PIC TRAINER

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This report is submitted in partial fulfillment of the requirement for the award of
Bachelor of Electronic Engineering (Industrial Electronics) With Honours

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia, Melaka

April 2010

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : PIC TRAINER
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Sesi Pengajian :

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To my beloved mom and dad

ACKNOWLEDGEMENT

Assalammualaikum W.B.T…

First of all, I would like to thank Allah for HIS firm hands in guiding me in the course of completing this thesis. Alhamdulillah.

I would like to show my highest gratitude to my supervisor, Encik Mazran B. Esro for his invaluable support, patient, assistance and especially his encouragement to this project. I truly have learnt a lot and all this would not be without his guidance. Thanks a lot Sir.

I also would like to thank all my fellow friends for their contribution in giving me a moral support throughout my project development period. Last but not least, to all my beloved family members who were always, stand by my side to encourage, advice, comfort, cherish, and support me during this entire project.

Lastly, I really appreciate to have this responsibility to finish this project. This task has taught a lot of lesson and knowledge which is much valuable for me in the future. Thank you very much…

ABSTRACT

The primary objective of this project is to design a PIC Trainer. This PIC Trainer is build in with testing feature, programmer feature and in-circuit debugger socket ready for ICSP downloading feature. It is a 3 in 1 combination PIC Educational Development Board. It comes with a PIC16F877A Microcontroller, Programmer software which can support PIC Microcontroller for testing and development. Users only need a PIC Trainer and a PC without purchase programmer or other accessories and can start learning how to program the PICs. This board is suitable for beginner needs, with it's development and programmer features and also others extra features can be easily to arrange and program. It's ICSP feature is suitable to beginners for product developments needs.

ABSTRAK

Objektif utama projek ini adalah untuk merekabentuk sebuah "PIC TRAINER". Projek ini lengkap dengan ciri pengujian, ciri pengaturcaraan dan soket di dalam litar bersedia untuk ciri muat turun "ICSP" (pengaturcaraan secara siri di dalam litar). Ia gabungan 3 dalam 1 litar pembelajaran pembangunan mikropemproses. Ia datang dengan satu mikropemproses PIC16F877A, perisian pengaturcaraan yang boleh menyokong mikropemproses "PIC" untuk pengujian dan pembangunan. Pengguna-pengguna hanya memerlukan "PIC TRAINER" ini dan sebuah komputer tanpa pembelian litar pengatucaraan atau aksesori lain dan boleh mula belajar bagaimana untuk memprogram mikropemproses tersebut. Litar ini adalah sesuai untuk keperluan pengguna-pengguna, dengan ciri-ciri pengaturcaraan dan juga ciri-ciri tambahan, ia memudahkan pengguna untuk memprogram. Ciri ICSP adalah sesuai untuk pengguna baru untuk pembangunan produk.

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CHAPTER I

INTRODUCTION

1.1   Background

Microcontrollers - "computers on a chip" as they are often termed - are among the most widespread, varied and flexible electronic control devices around. The number of applications they fulfilled is vast and increasing daily. They can be found in household appliances of all sorts, vehicle subsystems, a huge array of electronic devices and instrumentation, and also within larger electronic products such as personal computers.

The PIC trainer is composed of enhanced board for Microchip's 40-pin PIC micro controllers (PIC 18F877A series). The trainer is targeted to facilitate the developers by providing exclusive and futuristic enhancements. The PIC trainer is put into practice with enormous features and it allows the PIC micro controller to be interfaced with external circuits to a broad range of the peripheral devices, allowing the user to concentrate on just the software. All the interfacing circuits are optional, and this allows the designer to works on it.

The PIC trainer is designed to offer an easy to start platform for PIC microcontroller users. This board comes with basic components for the user to begin the project development. It also includes the sample of programs for each of the experiment. So this PIC trainer enables the user who does not have any experience to

have a basic knowledge about PIC microcontroller programming. This project scope shall include a PIC Programmer and trainer which consist of 7 segments, LCD, simple switches, keypad and LM35 temperature sensor.

1.2   Objective

The objectives of this project are to explore the applications of PIC microcontrollers, being familiar with C languages, designed to offer an easy to start platform for PIC microcontroller beginners to begin with the experiment and to research all information about PIC microcontrollers includes their characteristics and working principles.

1.3   Scope of the project

Scope of project is divided into two sections. The first one is software development and the second one focusing on hardware. For software development, the focusing area is:

a) To program the PIC by using C language.
b) Build sample of programs for each of the experiment and the difficulties of the sample programs are gradually increase from simple to complex.

For hardware section, the focusing area is:

a) PIC Trainer is targeted to be operated by using PIC 16f877a as a Microcontroller. Keypad, simple switch and temperature sensor are used as an input, while LCD, LED and 7 segments as an output. The idea of the project is as illustrated in Figure 1.1.
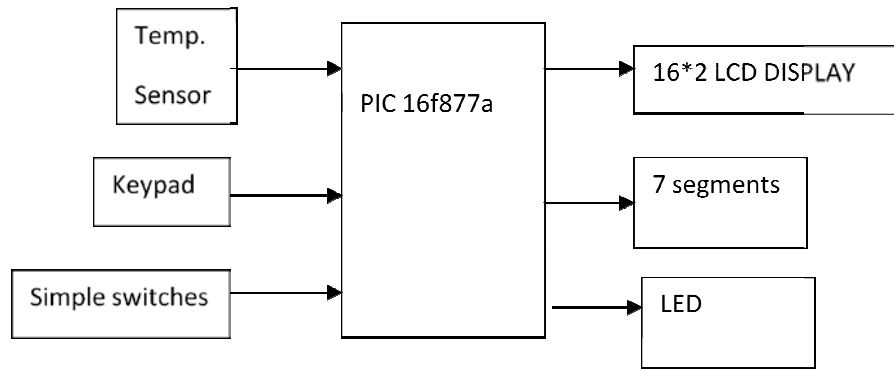
Figure 1.1: Block diagram of the system

b) Design the circuit that includes all the necessary components to make sure that
    the system completely functioning.
c) To design PCB using Orcad and produce commercial standard of PCB in form of
    Gerber file and ready to fabricate by PCB manufacturer.

1.4   Problem Statement

Students are less exposed to the concept of PIC microcontroller application.
Basically, students have their basic knowledge on programming, but they don't know
how to apply their knowledge on PIC microcontroller. To overcome the problem, the
objective of this project is to build a trainer consists of PIC programmer and
necessary components as an input and output for users to begin with the experiment.

CHAPTER II

LITERATURE REVIEW OF PROJECT
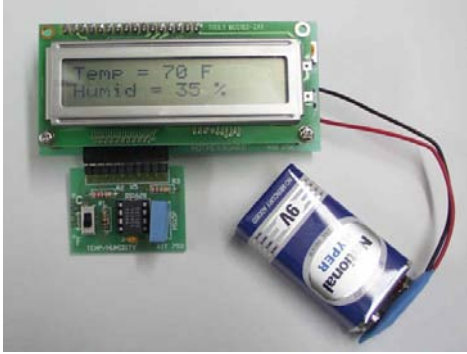

2.1   Similar Commercial Products

There are commercial products available, which focus only on certain functions and others offer too much of functions. This first kit which is produced by Kitsrus only teaches how to use a microcontroller for measuring temperature (in either degrees Fahrenheit or degrees Celsius), humidity, as a counter, as a timer and for analog to digital conversion. The disadvantages of this kit is not includes the built-in programmer. That mean users have to download the program into microcontroller in other programmer circuit and then plug in the microcontroller into the kit. Another disadvantage of this kit is the functions are very limited.

The second kit which is produced by Bizchip offers too much of function. This kit has too many features such as serial programmer, Dual DC motor controller, 10A DC motor driver, stepper motor driver, Dual 10A relay module and many more. The disadvantage of this kit is offers too many functions and the circuit much more complex for beginners to begin with the experiment. Another disadvantage of this kit is the cost to build it is very high.

Table 2.1**:** The comparison between similar products on the market.

1. KIT 75 PIC TRAINER by kitsrus.com	2. Mini40 PIC Microcontroller Training Kit by bizchip.com
Figure 2.1: Temperature/humidity sensor Figure 2.2: Counter/timer	Figure 2.3: Mini40 PIC MCU Trainer
Features: - Temperature/humidity sensor - Timer - Counter - Analog to digital conversion	Features: - Serial programmer - Dual DC motor controller - 10A DC motor driver - Stepper motor driver - Dual 10A relay module - Light sensor - Temperature sensor - 8-bit LED - 2*16 LCD

The target for this project is to build the PIC trainer with built-in programmer circuit and wide range of functionality. The project will use common components

such as simple switches, keypad and temperature sensor for input device. While for output device, it will use 16x2 LCD, 7 segment and LED.

2.2 Overview Of Major Component Involved

This is an overview of major component involved in the project. There are several major components such as PIC microcontroller, 16*2 liquid crystal display (LCD), LM35 temperature sensor and seven-segment display.

2.2.1 PIC microcontroller

PIC microcontroller is a device that functions as brain of the system. Every signal from input devices will be sent to a microcontroller to performing various mathematical operations and it will send back the signal to the output devices to perform the task as programmed. PIC16F877A microcontroller is chosen because it is a suitable microcontroller for this project. These are the features of PIC microcontroller:

a) Memory unit
   - For data storage in microcontroller.
b) Central processing unit
   - Registers are therefore memory locations whose role is to help with performing various mathematical operations or any other operations with data wherever data can be found.
c) Bus
   - The way that data goes from one block to one another.
     • Address bus: Consists of as many lines as the amount of memory that wishes to address. Transmit address from CPU memory.
     • Data bus: To connect all blocks inside the microcontroller.
d) Input-output unit
   - Send and receive data from controller.

e) Timer unit
  - Give information about duration, time and protocol.

f) Watchdog
  - Free run counter where the program needs to write zero in every time it executes correctly.

g) Analog to digital converter
  - Converting information about some analog value to a binary number and for follow it through to a CPU block so that CPU block can further process it.

2.2.2   Temperature Sensor (LM35)

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature in degrees Celsius (°C). Measured temperature from LM35 is more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

It has an output voltage that is proportional to the Celsius temperature. The scale factor is 0.01V/°C. The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 °C at room temperature and +/- 0.8 °C over a range of 0 °C to +100 °C. Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 °C temperature rise in still air.

The output voltage is converted to temperature by a simple conversion factor. The sensor has a sensitivity of 10mV / °C. The output voltage varies linearly with temperature. By using a conversion factor that is the reciprocal, that is 100 °C / V. The general equation used to convert output voltage to temperature is:

Temperature (°C) = Vout * (100 °C / V)

So if Vout is 1V , then, Temperature = 100 °C

Figure 2.4: LM35 Temperature Sensor

2.2.3   16x2 Liquid Crystal Display (LCD)

More microcontroller devices are using 'smart LCD' displays to output visual information. The following discussion covers the connection of a Hitachi LCD display to a PIC microcontroller. LCD displays designed around Hitachi's LCD HD44780 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 8 x 80 pixels of the display. Hitachi LCD displays have a standard ASCII set of characters plus Japanese, Greek and mathematical symbols [7].

For a 8-bit data bus, the display requires a +5V supply plus 11 I/O lines. For a 4-bit data bus it only requires the supply lines plus seven extra lines. When the LCD display is not enabled, data lines are tri-state which means they are in a state of high impendance (as though they are disconnected) and this means they do not interfere with the operation of the microcontroller when the display is not being addressed.

The LCD also requires 3 "control" lines from the microcontroller.

Enable (E)   This line allows access to the display through R/W and RS lines. When this line is low, the LCD is disabled and ignores signals from R/W and RS. When (E) line is high, the LCD checks the state of the two control lines and responds accordingly.

Read/Write   This line determines the direction of data between the LCD and
(R/W)   microcontroller. When it is low, data is written to the LCD. When it is high, data is read from the LCD.

Register select With the help of this line, the LCD interprets the type of data on
(RS)   data lines. When it is low, an instruction is being written to the LCD. When it is high, a character is being written to the LCD.

Logic status on control lines:

E   0 Access to LCD disabled
          1 Access to LCD enabled

R/W   0 Writing data to LCD
          1 Reading data from LCD

RS   0 Instruction
          1 Character

Writing data to the LCD is done in several steps:

Set R/W bit to low
Set RS bit to logic 0 or 1 (instruction or character)
Set data to data lines (if it is writing)
Set E line to high
Set E line to low