PICK AND PLACE ROBOT (ROBOTIC ARM)

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MAY 2009

" I hereby declare that I have read through this report entitle "title of the project" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Mechatronic)"

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PICK AND PLACE ROBOTIC ARM

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A report submitted in partial fulfillment of the requirements for the degree of_____

Faculty Of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2009

I declare that this report entitle "*title of the project*" 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 : .....

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Date : 06 MAY 2009

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ABSTRACT

This project is to design and develop a "Robotic Arm for Pick and Place Application" using PIC microcontroller. This project combines the knowledge of electronic and electrical. The objective of this project is to design and build a more compact, usable and cheaper pick and place robotic arm for educational purpose uses PIC microcontroller from Microchip Technology as the control system to control all the activities. Input devices such as Infrared sensors will send a signal to PIC; then PIC will make a response accordingly. The response normally involves turning ON or OFF an output signal to some of out devices such as servo motors and switches.

ABSTRACT

Projek ini adalah untuk mereka dan membina sebuah "Tangan Robotic untuk Kegunaan Angkat dan Letak" menggunakan mikropengawal PIC. Projek ini mengasimilasikan pengetahuan dari bidang elektronik dan elektrikal. Objektif kepada projek ini adalah untuk mereka dan membina sebuah tangan robotik yang lebih mampat, berguna dan murah untuk kegunaan pembelajaran menggunakan mikropengawal PIC daripada Microchip Technology sebagai sistem kawalan untuk mengawal semua aktiviti-aktiviti. Masukan komponen seperti sensor inframerah akan menghantar signal kepada PIC; dan PIC akan membuat respon-respon dengan tepatnya. Respon-respon ini pada kebiasaannya melibatkan penyalaan BUKA ataupun TUTUP signal kepada sesebuah komponen keluaran seperti motor servo elektrik dan suis.

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CHAPTER 1

INTRODUCTION

1.0 Background

This project is titled robotic arm for Pick and place robot which is meant to be constructed on hardware and software. This proposed project is to build a robotic arm that is capable to pick an object through the sensor that is attached to it and place the object accordingly to the coordinated places. The system that will be build will be divided into three circuits: microcontroller circuit, driver circuit and sensor circuit. These systems will be powered by a 9V battery. To create a systematic, faster and efficient operation, microcontroller will be used. This microcontroller will function to process the input received from the sensor circuit and perform the action programmed. The movements of the robotic arm are discussed detailed in Chapter 4. This robotic arm has one degrees of freedom (1 DOF).

1.1 Problem Statement

In today industries, most of the factories run by automated robots in order to deal with their daily production activities especially in the automation field which uses robotic arms from welding, material handling, and thermal spraying, to painting and drilling.

Although there are many robotic products available in the market, none of them are cheaper in terms of price. Ricky Hill [3] wrote for Energy Business Review saying that robotic fuel arm dispensing is an expensive fantasy. Another article from ScienceDaily wrote that most robot arms are expensive to build when subjected the case of ISELLA; a bionic robot arm built which is kind on the purse and gentle with people [4].

Most of the robotic arms available are too bulky. This can be proved as an article from NewScientistTech wrote that most robotic arm for example Schwartz's robotic arm requires computers, and bulky equipment [5].

The existing robotic arm was designed based on specific purpose and function. This means that its input and outputs is fixed and cannot be reprogrammed for any other application or use. This is to prevent for any modifications and alterations to their products.

So for this project, the above problems stated will be neutralized and a robotic arm will be produced suitable with the application for educational purposes.

1.2 Objective

In every project, there must be a reason why it was conducted. Objective defined how successful the project has been. It gives the benefits to organize the efforts toward accomplishing the desired project. Thus the objective for this project can be stated clearly in one single word that is:

"To design more **compact**, **usable** and **cheaper** pick and place robotic arm for educational purpose".

1.3 Scope

Scopes in a project is the vision for a person to know the parts that need to be perform. For this pick and place robotic arm, I have outlined several scopes for the whole project.

This project scopes are:

1. To determine the complexity and the degree of freedom (DOF) level of the robotic arm
2. To design a robotic arm
3. To determine and to study a suitable microcontroller
4. To study and familiarize with the programming language

1.4 Methodology

In this project, the whole process will be separated into two parts; the first will be constructing the robotic arm and the second will be developing program for the pick and place application. The flow chart of the project robotic arm is as shown in Figure 1.1.

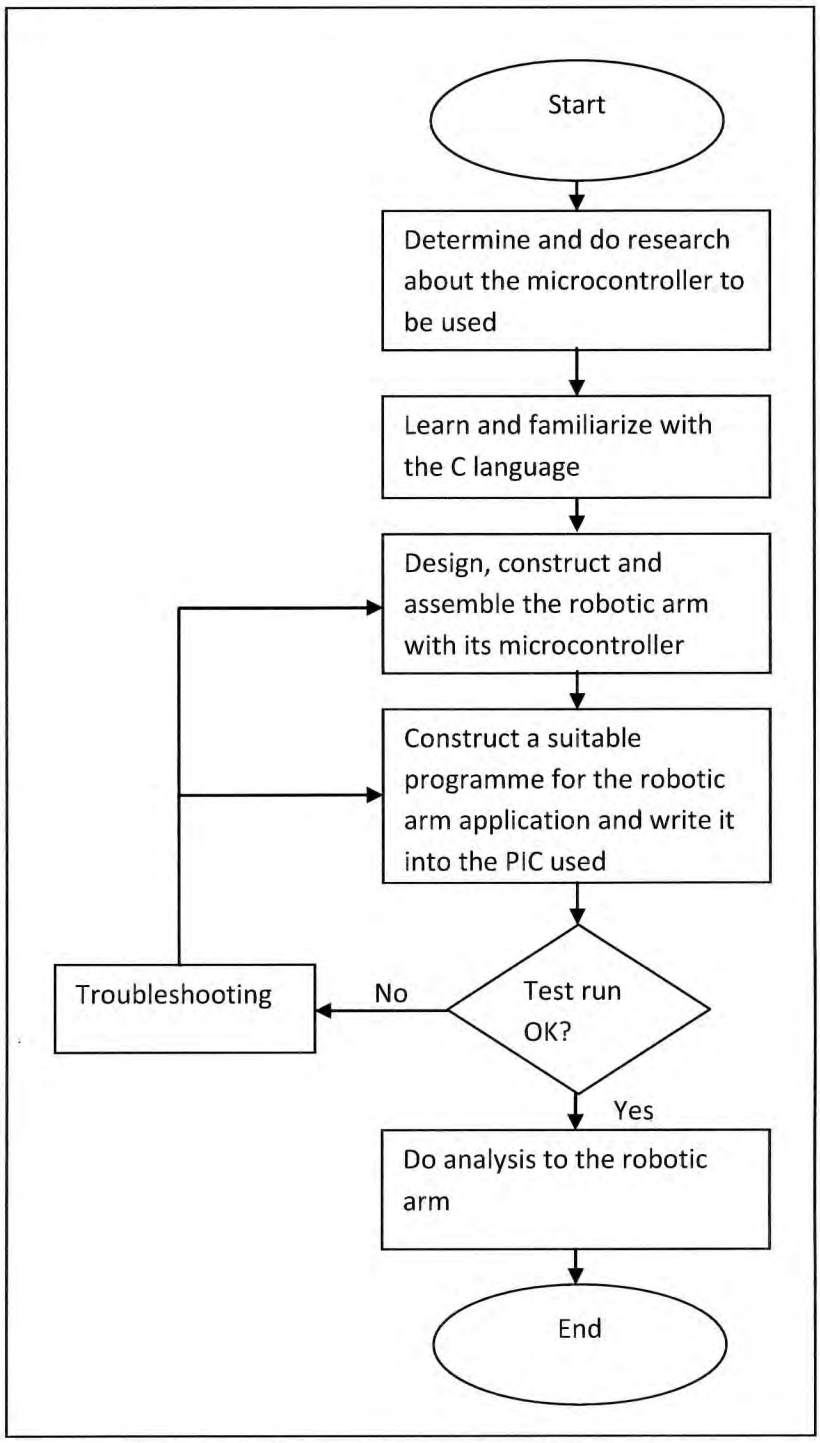

Figure 1.1 The flow chart of the robotic arm.

1.4.1 Determine and do research about the microcontroller to be used

Before starting to commend the project, problem statements need to be analyze and why the project is conducted. Problems that need to be identified would not only be the one which might occur during conducting the project but also with the system that is to be design. That includes the type of microcontroller that is going to be used.

There are many types of microcontroller that can be choose from such as 403 PowerPC CPU from Applied Micro Circuits Corporation (AMC), Nios II 32-bit from Altera, Blackfin from Analog Devices, AT89 series from Atmel, 8048 family from Intel, PIC16 series from Microchip Technology and many more.

Therefore, a suitable one is needed to suit with the application of pick and place robotic arm. In this process, every detail of the component to be used are identified and the budget to achieve the objective of the project that is to design a cheaper robotic arm.

1.4.2 Learn and familiarize with the programming language

After choosing the suitable microcontroller, then the next step is to choose a programming language in order to program the microcontroller and to use it. There are several types of languages offered for the programming but the most well known were assembler, BASIC, C and Pascal. Thus, research needed to be done in order to know which programming language can provide the better solution with the programming by knowing each languages pros and cons.

1.4.3 Design, construct and assemble the robotic arm with its microcontroller

After the above steps have been done, now is the time to design the desired robotic arm. There are many ways to design a robotic arm but several questions needed to be pointed out before designing it such as what is the object to be lift, how heavy is the object to be lift, how far can the arm stretch, how many degree of freedom is the robotic arm and what is the material used to build the robotic arm and its composition. These questions are compulsory in order to build a reliable and efficient robotic arm.

After these measurements have been taken, the robotic arm can now be constructed and assembled together with the microcontroller chosen.

1.4.4 Construct a suitable programme for the robotic arm application and write it into the microcontroller used

Based on the designed robotic arm, a suitable programme is being constructed using the programming language chosen to be written into the microcontroller used. This program is built to suit with the application of pick and place robotic arm.

During this stage, simulation is also being conducted through simulation software to verify that the programme written is working perfectly in order to protect the components and microcontroller from being damaged in case of any error.

1.4.5 Test run

This is the stage where the robotic arm was tested together with the programming to verify whether the robotic arm function as it was suppose to be or not.

If the test run fails, thus troubleshooting is needed to identify the faulty of the robotic arm from the design part and from the programming part. If the test run was a success, thus it can be continued with the analysis to the robotic arm.

1.4.6 Do analysis to the robotic arm

Analysis need to be done after completing with building the robotic arm. This is to know how far can the robotic arm go and what are its pros and cons. It was also needed to identify whether the arm functions as it was suppose according to the theory involved during designing it.

1.5 Organization of Report

In this project report, the first chapter will discuss the background, problem statement, objective, scope and methodology of the project. In chapter two, the literature review which acts as the reference of the project will be reviewed. The theory and design of the project will be explained in chapter three. In chapter four, the results of the project will be presented along with its discussion and analysis. In the final chapter which is chapter five, the project was concluded and suggestion was added for future planning.

1.6 Summary

This chapter is about the background of the project and the problem statement which encouraged for this project to be conducted. The objectives and scopes along with the methodology of the project will be covered in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Literature review is defined by Wikipedia [6] as *a body of text that aims to review the critical points of current knowledge on a particular topic*. Its goal is to bring the reader up to date with current literature on a topic and forms the basis for another goal, such as the justification for future research in the area. Thus for this project, several thesis and research has been reviewed to get the understanding of building a robotic arm.

2.1 Development of a Microcontroller Based Robotic Arm by Jegede Olawale, Awodele Oludele, Ajayi Ayodele and Ndong Miko Alejandro from Babcock University, Ilisan- Remo, Nigeria

This project thesis is about making a robotic arm which comprises of three stepper motors to interface with the Intel 8051 based microcontroller. This project studies about the 8051 microcontroller I/O signals to ensure that it is compatible with that of the robotic arm stepper motors and to test the robot's motor signals through programming the 8051 microcontroller.

Assembly programming is used to develop the programs for the EPROM 2732 on the 8051 microcontroller platform that takes robot's motor signal as I/O and controls the robot operation programmatically.

Three stepper motors and gears were used to construct the arm as it is a three dimensional structure. In the mechanical structure of the arm, there is a stepper motor at the base, which allows for circular movement of the whole structure; another at the

shoulder which allows for upward and downward movement of the arm; while the last stepper motor at the wrist allows for the picking of objects by the magnetic hand.

This thesis project designed an anthropomorphic type of robot design and is illustrated as shown below in Figure 2.1.

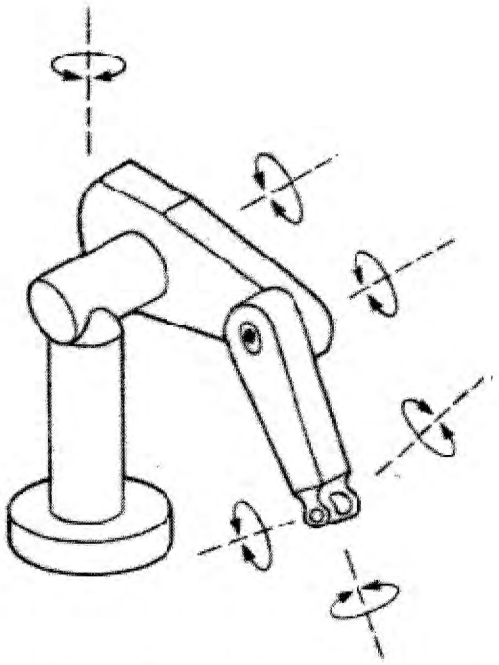

Figure 2.1 A typical prototype of anthropomorphic type of robot design [2]

The method employed in designing and constructing the robotic arm are based on the operational characteristics and features of the microcontrollers, stepper motors, the electronic circuit diagram and most importantly the programming of the microcontroller and stepper motors.

The figure below shows the electronic circuit diagram of the development board. The connection of the identified components and devices are as shown in Figure 2.2. The components shown are: the *MCU*, the *LATCH 74LS373, the EPROM 2732, Intel 8255 PIO, diodes, resistors, capacitors, inductors, transistors,* and *op-amps* [2].

These components work together to achieve the set goal of controlling the anthropomorphic-like arrangement of the stepper motor. The microcontroller is the processing device that coordinates all the activities of all the components for proper functioning.

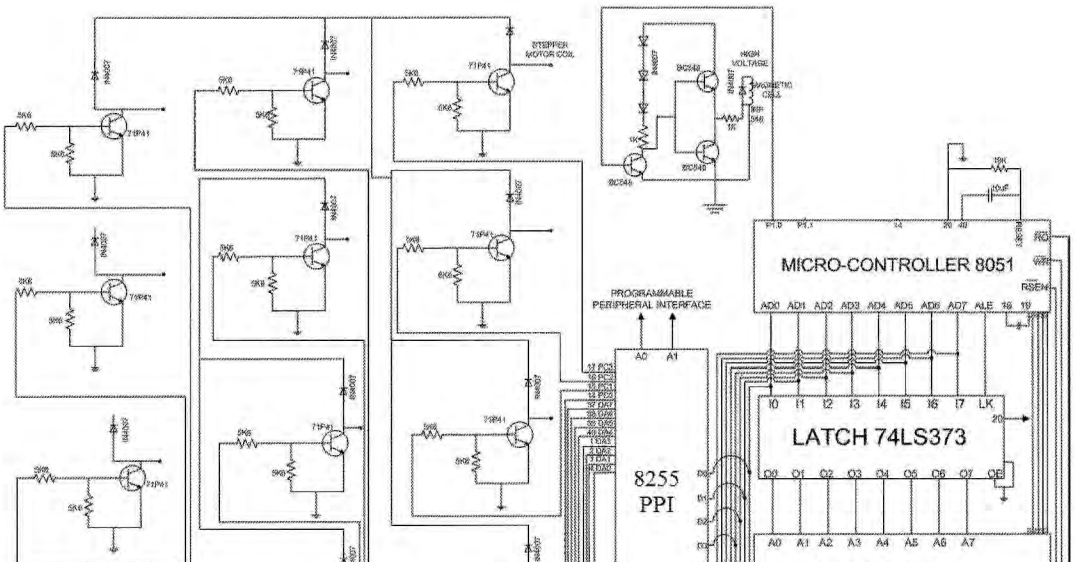

Figure 2.2 The electronic diagram of the development board [2]

The block diagram of the robotic arm designed is as shown in Figure 2.3.

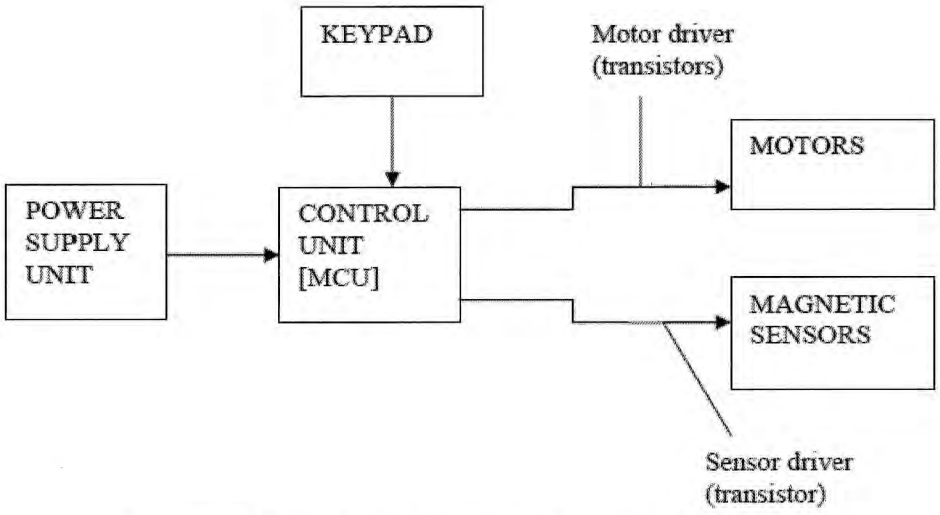

Figure 2.3 The block diagram of the robotic arm [2]