PULSE OXIMETER

AND

PULSE RATE

MONITOR

ABSTRACT AND MOTIVATION:

This project deals with simulating a pulse oximeter and pulse rate monitor using the software Proteus and then making a working model using the various components required(Arduino UNO R3, MAX30100, etc.).

Among so many types of devices that are essential during the concerning hours of pandemic, the necessity of pulse oximeter can never be denied. As per information fetched and verified, the virus named SARS-COV-2 is highly infectious and causes critical respiratory illness. This is also one of the major reasons why each of us should stay aware of the importance of the pulse oximeter.

The non-invasive device named pulse oximeter is mainly used to measure the oxygen levels in the blood. Once we enter our fingertip into a specific section of this device, it automatically shows the numerical value of our pulse rate and SpO2. Now, it is necessary to know how it can be helpful during the concerning hours of pandemic. First of all, if it shows you a lower oxygen saturation, then it indicates that you may have any respiratory disease like COPD or Covid-19. Noticeably, Covid patients generally get a gradual oxygen-level drop and this is exactly how we can determine the presence of Covid-19 in our body through this device. As mentioned before, it can also help one know about any existing respiratory disease, which may turn deadly at the final stage. It is not hard to guess that these are the reasons why the use of pulse oximeter are hugely increasing day by day.

Due to the reasons mentioned above we tried to build a working model of a pulse oximeter.

CONCEPT OF PROOF:

Pulse Oximeter uses the principal of spectrophotometry. We check the relative amount of two wavelengths absorbed by our blood arteries. This device uses two types of light i.e., Red light (660nm) and Infrared ray (940nm).

Our blood contains two type of hemoglobin:

• Oxygenated Hemoglobin- Hemoglobin which gets linked with oxygen. This type of hemoglobin absorbs more of infrared light as compared to red light.

• Deoxygenated Hemoglobin: - This is just opposite of the Oxygenated hemoglobin; this is the hemoglobin which does not link with oxygen. It absorbs more of red light as compared to infrared light.

This device uses two types of wavelengths to measure the oxygen amount in our blood and blood pressure. There are two ways to get the information by using two type of wavelength which are:

• Transmission method

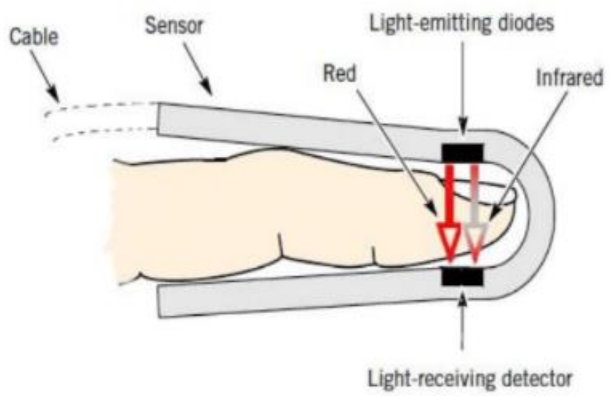
• Reflectance method

Transmission method:

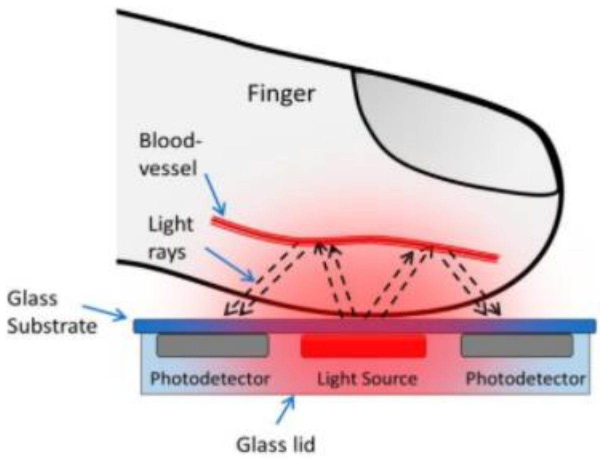
In transmission method, Light Emitting Diode and the light detector are present on different sides which are placed on probe. It is used to emit both the lights and make the light pass through our blood arteries. Some amount of the light gets absorbed and it decreases the intensity of light and remaining intensity of light gets detected by the detector and with the help of this data we get to know about our blood pressure and Saturation value of Oxygen in our blood (SpO_2).

Reflectance Method:

In Reflectance Method, Light Emitting Diode and detector are present on the same side of the probe. It emits both the lights and some of the light passes through the arteries and remaining light gets reflected from the arteries and then the reflected light reaches the detector and with the help of that data we can conclude the blood pressure and Saturation value of Oxygen in our blood (SpO2).



Transmission method



Reflectance method

METHODOLOGY ADOPTED:

In this project we interfaced MAX30100 Pulse Oximeter Sensor with Arduino that can measure Blood Oxygen & Heart Rate and display it on 16x2 LCD Display. The blood Oxygen Concentration termed as SpO2 is measured in Percentage and Heart Beat/Pulse Rate is measured in BPM. The MAX30100 is a Pulse Oximetry and heart rate monitor sensor solution.

The components used were:

1. MAX30100 Pulse Oximeter:

The sensor is an integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LED's, a photo detector, optimized optics, and low-noise analog signal processing to detect pulse and heart-rate signals. It operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.

2. Arduino UNO R3 Development Board:

Arduino UNO is microcontroller based on ATmega328P. This board contains 20 pins out of which 14 are digital pins and 6 are analog pins. It is programmable with the Arduino IDE and the program is transferred in the board by using Type B wire. It also powered by USB cable (type B) and it can also be powered by an external power source.

3. LCD display (16x2)

4. Potentiometer (10k)

5. Jumper wires

For interfacing the MAX30100 Pulse Oximeter Sensor with Arduino and displaying the value in serial monitor we connected the Vin pin of MAX30100 to Arduino 5V pin, GND to GND. And we connected the I2C Pin, SCL & SDA of MAX30100 to A5 & A4 of Arduino.

But we needed the values to be displayed on the LCD display as well. For that we connected the Vin pin of MAX30100 to Arduino 5V, GND to GND. Then the I2C Pin, SCL & SDA of MAX30100 to A5 & A4 of Arduino. Similarly we connected the LCD pin 1, 5, 16 to GND of Arduino and 2, 15 to 5V VCC. Then we connected LCD pin 4, 6, 11, 12, 13, 14 to Arduino pin 13, 12, 11, 10, 9, 8. We also used 10K Potentiometer at pin 3 of LCD to adjust the contrast of LCD.

IMPORTANT OBSERVATIONS:

Motion artefact is a common cause of erroneously low readings and false alarms. Movement such as that caused by shivering or by conditions marked by seizures or tremors can hamper the sensor's ability to accurately detect the amounts of light absorbed. Improper fixing of the sensor (too loose or too tight), can also cause motion artefact.

Heart rate tests evaluated the pulse oximeter's ability to read these heart rate values correctly. Pulse oximeter readings of the heart rate were accurate to within ±3 BPM, although the device needed approximately 10 seconds to stabilize to the correct value. Oxygenation testing produced a trial with SpO2 values between 70-100% which settled near the intended value, but varied within ±4% over time. The oxygenation displayed was observed to fluctuate anywhere between 0-100% given alterations in finger dock to probe attachment, probe alignment, and wall stabilization. Oxygenation values also depend greatly on maintaining proper probe placement on the finger dock.

Higher than normal levels of carboxyhemoglobin (carbon monoxide-bound hemoglobin) or methemoglobin (created when the iron in hemoglobin oxidizes) also skew pulse oximetry readings.

These substances absorb the oximeter's red and infrared wavelengths similarly to hemoglobin and oxyhemoglobin. Patients who have suffered smoke inhalation or carbon monoxide poisoning will have higher levels of carboxyhemoglobin. And higher levels of methemoglobin may occur with overexposure to various substances, such as nitrites and some topical anaesthetics. Patients so exposed should be monitored by alternative methods. Conditions that cause low blood flow or decreased perfusion will affect pulse oximetry readings. If the arterial pulse is weak, the oximeter will have difficulty isolating its signal from those of the surrounding venous blood, bone, and tissue.

CONCLUSIONS AND FUTURE SCOPE:

Pulse oximeter is probably one of the most important devices in respiratory monitoring over the last few years; numerous studies have focused on the technical aspects of the pulse oximeter and found that these instruments have a reasonable degree of accuracy, coupled with ease of operation. Most medical instruments have led to the wise spread use of the pulse oximeter for monitoring patients especially in ICUs.

We have shown and proven with the implementation design, and result that a pulse oximeter signal can be obtained using transmission of light through the finger, which then can be processed by the necessary circuitry.

We can conclude from our results that the theory governing the design of the core has great potential. The values for blood oxygenation follow a pattern similar to those we had expected to be produced. Thus making a few basic alterations to the overall design of our device would improve its performance significantly.

This set up can be installed in a mobile device like a watch by the virtue of which it can be accompanied by the user almost anywhere. It is a must have device for people with cardiac problems and can be used to do acute and quick health check-up. Before any sports event, this device can be used to check the health conditions of athletes. This device is quite convenient to be used by senior citizens. It can be used to check the wellbeing of people in manual labour sector.

CREDITS AND RESPONSIBILITIES:

1. Aditya Pal (20BT10004)

Supervision of the project and preparing project report

2. Ayashkanta Mishra (20ME10027)

Hardware setup and making video demonstrating final product

3. Chaitanya Gaur (20MA20017)

Writing code and editing lab report and ppt

4. Burra Nithish (20CS10018)

Code debugging and making ppt

References:

https://how2electronics.com/interfacing-max30100-pulse-oximeter-sensor-arduino/

Link of Video:

https://www.youtube.com/watch?v=7rGLp_dGRfs&feature=youtu.be

APPENDIX 1:

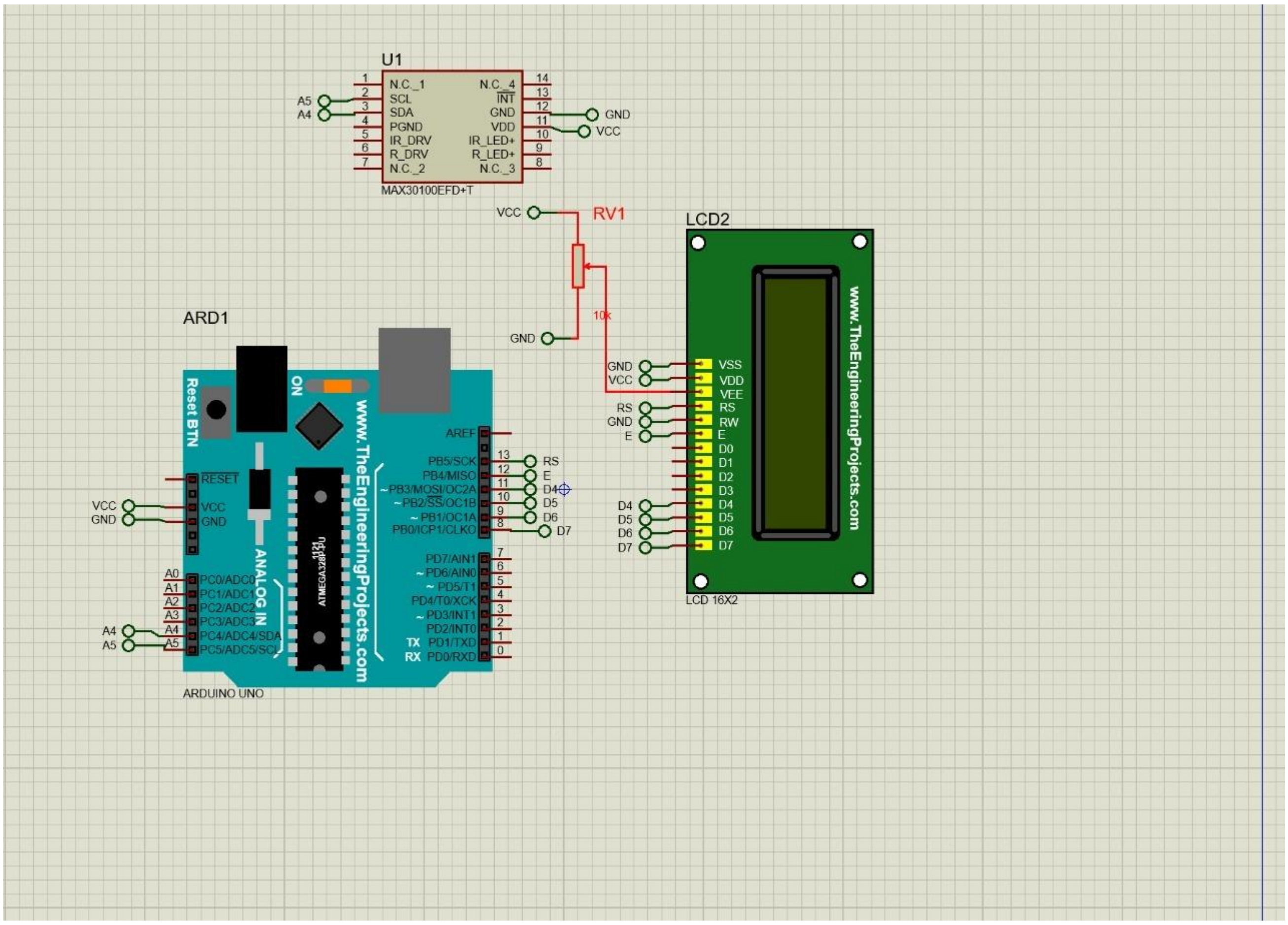
```
//code begins
#include <LiquidCrystal.h>
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
LiquidCrystal lcd(13,12,11,10,9,8);
#define REPORTING_PERIOD_MS 1000
PulseOximeter pox;
uint32_t tsLastReport= 0;
void onBeatDetected()
{
Serial.println("Beat!");
}
void setup()
{
Serial.begin(115200);
Serial.print("Initializing pulse oximeter..");
lcd.begin(16,2);
lcd.setCursor(0,0);
// this complete page contains the commands related to user interface
{
lcd.println("WELCOME USER");
delay(1000);
lcd.setCursor(0,1);
```

```
lcd.print("PULSE OXIMETER");
delay(2000);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("MEMBERS");
delay(2000);
lcd.clear();
lcd.setCursor(0,0);
lcd.println("AYASHKANTA MISHRA");
lcd.setCursor(0,1);
lcd.print("20ME10027");
delay(3500);
lcd.clear();
lcd.setCursor(0,0);
lcd.println("CHAITANYA GAUR");
lcd.setCursor(0,1);
lcd.print("20MA20017");
delay(3500);
lcd.clear();
lcd.setCursor(0,0);
lcd.println("ADITYA PAL");
lcd.setCursor(0,1);
lcd.print("20BT10004");
delay(3500);
lcd.clear();
```

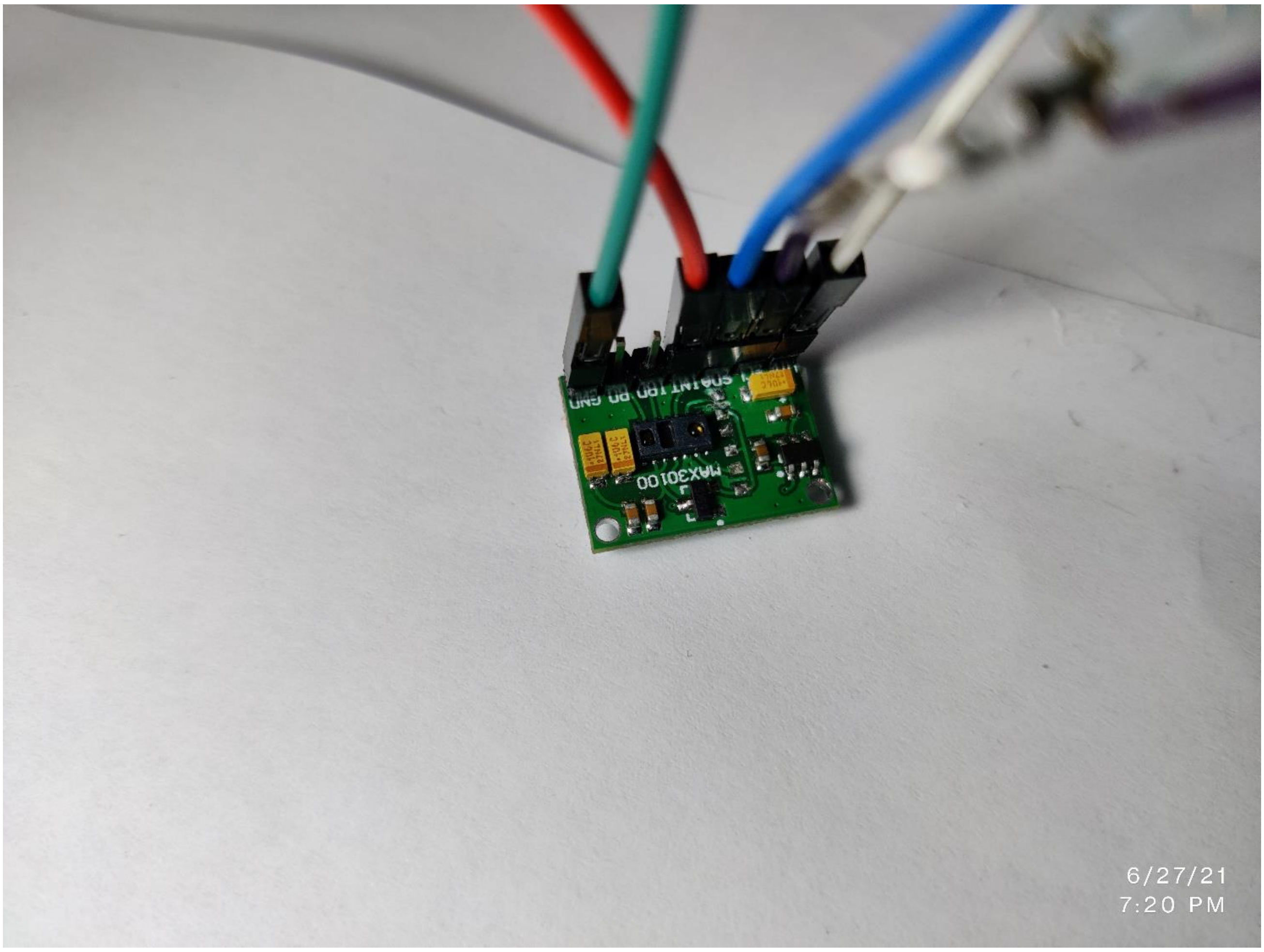
```
lcd.setCursor(0,0);
lcd.println("BURRA NITHISH");
lcd.setCursor(0,1);
lcd.print("20CS10018");
delay(3500);
lcd.clear();
}
lcd.print("Initializing...");
delay(3000);
lcd.clear();
if (!pox.begin()) {
Serial.println("FAILED");
for(;;);
} else {
Serial.println("SUCCESS");
}
pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);
// Register a callback for the beat detection
pox.setOnBeatDetectedCallback(onBeatDetected);
}
void loop()
{
// Make sure to call update as fast as possible
pox.update();
if (millis()-tsLastReport > REPORTING_PERIOD_MS) {
```

```
Serial.print("Heart rate:");
Serial.print(pox.getHeartRate());
Serial.print("bpm / SpO2:");
Serial.print(pox.getSpO2());
Serial.println("%");
lcd.clear();
lcd.setCursor(0,0);
lcd.print("BPM : ");
lcd.print(pox.getHeartRate());
lcd.setCursor(0,1);
lcd.print("SpO2: ");
lcd.print(pox.getSpO2());
lcd.print("%");
tsLastReport = millis();
}
}
```

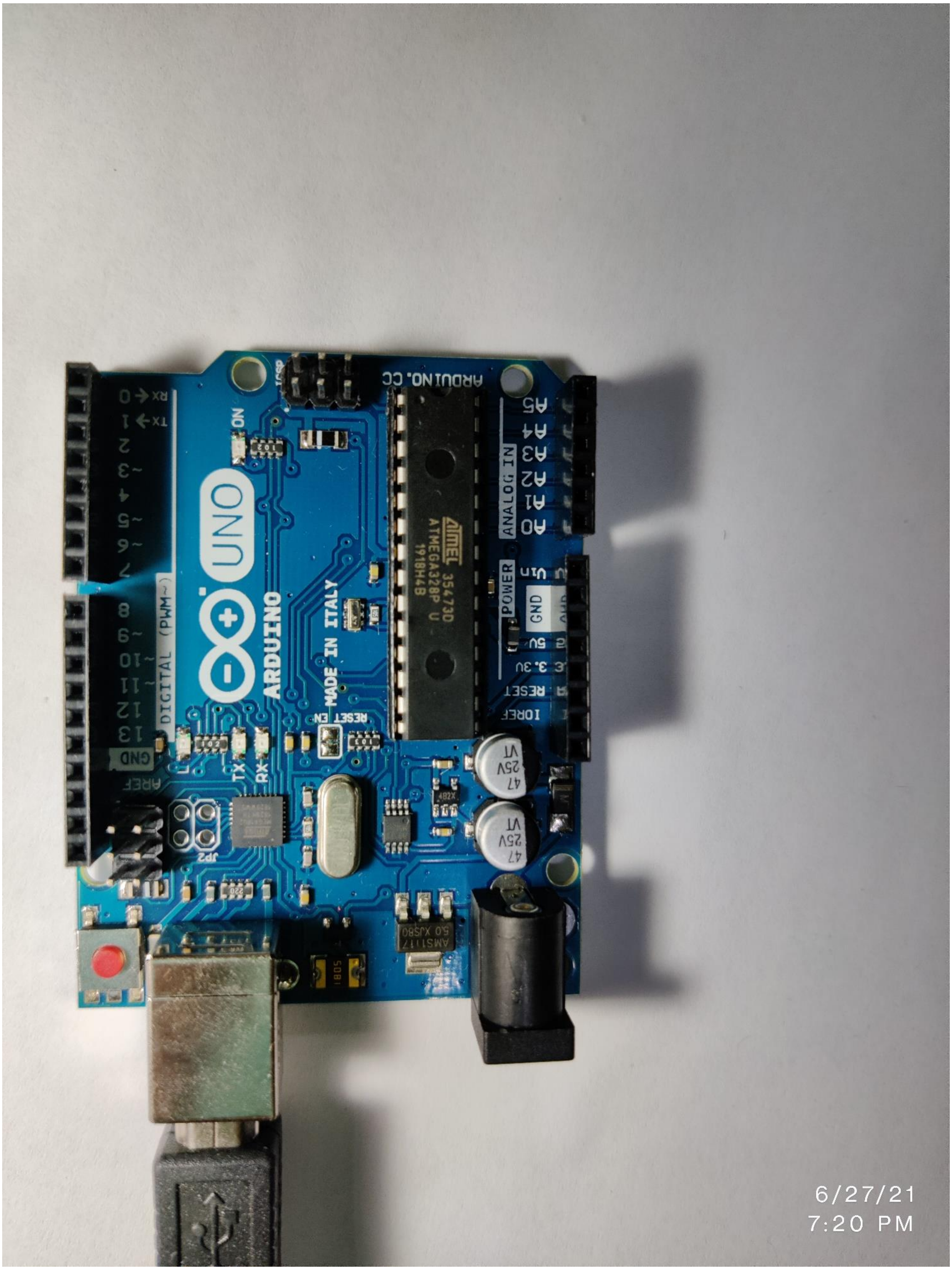
APPENDIX 2:



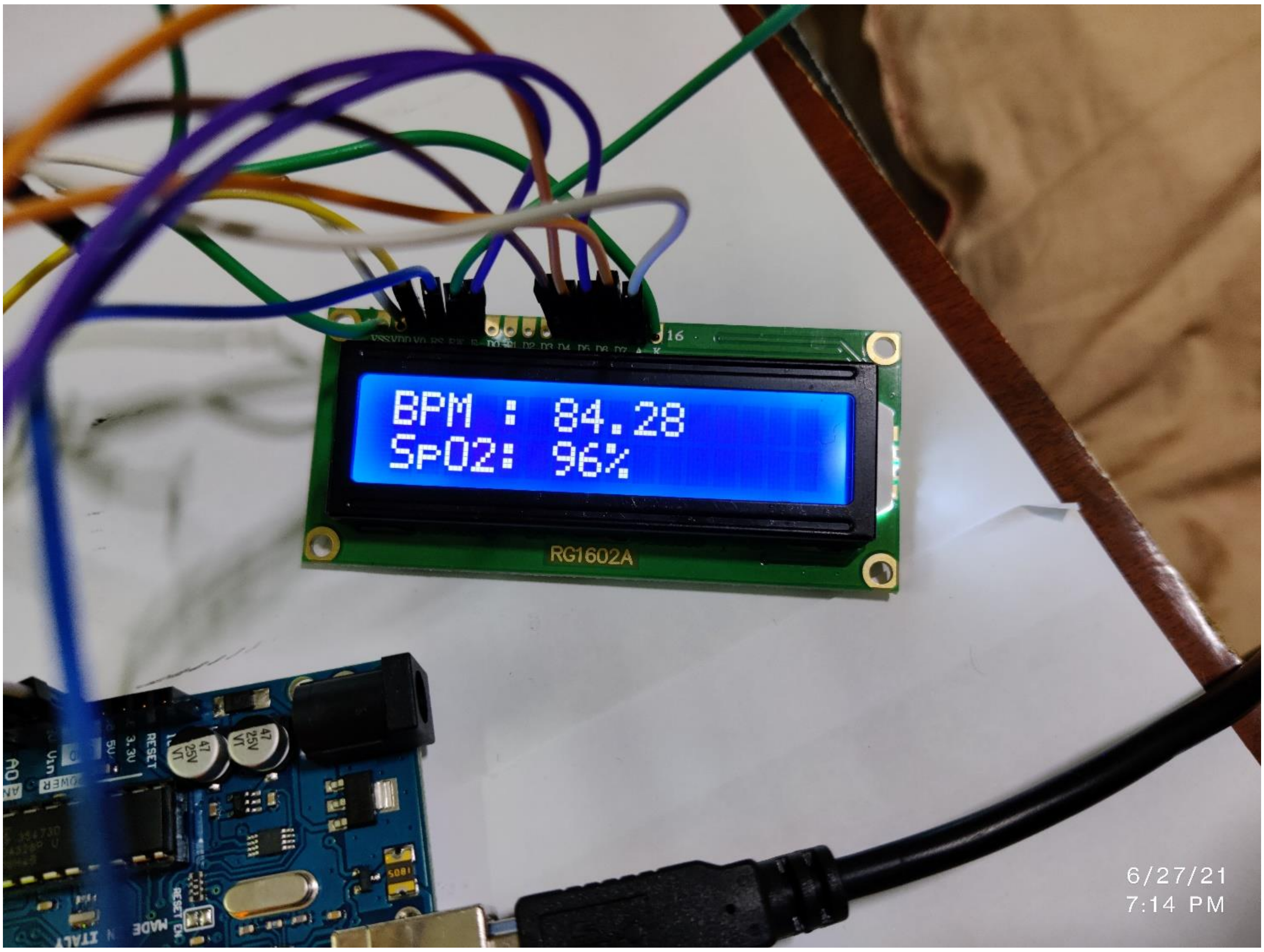
Circuit simulated on Proteus



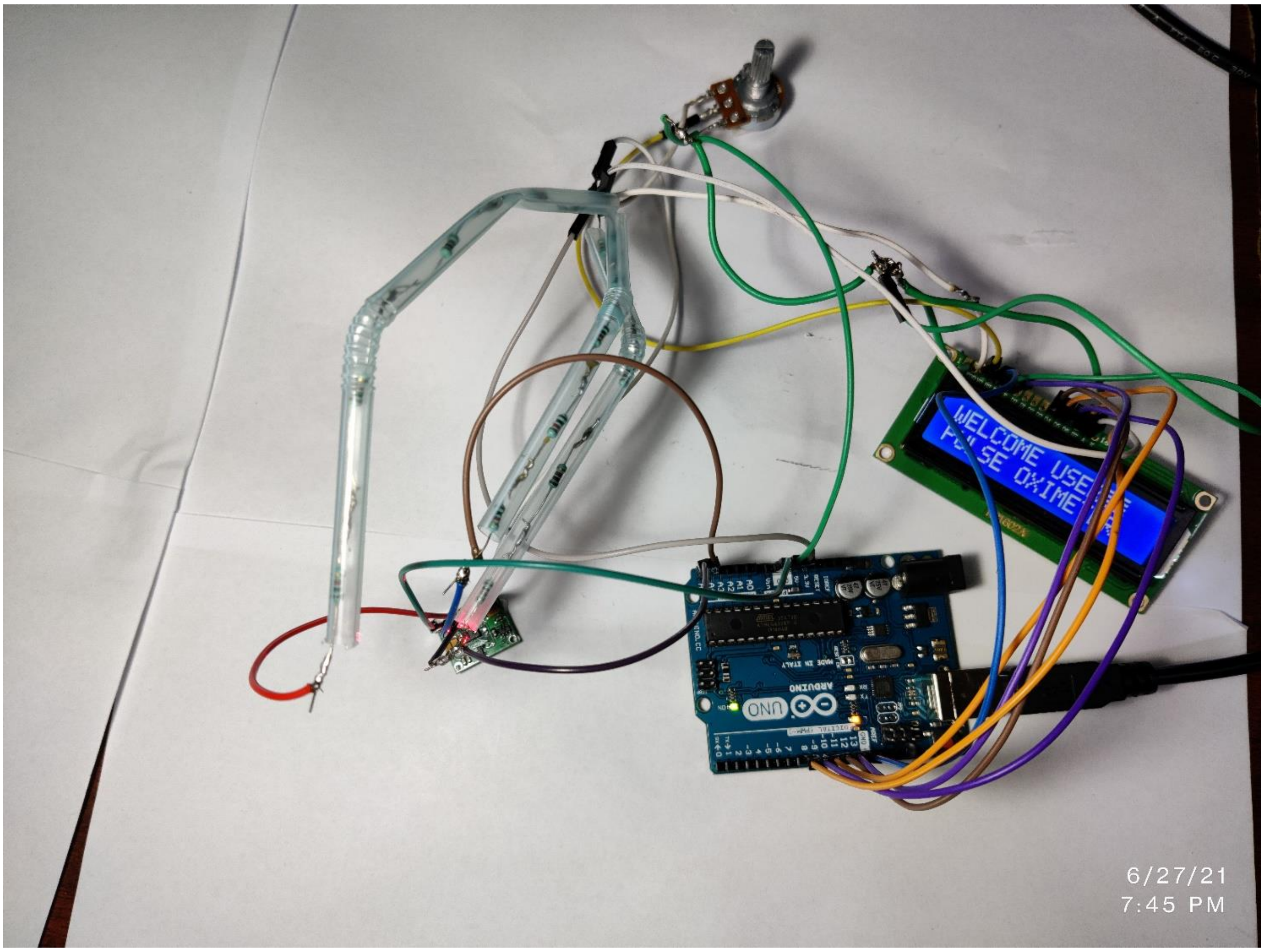
MAX30100 Sensor



<u>Arduino UNO R3 board</u>



LCD Display (16x2)



Completed project

APPENDIX 3:

Serial No.	Component name	Price(in INR)
1	Arduino UNO R3 board	999
2	MAX30100 sensor	468
3	Potentiometer(10K)	99
4	LCD display(16x2)	215
5	Jumper Wires	115