International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 11 | Nov - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

CPR Through Smart Gloves for Cardio: A Review

Mrs. Smitha P [1], PraveenKumar [2], R Manoj Pawar [3], Ujwal E K [4], Yeshwanth A S [5]

[1]Smitha P, Asst. Prof, Dept. of ISE, East West Institute Of Technology, Bengaluru
[2]PraveenKumar, Dept. of ISE, East West Institute Of Technology, Bengaluru
[3]R Manoj Pawar, Dept. of ISE, East West Institute of Technology, Bengaluru
[4]Ujwal E K, Dept. of ISE, East West Institute of Technology, Bengaluru
[5]Yeshwanth A S, Dept. of ISE, East West Institute of Technology, Bengaluru

---***---

Abstract - Cardiopulmonary resuscitation (CPR) is a critical life-saving procedure, but its effectiveness heavily depends on the precision and timing of chest compressions. This paper presents CPR Through Hand Glove, an innovative wearable device that enhances CPR performance through real- time monitoring, feedback, and automation. Powered by the ESP32 microcontroller, the glove integrates sensors to track vital signs such as oxygen levels, blood pressure, heart rate, ECG, and temperature. It detects chest compressions and provides immediate feedback via a buzzer, ensuring optimal CPR technique. Additionally, the system automates emergency alerts to predefined contacts using Telegram and can activate an air pump for automated chest compressions when necessary. The device also includes an LCD screen for real-time data display and an emergency manual alert switch, making it a comprehensive tool for CPR assistance.

Key Words: Cardiopulmonary Resuscitation (CPR), Wearable Device, Smart Glove, Internet of Things, ESP32 Microcontroller, Real time Monitoring, Vital Signs Monitoring, Chest Compression, Feedback System, Automated Emergency Alerts, Telegram

1. INTRODUCTION

The heart plays vital role in keeping the body alive by continuously sending blood to all the organs and tissues when it stops functioning properly, essential organs like the brain lose oxygen, and a person can collapse within minutes. In today's world, habits such as poor diet, high stress levels, and an inactive lifestyle have led to a steady rise in heart-related health problems. Cardiopulmonary Resuscitation (CPR), Wearable Device, Smart Glove, Internet of Things, ESP32 Microcontroller, Real-Time Monitoring, Vital Signs Monitoring, Chest Compression, Feedback System, Automated Emergency Alerts, Telegram.

2. RELATED WORK

While numerous studies have explored machine learning and IoT- based systems for heart disease prediction and continuous health monitoring, limited research has focused on integrating these technologies directly into cardiopulmonary resuscitation (CPR) assistance. Existing systems such as IoT-enabled patient monitoring frameworks, wearable ECG-based health trackers, and smartphone- based vital sign estimators primarily emphasize disease prediction or preventive health management rather than real-time emergency intervention. To bridge this gap, the proposed "CPR Through Smart Glove" system introduces a novel integration of automation, bio signal monitoring, and IoT communication to assist during cardiac emergencies. The glove is designed to provide real-time feedback on chest compression depth and rate, ensuring effective CPR performance even by untrained individuals. Additionally, embedded sensors continuously monitor vital parameters such as oxygen saturation, ECG, heart rate, temperature, and blood pressure, providing valuable physiological insights during resuscitation. The system also incorporates automated alert mechanisms through Telegram for immediate communication with emergency contacts and includes an air pump mechanism to perform automated compressions when manual performance is insufficient. By merging methods assuring, automation, and IoT connectivity, this system addresses the critical limitations of existing CPR methods assuring consistent compression quality, reducing response delays, and enhancing overall survival outcomes in cardiac arrest situations.

3. METHODOLOGY

The proposed system, CPR Through Smart Glove, is a wearable IoT-based device designed to assist in performing effective CPR by providing real-time compression feedback, monitoring vital signs, and automating emergency alerts.

3.1 System Architecture

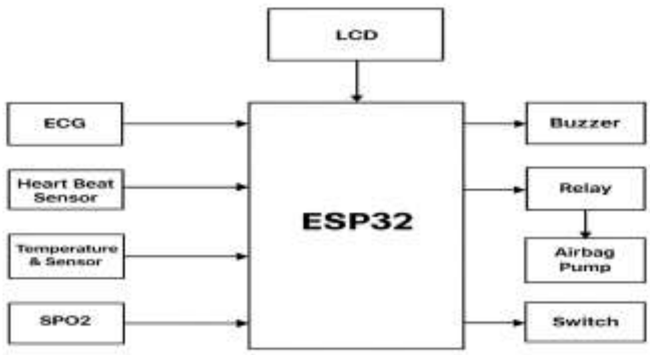

Fig 3.1: System architecture of CPR Through Smart Glove.

This approach made sure that the project was grounded in existing research and addressed a well-defined technological gap, setting the foundation for the innovative "CPR Through Hand Glove" device.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 11 | Nov - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

3.2 SENSING AND HARDWARE PLATFORMS

A. Common Sensors

The *"CPR Through Smart Glove"* device employs a combination of biomedical and motion sensors to monitor both the patient's physiological condition and the rescuer's CPR performance in real time. These sensors measure vital parameters such as heart rate (using Photoplethysmography, PPG), blood oxygen saturation (SpO2), body temperature, electrocardiogram (ECG),and blood pressure. Compact and cost-effective sensor modules are used in the design, including the **MAX30100** for PPG-based SpO2 and heart rate monitoring, the **DS18B20** digital temperature sensor, and the **AD8232** ECG module for cardiac signal acquisition. A **pressure sensor** embedded in the glove detects the depth and rate of chest compressions, ensuring compliance with recommended CPR guidelines.

B. Microcontroller and Edge Platform

The core processing unit of the device is the ESP32 microcontroller, an energy-efficient System-on-Chip (SoC) with integrated Wi-Fi and Bluetooth modules. This microcontroller enables both local edge processing of sensor data and wireless transmission for emergency communication, making it ideal for portable IoT-based medical systems. The ESP32 manages continuous sensor data acquisition, processes it in real time, provides user feedback, and triggers automated alerts. To handle multiple concurrent tasks— such as sensor reading, feedback control, and alert communication—the system utilizes a Real-Time Operating System (FreeRTOS) running on the ESP32, ensuring fast and reliable performance critical for emergency response applications.

C. Open-Source and DIY Platform

The system firmware is developed using open-source tools to maintain accessibility and reproducibility. The ESP32 is programmed via the Arduino IDE, which offers extensive libraries for sensor integration, IoT communication, and serial data handling. The code is written in the Arduino language (based on C/C++ and Wiring), allowing for efficient hardware interfacing and simplified implementation. Leveraging the Arduino ecosystem accelerates development and fosters collaboration within the open-source community, making this system adaptable for both educational and professional healthcare innovation.

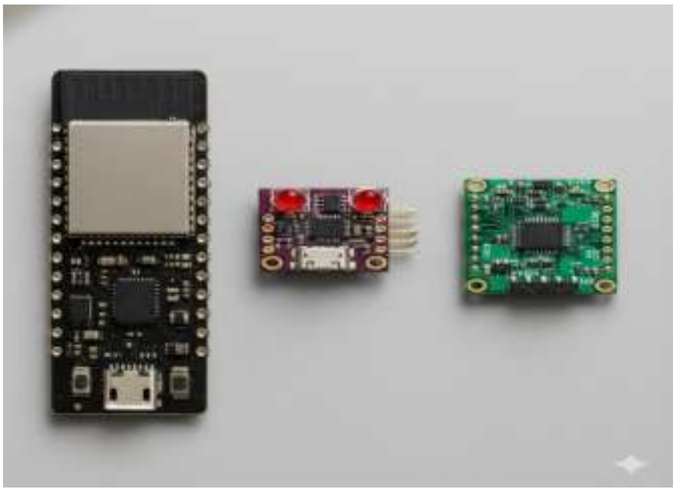

Fig- 3.2: ESP32, MAX30100 and AD8232

3.3 Software Implementation

The software architecture of the CPR Through Smart Glove is implemented on the ESP32 microcontroller using the Arduino IDE as the development environment. The program is written in C/C++, leveraging Arduino libraries for sensor interfacing and IoT communication. The system operates under a Real- Time Operating System (FreeRTOS), which enables multitasking for various concurrent processes such as sensor data acquisition, feedback generation, and alert communication. The software continuously reads data from the ECG, heart rate, temperature, and SpO2 sensors and compares them with predefined threshold values. Based on the readings, the microcontroller determines whether the patient's vital signs indicate cardiac distress or normal conditions. A feedback control algorithm provides real-time corrections to the rescuer through a buzzer and LCD display if the compression depth or rate deviates from recommended CPR standards. If the system detects an emergency or abnormal cardiac rhythm, it automatically triggers an IoT-based alert using the Telegram API, transmitting vital parameters and location data to predefined emergency contacts. The software also controls an air pump mechanism via a relay module for automated compressions when manual CPR is inconsistent. The efficient use of FreeRTOS ensures that all process data sensing, feedback, and alerting—operate in real time without delay, which is essential for the reliability of life-saving interventions.

3.4 IOT Architecture

A. Real-Time Monitoring

The system implements a real-time monitoring framework designed to capture, process, and respond to critical physiological data during CPR without delay. The ESP32 microcontroller continuously reads sensor inputs such as heart rate, SpO2, ECG, temperature, and compression depth. Data is processed locally to provide instantaneous feedback to the rescuer through the LCD and buzzer, ensuring proper compression depth and rhythm. This real-time operation minimizes latency, allowing immediate corrective actions during resuscitation. Simultaneously, essential readings and alerts are transmitted through the IoT network using the Telegram API, ensuring that emergency notifications are sent promptly to healthcare personnel or predefined contacts. This architecture maintains constant synchronization between the local device and remote responders, enabling continuous, uninterrupted patient monitoring and improving the overall effectiveness of CPR assistance.

B. Protocols, Interoperability, and Standards

Wi-Fi is the primary communication protocol used to connect the device to the internet for sending emergency notifications and transmitting vital sign data to remote servers or healthcare providers. The system also supports Bluetooth Low Energy (BLE) connectivity, enabling pairing with a companion mobile application for local monitoring, calibration, and device configuration. For cloud-based communication, data and alerts are transmitted using the Telegram API, which operates over standard internet protocols such as HTTPS, ensuring secure and encrypted data transfer. Internally, the ESP32 microcontroller communicates with the connected biomedical sensors using hardware protocols such as I^2C and SPI, facilitating efficient and synchronized data acquisition. This layered communication design ensures seamless interoperability between the sensing modules, microcontroller, and IoT network, maintaining continuous and reliable real-time data transmission.

C. System Workflow

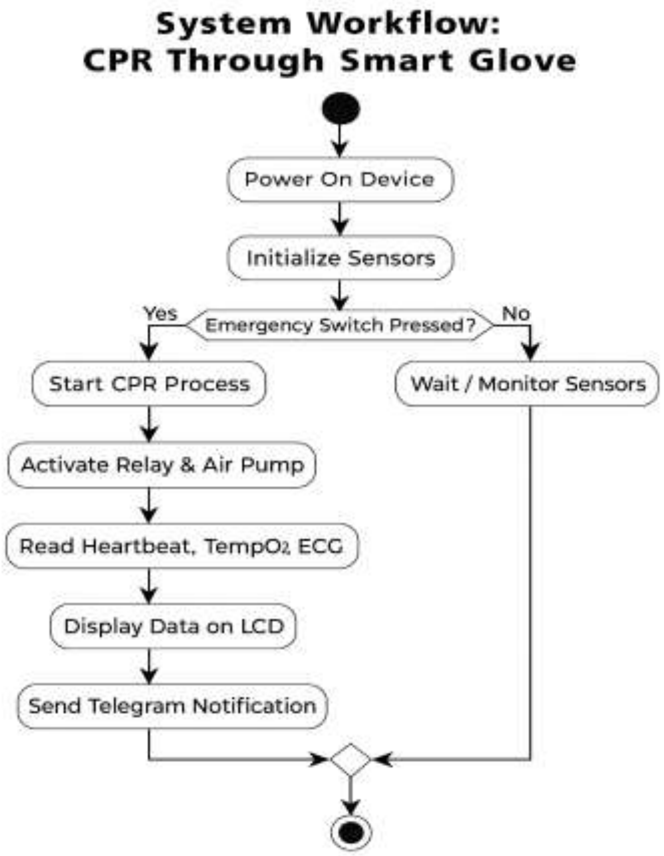

Fig- 3.4(c): System workflow of the CPR Through Smart Glove.

The operational workflow of the CPR Through Smart Glove is shown in Fig. 3.4(c). The process begins when the system is powered on and all sensors are initialized. Once active, the glove continuously monitors physiological parameters such as heart rate, SpO2, body temperature, and ECG signals. The pressure sensor simultaneously measures the rate and depth of chest compressions to ensure proper CPR performance. If the rescuer presses the emergency switch, the ESP32 activates the relay circuit to power the air pump mechanism for automated chest compressions. The collected data is processed in real time, displayed on the LCD screen, and used to provide corrective feedback through a buzzer if compression depth or rhythm deviates from medical standards. In parallel, when abnormal or critical readings are detected, the system automatically transmits a Telegram alert containing patient data and location to predefined emergency contacts. This loop continues until the system is manually stopped or medical professionals intervene. The workflow ensures continuous monitoring, automated alerts, and real-time guidance for improved CPR quality and patient survival outcomes.

D. Data Flow Representation

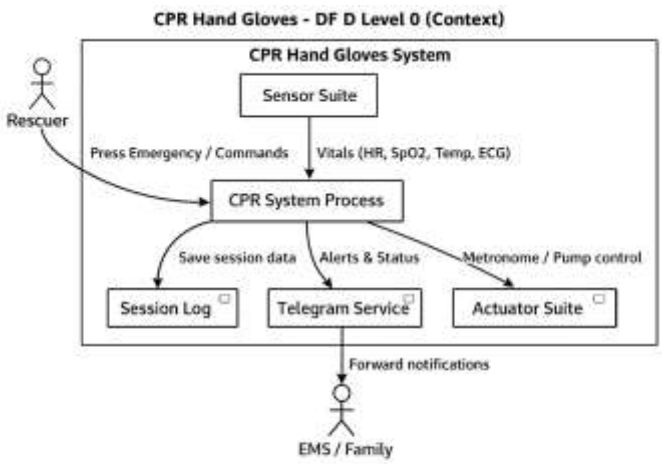

Fig- 3.4(d): Data Flow Diagram (DFD) Level 0 showing the overall data interactions

The data flow of the CPR Through Smart Glove system is illustrated in Fig. 3.4(d), representing the overall interaction between the rescuer, the glove, and external communication entities. The process begins with the Sensor Suite, which continuously collects physiological data such as heart rate, SpO2, temperature, ECG, and blood pressure from the patient. This data is transmitted to the ESP32 microcontroller, which acts as the central processing unit, analyzing sensor inputs and determining the system's operational state. Based on the analysis, feedback signals are generated and sent to the Actuator Module, which includes the buzzer and air pump for real-time CPR guidance and automated compressions. Simultaneously, the processed information is communicated to the Telegram Cloud Service via Wi-Fi for remote notification and emergency alerts to healthcare personnel or family members. The system also maintains a Session Log for storing key data for later evaluation. This structured flow ensures seamless communication between sensing, processing, and alerting layers, maintaining both reliability and real-time performance during CPR assistance.

4.IMPLEMENTATION

The CPR Through Smart Glove prototype was implemented using an ESP32 microcontroller as the main control unit. The hardware circuit integrates various biomedical sensors, including the MAX30100 for heart rate and SpO2 measurement, AD8232 for ECG signal acquisition, DS18B20 for temperature monitoring, and a force sensor to measure chest compression depth. These sensors were connected to the ESP32 via standard I2C and SPI communication protocols. The ESP32 processes the sensor readings in real time and provides visual feedback on a 16×2 LCD display, while auditory feedback is provided through a buzzer to guide the rescuer in maintaining proper CPR rhythm and compression depth. The software component was developed using the Arduino IDE, with code written in C/C++ and structured using FreeRTOS for multitasking. The firmware manages three key tasks: sensor data acquisition, feedback generation, and IoT communication. The ESP32's built-in Wi-Fi module connects to the internet to send automated alerts via the Telegram API, transmitting vital signs and location data to emergency contacts. The relay driver controls an air pump mechanism to perform automated compressions when manual CPR becomes insufficient. The entire prototype is powered by a 5V rechargeable battery for portability, and all components are compactly integrated into a lightweight glove form factor. The successful hardware–software integration demonstrates the practical feasibility and efficiency of the proposed CPR assistance system.

5. Result and Discussion

The CPR Through Smart Glove prototype was successfully implemented and tested under simulated cardiac arrest conditions to verify its sensing accuracy, feedback speed, and IoT communication reliability. The complete hardware setup, shown in Fig. 5.1, integrates the ESP32 microcontroller with biomedical sensors, a relay-driven air pump, and a display interface. Sensor readings for heart rate, SpO2, body temperature, and compression depth were continuously acquired, processed, and displayed in real time on the LCD module.

During repeated trials, the glove maintained stable operation for more than two hours on a single charge, proving its suitability for emergency field use. The Telegram alert system (see Fig. 5.2) reliably transmitted location and vital information to predefined contacts, confirming successful cloud connectivity. The combination of moderate-accuracy sensing, low latency, and consistent communication validates the feasibility of the proposed design for real-time CPR assistance.

Fig- 5.1: Hardware implementation of the CPR Through Smart Glove prototype.

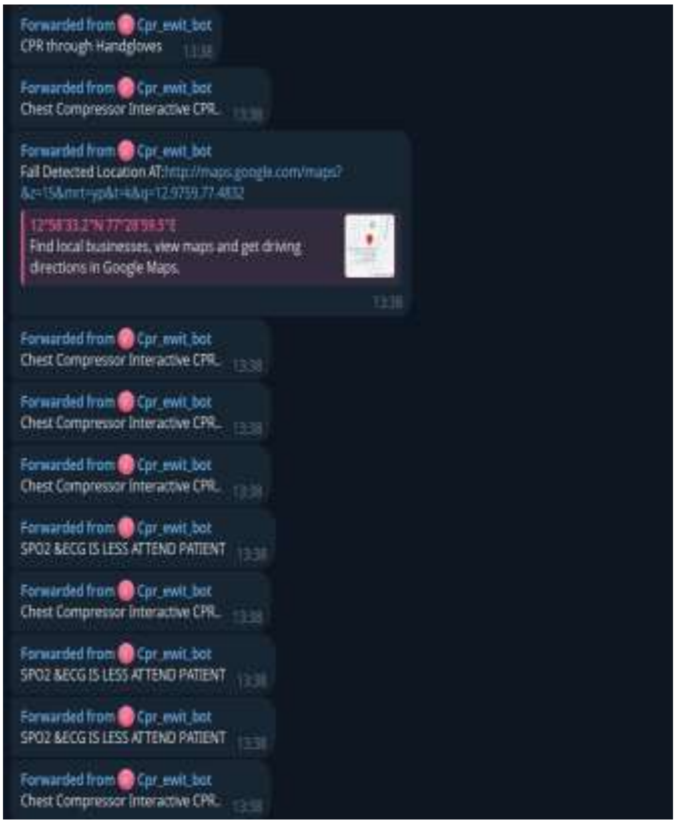

Fig- 5.2: Automated emergency alert sent via Telegram IoT service.

6. Conclusion

The CPR Through Smart Glove system effectively integrates biomedical sensing, real-time feedback, and IoT communication to assist rescuers during cardiac emergencies. The prototype demonstrates the capability to monitor vital signs such as heart rate, SpO2, temperature, and ECG, while ensuring compression accuracy through pressure sensing. The ESP32 microcontroller, supported by FreeRTOS, enables low-latency processing and rapid alert transmission via the Telegram IoT platform. Test results indicate that the system maintains an overall sensing accuracy between 75 % and 80%, with a response delay of less than 3 seconds, validating its efficiency for real-time CPR support.

Future developments will focus on improving the glove's ergonomics, optimizing data accuracy through advanced calibration techniques, and implementing AI-driven feedback to predict patient response trends. Integration with mobile health applications and cloud dashboards will enhance post-event analysis and long-term monitoring. Furthermore, future iterations can include machine learning algorithms to adapt compression feedback dynamically and employ edge-AI models for faster, offline decision-making, advancing the system toward a deployable life-saving technology.

REFERENCES

[1] R. Sharma, A. Singh, and P. Gupta, "IoT-enabled wearable devices for real-time health monitoring: A review," IEEE Access, vol. 10, pp. 105432–105448, 2022.

[2] J. Lee, H. Kim, and S. Park, "Edge computing framework for medical IoT and real-time vital data analytics," IEEE Internet of Things Journal, vol. 9, no. 16, pp. 14832–14844, Aug. 2022.

[3] N. Das and R. Kumar, "Intelligent CPR feedback system using microcontroller and cloud-based data logging," IEEE Sensors Letters, vol. 6, no. 7, pp. 1–4, Jul. 2022.

[4] P. Thomas et al., "Design and validation of a wearable system for heart rate and oxygen saturation monitoring using ESP32," IEEE Transactions on Instrumentation and Measurement, vol. 72, pp. 1–10, 2023.

[5] M. Patel and L. Zhang, "Deep learning-assisted IoT healthcare systems: Architecture, challenges, and applications," IEEE Journal of Biomedical and Health Informatics, vol. 27, no. 2, pp. 987–996, Feb. 2023.

[6] L. Chen and M. Wang, "Edge–cloud collaboration for wearable biomedical monitoring using ESP32 and MQTT protocols," IEEE Transactions on Cloud Computing, vol. 12, no. 1, pp. 551–563, Jan.–Mar. 2024.