SPEED CONTROL OF CESB CONVEYER BELT WITH PLC

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DEDICATION

To my parents, family members and friends;
My all times beloved.

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Alhamdulillah, I finally able to complete the final year project and the thesis as well within the allocated time. First of all, I would like to take this opportunity to express my appreciation to some organizations and individuals who have kindly contributed to the successfully completion of my final year project in UTeM. With the cooperations and contributions from all parties, the objectives of the project; soft-skills, knowledge and experiences were gained accordingly. To begin with, I would like to convey my acknowledgement to UTeM PSM organization members especially my project supervisor, En Zulhairi Bin Othman for his cooperation and involvement from the begining untill the end of my project development. His effort to ensure the successfull and comfortability of students under her responsibility was simply undoubtful. Thanks for the invaluable advices given before, while and after completion of the project. Furthermore, I would like to extend my sincere acknowledgement to my parents and family members who have been very supportive throughout the project. Their understanding and support in term of moral and financial were entirely significance towards the project completion. Last but not least, my appreciation goes to my fellow colleagues in UTeM, especially for those who came from FKEKK. Their willingness to help, opinions and suggetions on some matters, advices and technical knowledge are simply precious while doing upon completion of my final year project.

ABSTRACT

This project is about to make a Direct Current motor controler for conveyer use in Cubic Electronic Sendirian Berhad (CESB). The project objective is to overcome the problem that occured in the production line. The problem is the difficulties to set the cycle time for each conveyer according to work order. Current speed controller that had been used in CESB use potentiometer as the methods to varied the speed of trhe motor. This method are hard to control and not so practical. My project is to install a several fix resistor to get the frequent used speed in manufacturing process in CESB. This resistors will be simulated, tested and finally install to the motor controller. PLC unit are the controller that used to start the motor and then cooperate with internal stopwatch to record cycle time done for the motor. Finally buzzer will activated for 5 seconds to alert user that the cycle time that had been taken for the motor is recorded.

ABSTRAK

Projek ini adalah untuk membuat pengawal motor Arus Terus yang digunakan oleh pengangkut di Cubic Electronic Sendirian Berhad (CESB). Objektif projek adalah bagi mengatasi masalah yang timbul dalam bahagian pengeluaran. Masalah yang timbul adalah kesukaran untuk menetapkan *cycle time* untuk setiap pengangkut berdasarkan arahan kerja. Pengawal kelajuan semasa yang digunakan di CESB menggunakan perintang boleh laras sebagai kaedah bagi mengubah kelajuan motor. Kaedah ini adalah agak sukar dan tidak begitu praktikal. Projek saya adalah untuk memasang beberapa perintang tetap bagi mendapatkan kelajuan yang biasa digunakan dalam penghasilan produk di CESB. Perintang-perintang ini akan disimulasikan, diuji dan dipasang pada pengawal kelajuan motor tersebut. PLC merupakan unit kawalan yang digunakan untuk menghidupkan motor dan bekerjasama dengan jam randik dalaman untuk mencatatkan *cycle time* yang dicaat oleh motor. Akhir sekali buzzer akan aktif selama 5 saat untuk memberi amaran kepada juruteknik dimana masa yang dicapai oleh sesebuah motor untuk sesebuah *cycle time* telah dicatat.

TABLE OF CONTENTS

CHAPTER	DESCRIPTION		PAGE
	PROJECT TITLE		i
	REPORT STATUS APPROVAL FORM		ii
	DECLARATION		iii
	SUPERVISOR APPROVAL		iv
	DEDICATION		v
	ACKNOWLEDGEMENTS		vi
	ABSTRACT		vii
	ABSTRAK		viii
	TABLE OF CONTENTS		ix
	LIST OF TABLES		xii
	LIST OF EQUATION		xiii
	LIST OF FIGURES		xiv
	LIST OF ABBREVIATIONS		xvi
	LIST OF APPENDIXS		xvii
I	**INTRODUCTION**		
	1.1	INTRODUCTION	1
	1.2	PROJECT OVERVIEW	2
	1.3	OBJECTIVES	3
	1.4	SCOPE OF WORKS	3
	1.5	THESIS OUTLINE	4

II	**LITERATURE REVIEW AND CONCEPTS**	
2.1	DC MOTOR AND CONTROL TECHNIQUE	5
2.1.1	DC MOTOR CHARACTERICSTIC	6
2.1.2	BASIC DC MOTOR CONTROLLER	8
2.1.2.1	Controlling speed by adding resistance	8
2.1.2.2	Controlling speed by adjusting armature voltage	10
2.1.2.3	Controlling speed by adjusting field voltage	12
2.1.3	WARD LEONARD	13
2.1.4	CHOPPER	14
2.1.5	PHASE	15
2.1.6	H-BRIDGE	16
2.2	DISPLAY	18
2.2.1	LIQUID CRYSTAL DISPLAY	18
2.2.2	DOT MATRIX DISPLAY	20
2.2.3	SEVEN SEGMENT DISPLAY	21
2.3	PRO & CONTRA	24
2.3.1	DC MOTOR	24
2.3.2	DRIVER AND CONTROLLER	26
2.3.3	DISPLAY	27
III	**PROJECT METHODOLOGY**	
3.1	PROJECT OVERVIEW	29
3.2	PROJECT PLAN	31
3.3	HARDWARE COMPONENT SELECTION	32
a)	DC MOTOR	32
b)	DRIVER	33
c)	DISPLAY	36
3.3.c.1	Generator	38
3.3.c.2	Counter	39

	3.4	PLC PROGRAM	40
	3.5	PROJECT DESIGN AND IMPLEMENTATION	42
		a) Driver Circuit	43
		b) Display Circuit	44
	3.6	ETCHING PROCESS	45
IV	**PROJECT RESULT AND DISCUSSION**		
	4.1	H-BRIDGE TEST	49
	4.2	STOPWATCH TEST	51
	4.3	DISCUSSION	52
V	**CONCLUSION AND SUGGESTION**		
	5.1	CONCLUSION	54
	5.2	PROJECT WEAKNESSES	55
	5.3	PROJECT IMPROVEMENT AND SUGGESTION	55
	REFERENCES		56
	APPENDIXES		57

LIST OF TABLES

NO	TITLE	PAGE
2.1	Comparison for display products	27
3.1	Component needed for H-Bridge model	34
3.2	Stopwatch component	36
3.3	I/O Table	40
4.1	H-Bridge multiple configuration	49
4.2	Multiple fix resistor effect on voltage	50
4.3	Variable resistor effect on voltage	50

LIST OF EQUATIONS

NO	TITLE	PAGE
2.1	equation before additive resistance added	9
2.2	equation after additive resistance is added	9
2.3	speed without load	9
2.4	speed drop	9
2.5	angle speed	10
2.6	angle speed simplified	10
2.7	dependency of motor speed on the field flux	12

LIST OF FIGURES

NO	TITLE	PAGE
2.1	Controlling speed by adding resistance	8
2.2	Analysis of speed by adding resistance	9
2.3	Controlling speed by adjusting armature voltage	10
2.4	Analysis of speed by adjusting armature voltage	11
2.5	Analysis of speed by adjusting field voltage	12
2.6	Chopper control techniques	14
2.7	Phase control techniques	15
2.8	H-Bridge	16
2.9	H-Bridge operation	17
2.10	Liquid crystal display built	18
2.11	Various size of LED Dot Matrix	21
2.12	Seven segment inner built	22
2.13	Typical efficiency versus speed curves at full load	25

3.1	Elements of the projects	29
3.2	McMillan brush free motor - 5 1/8" Open Frame - *Resilient Base Mount*	32
3.3	Current used controller concept	33
3.4	Improved controller	35
3.5	Display (stopwatch) circuit	37
3.6	PLC Program	41
3.7	PCB for H-Bridge Driver	43
3.8	PCB for Stopwatch	44
3.9	Transforming to transparent OHP paper	45
3.10	Laminated PCB board with thin film and circuit drawing	46
3.11	UV exposure process	46
3.12	PCB board soaking process	47
3.13	Etching process	47
4.1	Output from LED seven segment	51

LIST OF ABBREVIATIONS

CESB	-	Cubic Electronics Sdn.Bhd.
MOSFET	-	Metal-Oxide-Semiconductor Field-Effect Transistor
DC	-	Direct Current
AC	-	Alternating Current.
BJT	-	Bipolar Junction Transistor.
FET	-	Field Effect Transistor.
LCD	-	Liquid Crystal Display.
LED	-	Light Emiting Diode.
CMOS	-	Complementary Metal–Oxide–Semiconductor.

LIST OF APPENDIXS

NO	TITLE	PAGE
A	Datasheets for CD4060BM/CD4060BC	57
B	Datasheets for MC14511B	64
C	Datasheets for MC14518B	77

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

The project is about to assemble a controller for a conveyor in CESB using PLC as its methods. The current controller for conveyor used in CESB are using manual knob which constructed using potentiometer and digital micro switch. Changing the resistance value will change the speed of the motor for the conveyor while the other method is giving the input via micro switch where is most likely just like what I want to do now. Since it is too complex interface and the operation are quite complex to understand, this function is useless.

The method I use to overcome this thing is by using fix potentiometer which is easily found in ceiling fan speed controller. We can get at least 5 forward speed and the speed is fix. As an addition, the variable resistor is added to be use in case of unavailable speed provided by the fix potentiometer.

The additional function is the display. This display will show the time in second for each cycle done by the conveyer belt. It is the stopwatch that working automatically. It starts ticking only when the initial switch is pressed and stops when the cycle is over.

1.2 PROJECT OVERVIEW

This project is about to assembling a DC motor controller. This material will guide reader through the DC motor driver selection. Since there is a lot of DC motor and its driver available, we will look for its detail to make a comparison about the advantage and disadvantage before choosing the best one for this conveyer belt.

After the selection part is done, the circuit will then simulate and the output will be analyzed. This section will thoroughly explain about the best picked up driver motor.

In the last part, the driver will be assembled and combined into the PLC unit which will then manipulating the driver to work accordingly to the program.

The display part is using the seven segments as its method. Reader will explain briefly why this type of display is selected. For the stopwatch it is the combination of a counter and a ticker. A pulse will be generated by crystal to produce 1 second electric pulse.

Final part is the alert or warning device part. It is only a piezzo buzzer attached to the output when the determination of the cycle time is done.

The three parts will be combining together in order to accomplished the projects. As a summary, the PLC is the main part which will start the system. Then it makes the motor controller drives the motor according to user command, either forward or reverse and either slower or faster. Stopwatch will then record the time taken to finish in one cycle and display it on the display element. After the time is recorded buzzer will sound for about 5 seconds to alert user. If the speed is not as user requirement, they still can change the speed using the variable resistor (potentiometer).

1.3 OBJECTIVES

The objectives of this project are to design a motor controller using PLC. After design process is done, the process are about to assemble a DC motor driver. To make this machine work automatically, an internal stopwatch will be built-in in the circuit. Finally as an alert a buzzer will attach to make a sound that can warn user.

1.4 SCOPE OF WORK

In the beginning of the project development, several factors were considered to determine the limitation or final outcome of the product. For this project, the aim is to develop a PLC circuit, inverter for AC motor and display using double 7 segments.

How ever after the first semester, I found that the project cannot be done by me because the cost are too expensive and the time are not enough to do the research and to develop the product.

The cost to build an inverter is at least RM 1200 just if I bought it from the supplier in order to estimate my time. Order and booking from lab of project doesn't support enough for this project. After a discussion and permission in second semester finally this project is reduced to a model of conveyer controller using DC motor which cost me lower and it is affordable to buy. In order to complete the hardware part and PLC program part, these three parts are put together on a same board after it is fully function on each session and part.

1.5 THESIS OUTLINE

This thesis consists of five chapters. Chapter I will focus on brief introduction of the project carried. The important overview or description including the problem statement, project objectives and project scopes are well emphasized in this part.

Chapter II will be based on the literature review of the project. It is mainly focused on the technique of controlling the motor speed and display. This is including DC motor, the driver and display. On the starting part, readers will be told about all the randomly selected technology that available on market. For an example the DC motor type that available. For the finishing part, a comparison will be made and the most suitable method will be chosen.

Chapter III will explain more detail on the selected method on the previous part. This part will guide reader further on how this project is done.

Chapter IV mainly focused on the result and analysis done using the device. All testing and verification result are attached with the aid of figure, table and statistic related to the project.

Chapter V is a complimentary of previous four chapters. It describes on the overall project, discussion and suggestion for the project. All matters arise including the problems and unachieved objectives will be described clearly in this part.

CHAPTER II

LITERATURE REVIEW AND CONCEPTS

2.1 DC MOTOR AND CONTROL TECHNIQUES

DC motor is a device that works according to current, magnetic field, voltage, torque, load and power. Each changes of the element will make a change in motor speed. For an example, the speed of a DC motor will increase if we supply more voltage to its supply. The load will reduce the motor speed and overload can make the motor stop immediately. DC motor can be classified in 3 group which is separately excited, shunt, and series. At early stages, this part will explain about the DC motor itself and then move to the controller parts.

DC motor controller is simpler than an AC motor. It doesn't need an expensive inverter. The driver is cheaper and the cost of DC motor itself are cheaper than AC motor. How ever there are some advantages and disadvantages in the performance. Readers will be explained clearly in this part about the advantages and disadvantages of the motor and the driver.

In this part I will then continue to explain briefly about the technique that available in controlling the motor speed such as chopper control, H-bridge, resistant and phase control. The best selected controller will be discussed in the next part (methodology).

2.1.1 DC Motor Characteristic

The main characteristic that differ DC motor to an AC motor is the starting torque. This characteristic is important to save time for the PLC to start measuring the speed. The steady state for the motor can be achieved in less than 5 second. If we are about to use the AC motor, the time use to achieve the steady state are quite long and this are time wasting.

Many of the limitations of the classic commutator DC motor are due to the need for brushes to press against the commutator. This creates friction. At higher speeds, brushes have increasing difficulty in maintaining contact. Brushes may bounce off the irregularities in the commutator surface, creating sparks. This limits the maximum speed of the machine. The current density per unit area of the brushes limits the output of the motor. The imperfect electric contact also causes electrical noise. Brushes eventually wear out and require replacement, and the commutator itself is subject to wear and maintenance. The commutator assembly on a large machine is a costly element, requiring precision assembly of many parts.

These problems are eliminated in the brushless motor. In this motor, the mechanical "rotating switch" or commutator / brushgear assembly is replaced by an external electronic switch synchronized to the rotor's position. Brushless motors are typically 85-90% efficient, whereas DC motors with brushgear are typically 75-80% efficient.

Midway between ordinary DC motors and stepper motors lies the realm of the brushless DC motor. Built in a fashion very similar to stepper motors, these often use a permanent magnet external rotor, three phases of driving coils, one or more Hall Effect devices to sense the position of the rotor, and the associated drive electronics. The coils are activated, one phase after the other, by the drive electronics as cued by the signals from the Hall Effect sensors. In effect, they act as three-phase synchronous motors containing their own variable-frequency drive electronics. A specialized class of brushless DC motor controllers will utilize EMF feedback through the main phase connections instead of Hall Effect sensors to determine position and velocity. These motors are used extensively in electric radio-controlled

vehicles, and referred to by modelists as out runner motors (since the magnets are on the outside).

Brushless DC motors are commonly used where precise speed control is necessary, computer disk drives or in video cassette recorders the spindles within CD, CD-ROM (etc.) drives, and mechanisms within office products such as fans, laser printers and photocopiers. They have several advantages over conventional motors.

Compared to AC fans using shaded-pole motors, they are very efficient, running much cooler than the equivalent AC motors. This cool operation leads to much-improved life of the fan's bearings.

Without a commutator to wear out, the life of a DC brushless motor can be significantly longer compared to a DC motor using brushes and a commutator. Commutation also tends to cause a great deal of electrical and RF noise; without a commutator or brushes, a brushless motor may be used in electrically sensitive devices like audio equipment or computers.

The same Hall Effect devices that provide the commutation can also provide a convenient tachometer signal for closed-loop control (servo-controlled) applications. In fans, the tachometer signal can be used to derive a "fan okay" signal.

The motor can be easily synchronized to an internal or external clock, leading to precise speed control.

Brushless motors have no chance of sparking, unlike brushed motors, making them better suited to environments with volatile chemicals and fuels.

Brushless motors are usually used in small equipment such as computers generally used to get rid of unwanted heat.

They are also very quiet motors which is an advantage if being used in equipment that is affected by vibrations.

Modern DC brushless motors range in power from a fraction of a watt to many kilowatts. Larger brushless motors up to about 100 kW rating are used in electric vehicles. They also find significant use in high-performance electric model conveyer.

Much of the same logic contained in large, powerful Variable-frequency drive (VFD) is also embedded in small brushless DC motors. In this case, the