

Heart Rate and Blood Oxygen Level Measurement

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Abstract: In this project, we will measure the pulse rate and blood oxygen level using a pulse oximeter sensor. This pulse oximeter is designed by using a pulse oximeter sensor which consists of one IR light and one RED light and another photodiode and the other photodiode is used on the same side. When this light falls on the finger then the light bombards blood from the finger and then it reflects, that reflected signal is received by the photodiode. The photodiode converts light energy into electrical form and is fed to the ATmega328 Microcontroller on Arduino. That will take the signal and shows pulses and oxygen saturation on LCD.

Keywords: Measuring heart rate and blood oxygen level; Reflectance pulse oximeter; non-invasive blood oxygen saturation.

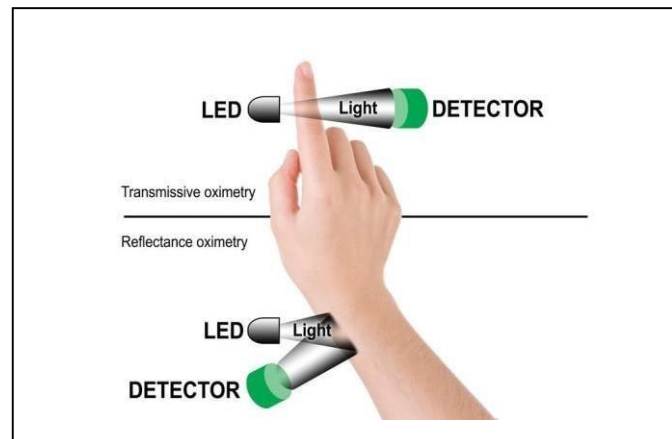


Fig1. Detection methods for measuring the blood oxygen level

I. INTRODUCTION

In this project, pulse oximetry is a non-invasive technique. there are two non-invasive techniques. one is transmissive and the other is reflectance to perform pulse oximetry (SPO2). Heart rate and oxygen saturation of blood which measured by a transmissive pulse oximeter consisting of the pulse oximeter sensor. Oxygen saturation is the measurement of the amount of oxygen dissolved in blood-based on whether it is hemoglobin or deoxyhemoglobin. Two different lights are used to measure the actual difference in the absorption of hemoglobin and deoxyhemoglobin. deoxygenated hemoglobin (Hb) has a higher absorption at 660nm and oxygenated hemoglobin (HbO2) has a higher absorption at 940nm. The pulse oximeter determines the light absorption of two wavelengths and calculates the absorption different lights are their red light and IR light are used to measure the actual difference in the absorption of hemoglobin and deoxyhemoglobin. By using these two properties we will calculate oxygen saturation. When the heart is pumping blood and there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood decreases. That the time between the increase and decrease of oxygenated blood, and pulse rate is determined.

$$SPO2 = V_{ir} / V_{red} * 100$$

The ratio of 0.9 represents SPO2 of 90%

Description:

A pulse oximeter sensor is used at the input. This sensor consists of two LEDs one is red led and the other one is IR led and the photodiode is also used to detect the red light and IR light. whenever this light falls on the finger, that passes into the body finger, light bombards the blood and then reflects, That reflected signal is received by a photodiode. The photodiode converts light energy into the form of electrical energy. The output of the pulse oximeter sensor is given to the Atmega328 microcontroller by using i2c protocol, with help of SDA and SCL pin, that signal is received by the microcontroller. Here oxygen saturation is a measurement of the amount of oxygen dissolved in blood based on, that is hemoglobin and deoxyhemoglobin.



Fig 2. Pulse Oximeter Sensor

II. PROPOSED METHODOLOGY:

2.1 Block Diagram:

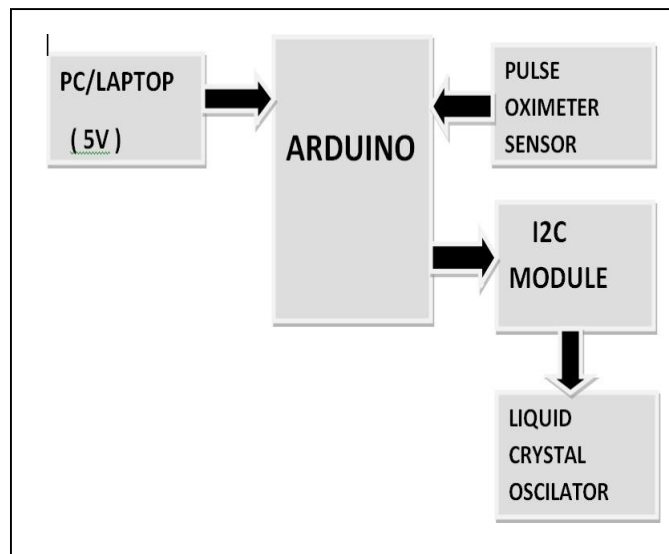


Fig.3 Block Diagram of System

Arduino UNO:

- **ATmega328 Microcontroller-** It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.
- **Digital I/O pins-** The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- **TX and RX LED's-** The successful flow of data is represented by the lighting of these LED's.

- **AREF-** The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- **Reset button-** It is used to add a Reset button to the connection.
- **USB-** It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board. **Crystal Oscillator-** The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board. **Voltage Regulator-** The voltage regulator converts the input voltage to 5V.
- **Analog Pins-** The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

Pulse oximeter Sensor:

The sensor has 7 pins that are Vin, Ground, SCL, SDA, INT, IRD, and RD. the sensor consists of two LEDs that is IR and RED. Light passes in the finger and reflects along with the photodetector detects the reflected light. The output of the photodetector is given to the A-to-D converter. That digital data will get filtered and that data collected from the register and send to the microcontroller using the I2C communication protocol.

I2C Module

I2C Serial Interface Adapter Module for for 16x2 (1602) Character LCD is great Serial Interface Module for interface. As the pin resources of Arduino controller is limited, many project may be not able to use normal LCD shield after connected with a certain quantity of sensors or SD card. However, with this I2C interface module, you will be able to realize data display via only 2 wires.

LCD Display:

We are using an alphanumeric LCD (Liquid Crystal Display) 16x2. The LCD is a very basic module and we can use it in various devices and circuits as well. Because LCD program is very easy and it is also economical. In that projection LCD, we will see the heart rate and blood oxygen level

Flowchart:

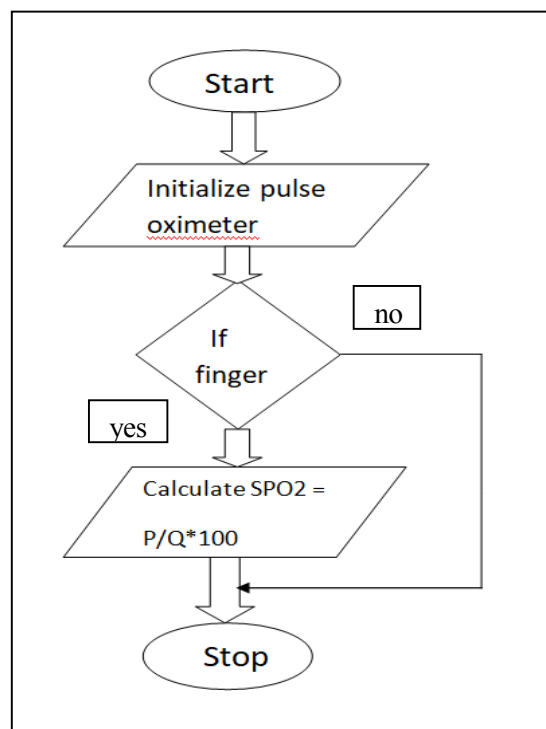


Figure 4. Flowchart

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The sensor is attached to the finger, as the sensor is reflected type, so lights from the sensor will be reflected in a sensor. Then infrared light absorbs by the oxygenated blood and red light absorbs by deoxygenated blood. Then that signal is given to the microcontroller. As the program, the amount of absorbs red light and infrared light in the blood is compared and data will be displayed on the LCD. Hence patients can be get known immediately about their health condition.

III. RESULT AND DISCUSSION

Table 1

Sr. No	Age	Health Condition	SPO2(In Medical Device)
1	25	Healthy	99.85
2	21	Healthy	99.65
3	16	Healthy	98.23

As we know the average SPO2 of a normal person is about 95% to 98%. Initially, we used a pulse oximeter sensor for accurate readings. Firstly we go through the software design of our project for circuit design and simulation we used proteus software.

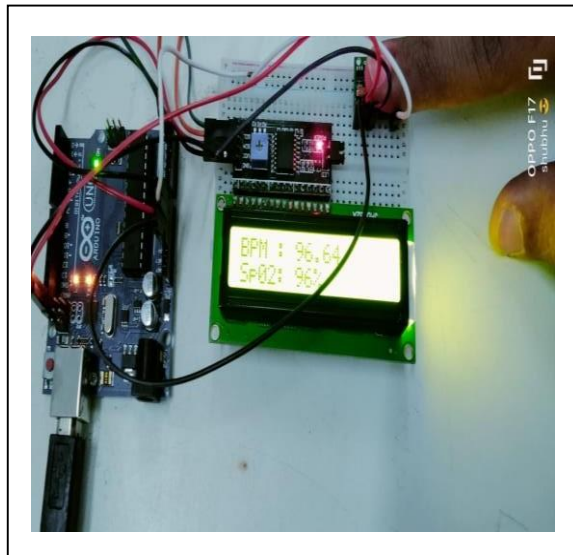


Fig 5. Hardware

IV. CONCLUSION

From this project, we got more knowledge regarding the ATmega328 microcontroller (Arduino) interfacing with LCD and the pulse oximeter sensor. We can calculate the reading of our project using this circuit with a pulse oximeter sensor for measuring the heart rate and blood oxygen level.

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