



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

# **DEVELOPMENT OF PICK AND PLACE PNEUMATIC MANIPULATOR TRAINER**

Thesis submitted in accordance with the partial requirements of the Universiti  
Teknikal Malaysia Melaka for the  
Bachelor of Manufacturing Engineering (Robotic and Automation) with Honours

By

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Faculty of Manufacturing Engineering

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## **APPROVAL**

This thesis submitted to the senate of KUTKM and has been accepted as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic And Automation). The members of the supervisory committee are as follow:

.....

Main Supervisor

(En. Khairol Anuar B. Rakiman)

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## **ABSTRACT**

The project that being done is the construction of a pick and place robot by utilizing PLC and pneumatic system. In order to make this project, an understanding toward the fundamentals of the PLC and the pneumatic system must be obtained. In order to do so, literature reviews in that particular aspect are being done thoroughly. This project uses the fully mechanism from the pneumatic component like linear actuator, gripper and rotary table. For the controller it used the PLC from Keyence. From this project, student can get some practical when using this robot in the education. This project can help the student to get more understanding when learn the subject that relevant on this robot. This project will expose how to design and assemble the pneumatic part and also how to wiring the PLC. From the result, this project is successful by completing the objective, but it has a few problems. Among of the problem is about the precision of robot, the speed movement and lastly about the repeatability.

## **ABSTRAK**

Projek ini menerangkan tentang rekabentuk, pemasangan dan pembinaan robot sebagai jurulatih pengolah. Projek ini menggunakan konsep pneumatik untuk mendapatkan pergerakan dan ia juga menggunakan PLC sebagai alat pengawalnya. Projek ini juga menggunakan mekanisme tersebut sepenuhnya iaitu dengan menggunakan komponen pneumatik penggerak lurus, pengepit dan meja berputar. Robot ini dikawal dengan menggunakan PLC daripada jenis Keyence. Daripada projek ini, para pelajar boleh mendapatkan latihan secara praktikal apabila menggunakan robot ini sebagai alat bantu pendidikan ditempat mereka. Projek ini boleh membantu pelajar untuk mendapatkan lebih pengetahuan apabila mempelajari perkara-perkara yang berkaitan dengan robot. Dalam melaksanakan projek ini, pengetahuan berkenaan unsur pneumatik dan pengaturcaraan PLC sangat penting kerana projek ini adalah berdasarkan kepada kedua-dua unsur ini.. Projek ini akan mendedahkan tentang bagaimana hendak mereka bentuk dan memasang bahagian-bahagian pneumatik dan juga bagaimana untuk membuat pendawaian PLC. Berdasarkan daripada hasil yang diperolehi, projek ini berjaya mencapai matlamatnya, walaubagaimanapun ia mempunyai beberapa masalah. Di antara masalah-masalah yang dihadapi adalah berkaitan dengan ketepatan, kelajuan pergerakan dan akhirnya berkenaan dengan kebolehulangan robot ini.

## **DEDICATION**

*For My beloved mother, family and also my friend*

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*Assalamualaikum .....*

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*Wassalam...*

*Mohd Azlan B. Hj. Daud*



# TABLE OF CONTENTS

Abstract	i
Abstrak	ii
Dedication	iii
Acknowledgement	iv
Table Of Contents	v
List Of Figure	ix
List Of Table	xiii
<b>1. INTRODUCTION</b>	<b>1</b>
1.1. Problem Statements	2
1.2. Objectives	3
1.3. Scope	3
<b>2. LITERATURE REVIEWS</b>	<b>4</b>
2.1 History Of Robot	4
2.2 What Robots Are ?	4
2.3 Industrial Robots	5
2.3.1 Interest Of Utilization Robot In Industry	7
2.4 Classification Of Robot	9
2.4.1 Cartesian Robot	9
2.4.2 Cylindrical Robot	10
2.4.3 Spherical/Polar Robot	12
2.4.4 Articulated Robot	13
2.4.5 Scara Robot	15
2.4.6 Parallel Robot	16
2.5 Resolution, Accuracy And Repeatability	17

2.5.1 Resolution	17
2.5.2 Accuracy	18
2.5.3 Repeatability	21
<b>3. METHODOLOGY</b>	<b>23</b>
3.1 Mechanical Component	25
3.1.1 Linear Actuator	25
3.1.2 Mechanical Gripper	30
3.1.3 Rotary Table	35
3.1.4 Solenoid Valve	39
3.2 Electric Component	42
3.2.1 Programmable Logic Controller ( Plc)	42
3.2.1.1 Inside A Plc	43
3.2.1.2 Plc Operation	44
3.2.2 Power Supply	45
3.3 Manipulator Design	46
3.3.1 Programming	46
3.3.2 Circuit Design	51
3.3.3 Body Structure Design	52
3.4 Assembly	52
3.5 Testing Stage	53
<b>4. DESIGN AND DEVELOPMENT</b>	<b>55</b>
4.1 Mechanical Structure	55
4.1.1 Base Design	55
4.1.1.1 Material List For Base	57
4.1.2 Adaptor Design	59
4.2 Electrical	63
4.2.1 PLC	63

4.2.1.1 PLC Cable	63
4.3 Programming	65
4.3.1 Input and Output	66
4.3.2 Description About The Movement	68
4.3.3 Sequence Movement	69
4.3.4 Timing Chart	70
4.3.5 Ladder Diagram	71
4.4 Assembly	72
4.4.1 Base assemble and main wiring	72
4.4.2 Pneumatic Part Assemble	76
4.4.3 Whole Attachment	81
4.4.4 Limits Switch Attachment	82
<b>5. RESULT AND DISCUSSION</b>	86
5.1 Testing and Result	86
5.2 Discussion	89
<b>6. CONCLUSION AND SUGGESTIONS FOR FUTHER WORK</b>	91
6.1 Conclusion	91
6.2 Suggestions for further work	92
<b>REFERENCES</b>	93
<b>APPENDICES</b>	
A : Assembly Layout with Bill of Material	
A1 : Assembly Layout	
B : Frame	
C : Base Plate	
D : Rotary Adapter	
E : Cylinder Adapter	

- F : Air Chuck Adaptor
- G : Cover Frame Front
- H : Cover Frame Back
- I : Cover Frame Side
- J : Standard Type of Series MHZ2
- K : Basic Type Of Series CXS
- L : Basic Type Of Series MSQ
- M : Solenoid Valve SY3000 series
- N : Ladder Diagram

## LIST OF FIGURES

Figure 1.1 : Typical Pick And Place Robot Work Cell	2
Figure 2.1 : Cartesian Robot	9
Figure 2.2 : Principle Of Robot	9
Figure 2.3 : Work Space	10
Figure 2.4 : Cylindrical Robot	10
Figure 2.5 : Principle Of Robot	11
Figure 2.6 : Work Space Of Robot.	11
Figure 2.7 : Spherical Robot	12
Figure 2.8 : Principle Of Robot	12
Figure 2.9 : Work Space Of Robot.	13
Figure 2.10: Articulated Robot	13
Figure 2.11 : Principle Of Robot	14
Figure 2.12 : Work Space	14
Figure 2.13 : Scara Robot	15
Figure 2.14 : Principle Of Robot	15
Figure 2.15 : Work Space Of Robot	16
Figure 2.16 : Parallel Robot	16
Figure 2.17 : Principle Of Robot	17
Figure 2.18 : Work Space Of Robot.	17
Figure 2.19 : Diagram Of Accuracy In Two Dimensions Frame, Without Mechanical Inaccuracy Consideration.	19
Figure 2.20 : Diagram Of Accuracy And Spatial Resolution In Which Mechanical Inaccuracies Are Represented By A Statistical Distribution	19
Figure 2.21 : Errors Affecting The Robot Structure	20

Figure 2.22 : Example Of Representation Of Resolution, Accuracy, And Repeatability Of A Robot Arm	22
Figure 3.1 : Flow Chart For Planning Stage	24
Figure 3.2 : Dual Rod Cylinder	25
Figure 3.3 : Component Part Of Standard Piping Model CXSM 10	27
Figure 3.4 : Dimension Of Standard Piping	29
Figure 3.5 : Gripper Model MHZ2-10D	31
Figure 3.6 : Dimension Of Gripper	33
Figure 3.7 : Component Part Of Gripper	34
Figure 3.8 : Component Part Of Gripper When It Closed	34
Figure 3.9 : Rotary table	36
Figure 3.10 : Dimension of Rotary table	37
Figure 3.11 : Dimension of Rotary table	38
Figure 3.12 : 5/2 Way Single Solenoid Valve	39
Figure 3.13 : Labeling of Solenoid Valve	41
Figure 3.14 : Dimension Solenoid Valve	41
Figure 3.15 : The Plc	42
Figure 3.16 : These Steps Are Continually Processed In A Loop.	45
Figure 3.17: Power Supply	45
Figure 3.18 : Example Flow Of The Sequence Movement	47
Figure 3.19 : Home Position	48
Figure 3.20 : Cylinder B Extend And Gripper Open ( ON )	48
Figure 3.21 : Cylinder C Extend And Gripper Close ( OFF )	49
Figure 3.22 : Cylinder C Retract	49
Figure 3.23: Motor A Rotate 90° ( ON And OFF )	50
Figure 3.24: Cylinder C Extend And Gripper Open ( ON )	50
Figure 3.25 : Back To Home Position.	51
Figure 3.26 : Base Structure	52
Figure 3.27 : Complete Assembling	53

Figure 4.1 : Base Assembly	55
Figure 4.2 : Material For Frame And Side Cover	56
Figure 4.3 : Base Material	56
Figure 4.4 : Base Frame	57
Figure 4.5 : Base Plate	58
Figure 4.6 : Cover Frame Front	58
Figure 4.7 : Cover Frame Back	59
Figure 4.8 : Cover Frame Slide	59
Figure 4.9 : Adaptor Assemble	60
Figure 4.10 : Rotary Table	61
Figure 4.11 : Air Chuck Adapter	62
Figure 4.12 : Air Cylinder Adapter	63
Figure 4.13 : Communication Port	64
Figure 4.14 : Telephone Cable	64
Figure 4.15 : RS232 Connector	64
Figure 4.16 : Wire Position	64
Figure 4.17 : Soldering Step	65
Figure 4.18 : Finished Communication Cable	65
Figure 4.19 : Label Of Input And Output	67
Figure 4.20 : Flow Of Sequence Movement	69
Figure 4.21 : Timing Chart	70
Figure 4.22 : Ladder Diagram	71
Figure 4.23 : Assembly Layout	72
Figure 4.24 : The Thread Has Already Done	73
Figure 4.25: The Screw Has Attach In Aluminum Profile	73
Figure 4.26: Aluminum Profile Already Put Together With Side Cover	74
Figure 4.27: Pin Connector	74
Figure 4.28: Power Source Connector	75
Figure 4.29: Start And Stop Button Will Attach At Side Cover Frame	75

Figure 4.30: Wiring	76
Figure 4.31: Rotary Table	77
Figure 4.32: Rotary Adapter	77
Figure 4.33: Assemble Is Already Done	78
Figure 4.34: Another Cylinder Attachment	78
Figure 4.35: Assemble Air Cylinder Adapter	79
Figure 4.36: Assemble The Cylinder With Air Chuck Cylinder	79
Figure 4.37: Attachment Among The Gripper And Air Chuck Cylinder	80
Figure 4.38: The Cylinder Has Attach At The Air Cylinder Adapter	80
Figure 4.39: Attachment For Pneumatic Part Is Already Done	81
Figure 4.40: Plc And The Solenoid Valve Wiring	82
Figure 4.41: The Limits Switch Together With The Base	82
Figure 4.42: Attachment The Limits Switch At The Front Cylinder	83
Figure 4.43: This Robot Is Already Finish With Assemble	83
Figure 4.44: Side View Of Robot Complete With Compressor	84
Figure 4.45: Right Corner View of Robot	85
Figure 5.1 : The Control Speed In Round Circle	87
Figure 5.2 : Control Speed During Adjusted	87
Figure 5.3 : Right Position	88
Figure 5.4 : Right Position	88
Figure 5.5 : Wrong Position	89
Figure 5.6 : Wrong Position	89
Figure 6.1 : Reed Switch	92



## LIST OF TABLES

Table 3.1 : Dimension Of Cylinder	26
Table 3.2 : Specification Of Cylinder	26
Table 3.3 : Standard Stroke Of Cylinder	26
Table 3.4 : Weight Of Cylinder	27
Table 3.5 : Component Part Of Standard Piping	28
Table 3.6 : Dimension Of Standard Piping	30
Table 3.7 : Specification Of Gripper	32
Table 3.8 : Holding Moment And Opening Of Gripper	32
Table 3.9 : Component Part Of Gripper	35
Table 3.10 : Specification Of Rotary Table	37
Table 3.11 : Dimension Of Rotary Table	38
Table 3.12 : Specification of Solenoid valve	40
Table 3.13 : Flow Characteristics Weight	40
Table 4.1 : Material list for base	57
Table 4.2 : List of Input	66
Table 4.3 : List of Output	66

# CHAPTER 1

## INTRODUCTION

In the modern age, every country more advanced and everything more sophisticated. Every country may can said not want to lag with modern age especially in robot utilization .Every work can make by human have more simple with helped by robot. Either it picks and place robot that many used in industry. Pick & Place robots are also used in a wide variety of material transfer applications. Basically, the machine takes a product from one spot in the manufacturing process and places it into another location. A good example is a robot picking items off a conveyor belt and placing them into packaging boxes. These fully automated systems increase efficiency, decrease the cost of production, and improve the consistency and quality of the finished products.

The typical pick and place application requires high amounts of repetitive motion. Robots can eliminate human operation of hazardous tasks such as chemical spraying or heavy lifting. Pick and place robots have high return on investment when consistent shaped parts or containers are handled. Unlike human operators, robots also have the ability to work for an extended time.



**Figure 1.1 : Typical Pick And Place Robot Work Cell**

The typical pick and placed robot can only perform its function within its work cell as being shown in figure 1.1. If a different shape of material is being used, the end effectors of the robot had to be changed as well to suit the material its handling.

### **1.1 Problem Statements**

Commonly engineering based student from polytechnic or university only learned the theory of PLC and pneumatic. The hands on knowledge within this particular area can be considered very limited. Due to that they have to be able to see and visualize the concept of these two more clearly. In order to do so application device must be within reached. To solve this problem, this project will integrate the usage of PLC and pneumatic for the purpose of training. The PLC and pneumatic trainer will be in the form of a simple pick and place pneumatic manipulator trainer.

## **1.2 Objective / Outcome**

The primary objective of design and development of pick and place pneumatic manipulator trainer. Are as below :

- 1) To understand the basic and advanced concept of the pick and place system.
- 2) To understand the functionality of the actuators and end effectors.
- 3) To create just simple robot with use PLC as a control system
- 4) To gain knowledge of sequential programming concept.
- 5) To understanding its application in the industrial area.
- 6) To eliminate the use of human power in material handling process.
- 7) Also to apply principles of robotics to a real world application.

## **1.3 Scope**

The scopes for this project are:

- 1) Design and develop the mechanical structure for the manipulator.
- 2) Assembly and testing the system operation.
- 3) Learn about the PLC programming and wiring also the pneumatic wiring.

## **CHAPTER 2**

### **LITERATURE REVIEWS**

#### **2.1 History Of Robot**

The history term robot firstly it used by a Czechoslovakian dramatist, Karel Capek ( “ chop’ek” ), he create term robot in his drama entitled “ Rossum’s Universal Robot” in early 1920s. The term of robot is originated from word ‘robota’ ,which means ‘slave laboratory’ [Man Zhihong (2004)].

#### **2.2 What Robots Are?**

Encyclopedia Britannica gives the following definition: "A robot device is an instrumented mechanism used in science or industry to take the place of a human being. It may or may not physically resemble a human or perform its tasks in a human way, and the line separating robot devices from merely automated machinery is not always easy to define. In general, the more sophisticated and individualized the machine, the more likely it is to be classed as a robot device" [ Encyclopedia Britannica (1973) ].

Other definitions have been proposed in "A Glossary of Terms for Robotics," prepared for the Air Force Materials Laboratory, Wright-Patterson AFB, by the (U.S.) National Bureau of Standards .Some of these definitions are cited below :

"Robot—A mechanical device which can be programmed to perform some task of manipulation or locomotion under automatic control." (Note: The meaning of the words "can be programmed" is not clarified. Programs can differ in their nature, and we will discuss this aspect later in greater detail.)

"Industrial robot— 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—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—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—A robot which can be programmed to make performance choices contingent on sensory inputs." [National Bureau of Standards (1980)].

### **2.3 Industrial Robots**

An industrial robot is a manipulator designed to move materials, parts and tools, and perform a variety of programmed tasks in manufacturing and production settings. Typical applications of robots include welding, painting, ironing, assembly, pick and place, packaging and palletizing, product inspection, and testing, all accomplished with high endurance, speed, and precision.

There a lot of definition that being used to describe what industrial robot really is.

a) RIA (USA Robot Industries Association )

“ A robot is a reprogrammable, multifunctional machine design to manipulate material, parts, tool, or specialized device, through variable programmed motions for the performance of a variety of tasks.”

b) JIRA ( Japan Industrial Robot Association )

“ Manipulator. A machine, the mechanism of which usually consisting of a series of segment jointed or sliding relative to one another, for the purpose of grasping and moving objects usually in several degrees of freedom. It may be controlled by an operator, a programmable electronic controller, or any logic system ( e.g cam device, wired, etc. ).”

c) BRA ( British Robot Association )

“ An industrial robot is a reprogrammable device designed to both manipulate and transport part, tool or specialized manufacturing implements through variable programmed motions for the performance of specific manufacturing tasks.”

d) ISO ( International Standards Organization )

“ A machine formed by a mechanism including several degrees of freedom, often having the appearance of one or several arms ending in a wrist capable of holding a tool or workpiece of an inspection device. In particular, its control unit must use a memorizing device sometimes it can use sensing or adaptation appliances taking into account environment and circumstances. These multipurpose machines are generally design to carry out a repetitive function and can be adapted to other functions.” [Abdul Rahman Bin Mohamad (2004)].

### 2.3.1 Interest of Utilization Robot in Industry

Another to decrease depending labors force where they have various sign, utilization robot have advantages to settle this problem. Base on the book it explain from the article some of the interest of robot such as :

a) Decreasing manufacturing cost.

Cost robot when it estimate annually is more lower than labor force total cost where the average cost robot lower than US\$5.00 per hour if compared with an labor force average US\$15.00 until US\$20.00 when it admitted facility such as changing, medical leave, rest leave and etc. robot can work 98% from the time allocated to it work but human need coffee break, lunch break and other time off for personnel reasons. Employee also must pay other remuneration like attendance allowance and etc. Robot also can decrease rate of reject by human from 50% to 5% and it can save the material and energy. Robot can decrease cost for product quality examination.

b) Increasing the productivity

Robot can work faster than human and with constant rate. So it can produce many products and it also decreases the error and repeat work. Example the welding robot can weld with average range 30 in/min for linear weld compare the human 10 in/min. Another example two robots for painting and work 20 hour spray external and internal car body take time 90 second with two layer painting and can work 20 hour a day while a expert painter need 15 to 20 min to do same duty.

c) Improve the manufacturing quality

Quality of work can perform by robot is more accuracy until 0.0008in and repeatability 0.004in. Velocity of one operation is cause to increase the product