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Sheild – Women Safety Application and IoT Device

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ABSTRACT: This project addresses the critical issue of women's safety by introducing SHEild, an intelligent safety application that leverages Internet of Things (IoT) technology, real-time GPS tracking, and cloud-based communication to provide immediate and reliable emergency response. The system comprises two core components: a user-facing mobile application and an IoT-enabled alert system integrated with self-defence mechanisms. When the user presses an emergency button, the system transmits the user's real-time location to pre-assigned emergency contacts and simultaneously activates a loud buzzer to draw the attention of nearby individuals. The application ensures alert authenticity through multiple verification methods, including GPS validation and cloud synchronization. Recognizing the broader implications of safety, the system also includes access to mental health resources, aiming to support users affected by psychological stress caused by unsafe environments. SHEild minimizes emergency response time and enhances the reliability and efficiency of personal safety protocols through a combination of IoT integration, real-time tracking, automated communication, and context-aware alerting. This approach provides a scalable and practical solution for enhancing user security, making it suitable for deployment in various public and private scenarios. The implementation of SHEild demonstrates the potential of integrating emerging technologies to address real-world safety challenges through a proactive and user-friendly system.

KEYWORDS: Cloud-based communication, emergency response system, GPS tracking, IoT-based safety device, women safety.

I. INTRODUCTION

Women's safety continues to be a pressing concern in the modern world, with rising cases of harassment, assault, and personal insecurity being reported across both urban and rural regions. Despite growing awareness and numerous campaigns, the need for rapid-response technologies and preventive safety mechanisms remains unmet. Conventional tools such as safety whistles or emergency dialers are often insufficient in situations where swift action is critical, especially under high-stress conditions where users may be unable to operate their devices effectively. Numerous mobile-based solutions have emerged in recent years, offering emergency contact features or location sharing.

However, many of these applications function as isolated systems with limited functionality, lacking real-time geolocation, intelligent automation, and integration with Internet of Things (IoT) technologies. Furthermore, they often overlook the emotional trauma and psychological aftermath experienced by users, offering no resources for mental health support or post-incident recovery.

To bridge these gaps, this work introduces SHEild, a comprehensive personal safety framework consisting of a mobile application tightly coupled with a IoT-enabled device. The system is designed to provide rapid, automated emergency alerts triggered by tactile input, real-time GPS tracking, and a cloud-connected architecture for secure and reliable data transmission. Importantly, SHEild incorporates a therapy section within the app that addresses emotional well-being, offering access to self-help content, calming audio, and guided recovery resources. A unique aspect of SHEild is its dual-layer approach—offering both proactive deterrence and reactive response. The device features an embedded





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emergency toggle button, a siren buzzer, and a non-lethal shock mechanism adapted from mosquito-repellent bat technology to fend off physical threats. This hardware component synchronizes with the mobile app, ensuring seamless operation during critical moments without requiring user focus or fine motor control.

This paper presents the detailed architecture, design methodology, and implementation of the SHEild system. It also evaluates performance under different real-world scenarios, with a focus on response time, usability, and system reliability. The proposed solution offers an effective, scalable, and user-centric approach to enhancing women's safety through a blend of software intelligence and embedded hardware technologies.

II. LITERATURE SURVEY

Ensuring personal safety, especially for women, has become a significant concern in recent years. Various safety applications and IoT-based emergency response systems have been developed to address this issue. This section reviews existing safety solutions, highlighting their capabilities and limitations.

2.1 Mobile-Based Safety Applications

Several mobile applications, such as bSafe, Safetipin, and 112 India, provide emergency alert features. These applications allow users to manually trigger distress signals via SOS buttons, location sharing, and emergency contact notifications. While effective, they depend on user intervention, which may not always be possible in high-risk situations.

2.2 IoT-Integrated Safety Systems

IoT-based security systems improve safety by providing real-time location tracking, automatic emergency alerts, and cloud-based notifications. Devices such as panic buttons and GPS-enabled trackers have been developed for quick response in emergencies. However, many existing systems lack automated distress detection, making them less effective in cases where the user is unable to manually trigger an alert.

2.3 Emergency Response and Law Enforcement Integration

Most safety applications focus on alerting predefined contacts but do not directly integrate with law enforcement agencies or emergency services. Some systems, like Aadhaar-linked emergency response in India, attempt to bridge this gap, but their implementation remains inconsistent. A seamless, automated communication system between users and authorities is still lacking in most existing solutions.

2.4 Mental Well-Being and Post-Emergency Support

Studies indicate that safety concerns significantly impact mental well-being. Some safety applications now include mental health resources, counseling services, and post-incident support. However, these features are often secondary, and their accessibility is limited.

2.5 Summary

While mobile-based safety applications offer quick distress alerts, they rely heavily on manual activation, which may not always be feasible during emergencies. IoT-integrated safety systems enhance real-time tracking and automated alerts, but many existing solutions lack seamless law enforcement integration. Additionally, while mental health support features are available in some applications, they are often secondary. Therefore, a cost-effective, automated, and user-friendly safety solution is required to ensure immediate emergency response without manual intervention, addressing the growing concerns around personal security.

III. METHODOLOGY

The The proposed SHEild system adopts a multi-tiered design approach that blends mobile application development with embedded IoT hardware to offer an intelligent, user-centric solution for women's safety. This section outlines the functional components, integration architecture, communication protocol, and the testing strategy followed during implementation.





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A. System Architecture

The architecture of the SHEild solution is bifurcated into two interdependent components designed to operate in realtime:

1. Android Mobile Application: Acts as the control interface, allowing users to initiate alerts, view location tracking, and access therapy features.

2. IoT Device: A portable, embedded system capable of independently initiating emergency protocols and delivering deterrent responses.

Both components are synchronized via cloud infrastructure to facilitate seamless interaction, data transmission, and emergency coordination.

B. Embedded Hardware Implementation

The device is engineered to ensure portability, responsiveness, and low power consumption. The key hardware components include:

• Microcontroller Unit (MCU): The ESP8266 Wi-Fi module is utilized for its robust connectivity features and low energy profile.

• Tactile Emergency Trigger: A mechanical push-button that initiates an immediate distress signal.

• Defensive Module: A shock delivery circuit derived from a 400kv step-up power module, calibrated for nonlethal deterrence.

Audible Alert: A high-decibel buzzer to attract attention from nearby individuals during an incident.

• Power Source: A rechargeable lithium-ion battery ensuring long operational runtime and consistent performance.

The enclosure is fabricated with water-resistant materials for daily usability and durability.

C. Software Development: Mobile Application

Developed using Android Studio with Java, the application incorporates modular subsystems to ensure scalability and maintainability. The core modules include:

- Emergency Management: Immediate alert generation and transmission to predefined contacts.
- GPS & Geofencing: Live location monitoring with virtual boundary alerts.
- Firebase Integration: Cloud synchronization for data storage, retrieval, and remote notification.

• Surrounding Capture: Activation of a Magnetometer for finding a potential electromagnetic device mode for real-time evidence collection.

• Mental Health Hub: Therapy tools including audio clips, guided sessions, and readable content for stress management.

D. Communication Protocol

The data flow across system layers is divided into three distinct channels:

- 1. Device-to-App Communication: Achieved via Wi-Fi Hotspot, ensuring minimal power drain.
- 2. App-to-Cloud Communication: Secured using HTTPS-based REST APIs connected to Firebase services.

3. App-to-User Communication: Emergency alerts are relayed via SMS and automated voice calls embedded with geolocation URLs.

E. Alert Trigger and Response Workflow

In an emergency, the system follows an automated chain of actions:

- 1. An alert is initiated through either the app interface or hardware trigger.
- 2. The user's current location is fetched using the GPS module.
- 3. Emergency contacts receive a distress message embedded with a Google Maps link.
- 4. The device's buzzer activates, drawing attention to the user's location.
- 5. The location is updated in 15-second intervals until the alert is deactivated manually.





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F. Security and Data Privacy

User confidentiality and data integrity are central to SHEild's operation. The system implements:

- AES-256 Encryption: All inter-device and server communication is protected using military-grade encryption.
- Access Controls: Role-based authorization restricts sensitive operations to authorized users.
- Minimal Data Retention: Only essential personal and emergency data are stored.
- Cloud Security Policies: Firebase rules prevent unauthorized access and enforce user-specific data isolation.

G. Evaluation and Testing Strategy

To validate performance and reliability, the system was subjected to a comprehensive testing cycle:

• Unit Testing: Ensured individual component functionality such as API responses, UI behaviour, and hardware control signals.

• Integration Testing: Verified consistency in communication between software and hardware layers.

Simulated Field Tests: Replicated real-world emergencies to measure response times and system reliability.

• User Acceptance Trials: Feedback was gathered from test users to improve interface clarity, feature accessibility, and overall system usability.

H. System Optimization Techniques

To ensure performance under constrained mobile and network environments, several optimizations were implemented:

• Background Service Throttling: GPS and Firebase listeners are scheduled to reduce battery drain during nonemergency usage.

• Lazy Initialization: Modules like the hidden camera and therapy section load dynamically only when triggered, optimizing memory usage.

• Offline Mode Support: Local storage ensures temporary data retention and deferred alert dispatch in case of network unavailability.

• Alert Redundancy: Multiple fallback mechanisms (SMS, Voice Call, Firebase Push) are triggered in parallel to ensure alert delivery even in unstable conditions.

H. System Flow Chart

The flowchart represents the streamlined workflow of the **SHEild Women Safety App and IoT Device**, a smart solution designed to enhance women's safety through integrated features. The system begins with a login interface where users or admins can access their respective functionalities.

Users proceed to enter their details and are directed to the SHEild Interface upon successful login, while admins can add users and manage access to the platform. Within the interface, users can access various safety and well-being features including Emergency SOS, Hidden Camera Detection, Siren Alert, Fake Call, Women's News, and multiple therapy options such as Audio Therapy, Yoga Therapy, Laughing Therapy, Talking Therapy, Spiritual Therapy, and Doctor Consultation.

If a hidden camera is detected, or if the SOS button on the IoT device is pressed, the system immediately sends an SOS message along with the user's real-time location to emergency contacts. The device is also equipped with a shock mechanism for self-defense, which activates only when both the toggle switch and push button are on. This layered system ensures a combination of physical safety, mental health support, and real-time emergency assistance, all aimed at empowering and protecting women in critical situations.





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IV. RESULTS AND DISCUSSION



Fig 1. Splash-Screen

Fig 2. Dashboard

Fig 3. Home

Fig 1. SHEild v3.0 introduces a smarter, safer space for women to grow and connect. Empowering Women Through Technology: Welcome to SHEild v3.0!

Fig 2. Choose your role to get started Login as Admin, User, or SHEild to proceed. Each role unlocks a unique experience tailored to your purpose.

Admins manage the platform and ensure smooth operations. SHEild provide guidance, support, and help create a safe digital environment.

Fig 3. The home screen acts as the central dashboard of the SHEild app. It contains quick-access buttons to major features such as Emergency SOS, Hidden Camera, Therapy, Women News, and Location Tracking.





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← Emergency Service	:	Helpline Numbers in India	Fake Call
		Women Helpline: 1091	Enter Caller Name
Enter first phone number		Women Helpline (Domestic Abuse): 181	Enter Caller Number
Enter second phone number		National Commission for Women: 011-26942369	
		Delhi Commission for Women: 011-23379181	
Enter third phone number		Child Helpline: 1098	
		Police: 100	SELECT CALLER IMAGE
Enter fourth phone number		Ambulance: 102	START FAKE CALL
^{Enter message} I am in danger, please come fa	ist	National Emergency Number: 112	DEFAULT FAKE CALL
		Fire: 101	
SAVE TRY IT		Senior Citizen Helpline: 14567	
		Cyber Crime Helpline: 1930	
STOP VOICE RECORDING	_	Railway Protection Force: 182	
VIEW RECORDINGS		Dailway Enquine 120	
HELPLINE NUMBERS		CLOSE	
Fig 4. Emergency	у	Fig 5. Helpline	Fig 6 Fake Call
Service	-	Numbers	Fig U. Fake Call

Fig 4. This screen allows users to input up to four emergency contact numbers along with a personalized distress message. It features two buttons—"SAVE" to store the inputs and "TRY IT" to test the functionality. Below that, the screen includes options to Start/Stop Voice Recording, View Recordings, and access Helpline Numbers. The UI is user-friendly with a pastel gradient background, rounded input fields, and a clear focus on safety and rapid communication during emergencies.

Fig 5. This screen displays a scrollable list of essential helpline numbers available in India. The interface uses a clean white card-like popup over the main screen, with a "CLOSE" button at the bottom.

Fig 6. The Fake Call Page where user can add their own call details to receive a call to move out unwanted situation.





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Fig 7. Simulates an incoming call interface to help users escape dangerous situations by pretending they are on an important or police-related call.

Fig 8. This feature uses your phone's magnetometer to detect hidden electronic devices like spy cameras. It shows magnetic field strength in microteslas (μ T) and alerts the user if any unusual magnetic activity is found. A safe reading shows "No electronic device detected," helping ensure privacy and safety.

Fig 9. This screen displays multiple therapy options including audio therapy, reading materials, yoga, spiritual practices, and special content.



Fig 10. The figure illustrates the assembled hardware prototype of an IoT-enabled emergency safety device designed to enhance personal security in high-risk situations. The system is powered by an ESP8266 Wi-Fi module, which serves as the central microcontroller unit (MCU) and facilitates wireless communication for alert notifications. A NEO 6M GPS module is integrated to acquire real-time geolocation data, enabling the system to transmit accurate user coordinates during emergencies.

A 400KV step-up power module is incorporated to deliver an electric shock as a deterrent mechanism, activated through a trigger button. This module is isolated and controlled via an electromechanical relay to ensure user safety and reliable switching. A push button is provided for manual activation of the emergency protocol, and a toggle switch allows for power control of the entire system. Additionally, a speaker is embedded to emit a loud siren, functioning as an audible alert to attract immediate attention from bystanders. The components are compactly arranged on a lightweight chassis to ensure portability and ease of use. This device demonstrates the feasibility of integrating IoT and basic defense mechanisms to build a cost-effective and efficient women safety system.

V. CONCLUSION

The SHEild platform introduces a practical and intelligent safety solution tailored to the needs of women in unpredictable environments. Unlike traditional systems, it leverages mobile hotspot-based connectivity to establish a reliable link between the user's smartphone and the IoT-enabled handheld device. This approach eliminates dependency on Bluetooth Low Energy (BLE) and enhances device independence in emergency conditions.

Through real-time GPS-based location tracking and cloud-integrated alert mechanisms, the system ensures swift communication with emergency contacts. Field tests confirmed that SHEild performs efficiently under varied conditions, delivering emergency alerts and live location updates with minimal delay.

One of the standout features of SHEild is its **hidden camera detection capability**, designed using the smartphone's magnetometer sensor. This function enables users to scan environments such as hotel rooms, trial rooms, or restrooms for concealed electronic devices. The ability to identify potential surveillance threats offers a valuable layer of personal privacy assurance, which is often overlooked in conventional safety tools.





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Additionally, the application extends support beyond physical security by integrating mental wellness tools that address the emotional aftermath of traumatic incidents. This dual-layered approach—combining reactive protection with proactive self-care—offers a more comprehensive framework for user safety.

Future developments may include integration with official public safety networks, voice-triggered emergency activation, multilingual accessibility, and AI-based risk zone detection. Such advancements could significantly elevate the system's adaptability and scope.

Overall, SHEild presents a robust, scalable, and user-focused platform that moves beyond emergency alerting to deliver an inclusive personal safety ecosystem. Its design, centered around real-world applicability and emotional resilience, sets a promising direction for future innovations in safety technology.

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