HANDHELD ENVIRONMENT METER

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This book is dedicated to my parents, family members and friends.

Last but not least, to my supervisor and all the UTeM lecturers.

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ABSTRACT

Handheld Environment Meter which measure and display the result value on a LCD. This project is a microcontroller based system which is uses a PSoC (Programmable System-On-Chip) microcontroller to control the whole. It is called Handheld Environment Meter. This Handheld Environment Meter able to measure environment temperature, pressure and humidity. Selectable switches are used to switch between every function of measurement. This project was developed with the main objective to introduce the PSoC Express which uses a program for allowing user to design and program the microcontroller without writing the source codes. PSoC Express is using the graphical diagram on program development and the successful simulated design will use to generate Hex code and program into PSoC microcontroller using PSoC Programmer. This Handheld Environment Meter has been overcome the problem of the product in current market which is limitation on measurement features. It was a combination of some measurement features. It can be said that this project was a low cost development but is very effective in real time.

ABSTRAK

Projek ini bertujuan untuk merekacipta sebuah alat pengukur untuk mengambil bacaan suhu, tekanan dan kelembapan keadaan alam sekeliling. Alat pengukur ini direkacipta berdasarkan konsep kawalan mikro dan pengaturcaraan terus diprogramkan ke dalam chip. Ia berkemampuan untuk mengesan keadaan sekeliling dan memaparkan bacaan pada paparan LCD. Dua suis digunakan untuk memilih jenis pengukuran samada bacaan suhu, tekanan atau kelembampan. Projek ini dilaksanakan dengan tujuan utama untuk memperkenalkan program PSoC Express kepada orang ramai. Ini kerana program ini membenarkan pereka untuk mereka sesuatu sistem kawalan mikro tanpa menulis bahasa pengaturcaraan seperti Bahasa C atau Bahasa Pemasangan. Pereka boleh menggunakan gambarajah blok sebagai pengaturcaraan untuk menjayakan rekaannya. Program yang telah disiapkan boleh disimulasi untuk memperolehi litar dan seterusnya diterjemah kepada Hex code untuk diprogramkan ke dalam chip. Alat pengukur keadaan sekeliling ini telah mengatasi masalah-malasah yang terdapat pada produk yang sedia ada di maket. Pengukuran tekanan alam sekeliling adalah fungsi yang jarang dijumpai pada maket sekarang. Selain itu, projek ini hanya melibatkan kos yang murah untuk menghasilkan fungsi yang standing malah melebihi produk yang berharga tinggi.

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LIST OF ABBREVIATIONS

ADC – Analog-to-Digital Converter

atm – Atmosphere

BOM – Bill of Material

CCS C Compiler – Customer Computer Service C Compiler

CMPLP – Computer Managed Personalized Learning Process

CPU – Central Processing Unit

CRC – Cyclical Redundancy Checking

CSA – CapSense Successive Approximation

CSD – CapSense Sigma Delta

CSR – CapSense Relaxation Oscillator

DAC – Digital-to-Analog Converter

DC – Direct Current

DIP – Dual Out-line Package

DTMF – Dual-tone multi-frequency

GUI – Graphic User Interface

HB LED – Hybrid Light Emitter Diode

Hex – Hexadecimal

Hg – Hydrargyrum

IC – Integrated Chip

I/O – Input and Output

IDE – Integrated Development Environment

ISO – International Standard Organization

IUPAC – International Union of Pure and Applied Chemistry

ISIS – Integrated Scientific Information System

kPa – Kilo Pascal

LCD – Liquid Crystal Display

LSI – Large-scale Integration

MAC – Multiply-Accumulate

MCU – Microcontroller Unit

MSB – Most Significant Bit

OEM – Original Equipment Manufacturer

PB – Push Button

PC – Personal Computer

PCB – Printed Circuit Board

PIC – Programmable Interrupt Controller

PSM – Projek Sarjana Muda

psi – Pounds per Square Inch

PSoC – Programmable System-on-Chip

PVC – Polyvinyl Chloride

PWM – Pulse Width Modulation

RAM – Random Access Memory

RH – Relative Humidity

ROM – Read Only Memory

SCL – Serial Clock

SDA – Serial Data

SIP – Single In-line Package

SMP – Symmetric Multiprocessing

SP – Service Pack

SPICE – Simulation Program with Integrated Circuit Emphasis

SRAM – Static Random Access Memory

SW – Switch

USB – Universal Serial Bus

UV – Ultra Violet

V – Volt

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CHAPTER I

INTRODUCTION

The Handheld Environment Meter has been designed to combine the functions of temperature meter, pressure meter and humidity meter. It is an ideal multi-function meter with scores of practical applications for professional and home use. The temperature function can be used to measure temperature in factories, schools, offices, hospitals or at home for checking and monitoring the environment temperature in term of providing a best condition for the particular situation. A digital temperature sensor is applied for this purpose to get more accurate real time value. The pressure function is used to measure atmosphere pressure in the field. Commonly, it can be used to determine the pressure in factories and biomedical field. However, some modifications are needed before being introduced to the biomedical field due to the calibration specification of different sector. The humidity sensitive component used in the meter is a very stable, laser trimmed, thermoset polymer capacitive sensing element with on-chip integrated signal conditioning. Applications of this function includes manufacturing factories field, store or logistic. Since the Handheld Environment Meter is a portable instrument tool, it allows user to bring along and basic tools for an engineer to troubleshooting some particular problem regarding the environment condition.

1.1 Background of Project

This project will develop a Handheld Environment Meter by using PSoC Express. The Handheld Environment Meter consists of three measurement functions which are temperature, pressure and humidity detection. The detection value will be displayed on a LCD. This project is able to overcome some of the limitations that other handheld environment meter available in market.

In this project, the development process focuses on the PSoC Express because it is a new software in microcontroller programming based. PSoC Express is a graphical modeling system that allows developers to create applications without resorting to text-based programming tools. On the other hand, developers no need to spend so much time on writing the source code and debugging the errors.

1.2 Project Objective

The main objective of this project is to introducing a new method of microcontroller program. In this project, the PSoC microcontroller which is manufactured by Cypress Semiconductor will be used. PSoC Express will be emphasized on this project including the advantages and the programming procedures. Compare to the existing method known as source code development to program the microcontroller, PSoC Express is a totally new and easier to handle during the development process.

Beside that, this project also focuses on the combination of functions of an environment meter available in current market. Common product in current market has a limitation of measurement function especially pressure detection. By encountering this problem, Handheld Environment Meter will be developed based on three basic measurement functions which is temperature, pressure and humidity.

1.3 Problem Statement

The major problem faced by designer is that when the situation requires a microcontroller to control the system, too much time is spend on the program development process. Based on the common microcontroller used in the market such as PIC from Microchip, a completed and successful compiled source code is necessary in order to operate the PIC. Normally, most of the development time is more on the writing of the source code.

Another problem often faced by programmer is that, many errors occurred during compiling the source code. Although the compiler program is able to debug and provide a reference for the user to make corrections, sometime it because too complicated and it is a wasting of time to make correction for all the errors.

By using PSoC Express program, designer is unnecessary to writing the command or deal with any complicated source codes. Dragging and dropping icons were simplified the designing processes and minimize the errors.

1.4 Scope of Work

This final project basically is a system-on-chip based which is divided into two categories i.e embedded design and hardware fabrication. This project produces a prototype model. A PSoC microcontroller (CY8C29466-24PXI) is used as the main component in this project. Design and simulation are performed using PSoC Express 3.0 visual embedded development tools. The successful simulated program is downloaded to the PSoC microcontroller using PSoC Programmer 2.30.0.16. Testing on PSOCEVAL1 evaluation board (PSoC Programmer Board) also was carried out.

Then the design is transferred to PCB as a prototyping by using Proteus 6.9 SP5. Then proceed with PCB fabrication which is the etching and soldering process. Testing and troubleshooting on the prototype model was repeated to ensure the all functionality of the prototype.

Based on research and study result, the existing environment meter in the market has limited capability on measurement functions especially is the pressure detection function. That's why it is very hard to find an environment meter with the pressure measurement function. Of course it exists but the price is expensive.

1.5 Short Brief on Methodology

To develop the project during PSM-I, PSoC Express has been used to design the program. By using this software, the program can be develop in shorten time compare with other microcontroller program compilers.

The successful simulated design was converted to the Hex code through PSoC Express. PSoC Programmer downloads the program in Hex code form into PSoC microcontroller via USB/Serial PSoC programmer board.

To verify the functionality of program, the I/O devices were connected to PSoC programmer board based on the schematic provided by PSoC Express. The completed connections of I/O devices were tested on different environment condition such as indoor and outdoor to test the temperature detection.

In PSM-II, the schematic generated by PSoC Express was converted into PCB design by using Proteus. This PCB layout was printed negative and mask on the PCB using UV Light. PCB with the circuit layout was put into automatic etching machine for dissolving the undesired copper.

Successful etching PCB has been drilled for insert the component. All the components were soldered step by step on the PCB. Completed soldered circuit was go through functionality testing process before assemble with the casing.

Lastly, the successful product was tested run for few hours to get the product specification such as sensitivity and operating time.