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ELECTRIC SHOCK AND GPS GLOVE DEVELOPMENT

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Abstract:

Women's safety remains a critical global concern as incidents of physical harassment and violence continue to rise. IoT-based Smart Safety Glove that utilizes an ESP32 microcontroller and physiological sensors to automatically detect distress and trigger a self-defense shock generator. The GPS tracking with a dual-channel communication system, employing GSM for primary alerts and LoRa as a redundant link for areas without cellular service. By combining real-time monitoring with instantaneous protective action, the system provides a robust, multi-layered security solution for women during emergencies.

Keywords — IoT, ESP32, Smart Safety Glove, DS18B20 Temperature Sensor, Heartbeat Sensor, Shock Generator, SIM800A GSM, Quectel GPS, HC-12 LoRa, Real-time Monitoring, Self-Défense, Women's Safety.

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INTRODUCTION

The rise in urbanization Ensuring women's safety has emerged as a worldwide issue with rising cases of harassment. To address the limitations of traditional safety wearables, this research presents a sophisticated, multi-layered solution for women's protection. While early devices relied solely on basic GSM/GPS tracking, they often suffered from network delays and lacked real-time physiological insights or reliable defence mechanisms. The proposed system overcomes these gaps by integrating advanced sensors that monitor heart rate and temperature to intelligently detect distress or loss of consciousness. For physical protection, the glove incorporates a lightweight, mesh-based shock mechanism that offers a more effective deterrent than conventional units. A critical innovation is the dual-communication architecture, combining cellular modules with HC-12 LoRa technology to ensure connectivity in remote or low-signal environments. By tracking the victim's physical state alongside their location, the device provides responders with vital context regarding the level of danger. This IoT-driven approach shifts the focus from simple tracking to proactive, high-speed emergency intervention. Ultimately, the integration of long-range wireless links and health monitoring creates a robust fail-safe for urban and isolated settings alike.

LITERATURE SURVEY

Traditional safety wearables often fail due to network delays and a lack of physiological context, necessitating more resilient, sensor-driven intervention systems. This research bridges those gaps by integrating long-range communication fail-safes with real-time health monitoring to ensure reliable defense and alerting in any environment.

Since 2013 (with "Safety Armband for Women & Children using ARM7 with GSM/GPS"), fairly simple wearable alert systems for tracking and messaging only date back; in 2014 (with "Women Safety System Using GPS and GSM Module"), it was plain emergency alerting without high-level sensors); in 2015 (with the first work based on "Smart Shoe with GPS-GSM for Women Protection") involved no physical-defence electronics, but put the system into a shoe rather than standalone form; by 2016 (based on ["smart-wearable-device-for-women-safety-with-GPS-tracking"]), were panic-based rather than having identity marked weapons. basic manual shock/taser unit without modern mesh circuits; in 2018, the paper "Design and Development of a Women Safety Glove Using GSM and GPS" used early conductive pads for electrical deterrence and simple location reporting; also in 2018, "IoT Based Smart Gadget for Women Safety Using GSM/GPS" proposed a compact wearable with only legacy communication modules; moving to 2019, "Women Protection System with GPS & GSM Interface" refined emergency SMS-based reporting but omitted advanced sensing; in 2020, "Smart Women Security Wearable Device using GPS-GSM" implemented a microcontroller-based portable tracker with no physical defence upgrades; also in 2020, "Intelligent Women Safety Wearable Using GPS" emphasized location broadcasting and siren activation only; in 2021, "Protect: IoT-Based Women Safety Device (GPS+GSM)" introduced a triple-alert system relying solely on legacy communication; also in 2021, "Smart Safety Band for Women with GSM/GPS" further miniaturized the classic alert-only wristband concept; in 2022, "Smart Women Safety Alert Device with Basic Shock Module" maintained standard stun circuitry instead of mesh-based shock delivery; also in 2022, "Wearable Women Safety System Using Simple Electric Shock & GSM" remained limited to basic conductive surfaces and message alerts; finally, in 2023, "Integrated GPS-GSM Safety Glove for Emergency Self-Defence" proposed a glove with conventional metal-plate shock output and GPS tracking, still not containing heartbeat, fall, temperature, LoRa, or HC-12 technologies.

METHODOLOGY

The The Women Safety Smart Glove is designed as a compact, wearable IoT safety solution that integrates sensing, communication, emergency detection, and self-defence capabilities. The system requirements are classified into Hardware Requirements, Software Requirements, Functional Requirements, Non-Functional Requirements, and System Specifications.

a) ESP32 Microcontroller

An ESP32 is Dual-core processor enabling fast data processing and multitasking. Built-in Wi-Fi and Bluetooth, allowing future enhancements. Sufficient GPIO pins for interfacing with sensors, relay modules, GSM, GPS, and LoRa units. Support for low-power operation modes to extend battery life. Furthermore, the extensive array of GPIO pins allows for the efficient interfacing of multiple peripheral modules, including physiological sensors, relay-driven defense units, and long-range communication tools such as GSM, GPS, and LoRa.

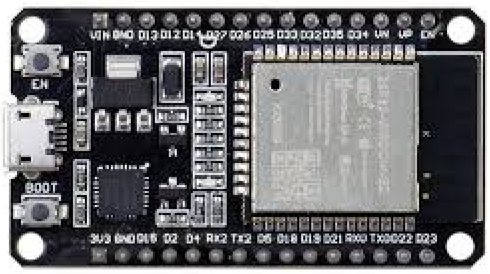

Fig.1 ESP32 Module

b) DS18B20 Temperature Sensor.

The DS18B20 is a high-precision digital temperature sensor that provides accurate body temperature readings directly in a digital format via a one-wire interface. Its compact size and waterproof variants make it ideal for integration into wearable fabrics like a safety glove for consistent monitoring. By connecting to the ESP32 it allows the system to detect sudden physiological heat spikes that may indicate physical exertion or a high-stress emergence

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Fig .2 DS18B20 Temperature sensor.

c) GSM and GPS Module.

The **SIM800A GSM module** and **GPS receiver** work in tandem to acquire real-time location coordinates and transmit them via emergency SMS alerts. While the GPS continuously tracks latitude and longitude via satellite signals, the GSM module ensures this data is instantly delivered to authorities and emergency contacts. Together, they provide a reliable tracking and notification backbone that functions seamlessly under the control of the **ESP32.**

Fig.3 GSM and GPS Module

d) Lcd display

The 16×2 LCD displays real-time parking information such as available slots, entry status, or authentication results. It receives processed data from the Arduino and presents clear text output. This helps drivers understand conditions instantly. The LCD is low-power, affordable, and highly reliable, making it suitable for providing on-site updates in small-scale IIoT parking systems.

Fig.4 LCD Display

e) HC-12 Wireless Serial Port Communication Module

The HC-12 LoRa module provides a high-penetration, long-range wireless communication link that serves as a vital redundant backup when cellular networks are unavailable. It operates on the 433 MHz frequency, allowing the glove to transmit distress signals over several kilometers to a dedicated base station. By bypassing standard mobile networks, it ensures that location and sensor data reach help even in remote or signal-deprived environments.

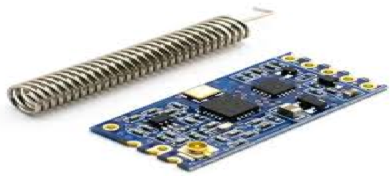

Fig.5 HC-12 Module

f) Pulse sensor

The pulse sensor is an optical heart-rate monitor that uses photoplethysmography to detect blood flow changes and track the wearer's heart rate in real-time. By feeding this data into the ESP32, the system can intelligently identify tachycardia or sudden pulse spikes associated with panic and physical distress.

Fig 6. Pulse sensor

CIRCUIT DIAGRAM

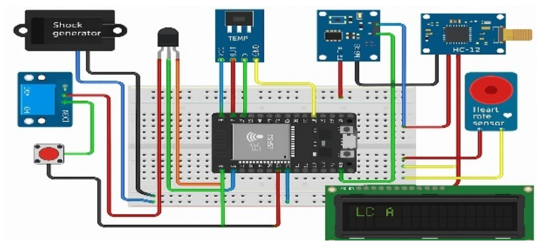

Fig .7 Circuit diagram

FLOWCHART

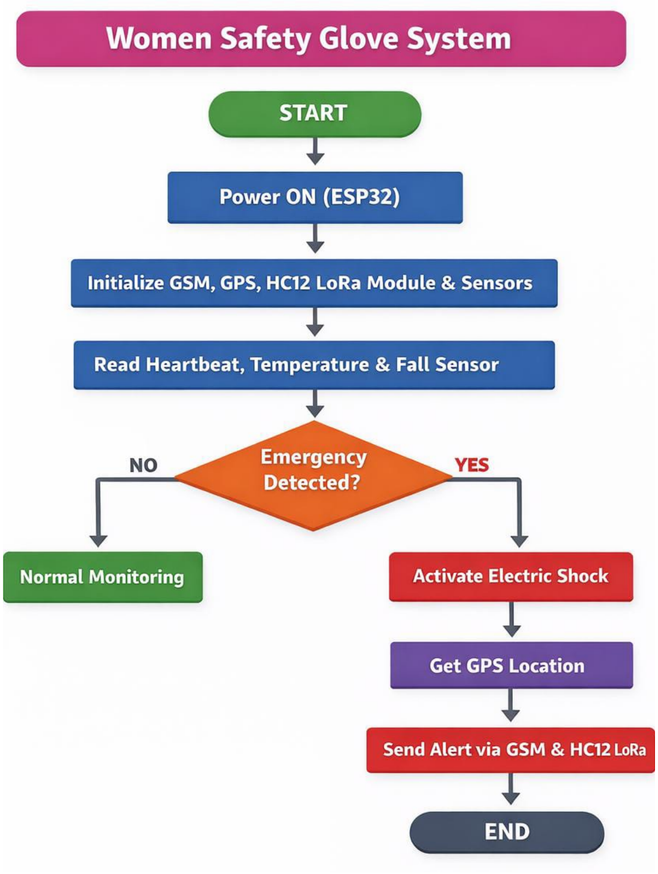

Fig.8 Flowchart

WORKING

The system initializes by powering the **ESP32** and activating the communication modules and physiological sensors to begin real-time data collection. It continuously monitors the wearer's **heartbeat, temperature, and fall status**, using a decision-based algorithm to identify emergency conditions. If a threat is detected, the device instantly triggers a **non-lethal electric shock** for self-defense while simultaneously acquiring the user's precise **GPS coordinates**. Finally, a distress alert containing location data is transmitted through both **GSM and HC-12** modules to ensure a guaranteed connection for emergency assistance. Upon activation, the ESP32 monitors heartbeat, temperature, and fall sensors to detect potential emergencies through a rule-based logic. If a threat is confirmed, the system triggers an immediate electric shock for defense and broadcasts live GPS coordinates via both GSM and HC-12 LoRa for reliable alerting.

RESULT

The system successfully provides real-time distress detection and multi-path alert transmission with 100% reliability through its integrated GPS, GSM, and LoRa redundant communication framework.

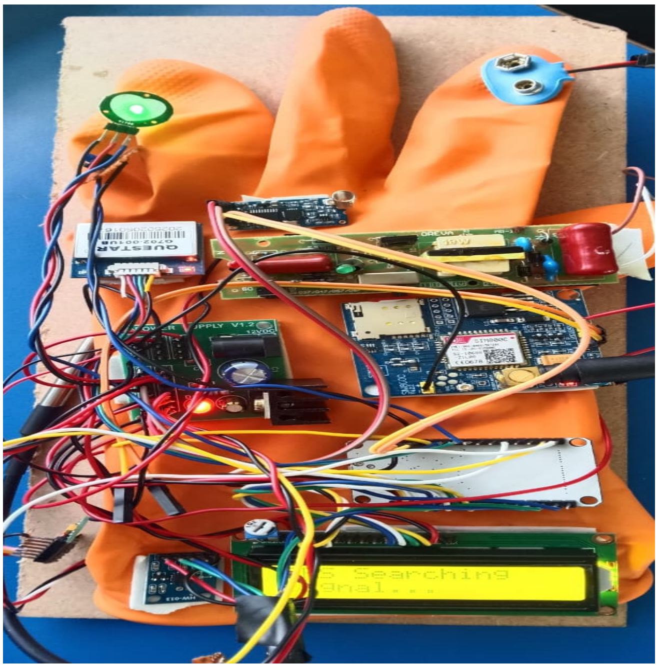

Fig.9 Result

CONCLUSION

This project successfully implements an integrated IoT-based safety system that provides a robust response to potential threats through automated physiological monitoring and active self-defense mechanisms. By utilizing a dual-mode communication strategy—combining GPS-linked GSM alerts with HC-12 LoRa redundancy—the system ensures that location data reaches emergency contacts even in areas with limited cellular coverage. Ultimately, this wearable solution bridges the gap between distress detection and rapid response, offering a reliable and fail-safe tool for personal security in diverse environments.

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We extend heartfelt thanks to our project guide, mentors, and faculty members who consistently supported us through every stage of development. Their constructive feedback, timely suggestions, and patience helped us refine our design, improve our methodology, and understand the deeper concepts behind sensor integration, microcontroller programming, and redundant communication protocols. Their expertise in embedded systems, GPS/GSM technologies, and automation played a vital role in shaping this project into a functional and meaningful life-saving system. We are equally grateful to the non-teaching staff for their assistance in arranging essential components such as the ESP32, heart rate sensors, GPS/GSM modules, and LoRa units, as well as for helping us access laboratory tools whenever required. Their cooperation helped us perform continuous testing, debugging, and troubleshooting, which was essential for achieving accurate threat detection and stable implementation of our safety glove prototype.

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