UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND PROTOTYPING OF HUMAN FOLLOWING MOBILE ROBOT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic and Automation) with Honours.

By

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2010

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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JUDUL: DESIGN AND PROTOTYPING OF HUMAN FOLLOWING MOBILE ROBOT

SESI PENGAJIAN: 2009/2010

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic and Automation) with Honours. The member of the supervisory committee is as follow:

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(EN. MOHD HISHAM BIN NORDIN)

ABSTRACT

The purpose for this project was to build a mobile robot prototype that can follow people in linear motion during walking. It will produce an intelligent robot, in which we called it as Human Following Mobile Robot. The robot is not controlled by controller; however it uses microcontroller (PIC) as a controller where the Infrared Sensor and Ultrasonic Sensor act as a detector for human movement. The infrared sensor consists of transmitter and receiver. For ultrasonic sensor are consists of two receivers and two transmitter which being applied to the robot. The object and human position will be defined by the reflection of the signals send by transmitter to receivers. Each signals received by the receivers is processed by the microcontroller in digital form. Then, it will send the order to the mechanical system to produced movement to the robot. The receiver is located at the front of the robot where human will holding the transmitter. The direction for the robot is determined by toward the transmitter signal to the receiver. In a nut shell robot will follow the signal from transmitter and avoid the obstacles by using ultrasonic sensor. Further research will be done to ensure the project will achieve the goal.

ABSTRAK

Tujuan penulisan kertas kerja ini dijalankan adalah untuk membina sebuah prototaip robot mobil yang berkemampuan mengikut manusia berjalan dalam keadaan garis lurus. Projek ini akan menghasilkan sebuah robot pintar dengan tajuk yang diberikan sebagai Robot Mobil Mengikut Manusia Berjalan (Human Following Mobile Robot). Robot ini akan beroperasi dengan menggunakan alat kawalan arah pergerakkan seperti pengesan Infra-merah(Infrared Sensor).Pengesan Infra-merah akan digabungkan dengan Pengesan Ultrasonik (Ultrasonic Sensor)dimana akan digunakan sebagai deria kepada robot yang akan mengesan pergerakkan dan dikawal dengan menggunakan pengawal mikro (PIC). Pengesan ultrasonic tersebut terdiri daripada dua buah penerima dan dua penghantar gelombang ultrasonic manakala untuk pengesan infra-merah terdiri daripada satu penghantar dan satu penerima yang akan dipasang pada robot mobil. Tindak balas yang diberikan oleh pengesan infra-merah pengesan ultrasonik terhadap penerima dan penghantar gelombang akan menentukan kedudukan objek dan manusia. Setiap gelombang yang diterima oleh penerima akan diproses oleh pengawal mikro sebagai suattu nilai digital lalu menghantar arahan ke bahagian litar keluaran yang terdiri daripada sistem mekanikal, seterusnya akan menghasilkan pergerakan pada robot mobile tersebut. Kombinasi penerima dan penghantar di letakan di bahagian hadapan robot mobil membantu menguatkan isyarat. Perbezaan antara isyarat yang dihantar dan diterima akan menentukan arah pergerakan robot mobil. Kajian-kajian akan dilakukan bagi memastikan projek ini dapat dihasilkan dengan jayanya.

DEDICATION

Dedicated to my father, Che Pa Bin Wahab and my mother, Che Normah Binti Ishak. To my supervisor, En. Mohd. Hisham Bin Nordin, lecturers and friends for all of their help and friendship.

ACKNOWLEDGEMENT

I would like to convey my appreciation and indebtedness to those who has been great surprised and helpful for the completion at the project to bring it to success in respect with favorable advice and feasible solution. Thus, I feed comfortably to take this golden opportunity to express my millions of gratitude to my supervisor, En. Mohd. Hisham Bin Nordin for her kindly advice and guidance during the project providing tremendous considerately and useful comment and materials to overcome each obstacle I had faced. Also special thanks to my friends that give me some help during doing this project. Thanks extended to FKP lecturer who had provided technical help and assistance throughout the project. Lastly I would like to thank my family, who has been the loveliest advisor to give continually support and inspiration throughout my campus life.

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LIST OF ABBREVIATIONS

PIC	-	Microcontroller
AVGs	-	Automated Guided Vehicles
PWM	-	Pulse-Width Modulated
IR Sensor	-	Infrared sensor
SVM	-	Support Vector Machine
RvCAD	-	Robot Vision CAD
HRI	-	Human Robot Interaction
LED	-	Light Emitting Device
ROAMER	-	Obstacle Avoiding Mobile Exploration Robot
PTFE	-	Polytetrafluoroethylene
IDE	-	Integrated Development Environment
DDS	-	Dunfield Development Systems

CHAPTER 1
INTRODUCTION

1.1 Background

Nowadays in manufacturing field, robot development has focused on robotic engineering. Robots gradually made their way into factories for dangerous repetitive accurate tasks (automobile assembly), handling hazardous wastes in the nuclear industries, great dexterity and precision (computer chip assembly) and delivery robots. The robots were designed to provide functionality or very useful.

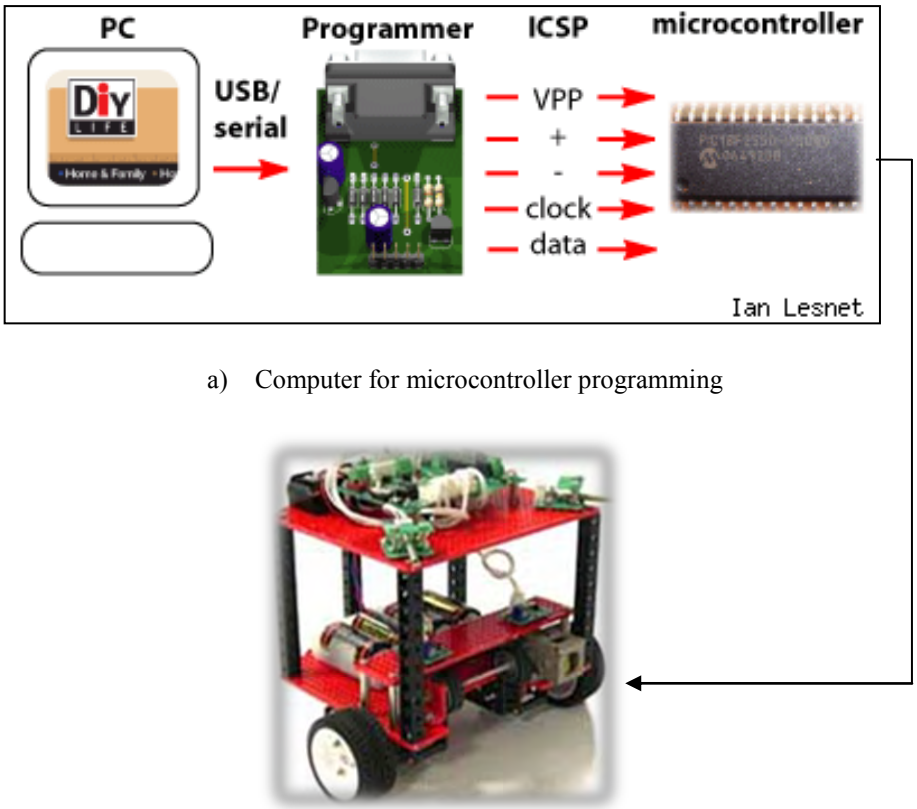
Robot is a computer-controlled machine that is programmed to move, manipulate objects, and accomplish work while interacting with its environment. Robots are able to perform repetitive tasks more quickly, cheaply, and accurately than humans. The word robot has been used since to refer to a machine that performs work to assist people or work that humans find difficult or undesirable. (Capek, 1921)

Autonomous robots are robots which can perform desired tasks in unstructured environments without continuous human guidance. Many kinds of robots have some degree of autonomy. Different robots can be autonomous in different ways. A high degree of autonomy is particularly desirable in fields such as space exploration, cleaning floors, mowing lawns, and waste water treatment. (Capek, 1921)

Some modern factory robots are "autonomous" within the strict confines of their direct environment. It may not be that every degree of freedom exists in their surrounding environment but the factory robot's workplace is challenging and can often contain chaotic, unpredicted variables. The exact orientation and position of the

next object of work and (in the more advanced factories) even the type of object and the required task must be determined. This can vary unpredictably (at least from the robot's point of view). One important area of robotics research is to enable the robot to cope with its environment whether this is on land, underwater, in the air, underground, or in space.

In a development of robot, it is have a wide variety of measuring devices to collecting data from manufacturing process for used in feedback control. Basically, there are the main devices to measuring the robot activities like sensor and transducer. The figures below show the steps to develop a robot. It is start from develop the structure and electrical part. Then, for the programming part, computer is used with the interface to program the microcontroller by follow the tasks of the robot.



a) Computer for microcontroller programming

b) Mobile Robot

Figure 1.1 Idea of the project

1.2 Robot Technology

Robot is a virtual or mechanical artificial agent. In practice, it is usually an electro-mechanical machine which is guided by computer or electronic programming, and is thus able to do tasks on its own. Another common characteristic is that by its appearance or movements, a robot often conveys a sense that it has intent or agency of its own.

A robot can be controlled by a human operator, sometimes from a great distance. But most robots are controlled by computer, and fall into either of two categories: -

a) An autonomous robot acts as a stand-alone system, complete with its own computer (called the controller).
b) Insect robots work in fleets ranging in number from a few to thousands, with all fleet members under the supervision of a single controller. The term insect arises from the similarity of the system to a colony of insects, where the individuals are simple but the fleet as a whole can be sophisticated.

1.2.1 History of Robot

The word 'robotics' comes from "Runaround", a short story published in 1942 by Isaac Asimov. One of the first robots Asimov wrote about was a robo-therapist. A Massachusetts Institute of Technology Professor, Joseph Weizenbaum, wrote the Eliza program in 1966, a modern counterpart to Asimov's fictional character. Weizenbaum initially programmed Eliza with 240 lines of code to simulate a psychotherapist. The program answered questions with questions.

Asimov created the four laws of robot behavior, cyber laws all robots had to obey and a fundamental part of positronic robotic engineering. The Isaac Asimov FAQ states, "Asimov claimed that the laws were originated by John W. Campbell in a conversation they had on December 23, 1940. Campbell in turn maintained that he picked them out of Asimov's stories and discussions, and that his role was merely to

state them explicitly. The first story to explicitly state the three laws was "Runaround", which appeared in the March 1942 issue of "Astounding Science Fiction". Unlike the Three Laws, however, the Zeroth Law is not a fundamental part of positronic robotic engineering, is not part of all positronic robots, and, in fact, requires a very sophisticated robot to even accept it." (Capek, 1921)

a) Law Zeros

A robot may not injure humanity, or, through inaction, allow humanity to come to harm.

b) Law One

A robot may not injure a human being, or, through inaction, allow a human being to come to harm, unless this would violate a higher order law.

c) Law Two

A robot must obey orders given it by human beings, except where such orders would conflict with a higher order law.

d) Law Three

A robot must protect its own existence as long as such protection does not conflict with a higher order law.

1.3 Problem Statement

The idea to invents and develops the Human Following Mobile Robot begin when some of the challenges come to mind at the golf course. Today, golf player need a caddy to carry-off the golf sticks. The same cases like in the hospital where the doctor are bring files and tools to the operation room or from operation room to the office. Sometimes they need an assistant to help them. It is not flexible. By using robots, it can replace the role of human. Robots are able to perform repetitive tasks more quickly, cheaply, and accurately than humans. In order to follow and get the human walking, robots should know the position of target person. The robots should

also estimate the next position of the person in order to move without delay follow

the human. To realize this, human and robots need to be in close proximity to each other as much as possible. Moreover, it is necessary for their interactions to occur naturally. It is desirable for a robot to carry out human following, as one of the human affinitive movements. The human following robot requires several techniques such as the recognition of the target human, the recognition of the environment around the robot, and the control strategy for following human stably. In this research, an intelligent environment is used in order to achieve these goals.

1.4 Objective of the project

The aim of this project is to develop a mobile robot that can follow human.

1.5 Scopes

Project scopes are important in order to develop these projects and it is required to assist and guide the development of the project. The scopes will be covered on design and programming of a mobile robot. Part of design will include the application of Catia DS Software. It is for mechanical structure to select the material should be use. Electrical and electronic part are related in programming where need to develop the interface between programming, electronic circuit and mechanical system. The scopes of this project are:

a) The designing and developing of mechanical structure will be performed manually by the author criteria.
b) The system of Human Following Mobile Robot is control by using PIC microcontroller and program the PIC via programming software.
c) The robot prototype only works on plane surface.
d) The robot prototype follow human in linear motion.
e) Sensing obstacles is required in the robot; it depends on the sensor and programming whether to avoid the obstacles or stop when found out the obstacles.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will focuses on data collecting from various resources for this project. It is actually discussing about the past project that similar with this project, the parts of autonomous robot whether from mechanical system, electronic circuit and programming. There are several of hardware related issues will be discusses in this section with involved the development of an actual robot.

Actually, autonomous mobile robot is a generally topic of robot. There are many different types of robots and the classification of such machines can be constructed in various ways. There many categories of robot available depending on its function and ability such as industrial robot, humanoids robot, and special function robot. These robot can be controlled either by human (remote control) or operating autonomously. In this project, a special function autonomous robot is build to complete the tasks given.

2.2 Introduction of Robot

The term of robot comes from a Czech word, *robota*, meaning "forced labor." In other words, the robots eventually overthrow their human creators. Actually, robot can defined as a machine that gathers information about its environment (senses) and uses that information (thinks) to follow instructions to do work (acts). This is the working definition of robots that Robotics exhibit developers used for this exhibit. Today, technology is revolution of rates making the identification of a robot somewhat difficult. However, robotic engineers would probably not say the VCR or thermostat is a robot. In other words, robots are doing more and more. Today's robots are incorporating multiple sensors and are able to use this information to behave autonomously that means, its can making decisions for them based on information that they receive. There is endless variety in the size, shape and jobs of robots. Some robots are used day after day in factories, while others are highly experimental and use artificial intelligence to behave more and more like living creatures, able to act independently in changing environments. Robots are being designed to perform precision surgery, explore space, the ocean and other dangerous areas. (Capek, 1921)

The designs of robots in movies give the impression that robots look and act like humans. The activities in this guide are designed to help those who see the exhibit recognize:-

a) How everyday activities that humans do are quite complex.
b) That they can do some things that robots cannot do and vice versa, robots can do some things that they cannot do.
c) There are many different kinds of robots each specially designed to do particular tasks.
d) How robots think, sense, and act.