

LAPURAN PROJEK TAHUN AKHIR
KURSUS DIPLOMA LANJUTAN KEJURUTERAAN ELEKTRONIK
KAJIAN KEJURUTERAAN, I.T.M., SHAH ALAM

MICROCOMPUTER CONTROLLED
ROBOTIC ARM

BY

HASSAN BIN ALIAS

DECEMBER 1984

ACKNOWLEDGEMENT:

The author would like to express his sincere gratitude to his project supervisor En. Ahmad Fauzi bin Ibrahim for his devoted and tireless guidance and encouragement during the course of accomplishing the project.

The author's appreciation to the following personnels for their encouragement and constructive comments without which the project would not have been accomplished better:-

1. En. Yusof (Course Tutor of the Electronic Department)
2. En. Azad Chacho (Project Coordinator)
3. En. Zainal (Lecturer of Computer Science)
4. En. Nazimuddin (Texas Instrument's Engineer)
5. En. Mail Sukadin (Lektron Cooperation's Engineer)
6. All Electronics Department Lecturers and Technicians.

Also the author like to thank the mechanical department which provided materials for making the chasis of this project.

Last but not least, the author's report is specially dedicated to his loving family; lecturers School of Engineering fellow classmate who had given their great encouragement during the course of his study in ITM.

Hassan Alias

Advanced Diploma in Electronics Engineering

M.I.T., SHAH ALAM.

PREFACE

The microcomputer controlled robotic arm is designed to have a five degree of freedom and of a small scale size. It has an articulated arm jointed at shoulder, elbow and wrist positions. Both the upper and lower arms rotate about the base and there is a motor driven gripper.

The entire robotic system can be divided into three main parts namely the controlling computer, interface board and the robot itself which is made up of mechanical parts.

The interface board is designed, base on memory mapped peripheral of the controlling computer, that is the robotic motors are treated as memory locations instead of input/output ports. Each of the arm movement is servo controlled, which mean, there is a position sensor feeding back information to the interface board, where it is compared with the programmed position and automatically taking corrective action. Since the servo action is independent of the host computer, it greatly simplifying the software design to drive the robot. This interface also employed a parallel bit data transfer from the data bus to the interface circuitry.

All the five axes are driven by a motor with an integral gearbox. For the wrist and gripper, small in-line gearboxes are used. The other axes namely shoulder, elbow and the base utilised a more powerful gearboxes. The motors require a 12V DC supply.

<u>CONTENTS</u>	<u>PAGE</u>
ACKNOWLEDGEMENT	i
PREFACE	ii
<u>CHAPTER 1</u> <u>INTRODUCTION</u>	
1.1 GENERAL	1
1.2 OBJECTIVE AND OUTLINE	4
1.3 APPLICATION	6
<u>CHAPTER 2</u> <u>HARDWARE DESIGN CONCEPTS AND</u> <u>ALTERNATIVES.</u>	
2.1 INPUT/OUTPUT INTERFACING	7
2.2 MEMORY MAPPED DEVICE INTERFACING	9
2.3 INTERFACING DAC	13
2.4 OPERATIONAL AMPLIFIER (OPAMP)	20
2.4.1 UNITY GAIN NON-INVERTING FOLLOWER	20
2.4.2 CURRENT TO VOLTAGE CONVERTER	21
2.4.3 NON-INVERTING FOLLOWER	21
2.4.4 DIFFERENTIAL AMPLIFIER WITH GAIN	22
2.4.5 SERVO AMPLIFIER	24
2.5 INTERFACE MOTORS TO MICROCOMPUTER	26
2.5.1 MOTOR CONTROL SYSTEM USING COMPARATOR	27
2.5.2 MOTOR CONTROL SYSTEM USING SUMMER	30
2.5.3 MOTOR CONTROL SYSTEM USING A DIGITAL POSITION CONTROLLER.	33

2.5.4 DISCUSSION	35
------------------	----

CHAPTER 3 HARDWARE DESIGN

3.1 INTERFACE CIRCUIT OPERATION	37
3.2 GRIPPER OPERATION	47
3.3 MECHANICAL CONSTRUCTION AND OPERATION	49
3.4 TESTING AND CALIBRATION PROCEDURE	53
3.4.1 SETTING THE MECHANICAL PART	53
3.4.2 TESTING THE INTERFACE BOARD	54

CHAPTER 4 SOFTWARE EXAMPLE AND DEVELOPMENT

4.1 SOFTWARE EXAMPLE AND DEVELOPMENT	56
4.2 PROGRAM EXAMPLE	58

CHAPTER 5 CONCLUSION AND FUTURE DEVELOPMENT

5.1 CONCLUSION	61
5.2 FUTURE DEVELOPMENT	63

APPENDICES

A.1 USER GUIDE	69
A.2 SLOT SETTING PROCEDURE AND SLOT BUS	70
A.3 WIRING DIAGRAM	74
A.4 LIST OF COMPONENT	77
A.5 DATA SHEET	79
A.6 THE INTEL 8080 INSTRUCTION SET	102
BILIGRAPHY	104