MICROPROCESSOR BASED THERMOMETER DEVICE

MOHD SUFIAN BIN MUSA

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

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka.

April 2007
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER
BORANG PENGEQAHL@1 STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : MICROPROCESSOR BASED THERMOMETER DEVICE
Sesi Pengajian : 2006 / 07

Saya ........................................................... (HURUF BESAR)
mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-

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 pdrtukaran antara institusi
   pdgahian tinggi.
4. Sila tandakan (√) :

☐ SULID* (Mengandungi maklumat yang beredarah 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)

SYAFEEZA BT AHMAD RADZI
Pensyarah
Fakulti Kej. Elektronik & Kej. Komputer (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Kampus Bukit Gambang 1200,
Ayer Keroh, 75450 Melaka

Alamat Tetap: 7573 TAMAN SEL KELAMAK,
98000 ALOR GINTING,

Tarikh: ... 3 MEI, 2007
Tarikh: ... 3 MEI 2007

Universiti Teknikal Malaysia Melaka
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER
BORANG PENGESAH@1 STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : MICROPROCESSOR BASED THERMOMETER DEVICE
Sesi Pengajian : 2006/07

Saya MOHD SUFFIAN BIN MUSA

(HURUF BESAR)
mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-
syarat kegunaan Seperintah bdkikut:
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 pdtrukaran antara institusi
   pdngian tinggi.
4. Sila tandakan ( √ ) :
   SULID* (Mengandungi maklumat yang berdampak 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)

SYAFEEZA BT AHMAD RADZI
Pensyarah
Fakulti Elektronik dan Keputeran (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karang Berjaya 1200,
Ayer Keroh, 75450 Melaka

Alamat Tetap: 7573, TAMAN SEL KELEMAT,
78000 ALOR SETAR,

Tarikh: 3 MEI 2007 Tarikh: 3 MEI 2007
"I hereby declare that this report is the result of my own work except for quotes as cited in the references."

Signature : ...........................................
Author : ...........................................
Date : ...........................................
"I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics) with honours."

Signature : [Signature]

Supervisor's Name : [Signature]

Date : 3 MEI 2007
“He who doesn’t trust himself, will never prevails himself in the future”

By Mohd Sufian Bin Musa

For my dear yanie, mum and sister Norazlina Musa.

&

Cik Syafeeza Ahmad Radzi and other family members and friends.
ACKNOWLEDGEMENT

With the grace of god and her love to all her devotees, mankind will always be loved by god if one’s attitude and daily lifestyle does not harm other people. May her shrine will always been shined to those who loved god and serve human kind. “Mohd Sufian Bin Musa”.

I would like to thanks my supervisor Cik Syafeeza Bte Ahmad Radzi for all the help, guidance and support to accomplish this thesis.

I also would like to thanks to my family who had been support me from starting the project till complete the project.

Also, not been forgotten to all my family members especially my darling sister Ms.Norazlina Bte Musa for everlasting support, motivation and ideas

Lastly, special thanks also go to housemate and all of my friends of 4 BENE who have directly or indirectly contributed and spent their precious time in helping me to complete this project. I thank you from the bottom of my heart. I wish you all the best in life and hope that our friendship will last forever.

Thank you.
ABSTRACT

This project is to design a thermometer that can display the current temperature at any time. The temperature is displayed by LCD at the press of the button. The logic of deciding the maximum and minimum temperatures is implemented in Assembly Language on microprocessor. This thermometer device uses the DS 1820 as a temperature sensor. This temperature sensor can detect any change of temperature in format from -55 °C to +125 °C. These sensors have relatively small physical sizes. The data from this sensor will be send to the brain of the thermometer- Integrated Circuit 16F84. This IC will be programming by the Assembly Language 8085. After that, as a result the LCD screen will show the temperature value in Kelvin and degree Celsius. All this process in the thermometer will use 5 Volt as a power supply for operates. This thermometer also used a microcontroller PID to control all the input from the circuit of sensor and the output to display temperature in digital number. This project is expected to improve the temperature measurement for everyone that need to know the accurate temperature.
ABSTRAK

# TABLE OF CONTENT

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT TITLE</td>
<td>i</td>
</tr>
<tr>
<td>STATUS FORM</td>
<td>ii</td>
</tr>
<tr>
<td>DISCLAIMER</td>
<td>iii</td>
</tr>
<tr>
<td>SUPERVISOR CONFIRMATION</td>
<td>iv</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>vi</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>vii</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>viii</td>
</tr>
<tr>
<td>TABLE OF CONTENT</td>
<td>ix</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xv</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xvi</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>xvii</td>
</tr>
</tbody>
</table>

## I INTRODUCTION

1.1. Introduction 1
1.2. Objective 2
1.3. Scope of Work 2
1.4. Problem Statement 2
1.5. Methodology 3
1.6. Thesis Outline 3
II LITERATURE REVIEW

2.1 Introduction 4

2.2 Concept of Project Development 4

2.3 DS1820 Temperature Sensor 5
   2.3.1 DS1820 Digital Thermometer – Calculating an 8-bit CRC Value 6
   2.3.2 Software on DS1820 Temperature Sensor 9

2.4 Software 12

2.5 Liquid Crystal Display (LCD) 13
   2.5.1 LCD Description 13
   2.5.2 PIN Assignment 15

2.6 General Description Integrated Circuit 16F84 16
   2.6.1 PIC16CXX Family 17
   2.6.2 Architectural Overview 18
   2.6.3 Data Memory Organization 19
   2.6.4 Pin Name of 16F84 20
   2.6.5 Block Diagram of 16F84 21

2.7 Software PIC16F84 22
   2.7.1 HEX Code For PIC16F84 24
   2.7.2 Source boost to create the C Language. 26

2.8 Power Supply Circuit Description 27
   2.8.1 LM7805 28
III Project Methodology

3.1 Introduction 29
3.2 Methodology Flow Chart 29
3.3 Flow Chart Description. 32
  3.3.1 Project Title 32
  3.3.2 The Information about the project 32
  3.3.3 Research and the basic project circuit. 32
  3.3.4 Research and the basic project circuit. 32
  3.3.5 Designing a project circuit 33
  3.3.6 Project circuit Testing 33
  3.3.7 Project circuit Testing 33
3.4 Thermometer Circuit 34
3.5 Develop the Programming 35

IV Result and Analysis 41

4.1 Introduction 41
4.2 Designing the PCB 41
  4.2.1 Building the PCB 44
4.3 Power Supply 47
4.4 Software 49
  4.4.1 SourceBoost IDE 49
  4.4.2 Proteus VSM 6 Professional 50
  4.4.3 Circuit Designing and Testing 51
4.5 The result from the completed Thermometer circuit. 52
V Suggestion and Conclusion 53

5.1 Suggestion 53
5.2 Conclusion 53

REFERENCES 54

APPENDIX 56
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>NO</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Overall Block Diagram</td>
<td>1</td>
</tr>
<tr>
<td>2.1</td>
<td>DS1820 Temperature Sensor</td>
<td>6</td>
</tr>
<tr>
<td>2.2</td>
<td>Shift Register Model</td>
<td>8</td>
</tr>
<tr>
<td>2.3</td>
<td>PCB Wizard 3 Printed Circuit Board Design Software</td>
<td>13</td>
</tr>
<tr>
<td>2.4</td>
<td>LCD model HD44780</td>
<td>14</td>
</tr>
<tr>
<td>2.5</td>
<td>The structure of the TN (Twisted Nematic) liquid crystal display</td>
<td>15</td>
</tr>
<tr>
<td>2.6</td>
<td>The crystal of the liquid crystal matches the constant direction</td>
<td>15</td>
</tr>
<tr>
<td>2.8</td>
<td>PIC16F84</td>
<td>17</td>
</tr>
<tr>
<td>2.1.0</td>
<td>Block Diagram of PIC16F84A</td>
<td>22</td>
</tr>
<tr>
<td>2.1.1</td>
<td>Software Source boost</td>
<td>27</td>
</tr>
<tr>
<td>2.1.2</td>
<td>Power Supply Circuit</td>
<td>28</td>
</tr>
<tr>
<td>2.1.3</td>
<td>LM7805</td>
<td>29</td>
</tr>
<tr>
<td>3.1</td>
<td>Flow Chart for this project part A</td>
<td>31</td>
</tr>
<tr>
<td>3.2</td>
<td>Flow chart of this project part B</td>
<td>32</td>
</tr>
<tr>
<td>3.3</td>
<td>Circuit on Protoboard</td>
<td>34</td>
</tr>
<tr>
<td>3.4</td>
<td>The circuit for LCD Thermometer</td>
<td>35</td>
</tr>
<tr>
<td>3.5</td>
<td>Choose project and go to wizard to start a new project.</td>
<td>36</td>
</tr>
<tr>
<td>3.6</td>
<td>Setting the general</td>
<td>37</td>
</tr>
<tr>
<td>3.7</td>
<td>Select the input and output pin (Port A)</td>
<td>38</td>
</tr>
<tr>
<td>3.8</td>
<td>Select the input and output pin (Port B)</td>
<td>39</td>
</tr>
<tr>
<td>3.9</td>
<td>Finish the wizard</td>
<td>41</td>
</tr>
<tr>
<td>4.1</td>
<td>Thermometer circuit build by PROTEUS software</td>
<td>43</td>
</tr>
<tr>
<td>4.2</td>
<td>Printing the circuit on the transparency paper.</td>
<td>43</td>
</tr>
</tbody>
</table>
4.3 Ultraviolet PCB (front) 44
4.4 Ultraviolet PCB (back) 44
4.3 Ultraviolet PCB (back) 45
4.4 Board with UV film inside to ultraviolet tanning lamp 45
4.5 The board in the developer. 46
4.6 The board in the Bubble etches that have the ferrie chloride to clear the Cooper 46
4.7 The PCB board front side 47
4.8 PCB board from back side. 47
4.9 Power supply block diagram 48
4.1.0 Power supply circuit diagram 49
4.1.1 The Power Supply Circuit 49
4.1.2 Relationship with programming language compiler 50
4.1.3 Schematic Diagram 52
4.1.4 Selecting the program 53
4.1.5 The LCD Thermometer. 53
<table>
<thead>
<tr>
<th>NO</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7</td>
<td>The pin assignment</td>
<td>15</td>
</tr>
<tr>
<td>2.9</td>
<td>Pin Name of IC16F84</td>
<td>20</td>
</tr>
</tbody>
</table>
LIST OF ABBREVIATIONS

LCD  Liquid Crystal Display
IC   Integrated Circuit
I/O  Input/Output
# APPENDIX

<table>
<thead>
<tr>
<th>NO</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Datasheet</td>
<td>58</td>
</tr>
<tr>
<td>B</td>
<td>Application Information</td>
<td>68</td>
</tr>
<tr>
<td>C</td>
<td>PCB Designing</td>
<td>71</td>
</tr>
</tbody>
</table>
CHAPTER I

PROJECT INTRODUCTION

1.1 INTRODUCTION

The LCD Thermometer is a one device that can display the current temperature at any time given. Over the last decade, the implementation of this idea has been attempted but it is not very effective because the measurement temperature is not too accurate. The solution for this problem is to design the thermometer with high accuracy using assembly language 8085 and the high sensitivity temperature sensor.

There have a one temperature sensor to detect the temperature, then the input will sent to the Integrated Circuit (IC) and finally to the Liquid Crystal Display (LCD) as an output. Actually, there could be several sources of errors during the measurement of temperature. The error is a calibration errors, sensor self heating and sensor time constant. To make sure the thermometer have the high accuracy, we should alert about the measurement error. This thermometer design will minimize all the errors during the measurement of temperature.
1.2 OBJECTIVE

The purpose of this design is to obtain an accurate temperature measurement. It can eased daily life and meant a lot to those who does need them. To success in this project, there are few objectives that have to achieve. Firstly we need to design the thermometer that can display the current temperature at any time. Then, the temperature value is display by LCD at the press of the button. Finally the logic of deciding the maximum and minimum temperature is implemented in Assembly Language on microprocessor.

1.3 SCOPE OF WORK

In this thermometer device, we had used the DS1820 as a temperature sensor. This temperature sensor can detect any change of temperature in format from -55 °C to +125 °C. These sensors have relatively small physical sizes. The data from this sensor will send to the brain of the thermometer- Integrated Circuit 16F84. This IC is programmed by the Assembly Language 8085. After that, as a result the LCD screen will show the temperature value in degree Celsius. All this process in the thermometer will use 5 Volt as a power supply for operates. This thermometer also uses a microcontroller PID to control all the input from the circuit of sensor and the output to display temperature in digital number.

1.4 PROBLEMS STATEMENT

This research is carried out to overcome the problem of current LCD thermometer in the market. One of the problem is the present LCD thermometer device is very expensive. Beside that, the measurements are not accurate and have much error. Also, mostly the thermometer design presently is too big and very weight.
1.5 METHODOLOGY

In this system, attention is given to three elements which consist of DS1820 temperature sensor, Integrated Circuit 16F84 Microcontroller and the Liquid Crystal Display (LCD). The main function for the temperature sensor is to detect the temperature value as an input. The IC16F84 is the brain of a microprocessor and is where all of the arithmetic and logical operations are performed. Finally the LCD is to display the temperature value as an output from IC.

1.6 THESIS STRUCTURE

The content of this thesis is about the flow of the project. This thesis is divided into five chapters to provide reader to understand the whole project. For the Chapter I, the overview of the project is briefly discussed.

The Chapter II will cover up all the project theory, perspective, method that are used to solve the problem and any hypothesis that related with the research of methodology.

Chapter III will cover the research methodology in this project. The Chapter IV covers the contrivance and the result of the data analysis or the project result.

Finally, the Chapter V will discuss whole content of this thesis and project. By the end of this chapter, there is some discussion for this project.
CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discusses the project theory, perspective, methodology and any hypothesis that related with the research of methodology.

2.2 CONCEPT OF PROJECT DEVELOPMENT

In today's world, that is important to know the actual temperature at any time given. Over the last decade, the implementation of this concept has been attempted but not all the design can measure the temperature accurately. Presently, the expensive thermometer such as infrared sensor has the ability to measure the temperature accurately. Hence, the solution is not only complex but also require a physical connection to access those device. A simple, cost effective solution is proposed here, by which devices as mentioned above can be controlled easily with users at anywhere on this world.
In this project, the temperature value will display at Liquid Crystal Display (LCD). So that is easy for user to read the temperature value. This device can be ON/OFF by push button.

2.3 DS1820 TEMPERATURE SENSOR

**PIN ASSIGNMENT**

![DS1820 Pin Assignment](image)

**PIN DESCRIPTION**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>DQ</td>
<td>Data In/Out</td>
</tr>
<tr>
<td>VDD</td>
<td>Optional VDD</td>
</tr>
<tr>
<td>NC</td>
<td>No Connect</td>
</tr>
</tbody>
</table>

Figure 2.1: DS1820 Temperature Sensor
This temperature sensor is able to measure temperatures from -55°C to +125°C in 0.5°C increments or Fahrenheit equivalent from -67°F to +257°F in 0.9°F increments. The 0.5°C or 0.9°F increment means the thermometer will get temperature readings like 30.5°C or 30°C but never 30.1°C (for the case with Fahrenheit it is different, only 0.9°F increments or decrements).

2.3.1 DS1820 Digital Thermometer – Calculating an 8-bit CRC Value

When a data is communicated between two devices, it is common to use some type of error checking. Common examples are parity, a checksum and a cyclic redundancy check (CRC). The general idea is that the transmitter calculates and transmits a value and the receiver performs the same calculations and compares the result with the check value.

When interfacing with the Dallas 1820 1-wire digital thermometer, various commands are issued by the PIC to a specific DS1820 and data is then returned to the PIC as a series of nine bytes. Eight of these bytes contain data related to the temperature or are user bytes. The ninth and final byte is the cyclic redundancy check (CRC). The DS1820 calculates this final CRC byte using a defined algorithm to operate on the other eight data bytes.

The receiving processor may then operate on the eight received data bytes using the same algorithm and compare this calculated CRC with that calculated by the DS1820. If the two results do not match, a transmission error has occurred and the designer may have to restructure the program and repeat the process until the two CRCs matches.