UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FACULTY OF ELECTRICAL ENGINEERING

FINAL YEAR PROJECT REPORT 2

PICK AND PLACE ROBOT USING LINE TRACKING

PREPARED BY:

MOHD AMMAR BIN MOHD ZAKARIA

B 010710180

BACHELOR OF MECHATRONIC ENGINEERING

ACKNOWLEDGEMENT

Alhamdulillah, finally the Final Year Project 2 (FYP) is complete. I take a great pleasure in this opportunity to thank many persons who generously advice and assists me while I was doing my Final Year Project 2 (FYP) which is compulsory to all UTEM students to pass before awarded the degree.

First of all, I would like to express my deepest thanks and gratitude to my project supervisor, Encik Mazree Bin Ibrahim for undivided support morally and physically, assistance, guidance, tolerance, which proved to be invaluable as to the completion of my Final Year Project 2 (FYP).

I also would like to thank the panel, Mr. Fahmi bin Miskon and Mr. Shahrudin bin Zakaria. I also would like to take this opportunity to express my appreciation to my family and friends for their patients, understanding and also for their undivided support that they had gave me throughout the completion of my project.

Last, but not least I also would like to thank all those helping and supporting me directly and indirectly during my Final Year Project 2.

ABSTRACT

This project is about to build an autonomous robot which is a Pick and Place Robot Using Line Tracking. This project is contains three main parts which are included electric circuit, mechanical design and programming. A Pick and Place Robot Using Line Tracking is an autonomous robot that had been combining from Pick and Place Robot and Line Follower Robot to make the robot works smarter. To build a good autonomous robot, the robot must be very easily and freely to be controlled by the pilot to make sure it can perform well. Commonly, this robot is used to pick and place items that need to sent. Usually for some function like in factory, send the container from front of line to end of line or some other function that need to sent item from other place to one another place. Basically, this robot is using several sensors to guide the direction which has been lined with white tape and the robot is using several motor to make the movement of the robot. These projects are focus on the usage of PIC as a controller, motor as a mover and sensor as the line guider. This robot functioning automatically and fully controlled by software which are programmable.

ABSTRAK

Projek ini adalah berkenaan dengan membina satu robot automatik yang diberi nama Pick and Place Robot Using Line Tracking. Projek ini terdiri daripada 3 bahagian utama iaitu bahagian litar elektrik, rekaan mekanikal dan juga program. Pick and Place Robot Using Line Tracking ini adalah salah satu robot automatik yang digabungkan daripada Robot Pick and Place dan juga Line Follower Robot bagi menjadikan Robot Pick and Place Robot Using Line Tracking ini bekerja dengan pintar. Umumnya robot ini digunakan bagi mengambil dan juga menghantar barang ke tempat yang hendak dihantar dengan mengikut garisan yang telah dibuat. Seperti di sesetengah kilang, menghantar barang dari Front of Line ke End of Line atau pun menghantar barang dari satu tempat ke satu tempat yang lain. Pada dasarnya, robot ini menggunakan beberapa sensor sebagai pengikut arah yang telah digariskan pada lantai dan robot ini juga menggunakan beberapa jenis motor untuk membuat pergerakan robot. Robot ini akan beroperasi dalam keadaan automatik dan sepenuhnya dikawal oleh program.

DECLARATION

"I hereby declared that I have read through this report entitle "Pick and Place Robot Using Line Tracking" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronic Engineering"

Signature : ....

Supervisor's Name : Encik Mazree Bin Ibrahim

Date : 12/05/2010

DECLARATION

"I hereby declared that this report entitle "Pick and Place Robot Using Line Tracking" is the result of my own work 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 : Mohd Ammar Bin Mohd Zakaria

Date : ......12/05/2010......

TABLE OF CONTENT

TABLE OF CONTENT

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLE

CHAPTER 1

INTRODUCTION

"*Robot* is a mechanical device which can be programmed to perform some task of manipulation or locomotion under automatic control."

"*Industrial robot* is a programmable, multi-function manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks."

"*Pick and place robot* is a simple robot, often with only two or three degrees of freedom, which transfers items from place to place by means of point-to-point moves.

Little or no trajectory control is available. Often referred to as a 'bang bang' robot."

"*Manipulator* is a mechanism, usually consisting of a series of segments, jointed or sliding relative to one another, for the purpose of grasping and moving objects usually in several degrees of freedom. It may be remotely controlled by a computer or by a human." [Note: The words "remotely controlled.. .by a human" indicate that this device is not automatic.]

"*Intelligent robot* is a robot which can be programmed to make performance choices contingent on sensory inputs."

This project is to design a robot. It included the mechanism, circuit and programming. After the base robot was built, the robot will undergo test run and than from the test we can collects data and identify the weakness and further improvement.

1.1 Background of the Project

A pick and place robot using line tracking is a robot that can sent item from one place to one another place by using line tracking. In current state, most of the industrial factory uses a lot of human to send and pick their items. Basically, this robot is using several sensors to guide the direction which has been lined with black or white tape and the robot is using several motor to make the movement of the robot. This project will focus on the usage of PIC as a controller, motor as a mover and sensor as the line guider. This robot will be functioning automatically and fully controlled by software which is programmable. This function will be able to help the owner in managing their timing in managing their items. Thus, this robot is solving a common problems faced by some industrial factory. This is the main reason why this paper is proposed as the final year project.

In this project, the main purpose is to build a robot that can be pick and place item and control by a programming. The entire objective, scope and other will be discussed in the next chapter

1.2 Objective

The main objective of this project is to build a Pick and Place Robot Using Line Tracking. In order to make this project successful, the objectives have been declared these objectives must be achieved in completing this project. Objectives are a guidance of any project, so the objectives have been listed below.

1) To design a suitable body, griper and wheel robot
2) To achieve smooth motion using the sensor and motor combination.
3) To build mechanical structure that suitable and can perform efficiently.
4) To implement programmable software to be cooperated with the PIC

1.3 Scope

The scope of this project is to build a robot structure that will function properly referring to the objective where the need of the design must be build in good shape to make sure it suitable with the motor and other stuff.

Next, to create a computer program that will process the whole data from input to the output. The program must be declared as the mechanical part is done to make sure the robot will function properly.

Lastly, perform an experiment that is including testing and commissioning the product to make sure the product well function as stated in the objective.

1.4 Problem Statement

Based on current problems faced by factory, human power is used in order to sort and send the item towards its location. Transferring item location to location uses human power and it does take a lot of human power as well as time.

As using human source, precious time is used up for unimportant things where as human got to look after the material that needs to be monitored before it reaches its storing location.

The waste of time because of the transferring of material and sorting material where as the workers can allow themselves to do other things rather than transferring material which can be done using this robot.

The transferring material from point to point are having problems nowadays which are the efficiency of transferring is not effective where as the workers need to make sure the previous line is totally ready for the transfer.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of Pick And Place Robot Using Line Tracking

A Pick and Place Robot Using Line Tracking is a robot that can sent item from one place to one another place by using line tracking. This robot have a basic elements which are include PIC micro controller and its associated assembly programming, DC motor subsystem, sensory subsystem, and some electronics & mechanical parts. For this project, the Pick and Place Robot by Using Line Tracking was constructed with to solve the human work in the industrial. This robot was programmed to travel following the tape that has been attach on the floor for the purpose of sending items from one location to another. This robot is using several sensors to guide the direction which has been lined with black or white tape and the robot is using several motor to make the movement of the robot. This project will focus on the usage of PIC as a controller, motor as a mover and sensor as the line guider. This robot will be functioning automatically and fully controlled by software which is programmable. In this chapter, there are several information about the stuff that need in this project. The information about the controller, motor and other information are described in this chapter. According to the observation and the survey from the sample project that have in the internet and journal, there are some method that been used. For the locomotion there are several method that been used.

- Servo motor
- Brushless motor
- Stepper motor

2.1.1 RC Servos

RC servos are hobbyist remote control devices servos typically employed in radio-controlled models, where they are used to provide actuation for various mechanical systems such as the steering of a car, the flaps on a plane, or the rudder of a boat. RC servos are composed of an electric motor mechanically linked to a potentiometer. Pulse-width modulation (PWM) signals sent to the servo are translated into position commands by electronics inside the servo. When the servo is commanded to rotate, the motor is powered until the potentiometer reaches the value corresponding to the commanded position. Due to their affordability, reliability, and simplicity of control by microprocessors, RC servos are often used in small-scale robotics applications. The servo is controlled by three wires, ground (usually black/orange), power (red) and control (brown/other colour).. Servo is wired as brown (negative), red (positive) and orange (signal). The servo will move based on the pulses sent over the control wire, which set the angle of the actuator arm. The servo expects a pulse every 20 ms in order to gain correct information about the angle. The width of the servo pulse dictates the range of the servo's angular motion. A servo pulse of 1.5 ms width will set the servo to its "neutral" position, or 90°. For example a servo pulse of 1.25 ms could set the servo to 0° and a pulse of 1.75 ms could set the servo to 180°.. Voltage ratings vary from product to product, but most servos are operated at 4.8 V or 6 V DC from a 4 or 5 cell NiCd or NiMH battery, or a regulated LiPo pack.

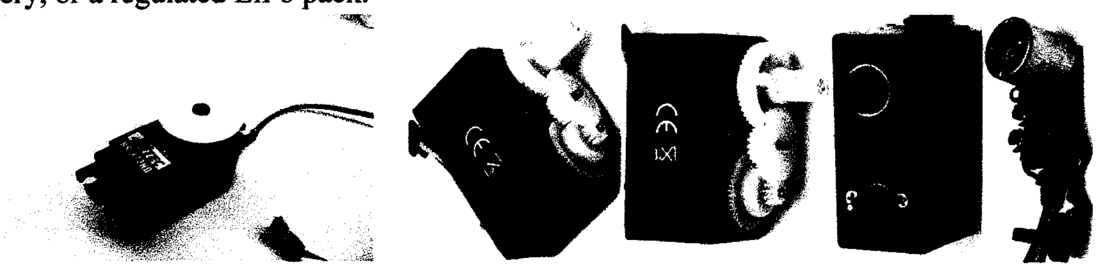


Figure 2.1: RC Servos Motor

2.1.2 Brushless DC Motor

A brushless DC motor is a synchronous electric motor which is powered by direct-current electricity (DC) and which has an electronically controlled commutation system, instead of a mechanical commutation system based on brushes. In such motors, current and torque, voltage and rpm are linearly related. A brushless DC motor powering a micro remote-controlled airplane. The motor is connected to a microprocessor-controlled brushless DC controller. This 5-gram motor is approximately 11 watts (15 mill horsepower) and produces about two times more thrust than the weight of the plane. Being an out runner, the rotor-can containing the magnets spins around the coil windings on the stator.

Two subtypes exist:

- The stepper motor type may have more poles on the stator (fixed permanent magnet).
- The reluctance motor.

In a conventional (brushed) DC motor, the brushes make mechanical contact with a set of electrical contacts on the rotor (called the commutator), forming an electrical circuit between the DC electrical source and the armature coil-windings. As the armature rotates on axis, the stationary brushes come into contact with different sections of the rotating commutator. The commutator and brush system form a set of electrical switches, each firing in sequence, such that electrical-power always flows through the armature coil closest to the stationary stator. In a brushless DC motor, the electromagnets do not move, the permanent magnets rotate and the gamaray remains static. This gets around the problem of how to transfer current to a moving armature. In order to do this, the brush-system/commutator assembly is replaced by an electronic controller.

The controller performs the same power distribution found in a brushed DC motor, but using a solid-state circuit rather than a commutator/brush system. Because the controller must direct the rotor rotation, the controller needs some means of determining the rotor's orientation/position (relative to the stator coils.) Some designs use Hall effect sensors or a rotary encoder to directly measure the rotor's position. Others measure the back EMF in the undriven coils to infer the rotor position, eliminating the need for separate Hall effect sensors, and therefore are often called sensorless controllers. Like an AC motor, the voltage on the undriven coils is sinusoidal, but over an entire commutation the output appears trapezoidal because of the DC output of the controller.

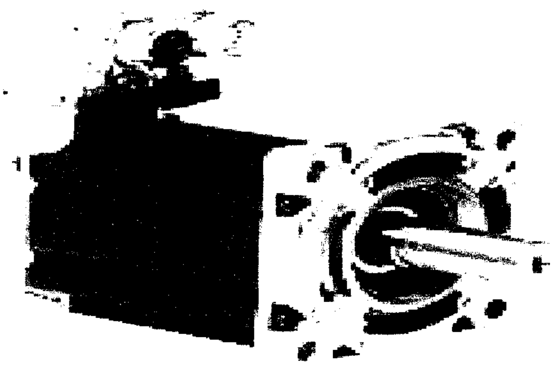


Figure 2.2: Brushless DC Motor

2.1.3 Stepper Motor

A stepper motor (or step motor) is a brushless, synchronous electric motor that can divide a full rotation into a large number of steps. The motor's position can be controlled precisely, without any feedback mechanism (see Open-loop controller). Stepper motors are similar to switched reluctance motors (which are very large stepping motors with a reduced pole count, and generally are closed-loop commutated). Stepper motors operate differently from DC brush motors, which rotate when voltage is applied to their terminals. Stepper motors, on the other hand, effectively have multiple "toothed" electromagnets arranged around a central gear-shaped piece of iron. The electromagnets are energized by an external control circuit, such as a micro controller. To make the motor shaft turn, first one electromagnet is given power, which makes the gear's teeth magnetically attracted to the electromagnet's teeth. When the gear's teeth are thus aligned to the first electromagnet, they are slightly offset from the next electromagnet. So when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one, and from there the process is repeated. Each of those slight rotations is called a "step," with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle. The characteristic of stepper motor:

1. Stepper motors are constant power devices.

2. As motor speed increases, torque decreases.

3. The torque curve may be extended by using current limiting drivers and increasing the driving voltage.

4. Steppers exhibit more vibration than other motor types, as the discrete step tends to snap the rotor from one position to another.

5. This vibration can become very bad at some speeds and can cause the motor to lose torque.

6. The effect can be mitigated by accelerating quickly through the problem speeds range, physically damping the system, or using a micro-stepping driver.

7. Motors with a greater number of phases also exhibit smoother operation than those with fewer phases.

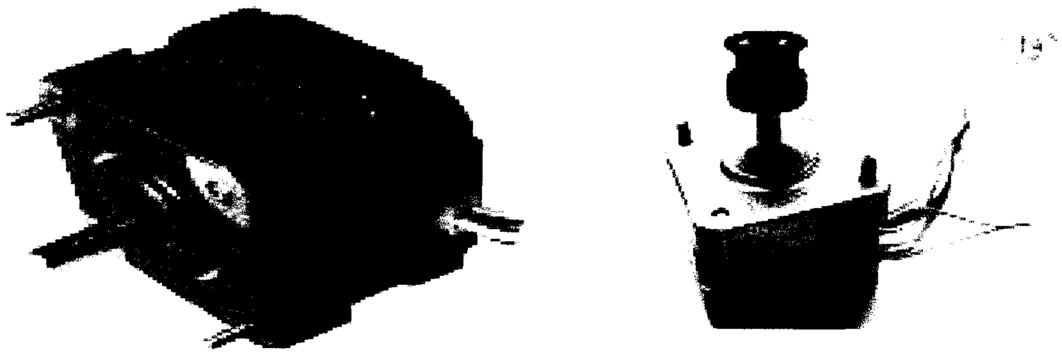


Figure 2.3: Stepper Motor

2.2 Navigator for Line Tracking

The navigator for line tracking there are several method that been used.

- IR sensor
- Inductive sensor
- Ultrasonic sensor

2.2.1 Infra-Red Proximity Sensor

This infra – red proximity sensor is easy to build, easy to calibrate and still, it provides a detection range of 35 cm (range can change depending on the ambient light intensity).

- Can be used for most indoor applications
- Can be measure the speed of object moving at a very high speed

    i) industry

    ii) tachometers

Infrared radiation (IR) is electromagnetic radiation whose wavelength is longer than that of visible light (400-700 nm), but shorter than that of terahertz radiation (100 µm - 1 mm) and microwaves (~30,000 µm). Infrared radiation spans roughly three orders of magnitude (750 nm to 100 µm). Direct sunlight has a luminous efficacy of about 93 lumens per watt of radiant flux, which includes infrared (47% share of the spectrum), visible (46%), and ultra-violet (only 6%) light. Bright sunlight provides luminance of approximately 100,000 candela per square meter at the Earth's surface. Infrared imaging is used extensively for military and civilian purposes. Military applications include target acquisition, surveillance, night vision, homing and tracking. Non-military uses include thermal efficiency analysis, remote temperature sensing, short-ranged wireless communication, spectroscopy, and weather forecasting. Infrared astronomy uses sensor-equipped telescopes to penetrate dusty regions of space, such as molecular clouds; detect cool objects such as planets, and to view highly red-shifted objects from the early days of the universe Humans at normal body temperature radiate chiefly at wavelengths around 10μm (micrometers). At the atomic level, infrared energy elicits vibrational modes in a molecule through a change in the dipole moment, making it a useful frequency range for study of these energy states for molecules of the proper symmetry. Infrared spectroscopy examines absorption and transmission of photons in the infrared energy range, based on their frequency and intensity.

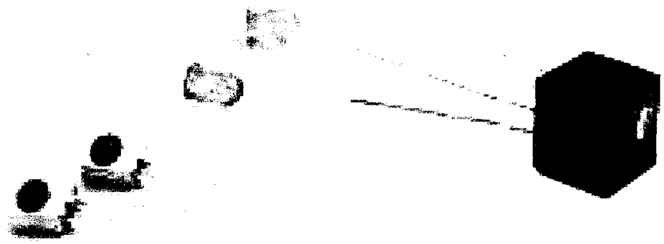


Figure 2.4: Infra-Red Proximity Sensor

2.2.2 Inductive Sensor

An inductive sensor is an electronic proximity sensor, which detects metallic objects without touching them. The sensor consists of an induction loop. Electric current generates a magnetic field, which collapses generating a current that falls asymptotically toward zero from its initial level when the input electricity ceases. The inductance of the loop changes according to the material inside it and since metals are much more effective inductors than other materials the presence of metal increases the current flowing through the loop. This change can be detected by sensing circuitry, which can signal to some other device whenever metal is detected.

Common applications of inductive sensors include metal detectors, traffic lights, car washes, and a host of automated industrial processes. Because the sensor does not require physical contact it is particularly useful for applications where access presents challenges or where dirt is prevalent. The sensing range is rarely greater than 6 cm, however, and it has no directionality.

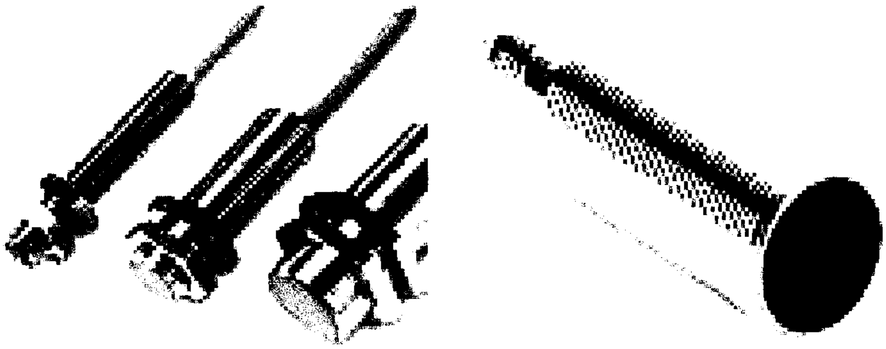


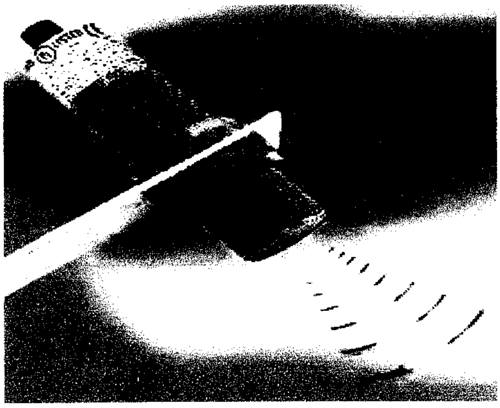
Figure 2.5: Inductive Sensor

2.2.3 Ultrasonic Sensor

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank, and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure the amount of liquid in a tank, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms, and non-destructive testing.

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 20,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed. The technology is limited by the shapes of surfaces and the density or consistency of the material. For example foam on the surface of a fluid in a tank could distort a read



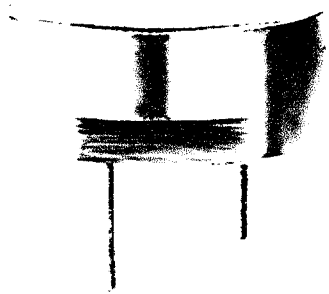


Figure 2.6: Ultrasonic Sensor

2.3 Controller

For controller they usually used:

- PIC
- PLC
- Relay
- Fuzzy logic
- PID controller
- State feedback

2.3.1 The PIC16F877A Microcontroller

A microcontroller is a computer-on-a-chip used to control electronic devices. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general purpose microprocessor (the kind that used in a pc). A typical microcontroller contains all the memory and interface needed for a simple application, whereas a general purpose microprocessor required additional chips to provide these function. A microcontroller is a single integrated circuit with the following key features:

- Central processing unit – ranging from small and simple 8-bit processor to sophisticated 32 or 64-bit processor.
- Input/output interfaces such as serial port
- Peripheral such as timer and watchdog circuit
- RAM for data storage
- ROM,EEPROM or Flash memory for program storage
- Clock generator – often an oscillator for a quartz timing crystal, resonator or RC circuit

This integration drastically reduces the number of chip and the amount of wiring and PCB space that would be needed to produce equivalent system using separate chip. The PIC16F877A (Programmable Interface Controller) contains a 8192 x 14 Flash EEPROM, 33 I/0 port pins, 8 channels of A/D converters, IC and SPI bus compatible pins, power on reset, watchdog timer, power saving sleep mode, brown-out detection circuitry including external interrupt and various internal interrupt sources.

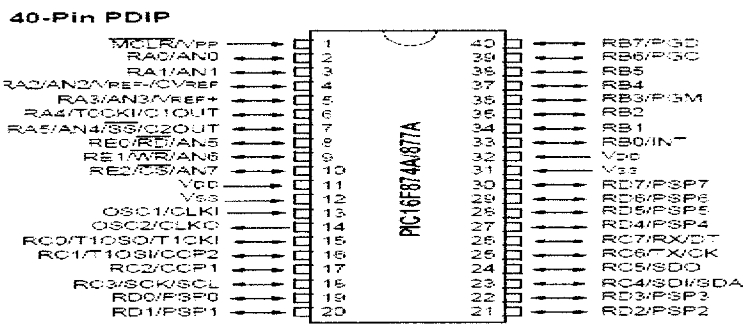


Figure 2.7: The diagram of PIC16F877A and its pin description.