Continuous Health Monitoring Wrist Band

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***Abstract* - The world is suffering from covid-19 disease which causes lakhs of deaths because of the vital signs variations in human body like heart rate, blood oxygen levels and temperature and more over. Healthcare has received a lot of attention over the previous ten years. the monitoring and recording of numerous medical parameters of patients has become a common occurrence. This device purpose to measure a biological parameter of the patient's body, early detection of disease, allow healthcare to keep track of patients who were either hospitalised or going about their daily lives and create a system that can be used to monitor a patient's body at any time using internet access. The main advantage of the wearable band which continuously measures the patient health, the measured values are stored into the could for future reference and it is a battery-operated device where external supply is not required to measure the real time data of Heartbeat and Blood Oxygen Level and the battery is rechargeable.**

1.INTRODUCTION

The world is suffering from deadly virus (covid-19), disease. It was first recognized in Wuhan, China which causes lakhs of deaths because of the vital signs variations in human body like heart rate, blood oxygen levels and temperature and more over. Healthcare has received a lot of attention over the previous ten years. the monitoring and recording of numerous medical parameters of patients has become a common occurrence. This device purpose to measure a biological parameter of the patient's body, early detection of disease, allow healthcare to keep track of patients who were either hospitalised or going about their daily lives and create a system that can be used to monitor a patient's body at any time using internet access. The main advantage of the wearable band which continuously measures the patient health, the measured values are stored into the could for future reference and it is a battery-operated device where external supply is not required to measure the real time data of Heartbeat and Blood Oxygen Level and the battery is rechargeable.

1.1 LITERATURE SURVEY

REFERENCE.1

In this paper the author has shown that the proposed method could lead to significant improvement in the life of battery for IoT enabled devices. Much of the early research work in IoT-based remote health monitoring deal with sensor nodes for capturing various health parameters. The author of this paper proposed the development of an ultra-low power ECG. The author Peter has presented a list of different sensors and techniques that can be used for non-invasive BP measurement. As described, the dry electrodes embedded into a smartphone, capture ECG signal which is then processed in the smartphone itself.

REFERENCE.2

The author of this paper developed a wearable physiological parameter monitoring device using Wireless software. The system can track pathological processes including a person's heart rate and temperature. The goal of the project is to create a reliable, low-cost, low-power, and accurate system that can be worn on a regular basis and measures vital signs using Zigbee module. Initially, wired communication was employed, but now Zigbee is being used. Since it is energy efficient, relatively cheap, and has a great range, Zigbee is recommended over Bluetooth and infrared wireless technology.

REFERENCE.3

The author of this paper has represented the use of web server using Ethernet shield instead of ZigBee since ZigBee has a short-range wireless data transfer rate of only a few megabits per second. It sends data over longer distances by passing it through intermediary devices on its way to further away destinations. It’s data rate transfer is of 250 Kbit/s. But ZigBee is not suitable for medical application as it may not be suitable for transmitting vital signs, especially for emergency messages, since these messages are critical for diagnosing the illness of patients as well as providing important clues to the urgency level.

REFERENCE.4
The primary goal of this research is to create a new design and construct a smart patient health tracking system. The sensors are inserted in the patient's body to detect the temperature and heartbeat of the patient using this. The two additional sensors are installed in the house to monitor the humidity and temperature of the room where the patient is staying. These sensors are linked to a control unit that computes the values of all four sensors. The derived values are subsequently sent to the base station via an IoT cloud. The values are then retrieved by the doctor at any location from the base station. Thus, the doctor can determine the patient's condition based on the temperature, heart rate, and room sensor information. and appropriate measures can be taken.

REFERENCE.5
New technologies, such as wearable gadgets and the cloud of things, are being introduced into the modern health-care system. It allows for greater flexibility in terms of recording and transmitting patient-monitored data via IoT. Secure data transfer is required for this connection. The goal of this study is to send data in a secure manner. The suggested system incorporates health-care security and the internet of things. The system is divided into two stages: storage and data retrieval. Data is stored and modified in the storage stage for future usage. Retrieve data from the cloud during the data retrieval stage. According to the request, the cloud server can share with authenticated users. Every 5 or 10 minutes, a patient wearing wearable gadgets updates his record.

REFFERENCE.6
The two authors Bilal and Khaled have proposed a wireless remote control home automation system for the elderly and disabled persons. The system is designed to facilitate the movement, control and monitoring of critical equipment for persons with disabilities. The system can use a remote control to control or monitor household appliances, which sends commands wirelessly through the XBee transceiver. The remote-control function includes buttons for controlling various household appliances and an LCD display for message notification.

REFFERENCE.7
In this paper, the author Chen Min et al. proposed an electronic health management system based on the second-generation RFID system. The Internet system can also collect and transform information for medical emergency management. Physiological signs such as body temperature, blood rate, and heart rate are sent from the patient through body sensors connected to specific parts of the patient's body. The system maintains a medical database containing user information and medical history.

1.2 Objective of Work
Health monitoring devices is very helpful nowadays because they monitor different vitals of the person and send them to remote location for further uses. This data can be used by medical experts (doctors) to monitor their patients simultaneously without their presence at their location. These bands increase the capacity of treating more patients remotely. This device not only transmits vital signs but also raises the monitoring efficiency of patients. Continuous health monitoring of a person is important during critical conditions. Hence these devices play an important role in recent situation where people can check their health condition through this wireless device.

2. GENERAL EXISTING HEALTH MONITORING DEVICES

2.1. PULSE OXIMETER

Fig.2.1 Pulse Oximeter
Due to major breakthroughs in medical, public health, personal and environmental cleanliness, life expectancy has increased in most nations during the last several decades. However, rising expectations

combined with dropping birth rates are likely to result in a large elderly demographic in the near future, which might put major strain on the socio-economic system. As a result, development of cost-effective, ease of use products for older healthcare and welfare is critical. Health monitoring, aided by communicable, wearable sensors, present day communication and information technologies, provides an efficient and cost-effective alternative that allows the aged people to remain in their homes instead of depending on costly institutional care. These devices will also allow healthcare workers to monitor vital physical signals of their patients in real time, analyse health problems, and can give response from afar. It is discussed and evaluated a number of low-cost, non-invasive health and activity monitoring systems that have been described in recent years in this work. It's also possible to use this technology in wearable systems. Finally, the compatibility of various communication technologies will be examined, as well as future views and research problems in various distant (remote) observing systems.

2.2. MORE PRO SMARTWATCH

The Smartwatch from Morepor is an excellent way to keep track of your blood oxygen levels, blood pressure, heart rate, sleep patterns, and fitness. It provides reminders and is compatible with both iOS and Android phones. Professional heart rate analysis is provided by this one-of-a-kind wearable. To do so, place your fingertips over the sensors for roughly 30 seconds. The output will be displayed quickly on the application without the use of gels or wires. The smartwatch includes a 1.14-inch High touchscreen display that can be viewed in even direct sunlight if the brightness is adjusted. The price is about ₹3000

Fig:2.2 More Pro Wrist Band

With a customized report on your app, learn more about your health with infrared dual detection plus green light for blood pressure and heart rate. For 30 days, health reports are available on the app. It works with multiple of devices, including those running iOS 8.0 or above and Android 4.4 or above.

2.3. REALME WATCH

The smartwatch has a 1.4-inch LCD touchscreen with a resolution of 320 by 320 pixels.The device is a 5.0 Bluetooth version with email and instant messaging capabilities. Accelerometer, heart rate, and SpO2 are among the sensors.

Fig: 2.3 Real me smart watch

Non-removable Li-Ion 160 mAh battery + Wireless charging power the device. The cost of this band is about ₹2500.

2.4. HUAWEI BAND 4

One of the most essential critical markers that might indicate the body's oxygen supply is blood oxygen saturation (SpO2). HUAWEI Band 4 allows you to measure SpO2 levels in real time, allowing you to check the level of oxygen in your blood whenever and wherever you need to use it.the price of this smart watch is about ₹1700.

Fig: 2.4 HUAWEI Wrist Band

The HUAWEI TruSeen accurately measures your heart rate. If your heart rate surpasses the maximum average heart rate, it sends out clever vibrations as a reminder. The invisible light in night mode ensures less distraction for a better night's sleep.

3. DEVELOPED HEALTH MONITORING WRIST BAND

BLOCK DIAGRAM AND WORKING

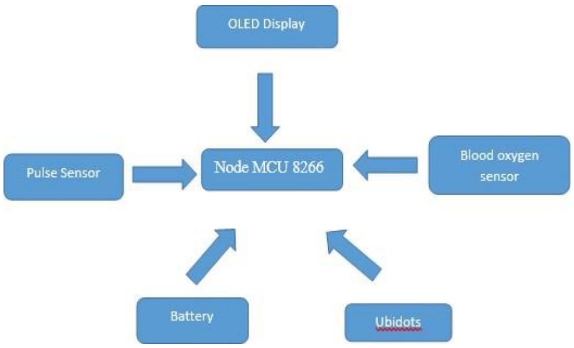

Fig 3.1 Block diagram

- The block diagram of health monitoring device is as shown in the above figure. It consists of ESP8266 WIFI module, battery, temperature and SPO2 sensor and an OLED display.
- The various sensors are connected to a WIFI module board. Normally this board is powered with a supply of 3.3v or 5V.
- Rechargeable Lithium-ion battery is used to power up the whole circuit.
- Whenever the person's fingertip is placed on the sensor the heart rate, blood oxygen level and temperature are being monitored and is displayed on the OLED screen.
- The data obtained can be transferred to the CLOUD through the ESP32 which can be accessed for further uses.

3.1 COMPONENTS USED

PULSE SENSOR

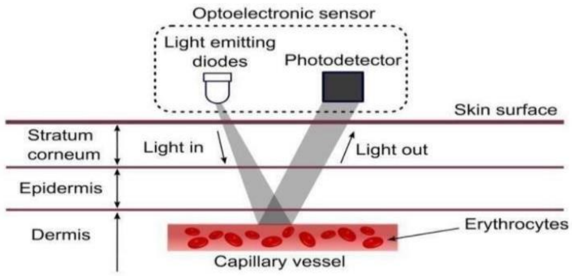

Fig 3.2 Pulse sensor

Pulse sensor is a major component that we have used in this project i.e. it is basically a simple heart-rate sensor. This sensor is a combination of a heart rate sensor with amplification. The current and voltage rating of this sensor is 0.004A current at a voltage of 5V.The diameter of pulse sensor is 15.9mm and the thickness size is 3.2mm.

Coming to the working of this particular sensor, it is quite simple where it consists of an LED and an LDR. The infrared LED acts as transmitter and an LDR as receiver. The person's heartbeat causes a variation in the flow of blood. During this, when a person places the finger on this sensor, a part of the light from the infrared led gets absorbed by the tissues and the rest of the light is reflected back. This reflected light is received by the receiver of an LDR. The total amount of light absorbed by the LDR will depend on the blood volume in the tissue from where the light is reflected. The output of this sensor is will be an electrical signal that is equivalent or proportional to the human heart rate. This is then further calculated for beats per minute (bpm).

ESP-8266 WIFI Module

Fig 3.3 ESP 8266

The ESP8266 WIFI module is a low cost WIFI microchip produced by Expressive Systems in Shanghai, China. The ESP8266 is a highly designed integrated chip. It features a complete WI- FI networking solution on a single chip. The on-board processor with integrated storage functions acts as a standalone microcontroller with GPIO (input and output), providing an easy and inexpensive way to integrate various sensors. The chip is already soldered to a board with integrated antenna and required components.

The pin configuration of ESP-8266 module is as mentioned below:

1. GND, Ground pin.
2. GPIO 2, General-purpose input/output pin No.2.
3. GPIO 0, General-purpose input/output pin No.0.
4. RX, receive data in, also used as GPIO3.
5. Voltage level pin (VCC) (+3.3 V and can handle up to 3.6V).
6. RST, Reset pin.
7. CH PD, Chip power-down.
8. TX, transmit data out, also used as GPIO1.

BLOOD OXYGEN SENSOR

Fig 3.4 SPO2 sensor

A SPO2 sensor is also known as Pulse oximeter sensor. This sensor is be used to monitor the oxygen saturation of a person's blood, usually through a finger and is also a measure of respiration systems.

This sensor consists of an infrared light source and a probe to transmit light through fingertip. The percentage of saturation can be calculated by measuring light absorption that gets changed due to the pulsation caused by the movement of blood flow through the arteries. There are different factors that can affect the SPO2 measurement which includes skin condition, wounds etc.…

Pulse oximetry is a painless and asymptomatic procedure for determining oxygen saturation levels. It can identify even slight variations in oxygen delivered from the heart to a extremities, such as the arms and legs, quite rapidly. This is done by measuring difference in light absorption in oxygenated or deoxygenated blood. This process is completely painless.

OLED DISPLAY

Fig 3.5 OLED display

OLED is Organic Light Emitting Diode. They're pretty light, almost paper-thin, potentially flexible, and produce a brighter, sharper images.

The module is a single-chip CMOS OLED driver controller with a bit more power. It also has the ability to communicate with the microcontroller. This display works by emitting the visible light. Thus, it can display deep black images. This display is thinner and lighter LCD.

In a place where low light conditions are present, an OLED screen can be used to achieve a higher contrast ratio. OLED is preferred than LCD display because during daylight the readings will not appear brighter and it might be difficult to notice. OLED's displays brighter crisp images and data can be seen easily. So, the OLED consumes less power than other displays.

ADVANTAGES:

- Lower cost in the future
- Better picture quality
- Better power efficiency and thickness

UBIDOTS

Ubidots is a data analytics and visualization start up that specializes in the Internet of Things (IoT). We can transform sensor data into information that counts for corporate choices, machine-to-machine interactions, educational research, and increasing global resource economization with the aid of this platform. We are utilizing the Ubidots Cloud platform in this project to visualize live data as well as save data in the cloud so that it can be accessible for subsequent study.

3.2 DASHBOARD OF UBIDOTS

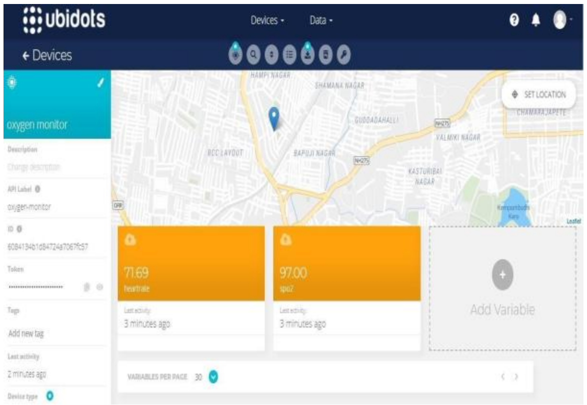

Fig 3.6 UBIDOTS

When logged in into our account this is the first look at our dashboard which shows the recent activity like when was our module online. As well as the location of it. For every project created a unique ID as well as Token which are required to interface our module to Ubidots.

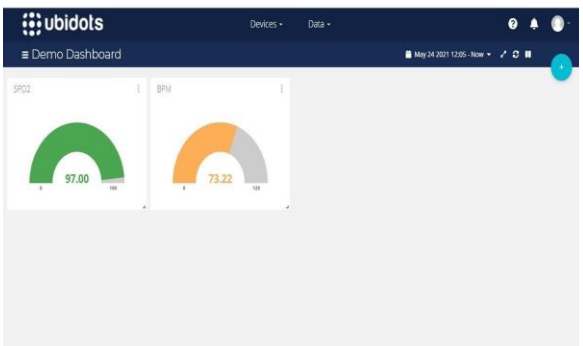

Fig 3.7 Dashboard of UBIDOTS

This is the final dashboard wherein we have implemented 2 gauges one for SPO2 (Blood oxygen level) and another for BPM (Beats per minute). Live data is displayed and is continuously stored in the cloud.

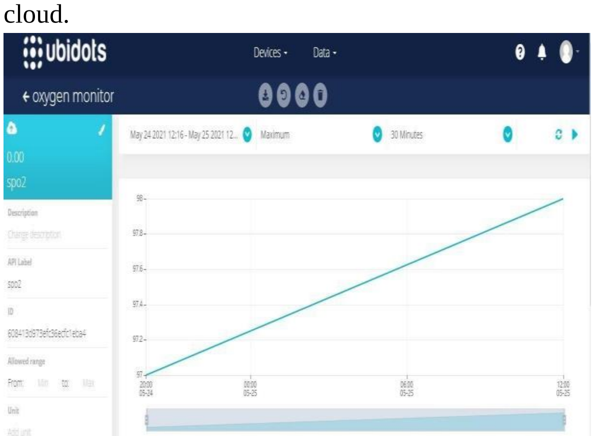

Fig 3.8 graph of Blood Oxygen level

The figure shows the readings taken in the afternoon at 12:16 pm

Graphical representation of live data of Blood oxygen level X axis (SPO2 in %), Y axis (Time in minutes).

Through the implementation of graph, we can easily identify the sudden drop in the oxygen level in the blood.

Fig 3.9 Graph of Heart rate

The figure shows that the readings taken in morning 11:28AM.

Graphical representation of live data of Heart rate X axis (BPM), Y axis (Time in minutes).

Through the implementation of graph, we can easily identify the variation of the heart rate.

All the data upload to cloud can be easily accessed and can be downloaded. The data will be in Excel format and sent via Email.

3.3 CIRCUIT DIAGRAM:

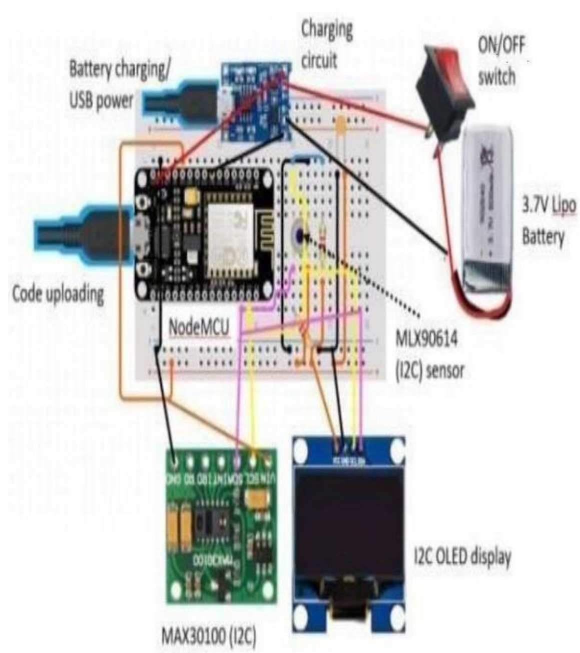

Fig 4.1 Circuit diagram

ACTUAL CIRCUIT AND WORKING

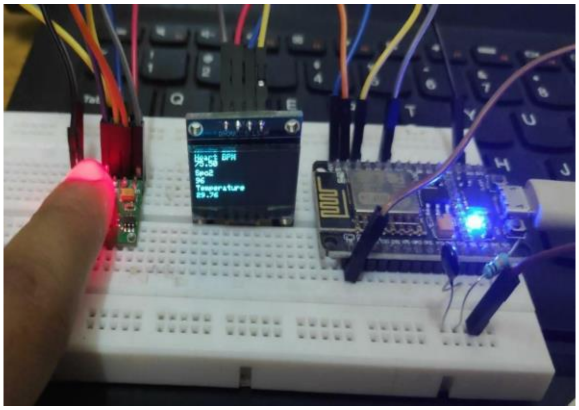

Fig 4.2 Actual module

The above shown figure is the actual model and circuit that has been developed using all the sensors.

3D CASING

Designed to fit in all the components in closed enclosure which makes it a wearable wrist band.

TOP VIEW

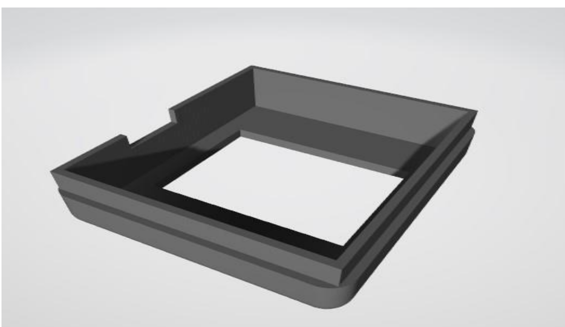

Fig 4.3 Top view of casing

BOTTOM VIEW

Fig 4.4 Bottom view of casing

3.4 RESULTS

We have taken readings of different Age groups at different timings and the vitals sings are tabulated.

AGE: 22 YEARS

Heart rate	Spo2	Date	Time
73.6	95	5/24/2021	8:27:21.255000+05:31
74.6	94	5/24/2021	8:27:23.195010+05:31
74.04	96	5/24/2021	8:28:15.355020+05:31
71.35	95	5/24/2021	8:28:21.385030+05:31
71.25	95	5/24/2021	8:28:32.395030+05:31
72.06	96	5/24/2021	8:29:21.265060+05:31
72.25	95	5/24/2021	8:29:12.258090+05:31
72.54	95	5/24/2021	8:30:11.125230+05:31
77.91	96	5/24/2021	8:30:09.305210+05:31

These readings were taken in morning before breakfast around 8:20AM to 8:30AM.

Heart rate	Spo2	Date	Time
71	95	5/24/2021	14:05:15.155000+05:31
68	96	5/24/2021	14:05:20.159000+05:31
69	94	5/24/2021	14:06:25.245000+05:31
72	94	5/24/2021	14:05:35.205000+05:31
75	95	5/24/2021	14:05:50.195000+05:31
75	96	5/24/2021	14:06:10.257000+05:31
69	96	5/24/2021	14:06:20.327000+05:31
75	94	5/24/2021	14:07:15.155000+05:31
69	96	5/24/2021	14:07:54.432000+05:31
72	95	5/24/2021	14:08:55.651000+05:31
74	94	5/24/2021	14:08:15.255000+05:31

This readings was taken in the afternoon around 2:00PM.

Heart rate	Spo2	Date	Time
70	94	5/24/2021	9:27:21.255000+05:31
68	96	5/24/2021	9:27:23.195010+05:31
68	94	5/24/2021	9:28:15.355020+05:31
75	95	5/24/2021	9:28:21.385030+05:31
71	96	5/24/2021	9:28:32.395030+05:31
74	96	5/24/2021	9:29:21.265060+05:31
70	92	5/24/2021	9:29:12.258090+05:31
72	96	5/24/2021	9:29:12.258090+05:31
69	95	5/24/2021	9:30:11.125230+05:31
74	94	5/24/2021	9:30:09.305210+05:31
75	95	5/24/2021	9:30:09.305210+05:31

This reading was taken in the night around 9:30PM.

AGE: 46 YEARS

Heart rate	SPO2	DATE	TIME
75.43	93	2021-05-22	07:28:21.255000+05:30
74.6	92	2021-05-22	07:28:22.255000+05:30
74.03	94	2021-05-22	07:28:22.255000+05:30
77.32	97	2021-05-22	07:28:23.255000+05:30
71.22	96	2021-05-22	07:28:24.255000+05:30
72.26	93	2021-05-22	07:28:25.255000+05:30
72.27	94	2021-05-22	07:29:26.255000+05:30
72.36	97	2021-05-22	07:29:27.255000+05:30
77.91	93	2021-05-22	07:29:28.255000+05:30
78.91	93	2021-05-22	07:29:28.255000+05:30

Heart rate	SPO2	DATE	TIME
73.75	97	2021-05-22	13:03:20.255000+05:30
75.28	95	2021-05-22	13:04:02.255000+05:30
76.2	94	2021-05-22	13:04:04.255000+05:30
75.36	93	2021-05-22	13:04:05.255000+05:30
77	93	2021-05-22	13:03:17.255000+05:30
72.32	95	2021-05-22	13:03:15.255000+05:30
72.65	94	2021-05-22	13:03:15.255000+05:30
73.62	96	2021-05-22	13:04:06.255000+05:30

Heart rate	SPO2	DATE	TIME
74.26	94	2021-05-22	21:40:20.255000+05:30
73.35	95	2021-05-22	21:41:10.255000+05:30
74.56	94	2021-05-22	21:41:21.255000+05:30
75	96	2021-05-22	21:41:22.255000+05:30
77.26	96	2021-05-22	21:41:23.255000+05:30
72.55	93	2021-05-22	21:41:24.255000+05:30
74.12	95	2021-05-22	21:41:54.255000+05:30
73.25	97	2021-05-22	21:42:03.255000+05:30
74	93	2021-05-22	21:42:04.255000+05:30
75.26	94	2021-05-22	21:42:07.255000+05:30
76.85	93	2021-05-22	21:42:08.255000+05:30
74.96	96	2021-05-22	21:42:11.255000+05:30

AGE: 55 YEARS

Heart rate	SPO2	DATA	TIME
69.65	96	2021-05-22 13:03:20.255000+05:30	
69	95	2021-05-22 13:04:02.255000+05:30	
71	94	2021-05-22 13:04:04.255000+05:30	
72.36	96	2021-05-22 13:04:05.255000+05:30	
74	94	2021-05-22 13:03:17.255000+05:30	
74.52	95	2021-05-22 13:03:15.255000+05:30	
72.65	92	2021-05-22 13:03:15.255000+05:30	
70.01	96	2021-05-22 13:04:06.255000+05:30	

Heart rate	SPO2	DATA	TIME
75.2	94	2021-05-22 07:28:21.255000+05:30	
68	96	2021-05-22 07:28:22.255000+05:30	
68.35	93	2021-05-22 07:28:22.255000+05:30	
70.31	95	2021-05-22 07:28:23.255000+05:30	
74.21	94	2021-05-22 07:28:24.255000+05:30	
72.85	95	2021-05-22 07:28:25.255000+05:30	
70.65	94	2021-05-22 07:29:26.255000+05:30	
74.11	96	2021-05-22 07:29:27.255000+05:30	
69.35	92	2021-05-22 07:29:28.255000+05:30	
68	95	2021-05-22 07:29:28.255000+05:30	

Heart rate	SPO2	DATA	TIME
74.26	95	2021-05-22 21:40:20.255000+05:30	
75	94	2021-05-22 21:41:10.255000+05:30	
72.88	96	2021-05-22 21:41:21.255000+05:30	
74.95	96	2021-05-22 21:41:22.255000+05:30	
68	94	2021-05-22 21:41:23.255000+05:30	
69.25	94	2021-05-22 21:41:24.255000+05:30	
68.45	94	2021-05-22 21:41:54.255000+05:30	
68.01	95	2021-05-22 21:42:03.255000+05:30	
70.12	94	2021-05-22 21:42:04.255000+05:30	
71	92	2021-05-22 21:42:07.255000+05:30	
70.65	93	2021-05-22 21:42:08.255000+05:30	
72.22	95	2021-05-22 21:42:11.255000+05:30	

3.5 CONCLUSION FROM THE RESULT

Blood oxygen Level

ABG stands for arterial blood gas and is a blood test. It monitors the amount of oxygen in your blood.

It can also tell you how much other gases are in your blood. The ABG test is quite precise. An artery rather than a vein will be used to take blood for an ABG test.

Normal: The ABG oxygen level for healthy lungs is between 80 and 100 mm of mercury. If your blood oxygen level was tested using a pulse oximeter, a normal value would be between 95 and 100 percent.

Below normal: Hypoxemia is defined as a blood oxygen level that is lower than usual. Hypoxia is a common source of worry. When oxygen levels are low, hypoxemia is more severe. This can cause problems mostly on body's tissues and organs. This is less than 89 percent. We begin to experience symptoms when our blood oxygen level falls outside of the normal range. Chest pain, rapid heartbeat, and shortness of breath are all symptoms of a heart attack. Medical attention is required right away.

Pulse Rate

The amount of times your heart beats each minute is known as your pulse rate. The normal heart rate ranges from 60 to 100 beats per minute, it also might vary from moment to moment. When we exercise, it might reach 120-150 beats per minute or greater, which is typical. If your resting heart rate is more than 120 beats per minute, when we have dizziness or faintness, we should seek medical help right away.

TACHYCARDIA is a term for a rapid heart rate. People with anaemia or thyroid gland disorders may experience this. BRADYCARDIA is a term for a low heart rate of less than 60 beats per minute, which might signal cardiac issues and mild Cardiac Arrest.

The people undergone test does not have any breathing issues, lung diseases such as asthma. So, the readings obtained are normal.

4. CODING

```
#include <PubSubClient.h>
#include <ESP8266WiFi.h>
#include <ESP8266WiFiMulti.h>
#include <stdio.h>
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
#include "Adafruit_GFX.h"
#include "OakOLED.h"

#define REPORTING_PERIOD_MS     1000
#define WIFISSID "" // Put your WifiSSID here
#define PASSWORD "" // Put your wifi password here
#define TOKEN "" // Put your Ubidots' TOKEN
#define DEVICE_LABEL "oxygen-monitor" // Put the device label
#define VARIABLE_LABEL_1 "heartrate" // Put the variable label
#define VARIABLE_LABEL_2 "SPo2" // Put the variable label
#define MQTT_CLIENT_NAME "EI_OXMO" // MQTT client Name, put a Random ASCII
PulseOximeter pox;
OakOLED oled;
uint32_t tsLastReport = 0;
char mqttBroker[] = "industrial.api.ubidots.com";
char payload[700];
char topic[150];
// Space to store values to send
char str_val_1[6];
char str_val_2[6];
int flag = 0;

int BPM,SpO2;
ESP8266WiFiMulti WiFiMulti;
WiFiClient ubidots;
PubSubClient client(ubidots);
void onBeatDetected()
{
  ;
}
void callback(char* topic, byte* payload, unsigned int length) {
  Serial.print("Message arrived [");
  Serial.print(topic);
  Serial.print("] ");
  for (int i = 0; i < length; i++) {
    Serial.print((char)payload[i]);
  }
  Serial.println();
}
void reconnect() {
  // Loop until we're reconnected
  while (!client.connected()) {
    Serial.println("Attempting MQTT connection...");
    // Attempt to connect
    if (client.connect(MQTT_CLIENT_NAME, TOKEN, "")) {
      Serial.println("connected");
    } else {
      Serial.print("failed, rc=");
      Serial.print(client.state());
```

```
      Serial.println(" try again in 2 seconds");
      // Wait 2 seconds before retrying
      delay(2000);
    }
  }
}
void setup()
{
  Serial.begin(115200);
  oled.begin();
  oled.clearDisplay();
  oled.setTextSize(1);
  oled.setTextColor(1);
  oled.setCursor(0, 0);

  oled.println("Initializing pulse oximeter..");
  oled.display();
  WiFiMulti.addAP(WIFISSID, PASSWORD);
  Serial.println();
  Serial.println();
  Serial.print("Wait for WiFi... ");
  while (WiFiMulti.run() != WL_CONNECTED) {
    Serial.print(".");
    delay(500);
  }
  Serial.println("");
  Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
client.setServer(mqttBroker, 1883);
client.setCallback(callback);

Serial.print("Initializing pulse oximeter..");
// Initialize the PulseOximeter instance
// Failures are generally due to an improper I2C wiring, missing power supply
// or wrong target chip
if (!pox.begin()) {
  Serial.println("FAILED");
  oled.clearDisplay();
  oled.setTextSize(1);
  oled.setTextColor(1);
  oled.setCursor(0, 0);
  oled.println("FAILED");
  oled.display();
  for (;;);
} else {
  oled.clearDisplay();
  oled.setTextSize(1);
  oled.setTextColor(1);
  oled.setCursor(0, 0);
  oled.println("SUCCESS");
  oled.display();
  Serial.println("SUCCESS");
  digitalWrite(1, HIGH);
```

```
  }
  pox.setIRLedCurrent(MAX30100_LED_CURR_24MA);
  // Register a callback for the beat detection
  pox.setOnBeatDetectedCallback(onBeatDetected);
}
void loop(){
if (flag == 0)
{
  client.connect(MQTT_CLIENT_NAME, TOKEN, "");
  Serial.println("MQTT connected again");
  flag = 1;
}
  if (!client.connected()) {
    Serial.print("Reconnecting ... ");
    reconnect();
  }
  // Make sure to call update as fast as possible
  pox.update();
  if (millis() - tsLastReport > REPORTING_PERIOD_MS) {

    // to computer Serial Monitor
    oled.clearDisplay();
    oled.setTextSize(1);
    oled.setTextColor(1);
    oled.setCursor(0, 0);
    oled.print("BPM : ");
    oled.println(pox.getHeartRate());
  oled.println("");
  oled.display();
  oled.setTextSize(1);
  oled.setTextColor(1);
  oled.print("SPO2 : ");
  oled.println(pox.getSpO2());
  oled.println("");
  oled.display();
  dtostrf(pox.getHeartRate(), 4, 2, str_val_1);
  dtostrf(pox.getSpO2(), 4, 2, str_val_2);
  sprintf(topic, "%s", ""); // Cleans the topic content
  sprintf(topic, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
  sprintf(payload, "%s", ""); // Cleans the payload content
  sprintf(payload, "{\"%s\":", VARIABLE_LABEL_1); // Adds the variable label
  sprintf(payload, "%s {\"value\": %s}", payload, str_val_1); // Adds the value
  sprintf(payload, "%s, \"%s\":", payload, VARIABLE_LABEL_2); // Adds the variable label
  sprintf(payload, "%s {\"value\": %s}", payload, str_val_2); // Adds the value
  sprintf(payload, "%s}", payload); // Closes the dictionary brackets
  Serial.println(payload);
  Serial.println(topic);
  client.publish(topic, payload);
  client.loop();
  tsLastReport = millis();
 }

}
```

5. RESULT

This device is being used to track the progression of a viral illness in the clinic.

This technology and the development of applications, including identifying an individual during home quarantine who requires a high level of care or a community in which a growing outbreak may be near and requires immediate intervention.

Advantages:

1. Wearable technology allows us to track our fitness levels, receive text messages faster, and also use GPS to track our whereabouts. Most of the devices that allow us to do so are also hands-free and portable, so we don't have to take them out of our pockets.
2. Wearable’s link to our smart devices, transferring data and allowing us to examine it later as well as in real time. This might assist us in defining objectives and measuring our progress toward achieving them.
3. Allows patients to communicate real-time data to health providers. Remote monitoring, also known as home health care, has the primary advantage of providing a patient to do additional check-ups and communicate test results to a doctor in real time without having to visit a medical facility. This benefit is extremely good for patients who have long-term illness and need to see a doctors on a regular basis.
4. The cost of existing health monitoring smart watches is about ₹2500 to ₹3000.but the developed wrist band is about ₹1500.

6. CONCLUSION AND SCOPE FOR FUTURE WORK

Remote patient monitoring (RPM) has been silently developing for decades, even in the absence of a worldwide epidemic. It seems to be becoming a necessary component of our healthcare delivery system. The cost-effectiveness and favourable health outcomes associated with RPM are attracting the attention of Medicare and commercial health insurers, resulting in increased access to the therapy for those patients who benefit the most. Patients' and practitioners' comprehension of RPM will continue to improve in the future, and technology will grow more advanced, resulting in more use.

Remote patient monitoring may assist keep vulnerable patients healthy in today's COVID-19 environment while also helping practitioners too attentively and efficiently track chronic health issues. RPM promises to help drive down individual and total healthcare expenditures in the future by allowing for more effective care management while reducing expenditures associated with emergencies and hospitalizations. With all of these compelling reasons to use remote patient monitoring, it's just a matter of time until RPM becomes a regular service for the majority of practices.

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