PACKAGING CD AND MINI CD MACHINE

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Dedicated to my beloved mother, father and brother.

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ABSTRACT

The introduction, literature review, methodology, results and conclusions for the development of a CD and Mini CD Packaging Machine is discussed in this report. Since industries nowadays are facing with a rising cost in labor and workforce, automation plays a big part to increase productivity and still maintain its quality. The machine that will be used as transfer medium in this project is a robot arm where, the main objective is to build, test and run the robot arm as a working machine. From the literature review done, the types of robot arms that are available in the market now have been studied. The types are such as cartesian, cylindrical, spherical and revolute can be used for multiple applications based on the industry's needs. A Programmable Logic Controller (PLC) will be used in this project that acts as the controller which determines the movements of the robot arm. The movements are gained from the Direct Current (DC) servo motors that will provide motion for the robot arm based on the Degrees of Freedom (D.O.F) required. As for the sensing systems, it is used to sense the size of the CDs where it will then trigger the PLC to perform the next process which is, pick and place. Next, for the pick and place purposes, vacuum pads shall be integrated with a basic pneumatic system to complete this project. To ensure the completion of this project, the methodologies have also been discussed here with a relevant flow chart and a Gantt chart. Lastly, as for the results of this project; the robotic arm has functioned properly and achieving all the objectives that are stated in this project.

ABSTRAK

Pengenalan projek, kajian latar belakang, metodologi kajian, keputusan dan kesimpulan untuk Mesin Pembungkusan Cakera Padat dan Cakera Padat Mini telah dibincangkan di dalam laporan ini. Oleh sebab industri kini banyak mengalami masalah dari segi kos kerja dan tenaga pekerja, automasi memainkan peranan yang penting dalam meningkatkan produkiviti dan juga meningkatkan kualiti produk. Mesin yang akan digunakan dalam projek ini sebagai mesin pangantara adalah robot lengan dan dimana objektif utama projek ini adalah untuk membina, menguji dan mengoperasi robot ini sebagai satu mesin yang sempurna. Daripada kajian latar belakang yang telah dijalankan, jenis-jenis robot lengan yang berada di pasaran juga telah dikenal pasti. Jenis - jenis robot ini terdiri daripada kartesian, silinder, sfera dan bulatan yang boleh digunakan untuk pelbagai aplikasi mengikut kehendak industri. Sebuah Kawalan Pengaturcaraan Logik (PLC) akan digunakan bagi tujuan mengawal pergerakan robot. Pergerakan ini didapati dari kegunaan motor servo Arus Terus (AT) dan ianya bergantung kepada tahap kebebasan darjah yang dikehendaki. Untuk tujuan sistem pengesan, ianya akan digunakan untuk mengesan saiz cakera padat dan kemudian memberi isyarat kepada PLC untuk proses seterusnya iaitu angkat dan letak. Untuk tujuan ini, vakum akan digabungkan dengan sistem pneumatik asas bagi menyiapkan projek ini. Untuk memastikan projek dapat disiapkan, metodologi telah dibincangkan dengan menggunakan carta alir dan carta Gantt yang bersesuaian. Akhirnya, setelah kajian latar belakang selesai; robot lengan ini dapat berfungsi dengan baik dan mencapai objektif yang telah dinyatakan untuk projek ini.

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CD	-	Compact Disc
DC	-	Direct Current
DOF	-	Degrees of Freedom
AT		Arus Terus
DOS	-	Disk Operating System
ECM	-	Electrically Commutated Motor
FBD	-	Function Block Diagram
IL	-	Instruction List
LAN	-	Local-Area Network
LD	-	Ladder diagram
PLC	-	Programmable Logic Controller
PSM	-	Projek Sarjana Muda
SFC	-	Sequential Function Charts
ST	-	Structured Text
PWM	-	Pulse Width Modulation

LIST OF APPENDIX

CHAPTER I

INTRODUCTION

1.1 Project Introduction

An industrial robot arm is meant to simplify task easier and still maintain its efficiency higher than that of a normal human operator in the industry [7]. The basic robot arm consist of several rigid links connected in series by revolute or prismatic joints which can perform various task such as welding, material handling (pick & place), and thermal spraying, to painting and drilling.

A robot arm in the industry nowadays uses at least two or more Degrees of Freedom (D.O.F) to pick and place object, where one for moving and another to pick the object by gripping. As so, the robot arm in this project will be built with 3 D.O.F to provide full efficiency towards the aim of the project.

This project includes the designing and the developing of the robotic arm which will be used to place the CD or Mini CD to their cover by acting as a transfer medium. The CD or mini CD from the Disc Section (such as a conveyor) will be picked and placed to their respective covers (packaging according to the CDs size) automatically.

The covers too will be in their respective sizes where Disc Cover 1 for CD and Disc Cover 2 for Mini CD. The Robot Arm is also capable of detecting the types of disc (CD or Mini CD) by the use of sensors. In normal operation, the CD or Mini CD will be placed at place A (such as a conveyor or Disc Section); then, the Robot Arm will receive the signal from the Disc Section and pick the Disc to transfer it into the Disc Cover Section. This operation will run automatically by the use of a PLC.

The gripper for the robotic arm will be built to include the sensors and the pneumatic vacuum pads to detect and pick the CDs without damaging it. Servo motors will be used to move the robotic arm according to the range of movement which is controlled by the PLC.

1.2 Project Objectives

There are several objectives that are to be achieved at the end of the project which includes:

a) To develop a robot arm that is capable of pick and place CD and Mini CD to their respective places.
b) To build, test and run the robot arm as a working machine by the use of a PLC.
c) To develop a PLC program that can be used to control the robot arm to perform its task.

1.3 Problem Statement

Industries nowadays are facing with the rising cost of labor and workforce because of the expanding global market that requires products to be delivered more and on time without affecting the quality of the product itself [12]. Human operators in industries

are more likely to cause mistakes and are not efficient compared to the use of machines. Machines are efficient and are considered cost saving on the long term.

The robot arm is basically a machine that can replace a human operator and perform various tasks efficiently and still maintain a constant speed while handling the process. By the use of the robot arm too, cost for labor or workforce can be reduced significantly while still maintain a proper production of an industry.

This project highlights the problem found in the Compact Disc or CD manufacturing industry. Since CDs has become in various sizes, packaging the CDs according to the sizes has made the respective industry to provide different packaging section or lines for different sizes of CDs to avoid any mistakes.

The robot arm that is being developed in this project can be used in this industry without facing any problem since it can differentiate the sizes of CDs, pick and place it according to the individual covers. The process too shall be more efficient and faster than a normal human operator.

1.4 Scope

As to ensure the completion of project achieves the stated objectives, the project shall be completed within these scopes:

i. The project involves building, testing and running a 3 Degrees of Freedom (D.O.F) robot arm as a working machine to perform its task.
ii. The hardware consists of mechanical structure and assembly; servo motors for movements, pneumatic system for pick and place purposes, sensors as the sensing devices and a Programmable Logic Controller (PLC) to control the whole robot arm.
iii. The Keyence KV Programmer will be employed to develop and implement the PLC program to control the processes of the robot arm.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter will provide details and discuss about the source that are related to this project. It consists of the products that are already in the market nowadays and also contains the theory of the components, equipments, programming software and controller that will be used in the project.

Research has to be done to provide an initial review in the robotic arm field before starting on this project. It is essential to know how to absorb some industrial robot arm methods that are connected directly or indirectly with this project. While carrying out research in the robotic arm field, any advantages or disadvantages about the current robot arm in the market can be taken as a reference to develop a successor pick and place robot arm. The main key points to take as reference are the control system involved, actuators and sensors used, and also the theories and analysis that are relative to the pick and place robot arm.

2.2 Robot Arm Constructions

An industrial robot is a general-purpose, computer-controlled manipulator consisting of several rigid links connected in series by revolute or prismatic joist. One end of the limb is attached to a supporting base while the other end is free and equipped with a tool or gripper to manipulate objects or to perform assembly tasks. The motion of the joints results in relative motion of the links.

Mechanically, a robot arm is composed of an arm and a wrist subassembly unit which is designed to reach work piece located within its work volume. The work volume is the sphere of influence that of a robot arm where its movements can deliver the wrist subassembly unit to any point within the sphere. The arm generally can move anywhere within the work volume by employing the correct Degrees of Freedom (D.O.F). The combination of the movements positions the wrist at the work piece. The wrist subassembly unit usually consists of three rotary motions.

The concept is illustrated by the Cincinnati Milacron T3 robot arm and Unimation PUMA robot arm as shown on Figure 2.1.

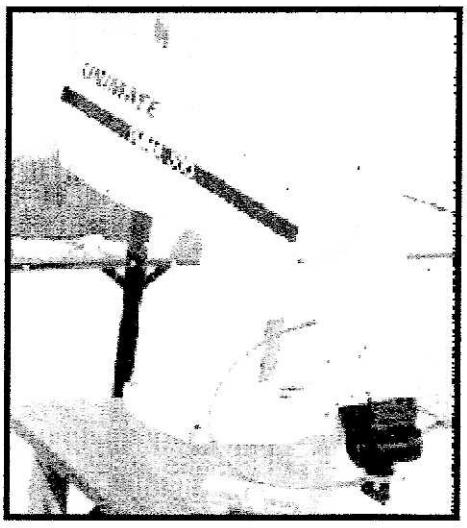

Figure 2.1 Unimation PUMA Robot Arm.

Many commercial industrial robot arms are widely used in manufacturing and assembly task, such as material handling, parts assembly, paint spraying, loading and unloading numerically controlled machines, space and undersea exploration, prosthetic arm research, and in handling hazardous materials. These robots fill in any of the four basic motion-defining categories as shown in Table 2.1.

Table 2.1 Four Robot Basic Motion.

No.	Types of Robot	Axes	Example
1	Cartesian Coordinates	3 Prismatic	IBM's RS-1 Robot
			EPSON
2	Cylindrical Coordinates	2 Prismatic and 1 Revolute	Versatran 600
			Prab
3	Spherical Coordinates	1 Prismatic and 2 Revolute	Unimate 2000B (Unimation Inc)
4	Revolute	3 Revolute	T3 (Cincinnati Milacron
			PUMA (Unimation)

(i) Cartesian X, Y, Z

Robot whose arm has three prismatic joints and axes that is coincident with a Cartesian coordinator as shown in Figure 2.2.

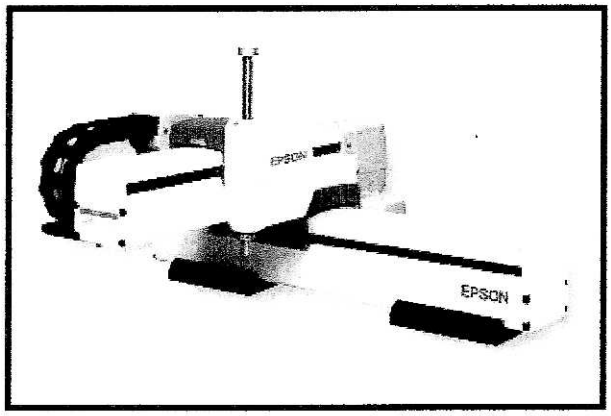

Figure 2.2 Cartesian Robot.

(ii) Cylindrcal

Robot whose axes form a cylindrical coordinate system. This robot is shown in Figure 2.3.

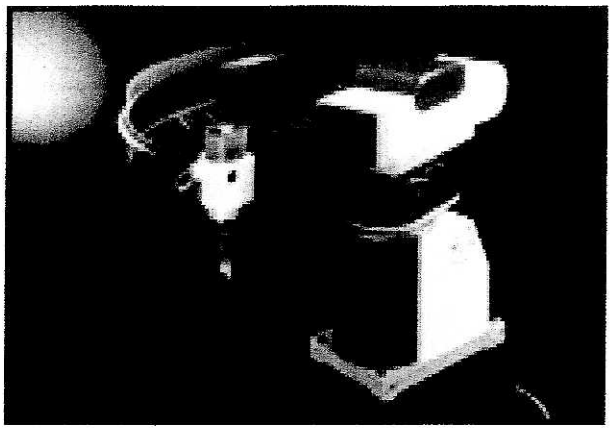

Figure 2.3 Cylindrical Robot.

(iii) Spherical

Robot whose axes form a polar coordinate system such as the spherical robot shown in Figure 2.4.

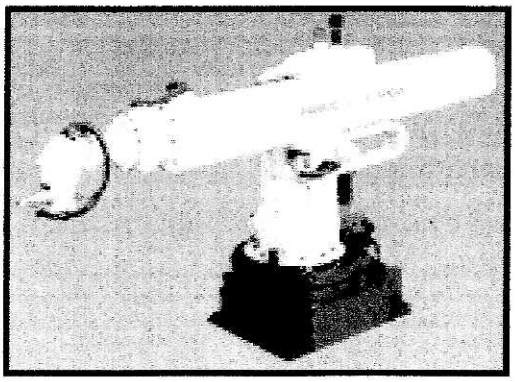

Figure 2.4 Spherical Robot.

(iv) Revolute

Robot whose arm has at least three rotary joints. This type of robot is shown in Figure 2.5.

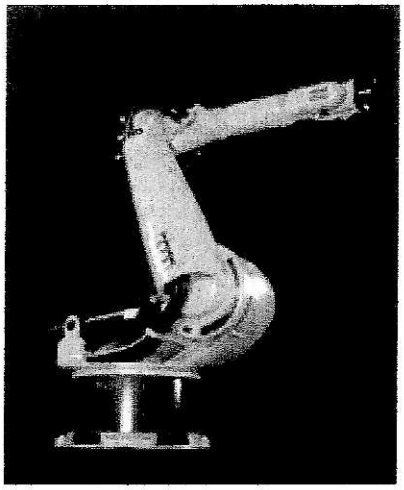

Figure 2.5 Revolute Robot.

2.3 Programmable Logic Controller (PLC)

A programmable logic controller, or PLCS, is a software-based equivalent of a relay panel. A PLC is a general-purpose device. One PLC can be programmed to control a variety of machines, and programs can be changed easily for new jobs or changes in production routines.

PLC was once primitive devices capable of providing only minimal feedback about machine operation and status. The situation has changed drastically, however, with the advent of more powerful computer chips and new standards that give a PLC access to information throughout a manufacturing plant. Whereas the first PLC generally provided only limited information about the status of relay contacts, new monitoring capabilities let the user know exactly what is happening on the floor. [13]

Computers have expanded PLC power through greater speed and programming flexibility. Today's PLC almost always have a port that permits a user to tie into a computer. Three developments have helped bring about this integration of PLC and