Project Report 2

Citizen Safety Device

Group 37

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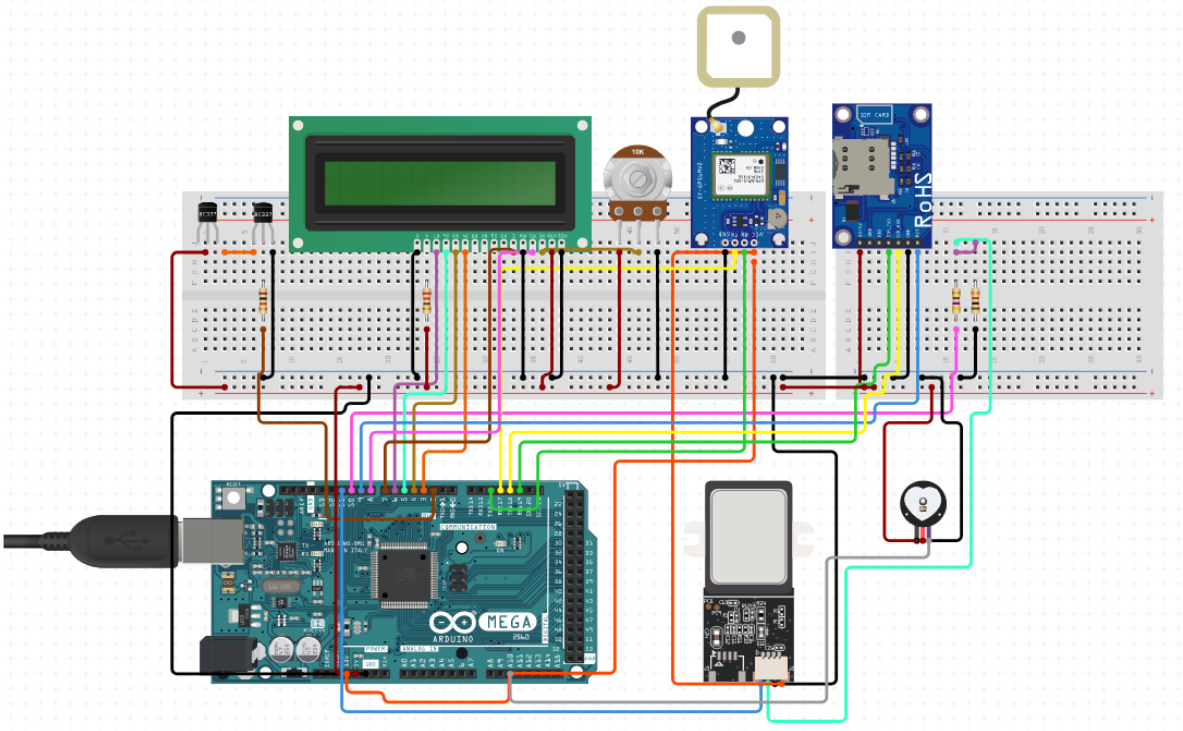
CHAPTER : 4

Circuit Diagram



- Fingerprint Scanner - TTL (GT-511C3) will read and identify fingerprints using an on-board optical sensor and CPU. When the system is activated, it will take constant input from the user's finger pressing on it.
- Heart Rate Pulse Sensor will measure heart bpm. This again will be a constant input taken from the user when the system is active.
- LCD 16x2 will be used to display intermediate messages and help with set up and status.
- Buzzer will ring and raise alarm as an output when danger is detected (heart bpm exceeds threshold or fingerprint input is not detected.)
- Ublox NEO-6M GPS Module retrieves the user' location and provides the current time and date. Output of this module will be extracted when danger is detected and alert is to be sent to the user's contacts.
- QuadBand GPRS-GSM SIM800L, on insertion of a valid SIM card, can be used for voice calls, sending text messages and accessing the internet. When the system is active and there is any discrepancy in the inputs, like fingerprint is not detected or the heart bpm

exceeds the threshold, it will be used to communicate alert messages and location coordinates to the user's trusted contacts. This will be the output of the system.

CHAPTER : 5

Comparison

We have selected to work on the Arduino microcontroller for our project. Here are some of the features of Arduino UNO and its comparison with other microcontrollers like Raspberry Pi, BeagleBone, Intel's Galileo, Intel's Edison.

	Arduino	**Raspberry-pi**	**BeagleBone**	**Intel's Galileo**	**Intel's Edison**
Strengths	Easy to connect with some LED's, sensors, motors into the board directly	All the Storage is provided from a SD card. You can connect this to your network with an Ethernet Cable.	Similar to a Raspberry Pi but more powerful, Based on the TI Sitara AM335x, an application processor SoC containing an ARM Cortex-A8 core	Same size and shape as an SD card and containing a dual-core Intel Quark x86 CPU at 400 MHz communicating via Bluetooth and Wi-Fi	The Intel Edison module is a SoC that includes an Intel Atom 500MHz dual-core, dual-threaded CPU and an Intel Quark 100MHz microcontroller.
	The Arduino is a microcontroller. The arduino can be programmed, but can't run an operating system	Raspberry Pi are computers. Those devices can run an operating system alone	BeagleBone are computers. Those devices can run an operating system alone	Intel's Galileo is a microcontroller. It can be programmed i, but can't run an operating system	Intel's Editson is a microcontroller. It can be programmed i, but can't run an operating system
	Good combination of Digital and Analog pins.	Perfect availability of general-purpose I/O pins	Abundant Digital and Analog pins are available .	Good combination of Digital and Analog pins.	Supports external storage Via. MicroSD card.

	Very versatile and extendable due to the availability of various external modules for different tasks.	Supports gigabit ethernet, WiFi, and Bluetooth	Supports gigabit ethernet, WiFi, and Bluetooth	Supports external storage via. MicroSD card.	Supports all WiFi protocols and Bluetooth
	Available in portable size	Video and Audio output ports are available	Enough memory storage(4GB) is available	Supports Gigabit, Bluetooth and Ethernet	Power adapter or USB port both can be used
	Light weight and comparatively cheapest		DDR3 RAM of 512 KB		Smallest in size

	Arduino	**Raspberry-pi**	**BeagleBone**	**Intel's Galileo**	**Intel's Edison**
Weaknesses	Very low clock frequency (16 MHz)	Requires standard 5V power supply. Highest clock frequency (1.2 GHz)	Does not support external memory (such as MicroSD cards).	Comparatively slower clock frequency (400 MHz) and the product is not longer supported by Intel	Comparatively slower clock frequency (500 MHz) and the product is not longer supported by Intel .
	Very low RAM(2KB).	Huge size	Huge size	Huge size and weight and not easily portable	Not cost effective
	Lowest storage (32KB)	No port for Analog pins.	Audio and video outputs are handled by a microHDMI connection.	. A compatible WiFi chip is must to use WIFi functionality	High Power consumption

	Very tedious and tiring connections	Supports only one WiFi protocol. .	Lack of reference materials available	Does not support audio and video output	Does not provide an Ethernet port.
	Slightly high power consumption	Storage is not available, needs a MicroSD card to function.	Quite expensive		It is complicated and difficult to use.

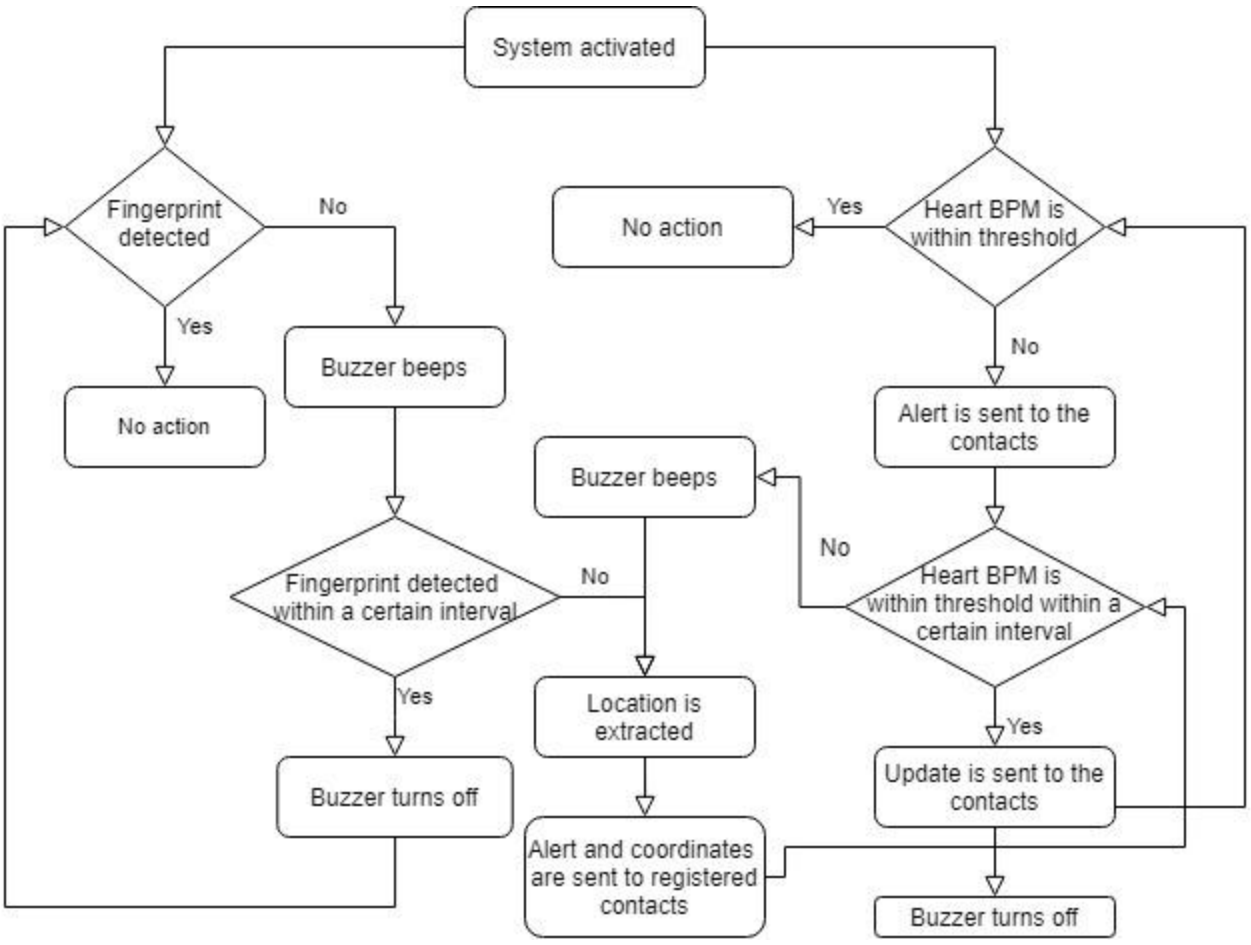
General characteristics

	Arduino	**Raspberry-pi**	**BeagleBone**	**Intel's Galileo**	**Intel's Edison**
Price	$29.95	$35	$89	$50	$79.90
Processor	ATMega 328	ARM11	ARM Cortex-A8	Intel Quark	Intel Atom CPU
Size	2.95"x2.10"	3.37"x2.125"	3.4"x2.1"	4.8 x 2.8	25 x 4mm
Clock Speed	16MHz	700MHz	700MHz	500 MHz, 100 MHz	400 MHz
Flash	32KB	SD Card	4GB(microSD)	4 GB eMMC	8 Mb
RAM	2KB	256MB	256MB	256MB	1GB
Input Voltage	7-12v	5v	5v	3.3 to 4.5 V	3V3, 5V
Analog Input	6 10-bit	N/A	7 12-bit	12-bit	12-bit
USB	N/A	USB 2.0	USB 2.0	USB 2.0	USB 2.0
Min Power	42mA (.3W)	700mA	170mA	450mA	100mA

		(3.5W)	(.85W)	(2.24W)	(0.5W)
EEPROM	1KB	N/A	N/A	11KB	N/A
PWM	6	N/A	8	6	4
Dev IDE	Arduino Tool	IDLE, Scratch, Squeak/Linux	Python, Scratch, Squeak, Cloud9/Linux	Arduino IDE	Arduino, Python, Node.js

CHAPTER : 6

Program Flow chart



CHAPTER : 7

Sensors

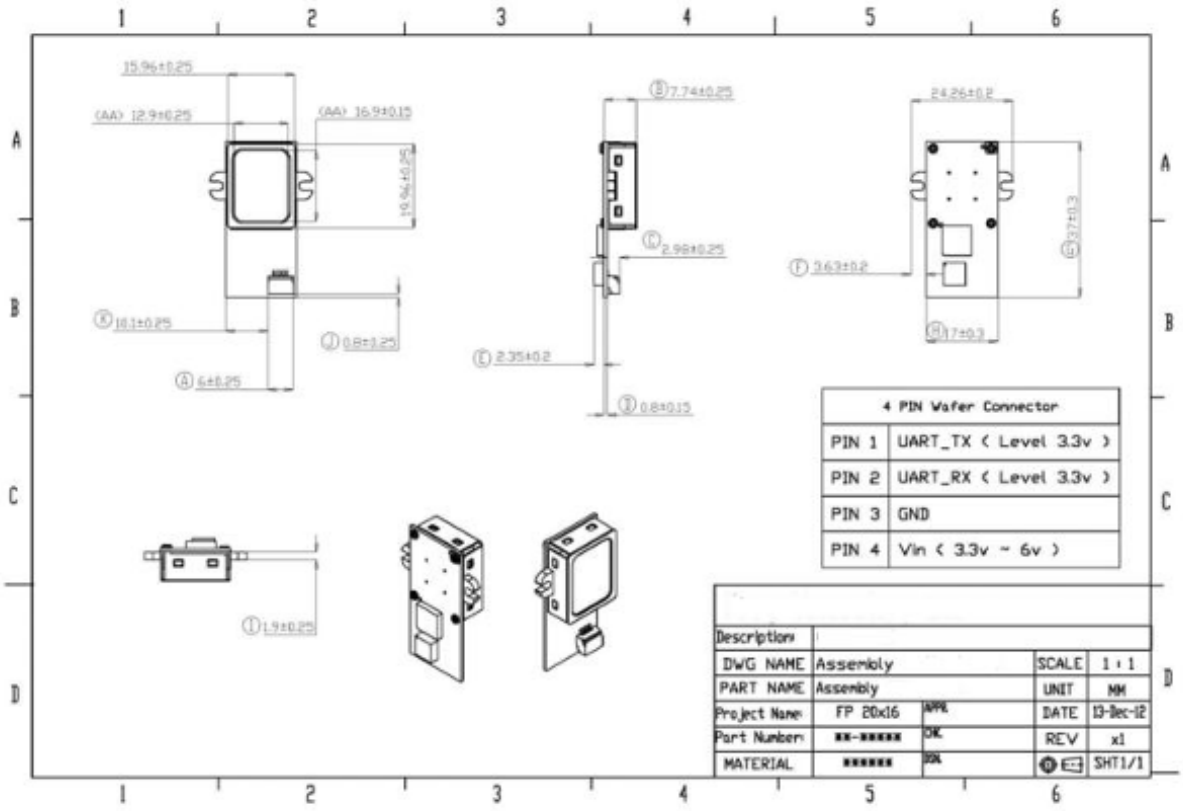
Fingerprint Scanner - TTL (GT-511C3)

1. **Details of operating principle with diagrams:**

   This device is one chip module with:

   - Fingerprint algorithm
   - Optical sensor

2. **Physical dimensions:**

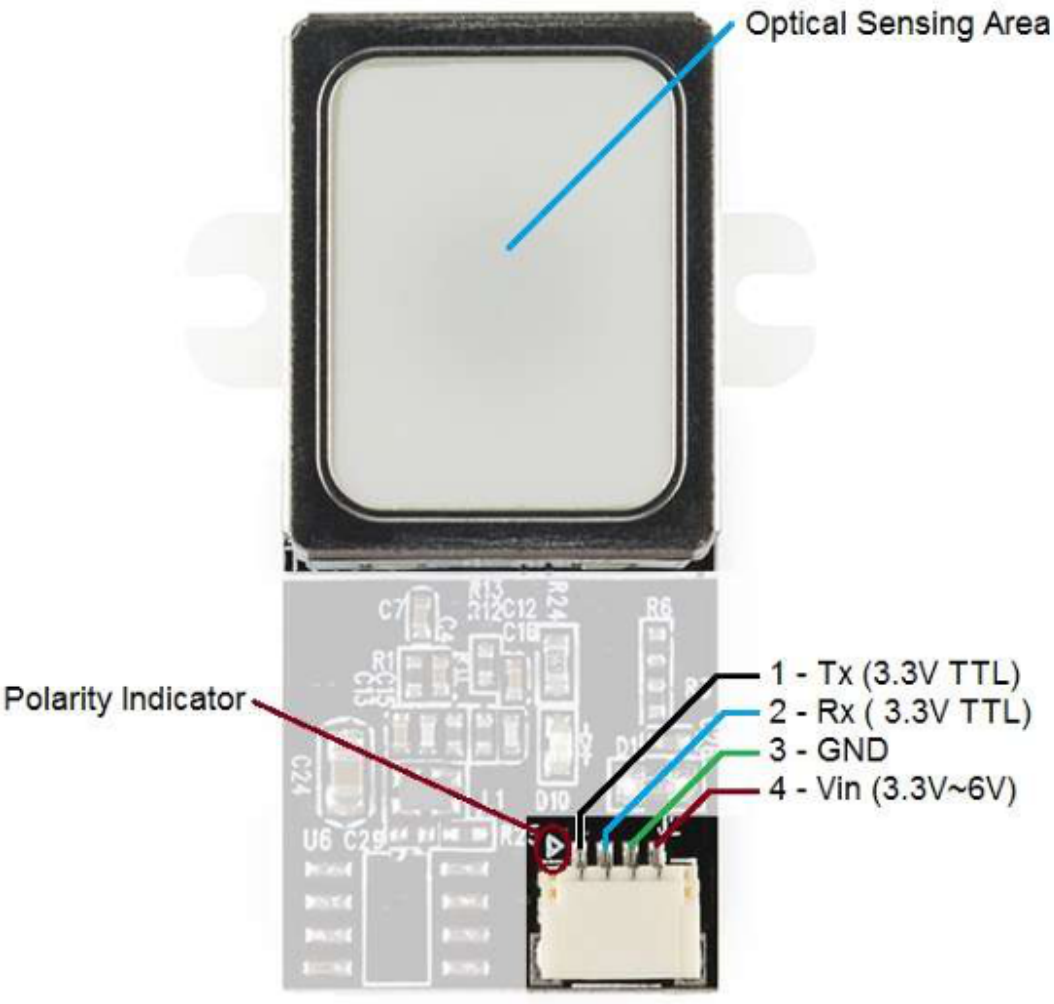


3. **Details of power ratings:**

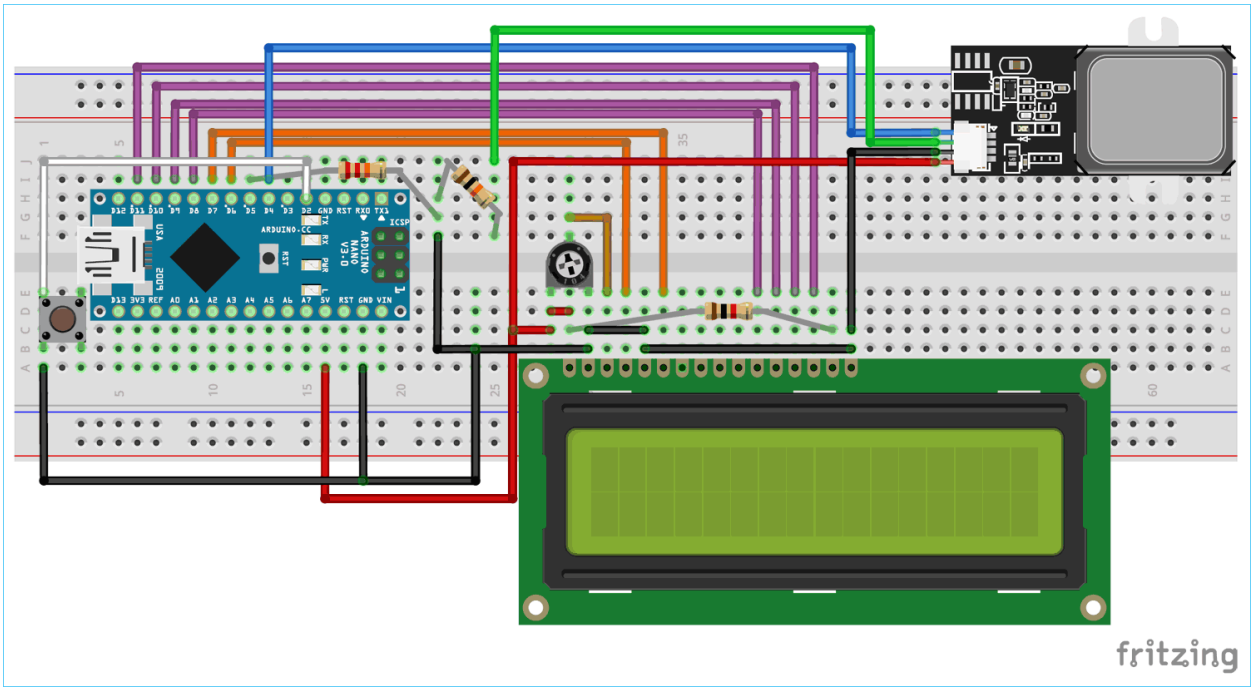
   Operating Voltage: 3.3V ~ 6Vdc

   Operating Current: < 130mA

4. **Pin diagram:**



5. **Type of interface with Arduino/Raspberry Pi:**



6. **Details of interfacing diagram:**

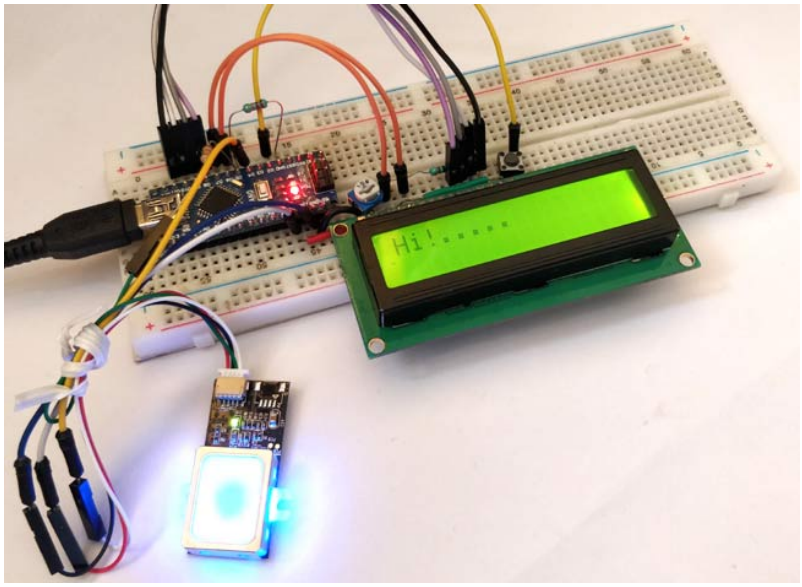
   The GT511C3 FPS has two power pins which can be powered by +5V pin of Arduino and two communication pins Rx and Tx which can be connected to any digital pin of Arduino for serial communication. Additionally, we have also added a push button and a LCD to display the sensor status.

7. **Code to communicate with the sensors**

```
 /* Connect Tx of FPS to Arduino Pin D4 and Rx of FPS to D5*/
#include "FPS_GT511C3.h"
#include "SoftwareSerial.h" //Software serial library
#include <LiquidCrystal.h> //Library for LCD
```

```
FPS_GT511C3 fps(4, 5); //FPS connected to D4 and D5

const int rs = 6, en = 7, d4 = 8, d5 = 9, d6 = 10, d7 = 11; //Mention the
pin number for LCD connection

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);//Initialize LCD method

void setup()
{
  Serial.begin(9600);
  lcd.begin(16, 2); //Initialise 16*2 LCD
  lcd.print("GT511C3 FPS"); //Intro Message line 1
  lcd.setCursor(0, 1);
  lcd.print("with Arduino"); //Intro Message line 2
  delay(2000);
  lcd.clear();
  fps.Open();         //send serial command to initialize fps
  fps.SetLED(true);   //turn on LED so fps can see fingerprint
  pinMode(2,INPUT_PULLUP); //Connect to internal pull up resistor as input
pin
}

void loop()
{
 if (fps.IsPressFinger())
  {
    fps.CaptureFinger(false);
    int id = fps.Identify1_N();
      lcd.clear();
      lcd.print("Detected");
      if (id==200) lcd.print("Unknown"); //If not recognised
      lcd.print(id);
      delay(1000);
  }
  else
  {
    lcd.clear(); lcd.print("Hi!....."); //Display hi when ready to scan
  }
}
```

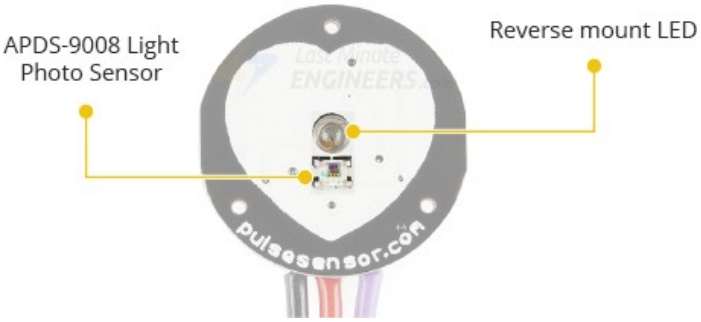
8. **Photos of working hardware:**



Heart Rate Pulse Sensor

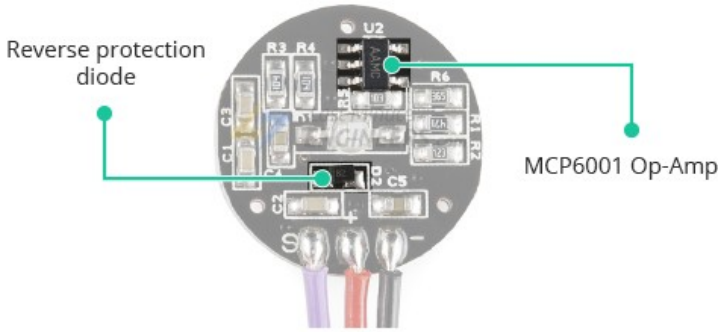
1. **Details of operating principle with diagrams**

   The front of the sensor is the side with the heart logo. This is where you place your finger. On the front side you will see a small round hole, from where the Kingbright's reverse mounted green LED shines.



   Just below the LED is a small ambient light photo sensor – APDS-9008 from Avago, similar to that used in cell phones, tablets and laptops, to adjust the screen brightness in different light conditions.

On the back of the module you will find the rest of the components including a microchip's MCP6001 Op-Amp and a bunch of resistors and capacitors that make up the R/C filter network. There is also a reverse protection diode to prevent damage if the power leads are accidentally reversed.



2. **Physical dimensions**

   L x W (PCB) 15.8mm (0.625″)

   Lead Length 20cm (7.8″)

3. **Details of power ratings**

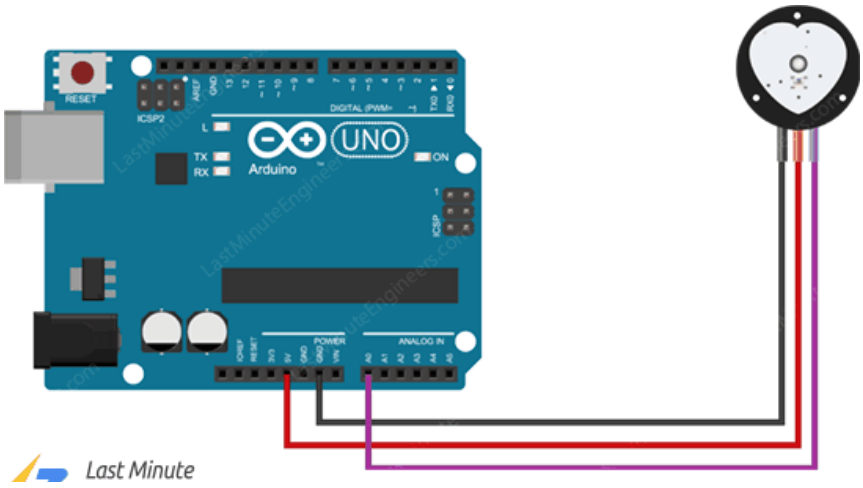
   VCC: 3.0 – 5.5V

   IMax (Maximum Current Draw): < 4mA

   VOut (Output Voltage Range): 0.3V to Vcc

4. Pin diagram

5. Type of interface with Arduino



6. **Details of interfacing diagram**

   The module can be powered from 3.3 or 5V. The positive voltage connects to '+' and ground connects to '-'. The 3rd 'S' wire is the analog signal output from the sensor and this will connect to the A0 analog input of an Arduino.

7. **Code to communicate with the sensors**

```
int const PULSE_SENSOR_PIN = 0;   // 'S' Signal pin connected to A0
int Signal;                // Store incoming ADC data. Value can range from 0-1024
int Threshold = 550;       // Determine which Signal to "count as a beat" and which
to ignore.

void setup() {
      pinMode(LED_BUILTIN,OUTPUT);  // Built-in LED will blink to your heartbeat
      Serial.begin(9600);           // Set comm speed for serial plotter window
}

void loop() {

Signal = analogRead(PULSE_SENSOR_PIN); // Read the sensor value
Serial.println(Signal);                // Send the signal value to serial plotter

if(Signal > Threshold){                // If the signal is above threshold, turn on
the LED
digitalWrite(LED_BUILTIN,HIGH);
}
else {
digitalWrite(LED_BUILTIN,LOW);     // Else turn off the LED
}
delay(10);
}
```

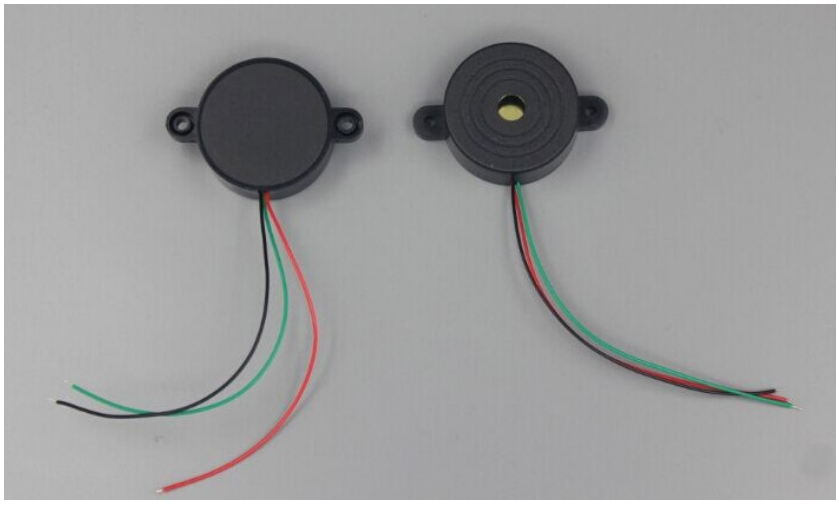
8. **Photos of working hardware**

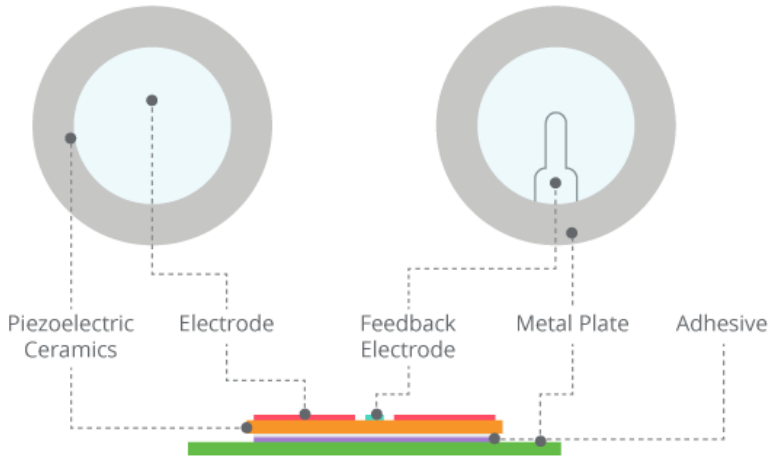
CHAPTER : 8

Actuators

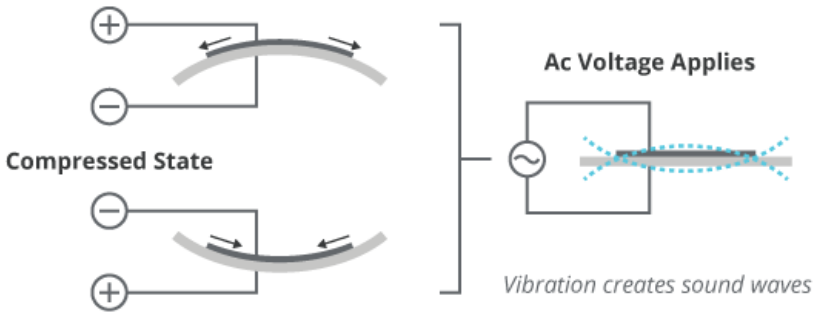
Buzzer

1. Details of operating principle with diagrams



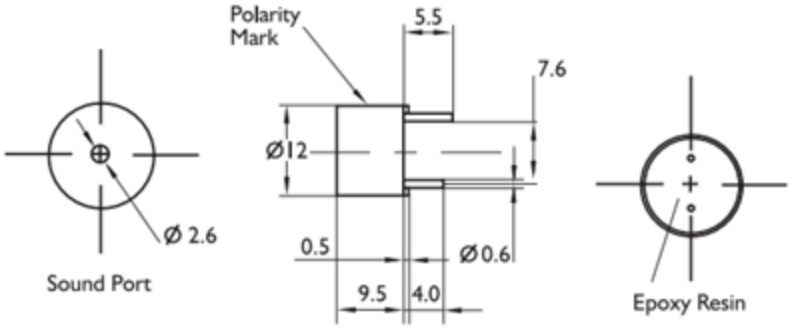


At the heart of all piezo-type buzzers is the piezoelectric element. The piezoelectric element is composed of a piezoelectric ceramic and a metal plate held together with adhesive. Both sides of the piezoelectric ceramic plate contain an electrode for electrical conduction. Piezo materials exhibit a specific phenomenon known as the piezoelectric effect and the reverse piezoelectric effect. Exposure to mechanical strain will cause the material to develop an electric field, and vice versa.



When an alternating voltage is applied to the piezoceramic element, the element extends and shrinks diametrically. This characteristic of piezoelectric material is utilized to make the ceramic plate vibrate rapidly to generate sound waves.

2. Physical dimensions



Dimensions : Millimetres
Tolerance : ±0.5mm

3. Details of power ratings

Rated Voltage: 6V DC

Operating Voltage: 4 to 8V DC

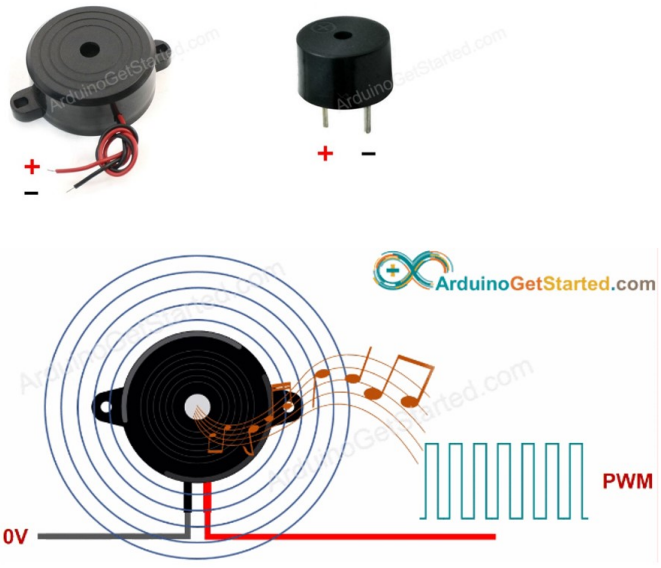
Rated Current* : ≤30mA

Sound Output at 10cm* : ≥85dB

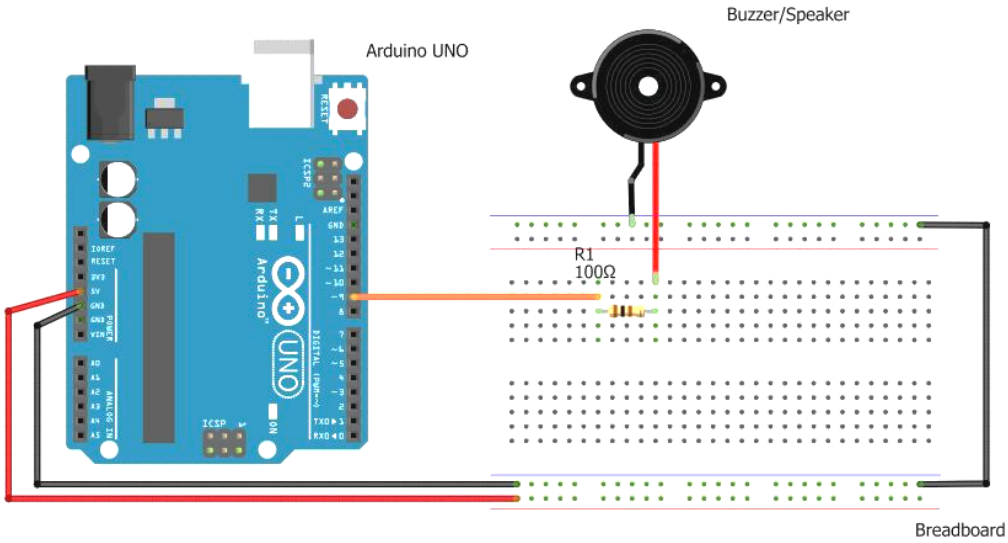
Resonant Frequency: 2300 ±300Hz

Tone: Continuous

4. Pin diagram



5. **Type of interface with Arduino/Raspberry Pi**



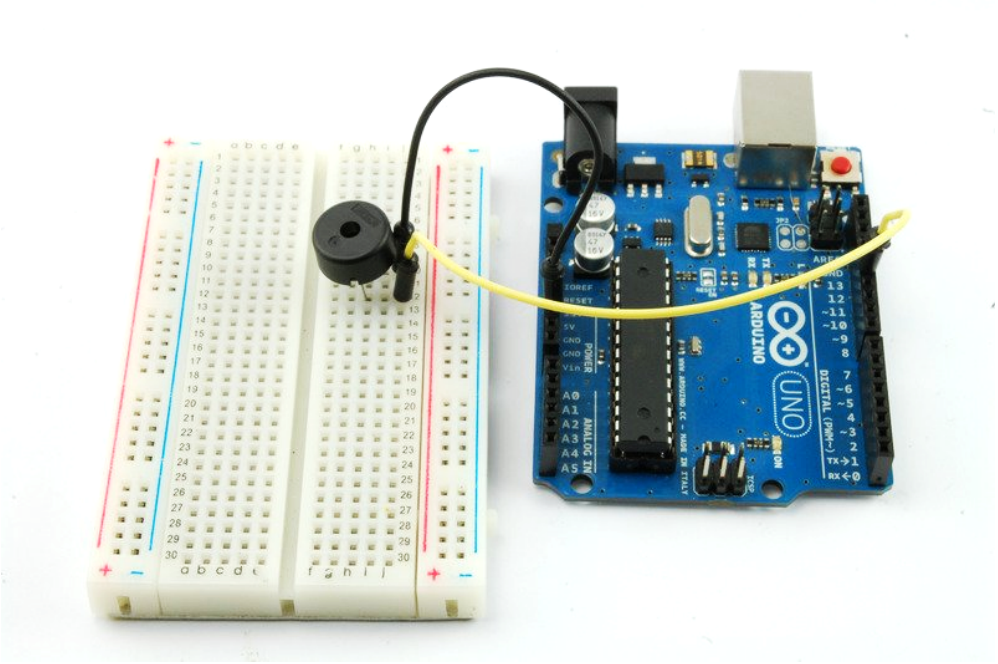
6. **Details of interfacing diagram**

   Here, the cathode is connected to the ground while the anode is connected in series with the resistor to the pin 9 of the arduino.

7. **Code to communicate with the sensors**

```
const int buzzer = 9; //buzzer to arduino pin 9

void setup(){
  pinMode(buzzer, OUTPUT); // Set buzzer - pin 9 as an output
}

void loop(){
  tone(buzzer, 1000); // Send 1KHz sound signal...
  delay(1000);        // ...for 1 sec
  noTone(buzzer);     // Stop sound...
  delay(1000);        // ...for 1sec
}
```

8. **Include photos of working hardware.**

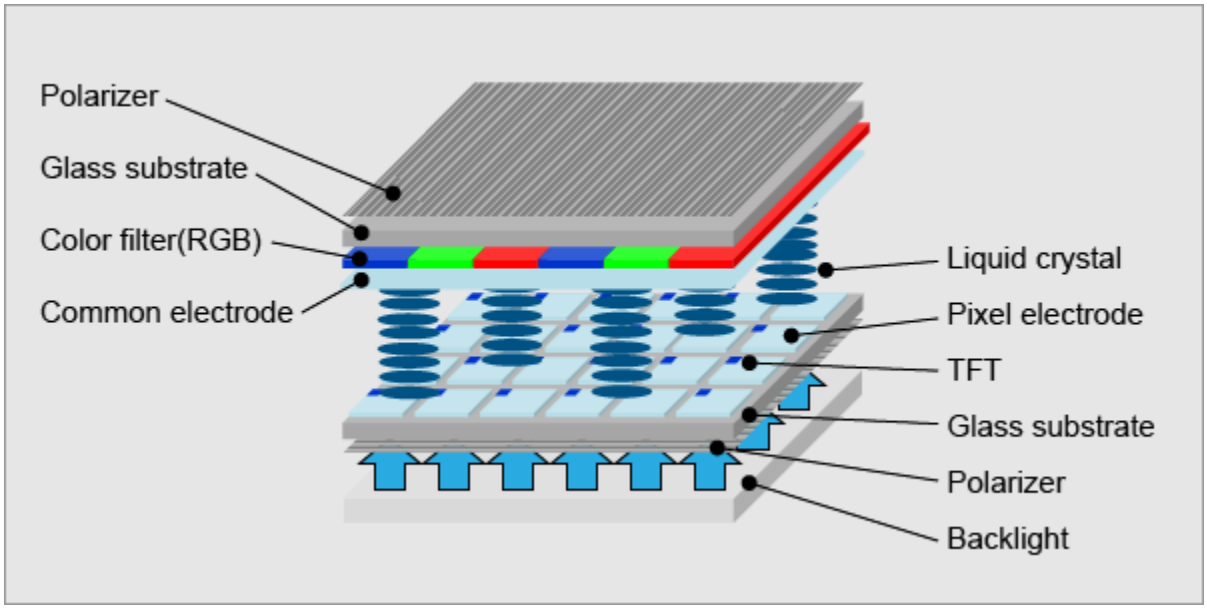


Displays

LCD Display 16X2

1. Details of operating principle with diagrams

In LCD 16×2, the term LCD stands for Liquid Crystal Display that uses a plane panel display technology, used in screens of computer monitors & TVs, smartphones, tablets, mobile devices, etc. Both the displays like LCD & CRTs look the same but their operation is different. Instead of electron diffraction at a glass display, a liquid crystal display has a backlight that provides light to each pixel that is arranged in a rectangular network.



Every pixel includes a blue, red, green sub-pixel that can be switched ON/OFF. Once all these pixels are deactivated, then it will appear black and when all the sub-pixels are activated then it will appear white. By changing the levels of each light, different color combinations are achievable.

2. Physical dimensions

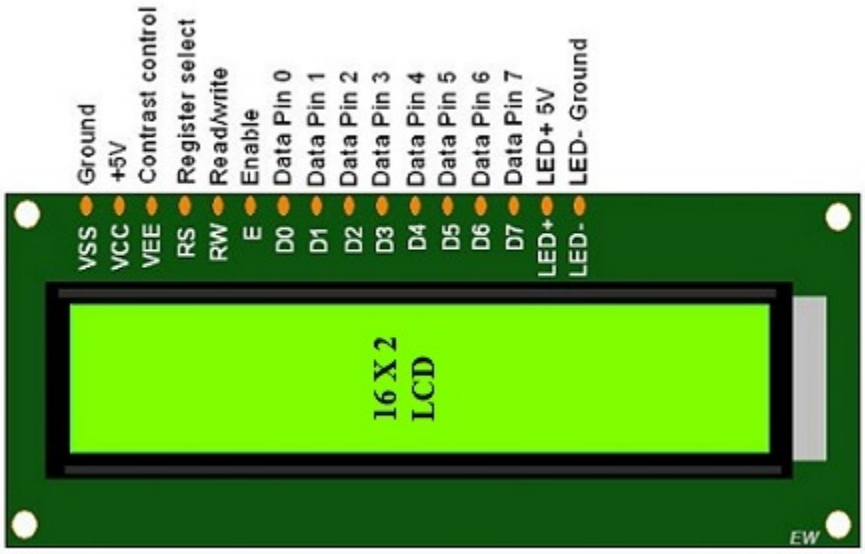
Size:	85.0 x 29.5 x 13.5 mm
Viewing area:	64.5 x 16.4 mm
Dot size:	0.56 x 0.61 mm
Character size:	3.00 x 5.23 mm
Weight:	35 g

3. **Details of power ratings**

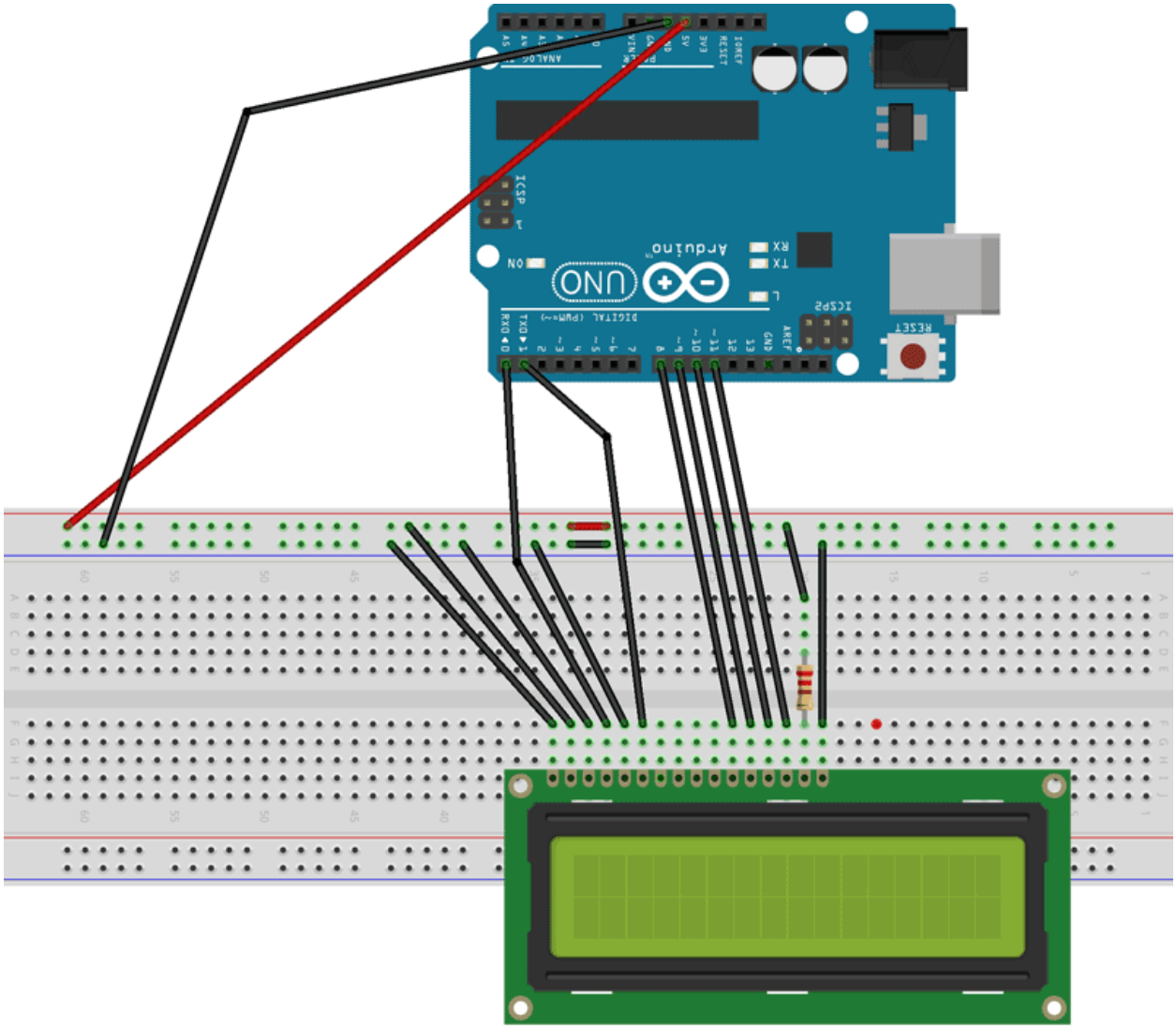
Operating Voltage: 4.7V to 5.3V

Operating Current: 1mA (without backlight)

4. **Pin diagram**



5. Type of interface with Arduino



6. Details of interfacing diagram

Before interfacing the LCD screen to the Arduino board, a pin header strip need to be solder to pin-14 or 16 of the LCD. We can notice this in the following circuit diagram. The following pins need to connect to wire the LCD to an Arduino board.

- RS pin of LCD to digital pin-12
- Enable pin is connected to digital pin-11
- D4 pin is connected to digital pin -5
- D5 pin is connected to digital pin- 4

- D6 pin is connected to digital pin-3
- D7 pin is connected to digital pin-2
- Read/Write pin is connected to GND
- VSS pin is connected to the GND terminal
- VCC pin is connected to 5V
- A 220-ohm resistor is connected from LED+ to 5V
- LED is connected to the GND terminal

7. Code to communicate with the sensors'

```
#include <LiquidCrystal.h>

const int rs = 12, en = 11, d4 = 6, d5 = 5, d6 = 4, d7 = 3;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void setup() {
  lcd.begin(16, 2);  // set up the LCD's number of columns and rows:
  lcd.print("Hello World!");  // Print a text to the LCD.
}

void loop() {
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  lcd.setCursor(0, 1);
  // print the number of seconds since reset:
  lcd.print(millis() / 1000);
}
```

8. Photos of working hardware