Arduino UNO based real time clock with Temperature and Humidity Sensing Circuit

Thu Zar Tin*, Kyi Kyi Aung**, Khin Myo Chit***, Me Me Soe****

Abstract

The purpose of the present research is to construct a kind of real time based clock with temperature and humidity sensing circuit. It is intended to use as a desktop appliance. The system design consists of Arduino UNO, DS 1307 real time clock module, input switches, DHT 11 temperature and humidity sensor and a 16 characters 2 lines LCD display. The goal of the circuit is to display a current, date and time, temperature and humidity of surrounding condition.

Key words: real time based clock, temperature and humidity sensor, Arduino UNO, LCD display

Introduction

A real time clock (RTC) is a battery powered clock that measures time even when there is no external power or the microcontroller is reprogrammed by using Arduino. Arduino based real time clock is a digital clock to display real time using a RTC IC DS 1307 which works on I2C protocol. In this circuit we have used a 16×2 LCD module to display the time in (hours, minutes, seconds, dates, months and years) format. Real time clock is commonly used in our computers, houses, offices and electronics device for keeping them update with real time. It is not only a real time clock but also a temperature and humidity sensing circuit. The temperature and humidity are major concern as global warming. In this circuit, the weather data measuring system is designed to investigate temperature and humidity intensities. The measurement values are also displayed on LCD. The basic structure of the system is illustrated with a block diagram in figure 1.

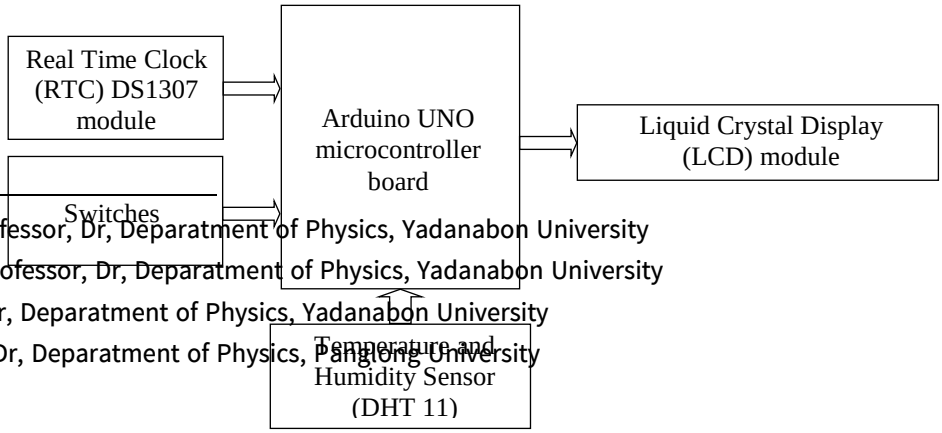

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Figure 1. Block diagram of real time clock with temperature and humidity sensing circuit

Theoretical Background of Arduino UNO and Electronic Devices

Arduino UNO

An Arduino is a tiny computer that can be programmed to process inputs and outputs going to and from the chip. The Arduino UNO is a microcontroller board based on the ATmega 328. Typically includes power LED, USB and DC power jacks, 14 digital input/output pins, 6 analog inputs and resettable fuse. Simply connect it to a computer with a USB cable or power it with a AC to DC adapter or battery. The components of Arduino UNO board are shown in figure 2. There are several types of Arduino; e.g. Arduino, Arduino Leonardo, Arduino Mega 2560, Arduino Mini, etc. The board can operate on an external supply of 7V to 12V. Arduino can be used for input or output. Each pin can give or receive approximately 40 mA of current. There are 6 analog input pins or ports, labeled A0 through A5.

ATmega 328 Microcontroller IC

A microcontroller is a tiny computer that contains a processor executing instructions and various types of memory to hold data and instructions from sketch and various ways to send and receive data. The microcontroller is the brain of breadboard Arduino. The ATmega 328 microcontroller IC is shown in figure 3.

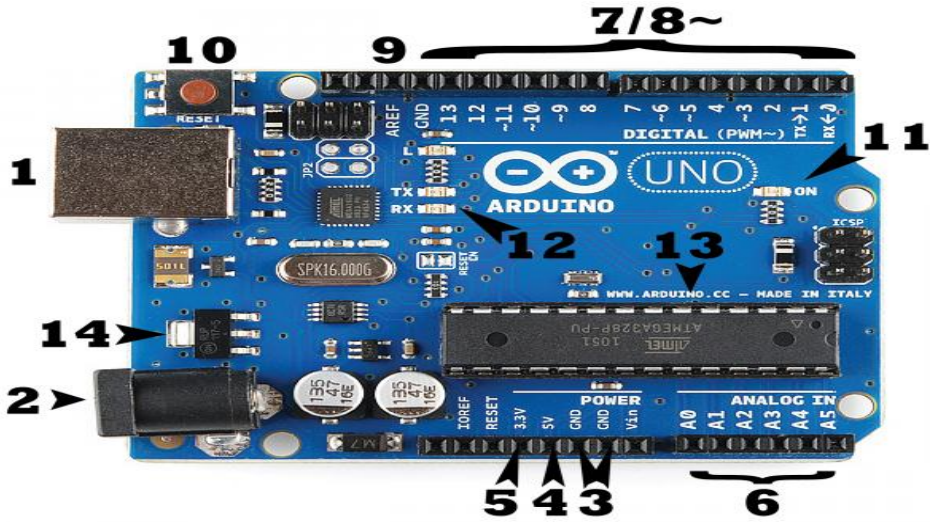

Figure 2. Components of Arduino UNO

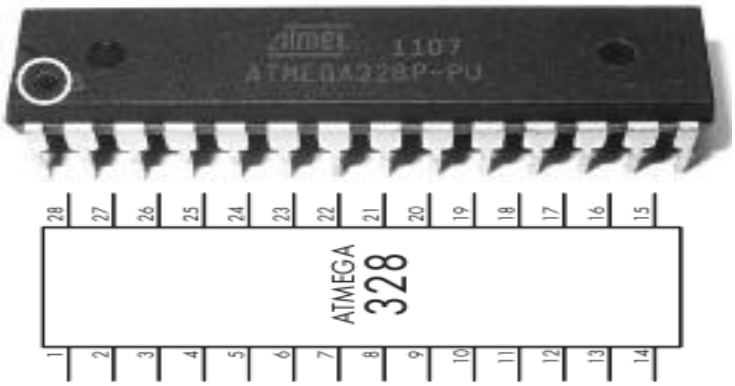

Figure 3. ATmega 328 microcontroller IC

Liquid Crystal Display (LCD) Module

Liquid crystal display (LCD) screen is an electronic display module and a wide range of applications. A 16×2 LCD display is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. LCD is easily programmable, has no limitation of displaying special and even custom characters (unlike in seven segments), animations and so on. A 16×2 LCD means that it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5×7 pixel matrix. This LCD has two registers, namely, command and data. Pins diagram of 16×2 LCD are shown in figure 4.

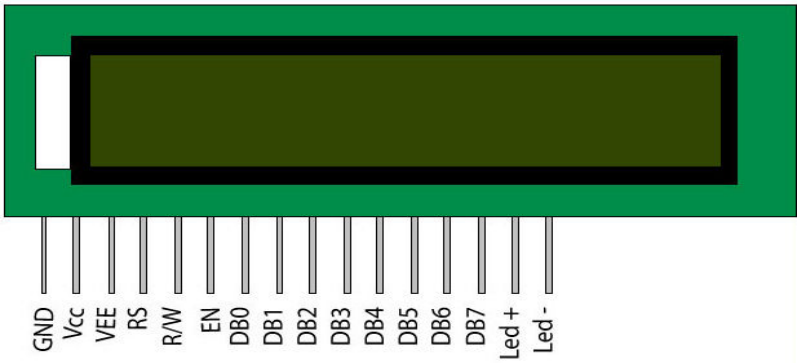

Figure 4. Pins diagram of 16×2 line LCD display

RTC (Real Time Clock) DS1307 Module

The DS1307 module is made up of the DS1307 chip which is a cheap and accurate RTC chip capable of storing time and data information for years after being set as long as the chip keeps getting power from and attached coin cell battery. The module even automatically makes variations the leap years in its memory once it is set. It works with either 5V or 3.3V voltage level and can be used. The RTC can program square wave output signal. It is automatic power–fail detect and switch circuitry. Real time clock can count seconds, minutes, hours, date of the month, month day of the week and year with leap–year. The DS1307 module includes several components such as power circuits, oscillator circuits, logic controller and I2C interface circuit and the address pointer register. The real time clock DS1307 module and pins description of DS1307 are shown in figure 5 and 6.

Figure 5. Real Time Clock (RTC) DS1307 module

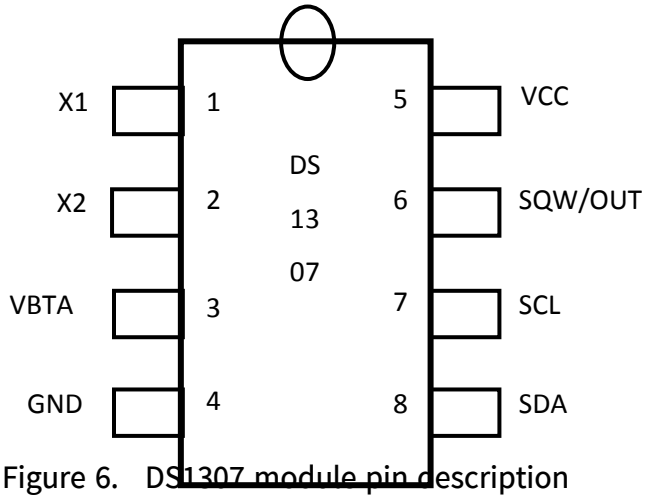

Figure 6. DS1307 module pin description

DHT11 Temperature and Humidity Sensor

The DHT11 is a very affordable digital temperature and humidity sensor. The timing of the reading is crucial as it is a advisable to take reading every two seconds. DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure surrounding air and spits out a digital signal on the data pin.

The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 95% with and accuracy of ±2 °C and ± 5%. The component is 4-pins signal row pin package. The DHT11 temperature and humidity sensor make it really easy to add temperature and humidity data. It is perfect for remote weather stations, home environmental control system and garden monitoring system. Pins description of DHT11 temperature and humidity sensor are shown in figure 7.

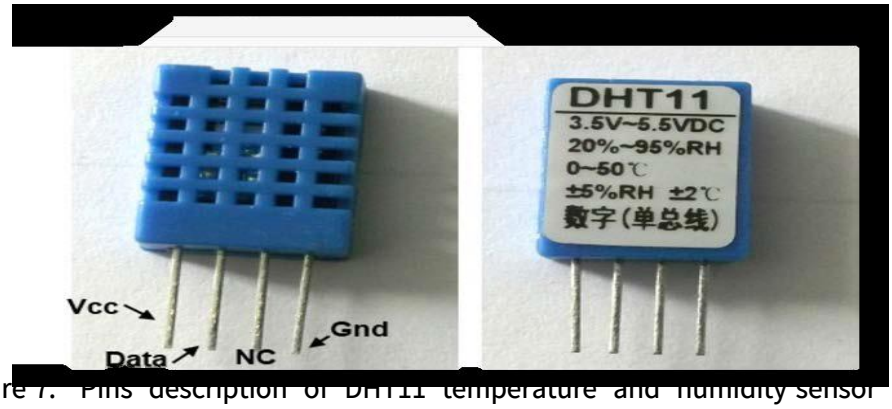

Figure 7. Pins description of DHT11 temperature and humidity sensor

Operation of the Circuit

The first step to operate the circuit is the programming Arduino UNO microcontroller board. Then the constructed circuit board was connected with the computer by using USB cable. The code is uploaded into the program memory of ATmega 328 on Arduino UNO development board. The program loading is completed successfully, the microcontroller development board resets itself for first time running the program. Then the microcontroller checks the input pins to read the values for DS1307 module and DHT11 module.

In this circuit DS1307 was programming with current date and time and it keeps the data even if the power supply to Arduino is removed. In real time clock I2C interface, the Arduino microcontroller acts as master and the DS1307 acts as slave. DHT 11, is a one wire serial output device. There is no need to calculate the temperature and humidity values.

The transmitted data are illustrated on the LCD display as degree centigrade and relative humidity in percentage respectively. Three buttons namely set, INC and DEC are used for setting, increasing and decreasing the time. The circuit diagram of RTC with temperature and humidity sensing on Proteus software is shown in figure 8.

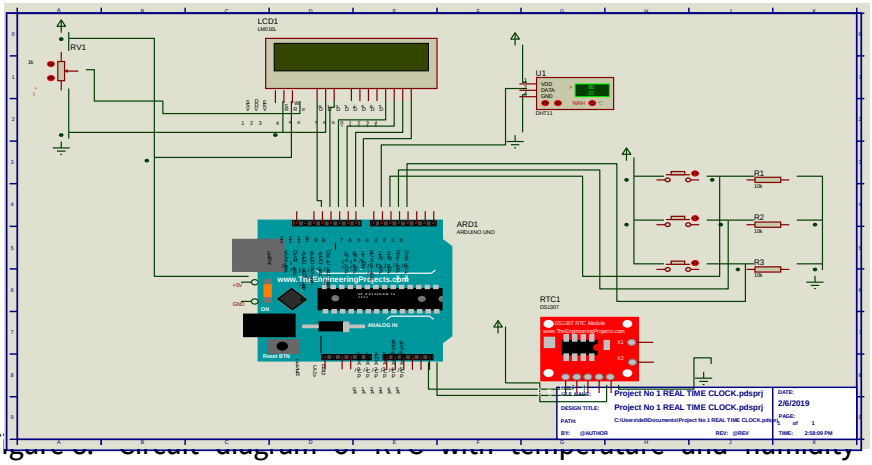

Figure 8. Circuit diagram of RTC with temperature and humidity sensing on Proteus software

Conclusion

Real time programming using I2C protocol with RTC was successfully implemented, and it helps to maintain real time clock necessary for various real time running systems. This circuit describes hardware design and implementation of low–cost smart clock based on Arduino. Arduino is used for reading from DS1307 and DHT11 then display it on 16 × 2 LCD. DS1307 sends time/date using 2 lines to Arduino. The advantages of these RTC circuit are high accuracy at a relatively low cost price and the external supply of batteries to store the current time even after disconnecting or main power failure. For connecting module to Arduino is also used I2C bus. For sensing the temperature in the room was used DHT11 sensor which has a range 3.5V to 5.5V of input voltage and it uses 5V TTL over only one wire. The sensor is accurate and the accuracy of measuring the humidity is 2% – 5%. The sensor has a maximum power consumption of 1.5 mA during measurement and it is able to measure and differentiate the value every two seconds. The photograph of real time with temperature and humidity sensing circuit operation are shown in figure 9. Therefore, it is an essential household appliance. It can be developed to control other real time based operating systems such as regular warming the rice cooker, filling the water tank, checking the mail box and so on.

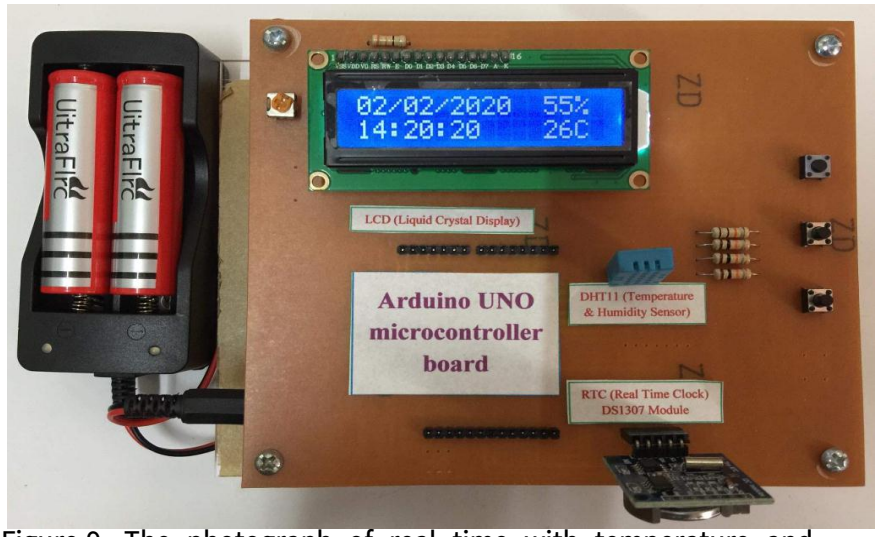

Figure 9. The photograph of real time with temperature and Humidity sensing circuit operation

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