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Acknowledgements

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MICROCONTROLLER CONTROLLED FOUR-DIGIT TIMER

Lei Lei Aung[1], Myo Nandar Mon[2], Khin Phyu Win[3], Moh Moh[4]

Abstract

A PIC microcontroller controlled four-digit timer system is constructed by using PIC16F877A microcontroller which determines the main function of the system. Four common cathode 7-segment displays are used to display the timing values. It counts up from 0000 to 9999 in every second. Displays are multiplexed by the transistor switches. The programming language used to control the system is CCS C language. The PIC has an internaloscillator and configure to operate at 4 MHz.

Introduction

Timer circuit has been used in many projects and there are basically 2 types that are used these days. One of them is the use of analog RC circuit where charging of the capacitor circuit determines the T (time) of the circuitry. This type of circuitry has large tolerance and is used in applications where the T is not so critical as the T is affected by the tolerance of the RC components used. The other is the used of crystal or ceramic resonators together with

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microprocessor, microcontroller or application specific integrated circuit that need higher precision T in the tolerance of up to 5 ppm (part per million). The timer that is constructed in this project is based on the PIC16F877A microcontroller. A microcontroller is an inexpensive signal-chip computer. Single-chip computer means that the entire computer system lies within the confines of the integrated circuit chip. The microcontroller on the encapsulated silver of silicon has features similar to those of the standard personal computer. Primarily, the microcontroller is capable of storing and running a program (its most important feature). The microcontroller contains a CPU (central processing unit), RAM (random access memory), ROM (read-only memory), I/O (input / output), lines, serial and parallel ports, timers, and sometime other built-in peripherals such as A/D (analog-to-digital) and D/A (digital-to-analog) converter. The microcontroller's ability to store and run unique programs makes it extremely versatile. It can program a microcontroller to make decisions (perform functions) based on predetermined situations (I/O-line logic) and selections).

Microchip Technology's series of microcontroller is called PIC chips. Microchip secures a trademark for the name PIC. Microchip uses PIC to describe its series of PIC microcontrollers. PIC is generally assumed to mean programmable interface controller. PIC16F877A microcontroller has been chosen for this project. It is a 40-pin device and is one of the popular microcontroller used in complex application. It fetches the instructions from its program memory one by one, decodes their instructions, and then carries out the required operations. It is also a main control unit of the system and it produces the timing signal every second. Timing values are viewed on the four seven segment displays.

Block diagram of the system is shown in Figure 1.

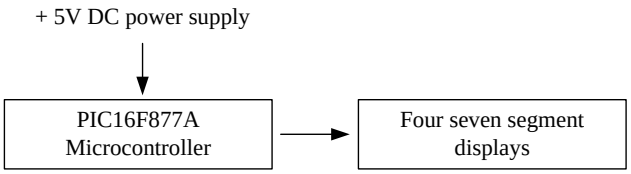

Figure1. Block diagram of the system

PIC16F877A MICROCONTROLLER

The PIC16F877A microcontroller is part of a family group of the 16F874A, the 16F876A and 16F877A. Generally, it can refer to them as 16F87XA. The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, an ICD, 2 comparators, 8 channels of 10-bit Analog-to Digital (A/D) converter, 2 Capture / Compare / PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port. The pin connection diagram of the 16F877A is shown in Figure 2.

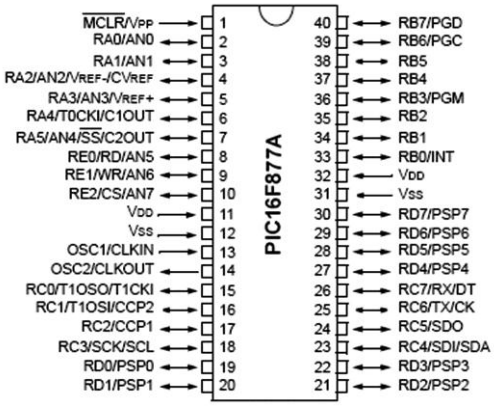

Figure2. The PIC16F877A pin connection diagram

SOFTWARE DEVELOPMENT

A PIC microcontroller is an integrated circuit and as such it is useless unless it is programmed and used properly in an electronic circuit to carry out a certain task. The software tools required to develop PIC microcontroller are stated as follow.

Required Software Tools

All microcontrollers require a program (or software) for their operation. This program is developed and tested by the programmer (or the user). The following software tools are normally required in a PIC microcontroller-based project development cycle: A text editor, CCS C compilers and PIC programmer device software

Text Editor

A text editor is used to write the program (or source code) so that it can be complied and loaded into the target microcontroller. CCS C compiler software contains built-in text editor to create a file and write the programs. A program file consists of a file name and a file extension. The file name can be given any name, but the file extension is usually chosen as.c in CCS C.

CCS C Compiler

There are several C compilers on the market for the PIC series of microcontrollers. These compilers have many similar features, and they can all be used to develop C-based high-level programs for PIC microcontrollers.

Some of the C compilers used most often in commercial, industrial, and educational PIC microcontroller applications are : mikroC, PICC18, C18 and CCS.

The popular and powerful mikroC, developed by MikroElektronika (web site: www.micro.com), is easy to learn and comes with rich resources, such as a large number of library functions and an integrated development environment with a built-in simulator and an in-circuit debugger (e.g., mikroLCD). A demo version of the combiner with a 2K program limit is available from MikroElektronika.

CCS has been developed by the Custom Computer systems Inc. (web site: www.ccsinfo.com). The company offers a limited-period demo version of their compiler. CCS provides a large number of built-in functions and supports an in-circuit debugger (*e.g*., LCD-U40) which are very helpful in the development of PIC microcontroller-based systems.

Every C program must contain a main function which is the starting point of the program execution. The program can be split into multiple functions according to their purpose and the functions could be called from main or the sub functions. In a large project functions can also be placed in different C files or header files that can be included in the main C files to group the related functions by their category. CCS C also requires to include the appropriate device file using # include directive to include the device specific functionality. There are also some preprocessor directives like # fuses to specify their fuses for the chip and # use delay to specify the clock speed. The functions contain the data declarations, definitions, statements and expressions. The compiler also provides a large number of standard C libraries as well as other device drivers that can be included and used in the programs. CCS C also provides a large number built-in functions to access the various peripherals included in the PIC microcontroller.

Programmer device software

It should install the programmer software which has been distributed with the programmer device. In this project, the USB-based Programmer device was used and the software (winpic 800 3.55 b) for this device was installed by the standard Windows software installation procedures. The programmer software is invoked automatically when working with CCS C compiler built-in text editor.

Program Language

There are types of languages: machines, assembly, and high-level languages. Each has advantages and disadvantages. Machine language is the language of 0s and 1s, which is the

only language the computer can understand. Other languages must be converted to machine language so the computer (Microprocessor or Microcontroller) can understand and execute the program. Each computer has its own machine language. This means that the machine languages of different manufactures are not compatible. The programmer uses the hex code to represent the opcode, operand address, and data since numbers can be represented in hex form much more easily than in binary form.

SYSTEM DEVELOPMENT

The source code is written on a PC host using a built-in text editor, or the edit window in the compiler or assembler application software, then it is compiled and downloaded to the chip. In order to develop system, some hardware tools are required.

Required Hardware Tools

The following hardware tools are normally required before a microcontroller-based project can be developed: A desktop or a laptop PC, PIC microcontroller programmer device, PIC microcontroller chip(s) and support components, Power supply and System hardware.

PIC microcontroller programmer device

A microcontroller programmer device is a stand-alone unit usually with one or more ZIF (zeroinsertion-force) type sockets mounted on it. The device is connected to the PC using either a parallel (or sometimes a serial) cable or by the USB interface. The new programmer devices with the USB interface do not require any external power supply as they are powered from the USB port of the PC they are connected to. The older devices with serial or parallel interfaces require an external main adaptor for their operation. The size of the ZIF socket determines the types of chips that can be programmed by the device. Some sockets are 40-pin which can be used to program microcontrollers with 40, 24, 20, 18, and 8 pins. Some programmer devices have sockets with only 18 pins and they are designed to program smaller microcontrollers with 18 or less pins.

Figure 3 shows a typical PIC microcontroller programmer device based on a USB-type interface. The programmer has a single 40-pin ZIF socket mounted on it. Microcontrollers with 40-pins (e.g. PIC16F877A) can be programmed by placing them directly on the socket and closing the handle. Devices with less number of pins (*e.g.*, PIC16F84) are normally placed at the far end of the socket near the handle. The Programmer in Figure 3 has the advantage that it can program a very large variety of PIC microcontroller chips.

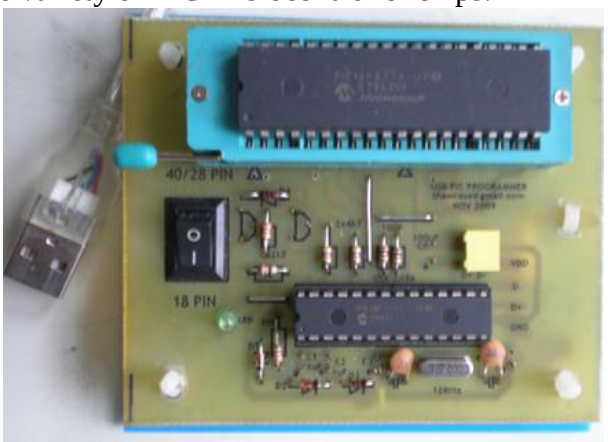

Figure 3. USB port-based PIC microcontroller programmer device

System Hardware

Four-digit timer system was constructed using PIC16F877A microcontroller.

The circuit diagram of 4-digit timer system is shown in Figure 4. Timing values (0000 to 9999) can be read on four common-cathode seven – segment displays. Displays were driven using only eleven output pins (seven PORTC pins and four PORTA pins) and four transistors.

BC547 transistors were used as switches in order to multiplex the displays. PORTC and PORTA pins drive the displays and the transistors via 220 Ω resistors and 2.2 kΩ resistors.

40-pin Dual-in-line (DJL) sockets were used for PIC167877A microcontroller. PIC was operated from 4 MHz crystal and 100 nF capacitor across the PIC to prevent high frequency instability.

PIC microcontrollers can operate from a power supply voltage in the range 2 to 6 V. The standard power supply voltage in digital electronic circuit is + 5 V and this is the voltage with which the PIC microcontrollers are mostly operated.

The power supply unit contains a power transformer which reduces the line voltage to 9 V ac. Bridge rectifier circuit converts this to dc voltage. The rectified dc voltage is then filtered by capacitors. Input line voltage variation and output current variation may cause transient effect in dc output voltage. It is eliminated by a monolithic type, three terminal regulated IC (LM7805). The output of regulator IC is + 5V dc.

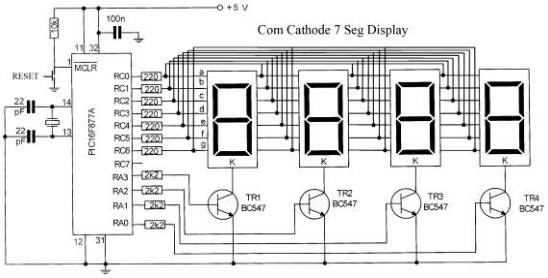

Figure 4. Complete circuit diagram of the system

Loading for Program Memory

There are five major requirements to load a program in the memory of PIC microcontroller. They are personal computer, complier or assembler software, programmer software, programmer and PIC microcontroller.

A personal computer, a programmer and a programmer software are used to load the contents of the HEX file in PIC.

Firstly, programmer software and complier software are installed into the personal computer. Then we write a program by using a text editor. And then it is changed into the hex file or machine language (the only understandable language for PIC) automatically using CCS C Compiler software.

Lastly, load the program (hex file) into the memory of PIC microcontroller via USB port, which is connected to the programmer by using the programmer software.

After completing the loading process, PIC can do specific operation by executing the instructions, which were stored in the program memory. Loading process for PIC is shown in Figure 5.

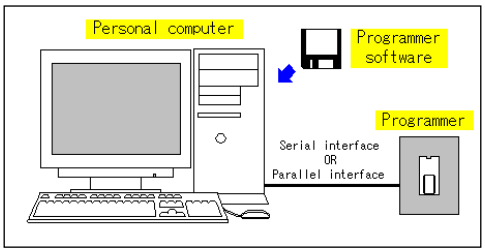

Figure 5. Loading Process for PIC

Result and Discussion

Control program for the PIC16F877A is written in assembly language. A PIC microcontroller operates on a set of instructions (on the user program) stored in its memory. A

microcontroller fetches the instructions from its program memory one by one, detected their instructions, and then carries act the required operations.

As soon as 5 V dc power supply is applied to the system program displays numbers 0 to 9999 on the display with a one second delay between each output. Modifying the control program the timer can also be used as a two-digit hour-minute digital clock or a stop-watch.

Conclusion

Using microcontroller integrated circuit is saving energy and cost. Since not much external components are needed, the design is relatively compact. By using a microcontroller it can obtain the advantages of light weight, low power consumption, better reliability and precise timing sequence.

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Firstly, we are deeply grateful to Rector, Dr Tin Maung Hla, Yangon University of Distance Education and Pro Rector Dr Khin Thant Sin, Yangon University of Distance Education, for their kind permission to carry out our research work. We would like to thank Head of Professor Dr Moh Moh, Department of Physics and Professor Dr Marlar Myint, Department of Physics, Yangon University of Distance Education, for their kind permission to carry out this research work.

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STUDY ON CURRENT-VOLTAGE CHARACTERISTICS OF ZnTe ELECTROPLATED FILM UNDER ILLUMINATION

Myo Nandar Mon[1], Thi Thi Win[2], Lei Lei Aung[3], Moh Moh[4]

Abstract

$Zn_{1-x}Te_x$ (x=0.22 mol) electroplated film was grown on stainless steel substrate with different viscosity levels. For more electrical contact, Ni-conductive layers were deposited on both sides of the cell by electroless Ni-plating. I-V characteristics were studied under illumination condition for all fabricated films. The largest value of conversion efficiency (6.908 %) was found at the ZnTe film with kinematic viscosity of 32.22 cP. According to the experimental data resulted from this research, the laboratory-prepared ZnTe film is credible, suitable and appropriate to use for photovoltaic cell application.

Introduction

Amongst the wide band gap II-VI semiconductor materials, Zinc Telluride (ZnTe) is the most attractive material and finds several applications in the field of device electronics. Zinc Telluride, II-VI compound semiconductor, with zinc-blende structure with lattice constant of 6.1037 Å, direct band gap of 2.26 eV at room temperature, and melting point of 1295°C. The II-VI compound semiconductors have considerable potential for integrated-optics applications due to their high electro-optic coefficients, wide transparency range from the

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