Enhancing Women's Safety And Security Through Ai Powered Wearables And Devices

[1]Ushasri, [2]B N Veerappa, [3]Maheswari L Patil

[1]Research Scholar, [2]Head of Department and Professor, [3]Associate Professor
[1]Computer and Information Sciences,
[1]GMIT (under VTU), Belagavi, India
[2]Computer Science and Engineering, GMIT, Davangere, India.
[3]Artificial Intelligence & Machine Learning, The Oxford College of Engineering, Bengaluru, India.

Abstract: This paper presents a conceptual framework for a Women's Safety Protocol — a proposed Python-based web application aimed at enhancing personal security through emergency alerts and real-time location tracking. By leveraging APIs such as Twilio and Geopy, the system is designed to discreetly notify emergency contacts when a user is in distress. Though still in the ideation stage, this proposal outlines the planned architecture, potential use of wearable integration, and future AI enhancements for emotional state detection. Future enhancement could involve AI-driven emotion detection using wearable devices.

The app utilizes Geopy to track the user's location with up to 200-meter accuracy, ensuring swift response capabilities. In the event of an emergency, it notifies multiple trusted contacts simultaneously and requests the user to verify their safety using a secure passcode. If the passcode is not entered, the system escalates the alert automatically. Through the combination of real-time tracking, automated alerts, and a discreet, intuitive interface, the Women's Safety Protocol offers a reliable and effective solution for women to access help promptly—enhancing personal safety and enabling rapid assistance from friends, family, or authorities.

Index Terms - In emergencies, real-time alerts and quick-response protocols, powered by the IoT, ensure women's safety by tracking location and enhancing security.

I. INTRODUCTION

Ensuring personal safety is a critical issue, for women who may encounter increased risks in public or secluded environments. With the rise of technology, security- focused websites have become accessible and effective. The Women's Safety Protocol is a proactive solution designed to provide an easy-to-use, reliable emergency response platform. Developed using the Python Flask framework, the platform offers women a discreet and accessible way to request help during emergencies. By leveraging real-time location tracking, automated alerts, and periodic safety checks, the system delivers a comprehensive safety tool for users.

The Women's Safety Protocol is built with an intuitive web interface that works seamlessly on both desktop and mobile devices, making it easy for users to access at any time. Users can activate an emergency mode, which prompts them to enter a passcode at regular intervals to confirm their safety. If the passcode is not entered correctly or on time, the website automatically sends urgent alerts to pre-designated emergency contacts via WhatsApp, including the user's approximate location for quicker assistance. By notifying multiple contacts simultaneously, the system helps minimize response times and enhances overall security. The project's primary goal is to provide a discreet yet powerful safety tool that enables users to feel more secure and independent, even in high-risk situations.

II. METHODOLOGY

The Women's Safety Protocol consists of four main components: Real-time alert system, Safety Verification through Periodic Prompts, Location tracking with Geopy and a user-friendly interface design.

2.1 Real-Time Alert System

Upon activation, users are required to set a passcode for future verification in the emergency alert mode. If the passcode is incorrect or not entered within the designated time, the system sends automatic alerts to pre-configured emergency contacts via WhatsApp. The Twilio API ensures these messages are delivered promptly.

2.2 Safety Verification through Periodic Prompts

The system periodically prompts the user to re-enter their passcode to ensure continuous safety. If the passcode is not entered correctly within the specified time, alert messages are automatically resent to emergency contacts, maintaining ongoing safety verification.

2.3 Location Tracking with Geopy

The website uses the Geopy library to estimate the user's location with an accuracy of about 200 meters. This location data is included in the alert messages, helping responders quickly pinpoint the user's whereabouts. By leveraging Geopy, the system ensures that location information is accurate and accessible, even if the user is unable to communicate directly.

2.4 User Friendly Interface Design

Developed using the Flask Python framework, the website offers an intuitive interface that prioritizes accessibility and ease of use. Optimized for both desktop and mobile devices, it ensures smooth access across platforms. The layout is designed for quick navigation, allowing users to activate emergency mode with minimal steps.

2.5 Future Integration with Emotion Recognition

The system can be extended with emotion recognition features using facial or voice analysis through deep learning models. This remains a future enhancement not covered in the current implementation.

III. ADVANTAGES OF THE WOMEN'S SAFETY PROTOCOL

3.1 Regular Safety Checks

Periodically prompting users to re-enter their passcode, the system adds a continuous layer of protection. This feature is particularly useful for users in prolonged unsafe situations, reinforcing the reliability of the safety protocol.

3.2 Enabling User Autonomy and Empowerment

The Women's Safety Protocol empowers users with a discreet and simple-to-use tool that enhances personal safety. It helps users take control of their security, offering a sense of autonomy and protection, even in risky situations.

3.3 Location-Based Automated Alert System

The automated alert system quickly notifies designated contacts in emergency situations. By including real-time location data in the alerts, it equips responders with crucial information to provide prompt assistance.

3.4 Improved Accessibility and User-Friendliness

Designed for ease of use, the Women's Safety Protocol provides a user-friendly experience. With compatibility across both mobile and desktop platforms, it ensures convenient access in various environments, enhancing usability.

3.5 Enhanced Reliability with Multiple Alerts

The protocol notifies multiple contacts simultaneously, enhancing the chances of a swift response. This redundancy ensures that someone in the user's support network is quickly alerted, giving both the user and their contacts greater peace of mind.

IV. LITERATURE SURVEY

In 2024, the study titled 'Safety with Technology: A Smart SOS Device' was conducted. The Empowering Women's Safety with a Raspberry Pi-based Device is an innovative initiative designed to combat violence against women by offering a multifunctional, wearable safety device. Equipped with a Raspberry Pi Camera Rev 1.3, GPS, a push button, a buzzer, and a camera module, the device can capture images and send emergency alerts via email to the nearest police station [1]. The methodology employed in this study involved One-click activation that leverages a Raspberry Pi, GPS, camera, and button to transmit alerts and images to authorities during emergencies. However, the study faces a drawback – manual activation is required. The user needs to physically press the button, which may not always be possible in certain situations.

In 2024, the study titled 'Securing IoT-Enabled Web Applications and Enhancing Women's Safety Through Advanced Technologies' was conducted. Internet of Things is rapidly reshaping the way we connect and manage physical objects, with smart homes and smart cities being prime examples of its transformative effects, leading to improved efficiency and financial benefits. However, the widespread use of IoT devices also brings about significant security challenges [2]. The methodology employed in this study involved IoT Security Framework that uses strategies like encryption, authentication, and integrity checks to protect web-apps against unauthorized access and vulnerabilities. However, the study faces a drawback – limited research on attack vectors. The lack of thorough studies on the relationships between various attack methods, key parameters, and email-based threats may result in gaps in overall security.

In 2024, the study titled 'Silent Alert: Advancing Women's Security through Smart Sign Recognition and AI' was conducted. In today's world, many advanced solutions are being developed with a focus on women's safety, particularly during the night. The proposed system leverages MediaPipe and various ML techniques—including Random Forest, Decision Tree, SVM, Gaussian Naive Bayes, K-Nearest Neighbors (KNN), Gradient Boosting, and a hybrid Stacking Classifier model—to create a robust safety solution [3]. The methodology employed in this study involved Machine learning-based safety model that employs MediaPipe and ML algorithms (including Random Forest, SVM, and KNN) to design an effective safety model for women. However, the study faces a drawback – complex implementation. Advanced ML techniques often require a lot of computational resources and specialized expertise to be effectively applied in real-time scenarios.

In 2023, the study titled 'Women's Safety in Cities Using Android' was conducted. An Android application was developed to help women feel safer. Given that many women feel vulnerable in large cities, researchers created the "Women's Safety in Cities Using Android" app. The app can be activated with a single click in an emergency. Once triggered, it uses GPS to determine the user's exact location and sends a message to their contacts with a link to the location's unique URL [4]. The methodology employed in this study involved Android Application Development – A safety app for women in urban areas that leverages GPS technology to track their location and send emergency alerts to contacts. However, the study faces a drawback – dependence on GPS accuracy. Poor GPS signals in certain urban areas could affect the accuracy of location tracking, leading to potential errors in emergency alerts.

In 2023, the study titled 'Exploring the Potential of Arduino Nano for Enhancing Women's Safety through Smart Sandals' was conducted. Crimes targeting women's safety and well-being remain alarmingly high, with the number of offenses continuing to rise across the country. Over the years, incidents of violence against women have dramatically increased. In response, a range of safety devices was developed to help women protect themselves in dangerous situations [5]. The methodology employed in this study involved Integrated Emergency System that combines wearable technology with a discreet emergency alert feature, ensuring it can still operate if the user is restrained or the device is confiscated. However, the study faces a drawback – reliance on technology. If the device experiences a malfunction or there is a delay in response, its effectiveness may be compromised in a critical emergency.

In 2023, the study titled 'Empowering Women's Safety: A Comprehensive GPS and GSM-Enabled Automated Anesthesia and Pepper Spray Defense System' was conducted, to provide security for women feeling vulnerable, thus allowing them to move freely, even during late hours. In case of danger, the device enables the user to activate pepper spray and an anesthetic injector by pressing an emergency button. The system is powered by an Arduino UNO and includes components such as pepper spray, an automatic anesthetic injector, a buzzer, and GPS technology [6]. The methodology employed in this study involved Arduino-Based System that uses an Arduino UNO, along with GPS, pepper spray, an anesthetic injector, and a buzzer, to provide safety during emergencies. However, the study faces a drawback – limited range. The device's effectiveness is confined to the surrounding area, potentially limiting its usefulness in more challenging or remote situations.

In 2023, the study titled 'Machine Learning Framework for Women Safety Prediction using Decision Tree' was conducted. Harassment and assault are major issues women face in urban environments. It uses a decision tree classifier (WSP-DT) to predict women's safety. The Twitter dataset is pre-processed to remove missing or irrelevant data before it is used for system implementation. The Natural Language Toolkit (NLTK) is then employed to analyze the tweets, performing tasks like lemmatization, stemming, stop- word removal, tokenization, and case conversion [7]. The methodology employed in this study involved WSP-DT Classifier that uses a decision tree classifier to evaluate and predict women's safety in online social networks, processing Twitter data with NLP techniques such as tokenization, lemmatization, and stemming. However, the study faces a drawback – data dependency. The accuracy of predictions is largely influenced by the quality and availability of data, which may hinder effectiveness in cases of insufficient or biased information.

In 2023, the study titled 'Design of Smart Shoe for Women Safety with Emergency Alert System' was conducted. To address the persistent issue of women's safety, a smart shoe has been developed to offer an added layer of protection in risky situations with an integrated emergency alert system to improve women's safety. It combines advanced sensors and communication technologies, such as an accelerometer, Atmega328 microprocessor, GPS, and GSM, to provide real-time safety support [8]. The methodology employed in this study involved Smart Shoe Development. The smart shoe features advanced sensors and communication technologies, including an accelerometer, GPS, and GSM, to bolster women's safety in threatening situations. However, the study faces a drawback – comfort and usability. The addition of technology may alter the shoe's comfort and weight, potentially reducing its appeal for everyday wear.

In 2023, the study titled 'Safety Watch Based on the Internet of Things' was conducted. The greatest fear for women worldwide is their safety in the face of threats like harassment, kidnapping, and other forms of violence. Modern safety measures typically rely on smartphones for features like location tracking and contacting emergency services. However, in such situations, the first thing attackers may grab and discard is the victim's phone, making it impossible for the device to establish contact for help [9]. The methodology employed in this study involved Hands-Free Wearable Device – designs a wearable safety device that eliminates the need for easily accessible items like phones or bags, allowing women to activate the alert system discreetly without drawing attention. However, the study faces a drawback – limited situational functionality. The device may not be useful in every scenario, especially if the user is incapacitated or unable to reach the activation button.

In 2023, the study titled 'Hope – An Arduino Based Safety device' was conducted. This system is designed for improving location tracking and emergency response efficiency. When a distress signal is activated, the system instantly sends a "Need Help" message via GSM to pre-registered contacts, along with real-time GPS coordinates, ensuring a fast and coordinated response. By enabling smooth communication between system components, Arduino technology enhances user security and speeds up reaction times [10]. The methodology employed in this study involved Arduino Implementation. The study uses an Arduino-based framework that combines GSM and GPS modules to facilitate real-time location tracking and emergency messaging for enhancing women's safety. However, the study faces a drawback – limited battery life. Dependence on battery-powered components may create operational challenges if the device runs out of power during an emergency.

In 2023, the study titled 'Real-time Monitoring of Women's Safety Through Bluetooth Low Energy and iBeacons' was conducted. A real-time tracking system for women's safety using Bluetooth Low Energy (BLE) and iBeacons. The Android Application Package (APK) then uses this data to send the mobile device's precise GPS coordinates to the server. When combined with the APK, this tracking method provides accurate location and iBeacon distance information. The system can also be integrated with Google Maps for more precise real-time monitoring [11]. The methodology employed in this study involved BLE and iBeacons that leverages Bluetooth Low Energy and iBeacons to support real-time tracking through the estimation of RSSI data. However, the study faces a drawback – environmental interference. Physical obstructions or interference can affect signal strength, potentially reducing the accuracy of tracking.

In 2023, the study titled 'Architectural Design and Recommendations for a Smart Wearable Device for Women's Safety' was conducted. It proposes an IoT-based safety system that notifies emergency contacts and authorities to assist women in danger or distress. The final prototype was developed through experimental computations, and its accuracy and efficiency were validated through a range of testing methods [12]. The methodology employed in this study involved IoT-based Safety System that creates a system that alerts emergency contacts and authorities to boost women's safety in emergency situations. However, the study

faces a drawback – dependence on connectivity. In areas with weak network coverage, the effectiveness may be diminished, disrupting alerts and communication.

In 2023, the study titled 'The Role of IoT in Woman's Safety: A Systematic Literature Review' was conducted. Various IoT-based solutions, including wearable devices, sensors, and ML algorithms, have been developed to enhance women's security. This study provides a comprehensive review of the literature on IoT devices for women's safety, exploring their key features and capabilities [13]. The methodology employed in this study involved IoT and Wearable Technology that incorporates IoT-enabled wearable devices, sensors, and machine learning algorithms to identify and respond to safety threats faced by women. However, the study faces a drawback – privacy concerns. Constant monitoring and data collection from such devices may raise privacy concerns for users.

In 2021, the study titled 'Women Safety System Design and Hardware Implementation' was conducted. Women's safety remains a critical issue in today's world. This study proposes a simple and cost-effective women's safety device that integrates Nod MCU, GSM, and GPS modules. In case of a threat, the user has a button on the device, which immediately tracks her location via GPS and sends an emergency alert to the local police and pre-saved contacts through the GSM module [14]. The methodology employed in this study involved Device Design. This study introduces an economical safety device incorporating Node MCU, GSM, and GPS modules, allowing women to quickly notify authorities and emergency contacts during emergencies. However, the study faces a drawback – dependence on signal strength. The system's effectiveness relies on the availability of GSM and GPS signals, which may be unreliable or absent in remote areas.

In 2020, the study titled 'A Novel Approach of Women Safety Assistant Device with Biometric Verification in Real Scenario' was conducted. A device that tracks a woman's location in real time and features an SMS alert function can ensure her safety and freedom of movement. This study introduces a safety tool for women, presenting a smart device that detects distress and responds accordingly. With a fingerprint module ensuring that authorized users only can access the device, it automatically sends an SMS to the appropriate authorities if the user fails to authenticate within a set time frame [15]. The methodology employed in this study involved smart device design. The study introduces a smart device with a fingerprint module, allowing only authorized users to access it, thereby enhancing personal security. It tracks the user's location in real time and sends alerts during distress situations. However, the study faces a drawback – user dependency. The system's reliance on the fingerprint module means that if a user is unable to use it due to incapacity, the device may fail to activate the emergency alert, potentially endangering their safety.

In 2019, the study titled 'IoT Based Smart Security Gadget for Women's Safety' was conducted. This article proposes a system designed to better women's safety. The portable device can be carried at all times, offering protection whenever a threat is perceived. The project aims to provide women with an immediate-response tool for reporting emergencies. The software allows women to quickly contact their guardians for help, helping them overcome fear. The smart bracelet alerts others by simply pressing a button, similar to a smart wristband concept [16]. The methodology employed in this study involved smart bracelet development. This project introduces a portable smart bracelet for women, allowing for rapid emergency reporting and direct communication with guardians. The system is designed to empower women and ease their concerns about personal safety. However, the study faces a drawback – limited functionality. Dependence on a button press may be problematic in situations where the user is unable to access or activate the device, potentially delaying the emergency response.

In 2017, the study titled 'A Proposed System for Security in Campuses using IoT Platform: A Case Study of A Women's University' was conducted. The responsibility for ensuring safety and creating a comfortable environment for all college campus members lies with the management. This study aims to assess the shortcomings of the current campus security system and propose a comprehensive solution, incorporating small, effective units to address security- related issues [17]. The methodology employed in this study involved Security System Analysis. This study examines existing campus security systems to identify their vulnerabilities, aiming to propose an integrated solution that leverages small, functional units to address the identified weaknesses. However, the study faces a drawback – implementation challenges. Introducing a new security system may face resistance from staff and students, as well as logistical challenges and the need for extensive training.

In 2017, the study titled 'Survey on women's safety mobile app development – (2017)' was conducted. With the prevalence of operating systems like Android, Windows, iOS, and others, developing mobile applications have become increasingly important. This portable application is specifically designed to promote women's well-being, helping to identify and assist them in times of need. It provides the user's precise location and

sends alerts to guardians, friends, and family through SMS [18]. The methodology employed in this study involved Mobile Application Development. This study aims to develop a mobile app that enhances women's safety by providing real-time location tracking and sending SMS alerts to guardians and loved ones during emergencies. However, the study faces a drawback – dependence on mobile connectivity. The app's functionality is hindered in areas with weak network coverage, limiting its effectiveness during critical situations.

These studies inform the conceptual development of our system, which seeks to combine proven strategies like location sharing with future possibilities such as wearable integration and AI analysis.

V. CONCLUSION

The Women's Safety Protocol is a powerful example of how technology can enhance personal safety for women. As concerns about women's safety in public spaces rise, this protocol emphasizes the importance of a responsive, tailored system that addresses the unique security challenges women face. By focusing on user-centered design, it ensures that safety tools are intuitive and accessible, allowing individuals to take proactive measures to protect themselves in real time.

Modern safety systems are most effective when they combine real-time data with actionable alerts, enabling both users and authorities to act quickly. To optimize emergency responses, this protocol automates location sharing and alert delivery, ensuring faster reactions from both personal contacts and local authorities. The real-time feature is vital, potentially preventing dangerous situations from escalating.

A key strength of this system is its flexibility. It adapts to various situations women may encounter, such as traveling alone, being late for work, or navigating unfamiliar areas, by offering location tracking and instant alerts. The protocol also values convenience and discretion, enabling users to request help without attracting undue attention. By connecting to commonly used platforms like WhatsApp, it ensures that messages are sent efficiently to pre-designated contacts during emergencies.

REFERENCES

[1] S. A. Sawant, S. Gurakhe, T. S. Shaikh, S. Bagmare, C. Rathad and S. Sobale, "Safety with Technology: A Smart SOS Device", pp. 1-6, doi:10.1109/ICCUBEA58933.2023.10392200, *2023 7th International Conference On Computing, Communication, Control And Automation (ICCUBEA)*, Pune, India, 2023.

[2] N. T. Singh *et al.*, "Securing IoT-Enabled Web Applications and Enhancing Women's Safety Through Advanced Technologies" *(ISCS)*, pp. 1-5, doi:10.1109/ISCS61804.2024.10581319, Gurugram, India, 2024.

[3] D. Senthilkumar, L. Bhavana and P. Ranjana, "Silent Alert: Advancing Women's Security through Smart Sign Recognition and AI", pp. 1-6, doi:10.1109/ADICS58448.2024.10533616, *2024 International Conference on Advances in Data Engineering and Intelligent Computing Systems (ADICS)*, Chennai, India, 2024.

[4] A.K, S. R and R. N, "Women's Safety in Cities Using Android", pp. 1383-1387, doi:10.1109/ICSSAS57918.2023.10331652, *2023 (ICSSAS)*, Erode, India, 2023.

[5] V. S, A. D, T. A and S. P, "Exploring the Potential of Arduino Nano for Enhancing Women's Safety through Smart Sandals", pp. 1792- 1797, doi:10.1109/ICAISS58487.2023.10250611, *2023 Second International Conference on Augmented Intelligence and Sustainable Systems (ICAISS)*, Trichy, India, 2023.

[6] H. B K, S. M L J, N. K. G N, C. K U, D. Lokesh and P. N. Mahendrakar, "Empowering Women's Safety: A Comprehensive GPS and GSM- Enabled Automated Anesthesia and Pepper Spray Defense System", pp. 1077-1081, doi:10.1109/I-SMAC58438.2023.10290183, *2023 7th International Conference on I-SMAC*, Kirtipur, Nepal, 2023.

[7] P. S. Sowmika, S. S. N. Rao and S. Rafi, "Machine Learning Framework for Women Safety Prediction using Decision Tree", pp.1089-1093, doi:10.1109/ICSSIT55814.2023.10060997,*5th International Conference on Smart Systems and Inventive Technology*, Tirunelveli, India, 2023.

[8] M. Hareni, S. Abishaya, P. Kavya and K. Rajasekar, "Design of Smart Shoe for Women Safety with Emergency Alert System", pp. 424-430, doi:10.1109/ICPCSN58827.2023.00075 *2023 3rd International Conference on Pervasive Computing & Social Networking (ICPCSN)*, Salem, India, 2023.

[9] D. Vaithiyanathan, K. Verma, P. Verma and B. Kaur, "Safety Watch Based on the Internet of Things", pp. 1332-1337, doi:10.1109/ICSSAS57918.2023.10331766, *2023 (ICSSAS)*, Erode, India, 2023.

[10] C. N. Savithri, L. B. S, B. Poornesh and V. Velappan, "Hope – An Arduino Based Safety device", pp.1-5, doi:10.1109/ICCEBS58601.2023.10448656 *2023 Intelligent Computing and Control for Engineering and Business Systems (ICCEBS)*, Chennai, India, 2023.

[11] V. Sharma S, S. Srinivasan, C. S. Ranganathan, N. Latha and G. E. Visuvanathan, "Real-time Monitoring of Women's Safety Through Bluetooth Low Energy and iBeacons", pp. 1282-1287, doi:10.1109/SmartTechCon57526.2023.10391725, *2023 Second International Conference On Smart Technologies For Smart Nation (SmartTechCon)*, Singapore, 2023.

[12] Manahil, R. Abdulla and M. E. Rana, "Architectural Design and Recommendations for a Smart Wearable Device for Women's Safety", pp. 215-220, doi:10.1109/DeSE58274.2023.10099522, *2023 15th International Conference on Developments in eSystems Engineering (DeSE)*, Baghdad & Anbar, Iraq, 2023.

[13] M. S. Farooq, A. Masooma, U. Omer, R. Tehseen, S. A. M. Gilani and Z. Atal, "The Role of IoT in Woman's Safety: A Systematic Literature Review," in *IEEE Access*, vol. 11, pp. 69807-69825, doi:10.1109/ACCESS.2023.3252903, 2023.

[14] S. Tayal, H. P. Govind Rao, A. Gupta and A. Choudhary, "Women Safety System Design and Hardware Implementation", pp. 1-3, doi:10.1109/ICRITO51393.2021.9596393, *2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, Noida, India, 2021.

[15] R. Khan, N. Mahfuz and N. Nowshin, "A Novel Approach of Women Safety Assistant Device with Biometric Verification in Real Scenario", pp. 426-431, doi:10.1109/WIECON-ECE52138.2020.9397938, *2020 IEEE International Women in Engineering, Conference on Electrical and Computer Engineering (WIECON-ECE)*, Bhubaneswar, India, 2020.

[16] T. M. R, Aishwarya, C. K. S, D. M. K and N. H, "IoT Based Smart Security Gadget for Women's Safety", pp. 348-352, doi:10.1109/ICAIT47043.2019.8987242, *1st International Conference on Advances in Information Technology (ICAIT)*, Chikmangalur, India, 2019.

[17] V. Singh and V. Kharat, "A Proposed System for Security in Campuses using IoT Platform: A Case Study of A Women's University", pp. 305- 310, doi:10.1109/CTCEEC.2017.8455076, *2017 International Conference on Current Trends in Computer, Electronics and Communication (CTCEEC)*, Mysore, India, 2017.

[18] R. Pavitra and S. Karthikeyan, "Survey on women's safety mobile app development", pp. 1-5, doi:10.1109/ICIIECS.2017.8276048, *2017 (ICIIECS)*, Coimbatore, India, 2017.