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IoT Based Pulse Oximeter

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ABSTRACT: A pulse oximeter is a medical instrument that indirectly measures the saturation oxygen level of a patients' blood, i.e whatproportion oftheoxygen-carryingmoleculesintheblood(called hemoglobin) are actually carrying oxygen. This is known as oxygen saturation or SpO2.This saturation pointoxygenlevelisveryimportanttomonitorwhile a patient is at risk for further process of medication. Inourpaperweproposedtodevelopapulseoximeter to measure the saturation point oxygen level and the same would be stored in the cloud and also it is availablelivetotheclient'shandhelddevice(mobile phone).In this paper, we seek to monitor a patient's heart rate and blood- oxygen level using a pulse oximeter. The pulse oximeter is designed using infrared and visible (red) light detection from light thatpassesthroughapatient'sfingerfromanemitter.
The absorption will tell when blood is moving through the finger and how much of this is oxygenrich. The output of this analog circuit will be fed into a Node microcontroller, which computes the pulse and oxygen level from these numbers. The values are uploaded to a cloud computing web host called Blynk application from where it can be viewed.

KEYWORDS: Spo2, Blynk Application, Microprocessor, Micro Controller, Oxygen Rich.

I. INTRODUCTION

Pulse oximeters have been used in medical settings for many years. In many cases, such as during an operation, in intensive care, the emergency room, even an unpressurized aircraft, a person's oxygen level may be unstable and needs monitoring. In addition, from these readings, the person's heart ratecanalsobedetermined.Thisprojectisanattempt to construct a working version of a pulse oximeter from a relatively cheap set of parts – including a microcontroller. A microcontroller has enough processing power to perform the tasks required for this design; however, in any commercial application, specialized hardware will be designed that is specifically suited to the task. The sampling portion of this design requires an infrared emitter and a red light emitter. The absorption of oxyhemoglobin and the deoxygenated form differs significantly between these wavelengths. Therefore, using the ratio of the twoabsorptionvaluesgivesthepercentageofarterial hemoglobinforoxyhemoglobin.Thedetectorsdonot give a very high voltage, so the output from the detector needs to be amplified using op amps before passing into the microcontroller for analysis. If not, the relative change will not be seen when the microcontroller makes the input a discreet value. This attempt at a pulse oximeter is fairly crude and does not take into consideration some importantfacts if it were to be used in a serious situation. For instance, it does not take into account other gasses in the blood stream. If a person has been rescued froma burning building, they may have carbon monoxide poisoning. In order to distinguish the difference between CO and O2, absorption at additional wavelengths must be performed. Another example is a person suffering from poor gas exchange in the lungs. Their blood may have a 100% oxygen level, but may still be suffering from too much carbon dioxide(CO2)thatcannotbeexchangedandexhaled.
The microcontroller is required to perform a discrete Fourier transform to determine the pulse. This transform will take a collection of data over timeand extract the amplitude of each of the frequencies it contains. In the case of our data, there should be a pretty distinct pattern of when there is blood movement. Therefore, we should obtain one frequency to the frequency of the pulse of the person using the device. In most design projects, there is a trade off to what should be done with hardware or with software. In our paper, there is not much of a design comparison. The sampling and amplification must be done in hardware with

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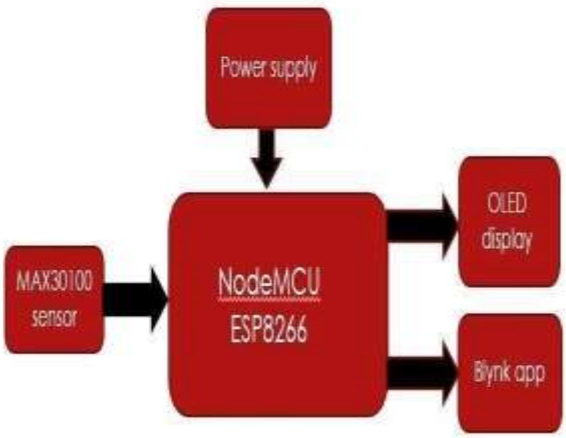
analog values to obtainthecorrectresults.Forthecalculationsandthe video generation, we need a device with enough processingpowerandfeaturestoperformmeetallthe timing requirements. In this case, the Node MCU is a good fit at a lowcost.

II. EXPERIMENTATION

The device has two LEDs, one emitting red light, another emitting infrared light. For pulse rate, only the infrared light is needed. Both the red light and infrared light is used to measure oxygen levels in the blood .When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood also decreases. By knowing the time between the increase and decrease of oxygenated blood, the pulse rate is determined. It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. This is the main function of the MAX30100: it reads the absorption levels for both light sources and stored them in a buffer that can be read via I2C.

BlynkisanapplicationthatrunsoverAndroid and IOS devices to control any IoT based application using Smartphones. It allows you to create your Graphical user interface for IoT application. Here we will set up the Blynk application to monitor BPM & SPO2 over Wi-Fi using NodeMCU ESP8266.So download and install the Blynk Application from Google Play store. IOS users can download from the AppStore.Oncetheinstallationiscompleted,openthe app & sign-up using your Email id andPassword.

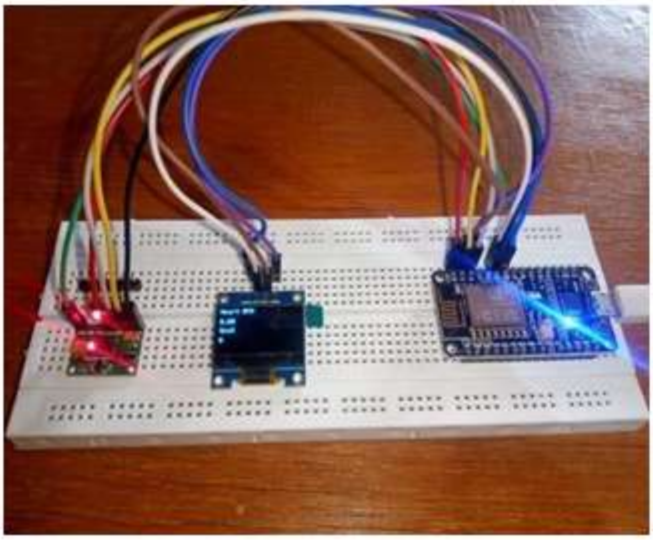


SOURCE CODE :

```
#include <Wire.h> #include
"MAX30100_PulseOximeter.h"          #define
BLYNK_PRINT Serial #include <Blynk.h>
#include
<ESP8266WiFi.h>#include<BlynkSimpleEsp8266.h>
#include "Wire.h"
#include      "Adafruit_GFX.h"      #include
"OakOLED.h"
#define REPORTING_PERIOD_MS 1000
OakOLEDoled; char auth[] = "N-
81lOStH83VwUeNu KHOzpLVzqjFXhO;
// Auth Token in the Blynk App.
Char    ssid[]    =     "XYZ";
// WiFi credentials. char pass[] = "password"; //
Connections : SCLPIN
-D1,SDAPIN-D2,INTPIN-D0
PulseOximeter pox; float BPM, SpO2;
uint32_t tsLastReport = 0;
const unsigned char bitmap [] PROGMEM=
{
0x00, 0x00, 0x00, 0x00, 0x01,0x80,0x18, 0x00,
0x0f,
0xe0,0x7f,0x00, 0x3f, 0xf9,0xff,0xc0,0x7f,0xf9,
0xff, 0xc0,0x7f, 0xff, 0xff, 0xe0, 0x7f,0xff,0xff,
0xe0,0xff, 0xff, 0xff,0xf0,0xff, 0xf7, 0xff, 0xf0,
0xff,0xe7, 0xff, 0xf0, 0xff, 0xe7, 0xff,0xf0,0x7f,
0xdb, 0xff,0xe0,0x7f,0x9b, 0xff, 0xe0, 0x00,0x3b,
0xc0, 0x00, 0x3f, 0xf9,0x9f, 0xc0, 0x3f,
0xfd,0xbf,0xc0,0x1f, 0xfd, 0xbf, 0x80,0x0f,0xfd,
0x7f, 0x00, 0x07,0xfe,0x7e, 0x00,
0x03,0xfe,0xfc,0x00,0x01, 0xff, 0xf8,0x00,0x00,
0xff, 0xf0, 0x00,0x00, 0x7f, 0xe0,0x00,
0x00,0x3f, 0xc0, 0x00,0x00, 0x0f,0x00, 0x00,
0x00,
0x06, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00,0x00, 0x00, 0x00
};
```

```
void onBeatDetected()
{
Serial.println("Beat Detected!"); oled.drawBitmap( 60, 20, bitmap, 28, 28, 1); oled.display();
}
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();
pinMode(16, OUTPUT); Blynk.begin(auth, ssid, pass); Serial.print("Initializing PulseOximeter..");
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");
pox.setOnBeatDetectedCallbak(onBeatDetected);
}
// The default current for the IR LED is 50mA and it could be changed by uncommenting the following line.
//pox.setIRLedCurrent(MAX30100_
LED_CURR_7_6MA);
}
void loop() { pox.update();
Blynk.run();
BPM = pox.getHeartRate(); SpO2 = pox.getSpO2(); if(millis() - tsLastReport>REPORTING_PERIOD_MS)
{
Serial.print("Heart rate:"); Serial.print(BPM); Serial.print(" bpm / SpO2:"); Serial.print(SpO2); Serial.println(" %"); Blynk.virtualWrite(V7, BPM); Blynk.virtualWrite(V8, SpO2); oled.clearDisplay(); oled.setTextSize(1); oled.setTextColor(1); oled.setCursor(0,16); oled.println(pox.getHeartRate()); oled.setTextSize(1); oled.setTextColor(1); oled.setCursor(0, 0); oled.println("Heart BPM"); oled.setTextSize(1); oled.setTextColor(1); oled.setCursor(0, 30); oled.println("Spo2"); oled.setTextSize(1);
```

Case2:



Result on OLED Display

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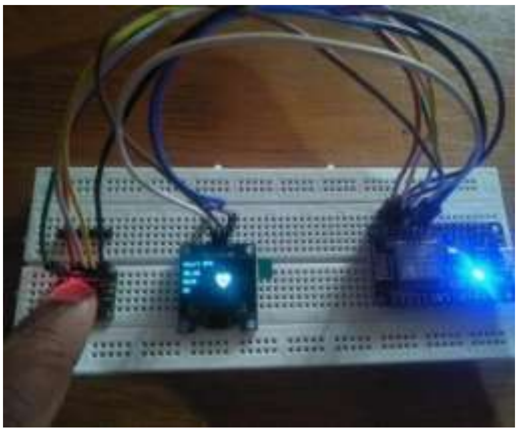
Result on Blynk App

When a finger is placed on the pulse oximeter
oled.setTextColor(1);
oled.setCursor(0,45); oled.println(pox.getSpO2());
oled.display(); tsLastReport =millis();
}
sensor the heart beat and oxygen level in blood are measured and the parameters are displayed on OLED display and Blynk app.

}

III. OBESERVATIONS FROM THE TESTS

Case1:
When no finger is placed on the sensor the pulse oximeter sensor senses no parameters so the OLED display shows zero readings and the same readings are observed in Blynk app.



Result on OLED Display

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Result on Blynk App

IV. CONCLUSION

We can conclude that this project can help to monitorhealthofapatientbymeasuringtheirbloodoxygen levelsandheartrateandcanupdatethedateontheinternet. Pulse oximeters are used to help with the early detectionofCOVID-19 infections. so there is a requirement of such systems to monitor health of critical healthpatients.

Pulse oximetry is universally used for monitoring respiratory status of patients in the ICU. Recent advances in signal analysis and reflectance technology have improved the performance of pulse oximeters under conditions of motion artifact and low perfusion. Multiwavelength oximeters may prove to be useful in detecting dyshemoglobinemia. Monitoring with pulse oximetry continues to be a critical component of standard of care of critically ill patients despite the paucity of data that such devices improve outcome.

SOME OF THE ADVANTAGES FROM THE ABOVE RESULTS

a) Early Detection of COVID-19Infections.
b) Smart Health MonitoringDevice.
c) Monitor the Health of PatientOnline.

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