Jurnal Teknokes
International: Rapid Review: Open Access Journal Vol. 16, No. 3, Sept. 2023, pp. 130–137 e-ISSN 2407-8964; p-ISSN 1907-7904

RESEARCH ARTICLE **OPEN ACCESS**

Manuscript received January 18. 2023; revised March 10. 2023; accepted March 12. 2023; date of publication March 25. 2023
Digital Object Identifier (**DOI**): https://doi.org/10.35882/teknokes.v16i1.516
Copyright © 2023 by the authors. This work is an open-access article and licensed under a Creative Commons Attribution-ShareAlike 4.0 International License (CC BY-SA 4.0)
How to cite: Novita Nur Azize Romadhini, Abd Kholiq, Triana Rahmawati, and Faraz Masood, "Monitoring BPM And Body Temperature Based Internet of Things (IOT) Thingspeak Platform)". Jurnal Teknokes. vol. 16. no. 3. pp. 130–137. March. 2023.

Monitoring Bpm and Body Temperature Based Internet of Things (IoT) Thing speak Platform

Novita Nur Azize Romadhini[1], Abd Kholiq[1], Triana Rahmawati[1], and Faraz Masood[2]

[1] Department of Electromedical Engineering, Poltekkes Kemenkes Surabaya, Surabaya, Indonesia
[2] Department of Computer Science, Aligarh Muslim University, Uttar Pradesh, India
Corresponding author: Abd Kholiq (e-mail:abd22@poltekkesdepkes-sby.ac.id).

ABSTRACT Technological advancements in the field of healthcare, coupled with contemporary scientific and technological progress, have led to significant advancements in various operational procedures within medical institutions. These advancements include the adoption of automated systems in lieu of human intervention. An example of this progress is the implementation of automated systems for monitoring individuals' heart rates and body temperatures. Heart rate and body temperature stand as critical indicators employed by medical professionals to assess both physical and mental well-being. Deviations from normal heart rate and body temperature values can signify underlying issues. Body temperature, specifically, can offer insights into internal bodily conditions. This transition to automated monitoring tools has resulted in heightened practicality and efficiency. These tools offer real-time monitoring capabilities and the option for remote oversight. The monitoring device's architecture employs the Max30102 as a BPM sensor, which boasts a digital output. Additionally, the MLx90614 sensor functions as a digital temperature sensor. The collected data is then processed and showcased on an I2C LCD screen, with information transmitted to the ThingSpeak platform via the ESP32, serving as a Wi-Fi module. Notably, the BPM sensor demonstrates a minimal error rate of 0.23% and a maximum of 2.11%, while the temperature sensor showcases a minimal error rate of 0.59% and a maximum of 3.37%. The outcomes of this research exhibit potential application in enhancing the efficiency of remote monitoring systems when integrated into patient monitoring setups.
.

INDEX TERMS BPM, Body Temperature, Max30102, Mlx90614, Thing speak

I.INTRODUCTION

The development of technology in the health sector as well as modern science and technology. Both in the treatment of patients and in technology that facilitates the development of health science itself. Has experienced very rapid development. Various operational processes in hospitals have now undergone many developments. namely by replacing human performance with automated systems[1]. An instance of this includes an automated mechanism designed to oversee both heart rate and human body temperature. Until now, the practice of monitoring individuals' heart rates and body temperatures has predominantly relied on manual procedures, necessitating nurses or doctors to regularly assess heartbeats and body temperatures at intervals, while also maintaining continuous vigilance to avert any potential harm to the patient's well-being.[2]. Medical practitioners utilize heart rate and body temperature as two crucial benchmarks to evaluate an individual's physical well-being and mental state.[3]. Because if the heart rate and body temperature are not normal. More effort is needed to prevent unwanted things from happening. Heart disease is known as one of the highest causes of death in the world. While body temperature can detect something that is in the body. Such as: infection. Inflammation. Stress. Etc. currently there are many tools available to calculate the pulse. Both conventional and digital. However. the tool that is made is only limited to checking the pulse gradually but not continuously in displaying information on the number of heartbeats[4]. The problem to be raised in this final project is how everyone can monitor their pulse anytime and anywhere in real time using the internet because in this era of globalization many people already use the internet. Therefore this tool can be integrated with smartphones. Observing Beats per Minute (BPM) is among the essential monitoring methods in medical assessments. This involves computing the BPM by gently placing pressure on the photodiode and infrared sensors using the index finger.[5][6]. The temperature of the human body has a big influence on the number of heartbeats. Because the speed of the human heart pumping blood throughout the body depends on changes in temperature. According to Gould. For every 1°C increase in temperature. There is an increase in the frequency of 20 beats per minute. so it is necessary to monitor simultaneously with the BPM on the patient's body so that the patient gets intensive care according to the disease he is suffering from [4][7]. In general. The health of the body is easiest to know from changes in body temperature due to the process of absorbing and releasing heat in the body. Normal adult body temperature ranges from 36.1° C to 37.5° C and for a newborn's heart rate it has a heart rate of around 130-150 bpm. Toddler's 100-120 bpm. Children 90-110 bpm. and adults 60-100 bpm[8]. Until now. The process of monitoring heart rate and body temperature is still done manually. So nurses or doctors must routinely check heart rate and body temperature numbers when treating patients. When there is negligence in monitoring or even the condition of not knowing whether the patient is normal or not. It can cause dangerous things to the patient due to delays in treatment. So the monitoring process must be carried out routinely by nurses or doctors. If not treated immediately. the patient can coma or even die[9][10]

Taking into account the provided health information, the procedure of assessing heart rate and body temperature within numerous medical facilities continues to rely on a manual approach. In this method, a nurse must be present to individually supervise patients, observing and documenting their heart rates and body temperatures.[11]. This method will take a long time and must be checked periodically so that it is less effective. Therefore. A monitoring tool is needed that can provide continuous information and can be monitored remotely. so that prompt handling can be carried out if an abnormal condition occurs in patient's heart rate and body temperature[12]. In this research. A wireless heart rate and human body temperature monitoring system was created. This system uses the Max30102 sensor[13][14] to detect heart rate. And the Mlx60914 sensor to detect body temperature. for data processing it uses ESP-32 as a microcontroller[15]. This system detects heart rate and body temperature in real time[16]. The processed data is then displayed on an LCD and can then also be monitored on the Things peak platform which can be accessed via a smartphone or PC[17]. The information provided on the website includes heart rate per minute. and body temperature[18]. Implementing Internet of Things (IOT) technology for heart rate and body temperature monitoring aims to enable real-time oversight of patients' well-being. This setup envisions direct online monitoring of patients' conditions through smartphones or computers, ensuring the utmost precision in capturing heart rate and body temperature data.[19].

II. MATERIALS AND METHOD

Conducted at the Ministry of Health's Health Polytechnic in Surabaya, the study focused on the Electromedical Technology Department. The tool's configuration followed the Pre-Experimental methodology and adopted the One Group Post Test Design. Within this framework, the researcher gathered BPM and temperature measurements from various groups. The primary objective was to oversee patients' BPM and body temperature. This oversight encompassed placing the device on patients' fingertips, facilitating the evaluation of BPM and body temperature readings..

This study utilizes the MAX30102 sensor to detect BPM and the MLX90614 sensor to detect body temperature [20]. The data obtained is then processed using the ESP32 microcontroller. BPM and Body temperature monitoring results are displayed on the LCD as well as the Thingspeak platform. In this study the independent variables were the patient's heart rate and body temperature. while the dependent variables were the MAX30102 and MLX90614 sensors which were used to detect bpm and body temperature. The control variable consists of the measurement results on the Android display because it is controlled or controlled by ESP-32 and the switch. This study utilizes the MAX30102 and MLX90614 sensors for data collection. The collected data is then processed by the ESP32 microcontroller which acts as a transmitter to transmit it

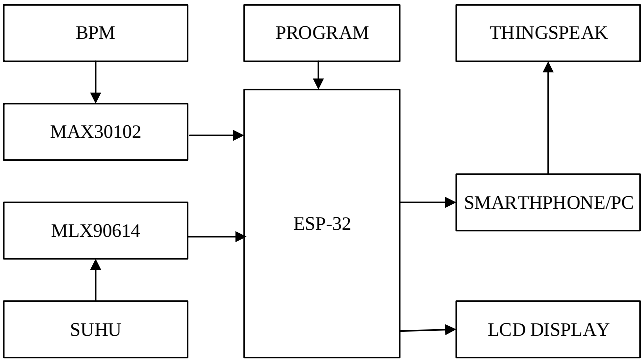

FIGURE 1 System Block Diagram Monitoring BPM And Body Temperature Based Internet Of Things (IOT) Thingspeak Platform

Data gets processed by the ESP32 microcontroller. The resulting outcome of the system entails the presentation of BPM and body temperature values on the Thingspeak platform. A visual representation of the system's structure is illustrated in FIGURE 1, depicting three key segments: input, processing, and output. In the input segment, buttons and MAX30102 sensors for BPM detection, located on the fingertip, are present. The button functions as a control input, while the MLX90614 sensor records body temperature. Transitioning to the processing phase, a microcontroller receives data from these sensors. The microcontroller undertakes data processing to render it suitable for transmission. Lastly, the output section encompasses platforms, with the primary one being the Thingspeak platform. This platform acts as an output interface, displaying the outcomes of the sensors' data that has been processed by the microcontroller.

In the block diagram FIGURE 1. When the power button is pressed. The device will turn on. The sensor will take input data. Namely the Max30102 sensor to detect heart rate and the Mlx90614 sensor to detect body temperature. Then it will be processed by the ESP-32 microcontroller and in it a digital data reading process will occur. Output from the ESP-32 microcontroller. Data in the form of values (numbers) will be displayed on the LCD and will also be displayed on a smartphone or PC with one of these platforms. Namely the Thing Speak Platform which can be monitored remotely and in real time. By visiting the Thingspeak platform users can view data results on the Thingspeak web server display, enabling them to remotely monitor and analyze BPM and Body Temperature data. at the time of data collection, the BPM module was compared with the original tool, Prior to comparison of the Pulse oximeter tool, calibration was carried out first with the Spo2 Simulator so that the results were in accordance

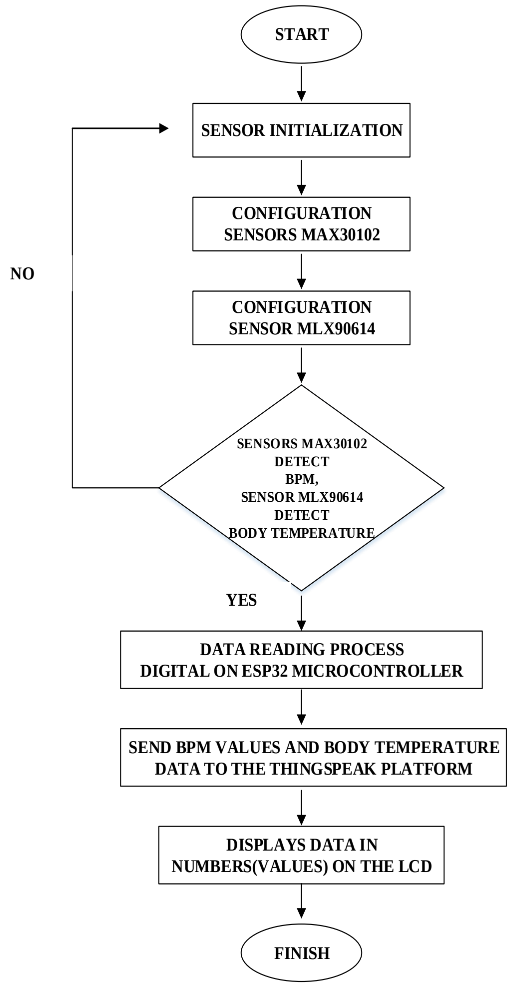

FIGURE 2 Process Flow Chart Monitoring BPM and Body Temperature Based Internet of Things (IOT) Thingspeak Platform

FIGURE 2 when the tool is turned on. in the flow chart above. after the start button is pressed. an initialization process occurs. The sensor of each parameter will work. The Max30102 sensor will detect heart rate with a photodiode that is used as a catcher of light waves emitted by infrared. The method of measuring heart rate in the blood vessels of the fingers in this system uses the reflection method. where infrared as a light source is paired parallel to a photodiode as a light sensor[21]. The photodiode receives signals or variations in response to reflected infrared light. This reflected light's intensity is transformed into an electric current by the photodiode. The magnitude of the received light relies on the infrared light's reflection from the blood vessels on the fingers. Subsequently, the microcontroller ESP-32 handles data processing, leading to the computation of heart rate (BPM) based on this information. Additionally, the MLX90614 sensor identifies body temperature by converting the temperature into a digital representation. The ESP-32, functioning as a microcontroller, processes this data, subsequently deriving the body temperature value. Once both parameter values are captured, they are showcased on the I2C LCD screen and concurrently transmitted, aided by the ESP8266 wifi module, to the Thingspeak Platform through a wifi connection.

A. DATA ANALYSIS

Data analysis in this study involved 10 randomly selected participants who were considered normal. Each participant underwent 10 repetitions of measurements to ensure data robustness. The functionality of the MAX30102 sensor is measured together with the Pulse oxymeter as a comparison tool. While the MLX90614 sensor is measured together with the Thermo gun as a comparison tool. Then the average value and standard deviation are calculated based on 10 repetitions of measurements. This allows a comprehensive analysis of sensor performance and the resulting data obtained from research[10].

Each measurement was repeated 10 times for accuracy and consistency. To get the average measurement value. The mean or average is calculated using Eq. (1). The mean represents the value obtained by dividing the sum of all measurements by the total number of data points in the set.

$$\bar{x} = \frac{x1+x2...+xn}{n} \tag{1}$$

In the Eq. (1). X represents the mean or average for the n measurements. Each measurement is denoted by x_1. x_2. X_n. The standard deviation is a measure of the variation in the data set or the degree of deviation from the mean. The formula for calculating the standard deviation (SD) can be represented by Eq. (2)

$$\text{SD} = \sqrt{\frac{\sum(xi-\bar{x})^2}{(n-1)}} \tag{2}$$

In Eq. (2). SD represents the resulting standard deviation. While n denotes the number of measurements. The %error is used to quantify the system error. A lower %error value indicates a smaller average difference between each data point. Errors can indicate deviations between a standard and a design or model. The formula for calculating the %error is shown in Eq. (3).

$$\text{ERROR} = \frac{(x_n - \text{x})}{x_n} \times 100\% \tag{3}$$

In Eq. (3). x_n represents the measured value from the engine calibrator. While X_n represents the measured value from the design.

III.RESULT

Within this research, an examination was conducted involving the module, employing a Pulse Oxymeter for the purpose of comparing BPM and a Thermo gun for comparing body temperature. A visual representation in FIGURE 5 outlines the assortment of systems within the module. These components encompass ESP32, MAX30102 sensors, and MLX90614. The power supply circuit has been constructed using Lithium batteries, linked to a step-down circuit to ensure accurate voltage regulation. Subsequently, the outcomes are presented on the LCD screen and can additionally be observed from a distance through the Thing Speak platform.

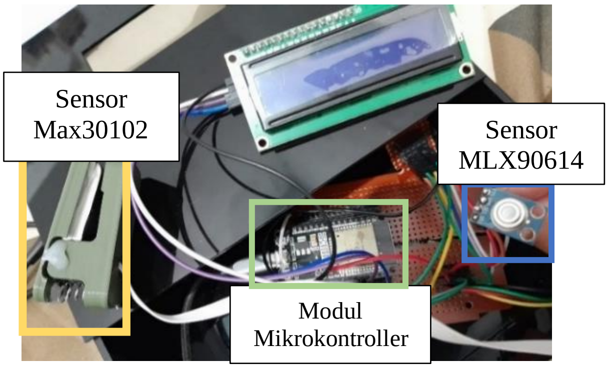

FIGURE 3 Circuit Display System Monitoring and Body Temperature Based Internet Of Things (IOT) Thingspeak Platform

Referring to FIGURE 3. The digital components of the device consist of the ESP-32 microcontroller. MAX30102 sensor. MLX90614 sensor. The module data collection process was carried out at the Poltekkes Kemenkes Surabaya. During the data collection process. Measurements were carried out by 10 respondents with 10 trials

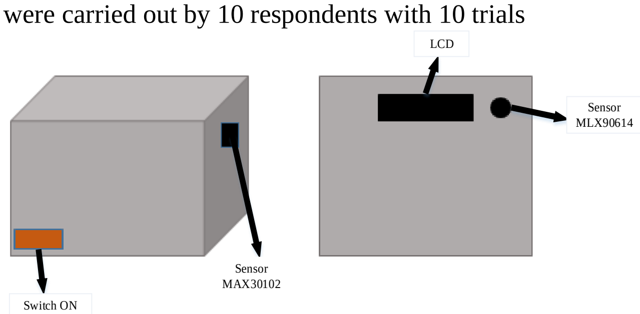

FIGURE 4 System Mechanical Diagram Monitoring BPM and Body Temperature Based Internet of Things (IOT) Thingspeak Platform

FIGURE 4 is a picture of the box design of the tool. back view and front view. there are placements for the MAX 30102 sensor and the MLX90614 sensor and there is also a switch

B. Respondent Data Collection Result

The data collection process for measuring BPM is carried out using a finger sensor placed on the respondent's finger. The BPM value obtained from this module is then compared with the BPM value obtained from a reference device known as a pulse oxymeter. A total of ten respondents (> 19 years) participated in the data collection process. The pulse oxymeter used as a reference tool was the Fingertip Pulse Oxymeter Type Lk87. labeled as the Finger Pulse Oxymeter[22]. The module used for data collection uses the MAX30102 sensor.

FIGURE 5 displays the Fingertip Pulse Oxymeter used for the comparison process. It provided a visual representation of the BPM readings for both the module and the comparator. To collect BPM data. Several steps are taken as illustrated in FIGURE 5, the first is Respondent placing their finger on the tool module. Ensuring proper placement for an accurate reading. Simultaneously. The fingers of their right hand were placed on the comparators. Enabling simultaneous comparisons.

FIGURE 5 The Fingertip Pulse Oximeter Brand LK87 was used as a comparison in this study.

In FIGURE 5 After an interval of 5 seconds. The module and comparator display the reading results. This short delay allows stable readings and consistent comparisons. And the results obtained are available for analysis and interpretation. Readouts are accessible via the Thing speak Platform and LCD I2C. Both of which are connected to the instrument module via the ESP-32 microcontroller. The screen can be easily activated using the rubber.

By following this careful data collection procedure. Valuable BPM measurements were obtained from the respondents. The use of the Finger Pulse Oximeter Type Lk87 as a comparison tool ensures reliable and accurate data collection. Its effectiveness in providing consistent readings is enhanced by the integration of the MAX30102 sensor in the module[23]. This contributes to the acquisition of efficient and effective BPM measurements. Increasing confidence in the data collected. Overall. This data collection process enables researchers to gather comprehensive and reliable data for their studies. The combination of reliable tools. Careful placement and convenient data access via the Thing speak platform. Provides a solid foundation for further analysis and interpretation. Researchers can now confidently proceed to explore BPM data collected from respondents and draw meaningful conclusions from their studies[24].

Data collection of temperature results is carried out with a sensor device that is placed on the fingertip. The sensor is placed on the respondent's finger. then the temperature value of the module is compared with the temperature value of the comparison tool (termoghun)[25]. Data collection was carried out on 10 respondents (> 19 years) by taking 10 respondents and collecting data for each respondent was taken 10 times.

FIGURE 6 Thermogun Merk Fluke was used as a comparison in this study.

In FIGURE 6 Thermogun Merk Fluke was used as a comparison in this study. The first is to place the tool module on the respondent and the comparator on the armpit. After 5 seconds. The module and comparator (Thermo gun) will display the reading results. And the results can be seen on the Thing Speak Platform and on the I2C LCD screen using the ESP-32 microcontroller connection on the tool module by activating the switch.

MAX30102 Sensor Range the specifications of the

- MAX30102 sensor circuit required are:

Using the MAX30102 sensor. Using +5VDC voltage and ground. Using a pull up resistor connected to the ESP-32 Microcontroller of 47K ohms on the SDA. SCL. And 3.3V pins. As well as a 1K ohm pull up resistor on the SDA. SCL. And 5V pins. The MAX30102 sensor circuit is obtained as shown MAX30102 Sensor Circuit

Sensor Circuit Setting or testing steps:

Connect the MAX30102 sensor circuit to the VCC and GND pins. And make sure the installation is not reversed because it can cause damage to the sensor. Measure the incoming voltage at the VCC and GND pins. And make sure the installation is not reversed because it can cause damage to the sensor. Check whether the SDA and SCL pins is installed correctly

- MLX90614 circuit

The output from the MLX90614 sensor is a configuration of numbers 1 and 0. which indicates a certain temperature. The magnitude of the data bit output voltage also depends on the amount of voltage input to the sensor. Setting or testing steps:Measure the incoming voltage to the sensor (+5V and GND) make sure it's not reversed because it can cause damage. Connect Pin (+) power to +5V. Pin (-) GND to GND and Pin (DQ) data to digital pin ESP32 with the addition of a 4.7k pull-up resistor. Check the output of the MLX90614 module using the serial monitor. and last Displays the temperature of the MLX90614 on the display.

TABLE 1
BPM measurement results and errors on Tools and Comparators

Respondent	Mean (BPM)	Error	STDV
1	81.4	±0.24%	±2.39
2	82.5	±0.96%	±1.82
3	86.6	±1.14%	±2.59
4	98	±0.50%	±1.08
5	71.5	±0.98%	±1.93
6	100.9	±1.27%	±2.64
7	78.1	±1.38%	±3.24
8	83.5	±0.71%	±1.66
9	83.6	±0.23%	±0.91
10	78.7	±2.11%	±5.03

TABLE 1 the largest error value recorded on the BPM module during measurement was 2.11%, with a standard deviation of ±3.02 and an average of 78.7. In contrast, the smallest error value observed was 0.23%. The difference in error values can be attributed to the movement of the respondent's finger during measurement. Finger movements may introduce artefacts or fluctuations in the signal captured by the BPM module, causing readings that differ slightly from benchmarks. These variations in positioning or stability may explain the observed differences in error values. After measuring the BPM, an error graph of the BPM module against the comparator is obtained. The graph obtained from the measurement error module with a comparison of measurements on 10 respondents (> 19 years) consisting of 10 women is as follows.

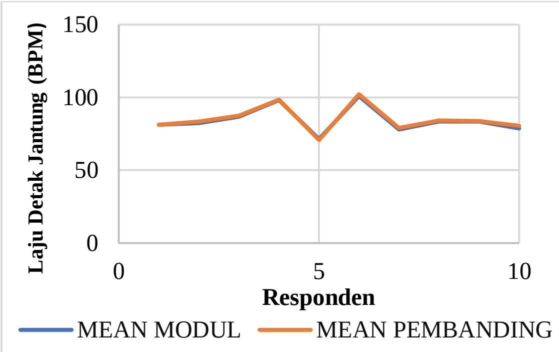

FIGURE 7 Graph BPM Responden

FIGURE 7 shows a graph of the error obtained from BPM measurements using the tool module and finger pulse oxymeter. Measurements for each respondent were carried out 10 times. Each measurement results in tool error from the module and comparator calculations. Based on the measurements, the error values obtained were 0.24%, 0.96%, 1.14%, 0.5%, 0.98%, 1.27%, 1.38%, 0.71%, 0.23% and 2.11%. The biggest error value is 2.11%, while the smallest error value is 0.23%.

TABLE 2
Temperature measurement results and errors on Tools and Comparators

Respondent	Mean(°C)	Error	STDV
1	26.03	±0.89%	±0.03
2	34.14	±2.26%	±0.05
3	35.57	±2.50%	±0.01
4	35.59	±3.37%	±0
5	25.84	0%	±0
6	35.57	±0.25%	±0.01
7	35.58	0%	±0.01
8	35.64	0%	±0.01
9	35.57	±0.75%	±0.02
10	35.47	±1.09%	±0.01

TABLE 2 The Temperature module's highest recorded error value during measurements stands at 3.37%, accompanied by a standard deviation of ±0 and an average of 35.59. Conversely, the lowest identified error value is 0.25%, paired with a standard deviation of ±0.01 and an average of 35.57. The difference in error values can be associated with the movement of the respondent's finger when measuring temperature. Movement of the finger during measurement greatly affects the measurement of body temperature, the finger must fit above the MLX90614 sensor so that the body temperature is read. These variations in positioning or stability may explain the observed differences in error values. After measuring the temperature, a graph of the temperature module error against the comparator is obtained. The graph obtained from the measurement error module with a comparison of measurements on 10 respondents (> 19 years) consisting of 10 women is as follows.

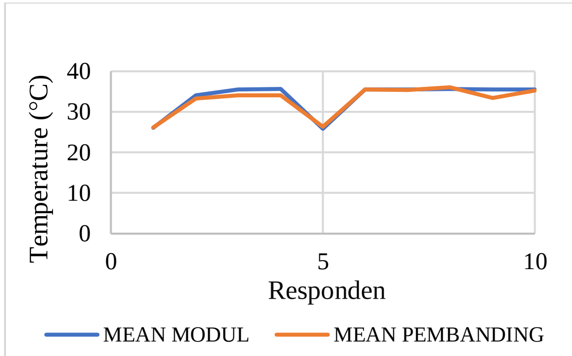

FIGURE 8 Graph of Respondents' temperatures on comparators and modulesf

In FIGURE 8 Shows the error graph obtained from temperature measurements using the tool module with a comparison tool, namely the thermo gun. Measurements for each respondent were carried out 10 times. Each measurement results in an instrument error from the module and comparator calculations. Based on the measurements obtained error values of 0.89%, 2.26%, 2.50%, 3.37%, 0%, 0.25%, 0%, 0%, 0.75%, and 1.09%. The biggest error value is 3.37%, while the smallest error value is 0.25%.

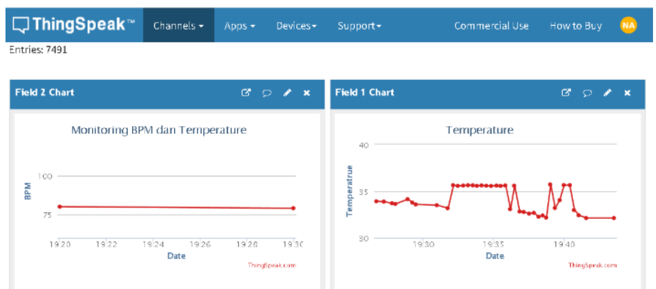

FIGURE 9 Display Platform Thingspeak

FIGURE 9 is a graph of BPM and Body Temperature on the Thingspeak platform. the display of the Thingspeak Graph shows daily temperature data for the past month. From the graph. for BPM there is a range of 75-100. and for body temperature 35-40.

IV. DISCUSSION

Collected data encompasses BPM readings obtained through a comparative analysis involving a pulse oxymeter and the max30102 module affixed to the patient's fingertip. Subsequently, an average BPM value is calculated, followed by the assessment of error. The error values retrieved include 0.24%, 0.96%, 1.14%, 0.5%, 0.98%, 1.27%, 1.38%, 0.71%, 0.23%, and 2.11%. The most substantial error identified is

2.11%, while the most minimal error value is 0.23%. For each distinct BPM reading, this analysis holds. With these findings in mind, the maximum error value within the BPM module corresponds to the smallest error, 0.23%, and the largest error, 2.11%. The maximum BPM error amounts to 3% of the BPM value. Notably, all error values within this module remain below a certain threshold. Consequently, the module aligns with established error standards, rendering it sufficiently reliable for obtaining both BPM values and body temperature readings.

The data taken is the result of body temperature obtained from a comparison in the form of the Thermo gun and the mlx90614 module. Then from the body temperature value. The average value is obtained and the error is searched. The error values obtained are 0.89%, 2.26%, 2.50%, 3.37%, 0%, 0.25%, 0%, 0%, 0.75%, and 1.09%. The biggest error value is 3.37%, while the smallest error value is 0.25%.

Seeing some shortcomings in 2011 Afif Ikraria made it but the shortcomings in this tool are that it is still not equipped with BPM and Temperature measurements. In 2013 it was developed by Dyah Koirunnisa by adding BPM monitoring. Then in 2015 developed again by Yogi Yuda Kusuma and Naja Filashofa Ahmada by adding a Wireless Nurse Call. The three monitoring tools that have been made are not yet equipped with a PC display. [8]

Based on the identification of these problems. The authors want to modify and improve the tool by being equipped with a data transmission system via wireless (wireless) and displaying it on a computer or smartphone that can be accessed remotely and monitored in real time.

In the series of modules that have been made there are several parts. Namely the MAX30102 sensor circuit. The Esp-32 Microcontroller. MLX90614 sensor. And 2 pin switch.

Data collection was carried out on 10 adult respondents aged over 20 years and by repeating data 10 times for each respondent using comparisons and time intervals every 10 seconds. This test is compared using a comparison tool. Namely a pulse oxymeter and temperature with a Thermo gun and gets the average value and also the error value. The error values generated by this BPM module are 0.24%, 0.96%, 1.14%, 0.5%, 0.98%, 1.27%, 1.38%, 0.71%, 0.23% and 2.11%. The biggest error value is 2.11%. While the error values generated by this sensor module temperature are 0.89%, 2.26%, 2.50%, 3.37%, 0%, 0.25%, 0%, 0%, 0.75%, and 1.09%.

The sequence of utilized components involves the deployment of the MAX30102 sensor module, designed to gauge blood oxygen levels. This sensor incorporates both infrared LEDs and red LEDs, in addition to the MAX30102 IC. This combination empowers the sensor to generate blood oxygen data through the I2C interface. Subsequently, the output from the MAX30102 module interfaces with the ESP-32 microcontroller. The data undergoes processing within the microcontroller to extract the BPM value, which is subsequently transmitted to the Thingspeak Platform. The transmitted data, facilitated by the wireless module, is presented in real-time or continuous format as BPM and Body Temperature signals. During the BPM value testing, the process yields both the average and error values, with the minimum error being 0.23 and the maximum error reaching 2.11. As for temperature measurement, the process yields both the average value and the smallest error, 0.25, along with the maximum error, 3.37.

IV. CONCLUSION

This study aims to design a wireless monitoring tool using the ESP32 microcontroller for remote monitoring of BPM and body temperature. The specific goal is IoT-based monitoring. designed a program to display the signal on a smartphone. send data from ESP32 to smartphone. designing circuits to process temperature and BPM. and test the function of the developed module.

After using the fingertip pulse module with the Max30102 sensor and the MLX90614 temperature sensor. it was found that the Max30100 sensor provides an accurate measurement in detecting BPM. while the MLX90614 temperature sensor provides accurate body temperature measurements.

This fingertip pulse module facilitates monitoring of vital signs by simply attaching it to a finger
the authors hope that further research can add parameters such as Spo2 and suggestions from this study that can be carried out for future researchers using other sensors so that the values obtained are more stable. The BPM value is taken on the wrist and the box design can be reduced to make it simple

REFERENCES

[1] C. Lemanski, "Pulse Oximetry for Perioperative Monitoring," J. Perianesthesia Nurs., vol. 31, no. 1, pp. 86–88, 2016, doi: 10.1016/j.jopan.2015.11.004.

[2] G. Tusman, S. H. Bohm, and F. Suarez-Sipmann, "VALIDATION OF OXYGEN SATURATION MONITORING IN NEONATES Background and Significance," Anesth. Analg., vol. 124, no. 1, pp. 62–71, 2017, doi: 10.1213/ANE.0000000000001283.

[3] J. Wannenburg and R. Malekian, "Body Sensor Network for Mobile Health Monitoring, a Diagnosis and Anticipating System," IEEE Sens. J., vol. 15, no. 12, pp. 6839–6852, 2015, doi: 10.1109/JSEN.2015.2464773.

[4] N. S. Ali, Z. A. A. Alyasseri, and A. Abdulmohson, "Real-Time Heart Pulse Monitoring Technique Using Wireless Sensor Network and Mobile Application," Int. J. Electr. Comput. Eng., vol. 8, no. 6, p. 5118, 2018, doi: 10.11591/ijece.v8i6.pp5118-5126.

[5] S. Krishna and V. Rongala, "Patient Monitoring System Using Thingspeak Platform," no. 09, pp. 688–692, 2021, [Online]. Available: www.irjmets.com.

[6] A. D. W. M. Sidik, I. Himawan Kusumah, A. Suryana, Edwinanto, M. Artiyasa, and A. Pradiftha Junfithrana, "Design and Implementation of an IoT-Based Electric Motor Vibration and Temperature Disruption Handling System," Fidel. J. Tek. Elektro, vol. 2, no. 2, pp. 30–33, 2020, doi: 10.52005/fidelity.v2i2.108.

[7] E. A. Suprayitno, M. R. Marlianto, and M. I. Mauliana, "Measurement device for detecting oxygen saturation in blood, heart rate, and temperature of human body," J. Phys. Conf. Ser., vol. 1402, no. 3, 2019, doi: 10.1088/1742-6596/1402/3/033110.

[8] S. J. Ayodele, F. P. Oko, and A. State, "IoT BASED PATIENT'S HEARTBEAT RATE MONITORING SYSTEM," pp. 1–14, doi:

10.1136/bmj.d4163.PMID.
[9] A. A. H. Mohamad, Y. S. Mezaal, and S. F. Abdulkareem, "Computerized power transformer monitoring based on internet of things," Int. J. Eng. Technol., vol. 7, no. 4, pp. 2773–2778, 2018, doi: 10.14419/ijet.v7i4.16280.
[10] N. Chinnamadha, R. Z. Ahmed, and K. Kalegowda, "Development of health monitoring system using smart intelligent device," Indones. J. Electr. Eng. Comput. Sci., vol. 28, no. 3, pp. 1381–1387, 2022, doi: 10.11591/ijeecs.v28.i3.pp1381-1387.
[11] Subandi, A. S. B. Nugroho, Nurkamilia, and A. A. Syahidi, "Body Temperature Measurement Tool for Early Detection of COVID-19 Based on Interactive Augmented Reality Technology and Sensor MLX90614: Framework and Prototyping," J. Ris. Komput., vol. 8, no. 5, pp. 142–144, 2021, doi: 10.30865/jurikom.v8i5.3622.
[12] V. Goel[1], S. Srivastava[2], D. Pandit[3], D. Tripathi[4], and P. Goel[5], "Heart Rate Monitoring System Using Finger Tip through IOT," Int. Res. J. Eng. Technol., vol. 5, no. 3, pp. 1114–1117, 2018, [Online]. Available: www.irjet.net.
[13] N. N. Sari, M. N. Gani, R. A. Maharani Yusuf, and R. Firmando, "Telemedicine for silent hypoxia: Improving the reliability and accuracy of Max30100-based system," Indones. J. Electr. Eng. Comput. Sci., vol. 22, no. 3, pp. 1419–1426, 2021, doi: 10.11591/ijeecs.v22.i3.pp1419-1426.
[14] V. GAY and P. LEIJDEKKERS, "A Health Monitoring System Using Smart Phones and Wearable Sensors," Int. J. ARM, vol. 8, no. 2, pp. 29–36, 2007.
[15] W. D. Yu, P. Ray, and T. Motoc, "WISH: A wireless mobile multimedia information system in healthcare using RFID," Telemed. e-Health, vol. 14, no. 4, pp. 362–370, 2008, doi: 10.1089/tmj.2007.0057.
[16] S.-Y. K. Pamela Shiao, C.-N. Ou, and L. A. Johnson Professor, "VALIDATION OF OXYGEN SATURATION MONITORING IN NEONATES Background and Significance," Am J Crit Care, vol. 16, no. 2, pp. 168–178, 2007.
[17] S. Budiyanto et al., "Design and monitoring body temperature and heart rate in humans based on WSN using star topology," Indones. J. Electr. Eng. Comput. Sci., vol. 22, no. 1, pp. 326–334, 2021, doi: 10.11591/ijeecs.v22.i1.pp326-334.
[18] M. F. Ahmed, M. K. Hasan, M. Shahjalal, M. M. Alam, and Y. M. Jang, "Design and implementation of an OCC-based real-time heart rate and pulse-oxygen saturation monitoring system," IEEE Access, vol. 8, pp. 198740–198747, 2020, doi: 10.1109/ACCESS.2020.3034366.
[19] Anggara Trisna Nugraha, "Design and Build a Distance and Heart Rate Monitoring System on a Dynamic Bike Integrated with Power Generating System," J. Electron. Electromed. Eng. Med. Informatics, vol. 4, no. 4, pp. 210–215, 2022, doi: 10.35882/jeeemi.v4i4.260.
[20] G. Jin, X. Zhang, W. Fan, Y. Liu, and P. He, "Design of non-contact infra-red thermometer based on the sensor of MLX90614," Open Autom. Control Syst. J., vol. 7, no. 1, pp. 8–20, 2015, doi: 10.2174/1874444301507010008.
[21] V. Akhila, Y. Vasavi, K. Nissie, and P. V. Rao, "An IoT based Patient Health Monitoring System using Arduino Uno," Int. J. Res. Inf. Technol., vol. 1, no. 1, pp. 2001–5569, 2017, [Online]. Available: www.ijrit.net.
[22] I Putu Anna Andika, Triana Rahmawati, and M. Ridha Mak'ruf, "Pulse Oximeter Portable," J. Electron. Electromed. Eng. Med. Informatics, vol. 1, no. 1, pp. 28–32, 2019, doi: 10.35882/jeeemi.v1i1.6.
[23] A. D. Babalola, K. F. Akingbade, and B. C. Ubochi, "The Performance of the STM32 Microcontroller and MAX30102 for Remote Health Monitoring Device Design," J. Digit. Innov. Contemp. Res. Sci. Eng. Technol., vol. 10, no. 3, pp. 51–68, 2022, doi: 10.22624/AIMS/DIGITAL/V10N1P4.
[24] A. Fontaine, N. Rodriguez, A. Koshi, and D. Morabito, "Reflectance-Based Pulse Oximeter for the Chest and Wrist," Reflectance-Based Pulse Oxim. Chest Wrist., no. April, p. 130, 2013.
[25] M. A. Burhanuddin et al., "The Design of Low-Cost Patient Monitor Based on Computer," Proc. - 2019 Int. Semin. Appl. Technol. Inf. Commun. Ind. 4.0 Retrosp. Prospect. Challenges, iSemantic 2019, pp. 405–410, 2019, doi: 10.1109/ISEMANTIC.2019.8884346.