UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DEVELOPMENT OF PLC CONTROLLED SERVO-DRIVEN MOTOR APPLICATION SYSTEM

This report is submitted in accordance with the requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

by

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DECLARATION

I hereby, declared this report entitled "The Development of PLC Controlled Servo-Driven Motor Application" is the results of my own research except as cited in references.

Signature :.....

Name : **NOR SAADAH BINTI MOHAMAD**

Date : 12 JANUARI 2016

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Electrical Technology Department) (Hons.). The member of the supervisory is as follow:

.....

(Project Supervisor)

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ABSTRACT

Colour preparation system is an example of an application that uses a servo motor. It is designed to help mix colours accurately. This project consists of three basic colours like red, yellow and blue that can produce a variety of new colours. Each box has a colour a solenoid valve to help stage the required quantity of colour and it will be sent to a colour processing. In this project, it is divided into two parts, hardware and software. For the main hardware are consist of servo motor and solenoid valve. In the main square, the stirrer will be driven by the servo motor for blending purposes. For developing the system, Graphical User Interface (GUI) is applied while software Programmable Logic Controlled (PLC) will control the movement of the servo motor. Finally, SCADA software is used to control at the whole project moving. By creating this project, application or implementation of this system can extend the colour mixture for further application in the industry as to produce a work that is easy and flexible.

ABSTRAK

Sistem penyediaan warna adalah satu contoh aplikasi yang menggunakan motor servo. Ia direka untuk membantu campuran warna dengan tepat dan cepat. Projek ini terdiri daripada tiga warna asas seperti merah, kuning dan biru yang boleh menghasilkan pelbagai warna baru. Setiap kotak warna mempunyai injap solenoid untuk membantu tahap kuantiti warna yang diperlukan dan ia akan dihantar ketempat pemprosesan warna.Projek ini terbahagi kepada dua bahagian ia itu perkakasan dan perisian. Bahagian perkakasan terdiri kepada mereka litar antaramuka oleh motor servo, pengesan injap solenoid dan motor servo. Dalam kotak utama, alat kacau akan dipacu oleh motor servo untuk tujuan campuran. Bahagian perisian AntaraMuka penggunaan grafik (GUI) untuk membangunkan sistem.Manakala perisian *programmable logic controlled* (PLC) akan memantau dan megawal pergerakan dan kelajuan motor servo. Akhir sekali, perisian SCADA digunakan untuk melihat keseluruhan projek yang bergerak. Dengan mencipta projek ini, permohonan atau perlaksanaan system campuran warna ini boleh meluaskan untuk permohonan selanjutnya sebagaimana dalam industri untuk menghasilkan kerja yang mudah dan fleksibel.

DEDICATIONS

To my beloved parents and friends.

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Alhamdulillah, I would like to express my grateful to Allah S.W.T. because the goodness that give me strength to complete this project. I have succeed finished my PSM project even though many challenged during the period for finishing this project. I would like to wish special thanks to my lovely parents and family because their support in term of financial and advice.

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LIST OF SYMBOLS AND ABBREVIATIONS

PLC	=	Programmable Logic Control
GUI	=	Graphical User Interface
HMI	=	Human Machine Interface
SCADA	=	Supervisory Control And Data Acquisition
PWM	=	Pulse Width Modulation

CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter explains about the project. The explanation include the problem statement of this project and also the objectives of the research. There are also have a few guidelines listed.

1.1 Background

This project is about development of PLC controlled servo driven motor application system. A servo motor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. A mixture system making colour as an example of application system of servo motor.

Besides that, SCADA system is also used in this project, which performs several functions. The three basic functions are the monitoring, control and user interface functions. The monitoring function collects data and sends it back to the central computer. The control function gathers data from monitoring sensors, processes it and send control signals back to the equipment according toa prescribed software program. The user interface is often a large control room where individuals can monitor SCADA input and output responses in real time.

1.2 Problem Statement

For a process control system that utilized DC motor in their operation, it is improper monitoring system. Several issues may arise from already system which is inaccuracy in terms of position and speed due to no feedback system. For second problem, the system is improper monitoring system without SCADA system. Next, almost system are controlled by microcontroller, there will be limitation of using microcontroller compared to PLC in certain industrial application. For this mixture process, there is a control and monitor system that can be the operation will proper.

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1.3 Objectives of Research

The project objectives are:

1. To utilize servo motor with a feedback for positioning.
2. To develop a HMI/SCADA system for process control and monitoring.

1.4 Scope of Research

There are a few scopes and guidelines listed to unsure the project is conducted within its intended boundary. The scopes are:

a) Study information the of PLC control servo motor system.
b) Familiarization the hardware and software.
c) Test run & troubleshoot the program.
d) Monitoring system with SCADA.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter discusses about the literature and review of structural analysis and some definition of the components used in this project such as PLC, servomotor, CX programmer and etc. There have many difference sources and researches about the concept, design and implementation of the servomotor by using PLC. It also included the investigation of what others have done in this area. This study included the areas of mechanical, electric, electronic and software development. Literature reviews are based on information that obtained from various sources, articles, technical reports, general reports, websites, books and personal communication.

2.1 Synopsis of Journal

In this part, it involve in finding information about fundamental related to this project. This includes materials such as text books, journal, manual, websites and catalogues. Table 2.1 below shows the summary of journals:

Table 2.1: Synopsis of Journals

NO	JOURNAL TITLE	AUTHOR
1	Development Of Automatic Color Mixing Machine Using PLC	Sachin S. Giri, Dr. M. J. Lengare, 2014
2	The Simulation Of The Control Of An Industrial Mixer Using PLC	Okoli Fj, Onubogu J.O And Okorogu V.N, 2013
3	Development Automated Multiple Water Filling	Ruhairi A.R, 2009
4	Motors & Drives Servo Motors: General Principles Of Operation.	Dave Polka, 2003
5	Programmable Logic Controller Control Servo Motor	Nuttaphong, 2010
6	Liquid Mixture Control System Using PLC	Azman A.R, 2013
7	Color Making And Mixing Process Using PLC	SanamdikarS.T.AndVartak C. 2014
8	Scada Supervisory Control And Data Acquisition	Stuart A.Boyer, 2004
9	Colour Mixing System With Trigerring Using PLC	Sandeep K.S And Manpreet K.S
10	Simulator System PLC Based Automatic Colour Mixer Hmi Integrated	Studi, Teknik, Ftpk& No,2013

2.1.1 Development of automatic colour mixing machine using PLC

This project was developed by (Sachin S. Giri, Dr. M. J. Lengare, 2014) from India. This paper uses the model of an industrial mixer which has already been developed in virtual machine. This colour mixing machine is of corob d200 of Asian paints equipment. This machine is based on microcontroller, and operates 230 VAC. The exact process of this machine is described as follow. The process of this machine is described as follow; the first step of this machine is filling the Steiner inside the tank situated at top of the machine. The strainer is completely filled inside the tank called as column. Then the next step is to give order as per requirement of customer. The communication between the corob machine and personal computer is done by suitable protocol. The communication between machine and PC is done by machine supported software.

The first step is fill the source tanks with the help of colour Steiner, Then the tanks are connected through pipes and at the of these pipes solenoid valve are fitted. There are two source tanks and one mixing tank with is taken into in system and as there are two source tanks, there are two solenoid valve as well. The mixing tank is situated below the two source tank and pipes coming from these source tanks is get emerged in to the mixing tank. The mixing tank consists of a stirrer the purpose of this stirrer is mix the colour uniformly present in the mixing tank. The main block or the brain of the system is Programmable Logic Controller (PLC). It is the controller which controls whole system. The level sensor, solenoid valve, load cell is connected to PLC in input and output module. Whole operation is done with the help of solenoid valve considering time factor of solenoid valve. The opening or closing of solenoid valve is done with help of PLC.

2.1.2 The Simulation of the Control of an Industrial Mixer using PLC

This project was develop by (Okoli, Onubogu, Okizie, &Okorogu, 2013) from Nigeria. This paper uses the model of an industrial mixer which has already been develop in virtual machine. The modelled components include heater, pumps, level sensor, thermostat, the electronic motor, indicators and the liquids. A model of each component has been develop individually and then articulated. These components are to be controlled by the action of the PLC which is to takes in field-inputs from these components and then gives appropriates control signals as the field outputs. The software program which is used to perform the control is develop in ladder logic language using bottom-top approach example individual programs that will run the motor, sensor, heater will be developed.

The blender is intended to take in two fluids for information pumps, mixer and high temperature them to a mixture before gathering the mixture at the yield pumps one after the other and afterward performing a warming and blending operation on this fluid inside the vessel. The mixture gathered from the yield pump and the entire procedure restarts. Figure 2.1 shows the simulation of the mixer in Logic Pro.

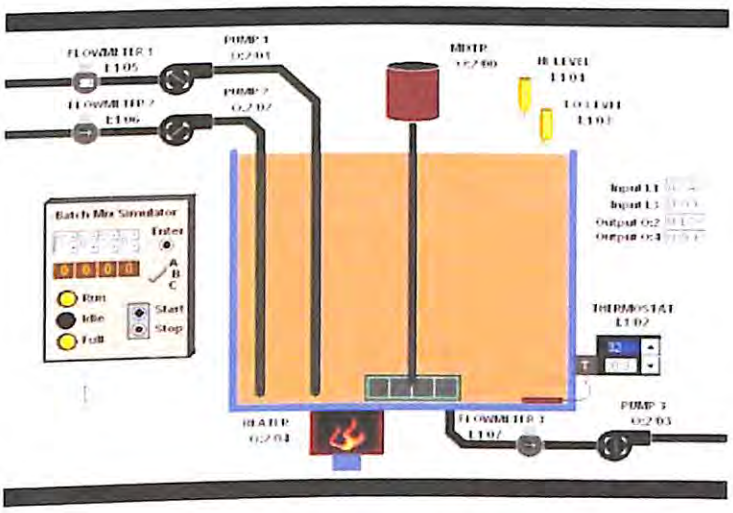

Figure 2.1: Actual simulation of the mixer in Logic Pro

2.1.3 Development Automated Multiple Water Filling

This project was develop by (Ruhairi A.R, 2009) from Malaysia. The purpose of this project is to apply filling system where this system can automatically filling two type of liquid into their bottle randomly. This filling system is based on Time Gravity Filler Selection Guide concept. This project is combination of PLC, DC motor system, it divided into four sections which are the loading system, the conveyor system, filling section and divider section. All section are controlled by the Keyence PLC. The mechanical drawing, measuring, welding and fabricating process, while electrical part consists of electrical drawing, wiring and programming. The software of Kyence PLC theory includes the electrical and mechanical actuators for hardware.

The machine was controlled by OMRON PLC for all logic functions, special modifications on programs available for special adaptation. The main components that used in this project is 40 gallons per minute double diaphragm for filling tank supply. It also use 20cm of stroke air cylinder with magnetic sensor for nozzle up and down movement. Lastly, the main components is hand wheel and shaft mounted stoppers for adjust the height and stroke

A DC motor was used in this project is to move the conveyor which transfer the product between stations. This motor operated at the voltage of 12Vdc, current starting is 1.2A while running current is 0.85A.

2.1.4 Servo Motor: General Principles of Operation

Based on the reference book by (Dave Polka, 2003) from United State of America. The servo that are used in industrial are used a closed loop system. This journal was stated about a principle of servo motor which how it works. First, a reference input or called velocity input is set to servo amplifier that control the speed of motor. It called feedback loop because it changes mechanical motion to electrical signal. Error detector will detect the error, if there is no error, it will sent directly to amplifiers. Figure 2.2 shows a servo motor block diagram.

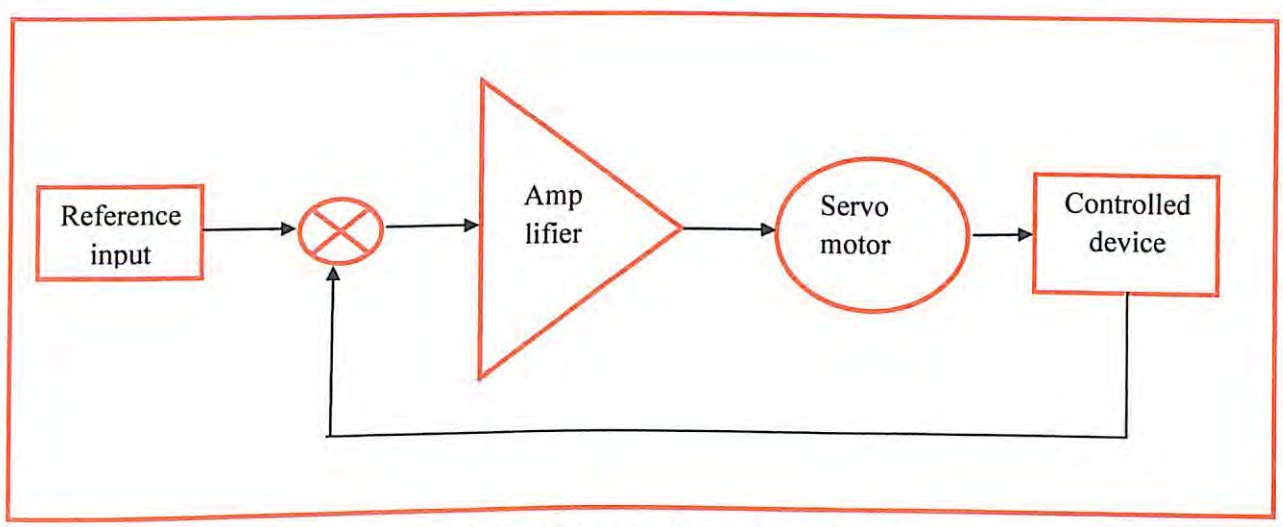

Figure 2.2: Typical Servo Motor Block Diagram

2.1.5 Programmable Logic Controller Control Servo Motor

Based on the journal from (Nuttaphong, 2010) typically servo motor control system are key elements in UML. From Figure 2.3 is representing a block diagram of PLC control servo motor. Motor can be divided in two types which loaded with brakes and no brakes. While encoder act to move feedback then it can be known about the position and speed of rotation. For servo driver, the current total of the servo controller and positioning controller same the servo controller will act as power supply. The function of servo controller is to control the motor positioning. The motor will commands by external devices such as PLC. PLC is commands to the servo in many form such as analogue. The servo will rotate the position and velocity as ordered.

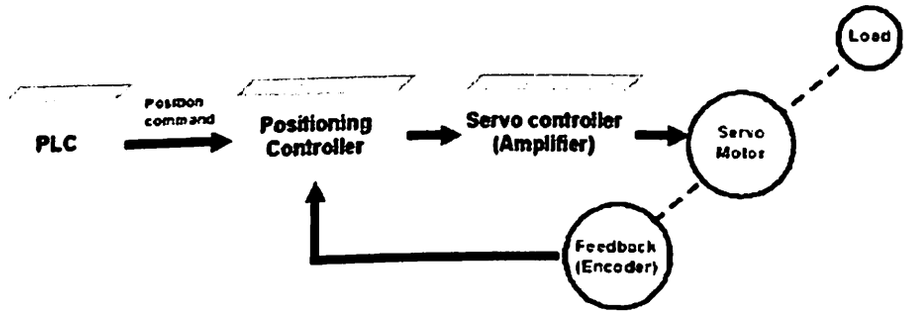

Figure 2.3: Block diagram of PLC Control Servo Motor

2.1.6 Liquid Mixture Control System Using PLC

This project was develop by (Azman A.R, 2011) from Malaysia. For this project PH sensor is used instead of litmus papers, which this pH sensor will determine either more acidic or alkaline The liquid mixing control system is the mechanism to control the composition of liquid to be mixed in the mixture process, used in the process industry, in sectors such as beverage, drinking water, food, chemistry, refinery and etc. This project consists of six tanks, with one mixture motor and five pumps are used and PLC is used to control the system.

Programmable Logic Controller (PLC) is used to control this Liquids Mixture Control system. The users can choose different volume of liquid from one of two separate tanks by selecting either one of two select buttons which locate on control panel, then the mixing process will be done, which the correct composition is determined by PH sensor of the mixture matching the PH value requirement as a product. After completing the mixing process this mixture will be transferred into the finishing tank as a complete product.

The motivation behind why picking PLC for this task on the grounds that it's well-adapted to a range of automation tasks. These are normally mechanical procedures in assembling where the expense of creating and keeping up the mechanization framework is high in respect to the aggregate expense of the computerization, and where changes to the framework would be normal amid its operational life. PLCs contain data and yield gadgets good with modern pilot gadgets and controls, minimal electrical configuration is needed, and the outline issue focuses on communicating the craved arrangement of operation.