AFFORDABLE PULSE OXY-TRACKER FOR ANDROID*

BY

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ABSTRACT

Advancements in medical technology have helped to overcome a number of health related issues and also provide with health monitoring solutions required to ensure normal functioning of human body. Moreover, it also aided early diagnosis of diseases. During this COVID-19 pandemic, the measurement of oxygen Saturation (SpO2) is one of the primary and vital procedures to check hypoxemia. Therefore, Oxygen saturation has garnered much importance in the management and understanding of patient care. The current study delineates the design of an affordable integrated system to measure oxygen saturation in the blood in percentages and also measure heart rate in BPM (beats per minute). The results of measurement are displayed on the mobile application available on android smartphone. Android based Pulse Oxy-Tracker includes MAX30100 sensor to measure SpO2 levels and heart rate, Arduino UNO microcontroller board for data acquisition and decision making, HC-05 Bluetooth module for wireless data communication, and an in-house built Android application for data reading, recording, and further medical usage.

KEYWORDS

BPM, oxygen saturation, Pulse Oxy-Tracker, MIT App Inventor, HC-05.

I. INTRODUCTION

Oxygen is essential for living and so regular monitoring of oxygen saturation in blood can help save lives in case of people with abnormalities. Human brain absorbs 20% of oxygen that is inhaled and any sort of hindrance in it can cause decline in activities of other organs and also lead to hypoxia. It is important to note that the normal percentage of oxygen saturation in blood falls between 80-100% [1]. For that reason, it becomes utterly necessary to keep the oxygen

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saturation levels in check. Additionally, human heart is also a vital organ whose normal functioning is essential for survival. Cardiovascular diseases are positioned first as the reason of human death. Therefore, heart conditions must also be regularly monitored and one such condition is pulse rate. The normal heart beat spans from 60-100 BPM.

The regular monitoring of aforementioned vital signs is very crucial to ensure healthy functioning of human body especially for patients with chronic diseases. Therefore, we propose Pulse Oxy-Tracker which is a portable device that can be used remotely to measure the oxygen saturation in blood and pulse rate. An android-based smartphone application was developed to view the results of measurement. A finger must be placed on the sensor area present in the device to display the data on the android phone.

Non-invasive SpO2 measurement in Pulse Oxy-Tracker is based on reflective type SpO2 detection where the emitter, Red and IR LED, and the receiver, photodiode, are present on the same side as shown in figure 1. This allows the measurement to be done on any part of the human body. [2] The arterial blood absorbs light with the change in pulse. The photodetector measures the oxygen saturation by measuring the change in intensity of the reflected light.

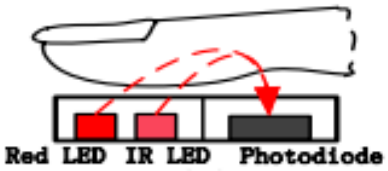

Fig. 1. Reflective type oxygen saturation detection [2]

Pulse oximetry is based on Beer-Lambart's Law. The MAX30100 sensor contains two LEDs with 660nm (red) and 940nm (infrared) wavelengths. [3] Oxygenated (HbO2) and deoxygenated haemoglobin (Hb) have different absorption coefficient at different wavelengths. In the red spectrum region, Hb absorbs more than HbO2, while in infrared region, Hb absorbs less than HbO2 as shown in figure 2. [4] By measuring the difference in these absorption coefficients, oxygen saturation is determined.

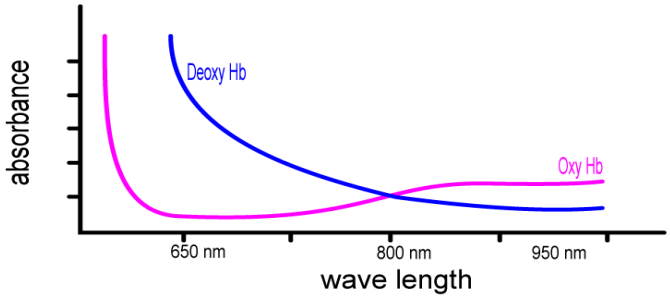

Fig. 2. Absorption of Hb and HbO2 at different wavelengths

II. REQUIREMENTS

MAX30100 sensor, HC-05 bluetooth module, Arduino UNO microcontroller, Android Smartphone to run mobile application. Arduino IDE was used for control system design.

III. METHODOLOGY

A. Prototype Design

The prototype was created to check the functionality of the system. The components of the system were packaged into a simple and small design to make it easily portable as shown in figure 3.

Fig. 3. Prototype design of Pulse Oxy-Tracker

B. System Integration

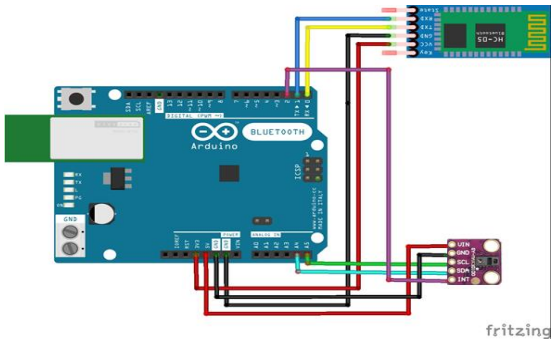

Fig. 4. Circuit diagram of Pulse Oxy-Tracker

Figure 4 shows the circuit diagram of the system. MAX30100 sensor was used to measure oxygen saturation in blood and pulse rate. This is done by placing the finger on the sensor region of the Pulse Oxy-Tracker. The results from the measurements are displayed on the Android smartphone. HC-05 bluetooth module allows wireless communication between the measuring unit and the smartphone.

Table 1 shows the pin connection of Arduino UNO with MAX30100 sensor and HC-05 bluetooth module.

TABLE I: PIN CONNECTION OF ARDUINO UNO WITH MAX30100 SENSOR AND HC-05 BLUETOOTH MODULE

Pin MAX30100	**Pin Arduino UNO**	**Pin HC-05**	**Pin Arduino UNO**
VIN	5V	VCC	3.3V
GND	GND	GND	GND
SCL	A5	TXD	RXD
SDA	A4	RXD	TXD
INT	D2		

C. Android Application

The android application was made using MIT App Inventor which was then installed on a smartphone. The Pulse Oxy-Tracker was connected to the smartphone by enabling the bluetooth on the phone and pairing it with the device. The android application was developed to display the values measured from the device as shown in figure 6.

IV. RESULTS

The measurement values obtained on the serial monitor of Arduino IDE software can be seen figure 5. Figure 6 displays the measurement of oxygen saturation and pulse rate on the android mobile application. The values obtained from Pulse Oxy-Tracker are accurate when compared to values obtained from standard devices. It measures heart rate to be 85 BPM and SpO2 level to be 95%.

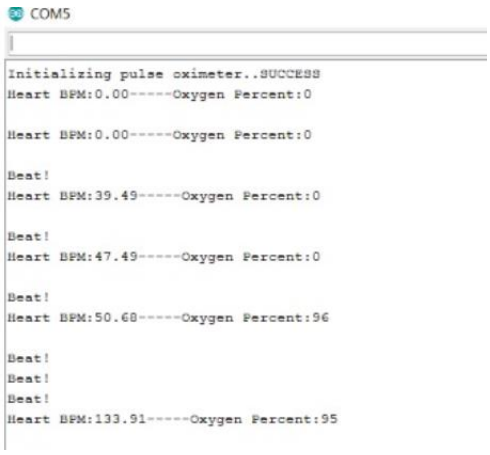

Fig. 5. Values obtained on serial monitor of Arduino IDE software

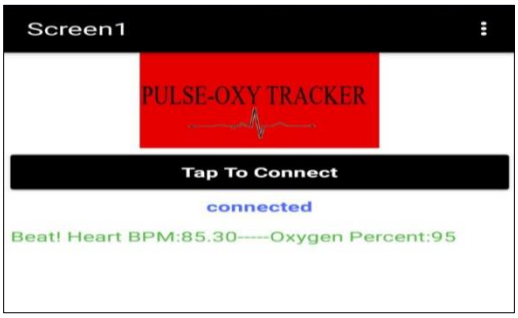

Fig. 6. Values obtained on mobile application

V. CONCLUSION

A portable, compact sized vital sign monitoring device was developed, named Pulse Oxy-Tracker, which could measure levels of oxygen saturation in blood and heart rate in BPM. The device was integrated with android mobile application which displayed real time values. [5] The values obtained were reliable when compared to values from standard industrial devices.

However, there are certain limitations in the system which can be further improvised. An efficient power supply need to be adapted to meet the power requirements of the system. The accuracy of the device can also be enhanced by use of better signal processing algorithms.

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