverse for 3 meters, it will move forward again and change direction to right side. Same things happen for every time sensor detect the obstacle and reverse the tire. For 1 meters distance movement, the system testing involved recording time measured by the robot to move from location A to location B. For three times of system testing, the robot took about 25 seconds to reach the end point. With that, it means the robot has capability to move 0.25 meters per second.

Basically, the result for the test from various aspect has proof the hypothesis that the system that develop are to detect obstacle object within specific range and able to follow certain black path that program and stored in the microcontroller. The whole result for the system testing phase is shown in Table 4.4 below.

Type of Testing	Result
Accuracy	Sense the obstacle from 3 meters range
Decision Making	Once detect the obstacle, it reverse 3 cm and move forward again
Time Travel	For 10 meters distance, it takes 25 second to move. Means 1 second can go to 0.25 meters
Direction	Always reverse when sense obstacle and select right side for new direction

Table 4.4 Full result for system testing

4.7: GENERAL AND SPECIFIC END USER OF THE SYSTEM

The final product basically can be use for target users such as factory which involved in activity moving things and transportation , the security department that want to saved cost by using surveillance camera activity and also for individual that want to continue or start new research on robotic field.

For security department, they can use this product as one security guard unit that move around in certain area and give information about surrounding activities by transmits any image to computer using wireless receiver transmitter signal. Any things that occur can be monitoring from safety room.

Then for car developer, they can install a sensor system that similar to this product. By having good sensor protection system, they can release a modern car that can detect obstacle object and avoid small accident. With this, they already save cost and time to fix their car if accident happens.

Moving things from one place to another place absolutely need robot to ensure the task become easier and smoothness. The idea of this product can be apply into vehicle that able to move around the factory and follow the line between two places without enter wrong path. Besides, we all know robot can do work 10 times faster and bigger than human.

4.8 FUTURE ENHANCEMENT

Some upgrade process have been planned to add for this robot in future. The upgrade process basically will focus more on GPRS mapping setting which will enable user to apply GPRS technology for this robot. The path simulation process also can be added once the GPRS setting apply.

Then the camera video will be able to communicate with computer and the result can be stream via internet which means it can be viewed by all people over the world. The computer also can give signal and instruction to the robot for any task that they wish to do.

After that, the sensor also will be able to detect obstacle at left, right and behind the vehicle where the sensor that will be added will functioning to pass all side sensing infrared to microcontroller .This will help the accuracy of system detection of obstacle.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

System detection that provided on robot body will be able to implement obstacle detection and line follower task. This robot also will do surveillance activities by launching camera viewing activity and communicate with computer server to transmit any image that record by it. Line following sensor will detect and follows any black line that have 3 meters length on a white surface based on the different values of its colors using infrared sensors .It will detect the value of black line and transmit it to the microcontroller before it execute instruction for the robot to perform appropriate task.

For any obstacle that detect by this robot, the infrared will give signal to microcontroller to stop 3 meters from the object and give execution for server motor to reverse and find another way to continue the movement. Same things will continues happen until the robot will not face the obstacle again. This kind of robot is useful to be use in any kind of situation such as to become surveillance camera, good protection for car from involved in hit accident and also be applied in many ways such as using it as a water sprinkler where it waters plants by the roadside while following the line.

The best processor that can be use for any robot development project is microcontroller which is easy to use and can be find in any electronic shop. For this project the microcontroller that being use is PIC16F876. Microcontroller can be said as the brain and intelligent for the robot where all the intelligence and programs are being stored. These microcontroller will response to any situation according to environment, as example in this case, the sensor infrared will detect and respond to any obstacle face by the robot. The program that will be uploading in this microcontroller is C programming.

By using high level programming technology such as C programming to build the system for this intelligence robot has proof and show how nowadays latest technology had gone through a big improvement. For C language itself, it has been provided with special feature including built in syntax and functions inside the coding itself that can make the way of programming this kind of robot development become easier and faster. So for this features its enable the way of program the microcontroller to follow certain instructions also very easy to learn since it just have one problem which is related to the integration of the program with the hardware. However, prior massive studies that absolutely needs for this project are done before this project is successfully completed.

The intelligence that stored in this robot is limited to line follower and obstacle avoidance only, but the impact of this project to society and university environment is more on beginning of creating more functional robot with high intelligence feasibility. It also show integration of Information Technology knowledge with electronic principal, so by doing this project, Information technology student can add more intelligence to this robot by upload more instruction and coding to this robot. The concept is the more instruction that robot has, the more intelligent the robot is. Infrared sensor along with microcontrollers have provides intelligence in the robot .These thing can be said as the eye for the robot and could detect black lines along with obstacle avoidance.

For the five months period of research and development, the project can be said as fully accomplished the objective and achieve the target. This robot now can be able to detect a line and detect obstacle avoidance besides doing surveillance activities. All of these functions has been developed using C and Visual Basic programming .Future works that need to be done to improve the intelligence and capabilities is needs since this robot is the creature for robotic development field in UTP itself. Hopefully in future, we can have robot that have more intelligence just like human.

REFERENCES

[1] Gebhard, H.April 2003, Pico PLC, Microcontrollers or Programmable Logic Controller? *Elector Eletronics: The Eletronics and Computer Magazine, no.320, Volume 9.*

[2] Iovine, J, 2002, *PIC Microcontroller Project Book*, New York, Mc Graw Hill.

[3] Iovine, J, 2002, Robots Android and Animations, *12 Incredible Project You Can Build, New York*, Mc Graw Hill Second Edition

[4] Terekso, J., Industry Week: Leadership in Manufacturing, *Robots Revolution*, http://www.industryweek.com/currentarticles?asp/article.asp?Articled=1313,3 May 2005

[5] The Star Online, Malaysian *achieves success in artificial intelligence research*.25 April 2005 http://thestart.com.my/news/story.asp?file=/2005/4/25/nation/10681102&sec=nation , 3 May 2005

[6] Wepopedia Online Dictionary, www.webpodia.com, 31 January 2005

[7] Microchip PIC 16876 Datasheets www.microchip.com/download/en/devicedoc/30292pdf, 3 February 2005

[8] www.google.com.my

[9] www.yahoo.com/search

APPENDIX

C Programming Code:

```
#include <16F876.h>                    //declare PIC
#include<STDLIB.h>                     //declare student library

#use delay(clock=4000000)              //clock delay common in PIC programing
#fuses HS,XT,NOPROTECT,NOWDT,NOLVP,PUT

#byte port_a=0x6
#byte port_b=0x7
#byte port_c=0x8

void gerak(int flag_kiri,int flag_tengah,int flag_kanan,int flag_depan);    //declare movement type
void pwm_kiri(long dutyratio_kiri);                                         //declare dutyratio for left side
void pwm_kanan(long dutyratio_kanan);                                       //declare dutyratio for right side
void stop(int time);                                                        //declare stop amount
void beep(int max);                                                         //declare beep section


int on_left_infra();                   //will off left InfraRed
int off_left_infra();                  //will on left InfraRed

int on_center_infra();                 //will off center InfraRed
int off_center_infra();                //will on center InfraRed
int on_right_infra();                  //will off right InfraRed
int off_right_infra();                 //will on right InfraRed
int on_front_infra();                  //will off front InfraRed
int off_front_infra();                 //will on front InfraRed
int on_left_motor();
int on_right_motor();
int off_left_motor();
int off_right_motor();


int refreshment();
```

```
int baca_kiri();                    //declare for left reading
int baca_tengah();                  //declare for center reading
int baca_kanan();                   //declare for right reading
int baca_depan();                   //declare for front reading
int baca_vr();                      //declare for Variable Regulator  reading


int x;
long dutyratio_kiri,dutyratio_kanan;                    //value from void pwm_kiri and
void pwm_kanan
int value_vr,value_kiri,value_kanan,value_tengah,value_depan;    //declare value for each way of
move type
int flat_kiri,int flag_tengah,int flat_kanan,int flat_depan;     //value from void gerak()
int lastpos;
int mode;


long speed 1 norm = 308;
long speed Imed = 102;
long speed 1 slow =51;
int main()
{
set_tris_a(Ox2F);
set_tris_b(OxC3);
set_tris_c(OxOO);

port_a=OxFF;
port_b=OxFF;
port_c=OxFO;          //This will turn of all LED and Motor on start up/tutup all led and motor on
start up
port_b_pullups(TRUE);


//////////////////////////////////////////
//setup for PWM
//control speed of motor
setup_ccp 1 (ccp_off);
```

```
setup_ccp2 (ccp_off) ;                          //setup for PWM // control speed of Motor

////////////////////////////

////////////////////////////////////////

//this two line of code will show the setup for Analog To Digital conversion and to read sensor///

setup_adc_ports(A_ANALOG);                      //That means all analog pins are in use
setup_adc(ADC_CLOCK_DIV_8);                     //That means the clock speed are divide by 8

////////////////////////////////////////

//This part is to test wheter all L E D are connect properly or not
//To turn LED or SENSOR to on mode on, referse '0' = on  else '1'=off


//L E D section

delay_ms(200);
output_low(PIN_C7);      //left side

delay_ms(200);
output_low(PIN_C6);       //center side

delay_ms(200);
output_low(PIN_C5);      //right side

delay_ms(200);
output_low(PIN_C4);      //front side

delay_ms(200);
```

```
//this part is to choose the mood of object avoidance point (obstacle movement)
//for option mode 1 = OFF
//for option mode 2 = ON


if(input(pin_B1)==0)
        {
        mode=1;
        }

else
        {
        mode=0;
        }


if(mode==0)
        {
        beep(2);
        }

else if(mode==1)
        {
        beep(3);
        }




//////////////////


flag_kiri=0;
flag_tengah=0;                  //// value initialization
```

```
flag_kanan=0;
flag_depan=0;

////////////////



while (TRUE)
{
        refreshsensor();
        gerak(flag_kiri,flag_tengah,flag_kanan,flag_depan);

}
        }



//we need to refresh sensor to check the value

int refreshment()
{
        baca_kiri();                    //declare for left reading
        baca_tengah();                  //declare for center reading
        baca_kanan();                   //declare for right reading
        baca_depan();                   //declare for front reading
        baca_vr();                      //declare for Variable Regulator (VR)



if(value_kiri>=value_vr)                //compare left value with Variable Regulator (VR)
        {
                flag_kiri=1;            //if true , left value = 1
        }

        else
```

```
        {
                flag_kiri=0;            //if false , left value = 0
        }


if(value_tengah>=value_vr)                      //compare center value with Variable Regulator
(VR)
        {
                flag_tengah=1;          //if true , center value = 1
        }

        else
        {
                flag_tengah=0;          //if false , center value = 0
        }


if(value_kanan>=value_vr)                       //compare right value with Variable Regulator (VR)
        {
                value_kanan=1;          //if true , right  value = 1
        }

        else
        {
                value_kanan=0;          //if false , right  value = 0
        }


if(value_depan>=value_vr)                       //compare front value with Variable Regulator (VR)
        {
                value_depan=1;          //if true , front  value = 1
        }
```

```
        else
        {
                value_depan=0;              //if false , front value = 0
        }
```

```
//In case of sensor detect black line on corresponding LED

if(flag_kiri==1)
        {
                output_low(PIN_C7);
        }

if(flag_tengah==1)
        {
                output_low(PIN_C6);
        }

else
        {
                output_high(PIN_C6);
        }

if(flag_kanan==1)
        {
                output_low(PIN_C5);
        }
```

```
else
        {
                output_high(PIN_C5);
        }



f(flag_depan==1)
        {
                output_low(PIN_C4);
        }

}
```

```
////////////////////////////////////////////////
// This is to read the value of the sensor

 //channel (0) = left Analog Digital
 //channel (1) = center Analog Digital
 //channel (2) = right Analog Digital
 //channel (3) = front Analog Digital
 //channel (4) = Voltage Divider or Variable Regulator (VR)



////////////////////////////////////////////////

// To create reference point, the value must be take when there is no infrared
//So at this time, the infrared should be turn off

////////////////////////////////////////////////
```

```
int baca_kiri()
{
on_left_infra();
set_adc_channel(0);
delay_us(20);
left_value=read_adc();
//delay_us(20);
off_left_infra();

}

////////////////////////////////////////////////

int baca_tengah()
{
on_center_infra();
set_adc_channel(1);
delay_us(20);
center_value=read_adc();
delay_us(20);
off_center_infra();

}
////////////////////////////////////////////////

int baca_kanan()
{
on_right_infra();
set_adc_channel(2);
delay_us(20);
right_value=read_adc();
off_right_infra();

}
////////////////////////////////////////////////
```

```
int baca_depan()
{
on_front_infra();
set_adc_channel(3);
delay_us(20);
front_value=read_adc();
off_front_infra();

}

////////////////////////////////////////////////

int baca_vr()

{
set_adc_channel(4);                    // this is the correct channel to read for VR values
delay_us(20);
vr_value=read_adc();
//delay_us(20);
}




////////////////////////////////////////////////////////////////

//This is to turn on and off the motor

int on_left_motor()

        {
        output_low(PIN_C3);    //This is left motor
        }

int on_left_motor()
```

```
        {
        output_high(PIN_C3);    //This is left motor
        }


int on_right_motor()

        {
        output_low(PIN_C0);    //This is left motor
        }


int on_right_motor()

        {
        output_low(PIN_C0);    //This is left motor
        }




///Infra Red (IR) Sensor On/OFF////////
////////////////////////////////////


int on_left_infra()
{
 output_low(PIN_B5);
}

int off_left_infra()
{
output_high(PIN_B5);
}
```

```
//////////////////////////////////////

int on_center_infra()
{
 output_low(PIN_B4);
}

int off_center_infra()
{
output_high(PIN_B4);
}



//////////////////////////////////////

int on_right_infra()
{
 output_low(PIN_B3);
}

int off_right_infra()
{
output_high(PIN_B3);
}


//////////////////////////////////////


int on_front_infra()
{
 output_low(PIN_B2);
}
```

```
int off_front_infra()
{
output_high(PIN_B2);
}

////////////////////////////////////

//This part for buzzer

void beep(max)

{
        int x; for (x=1 ;x<=max;x++)
                {
                output_low(PIN_A4); delay_ms(100); output_high(PIN_A4); delay_ms(100);

// calculation is   ==10% =102   50% =510
//20% = 204  60% = 612
//30% = 306   70% = 714
//40% = 408   80% = 816
// 90% = 918
//long speed 1 norm = 308; //long speed Imed = 102;
//long speedslow =51;

        void gerak(int flag_kiri,int flag_tengah,int flag_kanan,int flag_depan);

                lastO:
                if ((left_flag ==0) && (center_flag = 0) && (right_flag ==0))
                // 000 for the moment it stop
```

```
                { if (lastpos == 0)
                { if(left_flag=l)


                {
                on_left_motor(); on_right_motor(); pwm_kiri(speed Imed); pwm_kanan(speed 1 norm);
                lastpos=4;
                }

        else if (right_flag==l)
                {
                        on_left_motor(); on_right_motor(); pwm_kiri(speed 1 norm);
pwm_kanan(speed 1 med);
l                       astpos=1;       }
                }
                        else if (lastpos == 2)
                {
                                goto Iast2;
                }
                        else if (lastpos == 4)
                {
                        goto last4;
                }
                        else if (lastpos ==1)
                        goto last1;
        }



        else if (lastpos = 3)

        {

        goto Iast3;

        else if ((flag_kiri ==0) && (flag_tengah = 1) && (flag_kanan ==0))     // 010 go straight
```

```
last2:on_left_motor(); on_right_motor();
pwm_kiri(speed 1 norm) ;
pwm_kanan(speed 1 norm) ;
lastpos=2;

else if ((leftjlag ==!)&& (center_flag = 0) && (right_flag ==0)) III 00 turn left
last4:on_left_motor(); on_right_motor();
pwm_kiri(speedlmed); //10%
pwm_kanan( speed 1 norm);   //40%
lastpos=4;

else if ((left_flag ==0) && (centerjlag == 0) && (right_flag ==!)) // 001 turn right
lastl :on_left_motor(); on_right_motor();
pwm_kiri(speedlnorm);    //40%
pwm_kanan(speedlmed);    //10%
lastpos=l;

else if ((left_flag ==!)&& (center_flag = 1) && (rightjlag ==0)) // 110 turn left
last6:on_left_motor(); on_right_motor();
pwm_kiri(speedlslow);    //5%
pwm_kanan(speedlnorm);   //40% lastpos=6;


else if ((left_flag ==0) && (center_flag = 1) && (right_flag ==!)) //Oil turn right with a small
angle
lasts :on_left_motor(); on_right_motor();
pwm_kiri(speedlnorm);    //40%
pwm_kanan(speedlslow);   f/5%
lastpos=3;



//This is for found obstacle and stop

if((front_flag == !)&& (mode ==!))
{ stop(2000);
void stop(int time)
```

```
        {
        ON_LEFTJVIOTOR(); on_right_motor();
        pwm_kiri(0);
        pwm_kanan(0);
        delay_ms(time);

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
////////////////////////////////////
///value @ duty ratio
///
/// determine the ON time and the OFF time signal to the motor., the
//average value will decide the speed of the motors
//      | On | Off | //      | Time | Time |
// ————————      ———— <— one complete cycle for this lin //hot they use l/4Mhz = 250 OOOHz and use
only //      <— . l/980Hz—>
//          250 000/255 = 980 Hz freq for motor
//      <-1.02exp(-3)->
//
//so to calculate value for duty ratio we use this formula
//
// Convert Hz to T (Period) => l/980Hz= 1.02 exp(-3)
// So 50% duty ratio  = 50/100 x 1.02 exp(-3) =5.102 exp -4
//[Formula to calculate ]
// Therefore duty ratio =[ 5.102 exp -4 ] / [ 4 * 1 / 4Mhz]    <—
//[ value duty ratio ] / [T2div_value * 1/Clock]
//          =510
// 50% duty means 50% of the time is on and another 50% of the time is off
// in other words in on cycle the ON and OFF time are equal
// == 10% =102   50% = 510 //      20% = 204   60% = 612 //              30% = 306  70% = 714 //
40% = 408   80% = 816 //                    90% = 918 //                    100%= 1020


////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
////////////////////////////////////
```

```
void pwm_kanan(long dutyratio_right)
setup_timer_2(T2_DIV_BY_4,255,l);  //setup_timer_2 (mode, period, postscale)

setup_ccp 1 (ccp_pwm);
set_pwm 1 _duty(dutyratio_kanan);
void pwm_left(long dutyratio_kiri)
setup_timer_2(T2_DIV_BY_4,255,l);
setup_ccp2(ccp_pwm);
set_pwm2_duty(dutyratio_kiri);
```