DESIGN OF CONTROL SYSTEM FOR THE 
TURN TABLE MODULE

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Universiti Malaysia Sarawak
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Approval Sheet

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Design Of Control System For The Turn Table Module

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This report is submitted in partial fulfillment of the requirement for the Degree of Bachelor of Engineering (Hons.) Mechanical Engineering and Manufacturing System from the Faculty of Engineering Universiti Malaysia Sarawak 2002
Dedicated To My Beloved Family
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ABSTRACT

A programmable logic control system is an essentially device to control machinery and equipment without all the wiring, relays and timers that would normally be required. The Turn Table Module project was developed which included the processes such as manufacturing, designing, fabrication, analysis, PLC software control, wiring, electrical installation and selection. The project report presents the documentation of developing the control system that operates the Turn Table Module. A ladder diagram which drawn using MEDOC software to operate the machine prototype using Mitsubishi PLC control system has been developed. A flow chart of the process operation was drawn to implement the ladder diagram. The wiring diagrams for all electrical and electronic components also included. The troubleshooting, commissioning and debugging process of PLC and electrical components were done to ensure the safety and efficiency of the system.
ABSTRAK

Sistem kawalan pemrograman logic merupakan satu alat untuk mengawal mesin-mesin dan peralatan elektrik tanpa menggunakan pendawaian rumit, geganti dan pemasangan yang biasanya amat diperlukan dalam mesin. Projek “Turn Table Module” dibina merangkumi proses-proses seperti pembuatan, fabrikasi, mereka-bentuk, menganalisia, aturcara pengawalan PLC (Programmable Logic Controller), pendawaian, pemasangan dan pemilihan komponen elektrikal. Laporan projek ini memperihalkan dokumentasi dalam pembinaan sistem kawalan yang mengoperasikan Turn Table Module. Satu aturcara tangga (ladder diagram) yang dilukis dengan menggunakan perisian MEDOC untuk menjalankan prototaip mesin yang menggunakan sistem kawalan PLC jenis Mitsubishi telah dibina. Satu carta aliran dalam proses operasi dibuat untuk menjalankan aturcara tangga tersebut. Pendawaian untuk semua komponen elektrikal dan elektronik juga disertakan. Proses troubleshooting, commissioning dan debugging untuk PLC dan komponen-komponen elektrikal telah dijalankan untuk memastikan keselamatan dan kecekapan dalam system.
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CHAPTER 1

INTRODUCTION

1.1 Introduction To Control System

A control system consists of subsystems and processes assembled for the purpose of controlling the output of processes. Therefore, in its simplest way, a control system provides an output of response for a given input or stimulus and the output is controlled to be at some specific value or to change in some prescribed way as determined by the input of the system. There are two basic forms of control system, the open-loop and the closed-loop. In this project, the closed-loop control system is involved. The programmable logic controller is used to perform the control task. When the object is detected by the sensor, a feedback signal will be sent to the input PLC to perform the following task.

Control systems are an integral part of modern society. There are numerous applications around us like the space shuttle lifts off to the earth orbit, firing rockets, an automated guided vehicle used in the flexible manufacturing system, toilet auto flushing system and computer numerical controlled machines. We are not only creators of automatically controlled systems, in fact these systems exist naturally. For example our hands grasp the object and place it precisely at a predetermined location and our eyes follow a moving object to keep it in view.
In the modern automated industrial plant, the operator merely sets up the operation and initiates a start, and the operations of the machine are accomplished automatically. These automatic machines and processes were developed to mass-produce products, control very complex operations or to operate machines accurately for long periods of time. They replaced much human decision, intervention and observation.

Machines were originally mechanically controlled, then they were electromechanically controlled and today they are often controlled by purely electrical or electronic means through programmable logic controllers (PLCs), computers and computerized numerically controllers. The control of machines or processes can be divided into the following categories:

1) Electromechanical control.
2) Hardwired electronic control.
3) Programmable logic control (PLC).
4) Programmable hardwired electronic control.
5) Computer control.

1.1.1 The PLC Control System

The Turn Table Module In Chain Conveyor project will use the PLC in controlling all the sequences. The PLC control system can be easily found nowadays in the industrial manufacturing sector mostly in automation field. The process of the conveyor will be running automatically. Once the start push button is pressed, the process will begin.
Firstly, the PLC will run the conveyor motor. When one item is detected by a sensor reaching on the turn table, a stopper will stop the following items and the conveyor will idle immediately as well. Then the PLC will send a signal to the cylinder to push up the table and the another cylinder will rotate the turn table in order to obtain desirable orientation of the item before it being transferred properly on the conveyor. This can be shown in the Figure 1.1.

```
PLC
1. Running the conveyor
2. Detect item presents
3. Stop the conveyor
4. Stop the following item flows
5. Pop up turn table
6. Rotate the turn table
7. Pop down turn table
8. Running the conveyor
```

Figure 1.1 The PLC’s operation

In the conveyor, the PLC control system will perform all the sequences from the beginning until the end. It will also support all the sensing and actuating signals. Therefore no other types of associate control system required instead of using PLC.

In some manufacturing cells, programmable logic controllers are being used in controlling some machines in several workstations like automated assembly machines, pick and place machines and conveyors. Each machine uses only one PLC and there must be a main control system to control all the PLCs at the same time. Any changes or modification of process can be done in time by the related networks that linking to all
workstations. Sometimes PLCs are intimately associated with industrial robots as well. PLCs can control robots at one time or in-groups. They are ideal for controlling a manufacturing cell of which the robot is a part, assisting in coordinating the motions of the robot with the machines, which it works.

1.2 Turn Table Module in Chain Conveyor

The "Turn Table Module in Chain Conveyor" that uses the PLC control system is quite popular among the kind of control system found in automation industry in Malaysia and worldwide [Omron Inc, 1990]. We realize the importance of research of control system in manufacturing sector because all the manufacturing industry sectors need control systems in term of running the machines and controlling the manufacturing process. Therefore the PLC control system brings tremendous breakthrough in manufacturing development mostly for developing countries like Malaysia, as the Malaysian government is concerning the progress of manufacturing sector that seems to be vital to bring Malaysia towards Vision 2020.

This project will use a proper wiring technique to link all the electrical and electronic components. The components will be used in this project will be discussed later in the following chapters.

The turn table module in chain conveyor system can be applied in wrapping the product, product code scanning and changing the product orientation.
1.3 Overview Of The Project

*Turn Table Module in Chain Conveyor* is a new student final year project that will be developed in UNIMAS by two undergraduates student of the Mechanical Engineering and Manufacturing System Program, Mr. Leong Wei Chian, the author and Mr. Tan Weng Joo. Basically this project is divided into 2 parts:

(a) Mechanical design, analysis, fabrication and installation - handled by Tan Weng Joo

(b) Electrical wiring, circuit design and control system - handled by Leong Wei Chian that include the PLC programming, electrical circuit wiring, electrical parts and component installation, circuit design, control system design, troubleshooting, test run, control box mounting and installation.

1.4 Objectives Of The Project

The objectives of the project are listed below:

(a) To apply the following techniques into practice and application

   i) Mechanical design and fabrication.

   ii) Electrical wiring.

   iii) Electrical control system.

   iv) Industrial process controller, the Programmable Logic Controller.

   v) Process sensing.

(b) To improve problem solving skills by thinking analytically and practically.
(c) Simulating industrial practice on a realistic industrial system model. This can be seen by using a box as a product to be transferred on the chain conveyor system. The process will simulate the real industrial practice clearly.

(d) To develop a prototype based on the proposed design.

1.5 Rational Of The Project

In university, students are not fully exposing to real practice of control system instead of gaining knowledge from books in theory form. As a result it is important to learn the control system and apply it practically due to industrial process control systems are getting very important on par with computer and electronic technology. Almost all the control systems need computers hardware and software in processing, debugging, programming, process sensing, process monitoring, maintenance, real time control and faults finding. This project is likely can be related for student in learning the control system. As a result, undergraduates can appreciate the right value of control system to industry. Students exposed in the project will gain benefits and advantages in term of:

(a) To develop a fully automated control system for turn table module

(b) To develop a system which shows the importance of studying control system in manufacturing.

(c) This is to enhance the clarity of education in university in solution with industry.

(d) To learn the real practice of developing a project as the industrial sector expanding in Malaysia and this definitely demand a pool of expertise.
CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The literature review will focus on the characteristics and functions of the electrical and electronic components that will be used in developing and designing the circuit wiring, PLC control system and power supply panel. The explanations are important for developing and installing a proper manner power supply unit in term of safety as well. Besides that, research of automation control of the Pallet Stacker Automation Using Basic Stamp Machine developed by Jordan Automation Inc. also being referred.

In order to design a proper control system and circuit, there are a few important components need to look through. Sometimes the advantages of components chosen will also referred in order to make a good design. However, in terms of cost and the parts availability in the market, some components will be chosen according to the minimum requirement for its function from the proposed design for educational purpose. The explanations of the components are listed in the following sub titles.