IMPLEMENTATION OF AC MOTOR SPEED CONTROL USING PID CONTROLLER IN PROGRAMMABLE LOGIC CONTROLLER (PLC)

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ABSTRACT

Motor controller is an equipment that been use to determine the movement of an electric motor in a desired way. The speed control of motor is very difficult to be implemented by using conventional control techniques, as it quires a very complex mathematical model. The purpose of this project is to describe the research of PID controller design based on programmable logic controller (PLC) in order to control the speed of the motor. The model of the PLC that has been used in this project is OMRON CJIG-CPU42P where this PLC has a build in loop control that can be made the ladder diagram quite simple using function block in CX-process tools. In this project, the system without controller shows that is an open loop control. Hence, when break is applied there is no feedback for the system to increase the voltage in order for the motor to maintain the desired speed output. Compare by using the PID controller, when the breaking is applied there is a feedback for the system to increase the voltage to get the desired output. Analysis done and it shows that the Proportional-Integral controller with fine tuning is much better performance compare to the Proportional, Proportional-Integral-Derivative controller with and without fine tuning and without controller in the system.

ABSTRAK

Pengawal motor ialah peralatan yang digunakan untuk menentukan pergerakan elektrik motor dengan cara yang dikehendaki.Pengawalan kelajuan motor sangat sukar untuk dilaksanakan menggunakan teknik biasa seperti memerlukan model matematik yang sangat kompleks.Tujuan projek ini ialah untuk menerangkan penyelidikan corak pengawal *PID* berdasarkan *programmable logic controller (PLC)* dalam mengawal kelajuan motor.Model *PLC* yang digunakan dalam projek ini ialah OMRON CJIG-CPU42P dimana *PLC* ini telah dibina dalam kawalan gelung yang boleh dibuat dari *ladder diagram* yang mudah menggunakan *function block* dalam *CX-process tools.*Dalam projek ini,system tanpa pengawal menunjukkan ia adalah system kawalan terbuka.Jadi,bila gangguan dikenakan,tiada tindak balas dari system untuk meningkatkan voltan supaya dapat mengekalkan kelajuan output seperti yang dikehendaki.Analisis telah dibuat dan menunjukkan *PI mode* dengan *fine tuning* lebih bagus dari *P,PID mode* dan tanpa pengawal dalam suatu sistem.

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LIST OF ABBREVIATIONS

PLC	Programmable Logic Controller
P	Proportional Controller
PI	Proportional-Integral Controller
PID	Proportional-Integral-Derivative Controller
SP	Set Point
MV	Manipulated Variable
PV	Process Variable
FT	Fine Tuning

LIST OF EQUATIONS

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CHAPTER 1

INTRODUCTION

This chapter explains the background and the introduction of overall of this project which includes the introduction of project, problem statement, problem solving, objectives and scope of project.

1.1 Background

The proportional-integral-derivative (PID) controllers are widely used in many industrial control systems for several decades since Ziegler and Nichols proposed their first PID tuning method. This is because the PID controller structure is simple and its principle is easier to understand than most other advanced controllers. On the other hand, the general performance of PID controller is satisfactory in many applications. For these reasons, the majority of the controllers used in industry are of PI/PID type. PID controllers are widely used for process control applications requiring very precise and accurate control. Unlike on/off controls, the smooth and steady state control is achievable using these controllers. Various models are available featuring single loop with universal input, two to eight loops with eight independent inputs and sixteen control outputs.

1.1.1 Introduction to the project

The purpose of a motor speed controller is to take a signal representing the demanded speed, and to drive a motor at that speed. The controller may or may not actually measure the speed of the motor. If it does, it is called a Feedback Speed Controller or Closed Loop Speed Controller, if not it is called an Open Loop Speed Controller. Feedback speed control is better, but more complicated, and may not be required for a simple robot design. Motors come in a variety of forms, and the speed controller's motor drive output will be different dependent on these forms. The speed controller presented here is designed to drive a special dc motor which is suitable for education purposes.

To develop this project, the PID Controller considered in this study applies the required control voltage based on motor speed. The theory show that the control with Proportional-Integral-Derivative Controller (PID) can improve in terms of percentage overshoot and steady state error.

In developing this project, Programmable Logic Controller (PLC) ladder diagram programming will be constructed with PID control implementation and the hardware of motor control. Ladder diagram will be constructed in PLC while PID control will build using the block in CX-Process tools.

1.1.2 Problem Statement

Normally, mechanism in plant are easily damage without implementation of motor control in it system. The desired performance characteristics of control system are specified in term of the temporary response. The temporary response of a practical control system usually exhibits damped oscillation before reaching steady state.

1.1.3 Problem Solving

To solve the problem statement, control methodology such as a PID controller is used to limit the overshoot as well to reduce the starting motor current of the mechanism. The PID Controller is chosen to interface with the motor because it is suitable for application which has nonlinearities such as speed of the motor. Figure 1.1 shows the block diagram of AC motor with implementation of PID controller.

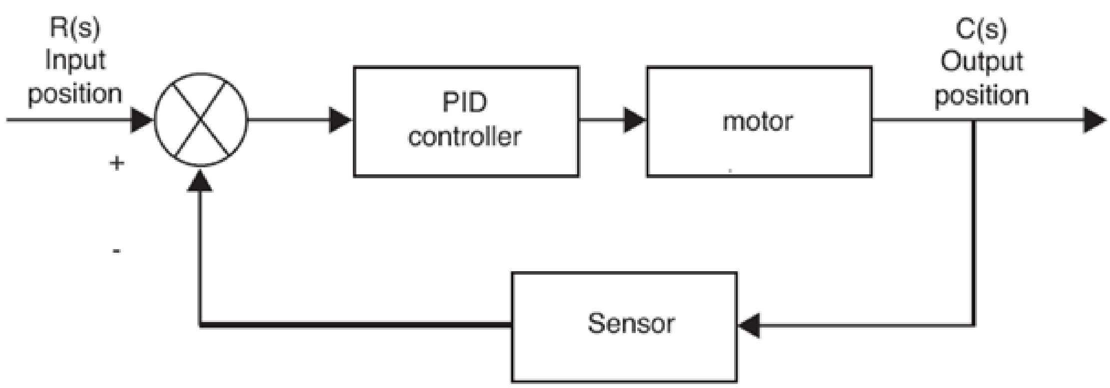

Figure 1.1: Implementation of PID Controller

1.2 Objective

The objectives of this project are to control the motor speed using Programmable Logic Controller (PLC) and to design the PID Controller in the Programmable Logic Controller (PLC) for better performance system of the motor control.

1.3 Scopes of Project

This project is to design a PID controller that can be use to control the speed of a motor. As a machine performance is an essential factor for a big production line, this project will examine the efficiency and performance of a motor with implementation of control methodology. Thus, the focuses of this project are stated below:-

i. Touch screen programming and hardware construction.

ii. Design, construct, wiring Panel PLC and Configure I/O card of PLC CJ1G-CPU42P.

iii. Construct the hardware consists of motor, inverter, relay and encoder.

iv. Studies of PLC Programming consist of CX-Programmer (Version 7.2) and CX-Process (Version 5.1)

v. Design PLC ladder diagram programming + function block in CX-process tools with PID Controller implementation.