CHAPTER 1

INTRODUCTION

1.1. Aim of Project

Final Year Project also aims to foster collaborative affected of the university. The aim of Final Year Project is to expose the undergraduate students to real project working environment, business operation as well as administrative functions. The aims of this project are; to develop an application system entitled “Digital Thermometer” that utilizes the BST based sensor. I have achieved my aim in this project to study about the performance for BST sensor and the parameters of BST sensor especially their sensitivity, linearity, dynamic range, physical seize and repeatability.

1.2. Project Overview

In this project, Barium Strontium Titanate (BST) Sensor Application: Digital Thermometer, I are used BST sensor as the system input. This project can be dividing into three different phases as shown in **Figure 1.1** below. The first phase is a Sensor Testing and then followed, by the second phase Signal Conditional and lastly is the Microcontroller Programming. This project can be divided to two categories. The categories are hardware and software. Further explanations on the process flow are shown in Chapter 3.

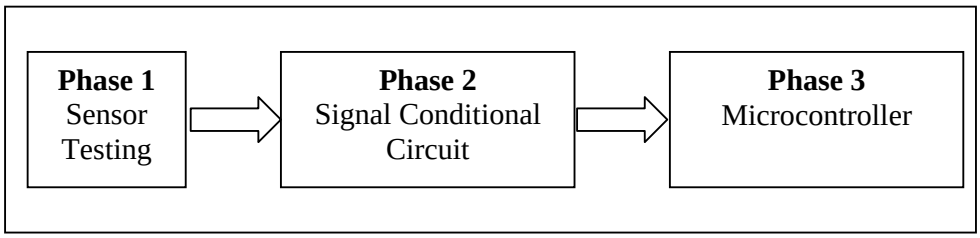

Figure 1.1: Project Methodology

1.2.1. Function

Digital Thermometer is an instrument for measuring temperature. The main function of the digital thermometer system is to measure and monitor temperature. The purpose of the digital thermometer is in measuring the temperature. In an office, hospital, home and etc, it allows a caregiver to record a baseline temperature.

1.2.2. Operation

This circuit is intended for precision temperature measurement, with a transmitter section converting heat to output voltage, which is proportional to the measured temperature. I can use a single-supply system to precisely measure the temperature at a location with 33°C to 88°C range. The circuit includes R_1, a low-cost BST sensor temperature sensor; IC_1, a LM358 differential amplifier; three resistors; a trimming potentiometer; and an ADC. I can omit the ADC if you need an analog output. The feedback resistor, R_F, should be a precision resistor to minimize the scale-factor error, but the accuracy of the remaining resistors is not critical. I can choose the grade of the BST sensor to achieve the required accuracy. The BST sensor provides an output current proportional to absolute temperature. In this application, the circuit offsets and scales the output to provide a full-scale range of 0V to 5V. The LM358 is a low-cost, low-power, differential operational amplifier. It has a high common-mode voltage range and extremely low bias current. The output swing of the amplifier is 0.56V to 2.08V with a single 9V power supply. The least significant digit displays then a 33°C to 88°C range is obtained

1.3. System Element

1.3.1. Software

The PIC (Programmable Interface Controller) line was originally developed by the semiconductor division of General Instrument Inc. A microcontroller is nothing without software. To program PICs are require a binary file of coded ones and zeros. Microchip offers an assembly language for PICs and a free assembler to get you going. Assembly language can be tough for a beginner. It is easier for a beginner or hobbyist who has limited time to use a higher-lever language and compiler to convert that higher-level language in to binary code.

PicBasic is a higher-lever language that is easy for beginners, hobbyists and even professionals to use for sample code development and rapid proof of the concept. I recommend it and use PicBasic often. I also write in assembly and recommend everyone to learn it at some point, but PicBasic is a great way to start and in most cases stick with it [2].

1.3.2. Processor

A **central processing unit** (**CPU**), or sometimes simply **processor,** is the component in a digital computer that interprets computer program instructions. CPUs provide the fundamental digital computer trait of programmability, and are one of the necessary components found in computers of any era, along with primary storage and input/output facilities. A CPU that is manufactured as a single integrated circuit is usually known as a microprocessor. Microprocessor is a silicon chip that contains a CPU. In the world of personal computers, the terms *microprocessor* and CPU are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles. This project introduces the microcontroller technology the capabilities and the specifications of a commonly

used Microcontroller Microchip PIC16F876 and describe the experiments conducted.

Following are the reasons why microcontrollers are incorporated in control systems:

a. ***Cost****:* Microcontrollers with the supplementary circuit components are much cheaper than a computer with an analog and digital I/O

b. ***Size and Weight****:* Microcontrollers are compact and light compared to computers

c. ***Simple applications****:* If the application requires very few number of I/O and the code is relatively small, which does not require extended amount of memory, and a simple LCD display is sufficient as a user interface, a microcontroller would be suitable for this application.

d. ***Reliability****:* Since the architecture is much simpler than a computer it is less likely to fail.

e. ***Speed:*** All the components on the microcontroller are located on a singe piece of silicon. Hence, the applications run much faster than it does on a computer.

In both cases the higher the value, the more powerful is the CPU. For example, a 32-bit microprocessor that runs at 50MHz is more powerful than a 16-bit microprocessor that runs at 25MHz. In addition to bandwidth and clock speed, microprocessors are classified as being either RISC (reduced instruction set computer) or CISC (complex instruction set computer).

1.3.3 Serial Port

Serial port is a socket on a computer that is used to connect a modem, data acquisition terminal or other serial device via a slow-speed serial interface. A port, or *interface*, that can be used for serial communication, in which only 1 bit is transmitted at a time. Earlier personal computers or PCs used the serial port for the mouse, and earlier Macintoshes used the serial port to attach a printer. Although widely used in data acquisition, the serial port is a legacy interface on the PC, having been superseded by the USB bus.

If present, the serial port on the back of a PC is a male 9-pin connector (DE-9 D-sub connector). Earlier PCs may have had two 9-pin connectors or one 9-pin. On a PC, serial ports are called "COM ports," identified as COM1, COM2, and etc

1.3.4 Temperature

Temperature is a physical property of a system that underlies the common notions of hot and cold; something that is hotter has the greater temperature. Temperature is one of the principal parameters of thermodynamics. The temperature of a system is defined as simply the average energy of microscopic motions of a single particle in the system. For a solid, these microscopic motions are principally the vibrations of the constituent atoms about their sites in the solid. For an ideal monatomic gas, the microscopic motions are the translational motions of the constituent gas particles. For multiatomic gas vibration and rational motion should be included too.

Temperature is measured with thermometers that may be calibrated to a variety of temperature scales. Throughout the world (except for in the U.S.), the Celsius scale is used for most temperature measuring purposes. The entire scientific world (the U.S. included) measures temperature using the Celsius scale, and thermodynamic temperature using the Kelvin scale.

1.3.5 Heat

Heat is a form of energy that is transferred from one object to another or from one part of an object to another part, due to a difference in temperature between the two. Heat always flows from heater objects to colder. There are three mechanisms for heat transfer first conduction, second convection and lastly radiation [5].

Conduction is the flow of heat energy through solid bodies. This heat flow occurs when two solid bodies of differing temperatures come into physical contact, or when one solid body experiences a temperature difference from one area to another.

Convection is the transfer of heat through the movement of a liquid or gas such as water or air. A good example is the uniform heating of water in a tea kettle. Water heated at the bottom of the kettle rises, allowing cooler water to move to the bottom, where it is then heated. This continuous stirring action brings the whole body of water to a near uniform temperature.

Radiation is the transfer of heat energy via the electromagnetic radiation emitted by an object. This radiation is emitted by objects in all directions without need of a solid or fluid to transfer the heat. The heat felt around a dying campfire from the glowing embers is felt primarily as a result of thermal radiation [6].

1.4 Project Management

Final Year Project is part of the integrated curriculum of University Malaysia Perlis (UniMAP) for degree programs. These hands-on experiences from the final year project subject will certainly reinforce what been taught at the University. The purpose of Final Year Project is to provide exposure to University Malaysia Perlis (UniMAP) student to the work so that they can relate theoretical knowledge with application in

industry. From the Final Year Project program, the students will also develop skills in work ethics, communication, management and etc. To enable students build and improve their creativity skill and sharing ideas with others, to expose student to Engineering practice and Engineering professional attitude, and to expose students to working environment and work in team.

Furthermore, this program will establish close relationship between the management, and student of University Malaysia Perlis. The initial project outline is shown in ***Figure 1.2*** below. An interim report completed half way through the project time allowed for a review of how the work was progressing and what needed to be done.

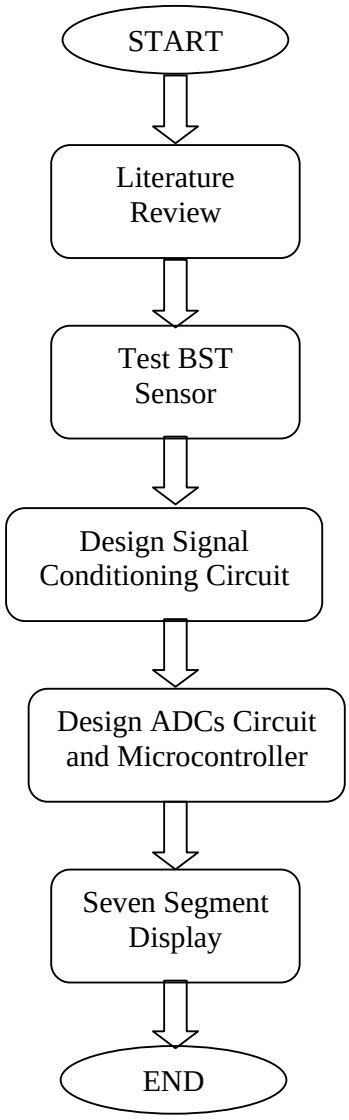

Figure 1.2: Flow Chart of Methodologies for this Final Year Project