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Research Paper

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Microcontroller Based Digital Clock Interfaced With Liquid Crystal Display

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***Abstract*—**Time is very important in every aspect of life. It is the quantity that measures the progressive existence of life and events. This paper presents a microcontroller PIC16F887 based digital clock which displays time progressively in real-time using liquid crystal display. To achieve the aim of this research, various relevant literatures were reviewed to note areas of advancement. It was found that liquid crystal display is the best component to display time. The constructed device is reliable and portable. It displays time accurately in numerical form on the 16*2 LCD. The portable clock makes use of the 24-hour timing format. This clock is monolingual as it uses English language only. The power supply is principally a 9V battery. This 9V is regulated by an integrated circuit LM7805, offering 5V to the microcontroller. The microcontroller is the central processing unit of this device. It is responsible for computations and logic manipulations to be displayed by the output LCD. The microcontroller was programmed using C language. C language is robust and powerful for operations and scientific applications. The designed clock was tested on Proteus software at simulation stage. The physical components were implemented on a breadboard to ascertain workability, and the design was implemented by soldering on vero-board as final construction. This digital clock is functional, portable and reliable. It is a viable solution to keeping record of time at every event or stage.

Keywords—Microcontroller, C language, Digital , Clock, Time, LCD, PIC16F887, Regulator, Battery

I. INTRODUCTION

A clock is an electronic device that keeps track and record of time to ensure events and programs are executed with proper documentation as to when they were carried out. In this modern age, electronic clocks have virtually replaced mechanical clocks that were used in the past. They are portable, highly efficient and durable. Majorly, two categories of electric clocks exist. Majorly, analog and digital clock exist [1].

Digital clocks are much available than their analog counterparts because they do not depend on any form of extrinsic source. Digital clocks read time in real-time using microcontrollers while analog clocks encounter challenges in presenting time records. Digital clocks dependent upon external sources of electricity often encounter failures when power outages occur. It is preferable to design clocks using batteries [2]

Digital clocks can be carried about easily due to their lightweight feature. Microcontrollers are integrated circuit components that act as central processors. The PIC is a special family of microcontrollers used for various engineering applications. Power electronics is the technology for converting, controlling and conditioning the flow of electrical energy from source to load based on load needs [3].

The clock presented in this paper is such that it presents its result on the screen of a 16*2 liquid crystal display for easy readability by the user.

This project aims to design and construct a microcontroller based digital clock interfacing with liquid crystal display.
Achieving this aim requires the following set of objectives;
i. To design a 24-hour mode microcontroller based digital clock interfacing with liquid crystal display.
ii. To construct the designed microcontroller based digital clock.
iii. To evaluate the performance of the designed and constructed digital clock.

Section I is the introduction to the paper, Section II is review of literature, section III contains the methodology supported with charts, Section IV presents results and explains the result and Section V concludes research with recommendations.

II. RELATED WORK

In order to ascertain current challenges, and identify areas of improvement in research related to the development of digital clocks, reviews are important. The review of literature done in this paper is for the purpose of understanding the motivation behind each work by previous researchers, areas of limitations and

recommendations for future advancement. The following reviews were carried out in order to improve on existing designs.

The research done in [2] is "Design of a digital clock based on microcontroller interfaced with 7-segment display". The central processing of this device is done by a microcontroller while the resulting input time from a keypad is displayed on the segment display after processing. The system is efficient but the need for an external decoder makes it very costly. It is not pocket friendly.

The work presented by [4] is titled "Design of a microcontroller based intelligent digital clock with timer". The system had complexity issues and it is not easily usable. In addition, it is relatively not portable and not easily carried around as desired. The system functions effectively as an event timer but has portability limitations. In [5], a segment display is used for presenting time but display was bottlenecked by several logic errors. These errors thereby reduce the reliability of the clock.

The design in [6] is a microcontroller based timer. It makes use of segment display showing numbers and characters in Bangla. The limitation is its complexity of usage. It is not easily used by speakers of English language.

In [7], the research carried out makes use of ATMega MCU. The developed clock operates in both 12-hour and 24-hour mode. It displays time on a liquid crystal display. The only significant limitations are the absence of time tracking mechanism or alarm system as well as portability.

III. METHODOLOGY

The method used is basically modular design. Various working units are connected to each other to form a complete system [8]. The design is presented by the block diagram in figure 1. The block diagram presents a regulated power supply which has a battery input of 9V and regulated by LM7805 to 5V for feeding the microcontroller. The buttons are connected to the MCU for time setting. The CPU is the microcontroller which does all computations and outputs the resulting accurate time on the liquid crystal display. Power supply and buttons are on input side, MCU is the processor while the LCD is the output device of this system.

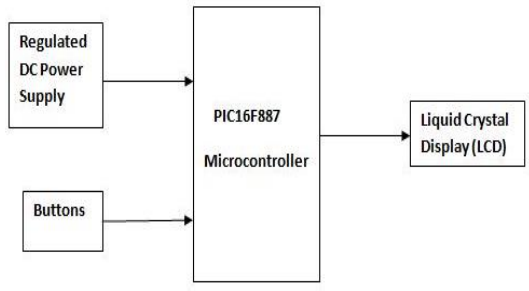

Figure 1: Block diagram of the MCU based digital clock

Flowcharts are usually presentations of how processes occur in a step by step mode. The flowchart of this device is as shown in figure 2. The flowchart presents the design such that when the entire system is put on, the LCD initializes and gets ready to be fed with information from the microcontroller. The buttons are pressed to input accurate time as required, the microcontroller computes input time setting. If the time is accurate, the microcontroller feeds the liquid crystal display with the information for display. On the other hand, if the time input is incorrect, the buttons are pressed again until accurate time is arrived at. This process is an intelligent decision making process controlled by the microcontroller. The microcontroller is programmed using C language. C language is a powerful programming language for coding microcontrollers. Microcontroller PIC16F887 is a special 40-pin member of the PIC microcontroller family. It has various engineering applications in electronics and communication, making it the most suitable for this research work.

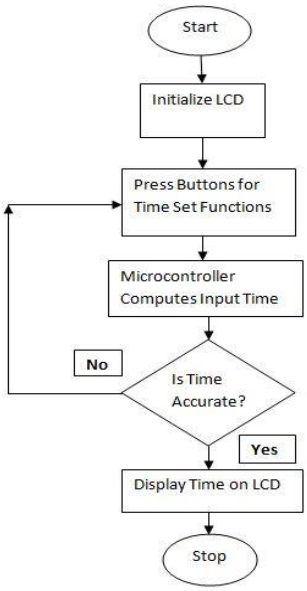

Figure 2: Flowchart of the MCU based digital clock

3.1 Materials

Software:

1. Proteus 8 software
2. Micro C pro

Hardware:

1. 9V battery with connector
2. Breadboard and Vero board
3. Lead
4. 7805 Voltage Regulator
5. One LCD 16*2 with Connector
6. One PIC16F887 Microcontroller
7. Five 10k Resistors
8. Two Ceramic Capacitors 22pF
9. One 4MHz Crystal Oscillator
10. Jumper Wires
11. 5 Buttons
12. 20k Variable Resistor

13. One 22uF electrolytic capacitor
14. PIC kit3 programmer
15. Personal Computer
16. Soldering bit and flux

PIC16F887 microcontroller is the central processing unit. It has 40 pins with 5 different ports named ports A, B, C, D and E respectively. With Vcc and GND pins which are special purpose pins. The datasheet is shown in figure 3.

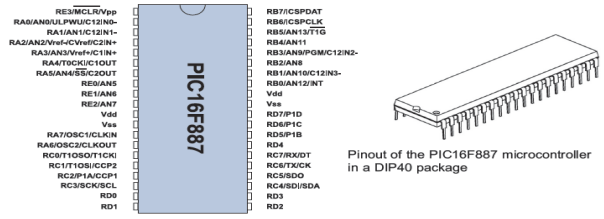

Figure 3: PIC16F887 microcontroller datasheet

The source code in C language is built into the microcontroller using PIC kit3 hardware through the micro C pro software. The entire circuit is designed and simulated on the ISIS environment of Proteus 8 software. The complete circuit is presented in figure 4.

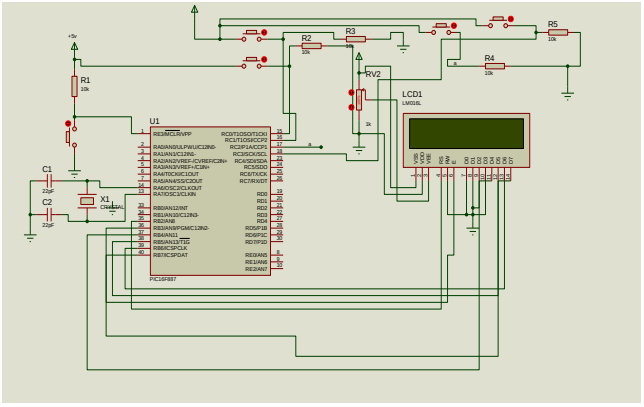

Figure 4: Circuit diagram of the digital clock

IV. RESULTS AND DISCUSSION

The various components were connected on a breadboard after successful simulation on Proteus 8 software. The simulation showed that the clock displays in the format; 00:00:00 which represents hour : minute : second. The implementation on breadboard gave a positive response after the LCD initialization process. The initialization of the liquid crystal display connected to the microcontroller on breadboard is shown in figure 5.

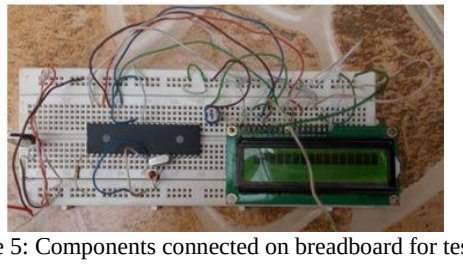

Figure 5: Components connected on breadboard for testing

The fully tested design on breadboard has been implemented by soldering the components on a circuit board. The soldering process was done in the laboratory with the aid of soldering bit, lead, veroboard, components and a working platform. The digital clock in its full operational 24-hour mode is presented in figure 6. It is clearly a portable device which reads “Time is 00:00:00” at initialization stage.

Figure 6: Soldered digital clock for final packaging

DISCUSSION

The major achievement of this work over the reviewed works is its high level efficiency. It also has proven to have the best operational mode which is the 24-hour mode. The time of the day is direct and does not require any extra interpretation. It has optimum size. It is a portable digital clock. The use of 9v battery makes it highly dependable as power outage does not arise at all. This is an economically viable solution to keeping track of time and can be used on the go by anyone.

The digital clock’s program code is in C language. The debugging process of the program code on the micro C pro for PIC software showed that the code was successfully compiled. The .hex file of the code after being loaded unto the PIC16F887 MCU at 4MHz oscillator frequency, ran, displaying “ TIME IS 00:00:00 ” and was incrementing the seconds and correspondingly minutes and hour as required and as the program has instructed it to do. The job of the buttons is to reset the time. First 00 represents hour, second 00 represents minutes and the last 00 represents seconds. Both seconds and hour are limited to 60 units while hour is based on a day’s 24-hour system.

PIC16F887 has 40pins among which are very special pins. RA3 is the digital input/output port A, AN3 is analog-digital channel 3, VREF+ is AD positive-voltage ref input, C1-IN+ is comparator 1, RA 7 is digital-input/output port A, OSC 1 is input1 for oscillator, CLKIN is the clock input, RB6 is I/O port B, ICSPCLK is for serial clock, MCLR is reset, RE3 is I/O for port E and VPP is MCU programming voltage.

Advantages of the device

1. It is very affordable
2. The clock is quite portable
3. Usability is easy
4. It is highly efficient

V. CONCLUSION AND FUTURE SCOPE

A cheap, portable and highly efficient PIC16F887 microcontroller based digital electronic clock has been proposed, implemented to display time in the 24-hour format. First set of digits represent hour, second set represent minutes while the third set represent seconds. It has been evaluated to be a very intelligent system with high durability and reliability.

The recommendation for future improvement is that, the clock should the integrated with an alarm system to help keep track of time for special events of interest. This can be done by redesigning to accommodate a buzzer.

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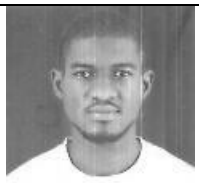
AUTHORS PROFILE



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