Vital Sign Monitor Device Equipped with a Telegram Notifications Based on Internet of Thing Platform

Agatha Putri Juniar S1, Sari Luthfiyah1, Tri Bowo Indrato1, Michelle Omoogun2
1Department of Electromedical Engineering Politekkes Kemenkes, Surabaya
2Middlesex University (Mauritius Campus Branch), Vacoas, Mauritius

Abstract

Vital Sign Monitor is a tool used to diagnose a patient who needs intensive care to know the condition of the patient. Parameters used in monitoring the patient's condition include body temperature and respiration. The contribution of this research designed a vital sign monitoring tool with IoT-based notifications so that remote monitoring can be done by utilizing web Thinger.io, LCD, RGB LEDs as a display of the results of the study and notify telegrams if it becomes abnormal to the patient's condition. Therefore, in order to produce accurate data in the process of data retrieval, a relaxed position of the patient is required and the stability of the wi-fi network so that monitoring is not hampered. The study used the DS18B20 digital temperature sensor placed on the axilla and the piezoelectric sensor placed on the abdomen of the patient. The results of the study were obtained by taking data on patients. The resulting temperature value will be compared to the thermometer, which produces the highest error value of 0.56%, which is still possible because the tolerance limit is 10%. and for the collection of respiration values that have been compared to the patient monitored obtained the highest error value of 6.2%, which is still feasible because the tolerance limit is 10%. In this study, there is often a crash library between the temperature sensor and other sensors, so for further research, recommend to replacing the temperature sensor.

Keywords

Vital Sign Monitor
Piezoelectric
DS18B20
Respiration Rate
Temperature

I. INTRODUCTION

Monitoring of vital signs is a measurement of a person's health condition[1][2][3]. Monitoring is necessary in case of symptoms of a disease that must be taken quickly so that the patient's condition does not worsen[4][5][6]. The patient's condition can deteriorate anywhere and anytime. Therefore, a tool equipped with a system that can notify the doctor to perform actions If the patient shows less or more results than normal[7][8][9].

In this study, the monitoring of vital signs was created to monitor heart rate, body temperature, oxygen saturation, and respiration. Previous research has been done by Anggi Zafria made a Prototype vital Monitoring Tool Sign Inpatients using Wireless Sensors as a Physical Distancing Effort to deal with Covid 19 using Zigbee[10][11][12]. For respiratory frequency gauges have also been made in 2018 by Ni Putu Anggi Trisna D about Design And Build Vital Signs Examination Tool Appear PC (Respiration &Heart Rate), using sensor FC-04, but the use of this sensor will make the patient uncomfortable because when measuring respiration that must use the mouthpiece so that it will affect the breath[13][14][15]. In addition, respiratory rate measuring instruments have also been made in 2015 by Wendi Era Sonata and Wildian with Design And Build Microcontroller-Based Human Breathing Rate Measurement Tool Atmega8535[16][17][18], at Andalas University Department of Physics FMIPA using LM35 temperature sensor, the tool has an accuracy of 96.5% for measurement of patients with mild activity. Another research in 2019 by Demtania Gusti Kristiani has been made the measuring of vital signs using the internet of things Technology[19][20][21]; it uses a flex sensor that has an error value of 2.3%. Meanwhile, if reviewed from the use of other sensors such as piezoelectric sensors that have been made by Hazhiyyah Nur Amalina in 2019 about monitoring respiratory rate and spo2 via android (respiratory parameter rate), in this study, it is recommended to use piezoelectric sensors because it is more sensitive to the stomach and chest movement to detect breathing rate[22][23][24].

The purpose of this study is to design a Vital Sign Monitoring Tool with IoT-Based Notification (Respiration
Parameters and Body Temperature). This monitoring can be used to diagnose patient health anywhere and anytime and so that the patient or user can monitor their vital condition displayed through the status on display, the application thinger.io, forwarded delivery to telegram if the patient's condition is not normal[25]. Patients with late adolescence can use this study to connect well with medical experts and receive timely treatment.

II. MATERIALS AND METHODS

A. Experimental Setup

This study used six normal subjects with the criteria the ages ranged between 22 and 27 years. The subjects were randomly sampled, and the data collection is repeated six times.

1) Materials and Tool

This study used piezoelectric as respiration sensor and DS18B20(DS18B20, Dallas, China) as a body temperature sensor, character LCD, RGB LED Arduino Mega 2560 microcontroller, and ESP32 used for serial communication. Oscilloscopes(Textronic, DPO2012, Taiwan) are used to test analog circuits.

2) Experiment

In this study, after the design was completed, DS18B20(DS18B20, Dallas, China) sensor testing was conducted using thermometers and piezoelectric sensor testing using patient monitors (Mindray, Beneheart D6, China).

B. The Diagram Block

In this research, Body temperature is detected by the DS18B20 sensor and the respiration rate using piezoelectric sensors. The results of the sensor readings will enter the Arduino Mega 2560 microcontroller as a data processor, which will then be sent serially to the ESP32. Furthermore, the wi-fi on the ESP32 will send data to the thinger.io server. If the data output from the parameters is not normal, a notification of the patient's vital status will be sent via Telegram accompanied by an LED indicator on the device if the patient is not in a state normal.

C. The Flowchart

The Arduino program is built based on a flowchart, as shown in Figure 2. which explains that when the on button is pressed, an initialization process occurs. The DS18B20 sensor and piezoelectric sensor will work to detect and calculate body temperature values and respiration rate values, and then these value data will be processed by the microcontroller. After the value of the two parameters has been taken, the value will be sent to the Arduino Mega microcontroller, which is communicated serially to the ESP32, which will be sent to Thinger.io, displayed on the LCD Display, and information will be sent to the Telegram accompanied by an LED indicator on the device if the patient is not in a state normal.

III. RESULTS

In this study, the test was carried out directly on the respondent to measure the value of the respiration rate and body temperature compared to using a patient monitor (Mindray, Beneheart D6 China), and a thermometer.
1) Vital Sign Tool Results

Figure 3 and Figure 4 above are the measurement results of the module with comparison. RGB LED as an indicator when there is an abnormality in the measurement of body temperature and respiration rate, the abnormality will be indicated by RGB LED color, if the parameter value below the average RGB LED will be red when normal will be green, and when above-average it will be blue.

Figure 5 is a view of the respiration rate and body temperature values that can be seen when the tool is connected to the Thinger.io. It can be viewed on the dashboard section of the thinger.io.

Figure 6 is a notification display of the respiration rate and body temperature value on Telegram. Telegram will give a notification if the respiration rate and body temperature values are abnormal.

2) Listing Program Arduino Mega 2560 Serial Communication

In this paper, the use of serial communication between Arduino Mega 2560 and ESP32 via TX RX aims to send sensor data readings to IoT Thingerio was shown in Listing Program 1.

Which consisted of the program of Arduino Mega 2560 as a sender of sensor data and as a display of data results on an LCD with an RGB LED indicator.

Listing Program 1: Program Arduino Mega 2560 as a sender of sensor data

```cpp
1. void loop() {
2.  read requests from ESP32
3.  String ask="";
4.  while (Serial.available() > 0)
5.  {
6.    ask += char(Serial.read());
7.    test variable request
8.    if (ask == "Y")
9.    {
10.   send the data
11.   kirimdata();
12.  }
13.  clear request variable
14.  ask = "";
15.  }
16.  }
17.  void kirimdata() {
18.  {
19.    read sensor value
20.    BPM = pox.getHeartRate();
21.    SPO = pox.getSpO2();
22.    String datakirim = String(BPM) + "#" + String(SPO);
23.    Serial.println(datakirim);
24.  }
25. }
```

3) Listing Program Arduino ESP32 Serial Communication
ESP32 as a receiver of sensor results whose data has been sent by Arduino Mega 2560 was shown in the **Listing Program 2**, and then the data is sent to IoT and telegram notification.

**Listing Program 2**: Program ESP32 as a received of data

1. #include <SoftwareSerial.h>
2. //variable untuk software serial (Rx, TX)
3. SoftwareSerial DataSerial(16,17);
4. 
5. //millis sebagai pengganti delay
6. unsigned long previousMillis = 0;
7. const long interval = 3000;
8. 
9. //variable array untuk data parsing
10. String arrData[4]; //sesuai jumlah sensor
11. int BPM,SPO;
12. 
13. void setup() {
14. Serial.begin(9600);
15. DataSerial.begin(9600);
16. }
17. 
18. void loop() {
19. //konfigurasi millis
20. unsigned long currentMillis = millis(); //baca waktu
21. millis saat ini
22. if(currentMillis - previousMillis >= interval)
23. {
24. //update previousMillis
25. previousMillis = currentMillis;
26. //prioritaskan pembacaan data dari arduino uno (hasil
27. kiriman data)
28. //baca data serial
29. String data = "";
30. while(DataSerial.available()>0)
31. {
32. data += char(DataSerial.read());
33. }
34. char buf[sizeof(data)];
35. data.trim();
36. data.toCharArray(buf,sizeof(buf));
37. char *p=buf;
38. while((str=strtok_r(p,",",&p))!=NULL)
39. {
40. //Serial.println("index ke: "+String(indexnya)+"\r\n" + arrData[indexnya]);
41. datanya: "+str);
42. 
43. if(indexnya>2)
44. {
45. //tampilkan nilai sensor ke serial monitor
46. Serial.println("HeartRate : " + arrData[0]);//BPM
47. Serial.println("Saturasi O2 : " + arrData[1]);//SPO
48. }
49. //minta data ke arduino Mega
50. DataSerial.println("Y");
51. delay(1500);

4) **Listing Program Temperature**

Initialization in the temperature program was shown in the **Listing Program 3** contains the DS18B20 temperature sensor library which is a serial communication using one data line.

**Listing Program 3**: Program Temperature

1. #include <OneWire.h>
2. #include <DallasTemperature.h>
3. #define ONE_WIRE_BUS 37
4. OneWire oneWire(ONE_WIRE_BUS);
5. DallasTemperature sensors(&oneWire);

5) **Listing Program RR**

**Listing Program 4** explains that when the device is first turned on or reset, the module will automatically look for a reference from the incoming signal via analog pin 3. This reference serves to limit the value of the respiration signal.

**Listing Program 4**: Listing Program RR

1. void resprasi()
2. {
3. total = total + readings[readIndex];
4. readings[readIndex] = analogRead(analogPin);
5. total = total + readings[readIndex];
6. readIndex = readIndex + 1;
7. if (readIndex >= numReadings) {
8. readIndex = 0;
9. }
10. average = total / numReadings;
11. sensor = average;
12. if ([ref<=sensor] {ref=sensor;}
13. else [ref=ref;hold=(ref*0.6);]
14. //=============pembacaan ketika ada nafas================
15. waktu=millis()-waktureset;
16. if (sensor>hold)
17. {
18. beat=1;
19. digitalWrite(ledresp,LOW);
20. }
21. if (sensor<(hold*0.9))
22. {
23. if(beat==1)
24. digitalWrite(ledresp,HIGH);
25. nafasmanual++;
26. beat=0;
27. //Serial.println("nafas" + nafasmanual);
28. }

| TABLE I. RESPIRATION VALUE MEASUREMENT IN MODULE COMPARED TO COMPARISON TOOL |
|-----------------------------------------------------------------------------|

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The DS18B20 sensor can detect human body temperature, so for further research, recommend replacing the temperature sensor. Behind the lack of research, this tool has the benefit of assisting health workers in monitoring vital signs in patients remotely, and there are notifications on telegrams that can be accessed by health workers easily when abnormal conditions occur in patients.

V. CONCLUSION

Overall this research can be concluded that the vital sign module can monitor well and can send notifications to Telegram by using IoT. The DS18B20 sensor can detect human body temperature with a good and stable level of accuracy, and It has been possible to make a respiration monitoring device with a ceramic piezoelectric sensor that displays the results of respiratory rate measurements in the form of a number plotting graph. An IoT program can be created to display the results of respiration measurements on Thingerio. Further, the system is able to connect Arduino Mega 2560 with ESP32 Module for serial communication. The results of data collection were carried out by comparing the tool with the comparison tool six times to 6 respondents. The data taken for the temperature parameter has the lowest error value of 0.22% and the highest error value of 0.56%. And for the respiration parameter, the lowest error value is 0%, and the highest error value is 6.2%. In this study, there is often a crash library between the temperature sensor and other sensors, so for further research, recommend replacing the temperature sensor.

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