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

Sari Luthfiyah[1], Agatha Putri Juniar S[1], , Tri Bowo Indrato[1], Michelle Omoogun[2]
[1]Department of Electromedical Engineering Poltekkes Kemenkes, Surabaya
Jl. Pucang Jajar Timur No. 10, Surabaya, 60245, Indonesia
[2]Middlesex University (Mauritius Campus Branch), Vacoas, Mauritius

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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 1oC. and for the collection of respiration values that have been compared to the patient monitor 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.

Corresponding Author:

Sari Luthfiyah
Corresponding Email: sariluth@poltekkesdepkes-sby.ac.id
Department of Electromedical Engineering
Poltekkes Kemenkes, Surabaya

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 Zafia 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 Hazhiyah 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 his 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 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 received by the health worker, and all parameters will be displayed on the LCD, as shown in Fig. 1.

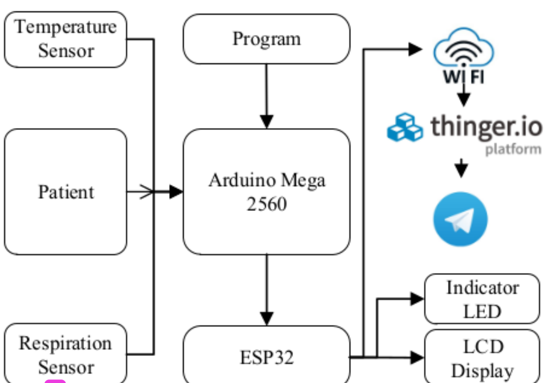

Fig. 1. The diagram block of the temperature and respiration rate

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.

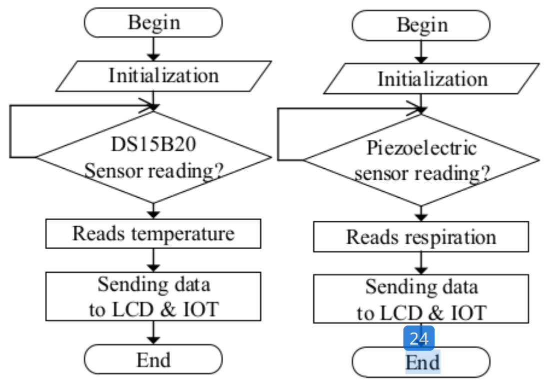

Fig. 2. The Flowchart of the temperature and respiration rate

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.

Fig. 3. The Display of Module Measurement Results with Comparison of respiratory rate values

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Fig. 4. The Display of Module Measurement Results with Body Temperature Value Comparison

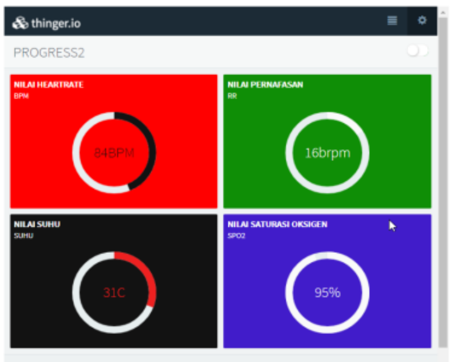

Fig. 5. Thinger.io Display

Fig. 6. Telegram Notification Display

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 Thingerio. 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 18 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

```
void loop() {
  read requests from ESP32
  String ask="";
  while (Serial.available() > 0)
  {
    ask += char(Serial.read());
    test variable request
    if (ask == "Y")
    {
      send the data
      kirimdata();
    }
    clear request variable
    ask = "";
  }
}
void kirimdata()
{
  read sensor value
  BPM = pox.getHeartRate();
  SPO = pox.getSpO2();
  String datakirim = String(BPM) + "#" +
String(SPO);
  Serial.println(datakirim);
}
```

3) Listing Program Arduino ESP32 Serial Communication

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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

```
#include <SoftwareSerial.h>
//variable untuk software serial (Rx, TX)
SoftwareSerial DataSerial(16,17);

//millis sebagai pengganti delay
unsigned long previousMillis = 0;
const long interval = 3000;

//variable array untuk data parsing
String arrData[4]; //sesuai jumlah sensor
int BPM,SPO;

void setup() {
Serial.begin(9600);
DataSerial.begin(9600);
}

void loop() {
//konfigurasi millis
unsigned long currentMillis = millis(); //baca waktu
millis saat ini
if(currentMillis - previousMillis >= interval)
{
  //update previousMillis
  previousMillis = currentMillis;
  //prioritaskan pembacaan data dari arduino uno (hasil
kiriman data)
  //baca data serial
  String data = "";
  while(DataSerial.available()>0)
  {
   data += char(DataSerial.read());
  }
char buf[sizeof(data)];
data.trim();
data.toCharArray(buf,sizeof(buf));
char *p=buf;
  while((str=strtok_r(p,"#",&p))!=NULL){
    //Serial.println(str);
   arrData[indexnya]=str;
   indexnya++;
   //Serial.println("index ke: "+String(indexnya)+"
datanya: "+str);
  }
if(indexnya>2)
{
  //tampilkan nilai sensor ke serial monitor
  Serial.println("HeartRate  : " + arrData[0]);//BPM
  Serial.println("Saturasi O2 : " + arrData[1]);//SPO
 }
   //minta data ke arduino Mega
   DataSerial.println("Y");
  delay(1500);
```

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

```
#include <OneWire.h>
#include <DallasTemperature.h>
#define ONE_WIRE_BUS 37
OneWire oneWire(ONE_WIRE_BUS);
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

```
void respirasi(){
 total = total - readings[readIndex];
 readings[readIndex] = analogRead(analogPin);
 total = total + readings[readIndex];
 readIndex = readIndex + 1;
 if (readIndex >= numReadings) {
 readIndex = 0;
 }
 average = total / numReadings;
sensor = average;
if (ref<=sensor){ref=sensor;}
else{ref=ref;hold=(ref*0.6);}
  //============pembacaan ketika ada
nafas=================
  waktu=millis()-waktureset;
  if(sensor>hold)
  {
   beat=1;
   digitalWrite(ledresp,LOW);
  }
  if(sensor<(hold*0.9))
  {
   if(beat==1){
   digitalWrite(ledresp,HIGH);
   nafasmanual++;
   beat=0;
   //Serial.println("nafas" + nafasmanual);
   }
```

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

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Modules	Measurement(BrPM)						Mean	Error (%)
	1	2	3	4	5	6		
Standard	18	17	15	13	14	16	15,5	4,3
Module	16	16	13	13	15	16	14,8333	
Standard	18	10	12	13	12	17	13,6667	3,7
Module	17	10	13	11	11	17	13,1667	
Standard	15	12	11	13	13	22	14,3333	2,3
Module	12	12	13	12	14	21	14	
Standard	10	12	13	12	20	19	14,3333	2,3
Module	10	13	11	11	20	19	14	
Standard	16	17	17	18	19	20	17,8333	0
Module	16	17	17	18	19	20	17,8333	
Standard	16	19	12	17	15	18	16,1667	6,2
Module	16	17	11	16	13	18	15,1667	

Table 1 above is the data obtained from the comparison display which is compared with the values listed on the module display. Data collection was carried out six times to 6 respondents. The data taken has the lowest error value of 0% and the highest error value of 6.2%.

TABLE II. MEASUREMENT OF BODY TEMPERATURE VALUE IN MODULE COMPARED TO COMPARISON TOOL

Modules	Measurement (°C)						Mean	Error (%)
	1	2	3	4	5	6		
Standard	36,6	36,6	36,7	36,5	36	36,3	36,45	0,41
Module	36,4	36,3	36,5	36,2	36,1	36,3	36,3	
Standard	36,8	36,3	36,7	36,7	36,5	36,5	36,54	0,56
Module	36,6	36,1	36,5	36,6	36,1	36,1	36,3	
Standard	36,1	36,4	36,3	36,5	36,5	36.6	36,36	0,34
Module	36,1	36,4	36,3	36,3	36,2	36,1	36,2	
Standard	36,3	36,5	36,5	36,5	36,5	36,4	36,5	0,22
Module	36,4	36,3	36,3	36,3	36,3	36,6	36,4	
Standard	36,7	36,6	36,6	36,6	36,6	36,5	36,6	0,45
Module	36,1	36,1	36,6	36,6	36,6	36,6	36,4	
Standard	36,4	36,5	36,5	36,5	36,5	36,6	36,5	0,27
Module	36,4	36,3	36,4	36,3	36,4	36,6	36,4	

Table 2 above is the data obtained from the comparison display which is compared with the values listed on the module display. Data collection was carried out six times to 6 respondents. The data taken has the lowest error value of 0.22% and the highest error value of 0.56%.

IV. DISCUSSION

Based on the results of the measurement of vital signs, which were compared with the values from previous studies, the temperature value measured using a thermometer obtained the highest error value of 0.56% while the results of the previous study were 0.5%, the result is still feasible because the tolerance limit is 1° C. and for the measurement of respiration values that have been compared with patient monitors, the highest error value is 6.2% while the results of previous studies are 5.36%, these results are 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 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.

REFERENCES

[1] N. V. Wardhani *et al.*, "A Portable Vital Sign Device with Liquid Crystal Display TFT Touchscreen," *Proc. - 2019 Int. Semin. Appl. Technol. Inf. Commun. Ind. 4.0 Retrosp. Prospect. Challenges, iSemantic 2019*, pp. 429–433, 2019, doi: 10.1109/ISEMANTIC.2019.8884351.

[2] M. Omoogun, V. Ramsurrun, S. Guness, P. Seeam, X. Bellekens, and A. Seeam, "Critical patient eHealth monitoring system using wearable sensors," *2017 1st Int. Conf. Next Gener. Comput. Appl. NextComp 2017*, no. July, pp. 169–174, 2017, doi: 10.1109/NEXTCOMP.2017.8016194.

[3] A. Singh and A. Chaudhary, "International Journal on Recent and Innovation Trends in Computing and Communication Real Time Respiration Rate Measurement Using Temperature Sensor," pp. 605–607, 2017, [Online]. Available: http://www.ijritcc.org.

[4] B. Mash, "Primary care management of the coronavirus (Covid-19)," *South African Fam. Pract.*, vol. 62, no. 1, pp. 1–4, 2020, doi: 10.4102/safp.v62i1.5115.

[5] T. Mikami *et al.*, "Risk Factors for Mortality in Patients with COVID-19 in New York City," *J. Gen. Intern. Med.*, vol. 36, no. 1, pp. 17–26, 2021, doi: 10.1007/s11606-020-05983-z.

[6] W. J. Wiersinga, A. Rhodes, A. C. Cheng, S. J. Peacock, and H. C. Prescott, "Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review," *JAMA - J. Am. Med. Assoc.*, vol. 324, no. 8, pp. 782–793, 2020, doi: 10.1001/jama.2020.12839.

[7] I. Prayogo *et al.*, "Sistem Monitoring Denyut Jantung Dan Suhu Tubuh Sebagai Indikator Level Kesehatan Pasien Berbasis IoT (Internet Of Thing) Dengan Metode Fuzzy Logic Menggunakan Android," *Program Studi Teknik Elektro, Fakultas Teknik, Universitas Trunojoyo*. 2017.

DOI: 10.35882/ijeeemi.v3i3.4 ISSN:2656-8624

[8] G. Basaranoglu, M. Bakan, T. Umutoglu, S. U. Zengin, K. Idin, and Z. Salihoglu, "Comparison of SpO2 values from different fingers of the hands," *Springerplus*, vol. 4, no. 1, pp. 2–5, 2015, doi: 10.1186/s40064-015-1360-5.

[9] J. Saha *et al.*, "Advanced IOT based combined remote health monitoring, home automation and alarm system," *2018 IEEE 8th Annu. Comput. Commun. Work. Conf. CCWC 2018*, vol. 2018-Janua, no. September, pp. 602–606, 2018, doi: 10.1109/CCWC.2018.8301659.

[10] A. Zafia, "Prototype Alat Monitoring Vital Sign Pasien Rawat Inap Menggunakan Wireless Sensor Sebagai Upaya Physical Distancing menghadapi Covid-19," *J. Informatics, Inf. Syst. Softw. Eng. Appl.*, vol. 2, no. 2, pp. 61–68, 2020, doi: 10.20895/insista.v2i2.126.

[11] A. M. Dondorp, M. Hayat, D. Aryal, A. Beane, and M. J. Schultz, "Respiratory support in COVID-19 patients, with a focus on resource-limited settings," *Am. J. Trop. Med. Hyg.*, vol. 102, no. 6, pp. 1191–1197, 2020, doi: 10.4269/ajtmh.20-0283.

[12] T. Greenhalgh, G. C. H. Koh, and J. Car, "Covid-19: A remote assessment in primary care," *BMJ*, vol. 368, pp. 1–5, 2020, doi: 10.1136/bmj.m1182.

[13] N. D. Putu Anggi Trisna, H. Andjar Pudji, and dan T. Moch Prastawa Assalim, "Seminar Tugas Akhir Rancang Bangun Alat Ukur Pemeriksaan Vital Signs Tampil PC (Respirasi & Heart Rate)," pp. 1–10, 2018.

[14] Q. Sun, H. Qiu, M. Huang, and Y. Yang, "Lower mortality of COVID-19 by early recognition and intervention: experience from Jiangsu Province," *Ann. Intensive Care*, vol. 10, no. 1, pp. 2–5, 2020, doi: 10.1186/s13613-020-00650-2.

[15] K. G. Andersen, A. Rambaut, W. I. Lipkin, E. C. Holmes, and R. F. Garry, "The proximal origin of SARS-CoV-2," *Nat. Med.*, vol. 26, no. 4, pp. 450–452, 2020, doi: 10.1038/s41591-020-0820-9.

[16] W. Sonata and W. -, "Rancang Bangun Alat Ukur Laju Pernapasan Manusia Berbasis Mikrokontroler Atmega8535," *J. Fis. Unand*, vol. 4, no. 4, pp. 332–338, 2015.

[17] M. Al-Balas, H. I. Al-Balas, and H. Al-Balas, "Surgery during the COVID-19 pandemic: A comprehensive overview and perioperative care," *Am. J. Surg.*, vol. 219, no. 6, pp. 903–906, 2020, doi: 10.1016/j.amjsurg.2020.04.018.

[18] M. A. Matthay, J. M. Aldrich, and J. E. Gotts, "Treatment for severe acute respiratory distress syndrome from COVID-19," *Lancet Respir. Med.*, vol. 8, no. 5, pp. 433–434, 2020, doi: 10.1016/S2213-2600(20)30127-2.

[19] D. G. Kristiani, T. Triwiyanto, P. C. Nugraha, B. G. Irianto, Syaifudin, and D. Titisari, "The Measuring of Vital Signs Using Internet of Things Technology (Heart Rate and Respiration)," *Proc. - 2019 Int. Semin. Appl. Technol. Inf. Commun. Ind. 4.0 Retrosp. Prospect. Challenges, iSemantic 2019*, pp. 417–422, 2019, doi: 10.1109/ISEMANTIC.2019.8884312.

[20] S. N. Byrareddy and M. Mohan, "SARS-CoV2 induced respiratory distress: Can cannabinoids be added to anti-viral therapies to reduce lung inflammation?," *Brain. Behav. Immun.*, vol. 87, pp. 120–121, 2020, doi: 10.1016/j.bbi.2020.04.079.

[21] Istikomah, "No 主観的健康感を中心とした在宅高齢者における 健康関連指標に関する共分散構造分析Title," 2014.

[22] H. N. Amalina, I. D. Gede, H. Wisana, and T. Rahmawati, "Monitoring Respiratory Rate and Spo2 Via Android (Parameter Respiratory Rate)," vol. 1, no. 1, pp. 1–7, 2019, doi: 10.1234/ijeeemi.v1i1.9xx.

[23] I. K. E. G. Mahardika, T. Hamzah, T. Rahmawati, and L. Soetjiatie, "Measuring Respiration Rate Based Android," *Indones. J. Electron. Electromed. Eng. Med. informatics*, vol. 1, no. 1, pp. 39–44, 2019, doi: 10.35882/ijeeemi.v1i1.7.

[24] Sarah Aghnia Miyagi, Muhammad Ridha Mak'ruf, Endang Dian Setioningsih, and T. Das, "Design of Respiration Rate Meter Using Flexible Sensor," *J. Electron. Electromed. Eng. Med. Informatics*, vol. 2, no. 1, pp. 13–18, 2020, doi: 10.35882/jeeemi.v2i1.3.

[25] A. D. Droitcour *et al.*, "Non-contact respiratory rate measurement validation for hospitalized patients," *Proc. 31st Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. Eng. Futur. Biomed. EMBC 2009*, pp. 4812–4815, 2009, doi: 10.1109/IEMBS.2009.5332635.

ATTACHMENT

[1] Schematic
https://drive.google.com/file/d/1slKW6YkkGnpo4o43Xc7TrQiw2OPhcPcN/view?usp=sharing

[2] Listing Program
https://drive.google.com/drive/folders/1_A5q5VFPrN73QhQjJH5uxzfV9RyEXvpZ?usp=sharing

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