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PREDICTION OF THE TYPE OF VENTILATOR FOR A PATIENT USING IOT BASED OXIMETER

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Abstract: The heart is one of the most vital organs in the human body. Therefore, its wellbeing and health are monitored continuously to determine the medical conditions of patients. The current paper presents a heart rate measuring device, which can also be used to measure oxygen saturation levels. All measured results have been analyzed by an Arduino platform to decide the patient's health status. The obtained measurements were also monitored using a mobile application by both the Guardian and Doctor. It then suggests the type of ventilator required for that patient through that application. It also produces a buzz sound as an alarm at the patient's end if the oxygen level goes out of the standard range. The design of this device is dependent on many types of platforms such as Arduino, Android and Cloud Server. This device can help the patients to check their health status and provide suggested course of action.

***Index Terms* – Pulse Oximeter, HR, Arduino, bpm, SpO2, Photoplethysmography, NodeMCU, LCD, MAX 30102.**

I. INTRODUCTION

COVID-19 is the worldwide pandemic disease which was firstly discovered in 2019. Accessing of the medical oxygen by the patient can be the deciding factor to live or die during this pandemic. Approximately 15% of all people with COVID-19 require oxygen support. Oxygen should be treated as an essential utility, as vital as electricity or water during this pandemic. Through WHO reports, it is found that **"Lack of oxygen killed the people, not the virus".** So, it is time to think "How we can measure our oxygen levels very frequently and take medications to save our lives ".

With an improvement in technology and miniaturization of sensors, there have been attempts to utilize the new technology in various areas to improve the quality of human life. One main area of research that has seen an adoption of the technology is the healthcare sector. As a result, this project is an attempt to solve a healthcare problem currently world is facing. The main objective of the project was to design a system which monitors the oxygen levels. It's comprised of three main parts. The first part being, detection of patient's health using sensor, second for sending data to cloud storage and the last part was providing the detected data for finding the health status and predict the type of ventilator required for a patient. This data enables a doctor or guardian to monitor a patient's health progress away from hospital premises.

The Internet of Things (IoT) concepts have been widely used to interconnect the available medical resources and offer smart, reliable, and effective healthcare service to the patients. The aim of the project was to come up with a Health Monitoring System that can be made with locally available sensors with a view to making it affordable if it were to be mass produced.

II. EXISTING SYSTEM

A pulse oximeter is a light based device used due to its simplicity to measure heart rate (HR) and the arterial oxygen saturation (SpO2) as a percentage of the haemoglobin in blood. Accordingly Photoplethysmography (PPG) signal is used to monitor the HR by detecting the variation in the blood volume in the investigated area. The variation in the heart rate relies primarily on the state of the patient (exercise, sleep, stress,etc). While, the average heart rate at rest should be between 60 to 100 bpm. Consequently, heart rates outside this range could be an indication of a medical condition. On the other hand, oxygen saturation depends on the concentration of haemoglobin in red blood cells, where the average normal value is 95% to 100%. Therefore, low values could be an indication of some diseases such as anaemia. Aditionally, its values are directly proportional to the amount of oxygen available in the surrounding atmosphere. This oximeter is regularly used in our houses to check our heart rate and oxygen levels.

Fig: Pulse Oximeter

III. PROPOSED SYSTEM

In proposed system, we designed a system that measures the heart rate and SpO2 levels of a person using a pulse oximeter sensor and the readings are displayed on the LCD connected to that sensor. If the SpO2 reading on the LCD is below the standard value (below 95%), then it gives buzz sound as an alarm to the patient indicating that he/she is in the status of risk. It also sends the results to the mobile application of the guardian or doctor far from the patient.

In that android mobile application, It displays

- **a)** HR and SpO2 readings
- **b)** The status of risk of the patient (emergency or critical or ICU)
- **c)** The type of ventilator (i.e. quantity of oxygen concentrator as 5 lit or 16 lit or 60 lit) required for a patient and
- **d)** Suggests the tests (CRP or CT-SCAN or deep blood tests) to be done to that patient.

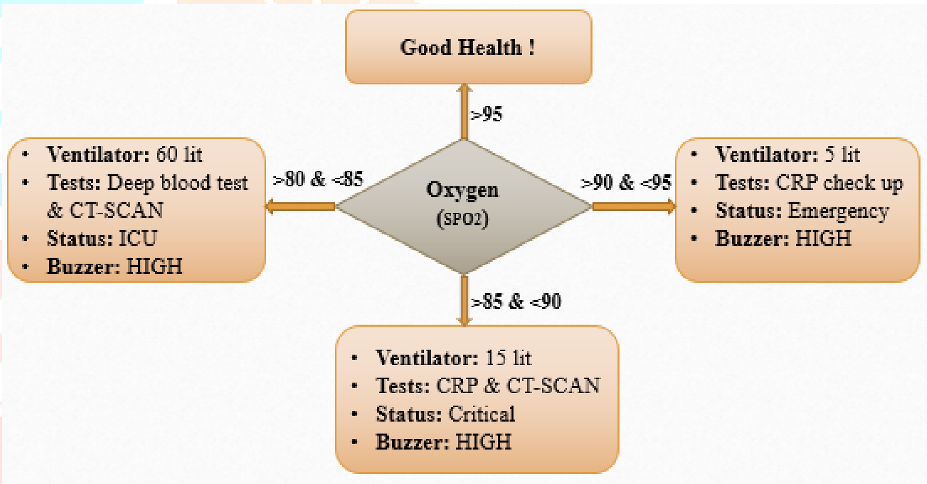


Fig: Proposed results at Guardian/Doctor end

IV. IMPLEMENTATION

At first, A code for LCD is written in Arduino IDE with all the predictions and status of risk. Then LCD is connected with the Arduino device. MAX 30102 sensor which is a pulse oximeter sensor that can measure both HR and SpO2 levels is connected to the Arduino. So, when you place a finger on the LED light present on the sensor, it will measure both heart rate and oxygen levels and display those readings on the LCD. A Buzzer is also connected to the arduino to produce alarm sound at the patient if the SpO2 level goes below 95%. This entire process happens at the patient's end.

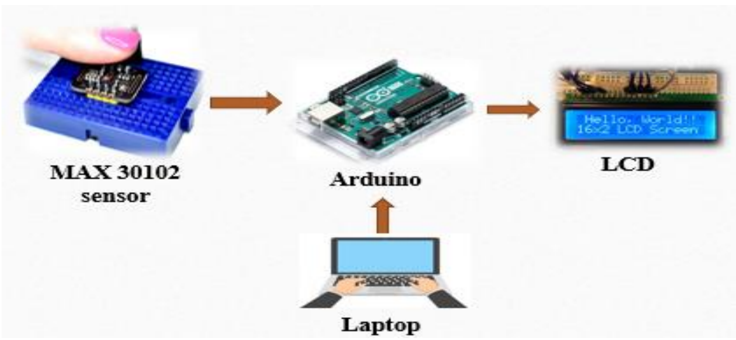


Fig: Process at patient end

Another code is written in the Arduino IDE for NodeMCU device and dumped that code into it. While writing code, we need to import some important libraries like **ESP8266WiFi** and **BlynkSimpleEsp8266** to work with ESP8266 wifi module and blynk mobile application to send the patient's health condition to the guardian or doctor from the arduino device. We have to provide WiFi connection to the NodeMCU device by including WiFi name and password in its code. Then using ESP8266 Wi-Fi module, NodeMCU communicates with the mobile through blynk application which acts as a virtual cloud between the Arduino device and the mobile. In this way, the patient's health status reaches the guardian or doctor.

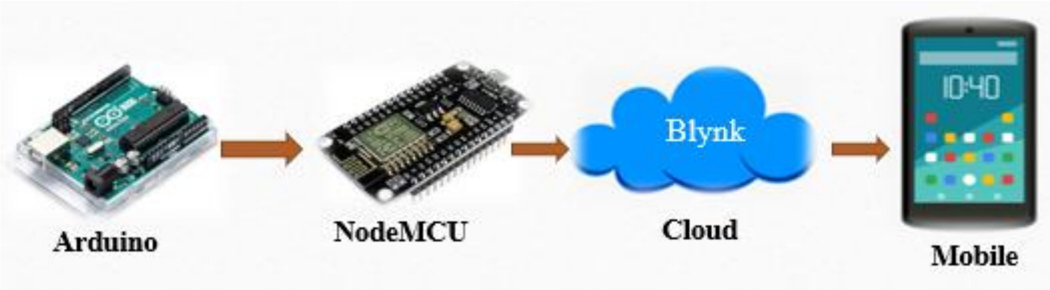


Fig: Process at Guardian/Doctor end

V. WORKING OF BLYNK APPLICATION

The Guardian or Doctor has to install Blynk mobile application in his android mobile. Now, he has to login into the app by entering working Email id. Now he receives an authentication token from blynk application development team through email. This authentication token is used while writing code for NodeMCU. This is how the mobile at guardian or doctor connects with the device at the patient. Not only a doctor or guardian, any number of persons can know the health status of the patient by logging in with the same email id.

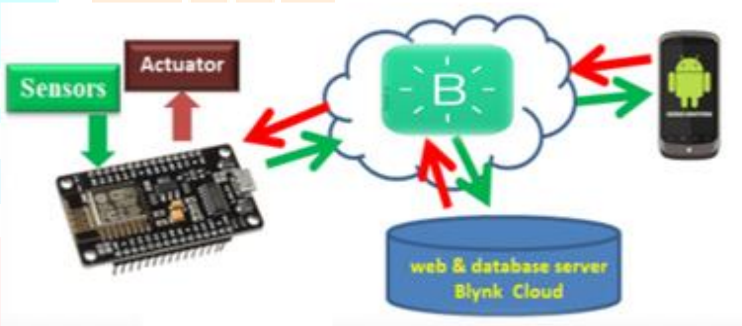


Fig: Working of Blynk Application

VI. HARDWARE REQUIREMENTS

a) Arduino Board

Arduino is a single board microcontroller, intended to make the application of interactive objects or environments more accessible. The hardware consists of an open source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM [1]. Pre-programmed into the on-board microcontroller chip is a boot-loader that allows uploading programs into the microcontroller memory without needing a chip/device programmer.

Fig: Arduino Board

b) NodeMCU

The **NodeMCU ESP8266 development board** comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

Fig: NodeMCU IOT chip

c) MAX30102 Sensor:

The **MAX30102** is an integrated pulse oximetry and heart-rate monitor module. It includes internal LEDs, photodetectors, optical elements, and low-noise electronics with ambient light rejection [2]. The **MAX30102** provides a complete system solution to ease the design-in process for mobile and wearable devices.

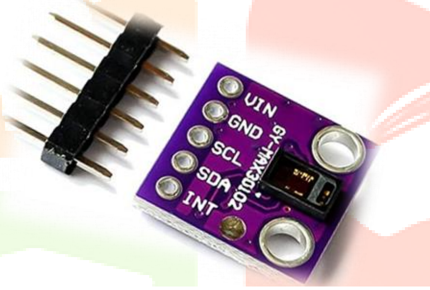


Fig: MAX30102 Sensor

d) LCD:

We can easily interface a **liquid crystal display** with an **Arduino** to provide a user interface. **Liquid crystal** displays are a commonly used to display data in devices such as calculators, microwave ovens, and many other electronic devices. **LCD 16x2** is a 16-pin device that has 2 rows that can accommodate 16 characters each. It can be used in 4-bit mode or 8-bit mode. It is also possible to create custom characters. It has 8 data lines and 3 control lines that can be used for control purposes.

Fig: LCD 16X2

e) Connectors:

The most commonly seen pin **headers** are 0.1" (2.54mm) single or double row **connectors**. This is a standard breadboard compatible pitch. These come in male and female versions, and are the **connectors** used to connect **Arduino** boards and shields together. Users can easily connect jumper wires to breadboards.

Fig: Connectors

f) Battery:

If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. It is found that using **9V** works well.

Fig: Battery (9V)

g) Buzzer:

The **buzzer** consists of an outside case with two pins to attach it to power and ground. When current is applied to the **buzzer** it causes the ceramic disk to contract or expand. Changing this, then causes the surrounding disc to vibrate. That's the sound that you hear.

Fig: Buzzer

VII. SOFTWARE

a) Arduino IDE:

Arduino IDE (Integrated Development Environment) is the **software** for **Arduino**. It is used for writing code, compiling the code to check if any errors are there and uploading the code to the **Arduino**. It is a cross-platform **software** which is available for every Operating System like Windows, Linux, macOS. contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .in. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information.

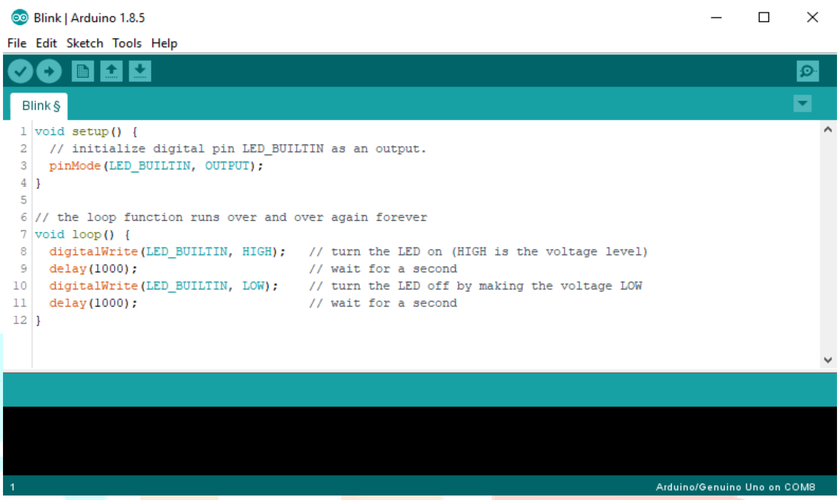


Fig: Arduino IDE

b) Blynk Application:

Blynk is a Platform with IOS and Android **apps** to control Arduino, Raspberry Pi and the likes over the Internet. **Blynk** Server is responsible for all the communications between the smartphone and hardware. You can use our **Blynk** Cloud or run your private **Blynk** server locally. After downloading the **Blynk app**, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen.

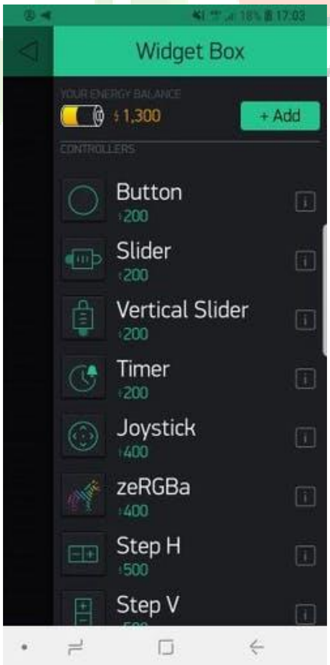
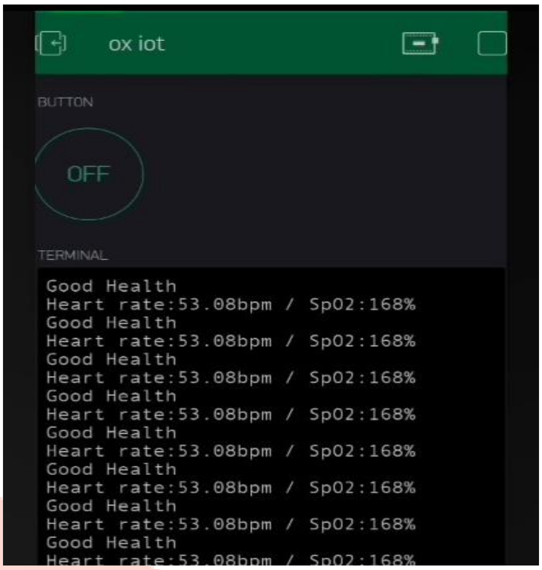


Fig: Blynk Environment

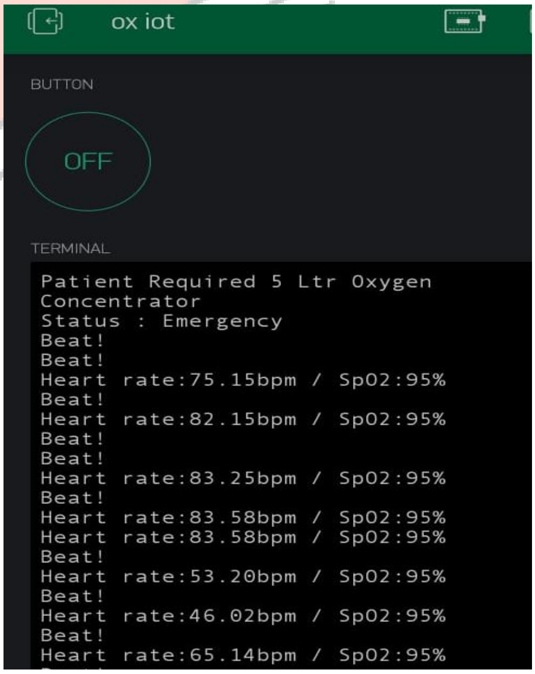
VIII. RESULTS:

When a finger is placed on oximeter sensor, it will show the HR and SpO2 levels of a person on LCD.

CASE-1:
If SpO2 readings on LCD is **greater than 95%**, then it displays "**GOOD HEALTH!**" on LCD and sends the same results to the guardian or doctor through app and **no buzzer** sound as alarm at the patient.



CASE-2:
If SpO2 readings on LCD is **greater than 90% and less than or equal to 95%**, then it produces buzz sound as alarm at the patient and sends the health status as **Emergency**, and type of ventilator as **Patient required 5 ltr oxygen concentrator** , and tests as **CRP** checkup**.**



CASE-3:
Similarly, If SpO2 readings on LCD is **greater than 85% and less than or equal to 90%**, then it produces buzz sound as alarm at the patient and sends the health status as **Critical**, and type of ventilator as **Patient required 15 ltr oxygen concentrator** , and tests as **CRP and CT-SCAN** checkups**.**

CASE-4:

Similarly, If SpO2 readings on LCD is **greater than 80% and less than or equal to 85%**, then it produces buzz sound as alarm at the patient and sends the health status as **ICU**, and type of ventilator as **Patient required 60 ltr oxygen concentrator** , and tests as **CT-SCAN and Deep blood tests.**

IX. CONCLUSION

This paper proposes an affordable heart rate monitoring devie based on an Arduino platform synchronised with an android application. It can monitor SpO2 and Heart rate, and basing on the measured values it can analyse the health status of the patient. The results are sent to the guardian or doctor through an android application. By following these predictions and suggestions, we can save the lives of the people.

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