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COVID-19 VENTILATOR AND HEALTH MONITORING DEVICE

Puvvati Jahnavi [*1], Banda Sai Krishna[*2], Kumche Lokesh Shanmuk [*3], Dr. Y. Chakrapani[*4]

[*1,2,3]Student, Electronics and Communication Engineering, ACE Engineering College, Hyderabad, Telangana, India.

[*4] Professor, Department of Electronics and Communication Engineering, ACE Engineering College, Hyderabad, Telangana, India.

ABSTRACT

Use of technology in healthcare is growing importance because of the tendency to acquire chronic disease like heart attack and high blood pressure. Heart rate and blood oxygen saturation and body temperature is a couple of such biometrics that is monitored in this project to provide information regarding the health of the body. By measuring the intensity change of light transmitted through tissue due to arterial blood, heart rate is measured. Furthermore, oxygenated blood has different light absorption characteristics than deoxygenated blood under red and infrared wavelengths. Comparing the absorptions produce an estimate of the oxygen saturation of blood. The purpose is to examine how heart rate and the oxygen saturation and body temperature of subject is measured from finger and then processed and displayed. The design, is small, easy to use, allows a noninvasive, real-time method to provide information regarding health. This enables an efficient and economical means for managing the health care. This project is intended to be used by engineers, medical equipment developers, anyone related to medical practice and interested in understanding the operation of pulse oximeter and health monitoring system.

Keywords: Heart rate/Pulse rate, BPM, Temperature, GSM Modem, Ventilator.

I. INTRODUCTION

In this project we will be Interfacing MAX30100 Pulse Oximeter Sensor with Arduino. The MAX30100 Sensor is capable of measuring Blood Oxygen & Heart Rate. Temperature sensor is also used to measure the temperature of a person. We can use any display like a 16x2 LCD Display to view the value of SpO2 , BPM and temperature. The blood Oxygen Concentration termed SpO2 is measured in Percentage and Heartbeat /Pulse Rate is measured in BPM and Temperature is measured in ˚C. The MAX30100 is a Pulse Oximetry and heart rate 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. You can use this sensor with any microcontroller like Arduino, ESP8266, or ESP32 and easily measure the patient's health parameters. The MAX30100 has an on-chip temperature sensor that can be used to compensate for the changes in the environment and to calibrate the measurements. This temperature sensor that measures in the range of
-40˚C to +85˚C with an accuracy of ±1˚C. Tis temperature sensor is used to measure the temperature of a human. In this project we will going to measure heart rate and oxygen levels and temperature of a body. If temperature is high then the alert message (E.g.: ALERT PLS, HIGH TEMPERATURE DETECTED FOR PATIENT 123:37.11) is sent to patient family members by using GSM module and also the ventilator will be switched on if needed according to the spO2 levels, BPM and temperature measurements.

II. METHODOLOGY

HEART RATE MEASUREMENT

The oxygenated hemoglobin (HbO2) in the arterial blood has the characteristic of absorbing IR light. The redder the blood (the higher the hemoglobin), the more IR light is absorbed. As the blood is pumped through the finger with each heartbeat, the amount of reflected light changes, creating a changing waveform at the output of the photodetector. As you continue to shine light and take photodetector readings, you quickly start to get a heartbeat (HR) pulse reading.

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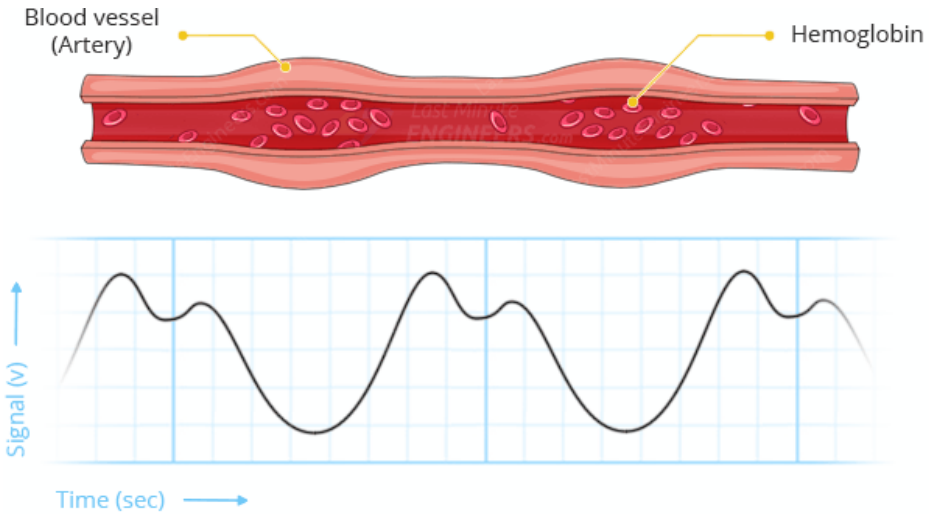

Figure 1: Heart Rate Measurement

PULSE OXIMETRY

Pulse oximetry is based on the principle that the amount of RED and IR light absorbed varies depending on the amount of oxygen in your blood. The following graph is the absorption spectrum of oxygenated hemoglobin (HbO2) and deoxygenated hemoglobin (Hb)

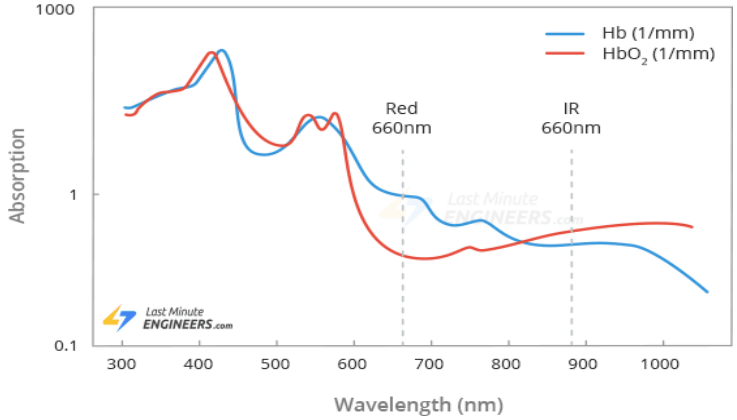

Figure 2: Pulse Oximetry

As you can see from the graph, deoxygenated blood absorbs more RED light (660nm), while oxygenated blood absorbs more IR light (880nm). By measuring the ratio of IR and RED light received by the photodetector, the oxygen level (SpO2) in the blood is calculated.

TEMPERATURE MEASUREMENT

The basic principle of working of the temperature sensors is the voltage across the diode terminals. If the voltage increases, the temperature also rises, followed by a voltage drop between the transistor terminals of base and emitter in a diode.

A thermistor is basically a sensitive temperature sensor that reacts precisely to even the minute temperature changes. It provides a huge resistance at very low temperatures. This means, as soon as the temperature starts increasing, the resistance starts dropping quickly.

III. RESULTS AND DISCUSSION

The ambition of the project was to plan a system which could gather reading of various important indications of the patient. Readings like heart rate, spO2 levels and temperature of a patient. The system is a form of heart rate detection application by sensing the change in blood volume in the finger arteries as the heart pumps blood. It consists of an infrared LED that transmits an IR signal through the subject's fingertip, from the part reflected by the blood cells. The reflected signal is detected by the photo diode sensor. The change in blood volume with the heart rate at the output of the photodiode is not too large to be detected directly by the microcontroller. Table 1 shows the results of SPO2 testing of ten patients. Table 2 shows the test results from

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BPM (heart rate) to ten patients. Table 3 shows the value of human body temperature test results against ten patients. The results of the measurement of heart rate parameters, oxygen saturation in blood and body temperature are represented in units of measured values displayed on 16x2 LCD. The measurement value is fluctuating because the measurement uses non-invasive method (without surgery).

Table 1. Results of spO2 testing

S. No	Patient	spO2 (%)
1	Patient 1	85.0
2	Patient 2	97.5
3	Patient 3	87.5
4	Patient 4	85.0
5	Patient 5	92.5
6	Patient 6	85.0
7	Patient 7	85.0
8	Patient 8	85.0
9	Patient 9	92.5
10	Patient 10	97.5

Table 2. Heart rate test results

S. No	Patient	Heart Rate (bpm)
1	Patient 1	74
2	Patient 2	68
3	Patient 3	78
4	Patient 4	82
5	Patient 5	70
6	Patient 6	64
7	Patient 7	86
8	Patient 8	80
9	Patient 9	78
10	Patient 10	74

Table 3. Temperature test results

S. No	Patient	Temperature
1	Patient 1	37.12
2	Patient 2	36.76
3	Patient 3	36.71
4	Patient 4	36.76
5	Patient 5	36.14
6	Patient 6	37.02
7	Patient 7	36.92

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8	Patient 8	37.12
9	Patient 9	36.98
10	Patient 10	37.04

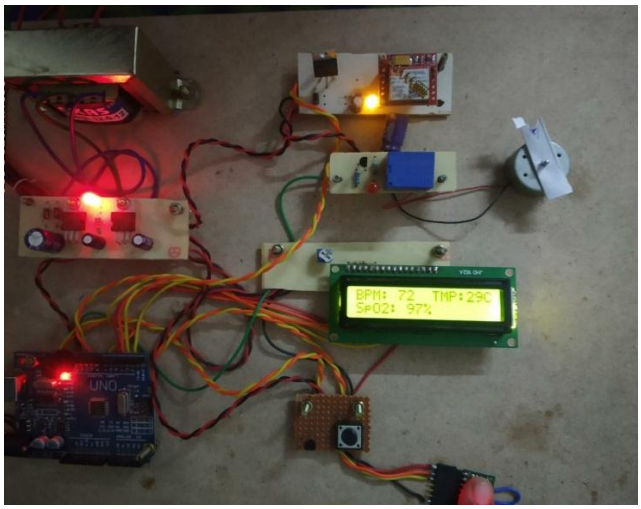

Figure 3: Results of spO2 level, Heartbeat and temperature

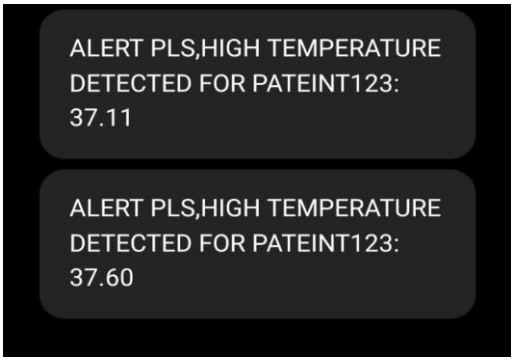

Figure 4: Alert Message

IV. CONCLUSION

At this time of COVID-19 outbreak, the demand for ventilator and health monitoring devices has increased with each passing day. To overcome the shortage of these devices, we don't have any other good solution yet that can help us in fulfilling this requirement. we can try to design own Arduino COVID -19 Ventilator. The main objective of this project is to make a small ventilator prototype using Arduino. It will also be capable of monitoring our health and provide data about our heartbeat, spO2 levels and body temperature. The Heart rate monitoring and pulse oximeter device available in market are high pricing where the designed device is the cheapest one. The design proposes small size, light weight, low power consumption, standardized signal processing capabilities. This device can produce highly reliable test results for heart rate and SpO2 level and temperature of a person. Our designed device has the advantage that it can be used by non- professional people at home to measure the heart rate and SPO2 level and temperature easily and safely. The system created in this study has been able to work in accordance with the planning, which can measure heart rate, oxygen saturation in blood and body temperature.

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