DESIGN A MULTI-FUNCTION DIGITAL THERMOMETER

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This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronic Engineering (Industrial Electronic) with honours.

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
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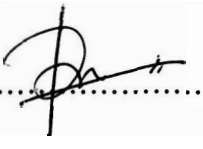
Signature : 

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Be Yourself in Everything You Do.

By

Md Ridzuan bin Talib

Specially dedicated to my beloved mother,
Che Eshah binti Ibrahim and my beloved late father,
Talib bin Yaacob, who have encouraged, guided and inspired me
throughout of my succeed and full of thanks because always be my side.

To my beloved sisters and all my supportive friends.
Always hoping and pray that you will be successful in whatever
you do and be strong in facing the challenges of life.

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ABSTRACT

This final project involved the design of a fully functional, multi-purpose digital thermometer. This was attempt at producing a portable device that could be widely used for a variety of different purposes. For example, think of the many situations where the precise measurement of temperature is of high importance. Temperature control and monitoring is important in homes for the comfort of its occupants. The main objective for this project is to develop a program that can measure surrounding temperature and can communicate between the sensor and microcontroller and then can monitor the temperature using the digital display. The purpose of the project is to build or design a system that can measure surrounding temperature and then give warning using the alarm after the temperature displayed on LCD. This temperature will be detected by thermistor sensor detector. The data will be sent in analog signal after that will be converting using analog to digital converter (ADC). The developed program will process all data in order to display the temperature on LCD screen.

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ABSTRAK

Projek ini bertujuan membina dan merekabentuk suatu alat yang dapat mengukur suhu pelbagai guna. Alat ini dapat digunakan untuk pelbagia kegunaan pada masa hadapan. Sebagai contoh, banyak tempat memerlukan suatu alat pengukur suhu yang tepat adalah sangat penting. Kawalan dan pemantauan suhu bagi sebuah rumah adalah penting untuk keselesaan dalam sesuatu kerja. Objektif utama dalam projek ini adalah untuk membangunkan sesuatu program yang dapat mengukur suhu persekitaran dan dapat berkomunikasi antara pengesan suhu dengan pengawal mikro seterusnya dapat memaparkan bacaan suhu dalam bentuk digital menggunakan paparan digital. Projek ini juga bertujuan untuk mereka suatu alat pengukur suhu yang dapat mengukur suhu persekitaran seterusnya dapat memberi amaran kepada pengguna selepas suhu di paparkan pada paparan digital. Pengesan suhu ini akan dikesan menggunakan *thermistor*. Kemudian isyarat akan dihantar menggunakan analog signal tetapi akan ditukarkan menggunakan *analog to digital converter* (ADC). Suatu program akan dibina terlebih dahulu untuk memproses segala data yang diperolehi dari pengesan untuk dipaparkan pada paparan digital.

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ABBREVIATION

LCD	-	Liquid Crystal Display
ADC	-	Analog to Digital Converter
A/D	-	Analog to Digital
D/A	-	Digital to Analog
LED	-	Light Emitting Diode
PIC	-	Peripheral Interface Controller
PCB	-	Printed Circuit Board
CS	-	Chip Select
CLK	-	Clock
DO	-	Data Output
I/O	-	Input Output
RAM	-	Random Access Memory
ROM	-	Read Only Memory
HEX	-	Hexadecimal
C	-	Celsius
K	-	Kelvin
F	-	Fahrenheit
MSB	-	Most Significant Bit
BCD	-	Binary Code Decoder
EEPROM	-	Electrical Erasable Programmable Read Only Memory
UART	-	Universal Asynchronous Receive and Transmit
LSI	-	Large-scale Integration
MPU	-	Microprocessor

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MCU	-	Microcontroller
DIP	-	Dual Inline Package
UV	-	Ultra Violet
SFR	-	Special Function Register
GPR	-	General Purpose Register
CPU	-	Central Processing Unit
NTC	-	Negative Temperature Coefficient
IDE	-	Integrated Development Environment
CE	-	Chip Enable
IC	-	Integrated Circuit

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CHAPTER 1

INTRODUCTION

1.1 Project Introduction

This project involved the design of a fully functional, multi-purpose digital thermometer. This was attempt at producing a portable device that could be widely used for a variety of different purposes. For example, think of the many situations where the precise measurement of temperature is of high importance [14]. Temperature control and monitoring is important in homes for the comfort of its occupants. It is important for gardeners who want to carefully monitor the atmospheric conditions within a greenhouse. It is also important in ensuring the correct operation of various electronic devices where many components may have a sensitive dependence on temperature.

Likewise, this digital thermometer comes equipped with an alarm feature which allows the user to program a specific temperature range. This is accomplished by entering lower and upper bound temperatures via four push buttons on the user interface. When the temperature recorded by this device crosses one of these boundary points, the "alarm" is triggered by flashing a message (HOT! or COLD) in the display window. Overall, this feature, in particular, greatly extends the applicability of our digital thermometer. The temperature-range interrupt feature could enable this device as a

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control unit which drives an air conditioner, fan, or heater in a climate controlled environment or it could send a control signal to turn on a sprinkler system if the upper threshold is passed [2].

1.2 Objective

To accomplish a project, the objective of the project must be clear and can be understand to achieve. So, the objectives of this project are:

i. To develop a program that can measure surrounding temperature and can communicate between the sensor and microcontroller.
ii. To create a program that can monitor the temperature with digital display.
iii. To study and recognize the type of thermistor and sensor that appropriate with project design.
iv. To explore how the microcontroller will operate.

1.3 Scope of Work

The purpose of the project is to build or design a system that can measure surrounding temperature and then give warning using the alarm after the temperature displayed on LCD [2]. This temperature will be detected by thermometer sensor detector. The data will be sent in analog signal and then will convert into digital signal using analog to digital converter (ADC). The developed program will process all data in order to display the temperature on LCD screen. All the process will execute in microcontroller. If the value does not satisfy the user requirement, the alarm will be activated [3].

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Some of the thermistor available in market is a device that can measure temperature and at the same time user can easily set the range of temperature depending on differentiate device and it can make electric device better functional. This method can make equipments last longer especially electric device. It is because they respond quickly to temperature changes, even small temperature increases cause their resistance to decrease significantly. The user can easily set the temperature range about -55 ℃ to 300℃ [4].

1.4 Problems Statement

Nowadays, temperature become unstable and not all device can hold the extremely high and low temperature. To conclude, this electric device needs a medium or other instrument that can control surrounding temperature and not affected the internal component. As an example, the air conditioning system where it has sensor or system that will ensure the air conditioner can hold much longer [4]. Thermistor is use as a sensor where it can measure temperature and will react to shut or switch on some device depending on suitability and user needs.

1.5 Report structure

The first chapter of this report is about the introduction. This chapter consists of introduction of project, objective of project, problem statement, and scope of work and the structure of this report.

The second chapter is about the literature review. This chapter shows the research of project that related to the theory and concept through the certain figure. It is about the explanation of the perspective and method of the past research and their relationship with this project.

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The third chapter is about the research methodology. This chapter is explaining the methods that used to overcome the problem of project such as the method to collect the data, process and analyzing the data.

The fourth chapter is about the result and discussion. This chapter explains the outcome of the project and comparison of this project with the past research. The explanation is very effective with the certain figure and tables.

The fifth chapter is the last chapter which shows the conclusion and suggestion. This chapter explains the summary of the project research that had been done. Also shows the suggestion for any change or upgrade the project.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

To complete this project, many researches and analyze about the digital temperature and their theories had been done. Several of sources were being the reference for this research such as texts book, journals and internet source. From the past research, many methods was achieved to solve the problem of this project and related to the theory.

2.2 Microcontroller

Microcontroller is an essential device that change the electronics design topology since its inception few decades ago. Basically, microcontroller is a computer system that is fabricated in a single integrated chip. A microcontroller chip consists of Central Processing Unit (CPU) memory modules, and several input / output peripherals.

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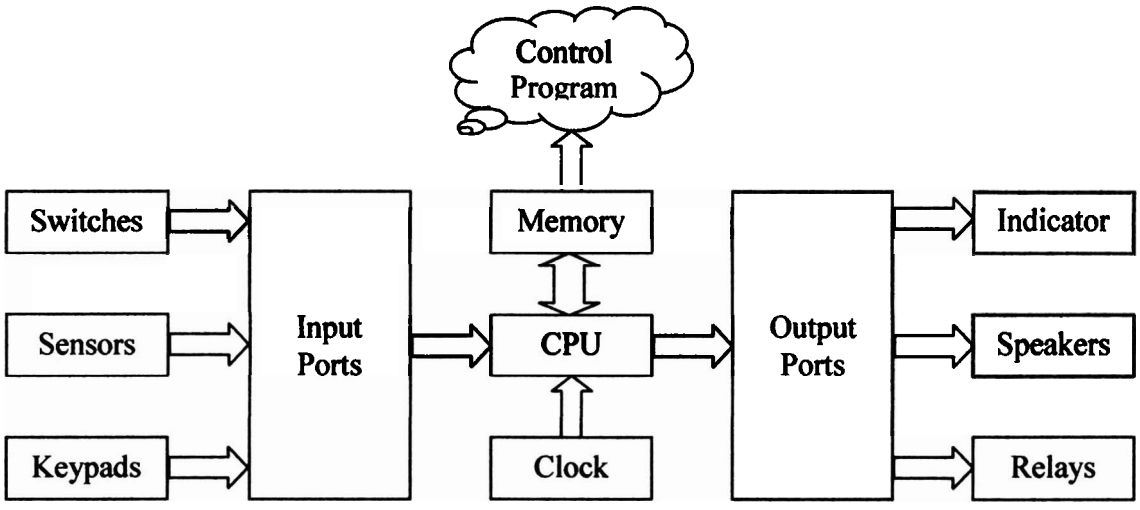

Figure 2.1: Block Diagram of Microcontroller [1]

The microcontroller is used as a device that can form the basis of an embedded system for electronics application. It provides a flexible low-cost solution to bridge the gap between single-chip computers and the use of large numbers of discrete logic chips.

Depending on various manufactures, microcontroller is divided into several categories, for examples 8-bit, 16-bit, 32-bit etc. Most commonly used microcontroller is 8-bit microcontroller. It is simple, small in size, and capable of doing most things related with control and input / output devices [1].

As for the manufactures, the competitiveness of the microcontroller market has encourages several big name companies to share a piece of the pie. Those companies are Motorola (68HC11, 68HC12), Intel (8051), Atmel (AVR) and Microchip (PICmicro) [5].

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2.3 PIC Microcontroller

The PIC microcontroller are based on RISC (Reduced Instruction Set Computer) architecture, therefore use a relatively small number of instructions Most PICs used 35 instructions compared to some general-purpose microprocessors (like Motorola 68000 and Intel 8085) that may have hundred.

Important feature of modem PIC devices is use of electrically erasable and programmable Flash memory for program storage. These Flash memory devices are often denoted by the use of the letter 'F' as part of the device coding (e.g PIC16F84). Flash devices are much easier to work for one-off prototyping because erasure and reprogramming is greatly simplified [4].

2.3.1 PIC 16F84A

PIC16F84A is a group of PIC16CXX family of low cost, high performance, CMOS, fully static and 8-bit microcontroller. A PIC16F84A microcontroller typically achieves a 2:1 code compression and up to 4:1 speed improvement at 20 MHz over 8-bit microcontroller in their class. The PIC16F84A has up to 68 byte of RAM, 64 byte of Data EEPROM memory and 13 inputs or outputs. A timer or counter also available [5].

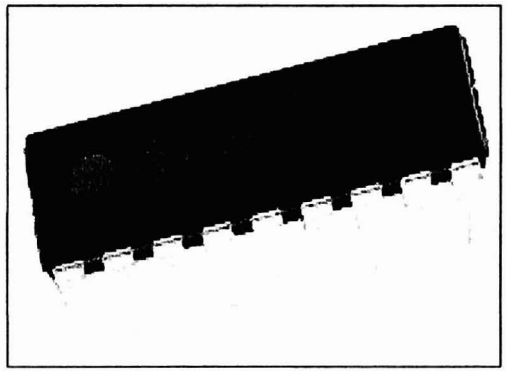

Figure 2.2: PIC16F84A [10]

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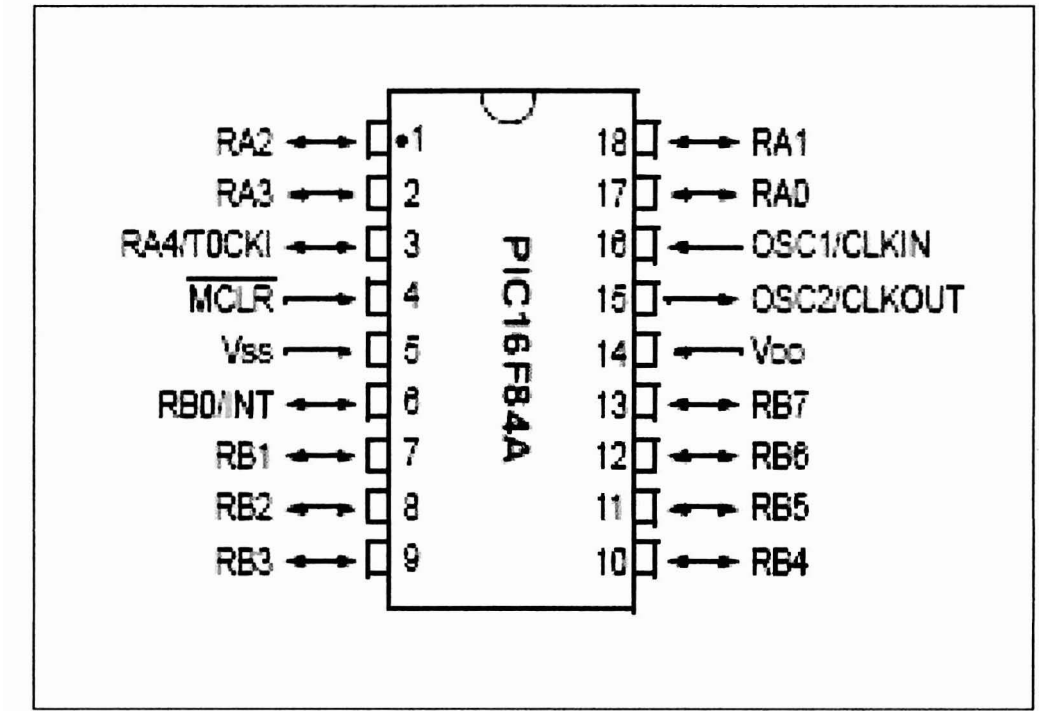

Figure 2.3: PIC16F84A pins label [10]

The PIC 16F84A has special controller to reduce external components, thus reducing cost, enhancing system reliability, and reducing power consumption. There are four oscillator options, of which in single pin RC oscillator provides a low cost solution, the LP oscillator minimizes power consumption, XT is a standard crystal and the HS is for High Speed Crystal. The SLEEP (power down) made offers power sawing. The user can make the chip from sleep through several external and internal interrupts and resets [3].

A microcontroller is a computer. All computers whether it is the desktop computer or a large mainframe computer in a major corporation or a microcontroller have several things in common. For example, all computers have a CPU (Central Processing Unit) that executes programs. The CPU loads the program from somewhere. On a desktop machine the browser program is loaded from the hard disk. The computer has some RAM (Random Access Memory) where it can store variables. The computer

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