

I0000003761

**ANALYSIS OF HAMPDEN ROBOT ARM
AND
DESIGNING A THREE d.o.f PROTOTYPE ROBOT ARM**

**Thesis is presented to fulfil the
requirement of Advanced Diploma in Electrical
Engineering of MARA Institute of Technology**

**MOHAMMAD FADZIL BIN MAHASSAN
AZIZEE BIN ABDUL AZIZ**

NOVEMBER 1994

**Department of Electrical Engineering
School of Engineering
MARA Institute of Technology
40450 Shah Alam
Selangor Darul Ehsan
MALAYSIA**

ACKNOWLEDGEMENT

In the name of Allah s.w.t., the Most Gracious, Ever Merciful, who has given us the strength and ability to complete this project and report.

All perfect praises belong to Allah alone, Lord of the world. May His blessings upon Prophet Muhammad s.a.w. and members of his family and companions.

We would like to express our deepest gratitude to our project supervisor, Ir. Dr. Syed Abdul Kader Al-Junid for his guidance, ideas, and patientness in advising and assisting our project. Our gratitude also goes to En. Maliki bin Omar and En. Ahmad Fakri bin Shaari for their guidance and willingness in sharing knowledge towards the accomplishment of this project.

We are greatly in debt to all technicians and laboratory assistants of Instrumentation Laboratory for their cooperation and support in providing components and equipments.

Also, thanks to our classmates and friends for their suggestions and contribution to this project.

Mohammad Fadzil bin Mahassan
Azizee bin Abdul Aziz
MARA Institute of Technology
Shah Alam
SELANGOR

ABSTRACT

**Analysis Of Hampden Robot Arm
And
Designing A Three Degree of Freedom Prototype Robot Arm**

**by
Mohammad Fadzil bin Mahassan
Azizee bin Abdul Aziz**

This thesis is to analyse the six axes robot arm manufactured by Hampden Inc. in the Instrumentation Laboratory, as it is not functioning according to specifications. From the analysis, two main problems have been identified. The check valve for the pneumatic system is blocked. Hence there is no output air pressure at the outlet. The stepper motor for gripper motion causes a voltage drop that effects all the devices and components that use the 12 V supply such that they cannot operates. Constructing a three degree of freedom (d.o.f) prototype robot arm starts from the analysis of mechanical parts. After that, the interface circuit, logic circuit and driver circuit have been designed to enable it to control the robot arm using the computer via computer programming.

TABLE OF CONTENTS

Topic	Page
Approval	i
Acknowledgement	iii
Abstract	iv
Table of contents	v
1.0 INTRODUCTION	1
1.1 Robot Arm: Structure and Design	2
1.1.1 Robot Joints and Links	2
1.1.2 Robot Configurations and Work Envelope	2
1.1.3 Drive System	3
1.1.4 End Effector	3
1.1.5 Robot Arm Kinematics	4
1.1.6 Robot Arm Dynamics	5
1.1.7 Robot Arm Control	5
1.2 Hampden Robot Arm	5
1.3 Designing a Prototype Robot Arm	7
1.4 Organisation of The Thesis	8
2.0 ANALYSIS OF HAMPDEN ROBOT ARM	9
2.1 Motion	9
2.2 Actuators and Mechanics	10
2.2.1 Torso Swivel	10
2.2.2 Wrist Roll	11
2.2.3 Elbow Bend	12
2.2.4 Shoulder Lift	13
2.2.5 Upper Arm Extension	14
2.2.6 Hand Grasps	15

1.0 INTRODUCTION

The term robot originated from the Czech word *robota*, which means work. Webster's New World Dictionary, 1988, defines robotics as 'the science of robotology' and robotology is defined as 'the means by which robot machines are put together and made to work'.

The Robot Institute of America defines a robot as '*a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialised devices, through variable programmed motions, for the performance of a variety of task*' (Beni, G. and Hackwood, S., 1985). However, this definition does not exclude human beings. With this definition, a robot must possess intelligent, which is normally due to computer algorithms associated with its control and sensing systems.

Today, robot is a general-purpose, computer controlled manipulator consisting of several rigid links connected by articulated or prismatic joints. One end of the chain is attached to the base and the other end is free to manipulate objects or perform assembly tasks.

Mechanically, a robot consists of an arm and a wrist. It is designed to reach the workpiece located in the work envelope. The arm assembly generally has three degree of freedom (d.o.f). The combination of the movements positions the wrist at the work envelope. The wrist will provide other degree of freedom, depending on the applications.

The six degree of freedom robot contains of three joints at the arm and another three joint at the wrist. Hence, the arm assembly is the positioning mechanism, while the wrist is the orientation mechanism.