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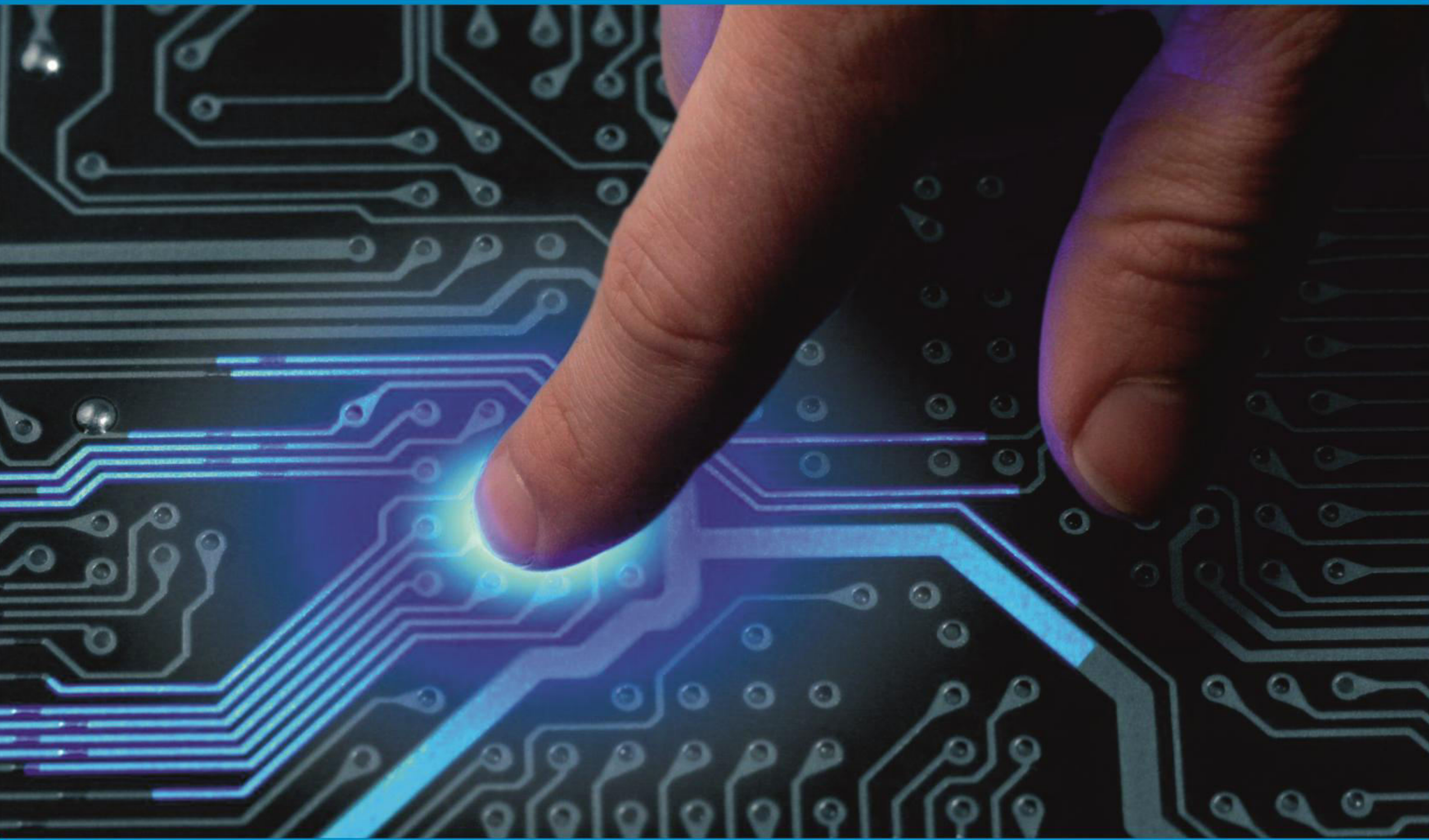

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Safe - Oxi: A Remote Blood Oxygen Saturation and Temperature Monitoring and Analysis System of a Covid Patient Using IOT

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ABSTRACT: The pandemic situation has been tough for everyone. Thousands of lives were lost. A major part of the affected and the casualties were the medical personnel's and doctors who were responsible fortreating Covid - 19 patients. In such times, the doctors and the medical staff are the most valuableasset for the country and its people. Hence, we provide a solution that may decrease the mortality ofsuch saviours. "Safe-oxi" is a safe and contact free approach in comparison to traditional use of pulseoximeter for calculation of covid patient's blood oxygen saturation and other useful parameters withthe use of IOT and Machine learning. Safe-oxi will also result in the overall efficiency of covidward as the system has made it possible to monitor multiple patients at the same time.Blood oxygen saturation is an important physiological parameter involved in respiration andcirculation, which is also a critical indicator in the area of medical and health monitoring. Here we present a safe and contact free approach in comparison to traditional use of pulse oximeter forcalculation of covid patient's oxygen saturation and temperature. Safe-Oxi hasbrought the world ofInternet of Things and machine learning to the covid ward.

KEYWORDS: Covid,Wireless,Internet Of Things,Pulse oximeter,KNN algorithm

I. INTRODUCTION

Mortality rate of doctors has been a rising concern since the beginning of Pandemic. COVID-19 has caused a huge burden and loss to the world with doctors bearing the brunt of physical burnout, mental stress, occupational risk of infection with increased risk of morbidity and mortality, being the front-line workers. Especially in India, the mortality of these doctors has made a dent in an already compromised health care system due to poor doctor patient ratio. The Indian Medical Association (IMA) National COVID-19 registry data suggests more than 1000 doctors have been infected with Covid-19 virus, where 75% of them are above the age of 50 years. Concerns have been raised since nearly 200 doctors have succumbed to COVID-19 so far with a significant number of healthcare professionals affected as well. IMA has issued a 'Red Alert' and requested the health authorities to ensure adequate safety of all doctors along with support from state sponsored medical and life insurance facilities to all involved in the coronavirus containment efforts. Doctors account for 0.5% of the total deaths in India due to Covid-19.

But that's not it, since a doctor is different from any other patient. A doctor or any medical staff is a valuable resource since absence of each medical authority can affect the treatment of patients vastly. Due to poor doctor to patient ratio, the hospitals have already been overflowing with patients. Also, the shortage of PPE suits havealso culminated into spreading covid among the medical staff responsible for the patients.
According to WHO, the virus that causes COVID-19 spreads primarily through droplets generated when an infected person coughs, sneezes or speaks. One can also be infected by touching a contaminated surface and then touching your eyes, nose or mouth before washing your hands.
Hence, it was really necessary to minimize the contact between a covid affected and the doctor also to provide a system that can allow doctors to treat multiple patients at the same time.

II. RELATED WORK

This project involves building of a web based as well as app-based system that once powered byIOT hardware can be used to get real time medical statistics of a covid patient, with good support ofmachine learning algorithms the system will be able to analyze each patient's condition and furtherhelp doctor in understanding the patient. The system has eliminated the use of pulse oximeter and thermometer separately by providing a device that may sense both. Further a

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real time alert systemhas also been introduced so that in critical situations doctors and responsible staff can be notified.Using this infrastructure, we hope to minimize the chances of spread of contagious diseases amongthe medical personnel.

Sr no.	Title	Year	Author And Publisher	Summary
1.	Development of Wearable Pulse Oximeter Based on Internet of Things and Signal Processing Technique	2017	YuyangXie, Yongjie Gao, Yuchun Li, Yu Lu IEEE	Wearable non-invasive blood oxygen saturation monitoring approaches overcomes the shortcomings of the traditional approaches, and reflects the tendency to change of breathing function in real time, which has great advantages. Thanks to the IOT and advanced signal processing algorithms, we have developed wearable pulse oximeters. These devices are able to detect data such as *SpO*2, *PR*, and *PI*. These data can then be transmitted to an APP. Then, the data could be uploaded to a server to generate a report.
2.	A patch-type wireless forehead pulse oximeter for SpO2 measurement	2017	A. Azhari, S. Yoshimoto, T. Nezu, H. Iida, H. Ota, Y. Noda, T. Araki, T. Umemura and T. Sekitani IEEE	A patch-type wireless wearable pulse oximeter system has been developed to measure the heart beat rate and oxygen saturation of blood in reflective mode from a person's forehead. The system uses light sources of two wavelengths in an optical sensor, separates photodetector signal and transimpedance amplifier output into (IR) and (PPG) signals, and then digitizes and transmits data wirelessly via a Bluetooth module to a remote PC in real time, where the SpO2 value is calculated.
3.	COVID-19 and mortality in doctor - how covid has affected the people working in medical sector.	2020	Karthikeyan Iyengar, Pranav Ish, Gaurav Kumar Upadhyaya, Nipun Malhotra, Raju Vaishya, Vijay Jain Springer	COVID-19 has been associated with an increased mortality in doctors and health care workers. Until an effective cure/vaccine is developed, risk assessments at work, mitigating confounding factors, adequate supply of personal protective equipment (PPE) and enhanced protection against infection are necessary to protect health care professionals on the coronavirus frontline. Otherwise, this occupational risk can lead to further untimely mortality and become another unintended consequence of the COVID-19 pandemic.

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III. PROPOSED ALGORITHM

A. *Design Considerations:*

- Stable Internet Connection
- Node MCU micro-controller (ESP8266)
- MAX30105 pulse oxi sensor
- Jumper cables
- APK or browser for accessing output
- Arduino IDE for writing and uploading code to ESP8266.
- Wire.h library for connection and port recognition between ESP8266 and sensors.
- MAX30105.h library for using and controlling pulse oxi sensor.
- heartRate.h library for calculating heart rate from the sensor readings.
- ThingSpeak.h library for connecting the micro controller to Thingspeak cloud.
- ESP8266WiFi.h library for using the Wi-Fi module of the micro controller.
- Axios JavaScript Library for fetching data and making a get request on thingspeak cloud.
- FireBase Web API for hosting and Management of Safe-Oxi Website.
- GoNative.io for Cross Platform app generation.

B. *Description of the Proposed Algorithm:*

In this section we have constructed a mathematical model that describes the functions of each of our modules.
The ratio of red to infrared signals, Z = R/IR, both reflected off the *arterial* blood, iscalculated. The "arterial blood" part is crucial, since most of the light is actually reflected offtissues and venous blood. How to pick portion of the signal corresponding to arterial blood?Well, this is the pulsatile component that varies with each heartbeat. In words of electricalengineers, it's the "AC part", while the remaining reflected light is the "DC part". Sinceabsolute intensities of R and IR light are not commensurate, the Z ratio is calculated fromrelative intensities, as shown in the first figure. In terms of actually calculated quantities, we use root-mean-square (RMS) of the mean-centred, baseline-levelled signal, *y*, to thealready known mean of the raw signal, $\langle Y \rangle$; see second figure. The Z ratio is only half of thework, however. The nonlinear sensor response requires an empirical calibration between Zand the final SpO2 values. I took the calibration equation from MAXIM's code:

SpO2 = | (-45.06*Z + 30.354) *Z + 94.845 |

Keep in mind this equation is valid *only* for MAX30102 design board purchased in 2017! It is likely that MAXIM may recalibrate its sensors at a later date.
The above procedure still produces a lot of false SpO2 readings. The red channel suffersfrom many artifacts, just like the IR one. It is reasonable to assume that both signals shouldbe strongly correlated. In fact, good quality signals, like the example in third figure, docorrelate very well. The Pearson correlation coefficient is in this case as high as 0.99. This is not always the case, as illustrated in the fourth figure. Although the IR signal would pass the heart rate quality filter with its $rm / r0$ = 0.76, the distorted R signal results in a poor correlation coefficient between the two equals to only 0.42. This observation offers the second quality filter: having the correlation coefficient between channels greater than certain threshold.
After several hit and trial calibration of equation the final equation for our device is:

SPO2=| (-45.06*Z+30.354)*Z+180 |;   Heart rate

For moderate-intensity physical activity, your target heart rate should be between 64%and 76%1,2 of your maximum heart rate. You can estimate your maximum heart rate basedon your age. To estimate your maximum age-related heart rate, subtract your age from 220.For example, for a 50-year-old person, the estimated maximum age-related heart rate wouldbe calculated as 220 – 50 years = 170 beats per minute (bpm). The 64% and 76% levelswould be:
64% level: 170 x 0.64 = 109 bpm, and
76% level: 170 x 0.76 = 129 bpm

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This shows that moderate-intensity physical activity for a 50-year-old person has the heart rate that remains between 109 and 129 bpm during physical activity.

For vigorous-intensity physical activity, your target heart rate should be between 77%and 93%1,2 of your maximum heart rate. To figure out this range, follow the same formulaused above, except change "64 and 76%" to "77 and 93%". For example, for a 35-year-oldperson, the estimated maximum age-related heart rate would be calculated as 220 – 35years = 185 beats per minute (bpm). The 77% and 93% levels would be:
77% level: 185 x 0.77 = 142 bpm, and
93% level: 185 x 0.93 = 172 bpm
This shows that vigorous-intensity physical activity for a 35-year-old person has thethat heart rate remains between 142 and 172 bpm during physical activity.Here we consider the minimum heart rate for moderate intensity physical activity, since that is the major.
Hence the formula for heart calculation of is
Actual heart rate= (BeatsPerMinute * 100)/(220-age)

IV. PSEUDO CODE

A. *Device Side*

```
Step 1: Device Setup and set count to 0
Step 2: Connection request to internet Connection
Step 3: Successful Connection
      if successful:
            Step 3.1 Receive Sensor Readings
              count=count+1
      else:
            goto step 2
Step 4: Connection Request to Thingspeak Cloud
Step 5: if count==100:
             Spo2 Calculation from IR and Red Reading.
       else:
            goto step 3.1
Step 6: Wait until response is received.
Step 7: Close Connection
Step 8: Goto step 3.1
```

B. *App Side*

```
Step 1: Enter Login Credentials
Step 2: Authentication
Step 3: if Successful:
            Open Dashboard
      else:
            Goto Step 1
Step 4: Fetch Data from Thingspeak
Step 5: Read and Analyze Dataset
Step 6: Fetch Live Data from covid API
Step 7: Run Data Analytics and Machine Learning Algorithms
Step 8: Predict Covid Probability on basis of Symptoms entered
Step 9: Generate view
```

V. SIMULATION RESULTS

The above-described technology makes it possible to create a cross platform and complete system for wireless and contact free system for doctors.This bridges the gap between Patients and their care takers by the benefit of real time SPO2 readings and Beats Per Minute measures.It must be noted that the observed data is also used for calculating the

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heart rate of the patient. In the Application the Covid predictor System make it really easy for doctors and others to assess the risk of patient.

Certain situations when the patient may be in discomfort or in a critical condition, the emergency message system comes in handy that sends a quick message to all the concerning Contacts including the medical staff attending the patient.Furthermore, An integration with the covid-19 API gives a real time Covid stats about the are the patient's currently in, this can help them in assessing the situation resources the patient may have access to.

Developer can also make the same application work for multiple devices, In this way, we minimize the time as well as efforts wasted by doctor in situations where patients are overflowing in hospitals which are in observed in abundance in these pandemic times. Below are the screenshots of the application created as well as the connection diagram for connecting The NodeMCU and The MAX30102 Pulseoxi sensor.

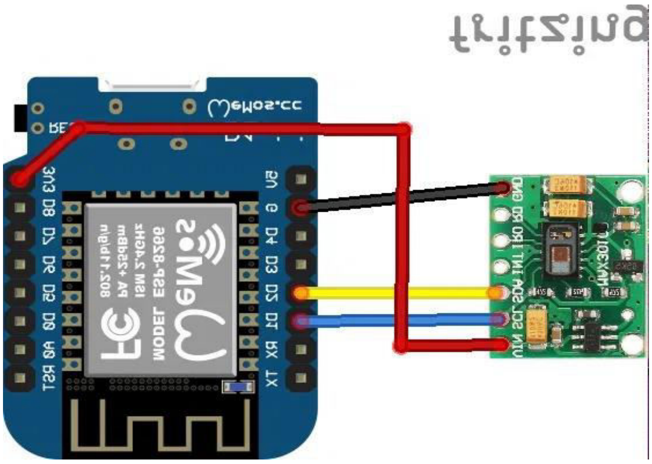

Fig.1.NodeMCU

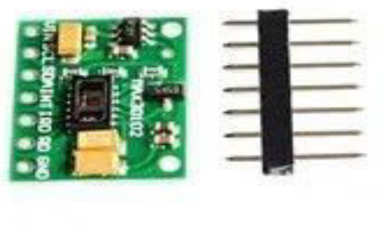

Fig. 2. Sensor

Fig. 3. Login system of mobile app

Fig 4. Home page of mobile application

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VI. CONCLUSION AND FUTURE WORK

In this way we would successfully make a safer and faster remote blood oxygen saturation system of a covid patient.Further we can also provide automatic medicine dispenser that will dispense medicine on doctor's permission. We can also make a detailed analysis of how each medicine has affected the patient and a track record that suggest the doctor medication.

REFERENCES

1. Development of Wearable Pulse Oximeter Based on Internet of Things and Signal ProcessingTechnique. YuyangXie, Yongjie Gao, Yuchun Li, Yu Lu. IEEE, 2017

2. A patch-type wireless forehead pulse oximeter for SpO2 measurement A. Azhari, S. YoshimotoT. Nezu, H. Iida, H. Ota, Y. Noda, T. Araki, T. Umemura and T. Sekitani. IEEE, 2017.

3. COVID-19 and mortality in doctor - how covid has affected the people working in medical sector.Karthikeyan Iyengar, Pranav Ish, Gaurav Kumar Upadhyaya, Nipun Malhotra, Raju Vaishya, VijayJain. Springer, 2020