TURTLETRON ROBOT

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Dedicated to my beloved family especially my parents, my siblings, boyfriend, supervisor, and also all my friends.

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ABSTRACT

The Turtletron Robot that will be build and program has a circular base and achieves locomotion using two wheels, each one powered by DC motors and gearboxes. The robot will operate in autonomous mode or under remote control by human. It will use an ultrasonic range finder and a linear shaft encoder to map its surrounding area during autonomous mode, and will also use the sonar to inhibit movement if an operator is directing the robot into an obstacle during remote control. The robot will also be equipped with a linear shaft encoder that will give it the ability to keep track of the distance that it has traveled and to create maps of its surroundings. The robot exhibited four modes of operation that are search, move, dazzle and touch. The robot is controlled by a Microchip PIC16F84 microcontroller to control all the movement, response to the environment, mapping and avoid obstacles as it explores by monitors the ultrasonic range finder.

ABSTRAK

Projek Turtletron ini akan dibina dan akan diprogram mempunyai satu reka bentuk yang bulat. Robot ini menjalankan pergerakan yang lancar dengan menggunakan two buah roda, setiap satunya dikuasai oleh motor arus terus (DC) dan kotak gear. Robot turtletron ini akan beroperasi secara otomatik atau boleh beroperasi di bawah kawalan manusia. Robot ini akan menggunakan sebuah alat pengesan julat ultrasonik dan pengekod lelurus aci untuk melakukan aktiviti pemetaan alam sekeliling sewaktu ia berada dalam operasi otomatik. Ia juga akan menggunakan ultrabunyi untuk melakukan pergerakan yang betul dan sepatutnya sekiranya seseorang pemegang alat kawalan jauh mengarahkannya mendekati halangan di mana tindakan yang boleh menyebabkan robot tersebut rosak akibat perlanggaran. Manakala, pengekod lelurus aci memberikan keupayaan kepada robot itu untuk mengesan dan mengira berapa jarak yang telah dilalui dan membuat pemetaan untuk persekitaran di mana ia berada. Semua pergerakan robot ini dikawal oleh model pengawal mikro yang bersiri PIC 16F84A. Robot ini akan bertindak balas terhadap alam sekelilingnya dan mengelakkan sebarang halangan dalam perjalanannya dengan menggunakan alat pengesan julat ultrasonik.

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LIST OF ABBREVIATON

A/D	-	Analog to Digital
ADC	-	Analog to Digital Converter
BJT	-	Bipolar Junction Transistor
BOR	-	Brown-out Reset
BS2	-	Basic Stamp II
CLK	-	Clock
CMOS	-	Complementary Metal Oxide Semiconductor
CPU	-	Central Processing Unit
DC	-	Direct Current
EEPROM	-	Electrically Erasable Programmable Read Only Memory
GPS	-	Global Positioning System
HIMM	-	Histogramic In-Motion Mapping
I/O	-	Input / Output
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCU	-	Micro Controller Unit
NPN	-	Negative - Positive – Negative (Diode)
OSC	-	Oscillator
PC	-	Personal Computer
PCB	-	Printed Circuit Board
PIC	-	Programmable Integrated Circuit
PNP	-	Positive – Negative – Positive (Diode)
PSM	-	Projek Sarjana Muda
PULSIN	-	Pulse In
PWM	-	Pulse-width modulation
RAM	-	Random Access Memory

SLAM	-	Simultaneous Localization and Map
SRF	-	Sonar Range Finder
TMR	-	Timer
VAR	-	Variable
WDT	-	Watchdog Timer

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CHAPTER 1

INTRODUCTION

1.1 Introduction of the project

The Turtletron robot is a robot with a brain. The PIC16F84A Microcontroller functions as the brain of the project because it is able to store and retrieve memory, make decisions and control the motor automatically. The robot can be operated in autonomous mode or under remote control by human operator. It is constructed as a circular base by using two Frisbees and achieves locomotion using two wheels, each one powered by DC motors and gearboxes. Apart from that, two casters wheel is used to balance the robot in its movement. The ultrasonic range finder and a linear shaft encoder work together to performed the mapping function towards its surrounding area during autonomous mode.

Robotics is the science and technology of robots, their design, manufacture and application. Robotics requires a working knowledge of electronics, mechanics and software. According to The Little Oxford Dictionary, the word 'robot' means: automation resembling or functioning like human [9].

The Robotics Institute of America (RIA) considers machines as robot if the machine fits the requirement as stated below [5]. A robot is a re-programmable, multi-functional manipulator (or device) designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.

1.2 Objectives

The objectives of this project are:

i. To construct a mobile robot turtle that consists of a circular base and achieves locomotion using two wheels.
ii. To design and construct a PCB circuit board which consists of the combination of hardware ultrasonic sensor and PIC Microcontroller.
iii. To study and understand the function of PIC Microcontroller as a controller processor.
iv. To design and implement a robot that can perform the functions of obstacle avoidance and mapping.

1.3 Problem Statement

Nowadays, remote controlled car in the market is usually controlled fully by user using the remote controller. The remote controlled car will go to the direction that commanded by the user using remote controller. However, it cannot react itself to avoid obstacle even if it is directing to crash an obstacle and cause a seriously damage. To overcome this problem, the remote controlled car will be modified with adding an ultrasonic sensor in front of the car and being monitor by a PIC microcontroller.

1.4 Scope of work

The robotic turtle will be constructed using two Frisbees as the casing for the robot's body. It is build using two wheels, each one powered by direct current dc motor and gear boxes to achieve locomotion. Turtletron will use an ultrasonic range finder and a linear shaft encoder to map its surrounding area during autonomous mode. A hand held remote control device uses an analog X and Y axis control stick as the input to two analog-to-digital converters residing on a PIC 16C71 as the remote control transmitter. Two PCB boards will be constructed as a main controller board. A PIC16F84 microcontroller will be used to monitor the ultrasonic range finder and control the direction of the two geared dc motor.

1.5 Report Structure

This thesis is a documentary delivering the idea generated concepts applied, activities done, and the preliminary final project product itself. It consists of five chapters. Following is a chapter-by-chapter description of information in this thesis.

Chapter 1 gives a basic introduction on how the idea of this project is generated. This chapter contains introduction, objective of the project, problem statement, scopes of works and report structure.

Chapter 2 is a literature review on theoretical concepts applied in this project. The history of evolution turtle-like robot is being discussed here. This chapter concludes with the brief explanation on how the Turtletron Robot work and gives a deeply explanation about what are microcontroller, motor and sensor being used for this project. As a results of that, the reasons of choose the specific microcontroller, motor and sensor to use in the Turtletron Robot is clarify here.

Chapter 3 will discuss about the project methodology and introduces the construction of the project, which involves hardware development and software development. Basically, hardware development for the project concludes with circuit design, prototype or body design and PCB fabrication. Besides that, software

development for the project will be discuss on what is programming language, how to use PicBasic Pro compiler to develop programmers, and how to use PIC Program to flash program into PIC microcontroller. After that, the programming flows are explained through the flow chart.

Chapter 4 will be covered all the result and analysis of the designing process, function ability and operation of the Turtletron robot.

Chapter 5 will be the discussion and conclusion of the PSM II project. The chapter includes with discussion on the analyzable of the software of Proteus, sensor, PIC, DC motor and results obtained for the main controller circuit and remote control circuit. This chapter concludes with some recommendations and applications that can be implemented in future.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is discussed about the literature review on theoretical concepts applied in this project. In this chapter, a summary of literature related to the turtletron robot is presented. The history of evolution turtle-like robot is being discussed here. This chapter concludes with the brief explanation on how the Turtletron Robot work and gives a deeply explanation about what are microcontroller, motor and sensor being used for this project.

2.2 History Evolution of Turtle-Like Robot

William Grey Walter built the first robotic turtles in the late 1940s. His work in robotics was an extension of his research in neurophysiology. Walter's studies of the brain and its neural networks led him to wonder about what type of behavior could be created using just a few neurons. In 1948, Walter built a three-wheeled turtle-like mobile robot that measured 12 inches in height and 18 inches in length to experiment with this concept. Amazingly this robot used just two electronic neurons, but exhibited interesting and complex behaviors. The first two robots were named Elmer and Elsie. He later named the style of robots Machina Speculatrix after

observing the complex behavior they exhibited. The robot exhibited four modes of operation that are search, touch, dazzle and move [15].

The robot's nervous system consisted of two sensors connected to two neurons. One sensor was a light-sensitive resistor mounted onto the shaft of the front wheel steering-drive assembly. This arrangement ensured that the photosensitive resistor was always facing in the direction that the robot was moving. The second sensor was a bump switch attached to the robot's outer cover. The three wheels of the robot were arranged in a triangular configuration. The front wheel had a motorized steering assembly that could rotate a full 360 degrees in one direction. The front wheel also contained a drive wheel for propulsion. The figure below shows a robot turtle built by Walter during the 1940s. This robot is now on display at the Smithsonian [15].

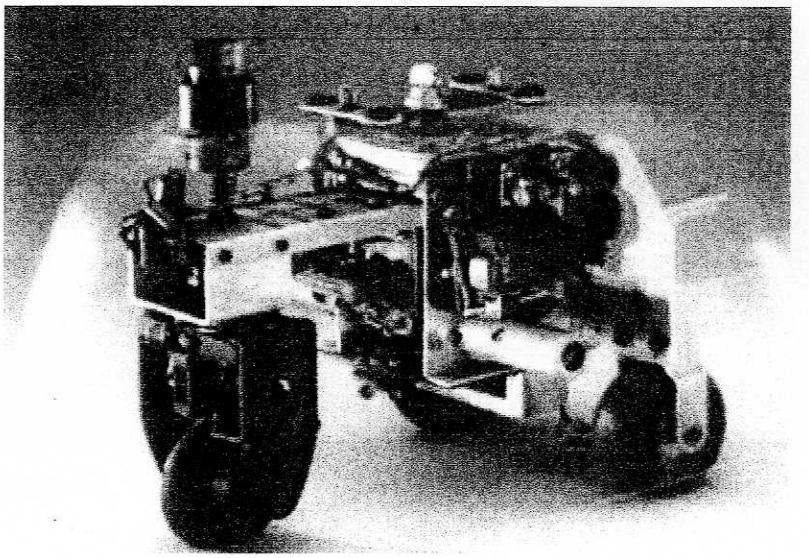

Figure 2.1: Robot Turtle built by robotic pioneer William Grey Walter [15].

The robot exhibited four modes of operation described below. The first mode is the search mode. If the room is at low light level or darkness, the robot responds by searching for a light source. The steering motor is on full speed and the drive motor is at half speed. The second mode is the move mode. If the robot found light, it will responds by turning the steering motor off and the drive motor on at half speed. The third mode is dazzle. The robot will encounters bright light and responds by setting the steering motor to half speed, while the drive motor is reversed. Finally,

the last mode is the touch mode. If the robot hits an obstacle, it will responds by setting the steering motor to full speed, with the drive motor reversed [15].

In the 1950s, W. Grey Walter had reported the strange richness provided by this particular sort of permutation introduces right away one of the aspects of animal behavior and human psychology. The Machina Speculatrix is designed to illustrate: the uncertainty, randomness, free will or independence so strikingly absent in most well designed machines [3]. Although the robot will be building is turtle-like, it is not intended to recreate any of the experiments of W. Grey Walter, although it could easily implement the sensors and program the microcontroller to do so.

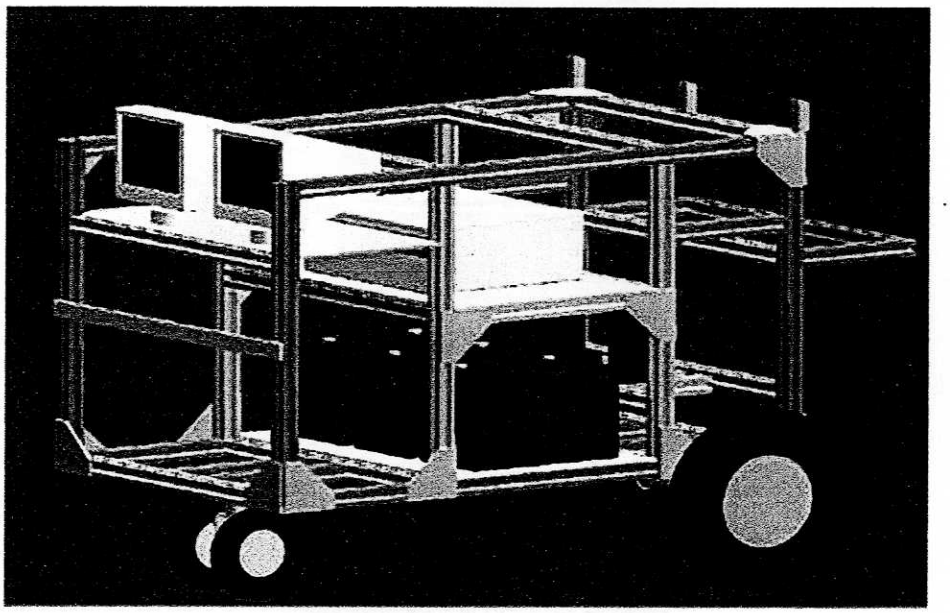

Figure 2.2: Robot which using camera sensor to avoid obstacle [3].

At Stanford, Hans Moravec developed CART in the late 1970s. This mobile robot's task was obstacle avoidance using a camera sensor. The robot would take nine pictures at one location to create a two-dimensional world model. It would then move 1 meter ahead and repeat the process. To process those nine images took 15 minutes: 5 minutes to digitize the 9 pictures; 5 minutes to perform a low level visual reduction of the image, in which obstacles were represented as circles; and 5 minutes for the maintenance of the world model and path planning. Cart was successful at avoiding obstacles, albeit very slow. It had, however, problems in getting its own position right or to see obstacles which lacked sufficiently high contrast [3].