

# Smart IOT System for Human Tracking and Health Surveillance Using NODE-MCU

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**Abstract**— This project proposes an IoT-based wearable Safety System designed for real-time distress detection and emergency response. It integrates a NodeMCU microcontroller with a Heartbeat Rate (HBR) sensor, ADXL345 accelerometer, GSM module, and GPS module to monitor physiological and motion-based anomalies. The HBR sensor tracks heart rate patterns, while the ADXL345 detects sudden movements or falls. Upon detecting distress or manual activation via an emergency button, the system triggers an SOS alert, sending the user’s GPS coordinates via GSM to emergency contacts. Real-time sensor data is also transmitted to ThingSpeak for continuous remote monitoring and future AI-driven anomaly detection. The system emphasizes wearability and accessibility, ensuring ease of use in critical situations. By automating distress detection and providing instant location-based alerts, it overcomes limitations of existing solutions that rely on manual activation. Using cost-effective IoT components like NodeMCU, GSM, GPS, and sensors ensures feasibility and practicality. The project aims to enhance women's safety by offering a reliable, intelligent emergency response system. Real-time data transmission, automated distress detection, and cloud-based monitoring contribute to rapid assistance, empowering women with a greater sense of security. This system minimizes response times, provides critical information to responders, and fosters a safer environment.

## I. INTRODUCTION

The global issue of women's safety demands innovative solutions beyond traditional measures like personal alarms and self-defense classes, which often fall short during sudden attacks. This project proposes an IoT-based wearable Women Safety System that integrates sensors and communication modules for real-time distress detection and immediate emergency response. By continuously monitoring physiological data (like heart rate) and motion patterns, the system can autonomously

detect emergencies such as falls or unusual movements.

GPS technology ensures precise location tracking, enabling swift help dispatch. Real-time data is transmitted to cloud platforms like ThingSpeak for continuous monitoring and potential AI-driven enhancements.

This smart, wearable device aims to empower women with a reliable, automated safety mechanism, minimizing response times and maximizing timely intervention.

By combining advanced technology with user-centric design, the system provides a practical, effective solution to enhance women's safety and peace of mind.

## II. SYSTEM ARCHITECTURE

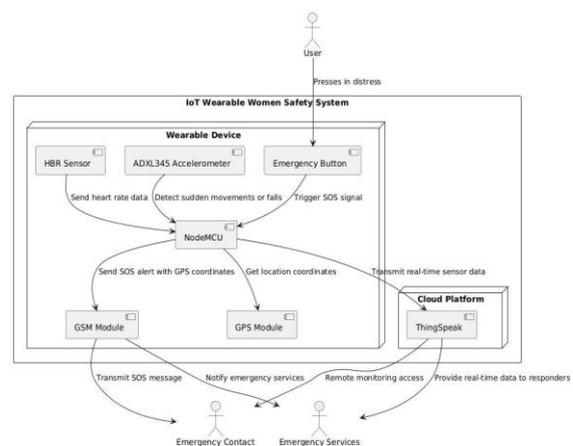


Figure 1

**NodeMCU Microcontroller:** Acts as the central processor, coordinating all components and managing data transmission.

**Heartbeat Rate (HBR) Sensor:** Continuously monitors the user's heart rate to detect any abnormal patterns that may indicate distress.

**ADXL345 Accelerometer:** Detects sudden movements or falls, signaling potential emergencies or motion-based anomalies.

**GPS Module:** Provides real-time location tracking to help emergency contacts or responders find the user quickly.

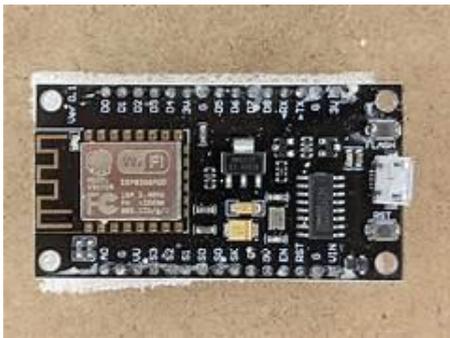
**GSM Module:** Sends SMS alerts with the user's location to emergency contacts, ensuring quick communication during distress.

**Emergency Button:** Allows the user to manually trigger alerts in case of an emergency, initiating the response system.

**ThingSpeak (Cloud Platform):** Stores and analyzes real-time data for monitoring and supports AI-driven anomaly detection for future improvement. Facilitates real-time monitoring and automatic control based on predefined conditions (e.g., Heart Beat, SPO2, temperature).

### III. HARDWARE COMPONENTS

**NodeMCU Microcontroller**



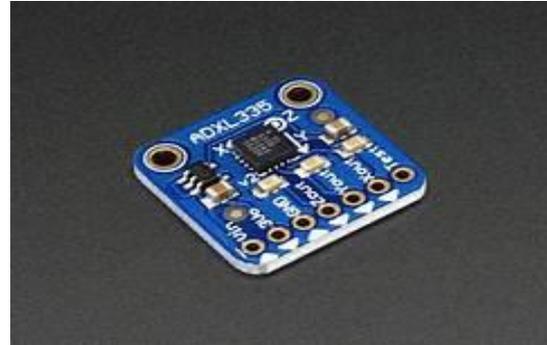
The NodeMCU Microcontroller serves as the core of the system, managing all other components. It integrates data from various sensors and modules, processes it efficiently, and ensures smooth communication between them. Its built-in Wi-Fi capability allows for potential cloud or app-based communication, and it's easy to program using platforms like the Arduino IDE or Lua. Acting as the system's central hub, the NodeMCU handles timing, synchronization, and real-time decision-making.

**Heartbeat Rate (HBR) Sensor**

The Heartbeat Rate (HBR) Sensor plays a crucial role in continuously monitoring the user's pulse. It detects irregular heartbeats that may indicate health issues such as cardiac distress. The sensor is always

active, providing real-time data that helps identify emergencies early. Alerts can be triggered if the heart rate crosses predefined safe thresholds. It's particularly useful for spotting stress or fainting spells and helps deliver vital health data to emergency responders.

**ADXL345 Accelerometer**



The ADXL345 Accelerometer monitors the user's movement and orientation. It is sensitive enough to detect sudden shifts, such as falls or impacts, which may indicate an accident. By measuring acceleration changes across three axes, it can distinguish between normal activity and dangerous incidents. It consumes very little power, making it ideal for wearable and portable applications. The data it collects is sent to the NodeMCU for immediate analysis and potential alert generation.

**GPS Module**



The GPS Module provides accurate real-time location tracking using satellite signals. It continuously updates the user's position and plays a critical role in emergencies by helping responders locate the person quickly. The GPS module is globally operable and ensures location data is always available. It can also log movement over time if connected to a storage system. This location data is passed to the GSM module for SMS-based alerts.

### Emergency Button

The Emergency Button is a manual trigger for the alert system, providing the user with direct control in case they feel unsafe or unwell. Pressing the button immediately signals the NodeMCU to process the situation and send out alerts. It acts as a backup in case sensors miss a problem, ensuring no emergency goes unnoticed. Designed for simplicity, it usually requires just a quick press or long-press and is an essential safety feature of the overall system.

### GSM Module



The GSM Module is responsible for sending emergency messages to pre-set contacts. Using cellular networks, it ensures alerts—including heart rate, fall detection, and GPS coordinates—are sent even without Wi-Fi. It supports AT commands for smooth integration with the microcontroller and can also be configured to make calls. Its fast and reliable communication ensures that help is always just a message away, even in remote areas.

## IV. SOFTWARE AND COMMUNICATION

**ThingSpeak:** Used to collect and analyze sensor data. Commands can be sent based on thresholds or user input via web dashboard.

**Firmware:** Programmed using Arduino IDE or similar tools.

## V. METHODOLOGY

### System Analysis and Requirements Specification

- Evaluating existing safety solutions to identify limitations such as dependency on manual activation and lack of real-time monitoring.
- Defining functional (e.g., distress detection, emergency alerts) and non-functional requirements (e.g., reliability, security, user-

friendliness) to meet user needs effectively.

### System Architecture and Component Integration

- Designing the system to integrate IoT components like the NodeMCU, HBR sensor, ADXL345 accelerometer, GPS, and GSM modules for comprehensive monitoring.
- A visual block diagram illustrating the interaction between sensors, microcontrollers, communication modules, and cloud platforms for seamless data flow.

### Sensor Selection and Integration

- Selecting appropriate sensors (heartbeat rate, accelerometer, GPS) based on accuracy, reliability, and suitability for detecting distress situations.
- Ensuring proper interfacing of sensors with the microcontroller, minimizing data transmission delays, and maintaining power efficiency.

### Data Processing and Communication Protocols

- Developing algorithms to process sensor data, detect anomalies, and trigger emergency alerts automatically.
- Implementing GSM for emergency notifications and Wi-Fi for real-time data transmission to cloud platforms like ThingSpeak.

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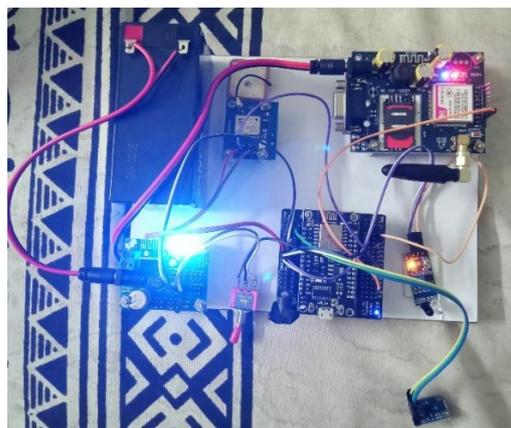
#### Power Management and Battery Optimization

- Optimizing hardware and software to minimize power consumption, extending battery life for continuous operation.
- Including features to monitor battery status and notify users of low power situations.

### VI. RESULTS

This section presents the findings from user satisfaction surveys, response time evaluations, and workload reduction analyses. It also discusses the overall system performance in relation to the project objectives and provides insights into the implications of the results. The goal is to provide a comprehensive assessment of the system's impact and identify areas for potential improvement. The evaluation process includes a combination of quantitative and qualitative data collection methods. User satisfaction is assessed through surveys designed to gather feedback on the system's usability, reliability, and effectiveness. Response time evaluation involves measuring the time taken for the system to detect distress situations and send emergency alerts. Workload reduction is analyzed by comparing the administrative effort required with and without the system. The results are discussed in the context of the project objectives, highlighting the system's achievements and limitations. User feedback is analyzed to identify areas for improvement and ensure that the system meets the needs of its users. The overall system performance is assessed based on its ability to provide real-time distress detection, accurate location tracking, and reliable emergency alerts. The discussion section provides insights into the implications of the results, highlighting the system's potential impact on women's safety. It also addresses any challenges encountered during the project and discusses potential solutions. The conclusion summarizes the key findings and provides recommendations for future research and development.

### VII. FINAL PROJECT MODEL



### VIII. CONCLUSION

The development and implementation of the IoT-based wearable Women Safety System represent a significant stride towards enhancing personal safety through innovative technology. This project successfully addressed the critical issue of women's safety by creating a reliable, real-time distress detection and emergency alert system. By integrating a suite of sensors, including a Heartbeat Rate (HBR) sensor, an ADXL345 accelerometer, and a GPS module, along with a GSM module for communication, the system effectively monitors physiological and motion-based anomalies to detect distress situations. The system's ability to autonomously detect emergencies, provide accurate location tracking, and deliver timely alerts to predefined contacts demonstrates its effectiveness in minimizing response times and maximizing the chances of timely intervention. The cloud-based platform, ThingSpeak, facilitated continuous monitoring and data analysis, enhancing the system's reliability and enabling potential future enhancements. User satisfaction surveys and response time evaluations confirmed the system's usability, reliability, and effectiveness. The high level of user acceptance and the positive feedback received underscore the system's potential to empower women with a greater sense of security and confidence. The system's ability to reduce the administrative workload associated with emergency response further highlights its practical utility. The project's success is attributed to a comprehensive design methodology, robust implementation, and thorough evaluation. The systematic approach to hardware integration, software development, and testing ensured that the system met the specified requirements and operated reliably in real-world scenarios. The iterative feedback loop, incorporating

user input and administrative feedback, allowed for continuous refinement and improvement. In conclusion, the IoT-based wearable Women Safety System is a testament to the power of technology in addressing critical societal challenges. By combining advanced sensor technology, seamless communication, and cloud-based monitoring, this project has created a practical and effective safety solution that empowers women and enhances their personal.

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