PROGRAMMABLE LOGIC CONTROLLER TRAINING MODULE FOR POSITIONING AND SORTING

MUHAMAD FAUZI BIN ANUAR

A project report submitted in partial fulfilment of the requirements for the award of the degree of Master of Engineering (Mechanical – Advanced Manufacturing Technology)

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

JUNE 2014
To my beloved mother Hajah Nurhajati, father Haji Anuar, mother-in-law Hajah Rasenah, my wife Fauziah, my son Muhammad Faris and Muhammad Fitri, and my daughter Faezah and Fatiha. Thank for all your support.
ACKNOWLEDGEMENTS

Alhamdulillah, thank to Allah s.w.t., because of Him we are still here, breathing His air, pleasuring His entire gift in this world. And most of all, for giving me opportunities to learn His knowledge.

In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my main thesis supervisor, Associate Professor Dr. Adnan Hassan, for encouragement, guidance, advices, critics, motivation and friendship. Without his continued support and interest, this thesis would not have been the same as presented here.

I am indebted to my parents, Haji Anuar and Hajah Nurhajati, without whose help, encouragement and patience. I would also like to thank my wife, Fauziah, for her love, support and encouragement and other help throughout. Without their continued support, I would never have gotten this thesis completed and who made it all worthwhile.

My fellow postgraduate students should also be recognised for their support. My sincere appreciation also extends to all my colleagues and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. I am also grateful to all my family members.
ABSTRACT

In this project, a prototype of a Programmable Logic Controller (PLC) training module for positioning and sorting was designed and developed. The design was based on Programme Educational Objectives (PEO) and Program Learning Outcomes (PLO) for Diploma in Industrial Mechatronics Engineering Technology and Course Learning Outcomes (CLO) for Automation course (HFC4033) in Kolej Kemahiran Tinggi MARA Balik Pulau. The prototype consists of two main parts that are: i) Plug and Learn PLC Controller, and ii) Positioning and Sorting Training Kit. Plug and Learn PLC Controller was developed using the Siemens S7-200 CPU 226 as a controller and EM 253 was used as positioning wizard module. Positioning and Sorting Training Kit used standard automation components namely conveyor, sensor and others as input/output (I/O) to the prototype system. The learning activities were conducted using two approaches that is Teacher Centred Learning (TCL) approach and Student Centred Learning (SCL) approach. The effectiveness of the learning approach and the PLC Training Module was evaluated using rubric marking scheme and qualitative survey questionnaire. Based on this evaluation, two group taught in SCL approach managed to complete assigned tasks faster than the group taught using TCL approach. Group from the TCL approach completed the task in procedural stages (structured) compared to the groups from the SCL approach that completed the task in less structured (unstructured). However not all groups using SCL method scored high marks in evaluation criteria for project functionality, design skills and level of understanding. Finding also suggests that SCL approach does not guarantee better performance among passive student. With this PLC training module using SCL approach, the finding shows that the learning strategy can better prepare student to solve real industrial problem. However, it does not necessarily motivated passive student.
ABSTRAK

# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td></td>
<td>ii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td></td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td></td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td></td>
<td>v</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td></td>
<td>vi</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td></td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td></td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td></td>
<td>xii</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td></td>
<td>xv</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td></td>
<td>xvi</td>
</tr>
</tbody>
</table>

## 1 INTRODUCTION

| 1.1 | Introduction | 1 |
| 1.2 | Background of Study | 1 |
| 1.3 | Characteristics of Design Project | 3 |
| 1.4 | Statement of Problems | 4 |
| 1.5 | Objective of Study | 5 |
| 1.6 | Scope of Study | 6 |
| 1.7 | Important of Study | 6 |
2 LITERATURE REVIEW
  2.1 Introduction 8
  2.2 Overview on the Automation Course in KKTMBP 8
  2.3 Overview of the Student Centred Learning 10
  2.4 Positioning Module EM 253 12
  2.5 Sorting Material 13
    2.5.1 Proximity Sensors 14
  2.6 Electrical Drive 16
    2.6.1 Stepper Motor 17
  2.7 Pneumatic Actuator 18
  2.8 Programmable Logic Controller 19
  2.9 Siemen S7-200 Programming 20
  2.10 Review of on Related Works 24
    2.10.1 Problem Based Learning Approach in Programmable Logic Controller by Ahmad Fairuz Muhd Amin et al. (2005) 24
    2.10.2 Application of Problem-Based Learning to PLC Experiment by Hu et al. (2010) 25
  2.11 Summary of Literature Review 26

3 METHODOLOGY
  3.1 Introduction 27
  3.2 Project Planning 27
  3.3 Project Flow Chart 27
  3.4 Mission Statement 28
  3.5 Gather Raw Data 29
  3.6 Class Structure and Format 33
  3.7 Prepare PLC course using SCL Approach 35
  3.8 Developing Ill-Structured Problems 35
  3.9 Develop a Trigger Question 38
  3.10 The Method Applied Inside the Controller 38
  3.11 Experiment Scheme 40
### DEVELOPMENT OF THE PROTOTYPE TRAINING KIT

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Introduction</td>
<td>48</td>
</tr>
<tr>
<td>4.2</td>
<td>CAD Model and Drawing</td>
<td>48</td>
</tr>
<tr>
<td>4.3</td>
<td>Develop the PLC Training Set</td>
<td>51</td>
</tr>
<tr>
<td>4.4</td>
<td>Electrical and Pneumatic Diagram</td>
<td>53</td>
</tr>
<tr>
<td>4.4.1</td>
<td>Electrical and Pneumatic Diagram</td>
<td>53</td>
</tr>
<tr>
<td>4.4.2</td>
<td>Pneumatic System</td>
<td>56</td>
</tr>
<tr>
<td>4.5</td>
<td>Integration between the Controller and Training Kit</td>
<td>57</td>
</tr>
<tr>
<td>4.6</td>
<td>EM253 Position Module Setup Wizard</td>
<td>58</td>
</tr>
<tr>
<td>4.7</td>
<td>Assignment List of Input and Output</td>
<td>65</td>
</tr>
<tr>
<td>4.8</td>
<td>Sequence Step Diagram</td>
<td>66</td>
</tr>
<tr>
<td>4.9</td>
<td>PLC Logic Programming</td>
<td>68</td>
</tr>
</tbody>
</table>

### LEARNING APPROACH AND RESULT ANALYSIS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Introduction</td>
<td>77</td>
</tr>
<tr>
<td>5.2</td>
<td>Sample of Work Sheet</td>
<td>77</td>
</tr>
<tr>
<td>5.3</td>
<td>Student Result</td>
<td>79</td>
</tr>
<tr>
<td>5.4</td>
<td>Analysis on Student Feedback</td>
<td>82</td>
</tr>
<tr>
<td>5.4.1</td>
<td>Student Feedback on TCL Approach</td>
<td>83</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Student Feedback on SCL Approach</td>
<td>85</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Student Feedback on the PLC Training Module</td>
<td>88</td>
</tr>
<tr>
<td>5.5</td>
<td>Analysis of Effectiveness of the Training Module</td>
<td>89</td>
</tr>
</tbody>
</table>
6 CONCLUSION

6.1 Introduction 90
6.2 Conclusion 90
6.3 Suggestion for Future Development 93

REFERENCES 94
APPENDICES 99
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE NO.</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Siemens PLC characteristic</td>
<td>20</td>
</tr>
<tr>
<td>3.1</td>
<td>Automation Syllabus</td>
<td>31</td>
</tr>
<tr>
<td>3.2</td>
<td>Objectives and Syllabus Used In Developing the Training Module</td>
<td>32</td>
</tr>
<tr>
<td>3.3</td>
<td>Relationship between Dimensions of Performance and Objectives / Syllabus</td>
<td>43</td>
</tr>
<tr>
<td>3.4</td>
<td>Marking Rubric</td>
<td>44</td>
</tr>
<tr>
<td>4.1</td>
<td>The PLC Assignment List in Project</td>
<td>66</td>
</tr>
<tr>
<td>5.1</td>
<td>Efficiencies of TCL method</td>
<td>83</td>
</tr>
<tr>
<td>5.2</td>
<td>Deficiencies of TCL method</td>
<td>84</td>
</tr>
<tr>
<td>5.3</td>
<td>Efficiencies of SCL Method</td>
<td>86</td>
</tr>
<tr>
<td>5.4</td>
<td>Deficiencies of SCL Method</td>
<td>87</td>
</tr>
<tr>
<td>5.5</td>
<td>The Efficiencies of the PLC Training Module</td>
<td>88</td>
</tr>
<tr>
<td>5.6</td>
<td>The Deficiencies of the PLC Training Module</td>
<td>89</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE NO.</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>The Basic Teacher Centred Learning Approach (Existing)</td>
<td>9</td>
</tr>
<tr>
<td>2.2</td>
<td>Student Centred Learning (SCL)</td>
<td>12</td>
</tr>
<tr>
<td>2.3</td>
<td>Positioning Module EM 253</td>
<td>13</td>
</tr>
<tr>
<td>2.4</td>
<td>Inductive and Capacitive Sensor</td>
<td>14</td>
</tr>
<tr>
<td>2.5</td>
<td>Photoelectric Proximity Sensor Configurations: (A) Diffuse Reflector; (B) Retro Reflector; (C) Through Beam, (D) Fixed Focus, and (E) Fibre Optics</td>
<td>15</td>
</tr>
<tr>
<td>2.6</td>
<td>A Rotating Electric Motor</td>
<td>16</td>
</tr>
<tr>
<td>2.7</td>
<td>Stator and Rotor Electric Fields and the Forces Acting On a Rotating Machine.</td>
<td>16</td>
</tr>
<tr>
<td>2.8</td>
<td>Internal Structure of PLC</td>
<td>19</td>
</tr>
<tr>
<td>2.9</td>
<td>Siemen PLC S7-200 CPU226</td>
<td>20</td>
</tr>
<tr>
<td>2.10</td>
<td>MicroWin software</td>
<td>21</td>
</tr>
<tr>
<td>2.11</td>
<td>Timer</td>
<td>21</td>
</tr>
<tr>
<td>2.12</td>
<td>Counter</td>
<td>22</td>
</tr>
<tr>
<td>2.13</td>
<td>RS/SR</td>
<td>23</td>
</tr>
<tr>
<td>3.1</td>
<td>Project Flow Chart</td>
<td>28</td>
</tr>
<tr>
<td>3.2</td>
<td>Mission Statement</td>
<td>29</td>
</tr>
<tr>
<td>3.3</td>
<td>PLO and PEO Matrix</td>
<td>30</td>
</tr>
<tr>
<td>3.4</td>
<td>CLO and PLO Matrix</td>
<td>30</td>
</tr>
<tr>
<td>3.5</td>
<td>Screenshot of the Lecture Note of 4A Class</td>
<td>34</td>
</tr>
<tr>
<td>3.6</td>
<td>Screenshot of the Practical Question of 4A Class</td>
<td>36</td>
</tr>
<tr>
<td>3.7</td>
<td>Screenshot of the Practical Question of 4B Class</td>
<td>37</td>
</tr>
<tr>
<td>3.8</td>
<td>Positioning and Sorting Flow Chart</td>
<td>37</td>
</tr>
</tbody>
</table>
3.9 Screenshot of the Trigger Question 38
3.10 PLC Experiment Scheme by SCL Approach 41
3.11 PLC Experiment Scheme by TCL Approach 42
3.12 Rubric Marking Formula 45
3.13 Rubric Marking Scheme 45
3.14 Questionnaire for 4A Class 47
3.15 Questionnaire for 4B Class 47
4.1 Isometric View of Plug N Learn PLC Controller 49
4.2 Panel Layout of the Plug N Learn PLC Controller 49
4.3 Isometric View of the Positioning and Sorting Training Kit 50
4.4 Panel Layout of the Positioning and Sorting Training Kit 50
4.5 Top View of the Positioning and Sorting Training Kit 50
4.6 Front View of the Positioning and Sorting Training Kit 51
4.7 Side View of the Positioning and Sorting Training Kit 51
4.8 Working Prototype of the Plug N Learn PLC Controller 52
4.9 Working Prototype of the Positioning and Sorting Training Kit 52
4.10 S7-200 CPU 226 Wiring Diagrams 53
4.11 Connecting an EM 253 Position Module to an Oriental Motor Driver 54
4.12 Wiring Diagram of the Positioning and Sorting Training Kit 54
4.13 Actual Wiring Diagram of the Plug N Learn PLC Controller 55
4.14 Actual Wiring Diagram of the Positioning and Sorting Training Kit 55
4.15 Pneumatic Wiring Diagram at the Positioning and Sorting Training Kit 56
4.16 (a) Solenoid Valve and (b) Filter Regulator 56
4.17 Cylinder for Eject Part 57
4.18 Training Set Wiring Diagram 57
4.19 Integration between Controller And Training Kit 58
4.20 Module Position 58
4.21 Module Input Response 59
4.22 Motor Speeds 60
4.23 Jog Setting 60
4.24 Acceleration and Deceleration Times 61
4.25 Jerk Time 61
4.26 Reference Point Setting 62
4.27 Command Byte 62
4.28 Motion Profile Setting 63
4.29 Configure V-Memory 64
4.30 Configuration Generate 64
4.31 Position Configuration for 0 (Module 0) 65
4.32 The Sequence Step Diagram of the PLC 67
4.33 PLC program (network 1 to network 2) 68
4.34 PLC program (network 3 to network 5) 69
4.35 PLC Program (network 6 and network 8) 70
4.36 PLC Program (network 9 and network 11) 71
4.37 PLC Program (network 12 and network 15) 72
4.38 PLC Program (network 16 and network 18) 73
4.39 PLC Program (network 19 and network 21) 74
4.40 PLC Program (network 22 and network 24) 75
4.41 PLC Program (network 25 and network 28) 76
5.1 Answer Script Screenshot of Student 4A Class 78
5.2 Answer Script Screenshot of Student 4B Class 78
5.3 Student Perform the Experiment 79
5.4 Screenshot of Answer Script for Trigger Question (a) 1 and (b) 2 81
5.5 Screenshot of Rubric Marking Scheme for (a) 4A and (b) 4B 81
# LIST OF ABBREVIATIONS

i. Programmable Logic Controllers  
   Programmable Logic Controllers (PLC)

ii. Direct Current  
    Direct Current (DC)

iii. Alternating Current  
     Alternating Current (AC)

iv. Central Processing Unit  
    Central Processing Unit (CPU)

v. Liquid-Crystal Display  
   Liquid-Crystal Display (LCD)

vi. Plug And Play  
    Plug And Play (PNP)

vii. Earth Leakage Circuit Breaker  
     Earth Leakage Circuit Breaker (ELCB)

viii. Miniature Circuit Breaker  
      Miniature Circuit Breaker (MCB)

ix. Problem-Based Learning  
    Problem-Based Learning (PBL)

x. Student Centred Learning  
   Student Centred Learning (SCL)

xi. Teacher Centred Learning  
    Teacher Centred Learning (TCL)

xii. Light Emitting Diode  
     Light Emitting Diode (LED)

xiii. Kolej Kemahiran Tinggi MARA Balik Pulau  
      Kolej Kemahiran Tinggi MARA Balik Pulau (KKTMBP)

xiv. Input/Output  
     Input/Output (I/O)

xv. Dominant Reset / Dominant Set  
    Dominant Reset / Dominant Set (RS/SR)

xvi. Programme Educational Objectives  
     Programme Educational Objectives (PEO)

xvii. Program Learning Outcomes  
      Program Learning Outcomes (PLO)

xviii. Course Learning Outcomes  
      Course Learning Outcomes (CLO)
# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX NO.</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Gantt Chart</td>
<td>99</td>
</tr>
<tr>
<td>B</td>
<td>Mapping Objective and Syllabus</td>
<td>102</td>
</tr>
<tr>
<td>C</td>
<td>Drawing</td>
<td>108</td>
</tr>
<tr>
<td>D</td>
<td>Student Name and Group</td>
<td>116</td>
</tr>
<tr>
<td>E</td>
<td>Practical Question</td>
<td>119</td>
</tr>
<tr>
<td>F</td>
<td>Trigger Question 1</td>
<td>126</td>
</tr>
<tr>
<td>G</td>
<td>Trigger Question 2</td>
<td>130</td>
</tr>
<tr>
<td>H</td>
<td>Rubric</td>
<td>147</td>
</tr>
<tr>
<td>I</td>
<td>Qualitative Survey Questionnaire</td>
<td>150</td>
</tr>
<tr>
<td>J</td>
<td>Student Result</td>
<td>155</td>
</tr>
<tr>
<td>K</td>
<td>Survey Answer Script</td>
<td>193</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter is introduced and consist of the Background of Study, Characteristics of Design Project, Problem Statements, Objectives of Study, Scopes of Study and Important of Study.

1.2 Background of Study

Well know, the Personal Computer (PCs) is popular used for process control (Rullán, 1997). However, PCs is commercial-grade controllers are not normally designed to tolerate the shock, vibration, temperature, and electrical noise frequently found on the manufacturing floor (Gee, 1995). Therefore to overcome this problem a Programmable Logic Controller (PLCs) are been used widely. The use of PLC equipment has been increasing day by day being parallel to progress in the systems of controls nowadays. Besides having technological advantages of using PLC, it also decreases the prices in the advanced level and complex control systems.
Petruzella, F. D. (2005) defined Programmable Logic Controller (PLCs) is a specialized computer used for the control and operation of manufacturing process and machinery. It uses a programmable memory to store instructions and execute functions including on/off control, timing, counting, sequencing, arithmetic, and data handling (Johnson, 2007). Where older automated systems would use hundreds or thousands of electromechanical relays, a single PLC can be programmed as an efficient replacement (Hassapis, 2003; Kamen and Gazarik, 1997; Anderson, 2002). The functionality of the PLCs has evolved over the years to include capabilities beyond typical relay control. Sophisticated motion control, process control, distributive control systems, and complex networking have now been added to the PLC’s functions (Saygin and Kahraman, 2004). Therefore, PLCs provide many advantages over conventional relay type of control, including increased reliability, more flexibility, lower cost, communication capability, faster response time and convenience to troubleshoot (Rehg, 2002).

PLC can be a part of an automated system in manufacturing company (Barrett, 2008). The automation systems use electro-pneumatic technology. Electro-pneumatic technologies are formed mainly by three kinds of elements: actuators or motors, sensors or buttons and control elements like valves. Most of the control elements used to execute the logic of the system was substituted by the Programmable Logic Controller (PLC). Sensors and switches are plugged as inputs and the direct control valves for the actuators are plugged as outputs. An internal program executes all the logic necessary to the sequence of the movements, simulates other components like counter, timer and control the status of the system (Świder et al., 2005).

With the use of the PLC, the manufacturing lead time will be reduced. Because it is possible to create and simulate the system as many times as needed. Therefore, time can be saved, risk of mistakes reduced and complexity can be increased using the same elements.

For the reason and advantage of PLC as main control device used by the industry, thus the learning model or tool must be design and develop to prepare students knowledge and experience to the real-world situation. In Kolej Kemahiran
Tinggi MARA Balik Pulau (KKTMBP), the automation course, which is done by practicing PLC simulation in the laboratories, will increase the knowledge of the students in this subject. However, the successful of it will decrease if the PLC education module is not suitable for the education purpose. For this concern, the PLC education module, which is the subject of this thesis, is considered.

1.3 Characteristics of Design Project

The topic of this project named as: Programmable Logic Controller Training Module for Positioning and Sorting. A small scale (prototype) positioning and sorting machine will be developed and it was fully automated and controlled by programmable logic controller (PLC). The prototype of project will be designed for education purpose in Kolej Kemahiran Tinggi MARA Balik Pulau. The observation of the education module will be done to measure it effectiveness and it deficiencies.

The aim of this project is to develop a training module 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 module will be used as a demo to show how a mechanical system aided by programming system to enhance its functions without human intervention. By development of training module, 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 module. The purpose of this project is to fulfil 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 module for their automation and PLC curriculum.

In this project, stepper motor, electro-pneumatic, sensor and conveyer were used for PLC education. These all elements are fixed in the training module. So, students will be given education about programming of PLC, PLC wiring and setting the stepper motor into Programmable Logic Controller. Inside the module S7-200
CPU 226 PLC was used that the SIEMENS firm manufactured, this PLC is enough for the education at the basic level (Yilmaz and Çobantepe, 2010).

1.4 Statement of Problems

The trend toward automation of production equipment is putting great demands on people since the early of 1970s. The manufacturers have worked to increase productivity, capability, reliability, and flexibility by using technologies. In order to achieve these are making use more and more automation in manufacturing. PLC is one of the solutions. PLCs remain the tool of choice for end-users as they are designed specifically for use in industrial environments and are guaranteed long-term support by vendors (Hajarnavis and Young, 2008). At this point, understanding PLC system, PLC programming and PLC connections and briefly PLC education are important for the student (Bayrak and Cebeci, 2012) especially student that involved with automation, manufacturing and mechatronics engineering discipline.

The PLC education, which is done by practicing in the laboratories, will increase the success of the students in this subject who attends to vocational high school (Yilmaz and Katrancioglu, 2011). In Kolej Kemahiran Tinggi MARA Balik Pulau, the PLC courses were taught to semester three students for Diploma in Manufacturing Engineering Technology programme and Diploma in Industrial Mechatronics Engineering Technology programme. At the middle of this course, the student will practically do a laboratory exercises. Generally, teacher will give a short introduction of experiment scheme, and then tell students how to connect input and output ports of PLC to a simulation I/O (input/output) panel. The simulation I/O panels provide switches for input into the PLC and light emitting diodes (LEDs) for output from the PLC. The LED were arranged to meet the suitability of the simulation mask for example a traffic light simulator. Experiment result is only checked with LED effect. Thus, students not have experience in a real industrial situation. From author’s experience, this traditional approach resulted in:-
a) Many students do experiment by copying other student’s program because doing a same simulation I/O. Then, program ability of PLC does not be trained.

b) Student will have a problem to understand the integration between PLC and connecting the I/O based on the real situation in the industry

c) Less experience because the existing training system is too simple and does not meet the requirement in the manufacturing industry

d) Student will have a problem to start programming the PLC controller if the problems are slightly different.

1.5 Objective of Study

The main objectives of this project are:-

a) To design Programmable Logic Controllers training module for positioning and sorting as an input/output (I/O)

b) To develop a PLC training module towards Student Centred Learning (SCL) approach for teaching and learning of the:-
   i) Integration between controller (PLC) and its I/O (positioning and sorting).
   ii) Setup and configure the I/O
   iii) PLC Logic programming (software structure)

c) To evaluate effectiveness of the designed training module by comparison between Teacher Centred Learning approach and Student Centred Learning approach.
1.6 Scope of Study

The main aim of this study is to design and development of PLC training module for positioning and sorting. At this stage basic there is important to recognize the scope of study. The scope consists five main section stated below: The scope of the study is:-

a) the PLC training module is using for student mechatronics semester four undertaking the automation course at KKTMBP of January - June 2014 session
b) student will not involve in hardware development but focusing on integration between controller and input/output and setup and construct a PLC logic programming using prototype develop in the study
c) for student understanding in the knowledge, comparison between existing approach (Teacher Centred Learning) and Student Centred Learning approach based on achievement in technical knowledge (problem solving skill – quality and timing) and soft skill (team work and presentation skill)
d) conduct a questionnaire survey to identify the effectiveness and deficiencies of the both approach and the developed prototype

1.7 Important of the Study

Consumer product manufacturers increasingly rely on the cooperative development of multi-disciplinary technical systems that often span the electrical, mechanical, and industrial engineering domains. Design and production engineers are frequently organized into cross-functional teams in which members bring critical skills to the assembled group (Wagner, 1999). To facilitate multi-disciplinary teams, engineers must develop their teamwork, problem solving, synergistic design, and communication skills as well as the traditional technical competencies (Slivovsky et al., 2003; Simpson et al., 2001). Further, it is increasingly presumed that competitive engineering graduates will have these skill sets in place and be able to contribute immediately to their assigned teams (Steiner, 2004). In essence, the expanding
implementation of sensors, actuators, and digital control across all engineering systems suggest that students need a mechatronic systems perspective (Grimheden and Hanson, 2001) with an opportunity to develop leadership, communication, and interpersonal skills. The availability of mechatronic courses within the engineering curriculum can help prepare students for the global workplace. In order to make this happen, the study for design and development of PLC training module for positioning and sorting are importance. In this training module, student will be able to:-

a) Learn the basic operation of positioning and sorting.
b) Structure of input and output (switches button and components) and their address.
c) Identify the positioning and sorting components on PLC training module.
d) Describe the function of PLC logic programing such as position and timer function.
e) Design a ladder diagram and function block diagram program structure and learn how to program then minimize the program language to be a simple network program.
REFERENCES


Ribeiro, L. R. C. and Mizukami, M. G. (2005) An experiment with PBL in higher education as appraised by the teacher and students. *Interface - Comunic., Saúde, Educ.*, v.9, n.17, p.357-68,


