DIGITAL ALTIMETER BASED ON PIC MICROCONTROLLER

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

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Tajuk Projek : DIGITAL ALTIMETER BASED ON PIC MICROCONTROLLER

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DEDICATION

First of all, I would like to convey my heartiest appreciation to my project supervisor En. Mohd Shahril Izuan bin Mohd. Zin for his advise, precious guidance and co-operation. Under his guidance, I have developed, improved and achieved the completion of the project. He always gives me the wisdom to think and work independently. Besides that, I would also like to thank other lecturers and technicians in Electronic Engineering and Computer Engineering Faculty for giving me the advices and the opportunity to handle this project as well as their encouragement. Thanks also to my friends who have lend me their helping hand that made the task of the project much easier and able to complete on time. At last but not least, I would like to express my gratitude to both of my parents who had provided me with financial support and encouragement throughout my course of studies.

"THANK YOU"

ABSTRACT

"Digital Altimeter Based On PIC Microcontroller" is a device used to measure height above sea level in meter and pressure as well with some additional functions such as to measure temperature and to convert results in meter to feet or °C to °F. The concept in used for this project is that the relationship of the pressure to height within the first 5000 meters or so above sea level can be regarded as linear allowing it to be used as the basis for a barometer altimeter. This project used PIC16F84 microcontroller, which treated as the main component in hardware part. The software (in assembly language) programmed in the PIC16F84 implements all the calculation and displayed the results through the liquid crystal display.

ABSTRAK

"Digital Altimeter Based On PIC Microcontroller" merupakan satu alat yang digunakan untuk mengukur ketinggian di atas paras laut dalam unit meter dan juga mengukur tekanan udara. Beberapa fungsi tambanhan yang lain adalah seperti mengukur suhu persekitaran dan penukaran nilai ukuran dalam meter kepada unit 'feet' atau penukaran nilai ukuran dalam °C kapada °F. Konsep operasi yang digunakan untuk projek ini adalah berdasarkan kepada perhubungan di antara tekanan udara dengan ukuran tinggi di dalam lingkungan 5000 meter di atas paras laut yang dianggap linear. Konsep inilah yang membolehan ia sebagai asas binaan barometer altimeter. Di dalam projek ini, PIC16F84 microcontroller digunalan sebagai komponen utama yang mengaplikasikan keseluruhan pengiraan dan nilai pengiraan dipaparkan melaui "liquid crystal display" atau lebih dikenali sebagai LCD.

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LIST OF ABBREVIATION

A/D	-	Analog-To-Digital
ASCII	-	American Standard Code for Information Interchange
CAD	-	Computer Aided Design
CHAP.	-	Chapter
CLKIN	-	Clock In
CLKOUT	-	Clock Out
CMOS	-	Complementary Metal–Oxide–Semiconductor
CPU	-	Central Processing Unit
D/A	-	Digital-To-Analog
DC	-	Direct Current
E	-	Enable
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
FSO	-	Full Scale
GND	-	Ground
HS	-	High-Speed crystal
I	-	Input
I/O	-	Input/Output
IC	-	Integrated Circuit
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
LP	-	Lower-power crystal
mA	-	miliAmpere
mb	-	milibars
MCLR	-	Master Clear
MCU	-	Microcontroller Unit

mV	-	miliVolt
O	-	Output
OP-AMP	-	Operational Amplifier
OSC	-	Oscillator
P	-	Power
P.U.T	-	Power-up Timer
PCB	-	Printed Circuit Board
PIC	-	Peripheral Interface Controller
PLL	-	Phased-Locked Loop (PLL)
psi	-	Pound-force per square inch
PSM	-	Projek Sarjana Muda
PWM	-	Pulse Width Modulation
R	-	Resistor
R/W	-	Read/Write
RA	-	Pin on port A
RAM	-	Random-Access Memory
RB	-	Pin on port B
RC	-	Resistor-Capacitor
RISC	-	Reduced Instruction Set Computer
ROM	-	Read-Only Memory
RS	-	Register Select
ST	-	Schmitt Trigger input
UART	-	Universal Asynchronous Receiver Transmitter
UTeM	-	Unervisiti Teknikal Malaysia Melaka
v.f.c	-	Voltage-To Frequency Converter
VCO	-	Voltage Controlled Oscillator
XT	-	Crystal Oscillator

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CHAPTER I

INTRODUCTION OF THE PROJECT

1.1 Introduction

Three quarter of the Earth's atmospheric pressure is held within the first seven miles above the surface, although its presence can still be detected at around 5000miles high. The amount of pressure exerted at any point within the atmosphere is relative to the depth below its surface and to its density at any given moment. The Earth has a surface area of about 197 million square miles and at sea level the average pressure is about one kilogram per square centimeter (14.72 pounds per square inch).

As a round figure, at sea level the average pressure is expressed as having a value of one bar, although we are probably as 1000 milibars (mb). More precisely, meteorogists take the average atmospheric pressure at sea level as 1013.25mb measured at an air temperature of 0°C and at latitude of 45°C. Therefore, within the first 5000 meters or so above sea level, the pressure to height relationship can be regarded as linear, allowing it to be used as the basis for a barometer altimeter.

On the basis of all these facts, it has been decided to design and construct a digital altimeter based on MCU (Microcontroller Unit), temperature compensated

pressure sensor and a liquid crystal display unit. It used a 9V battery as its supply and displayed the height above sea level in meter and even in feet. Besides it also displayed the pressure in terms of milibar and the temperature is in terms of either °C or °F.

Basically, this altimeter consists of two parts; they are sensing part and control part. In the sensing part, the temperature compensated pressure sensor is used to sense the ambient pressure and therefore generates constant voltages and this voltage is than compared and amplified.

The subsequent voltage is ten be the input of Phase Locked Loop (PLL). Different input voltage will course the PLL to convert them into different frequency of waveform (square wave). The microcontroller, which is used for control part, treated as the main component. However, the software programmed in the PIC16F84 implements all the calculations and displayed the results through the liquid crystal display. The further description of the circuit will be discussed in the following chapter.

Basically, the function of the system can be explained by block diagram as shown in Figure 1.1.

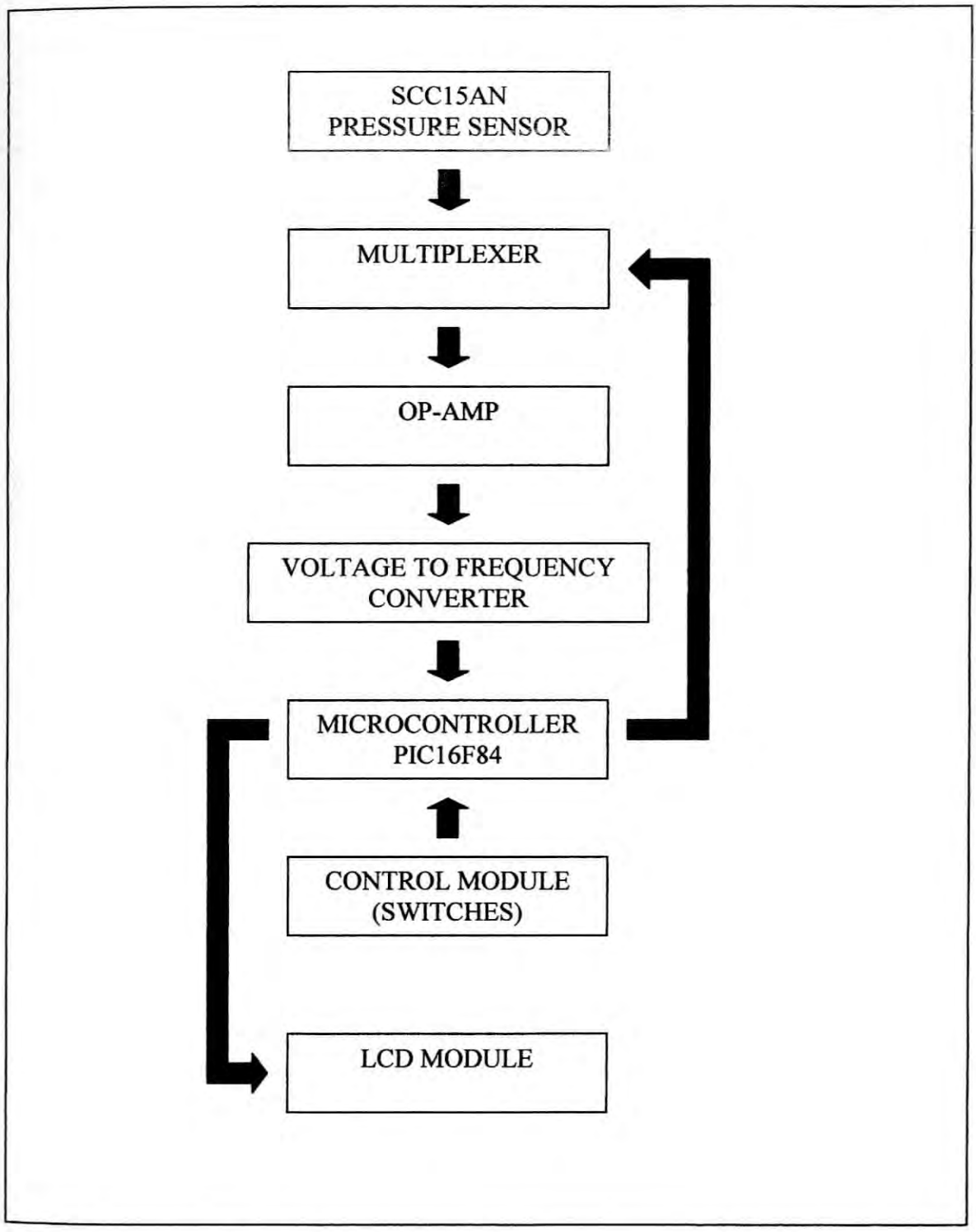

Figure 1.1 : Block Diagram Of Digital Altimeter Based PIC Microcontroller

1.2 Problem Statements

The multifunctional digital altimeter in today market is quite expensive. This is not economical for the people who just need them for hiking or mountaineering. Therefore the idea of designing a more economical and practical digital altimeter appeared to overcome this problem. With some additional functions such as to measure temperature and to convert results in meter to feet or °C to °F will be a helpful tool for the hikers.

Moreover, the design of this altimeter is small in size where it is easy to bring. The weight of the device is just under 500grams, and this is an important aspect for the hikers and mountaineers. Other advantages of the altimeter is that it is easy to use and the result is display on the LCD clearly and understandable where the contrast of the LCD can be adjusted. The altimeter also shows the value of the pressure and temperature where some altimeter do not have this feature.

1.3 Projects Objective

The main objective or purpose to build this project is to measure how high we have climbed or descended and the ambient temperature as well as the air pressure.

Other objectives of the project are:

(a) To be able to learn or discovered new knowledge such as PIC16F84 microcontroller and assembly language.
(b) To study the relationship between pressure and height and the concept that used as the basis for an altimeter.
(c) To develop the knowledge in designing a more economical and practical digital altimeter for hiking or mountaineering purpose.

Beside that this Final Year Project is compulsory for the final year Degree students in Faculty of Electronics and Computer Engineering of Universiti Teknikal

Malaysia Melaka. It is the most important single piece of work in the degree program. From here, it provides the opportunity for me to demonstrate independence and originality, to plan and organize a project, and to put into practice some of the techniques you have been taught throughout the course.

1.4 Scopes Of Work

The scopes of work on this project involve programming of PIC16F84 microcontroller which plays the most important part of the project. The software employed to process the overall system of this project is assembly language (PIC16F84 base). By using this software implementation, the expected results that are height, pressure and temperature are shown on the Liquid Crystal Display (LCD).

For hardware part, the project consists of a pressure sensor, a Liquid Crystal Display (LCD) and a PIC16F84 microcontroller. Pressure sensor is used to generate difference voltages when subjected to different ambient pressures. The design of this project is not that complicated since the system of this project is microcontroller-based. Software plays a more important role in this project.

Other scope of works that involved in the project are :

(a) Using Computer Added Design Software like Protel 99 SE and Proteus 6 Professional.
(b) Background of study and research of material in used for the project.
(c) Designing the project circuit on the PCB including several techniques like etching, drilling and soldering.
(d) Techniques used for testing and troubleshooting.

1.5 Expected Result

At the end of this final year project, the expected results is a economical and practical digital altimeter with functions as below:

(a) To measure height above sea level in meter.
(b) To measure pressure.
(c) To measure temperature.
(d) To convert results in meter to feet or °C to °F.

Moreover, the management, organization, reliability and punctuality of the project are expected in well planned. A good report is a also expected which able to show the achievement related to the project, the procedures, the theoretical and practical techniques and making suggestions for improvement or further work based on the experiences.

Other expected results of the proposed project are:

(a) Demonstration of independence and originality in planning and organizing a large project and to put into practice some of the techniques that have been taught throughout the course.
(b) Depth investigation in a topic, involving the investigation, analysis, specification, documentation and critical evaluation activities in both an academic and a practical context.
(c) Improvement in communication skill which plays a very important role in working environment in the future.
(d) Be awarded an Honours Degree in UTeM where this project is a part of the final year assessment.

1.6 Report Structure

The final year project report is one of the requirements in completing the final year project. It shown in details all the procedures, specifications, features and other related information of the project. This report consists six chapters and every chapter described the project in detailed.

The first chapter of the report is the Introduction Of The Project. This chapter introduced the project title, problem statement, project objective, scopes of work, expected results as well as the report structure. It gives the overall picture of the project.

The next chapter is Chapter II, Literature Review where all the research and studies on the project is explained. While the Chapter III explained the methodology used in completing the project. In this chapter, the project planning including the Gantt chart is elaborated too.

The following chapter is Hardware & Software Description. This chapter consists two parts, the hardware part and the software part. In the hardware part, the PIC16F84 microcontroller, temperature compensated pressure sensor, 4046 phased-locked loop, 4052 multiplexer, LM324 low power quad op-amp and the liquid crystal display are described in detailed. On the other hand, the software part explained the programming language in used, the flow chart and the software simulation program.

The Chapter V is the Result and Analysis of the project. This is the most important part of the report where all the results and analysis obtained are explained and shown. Last but not least, the Chapter VI is the Conclusion of the report where discussion is made and the suggestion for future work is given. Overall the report will give you the clear picture of the project.

CHAPTER II

LITERARUTE REVIEW

2.1 What Is Altimeter And The Concept In Used

An altimeter is an active instrument used to measure the altitude of an object above a fixed level. The traditional altimeter found in most aircraft works by measuring the air pressure from a static port in the airplane and it is an analogue altimeter. An altimeter cannot, however, be adjusted for variation in air temperature.

A radar altimeter measures altitude more exactly, using the time taken for a radio signal to reflect from the surface back to the aircraft. The radar altimeter is used to measure the exact height during the landing procedure of commercial aircraft.

Mountaineers use barometric altimeter when on high-altitude expeditions, as do skydivers. For a barometric altimeter, the concept in used is that within the first 5000 meters or so above sea level, the pressure to height relationship can be regarded as linear.

As a round figure, at sea level the average pressure is expressed as having a value of one bar, although we are probably as 1000milibars (mb). More precisely, meteorogists take the average atmospheric pressure at sea level as 1013.25mb