DIGITAL REMOTE THERMOMETER

NOORAIHAN BINTI RASIP

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DIGITAL REMOTE THERMOMETER

NOORAIHAN BINTI RASIP

This Report Is Submitted In Partial Fulfillment of Requirements For The Bachelor Degree of Electronic Engineering (Industrial Electronic)

Faculty of Electronic Engineering and Computer Engineering
Universiti Teknikal Malaysia Melaka

April 2007

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FACULTY OF ELECTRONIC ENGINEERING AND COMPUTER ENGINEERING

Status Validation Form
Bachelor Final Project II

Project Title : **DIGITAL REMOTE THERMOMETER**
Session : **2006/2007**

I **NOORAIHAN BINTI RASIP** declared that I agree to let this Bachelor Project report to be kept at The Library with following conditions:

1. This report is the property of Universiti Teknikal Malaysia Melaka
2. The library is only allowed to make copies for educational purpose.
3. The library is allowed to make copied to be trade between higher learning institutions.
4. Please tick (√)

☐	CONFIDENTIAL	(Contains restricted information with degree of security or importance to Malaysia as stated in AKTA RAHSIA RASMI 1972)
☐	LIMITED	(Contains restricted information decided by an organization/agency where the research is
√	UNLIMITED	

Writer : Nooraihan Binti Rasip

Permanent Address: J7379, Jln Saga

Taman Maju,77000 Jasin, Melaka.

Date: 30 April 2007

Verified by :

Supervisor: En Masrullizam Bin Mat Ibrahim

MASRULLIZAM B MAT IBRAHIM
Pensyarah
Fakulti Kej Elektronik dan Kej Komputer (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

Date: 30 April 2007

*NOTES: If this report is CONFIDENTIAL OR LIMITED, please attach a letter from the authorities/organization/agency which includes the due date of this report to be classified as CONFIDENTIAL or LIMITED.

"I declared that this thesis is the result of my own work except the ideas and summaries which I have clarified their sources."

Signature : ……

Writer : NOORAIHAN BINTI RASIP

Date : 30 April 2007

SUPERVISOR APPROVAL

"I declared that I have read this thesis and in my point of view this thesis is qualified in term of scope and quality for the purpose of awarding the Bachelor of Electronic Engineering (Industrial Electronic)"

Signature : .....

Supervisor : MR. MASRULLIZAM BIN MAT IBRAHIM

Date : 30 April 2007

Dedicated to my beloved friends and family

And everything is possible with you by my side my love

ACKNOWLEDGEMENT

Firstly, I'd like to thank God because with His blessing I'm able to prepare this report and final project for Universiti Teknikal Malaysia Melaka.

I would like to express our greatest gratitude and sincere thanks to my supervisor, Mr Masrullizam Bin Mat Ibrahim, for his valuable advice and assistance in the supervision and consultation of this Final Year Project. In fact, he has given me guidance when obstacles arise throughout this period time. Once again, I thank him for his tolerance and endeavors.

Special thank to my friends Miss Elda and Miss Nurmala for giving me support and encourage me to finish this report.

This project would not have been like this if they had not given great support and encouragement on me when other academic assignments and test has pressured me. The golden glory for me was during accomplishing this project is when my project successfully completed in the right path.

Finally I would like to express my deepest gratitude to my fellow friends, my beloved family and last but not least Ahmad Rawandi for all the encouragement and inspiration. To everybody who is involved in preparing this report either direct or indirect, I would like to say thank you very much.

DECLARATION

This Final Year Project contains information pertaining of Digital Remote Thermometer using PIC microcontroller. This Project comes under the subject BENU 4983 Project offered by Faculty of Electronic Engineering & Computer Engineering, UTeM. This documentation report aims to provide the reader about the overall information techniques about this project. The focus of the project is remote the thermometer using PIC microcontroller.

I admired that this is an original my own work with the acceptation which I have referenced them to explained sources.

ABSTRACT

Digital remote thermometer in the market currently, mostly the output is represented in BCD display to show the measured temperature. Beside, digital remote thermometer is usually used in certain area such office building and factory where the temperature has to stable in order to produce a quality product. But most of this digital remote thermometer is not user friendly because only display the temperature of the room without gives a clear warning to the user. Thus, this project is to build a digital remote thermometer with using PIC microcontroller. The PIC is to produce output of the thermometer where in this project the output is an alarm. Therefore, users are able to know the temperature of the certain area. Distance between transmitter and receiver circuit can reach hundred meters, provided both units are connected to the mains supply. In this project, main power supply will be used a transmission medium to transmit the data. By using the main supply where there is existing connection in building, the thermometer can transmit the data to the whole building. The operation of this remote thermometer is based on the temperature measured by a sensor in range of 0°C to 100°C. Signal from the temperature sensor are sent to the microcontroller by using transmission line. Microcontroller are used for this project is PIC 16F877A. The output from the system will sound the alarm when the temperature is over the value specified. While the input are the frequency value where it is determine the limitation for every measured temperatures.

ABSTRAK

Dibandingkan dengan kebanyakan termometer kawalan digital yang digunakan pada masa kini, kebanyakannya menggunakan paparan BCD untuk memaparkan nilai keluaran bagi suhu sesuatu bilik yang disukat. Selain itu, ia biasanya digunakan pada bangunan pejabat dan kilang yang memerlukan suhu yang sentiasa stabil bagi mengekalkan kualiti sesuatu produk yang dihasilkan. Tetapi kebanyakan thermometer kawalan digital tidak mesra pengguna kerana hanya memaparkan nilai suhu tanpa memberikan isyarat amaran yang kepada pengguna. Maka, tujuan projek ini adalah untuk merekabentuk satu termometer kawalan digital yang menggunakan pengawal mikro sebagai unit utama. Melalui projek ini, pengguna dapat mengetahui keadaan suhu sesuatu bilik tanpa perlu berada di dalam bilik atau tempat tersebut. Selain itu, jarak antara pemancar dan penerima boleh mencapai sehingga 100 meter dengan menggunakan bekalan kuasa. Tujuan bekalan kuasa digunakan adalah sebagai medium penghantaran bagi mengawal suhu pada jarak yang jauh. Termometer ini akan beroperasi berdasarkan suhu yang disukat melalui pengesan yang boleh menyukat suhu antara 0°C hingga 100°C. Isyarat daripada alat pengesan ini akan dihantar kepada pengawal micro PIC menggunakan talian pemancar bekalan kuasa dan diterima dari litar penerima yang terus disambung kepada PIC. Dari masukan tersebut, maklumat mengenai keadaan suhu didalam bilik tersebut ditentukan oleh mikro pengawal. Pengawal mikro yang digunakan dalam projek ini adalah PIC 16F877A. Sistem ini akan membunyikan penggera untuk memberi amaran kepada pengguna jika suhu tersebut melebihi had yang ditentukan dalam pengawal mikro PIC.

TABLE OF CONTENTS

CHAPTER	CONTENT	PAGE
	PROJECT TITLE	i
	SUPERVISOR APPROVAL	v
	ACKNOWLEDGEMENT	vii
	DECLARATION	viii
	ABSTRACT	ix
	ABSTRAK	x
	TABLE OF CONTENTS	xi
	LIST OF TABLES	xv
	LIST OF FIGURES	xvi
	LIST OF ABBREVIATION	xviii
	LIST OF APPENDIX	xix
1	INTRODUCTION	
	1.1 Introduction	1
	1.2 Problem Description	2
	1.3 Project Objectives	3
	1.4 Problem Statement	3
	1.5 Scope of Project	4
	1.6 Method	5
	1.7 Thesis Outline	5

2 LITERATURE REVIEW

2.1 Type of Sensor 7

2.1.1 Contact sensor 8

2.1.2 Non-contact sensor 8

2.1.3 Dew point temperature 9

2.1.4 Thermal Imaging 9

2.2 Example of Temperature Sensor

2.2.1 Thermometer 10

2.2.2 Thermocouple 11

2.2.3 Thermistor 12

2.2.4 Thermostat 13

2.2.5 Precision Integrated temperature sensor 14

2.3 Microcontroller 15

2.4 Foundation Using PIC Microcontroller 16

2.5 PIC Microcontroller 17

2.5.1 Advantage of PIC 17

2.6 PIC 16F877A Microcontroller 18

2.5.1 Memory 19

2.6.1.1 Flash Program Memory 20

2.6.1.2 EEPROM Data Memory 21

2.6.2 Peripherals 21

2.6.3 Power Supply 22

2.7 Transformer 22

2.8 Voltage Frequency Converter 24

2.9 LED Temperature Thermometer Project 24

2.10 Decoding Of Infrared Remote Control Software 25

2.11 Digital Remote Thermometer 26

2.12 Infra-Red Sensor 26

2.13 A PIC-Based Temperature Alarm 28

3 PROJECT METHODOLOGY

3.1 Overview 30
3.2 Method 30
3.3 Process Flow Chart 31
3.4 Project Block Diagram 32
3.4.1 Operation of Block Diagram 32
3.5 Troubleshooting Method 33
3.6 Etching Process 35
3.6.1 Exposing and Developing The Resist Layer 37
3.6.2 Etching the PCB 38
3.6.3 Drilling and Shaping the PCB 40
3.7 Transmitter and Receiver Circuit
3.7.1 Transmitter Circuit 41
3.7.2 Receiver Circuit 42
3.8 Voltage Regulator Circuit 43
3.9 Sensor
3.9.1 Precision Centigrade Temperature Sensor (IC) 44
3.10 Software Development 45
3.10.1 MPLAB IDE Software 46

4 RESULT AND ANALYSIS
Introduction 47
Transmitter Circuit 47
Alarm Circuit 51
5 CONCLUSION

5.1 CONCLUSION 53
5.2 FUTURE IMPROVEMENT 54
REFERENCES 55
APPENDIX 56

LIST OF TABLES

NO	TITLE	PAGE
2.1	List of Microcontroller and its features.	16
2.2	Input and Output PORTS	18
4.1	Component Part of Transmitter Circuit	50
4.2	Component Part of alarm circuit	52

LIST OF FIGURE

NO	TITLE	PAGE
2.1	Mercury Thermometer	10
2.2	Universal Bayonet Thermocouple Probes	11
2.3	NTC thermistor, bead type, insulated wires.	12
2.4	Bi-metallic thermostat for buildings	13
2.5	Basic Centigrade Temperature Sensor	14
2.6	PIC16F877A	19
2.7	Internal Structure of Flash Program Memory	20
2.8	Laminated core transformer	23
2.9	Voltage frequency converter IC	24
2.10	The basic principle of IR sensor	27
3.1	The process flow chart	31
3.2	The block diagram of the project	32
3.3	Single Sided PCB Layout for exposure process	36
3.4	Transmitter Circuit	41

3.5	Receiver Circuit	42
3.6	Voltage Regulator Circuit	43
3.7	Programming the microcontroller	44
4.1	Simulation of Transmitter Circuit	48
4.2	Transmitter Circuit	49
4.3	Simulation of alarm circuit	51
4.4	Alarm Circuit	52

LIST OF ABBREVIATION

LED	-	Light Emitting Diode
MCU	-	Microcontroller Unit
PIC	-	Peripheral Interface Controller
	-	Programmable Logic Controller
EEPROM	-	Electrically Erasable Programmable Read Only Memory
IC	-	Integrated Circuit
CPU	-	Central Processing Units
ROM	-	Read-Only Memory
I/O	-	Input/ Output
Hz	-	Hertz
DC	-	Direct Current
AC	-	Alternating Current
RAM	-	Random-Access memory
RD	-	Read
WR	-	Write
ADC	-	Analog to Digital Converter

LIST OF APPENDIX

NO	TITLE	PAGE
A	Datasheet PIC 16F877A	56
B	Datasheet LM331	66

CHAPTER 1

PROJECT OVERVIEW

1.1 INTRODUCTION

Thermometer is a device that measures the temperature of things. The name is made up of two smaller words: "Thermo" means heat and "meter" means to measure. Applications thermometer is widely used in many fields. Many applications using a controller based system to navigate and handling the signal throughout the sensor. By utilize the capability of microcontroller, remote thermometer sensor can monitor and control the temperature in several locations in an office building. Microcontroller is a comprised unit of microprocessor, analog to digital converter, RAM and several digital inputs/outputs. This system used PIC16F877A microcontroller as a processing centre for all the input and output.

In this project, PIC microcontroller will monitor the temperature on a fix area and will aware the user when in some ranges of temperature which is specified early. This project will utilize the microcontroller to read input from the sensor. From the input, the microcontroller will recognize the temperature level either normal or over due. Then output from PIC will be sent to an alarm system. The other important part for the system is the sensor that will sense the temperature level.

1.2 PROJECT DESCRIPTION

This project is about creating a digital remote thermometer that operates merely similar to the operational thermometer that we can found out today. The data of the temperature is monitored and controlled by microcontroller.

The digital remote thermometer is used to measure the temperature level from a certain distance. This project will produce warning signal when the temperature are over the limit. The temperature sensor can able read the temperature in range between 0°C and 100°C.

This project is used microcontroller which has advantages where can process the data and perform the action based on input reading. If we refer to conventional remote thermometer in market today, it is expensive. But instinctively this will create another solution of producing a digital remote thermometer with using microcontroller.

1.3 PROJECT OBJECTIVES

The objective of this project is to design a digital remote thermometer that will monitor the temperature remotely. This project will produce a warning user when temperature rising above the temperature specified. This project also builds around PIC microcontroller as a brain of the system.

1.4 PROBLEM STATEMENT

In order to support quality, regulatory and accreditation requirements, more industries today are requiring specialized systems to monitor temperature level. PIC is included in this digital system that makes the hardware more compact, where it can program and produces more outputs. So, there is not necessary now to build a digital remote temperature with a complex circuit.

1.5 SCOPE OF PROJECT

Every project has it own defined scope to make it different from any other projects. In the first of this project, is to acknowledge and able to use PIC microcontroller for this digital remote thermometer that will control system. The important scope here is designing the circuit that can function with all the peripherals connected to it which can either be as an input or output from the controller.

For the second part, is to use the appropriate sensor for the system. In this part, the sensor chosen can be able to monitor the temperature level away from the area. The temperature will be monitored remotely where temperature sensor will transmit the reading to the receiver circuit. Then receiver circuit will send the information to the controller.

The final part is program built the program for the project. The program must be able to control all the input and output connected to the microcontroller. The program builds on MPLAB software and simulate before it is downloaded into the microcontroller. The simulation ensures the program run smoothly with all the peripherals and run effectively before implemented on the real circuit.

1.6 METHOD

From other electronic project, which referring to the concept of controlling the temperature level, alarm system and basic PIC source code as a reference to the PIC programming language. Some reference obtained used different type of PIC microcontroller and for this project PIC 16F877A is used.

Resources play important roles in order to make a comparison before deciding the suitable method that can be applied for this project. Resources like web pages, journals and researching through books was really helpful.

1.7 THESIS OUTLINE

The first chapter is including the introduction, project description, project objectives, problem statement, scope and methodology of project. Beside that, the objectives of the project have been comprised. The second that is the literature review about the project. In the literature review, it includes several previous research has done for this project until its present state. Moreover, this chapter exposed the ideas that have been explored for the project.

The third section is about the project methodology. In this chapter, the methods and the project flow chart has been explained in clearly. The fourth chapter is about the component of microcontroller and external circuit that connected to the microcontroller. In this chapter, the functional of microcontroller, other part of the components and circuit will be explained in detail about how it's functional and connection to the PIC microcontroller.