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Elderly People Health Monitoring System by Using IoT

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Abstract: IoT-based Health Monitoring systems have emerged as a hot topic and critical research area today. Nowadays, the elderly face serious health problems as a result of inadequate health monitoring. Technologies to monitor their activities at home must be strengthened. Elderly people are frequently left home alone because their children work or live far away. As a result, many people struggle to keep track of them consistently. This project aims to build an Internet of Things Health Monitoring System that uses the ESP8266 ESP-01 for IoT wireless data transmission via the Blynk application's Android platform. For the healthiest elderly people, resting heart rates range from 60 to 100 beats per minute. Therefore, the result that gets for the pulse sensor is accurate. Furthermore, the average DS18B20 temperature sensor does not show significant differences between the body thermometer and temperature sensor (DS18B20). As a result, the DS18B20 temperature sensor can be used to take body temperature readings. The elderly people's data records are kept for an extended time. The information is saved with the help of an Android app that controls the app's device. When the temperature or pulse sensor is beyond in critical state, the alert will appear in the smartphone and send a notification to the email. The data of elderly people also can convert to excel with the date and time. This proposed system allows elderly and chronically ill patients to live independently in their own homes with care facilities while feeling secure in the knowledge that they could be being monitored.

Keywords: Health Monitoring System, IoT, Blynk Android Application

1. Introduction

Nowadays, health monitoring is a major issue. Due to a lack of proper health monitoring, the elderly face serious health problems [1]. There are numerous IoT devices available today to monitor the health of elderly people via the internet. The benefit of these smart devices is that they can keep an eye on the elderly. It used to use a large and fixed monitoring device. Only in hospitals can the health status of

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elderly people be determined when they are on a bed. These monitoring devices are only available in hospitals and are constantly attached to the bodies of the elderly. Many of them are difficult to use, so doctors and family members must have a handy device that monitors their elderly patients when they are not present. Developing monitoring systems aims to reduce health care costs by lowering physician office visits, hospitalizations, and diagnostic testing procedures [2]. In such areas where the epidemic is spreading, monitoring these elderly people using remote health monitoring technology is always good. So the Internet of Things (IoT) based health monitoring system is the current solution [3].

This project will create an IoT-based Health Monitoring System that monitors the elderly's heart rate and body temperature and sends a notification and email alert when those readings exceed critical values. Pulse rate and body temperature readings appear on the Blynk app, which can be accessed from anywhere via the internet to monitor the health of the elderly. The data will be exported to CSV and emailed to you. Excel will be used to view the data.

Adding to this, the earlier the cause is identified, the sooner the elderly people will be treated. Body temperature and heart rate are the two most important factors in analysing elderly people data. This paper will deal with the IoT and blynk app source information [4].

2. Materials and Methods

This paper proposes a monitoring system that detects the body temperature and the heartbeat rate of elderly people. Figure 1 depicts the block diagram of the proposed system prototype. The developed system prototype has two sides. On the elderly's side the readings are displayed on a Liquid Crystal Display (LCD) screen whereas on the family's side the readings are stored in the Blynk application. The DS18B20 digital temperature sensors and the ESP8266-01 were used as the hardware. In contrast, the software used is the Arduino IDE Software and the Blynk application, which must be connected to the ESP8266-01. To begin, it must construct the temperature circuit. When the sensor receives the result, it wirelessly connects to the internet modem (Router) and sends data to the Blynk application. Blynk is a smartphone platform that provides iOS or Android to control various microcontroller platforms such as Arduino by wireless data reading and understanding bits over the internet. The data from the pulse sensor and body temperature would be collected for the elderly to know the real-time situation continuously and as a tool to access. This section contains a summary of every process used to finish the project. To accommodate the implementation of the project, all processes listed must be accompanied. The data will then be transmitted to the user via notification by the Microcontroller. When the conditions become abnormal, it detects them and alerts the people nearby by popping the alert system and sending an urgent message and email. Finally, the data can be exported to CVS and sent via email in the form of an excel spreadsheet.

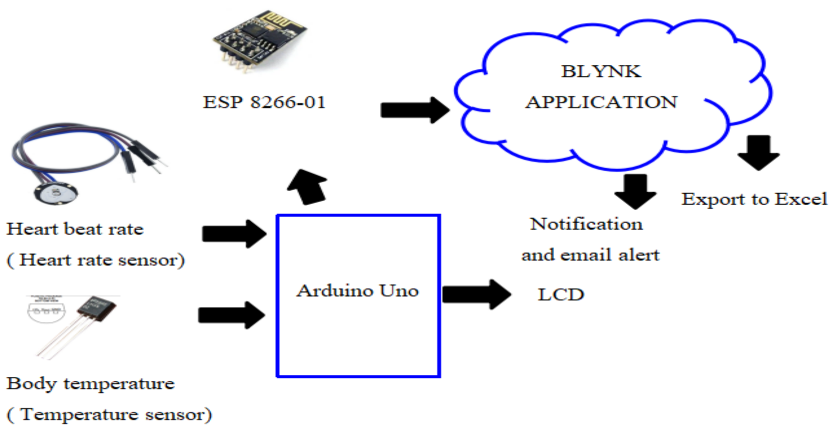


Figure 1: Block diagram of the developed system

2.1 Hardware Requirements

Table I summaries the system's hardware components. The heartbeat sensor measures the heartbeat rate, whereas the DS18B20 digital temperature sensors measure the body temperature of the elderly. Collected readings are processed when sensors are attached to an Arduino board. The ESP8266-01 wireless module is connected to the Arduino board and used to send the sensor data collected to the Blynk application.

Table 1. Hardware requirements summary

No.	Required component	Quantity
1.	Arduino Uno	1
2.	Pulse sensor	1
3.	DS18B20 digital temperature sensors	1
4.	ESP8266-01 module	1
5.	Jumper wires	1 Packet
6.	LCD	1

2.1.1 DS18B20 digital temperature sensors

A digital temperature sensor such as the DS18B20. It used a single wire protocol to measure temperature from -67oF to +257oF (-55oC to +125oC) with +5% accuracy. The data received from the 1-wire can range from 9-bit to 12-bit in length. This sensor operates on a single wire protocol and is controlled by a single pin on the microcontroller. It is a high-level protocol. It was programmed into each sensor with a 64-bit serial code, which aids in the control of multiple sensors. It operates on a single microcontroller pin and one type of temperature sensor, providing 9-bit to 12-bit readings. These values represent the temperature of a specific device [5].

2.1.2 Pulse sensor Arduino

The pulse is a well-designed Arduino plug-and-play heart-rate sensor. Its purpose is to irradiate the skin with light from an LED, and then the light reflected from the body starts to hit the detector, where changes in heartbeat and body movement are measured.

2.1.3 ESP8266-01

The ESP8266-01 is a very user-friendly and low-cost device for providing internet connectivity to projects [6]. Espressif Systems, based in Shanghai, China, created the module, which includes a full TCP/IP stack and a microcontroller. It functions as both an access point (can create hotspots) and a station (can connect to Wi-FiWi-Fi), allowing it to easily fetch data and upload it to the internet, facilitating the Internet of Things. It can also pull data from the internet via APIs, allowing your project to access any information available on the internet and thus become more intelligent.

2.1.4 Liquid Crystal Display

The LCD used in this project is a 162 LCD that only displays 32 characters. When programmed with the help of the Liquid Crystal library, this LCD is a 16-pin device that can display values. The 16 pins include the VCC pin, which is the power supply for the LCD and is typically connected to the Arduino's 5V, and the GND pin, which is connected to the Arduino's ground pin (0V). The LCD's contrast is controlled by the Vo pin, which is connected to 5V for maximum brightness or to the signal pin for brightness adjustments.

2.1.5 Arduino IDE

The Arduino Software IDE, which is a cross-platform Java application derived from the IDE for the Processing programming language and the Wiring project. The goal of this programming is to introduce artists and other newcomers who are unfamiliar with software development to programming. Syntax highlighting is one of the code editor's features. Finally, with a single click, it compiles and uploads programs to the board.

2.1.6 Blynk Application

It enables the creation of one or more projects. Each project can include graphical widgets such as notifications, supercharts, value displays, and even a text terminal, as well as interact with one or more devices. The Blynk library allows you to control Arduino or ESP32 pins directly from your phone without writing any code. It is also possible to share a project with others in order for them to access the connected devices but not modify the project. The platform has three major components:

1. Blynk App - It enables to create of interfaces for projects by utilising various widgets that can supply to it.
2. Blynk Server - This server is in charge of all smartphone and hardware kit communications. It has the option of using the Blynk Cloud or running a private Blynk server. It is open-source and can easily handle a wide range of devices.
3. Blynk Libraries: It is required for popular hardware platforms to communicate with the server and process incoming and outgoing commands.

2.2 Validation

To ensure the data gained is valid, a data measurement comparison between the project and the available thermometer with the smartwatch is done. A test with an automatic thermometer which is used by most people had been measured.

2.2.1 Flexible digital thermometer

The MT-B132FB 10” Flexible Digital Thermometer is 10 second measuring time and flexible tip for comfortable measuring. The measured range is 32.0 °C to 43.0 °C (89.6 °F to 109.4 °F), and the accuracy is 0.1 °C (0.2 °F): 35.5 °C 42.0 °C (95.9 °F 107.6 °F) 0.2 °C (0.3 °F): other range. When the measurement is complete, the alarm will sound, as will the fever alarm (if the temperature rises above 37.8 °C/100 °F).

2.2.2 X7 smartwatch

The HS6620D processor powers the X7 smartwatch. It supports Bluetooth 4.2 and 5.0 versions and has dual-mode Bluetooth functionality. Sensors include G-sensors, heart rate monitors, and blood pressure monitors. The X7 smartwatch has a 200 mAh battery that provides several days of standby time. It makes use of the Fit pro support app, which is available on both the iOS and Android platforms.

3. Proposed health Monitoring System Implementation

The proposed health monitoring system prototype development is divided into several sections, as shown in Figure 2 and Figure 3. Sensor accessories, microcontrollers, power supplies, LCD screens, ESP8266-01, and smartphones, as well as the Blynk application, are among them. All sensors are neatly and conveniently installed on the user's hand. The product is lightweight, stable, clearly labeled, and portable. It allows for the components to be inserted and function properly. The LCD screen is placed in such a way that the user can easily read the measured readings. Users can power the device with a 5V battery or by connecting it directly to an external power supply. When the prototype's power supply is connected and the ESP8266-01 is connected to the WIFI, the sensor will begin measuring the patient's body temperature and heart rate to determine their overall health status. Following that, the sensor readings are displayed on the LCD screen. The data will then be sent to the Blynk application by the system. Users can use the Blynk app on their smartphones to keep track of their loved ones. The flow chart of the entire work process is shown in Figure 4.

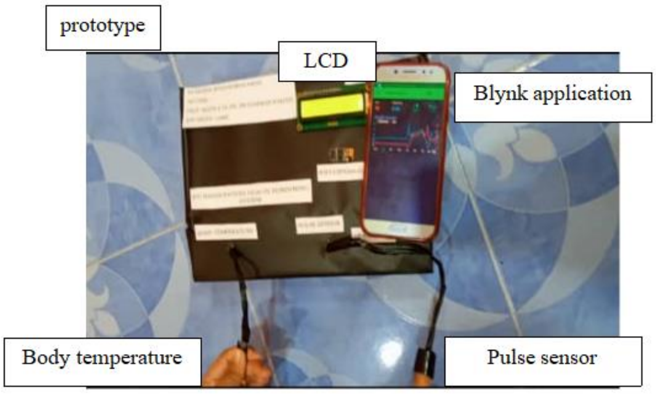


Figure 2: The front of the prototype health monitoring model

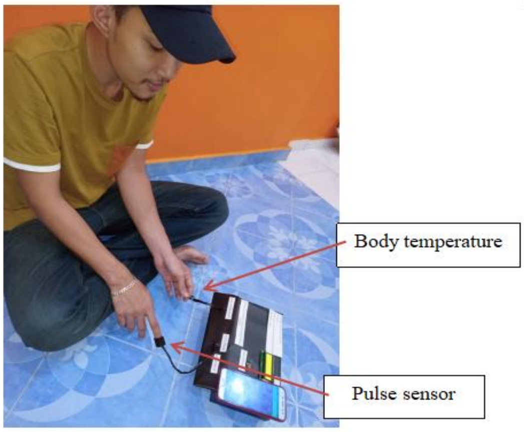


Figure 3: System setup

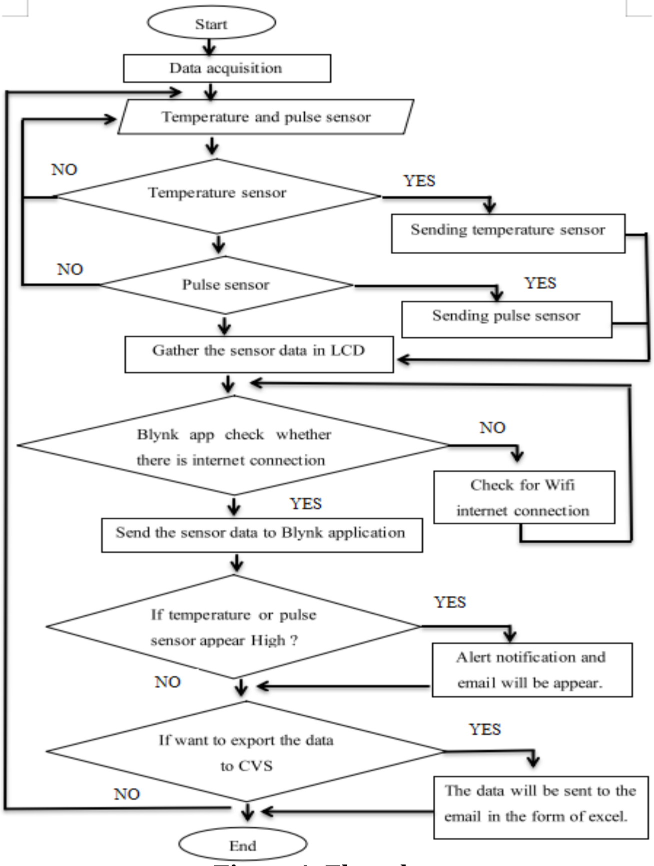


Figure 4: Flow chart

4. Results and Discussion

The developed system prototype monitors body temperature and heartbeat rate for elderly people. A Blynk application utilizes to store and virtualize the elderlys' data. The aggregated data can also be extracted in excel format for offline analysis, allowing the family to track data in real-time and keeping track of the elderly's health conditions. A 16×2 LCD displayed the elderly's body temperature and heartbeat readings. The elderly people can see their temperature and heartbeat readings while at the same time the readings are sent to the database. The data were analyzed and organized in graphical form in terms of a line graph in different fields. The fields receive real-time data from the sensor nodes corresponding to the elderly's body readings.

4.1 Results

All of the data was collected using Blynk. Users must first register in order to create an account. Blynk will then send the Auth Token to the registered email address. After receiving the Auth Token, users can use the app to create their own data, such as super charts, display values, notifications, eventors, and so on. The Blynk Application interface is depicted in Figure 5. The eventor setting is used to trigger the alert notification. When the temperature rises above 37 degrees Celsius, it raises the temperature. When the BPM exceeds 120, it is set to high. As a result, if the temperature or BPM is too high, the message "Alert! Temperature is high!" will appear. And in the email, it will say, "Alert!! Temperature is high!! Alert!! Then, for BPM, it will say "Alert! BPM is high!" and for email, it will say "Alert! BPM is high!! Alert!!".

If the condition of the elderly worsens, consumers are also notified via warning notifications, as shown in Figure 6. Furthermore, different data parameters are recorded in Figure 7 and Figure 8 depict the data and graphical data of person 1 and person It indicates that the result will be sent to the user via the Blynk application and displayed in the excel spreadsheet every 1 second for each individual. BPM was calculated to obtain the resulting data by counting how many times heartbeats in a minute. These include heart rate and body temperature, which are sent in CSV format via the Report feature in Excel. Therefore, it is reasonable to conclude that the author's prototype is very well for measuring temperature and pulse sensor and is successfully applied in Blynk application and send a notification with email when the condition is abnormal.

Table 2 shows the validation table. It includes the average BPM value by pulse sensor (Author's Prototype), the average BPM value by X7 smartwatch, the average temperature value by DS18B20 (Author's Prototype), and the average temperature value by the thermometer. As an outcome, it is reasonable to conclude that the author's prototype is very well for measuring temperature in a manner similar to that of a standard device with a deviation of less than 1%. A percentage that is very close to zero indicates that it is very close to the desired value, which is good. Throughout 60 seconds, the average of the pulse sensor and the temperature sensor is taken. While for the BPM by using a pulse sensor, the higher percentage error is 28.9% for person 2. For most healthy elderly people, resting heart rates range from 60 to 100 beats per minute. Therefore, the result that gets for the pulse sensor is accurate. The signal from the photosensor is generally small and noisy, it is passed through with an R/C filter network before being amplified using an Operational Amplifier to produce a signal that is so much larger, smoother, and easier to diagnose.

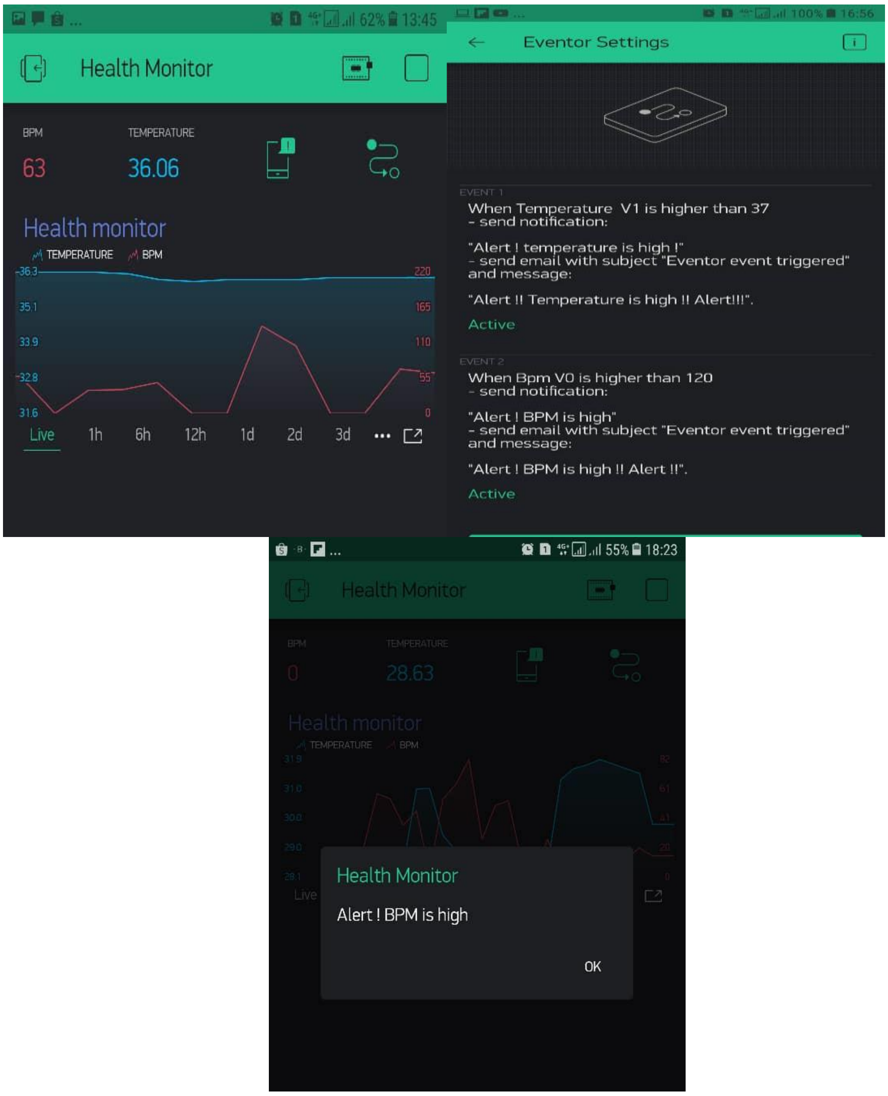


Figure 5: The Blynk Application interface

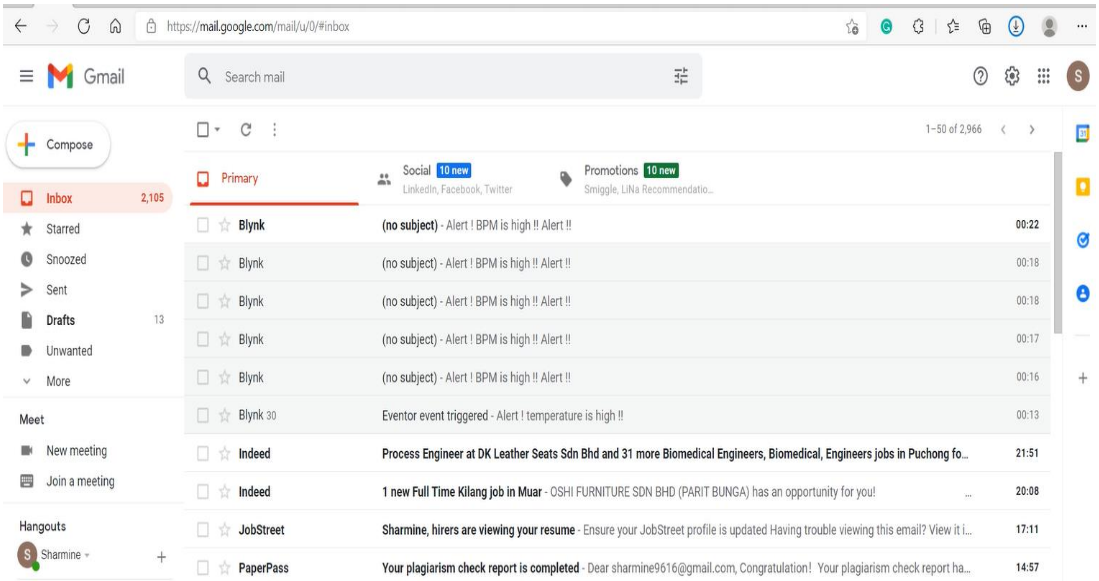
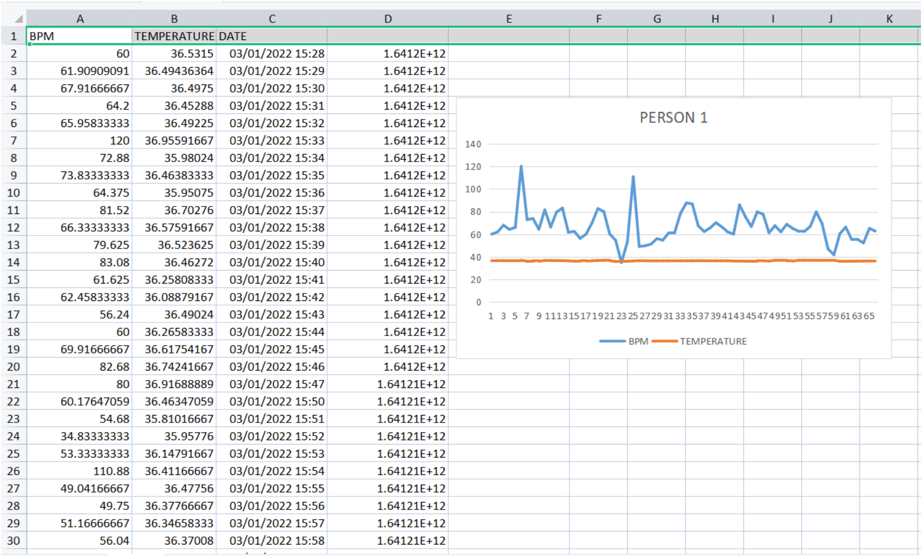
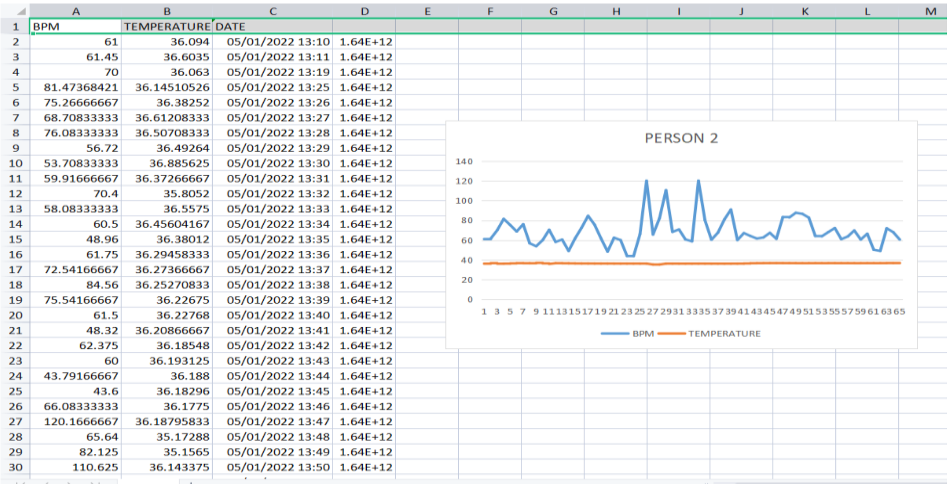


Figure 6: Remote patient monitoring system alarming interface



	A	B	C	D
1	BPM	TEMPERATURE	DATE	
2	60	36.5315	03/01/2022 15:28	1.6412E+12
3	61.90909091	36.49436364	03/01/2022 15:29	1.6412E+12
4	67.91666667	36.4975	03/01/2022 15:30	1.6412E+12
5	64.2	36.45288	03/01/2022 15:31	1.6412E+12
6	65.95833333	36.49225	03/01/2022 15:32	1.6412E+12
7	120	36.95591667	03/01/2022 15:33	1.6412E+12
8	72.88	35.98024	03/01/2022 15:34	1.6412E+12
9	73.83333333	36.46383333	03/01/2022 15:35	1.6412E+12
10	64.375	35.95075	03/01/2022 15:36	1.6412E+12
11	81.52	36.70276	03/01/2022 15:37	1.6412E+12
12	66.33333333	36.57591667	03/01/2022 15:38	1.6412E+12
13	79.625	36.523625	03/01/2022 15:39	1.6412E+12
14	83.08	36.46272	03/01/2022 15:40	1.6412E+12
15	61.625	36.25808333	03/01/2022 15:41	1.6412E+12
16	62.45833333	36.08879167	03/01/2022 15:42	1.6412E+12
17	56.24	36.49024	03/01/2022 15:43	1.6412E+12
18	60	36.26583333	03/01/2022 15:44	1.6412E+12
19	69.91666667	36.61754167	03/01/2022 15:45	1.6412E+12
20	82.68	36.74241667	03/01/2022 15:46	1.6412E+12
21	80	36.91688889	03/01/2022 15:47	1.64121E+12
22	60.17647059	36.46347059	03/01/2022 15:50	1.64121E+12
23	54.68	35.81016667	03/01/2022 15:51	1.64121E+12
24	34.83333333	35.95776	03/01/2022 15:52	1.64121E+12
25	53.33333333	36.14791667	03/01/2022 15:53	1.64121E+12
26	110.88	36.41166667	03/01/2022 15:54	1.64121E+12
27	49.04166667	36.47756	03/01/2022 15:55	1.64121E+12
28	49.75	36.37766667	03/01/2022 15:56	1.64121E+12
29	51.16666667	36.34658333	03/01/2022 15:57	1.64121E+12
30	56.04	36.37008	03/01/2022 15:58	1.64121E+12

Figure 7: Data and graphical data of person 1



	A	B	C	D
1	BPM	TEMPERATURE	DATE	
2	61	36.094	05/01/2022 13:10	1.64E+12
3	61.45	36.6035	05/01/2022 13:11	1.64E+12
4	70	36.063	05/01/2022 13:19	1.64E+12
5	81.47368421	36.14510526	05/01/2022 13:25	1.64E+12
6	75.26666667	36.38252	05/01/2022 13:26	1.64E+12
7	68.70833333	36.61208333	05/01/2022 13:27	1.64E+12
8	76.08333333	36.50708333	05/01/2022 13:28	1.64E+12
9	56.72	36.49264	05/01/2022 13:29	1.64E+12
10	53.70833333	36.885625	05/01/2022 13:30	1.64E+12
11	59.91666667	36.37266667	05/01/2022 13:31	1.64E+12
12	70.4	35.8052	05/01/2022 13:32	1.64E+12
13	58.08333333	36.5575	05/01/2022 13:33	1.64E+12
14	60.5	36.45604167	05/01/2022 13:34	1.64E+12
15	48.96	36.38012	05/01/2022 13:35	1.64E+12
16	61.75	36.29458333	05/01/2022 13:36	1.64E+12
17	72.54166667	36.27366667	05/01/2022 13:37	1.64E+12
18	84.56	36.25270833	05/01/2022 13:38	1.64E+12
19	75.54166667	36.22675	05/01/2022 13:39	1.64E+12
20	61.5	36.22768	05/01/2022 13:40	1.64E+12
21	48.32	36.20866667	05/01/2022 13:41	1.64E+12
22	62.375	36.18548	05/01/2022 13:42	1.64E+12
23	60	36.193125	05/01/2022 13:43	1.64E+12
24	43.79166667	36.188	05/01/2022 13:44	1.64E+12
25	43.6	36.18296	05/01/2022 13:45	1.64E+12
26	66.08333333	36.1775	05/01/2022 13:46	1.64E+12
27	120.1666667	36.18795833	05/01/2022 13:47	1.64E+12
28	65.64	35.17288	05/01/2022 13:48	1.64E+12
29	82.125	35.1565	05/01/2022 13:49	1.64E+12
30	110.625	36.143375	05/01/2022 13:50	1.64E+12

Figure 8: Data and graphical data of person 2

Table 2: Validation table

	Average BPM value by pulse sensor (Author's Prototype)	Average BPM value by X7 smartwatch	Percentage error (%)	Average temperature value by DS18B20 (Author's Prototype)	Average temperature Value by thermometer	Percentage error of temperature (%)
Person 1	68	82	17.1	36.6	36.3	-0.8
Person 2	64	90	28.9	36.4	36.4	0.0
Person 3	75	86.3	13.1	36.4	36.4	0.0

5. Conclusion

The prototype proposed in this work successfully measured and displayed temperature and pulse sensor readings on LCD and smartphones using the Blynk application. The results show that the readings obtained are accurate because they have been validated. Thus, these innovations can help family member monitor their elderly people remotely. Furthermore, an email and notification alert will be sent when the reading exceeds critical values. Finally, this prototype also successfully exported data to CVS, data sent to the email in the form of excel.

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