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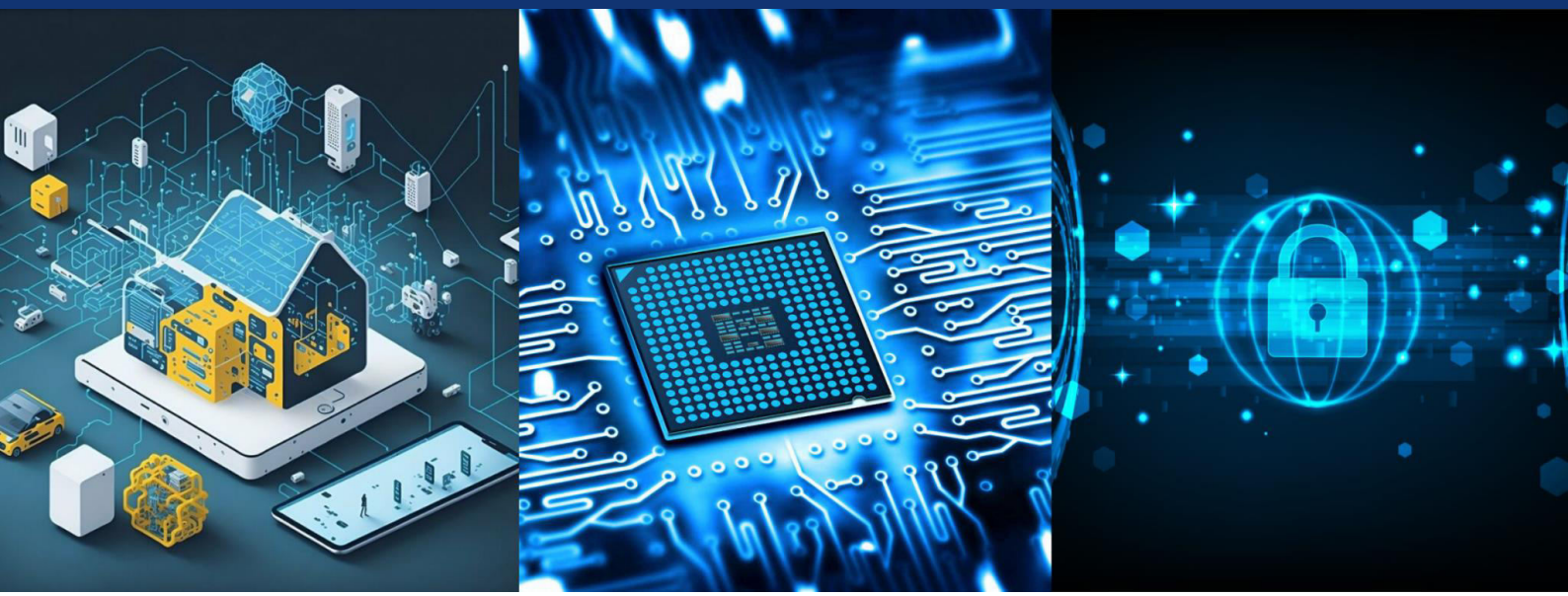

International Journal of Innovative Research in Computer and Communication Engineering

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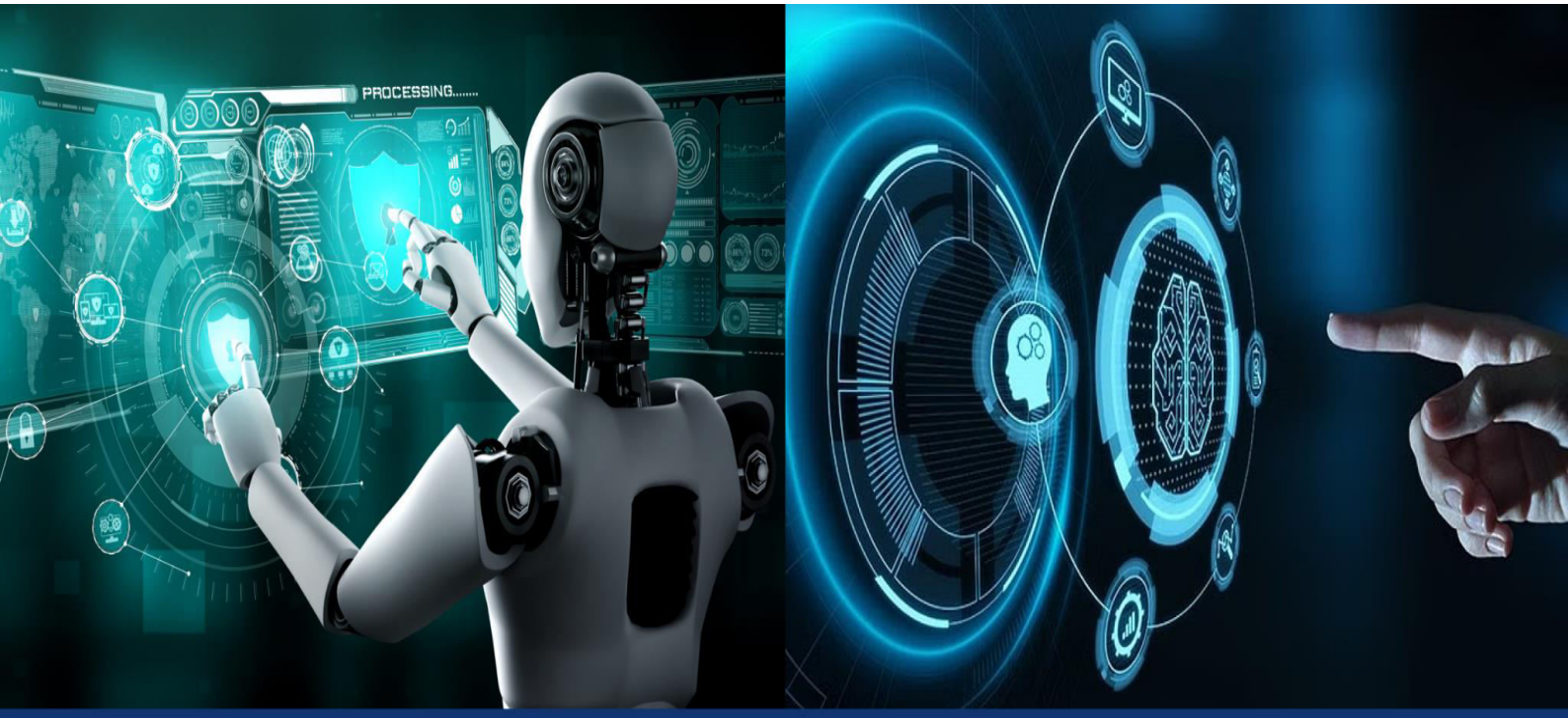

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International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

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IoT- Smart Self-Defense Gadget for Women's Safety Using Embedded C

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ABSTRACT: As women continue to face increasing threats to their safety in public and private spaces conventional mobile-based safety systems prove limited due to their manual activation requirements and reliance on user interaction this paper proposes a wearable iot-based women safety gadget named watch me that autonomously detects emergency situations through biometric sensing and real-time monitoring built using embedded C and IoT frameworks the device integrates heart rate sensors gps tracking and emergency communication modules to deliver automatic alerts and precise location data without manual input the system improves response time and situational awareness by utilizing remote data monitoring and a compact hands-free form factor experimental validation confirms the effectiveness of the solution in detecting abnormal stress conditions and triggering alerts in real-world scenarios highlighting its potential as a reliable and scalable self-defense module for women's safety in high-risk environments

KEYWORDS: IoT, Embedded C, Wearable Device, Heart Rate Sensor, GPS Tracking, Emergency Alert System

I. INTRODUCTION

The growing concern over women's safety in today's society demands the development of intelligent, responsive, and accessible security solutions. Despite advancements in surveillance and mobile-based emergency applications, limitations such as high operational costs, delayed responses, and device dependency hinder their effectiveness, especially in critical scenarios. Traditional safety mechanisms often fail to provide real-time protection, especially when victims cannot access their phones or alert authorities manually.

IoT-based wearable safety systems have emerged as a transformative approach to addressing these challenges. By integrating embedded systems, biometric sensors, GPS modules, and wireless communication, these smart devices offer automated real-time responses, empowering women with proactive self-defense and immediate alert capabilities. This shift aligns with global safety and technology policies, which advocate for leveraging digital innovations to improve personal security.

Reports from UN Women, National Crime Records Bureau (NCRB), and India's Ministry of Electronics and IT emphasize the importance of incorporating IoT, AI, and real-time monitoring technologies to enhance public safety, particularly for vulnerable populations.

II. LITERATURE SURVEY

The development of IoT-based women safety systems builds upon several foundational works aimed at overcoming limitations in conventional emergency response mechanisms, especially where human intervention or centralized monitoring is necessary.

A. Gupta and S. Rathi (2020) explored limitations of centralized alert systems, noting their inefficiencies in rural or network-deficient areas. They proposed a GPS and GSM-based wearable device that sends location data to authorities without requiring smartphone dependency. However, the system lacked real-time tracking and user interactivity.

Sharma et al. (2021) examined LoRa and ZigBee for long-range, low-power emergency communication. While these protocols significantly extended battery life and communication range, they struggled in urban environments due to

signal interference.

Kumar and Mehta (2022) proposed a multi-sensor system with voice activation and biometric verification to prevent false triggers. Their approach improved reliability and personalization but faced challenges related to cost and device bulkiness.

Patel et al. (2023) introduced a hybrid model using GPS, GSM, and cloud-based databases to store incident data and allow delayed reporting. Despite its data-rich features, the system's reliance on cloud connectivity posed risks in areas with unstable internet access.

Year	Title	Authors	Description	Drawbacks
2023	Women's Safety System using Arduino Nano and GPS	Harshitha N, Gagana P, Sahana B, Sushmitha H C, Prof. (Dr.) HK Shreedhar	Device with GPS module to track location and notify emergency contacts. Activated via smartphone app or device button; supports micro USB charging and Android app for data display.	Buzzer/vibration only works when the application is open.
2021	IoT-based Smart System for Women's Safety (Student Safety Focus)	Bharathsrinath.S, Dhamu.M, R.Dhanush, Kathiresan.A	Two units (School and Bus) using Bluetooth low-energy; live GPS tracking with calls to registered contacts. Accurate location tracking even with rapid movement.	Cannot detect danger if victim unable to press buzzer or take action.
2021	Design and Implementation of Smart Slippers for Women Safety	Kavitha A K, Nithyasree G, Nivedha B, Vaishnavi S	Safety slippers with shock circuit to paralyze attacker using metal pins. Suitable for users with mobility issues.	Power supply issues if battery is depleted.
2021	IoT-based Smart Security and Safety System for Women and Children	K. Srinivasan, T. Navaneetha, R. Nivetha, K. Mithun Sugadev	Uses microcontroller, GSM, GPS modules to send location and notifications. Includes temporary stun effect for attacker deterrence.	Requires pressing a button in emergency for activation..

Table 1: Literature survey review

III. METHODOLOGY

The IoT-based Women's Safety system is designed with a modular architecture to ensure real-time tracking, rapid emergency alerting, and reliable communication. The system integrates essential components such as GPS for precise location tracking, voice recognition for hands-free emergency activation, shock detection circuits for incident sensing, and wireless communication modules for alert transmission. A mobile application serves as the user-friendly interface, providing seamless interaction for monitoring, alert management, and emergency contact notifications. Each module works in harmony to collect, process, and transmit critical safety data securely and efficiently. This comprehensive approach ensures timely assistance and effectively enhances personal safety in urgent emergency situations. The diagrams below illustrate the interactions between the wearable device, microcontroller, communication network, mobile app, and emergency response systems.

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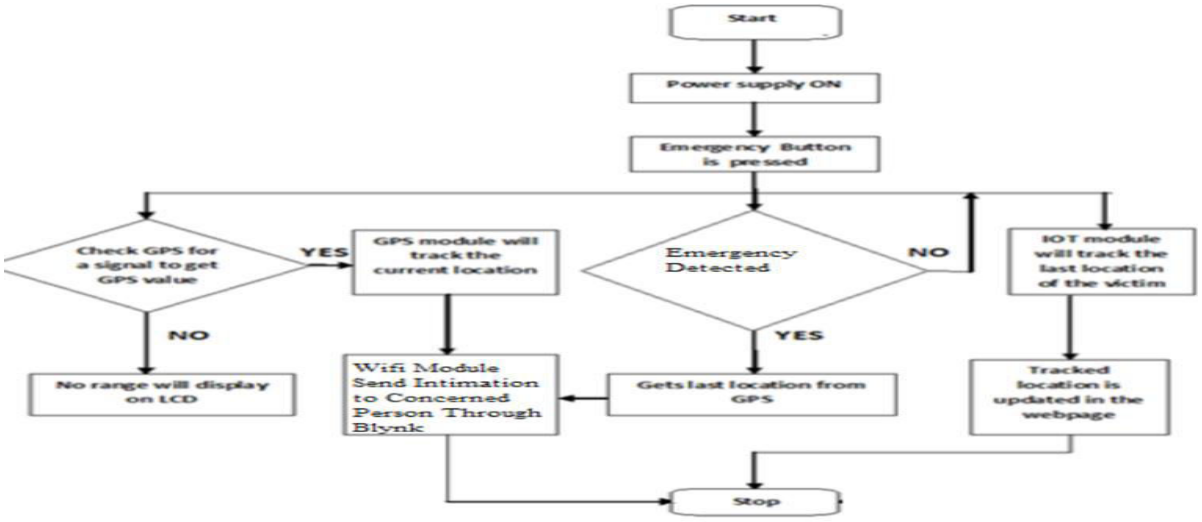

Fig 1: End-to-End Flow of Emergency Detection, Alerting, and Response in IoT-Based Women Safety System

IV. IMPLEMENTATION

The wearable safety device was developed using a microcontroller such as Arduino or ESP32, which acts as the system's central processor, managing inputs from various sensors and modules. The GPS module is responsible for continuous location tracking, ensuring that the user's real-time geographic position can be shared during an emergency. A voice recognition module is integrated to detect specific keywords or panic phrases spoken by the user, enabling hands-free activation of the alert system. To enhance responsiveness, a shock sensor is included to identify sudden physical impacts or assault-like movements, triggering an emergency alert if abnormal activity is detected.

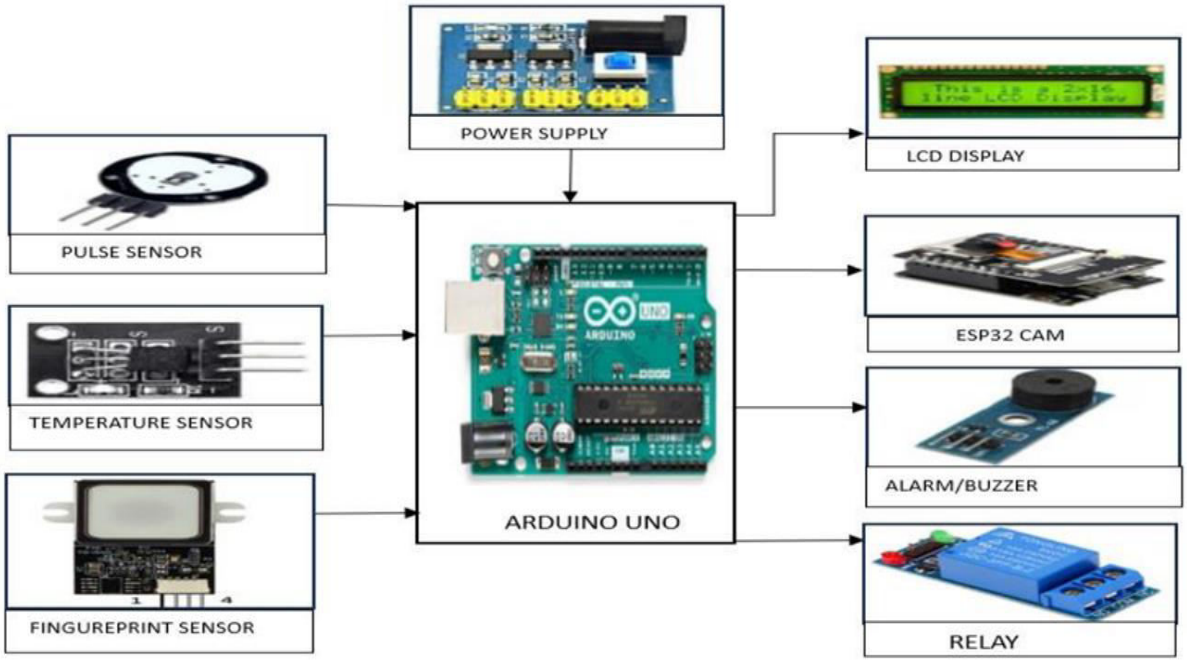

Fig.2: Hardware Setup and Sensor Integration

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The emergency detection and alert generation mechanism is designed to respond quickly and reliably to any signs of distress. The system continuously monitors multiple input sources to identify potential emergencies. A distress signal can be triggered in three primary ways: through voice command recognition, shock sensor activation, or manual button press. The voice recognition module listens for specific pre-programmed keywords or panic phrases, enabling the user to activate the system even in situations where physical movement may not be possible. The shock sensor detects sudden physical impacts or abnormal movements, such as a fall or forceful push, which are interpreted as possible signs of danger. In cases where the user is able to act manually, pressing the emergency button instantly initiates the alert process.

Once a distress signal is detected, the system activates a buzzer to provide an immediate audible alert, drawing the attention of nearby people. Simultaneously, the microcontroller communicates with the GSM or Wi-Fi module to send an alert message to preconfigured emergency contacts. This message includes the user's current GPS coordinates to assist with swift location tracking. In addition to sending a text-based alert, the system can optionally include a live location-sharing link—such as a Google Maps URL—so that the user's movements can be tracked in real time by guardians, family members, or emergency services. This multi-channel response ensures that the user receives timely help and that critical information reaches the right people without delay.

Fig 3: Alert Messages

V. CONCLUSION AND FUTURE WORK

This project successfully implements an IoT-based women safety system using embedded microcontrollers for real-time GPS tracking, voice recognition for emergency activation, and integrated shock circuits for alerts. The wearable devices like wristbands and smart spectacles enable tear gas release and loud audio alerts that broadcast the user's

location. The system ensures prompt and reliable emergency signaling, enhancing personal security in critical situations. Experimental evaluation confirmed accurate location tracking, effective alert activation, and seamless integration of hardware components.

For future development, the system can be enhanced by adding automatic calling to emergency contacts and police, real-time image capture during emergencies, and improved network connectivity. Integration with mobile apps and expanding coverage to rural areas will increase accessibility and user confidence.

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