International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Heartbeat Counter with Surrounding Temperature and Humidity

Submitted By:

Prof. Snehal Ranit, E&TC Department, GSMCOE
Prof. Harshalata Toke, E&TC Department, GSMCOE
Ujwal Lekurwale, E&TC Department, GSMCOE
Swaraj Mandhare, E&TC Department, GSMCOE

ABSTRACT

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy.

In order to measure the body temperature, we use thermometers and a sphygmomanometer to monitor the Arterial Pressure or Blood Pressure.

Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor.

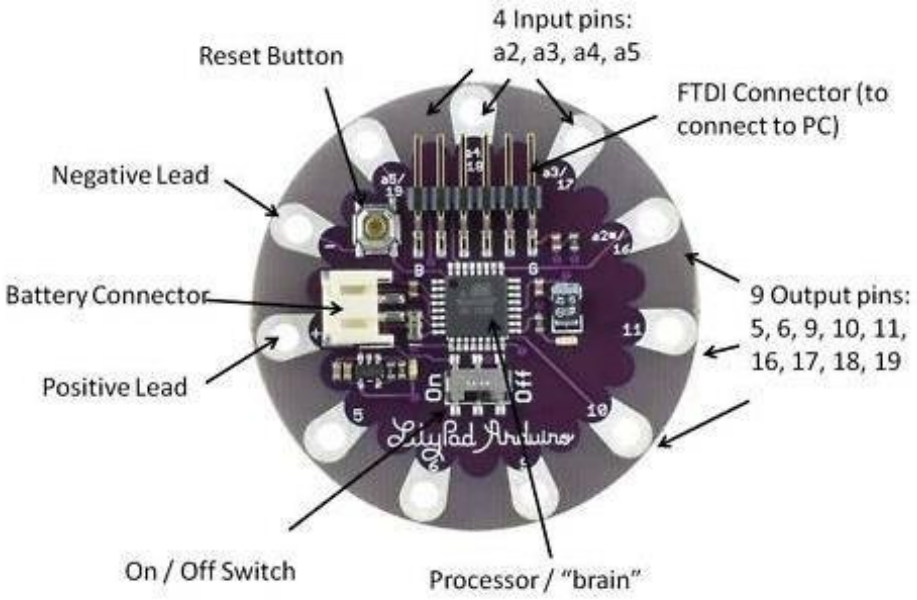
In this project, we have designed a Heart Rate Monitor System using Arduino and Heartbeat Sensor. You can find the Principle of Heartbeat Sensor, working of the Heartbeat Sensor and Arduino based Heart Rate Monitoring System using a practical heartbeat Sensor.

Arduino Uno

The Uno is a huge option for your initial Arduino. It consists of 14-digital I/O pins, where 6- pins can be used as PW pulse width modulati outputs), 6-analog inputs, a reset button, a power jack, a USB connection and more. It includes everything M(required to hold up the microcontroller; simply attach it to a PC with the help of a USB cable and give the supply to get started with a AC-to-DC adapter or battery.

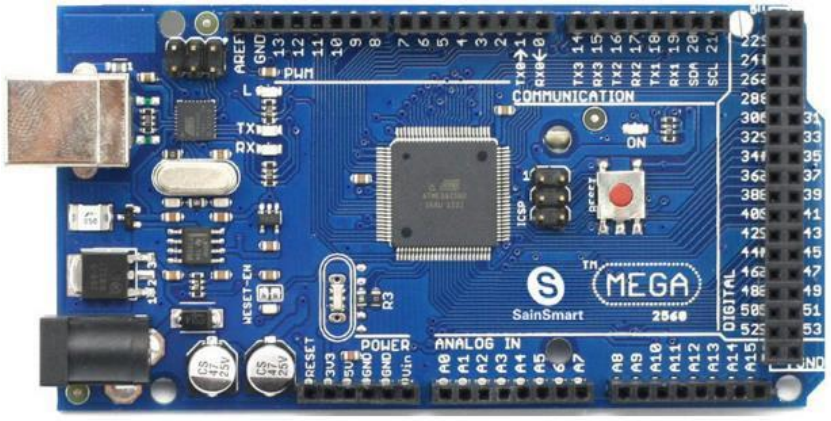
Lily Pad Arduino Board

The Lily Pad Arduino board is a wearable e-textile technology expanded by Leah " Buechley" and considerately designed by "Leah and SparkFun". Each board was imaginatively designed with huge connecting pads & a smooth back to let them to be sewn into clothing using conductive thread. This Arduino also comprises of I/O, power, and also sensor boards which
are built especially for e-textiles. These are even washable!



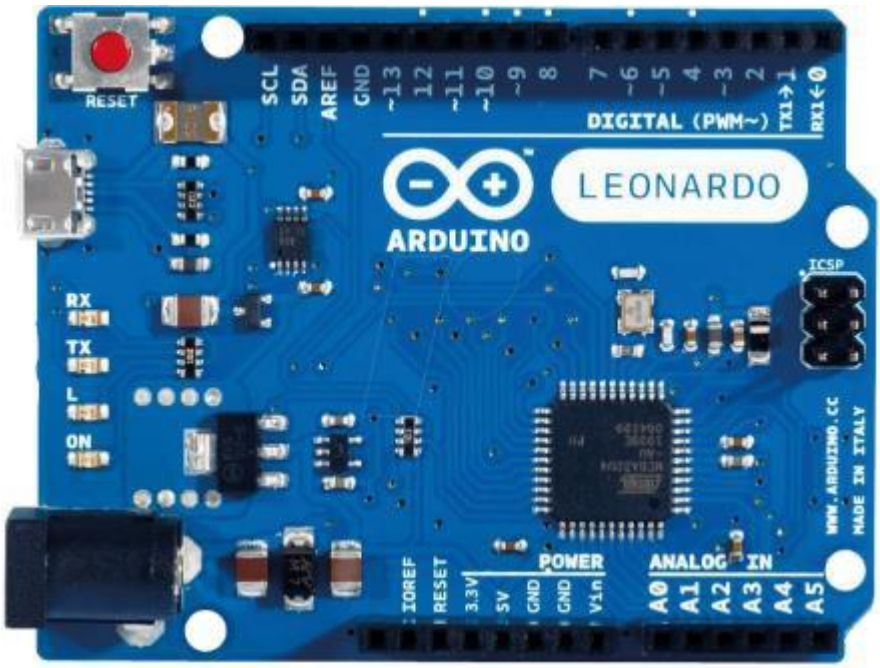
Arduino Mega (R3) Board

The Arduino Mega is similar to the UNO's big brother. It includes lots of digital I/O pins (from that, 14-pins can be used as PWM o/ps), 6-analog inputs, a reset button, a power jack, a USB connection and a reset button. It includes everything required to hold up the microcontroller; simply attach it to a PC with the help of a USB cable and give the supply to get started with a AC-to-DC adapter or battery.The huge number of pins make this Arduino board very helpful
for designing the projects that need a bunch of digital i/ps or o/ps like lots buttons.

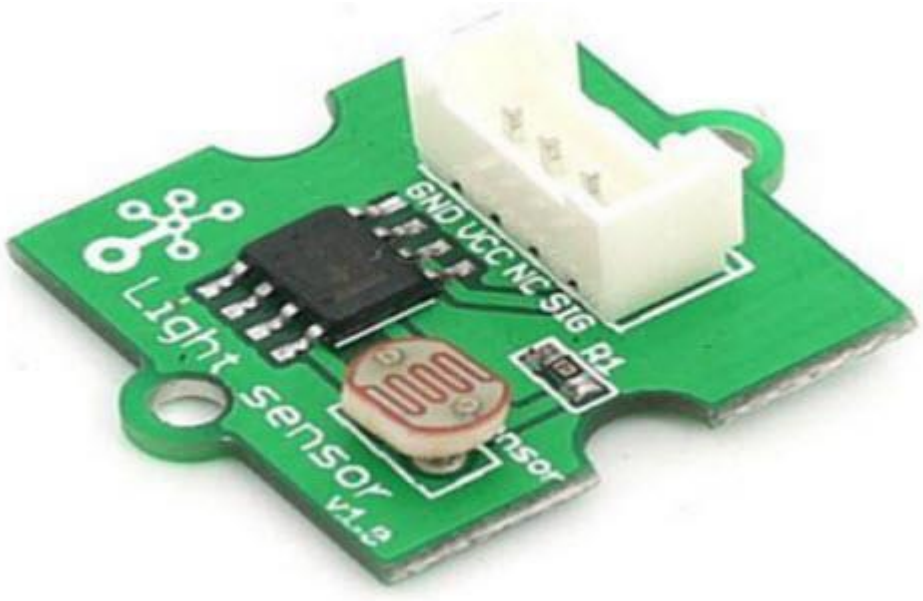


Arduino Leonardo Board

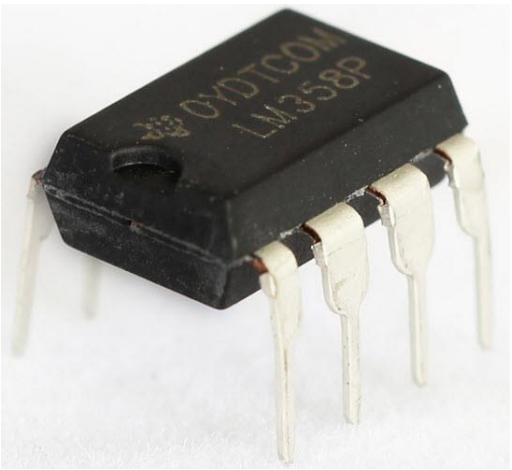
The first development board of an Arduino is the Leonardo board. This board uses one microcontroller along with the USB. That means, it can be very simple and cheap also. Because this board handles USB directly, program libraries are obtainable which let the Arduino board
to follow a keyboard of the computer, mouse, etc.



LM358 IC :



The LM358 IC is a great, low power and easy to use dual channel op-amp IC. It is designed and introduced by national semiconductor. It consists of two internally frequency compensated, high gain, independent op-amps. This IC is designed for specially to operate from a single power supply over a wide range of voltages. The LM358 IC is available in a chip sized package and applications of this op amp include conventional op-amp circuits, DC gain blocks and transducer amplifiers. LM358 IC is a good, standard operational amplifier and it is suitable for your needs. It can handle 3-32V DC supply & source up to 20mA per channel. This op-amp is apt, if you want to operate two separate op-amps for a single power supply. It's available in an
8-pin DIP package



Pin Configuration of LM358 IC

The pin diagram of LM358 IC comprises of 8 pins, where

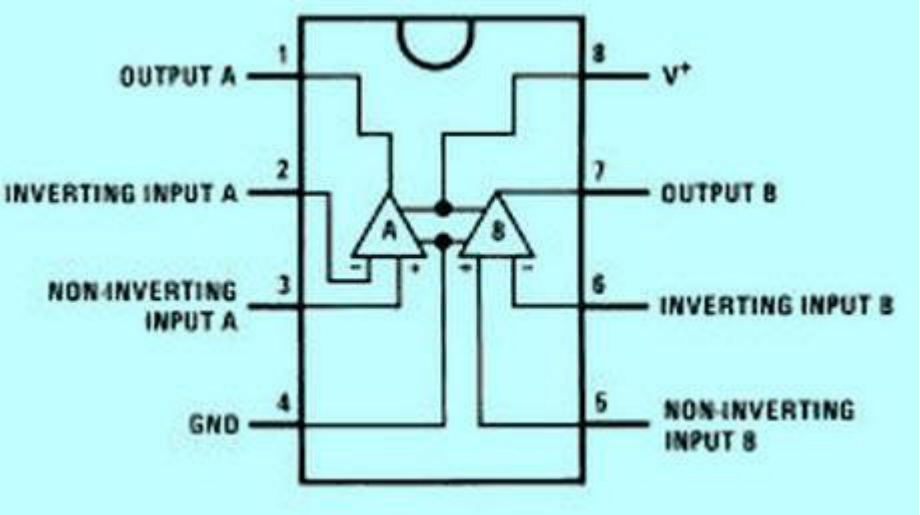
Pin-1 and pin-8 are o/p of the comparator

Pin-2 and pin-6 are inverting i/ps

Pin-3 and pin-5 are non inverting i/ps

Pin-4 is GND terminal

Pin-8 is VCC+



Features of LM358 IC

The features of the LM358 IC are

It consists of two op-amps internally and frequency compensated for unity gain

The large voltage gain is 100 dB

Wide bandwidth is 1MHz

Range of wide power supplies includes single and dual power supplies

Range of Sing power s upply is from 3V to 32V

Range of dual power supplies is from + or -1.5V to + or -16V

The supply current drain is very low, i.e., 500 µA

2mV low i/p offset voltage

Common mode i/p voltage range comprises ground

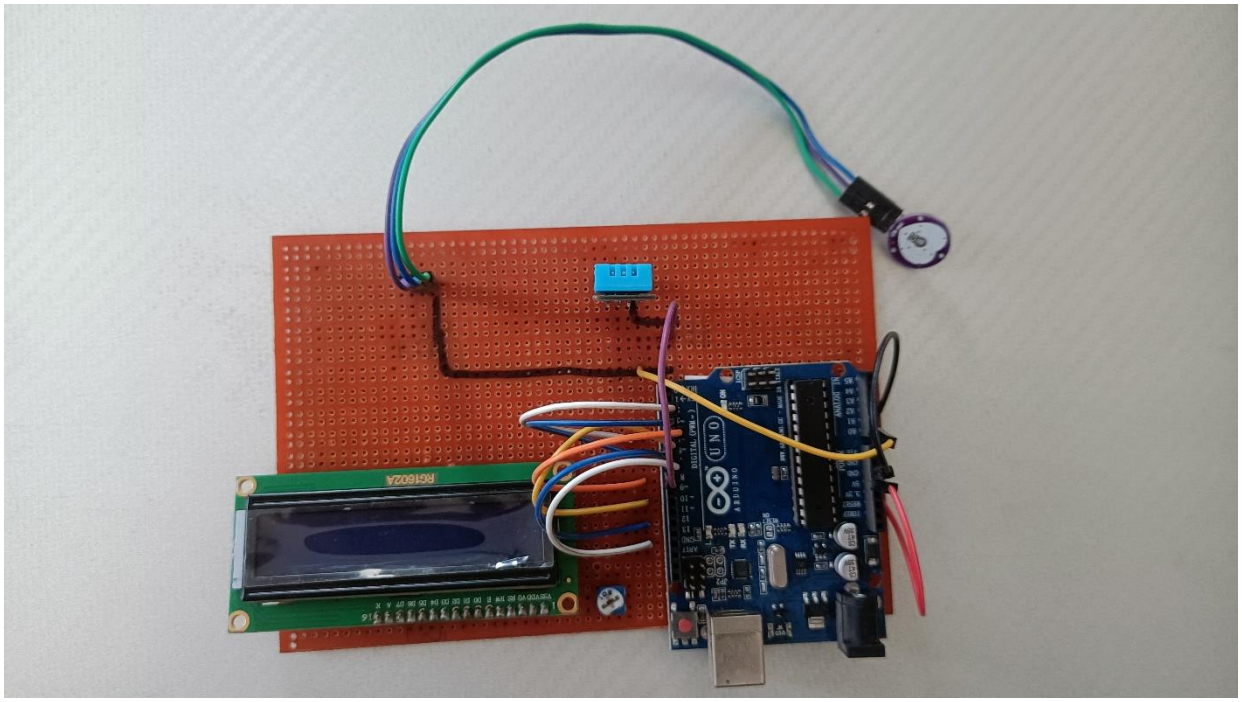
The power supply voltage and differential i/p voltages are similar

o/p voltage swing is large.

Monitoring heart rate is very important for athletes, patients as it determines the condition of the heart (just heart rate). There are many ways to measure heart rate and the most precise one is using an Electrocardiography

But the more easy way to monitor the heart rate is to use a Heartbeat Sensor. It comes in different shapes and sizes and allows an instant way to measure the heartbeat.

Heartbeat Sensors are available in Wrist Watches (Smart Watches), Smart Phones, chest straps, etc. The heartbeat is measured in beats per minute or bpm, which indicates the number of times the heart is contracting or expanding in a minute.



Principle of Heartbeat Sensor

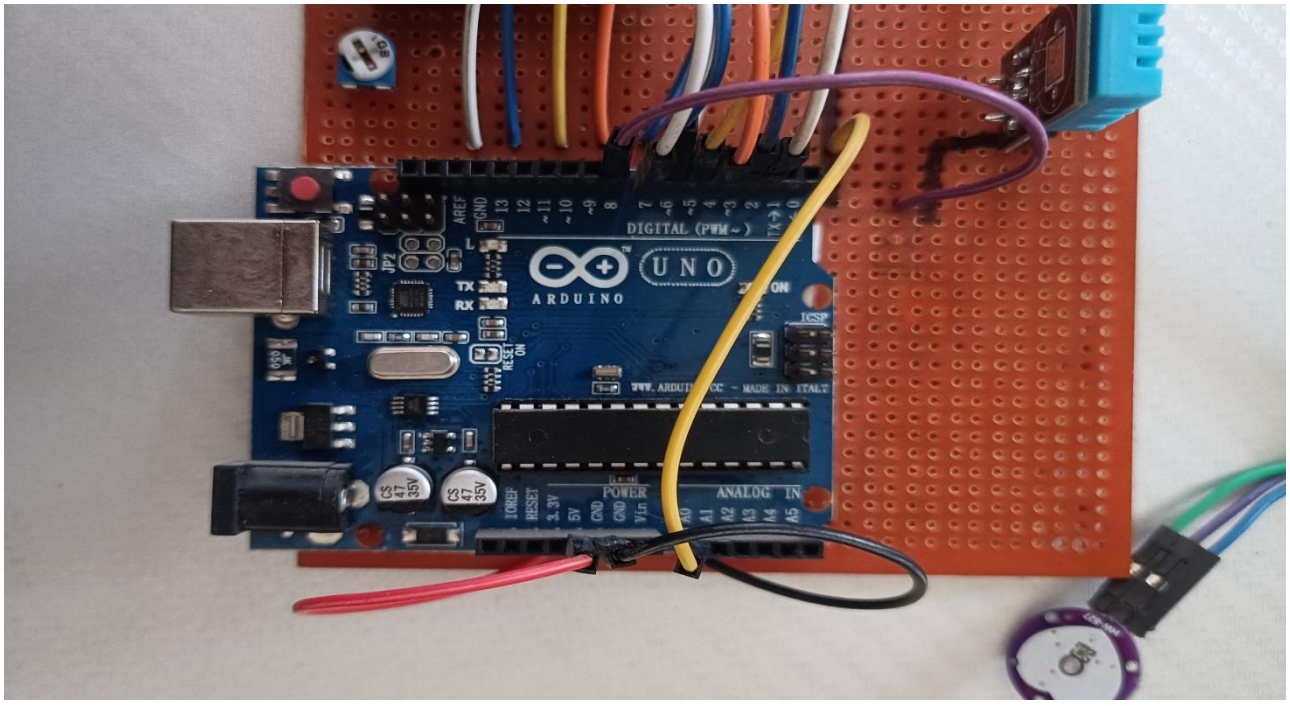
The principle behind the working of the Heartbeat Sensor is Photoplethysmograph. According to this principle, the changes in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ.

Usually, the source of light in a heartbeat sensor would be an IR LED and the detector would be any Photo Detector like a Photo Diode, an LDR (Light Dependent Resistor) or a Photo Transistor.

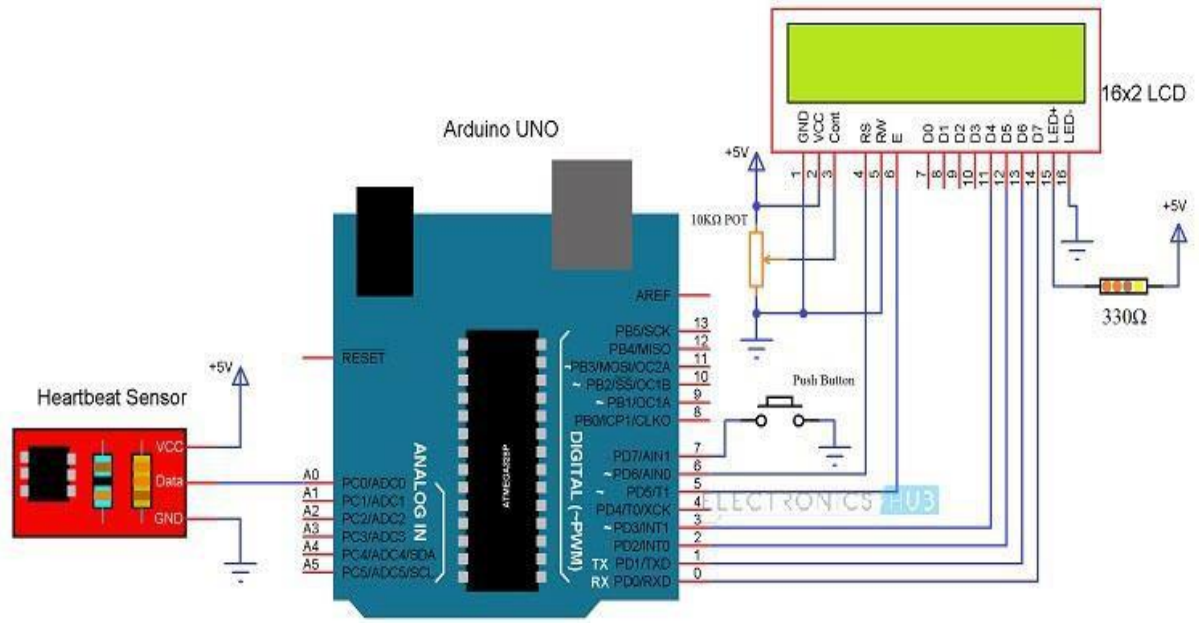
With these two i.e. a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor.

In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver.

Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor.



Architecture of Project



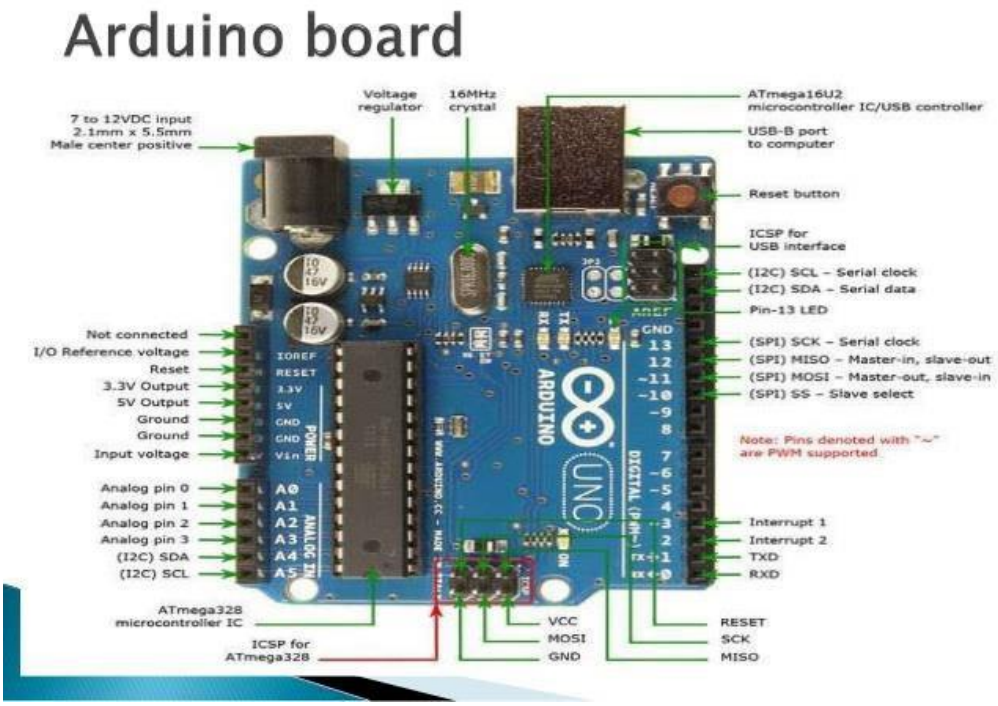
The following image shows the circuit diagram of the Arduino based Heart Rate Monitor using Heartbeat Sensor. The sensor has a clip to insert the finger and has three pins coming out of it for connecting VCC, GND and the Data.

Heart beat sensor module's output pin is directly connected to pin 8 of arduino. Vcc and GND are connected to Vcc and GND. A 16x2 LCD is connected with arduino in 4-bit mode. Control pin RS, RW and En are directly connected to arduino pin 12, GND and 11. And data pin D4-D7 is connected to pins 5, 4, 3 and 2 of arduino. And one push button is added for resetting reading and another is used to start the system for reading pulses. When we need to count heart rate, we press start button then arduino start counting pulses and also start counter for five seconds. This start push button is connected to pin 7 and reset push button is connected to pin 6 of arduino with respect to ground.

Components Required

- Arduino UNO x 1
- 16 x 2 LCD Display x 1
- 10KΩ Potentiometer
- 330Ω Resistor (Optional – for LCD backlight)
- Push Button
- Heartbeat Sensor Module with Probe (finger based)
- Mini Breadboard
- Connecting Wires

1)Arduino UNO x 1



Defining Arduino: An Arduino is actually a microcontroller-based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices.

How to use Arduino Board?

The 14 digital input/output pins can be used as input or output pins by using pin Mode(), digital Read( ) and digital Write() functions in Arduino programming. Each pin operates at 5V and can provide or receive a maximum of 40mA current and has an internal pull-up resistor of 20-

50 K Ohms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

Serial Pins 0 (Rx) and 1 (Tx): Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.

External Interrupt Pins 2 and 3: These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

PWM Pins 3, 5, 6, 9 and 11: These pins provide an 8-bit PWM output by using analogWrite() function.

SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK): These pins are used for SPI communication.

In-built LED Pin 13: This pin is connected with a built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, its off.

Along with 14 Digital pins, there are 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts, but this limit can be increased by using AREF pin with analog Reference () function.

Analog pin 4 (SDA) and pin 5 (SCA) also used for TWI communication using Wire library.

Arduino Uno has a couple of other pins as explained below:

AREF: Used to provide reference voltage for analog inputs with analogReference() function.

Reset Pin: Making this pin LOW, resets the microcontroller.

How to program on arundio:

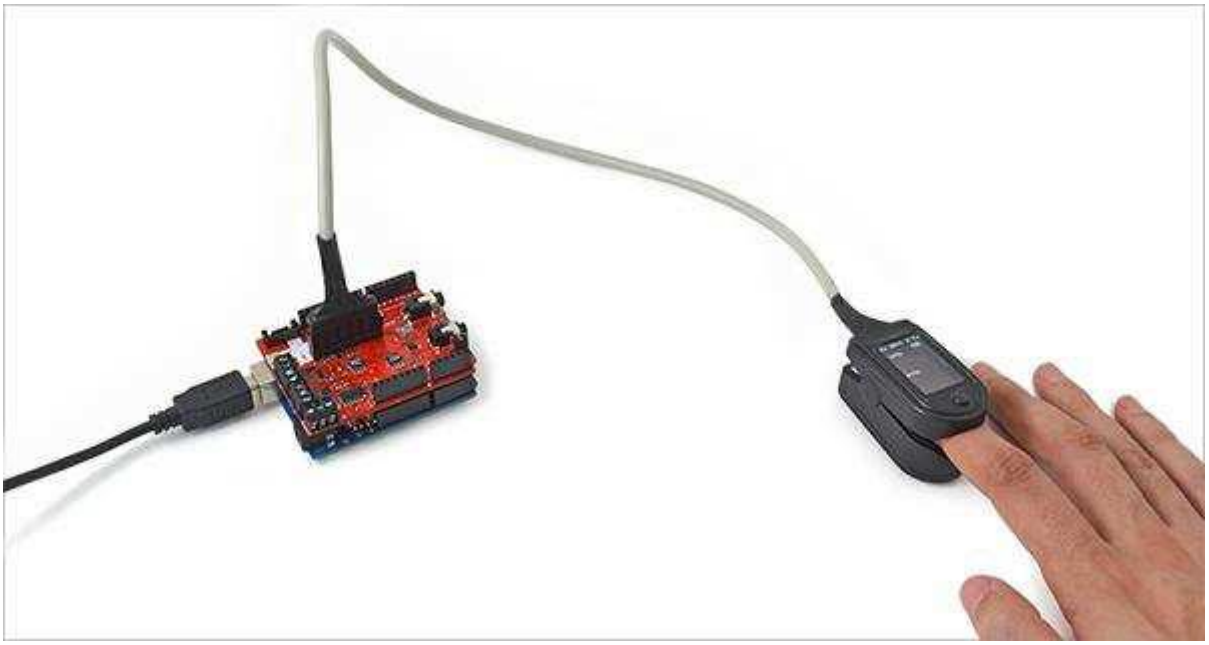
The Arduino tool window consists of the toolbar with the buttons like verify, upload, new, open, save, serial monitor. It also consists of a text editor to write the code, a message area which displays the feedback like showing the errors, the text console which displays the output and a series of menus like the File, Edit, Tools menu. Thus, the code is uploaded by the bootloader onto the microcontroller.

2)16 x 2 LCD Display x 1

A liquid-crystal display (LCD) is flat-panel display or electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly[1] instead using a backlight or reflector to produce images in color or monochrome.[2] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the color of the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance.

3)10KΩ Potentiometer

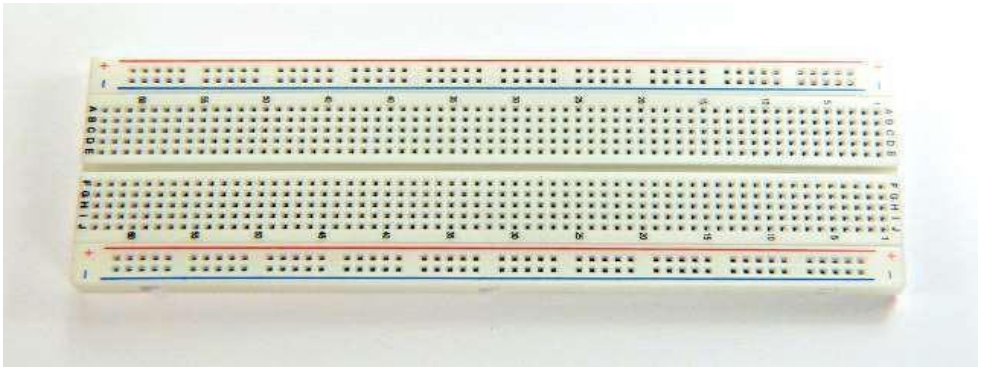
4)Heartbeat Sensor Module with Probe (finger based)



A heart rate monitor (HRM) is a personal monitoring device that allows one to measure/displa y heart rate in real time or record the heart rate for later study. It is largely used to gather heart rate data while performing various types of physical exerc ise . Measuring electrical heart information is referred to as Electrocardiography (ECG or EK G)

Medical heart rate monitoring used in hospitals is usually wired and usually multiple sensors are used. Portable medical units are referred to as Holter moni tor . Consumer heart rate monitors are designed for everyday use and do not use wires to connect.

5)Mini Breadboard



A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate.

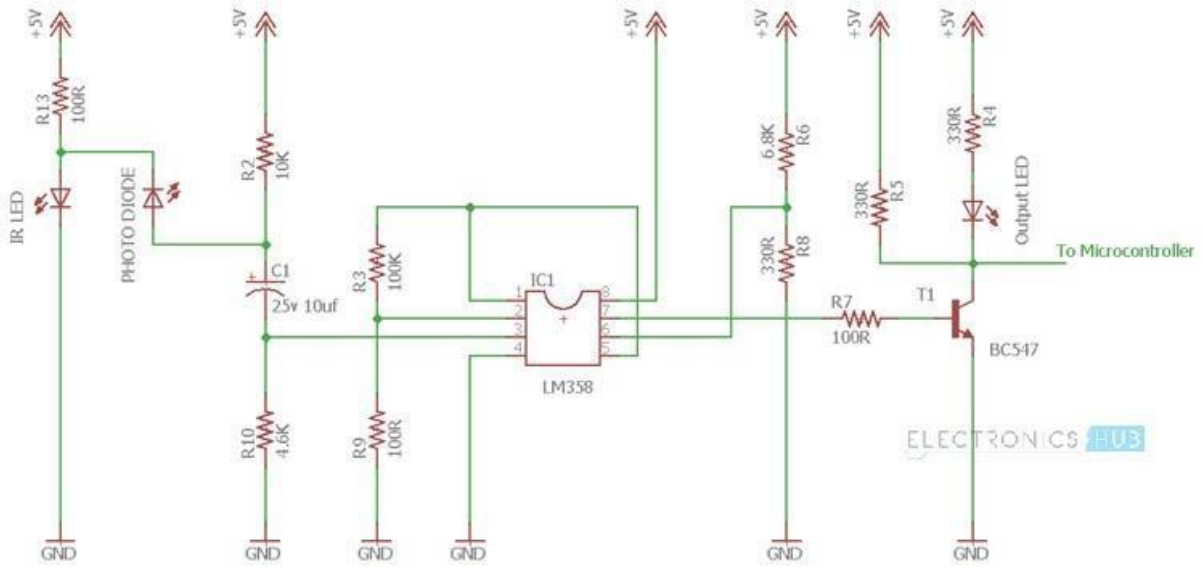
6)Connecting Wires

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

Working of Heartbeat Sensor

A simple Heartbeat Sensor consists of a sensor and a control circuit. The sensor part of the Heartbeat Sensor consists of an IR LED and a Photo Diode placed in a clip.

The Control Circuit consists of an Op-Amp IC and few other components that help in connecting the signal to a Microcontroller. The working of the Heartbeat Sensor can be understood better if we take a look at its circuit diagram.



The above circuit shows the finger type heartbeat sensor, which works by detecting the pulses. Every heartbeat will alter the amount of blood in the finger and the light from the IR LED passing through the finger and thus detected by the Photo Diode will also vary.

The output of the photo diode is given to the non – inverting input of the first op – amp through a capacitor, which blocks the DC Components of the signal. The first op – amp cats as a non – inverting amplifier with an amplification factor of 1001.

The output of the first op – amp is given as one of the inputs to the second op – amp, which acts as a comparator. The output of the second op – amp triggers a transistor, from which, the signal is given to a Microcontroller like Arduino.

The Op – amp used in this circuit is LM358. It has two op – amps on the same chip. Also, the transistor used is a BC547. An LED, which is connected to transistor, will blink when the pulse is detected.

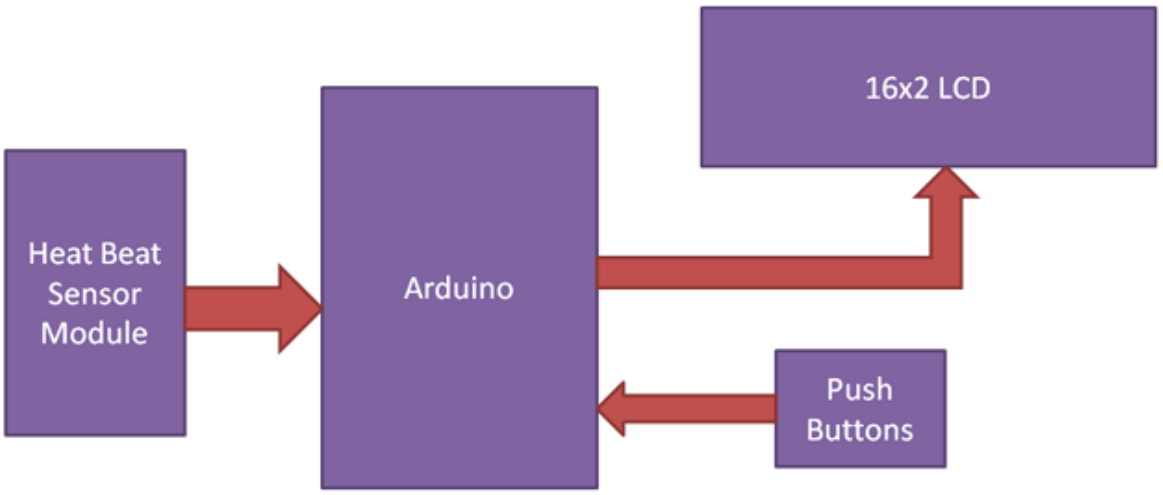
Working of this project is quite easy but a little calculation for calculating heart rate is required. There are several methods for calculating heart rate, but here we have read only five pulses. Then we have calculated total heart beat in a minute by applying the below formula:

Five_pusle_time=time2-time1; Single_pulse_time=
Five_pusle_time /5; rate=60000/ Single_pulse_time;
where time1 is first pulse counter value time2 is list
pulse counter value
rate is final heart rate.

When first pulse comes, we start counter by using timer counter function in arduino that is millis();. And take first pulse counter value form millis();. Then we wait for five pulses. After getting five pulses we again take counter value in time2 and then we substarct time1 from time2 to take original time taken by five pulses. And then divide

this time by 5 times for getting single pulse time. Now we have time for single pulse and we can easily find the pulse in one minute, deviding 600000 ms by single pulse time.

Rate= 600000/single pulse time.



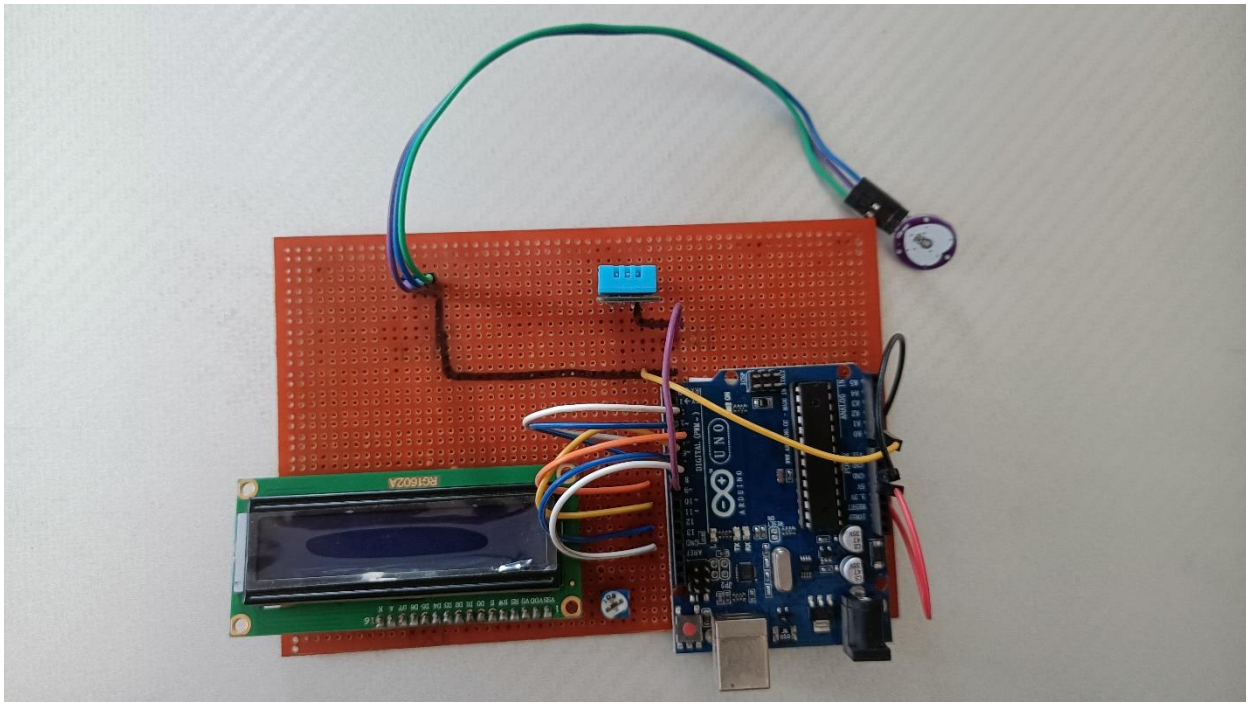
In this project we have used **Heart beat sensor module** to detect Heart Beat. This sensor module contains an IR pair which actually detect heart beat from blood. Heart pumps the blood in body which is called heart beat, when it happens the blood concentration in body changes. And we use this change to make a voltage or pulse electrically.

Circuit Design of Interfacing Heartbeat Sensor with Arduino

The circuit design of Arduino based Heart rate monitor system using Heart beat Sensor is very simple. First, in order to display the heartbeat readings in bpm, we have to connect a 16×2 LCD Display to the Arduino UNO.

The 4 data pins of the LCD Module (D4, D5, D6 and D7) are connected to Pins 1, 1, 1 and 1 of the Arduino UNO. Also, a 10KΩ Potentiometer is connected to Pin 3 of LCD (contrast adjust pin). The RS and E (Pins 3 and 5) of the LCD are connected to Pins 1 and 1 of the Arduino UNO.

Next, connect the output of the Heartbeat Sensor Module to the Analog Input Pin (Pin 1) of Arduino.



Finger measuring heartbeat module

This project uses bright infrared (IR) LED and a phototransistor to detect the pulse of the finger, a red LED flashes with each pulse. Pulse monitor works as follows: The LED is the light side of the finger, and phototransistor on the other side of the finger, phototransistor used to obtain the flux emitted, when the blood pressure pulse by the finger when the resistance of the photo transistor will be slightly changed. The project's schematic circuit as shown, We chose a very high resistance resistor R1, because most of the light through the finger is absorbed, it is desirable that the phototransistor is sensitive enough. Resistance can be selected by experiment to get the best results. The most important is to keep the shield stray light into the phototransistor. For home lighting that is particularly important because the lights at home mostly based 50HZ or 60HZ fluctuate, so faint heartbeat will add considerable noise.

When running the program the measured values are printed. To get a real heartbeat from this could be challenging.

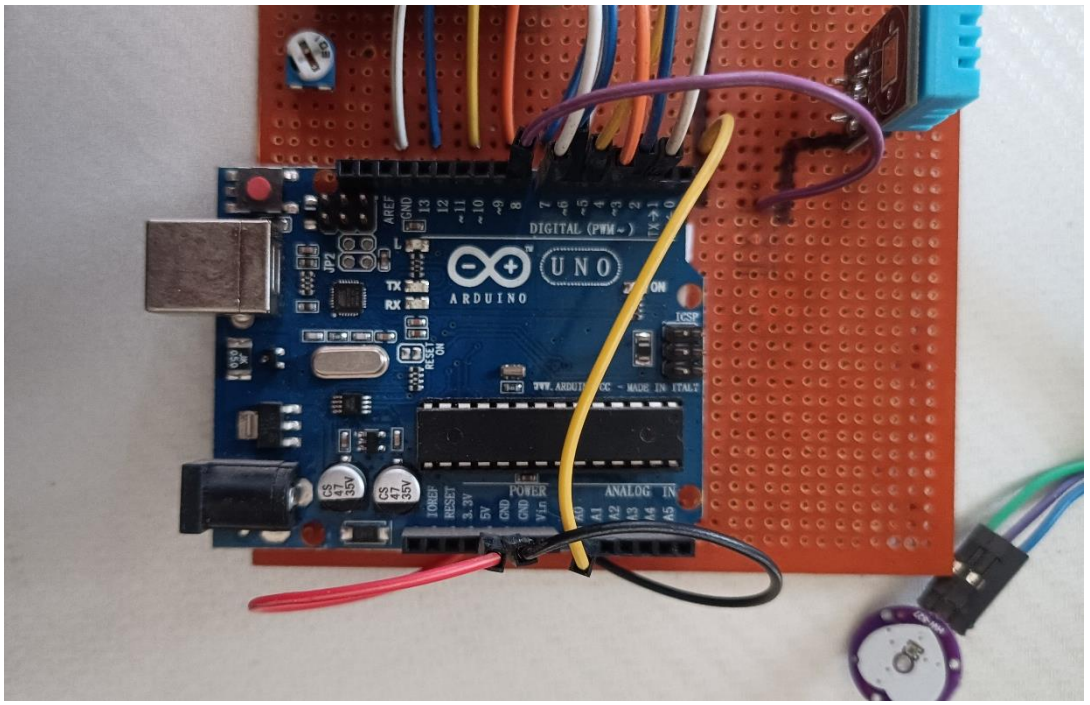
Working of the Circuit

Upload the code to Arduino UNO and Power on the system. The Arduino asks us to place our finger in the sensor and press the switch.

Place any finger (except the Thumb) in the sensor clip and push the switch (button). Based on the data from the sensor, Arduino calculates the heart rate and displays the heartbeat in bpm.

While the sensor is collecting the data, sit down and relax and do not shake the wire as it might result in a faulty values.

After the result is displayed on the LCD, if you want to perform another test, just push the rest button on the Arduino and start the procedure once again.


UNO
ARDUINO
DIGITAL (PWM~)
POWER
ANALOG IN

CODE

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(6, 5, 3, 2, 1, 0); int
data=A0;
int start=7;

int count=0;

unsigned long temp=0;



byte customChar1[8] = {0b00000,0b00000,0b00011,0b00111,0b01111,0b01111,0b01111,0b01111}; byte
customChar2[8] = {0b00000,0b11000,0b11100,0b11110,0b11111,0b11111,0b11111,0b11111}; byte
customChar3[8] = {0b00000,0b00011,0b00111,0b01111,0b11111,0b11111,0b11111,0b11111}; byte
customChar4[8] = {0b00000,0b10000,0b11000,0b11100,0b11110,0b11110,0b11110,0b11110}; byte
customChar5[8] = {0b00111,0b00011,0b00001,0b00000,0b00000,0b00000,0b00000,0b00000}; byte
customChar6[8] = {0b11111,0b11111,0b11111,0b11111,0b01111,0b00111,0b00011,0b00001}; byte
customChar7[8] = {0b11111,0b11111,0b11111,0b11111,0b11110,0b11100,0b11000,0b10000}; byte
customChar8[8] = {0b11100,0b11000,0b10000,0b00000,0b00000,0b00000,0b00000,0b00000};


void setup()

{

lcd.begin(16, 2); lcd.createChar(1,
customChar1); lcd.createChar(2,
customChar2); lcd.createChar(3,
customChar3); lcd.createChar(4,
customChar4); lcd.createChar(5,
customChar5); lcd.createChar(6,
customChar6);
lcd.createChar(7, customChar7);
```

```
lcd.createChar(8, customChar8);



pinMode(data,INPUT);

pinMode(start,INPUT_PULLUP);

}



void loop()

{

lcd.setCursor(0, 0); lcd.print("Place The Finger"); lcd.setCursor(0, 1); lcd.print("And Press Start");


while(digitalRead(start)>0);



lcd.clear();

temp=millis();



while(millis()<(temp+10000))

{

if(analogRead(data)<100)

{

count=count+1;



lcd.setCursor(6, 0); lcd.write(byte(1)); lcd.setCursor(7, 0); lcd.write(byte(2)); lcd.setCursor(8, 0);
```

```
lcd.write(byte(3));

lcd.setCursor(9, 0);

lcd.write(byte(4));



lcd.setCursor(6, 1);
lcd.write(byte(5)); lcd.setCursor(7,
1); lcd.write(byte(6));
lcd.setCursor(8, 1);
lcd.write(byte(7)); lcd.setCursor(9,
1); lcd.write(byte(8));


while(analogRead(data)<100);



lcd.clear();

}

}



lcd.clear(); lcd.setCursor(0, 0);
count=count*6; lcd.setCursor(2, 0);
lcd.write(byte(1)); lcd.setCursor(3,
0); lcd.write(byte(2));
lcd.setCursor(4, 0);
lcd.write(byte(3)); lcd.setCursor(5,
0);
lcd.write(byte(4));


lcd.setCursor(2, 1);
lcd.write(byte(5)); lcd.setCursor(3,
1); lcd.write(byte(6));
lcd.setCursor(4, 1);
lcd.write(byte(7)); lcd.setCursor(5,
1); lcd.write(byte(8));
lcd.setCursor(7, 1); lcd.print(count);
lcd.print(" BPM"); temp=0;
while(1);
```

}

Applications of Heart Rate Monitor using Arduino

- A simple project involving Arduino UNO, 16×2 LCD and Heartbeat Sensor Module is designed here which can calculate the heart rate of a person.
- This project can be used as an inexpensive alternative to Smart Watches and other expensive Heart Rate Monitors.

CONCLUSION

Upload the code to **Arduino** UNO and Power on the system. The **Arduino** asks us to place our finger in the **sensor** and press the switch. Place any finger (except the Thumb) in the **sensor** clip and push the switch (button). Based on the data from the **sensor**, **Arduino** calculates the **heart rate** and displays the **heartbeat** in bpm.

REFERENCES

- https://www.electronicshub.org/heartbeat-sensor-using-arduino-heart-rate-monitor/#Applications_of_Heart_Rate_Monitor_using_Arduino
- https://www.youtube.com/watch?v=_J7pyL_3-AI