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EMBEDDED CONTROLLER DESIGN FOR A COMPRESSOR SYSTEM

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“I hereby declare that this PSM Report is the result of my own, as clearly stated in the sources of references and sources is explained and stated.”

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SUPERVISOR APPROVEMENT

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I dedicate this to my parents, my beloved family, my supervisor, my friends
and electrical engineering education.



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ABSTRACT

The development of a controller for car air-conditioner compressor in this project is an improvement from the original system. The original system needs two combinations of system to run the compressor. As a solution, a new innovation of controller for car air-conditioner compressor is designed with same operation. The design will be operated using PIC (PIC 16F877A) and it is programmed by using C-Language. As a result, the original system is reduced from two to only one system, and gives more advantages.



ABSTRAK

Penciptaan pengawal untuk kompressor penghawa dingin kereta dalam projek ini merupakan penambahbaikan daripada sistem asal. Sistem asal memerlukan dua gabungan sistem untuk menggerakkan kompressor. Sebagai jalan penyelesaian, pembaharuan bagi pengawal untuk kompressor penghawa dingin kereta telah dicipta dimana operasi sebelumnya akan dikekalkan. Rekaan ini dilaksanakan menggunakan PIC (PIC16F877A) dan diprogramkan menggunakan C-Language. Hasil dari ciptaan ini, sistem asal yang menggunakan gabungan dua sistem dapat dikurangkan kepada hanya satu sistem. Ini memberi lebih banyak kelebihan.



CONTENTS

CHAPTER	TITLE	PAGE
	PERSONAL INFORMATION	i
	PROJECT TITLE	ii
	DECLARATION	iii
	SUPERVISOR APPROVEMENT	iv
	DEDICATION	v
	ACKNOWLEDGEMENT	vi
	ABSTRACT	vii
	CONTENT	viii
	LIST OF FIGURE	xii
	LIST OF TABLE AND FLOW CHART	xii
1.0	INTRODUCTION	1
1.1	INTRODUCTION OF THE PROJECT	1
1.2	OBJECTIVES	2
1.3	SCOPES OF WORKS	3
1.4	PROBLEM SOLVING	3
1.4.1	PROBLEM STATEMENT	3
1.4.2	PROBLEM SOLVING	4
2.0	LITERATURE REVIEW	5
2.1	INTRODUCTION	5



2.2	PERIPHERAL INTERFACE CIRCUIT (PIC)	5
2.2.1	WHERE ARE MICROCONTROLLER USED	6
2.2.2	PART OF MICROCONTROLLER	7
2.3.3	GETTING STARTED WITH MICROCONTROLLER	8
2.3.4	REQUIRED PARTS AND SUPPLIES	8
2.2.5	A SIMPLE PIC CIRCUIT	9
2.2.6	EXAMPLE A CONNECTION AND INTERFACE I/O	10
2.2.7	BEFORE MAKING SOME CODE	11
2.2.8	CLOCK CYCLES, OSCILLATORS AND FUSES	11
2.2.9	PROGRAM MEMORY AND PROGRAM COUNTER	12
2.2.10	RAM	13
2.2.11	I/O PORTS AND PERIPHERAL	14
2.3	C-LANGUAGE PROGRAMMING	15
2.31	C BASICS	15
2.32	HISTORY OF C	16
2.33	CHARACTERISTIC OF C	16
2.34	C PROGRAM STRUCTURE	18
2.35	VARIABLES	20
2.36	DEFINNING GLOBAL VARIABLES	21
2.37	PRINTING OUT AND INPUTTING VARIABLES	24
2.38	CONSTANTS	24
2.39	ARITHMETIC OPERATIONS	25
2.3.10	COMPARISON OPERATORS	28
2.3.11	LOGICAL OPERATORS	28
2.4	PCWH COMPILER	31
2.4.1	COMPILER COMPARISON CHART	31
2.4.2	IDE FEATURES	32
2.4.3	COMPILER FEATURES	33
2.4.4	BUILT IN FUNCTIONS	34
2.4.5	SUPPORTED DEVICES	42
2.5	CD2M SOFTWARE	45



2.6	CAR AIR CONDITIONING SYSTEMS	45
2.6.1	COMPRESSOR	46
2.6.2	CONDENSER	47
2.6.3	EVAPORATOR	47
2.6.4	PRESSURE REGULATING DEVICES	48
2.6.5	ORIFICE TUBE	48
2.6.3	THERMAL EXPANSION VALVE	49
2.6.4	RECIEVER DRIER	49
2.6.5	ACCUMULATOR	50
2.7	COMPRESSOR SYSTEM	51
2.8	AIR REGULATOR	53
2.9	PRESSURE SWITCH	54
2.10	INDUCTION MOTOR	55
	METHODOLOGY	
3.0	3.1 FLOW CHART	58
	3.2 GANTT CHART	59
4.0	PROJECT RESULT	61
	4.1 HARDWIRE CONNECTION DIAGRAM	61
	4.2 INTERFACE SCHEMATICS DIAGRAM BETWEEN PIC AND COMPRESSOR	63
	4.3 SERIAL RS232	64
	4.4 OVERALL OPERATION	65
	4.5 C-LANGUAGE PROGRAMMING	66
	4.6 PICTURE OF PROJECT	67
	4.7 FLOW CHART OF OVERALL OPERATION	69
	4.8 COMPRESSOR WORK	70
5.0	DISCUSSION AND SUGGESTION	72



6.0	CONCLUSION	75
	REFERENCES	76
	APPENDIX	77



LIST OF FIGURE

FIGURE	TITLE	PAGE
2.2.5	A simple PIC Circuit	9
2.2.6	Example Connection and interface with I/O	10
2.6	Car air-conditioning system	45
2.7	Compressor System	51
2.8	Air regulator	53
2.9	Pressure Switch	54
2.10	Induction Motor	55
4.1	Hardwire connection diagram	61
4.2	Interface schematics	62
4.3	Serial RS232	63
4.5	Picture Of Project	65
5.1	Compressor Work	68

LIST OF TABLE AND FLOW CHART

2.3.1	Compiler Comparison Chart	21
3.1	Methodology flow chart	58
3.2	Gantt Chart	59
5.4	Flow Chart Of Overall Operation Project	71

CHAPTER 1

INTRODUCTION



CHAPTER 1

INTRODUCTION

This chapter will discuss about introduction, objectives, scope, and the problem statement for this project.

1.1 INTRODUCTION OF THE PROJECT

This project is built for a car air-conditioner compressor system that is controlled automatically by using microcontroller (PIC). The purpose of this project is to give an option and different technology to control car air-conditioner compressor. It is a combination of electrical, electronics and mechanical engineering field to represent the new invention regarding the design and development process.

This project is conducted in order to overcome the problem from the original system. It is because, the old design of an air-conditioner compressor controller needs two combination of systems to run a compressor. The old system will operate although the hardware from compressor part has any problem. It will damage car engine. This new design, only needs one system to allow a car air-conditioner compressor being function. Its operation will stop if the hardware component from compressor has a problem. This new design provides more advantages compared to the original system.



1.2 OBJECTIVES

- ❖ To learn a basic concept of an air conditioner system and a compressor system.
- ❖ To learn a concept of microcontroller (PIC) and C language programming to get finest tune.
- ❖ To implement a hardware installation, that indicates electrical parts, electronics parts and mechanical parts of a compressor and PIC controller to get a highly reliable and smooth operation for this project.
- ❖ To learn more on hardware and software installation and troubleshooting.



1.3 SCOPE OF WORKS

- ❖ To design and develop a controller for a car compressor system.
- ❖ To use a microcontroller (PIC16F877A) and program it using a C-Language programming.
- ❖ To make a hardware installation, that indicates wiring, soldering, testing and troubleshooting for both PIC controller and compressor.
- ❖ To build an interface between PIC controller and compressor.

1.4 PROBLEM SOLVING

1.4.1 Problem Statement

- ❖ The original system needs two combinations of systems to run car air-conditioner compressor.
- ❖ The original system will operate continuously although the hardware parts from compressor encounter any problem.
- ❖ The original system has complex hardwire connection.
- ❖ The original system is combination of thermostat and timer system. So, the operation of compressor is not accurate for the calculation of pressure.



1.4.2 Problem Solving

- ❖ Design a controller that only needs one system to assure a car air-conditioner compressor works.
- ❖ Design a system that will stop operate when the hardware from the compressor face a problem.
- ❖ Reduce hardwire connection.
- ❖ Used pressure switch to make sure that the output of pressure from the compressor is enough for the air-conditioner being function.

CHAPTER 2

LITERATURE REVIEW



CHAPTER 2

This chapter will explain the theoretical part of this project.

LITERATURE REVIEW

2.1 INTRODUCTION

First step to develop a controller to control an air-conditioner compressor, research with a related field especially in Peripheral Interface Circuit (PIC) as controller need to be done. Secondly, a basic knowledge about car air-conditioner system, especially compressor system need to be explores. It is a main component that will be controlled. Lastly, a group of component that will be used on the compressor system like pressure switch and air regulator has to be list out.

2.2 Peripheral Interface Circuit (PIC)

Microcontrollers are wonderfully useful devices. They incorporate all necessary parts of a complete computer into a single IC that need almost no external parts to run.



2.21 Where are Microcontrollers Used

Anything that is computerized but does not have a full-fledged PC inside most likely uses a microcontroller. This includes things such as audio/video equipment, watches, microwaves ovens, and more. A **microcontroller** is different from a **microprocessor** in that a microprocessor usually requires a number of external parts such as RAM or ROM to operate. A microprocessor such as a PC processor can not do anything by itself without a motherboard and associated chips connected.

A microcontroller is sometimes referred to as an **embedded** processor because it can be embedded into a device that has some function other than being a general purpose computer. This generally implies that microcontrollers are less expensive and less powerful than a full-fledged microprocessor, a microcontroller can be dedicated to a specific task, and it can actually do many things that a full PC is not very good at. This is because a microcontroller and its program are very tightly integrated. Time-critical applications are very well suited to a microcontroller. Often in PCs, timing-sensitive tasks are performed by a microcontroller. A keyboard or mouse is a good example. If a PC spent all its time scanning the keyboard and mouse, it would have trouble doing other tasks. Instead each device contains a microcontroller that monitors user input. When something happens that the computer needs to know about, it sends a message to the computer. The computer does not care about the keyboard or mouse except when there is input. This also gives others advantages such as reducing the number of wires needed to connect peripherals. The first PIC ever designed, long before Microchip Inc. was around (General Instruments were the original PIC developers) was made for the specific purpose of offloading work of I/O and other tasks from the main CPU in a large computer (*PIC16F87XA Data Sheet 28/40/44-Pin Enhanced Flash Microcontrollers*).



2.22 Parts of a Microcontroller

In most microcontrollers all components are contained inside a single chip. Only a few external parts are usually required to make the micro run. The major parts of a microcontroller are:

- **CPU** - The CPU core. Many small micros use an 8-bit CPU, although 16 and 32 CPUs also exist.
- **Program Memory** - Memory used to store the program to be run. Flash RAM is used on modern micros.
- **RAM** - Temporary memory used during program execution. SRAM is usually used.
- **EEPROM** - Permanent storage to allow programs to save settings and other data when the power is off.
- **Oscillator** - Support for different types of clock sources are usually available, including crystals, resonators, external clock sources, and internal clocks. The clock affects the speed of the program execution, timers and other parts. Speeds from 4-40MHz are typical.
- **I/O Ports** - Pins for interfacing the micro to other devices. Most micros allow individual control of each pin, making them very flexible.
- **Peripherals** - Many useful peripherals are common, such as:
 - **USARTs** - Serial ports which can send and receive data at up to 1Mbps or more.
 - **Comparators and A/D Converters** - For sensing and measuring analog signals.
 - **Timers** - For counting pulses and measuring accurate time intervals.
 - **Interrupts** - A method of responding to external triggers or special conditions of the other peripherals. (such as data being received on a USART)
 - **Pulse Width Modulators (PWM)** - For controlling motors, lamps, LEDs and other power control devices.



2.23 Getting Started with PIC Microcontrollers

Unlike other electronics projects, using a micro involves both software and hardware. Build a circuit with a PIC, but unless put some software into it, the circuit will probably be useless. But this is great for people that want to play with electronics but come from the purely software side of things.

2.24 Required Parts and Supplies

Playing with PIC microcontrollers can be a lot of fun, but it need to have a basic set of parts, tools, and software before begin. The following is a list of parts and supplies that are recommended:

- **PIC Microcontroller** - The PIC16F877A is recommended as a good device for beginners. Start with a DIP style package. Surface mounted (SMT) devices are only useful in production prototypes, or when a DIP of your chosen part is not available.
- **PIC Datasheet** - Make sure download the PDF datasheet for the PIC that want to using. At least Read first PIC datasheet cover to cover so that can understand all the aspects of the micro.
- **Prototyping Parts** - A basic assortment of resistors, capacitors, LEDs, switches, batteries, etc. will help a lot. Also, some white plug-in prototyping board will allow to try out different circuits easily.
- **Development Software / Compiler** - Need some way of writing code and compiling it. The Source boost IDE and compiler are highly recommended. A free version supports all the features of the PIC16F627A.
- **PIC Programmer Hardware / Software** - Need some way of getting compiled program into the PIC.

