Microcontroller-Based Digital Clock System

Zin Mar Oo
Computer University, Pathein
simplelay2009@gmail.com

Abstract

Electronic clocks have predominately replaced the mechanical clocks. They are much reliable, accurate, maintenance free and portable. In general, there are two kinds of electronic clocks. They are analog clock and digital clock. But digital clocks are more common and independent of external source. This system is mainly intended to develop digital clock by using PIC controlling system. The microcontroller-based digital clock is constructed with PIC16F628 in this system. Various types of digital clocks and modules are available in the market nowadays but this clock is different at least in the accurate time. To do controlling in microcontroller is only the feature of the clock. To show the time, 16character × 1line Liquid Crystal Display (LCD) is used.

1. Introduction

Microcontroller is also called embedded controllers because the microcontroller and support circuits are built into the devices they control. Moreover, microcontrollers are more compact and powerful than normal analog devices. They can be reprogrammed later and can perform the required controlling system.

Microchip's PIC micro microcontroller devices have become a popular design choice for low-power and low-cost system solutions. The microcontrollers have multiple general-purpose input/output pins. PIC microcontrollers are constructed using CMOS technology, which decrease the current chip's size and power requirements considerably. Microcontroller is a Single on Chip Device because it has the essential components required for digital computing.

Time is such a fundamental concept that it is very difficult to define. Thus, the microcontroller is used to achieve the desired digital clock in this system. Digital display clock is an attraction for office, industrial and household purpose because the time can be readout directly and its time is very precise [2].

2. Related work

Nowadays, PIC microcontroller is used for a few kilobytes requirements of device control instead of personal computer. PIC microcontroller is very useful for the application areas of communication, transportation, product manufacturing and automatic control etc. Devices that utilize microcontrollers include car engines, consumer electronics (VCRs, microwaves, cameras, pagers, cell phones, digital clock), computer peripherals (keyboards, printers, modems…), test/measurement equipment (signal generators, multimeters, oscilloscopes…). PIC microcontrollers have gained popularity in control applications for their simplicity of use and modifiability. All over the world, microcontroller is used to reduce the cost, human power and electricity, Microcontroller is used for secure system [6].

3. Microcontroller

A microcontroller is a computer control system on a single chip. It is one of the most important developments in electronics since the invention of the microprocessor itself. It is essential for the operation of devices such as mobile phones, DVD players, video cameras, and most self contained electronic systems. 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 the instructions and execute them one by one. Microcontrollers include EPROM program memory, user RAM for storing program data, timer circuits, an instruction set, special function registers, power on reset, interrupts, low power consumption and a security bit for software protection [3].

3.1. Overview of PIC16F628

PIC16F628 is used for this system. Figure 1 shows the outline of a PIC16F628.

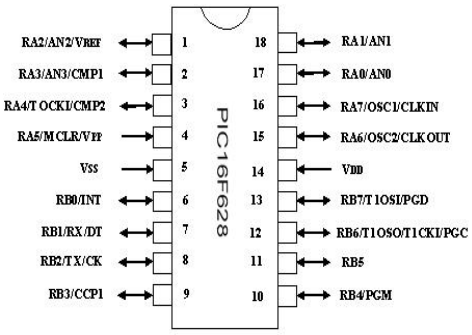

Figure 1. Pin Layout of PIC16F628

PIC s are popular with developers due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial

programming (and re-programming with flash memory) capability**.**

PIC16F628 is eighteen pin enhanced FLASH-Based 8-Bit CMOS microcontroller. To begin with, the PIC16F628 uses Harvard architecture, in which, program and data are accessed from separated memories using separate buses [4].

4. 16Characters × 1Line LCD

A 1 line x 16 character displays suitable for direct panel mounting with a large easily read STN (super-twisted nematic) display and optional LED (Light Emitting Diode) backlight. LCD is very helpful in providing user interface as well as for debugging purpose. LCDs are very simple to interface with the controller as well as are cost effective.

The LCD requires 3 control lines (RS, R/W & EN) & 8 (or 4) data lines. The number on data lines depends on the mode of operation. If operated in 8-bit mode then 8 data lines + 3 control lines i.e. total 11 lines are required. And if operated in 4-bit mode then 4 data lines + 3 control lines i.e. 7 lines are required. Figure 2 shows block diagram of 16 characters X 1 line LCD [5].

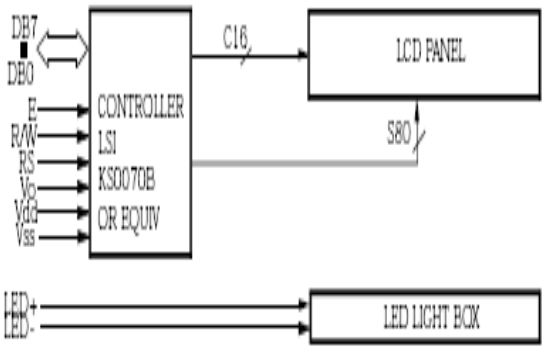

Figure 2. Block Diagram of 16characters × 1line LCD

5. System Design and Implementation

This system intends to develop digital clock using PIC16F628 microcontroller and liquid crystal display (LCD).

5.1. 5V Power Supply

A power supply is an essential part of each electronic system from the simplest to the most complex. The DC power supply converts the standard 220v, 50Hz AC into a constant DC voltage. The DC voltage produced by a power supply is used to power all types of electronic circuits.

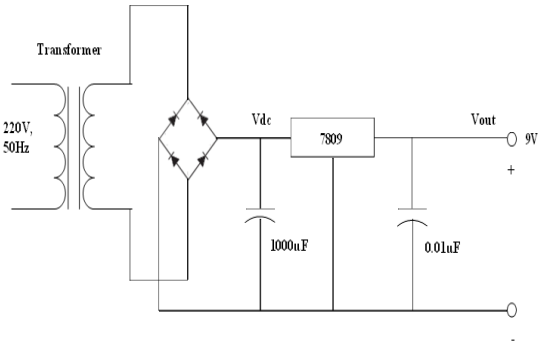

Figure 3. DC supply output voltage

In this system, the step-down power transformer is used. The system uses 5V for LCD display and 16F628 PIC. So, 9V AC is converted to 9V DC by using full-wave bridge receiver power supply. Then, the system uses 9V DC to step down 5V Dc.

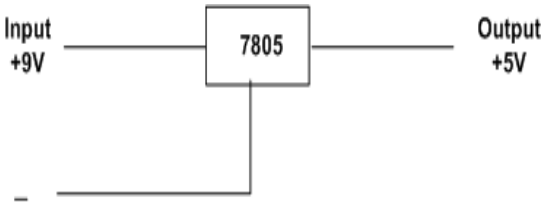

Figure 4. 5V DC supply output voltage

5.2. Microcontroller-based Digital Clock

Proposed block diagram of microcontroller-based digital clock is shown in Figure 5.

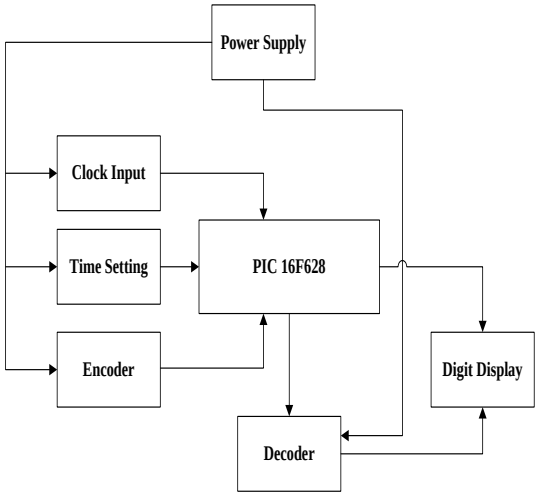

Figure 5. Block Diagram of Microcontroller-based Digital Clock

To obtain the complete system, PIC16F628 and Liquid Crystal Display (LCD) are needed. In this PIC16F628, the appropriate program and voltages are used to operate the whole circuit. For digital clock, 16character x 1line LCD are used to show the hours, minutes, and seconds.

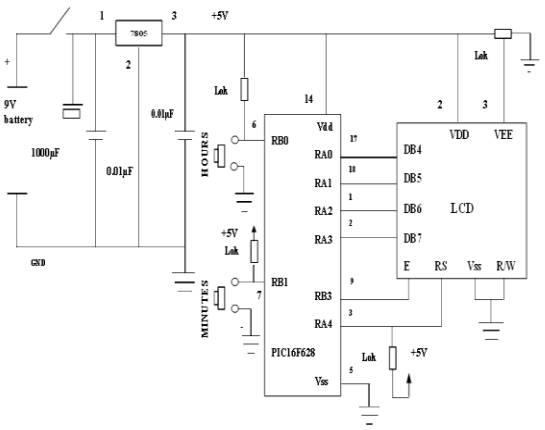

Figure 6. Complete Circuit Diagram of the System

5.3. LCD Display Processing

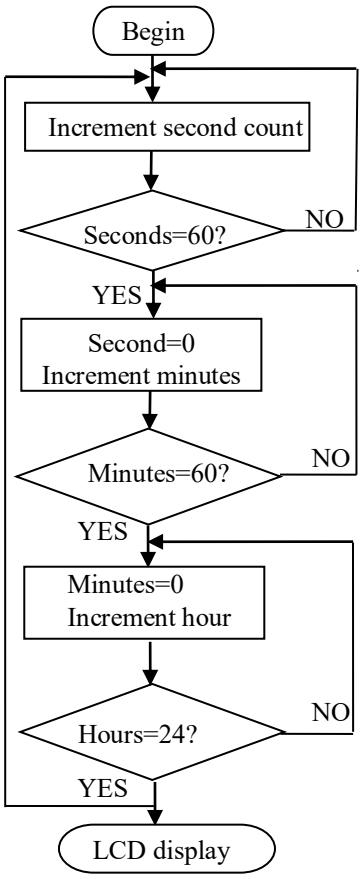

Figure 7. Flowchart of the LCD Display Processing

In this system, Liquid Crystal Display (LCD) is used to display hours, minutes and seconds. LCD clock is a digital clock with a general facility of setting time. In LCD display process, one digit is controlled in the one millisecond interval. The LCD display is a way similar to that of an analogue clock as it indicates minutes on the outer circle and hours on the inner circle.

The system begins to increase second count. If the second count is equal 60 seconds then the system increases minutes count. If the minute count is equal 60 minutes then the system increases hour count. If the hour is 24 hours, then the system restarts to increase second count.

5.4. Clock Processing

In the clock mode, when detecting that a switch in zero seconds is pushed, it makes a second display 00 seconds. As for the setting switch in zero seconds, last look checking is done.

Setting processing in zero seconds is done only in case of being OFF in the condition before detecting switch ON. Even if the switch is continuously pushed, the ON condition behind the first change doesn't influence setting in zero seconds.

In the clock mode, when a time setting switch is continuously pushed for one second, it jumps to display time processing. Before processing in time setting, it makes a position for hour, it makes 00 seconds and it makes the change detection interruption of the RB port possible. The change detection of the RB is to detect the change of the rotary encoder.

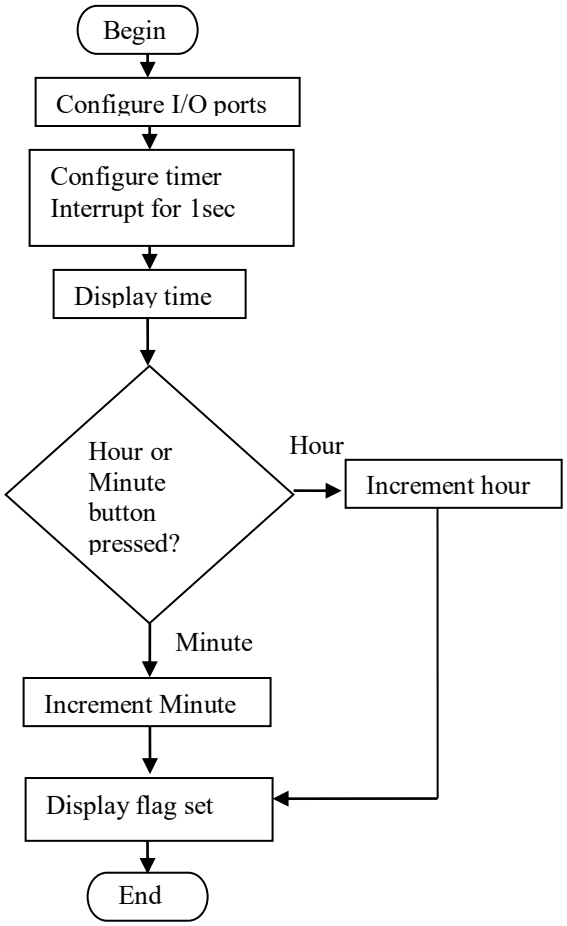

Figure 8. Flowchart of the Clock Processing

5.5. Experimental Result

When the power is connected to the circuit, the display system is 00:00:00 hour. It is stated the display system when the time adjustment switch is ON. Figure 9 shows Front View Photograph of Digital Clock.

Figure 9. Front View Photograph of Digital Clock

5.5.1. Advantages of Microcontroller-based Digital Clock

There are several advantages of microcontroller-based digital clock. They are as follows:

- The time is indicated by direct readout.
- It has become feasible only after the advent of the integrated circuits which reduced the complexities of the circuit involved.
- It has the higher accurate time than any other digital clock.
- It can operate continuously even if the Alternating Current (AC) power supply is cut become of backup battery [1].

6. Conclusion

Microcontrollers have become excellent tools for learning about electronics, digital interfacing and programming. They also provide the capabilities to fairly easily and inexpensively create sophisticated electronic applications that control real-world devices. PIC based control system is very effective although it is a very small size and less circuitry with higher techniques. This system gives the outputs of seconds, minutes and hours. In this display system, the output of PIC is connected with the input of decoder to drive 1line x16character LCD. Although the designed used for this system is quite a simple one, it is reliable and acceptable for some applications.

7. References

[1] Inoue, S. “Digital Clock”, PIC Circuit Gallery. October 2005.

[2] Julio Sanchez Maria, Microcontroller Programming, 2002.

[3] M. Bates “Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation, Second Edition”, Greated Britian, p-3, p-4, ISBN-10:0-7506-80288, 2006.

[4] Microchip Co, Ltd, PIC16F628 Data Sheet, Microchip Technology Incorporated, 2003.

[5] http:// en.wikipedia. org/ wiki/ Liquid-crystal-display.

[6] http://www.mikroelektronika.co.yu

[7] U Maung Maung Myat, 2001. Electronic Professional, Volume 2.

[8] Tyyer, S. B.1995. “ Programmable Digital Clock”, Electronic Project Volume 16.

[9] Iovine, J. 2002. PIC Microcontroller Project Book.Printed by Mc Graw-Hill.