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Arduino Digital Clock without RTC Module

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Abstract: ***This paper analyzes a clock using Arduino without Real time clock (RTC). The development of the digital clock in Arduino is to provide its own time without RTC. Generally, electronic circuit designers use RTC to construct a clock. Such a circuit requires an extra circuit and power. The CMOS battery supplies power to the RTC, once the CMOS battery power is discharged. It automatically erases the date and time and requires an update from an external device. Considering these facts, RTC is avoided and code with nested looping is used to maintain timing in Arduino. It enables us to modify the time using a keypad and LCD without an external device. Continuous power is supplied to the Arduino using a battery backup. Such a circuit is simple with reduced code. All features available in RTC are available in this circuit.***
Keywords: Arduino Atmega 328P, RTC, LCD16 x 2, Keypad 4x3.

I. INTRODUCTION

This paper aims at designing a digital clock on the Arduino platform without traditional RTC. Arduino is an open-source programmable single board computer. It is a very easy-to-use, powerful and has high applications in the hobby and professional market. Arduino board consists of Integrated Development Environment (IDE) where programs can be written and executed, and these programs are known as a sketch in Arduino.

This circuit is useful in automatic street lights, alarm systems, time maintenance systems, etc. The clock works in 24-hour mode and is configured by programming the Arduino (Atmel ATmega328) microcontroller [1]. By using traditional RTC to provide a time system to a Arduino will make the device bigger [2]. When CMOS battery power is discharged, it automatically erases the time present in the RTC and needs an update through the external device. So, a dedicated code is written for the Arduino to provide its own time. This system incorporates code, which is more accurate than the RTC module [3]. To display the time, an LCD of size 16 x 2 is interfaced with Arduino.

The majority of digital clocks make use of electronic mechanisms and LCD, LED, or VFD displays. The digital clock is easier to know the time because a layman with knowledge of numeric can read the digital clock. The Arduino outputs either 5 V or 3.3 V so the LCD is powered by wiring VSS to the ground and VDD to the 5 V pins on the Arduino [4]. A lithium battery is used to supply the power to the Arduino [5]. When external power is disrupted to the Arduino, the battery connected to the Arduino continuously supplies power to the Arduino.

So, time is maintained without any interruption. In rare circumstances, if battery power also goes off the time value is reset [10]. This circuit enables to renter the time value using a keypad and display. The keypad is the prototype's input device for entering values to update the time. The 4 x 4 keypad is made up of switches that are later assembled on a PCB. To change the time, use the numeric keys on the keypad. This aids in manually setting and editing the time [6].

II. LITERATURE SURVEY

N.A.M. Alias, et al. [2] [3] highlights that RTC to provide a time and date system to a microcontroller will make the device bigger and other Project Guidance at Arduino Forum suggested that the RTC Module loses time tracking after power is disconnected and it is not possible to update the time using a keypad.

Kambhampati Sai Sandilya, et al. [6] highlights that the clock comes with an external alphanumeric keypad to give the time and text input. Other components used are LCD, DS1307 RTC timer, and alarm (buzzer). Sitaraa Kumar, et al. [7] highlights that the primary use of reminders in alarm clock is to set up meetings, appointments, tasks that use Arduino Uno. Tony DiCola et al. [9] highlights that the Setup for Meetings, Appointments, Reminders, and Tasks, this clock uses an Arduino Uno and Google Calendar to automatically set alarms. Author Kuldeep Singh Kaswan et al. [15] highlights that Arduino boards are playing very important roles in many disciplines today. Various Application areas of Arduino are discussed.

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III. METHODOLOGY

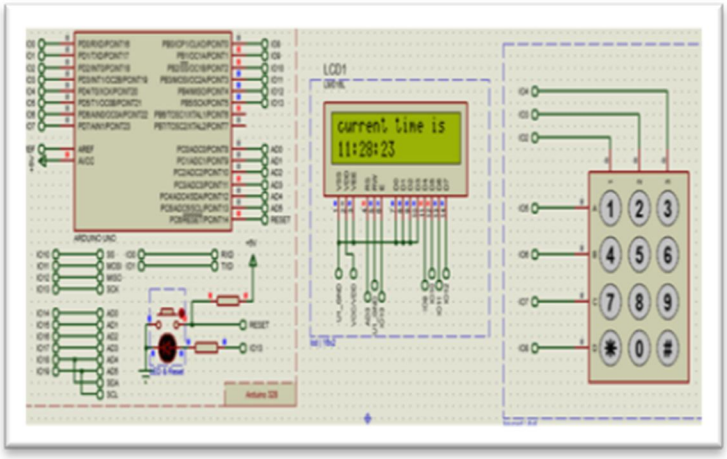


Fig. 1: Basic circuit constructed in proteus

Fig.1 shows, the basic circuit constructed in proteus. Arduino UNO interfaced with 16 x 2 LCD and 4 x 3 keypad.4x3 Keypad connections are done by connecting Keypad columns 1, 2, 3 to Arduino Uno pin 2, 3, 4 respectively. And Keypad row 1, 2, 3, 4 is connected to Arduino Uno pin 5, 6, 7, 8 respectively. Further, 16 x 4 LCD Connections are made by connecting LCD 16 x 2 DB0, DB1, DB2, DB3, to Arduino Uno pin GND. And LCD 16 x 2 DB4, DB5, DB6, DB7 to Arduino Uno pin 9, 10, 11, 12 respectively. LCD 16 x 2 E to Arduino Uno pin 13, LCD 16 x 2 RS to Arduino Uno pin A3, LCD 16 x 2 RW to Arduino Uno GND, LCD 16 x 2 VDD to Arduino Uno VDD LCD 16 x 2 VSS, VEE to Arduino Uno GND.

The 24-hour digital clock is programmed by the ARDUINO (Atmel ATmega328P) microcontroller. The main function of the clock is to display time using Arduino Uno microcontroller. The clock's hardware part requires LCD Display and 4 x 3 Key Pad to interface with Arduino. The program is burned in ROM present in Arduino, then LCD Displays "SET TIME". Time is set through a 4 x 3 keypad, in the format Second: Minute: Hours. This value is stored in Arduino RAM until power disruption. When power is disrupted to the Arduino, the battery connected to the Arduino continuously supplies power to the Arduino. So, time is maintained without any interruption. In rare circumstances, if battery power also goes off the time value is reset. This circuit enables the renter of the time value using a keypad and display.

A. Block Diagram

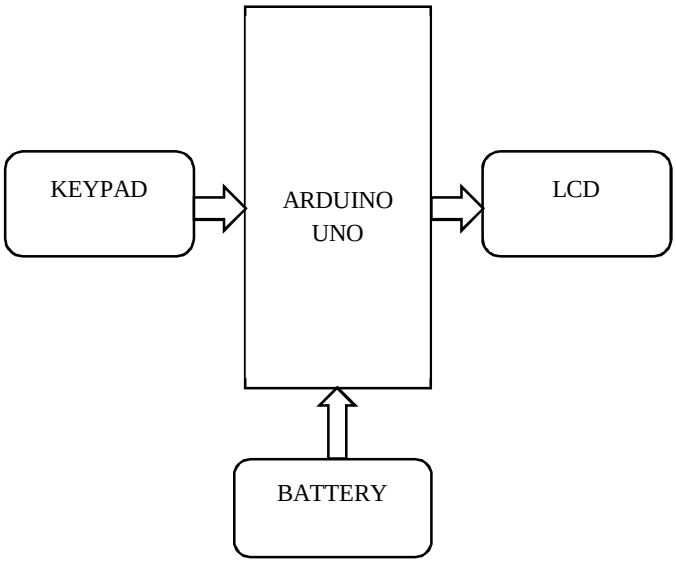


Fig 2: Block diagram of Circuit

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Fig 2 shows the block diagram of the circuit. It explains all the components present in the circuit and describes the way the components of the circuit are interconnected to the Arduino. The 4 x 3 keypad is an input device interfaced with the Arduino. And 16 x 2 LCD is an output device interfaced with the Arduino. The secondary battery, Lithium-Ion is interfaced with Arduino. The keypad enables to provide initial time and also helps in setting and changing the time. The time entered through the keypad is stored in Arduino RAM, the program stored in ROM updates this time regularly. This way the Arduino maintains the digital clock without RTC. The 16 x 2 LCD displays the current time and also displays appropriate messages to the user to update the time.

B. Components Used

1) *Arduino Uno:* Arduino is a microcontroller board based on the ATmega328P that is open source. It is a platform that enables to construct and program electronics devices. Arduino can receive and transform information to electronic devices. It comprises two parts namely hardware and software. The hardware is known as Arduino Uno circuit board and software is used to program the board. The program is generally developed using Simplified C++ language. The main advantage of Arduino is user friendly; the program can be directly loaded into the device without the need of a hardware programmer to burn the program. Arduino Uno has 14 digital I/O pins (six of which can be used as PWM outputs), six analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button [11]. Arduino microcontroller can be connected to computer with a USB cable. It may power with AC-to-DC adapter or with a battery. Arduino Uno is used to control the functions of the clock. Further it is ready to support any type of devices [12].
2) *16 x 2 LCD:* Liquid-Crystal Display (LCD) uses the light-modulating properties of liquid crystals. The liquid crystals are combined with polarizers that use reflectors to produce images in monochrome or color. LCD is available in flat-panel display used in most embedded projects, because of their low price, availability, and programmer-friendly. Most commonly used LCD is 16 x 2, that contains 16 Columns and 2 Rows. Such display panel have (16 x 2=32) 32 characters in total and each character will be made of 5 x 8 Pixel Dots. The 16 x 2 intelligent alphanumeric dot matrix displays can show 224 different characters and symbols. LCD is used to display the current time and other display purposes [8].
3) *4 x 3 Keypad:* Keypad is a mostly widely used input unit used to transfer information to the system. In this circuit the keypad helps to enter and update time manually. The 4 x 3 keypad has combination of switches; each key occupies one digital pin of the Arduino. The keypad is housed with numerical and with two special characters * and #. Such keypad is later fabricated on a PCB. Keypads are organized in matrix form of rows and columns. By using a 4 x 3 keypad it reduces occupied pins. With this module, all 12 switches are used by occupying only 7 pins of the microcontroller. When a key is pressed, a row and column make contact, and Arduino handles the keyboard's hardware and software interfacing. The program present in the ROM scans the key pressed identifies it and sends the scan code to the appropriate circuit.
4) *Secondary Batteries:* Secondary batteries are also called as rechargeable batteries. Secondary batteries consist one or more electromechanical cells. They are used to power up the electronic devices. Such batteries convert chemical energy to electrical energy. Rechargeable batteries must be charged before first use. Secondary batteries are available in many different sizes and configurations. The secondary batteries that are most likely to be used with Arduino-based systems are Lithium-Ion, Lithium Polymer, Nickel Metal Hydride, and sealed lead-acid batteries. Batteries are used to keep the timing [14].
5) *Simulators:* Proteus 8.10 is software used to design Printed Circuit Board PCB prototype. In this virtual prototype system enables system testing. The prototype can make perfect simulation of the circuit without any errors. Proteus simulator can construct the circuit without electronic components bread boards and wires. This prototype helps to identify the output of the circuit without its physical existence [13].

C. Working Principle

Initially, the current time value is inputted through a keypad. This value is displayed on the LCD screen. The second value is incremented by one; when it reaches 60, the minute is updated by one, and the second is reset. This process continues until the minute reaches 60. When the minute value reaches 60, the hour is updated by one, and the minute and second are reset to zero. Once the hour value reaches 24, the hour value is reset to 00. The process of updating seconds, minutes, and hours is continued as mentioned above. The above operation is repeated infinitely. In certain circumstances like battery failure, the time is to be inputted through Keypad. The program displays appropriate messages to help the user to enter the time value. Once the time value is entered, the program maintains and updates this time successfully.

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D. Flow Diagram

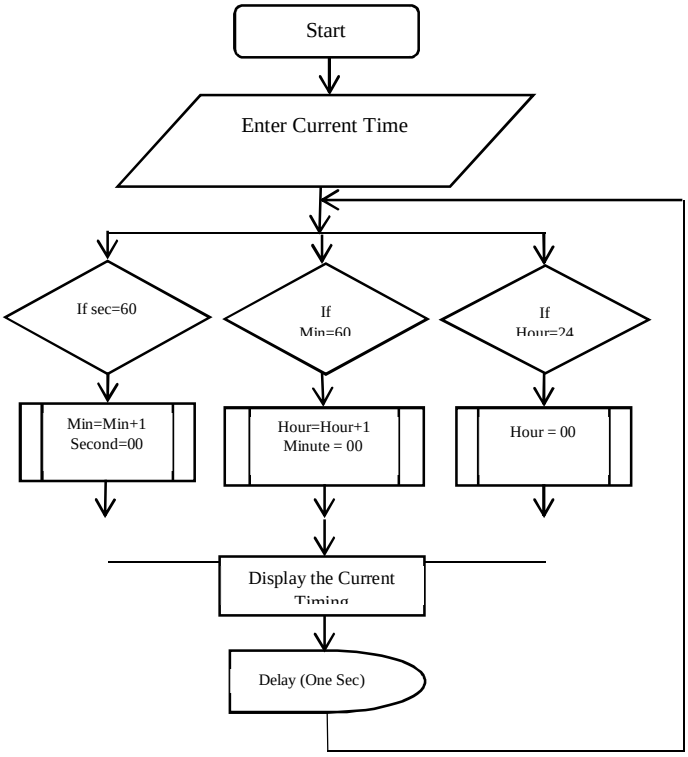


Fig 3: Flowchart of working of the circuit

IV. RESULTS

The primary requirement is a clock without RTC. The time is displayed on the LCD screen. It enables to modify the time without external devices. It displays the time that can be used for various applications like automatic street light control and traffic light control. The time displayed on the screen gives a quick insight into real-world happenings.

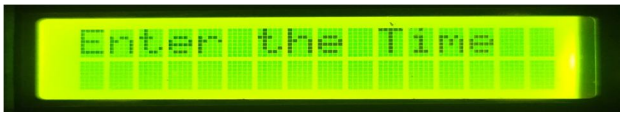


Fig 4: LCD display



Fig 4: Output

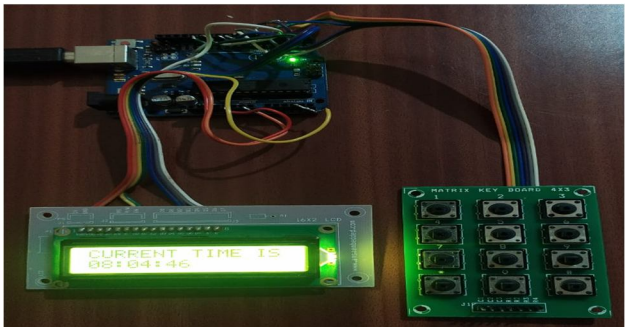


Fig 4: Circuit

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V. CONCLUSION

This paper describes the design and implementation of an Arduino Uno-based digital clock. The product is simple, small in size, consumes less power (no CMOS battery is required), and allows to change the timings without using any external devices. Future research could include the addition of appropriate circuits such as automatic street light controllers that use timing and traffic light controllers.

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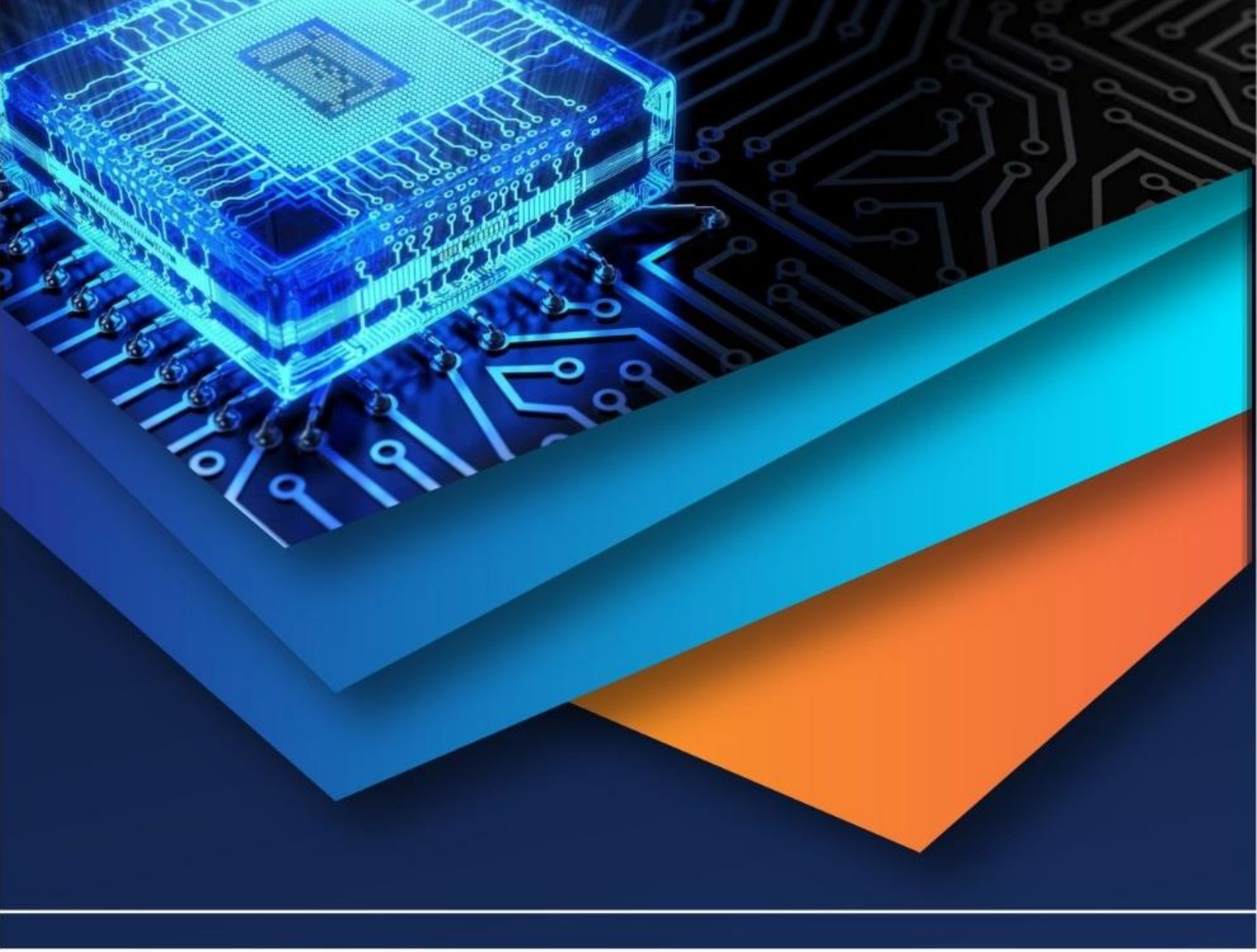
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