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Original Research

Design and Implementation a Device that Monitoring Oxygen Saturation in Blood for Smoking People

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Abstract:

This is normally done by acquiring data from volunteers, after which the necessary coefficients are extracted, for computing the saturated oxygen content. Such a calibration technique is dependent on the sample population, and hence is undesirable. The work presented here, makes use of a calibration-free algorithm published earlier, incorporating it into a micro-controller, leading to a compact, power-efficient, oximeter. Moreover, present day oximeters do not give access to the raw PPG data, which could be used for extracting important cardiovascular parameters. The preliminary design presented here provides a serial port interface in order to acquire and communicate the PPG signal to a PC, for further offline analysis.

1.1 Introduction:

This chapter will deal with a general introduction about the project, previous research, and the goal of the work of the device.

1.2 Pulse Oximetry:

It is a technique used to indirectly know the percentage of oxidation of blood (the direct method is to take a sample of arterial blood and analyze it) and the device also measures the number of heartbeats. Although the device's oxygen saturation reading is not always identical to the arterial SaO2 reading from an arterial blood gas analysis, it is a safe, convenient, and not invasive or costly method for measuring blood oxygen saturation in clinical use. The first device was invented in 1940 by the scientist Milliken [1].

1.3 Background | Historical Reviewd

Cristian Rotariu et al. proposed an efficient long time continuous patient monitoring

system, which includes determination of oxygen saturation level in blood and heart rate and provides a better medical assistance for patients. This system includes SpO2 and heart rate acquisition by using wireless network in support of microcontroller firmware and provides the results in central monitoring system using graphical user interface. To determine the precision of SpO2 and HR, they have considered METRON simulator through which better accuracy has been maintained. The major advantage of this methodology is that it is used for remote monitoring of patients suffering from chronic diseases [2].

A survey was done by Alexandros pantelopoulos et al. which made study of wearable sensor-based system for health monitoring. The study was on different bio signal like ECG, BP, RR, SPO2, HR, Glucose level, EMG and EEG. The wearable sensors used for determination of these bio signals are chest electrodes, piezoelectric sensor, oximeter, strip base glucose meter, skin electrodes and scalp placed electrodes respectively. In this survey oximeter is defined as "a device which indicates the oxygenation or the amount of oxygen that is being carried in a patient's blood" [3].

An online based graphical display system was developed in determination of Spo2 and heart rate by Dilpreet Kaur et al. This system consists of a photo-platysma-graph probes that senses PPG signal and converts it into electrical signal which is then passed onto driver circuit. This circuit corresponds to the controlling of led switching with monitoring of ac & dc components. Further, this data is passed onto amplifier which improvises the signal strength and converts the data into digital signal using ADC. This signal is further processed by microcontroller and displayed [4]. Sangeeta Bagha et al. made a real time analysis of photoplethysmography signal for determination of oxygen saturation level and rate. This system involves development of the oximeter system in support of LabVIEW software. The hardware system includes sensor unit followed by transimpedance amplifier and sample hold circuit to obtain red and infrared PPG. This data is passed onto LabVIEW through DAC. This system is real time feasible which would reduce the performance of conventional oximeter [5]. Gayathri.R et al. developed a oximeter using MSP microcontroller. This system majorly classified into transmitter and receiver section. In transmitter section, the Spo2 signal from the sensor module is amplified by op-amps followed by ADC conversion. This digital data is transmitted to the receiver section by the support of Zigbee module. In the receiver section, Zigbee module supports in reception of transmitted data which is further stored in AT mega controller and displayed in PC. The main advantage of this system is to reduce the power consumption [6]. M. Laghrouche et al. designed a low-cost embedded oximeter for the purpose of diagnosing and treatment of diseases using medical devices. In this method, a wearable oximeter system used for continuously monitoring physiological signals which is difficult for the advancement of diagnosing and treatment of diseases. The device used to measure heart rate and SpO2 can be measured by nonprofessionals at homes. This system measures real time data for the analysis of arterial SpO2 and heart rate using wireless transmission [7]. Raksha Iyer et al. proposed an advanced low-cost system for the determination and calculation of physiological parameters of human subjects. In this system the heart rate is measured by heartbeat sensors. Oxygen saturation level, heart rate is determined by oximeter. Temperature determination is done by LM34, and the weight is determined by weight sensor. These sensors are monitored, and the signals are processed by passing through signal conditioning and microcontroller and its results are displayed in display unit [8]. Kiran Kumar et al. using a programmable system on chip, they developed portable health monitoring system. The main objective is to design a low cost, low power consumption and use of flexible network for determination of heart rate, oxygen rate, PH level and ECG. In this method, the sensor signal is passed on to PSoC circuit which is processed by using the inbuilt ADC, UART, Amplifier and microcontroller whose results are displayed on LCD with the support of trans receiver units. The major feature of this technique is use of PSoC circuits in replacement of microcontroller. However, the system is yet to be properly implemented as the device size is larger and is not feasible for daily life usage [9]. Abhishek Ekhare et al. developed an efficient oximetry technique which quickly determines the decrease in patient's blood oxygen saturation levels and rate. This system uses a wireless technique to transfer the results to a remote location like computer or mobile phones in emergency conditions. The data from the oximeter probe is passed onto photo detector from which is given to signal conditioning circuit that consists of multiple filters and amplifiers and is given to the microcontroller unit for monitoring applications and transmitted via GSM module. The information regarding reduction of Spo2 rate falling below 90% or pulse rates below 60 or above 150 is immediately noticed and passed onto health care consultant. It is tested on real time patients and proved to be efficient [10].

1.4 Aim of Work:

Design a monitoring device, Arduino based kit that provides simultaneously data about the oxygen saturation in the blood and make a difference between smokers and non-smokers people, then showed the results by using digital display.

2.2 Types of Oxygen Meter Device:

According to the Food and Drug Administration (FDA)Trusted Source, there are two types of oximeters [11]: Prescription oximeters: These are FDA-reviewed and require a prescription. Doctors typically use these devices at clinics or in hospital settings. Over-the-counter (OTC) oximeters: The FDA does not review these products, and they do not require a prescription. People can buy them for home use at drugstores or online. They are not medical devices, which means they may be more suitable for people who play sports or participate in aviation activities.

Research suggests that cheaper, OTC, and non-FDA-approved devices may eventually be able to provide medically accurate oxygen level readings. According to a 2016 study, while many affordable devices did not provide accurate readings, others provided readings similar to FDA-approved devices. The researchers also note that none of the devices reached the standards set by the World Federation of Societies of Anaesthesiologists. Yet the study authors express hope for the eventual clinical use of more affordable oximeters in clinical or other settings. when oximeter used first? 1940's: Millikan, a British scientist, used a dual light source to create the first practical aviation ear oxygen meter. During Second World War, many pilots were saved from under pressurized cabins by using oximetry testing.

2.3 Components of the device used in the particle side:

1- OXEMETER SENSOR MAX 30 100 Oximeter sensor for measuring oxygen in the blood through the finger and for measuring heart rate as well. It is called the SpO2 sensor. The sensor is used in various medical applications. The energy consumption of this sensor is very low, so it can be used with the simplest batteries and for long periods, such as portable monitoring devicesa [12].

Figure 2.1: Oxemeter Sensor Max 30 100

2- ARDUINO Nano

is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output [13].

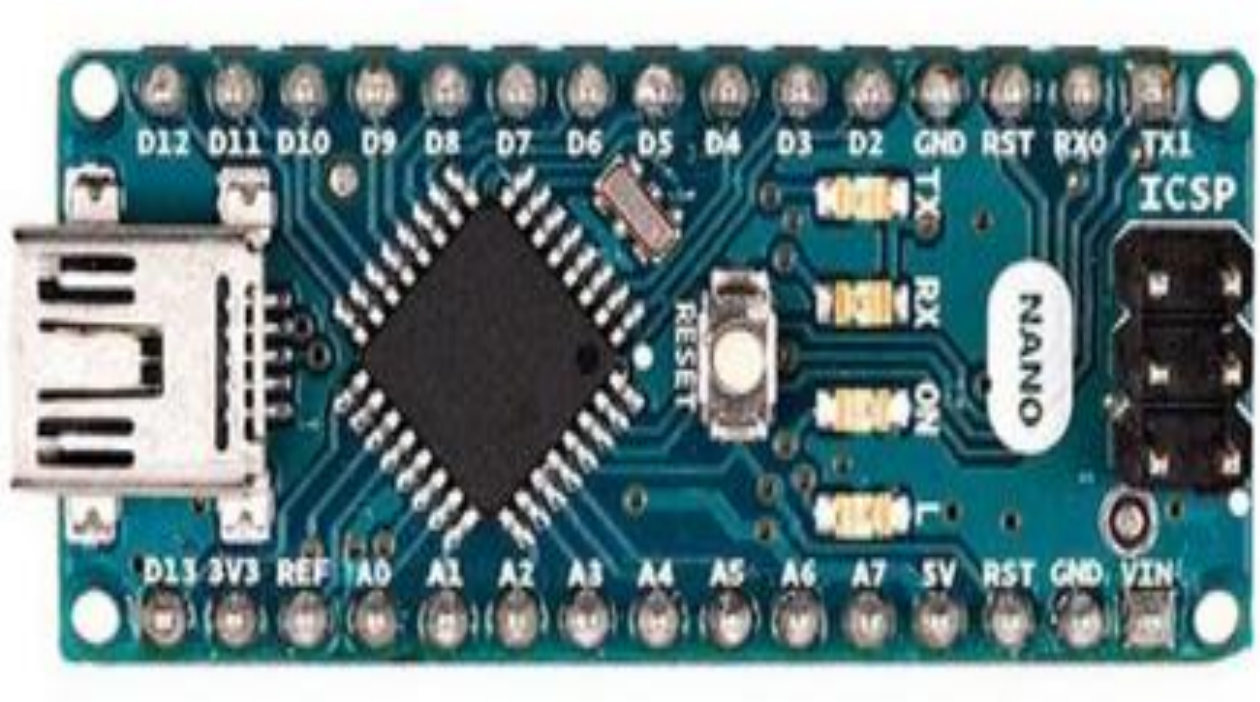


Figure 2.2: Arduino Nano.

3- Bread BOARD

The Breed board, also known as the project steering committee, is responsible for ensuring that the project is properly managed. The project board may be for that specific project [14].

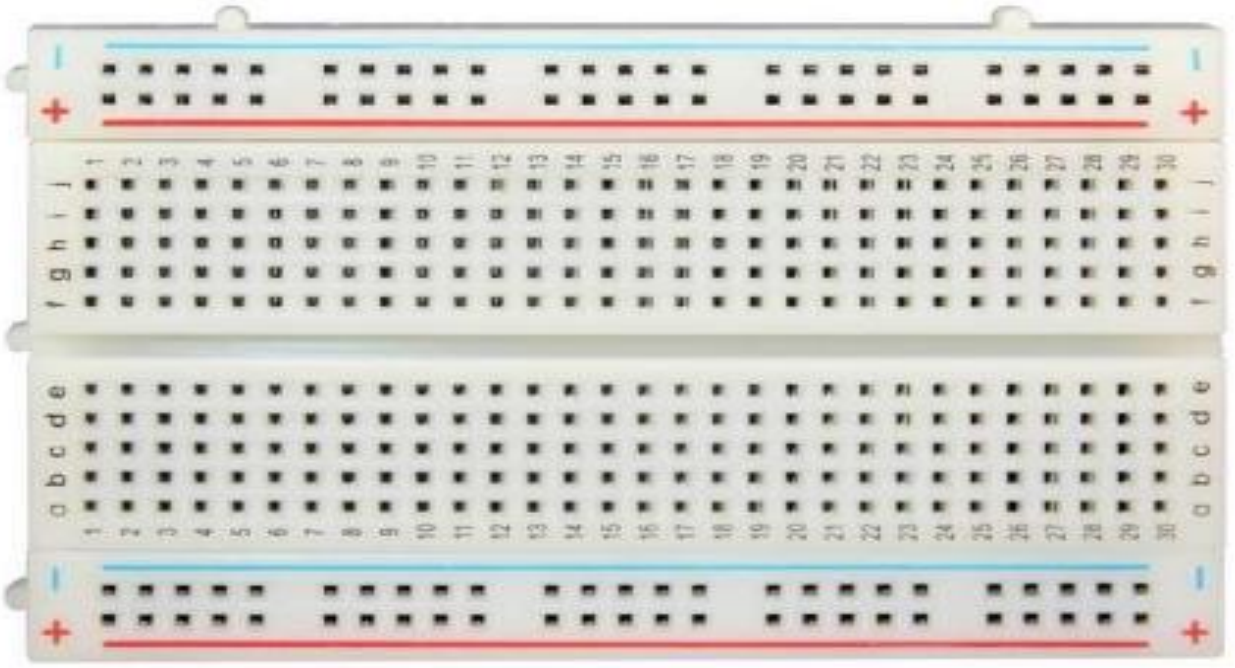


Figure 2.3: bread board

4- Simple LCD Screen

A liquid crystal display (LCD) is an optical device consisting of crystals arrayed on a thin surface divided into many pixels supported by a backlight. The crystal converts polarized light to show an image, symbol, or signal. The screen consists of pixels that display dots of color or light. By means of the electric field we control the direction of the light and with the help of polarization filters and backlights [15].

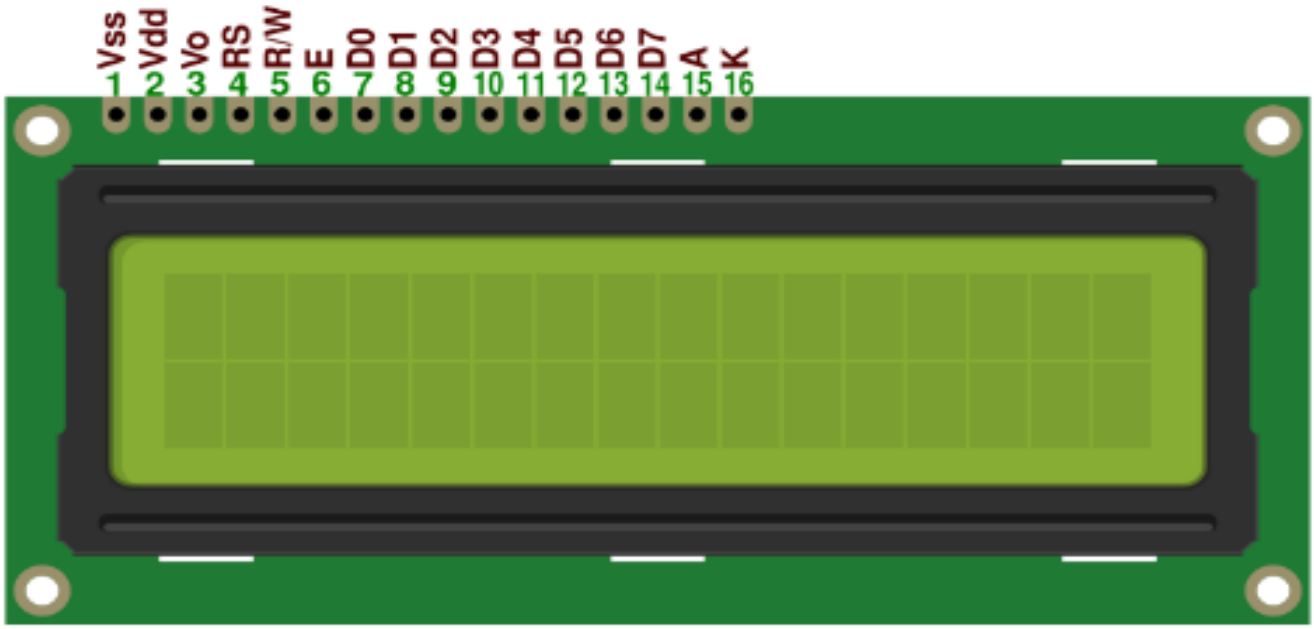


Figure 2.4: 16×2 LCD interfacing.

5- transformed

It is a transformer that receives an alternating voltage difference of a value ranging between 220 volts to 240 volts and converts it to 12 volts or 24 volts alternating. The coils are attached to the center of the transformer with adhesive tape, so the term transformer center is tapped 12_0_12

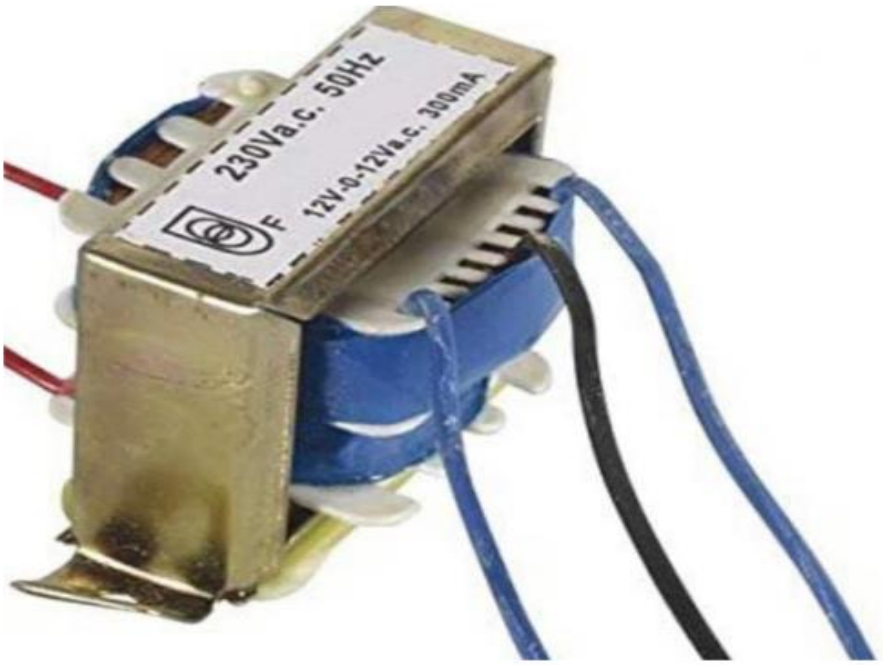


Figure 2.4: BETTERY 9V

2.4 The System Advantage:

oximeters are useful for people who have conditions that affect oxygen saturation. For example, a sleep specialist might recommend an oximeter to monitor the nighttime oxygen saturation level of someone with suspected sleep apnea or severe snoring. oximetry can also provide feedback about the effectiveness of breathing interventions, such as oxygen therapy and ventilators. Some doctors use oximetry to assess the safety of physical activity in people with cardiovascular or respiratory problems, or may recommend that a person wears a oximeter while exercising. A doctor may also use oximetry as part of a stress test.

Some hospitals also use oximeters for particularly vulnerable patients. For instance, infants in neonatal intensive care units may wear oximeters, which can alert staff of a drop in oxygen saturation.

2.5 Some benefits of oximetry include:

- monitoring oxygen saturation over time.
- alerting to dangerously low oxygen levels, particularly in newborns.
- offering peace of mind to people with chronic respiratory or cardiovascular conditions.
- assessing the need for supplemental oxygen.
- monitoring oxygen saturation levels in people under anesthesia.
- indicating dangerous side effects in people taking drugs that affect breathing or oxygen saturation

3.2 System Unites

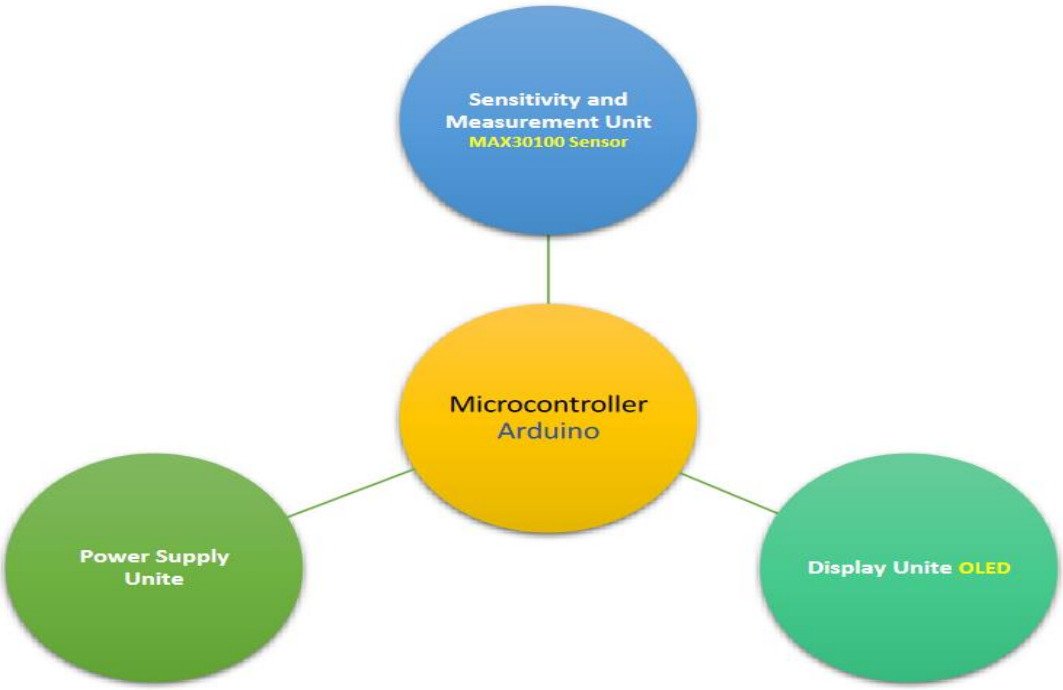


Figure 3.1: System Unites

3.2.1 Microcontroller:

Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Nano board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery. Arduino Nano Programming The programming of an Arduino nano can be done using the Arduino software.

Difference between Arduino Nano and Arduino Nano. The Arduino Nano board is like an Arduino Nano board including similar microcontroller like Atmega328p. Thus, they can share a similar program. The main difference between these two is the size. Because Arduino Nano size is double to nano board. So, Nano boards use more space on the system. The programming of Nano can be done with a USB cable whereas Nano uses the mini-USB cable. [17]

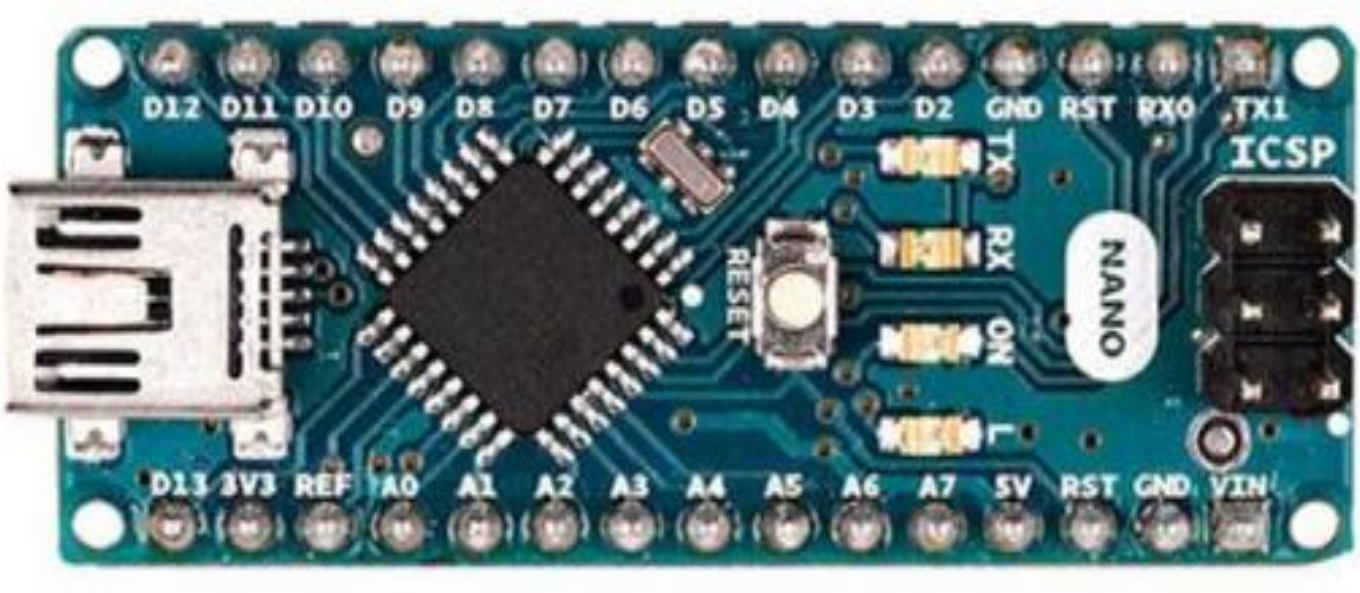


Figure 3.2: Arduino Nano

3.2.2 Sensitivity and Measurement Unit:

MAX30100 Sensor

MAX30100 Pulse Oximeter SpO2 and Heart-Rate Sensor Module The MAX30100 is an integrated pulse oximetry and heartrate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. The MAX30100 breakout operates from 1.8V and 5.5V. The device has two LEDs, one emitting a red light, another emitting infrared light. For pulse rate, only the infrared light is needed. Both the red light and infrared light is used to measure oxygen levels in the blood. When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood also decreases. By knowing the time between the increase and decrease of oxygenated blood, the pulse rate is determined. It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. It connected with Arduino [18]

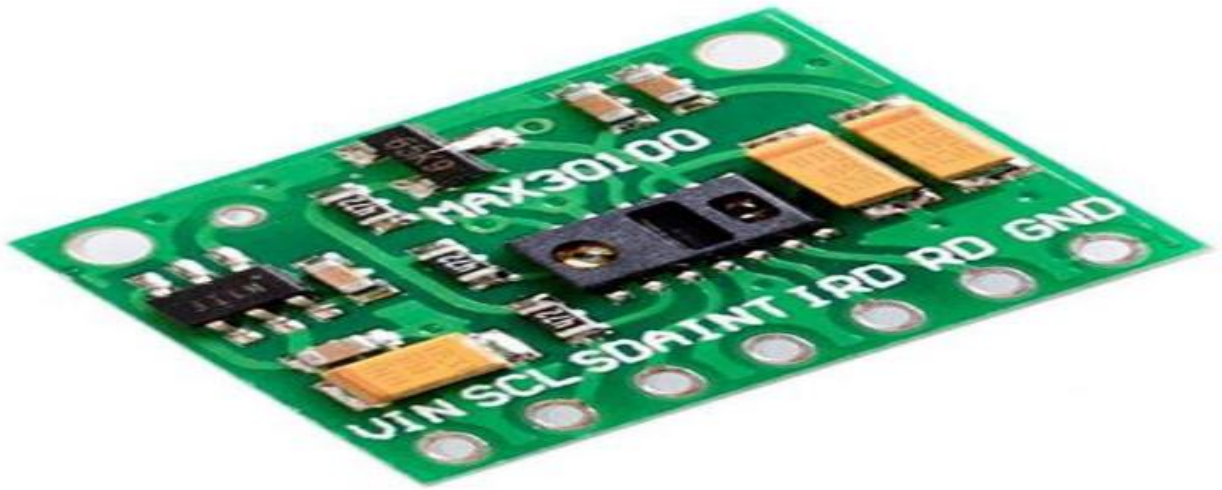


Figure 3.3: MAX30100 Sensor.

3.2.3 Display Unite

LCD SCREEN

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. he main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc. [19]

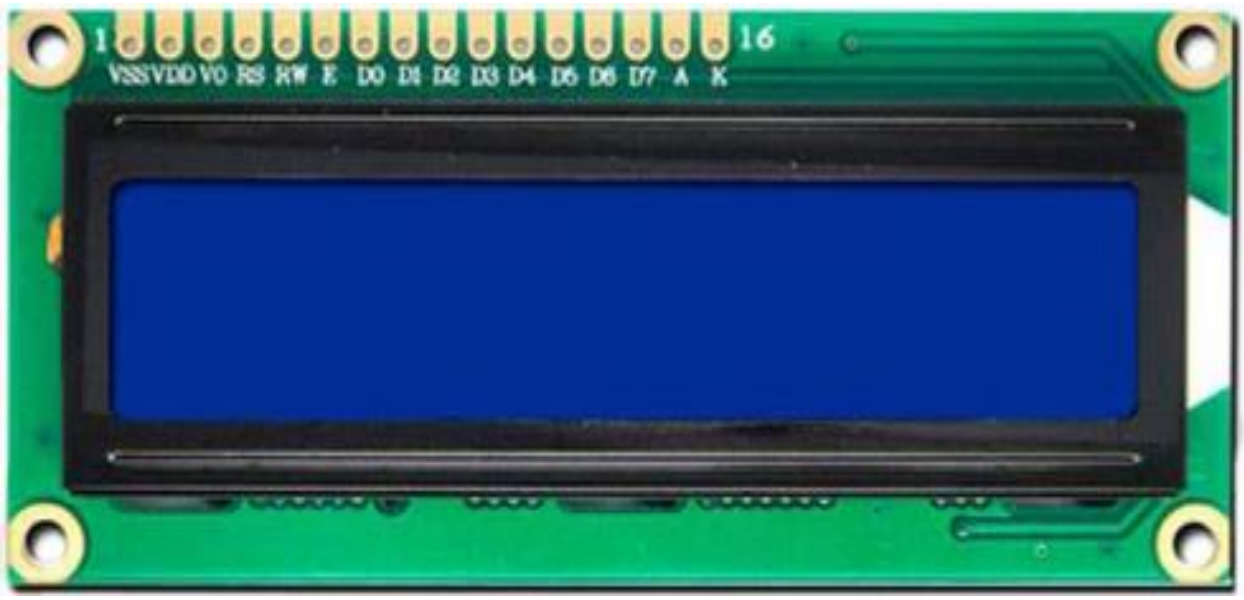
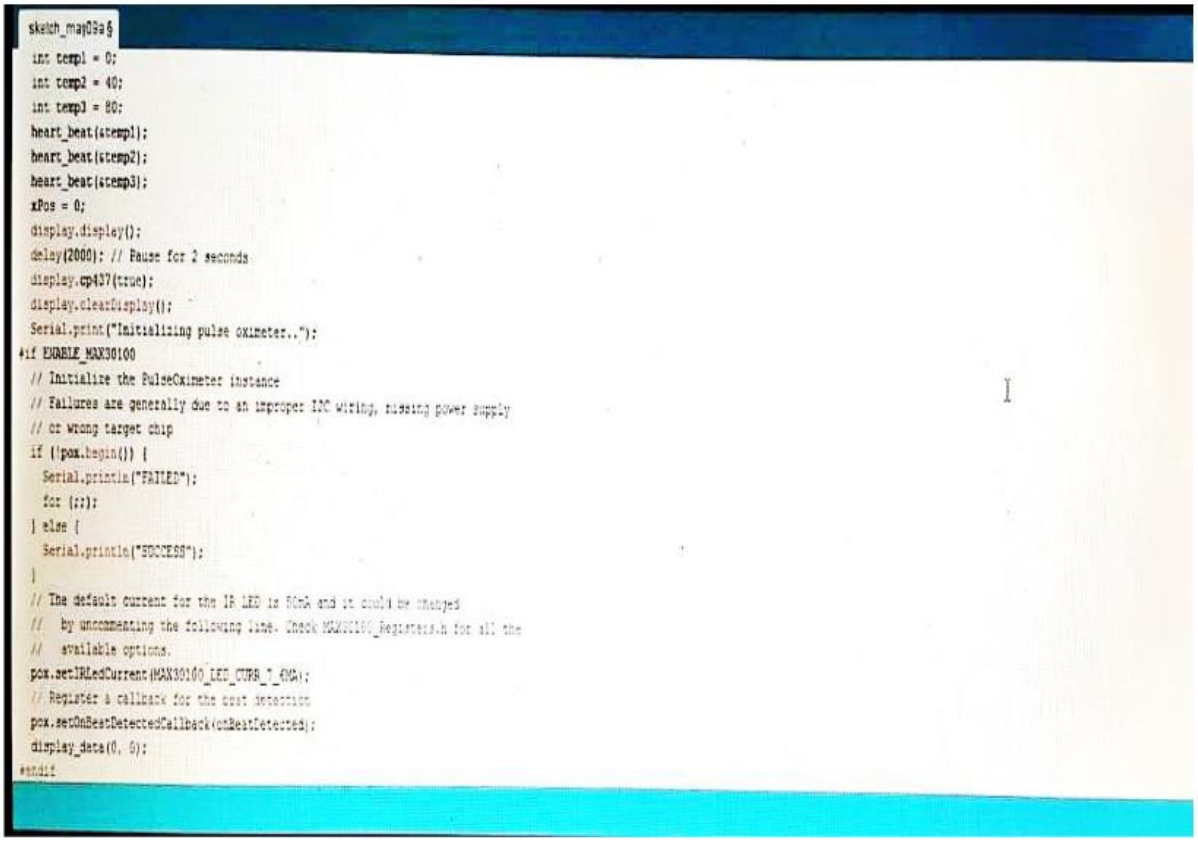
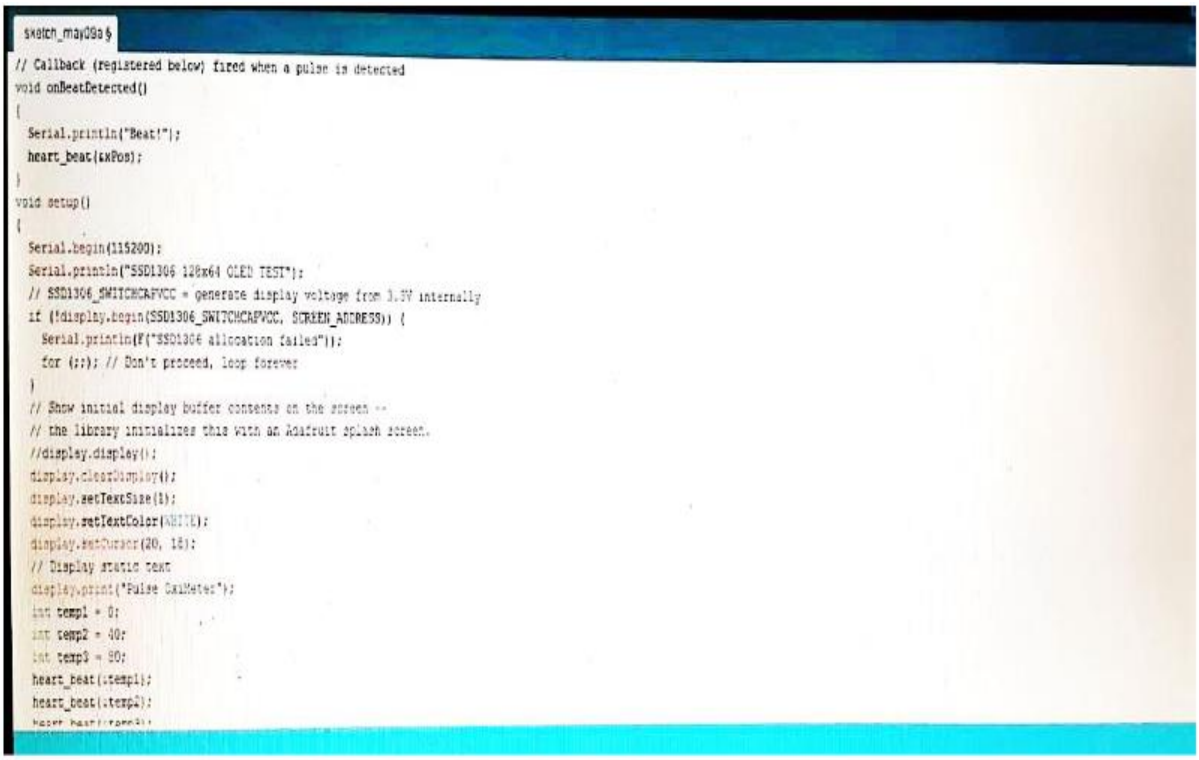


Figure 3.4: LCD SCREEN

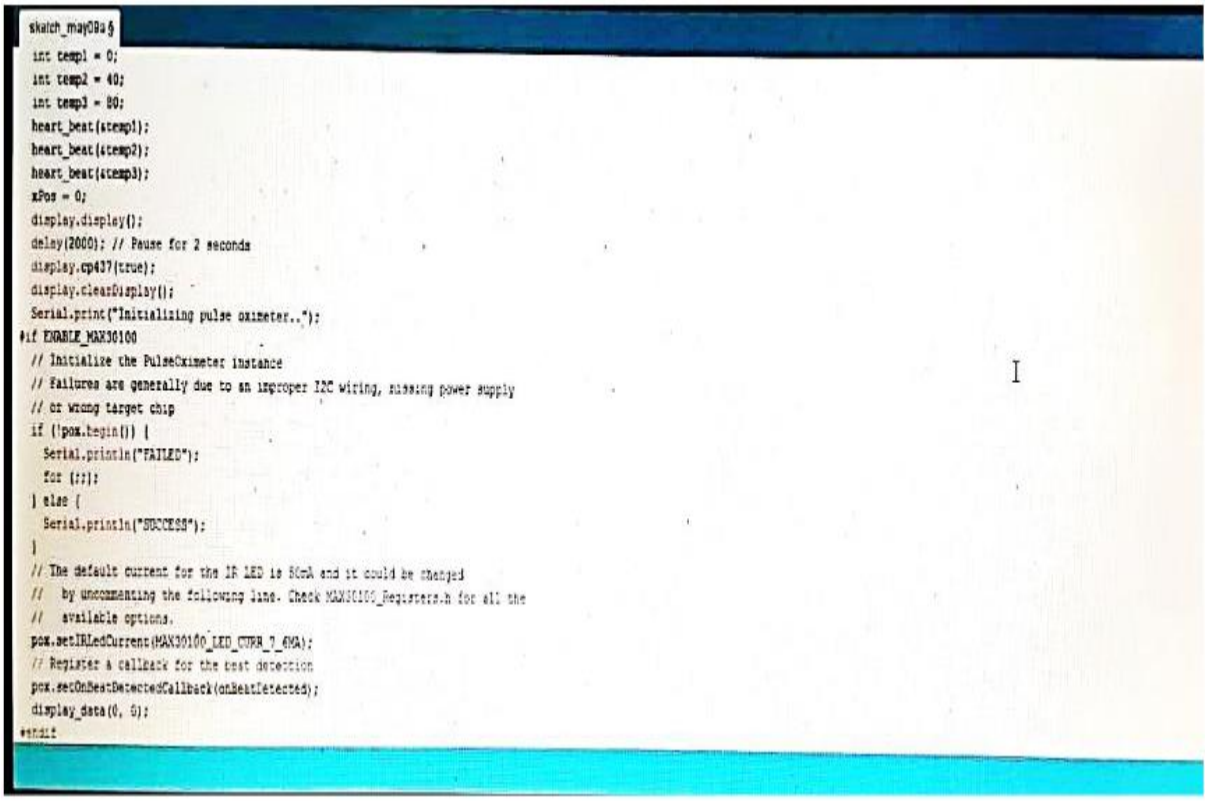
Results and Discussion:

This chapter deals with the study and discussion of the results and the code of the electrical connection map





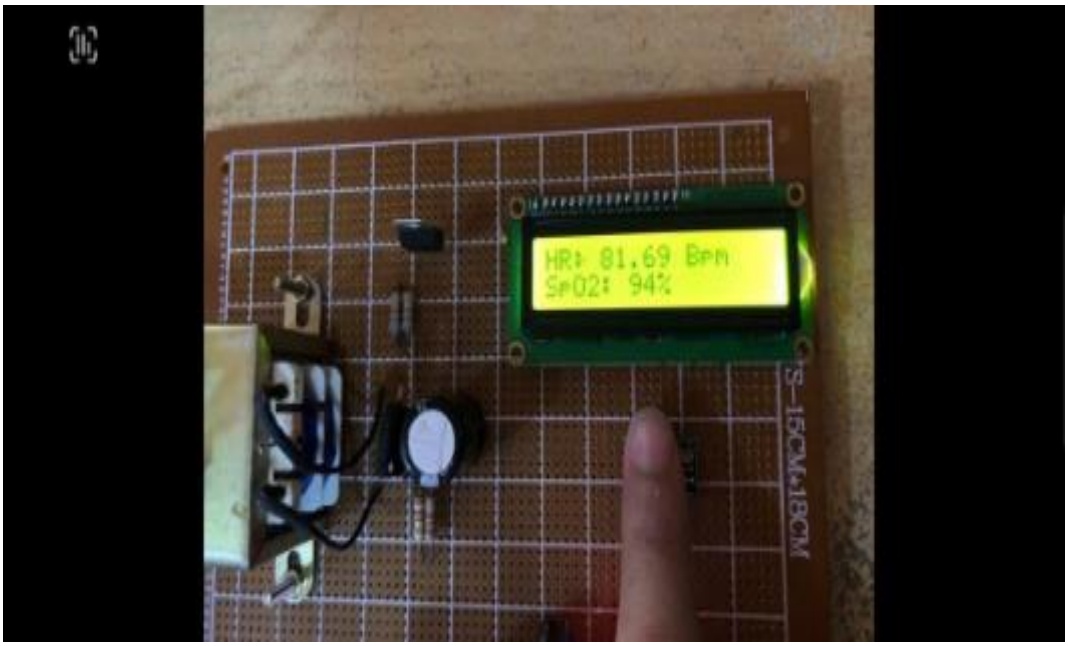
```
sketch_may09a§
// Callback (registered below) fired when a pulse is detected
void onBeatDetected()
{
  Serial.println("Beat!");
  heart_beat(&xPos);
}
void setup()
{
  Serial.begin(115200);
  Serial.println("SSD1306 128x64 OLED TEST");
  // SSD1306_SWITCHCAPVCC = generate display voltage from 3.3V internally
  if (!display.begin(SSD1306_SWITCHCAPVCC, SCREEN_ADDRESS)) {
    Serial.println(F("SSD1306 allocation failed"));
    for (;;); // Don't proceed, loop forever
  }
  // Show initial display buffer contents on the screen --
  // the library initializes this with an Adafruit splash screen.
  //display.display();
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.setCursor(20, 16);
  // Display static text
  display.print("Pulse OxiMeter");
  int temp1 = 0;
  int temp2 = 40;
  int temp3 = 80;
  heart_beat(&temp1);
  heart_beat(&temp2);
```



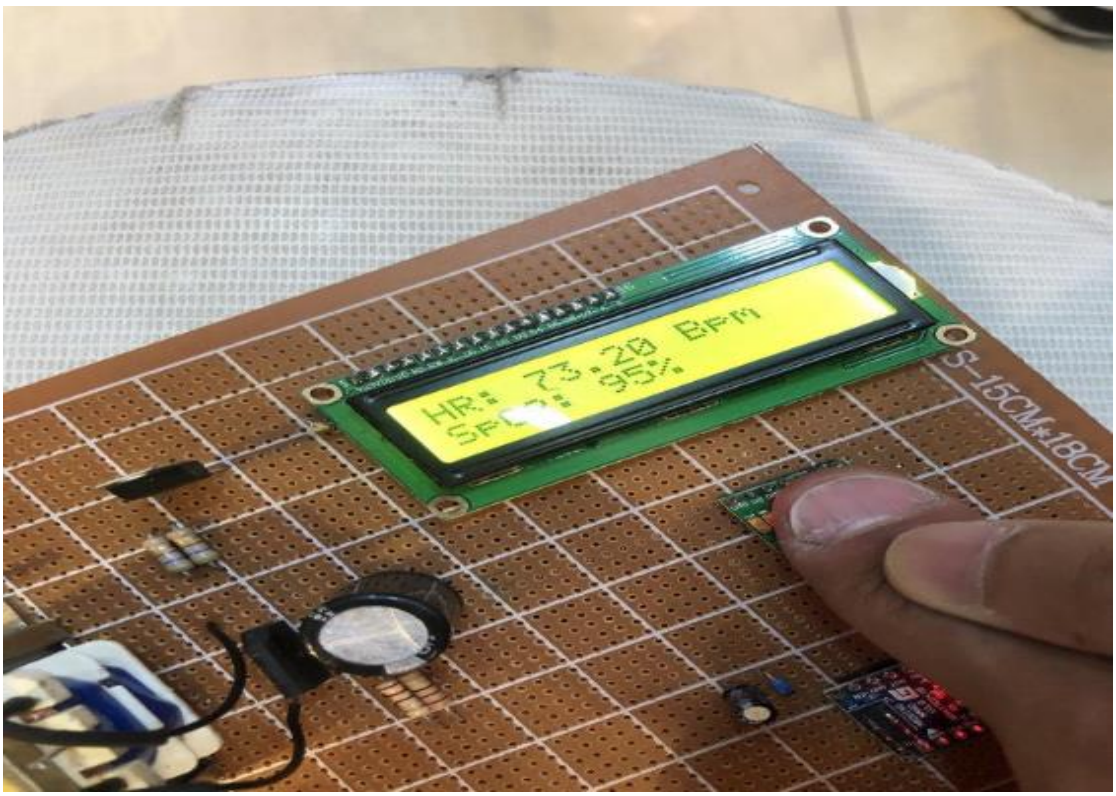
```
sketch_may09a§
  int temp1 = 0;
  int temp2 = 40;
  int temp3 = 80;
  heart_beat(&temp1);
  heart_beat(&temp2);
  heart_beat(&temp3);
  xPos = 0;
  display.display();
  delay(2000); // Pause for 2 seconds
  display.cp437(true);
  display.clearDisplay();
  Serial.print("Initializing pulse oximeter..");
#if ENABLE_MAX30100
  // Initialize the PulseOximeter instance
  // Failures are generally due to an improper I2C wiring, missing power supply
  // or wrong target chip
  if (!pox.begin()) {
    Serial.println("FAILED");
    for (;;);
  } else {
    Serial.println("SUCCESS");
  }
  // The default current for the IR LED is 50mA and it could be changed
  //   by uncommenting the following line. Check MAX30100_Registers.h for all the
  //   available options.
  pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);
  // Register a callback for the beat detection
  pox.setOnBeatDetectedCallback(onBeatDetected);
  display_data(0, 0);
#endif
```

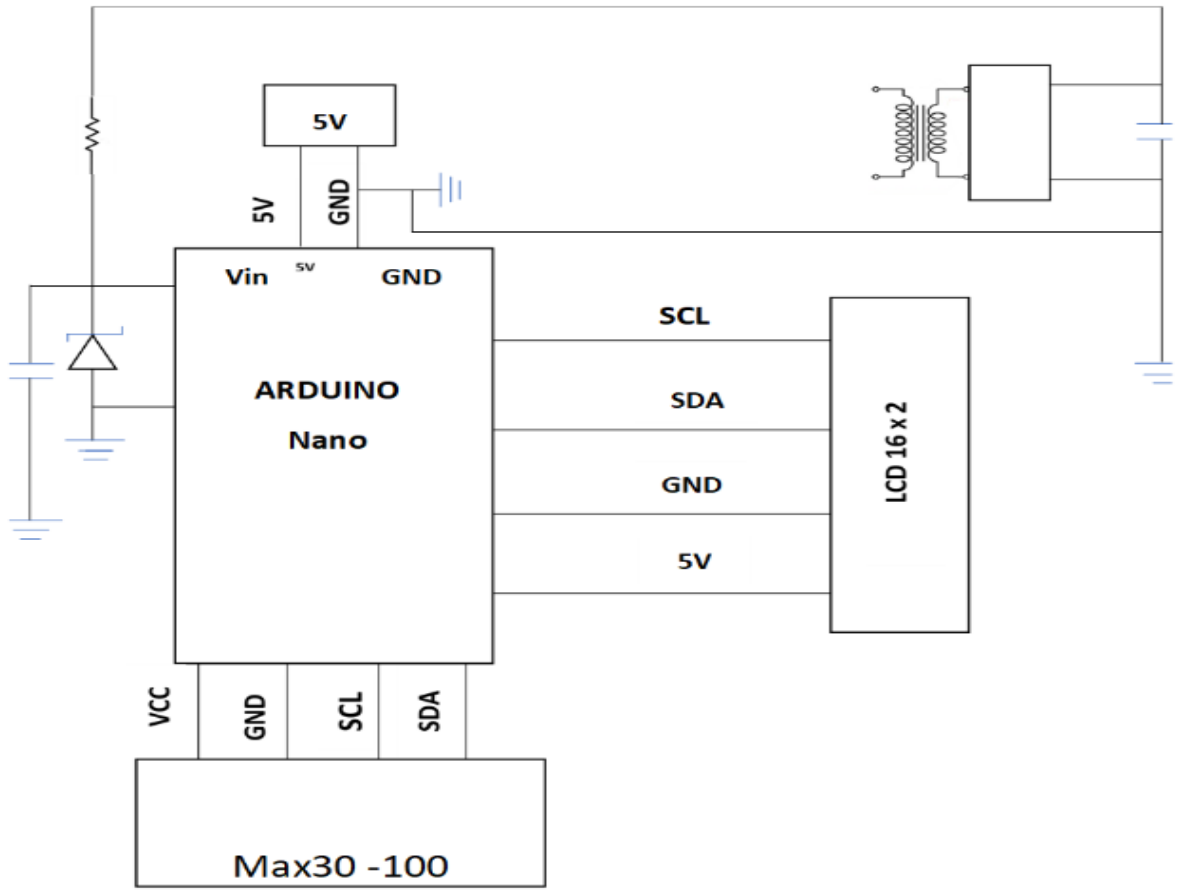
Using Arduino, we programed the sensors to check the patient physical activities, spo2 and heart rate (vital signs) using MAX30100 sensor. We start the test by placing the patient left index finger on the MAX30100 the sensor will detect the body temperature, the heart rate and the spo2, the sensor will transfer the data to the Arduino and showing the result on the display. Both the red light and infrared light is used to measure oxygen levels in the blood. When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood also decreases. By knowing the time between the increase and decrease of oxygenated blood, the pulse rate is determined. It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. It connected with Arduino.

-We examined the 23-year-old smoker, Muhammad Emad, and the results came out SpO2 {94} HP: 81.69 Bpm. We notice an increase in the percentage of HP and a decrease in the percentage of oxygen O2 due to smoking for more than 5 years due to the filling of the lung with smoke.



- We examined the non-smoker, Nabil Muhammad Saleh, 45 years old, and the results came out SpO2 {95 %} HP: 73.20 bpm. We note a high percentage of oxygen in the blood for a non-smoker person to have normal lung function compared to a smoker. According to studies, a non-smoker lives a longer life than a smoker, in addition to the activity and vitality enjoyed by a non-smoker, and the chances of them suffering from cardiovascular diseases are reduced. This study, which was conducted in Norway on 45 thousand non-smokers, has a very low death rate compared to smokers and proven Studies that the appearance of a non-smoker person is younger due to the lack of nicotine and the purity of blood in the body of a non-smoker, unlike a smoker.





Conclusion:

In keeping with the era of development, the smart technology system is being updated day by day. The health field is one of the most important areas in these developments, because human health is an important thing and must be monitored on an ongoing basis. The physical health monitoring system ensures continuous monitoring of the patient, knowledge of the patient's body condition and identification of risks. The device is very light and can be carried easily, and the components used in the system are available at a low cost. Besides, the manufacturing cost is very low, which makes it accessible to everyone of all ages and class, especially in the circumstances of facing the Corona virus in our day.

Future Work:

It is very necessary to develop medical devices so keep up work and easy to use, it could add a sensor to measure the temperature or setting digital screen larger and sharper displays in which the results of the percentage of oxygen in blood as well as changing the number of heart rhythm and can develop a device the size and reduce the cost of the device in the future and it is not strange connecting device the percentage of oxygen p network the Internet to see the remote reading and development when the device is easy to use and read and uncomplicated. It is possible to work on integrating the device together with other portable devices such as the mobile phone and watching the readings through it. Working on adjusting the device to be accurate in the respiratory system efficiency scale and working to be a substitute for the examination of gases necessary in the laboratory to give an accurate indication of the basic deficit or levels of carbon dioxide.

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