LIGHT GUIDED PATH TRACKER ROBOT

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This Report is submitted in Partial Fulfillment of Requirements for the Degree of Bachelor in Mechatronic Engineering

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MAY 2010

ACKNOWLEDGEMENT

In The Name of Allah the Most Merciful and Most Compassionate

There are many individuals that had contributed to the success of this Final Year Project (FYP). First and foremost, our gratitude goes to Al-Mighty for bestowing the strength and patience in completing this report. My warmest gratitude goes to my supervisor, Mr. Prof. Madya Dr. Ismadi bin Bugis for giving the most beneficial guidance and assistance to me in finishing my FYP.

My in most appreciation goes to Mr. Mohd Shahrieel bin Mohd Aras, Mr. Hyreil Anuar bin Kasdirin and Mr. Zamani bin Md Sani for giving me a good comments and developing critics during FYP seminar.

Last but not least, I would like to express my deepest gratitude to my beloved mother and father, as well as our family members and everyone who has involved directly or indirectly for their moral support and understanding. It’s not an easy way to me for survive without their helping.

Thank you.

ABSTRACT

This project basically is to build a mobile robot that is able to sense light and move toward the light source as an attraction of a robot. At the end of this project, a Light Guided Path Tracker Robot was build. The robot is operated without using any external controller to control a movement of the robot. Cadmium Sulfide (CdS) photocells are used as a sensors for the robot that will detect the light source and controlled by PIC 16F877A as a controller. The sensor acts as radar to detect light illuminating from surrounding and will produce a certain differential potential. These potential differentials which is an analog signal processed by a microcontroller as a digital value, and a microcontroller will sending an instruction to the output which is consist of a mechanical system to make the robot move.

ABSTRAK

Projek ini pada asasnya adalah untuk membina sebuah robot mobil yang berkebolehan untuk mengesan cahaya dan akan bergerak ke arah sumber cahaya tersebut. Projek ini akan menghasilkan sebuah robot pintar dengan nama yang diberikan sebagai Light Guided Path Tracker Robot. Robot ini akan dikendalikan tanpa mengunakan sebarang alat kawalan luar untuk mengawal arah pergerakannya. Perintang peka cahaya (CdS photocell) akan digunakan sebagai deria kepada robot yang akan mengesan cahaya dan akan dikawal dengan menggunakan pengawal mikro PIC 16F877A. Tindak balas yang diberikan oleh perintang peka cahaya terhadap pencahayaan sekeliling akan menghasilkan satu bezaupaya yang tertentu. Bezaupaya tersebut seterusnya akan diproses oleh pengawal micro sebagai suatu nilai digital seterusnya menghantar arahan ke bahagian litar keluaran yang terdiri daripada system mekanikal dan seterusnya akan menghasilkan pergerakan terhadap robot.

"I hereby declared that I have read through this report entitle "Light Guided Path Tracker Robot" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronic Engineering"

Signature	:	…….
Supervisor's Name	:	Prof. Madya Dr. Ismadi bin Bugis
Date	:	11th May 2010

"I hereby declared that this report entitle "Light Guided Path Tracker Robot" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree."

Signature : ……

Name : Huzaifa bin Musa

Date : 11th May 2010

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LIST OF SYMBOLS

$\emptyset$	-	Magnetic Flux
I_a	-	Armature Current
V_o	-	Voltage Output
R_a	-	Armature Resistor
E_a	-	Electro Magnetic Field (EMF)
K	-	Motor Constant
n	-	Rotational Speed (rpm)
ω	-	Motor Speed
V_t	-	Total Voltage
T_e	-	Electrical Output Torque
D	-	Duty Ratio
t_{on}	-	Time ON switch
f	-	Frequency
V_{in}	-	Voltage Input
P_{on}	-	Output Power
R_f	-	Fixed Resistor
rpm	-	Revolution Per Minutes
PWM	-	Pulse Width Modulation
LDR	-	Light Dependent Resistor
ADC	-	Analog to Digital Converter

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

In this section, an introduction towards project will be briefed. This chapter consists of background, problem statement and scope of the project.

1.1 Project Background

Light Guided Path Tracker Robot is a mobile robot that similar with Light Seeking Robot, Light Finding Robot, Light Sensing Robot, Light Chasing Robot, Light Tracking Robot and Light Following Robot. As the name suggests, it able to directs itself towards the visible light as an attraction point. A user can direct shine flashlight to robot sensors and as a respond, the robot will follow the source of light. Its speed is dependent upon the intensity of the light detected. The higher intensity of the light, the faster movement of the robot. To accomplish this project, it is divided on three parts which are mechanical part, electronic part and software part.

In the mechanical part, the base of the mobile robot will be designed and fabricated. In the electrical part, there are three different circuit need to design and construct which are light sensing circuit, PIC microcontroller board and motor controller circuit. For software part, the robot will be programmed in MicroC V8.1 software.

1.2 Problem Statement

Most of the light sensing robot that has already built can only functioning well at dark environment. Some robot is designed with 3 sensors, a center, a left and a right. And some other are designed with 2 sensors, a left and a right. The movement of a robot created is also limited because the robot can only move forward, turn right and turn left, and the robot do not have ability to go backward, reverse left and reversed right. Some robot does no use microcontroller as its mind and the robot speed cannot be controlled.

The purpose of this project is to overcome all the problems faced on the light sensing robot that had been mentioned previously.

1.3 Objective of Project

The main objective of this project is to build the robot that is able to sense and follow the visible light by using PIC microcontroller as the main controller. To ensure the project progresses smoothly, there are some objectives that need to be achieved:

a) To do simulation and build the electronic circuit.
b) To design and establish the mechanical structure of robot.
c) To achieve multi direction motion.
d) To control the speed of robot by using the intensity of the light.
e) To measure the resistance value of Light Dependent Resistor (LDR) when the LDR is exposed to the light and direction of the robot will be determined from resultant of the light.

1.4 Scope of Project

To understand the function of components for the robot, there are some theories about project background research and literature review that must be studied. The components such as PIC microcontroller, light dependent resistor (LDR) sensor and motor will be considered as main component in this project. Light Guided Path Tracker Robot uses a microcontroller for processing the sensor readings and responds by controlling the motors. The microcontroller that will be used in this project is PIC 16F877A, this is due to its internal ADC which is important in converting the analog signal from the light dependent resistor (LDR) sensor to digital signal that can be read by the microcontroller. There are some software will be implemented in this project which include :

a) MicroC – used for compiling the hex file to PIC
b) Proteus – used for simulation of PIC and PCB layout design
c) Solidworks – used for mechanical structure design

CHAPTER 2

LITERATURE REVIEW

To have a brief understanding of the researches related to the project, a few literature reviews had been done. This chapter will describe the related literature reviews.

2.1 Literature 1

Title : Autonomous Light Finder Robot
Author : Katja and Guido Socher July 30, 2006 [1]
Institute : University of Pittsburgh, Pittsburgh, Pennsylvania, United States.

Autonomous Light Finder Robot is an autonomous robot controlled by an AVR microcontroller. As its name suggests, the robot has been programmed to run towards the brightest spot in the room. The robot has only 2 wheels which are driven by 2 independent motors. The independent motors used are the 2 small gear-box motors. The third wheel is a ping-pong ball. This enables the robot to turn on the spot.

The robot uses an AT90S4433 as its controller. For an autonomous robot it is obviously important that it can operate from batteries. Since the microcontroller runs with 4.5V, the motors also must work with 3-5V. The motors also not take too much current otherwise the batteries and the control circuit will get too big and heavy. For this design, the robots use an integrated motor driver chip, called L293D. This chip contains 4 digital output amplifier stages with extra protection diodes to protect against high voltages induced by the coils of a motor. Two of the output stages can be used to drive one motor. This way it is possible to let the motor turn left or right.

The Autonomous Light Finder Robot uses two types of sensor, which are touch sensors and light sensors. The touch sensors are simple switches made out of steel wire. The light sensors are 3 photo resistors and the card board is placed between the photo resistors. This card board creates shadows on the resistors when the light comes from the side. Only when the light comes exactly from the top it will provide for an equal amount of light on all 3 sensors. Comparing the values of the 3 sensors the robot can decide in which direction to go. Based on the comparison of the photo sensors, the robot can then decide which motor to turn. Since the robot have only 2 wheels , so the robot can turn its self on the spot by turning one of the wheels faster or even turning them in opposite direction.

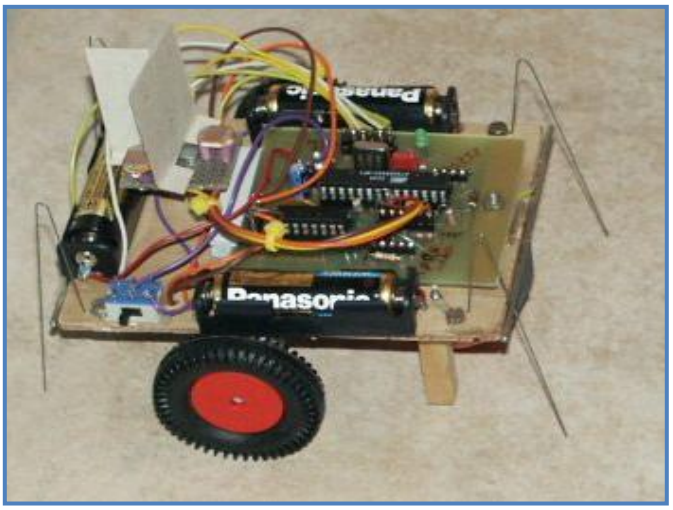

Figure 2.1 : The Autonomous Light Finder Robot [1]

2.2 Literature 2

Title	:	Light Rover
Author	:	Thientu Ho and David Shu April 22, 2005 [2]
Institute	:	Cornell University, Ithaca, New York, United Stated.

Light Rover is a robot that can sense and follow light. A user can shine a flashlight at its front and Light Rover will respond by following the light source. Its speed is dependent upon the intensity of the light detected. Light Rover uses a microcontroller for processing the sensor readings and responds by controlling the motors.

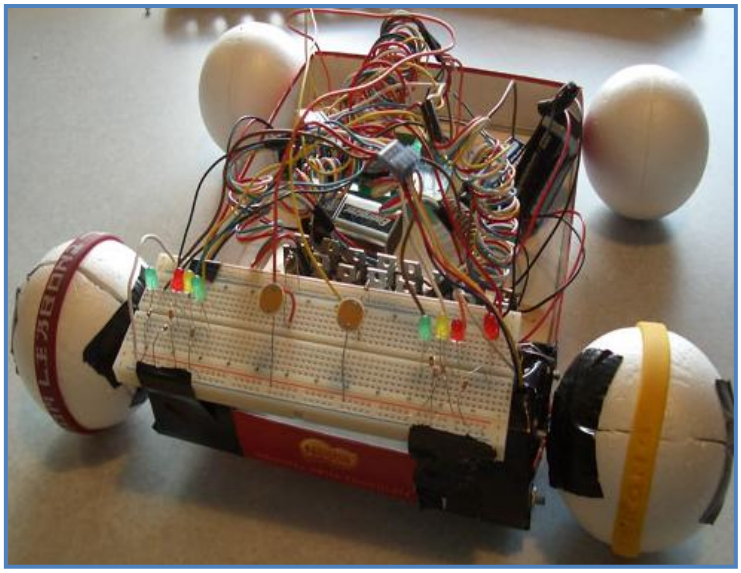

Figure 2.2 : Light Rover [2]

Light Rover is designed with two sensors in mind, a left and a right. When more light is detected on the left side, the robot will move towards it by rotating the right motor forward and the left motor backwards. The robot will know to move forward when both sensors received about the same amount of light. The robot is only designed to respond to visible light.

The robot uses two (2) bipolar stepper motor as a wheel and based on it, a major hardware design task in this project was to drive the bi-polar motors. These motors have no center taps on their windings. Therefore, to reverse the direction of the magnetic field produced by a coil, the current through the winding need to reverse by using the H-bridge stepper motor control circuit.

The controller uses is Atmel MEGA32 microcontroller. The sensors uses for the light rover are 2 CDS-T08 photocell sensors. The light sensing circuit consists of two photocells mounted on either side of the vehicle. The photocell produces a variable resistance based on light intensity.

2.3 Literature 3

Title : Veroboard Bot

Author : Jd Stufu, March 30, 2005 [3]

Institute : University of Valladolid, Valladolid, Spain

Veroboard Bot is a light sensing robot that can move towards a bright light source. The robot has the ability to avoid obstacles while seeking for the location in its environment that has the greatest amount of light. The Veroboard Bot uses PIC16F84A microcontroller as a controller.

Veroboard Bot is a differential drive photophile robot with tactile sensor. Photophile means that the robot will seek for the location with the greatest amount of light. It does this through the use of its two light dependent resistor (LDR) sensors. The LDR changes in resistance with respect to the amount of light expose to it. Its resistance is near infinity in absolute darkness and near zero when in bright light. The Veroboard Bots have two LDR sensors located in front of its, one on the left and one on the right.

Differential drive means it uses two DC motors for steering. Both motors turn on at the same speed but opposite rotation (right motor clock wise and left motor counter clock wise) to move the robot forward. To turn left, left motor if turned off while right motor turns on in clockwise rotation. To turn right the left motor is turned on in counter clockwise rotation while the right motor is turned off. To move backwards, the motors should both turn on at the same speed but opposite their direction of rotation is in opposite to the rotation of direction while moving forward. The direction of rotation of the DC motor shaft is dependent on the polarity of supply voltage applied to its terminal. Changing the polarity of the supply voltage changes the direction of rotation of the DC motor shaft. Changing the polarity of the supply voltage can be done by a solid state switch in H-bridge configuration. These solid state switches are already integrated inside a chip called L293. The L293 has 4 inputs that directly controls the 2 DC motors, 2 for each.

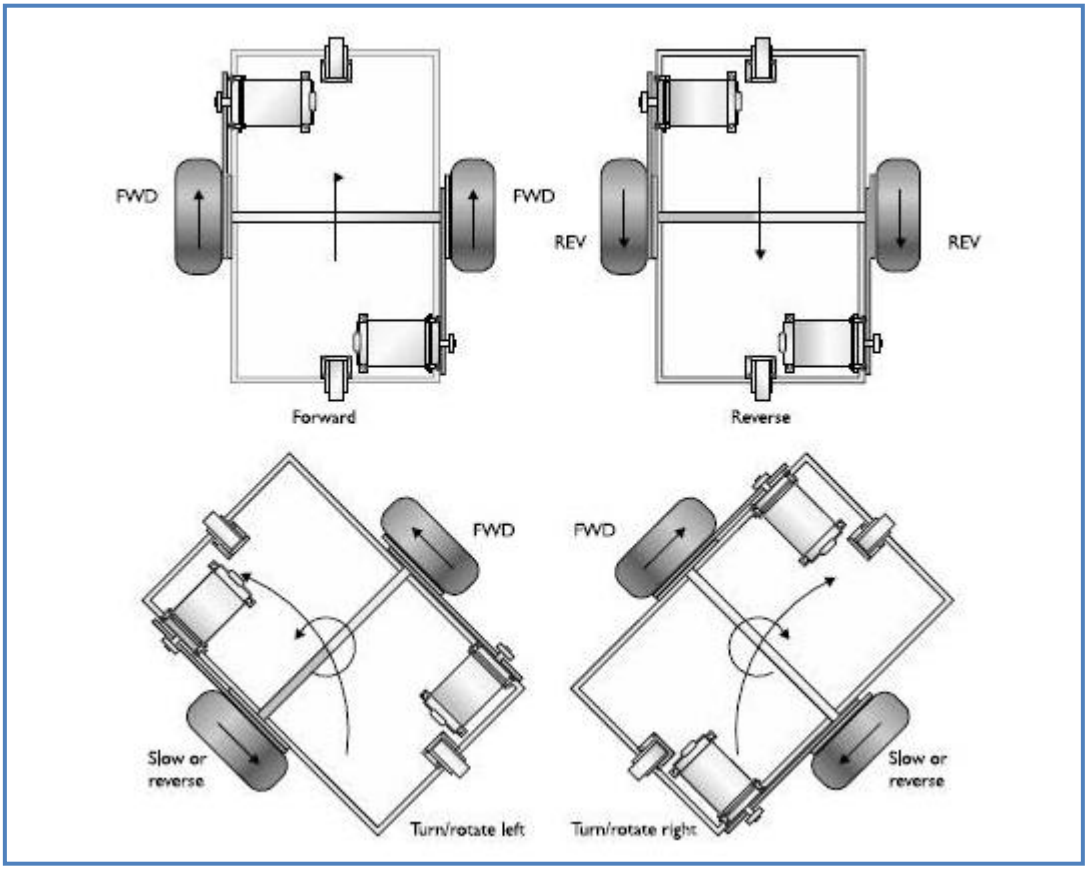

Figure 2.3 : Differential Steering [3]

2.4 Literature 4

Title	:	Light Seeking Robot
Author	:	Nicholas David Densley May 6, 2001 [4]
Institute	:	Sheffield Hallam University , South Yorkshire , England

This project is aimed at looking into the coding required for a light seeking robot. The rational for this is to look into what AI programming techniques can be used to enable a robot to cope with a dynamic environment. A dynamic environment is an area that is not clear of obstacles and the robot must be able to navigate them in an appropriate manner whilst taking into account its own power considerations.

This project aims to produce a small light seeking robot to demonstrate some of the coding produced. To control the robot an embedded PIC16F877 chip is to be used. The base of the robot is simply two bi-directional dc motors in a plastic casing. An L293N driver chip has been selected, this chip is capable of supplying a constant 1A per channel, to two bi-directionally controlled motors.