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Research Article

Design SPO2 and BPM Monitoring System To Monitor The Patient's Health Using Anroid

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ABSTRACT

Background: Many efforts have been continuously developed in order to avoid contacting with the Covid-19 viruses and other infectious diseases during the pandemic. For people infected with Covid-19, monitoring their oxygen saturation and heart rate at all times is very important. Beside that the chance of being exposed by the viruses from the patient is very high. In this study, a device that can monitor SpO2 in the blood and heart rate using the Blynk application is designed. Health workers can control patients using an android that has the Blynk application installed.The measurement patient results can be monitored with the LCD manually and remotely via Android. Android-based measurements can reduce the risk of health workers making direct contact with the virus and the patient of covid-19. The information can be monitored in real time..
Methods: This system is designed using a wifi-based Esp8266 Wemos D1 mini module as the input and output controller. The detection of the oxygen levels as well asthe BPM is conducted by using Max30100 censor
Results: The studies show that the measurement results performed on the LCD can be read on an Android using the Blynk application. Data transmission that comes from several devices can be monitored in one android. The results show that the measurement data on the LCD are the same as those performed using the Blynk application
Conclusion: The results shown that the measurement error level resulted by the SPO2 as well as the BPM is detected to the value of 0.021% and 0.012%, respectively. Beside that this developed device is also shown to be portable, effective, safe and easy to use.

Key words: NodeMCU; Modul ESP8266; Oximetry; IoT

INTRODUCTION

The Covid-19 pandemic has brought many changes to people's living habits as well as in the field of health services. The development of various tools that can facilitate human life is currently increasing. This increase is influenced by the rapid progress in the field of technology and information. The need for data transmission and automatization systems in measuring activities in the field of medical devices also grows continuously. By this reason the research on the role of digital technology dealing with the pandemic is continuouslyinvestigated [1].In general, the use of mobile phones is only as a medium of communication in the form of telephones and messages. Over time, mobile phones is continuously developed with the Android system. The android system can be used as a basis for controlling and monitoring application systems [2]. Monitoring using Android is built with the NodeMCU ESP8266 module. This module has been integrated with a microcontroller as a controller and wifi as a connecting medium with internet-based devices [3].The result of the development of the NodeMCU ESP8266 module is the Wemos D1 mini. Wemos D1 mini is a mini wifi board based on ESP8266 which is known to be economical for making mini-projets without using Arduino as a microcontroller. As a liaison for measurement results so that they can be monitored by users, we can use one of the platforms, namely the blynk application system. It is designed for Internet of Things (IoT) systems that can control remote functions, display sensor data, store data and monitor [4].

The use of technology and research based on microcontrollers has been carried out intensively.A design of a medication reminder alarm for TB sufferers based on the Atmega 328 microcontroller is designed by using a time control system and by adding a DF Player as a sound output [1,5].Research on how to build a web-based information system to determine the development of the final project of Nursing Science Study Program of STIKES MW Kendari can be conductedby using Bootstrap Framework. Through this system, information about a student's final project can be found quickly and efficiently [6]. The design using android and the IoT has been widely used by the reason it can help and save time. The android-based application design to monitor infant growth for the integrated services post (posyandu) attendances is very helpful for cadres, health workers and parents for detecting the development of the nutritional status of children under five years who are registered at the posyandu [2].In addition, monitoring the condition of air pollution in an area of study can be known by using SO2 gas and internet-based NodeMCU [7]. It is documented in [8] that the MAX 30102 photometric sensor can be modified by integrating an ESP32, an LCD output and a server used to monitor oxygen saturation and heart rate.Data transmission technology through the IoT platform strongly supports the telemidicine process, one of which is sending ECG, temperature and humidity data [9]. The application of IoT in the healthsector brings new developments in health services, especially in diagnosing patients remotely or to avoid direct contact with patients due to infectious diseases. This technology works automatically and intelligently to process decisions that have been widely used in various fields such as education, security, business and the health industry [10].

Conventionally, monitor SPO2 levels and patient's heart rate is conducted by using oximetry which is carried out by controlling directly in front of the patient and by reading the measurement results on the screen or LCD.This activity certainly requires time and energy. In addition, during the COVID-19 pandemy, patients infected by COVID-19are very vulnerabletransmitting the viruses tohealth workers, even though health they have benn fully protected using PPE.The existence of a medical device monitoring system using an Android in an isolation treatment room can make the health workers easier to monitor the patient's condition at once and can provide a secure sense of not to be infected by the viruses.The application of technology consisting of modifying the ESP8266 Wemos D1 mini module as a controller and integrating the MAX30100 sensor as a detector of oxygen saturation and heart rate can help in seeing the measurement results on the LCD layer and on Android smartphones through the blynk application.

METHOD

The main component used as a controller and sender of the data to the android is Wemos D1 mini which is a mini wifi board based on ESP-8266EX. The ESP-12Fwemos D1 mini is a mini wifi board based on ESP8266. The sensor used to detect oxygen levels (SPO2) and a person's heart rate in this study is the MAX30100 sensor. This sensor has been integrated to monitor oxygen saturation and heart rate. TheMAX30100 sensor combines two leds, a photodetector, optimized optics and low noise. The required working voltage is 1.8 V with IR_LED 3.3 V[8].The whole working schema of the devise can be seen in Figure 1.

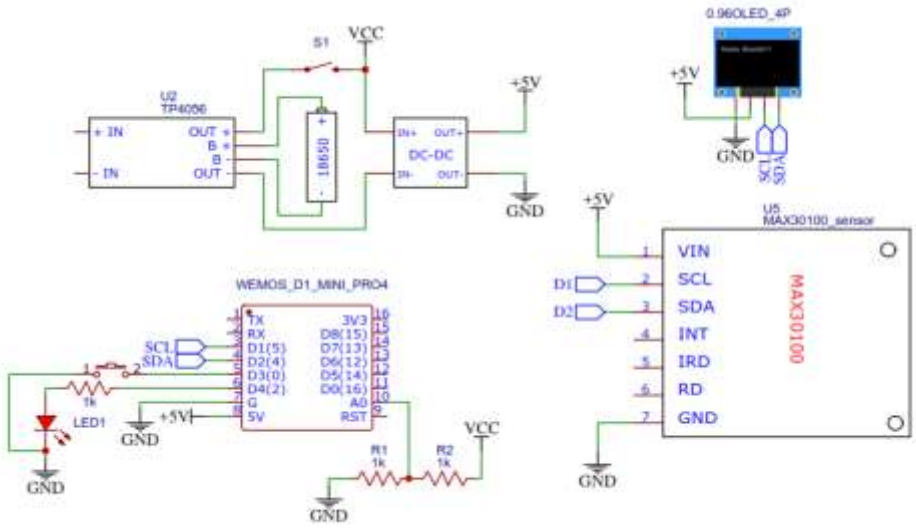

Figure 1. Circuit schematic

The next component is an LCD OLED (Liquid Crystal Display Organic Light Emitting Diode) which functions to display the output of SPO2 and BPM measurements. Emissive electroluminescent layer is a sheet of organic compounds that will emit light when an electric current is passed. This layer of organic semiconductor material is placed

between two electrodes. The passive-Matrix OLED display is very attractive in the sense the shape is very simple as well as minimalist. By this fact it is possible to make a small device design which makes easier in reading SPO2 and BPM outputs and tends to consume low power. 2 pins SDA and SCL are connected from Wemos D1 mini which is the data that has been processed as SPO2 and BPM values [11].

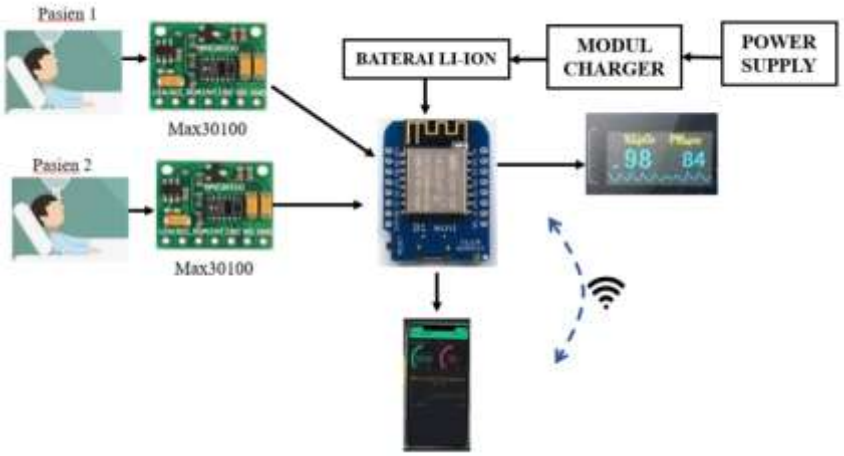

*Figure 2.**Block diagram***

First the hardware design which is the minimum system design and the circuit schemais carried out. Second, the tool is assembled according to the schema by using the help of solder and wax glue for maintaining the stability of the relationship among the components. The next design is to build software by firstly going to the Blynk Cloud web then we create an account so that we can make designs as needed. The ID template in the Blynk application is entered in the Arduino program which will be uploaded to the ESP8266 Wemos D1 mini module. In this study, monitoring the results of SPO2 and BPM measurements was carried out on two devices simultaneously, namely oximetry 1 and oximetry 2. Both tools are connected by 1 anroid.The corresponding block diagram is presented in Figure 2. Health workers only need to choose one android oximetry to see the measurement results. The calibration of the tool is carried out by conducting a test in which the instrument is directly applied to the patient. The measurement results with the prototype are compared with the measurement results with a standard oximetry tool so that the error value can be calculated.

RESULTS

A result of the research this study shows that the measurement data of SPO2 and BPM can be seen on the LCD directly. Remote measurement results can only be seen on android when the device and android are connected to wifi. Based on the results of the hardware design, the resulting tool design is as shown in Figure 3. Testing or calibration of the device is carried out by comparing the results of IoT-based oximetry measurements and standard oximetry. The measurement results compared are SPO2 and BPM. After taking measurements, the error value of the tool that has been designed is calculated. The results of the oximetry analysis 1 and 2 are shown in Table 1.

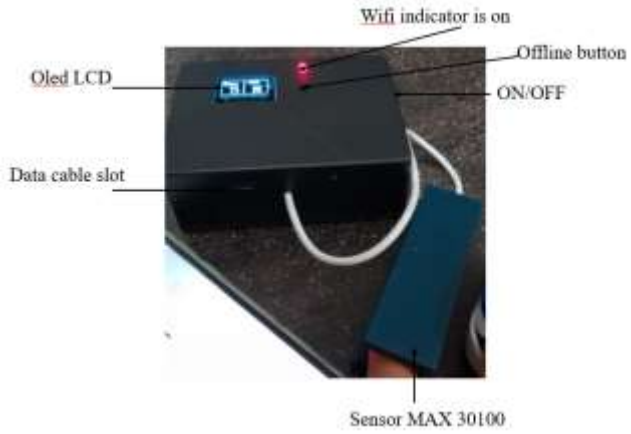

*FIGURE 3.**Oximetry design***

Table 1. Data analysis of the error values of SPO2 and BPM measurements in a person using prototype oximetry and standard oximetry

NO	SPO2 Prototype	SPO2 Standar	BPM Prototype	BPM Standar	SPO2 ERROR (%)	BPM ERROR (%)
OXIMETRY 1						
1	96	94	91	97	0,02	0,06
2	100	85	92	90	0,18	0,02
3	99	99	87	84	0,00	0,04
4	98	98	101	101	0,00	0,00
5	99	94	84	87	0,05	0,03
OMIMETRY 2						
NO	**SPO2 Prototype**	**SPO2 Standar**	**BPM Prototype**	**BPM Standar**	**SPO2 Error (%)**	**BPM Error (%)**
1	82	97	94	98	0,15	0,04
2	98	81	84	94	0,21	0,11
3	99	97	85	87	0,02	0,02
4	98	98	101	105	0,00	0,04
5	98	95	89	91	0,03	0,02

DISCUSSION

When the MAX30100 sensor is connected to the patient, the sensor begins to detect oxygen levels and heart rate through the blood. When the device is turned on, the MAX30100 sensor through the emitting diode emits light on the finger. The light emitted is absorbed by oxygenated blood and

the rest is reflected from the finger and then received by the detector as input to the microcontroller. The amount of oxygen in the blood will affect the absorption of the wavelength produced by an infrared.Changes in heart rate pumping blood will affect the changes in the rate of each blood cell[11]. Changes received by the MAX30100 sensor (processing signal) will be sent to the ESP8266 module for processing and the measurement results are displayed on the LCD screen and sent to android via the Blynk application that has been installed on android. In this study 2 monitoring tools were carried out, oximetry 1 and oximetry 2, while the display of the Blynk application on android is shown in Fig. 4a. showed that the measurement on the LCD have the same value as the value on the Android, this is shown in Fig. 4b. The results of the test measurement of the tool obtained that the oximetry 1 tool had a maximum error value of 0.18% while the maximum oximetry 2 was 0.11%.

CONCLUSION

Oximetry prototype design has been completed. SPO2 and BPM data transfer in real time can use the ESP8266 Wemos D1 mini module as cnntroller, anroid as data viewer and Blynk application as platform. The mesrument results on LCD show same value with the application on anroid. Clearly, data will be sent when the modul ESP8266 and anroid connected to internet..

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