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Visual Health Track Monitor: An IoT-Enabled Remote Vital Sign Monitoring System

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Abstract

During the COVID-19 pandemic, the need for remote patient monitoring became critical due to hospital overcrowding and the high risk of infection transmission. This study presents the design and implementation of the Visual Health Track Monitor, an Internet of Things (IoT)-based biomedical device developed to enable contactless, continuous monitoring of vital signs including oxygen saturation (SpO_2), body temperature, and pulse rate. The system integrates the MAX30100 and MLX90614 sensors with an Arduino Uno microcontroller, an OLED display, and an HC-05 Bluetooth module to transmit real-time health data to a mobile application. Alerts are generated automatically in response to abnormal readings, enabling timely medical intervention. The proposed device enhances telemedicine infrastructure and addresses key limitations in conventional patient monitoring by minimizing direct contact while ensuring accurate physiological assessment.

Keywords: Remote Health Monitoring; IoT; Arduino Uno; SpO_2; Pulse Rate; Body Temperature; MAX30100; MLX90614; HC-05; Telemedicine; Mobile Application

1. Introduction

The COVID-19 pandemic highlighted critical gaps in healthcare infrastructure, particularly in the ability to monitor patients remotely during periods of quarantine. A substantial number of individuals were required to isolate at home due to limited hospital capacity, making it difficult for healthcare professionals to consistently monitor patients in need [1, 2]. Furthermore, the potential for infection transmission posed a significant risk to both medical personnel and other patients, underscoring the need for contactless monitoring solutions. To address these challenges, the *Visual Health Track Monitor* was developed to enable continuous, remote observation of key vital signs—blood oxygen saturation (SpO_2), body temperature, and pulse rate. By reducing direct exposure, the system supports timely medical intervention. The device employs an IoT-based approach, integrating MAX30100 and MLX90614 sensors, an Arduino Uno microcontroller, and an HC-05 Bluetooth module for wireless data transmission to a mobile application. Data are displayed locally on an OLED screen and stored in the application's database for further analysis. Automated alerts are generated when readings deviate from normal ranges, expediting clinical response. By minimizing contact while maintaining reliable monitoring, the Visual Health Track Monitor addresses the limitations of conventional systems and advances the scope of telemedicine [3].

2. Materials and Methods

The Visual Health Track Monitor is designed to facilitate contactless, continuous, and remote monitoring of vital health parameters. This section elaborates on the system architecture, hardware and software components, and operational flow, with visual illustrations supporting each stage of the device development and implementation.

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2.1. System Architecture

The system architecture centers on an Arduino Uno microcontroller, which acts as the processing unit, interfacing with all sensors, display modules, and communication components [4]. Users initiate measurements by placing a finger on the sensor, enabling the MAX30100 to capture heart rate and SpO_2, and the MLX90614 to record body temperature without contact [5–8]. Processed data are displayed on a local OLED screen and transmitted via the HC-05 Bluetooth module to a mobile application [9]. The application logs, visualizes, and forwards readings to a hospital server for remote access by medical personnel, as illustrated in Figure 1.

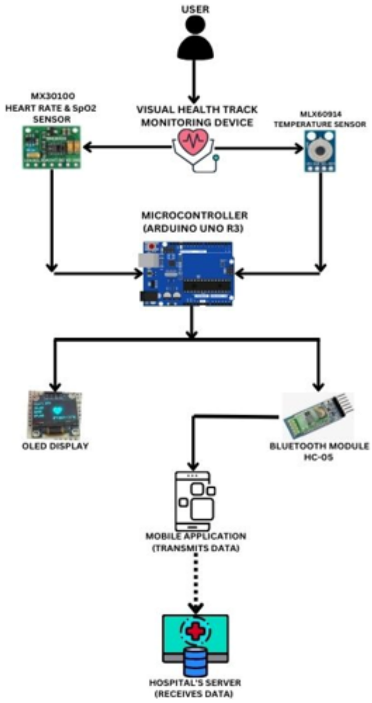


Figure 1: System architecture showing data flow from user to hospital server via mobile application.

2.2. Hardware Integration

The internal wiring of the device demonstrates the integration of sensors, microcontroller, display, and communication modules. Each component is powered via the Arduino Uno's voltage lines, with communication established through I2C for the OLED display and sensors, and serial communication for the Bluetooth module. This connectivity is shown in Figure 2.

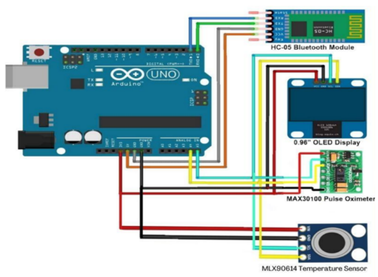
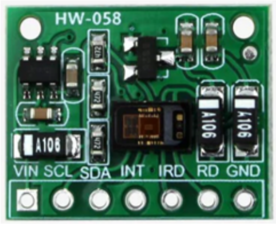


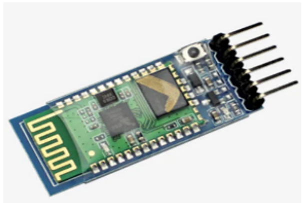
Figure 2: Internal circuit diagram illustrating connections between Arduino Uno and all system modules.

The assembled system comprises five core components (Figure 3): the MAX30100 sensor, which simultaneously measures pulse and blood oxygen using photoplethysmography; the MLX90614 sensor, which provides non-contact, infrared-based body temperature measurements; the HC-05 module for Bluetooth communication; an Arduino Uno for data acquisition and control; and an OLED display for immediate visual feedback. Each module is powered through the Arduino and connected using standard communication protocols to ensure seamless integration.



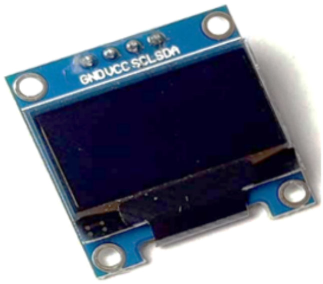
(a) MAX30100

(b) MLX90614



(c) HC-05 Bluetooth

(d) Arduino Uno



(e) OLED Display

Figure 3: Hardware components of the Visual Health Track Monitor.

2.3. Mobile Application

The mobile application, branded as “Vital Track,” facilitates seamless communication between the device and medical providers. As shown in Figure 4, the application interface allows users to connect via Bluetooth, start measurements, and access logged health data. Alerts are generated automatically if vital signs exceed predetermined thresholds, ensuring timely interventions.

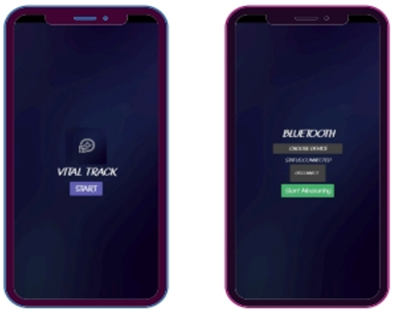


Figure 4: Mobile application interface displaying health parameters and Bluetooth connectivity.

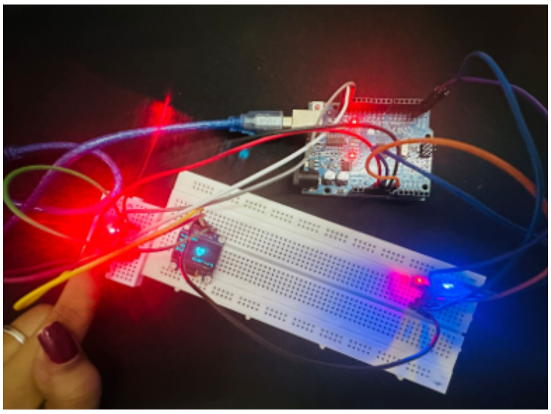
2.4. Operational Workflow

The user initiates data collection by placing a finger on the sensor module. The MAX30100 records heart rate and SpO_2, while the MLX90614 captures body temperature. The Arduino processes these inputs and transmits them via the HC-05 module to the mobile app. Simultaneously, results are displayed on the OLED screen for immediate user feedback. Historical data are stored in the application’s database for retrospective analysis. This integrated system allows health professionals to access critical physiological information remotely and promptly, reducing risk to both patients and caregivers, and making it a robust tool in pandemic and telemedicine scenarios.

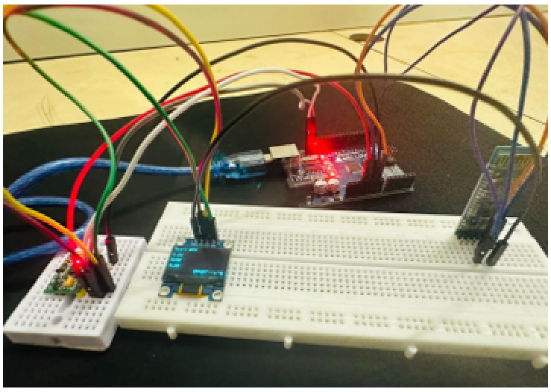
3. Results and Discussion

The Visual Health Track Monitor was successfully implemented and tested on multiple volunteers to assess its real-time monitoring capability. The system reliably measured SpO_2, heart rate, and body temperature simultaneously using the integrated MAX30100 and MLX90614 sensors. Upon placement of the finger on the sensor module, the LEDs on the MAX30100 activated, indicating active sensing. The assembled prototype, consisting of the Arduino Uno, OLED display, Bluetooth module, and sensors, visualized the vitals on the OLED screen and transmitted them wirelessly to the mobile application with minimal latency.

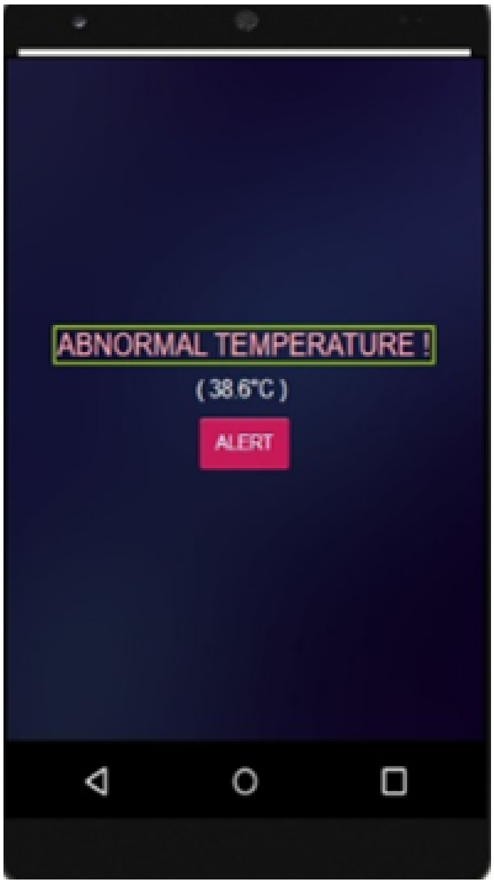
The setup demonstrated stability under typical indoor lighting conditions and produced measurements comparable to clinical instruments. The mobile application effectively received sensor data without interruption and displayed alerts in real time when abnormal values were detected. For instance, when a body temperature reading exceeded 38°C, the system automatically triggered a notification, enhancing the responsiveness of remote monitoring. The testing process and observed outcomes are illustrated in Figure 5.



(a) Sensor activation upon finger placement.



(b) Display and transmission of sensor data.



(c) Mobile alert indicating abnormal body temperature.

Figure 5: Prototype testing and validation.

The integrated alert system significantly enhances remote monitoring by instantly notifying healthcare providers of critical deviations, which is particularly valuable in pandemic situations where rapid intervention is required, and contact must be minimized. The compact hardware design (Figures 3 and 2) effectively consolidates sensing, processing, and wireless transmission in a single platform, ensuring robust and responsive operation. Some limitations were noted: an initial factory flaw in the MAX30100 sensor required manual PCB modification, and the current prototype's exposed wiring prevents it from being wearable. Nevertheless, the system reliably delivers continuous, wireless monitoring and data storage in a user-friendly format. Its compatibility with hospital servers (Figure 1) positions it well for broader telemedicine integration. The OLED output (Figure 3e) supports immediate local assessment, and archived data enable trend analysis and long-term patient monitoring. Future development may incorporate artificial intelligence for automated diagnosis or predictive health modeling based on accumulated data. In summary, results confirm that the Visual Health Track Monitor offers a practical, cost-effective solution for remote health monitoring in contexts requiring minimal physical contact or continuous supervision.

4. Conclusion

The Visual Health Track Monitor demonstrated the capability to remotely and continuously monitor critical vital signs such as SpO_2, pulse rate, and body temperature. By integrating sensor technology with microcontroller-based processing and wireless communication, the system effectively minimized the need for direct contact between healthcare professionals and patients—an essential feature during infectious disease outbreaks. The prototype was validated through multiple trials and consistently delivered real-time, accurate measurements comparable to clinical devices. Its ability to transmit data to a mobile application and generate alerts in response to abnormal health parameters enhances its utility for early detection and timely intervention. While the current design is limited by form factor constraints and non-wearable architecture, it establishes a functional foundation for scalable health telemetry systems.

With future integration of artificial intelligence, the system could support predictive analytics and personalized health insights based on historical trends. Overall, the device underscores the importance of IoT-enabled biomedical monitoring in strengthening telemedicine frameworks and improving healthcare accessibility in resource-constrained settings.

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Declaration of Competing Interests

The authors declare no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author Contributions

Janani V.L.: Conceptualization, Mobile Application Design, Writing – Review and Editing; **Hansica B.S.**: Methodology, Circuit Design, Writing – Original Draft; **Kiruthika V.**: Sensor Integration, Testing, Data Validation; **Kanishga B.**: Hardware Setup, Visualization, Investigation; **T. Manikandan**: Supervision, Technical Guidance, Resources, Final Review.

References

[1] J. L. Wu, A. Jayaraman, and R. D. Norris, "Wearable health monitoring systems: A review," *IEEE Transactions on Biomedical Engineering*, vol. 67, no. 12, pp. 3421–3432, 2020.

[2] A. N. Rodriguez, J. G. Chen, and J. A. Smith, "The role of iot in healthcare: A review," *Journal of Healthcare Engineering*, vol. 2019, p. Article ID 4521783, 2019.

[3] D. L. Zhang, X. F. Li, and Q. W. Liu, "Development of a wireless health monitoring system based on iot," *Journal of Medical Systems*, vol. 43, no. 4, pp. 78–87, 2019.

[4] A. Khalifeh, F. Mazunga, A. Nechibvute, B. M. Nyambo, *et al.*, "Microcontroller unit-based wireless sensor network nodes: A review," *Sensors*, vol. 22, no. 22, p. 8937, 2022.

[5] J. Wan, Y. Zou, Y. Li, and J. Wang, "Reflective type blood oxygen saturation detection system based on max30100," in *2017 International Conference on Security, Pattern Analysis, and Cybernetics (SPAC)*, pp. 615–619, IEEE, 2017.

[6] Y. Yusoff, M. Morsin, Y. Saidun, and M. H. Dahri, "A study on the development of a heart rate monitoring system to determine its accuracy and effectiveness," *International Journal Of Technical Vocational And Engineering Technology*, vol. 5, no. 2, pp. 11–21, 2024.

[7] S. Costanzo and A. Flores, "A non-contact integrated body-ambient temperature sensors platform to contrast covid-19," *Electronics*, vol. 9, no. 10, p. 1658, 2020.

[8] P. W. Rusimamto, R. Harimurti, Y. Anistyasari, L. Anifah, *et al.*, "Design and implementation of thermal body system employing thermal sensor mlx 90614 for covid-19 symptoms early detector," in *International Joint Conference on Science and Engineering (IJCSE 2020)*, pp. 317–321, Atlantis Press, 2020.

[9] G. N. Mori and P. R. Swaminarayan, "Measuring iot security issues and control home lighting system by android application using arduino uno and hc-05 bluetooth module," in *Data Science and Intelligent Applications: Proceedings of ICDSIA 2020*, pp. 375–382, Springer, 2020.