

raf

TJ223.P55 .G86 2009.



000068117

Automated speed control / Guna Raja.



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

**BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II**

Tajuk Projek : AUTOMATIC SPEED CONTROL

Sesi Pengajian : 2008/2009

Saya GUNA A/L RAJA mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan () :

SULIT*

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD*

(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:


(TANDATANGAN PENULIS)


(COP DAN TANDATANGAN PENYELIA)

Alamat Tetap: Lot 14, Kampung Baru

43900 Sepang,

Selangor Darul Ehsan.

Tarikh: 30 APRIL 2009

CHAIRULSYAH WASLI
Pensyarah
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Karung Berkunci No 1752
Pejabat Pos Durian Tunggal
76109 Durian Tunggal, Melaka
Tarikh: 30 APRIL 2009

AUTOMATIC SPEED CONTROL

GUNA A/L RAJA

**This report is submitted in partial fulfillment of the requirement for the award of
Bachelor of Electronic Engineering (Industrial Electronics) With Honours**

**Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka**

April 2009


“I hereby declare that this report is the result of my own work except for quotes as cited
in the references.”

Signature : 

Author : GUNA A/L RAJA

Date : 30 APRIL 2009

“I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics) With Honours.”

Signature : 

Supervisor's Name : MR. IR. CHAIRULSYAH WASLI

Date : 30 APRIL 2009

To beloved father and mother

ABSTRACT

This project is aimed to design and build a control system that keeps the speed of DC motor at a certain speed. The PLC (Programmable Logic Controller) is used as a controller to control the speed of DC motor. Optoelectronic sensor will be used to measure the speed of DC motor. In this system, the photo detector sensor was used for measure the rotation speed of DC motor. This system is also can measure the speed of rotation even there is any disturbance occurred in systems. The disturbances could be such as oil or water. When there is any disturbance occurred in system, the PLC will be triggered and control the rotation of motor to the setting speed. There are three types of disturbance that can be adapted to the system, which are zero disturbances, low disturbance and high disturbance. The zero disturbances will not give any effect to the system. However, the low disturbances will slower the speed of rotation a little and the high disturbance will slower the speed quite big. The main objective of this project is to design a system with PLC to measure the speed of rotation of DC motor even there is any disturbance cored in systems. The speed of rotation can be detected by using the optoelectronic sensor. This LED will produce a beam of light to rotated disk. The interrupted beam light will be captured by the photo detector and the speed will be measured. The PLC acts as a main part in this project as it triggers and controls the whole circuit. The PLC controller is controls the speed of rotation. There are three types of speed conditions will be measured. There are high speed, medium speed and low speed. The measured speed will be display in a seven segment display or LCD. However, the reading that displays in seven segments are depends to the capability of the light sensor.

ABSTRAK

Projek ini bertujuan untuk membina sebuah sistem kawalan halaju motor arus terus. Sistem ini dikawal dengan menggunakan sistem PLC (Programmable Logic Controller). Kelajuan motor arus terus akan diukur dengan menggunakan pengesan cahaya. Sistem ini juga dibina dengan bertujuan untuk mengesan kelajuan motor arus terus sekiranya diberi gangguan secara manual pada motor arus terus. Antara bentuk gangguan yang mungkin diberi ialah minyak ataupun air. Sistem ini boleh beroperasi ketika tiada gangguan, gangguan rendah dan ketika gangguan yang tinggi yang dikenakan pada sistem tersebut. Sistem ini akan beroperasi tanpa sebarang masalah ketika tiada gangguan yang dikenakan. Manakala, ketika gangguan yang rendah dikenakan pada sistem ini, kelajuan motor akan berkurang sedikit. Pada ketika gangguan yang tinggi dikenakan, kelajuan motor akan berkurang terlalu rendah daripada keadaan asalnya. Objektif utama projek ini adalah untuk membina sebuah sistem yang dikawal oleh PLC untuk mengawal kelajuan motor arus terus secara automatik walaupun terdapat sebarang gangguan secara manual dalam sistem tersebut. PLC memainkan peranan yang penting dalam sistem kawalan ini. Sistem PLC akan tetap mengawal kelajuan motor arus terus walaupun terdapat sebarang gangguan pada sistem ini. Kelajuan motor arus terus yang diukur dengan menggunakan pengesan cahaya akan dipaparkan pada ruas tujuh dalam bentuk integer. Ketepatan bacaan kelajuan motor yang dipaparkan bergantung kepada keupayaan pengesan cahaya untuk mengesan kelajuan putaran motor arus terus secara tepat.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	PROJECT TITLE	ii
	DECELERATION	iii
	DEDICATION	v
	ABSTRACT	vi
	ABSTRAK	vii
	TABLE OF CONTENT	viii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF SHORTFORMS	xiv
	LIST OF APPENDIX	xv
I	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Objective of Project	2
	1.3 Problem Statement	2
	1.4 Scope of Work	3
	1.5 Flowchart	4

II	LITERATURE REVIEW	6
2.1	Automatic Control	6
2.2	Theory of Control	7
2.2.1	Introduction	7
2.2.2	Closed-Loop Control	8
2.2.3	Control Strategies	9
2.2.4	Control Specification	11
2.3	Programmable Logic Controller	12
2.3.1	Introduction	12
2.3.2	Basic Operation of PLC	13
2.3.3	Specification of PLC	14
2.3.4	Advantages of PLC	16
2.4	DC Motor	17
2.4.1	Introduction	17
2.4.2	Comparison of Motor Types	18
2.4.3	DC Drive Types	19
2.4.4	DC motor	22
2.4.5	DC Motor Control Characteristic	24
2.5	Speed Measurement Unit	26
2.5.1	LED	26
2.5.2	Sensing Unit	29
2.6	Photo Detector	31
2.6.1	Introduction	31
2.6.2	Photo detector Characteristic	32
2.6.3	Photo Detector Specification	34

III	PROJECT METHODOLOGY	37
	3.1 Project Methodology Workflow	37
	3.2 Analysis	40
	3.2.1 DC Motor Speed Control	40
	3.2.2 Adjustable Power Supply	41
	3.2.3 Photo-Electric Counter	43
	3.2.4 Calculation	45
IV	RESULTS AND ANALYSIS	48
	4.1 Calculation Analysis	48
	4.2 Animation Analysis	49
	4.3 Ladder Diagram Analysis	51
	4.4 DC Motor Speed Control Analysis	53
	4.5 Photo-Electric Detector Analysis	55
	4.6 Real Model of Project	56
	4.7 Measurement Analysis	57
V	DISCUSSION AND CONCLUSION	58
	5.1 Discussion	58
	5.2 Improvement and Suggestion	60
	5.3 Conclusion	60
	REFERENCES	61
	APPENDIX (A – E)	62

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1	Comparison of motor type	18
Table 2.2	Comparison of non-regenerative and regenerative capabilities	21
Table 2.3	The available LED's colors with wavelength range, voltage drop and material	28
Table 2.4	Advantages, disadvantages and applications of sensors	30
Table 3.1	Specification of DC motor	38
Table 4.1	Input and Output of the Ladder Diagram	51
Table 4.2	Comparison between calculated and measured speed	57

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1	The Flowchart of the Methodology	4
Figure 2.1	The concept of the feedback loop	7
Figure 2.2	Control panel with PLC (grey element in center)	12
Figure 2.3	A PLC unit with its range of applications	13
Figure 2.4	A Basic Operation Block Diagram	14
Figure 2.5	Electric Motor	17
Figure 2.6	DC drives type	19
Figure 2.7	DC motor Characteristic	24
Figure 2.8	Horsepower vs speed	25
Figure 2.9	Types of sensors	29
Figure 3.1	Workflow Description	39
Figure 3.2	DC Speed Controller Circuit	40
Figure 3.3	Adjustable Power Supply	41
Figure 3.4	Schematic Diagram for Photo-Electric Counter	43
Figure 4.1	Animation of automatic speed controller	49
Figure 4.2	Ladder Diagram for the System Operation	52
Figure 4.3	Pulse layouts for three conditions	53
Figure 4.4	The output when set to slow speed	54
Figure 4.5	The output when set to medium speed	54
Figure 4.6	The output when set to high speed	54

Figure 4.7	Common Anode 7 Segment Displays	55
Figure 4.8	Model of the Project	56

LIST OF SHORTFORMS

UTeM	-	Universiti Teknikal Malaysia Melaka
rpm	-	rotation per minute
PLC	-	Programmable Logic Controller
dc	-	direct current
Amp	-	ampere
V	-	voltage
LED	-	Light Emitting Diode

LIST OF APPENDIX

APPENDIX	TITLE	PAGE
A	FA-130RA Datasheet	63
B	CD4093B Datasheet	64
C	3 Digit BCD Counter	70
D	CD4543B Datasheet	75
E	PLC Input and Output Diagram	79

CHAPTER I

INTRODUCTION

Projek Sarjana Muda (PSM) or Bachelor's project is one of the important subjects that each of UTeM's students should taken in order to fulfill the requirement for the award of Bachelor of Electronic Engineering with Honours. Each of students will spend around one year or two semesters to design and complete their Bachelor's project. In this chapter, the background of the project has been discussed briefly.

1.1 Introduction

This project requires designing a control system that keeps the speed of DC motor at a certain speed. Optoelectronic sensor will be used to measure the speed of DC motor. In this system, we also can use the photo detector sensor for measure the rotation speed of DC motor. This LED will produce a beam of light to rotated disk and the speed will be measured. Then, the measured value will be display in the LCD or seven segment display. It is also describes its accuracy and scope of range. The system will use PLC as controller to control the speed even if there are disturbances cored at system. PLC act as a main part in this project as it triggers and controls the whole circuit. The PLC controller is controls the speed of rotation. There are three types of speed

conditions that will be measured. There are high speed, medium speed and low speed. The measured speed will be display in a seven segment display or LCD. However, the reading that displays in seven segments are depends to the capability of the beam of light sensor. If the beam is too accurate, then we can obtain the better reading of the speed.

1.2 Objective of Project

There are a few objectives that will be fulfilled in order to complete this project.

- a) To study the characteristic of DC motor and the Programmable Logic Control (PLC) that used as controller to control the speed even if there are disturbances cored at system.
- b) To design a system that will measure the speed of rotation of DC motor even there is any disturbances occurred in the system.
- c) To display the measured speed as a form of rpm (rotation per minute) in seven segment display or LCD.

1.3 Problem Statement

This project is design based from idea to overcome some of the problems that could be occurred in manual control systems. Manual controlling system needs a manual system or process to activate and deactivate the speed system. Besides that, manual controlling system always needs a person or systems to watch their process for 24 hours. Then, there are also not using the optoelectronic sensor to measure the speed of rotation.

1.4 Scope of Work

This system is able to use the PLC controller to control the speed rotation of DC motor. The DC motor circuit will be designed and integrated with the PLC. The PLC will be designed and developed to be function as a controller to control the speed of rotation. When there is any disturbance occurred in system, the PLC will be triggered and control the rotation of motor to the setting speed. There are three types of disturbance that can be adapted to the system, which are zero disturbances, low disturbance and high disturbance. The zero disturbances will not give any effect to the system. However, the low disturbances will slower the speed of rotation a little and the high disturbances will slower the speed quite big. The disturbances could be such as oil or water. The measured speed of rotation will be display in LCD or seven segment displays. The speed of rotation can be detected by using the optoelectronic sensor such as a photo detector. This LED will produce a beam of light to rotated disk. The interrupted beam light will be captured by the photo detector and the speed will be measured.

1.5 Flowchart

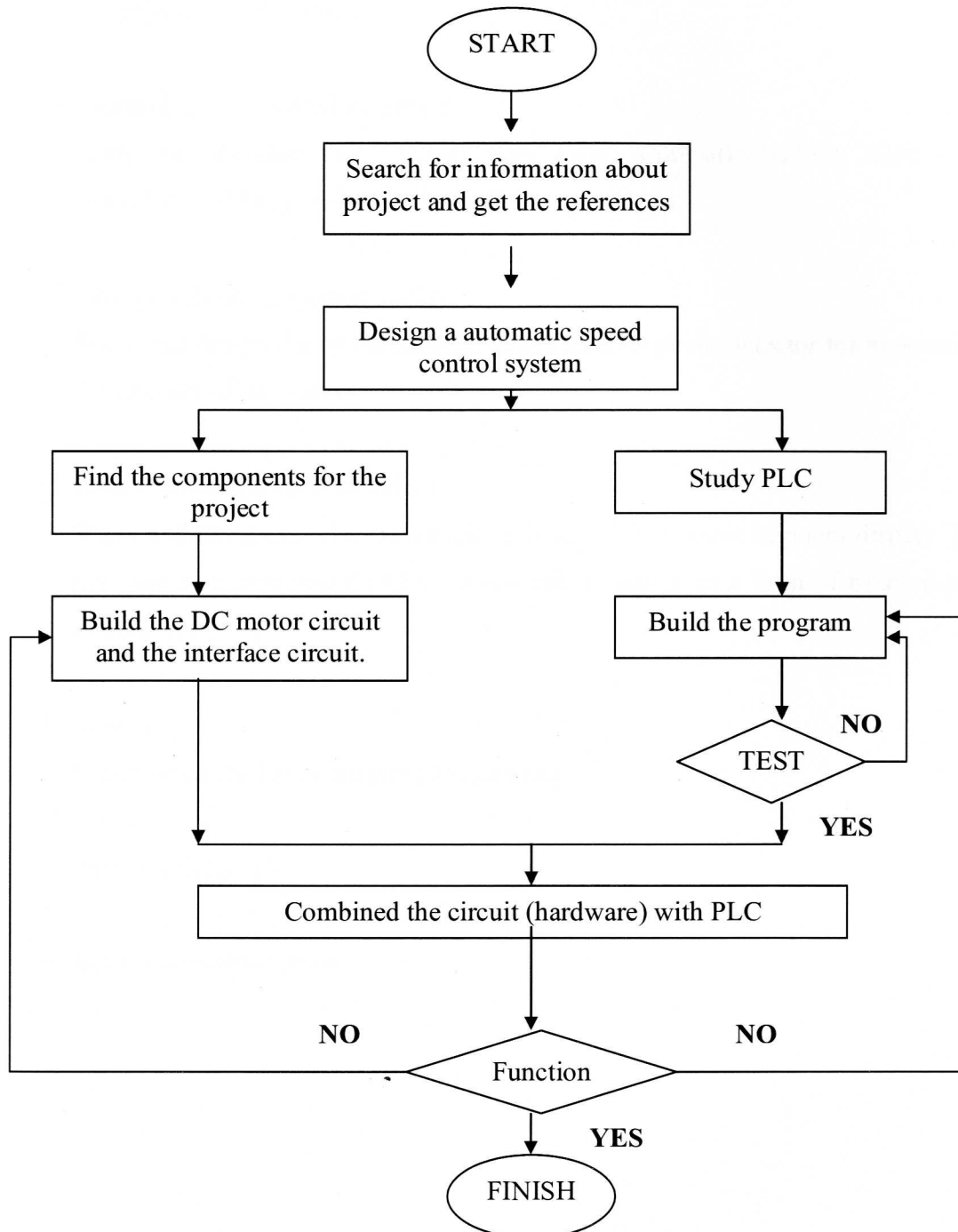


Figure 1.1 The Flowchart of the Methodology

- a) Research about DC motor circuit.

Study the characteristic of DC motor and design the circuit in order to achieve the objective of the project.

- b) Research about controlling circuit.

Study and develop the Programmable Logic Controller (PLC). Then, the controller will be combined with the DC motor circuit.

- c) Research about measuring circuit.

Study and design the optoelectronic sensor such as photo detector for measuring the rotation of DC motor.

- d) Research about display circuit.

Study and design the display circuit such as LCD or seven segment display. So that, the measured speed of DC motor can be shown as a form of rotation per minute (rpm).

- e) Testing.

Combine all the hardware parts and test run.

- f) Analysis the result.

- g) Submit complete report.

CHAPTER II

LITERATURE REVIEW

A literature review is a body of text that aims to review the critical points of current knowledge on a particular topic. In this chapter, each part of the project has been focused so that the more details about the project can be understood clearly. Besides that, the process and systems that involved in project are also discussed so that the process of the project can be understood.

2.1 Automatic Control

Automatic control is the research area and theoretical based for mechanization and automation, employing methods from mathematics and engineering. A central concept is that of the system which is to be controlled, such as a rudder, propeller or an entire ballistic missile. The systems studied within automatic control are mostly the linear systems. ^[4]

Automatic control systems are composed of three components such as:

- i. Sensors, which measure some physical state such as temperature, liquid or speed level.
- ii. Responders, which may be simple electrical or mechanical systems or complex special purpose digital controllers or general purpose computers.
- iii. Actuators, which affect a response to the sensors under the command of the responder. For example, by controlling a gas flow to a burner in a heating system or electricity to a motor in a refrigerator or pump.

2.2 Theory of Control

2.2.1 Introduction

Control is a system that deals with the behavior of dynamical systems. The desired output of a system is called the reference. A controller manipulates the inputs to a system to obtain the desired effect on the output of the system when one or more output variables of a system need to follow a certain reference over time

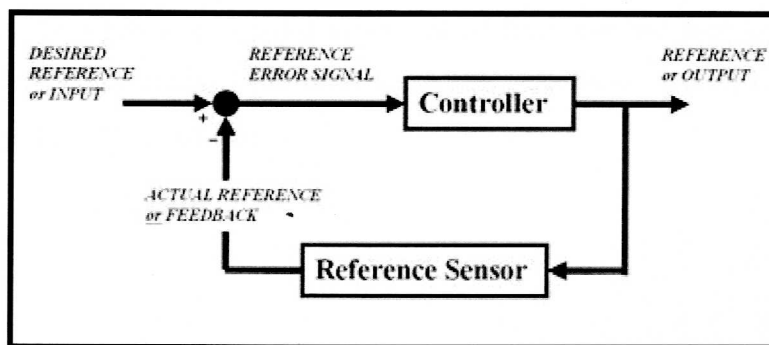


Figure 2.1 The concept of the feedback loop

2.2.2 Closed-Loop Control

A closed-loop control uses a feedback to control states or outputs of a dynamical system. The process inputs have an effect on the process outputs such as velocity or torque of the motor, which is measured with sensors and processed by the controller. The result of the control signal is used as input to the process.

Closed-loop control has the following advantages over open-loop control:

- a) Disturbance rejection such as unmeasured friction in a motor.
- b) Guaranteed performance even with model uncertainties, when the model structure does not match perfectly the real process and the model parameters are not exact.
- c) Unstable processes can be stabilized.
- d) Reduced sensitivity to parameter variations.
- e) Improved reference tracking performance.

In some systems, closed-loop and open-loop control are used simultaneously. In such systems, the open-loop control is termed of feed forward and serves to further improve reference tracking performance. The common closed-loop controller architecture is the PID controller.