

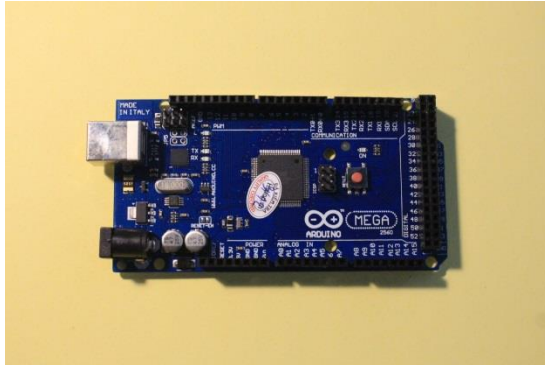
DIGITAL LOGIC DESIGN LABORATORY REPORT

Project Name	Mini Project 1
Description	Design and implement the digital clock combining thermometer by using Arduino , LCD display and IC DS3231
Author(ID)	Tran Duy Bao (ITITI15076)
Date	12-12-2016

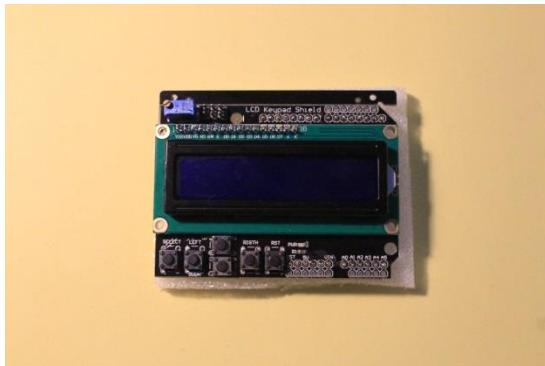
1. Device and operations

a) Devices :

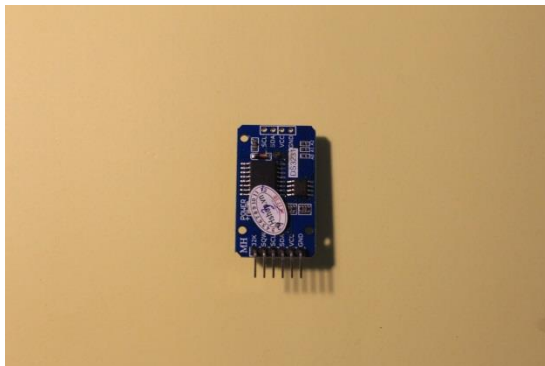
- **Arduino Mega2560 R3**



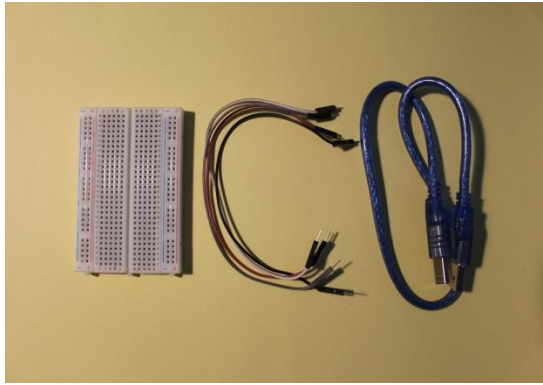
- **LCD 1602 Keypad Shield**



- **IC RTC DS3231**

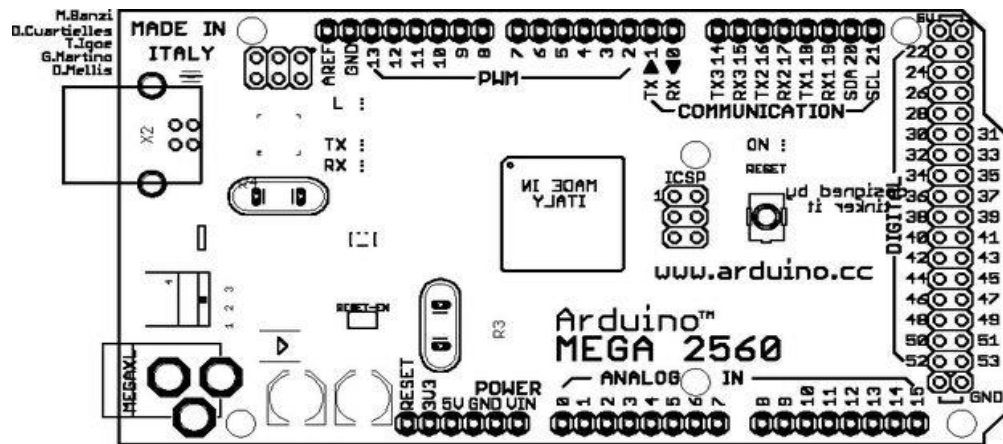


- **Others : test board, wires, USB-B cable**



b) Operator :

- **Arduino Mega2560 R3 :**



5V **8-bits** **16 Mhz** **AVR**

- The Mega 2560 is a microcontroller board based on the **ATmega2560** . Its specification :
 - + 54 digital input/output pins (of which 15 can be used as PWM outputs).
 - + 16 analog inputs.
 - + 4 UARTs (hardware serial ports).
 - + 5 GND ports, 3 5V ports and a 3.3V port.
 - + A 16 MHz crystal oscillator.
 - + An USB connection.
 - + A power jack.
 - + An ICSP header.
 - + A reset button.

- The LCD 1602 Keypad Shield is developed for Arduino compatible boards. It includes a 2x16 white character blue backlight LCD and 6 momentary push buttons. Pins 4, 5, 6, 7, 8, 9 and 10 are used to interface with the LCD. Analog Pin 0 is used to read the pushbuttons. The LCD shield supports contrast adjustment and backlit on/off functions. It also expands analog pins for easy analog sensor reading and display.

- Specification:

+ Operating voltage : 5V.

+ 5 Push buttons to supply a custom menu control panel.

+ RST button for resetting arduino program.

+ Integrate a potentiometer for adjusting the backlight.

+ Pin used:

D4 to D7 : LCD Data transmission.

D8 : Register select.

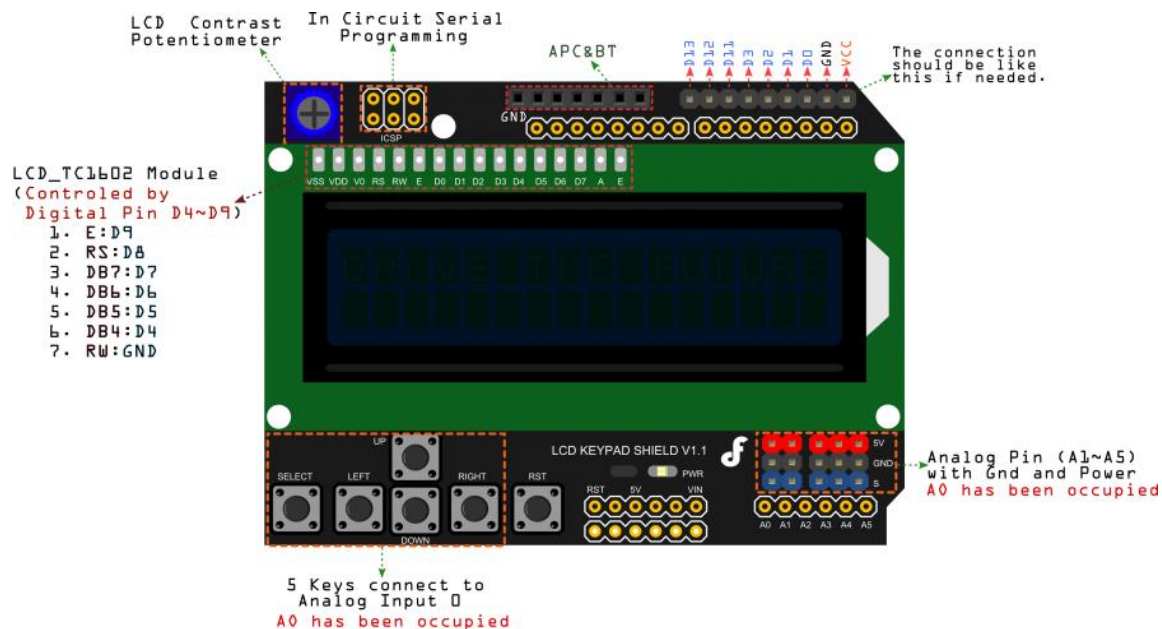
D9 : Enable pin.

D10 : Backlight control.

+ Expanded available I/O pins.

+ Expanded Analog Pinout.

+ Dimension: 80 x 58 mm.

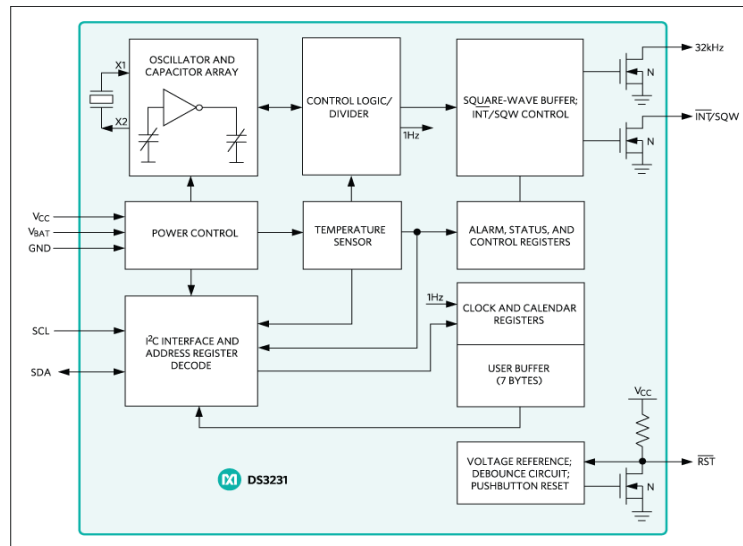


LCD 1602 Keypad Shield pinout diagram

- I²C RTC(Real-time clock) DS3231:



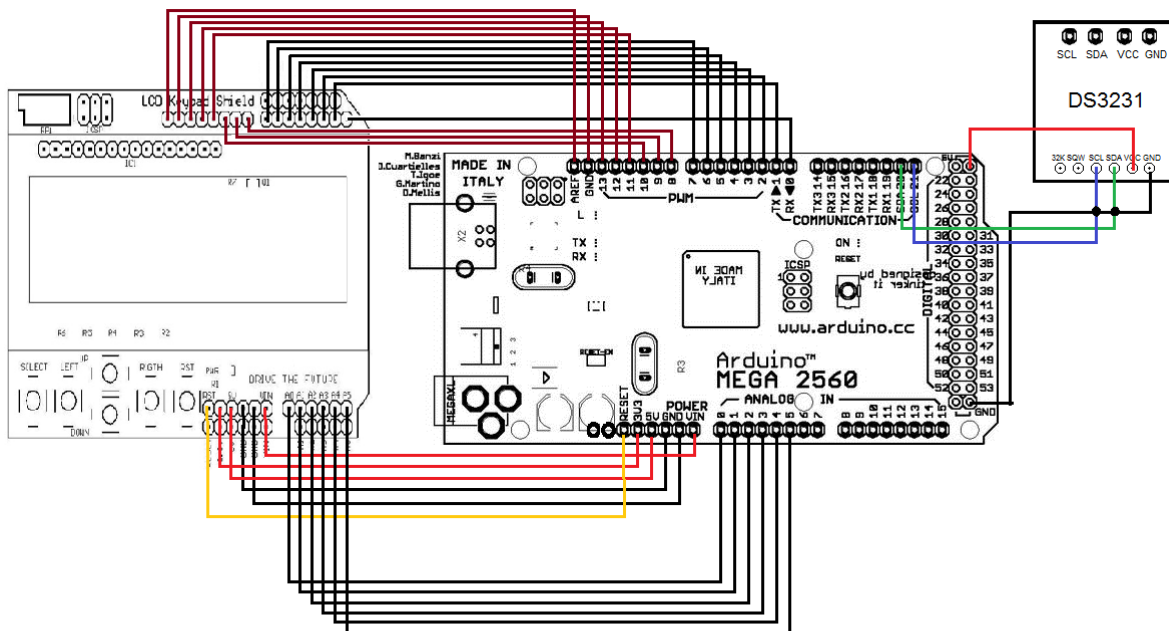
- In general, The DS3231 is a low-cost, extremely accurate I2C real-time clock (RTC) with an integrated temperature compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted.
- Specification :
 - + Real-Time Clock Counts Seconds, Minutes, Hours, Date of the Month, Month, Day of the Week, and Year, with Leap-Year Compensation Valid Up to 2100.
 - + Operating voltage : 3.3 – 5V.
 - + Accuracy $\pm 2\text{ppm}$ from 0°C – $+40^{\circ}\text{C}$.
 - + Accuracy $\pm 3.5\text{ppm}$ from -40°C – $+85^{\circ}\text{C}$.
 - + Digital Temp Sensor Output : $\pm 3^{\circ}\text{C}$ Accuracy.
 - + Two-time of Day Alarms (not available in this project).
 - + Dimension: 38 x 22 mm.



DS3231 Block Diagram

- You can find out more about DS3231 Datasheet at :
<https://datasheets.maximintegrated.com/en/ds/DS3231.pdf> .

2. Schematic



Mini Project Schematic

- This project need a 5V power supply in other to work. You can use power jack or usb-b jack connect to Arduino.

3. Function explanation

a) LCD display.

- **LiquidCrystal(rs, enable, d4, d5, d6, d7)**

Creates a variable of type LiquidCrystal. The display can be controlled using 4 or 8 data lines. If the former, omit the pin numbers for d0 to d3 and leave those lines unconnected. The RW pin can be tied to ground instead of connected to a pin on the Arduino; if so, omit it from this function's parameters. for example:

```
LiquidCrystal lcd(8, 9, 4, 5, 6, 7);  
// LCD RS pin to digital pin 8  
// LCD Enable pin to digital pin 9  
// LCD D4 pin to digital pin 4  
// LCD D5 pin to digital pin 5  
// LCD D6 pin to digital pin 6  
// LCD D7 pin to digital pin 7
```

- **lcd.begin(cols, rows)**

Initializes the interface to the LCD screen, and specifies the dimensions (width and height) of the display. begin() needs to be called before any other LCD library commands. for example:

```
lcd.begin(16, 2);
```

- **lcd.setCursor(col,row)**

Set the location at which subsequent text written to the LCD will be displayed. for example:

```
lcd.setCursor(0,0);
```

- **lcd.print(data)**

Prints text to the LCD. for example:

```
lcd.print("Welcome to my MP");
```

- **Serial.begin()**

Initialize the serial communications, for example:

```
Serial.begin(9600);
```

b) DS 3231

- **Get time**

Get the real time of the I²C, for example:

```
DS3231_get (&t);
```

- **Get temperature**

Get the temperature of the I²C, for example :

```
float temp;  
temp = DS3231_get_treg();
```

4. Tasks of mini project.

1

- Prepare devices

2

- Build the circuit base on the Schematic

3

- Build and implement the code

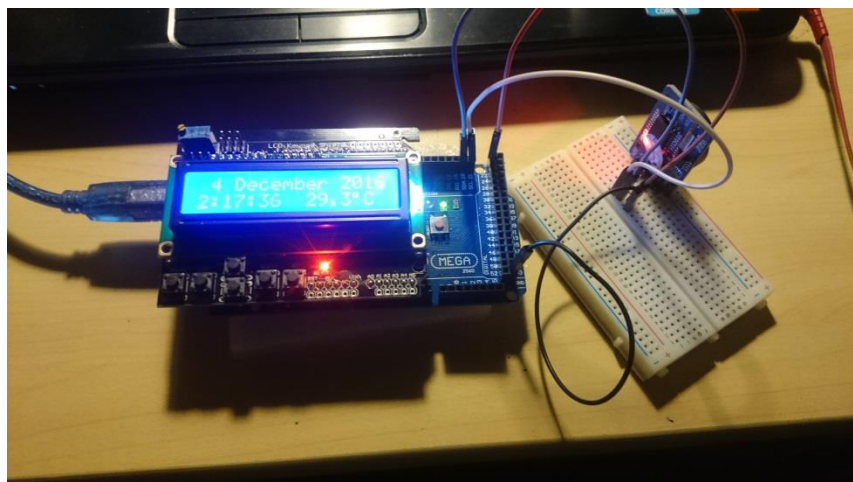
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- Upload the code to device

Download the project full code :

https://drive.google.com/open?id=0B6b_RfOtAEzkYVlyTVlUYUVvclk

- After finishing these steps , the project is also finished.



The Mini Project