Covid-19 Patient Health Monitoring System Using IoT

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***Abstract*— Monitoring Covid-19 patients is extremely challenging due to under-resourced or risk of infection. With the increased demand for hospital beds and the difficulty of delivering care, some health centers have advised individual with milder symptoms to stay home. Hence, this paper presents a health monitoring system based on IoT that helps the medical staff to monitor blood saturation, heart rate, pulse rate and body temperature remotely. A Biosensor Module MAX3100 is used to read blood saturation level and heart rate of the patient while body temperature sensor, DS18B20 is employed to scan the body temperature. The measurement of room temperature and humidity level is done through humidity sensor. ESP32 Arduino will encode and decode all input data before execution process. The patient's fingers are connected to the sensors and the data is displayed on the smart phone or PC. The proposed system was tested and provide the intended output. Therefore, with the aid of this proposed system, medical staff can examine and keep track on several patients' status simultaneously and without the hassle of being infected by the virus as it is monitored remotely.**

Keywords— Covid-19 patient, Covid-19 Patient Health Monitor, Monitor, IOT, Sp02

I. INTRODUCTION

The Covid-19 pandemic is a crucial issue faced by the health organization worldwide. In Malaysia, the total number of active cases reported as of June 2022 is 27,318 with the average hospital bed utilization is 70% nationwide [1-2]. Despite the current situation being under control, a potential new wave of Covid-19 infection may emerge sooner than expected based on the rise in daily cases recorded recently [3].

In order to restrict and control the transmission of Covid-19 infection, social distancing has been considered as one of the most necessary prevention actions by the authorities. This includes isolation of the known cases and their contact. With the rising number of cases, the healthcare and medical sector face an excessive activity and precedented pressure. Thus, regular monitoring of the health complications of numerous isolated patients becomes extremely challenging when the number of medical staff and facilities are limited. The under-staffed and overloaded patients could reduce the treatment efficiency.

As a result, several mitigation measures have been implemented to restrict the spread of Covid-19. One of the potential solutions is the integration of Internet of Things (IoT) into the healthcare sector [17]. The Internet of Things is considered as one of the feasible solutions for any remote value tracking problems such as health monitoring [4-9], agriculture [10,11], transportation [12] and green technology [13]. The advancement of this technology has given a significant impact on healthcare and well-being sector especially during the COVID-19 crisis.

In 2020, R. Pariambodo [4] proposed a monitoring system for Covid-19 patients in self-isolation to monitor physiological data like SpO_2 and heart rate together with location information of the patients. This monitoring system use pulse oximeter to measure the blood oxygen and heart rate. The data received from the sensor will be sent to the server together with patient ID and location coordinates. This data is then transferred into Elasticsearch to be indexed and displayed on Kibana dashboard.

A. Hidayat et al. in [5] developed a portable pulse oximetry kit equipped with Global Positioning System (GPS) and utilizing Internet of Things (IoT) to monitor the covid-19 patients remotely through smartphone. V. Sahukara in [6] presented a smart tracking system of patient health information such as temperature, pulse rate, height and weight using Radio Frequency Identification (RFID). Al-Humairi et al. in [7] introduced an adaptive monitoring system and model of a smart Artificial intelligence (AI) helmet for Covid-19 detection based on body temperature. A disinfection robot presented in [8] is designed to disinfect surfaces using UV-C lights. L. Priyan et al. in [9[suggested a mobile application to monitor physical distance using Bluetooth or camera module through Augmented Reality to monitor user distance from other individual.

As body temperature is an important data during quarantine, this paper presents a Covid-19 Patient Health Monitoring System using IoT that is able to remotely monitor blood saturation, heart rate, pulse rate and body temperature simultaneously. The additional features of body temperature and heart rate are the significant of this proposed system. The rest of this paper is organized as follows. Section 2 provides a methodology of the proposed system, Section 3 is the result and discussion, and Section 4 is the conclusion.

II. PROPOSED METHODOLOGY

Fig. 1 illustrates the the block diagram of the Covid-19 Patient Health Monitoring system. The system is divided into three sections which are input, processor and output. The input sources includes the biosensor module (MAX30100), body temperature sensor (DS18B20) and humidity sensor (DHT11). The processor section will determine which ESP32 Arduino will be linked using the Arduino IDE software. The output section comprises of ESP32 webserver that compile all the data such as blood saturation level, body temperature, and pulse rate before sending it to the smartphone or PC.

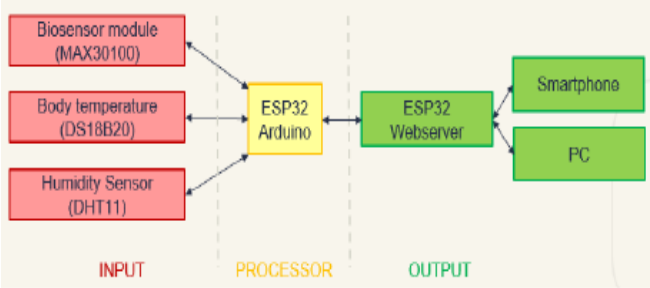


Fig. 1: Block diagram of Covid-19 Patient Health Monitoring system

As shown in Fig. 2, once the input sensors are activated, the ESP32 Arduino will receive signals from its input sensor. ESP32 will process the information from the input data and convert it for execution process. After the data has been processed, a specific protocol called Hypertext Transfer Protocol is used for communication between the client and server (HTTP). Once the client's request has been approved (Wi-Fi connected), all information can be accessed through webserver from any smartphone or PC by using designated IP address.

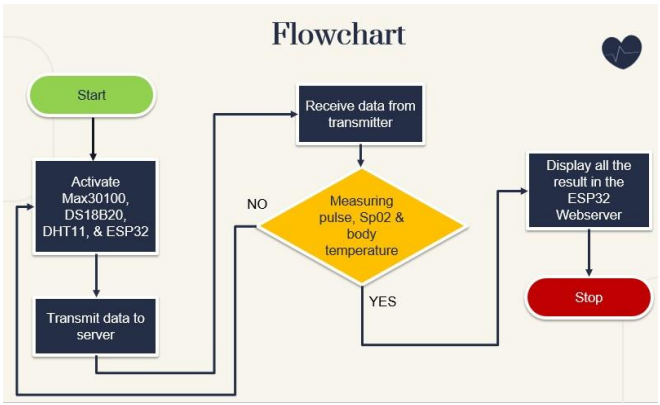


Fig. 2: Flowchart of the Covid-19 Patient Health Monitoring system

Fig. 3 shows a schematic diagram of the proposed system while Fig. 4 is the circuit diagram of the proposed system.

A. Biosensor Module (MAX30100)

The heart rate and blood saturation are measured using the MAX30100 sensor. Two LEDs, a photodetector, enhanced optics, and low-noise analogue signal processing are all features of this device. It operates from 1.8V and 3.3V power supplies and can be turned down through software with negligible standby current, enabling the power supply to stay connected at all times.

B. Body temperature Sensor

For measuring the body temperature, the proposed system uses DS18B20 sensor. It is a temperature sensor with a 1-Wire Interface that uses only one digital pin for two-way communication with an Arduino. It is relatively accurate with temperature range of -55°C to +125°C with an accuracy of 0.5°C. The temperature sensor's resolution can be adjusted by the user to 9, 10, 11, or 12 bits. However, at beginning, 12-bit resolution (precision of 0.0625°C) is the default option. During active temperature conversions, the sensor uses just 1mA and could be powered by a 3V to 5.5V power supply. The probe will gather our body temperature data as we hold it, and it will send that information to the Arduino for temperature monitoring.

C. Temperature and Humidity Sensor

Using a DHT11 sensor, the data on temperature and humidity are gathered. With an accuracy of 1°C and 1%, the DHT11 sensors can measure humidity from 20% to 90% and temperature from 0°C to 50°C, respectively. The data is sent to the Arduino through a signal cable.

D. ESP32 Arduino

The ESP32 is a single 2.4GHz Wi-Fi and Bluetooth with low-power capabilities. It incorporates a power amplifier, low-noise amplifiers, filters, an antenna switch, and a power management module.. The ESP32 Arduino will perform as the processor for this mechanism, collecting all health assessment detections from the biosensor module, temperature sensor, and humidity sensor, so the processor could command an output to show the result and save information in the cloud.

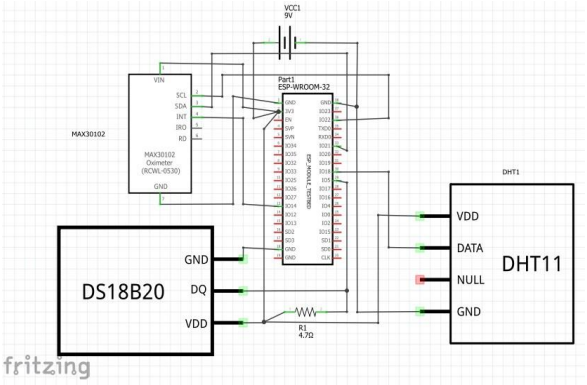


Fig. 3: Schematic diagram of the Covid-19 Patient Health Monitoring system

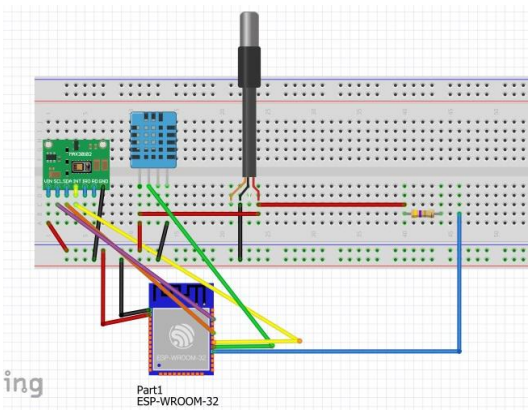


Fig. 4: Circuit diagram of the Covid-19 Patient Health Monitoring system

III. RESULT AND DISCUSSION

The testing was conducted using Arduino IDE software and ESP32 webserver. The instrument used to obtain the information needed are biosensor module MAX30100, body temperature sensor DS18B20 and humidity sensor DHT11.

Fig. 5 presents the successful connection of the Arduino with the system. The serial monitor can be access either in the tools option on the top bar screen or by clicking the magnifier icon on the top right of the screen. Information such as Wi-Fi connection status, IP address, and system connection status in the serial monitor are shown in Fig. 6 (a). Once the system has been initialized, it will display the body temperature, heart rate, blood saturation level, humidity level and room temperature result every 2 seconds as shown in Fig. 6 (b).

Fig. 7 displays the information collected by the sensors when the system was tested using the ESP32 webserver. User only need to copy the IP address displayed in the serial monitor and paste it on any website such as Google, Yahoo, Bing, or Safari.

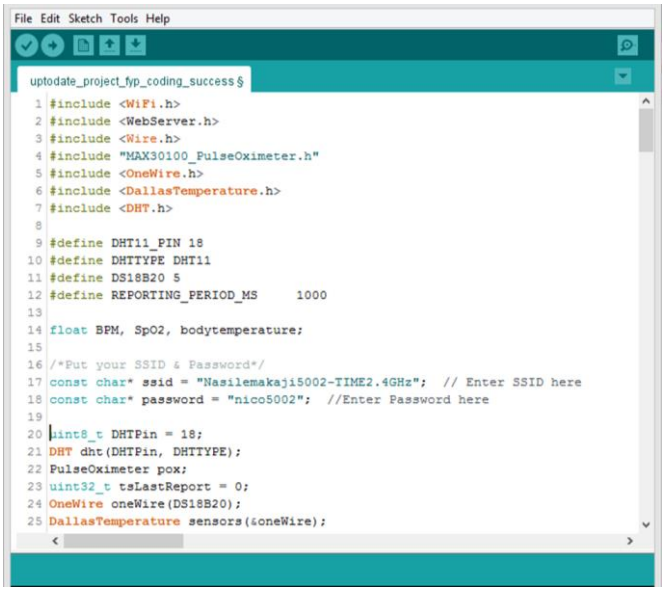


Fig. 5: System testing using Arduino

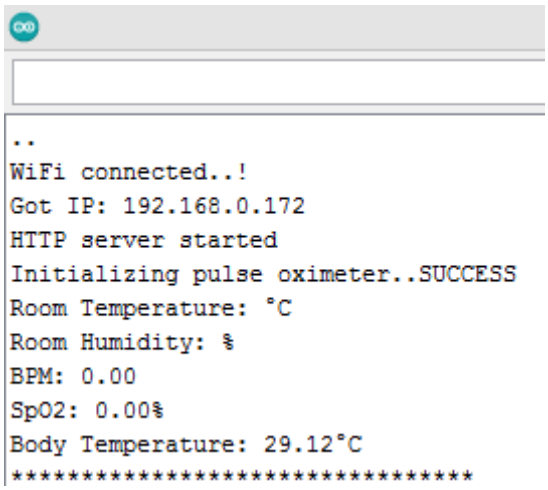


Fig. 6 (a): Initial information of connection status

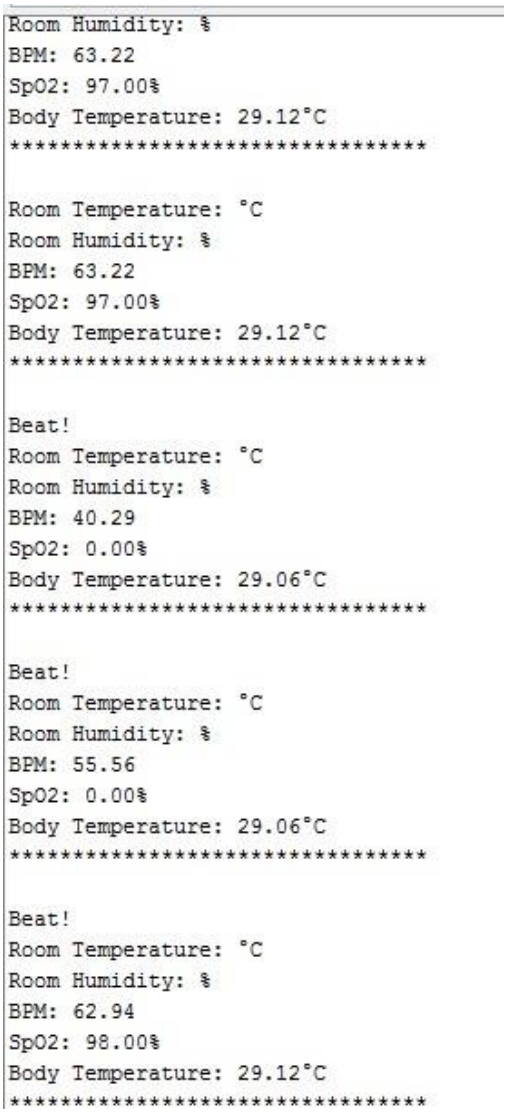
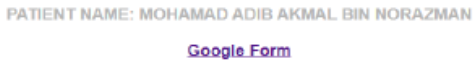


Fig. 6 (b) : Result of the health assessment in serial monitor



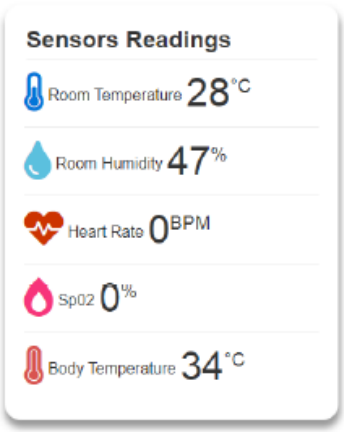


Fig. 7: Result in the Webserver

With this IoT health monitoring system, the medical staff can easily monitor patient body temperature, heart rate,

blood saturation and room temperature via authorized smartphone or PC and thus able to provide any medical helps needed in time. In the same time it can alleviates a significant amount of physical pressure on nurses and doctors.

IV. CONCLUSION

In conclusion, this project introduced a Covid-19 Patient Health Monitoring System using IoT that enables medical staff to monitor their patient remotely. This will help lowering the risk of infection among healthcare personnel and alleviate the rising demand for PPE (personal protective equipment) kits and other necessities.

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REFERENCES

[1] "COVID-19 Cases in Malaysia", https://covidnow.moh.gov.my/cases (accessed: 26 June 2022)

[2] "COVID-19 Hospitalisations in Malaysia", https://covidnow.moh.gov.my/hospitalisations (accessed : 26 June 2022).

[3] "Brace for possibility of new Covid-19 wave", https://www.nst.com.my/news/nation/2022/06/806847/brace-possibility-new-covid-19-wave (accessed: 26 June 2022)

[4] R. Priambodo and T. M. Kadarina, "Monitoring self-isolation patient of COVID-19 with internet of things," in 2020 IEEE International Conference on Communication, Networks and Satellite (Comnetsat), 2020.

[5] A. Hidayat et al., "Designing IoT-based independent pulse oximetry kit as an early detection tool for covid-19 symptoms," in 2020 3rd International Conference on Computer and Informatics Engineering (IC2IE), 2020.

[6] K. V. Sahukara, M. B. Ammisetty, G. S. K. G. Devi, S. Prathyusha, and T. S. Nikhita, "COVID-SAFE: IoT based health monitoring system using RFID in pandemic life," in 2021 IEEE *International* Conference on RFID Technology and Applications (RFID-TA), 2021

[7] Al-Humairi, S.N., Zainol, M.H., Razalli, H., Raya, L.B., Irsyad, M.I., Abdullah, & Daud, R.J. (2020). Conceptual Design: A Novel Covid-19 Smart AI Helmet.

[8] M. N. Mohammed et al., "2019 novel Coronavirus disease (covid-19): Toward a novel design for disinfection robot to combat Coronavirus (covid-19) using IoT based technology," in 2021 IEEE 12th Control and System Graduate Research Colloquium (ICSGRC), 2021

[9] L. Priyan, M. G. M. Johar, M. H. Alkawaz, and R. A. A. Helmi, "Augmented reality-based COVID-19 SOP compliance : Social distancing monitoring and reporting system based on IOT," in 2021 IEEE 12th Control and System Graduate Research Colloquium (ICSGRC), 2021

[10] N. Z. Malika, M. G. Md Johar, M. H. Alkawaz, A. Iqbal Hajamydeen, and L. Raya, "Temperature & humidity monitoring for poultry farms using IOT," in 2022 IEEE 12th Symposium on Computer Applications & Industrial Electronics (ISCAIE), 2022

[11] F. J. Adha, M. Gapar Md Johar, M. H. Alkawaz, A. Iqbal Hajamydeen and L. Raya, "IoT based Conceptual Framework for Monitoring Poultry Farms," 2022 IEEE 12th Symposium on Computer Applications & Industrial Electronics (ISCAIE), 2022

[12] A. N. B. Hanif, S. N. S. Al-Humairi, and R. J. Daud, "IoT-based: Design an autonomous bus with QR code communication system," in 2021 IEEE International Conference on Automatic Control & Intelligent Systems (I2CACIS), 2021

[13] S. P. Mariadass, S. Najah Saud Al-Humairi, and R. J. Daud, "Design a portable solar mobile system with an IoT integration-based," in 2021 IEEE 12th Control and System Graduate Research Colloquium (ICSGRC), 2021