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Date: 7/5/2007

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THE DESIGN OF A SMALL SCALE AUTOMATED MACHINE FOR LEARNING PURPOSE

LIM SENG TAT

This Report Is Submitted In Partial Fulfillment of Requirements for the Bachelor Degree of Mechanical Engineering (Structure and Material)

Fakulti Kejuruteraan Mekanikal
Universiti Teknikal Malaysia Melaka

May 2007

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DECLARATION

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DEDICATION

Dedicated to my beloved family Father (Mr. Lim Tang Teng), Mother (Mrs Pua Dee), Brother (Lim Seng Jwee), Sisters (Lim Hwee Chin) and also my friends which always be my side

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My family, who inspired me whether through the storm and carry on. My beloved, who kept me through it all.

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ABSTRACT

This project is presents the designing of a small scale automate machine for learning purpose. The design of this machine is fully study and reviews from the sorting system by using sensor that controlled by programmable logic control (PLC) that currently uses in industry. The main objective of this project is to develop a machine acts as training kit that used for education and training purpose. The machine is formed by mechanical system, pneumatic system, electrical system and control system. It performs the task similar to industry sorting machine and used at demo session in training courses or lectures to show students and trainees the application of automation in industry. The machine is fully automated and able to identify up to three different colors specimen and sort them into different categories.

Execution of this project required application of knowledge on role of Mechanical and Controller. Theoretical knowledge like machine components design, solid mechanic, mechanic of machine, control system etc. required during conceptual design of the machine. Application of knowledge like computer aided design system, process manufacturing, technology of workshop required during constructed the prototype of the machine. A lot of industrial experience and knowledge were gained along executive this project.

A well functioning prototype will be manufactured as the final outcome of the project. This is an industrial project and the specifications and requirements are based on sponsor needs. Enhancement and stepped-up of machine will be made from time to time to fulfill sponsor's requirements.

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ABSTRAK

Projek ini melibatkan pembanganan suatu automasi mesin yang bersaiz kecil bertujuan untuk pembelajaran dan latihan. Objektif utama mesin ini dibangunkan adalah sebagai alat makmal atau prototaip untuk mempersembahkan demo aplikasi automasi dalam industri kejuruteraan semasa sesi latihan atau sesi makmal. Projek ini terdiri daripada sistem berisi udara, sistem mekanikal, sistem elektrik dan sistem kawalan. Mesin berfungsi dan aplikasi dengan membezakan tiga jenis warna ke atas spesimen dan bahagikan mereka secara automatik.

Sepanjang pelaksanaan projek ini, ia memerlukan aplikasi pengetahuan mekanikal dan kawalan. Teori-teori pengetahuan sepeti mekanik pepejal, rekabentuk, rekabentuk berbantu komputer dan lain-lain perlu diaplikasi sepanjang melaksanakan projek ini. Pelaksaan projek in dapat memupuk banyak pengalaman berkaitan industri automasi dan rekabentuk dalam aspek kejuruteraan mekanikal.

Satu prototaip projek in akan dihasilkan sebagai keputusan akhir projek ini. Projeck ini merupakan suatu projek industri. Semua tata syarat dan keperluan perlu dipatuhi sepanjang pelaksanaan projek ini. Perubahan spesifikasi projek ini akan dilakukan dari semasa ke semasa mengikut kehendak penaja projek ini.

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CONTENT

	SUPERVISORY VERIFICATION	I
	DECLARATION	II
	DEDICATION	III
	ACKNOWLEDGEMENT	V
	ABSTRACT	VI
	ABSTRAK	VII
	CONTENTS	VIII
	LIST OF TABLES	XIII
	LIST OF FIGURES	XV
	LIST OF ABBREVIATIONS	XVIII
	LIST OF APPENDICES	XIX

CHAPTER	TOPIC		PAGE
1	**INTRODUCTION**		
	1.1	Introduction	1
	1.2	Problems Statement	3
	1.3	Objectives of Project	5
	1.4	Scopes of Project	6
	1.5	Thesis Outline	7
	1.6	Summary	8
2	**LITERATURE REVIEW**		
	2.1	Introduction	9
	2.2	Automation	10
		2.2.1 Automation History	11
		2.2.2 Roles of Automation	14

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	2.2.3 Automation Activities	15
2.3	Industrial Color Sensing Technology	16
2.4	Machine Design	20
	2.4.1 Design for Automation	20
	2.4.2 General Consideration in Machine Design	21
2.5	Computer Aided Design (C.A.D)	23
	2.5.1 SolidWorks	24
2.6	Programmable Logic Controller	25
	2.6.1 Background and Development of PLC	27
	2.6.2 Ladder Diagram	28
	2.6.3 PLC Training Kit	31
2.7	Sensor	32
	2.7.1 Inductive Proximity Sensor	33
2.8	Motor and Motion Control System	34
	2.8.1 Steps in Selecting Motor	35
2.9	Pneumatic System	36
	2.9.1 Pneumatic Cylinder	38
	2.9.2 The Electromagnetic Valve	40
	2.9.3 Solenoid	41
	2.9.4 Manifold	42
	2.9.5 Filter-Regulator-Lubrication Unit	43
2.10	Mechanical Limit Switch	43
2.11	Color Sensor	45
	2.11.1 Principles of Color Measurement	46
	2.11.2 Theory of Color Operation	48
	2.11.3 Reflective Sensing	49
	2.11.4 Trans-Missive Sensing	50
2.12	Summary	51
3	**METHODOLOGY**	
3.1	Introduction	52
3.2	Description of Methodology	54
3.3	Summary	56

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4	**GEOMETRICAL DESIGN**		
	4.1	Introduction	57
	4.2	Conceptual Design	58
		4.2.1 Functions and Task Specification of Machine	58
		4.2.2 Specification Definition	59
		4.2.3 Concept Generation	60
		4.2.3.1 Concept of Design 1	60
		4.2.3.2 Concept of Design 2	63
		4.2.3.3 Concept of Design 3	65
		4.2.3.4 Concept of Design 4	67
		4.2.3.5 Concept of Design 5	69
		4.2.4 Concept Selection	71
		4.2.5 Concept Screening	73
		4.2.6 Concept Scoring	76
		4.2.6.1 Station A	77
		4.2.6.2 Station B	78
	4.3	Detail Design	79
		4.3.1 Design Consideration	79
		4.3.2 Detail Design of Station A	80
		4.3.3 Detail Design of Station B	82
		4.3.4 Detail Design of station C	84
	4.4	Summary	86
5	**INSTALLATION OF PNEUMATIC SYSTEM AND PROGRAMMBLE LOGIC CONTROLLER**		
	5.1	Introduction	87
	5.2	Pneumatic System	88
		5.2.1 Components of Pneumatic System	89
		5.2.2 Assembly of Pneumatic Components	90
		5.2.2.1 Blower	91
		5.2.2.2 Manifold and Solenoid Valve	92
		5.2.2.3 Stopper	93
		5.2.2.4 Sorting	94

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		5.2.2.5 Pick and Place	95
		5.2.2.6 Vacuum System	96
	5.3	Installation of Motor	96
		5.3.1 Selection of Motor	97
		5.3.2 Assembly of Motor	98
	5.4	Installation of Programmable Logic Control Unit	99
		5.4.1 Selection of Programmable Logic control Unit	99
		5.4.2 Descriptions of Input/Output Points	100
	5.4	Summary	101
6	**COSTING**		
	6.1	Introduction	102
	6.2	Costing of Mechanical Structure Components	102
		6.2.1 Pick and Place Station	103
		6.2.2 Passing Station	104
		6.2.3 Sorting Station	104
		6.2.4 Total Cost for Mechanical Parts Fabrication	105
	6.3	Costing of Industrial Standard Components	105
		6.3.1 Aluminum Profile	106
		6.3.2 Bearing	106
		6.3.3 Fasteners	107
		6.3.4 Total Cost for Industrial Standard Components	107
	6.4	Costing of Pneumatic Components	108
	6.5	Costing of Electronic Components and Programmable Logic Controller	109
		6.5.1 Sensor	109
		6.5.2 Programmable Logic Controller	109
		6.5.3 Electronic Components	110
		6.5.6 Total cost for Electronic and Controller Components	110

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	6.6	Total Cost	110
	6.7	Summary	111
7	**DISCUSSIONS**		
	7.1	Introduction	112
	7.2	Mechanical Design	112
		7.2.1 Mechanical Components design	113
		7.2.2 Mechanical Components Material and Tolerance Control	115
		7.2.3 Machine Assembly	116
		7.2.4 Advantages of the Design	117
	7.3	Machine Capabilities	119
	7.4	Costing Evaluation	124
	7.5	Summary	125
8	**CONCLUSION AND RECOMMENDATION**		
	8.1	Conclusion	126
	8.2	Recommendations	127
		REFERENCES	129
		APPENDICES	131

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LIST OF TABLES

NO	TABLE	PAGE
2.1	Development in the History of Automation of Manufacturing Process	13
4.1	Concept Screening for Station A	74
4.2	Concept Screening for Station C	75
4.3	Rating with relative performance	76
4.4	Concept Scoring for Station A	77
4.5	Concept Scoring for Station C	78
4.6	Lists of Mechanical components for Pick and Place Station	81
4.7	Lists of Mechanical components for Passing Station	83
4.8	Lists of Components for Sorting Station	85
5.1	List of Pneumatic Components	89
5.2	Motor Specification	97
5.3	Definitions of Input and Output of P.L.C Unit	100
6.1	Mechanical Components for Pick and Place Station	103
6.2	Mechanical Components for Passing Station	104
6.3	Mechanical Components for Sorting Station	104
6.4	Total Costing for mechanical Parts Fabrication	105
6.5	List of Costing for Aluminum Profiles	106
6.6	List of Costing for Bearings	106
6.7	List of Costing for Fasteners	107
6.8	Total Cost for Industrial Standard Components	107
6.9	List of Costing for Pneumatic components	108
6.10	List of Costing for Sensors	109
6.11	Costing for Programmable Logic Controller	109
6.12	List of Costing for Electronic Components	110
6.13	Total cost for Electronic and Controller Components	110

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6.14	Total Costing of Small Scale Automated Machine.	111
7.1	Machine Capabilities of Each Station.	120

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LIST OF FIGURES

NO	TABLE	PAGE
2.1	Sorting workstation with web camera	19
2.2	A sample Panasonic PLC with super fast (0.32usec / inst.) processor, large program memory, 8 built-in high speed counters	30
2.3	A sample PLC training kit	31
2.4	Steps in Selecting Motor	36
2.5	The pneumatic components: valves and cylinders	38
2.6	Single-Rod Double-Acting Piston	39
2.7	Double-Rod Double-Acting Piston	39
2.8	Spring Return Piston	39
2.9	How Electromagnetic valve work	40
2.10	Schematic of mechanical limit switch	44
2.11	Color measurements with the human eye (a), colorimeter (b), spectrophotometer (c), and RGB sensor (d).	47
2.12	Color sensor with light-to-analog voltage conversion.	49
2.13	The color of reflected light depends on the colors that a surface reflects and absorbs.	50
2.14	The R, G, and B outputs of the sensor are determined by the Color of light falling on sensor.	51
2.15	Color sensing of a transparent medium such as a color filter, liquid or gas.	51
3.1	Activity Flow Chart	53
4.1	First Concept Design	60
4.2	Specimen passes to conveyor when conveyor system moves backward.	62

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4.3	Specimen drop to turn table as conveyor system move forward	62
4.4	Second Concept Design	63
4.5	Side View of Pick and Place System.	63
4.6	Top View of the Multi Conveyor system	64
4.7	Third Concept Design	65
4.8	Front view of Pick and Place Module.	66
4.9	Angle Rotational Sorting Module.	66
4.10	Forth Concept Design	67
4.11	Twin Rod Cylinder Pick and Place Station	68
4.12	Turn Channel Sorting Station	68
4.13	Fifth Conceptual Design	69
4.14	Hopper	70
4.15	Sorting Station	70
4.16	Concept Selection Flow	72
4.17	Explore View of Pick and Place Station	80
4.18	Explore View of Passing Station	82
4.19	Alignment of Bracket for Specimen Dropped Down.	83
4.20	Explore View of Sorting Station	84
5.1	Pneumatic System of Machine	88
5.2	Mounting of pneumatic components on mechanical structure	90
5.3	Blower in Station B	91
5.4	Function of compact cylinder as stopper at station B.	93
5.5	Function of Compact cylinder B in Station C	94
5.6	(a) Twin rod cylinder vacuum up the specimen	95
	(b) Twin rod cylinder vertically place the specimen	95
5.7	Motor Dimensions	97
5.8	Delay Functions in Change Rotational Direction of Motor	98
5.9	Control System of Small Scale Automated machine	101
7.1	Mechanical Components for Sorting Station	113
7.2	Mechanical Components for Pick and Place Station and Passing Station	113
7.3	Designing of Counter Bore	114
7.4	Designing of Slot on Mechanical Component	115

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7.5	Tolerance Control of Mechanical Component	116
7.6	Geometrical Design of Small Scale Automated Machine	117
7.7	Sequential Process of Pick and Place Station	121
7.8	Sequential Process of Passing Channel	122
7.9	Sequential Process of Sorting Station	123
7.10	Distribution of percentages costing for each component of machine	124

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LIST OF ABBREVIATIONS

SYMBOL	DEFINATION
P.L.C	Programmable Logic Control
D.C	Direct Current
I/O	Input and Output Points
C.A.D	Computer Aided Design
F.R.L	Filter-Regulator-Lubrication unit
CZ-11	Color Sensor Unit
A.C	Alternative Current
D.C	Direct Current
C.I.M	Computer Integrated Manufacturing

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LIST OF APPENDICES

APPENDIXES	TOPIC
A	Dimensional Drawings of Mechanical Structure Components
B	Assembly Drawings of Station A, B and C
C	Conceptual Design
D	Components Specifications
E	Steps In Assembly Machine Components
F	Pictures

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In the age of industrial automation, the high speed process for testing and sorting the product are the prominent activity that can enhance the productivity in manufacturing line. The role of automation in industries is becoming increasingly popular globally, as an element of long-term competitive advantage. However, the use of automation in Malaysian industries is still not widespread. Most of the local industries are still using conventional (traditional) material testing and sorting system. This is a disadvantage to them as it is not cost-effective in utilizing and maintaining this type of system at the present moment.

The topic of this project named as: Designing a Small Scale Automate Machine for Education Purpose. A small scale sorting machine will be generated if compare to actual one and it was fully automate and controlled by programmable logic controller (PLC). The project has to start from zero by drafted out concept of design for the machine; then design the mechanism of the machine by determine the

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flexibility and stability of machine's structures until construct the PLC programmed and pneumatic system.

The aim of this project is to generate a training kit that will be used on training courses, education lectures or lab sessions to show the application of automation in industry and bear out ease of use of automation in processing and production line. The training kit will be used present a demo to show how a mechanical system aided by programming system to enhance its functions without human intervention. By development of training kit, this will provide convenience for trainer or lecture do their presentation to trainee or students and they easy understand by observe the demo executed by training kit. The purpose of this project is to fulfill requirements in market especially high education institutes, manufacturing industries and semiconductor industries because these areas needed different types of small scale automate machine as training kit for their automation and PLC curriculum. In addition, automation type training kits still deficiency in Malaysia, so it is necessary in development a project in design a small scale automated machine as training kit. The small scale automated machine functions as an automated sorting machine that will differentiate incoming materials and separate them into different channel. The final product of this project will used during training courses, learning lessons or lab sessions to show how machine controlled by PLC and work coordinate between mechanical parts, electrical parts, sensors and pneumatic parts by execute a demo through the small scale machine. Students and trainees will more understand the application of automation in industry usage and this will make automation technology generalization in Malaysia.

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There are several important roles should be considered for this project and they included:

a) Mechanical structure design.

b) Mechanism of the machine.

c) Ease of assembly and ease of manufacturing.

d) Applications of the pneumatic system in automation

e) Applications of the PLC and sensor in automation

During involve this project; knowledge on mechanical, manufacturing, pneumatic and programming should be applied. This project process starts from geometrical design, conceptual design, detail design, mechanical parts fabrication, machine components assembly, PLC installation, pneumatic system installation up to test run of machine and troubleshooting problem solving. This project brings development of automation industry and familiar application of automation to industrial trainees, engineers and undergraduate students.

1.2 Problems Statement

Automation plays an important role in many industries area to increase processing efficiency and productivity of production lines. Whereas, automation and PLC still not familiar in our country. Development of industry area leans upon development of automation because it reduces production cost and time of completion products. In additions, a lot of local manufacturing industries depend on automation for their production process; they spend a lot of money to import automated machine from foreign country for their company usage. This increases cost of their products and lower their ability to competitive with other countries products. This is a big lost to our country. As a result, technology of automation

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should be brought in to Malaysia as it will round into development of Malaysia economy.

To generalize the technology of automation, technology of automation should be brought into Malaysia. Automation and PLC training courses must be provided to engineers, technicians, machinists, and university or college students to indoctrinate them usage and application of automation technology. From the training courses, they will learnt about automation, PLC, machine design and understand those concepts, knowledge and theory related to automation industry. During the training session, training kit should be provided and presenter can do demo shows how automation works and runs to students. But the training kits on market still less and difficult found. Besides, automation involving a lot of mechanical elements and electrical elements, so training kits provided during training session should be as lot as could with different types and each type shows different functions. This will make trainee more understand application of automation in machine.

With the training kit during the training course, student will provided opportunity look through the running process of automate machine and understand the relationship between PLC, sensors, motors and how they coordinated to each other to form a process system; study on how the mechanical parts and electrical parts of machine controlled by PLC. Since the training kit will run the same process as in industry like: sorting, checking and so on but it just with small scale compare to actual one, so this will make student more understand the application of automation technology. By the side, the training kit will perform the process system as well as a real one and this will make student realise application of automation in industry.

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Since there is still less of this type of small scale automate machine act as training kit on market, so it is necessary develop a project to fulfill any requirements from industry or education areas. This small scale automate machine not just can be widely used on training courses for industry; it also can be used as education equipments for high education institute for lab session and provide opportunity for student learn on automation.

1.3 Objectives of Project

The aim of this project basically is to develop an automated machine by using PLC as a training kit used for training session. The objectives of the project includes as below:

a) To design a small scale automate machine that act as training kit used for training and learning purpose.

b) To design an automate machine by using the concept of sorting to differentiate colors of in coming specimens or materials and separate them effectively.

c) To design a training kit that shows the application of P.L.C, sensors, motors and pneumatic system in automation and how they work together and incorporate with mechanical components to perform a specific task.

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