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Sonic Weapon for Women Safety

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Abstract

This paper introduces an IoT-integrated teaser gun designed specifically for enhancing women's safety. The device, incorporating an ESP32 module, integrates GPS tracking and IoT functionalities to provide real-time location monitoring and emergency response capabilities. Upon activation via a panic button, precise GPS coordinates are transmitted to a centralized database accessible through web and mobile applications, enabling rapid assistance in critical situations. Furthermore, the device employs preset location monitoring to identify and alert users and designated receivers of potential safety threats in high-risk areas. Audible alert mechanisms are integrated to promptly notify users of impending dangers, empowering women to prioritize their safety effectively. This innovative solution addresses the urgent need for proactive measures to combat gender-based violence, offering a comprehensive approach to ensuring women's safety in vulnerable situations.

Keywords: Women's Safety IoT Innovation; Smart Self-defense for Women; Women Empowerment with IoT; Innovative Security Tech; Real-Time GPS-Tracked Safety; Smart Women Safety Solution.

1. Introduction

In recent years, concerns regarding women's safety have become increasingly prevalent, spurred by rising incidents of gender-based violence and harassment worldwide. [1] Recognizing the critical need for proactive solutions to address these challenges, this paper introduces an innovative approach towards enhancing women's safety through the integration of IoT technology with a specially designed teaser gun.

Traditional methods of self-defense often lack real-time communication and tracking capabilities, leaving individuals vulnerable in emergency situations. [2] To bridge this gap, our device leverages the power of IoT to combine the functionality of a teaser gun with GPS tracking and communication features, providing women with an effective means of self-protection and emergency assistance.

Central to the device's design is the utilization of an ESP32 module, enabling seamless integration of IoT capabilities. This module serves as the backbone for enabling internet connectivity and communication with external databases and applications. [3] By harnessing the ESP32's robust features, our device ensures reliable and efficient transmission of critical data, including GPS coordinates and emergency alerts.

At the heart of the device lies its ability to provide real-time location tracking and emergency response. In the event of an emergency, users can activate the device's panic button, triggering the immediate transmission of precise GPS coordinates to a centralized database. These coordinates are then accessible through web and mobile applications, facilitating swift intervention and assistance by designated responders.

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Moreover, the device incorporates preset location monitoring to proactively identify and address potential safety threats in high-risk areas. By analysing historical data and reported incidents, the device can detect proximity to predefined danger zones and issue timely alerts to both the user and designated receivers. This proactive approach empowers women to navigate their surroundings with greater confidence and security.

Furthermore, audible alert mechanisms are integrated into the device to provide [4] immediate warnings of impending dangers. These alerts serve as a crucial line of defense, ensuring that users are promptly notified of potential threats, thereby enabling them to take proactive measures to ensure their safety.

2. Literature survey

The research paper [1] presents a comprehensive Women Safety Device integrating a Shock Taser and Location Tracking, implemented through Arduino Uno microcontroller. The device aims to address the critical issue of women's safety by combining a shock taser for self-defense with a real-time location tracking system. Utilizing high-voltage, low-current pulses generated by Arduino Uno, the shock taser serves as a deterrent against potential threats, while GPS and GSM technologies enable continuous monitoring of the user's position. Upon activation, the device swiftly communicates the user's location to predefined contacts via SMS, ensuring prompt response in emergencies. By merging personal defense with proactive tracking, the device contributes to fostering safer environments for women and offers peace of mind to both users and their loved ones.

The paper [2] discusses the development of a Teaser Glove for Women Safety, designed to offer protection using electric shock technology. This compact and lightweight smart glove delivers low current, high voltage electric discharge to temporarily immobilize attackers without causing major injury. The device utilizes components readily available in the market, making it cost-effective and easily accessible. Input parameters of 3 V with 3 to 5 Amps are provided, yielding an output range of 100 to 500 mA and 600 V. The glove integrates various technologies, including Arduino boards, sensors, electric circuits for high-voltage shock delivery, and GPS/GSM modules for tracking purposes. The circuit comprises batteries, resistors, capacitors, step-up transformers, transistors, diodes, LEDs, and switches, enabling efficient operation. The glove's design incorporates materials like leather, PVC, synthetic rubber, and metal rivets acting as electrodes, ensuring durability and conductivity. The spring mechanism triggers the shock delivery upon contact with the opponent, restricting their movement. The paper provides detailed circuit diagrams, design calculations for spring stiffness, and insights into the conduction of electric current through the human body. Overall, the Teaser Glove represents a promising approach to women's safety, offering a practical and affordable solution with potential for further enhancements through GPS and GSM integration for location tracking.

In this paper [3] presents a Women Safety Device utilizing IoT technology, designed to provide wearable safety for women using Arduino. The device aims to ensure women's safety in potentially dangerous situations by leveraging a wireless sensor network for communication and alerting. Integrated GPS and GSM technologies enable the device to share the user's location directly with relevant authorities and saved contacts. In case of emergencies, a switch activates manual alerts and triggers a shock, accompanied by the activation of a buzzer and a laser diode. The project addresses the pressing issue of women's safety in today's world, offering a practical solution leveraging contemporary technology. Through the combination of Arduino, GPS, GSM, and other components, the device provides a versatile and effective means of protection for women. The paper outlines the hardware and software requirements, including Arduino Uno, GSM modules, switches, LCDs, buzzers, GPS modules, inverters, batteries, laser diodes, and transformers. Furthermore, it details the functionalities of key components such as Arduino Uno, switches, relays, buzzers, power supplies, transformers, GSM modules, laser diodes, and GPS modules, providing a comprehensive understanding of the device's architecture. The proposed system offers advantages such as portability, low power consumption, compactness, ease of installation, and environmental friendliness.

This paper [4] proposed a wearable safety device powered by the NodeMCU microcontroller, aiming to enhance women's safety in diverse situations. Leveraging IoT technology, the device establishes robust communication channels and promptly triggers alerts upon detecting sensor readings surpassing predefined thresholds. Integrated GPS and GSM functionalities ensure swift transmission of the user's location to designated authorities and contacts during emergencies. Furthermore, manual switches empower users to activate distress signals or deactivate the system as needed. Through the utilization of the ThingSpeak IoT platform, the device facilitates continuous health monitoring by uploading sensor data to the cloud at regular intervals. This comprehensive approach underscores a commitment to women's safety, integrating advanced communication, location tracking, and health monitoring features into a compact and wearable form factor

2.1. Design Methodology

The design methodology for the system entails a systematic approach to achieve its intended functionality and operational flow. Below is an elucidation of the design methodology:

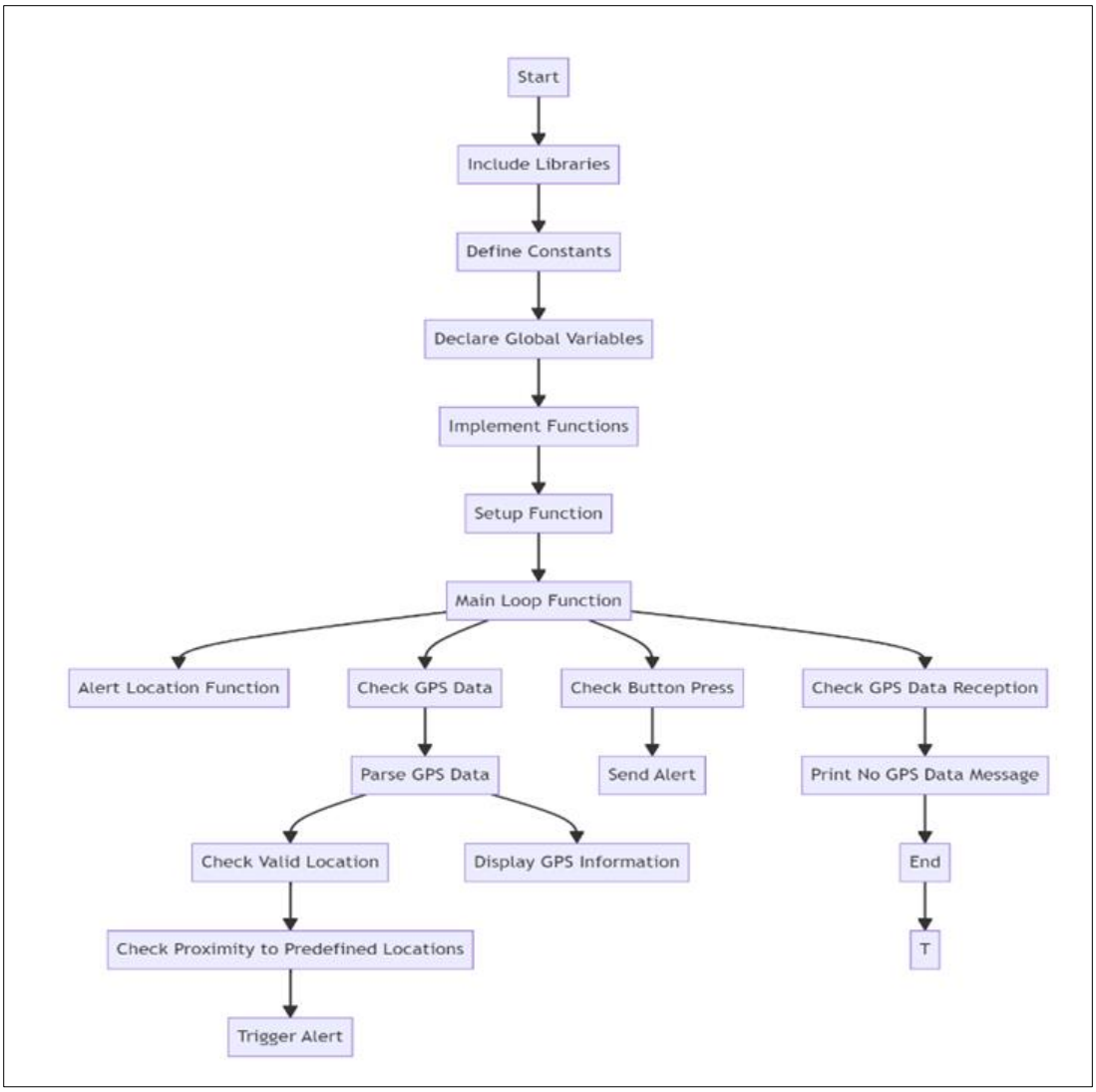

Figure 1 Flow Chart for Proposed

2.1.1. Initialization and Setup

- The system initialization process begins with setting up the required components, including the GPS module, button input, LED indicator, and buzzer.
- Upon power-up, the system establishes a connection to a designated Wi-Fi network using the provided credentials.

2.1.2. GPS Data Acquisition

- The system continuously retrieves GPS data using the TinyGPS++ library, which interfaces with the GPS module via software serial communication.
- Latitude and longitude coordinates, along with other relevant GPS parameters such as speed and timestamp, are extracted from the GPS data stream.

2.1.3. Proximity Detection

- Utilizing a basic proximity detection algorithm, the system calculates the distance between the current GPS coordinates and predefined locations stored in the system.

- The Haversine formula is employed to calculate the geographical distance between two GPS coordinates, determining if the system is within the vicinity of predefined locations.

2.1.4. Alerting Mechanism

- In the event that the system detects proximity to a predefined location or receives a trigger signal from the button input, an alerting mechanism is activated.
- The alerting mechanism involves flashing the LED indicator and emitting audible signals through the buzzer to attract attention and indicate an emergency situation.

2.1.5. Emergency Response Protocol

- Upon triggering an alert, the system executes predefined emergency response protocols, which may include transmitting the user's location coordinates to designated contacts or initiating additional safety measures.

2.1.6. Continuous Monitoring and Feedback

- The system operates in a loop, continuously monitoring GPS data and button inputs to ensure prompt detection and response to emergency situations.
- Real-time feedback, including GPS coordinates, speed, and date/time information, is provided through serial communication for monitoring and debugging purposes.

The design methodology encompasses the systematic setup, data acquisition, proximity detection, alerting mechanisms, emergency response protocols, and continuous monitoring of the system. These elements collectively ensure the system's functionality and effectiveness in detecting and responding to emergency situations in real-time.

2.2. Working

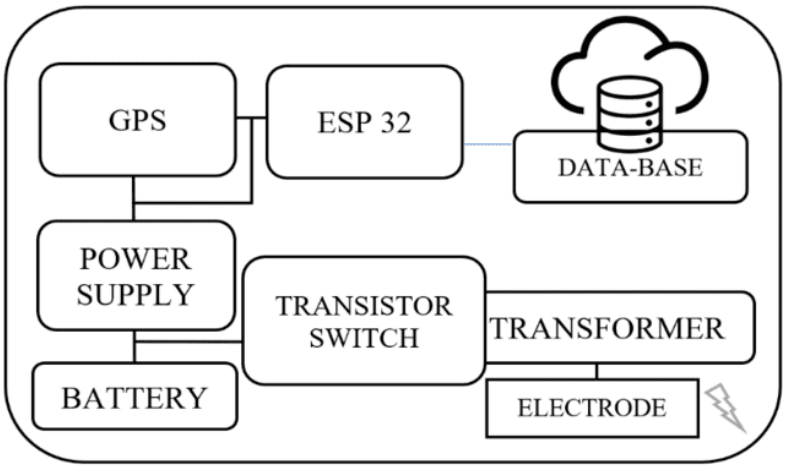

Figure 2 Block Diagram of the System

The proposed system is depicted in the block diagram, featuring an IoT interface along with the integration of a stun gun for enhanced security deployment.

The functioning of the system can be delineated into several key modules, each contributing to its overall efficacy and functionality:

2.2.1. GPS Module

The system utilizes a GPS module to obtain real-time latitude and longitude coordinates of the user's location.

These coordinates are continuously monitored and updated, providing accurate positioning information.

2.2.2. Button Input Module

- A button input module is integrated into the system, enabling users to trigger emergency alerts manually.
- Upon activation, the button prompts the system to initiate emergency response procedures.

2.2.3. Alerting Mechanism

- An alerting mechanism comprising an LED indicator and a buzzer is employed to provide visual and auditory cues in emergency situations.
- When an emergency alert is triggered, the LED flashes and the buzzer emits audible signals to attract attention.

2.2.4. Wi-Fi Connectivity

- The system leverages Wi-Fi connectivity to establish a network connection and facilitate data transmission.
- Upon boot-up, the system automatically connects to a predefined Wi-Fi network using the provided credentials.

2.2.5. Predefined Locations

- The system incorporates predefined location coordinates, representing areas of significance or known emergency zones.
- These coordinates serve as reference points for proximity-based alerting and response.

2.2.6. Proximity Detection

- Utilizing a basic proximity detection algorithm, the system calculates the distance between the user's current location and predefined coordinates.
- The Haversine formula is employed for distance calculation, represented as:

$$a = \sin^2(\frac{\Delta \text{lat}}{2}) + \cos(\text{lat1}) \cdot \cos(\text{lat2}) \cdot \sin^2(\frac{\Delta \text{lng}}{2})$$

$$c = 2 \cdot \text{atan2}(\sqrt{a}, \sqrt{1-a})$$

$$\text{distance} = \text{EarthRadius} \cdot c$$

- Here, Δlat and Δlng represent the differences in latitude and longitude between two GPS coordinates, respectively. EarthRadius is the radius of the Earth in kilometers. These formulas enable accurate distance calculation, facilitating proximity-based alerting and response.

2.2.7. Emergency Response

- In the event of an emergency alert, the system executes predefined emergency response procedures.
- These procedures may include notifying designated emergency contacts, transmitting the user's location coordinates, and activating additional safety measures.

2.2.8. Continuous Monitoring

- The system continuously monitors GPS data and button input, ensuring prompt detection and response to emergency situations.
- Data processing and alert triggering occur in real-time, minimizing response times and enhancing user safety.

In essence, the system amalgamates advanced GPS technology, intuitive user interfaces, and robust alerting mechanisms to deliver a comprehensive safety solution. By seamlessly integrating these modules, the system empowers users with enhanced situational awareness and rapid emergency response capabilities, thereby fostering a safer and more secure environment.

3. Results

The implementation of the proposed system yielded notable outcomes in augmenting safety measures and enhancing situational awareness. Through a comprehensive integration of IoT technology, the system effectively provided timely caution alerts and facilitated precise location tracking, thereby empowering users with actionable insights in potentially risky scenarios.

Figure 3 Caution Message and Alert

The caution alert messages, convey critical information about potential threats or unsafe situations, serve as an essential lifeline for recipients. Equipped with real-time data and contextual insights, these alerts empower receivers to assess the situation accurately and provide timely assistance or guidance to the user.

Moreover, the interactive map interface enhances the receiver's ability to track the user's location in real-time, facilitating precise navigation and coordination of response efforts. By visualizing the user's movements and surroundings on a dynamic map interface, receivers can effectively monitor the situation and devise optimal strategies for intervention or support.

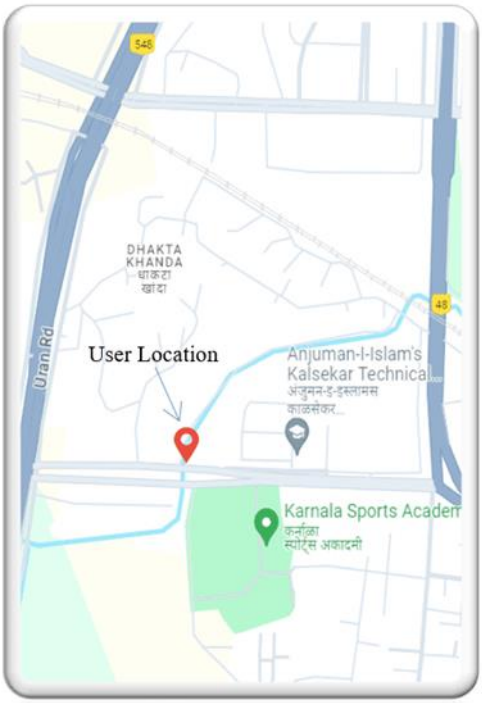

Figure 4 Real Time Map Interface

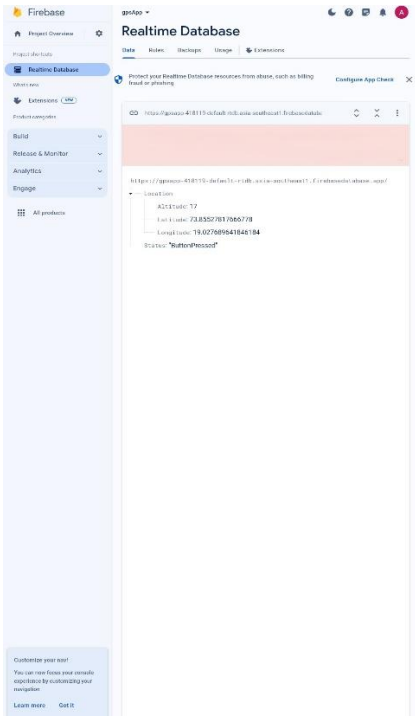

Figure 5 Firebase Console

By seamlessly integrating caution alerts and dynamic mapping functionalities, the system emerges as a holistic safety platform, reshaping conventional notions of personal security amidst the complexities of modern urban landscapes.

These advanced systems offer sophisticated mechanisms for preemptive alerting in high-risk environments, effectively preempting potential threats and elevating overall safety standards.

4. Conclusion

The research underscores the indispensable role of technology in fortifying women's safety, an imperative amidst the escalating concerns of harassment and assault. In response to these challenges, there's an acute need for meticulous

attention and innovative solutions. Emerging technologies, notably IoT, present a compelling avenue to confront assailants and bolster women's security, fostering confidence and resilience within communities worldwide.

Amidst the burgeoning wealth of data in today's era, there has been a notable evolution in safety device design, catalyzed by the advent of IoT solutions. These advanced systems offer sophisticated mechanisms for preemptive alerting in high-risk environments, effectively preempting potential threats and elevating overall safety standards.

By seamlessly integrating IoT technology, these systems enable continuous monitoring and data recording, empowering individuals with real-time insights and actionable intelligence. Through predictive analytics and proactive measures, such solutions facilitate a proactive approach to risk mitigation, significantly enhancing the safety landscape.

Looking ahead, it is imperative to recognize the transformative potential of technology in reshaping societal paradigms and combatting gender-based violence. Continued research and innovation in IoT hold the promise of further augmenting safety measures, fostering an environment where individuals can navigate public spaces with confidence and security.

In essence, the convergence of technology and women's safety stands as a beacon of progress in the ongoing pursuit of gender equality and social equity. By harnessing the power of innovation, we pave the way for a future where every individual, irrespective of gender, can thrive in an environment free from the specter of violence and fear.

Future implementation

In future implementations, the integration of LoRa wireless technology presents a significant advancement in women's safety systems. LoRa facilitates the establishment of standalone and dedicated networks tailored specifically for women's safety, eliminating the dependence on traditional IoT internet connections. This development ensures continuous location monitoring over long ranges, even in areas with limited internet coverage, thereby enhancing the accessibility and reliability of safety mechanisms. Moreover, the implementation of active encryption within the LoRa network strengthens security measures, mitigating potential breaches and safeguarding sensitive user data. By leveraging the capabilities of LoRa technology, future iterations of safety devices can achieve heightened levels of efficiency, scalability, and resilience, effectively addressing the evolving safety needs of women in diverse environments. This proactive approach to technology integration underscores a commitment to advancing safety solutions, empowering women with robust and adaptable tools to navigate their surroundings with confidence and peace of mind.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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