

## 10th International Conference on Science & Sosial Research

Virtual Conference

6 - 7 Nov 2023

Organised by: Research Nexus UiTM (ReNeU), Universiti Teknologi MARA

### IoT-Based Home Health Monitoring System

Hashimah Hashim<sup>1\*</sup>, Nor Azira Hanis Halim<sup>1</sup>, Zambri Harun<sup>2</sup>

<sup>1</sup> Faculty of Electrical Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

<sup>2</sup> Department of Mechanical and Manufacturing Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia

hashimah655@uitm.edu.my, azirahanis5096@gmail.com, zambri@ukm.edu.my  
Tel: +60197532833

---

#### Abstract

The project aims to design a system that monitors heart rate, body temperature, and activity, with readings available on a phone, anytime, and anywhere. The system used three sensors: a heartbeat sensor, a temperature sensor, and an ECG sensor, which would be interfaced with an Arduino UNO microcontroller, an open-source computing platform. The results show that the 80% accuracy of the vital measurements displayed on Blynk is approaching the exact value, and any abnormal vital measurements would alert the user via a smartphone notification.

Keywords: Temperature sensor; ECG sensor; Pulse heart rate sensor; Wi-Fi module

eISSN: 2398-4287 © 2025. The Authors. Published for AMER by e-International Publishing House, Ltd., UK. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). Peer-review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers DOI: <https://doi.org/10.21834/e-bpj.v10iSI40.7711>

---

#### 1.0 Introduction

In 2020, the whole world was facing COVID-19, which was first reported on December 31, 2019, by the World Health Organization (WHO). The virus, first identified in Wuhan, China, quickly spread across the globe, infecting millions. Uncountable families have lost their family members to COVID-19. People become infected with the COVID-19 virus when they inhale air containing droplets and tiny airborne particles. People who had been exposed to the virus would face various complications such as pneumonia, acute respiratory distress syndrome (ARDS), multi-organ failure, septic shock, and death. The lungs are the organs most affected by COVID-19. Therefore, a movement control order (MCO) has been implemented in many countries to prevent the virus from spreading. This led many people to stay at home, limiting their access to medical facilities.

The usage of telemedicine is one of the technical developments in the medical field that has gained popularity in recent years. The goal of telemedicine is to provide health services to people living far from medical facilities (Zanjali et al., 2016). Telemedicine can also be employed in the current situation, where individuals are required to remain at a safe distance from hospitals and visit them only in an emergency. The world of health is continually evolving, and technological advancements have the potential to develop tools for the health sector. This technology was more popular during the COVID-19 pandemic, when people accessed health facilities while staying at home. Several studies on the health of drivers using the Internet of Things (IoT) while staying at home have been conducted. For example, S. Nookhao, V. Thananant, and T. Khunkhao designed a system comprising an Arduino ESP32 microcontroller board with built-in Wi-Fi and DS18B20 and pulse sensors to monitor patients' health conditions (Nookhao et al., 2020). At the same time, data were delivered in real time via Wi-Fi to the ThingSpeak IoT platform.

eISSN: 2398-4287 © 2025. The Authors. Published for AMER by e-International Publishing House, Ltd., UK. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). Peer-review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers DOI: <https://doi.org/10.21834/e-bpj.v10iSI40.7711>

Meanwhile, D. Srivastava and M. M. Tripathi designed a system that measures temperature, heartbeat, echocardiogram (ECG), blood pressure, and respiration rate using the Arduino Mega module (Srivastava et al., 2018; Edwan et al., 2020). The observed parameters were sent to the ESP8266 Wi-Fi module and displayed on the LCD. Other researchers have also used Arduino UNO in their research on health monitoring systems (Sani, 2021; Kamarozaman et al., 2021; Jiang et al., 2021).

A study by S. Dadhich, P. Dabre, R. Dabreo, and P. Raut proposes an IoT-based doorbell that notifies the homeowner when a guest with a fever arrives, potentially a COVID-19 patient (Dadhich et al., 2021). NodeMCU and MLX90614 non-contact infrared temperature sensors were used in their system. All the system's readings are logged in to the Firebase online database and displayed on the mobile application. N. Kamal and N. Ishak designed a system that used two infrared (IR) sensors coupled to an Arduino UNO for entrance detection (Kamal et al, 2021). It records the total number of consumers or shoppers who enter and exit the store. A digital non-contact Infrared temperature sensor (MLX90614) and an APDS-9960 digital RGB, ambient light, gesture, and proximity sensor were also connected to the Arduino UNO to capture the temperature of passing customers and to trigger an alarm if the temperature surpasses 37.5 °C. E. T. R. Babar and M. U. Rahman developed an inexpensive and automated method for continuously measuring three essential vital indicators using microelectronics and the IoT (Babar et al, 2019). Technology uses wearable sensors to monitor physiological indicators and wirelessly transmit the data. Based on the levels of these indicators, the system can automatically trigger alarms to highlight life-threatening conditions. R. Byfield, M. Miller, J. Miles, G. Guidoboni, and J. Lin developed a blood pressure (BP) measurement unit based on two photoplethysmography (PPG) sensors, which can be used to calculate the pulse wave velocity (PWV) of blood flow (Byfield et al., 2022). The research showed that PPG-based sensors for estimating PWV and BP have significant potential as a supplementary technique for detecting biological vital signs when integrated with machine learning (ML).

Nowadays, health monitoring is essential for healthcare needs. As a result, it is important to monitor your body temperature, heart rate, and ECG. People can now have an actual monitoring system that displays real-time data on their vital signs from anywhere, at any time, before leaving the house. The monitoring system can be automatically monitored via smartphones using IoT to conduct regular health checks, with data accessible only on cell phones. The monitoring system improves the user's well-being. The research aims to develop a system that monitors human physiological parameters from anywhere using a mobile phone application (Blynk) and notifies the user of any abnormal values. The monitoring system uses IoT technology directly, and a health officer can further examine the historical data. The data are derived from the patient's heart electrical activity signal (measured with the AD8232 ECG sensor), heart rate (measured with a pulse sensor), and body temperature (measured with the MLX90614 infrared heat sensor).

## 2.0 Methodology

This section explains the project's method, including its components, hardware, schematics, and flowchart. The sensors measured the input from the patient's body. The microcontroller received data from the connected sensors: ECG (AD8232), pulse, and temperature (MLX90614) sensors. All the sensors are used individually depending on their demands. Following that, the microcontroller transmitted the data to the Blynk application on the mobile phone via a Wi-Fi module, as shown in Fig. 1.

The Arduino UNO was selected as a microcontroller because it has many analogue pins that can be used as data receivers. The pulse sensor, which detects the pulse heart rate, is mounted on the tip of the patient's finger. The sensor emits infrared light, which is absorbed by the blood at the fingertip. With a 5-volt supply, the sensor is connected to Arduino pin A2. The MLX90614 temperature sensor detects temperature by reflecting infrared rays onto the human body, which are then read back by the sensor as temperature readings in Celsius and Fahrenheit, with human body values and room temperature for comparison. The sensor contains four connections: VCC, which connects to the Arduino 3.3V; GND, which connects to the Arduino GND; SCL, which connects to the Arduino SCL; and SDA, which connects to the Arduino SDA. The pin terminal description is shown in Table 1.

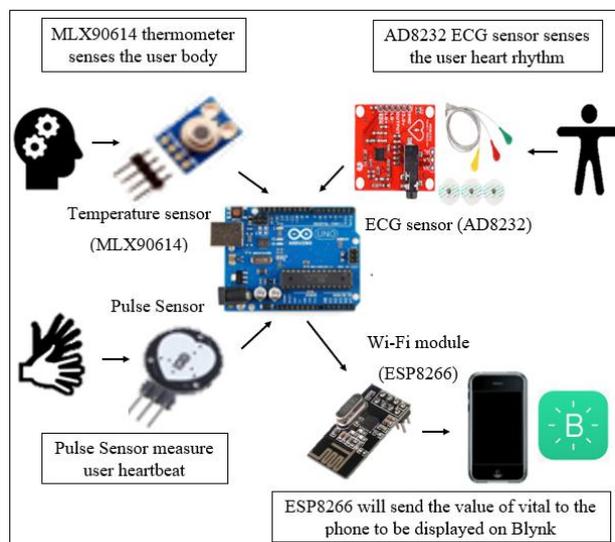


Fig. 1: Components used in the project.

Table 1. Pin terminal of the MLX90614 sensor.

Pin Terminal	Description
VCC	Power supply
GND	Ground
SCL	Serial clock
SDA	Serial data

The AD8232 is an integrated signal conditioning block used for ECG and other biopotential measurement applications. This type of sensor is designed to extract, amplify, and filter tiny biopotential signals in noisy environments, such as those caused by mobility or remote electrode placement. The three parts of the human body are connected to the AD8232 ECG sensor. The AD8232 heart rate monitor has nine connections on its IC, five of which are connected to the Arduino board, as shown in Fig. 2(a). All software and hardware components have been integrated to construct an outpatient monitoring system, as shown in Fig. 2(b).

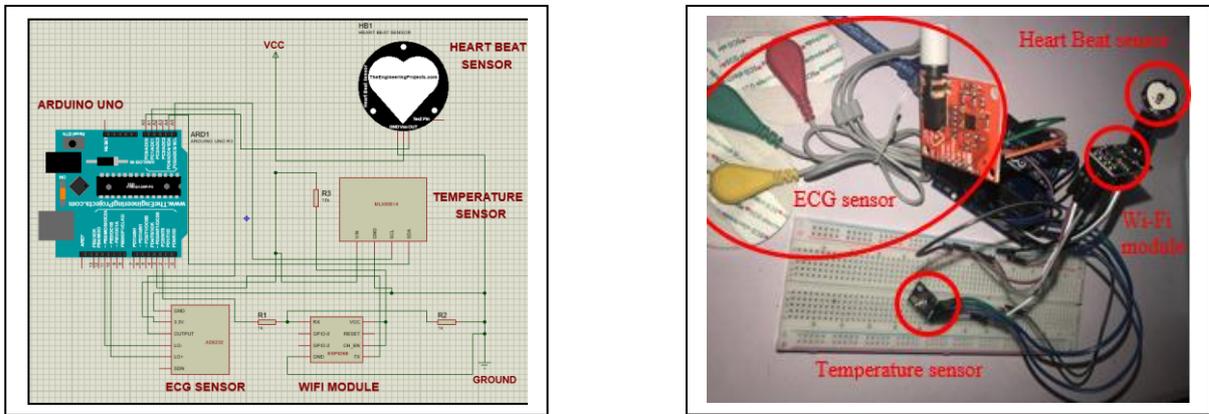


Fig. 2. (a) Schematic of the project; (b) Hardware of the project.

IoT is a concept in which electronic devices communicate with one another without human intervention, enabling them to share information automatically over the Internet. By using TCP/IP (Transmission Control Protocol/Internet Protocol), communication across global networks has become more accessible, enabling system consolidation and the creation of interconnected networks within networks (Yusuf et al., 2020). IoT is a technology implemented to monitor patients' health. Smartphones are commonly used to support IoT applications. Some researchers have developed a smartphone-based health application specifically designed to monitor patients with cardiac and arterial conditions (Bagot et al., 2019). The Blynk app is an application editor that allows users to develop one or more projects that connect with many devices. Wi-Fi modules connect the Blynk application to the Arduino UNO microcontroller.

Meanwhile, in Blynk, a "New Project" is selected to create a system that displays heart rhythm waveform, heartbeat, and temperature values as shown in Fig. 3. The notification generated when a measurement exceeds the standard range is shown at the bottom of the picture.

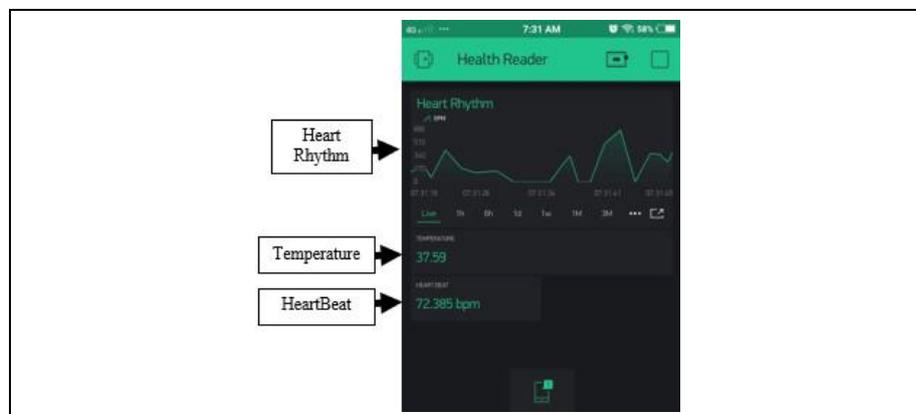


Fig. 3: Blynk application interface.

### 3.0 Results and Discussion

Four candidates (A, B, C, and D) participated in the experiment; A was 51 years old, B was 24 years old, C was 18 years old, and D was 10 years old. Two physical activities were required to view the differences in body temperature and heartbeat. Figure 4(a) shows

the monitored body temperature from 2 to 16 minutes before physical activity. The temperature measurements indicate that all the candidates have normal resting temperatures. Figure 4 (b) shows their body temperature after some physical activity. The body temperature of all candidates is higher than before their physical activity.

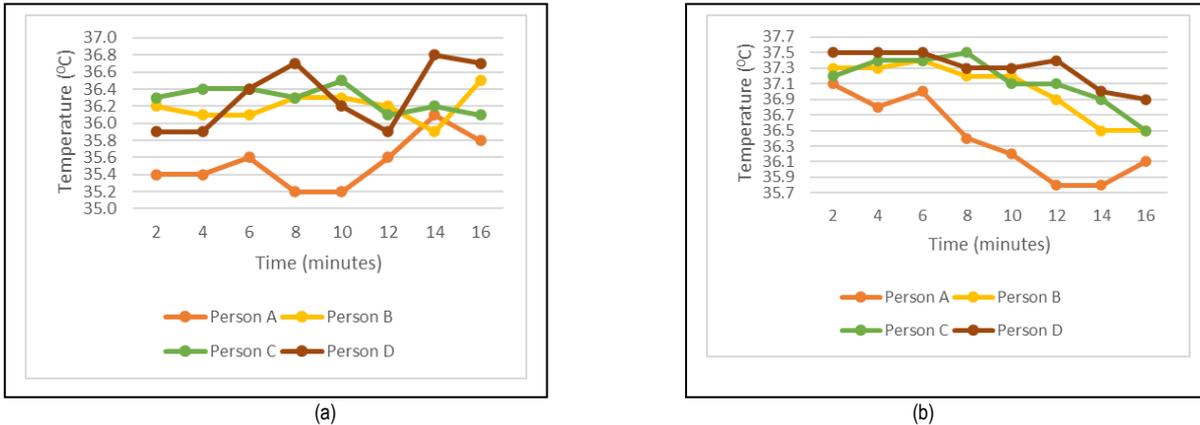


Fig. 4. (a) Data of the body temperature before the workout; (b) Data of the body temperature after the workout.

Heartbeat data before and after the workout were also monitored for the same candidates, A, B, C, and D, as shown in Figure 5(a). The heartbeat of candidate D is slightly higher, likely due to her higher metabolism at a younger age. Figure 5(b) shows the candidates' heartbeats after physical activity. All candidates' heartbeats remained within the normal range.

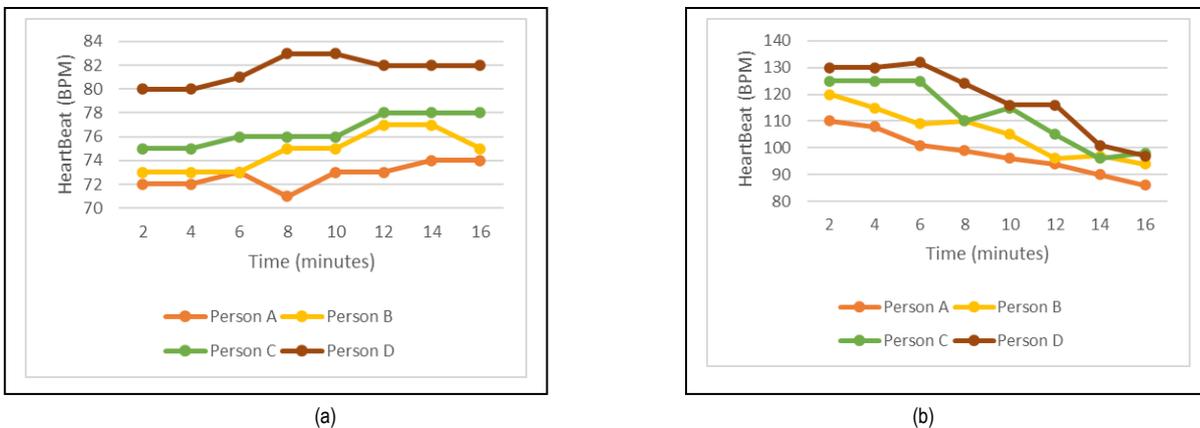


Fig. 5. (a) Data of the heartbeat before the workout; (b) Data of the heartbeat after the workout.

The comparison of body temperature before and after the workout is shown in Figure 6(a). The data show a considerable increase in body temperature following the workout, rising to 37.5 °C, and then gradually decreasing over time. Figure 6(b) presents the comparison of the candidates' heartbeats before and after the workout. After physical activity, the heart rate increased substantially to 132 beats per minute, and then gradually decreased over time.

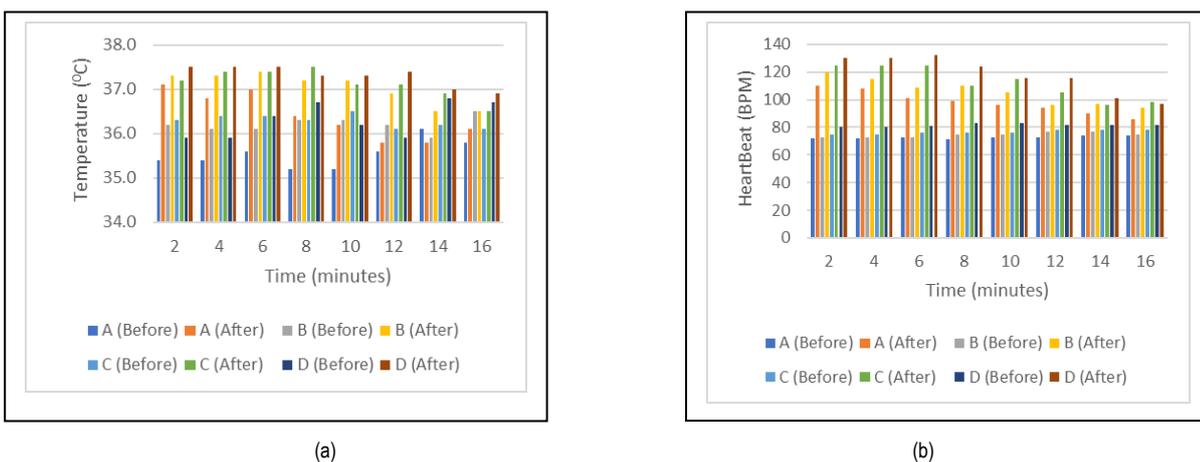


Fig. 6. (a) Data of the body temperature; (b) Data of the heartbeat before and after the workout.

Table 2 shows the heart rate tabulated data from the Blynk application between 2 and 16 minutes. An IoT-based home health monitoring system using the Blynk application is a practical solution that can be easily installed on any smartphone. Blynk is user-friendly because it has a simple layout and instructions that people of all ages can use. Blynk also does not require a strong internet connection to work, unlike a research project that used a website accessible only to medical staff. The websites are not user-friendly for people unfamiliar with technology, such as the elderly and children. Besides that, a website also needs a strong internet connection to function properly (Babar et al., 2019; Harun et al., 2022).

Table 2. Heart rate data from the Blynk application.

Time (minutes)	Candidate Age (years old)			
	A (51)	B (24)	C (18)	D (10)
2	72 bpm	73 bpm	75 bpm	80 bpm
4	72 bpm	73 bpm	75 bpm	80 bpm
6	73 bpm	73 bpm	76 bpm	81 bpm
8	71 bpm	75 bpm	76 bpm	83 bpm
10	73 bpm	75 bpm	76 bpm	83 bpm
12	73 bpm	77 bpm	78 bpm	82 bpm
14	74 bpm	77 bpm	78 bpm	82 bpm
16	74 bpm	75 bpm	78 bpm	82 bpm

#### 4.0 Conclusions

An automated, open-source, low-cost system for measuring heartbeat, body temperature, and ECG waveforms have been developed by using ECG technology; the system can help reduce the risk of emergencies and potentially prevent heart attacks. It also has the potential to minimize treatment costs, while enabling patients to be monitored from home or other locations. When integrated with Arduino, the system can store data and transfer it to physicians for patient follow-up. The results show that after a workout, human core body temperature can increase due to both exercise and environmental factors such as temperature and humidity. The body directs excess blood to the skin to promote cooling, reduces blood flow to the muscles, and increases heart rate. Several calculations were performed, including changes in body temperature, maximum age-related heart rate (MHR), and ECG heart rate. Candidate C experienced a 3.67 °C increase in body temperature. The human body regulates this heat through perspiration. The MHR of candidate A was calculated to be approximately 172.3 bpm; any activity exceeding this rate could pose a life-threatening risk. Comparison of heart rate measurements between Blynk and Serial Plotter showed slight differences, likely due to noise transmitted during program execution. All vital measurement data can be linked and displayed directly to hospitals, allowing doctors and nurses to monitor patient health remotely from the office.

#### Acknowledgements

This project was financially supported by the MyRA Research Grant Scheme, File No.: 600-RMC/MyRA 5/3/LESTARI (028/2020), under Universiti Teknologi MARA internal grant scheme. The authors would also like to thank the Faculty of Electrical Engineering, Universiti Teknologi MARA, for providing the laboratory facilities and financial support.

#### Paper Contribution to the Related Field of Study

Heart disease has emerged as a significant health concern in recent decades, contributing to numerous deaths from related medical conditions. Heart illness is not something to be taken lightly. The disease can be prevented by early monitoring of the electrocardiogram (ECG) signal. Therefore, this paper presents a system designed to track heart activity, body temperature, and heart rate, allowing users to monitor these vital signs anytime and anywhere via a smartphone.

#### References

- Babar, E. T. R., Usmani, A. A., Kayani, A., Yaqub, A. & Rehman, M. U. (2019). A Smart, Low Cost, Wearable Technology for Remote Patient Monitoring. In Proceedings of IEEE Global Conference on Internet of Things. pp. 1–5.
- Bagot, M., Launay, P., & Guidic, F. (2019). Adaptive Strategies for Patient Monitoring in Mobile Health Applications. In Proceedings of 6th International Conference on Social Networks Analysis, Management and Security. pp. 397– 404.
- Byfield, R., Miller, M., Miles, J., Guidoboni, G., & Lin, J. (2022). Toward Robust Blood Pressure Estimation from Pulse Wave Velocity Measured by Photoplethysmography Sensors. *IEEE Sensors Journal*. 22(3), 2475–2483.
- Dadhich, S., Dabre, P., Dabreo, R., & Raut, P. (2021). Contactless IoT Doorbell for Covid-safe Household. In Proceedings of IEEE 9th Region 10 Humanitarian Technology Conference. pp. 1-4.
- Edwan, E., Abu-Musameh, M., & A. Alsabah. (2020). Blood Pressure Monitoring Using The Arduino-Android Platform. In Proceedings of International Conference on Assistive and Rehabilitation Technologies. pp. 87-91.

Harun, Z., Molla, A. H. A. Khan, Safuan, U. Z. M. S. S. b. Azman, & Hashim, H. (2022). End-of-Life Vehicle (ELV) Emission Evaluation Using IoT in Malaysia. In Proceedings 9th International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE), Semarang, Indonesia, pp. 1-6

Jiang, W. et al. (2021). A Wearable Tele-Health System towards Monitoring COVID-19 and Chronic Diseases. IEEE Reviews in Biomedical Engineering. 15, 61-84.

Kamal, N., & Ishak, N. (2021). Implementing Smart Counter to Support Social Distancing. In Proceedings of IEEE 12th Control and System Graduate Research Colloquium. pp. 244-247.

Kamarozaman, N., & Awang, A. H. (2021). IOT COVID-19 Portable Health Monitoring System using Raspberry Pi, Node-Red and ThingSpeak. In Proceedings of IEEE Symposium on Wireless Technology & Applications, pp. 107-112.

Nookhao, S., Thananant, V., & Khunkhao, T. (2020). Development of IoT Heartbeat and Body Temperature Monitoring System for Community Health Volunteer. In Proceedings of Joint International Conference on Digital Arts Media and Technology with ECTI Northern Section Conference on Electrical Electronics Computer and Telecommunications Engineering, pp. 106-109.

Sani, S. (2021). Design and Implementation of A Low-Cost ECG Monitoring System Using ARM Cortex-M4 Family Microcontroller. In Proceedings of IEEE International Conference on Consumer Electronics, pp. 1-2.

Srivastava, D., & Tripathi, M. M. (2018). Transformer Health Monitoring System Using Internet of Things. In Proceedings of 2nd IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems, pp. 903-908.

Yusuf, R. G. F., Kamelia, L., Hamidi, E. A. Z., & Ulfiah. (2020). The Monitoring System Prototype Of Health Condition For Home Care Patients Base On The Internet Of Things. In Proceedings of 6th International Conference on Wireless and Telematics, pp. 1-4.

Zanjal, S. V., & Talmale, G. R. (2016). Medicine Reminder and Monitoring System for Secure Health Using IOT. Physics Procedia. 78, 471-476.