


“I have read this thesis and in my opinion, it is suitable in term of scope and quality for the purpose of awarding Bachelor Degree in Electronic Engineering (Industrial Electronic)”

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**DEVELOPMENT OF BASIC CALCULATOR USING
MICROCONTROLLER AND LIQUID CRYSTAL DISPLAY**


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March 2005

“I hereby declare that this thesis is the result of my own effort except as clearly stated in the sources of reference”

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ABSTRACT

This project explains the development of a basic calculator using a PIC microcontroller and an LCD (Liquid Crystal Display) as the display. This project can be self-operational in controlling the operation of the input and output device used. The input device used is a 4x4 keypad and the output device used is the LCD display. A program is written using C language by using the MPLAB IDE Environment. The program is then assembled to be connected into a hexadecimal file and downloaded into the PIC microcontroller. This project is able to analyze data from the press keypad through microcontroller and display it at LCD display. The functionality is implemented in software (MPLAB IDE). The work that will be done includes development of PIC circuit, software for PIC to taking input from keypad for calculation and displayed it to LCD display. The project executes simple calculation and the result is displayed on the LCD.

ABSTRAK

Projek ini menerangkan mengenai pembangunan kalkulator asas yang menggunakan pengawal mikro dan pemapar LCD sebagai paparan. Projek ini beroperasi secara bersendirian dalam mengawal operasi peranti masukan dan peranti keluaran yang digunakan. Peranti masukan yang digunakan ialah 4 x 4 papan kekunci, manakala pemapar LCD digunakan sebagai peranti keluaran. Aturcara ditulis dengan menggunakan bahasa C di MPLAB IDE. Seterusnya aturcara tersebut ditukarkan ke fail hexadesimal dan dimuat turun ke dalam pengawal mikro PIC. Projek ini mampu untuk menganalisa data dari kekunci yang ditekan dan memaparkan keputusannya di pemapar LCD. Kerja-kerja yang dijalankan meliputi pembangunan litar pengawal mikro dan perisian bagi pengawal mikro untuk menerima masukan daripada papan kekunci dan memaparkannya pada pemapar LCD. Unit ini dapat berfungsi sebagai kalkulator asas dan keputusan bagi operasi pengiraan yang dibuat dipaparkan di pemapar LCD.

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CHAPTER I

INTRODUCTION

1.1 Introduction

The aim of this final project is to develop a software and hardware for the use of simple calculator by using LCD (Liquid Crystal Display) with a microcontroller. This unit is built to control the microcontroller so that it can be self operational in controlling the operation of the input and output device used.

For the input device, the 4 x 4 keypad is used. Meanwhile the output device used is the LCD. The microcontroller 16F877 is used because it is required no support device such as serial port is connected to it. This unit is able to analyze data from the press keypad and display it at LCD (Liquid Crystal Display) at the same time.

1.2 Project Objective

The objective of this final project is to gain knowledge in interfacing between keypad, microcontroller and LCD. It is built to learn interfacing between software and hardware and gain experience and practice the electronics theories into practice.

It is also to enhance knowledge in assembly language and C language programming. In this project, MPLAB IDE software is used to compile the program for the microcontroller. This unit also can be self-operational in controlling the operation without the computer hose.

1.3 Project Scope

This project consists of two parts as mention earlier which is hardware and software development. While implementing this unit, a microcontroller assembly language programming is learned. Besides, it is also can get more knowledge and learn about the keypad, PIC microcontroller and LCD.

This unit are consisting a development of a basic calculator using chosen PIC microcontroller, keypad and LCD. There are PIC 16F877, keypad 4 x 4 and Hitachi HD44780 16 x 2 lines.

A microcontroller circuit is built which can receive and process input from the keypad and displaying the result to the LCD. A program is written using C language to initialize the PIC, set the input port, receive the input from the keypad, and process the input and lastly displaying the result to the LCD.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

The main important things for this project are divided to two main parts, which is hardware and software development. The hardware parts consisting of a PIC 16F84, LCD and keypad. Meanwhile the software parts are consisting of MPLAB IDE (assembly language), EEPROM programmer and cross assembler.

2.2 Problem Statements

The development of the project requires knowledge of assembly language, C++ and electronic theories. This knowledge is although this subject was taught during the degree course; they would be implemented in an unfamiliar environment. The specification and the programming of the PIC and LCD have to be studied thoroughly.

Interfacing between the keypad, PIC microcontroller and the LCD have to be analyzed in order to obtain a successful interfacing.

2.3 Project Methodology

The research that have been done is regarding on PIC 16F877, LCD, assembly language and C language to interface the PIC 16F877 between LCD and keypad. The 4 x 4 keypad is used as an input and the functionality is implemented by software. Actually, the purpose of display at LCD is able to see the number as the keypad is pressed.

2.3.1 Block Diagram

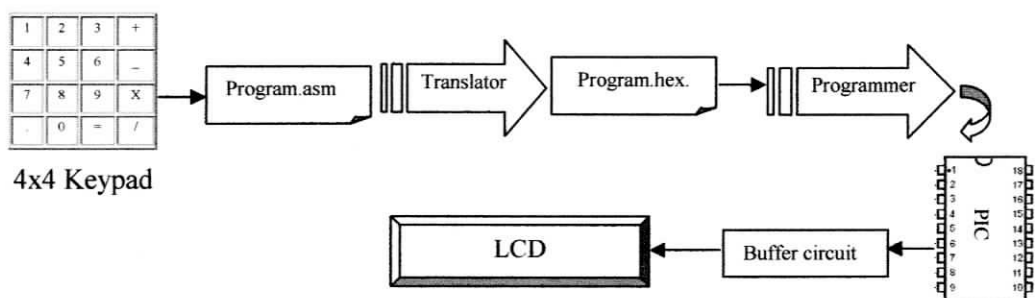
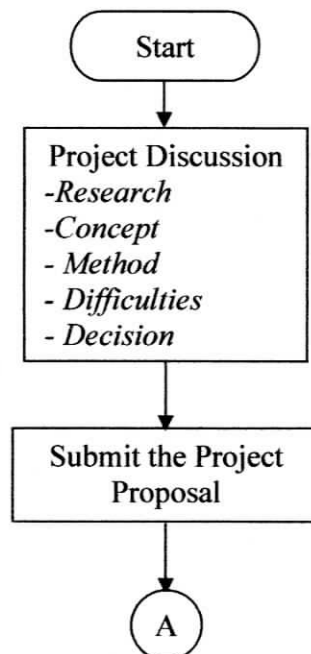


Figure 2.1: System Block Diagram

The system block diagram of this project is shown in Figure 2.1. For the beginning, interface circuit between PIC 16F877, LCD and keypad is built. MPLAB IDE software brings an ease of software development previously unseen in the 8-bit micro controller. The MPLAB IDE allowing editing source files in assembly language. Assembly language is a set of rules used in writing a program of PIC and the assembler is as a translator for assembly language into a machine language (hexadecimal).The ability to use MPLAB IDE with multiple debugging tools allows users to easily switch from the cost-effective simulator to a full-featured emulator with minimal retraining.

2.3.2 Flow Chart

This is a flow chart, which showed the outline of the project processing.



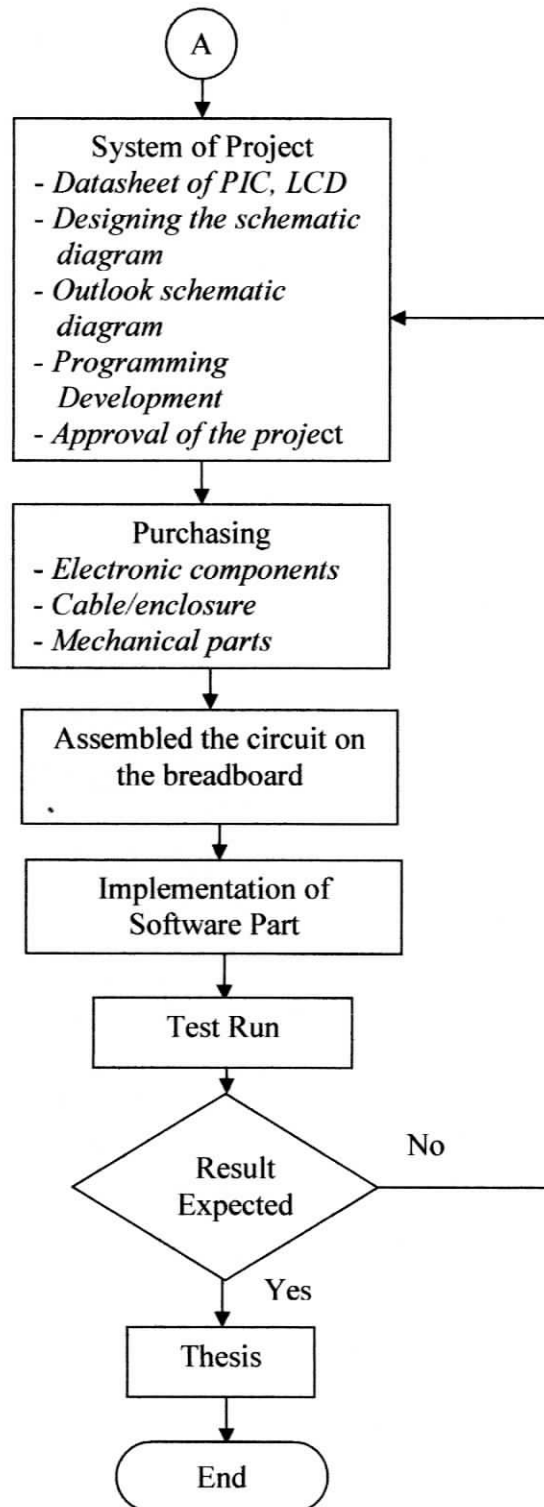


Figure 2.2: Flow Chart of Project Development

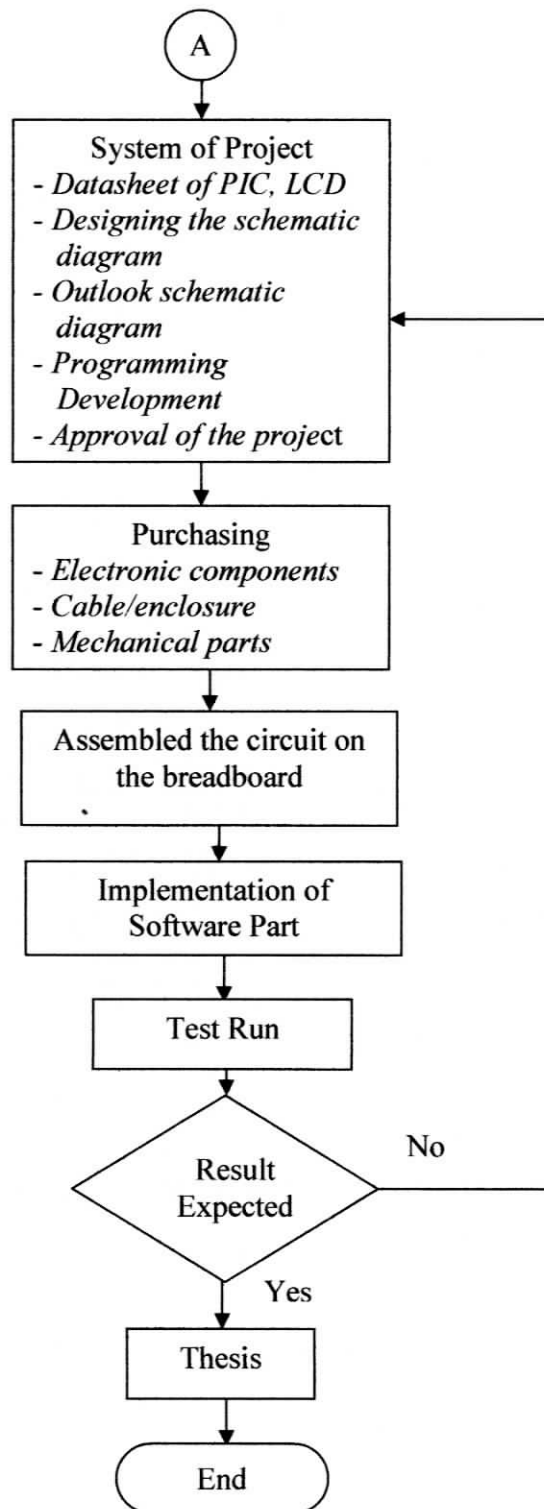


Figure 2.2: Flow Chart of Project Development

2.3.3 Simulation By Proteus 6 Profesional Software

By using the simulation, this unit can run and working properly as a basic calculator which is it can do the operation of add, subtract, divide and multiply. Besides, try and error is done by simulation which is to see the output from the programs that have been done.

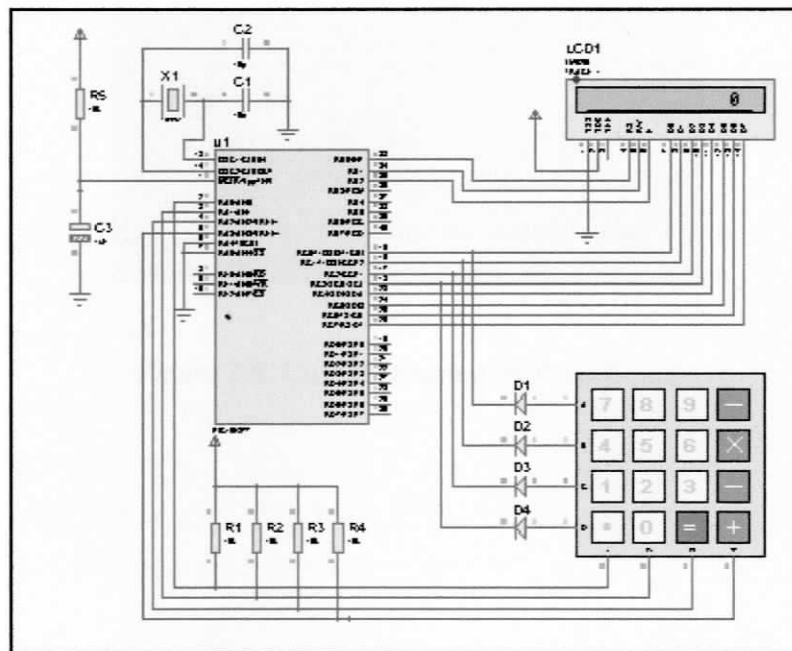


Figure 2.3: Simulation Circuit Diagram

2.3.4 Assembly Circuit On The Breadboard

To ensure the circuit is correct and can function properly, the circuit diagram is assembled on the breadboard. After testing the circuit successfully, the circuit is then transferred to the PCB board. To transfer it to the PCB board, all the procedures are

followed like designing the PCB circuit, etching, drilling, soldering etc. Below is the circuit that is assembly on the breadboard.

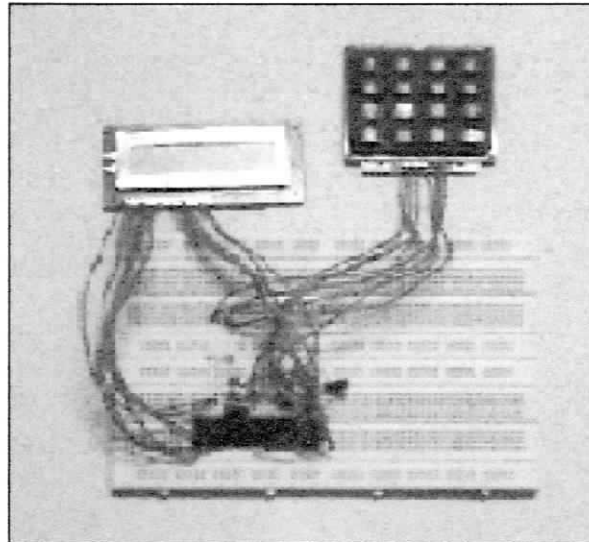


Figure 2.4: Circuit Diagram on Breadboard

CHAPTER III

HARDWARE DEVELOPMENT

3.1 Introduction

The hardware development, it is consists of a microcontroller 16F877, keypad and LCD (Liquid Crystal Displays). 4 x 4 keypad is used as an input.

The purpose of display at LCD is able to display the number that has typed in and also the result of the calculation.

A microcontroller is a computer control system on a single chip. It has many electronic circuits built into it, which can decode written instructions and convert them to electrical signals. The microcontroller will then step through these instructions and execute them one by one. The list of these instructions given to the microcontroller is called a program.