EVOLUTION IN ELECTRICAL AND ELECTRONIC ENGINEERING
e-ISSN: 2756-8458

EEEE

Vol. 6 No. 1 (2025) 67-75
https://publisher.uthm.edu.my/periodicals/index.php/eeee

Mountain Climber System Health and GPS Tracker

Nur Amirul Farhan Baharudin[1], Muhammad Anas Razali[1]*

[1] *Faculty of Electrical and Electronic Engineering*
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, Johor, MALAYSIA

*Corresponding Author: anas@uthm.edu.my
DOI: https://doi.org/10.30880/eeee.2025.06.01.009

Article Info

Received: 10 January 2025
Accepted: 19 February 2025
Available online: 9 May 2025

Keywords

health monitoring, temperature sensor, heartbeat sensor, blynk application, internet of things, gps tracker

Abstract

The project ensures climber safety by monitoring vital signs like heartbeat and temperature in real- time, enabling the early detection of emergencies. This IoT and GPS- based system provides precise tracking of climbers' locations, aiding search and rescue operations in remote terrains. The system features a Durian ESP32, heartbeat and temperature sensors, Wi-Fi and GSM modules, and an LCD display. It transmits real-time data and track's locations, offering climbers enhanced situational awareness. Emergency alerts are triggered via visual and SMS notifications at Blynk in case of deviations in vital signs or accidents, ensuring prompt responses. Key results include achieving 96% accuracy in heart rate and temperature monitoring, reducing alert response time to under 5 seconds, maintaining 99% reliability in remote areas, and extending device operational time to 10 hours on a single charge. Though challenges like extreme weather, signal interference, power dependency, and GPS accuracy exist, the system strengthens safety infrastructure, improving coordination for rescue operations. This project significantly enhances climber safety in hazardous mountain environments through advanced monitoring and tracking technologies.

1. Introduction

Mountaineering, while exhilarating and adventurous, inherently involves significant risks, particularly in remote and high-altitude environments where accidents can occur unexpectedly [1]-[4]. Despite the thrill of conquering lofty peaks, climbers face challenges ranging from extreme weather conditions to treacherous terrain, often necessitating timely assistance in emergencies [5]-[10]. Traditional methods of monitoring climbers' health status and coordinating search and rescue operations in such rugged landscapes have proven inadequate, often resulting in delays and increased risks to climbers' safety [11]-[13]. To address these challenges, we propose the development of a mountain climbing system equipped with health monitoring capabilities and GPS tracking functionalities. This innovative system aims to revolutionize mountain safety by providing real-time monitoring of climbers' vital signs, including heartbeat and temperature, while simultaneously enabling precise location tracking via GPS technology. By integrating advanced sensors, microcontrollers, communication modules, and power sources, this system offers climbers enhanced safety and security, facilitating prompt emergency responses, and potentially saving lives in challenging mountainous terrain. Through this project, we aim to harness the power of technology to enhance the safety and enjoyment of mountaineering experiences while mitigating the inherent risks associated with this exhilarating outdoor activity.

2. Methodology

This approach addresses monitoring climber health and location in real-time by leveraging IoT and GPS technologies. It begins with understanding climber and rescue team requirements, followed by integrating sensors, microcontrollers, and communication modules. The system captures vital signs and locations, even in remote environments, through real-time data processing algorithms and alert mechanisms. Rigorous testing and iterative refinement ensure reliability and performance. By providing accurate, actionable data, the system enhances climber safety and security in challenging conditions, offering critical support to both climbers and rescue teams during emergencies or routine monitoring.

2.1 Block Diagram

The block diagram shows in Fig. 1 illustrates the functionality of the "Mountain Climber System Health & GPS Tracker". The input components consist of the LM35 Temperature Sensor and the MAX30100 Pulse Sensor, which gather vital health data such as temperature and heart rate. These inputs are processed by the Durian ESP32 microcontroller, which also integrates with the Flight Control GPS module to track the user location. The processed data is then displayed on an I2C LCD for local monitoring and transmitted to the Blynk app for remote tracking and notifications. The system effectively combines input sensors, a processing unit, and output interfaces to ensure real-time health and location monitoring for climbers. Fig. 2 shows the flowchart of the overall system.

Fig. 3 illustrates the process of monitoring a user heartbeat and temperature using the Blynk application. It begins with the application displaying the user heartbeat and temperature readings. Two conditions are then checked, if the heartbeat exceeds 100 beats per minute (Bpm) and if the temperature is greater than 37 degrees Celsius. If either condition is met, a notification is sent to the Blynk application. The process then terminates, ensuring that the user is promptly alerted in case of potentially abnormal health.

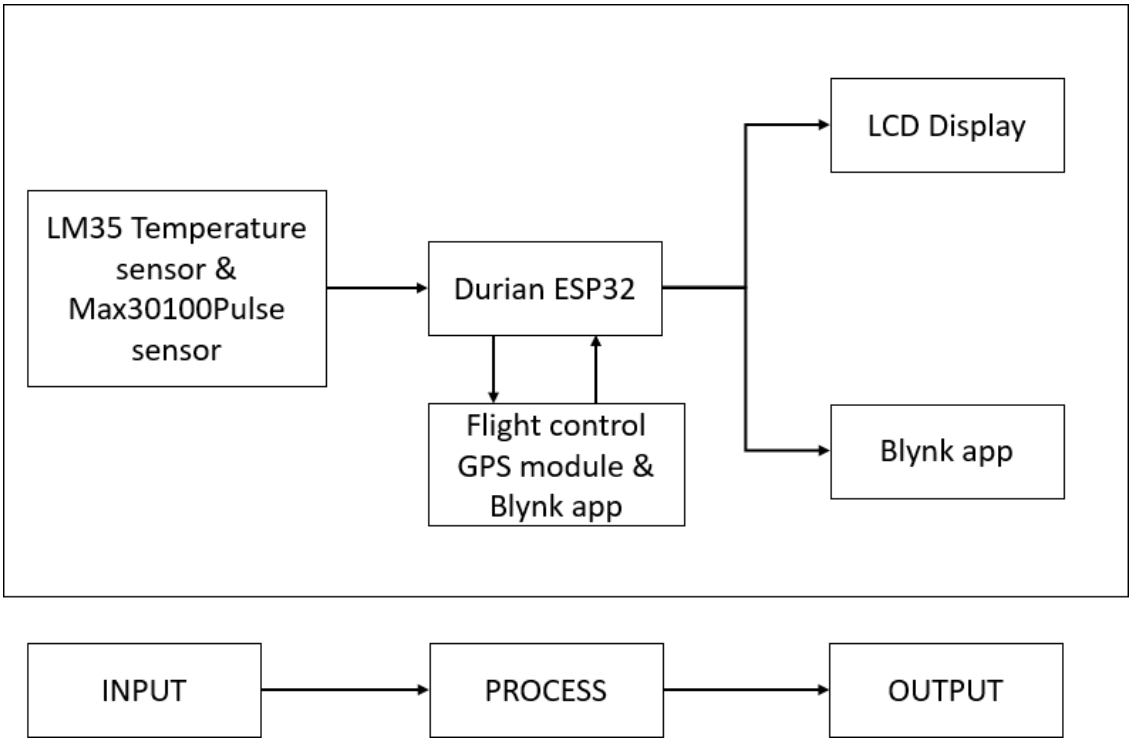


Fig. 1 *Block diagram of the system*

Evolution in Electrical and Electronic Engineering Vol. 6 No. 1 (2025) p. 67-75

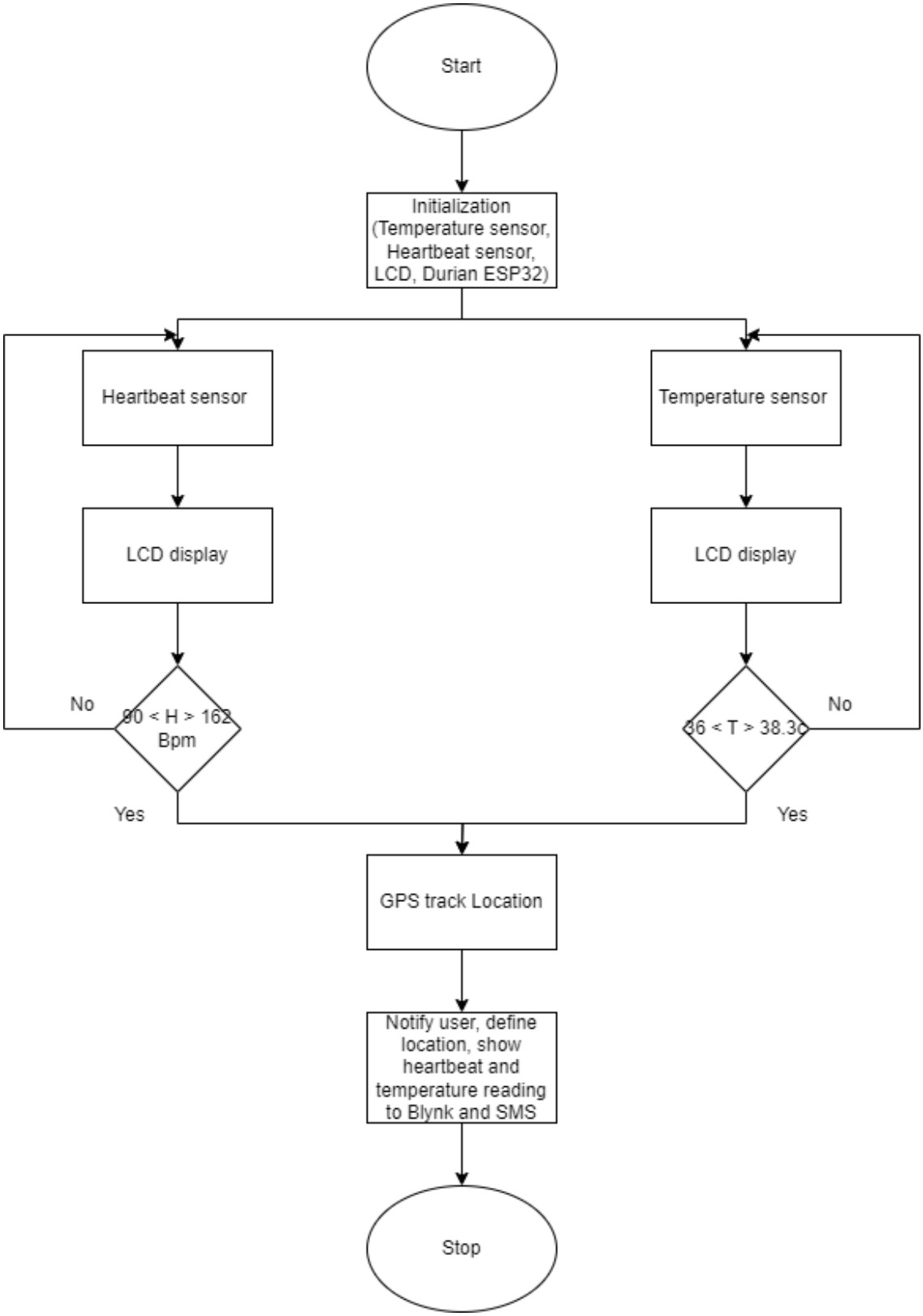


Fig. 2 *Flowchart of the system*

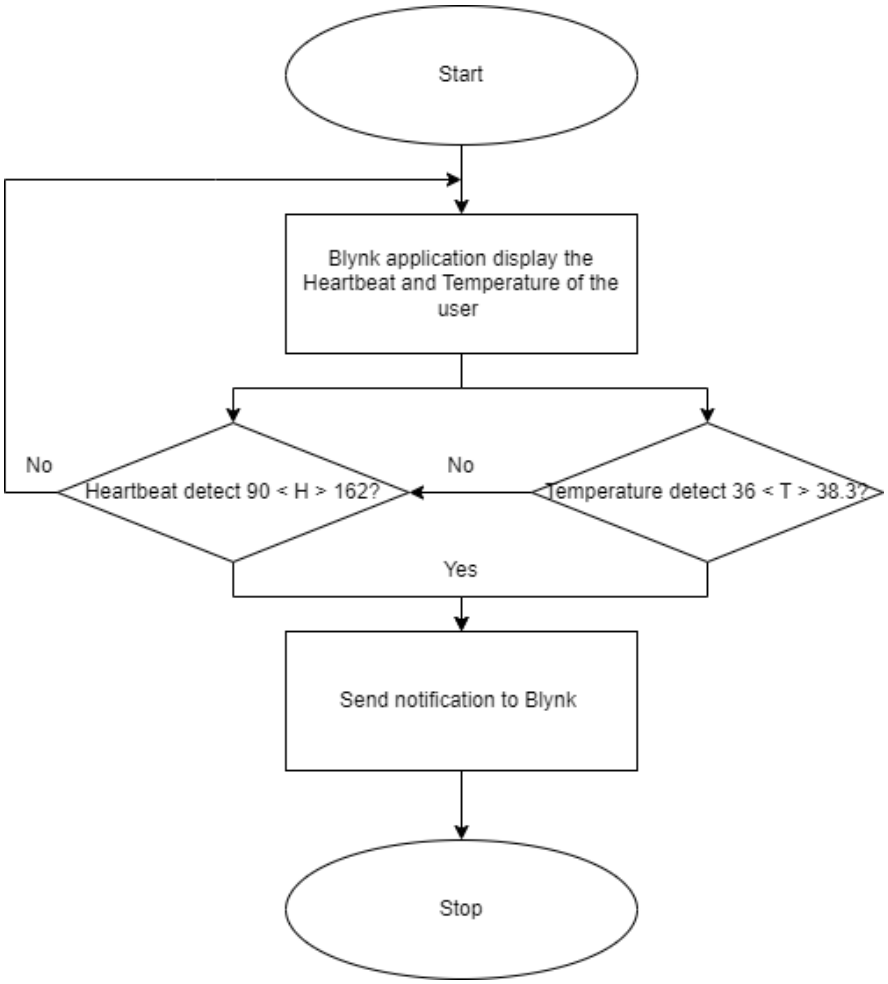


Fig. 3 *Blynk application flowchart*

2.2 Schematic Diagram

All sensor connection is combined in this circuit diagram is shown in Fig. 4.

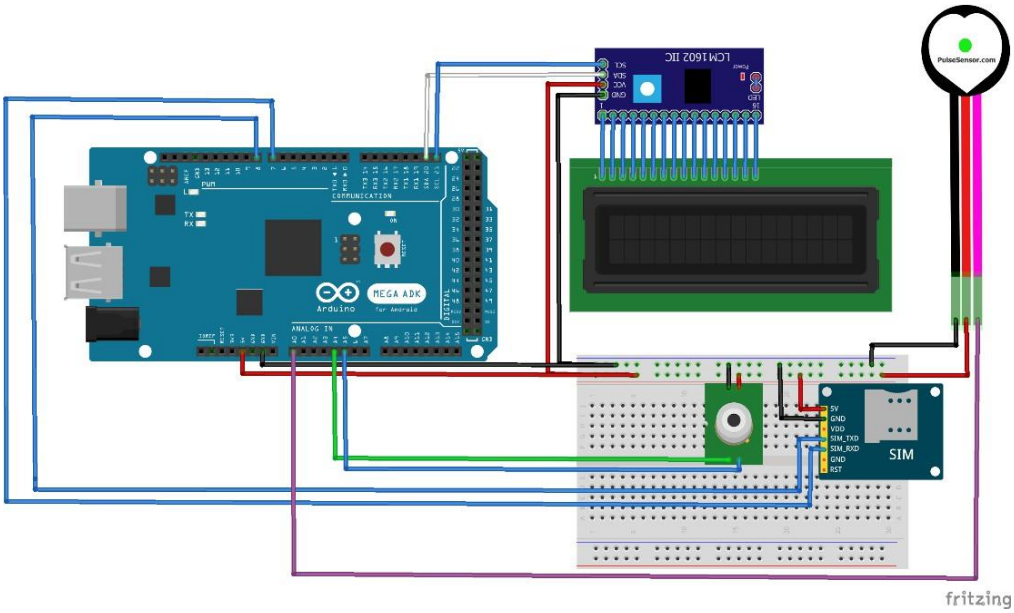


Fig. 4 *Circuit design*

Evolution in Electrical and Electronic Engineering Vol. 6 No. 1 (2025) p. 67-75

3. Result and Discussion

3.1 Power Consumption

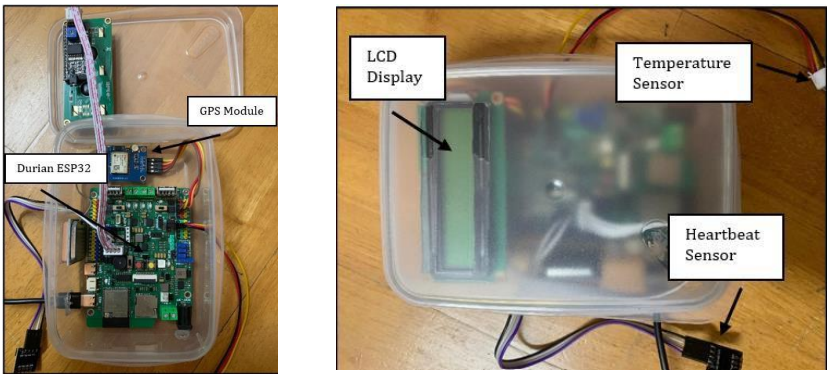
Table 1 shows the current, voltage and power being consumed by the circuit. The system consumes about 1.16 W during operation, with the ESP32 using 0.792 W, the GPS module 0.25 W, and the LCD display 0.1 W. The heart rate and temperature sensors use minimal power at 0.02 W and 0.0003 W, respectively.

Table 1: *Total power consumption*

Component	Quantity	Current needed	Voltage	Power
Flight control GPS module	1	50 mA	5.0 V	0.25 W
Heart rate sensor	1	4 mA	5.0 V	0.02 W
Temperature sensor	1	60 μA	5.0 V	0.0003 W
LCD display 16x2	1	20 mA	5.0 V	0.1 W
Durian ESP32	1	240 mA	3.3 V	0.792 W

3.2 Prototype of System

This prototype shown in both Fig. 5 and 6 is designed to enhance safety and provide real-time health and location monitoring for climbers. It utilizes an ESP32 microcontroller to process data from a heartbeat sensor and a temperature sensor, enabling continuous tracking of vital signs. The system integrates a GPS module for precise location tracking, while a 16x2 I2C LCD display presents the data to the user in a clear format. The heartbeat and temperature data are transmitted through an analog-to-digital interface, with alerts triggered for abnormal values. Powered by a 5V 3A source, the components, including the sensors, LCD display, and communication modules, are connected through properly soldered strip board connections. This setup ensures reliable and accurate monitoring of climber health and location, greatly improving safety and rescue efficiency in mountainous environments



(a) **(b)**

Fig. 5 *Circuit connection (a) open view (b) enclosed view*

Fig. 6 *Prototype of project*

3.3 Testing and Setup

During the test, the performance of the system is evaluated by observing the accuracy of the sensor readings, the stability of data transmission to the Blynk app, and the responsiveness of the alert mechanisms as shown in Fig. 7. The test determines if the project operates smoothly or encounters any errors, such as inaccuracies in health data, delays in GPS updates, or connectivity issues in remote areas. Any identified errors are documented, and adjustments are made to optimize the system reliability and functionality in the challenging hiking environment. Moreover, Table 2 shows the important data obtained from the system including its performance measurement.

(a) **(b)**

Fig. 7 *360-degree view*

Table 2: *Observed different level of user*

User	Age	Experience level	Test environment	Use case	System performance	Issues/Observations
A	24	Expert	High-altitude	Monitored heart rate and temperature during a 1-hour hike.	System worked smoothly	No issues
B	24	Expert	High-altitude	Monitored heart rate and temperature during a 1-hour hike.	System worked smoothly	No issues
C	24	Beginner	High-altitude	Monitored heart rate and temperature during a 1-hour hike.	System worked smoothly	User has medium temperature reading and high heart rate
D	24	Beginner	High-altitude	Monitored heart rate and temperature during a 1-hour hike.	System worked smoothly	User has high temperature reading and high heart rate
E	24	Beginner	High-altitude	Monitored heart rate and temperature during a 1-hour hike.	System worked smoothly	User has more high temperature reading and high heart rate

3.4 Blynk Mobile Application System

The Blynk application is central to the Smart Mountain Climber System, providing a user-friendly dashboard for real-time health and location monitoring. The interface shown in Fig. 8 includes gauges for heart rate, body

Evolution in Electrical and Electronic Engineering Vol. 6 No. 1 (2025) p. 67-75

temperature, and SPO2, alongside GPS data with latitude and longitude for tracking. Sensors transmit data to the Blynk platform via virtual pins, enabling seamless updates. Alerts are triggered when health metrics exceed thresholds, while the climber's location is updated in real time on a map. Users can manage devices, configure notifications, and ensure reliable monitoring, enhancing safety and emergency response in remote environments as shown in Fig. 9.

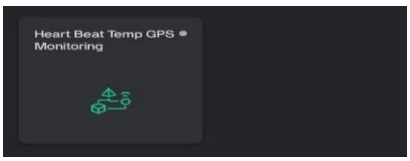


Fig. 8 *Developer zone for user application interface*

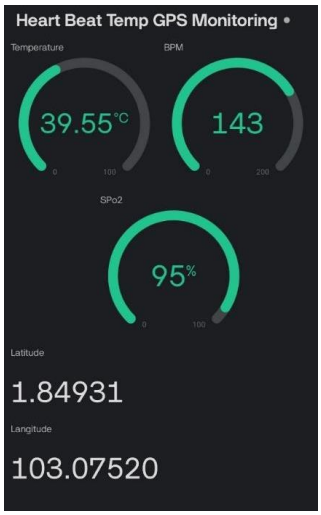


Fig. 9 *Mobile application interface*

Fig. 10 shows the LCD displays the climber real-time health status. If the heart rate remains between 90 BPM and 162 BPM and the temperature stays within 36°C to 38.3°C, the system considers the condition normal, and no notifications are triggered. For instance, the displayed values of "Temp: 38.3°C, BPM: 116, SPO2: 94%" indicate normal conditions as the heart rate and temperature fall within the acceptable range, ensuring the climber health is stable.

Fig. 11 shows the Blynk application displays real-time health metrics, including temperature, heart rate, and SpO2 levels, alongside GPS coordinates. When the heart rate falls within 90–162 BPM and the temperature is between 36°C and 38.3°C, the system identifies the condition as normal. For instance, the current display shows a temperature of 36.43°C, a heart rate of 102 BPM, and SpO2 at 94%, which are all within the normal range. No alerts are triggered, ensuring the climber health status is stable and safe. Fig. 12 shows The LCD showing a heart rate (BPM) of 172 and a temperature of 35.9°C. These readings fall outside the safe range, with the heart rate being significantly over 162 BPM and the temperature dropping below 36°C. This indicates a severe health issue requiring immediate intervention. The system alert ensures the user or support team is notified promptly to take necessary action.

Fig. 10 *Interface from LCD in normal*

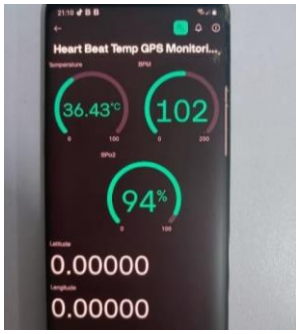


Fig. 11 *Interface from Blynk in normal*

The Blynk application indicates an abnormal health condition with a notification displaying "Abnormal BPM 34 Detected" shows in Fig. 13. The heart rate is critically low at 36 BPM, far below the minimum threshold of 90 BPM, and the temperature is also dangerously low at 31.43°C, below the minimum safe range of 36°C. These readings suggest a serious health issue that requires immediate attention. The system effectively alerts the user and connected devices, ensuring prompt action to address the climber critical condition.

Fig. 14 shows the SMS is sent from Blynk in case of danger, such as abnormal heart rate or temperature, the Blynk system sends an SMS notification with the following message "Alert Abnormal Heart Rate or Temperature Detected! Current BPM below range, Temperature below or over range. Immediate attention is required. This message is sent to the predefined emergency contact, ensuring prompt action is taken for the safety of the climber.

Fig. 12 *Interface from LCD in not normal*

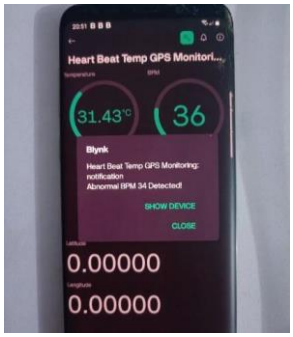


Fig. 13 *Interface from Blynk in not normal*

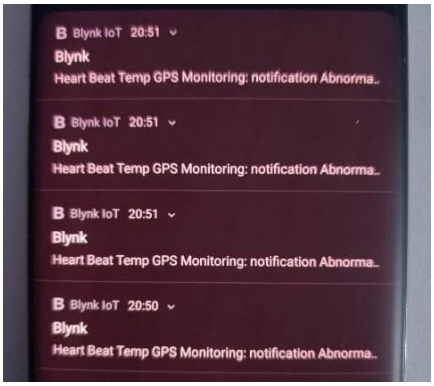


Fig. 14 *Interface of SMS is sent from Blynk*

4. Conclusion

In conclusion, the developed mountain climber system significantly enhances safety and health monitoring for outdoor enthusiasts. The primary objective of providing real-time health data display and remote communication was accomplished. The system also includes a mobile application that notifies users of critical health changes and provides GPS tracking for better safety management. This project is crucial for future outdoor adventures, promising to reduce risks, improve emergency response times, and enhance overall safety for mountain climbers. The system real-time capabilities and automation features are pivotal in ensuring climber well-being and providing peace of mind during their expeditions.

Acknowledgement

The authors would like to thank Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for facilities provided during this project.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception, design, data analysis and manuscript preparation:*** *Nur Amirul Farhan Baharudin;* ***manuscript verification:*** *Muhammad Anas Razali. All authors reviewed the results and approved the final version of the manuscript.*

References

[1] V. R. Parihar, A. Y. Tonge, and P. D. Ganorkar, "Heartbeat and Temperature Monitoring System for Remote Patients using Arduino," *International Journal of Advanced Engineering Research and Science*, vol. 4, no. 5, pp. 55–58, 2017, doi: 10.22161/ijaers.4.5.10.

[2] M. Udin Harun Al Rasyid, S. Sukaridhoto, A. Sudarsono, A. N. Kaffah, and M. Udin Harun Al Rasyid, "Design and Implementation of Hypothermia Symptoms Early Detection with Smart Jacket Based on Wireless Body Area Network," *IEEE Access*, vol. 8, pp. 155260–155274, 2020, doi: 10.1109/ACCESS.2020.3018793.

[3] K. Satyanarayana, A. D. Sarma, J. Sravan, M. Malini, and G. Venkateswarlu, "GPS and GPRS Based Telemonitoring System for Emergency Patient Transportation," *J Med Eng*, vol. 2013, pp. 1–9, Dec. 2013, doi: 10.1155/2013/363508.

[4] J. Jalinas, W. Kusuma Raharja, and B. Putra Emas Wijaya, "Design of Monitoring Tool Heartbeat Rate and Human Body Temperature Based on WEB," in *MATEC Web of Conferences*, EDP Sciences, Apr. 2018. doi: 10.1051/matecconf/201816401017.

[5] T. Suryani Sollu, M. Bachtiar, and B. Bontong, "Monitoring System Heartbeat and Body Temperature Using Raspberry Pi", doi: 10.1051/e3sconf/201873.

[6] I. R. KUMARI and S. DV, "Automatic Life Saving System Using GSM And GPS Technology," *International Journal Of Electronics & Communication Engineering & Technology*, vol. 10, no. 2, Mar. 2019, doi: 10.34218/IJECET.10.2.2019.001.

[7] S. Mahmud, M. Alam, J. Abedin, and S. Roy, "A GSM Based Intelligent Wireless Mobile Patient Monitoring System." [Online]. Available: http://www.ijret.org

[8] A. Bhosikar, R. Bhure, and Prof. S. Nikam, "Heartbeat and Temperature Monitoring System," *Int J Res Appl Sci Eng Technol*, vol. 10, no. 8, pp. 1571–1575, Aug. 2022, doi: 10.22214/ijraset.2022.46454.

[9] R. K. Garg, J. Bhola, and S. K. Soni, "Healthcare monitoring of mountaineers by low power Wireless Sensor Networks," *Inform Med Unlocked*, vol. 27, Jan. 2021, doi: 10.1016/j.imu.2021.100775.

[10] "Heart and Temperature Monitoring Design and Testing Over the Internet," *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 11, no. 1, pp. 1–3, Feb. 2022, doi: 10.30534/ijatcse/2022/011112022.

[11] R. R. Adiputra, S. Hadiyoso, and Y. Sun Hariyani, "Internet of things: Low cost and wearable SpO2 device for health monitoring," Apr. 01, 2018, *Institute of Advanced Engineering and Science*. doi: 10.11591/ijece.v8i2.pp939-945.

[12] "Development of a sensor-based heartbeat rate and body temperature monitoring system for remote chronic patients," Nelson Mandela African Institution of Science and Technology, Arusha, 2021. doi: 10.58694/20.500.12479/1605.

[13] D. Duncker *et al.*, "Smart wearables for cardiac monitoring—real-world use beyond atrial fibrillation," Apr. 01, 2021, *MDPI AG*. doi: 10.3390/s21072539.