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Design and Development of an Adept Health Parameter System

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A B S T R A C T

The heart is the most crucial organ in the human body. Therefore, it's critically important to periodically check on it and keep up to date on how it's functioning. Blood oxygen saturation (SpO2) and heart rate (HR) are significant biomarkers that are directly related to the heart and pulmonary system. Monitoring SpO2 and HR gives us a great visualization of how effectively the heart is working. An opto-electronic non-invasive medical device called a pulse oximeter (PO) may measure and record changes in heart rate and blood oxygen saturation at the fingertip. In this study, we designed and developed an intelligent system for monitoring a subject's SPO2 and Heart Rate, which will help establish rapid access to a physician. Our intended system's independently developed kit, which is coupled with the created software, will be able to identify SPO2 and Heart Rate. The calling system will commence and connect to the doctor in response to the output.

Keywords: SpO_2, Heart Rate, Arduino, Optical Device, Intelligent System

1. Introduction

Systems to gauge pulse oxygen saturation are based on two ideas concerning the characteristic of blood flow rate in relation to the status of oxy- and deoxy-hemoglobin. The absorption of red and infrared light by oxy- and deoxy-hemoglobin is distinct from one another, and the volume of arterial blood in tissue varies with each heartbeat (Torp and Modi, 2022). The use of pulse oximeters is safe and generally tolerated. Finger or toenail beds are the most often utilised tissue beds. Since arterial saturation is of greatest concern to physicians, the machine's algorithm searches for very minute arterial pulsations in the arteriolar/capillary tissue beds. A reliable signal may therefore be difficult to obtain in individuals with inadequate perfusion to or extensive movement of the extremities. In some circumstances, other application locations like the forehead and earlobes (Agashe, 2006), nasal alar, or lip have been employed successfully.

Typical pulse oximeters are used to identify hypoxia. But thanks to recent advancements, some pulse oximeters can now also measure other factors, including methemoglobin and carboxyhemoglobin levels, total haemoglobin, and even oxygen saturation levels exceeding 100%. In some pulse oximeters, volume status in intubated patients as well as respiratory rate can be exhibited by looking at the pulse pressure change with the respiratory cycles and the display of the pulse wave activity parameters (Tusman, 2017). An index of perfusion has been used to determine if improved blood flow following sympathectomy has been successful. (Ginosar, 2009).

1.1 Normal and Critical values

At sea level, oxygen saturation values between 96% and 100% are regarded as typical. At higher altitudes, average people could have decreased oxygen saturation levels. With an accuracy of 2% to 4% and a typical calibration range of 70% to 100%, pulse oximeter readings below 70% may not be accurate when compared to invasive blood gas measurements, which are the industry standard. Even while they might not have perfect accuracy, they often track oxygen saturation and show lower amounts. There are some technical justifications for the 70% calibration, but by that point, patients typically have clinical signs of hypoxemia that don't require invasive clinical confirmation, and the course of treatment for reversing that level of hypoxia would be the same as it would be for a patient with a 70% saturation. At sea level, critical findings that would necessitate intervention for the majority of patients are probably in the mid to upper 80% range, with the partial pressure of oxygen being in the 60 mmHg range. However, at high altitudes or in individuals with hypoxic heart abnormalities, where venous blood mixes with arterial blood before entering the systemic circulation, the critical levels that call for therapy may be lower (Sorino, 2022).

1.2 Constraining Factors

Light is absorbed through a tissue bed of pulsing blood in pulse oximetry. As a result, things that affect those characteristics can affect how pulse oximeters read. Artificial fingernails and nail polish are two frequent instances of interfering variables (Hakverdioğlu, 2014 & Yek, 2019). Numerous articles have been written about this subject, however they all come to different conclusions that primarily blame blue or black nails. Additionally, it has been noted that artificial fingernails are ineffective or harmful. It will be tough to generalise on which nail treatments are safe and should ideally be avoided due to the constantly shifting fashion trends. It can be effective to place the sensor sideways on a finger that does not provide a reading, but it should be kept in mind that this will be outside the sensor's calibration. Patients with dark complexion may have a 2% overestimate of their oxygen saturation. Which gadget is utilised determines this. In colder climates, pulse oximeter accuracy may suffer. For accurate measurements, a warm site temperature of about 33°C should be maintained. The serum in the blood will be coloured by intravenous dyes such methylene blue or indocyanine green, which are occasionally employed for surgical or diagnostic operations. These dyes may interfere with the spectrum of light absorption and result in low values (Piñero, 2004 & Sidi, 1987).

1.3 Motivation of the work

It has been noted that in some unexpectedly serious situations, doctors might not be present. But that circumstance necessitates seeking medical advice. The systems that are now in place require more time to deliver this kind of data, thus our effort is focused on finding a solution in this area. We are taking action to shorten the connection time with the doctor. We have created an intelligent system through our current effort to collect real-time SPO2 (from a pulse oximeter) and heart rate data from individuals. This will be implemented via a Python software algorithm, and the computation to validate it will be done therein. Once the deviation is noticed, the calling device will be triggered promptly as feasible so that a consultation with a doctor can be set up as soon as possible for immediate and effective healthcare support.

2. Materials Required

Arduino Uno had been bought alongwith MAX301000 Pulse Sensor, WSP8266 WiFi Module, 16x2 LCD, Resistors and accessories to build the hardware system. The block diagram of the assembly and work floe has been shown in Figure 1 and 2 below, respectively.

Fig. 1: Block diagram of the system

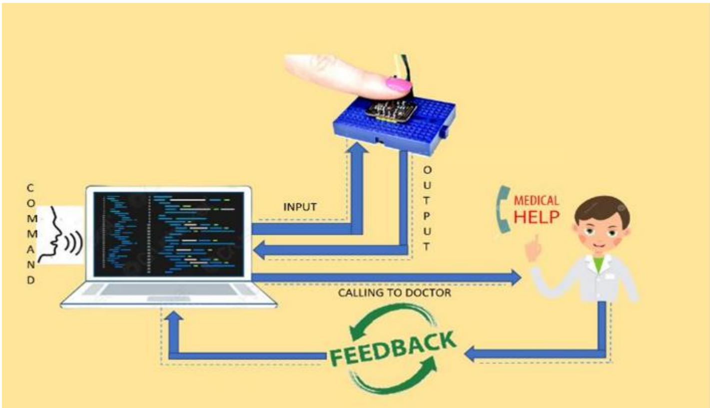

Fig. 2: System Workflow Diagram

3. Result and Discussions

We used an AI system in our work to make it simple to use and reduce the time spent with a doctor or other healthcare professional.The entire system is connected to a computerised system, which aids in the operation of the system's overall programme.It is simple to use, portable to the needed location, and not just for one patient; it can be used for several patients sequentially and heed the doctor's recommendation, which will help keep costs down. The device and intelligent system we established provided us with real-time SpO2 and Heart Rate values and sent those to doctors. The doctor can provide feedback via the calling mechanism included in othe built AI system if the findings of the developing technology indicate that the patient needs more contact or any kind of recommendation. After the device had been constructed, few findings that were compiled from feedback from acquaintances have been recorded. The outcomes were typical, where figure depicts a graph of Pulse rate and depicted in Figure 3.

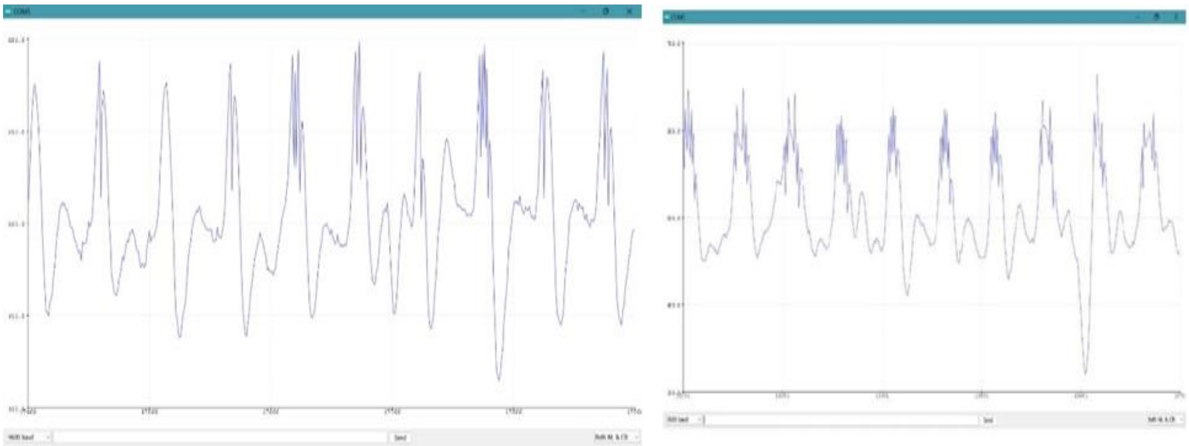

Fig. 3: Pulse rate measured by two volunteers in graphical format

4. Conclusion

Since the result acquired from the constructed PO device has less than 5% errors state in comparison to the conventional device, the overall goal of this research has been accomplished. Given the high cost of standard equipment, locally made items, like the home-built AI gadget used in this study, have the potential to be significantly more affordable. This AI device also has the additional capability of saving the test results so that the user can review and analyses them at a later time. The system thus built is easy to operate, no prior trainings are required, portable and cost effective and provides great feasibility in connecting doctors as and when required.

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