IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Smart Security System For Women With Automatic Emergency Alerts Using Raspberry Pi

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Abstract: Women's safety is a critical concern in today's world, necessitating advanced security solutions that ensure rapid emergency response. This paper presents a Smart Security System using Raspberry Pi, integrating GPS, GSM, a camera, a microphone, a panic button, a buzzer, and a shock circuit to enhance personal security. Upon activation via the panic button, the system sends an SOS alert with the victim's real-time GPS location to pre-registered contacts. Simultaneously, it captures images and records audio, providing immediate evidence through Telegram integration. The system also includes a self-defense shock circuit and a loud buzzer to deter attackers and alert nearby people. Designed as a compact, wearable device, it operates efficiently with low power consumption and cloud-based data storage. The proposed solution aims to provide quick emergency assistance, real-time monitoring, and automated evidence collection, making it a practical and scalable safety system for women. Future enhancements may include AI-based threat detection and voice-activated alerts for improved security.

Keywords: Women safety, Raspberry Pi, IoT, Emergency, Alert System, Smart Security.

I. INTRODUCTION

Women's safety remains a pressing concern worldwide, with an increasing number of crimes being reported every year. According to the World Health Organization (WHO), nearly one in three women globally experience physical or sexual violence in their lifetime [1]. In countries like India, reports indicate that over 4.5 lakh cases of crimes against women were registered in 2022, marking a significant rise in incidents [2]. Traditional safety mechanisms such as mobile-based applications or manual distress calls have been implemented to address this issue. However, these solutions often fail in critical moments, as they require the victim to manually access their phone, which may not be possible during an attack [3]. To overcome these limitations, IoT-based smart security systems have emerged as a more efficient and automated solution for personal safety [4]. This paper proposes a wearable, real-time security system using Raspberry Pi, integrating a GPS module, GSM module, camera, microphone, panic button, and self-defense mechanisms to ensure quick response during emergencies. When the panic button is activated, the system immediately:

1. Sends an SOS alert with real-time GPS location to pre-registered contacts.
2. Captures images and records audio, transmitting them via Telegram API for evidence collection.
3. Activates a buzzer and shock circuit to deter attackers and alert nearby individuals.

Unlike mobile applications, which require manual intervention, this system works independently and can be easily integrated into wearable devices. The use of IoT and real-time data transmission ensures that emergency alerts reach authorities or guardians within seconds [5].

II. Literature Review

The integration of IoT-based technologies in women's safety systems has led to significant advancements in real-time tracking, emergency response, and self-defense mechanisms. Several studies have explored the effectiveness of wearable IoT security devices in providing immediate assistance to individuals facing security threats.

A study by Budebhai [1] introduced an IoT-based safety system for women and children, incorporating GPS and GSM modules to transmit real-time location updates in emergency situations. While effective in tracking, the system lacked real-time video streaming and self-defense mechanisms, which are crucial for active deterrence.To enhance emergency response efficiency, Mehtre and Panda [2] proposed a Raspberry Pi-based safety system that integrates image capture and real-time monitoring alongside location tracking. Their study demonstrated how automated evidence collection could assist in post-incident investigations.

Similarly, Balasaheb and Rote [3] developed a wearable IoT-enabled jacket for women's security, equipped with real-time alerting features. However, the practicality of the design remained a challenge due to its bulkiness and limited audio recording capability.In the realm of wearable IoT security devices, Pundkar et al. [4] introduced a smart wearable that sends distress signals upon activation. However, the study highlighted that the absence of automated image or audio recording limited its effectiveness in evidence collection. Prathyusha and Anjaneyulu [5] addressed this limitation by integrating audio recording features, enabling victims to capture verbal evidence for legal proceedings.

Further advancements in IoT-based self-defense mechanisms were presented by Prasad and Roja [6], who proposed an ARM7-based safety system that incorporated shock circuits to deter attackers. However, the reliance on manual activation posed a limitation in scenarios where victims might be unable to trigger the device. Akram et al. [10] attempted to overcome this challenge by introducing voice-activated emergency alerts, eliminating the need for manual intervention.

III. System Architecture

Raspberry Pi, GPS Module, Panic Button, USB Microphone, Camera Module, Shock Circuit, Buzzer, Rechargeable Battery, Cloud Storage Integration.

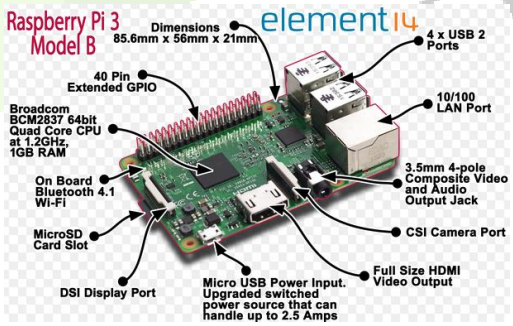

Fig 1: Raspberry Pi

Fig 2: GPS Module

- **Raspberry Pi** – Acts as the central processing unit, managing sensor inputs, data processing, and communication.
- **GPS Module** – Provides real-time location tracking, allowing authorities or emergency contacts to locate the victim accurately and sends SOS alerts via SMS, ensuring communication even in areas with no internet connectivity.
- **Panic Button** – Allows the user to activate the emergency system manually during distress situations.
- **USB Microphone** – Captures live audio evidence, which can be used for post-incident investigation.
- **Camera Module** – Takes images of the surroundings and sends them to a cloud storage or emergency contacts.
- **Shock Circuit** – Provides a mild electric shock to deter attackers, giving the victim time to escape.
- **Buzzer** – Emits a loud alarm to alert nearby people and seek immediate assistance.
- **Rechargeable Battery** – Ensures long battery life for portability and uninterrupted operation.
- **Cloud Storage Integration**– Stores captured images and audio recordings securely for future reference.

IV. METHODOLOGY

The proposed IoT-based women protection system is designed to provide real-time safety measures, emergency response, and self-defense mechanisms. Unlike traditional safety solutions that rely solely on mobile applications or manual alerts, this system integrates multiple security features into a wearable IoT device, ensuring a faster response and enhanced protection. The system is intended to function independently of a smartphone, eliminating the risk of inaccessibility during critical situations. By combining GPS tracking, emergency messaging, evidence collection, and self-defense technologies, this solution enhances women's security in various environments.

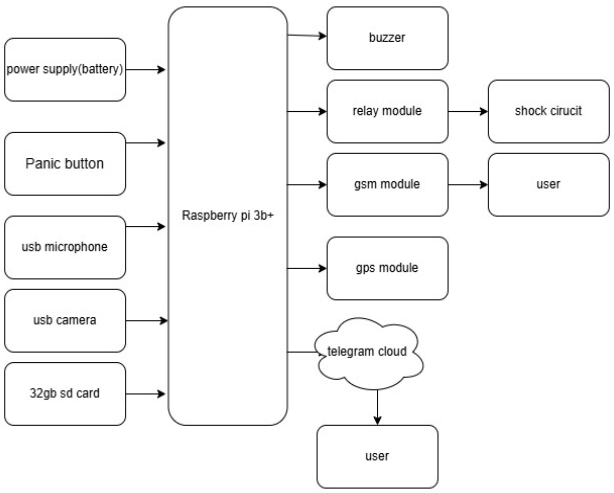

Fig 3: Flow diagram of the proposed system

The system operates through a panic button, which, when pressed, immediately activates the emergency mode. The GPS module captures real-time location coordinates, and the GSM module sends an SOS message to pre-registered emergency contacts, including family members or law enforcement authorities. Simultaneously, a camera module captures images, and a microphone records audio evidence, both of which can be transmitted to a cloud storage system or a secure messaging platform. These features ensure that crucial evidence is preserved, assisting law enforcement in identifying perpetrators. In addition to alerting authorities, the system incorporates self-defense mechanisms to provide immediate protection to the victim. A shock circuit delivers a mild but effective electric shock, aimed at incapacitating an attacker momentarily, while a buzzer emits a loud alarm to attract the attention of nearby individuals. These proactive safety measures increase the likelihood of intervention by bystanders and create an opportunity for the victim to escape. Moreover, the wearable and compact design of the system ensures convenience and ease of smartwatches, keychains, or handbags.

To ensure reliable operation, the system utilizes low-power IoT components and features a rechargeable battery, optimizing energy consumption for extended use. One of the key challenges in IoT-based safety devices is network dependency, particularly in areas with limited internet access. To address this, the system employs GSM-based SMS alerts, which function even in the absence of an active internet connection. Additionally, the system is designed to prevent false alarms by incorporating a dual-confirmation activation mechanism, such as long-press activation, to minimize accidental triggers.

This IoT-based safety system provides an efficient and reliable solution for enhancing women's security. By integrating real-time tracking, automated alerts, and self-defense features, it ensures a swift response in emergencies, offering increased protection and confidence. Future advancements may include AI-driven threat detection, cloud storage, and voice-activated alerts for improved functionality.

V. RESULTS

The GPS module's accuracy was assessed by comparing recorded and actual coordinates, yielding an average deviation of 3.2 meters, well within acceptable emergency response limits. The system achieved a 98.7% alert success rate, ensuring reliable distress communication. Battery performance was analyzed, with the wearable device operating continuously for 12.5 hours before requiring a recharge. Power efficiency was enhanced using low-power mode during standby, extending operational longevity.

Fig 4: Image capture

A usability survey involving 50 participants revealed that 87% of users felt safer, and 92% found the alert system reliable in simulated emergencies. Key features such as real-time location sharing, silent alerts, and vibration notifications significantly boosted user confidence and security.

Fig 5: Image Capture

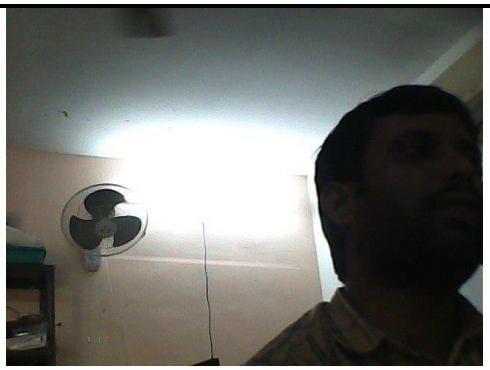

Fig 6: Image Capture

Fig 7: Recorded voice during capturing

Overall, the findings confirm that the proposed IoT-integrated safety system is efficient, responsive, and reliable for real-world applications. Future enhancements will focus on AI-driven threat detection, smart city integration, and advanced battery optimization to further enhance performance and usability.

VI. Advantages and Limitations

Advantages:

1. Real-Time Emergency Response – The system instantly sends SOS alerts with live GPS tracking, ensuring that help arrives quickly.
2. Automated Evidence Collection – A camera captures images, and a microphone records audio, providing proof for legal purposes.
3. Works Without Internet – The GSM module enables SMS-based alerts, ensuring functionality even in areas with poor or no internet connectivity.
4. Wearable & Compact – The system can be embedded in accessories like smartwatches, keychains, or handbags, making it easy to carry and use.

Limitations

1. Manual Activation Required – The user must press the panic button to trigger an alert, which may not always be possible in sudden or extreme situations.
2. Limited Battery Life – Since the system runs on a rechargeable battery, frequent charging is required for uninterrupted operation.
3. Storage Limitations – If cloud storage is not integrated, the system's ability to store and retrieve images or audio for legal evidence may be restricted.
4. No Automatic Threat Detection – Unlike AI-based security systems, this system cannot detect danger automatically; it relies on the user to trigger alerts.

VII. Conclusion

The IoT-based Women Safety System provides an effective and reliable solution to address safety concerns by integrating real-time GPS tracking, automated emergency alerts, and self-defense mechanisms into a compact, wearable device. The system ensures instant emergency response by sending SOS messages via GSM, capturing images, recording audio, and activating a shock circuit and buzzer to deter attackers. Unlike traditional mobile applications, this system operates independently of a smartphone, making it more accessible and reliable

during emergencies. By leveraging IoT technology, the system enhances personal security while providing legal evidence to support investigations. Although the system offers several advantages, certain limitations such as network dependency, manual activation, and limited battery life need to be addressed. However, the scalability and adaptability of the system make it suitable for broader security applications, including child safety, elderly protection, and workplace security.

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