UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AN ACCURACY STUDY ON THE POSITIONING OF THE PICK AND PLACE MANIPULATOR TRAINER

This report submitted in accordance with the requirements of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic and Automation) with Honours.

By

DENIS CHUA KIANG WUI

FACULTY OF MANUFACTURING ENGINEERING

2009

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PSM

JUDUL:

AN ACCURACY STUDY ON THE POSITIONING OF THE PICK AND PLACE MANIPULATOR TRAINER

SESI PENGAJIAN:
Semester 2 2008/2009

Saya **DENIS CHUA KIANG WUI** mengaku membenarkan laporan PSM / tesis (Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM / tesis adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM / tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. *Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☒	TIDAK TERHAD	

(TANDATANGAN PENULIS)
Alamat Tetap:
NO 72 PT654,
JLN SRI KRUBONG11,
TMN SRI KRUBONG,
75250 MELAKA

Tarikh: 12/5/2009

(TANDATANGAN PENYELIA)

Cop Rasmi:
KHAIROL ANUAR BIN RAKIMAN
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka

Tarikh: 18-05-09

* Jika laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled **"AN ACCURACY STUDY ON THE POSITIONING OF THE PICK AND PLACE MANIPULATOR TRAINER"** is the result of my own research except as cited in the references.

Signature	:	.....
Author's Name	:	DENIS CHUA KIANG WUI
Date	:	12/5/2009

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic and Automation) with Honours. The members of the supervisory committee is as follow:

.....

(PSM Supervisor)

KHAIROL ANUAR BIN RAKIMAN
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka

ABSTRACT

This project is a further study to improve the pick and place manipulator trainer to be more accurate on positioning through identifying the problems that had occur on the previous manipulator project. Through the literature review, some idea on the particular part which requires improving are studied. Then, the study on existing hardware is done by identifying problem using calculation and graphical review. The critical parts involved are gripper, rotary table, and dual rod cylinder. In order to overcome the limitation of positioning, the control system is improved by changing and adding the feed back component's signal to the pneumatic actuator such as sensor, reed switch, and directional valve. On the other hand, the OMRON CPM 2A controller will be use to replace the Keyence KV- 16T. Through this project, theoretical knowledge and practical skill is applied into this manipulator. This project provides a further understanding on software coding and hardware usage.

ABSTRAK

Projek ini merupakan kajian sambungan untuk memperbaiki robot supaya lebih tepat capai kedudukanya. Pada permulaan, masalah yang dihadapai dari robot tersebut perlu dikenalpastikan. Dari karya jurnal, beberapa bahagian yang dirancang untuk diperbaiki perlu faham dan mendapatkan beberapa idea. Seterusnya, bahagian robot dikaji melalui pengiraan dan graf. Bahagian yang berkaitan dalam kajian ini adalah penyepit, meja berputar dan silinder. Untuk menyelesaikan masalah robot capai kedudukan, jenis kawalan diperbaiki dengan menggunakan alat-alat suapbalik pada silinder seperti penderia, reed switch dan directional valve. Pengawal robot tersebut digantikan dengan OMRON CPM 2A kepada Keyence KV- 16T. Daripada projek in, pengetahuan and praktikal kemahiran dapat diaplikasikan ke dalam projek ini. Projek ini mampu banyak membantu dari segi pemahaman yang berkaitan dengan perisian robot dan perkakasan yang digunakan dalam projek ini.

DEDICATION

To my beloved family and friends.

ACKNOWLEDGEMENT

I would like to take an opportunity to say thank for my supervisor Mr. Khairol Anuar Bin Rakiman for continue support and guide to complete the project. During this project, he has given me uncountable advice and suggestion to overcome the problem had faces. Sometime he will guide me back on the track when I lost or miss the scope. Beside, I want to appreciate the technician those who expend their time direct or indirect to guide and teach me to use the lab equipments. They also are willing to give me their knowledge and opinion as a referring in the project. Furthermore, I want thank to my friends that helped and support in knowledge to overcome the difficulties. Finally, thanks to the faculty is given us a chance to applied the knowledge had learn before in this project.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

CNC - Computer Numerical Control

PLC - Programmable Logic Controller

a - Safety Margin

f - Force

g - Gravitational Acceleration

I/O - Input and Output

I - Moment of Inertia

kg - Kilogram

m - Mass

cm - Centimeter

mm - Mili-meter

mJ - Milli-joule

MPa - Mega Pascal

N - Newton

Nm - Newton Meter

VAC - Alternative Voltage

VDC - Direct Voltage

μ - Coefficient of Friction

ω - Angular Acceleration

CHAPTER 1
INTRODUCTION

1.1 Background

Nowadays, robots play an important role in industry. They can replace human labor in highly hazardous situations, especially in the processes of nuclear clean-up, dismantling and decontamination (Caldwell, 1999). In the industry field, robot manipulator arm is a most common industrial robot to perform the pick-and-place operation. Industrial robots have used three primary actuator types: electric motors (DC or AC), hydraulic cylinders and pneumatic cylinders (Caldwell, 1989). Mostly, the controlled motion was done using electric motors and computers due to powerful if compare with other forms of actuation have become practical for providing motion. But in term of cost, there is not economical and need more experience in programming.

Pneumatic actuators are widely using in robotic systems due to low cost, quickness of response and high power with low weight, power and high volume ratios (Henke, 1970). Moreover, it has a high payload-to-weight ratio that is especially important for pick and place task. They are also clean, easy to work with, and lightweight. In addition, compressed air is readily available at nearly every industrial facility. Unfortunately, position stabilization of a pneumatic actuator is difficult during the motion with high accuracy at the desired positioning.

A hierarchical close loop feedback control for pneumatic manipulators is proposed to overcome this type of problem. Where the flow of the actuator is controled for velocity, speed, and air consumption. An electrical signal to the controller is conduct as a feed back to the close loop system for read the positioning of the manipulator.

1.2 Objective

The purpose of this project is to have an accuracy study on the positioning of the pick and place manipulator trainer. Thus, the following are the objectives of this project:

a) To identify the specification and function of the existing hardware.
b) To understand the sequence of the manipulator trainer.
c) To analyse the correct position for each motion.
d) To ensure the programming in order to control the manipulator trainer.

1.3 Scope

The scope of this invention cum study will be covering the following:

a) Analysis the existing and improve hardware by come out result in graphical form.
b) Redesign and apply the suitable electrical circuit.
c) Select suitable component and device.
d) Develop a fluent sequence control system and system operation.
e) Program the PLC for increase the stability of the system.

1.4 Problem Statements

Through the observation and testing for the existing manipulator trainer, there were some problems and limitations as below:

a) Manipulator just can run for one cycle only.
b) All of the input signals are using mechanical type sensor with mechanical part for sensing the path.
c) The accuracy, repeatability, and stability are out of effectiveness because using the mechanical part to fix the limit of manipulator path.
d) The position of the manipulator cannot reset for homing when is needed.
e) When the OFF button is press emergency, the manipulator still in running condition.
f) Once the ON and OFF button is press equally, still can operate the manipulator is cause of improper interlock in the programming.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction to Control Design

Robot is a re-programmable, multifunction manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks. It usually consisting of a series of segments, jointed or sliding relative to one another, for the purpose of grasping and moving objects usually and several degrees of freedom. It may be remotely controlled by a computer or controller.

Controllers are the most important components in a robot system. If a robot has n joints, n controller are needed to control all joint actuators. The design of robot control is to solve the problem how robot's actuators are driven to achive a desire performance. A robot control system is actually the intergration of electonic hardware and computer control software.

Marco A.M (1990) discovered that high accuracy is generally unachievable in manipulators capable of producing high task forces due to such factors as high joint, actuator, and transmission friction and link elastic and geometric distortions (Marco A. M, 1990). To overcome this limitation, a suitable control system in the pick and place manipulator system should be selected.

These are the terms for select of control system in robotics, as (Asfahl C.R, 1985):

a) Control resolution

   Capability of robot's positioning system to divide the motion range of each joint into closely spaced points.

b) Accuracy

   Capability to position the robot's wrist at a desired location in the workspace, given the limits of the robot's control resolution.

c) Repeatability

   Capability to position the wrist at a previously taught point in the workspace.

There are two common classes of control systems, with many variations and combinations as open loop system and close loop system in Figure 2.1 and Figure 2.2. Through the control system, an automatic sequential control system may trigger a series of mechanical actuators in the correct sequence to perform a task like energize the solenoid valve to control the cylinder perform the physical task.

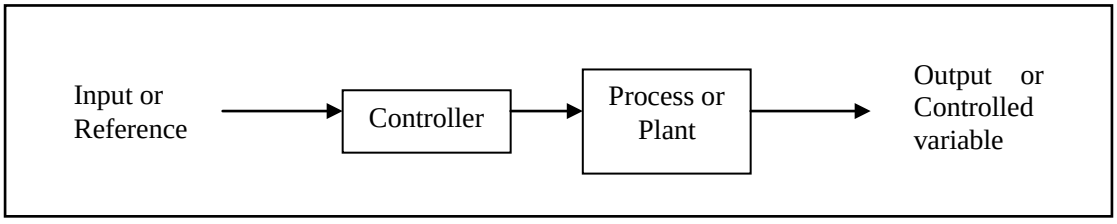

Figure 2.1: Open Loop Control System