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FemSAFE: VOICE ACTIVATED WOMEN'S SAFTEY DEVICE

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Abstract: Ensuring women's safety remains a critical challenge, with conventional security measures often failing in emergencies. Many existing solutions need to be manually activated, which isn't always achievable in distressing situations. To present this, we propose an IoT-based personal safety gadget that integrates voice activation, automatic distress detection via blood pressure fluctuations, GPS tracking, and real-time audio-video recording with storage for legal evidence. The device provides instant emergency response by alerting police, family, and trusted contacts while enabling live tracking and evidence collection. By leveraging IoT and AI-driven automation, this system ensures proactive protection without relying solely on manual triggers. This paper explores the technological advancements behind the system, its real-world applications, and its potential to redefine personal safety standards for women worldwide.

Keywords: IoT-based Safety Device, Automatic Distress Detection, Real-Time Tracking, Voice-Activated Emergency System, AI-Driven Personal Security

I. INTRODUCTION

Women's safety continues to be a major concern worldwide, as conventional security measures often lack during emergencies, especially when the victim is unable to manually seek help. Addressing this gap, we present an IoT-based smart safety device designed to deliver real-time protection through intelligent, automated features. In contrast to conventional systems that rely heavily on user activation, our device introduces voice-based SOS triggers and automatic emergency detection through physiological monitoring, specifically abnormal blood pressure (BP) fluctuations. These features guarantee that even in high-stress or incapacitating scenarios, the device activates autonomously to safeguard the user. This innovative safety solution integrates multiple core technologies to maximize responsiveness and support. It employs voice activation to initiate alerts using a secure codeword, providing a discreet and immediate method to signal distress. Simultaneously, the system constantly monitors the user's BP, and any irregularities automatically trigger an emergency protocol without the need for manual input. Upon activation, the device sends SOS alerts to nearby police stations, as well as to pre-designated family members and trusted contacts, ensuring that help is promptly mobilized. Real-time GPS tracking offers continuous location updates to aid rescue efforts efficiently. Further enhancing its utility, the device includes live audio and video recording capabilities, enabling the capture of critical evidence during the incident. These recordings are safely preserved and can later support legal investigations and proceedings. By combining IoT, artificial intelligence, and robust real-time monitoring, this smart safety device redefines personal protection as proactive, intelligent, and user-centric. Our goal is to empower women with safety at their fingertips without dependence on manual activation making protection intuitive, reliable, and effectively that operates beyond manual triggers, making safety intuitive, accessible, and deeply integrated into everyday life.

II. LITERATURE SURVEY

Recent advancements in IoT and AI-based have opened the door for enhanced safety solutions for women. A wide range of research has explored wearable safety devices with features such as GPS tracking, alert systems, and real-time monitoring. However, the implementation of a voice-activated safety system remains a novel and underexplored area. While existing systems provide crucial safety enhancements, they often suffer from manual dependency, high infrastructure costs, and activation limitations. False positives and accuracy issues further impact their effectiveness.

Our proposed IoT-based safety device aims to overcome these challenges by integrating automatic distress detection (via BP fluctuations), voice-activated SOS, live GPS tracking, and real-time audio-video recording for evidence collection. By addressing the shortcomings of previous research, this solution ensures enhanced reliability, accessibility, and real-time security for women in distress. Several scholarly works have investigated the integration of IoT in women's

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safety, leading to innovative yet imperfect solutions. The following section analyses the available literature regarding IoT-based safety devices, emphasizing their methodologies, advantages, and limitations.

Reference paper1: This paper introduces an innovative safety device featuring an artificial nail embedded with a pressure sensor to detect distress situations. The system integrates a pepper spray mechanism for immediate self- defense and an automatic location-based alert system that sends distress messages to emergency contacts. This approach ensures a quick response and proactive safety for users. However, the device's high cost may limit accessibility, and it may lead to false activation, which could lead to unintended alerts. [1]

Ref paper2: Author introduces a wearable device that constantly track health parameters such as pulse and temperature. In case of distress, it sends alerts via the Blynk app to designated contacts, ensuring timely assistance. The device also features GPS-enabled real-time location tracking for accurate victim identification. Its key advantages include continuous health monitoring and instant alerts. However, its functionality depends on smartphone connectivity, and potential sensor accuracy issues may affect reliability. [2]

Ref. paper3: The paper introduces a beacon-based wearable help button that triggers emergency alerts with a simple press. The system relies on solar-powered Access Points (APs) to relay distress signals to central stations, ensuring efficient communication in emergencies. Additionally, Bluetooth Low Energy (BLE) technology is used to send alerts, making it effective even in low-network areas. The key advantages include accurate tracking and functionality in regions with poor cellular connectivity. However, its effectiveness is limited to areas with pre-installed infrastructure, restricting its widespread usability. [3]

Ref_paper4: Utilizes IoT-based fingerprint authentication to trigger emergency alerts, ensuring rapid response in critical situations. The system sends messages, audio recordings, and images to emergency contacts and law enforcement, enhancing situational awareness. Additionally, a GPS module enables real-time location tracking for accurate victim identification. The device offers hands-free activation and multiple alert mechanisms, making it highly efficient. However, its reliance on fingerprint authentication may lead to false positives, and network dependency could affect timely communication. [4]

Ref*paper5: Proposes an innovative safety mechanism by integrating IoT-enabled streetlights with emergency response capabilities. The system ensures real-time monitoring and immediate distress alert transmission, enhancing urban safety. It leverages existing telecommunication infrastructure to facilitate rapid emergency response. The key advantage of this approach is its ability to utilize pre-existing infrastructure for efficient deployment. However, putting it into practice involves substantial investment in infrastructure, which may limit its scalability in underdeveloped areas. [5]

Ref^paper6: Introduces a fingerprint-based distress signal activation system to ensure quick emergency response. The device is equipped with a shockwave generator for self-defence, providing an immediate protective measure against threats. Additionally, it integrates with a smartphone app designed to supports users navigate to designated safe zones. The key advantages of this system include automated alerts and an inbuilt self-defence mechanism. However, its reliance on fingerprint authentication may lead to errors, and the use of a shockwave generator raises potential legal and ethical concerns. [6]

Ref._paper7: The author introduces a discreet, wearable safety solution that integrates GPS and IoT technology into footwear. When triggered, the system sends real-time location and emergency alerts to pre-set contacts via a connected mobile application. Its unobtrusive design ensures user comfort and allows for regular use without drawing attention. Key advantages include real-time tracking and mobile integration. However, the system faces limitations such as limited battery life and potential GPS signal issues in remote or enclosed areas. Despite this, it presents a practical and proactive approach to enhancing women's personal safety. [7]

Ref__paper8: The authors of the approach have highlighted an innovative technique to enhancing women's safety through the integration of IoT and Machine Learning (ML) technologies into a portable bag. The smart bag is integrated with multiple sensors and communication modules that monitor environmental cues and user behavior. By leveraging ML algorithms, the system can predict potentially dangerous situations based on anomalous patterns in the data collected. Upon detecting a threat, the bag automatically sends real-time emergency alerts, including the user's location, to predefined contacts or emergency services, thereby facilitating swift assistance. The primary advantages of this design incorporates its discreet and easily portable design, allowing users to Take it along effortlessly as part of their daily routine. The incorporation of ML enables proactive threat detection, enhancing the user's sense of security. However, the system also faces certain challenges. The accuracy of threat prediction heavily depends on the quality and quantity of

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data used to train the ML models, necessitating regular updates and retraining to maintain reliability. Additionally, it could result in false predictions, which could lead to unnecessary alerts and potential desensitization to genuine threats. Despite these limitations, the smart bag represents a significant step forward in utilizing advanced technologies to bolster personal safety for women. [8]

REF paper9: The research outlines a wearable safety jacket designed to enhance women's security through integrated technology. The jacket incorporates live audio and video streaming capabilities, allowing real-time monitoring of the wearer's surroundings. Equipped with GPS functionality, it enables real-time location tracking, ensuring that the wearer's position can be continuously monitored. Additionally, the jacket features a panic alert system that, when activated, sends immediate distress signals to predefined contacts or emergency services, facilitating swift assistance. The primary advantages of this safety jacket include its discreet design, which allows for inconspicuous use, and the integration of multiple safety features such as live audio/video streaming and real-time tracking. However, the jacket also presents certain challenges. Its design may be considered bulky, potentially affecting user comfort and regular use. Moreover, the continuous surveillance capabilities raise privacy concerns, as constant monitoring could lead to potential misuse of personal data. Despite these limitations, the IoT-enabled safety jacket signifies an important technological leap in wearable technology aimed at enhancing women's safety. [9]

Ref@paper10: A simple and cost-efficient solution to enhance women's personal safety. The system uses an Arduino microcontroller in combination with a satellite-based positioning system for detecting the user's real-time location and a cellular communication network module to send that location via SMS to pre-registered emergency contacts. The device is activated by a panic button, making it user-friendly and easy to operate even in high-stress situations. This method ensures that help can be alerted promptly without the need for internet connectivity. The key advantages of this **sys**tem include its low implementation cost, broadening accessibility to a large population, and its SMS-based communication, which functions in areas with basic cellular coverage. Additionally, its straightforward design makes it effortless to use. However, the model does have limitations. Its effectiveness depends on GSM network availability, which can limit functionality in remote or low-signal areas. There may also be delays in message delivery under poor signal conditions. Despite these drawbacks, the device offers a practical and scalable solution for real-time emergency alerting in women's safety applications. [10]

Reference_paper11: The study presents a comprehensive review of existing technologies aimed at enhancing women's safety. The study explores various IoT-based wearable devices designed to provide real-time tracking, instant emergency alerts, and sensor-based automatic detection of distress situations. These devices typically integrate components such as GPS for location tracking and GSM modules for communication, facilitating prompt assistance when needed. The paper highlights the advantages of these devices, including their compact design, which ensures ease of use and portability. However, it also acknowledges certain limitations, such as dependence on network signals, limited battery life, and potential delays in areas with poor connectivity. The authors emphasize the requirement for continuous advancements in technology to address these challenges and improves the reliability and effectiveness of personal safety devices for women. [11]

III. PROBLEM IDENTIFICATION

One of the primary challenges in ensuring personal safety, particularly for women, is the inability to activate protective devices during moments of physical or psychological distress. In high-risk situations, relying on manual intervention is often impractical or impossible. Additionally, existing safety systems generally lack the capability to detect danger automatically, as they depend on the user to trigger alerts. This limitation frequently results in delayed emergency responses, as authorities are not notified in real time. Furthermore, the absence of real-time location tracking makes it difficult to pinpoint the victim's whereabouts, hindering timely assistance. Another critical issue is the lack of evidence collection during incidents, which poses obstacles in pursuing legal action due to insufficient proof. Lastly, traditional safety measures, though widely used, often fall short in effectiveness due to their dependence on manual operation and lack of adaptability to dynamic situations.

IV. SUMMARY

This project focuses on the development of an intelligent IoT-based safety device tailored specifically to enhance the personal security of women in situations that may pose a threat or emergency. A key innovation of this system is the integration of a voice-activated trigger an uncommon feature in current safety devices which enables users to initiate emergency alerts through pre-set voice commands. This hands-free functionality is particularly valuable in scenarios where physical interaction with the device is not feasible.

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At the heart of the system is an SOS alert mechanism that dispatches real-time emergency notifications, including precise GPS location data, to nearby law enforcement agencies and preselected trusted individuals such as family members and close friends. This dual alert pathway facilitates a swift response from both authorities and the user's personal support network.

The device also incorporates live audio and video streaming functions. Once activated, it begins capturing and transmitting real-time footage, which is securely stored for future reference. This feature not only provides situational awareness but also creates a digital record that can be used as legal evidence if necessary.

An advanced safety enhancement comes from its health-monitoring capability. By continuously tracking the user's blood pressure, the system can detect critical anomalies that may indicate physical distress. In situations where the user is unable to speak or manually activate the device, these physiological signals can autonomously initiate the safety protocols, ensuring help is summoned even when the individual is incapacitated.

By integrating IoT connectivity, biometric monitoring, and real-time communication, this device offers a robust and proactive safety solution. It moves beyond traditional systems that rely solely on manual activation, offering a smarter and more responsive approach to women's personal security.

V. APPLICATIONS

1. **Women's Personal Safety in Public Spaces**
Provides discreet yet powerful protection for women during travel, late-night commutes, or in unfamiliar environments by enabling rapid alerts and real-time tracking.

2. **Safety Assurance for Working Professionals**
Ideal for women in fields requiring late shifts or travel—such as healthcare, hospitality, or law enforcement—ensuring constant monitoring and emergency support.

3. **College and School Student Security**
Offers guardians peace of mind by equipping students with a wearable device that provides live location updates and emergency communication features.

4. **Protection in Domestic Violence Situations**
Acts as a silent alert system in high-risk domestic environments, where victims may be unable to manually call for help.

5. **Emergency Support for Elderly Individuals**
Can be adapted to serve as a health and safety monitoring device for elderly users, with fall detection, pulse monitoring, and instant alert capabilities.

6. **Field Worker and Remote Area Safety**
Useful for individuals working in isolated or hazardous areas (e.g., surveyors, agricultural workers), ensuring they can be located and assisted during emergencies.

7. **Legal Evidence Collection in Assault or Threat Scenarios**
Enables automatic audio/video recording and secure storage, aiding law enforcement and judicial processes by preserving incident proof.

8. **Travel Companion for Solo Travelers**
Enhances security for solo female travellers by offering both real-time locations sharing and emergency deterrent mechanisms.

9. **Child Safety Monitoring Tool**
Adaptable for use by children to ensure parents can track their whereabouts and receive alerts in case of panic or danger.

10. **Assistive Technology for Differently-Abled Individuals**
Supports individuals with speech or mobility impairments by providing voice-activated or biometric-triggered emergency response systems.

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VI. CONCLUSIONS AND FUTURE SCOPE

The proposed IoT-based safety device offers a significant advancement in personal protection, particularly for women, by integrating multiple smart technologies into a compact and user-friendly wearable solution. Utilizing voice recognition, pulse rate monitoring, real-time GPS tracking, and live audio/video recording, the system ensures that emergency situations are detected and addressed proactively. The dual-mode activation system—both manual and automatic—provides flexibility, while the use of ESP32 microcontrollers, SIM800L GSM, and NEO-6M GPS modules allows for swift SOS communication even in offline environments. The inclusion of an audible buzzer enhances on-site alerting, drawing public attention during threats. Moreover, cloud support and low-power operation enhance the device's scalability and long-term usability. This project exemplifies how emerging technologies can be harnessed to create intelligent safety solutions, transforming the approach from reactive to preventive. It holds promise as a pioneering tool in redefining how personal safety can be managed through technology.

- **AI-Based Threat Prediction**: Incorporating machine learning to analyse surroundings and predict unsafe situations in real-time.
- **Biometric Security Enhancements**: Adding fingerprint or facial recognition to restrict unauthorized access to the device.
- **Real-Time Crime Mapping**: Using AI with crime databases to alert users about nearby high-risk zones.
- **Advanced Self-Defence Modules**: Integration of compact pepper spray or stun components for immediate physical defences.
- **Sustainable Power Options**: Enhancing battery performance through solar charging or higher-capacity cells for uninterrupted operation.
- **Wearable Design Innovation**: Miniaturizing the device into stylish forms such as rings, pendants, or bracelets for seamless daily use.
- **AI-Powered Cloud Integration**: Enabling intelligent data processing, live updates, and personalized emergency responses through cloud platforms.
- **Community Alert Network**: Creating a connected ecosystem where nearby users are instantly notified to support victims collectively.
- **Global Deployment Potential**: Adapting the system for broader geographic and cultural contexts to make it a universally adopted safety tool.

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