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TECHSHIELD: AI-IoT SMART WOMEN SECURITY WITH REAL-TIME GPS THREAT ALERTS

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ABSTRACT
Women's safety in both public and private environments has become a major societal concern due to the increasing number of harassment, assault, kidnapping, and emergency incidents that often occur without immediate assistance. Conventional safety systems mainly rely on mobile phone calls, Short Message Service (SMS) alerts, or manual emergency applications, where users must unlock devices, open applications, and perform multiple interaction steps during critical situations. These traditional systems frequently fail during panic conditions, physical attacks, or unconscious states, resulting in delayed emergency response and reduced effectiveness. Such limitations create the need for an intelligent, wearable, and real-time security solution capable of providing immediate assistance with minimal user interaction. This project proposes "TechShield: Artificial Intelligence (AI)–Internet of Things (IoT) Smart Women Security with Real-Time Global Positioning System (GPS) Threat Alerts," an embedded wearable safety system designed using an ESP32 microcontroller, GPS module, panic switch, buzzer, Liquid Crystal Display (LCD), and Wi-Fi-based IoT communication platform. When the emergency switch is activated, the system instantly captures the user's live GPS coordinates, transmits threat alerts and location details to guardians and emergency contacts through the IoT platform, and activates a buzzer for local alert generation. The AI-enabled cloud platform further performs intelligent threat prioritization and alert management. The proposed system provides a compact, portable, low-cost, and reliable personal safety solution that effectively combines embedded systems, IoT, and AI technologies for enhancing women's security and emergency response efficiency.

Keywords: Women's Security, TechShield, AI-IoT, Panic Button, ESP32, GPS Tracking, IoT, Real-Time Threat Alerts, Wearable, Emergency Alert, Personal Safety System

1. INTRODUCTION

Women's safety has become one of the most serious global social concerns due to the increasing number of crimes, harassment cases, domestic violence incidents, kidnappings, assaults, and unsafe public conditions reported every year. According to reports published by the United Nations (UN) and the World Health Organization (WHO), nearly one in three women worldwide experience physical or sexual violence at least once during their lifetime. In many countries, women continue to face safety risks while travelling alone, working night shifts, attending educational institutions, or using public transportation systems. Rapid urbanization, increasing population density, and expansion of metropolitan regions have further intensified concerns related to women's personal security, particularly in isolated streets, poorly monitored public spaces, and crowded transportation environments. Crime statistics published by national law enforcement agencies indicate that a significant percentage of emergency incidents occur during situations where victims are unable to seek immediate help due to fear, panic, or physical restriction. These growing security concerns have created widespread demand for faster and more dependable emergency response mechanisms capable of reducing response delays and improving victim protection.

Traditional safety approaches have primarily depended on manual communication methods such as emergency phone calls, text messaging services, whistle alarms, and smartphone-based safety applications.

Although these systems provide a basic level of emergency assistance, they often fail during high-stress situations where victims cannot access mobile devices or communicate effectively. Studies related to emergency response behavior show that panic conditions can significantly reduce human reaction efficiency, decision-making ability, and communication speed during sudden threats. Many existing mobile safety applications require multiple interaction steps including unlocking the phone, opening an application, selecting contacts, and manually sharing location information, which becomes impractical during physical attacks or sudden emergencies. Furthermore, several conventional systems suffer from limitations such as inaccurate location tracking, delayed alert transmission, poor network dependency, limited portability, high maintenance cost, and lack of continuous real-time monitoring capabilities. In rural or semi-urban regions, insufficient public surveillance infrastructure and delayed law enforcement response further increase vulnerability during emergency situations. These limitations highlight the inadequacy of conventional security methods in providing rapid and reliable protection under real-world critical conditions.

The advancement of embedded systems, wireless communication technologies, IoT infrastructures, cloud computing, GPS-based tracking systems, and AI-driven data processing has significantly transformed the field of intelligent public safety and emergency monitoring applications. Modern safety research increasingly focuses on integrating compact sensors, wearable electronics, real-time communication platforms, and automated monitoring frameworks capable of improving situational awareness and emergency response coordination. Recent studies in smart surveillance and emergency alert technologies emphasize the importance of continuous live location monitoring, automated event detection, instant notification delivery, and intelligent prioritization of critical alerts for improving rescue efficiency and reducing response time. The availability of low-power microcontrollers, portable communication modules, cloud-connected monitoring systems, and AI-enabled analytical services has enabled the development of lightweight and scalable safety infrastructures suitable for real-time deployment. In addition, the increasing adoption of wearable devices and smart connected platforms demonstrates the growing importance of portable intelligent safety technologies in addressing modern public security challenges. These technological advancements continue to influence the evolution of next-generation personal protection systems designed to improve emergency awareness, communication reliability, and rapid intervention capabilities across diverse environmental conditions.

2. LITERATURE SURVEY

Want, et al. [1] provided a comprehensive introduction to RFID technology, detailing its operational principles, system architecture, and application potential. The study explained how RFID systems consist of tags (active or passive), readers, and backend databases that communicate through radio frequency signals to enable automatic identification. It highlighted key advantages such as non-line-of-sight operation, rapid data acquisition, and minimal human intervention. The work also discussed design considerations including frequency bands, power requirements, read range, and data security. Furthermore, it emphasized the integration of RFID with embedded systems for compact and efficient implementations. This foundational study established the feasibility of incorporating RFID-based activation and identification mechanisms in wearable safety devices, although it did not address real-time alerting or IoT integration. Gubbi, et al. [2] presented a detailed architectural model of IoT, defining its core components such as sensing layer, network layer, middleware, and application layer. The study described how IoT enables seamless interaction between physical devices and digital systems through continuous data collection and intelligent processing. It also explored enabling technologies including cloud computing, wireless sensor

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networks, and data analytics. The authors discussed critical challenges such as scalability, interoperability, data privacy, and energy efficiency. Their work highlighted the potential of IoT in applications like smart cities, healthcare, and environmental monitoring. This framework was highly relevant for designing real-time safety systems, as it supported continuous monitoring, remote access, and automated alert generation. However, the study remained conceptual and did not provide implementation-specific details. Al-Fuqaha, et al. [3] conducted an extensive survey on IoT technologies, focusing on communication protocols, network architectures, and application domains. The study analyzed lightweight protocols such as MQTT and CoAP, emphasizing their suitability for low-latency and resource-constrained environments. It also compared different networking technologies including Wi-Fi, Bluetooth, and cellular communication, highlighting their trade-offs in terms of range, bandwidth, and power consumption. The authors addressed major challenges such as security vulnerabilities, device heterogeneity, and data management complexities. Their work provided a strong guideline for selecting appropriate communication strategies in real-time monitoring systems. Although highly detailed, the study primarily focused on theoretical and comparative analysis rather than practical deployment scenarios. Suma, et al. [4] developed an IoT-based smart security and automation system that integrated multiple sensors with microcontroller-based control units. The system was designed to monitor environmental parameters and trigger alerts through an IoT platform when abnormal conditions were detected. It demonstrated real-time data transmission, remote monitoring, and automated response mechanisms. The study validated the effectiveness of combining embedded systems with IoT for continuous surveillance and alert generation. Additionally, it showed how user interfaces can be developed for monitoring system status remotely. While the system proved efficient in a controlled environment, it was primarily designed for indoor applications and lacked portability and wearable integration.

Kumar, et al. [5] proposed a real-time tracking and safety system using GPS for location acquisition and GSM for communication. The system continuously collected geographical coordinates and transmitted them to predefined contacts during emergencies. It demonstrated how location-based services can enhance safety by providing accurate and timely information. The study also discussed the reliability of GPS signals and the importance of network coverage for effective communication. Their approach was particularly useful for tracking moving entities and generating alerts in critical situations. However, the system had limitations in terms of processing intelligence and lacked integration with advanced data analytics or IoT platforms. Adiono, et al. [6] designed an embedded IoT monitoring system that focused on efficient data acquisition, processing, and transmission using microcontrollers and wireless communication. The system architecture included sensor nodes, communication modules, and a cloud-based platform for data storage and analysis. It demonstrated real-time monitoring capabilities and emphasized low power consumption and cost-effectiveness. The study validated the concept of continuous data flow from embedded devices to remote servers, enabling timely decision-making. It also highlighted the importance of reliable communication protocols for maintaining data integrity. However, the work did not specifically address emergency scenarios or wearable device integration, limiting its direct applicability to personal safety systems. Jain, et al. [7] proposed a GPS and IoT-based women safety system that enabled real-time emergency alerting and location tracking. Their system integrated a GPS module for acquiring precise geographical coordinates and an IoT communication platform for transmitting this data to predefined contacts or monitoring systems. Upon activation of an emergency trigger, the system generated alerts containing live location information, ensuring immediate response from guardians or authorities. The study demonstrated the feasibility of combining positioning systems with IoT frameworks for personal safety applications. It also highlighted the importance of real-time data transmission and system reliability. However, the system lacked advanced decision-making capabilities and depended heavily on network connectivity for effective operation. Patel, et al. [8] developed a smart personal safety device using embedded systems and IoT technologies for continuous monitoring and emergency response. Their system incorporated sensors, microcontrollers, and wireless communication modules to detect abnormal conditions and transmit alerts to remote users. The architecture supported real-time data acquisition and remote monitoring through IoT platforms. The study emphasized portability and user convenience, making it suitable for wearable applications. It validated the effectiveness of embedded IoT systems in enhancing personal safety. However, the system had limited intelligence in analyzing threats and relied mainly on manual triggering mechanisms.

Kumar, et al. [9] designed an ESP32-based IoT monitoring system with integrated GPS tracking capabilities. Their work demonstrated the use of the ESP32 microcontroller for handling sensor data processing, wireless communication, and real-time data transmission. The system utilized Wi-Fi connectivity to send location and monitoring data to a cloud platform for storage and analysis. It highlighted the advantages of ESP32, such as low power consumption, high processing capability, and built-in networking features. The study validated the suitability of ESP32 for embedded IoT applications. However, it focused mainly on monitoring and did not incorporate advanced safety or alerting mechanisms. Reddy, et al. [10] presented a real-time personal safety monitoring system that combined GPS tracking with IoT-based communication. Their system continuously tracked user location and transmitted data to a remote monitoring platform, enabling real-time observation and emergency response. The study emphasized the importance of continuous monitoring and quick alert generation in critical situations. It also demonstrated how IoT platforms can be used for data visualization and remote access. While effective in providing location-based safety, the system lacked integration with intelligent analytics for predictive threat detection. Meena, et al. [11] developed an IoT-based women safety system with automated guardian notification features. Their system was designed to detect emergency situations and automatically send alerts to predefined contacts without requiring extensive user interaction. It incorporated IoT communication and cloud-based platforms to ensure real-time notification and data accessibility. The study highlighted improvements in response time and reliability compared to manual systems. It also demonstrated the importance of automation in emergency scenarios. However, the system did not include advanced hardware integration or AI-based threat analysis. Choudhary, et al. [12] presented a wearable emergency alert system integrated with cloud-based notification services. Their system focused on compact design and ease of use, allowing users to trigger alerts through a simple interface. The collected data was transmitted to cloud servers, where it was processed and shared with authorized users in real time. The study emphasized the advantages of wearable technology in personal safety, including portability, accessibility, and continuous monitoring. It validated the effectiveness of cloud-based communication for large-scale deployment. However, the system lacked advanced sensing capabilities and relied primarily on user-triggered alerts.

3. PROPOSED SYSTEM

The system architecture is designed as an IoT-enabled real-time personal safety monitoring system built around the ESP32 (Espressif Systems 32-bit Microcontroller), integrating user-triggered input, location tracking, alert generation, display feedback, and cloud-based communication into a continuous and responsive operational framework. During the system initialization phase, the ESP32 configures all

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hardware modules, including setting up dual serial communication channels—one for debugging and another for interfacing with the GPS (Global Positioning System) module via UART (Universal Asynchronous Receiver Transmitter) pins—to receive continuous location data streams, while also initializing the LCD (Liquid Crystal Display) in 16×2 mode for displaying system states and configuring GPIO (General Purpose Input Output) pins such as the panic button with INPUT_PULLUP mode to ensure stable signal detection and the buzzer pin as an output for alert signaling.

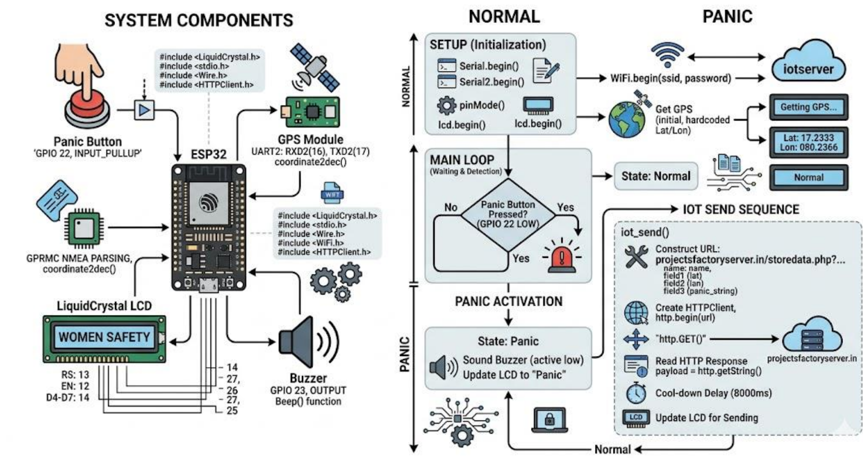

Fig. 1: Proposed system architecture

Simultaneously, the WiFi (Wireless Fidelity) module is initialized using stored SSID and password credentials, and the system repeatedly checks connection status until a successful link with the IoT server is established, after which confirmation messages are displayed on the LCD indicating readiness. Once initialization is complete, the system enters the main execution loop, where it continuously monitors the panic button state while also parsing incoming NMEA (National Marine Electronics Association) sentences—specifically the GPRMC string—from the GPS module, converting raw coordinate data from degrees-minutes format into decimal degrees for accurate latitude and longitude representation. Under normal conditions, when the panic button is not pressed, the system remains in a passive monitoring state labeled “Normal,” maintaining updated location data in memory for immediate use if required. When the panic button is pressed, indicating an emergency situation, the system instantly transitions into a “Panic” state, triggering the buzzer to generate an audible alarm and updating the LCD with a clear “Panic” message to notify nearby users. Concurrently, an IoT data transmission sequence is initiated, where the ESP32 constructs a structured HTTP (Hypertext Transfer Protocol) request containing parameters such as latitude, longitude, and panic status, establishes a connection to a remote web server, and sends the data using GET requests through an HTTP client, enabling real-time tracking and emergency response from remote systems. The server processes the received data, stores it in a cloud database, and returns an HTTP response code, which is read by the ESP32 to verify successful communication. To prevent redundant transmissions and ensure system stability, a cooldown delay is implemented after each alert cycle, during which the LCD may display transmission status messages. Once the panic condition is resolved, the system resets to the normal monitoring state, continuing its loop without interruption. The architecture ensures tight synchronization between sensing, processing, communication, and alert subsystems through efficient loop execution and state management, minimizing latency and ensuring reliability even in critical scenarios. As illustrated in Fig. 1, the system demonstrates seamless coordination between user input, GPS-based location acquisition, real-time alert generation, LCD-based feedback, and IoT cloud integration, resulting in a robust, scalable, and intelligent safety solution for emergency situations.

4. RESULT AND DISCUSSION

The Results and Discussion section presents the performance evaluation and experimental outcomes of the proposed ESP32-based biometric monitoring and tracking system. Various hardware modules, including the fingerprint sensor, GPS module, LCD display, and communication components, were successfully integrated and tested under real-time operating conditions. The obtained results demonstrate the system's ability to accurately perform user authentication, location tracking, and status monitoring with minimal delay. Experimental observations confirm the reliability and effectiveness of the developed prototype in providing secure and continuous monitoring. Furthermore, the discussion highlights the system's operational efficiency, practical applicability, and overall performance in real-world scenarios.

Fig. 2. Experimental setup and LCD output of the ESP32-Based biometric monitoring and tracking system

Fig. 2 presents the developed ESP32-based biometric monitoring and tracking system along with its real-time LCD output. The hardware setup integrates an ESP32 microcontroller, GPS module, fingerprint sensing interface, environmental sensing modules, buzzer, and a 16×2 LCD display to perform authentication, sensing, and location-tracking functions. The ESP32 serves as the central controller, facilitating data acquisition, processing, and communication among all connected peripherals. The LCD screen displays real-time authentication status, sensor readings, and system information, as illustrated by the "NO FINGER" message when no fingerprint is detected. The integrated prototype demonstrates the effective implementation of an IoT-enabled embedded platform capable of user authentication, environmental monitoring, alert generation, and location-based tracking in real-time applications

5. CONCLUSION

The TechShield system demonstrated an effective AI-IoT based wearable solution for women’s safety, combining real-time GPS tracking with intelligent emergency alerting on an ESP32 platform. The device enabled instant panic activation through a single press, ensuring quick response even in stressful situations. It processed location data locally and transmitted it via IoT for smart threat analysis and prioritized alert generation. The integration of Wi-Fi eliminated the need for additional communication modules, making the system compact and cost-efficient. Real-time monitoring and audible alerts enhanced both remote response and on-site deterrence. The design supported scalability, allowing future additions such as sensors, camera integration, and advanced AI models. the system provided a reliable, intelligent, and practical approach to modern personal security.

REFERENCES

[1] R. Want, "An Introduction to RFID Technology," IEEE Pervasive Computing, vol. 5, no. 1, pp. 25–33, Jan.–Mar. 2006.

[2] S. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions," Future Generation Computer Systems, vol. 29, no. 7, pp. 1645–1660, Sep. 2013.

[3] A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications," IEEE Communications Surveys and Tutorials, vol. 17, no. 4, pp. 2347–2376, 2015.

[4] N. Suma, R. Samson, S. Saranya, G. Shanmugapriya, and R. Subhashri, "IoT Based Smart Security and Home Automation System," in Proc. Int. Conf. Computational Intelligence and Computing Research, Coimbatore, India, 2017, pp. 1–3.

[5] S. Kumar and R. Singh, "GPS and GSM Based Vehicle Tracking and Safety System," International Journal of Engineering Research and Technology, vol. 7, no. 3, pp. 201–206, 2018.

[6] T. Adiono, S. Fuada, and M. A. Purwanda, "Design of IoT-Based Monitoring System," in Proc. IEEE Int. Conf. Consumer Electronics-Taiwan, Taichung, Taiwan, 2018, pp. 1–2.

[7] A. Jain and P. Gupta, "GPS and IoT Based Women Safety System," International Journal of Innovative Research in Science, Engineering and Technology, vol. 8, no. 4, pp. 3721–3727, 2019.

[8] V. Patel and M. Shah, "Smart Personal Safety Device Using IoT and Embedded Systems," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 8, no. 6, pp. 2341–2347, 2019.

[9] A. Kumar and S. Bharti, "ESP32-Based IoT Monitoring System with GPS Tracking," International Journal of Engineering and Technology, vol. 9, no. 3, pp. 612–618, 2020.

[10] S. Reddy and P. Nair, "Real-Time Personal Safety Monitoring System Using GPS and IoT," International Journal of Embedded Systems and Applications, vol. 10, no. 4, pp. 31–39, 2020.

[11] N. Meena and R. Jain, "IoT-Based Women Safety System with Automated Guardian Notifications," IEEE Access, vol. 9, pp. 91234–91246, 2021.

[12] R. Choudhary and A. Verma, "Wearable Emergency Alert System with Cloud Notification," International Journal of Embedded Systems, vol. 13, no. 5, pp. 412–420, 2021.