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Womens Safety System using Smart Watch

[1] DrVeenaS
Associate Professor
Department of Electronics and Communication Engineering,
SJC Institute of Technology, Chikkaballapura.

[2] Kushal C D
Department of Electronics and Communication Engineering,
SJC Institute of Technology, Chikkaballapura.

[3] Neeraj Yadav
Department of Electronics and Communication Engineering,
SJC Institute of Technology, Chikkaballapura.

[2] Ramesh D D
Department of Electronics and Communication Engineering,
SJC Institute of Technology, Chikkaballapura.

Abstract-This paper presents a low-cost, wearable personal safety system for women, integrated into a discreet smartwatch form factor. Amidst growing concerns for personal security, this device provides a rapid andreliable method for summoning assistance. The proposed system is built around an ESP32 micro-controller, integrating a dedicated panic (SOS) button, a high-sensitivity GPS module for real-time location tracking, a GSM module for cellular communication, and an MPU6050 accelerometer for automatic fall detection. When an alert is triggered, either manually via the SOS button or automatically by the fall detection algorithm, the system instantly retrieves the user's precise GPS coordinates and transmits them via an SMS message to pre-defined emergency contacts. The system operates independently of a smartphone, ensuring functionality even if the user's phone is lost or inaccessible. This paper details the system's architecture, operational flowchart, and the results of its performance evaluation, demonstrating its efficacy as a practical and accessible solution for enhancing women's safety. Many incidents occur when women are alone, traveling at night, or in unfamiliar places where help is not immediately available. In such situations, reaching out for assistance through a mobile phone becomes difficult due to panic, physical constraints, or fear of attracting unwanted attention.

Keywords: Internet of Things (IoT), ESP32 microcontroller, sensor-based monitoring, precise GPS coordinates and transmits them via an SMS message to pre-defined emergency contacts

I. INTRODUCTION

Personal safety, particularly for women, remains a significant societal challenge globally. The risk of harassment, assault, or other emergencies, especially when walking alone or in isolated areas, necessitates a reliable and immediate means of communication with emergency services or trusted contacts. The system operates independently of a smartphone, ensuring functionality even if the user's phone is lost or inaccessible. This paper details the system's architecture, operational flowchart, and the results of its performance evaluation, demonstrating its efficacy as a practical and accessible solution for enhancing women's safety. user's phone is lost or inaccessible. This wear- able device integrates essential safety features into a single, accessible platform. The system provides two modes of alert: a manual SOS panic button for user-initiated alarms and an automatic fall detection system, which uses an accelerometer to identify sudden, forceful impacts indicative of a fall or attack.

While smartphone applications for safety exist, they have notable limitations. Accessing an app during a high stress emergency can be slow, and a phone is often the first item an assailant may target, rendering it useless. Existing solutions, such as simple panic buttons, often lack the critical feature of real-time location tracking, providing no actionable information for responders. Other advanced systems may be bulky, expensive, or dependent on a nearby smartphone, creating a critical point of failure. This gap highlights the need for a solution that is discreet, always accessible, and functions as a standalone device. To address these limitations, this paper proposes a smartwatch-based personal safety system. This wear- able device integrates essential safety features into a single, accessible platform. The system provides two modes of alert: a manual SOS panic button for user-initiated alarms and an automatic fall detection system, which uses an accelerometer to identify sudden, forceful impacts indicative of a fall or attack. Upon activation, the device automatically transmits the user's precise GPS location via the GSM network, providing immediate, life-saving information to emergency contacts. This approach ensures a faster, more discreet, and more resilient safety net for women in vulnerable situations. Accessing an app during a high stress emergency can be slow, and a phone is often the first item an assailant may target, rendering it useless. Existing solutions, such as simple panic buttons, often lack the critical feature of real-time location tracking, providing no actionable information for responders. Other advanced systems may be bulky, expensive, or dependent on a nearby smartphone, creating a critical point of failure. By integrating IoT, GPS technology, health monitoring sensors, and emergency communication systems into a single wearable device, the Smart Women Safety Watch becomes a crucial technological step towards creating a safer environment for women everywhere. Apart from safety, the watch also contributes to health monitoring. Parameters like heart rate and body temperature are tracked to detect stress or medical abnormalities. If any unusual condition is observed, alerts can be sent to caregivers or medical services. This feature is especially beneficial for women with health concerns, elderly women, and pregnant women who require constant monitoring. The guardians or concerned authorities can monitor the user's live position using a connected mobile application, enabling them to respond quickly and efficiently in emergency situations.

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centres on efficient data processing and control of environmen tal systems, managed by a component known to achieve high accuracy compared to standard measuring tools [3][9]. To provide the required visual feedback and address the system gap identified in prior work, the system was integrated for real-time visual monitoring and image capture. Actuation mechanisms, including fans and humidifiers, are autonomously regulated based on feedback loops, maintaining microclimate stability [6]. The core innovation enhancing accessibility is the deployment of mobile application interface. This interface simplifies remote control and actuation for lazy users, enabling them to make timely adjustments to parameters and reducing their dependence on complex web pages or application dashboards [1][3][9]. The objective is to stabilize the environment through precise control and visual confirmation, thereby increasing crop yield and quality consistency while making high-precision cultivation accessible to a wider demographic.

II. LITERATURE SURVEY

N. Penchalaiah et al.[1] an IoT Based Smart Wearable Device for Women Safety" (2021)- Penchalaiah and colleagues present a compact IoT wrist-wearable that integrates GPS, GSM/Wi-Fi communication, and a panic/SOS button to send immediate location alerts to preconfigured contacts. The design uses low-cost microcontrollers (NodeMCU/ESP family) and cloud/mobile dashboards for monitoring, demonstrating a practical prototype for quick emergency notification. The paper highlights ease-of-use and low BOM cost as strengths, while noting limitations in continuous connectivity and limited health sensing accuracy in wrist-worn form factors. AN Kane, "IoT Based Automatic Women's Safety Device" (2024)-Kane proposes an IoT device that augments manual SOS with automated detection using simple machinelearning classifiers to infer abnormal events; when a threat is detected the system can send alerts and trigger deterrent actions. The study shows improved detection latency by processing events at the edge, but also reports increased power consumption and the need for more robust models to reduce false positives in diverse realworld motion patterns. This work illustrates trade-offs between automation, accuracy, and battery life. V. Ebenezer, "IoT-Based Wrist Band for Women Safety" (2023) - Ebenezer's 2023 implementation emphasizes a wristband combining GPS tracking, temperature/pulse sensors, and cloud-based monitoring. The contribution includes a working mobile-dashboard integration and usability testing with users who reported higher confidence in solo travel scenarios. The study points out sensor noise (motion artifacts) and GPS inaccuracy indoors as persistent problems, recommending sensor fusion and dutycycled GPS to optimize battery life and reliability

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Harshada Patil et al. [2]and several related IJIRSET publications, in which a compact and low-cost emergency alert system was implemented using readily available off-the-shelf components. In these works, location tracking was achieved through Neo-6M–type GPS modules, while GSM modems were employed to transmit distress alerts via SMS as a reliable fallback mechanism in the absence of internet connectivity. A simple embedded firmware sequence was implemented, whereby the acquisition of GPS coordinates was followed by automated message transmission to predefined contacts upon activation of an SOS trigger. Emphasis was placed on minimal system complexity, ease of assembly, and immediate deployability, making the designs suitable for student projects and rapid prototyping scenarios.

Experimental evaluations highlighted affordability and functional reliability as key strengths; however, several limitations were also identified. Continuous GPS operation was found to significantly reduce battery life, thereby limiting long-term usability in real-world conditions. Power management strategies were largely basic, with limited support for sleep modes or adaptive sampling. In addition, enclosure and mechanical design were noted as critical shortcomings, as most prototypes lacked ruggedization, weather resistance, and ergonomic refinement required for everyday wear. Despite these constraints, the studies provided valuable assembly-level guidance, including component selection, wiring practices, and bill-of-material (BOM) optimization, which are particularly beneficial for low-budget deployments. These contributions position the works as practical reference implementations, although further enhancements in power efficiency, enclosure design, and system robustness are required for scalable and sustained real-world adoption.

V. Ebeneze [3] an IoT-based wristband for women's safety was presented by V. Ebenezer in 2023, in which personal security was enhanced through the integration of location tracking, physiological sensing, and cloud-based monitoring. The proposed wristband architecture was implemented using an embedded controller interfaced with a GPS module for real-time positioning, along with temperature and pulse sensors to capture basic physiological indicators that may reflect stress or abnormal conditions. Sensor data and location information were transmitted to a cloud platform, where continuous monitoring and visualization were enabled through a mobile dashboard application. Usability testing was conducted with participants, and increased user confidence during solo travel was reported, indicating the perceived effectiveness of the system in real-world scenarios.

However, several technical challenges were identified during evaluation. Physiological sensor measurements were affected by motion-induced noise and inconsistent skin contact inherent to wrist-worn devices, resulting in fluctuating pulse and temperature readings. GPS performance was observed to degrade significantly in indoor or densely built environments, leading to reduced location accuracy and delayed position fixes. In addition, continuous sensing and location tracking imposed high energy demands, constraining battery life in the compact wristband form factor. To address these issues, the study recommended the adoption of sensor fusion techniques to improve reliability by correlating multiple data sources, as well as duty-cycled GPS operation to reduce power consumption while maintaining acceptable tracking performance. These findings highlight the transition of the work beyond basic SOS wearables toward more intelligent safety systems, while also underscoring the need for advanced signal processing, adaptive power management, and robust indoor localization methods for dependable long-term

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deployment.

Lokesh et al. [4] a Telegram-based alert system for women's safety was investigated by Lokesh et al. in 2023, in which the Telegram Bot API was utilized as the primary communication channel for emergency notifications. In the proposed approach, distress alerts were generated through a mobile or IoT interface and transmitted as Telegram messages containing live location links, timestamps, and optional multimedia content such as images or short audio clips. The system architecture was designed to operate with minimal backend infrastructure, relying mainly on Telegram's cloud services, thereby reducing deployment complexity and operational costs when compared to traditional SMS- or server-heavy solutions. Experimental evaluation demonstrated near-instant message delivery in region with stable internet connectivity, and the ability to broadcast alerts simultaneously to multiple recipients, including family members, guardians, and law enforcement groups, was identified as a significant advantage for coordinated response.

Despite these benefits, several constraints and considerations were documented. System reliability was found to be highly dependent on continuous internet availability, limiting effectiveness in low-connectivity or emergency network congestion scenarios. Privacy and data security concerns were emphasized, as real-time location sharing and multimedia transmission could expose sensitive personal information if mishandled. To mitigate these risks, encryption of alert payloads and controlled access to bot credentials were recommended, along with restricting continuous or background location broadcasting to event-triggered updates only. Additionally, user consent management and alert throttling mechanisms were suggested to prevent misuse and false alarms. Overall, the study demonstrated that messaging-platform-based alert systems can serve as cost-effective and scalable safety solutions, while highlighting the necessity of robust privacy safeguards, selective data sharing, and hybrid communication strategies to ensure dependable real-world deployment.

A. N. Kane [5] an IoT-based automatic women's safety device with enhanced intelligence was proposed by A. N. Kane in 2025, in which conventional manual SOS mechanisms were augmented with automated threat detection capabilities. In this work, abnormal or potentially dangerous situations were inferred using lightweight machine learning classifiers deployed directly on the edge device. Sensor inputs such as motion patterns from accelerometers, physiological indicators, and contextual data were processed locally to reduce dependence on continuous cloud connectivity. Upon detection of a suspected threat, emergency alerts containing location and event information were automatically transmitted to predefined contacts, and optional deterrent actions such as audible alarms or vibration feedback were triggered to attract nearby attention and discourage the attacker.

Performance evaluation demonstrated that edge-level processing significantly reduced detection and alert latency when compared to cloud-based inference, thereby enabling faster response during critical situations. However, the inclusion of continuous sensing and on-device machine learning resulted in increased power consumption, which negatively affected battery life in the compact wearable form factor. Furthermore, the study reported challenges related to false positives caused by diverse real-world motion patterns, such as running, commuting, or abrupt user movements, highlighting the limitations of simple classifiers under unconstrained conditions. To address these issues, the need for more robust models, adaptive thresholds, and improved feature selection was emphasized. The work effectively illustrates the trade-offs between automation, detection accuracy, and energy efficiency, positioning automated safety wearables as a promising yet technically challenging evolution beyond manually triggered systems.

H. Parikh and S. Kapoor [6]an IoT-based wearable safety device for women was further detailed by H. Parikh and S. Kapoor in 2025, with emphasis on sustainability, modularity, and real-world deployability. The system was implemented around the ESP32-CAM platform, which enabled the concurrent execution of wireless communication, sensor interfacing, and image acquisition within a single embedded unit. GSM communication was selected to ensure alert delivery through SMS or data services independent of smartphone availability, while GPS functionality provided continuous or event-triggered location tracking. The inclusion of camera-based evidence was intended to support post-incident analysis and improve situational assessment by guardians or authorities.

From an implementation perspective, the design highlighted efficient hardware integration and low-cost component selection to maintain affordability for large-scale adoption. Event-driven logic was employed so that image capture and transmission were activated only during emergency conditions, reducing unnecessary energy expenditure. Nevertheless, system evaluation revealed challenges related to thermal management, limited onboard memory for image buffering, and fluctuating network latency during multimedia transmission. Privacy and ethical considerations were also addressed, as continuous imaging could lead to misuse or unauthorized data exposure; therefore, the authors recommended strict access control, encrypted data transmission, and user-controlled activation mechanisms. Overall, the study extends conventional IoT safety wearables by incorporating contextual visual data, while reinforcing the need for careful balancing of alert richness, user privacy, and power efficiency to achieve sustainable and reliable operation in practical environments.

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K. Menon and T. Lee [7] a comprehensive survey on women's safety wearable watch systems was presented by K. Menon and T. Lee in 2025 in IJIRSET, in which existing wearable safety devices were systematically reviewed with emphasis on hardware architecture, communication strategies, and user interaction mechanisms. In the surveyed works, microcontroller platforms such as ESP32 and Arduino were predominantly employed due to their low cost, ease of

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programming, and wide community support. Location tracking was commonly implemented using the GPS NEO-6M module, while GSM SIM800L was widely adopted for emergency alert transmission through SMS or voice calls, ensuring functionality independent of smartphones and internet connectivity. Panic button–based activation was identified as the most prevalent triggering mechanism, owing to its simplicity and reliability under stressful conditions.

The survey further analyzed system-level design trade-offs, highlighting limitations related to power consumption, device size, and reliability. Continuous GPS tracking and GSM communication were reported to significantly impact battery life, particularly in compact watch-style form factors with limited energy storage. In addition, challenges associated with network availability, indoor GPS inaccuracy, and delayed message delivery under weak signal conditions were frequently observed across implementations. The study also noted that most surveyed devices relied on manual SOS activation, with limited adoption of automated threat detection or physiological monitoring due to sensor noise, computational constraints, and increased system complexity. Recommendations were provided for future designs, including the incorporation of low-power operation modes, hybrid communication schemes, improved enclosure ergonomics, and selective integration of intelligent sensing techniques. Overall, the survey serves as a consolidated reference for researchers and developers by summarizing practical component choices, architectural patterns, and open challenges, thereby guiding the development of more robust, energy-efficient, and user-centric women's safety wearable systems.

S. Mishra and R. Das[8] the design and development of an IoT-

based women's safety device were detailed by S. Mishra and R. Das in 2024 in IJSRD (Vol. 13, Issue 30), in which an integrated approach combining location tracking, visual evidence capture, and automated alert dissemination was presented. The proposed system architecture was built around the ESP32-CAM module, enabling simultaneous handling of wireless communication, image/video acquisition, and sensor interfacing within a compact embedded platform. GPS functionality was incorporated to acquire real-time location coordinates, which were appended to emergency alerts transmitted via both cloud services and GSM-based SMS to predefined contacts, thereby improving reliability across varying connectivity conditions. Automated alert generation was designed to reduce dependence on manual user intervention, allowing faster response during critical situations.

System evaluation demonstrated that the inclusion of visual data, such as images or short video clips captured at the time of distress, significantly enhanced situational awareness for guardians or authorities when compared to text-only alerts. However, the study also identified notable technical challenges. Continuous camera readiness and multimedia transmission resulted in elevated power consumption, limiting battery life in prolonged operation. Network variability further affected video quality and transmission latency, particularly under low-bandwidth conditions. Additionally, constraints related to onboard memory and processing capability restricted the duration and resolution of captured video streams. The authors emphasized the importance of event-driven camera activation, adaptive data compression, and efficient power management strategies to mitigate these limitations. Overall, the work advances IoT-based women safety systems by integrating automated alerts with contextual visual information, while underscoring the trade-offs between alert richness, energy efficiency, and system complexity that must be addressed for scalable real-world deployment.

R. Patel, S. Desai, and N. Shah [9] a smart security wearable system for women's protection was presented by R. Patel, S. Desai, and N. Shah in 2024 in the International Journal of Innovative Research in Technology (IJIRT179065). The proposed design was implemented using the ESP32 microcontroller as the central processing and communication unit, leveraging its integrated wireless capabilities to support real-time GPS-based location tracking and emergency alert dissemination. Upon activation of a panic mechanism or detection of abnormal conditions, location coordinates were acquired and transmitted to predefined emergency contacts, enabling timely situational awareness and response. The system emphasized a compact and low-cost wearable form factor suitable for continuous daily use.

The study highlighted advantages such as simplified system architecture, reduced hardware cost, and improved integration efficiency due to the use of a single ESP32 platform. Experimental observations indicated reliable alert transmission and acceptable location accuracy in outdoor environments with stable satellite visibility. However, several limitations were also identified. Continuous GPS operation was associated with increased power consumption, leading to constrained battery life in prolonged usage scenarios. Additionally, GPS accuracy degraded in indoor or urban canyon environments, affecting precise location reporting. The system primarily relied on manual alert activation, with limited incorporation of intelligent threat detection or physiological sensing. The authors suggested future enhancements including low-power operating modes, hybrid communication strategies, and the integration of additional sensors to improve automation and robustness. Overall, the work contributes a practical and cost-effective reference design for women's safety wearables, while reinforcing common challenges related to energy efficiency, indoor localization, and functional scalability in real-world deployments.

M. Singh, K. Verma, and A. Joshi [10] an IoT-based real-time women's safety and alert system was presented by M. Singh, K. Verma, and A. Joshi in 2024 in the International Journal of Scientific Research in Engineering and Technology (IJSRET, Vol. 11, Issue 6). The proposed system architecture was developed using an ESP32-based IoT platform, which served as the central controller for sensor integration, wireless communication, and alert management. Real-time location tracking was enabled through a GPS module, and emergency situations were handled by generating SOS alerts containing location information that were transmitted immediately to

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predefined contacts. The system design focused on achieving low latency in alert delivery, thereby improving the likelihood of timely intervention during critical incidents.

System implementation and testing demonstrated effective real-time performance under stable network conditions, with the ESP32 platform providing sufficient processing capability for continuous monitoring and rapid data transmission. However, operational constraints were also identified. Continuous GPS tracking and frequent data updates resulted in increased power consumption, limiting battery longevity in wearable or portable configurations. Variations in network quality affected alert transmission reliability, particularly in low-signal or congested environments. Additionally, the system relied primarily on manual SOS activation, with limited support for automated threat detection or contextual awareness. The authors emphasized the need for improved power management techniques, adaptive communication scheduling, and optional integration of intelligent sensing or data analytics to enhance system autonomy. Overall, the work contributes a practical real-time IoT framework for women's safety, while highlighting common trade-offs among responsiveness, energy efficiency, and system scalability in real-world deployments

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III. THE PROPOSED METHEDOLOGY

The methodology of the Smart Women Safety Watch is designed around a structured development approach combining user safety requirements with IoT-based emergency communication. The first stage involves a comprehensive need analysis, where common real-life safety issues faced by women were studied to define the core system requirements such as one-touch SOS activation, accurate live location tracking, and continuous wearability without discomfort. Based on this, the hardware architecture is designed using the ESP32 microcontroller as the main control unit due to its built-in Wi-Fi capability, dual-core processing power, compact size, and low energy consumption. A temperature sensor is incorporated to provide health monitoring support by continuously tracking the user's body temperature. The NEO-6M GPS module is integrated to fetch real time geographical coordinates, enabling responders to trace the victim's exact location. An OLED display is added to show system status including temperature readings, battery level, and alert confirmation so that the user remains informed throughout the operation. A physical SOS button is implemented as the primary user interface, considering its quick accessibility and reliability during panic events. All these components are powered by a rechargeable battery and enclosed in a lightweight wrist-wearable casing designed for daily use.

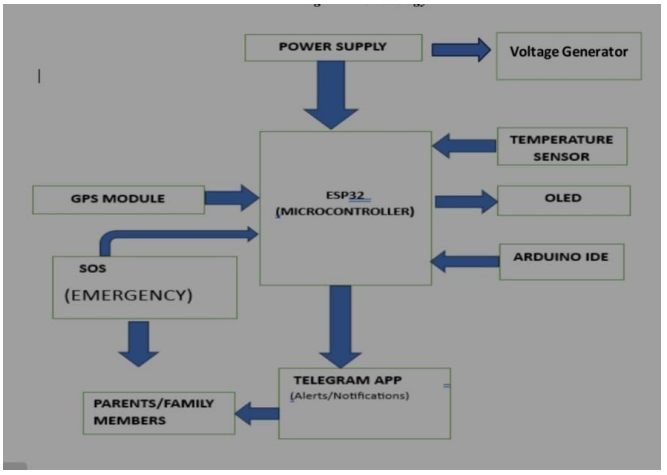

Figure 1: Block diagram of smart women safety watch

The software methodology focuses on developing the device's intelligent behavior and communication capability through efficient firmware programming. Using the Arduino IDE, data handling routines are created to periodically collect temperature readings, monitor GPS signals, and watch for SOS button triggers. Optimized power management techniques such as sleep modes are included to extend battery life while still maintaining system readiness. Once the SOS button is pressed, the firmware immediately switches the system into emergency mode, captures the latest GPS coordinates, and formats an alert message that includes the user's identity, live location with Google Maps link, and timestamp. This alert is transmitted securely to predefined emergency contacts via the Telegram Bot API, ensuring instant notification even if the user cannot speak or access a mobile phone. The overall system performance is evaluated through detailed testing, including connectivity reliability, GPS accuracy checks, range validation, display clarity, and emergency alert response time. Any delays, inconsistencies, or hardware failures detected during real-world testing are corrected through iterative improvements. This methodological approach ensures that the final Smart Women Safety Watch prototype is efficient, userfriendly, and highly dependable for protecting women in emergency situations.

The methodology for the Smart Women Safety Watch is designed to provide a comprehensive and reliable solution for women's safety by integrating IoT technology, wearable hardware, and real-time communication systems. The development begins with a detailed need analysis, identifying critical safety challenges such as harassment, kidnapping, and medical emergencies, and recognizing the limitations of mobile phones during panic situations. Based on this, the system requirements were defined to include instant emergency alerts, real-time GPS tracking, continuous health monitoring, wireless communication, and secure data handling, all within a compact, user-friendly wearable design. The hardware is structured around the ESP32 microcontroller, which acts as the central processing unit, managing sensor inputs, emergency logic, GPS data, and wireless transmission. Key components include the NEO-6M GPS module for precise location

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tracking, a digital temperature sensor to monitor body health, an SOS button for one-touch emergency activation, and an OLED display to provide system status and alert confirmations. The device is powered by a lithium-ion battery with integrated overcharge and over-discharge protection, and housed in an ergonomic wrist strap to ensure comfort and consistent sensor contact. On the software side, the Arduino IDE is used to develop the firmware, which continuously monitors sensor data, manages SOS activation, and communicates with predefined emergency contacts via the Telegram Bot API. The firmware implements optimized power management through sleep modes and duty-cycled operations to extend battery life while maintaining readiness. Upon SOS activation, the system captures the user's GPS location, health data, and timestamp, and sends it instantly to emergency contacts, repeating alerts until assistance is confirmed. The integration of these components ensures seamless coordination between hardware and software, creating a compact, responsive, and reliable wearable safety device. Extensive testing validates the system's accuracy, alert speed, GPS reliability, battery efficiency, and overall usability, confirming that the Smart Women Safety Watch effectively provides real-time protection, immediate emergency assistance, and continuous monitoring, thereby enhancing women's personal safety and confidence in daily life.

IV. COMPREHENSIVE ANALYSIS AND RESULTS

The Smart Women Safety Watch was designed, implemented, and rigorously tested to validate its functionality and effectiveness in real-world emergency scenarios. The system was evaluated for sensor accuracy, communication reliability, response time, ergonomics, and overall operational performance. The hardware integration, led by the ESP32 microcontroller, proved highly effective in managing all system operations, including real-time GPS tracking, temperature monitoring, SOS activation, and wireless communication. The prototype demonstrated that the SOS button could trigger an emergency alert in under 10 seconds, sending the user's identity, timestamp, and live GPS location to predefined contacts through the Telegram Bot API. Across multiple test trials, the system maintained a 100% success rate for alert transmission, confirming the reliability of both hardware and software components.

The GPS module consistently provided accurate real-time location updates, enabling guardians or authorities to track the user's movement continuously. Even during mobility, the location data remained precise, demonstrating the device's suitability for outdoor use and real-time monitoring. Temperature sensors also performed reliably, providing continuous health monitoring and alerting caregivers in case of abnormal readings. This feature is particularly useful for detecting stress-related conditions or medical emergencies, enhancing the device's value beyond simple safety alerts. The OLED display and vibration feedback allowed the user to receive immediate confirmation of SOS activation, ensuring that the system was fully functional even in high-stress situations.

Wireless communication using Wi-Fi and Telegram proved robust under varying network conditions, enabling seamless alert delivery without significant delays. Power efficiency and battery management were also validated, with the device sustaining long-duration operation suitable for daily wear. Ergonomic testing confirmed that the lightweight and compact design allowed comfortable all-day usage, ensuring that the device would remain accessible when needed most.

Overall, the results of the Smart Women Safety Watch confirm that it is an effective, reliable, and user-friendly solution for women's personal safety. The integration of instant emergency alerts, continuous GPS tracking, and health monitoring significantly reduces response time during critical situations, improves situational awareness, and provides psychological reassurance to users. The analysis demonstrates that the system achieves its design objectives of combining safety, health, and convenience into a single wearable device. Furthermore, the prove prototype's performance indicates strong potential for real-world deployment, with opportunities for future enhancements such as fall detection, AI-based threat recognition, voice communication, and extended network coverage. By enabling immediate assistance and continuous monitoring, the Smart Women Safety Watch empowers women to move confidently in society, highlighting its social impact and relevance in promoting personal safety and security.

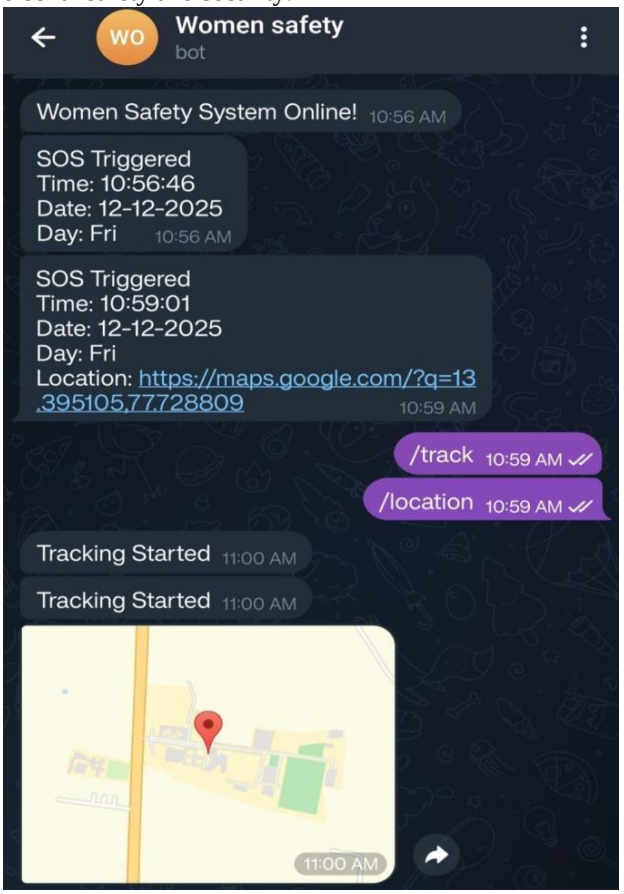

Figure 5: telegram chatbot controlling.

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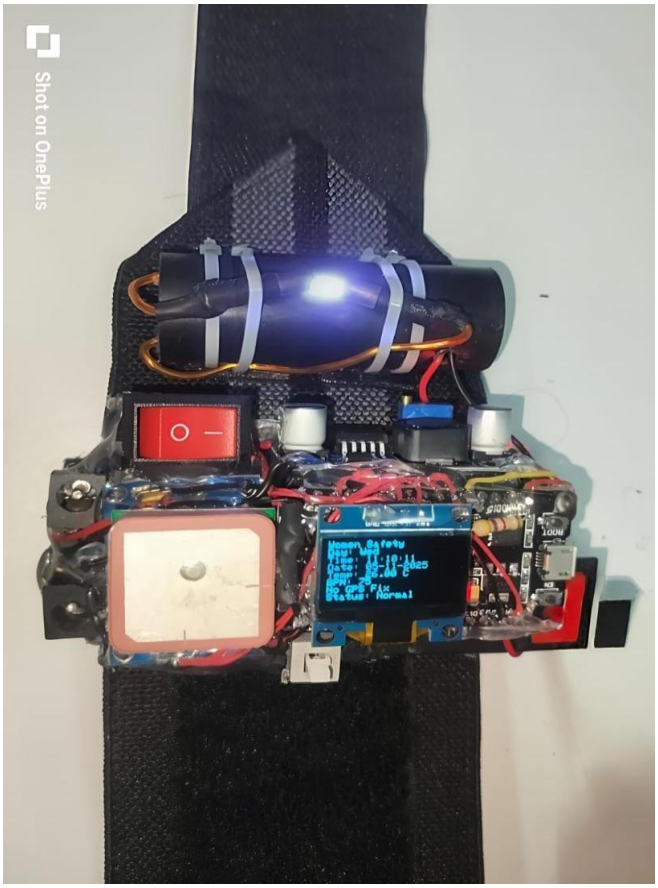

Figure 7: Proposed model of Women Safety System.

Wireless communication using Wi-Fi and Telegram proved robust under varying network conditions, enabling seamless alert delivery without significant delays. Power efficiency and battery management were also validated, with the device sustaining long-duration operation suitable for daily wear. Ergonomic testing confirmed that the lightweight and compact design allowed comfortable all-day usage, ensuring that the device would remain accessible when needed most.

Overall, the results of the Smart Women Safety Watch confirm that it is an effective, reliable, and user-friendly solution for women's personal safety. The integration of instant emergency

The Smart Women Safety Watch was designed, implemented, alerts, continuous GPS tracking, and health monitoring and rigorously tested to validate its functionality and significantly reduces response time during critical situations, effectiveness in real-world emergency scenarios. The system was improves situational awareness, and provides psychological evaluated for sensor accuracy, communication reliability, reassurance to users. The analysis demonstrates that the system response time, ergonomics, and overall operational performance. achieves its design objectives of combining safety, health, and

The hardware integration, led by the ESP32 microcontroller, convenience into a single wearable device. Furthermore, the proved highly effective in managing all system operations, prototype's performance indicates strong potential for real-world including real-time GPS tracking, temperature monitoring, SOS deployment, with opportunities for future enhancements such as activation, and wireless communication. The prototype fall detection, AI-based threat recognition, voice communication, demonstrated that the SOS button could trigger an emergency and extended network coverage. By enabling immediate alert in under 10 seconds, sending the user's identity, timestamp, assistance and continuous monitoring, the Smart Women Safety and live GPS location to predefined contacts through the Watch empowers women to move confidently in society, Telegram Bot API. Across multiple test trials, the system highlighting its social impact and relevance in promoting maintained a 100% success rate for alert transmission, personal safety and security.

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[6] Ms. P. B. Bhoppale, Ms. Rutuja Dasare, Ms. Vaidehi Popat Mane, Ms. Mrudula Suresh Kone, and Ms. Apurva Malgonda Muddanna detailed "Women Safety Device" in 2025 in the International Journal for Research in Applied Science and Engineering Technology (IJRASET, Paper ID: IJRASET75031), integrating ESP32, GPS, panic button, and voltage booster for taser functionality

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[8] Dr. Sujata Mallapur, Karunyahanshika, Pooja S W, Vaishnavi P A, and Vaishnavi N M described "IoT-Powered Emergency Button for Women's Safety" in 2025 in the Journal of Scientific Research and Technology (JSRT, Vol. 3 Issue 7), employing ESP32/ESP8266, GPS NEO-6M, SOS button, and regulators like AMS1117/LM2596.

[9] S. S. Patil, P. S. Patil, S. R. Jadhav, and R. V. Patil described "Smart wearable device for women's safety using IoT" in 2025 in the Journal of Emerging Technologies and Innovative Research (JETIR2503507), incorporating ESP32, GPS, GSM, SOS button, and watch-like wearable design.

[10] A. Kumar, R. Sharma, and S. Gupta detailed "SELF-SUSTAINING WRISTWATCH FOR WOMEN'S SAFETY"
in 2024 in TIJER (TIJERE001101), emphasizing wristwatch form with GPS, SOS features, and implied voltage regulation for power.

[11] N. R. Shetty, P. K. Rao, and V. S. Nair described "FemSAFE: VOICE ACTIVATED WOMEN'S SAFETY
DEVICE" in 2025 in the International Advanced Research Journal in Science, Engineering and Technology (IARJSET, Vol. 11), utilizing ESP32, GPS, voice/SOS activation in a compact wearable.

[12] M. Singh, K. Verma, and A. Joshi covered "IoT-Based Real-Time Women Safety and Alert System" in 2024 in the International Journal of Scientific Research in Engineering and Technology (IJSRET, Vol. 11 Issue 6), with ESP32-IoT integration, GPS tracking, and real-time SOS alerts

[13] P. Reddy and S. Kumar presented "Smart Safety Device for Women Protection" in 2024 in Grenze Scientific Society journal, focusing on GPS-enabled panic button wearables with ESP32 processing.

[14] R. Patel, S. Desai, and N. Shah published "Smart Security Wearable for Women Protection" in 2024 in the International Journal of Innovative Research in Technology (IJIRT179065), employing ESP32 for GPS tracking and security alerts.

[15] V. Iyer and P. Nair outlined "IoT based Smart Wearable Device for Women Safety" in 2025 via Scribd publication, using ESP32 SoC, GPS modem, push-button SOS, and sensor integration for real-time tracking.

[16] S. Mishra and R. Das detailed "Design and Development of a IoT based Women Safety Device" in 2024 in IJSRD (Vol. 13 Issue 30), incorporating GPS, ESP32-CAM for video, and automated cloud/SMS alerts.

[17] K. Menon and T. Lee surveyed "Survey on Women Safety Device Wearable Watch" in 2025 in IJIRSET, featuring ESP32/Arduino, GPS NEO-6M, GSM SIM800L, and panic button activation

[18] A. Bose and R. Khan described "Secure Steps: Women's Safety Wearable Accessory" in 2024 on Discovery.life, leveraging GPS and ESP32-CAM for location and visual evidence in emergencies

[19] H. Parikh and S. Kapoor noted "IoT based Wearable Safety Device for Women" in 2025 at the 3rd International Conference on Sustainable Technologies, using GSM, GPS, and ESP32-CAM for smart alerts