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Smart pulse oximeter systems for spo2 measurement based on IOT

[1]L. K. Hema, [2]R. Mohana Priya, [3]Rajat Kumar Dwibedi, [4]J Vijay

Abstract--*For a patient with arrhythmia, a surveillance and warning device, particularly during the night of rest, can reduce the risk of death from heart attacks. A public pulse oximeter attached to the Internet of Things (IoT) system enables a family member to monitor a patient remotely. It is critical to provide an actual-time alert system capable of alert a patient when they are at danger. The unit uses a pulse oximeter module, a WLAN router to link the device to the cloud server, which is capable of displaying data on the Android display. Equipment for the patient is powered by a generator. Battery power is monitored, too. The heart rate's lowest reading accuracy was 96.9 per cent (normal, bradycardia and tachycardia) compared to the fingertip pulse oximeter's measured efficiency. Remote control data transmission speed depends on Internet access capacity.*

Keywords--*Cloud, Security, Emergency, Heart rate, IoT*

I INTRODUCTION

Many years earlier pulse oximeter was used in surgical services [1]. In certain situations, e.g. during an procedure, the emergency department in intensive care, or an unpressurized plane, a person's oxygen level can be low and require control [2]. On top of that, the heart rate of the individual may also be estimated from such readings. This project is an effort to create a functioning version of a pulse oximeter from a fairly inexpensive collection of components-including a microcontroller [3-6]. An off - the-shelf microcontroller has adequate computing capacity to conduct the tasks needed for this design; however, customized hardware uniquely tailored to the role must be built in every commercial application.

The sampling part of this system includes an infrared emitter (wavelength approximately 940 nm) and a red light emitter (wavelength approximately 660 nm) [7-8]. Such wavelengths vary considerably between the absorption of oxyhemoglobin and the deoxygenated type. Using the average of the two absorption values therefore giving the amount of oxyhemoglobin arterial haemoglobin. The detectors do not provide a very high voltage, so it is important to amplify the detector performance using op amps before moving into the microcontroller for study. If not, the proportional shift can not be shown because the microcontroller allows a separate value of the data [9].

[1]Associate Professor, ECE Department, Aarupadai Veedu Institute of Technology,Vinayaka Mission's Research Foundation, Deemed to be UniversityIndia, Email:hemalk@avit.ac.in

[2]Assistant Professor, ECE Department, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation, Deemed to be University India

[3]Assistant Professor, ECE Department, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation, Deemed to be University India

[4]Assistant Professor, ECE Department, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation, Deemed to be University India

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This attempt at a pulse oximeter is fairly crude and does not take into consideration some important facts if it were to be used in a serious situation. For eg, it doesn't take certain gasses in the blood stream into consideration [10]. If a individual is saved from a burning building they can be contaminated with carbon monoxide. To discern the disparity between CO and O2, the absorption will be done at different wavelengths. Another example is a person who suffers from inadequate flow of gas in his lungs [11-13]. A blood can have an oxygen content of 100 per cent, but they will also die from so much carbon dioxide (CO2) that can not be recycled and exhaled. To calculate the frequency, the microcontroller is needed to conduct a discrete Fourier transformation. This process would take data collection over time and determine the amplitude of each of the frequencies found therein [14]. In the case of our records, when there is blood flow there should be a very distinct pattern. And we will get one frequency where the amplitude is far greater than the other observed frequencies.That should equate to the individual using the device's pulse frequency [15].

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 analog values to obtain the correct results. For the calculations and the video generation, we need a device with enough processing power and features to perform meet all the timing requirements. In this case, the Node MCU is a good fit at a low cost.

II SYSTEM METHODOLOGY

Fig 1 shows the block diagram of the proposed system. It consists of the following parts.

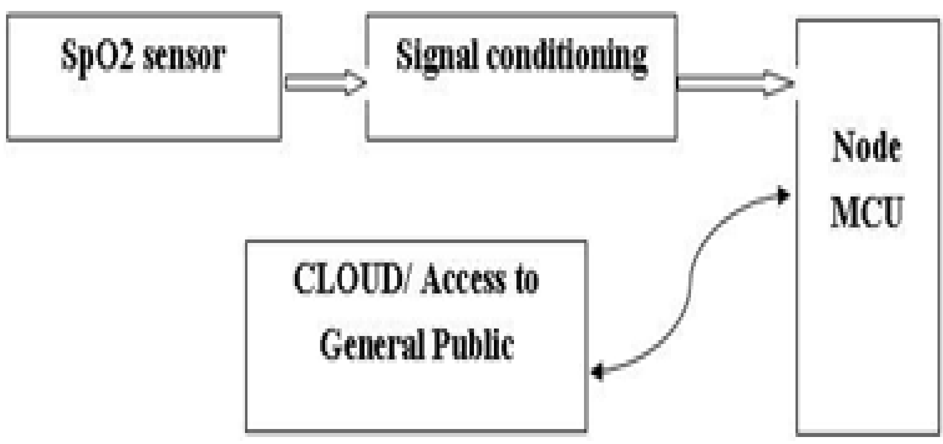

Figure 1: IOT enabled Pulse oximeter

The pulse oximeter is based on the idea that determinations of arterial oxygen saturation can be produced using two wavelengths, given the tests are carried out on the pulsating side of the waveform. The two wavelengths suggest that there are just two absorbers; oxy hemoglobin (HbO2) and decreased hemoglobin (Hb) respectively. Such findings, which have been confirmed from scientific practice, are focused on:

(i) Pigments of the flesh, muscle, cartilage, bone, arterial blood, venous blood can retain light that passes through the ear or finger

(ii) The absorbance is additive and complies with Beer-Lambert law: A =–logT =loglo/I= eDC

(iii) Much of the absorbance becomes set over time and does not alter. Also blood in the capillaries and veins is stable in composition and flow under continuous metabolic conditions, at least for brief periods of time

(iv) Even the blood supply is pulsatile through the lungs and arterioles. Thus, calculating the altering signal simply tests the absorbance attributed to arterial blood which allows it easier to assess arterial oxygen saturation (SaO2). All the other absorbers who are actually part of the continuous context signal are uninfluenced by this.

Figure (a) shows a standard fingertip oximeter probe in operation while Figure (b) shows a standard pulse oximeter probe being built. The absorption by a picture sensor of certain chosen wavelengths of light flowing into living tissue is measured.

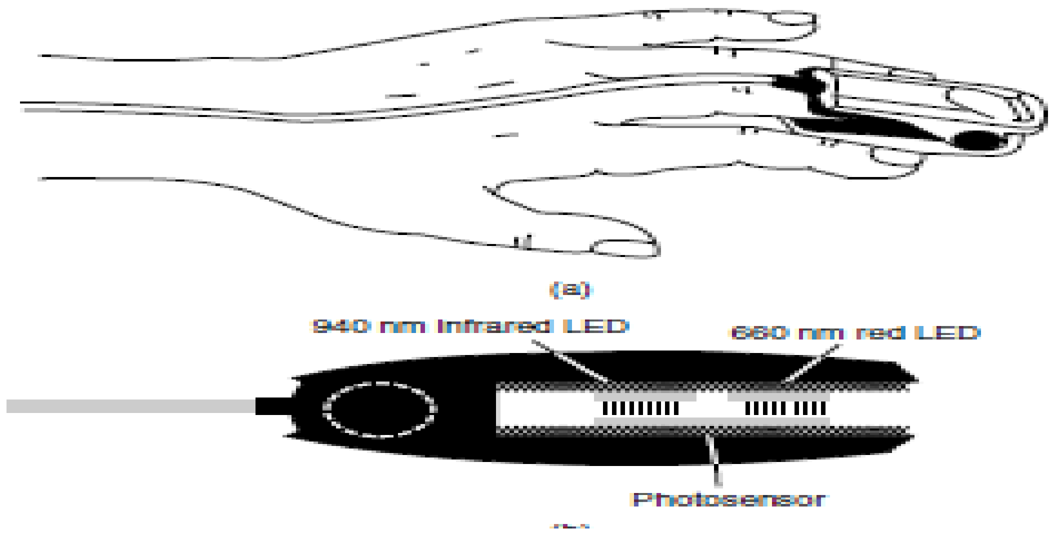

Figure 2:A typical finger tip pulse oximeter probe, b. Components of pulse oximeter probes

Based on the maker, the red and the infrared LEDs inside the probe are guided in various ways. Many of the probes have a single photo detector (PIN-diode), and the origins of light are normally sequenced on and off. Photodiode and led pre processing will require significant time and energy to get the required signal. Hence we use a sensor called Proto central MAX30100. The sensor contains the necessary circuits to obtain the desired signals. The MAX30100 is an optimized system for sensor pulse oximetry and heart rate tracking. To monitor pulse oximetry and heart rate signals, it incorporates two LEDs, a object detector, refined optics, and low-noise analog signal processing. The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down with negligible standby current via software which enables the power supply to remain linked at all times.

The MAX30100's SpO2 circuitry comprises of ambient light cancelation (ALC), 16-bit sigma delta ADC, and patented, independent time sensor. The SpO2 ADC is a continuous time-over-sample sigma delta converter

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with a resolution of up to 16 bits. The data rate of the ADC display is programmable from 50Hz to 1 kHz. The MAX30100 features a patented discrete time filter to eliminate 50Hz/60Hz interference and residual atmospheric noise at low frequencies.

The MAX30100 features an on-chip temperature sensor to (optionally) calibrate the SpO2 subsystem's temperature dependency. The SpO2 algorithm is fairly indifferent to the wavelength of the IR LED but the wavelength of the red LED is important for accurate data interpretation. Data from the temperature sensor can be used to account for the SpO2 error for adjustments in atmospheric temperature.

The MAX30100 combines red and IR LED drivers for the SpO2 and HR calculations to power LED pulses. With appropriate input voltage the LED current can be configured from 0mA to 50mA (typical only). Based on usage cases, the Lead pulse duration can be optimized from 200μs to 1.6ms to improve calculation precision and power consumption.

The ESP8266 is a low- WiFi chip with complete TCP / IP stack capabilities as well as MCU (Microcontroller Unit). That module enables MC to link to a wi-fi and use Hayes-style commands to create basic TCP / IP connections.

The microcontroller used for interfacing the sensor is the Node MCU. It is a lua based microcontroller consisting of an ESP8266 WiFi module. This is the controller used for communicating the results to online web server. It's an IoT network and is open source. This requires software operating on the Espressif system's ESP8266 WiFi and hardware working on the ESP-12 computer.

The Arduino Integrated Programming Environment-or Arduino Program (IDE)-includes a text editor for code writing, a message field, a text screen, a toolbar with specific task buttons and a set of menus. It's used to link and work with the Arduino and Genuino hardware to upload the programs. The steps are as follows:

- To install and configure Arduino IDE for ESP8266.
- Launching of ESP8266 Arduino IDE for NODE MCU.
- The programming of ESP8266 Arduino is carried out further.
- To enable the ESP8266 WiFi connectivity.
- To use the ESP8266 in specific applications, we have to send request to the web server and get the response we need a web server.
- To create a Web Server using ESP8266, include the header <ESP8266WebServer.h>

III RESULT & DISCUSSION

The hardware circuitry of the IoT enabled Pulseoximeter has several components like power regulator, transformer, node microcontroller, ESP8266 module and pulse oximeter sensor. The spo2 sensor measures and sends the oxygen level to ESP8266 module and sends that data to Thingspeak web computing host, so the data made available in cloud. This method helps to view the patients’ oxygen level lively in clients handheld device mainly doctors, patient relations and insurance clients.

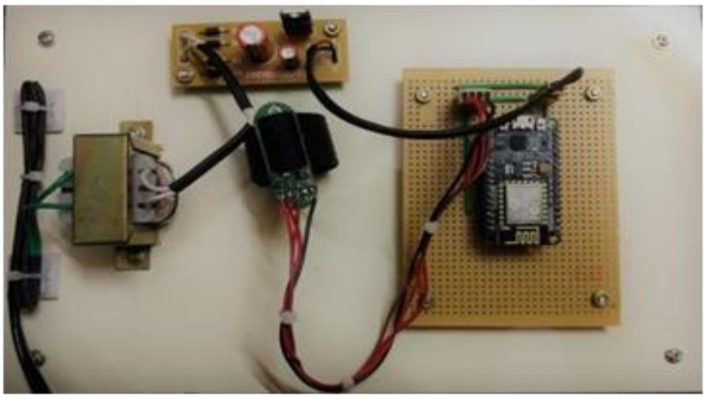

Figure 3: Hardware circuitry of IoT enabled Pulse oximeter

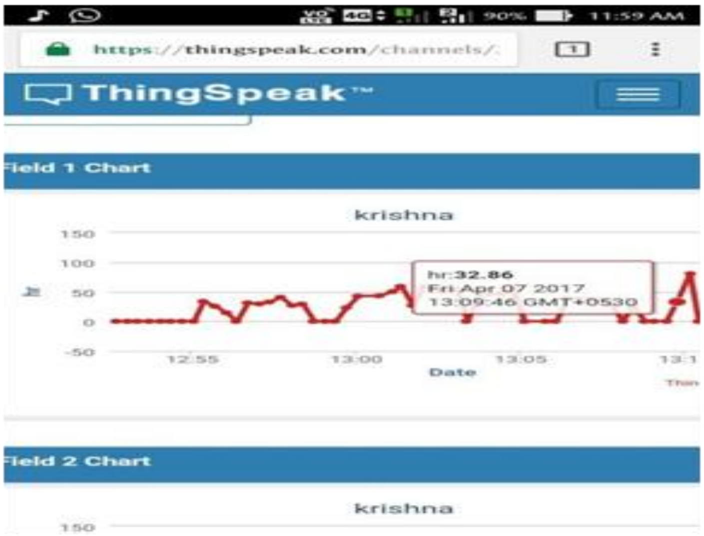

Figure 4: Heart rate output in clients' handheld device

The above Fig.4 shows the output image of the value of heart rate lively through mobile gadget.

Figure 5: SpO_2 Output in clients' handheld device

The Fig 5 shows the output image of the SpO2 value lively through the mobile i.e., clients' hand held device.

IV CONCLUSION

The IoT Enabled Pulse Oximeter developed has been a relative success compared to mainstream Pulse Oximetry and Pulse-Rate devices. Thus our aim to make the system accessible and portable has been proved and tested thoroughly. With the connection with the Internet, even remote doctors can assess the condition of the person by checking the result from the web. Hence, the device has proved to be fruitful despite its challenges.

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