Smart Shoe-Based Women Safety Device Using ESP32 With GPS And GSM Alert System

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Abstract- Women's safety has become a significant concern in modern society, especially during travel or late hours. This project presents the design and development of a compact wearable safety device that can be integrated into footwear. The proposed system uses an ESP32 microcontroller along with GPS and GSM modules to provide real-time location tracking and emergency alert messaging.

Initially, a basic prototype was developed using a standard ESP32 board to test communication between hardware components. Later, the system was improved by using a compact ESP32 Mini module that can be attached near the leg, making the device more portable and practical for real-world use. When the emergency push button is pressed, the system reads the GPS coordinates and sends the user's location to predefined contacts using the GSM network.

The system is designed to be simple, low-cost, and reliable. The project demonstrates how embedded systems and IoT technologies can be used to develop practical safety solutions. Future work will focus on reducing device size and integrating the circuit directly inside footwear.

Keywords-Women Safety, Smart Shoes, ESP32, GPS Tracking, GSM Module

I. INTRODUCTION

Ensuring women's safety is a major challenge in many parts of the world. In emergency situations, the ability to quickly alert family members or authorities can significantly improve personal safety. With the rapid growth of embedded systems and IoT technologies, compact and portable safety solutions can now be developed using microcontrollers and wireless communication modules.

The objective of this project is to design a wearable safety device that can send an emergency alert along with real-time GPS location using a single button press. The device is designed to be integrated with footwear so that it remains discreet and easily accessible to the user. This project focuses on developing a practical prototype using ESP32, GPS, and GSM technologies.

II. PROJECT DEVELOPMENT

2.1 Prototype 1

In the first stage of development, a basic prototype was created using a standard ESP32 development board. The objective of this stage was to test communication between the ESP32 microcontroller, GPS module, and GSM module. The prototype was assembled on a breadboard to verify UART communication and SMS transmission functionality.

Although the system was able to successfully transmit location information, the setup was relatively large and not suitable for wearable implementation. This prototype helped us understand the hardware requirements and communication process between the different modules.

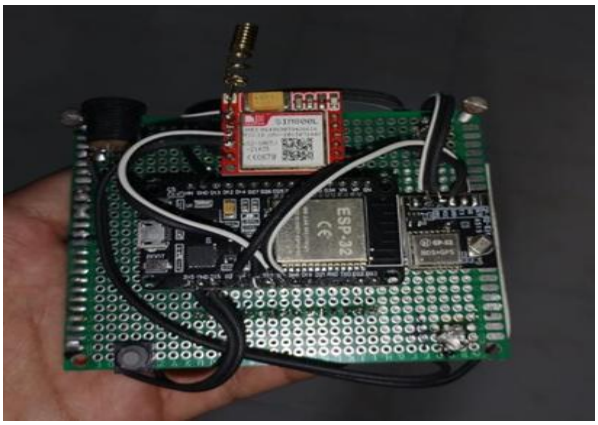

Fig. 1: First Prototype of the Project

2.2 Prototype 2

In the second stage, the design was improved to make the system more compact and wearable. An ESP32 Mini module was used instead of the larger

development board. The circuit was optimized to reduce size and improve power efficiency. The device was designed in such a way that it could be attached near the user's leg during testing.

Fig. 2: Second Prototype of the Project

The second prototype included the following main components:

- ESP32 Mini microcontroller
- GPS module for location tracking
- SIM800L GSM module for communication
- Emergency push button
- Battery power supply with voltage regulation

This prototype was more practical and closer to the final wearable safety device.

III. CIRCUIT DESCRIPTION OF PROTOTYPE 2

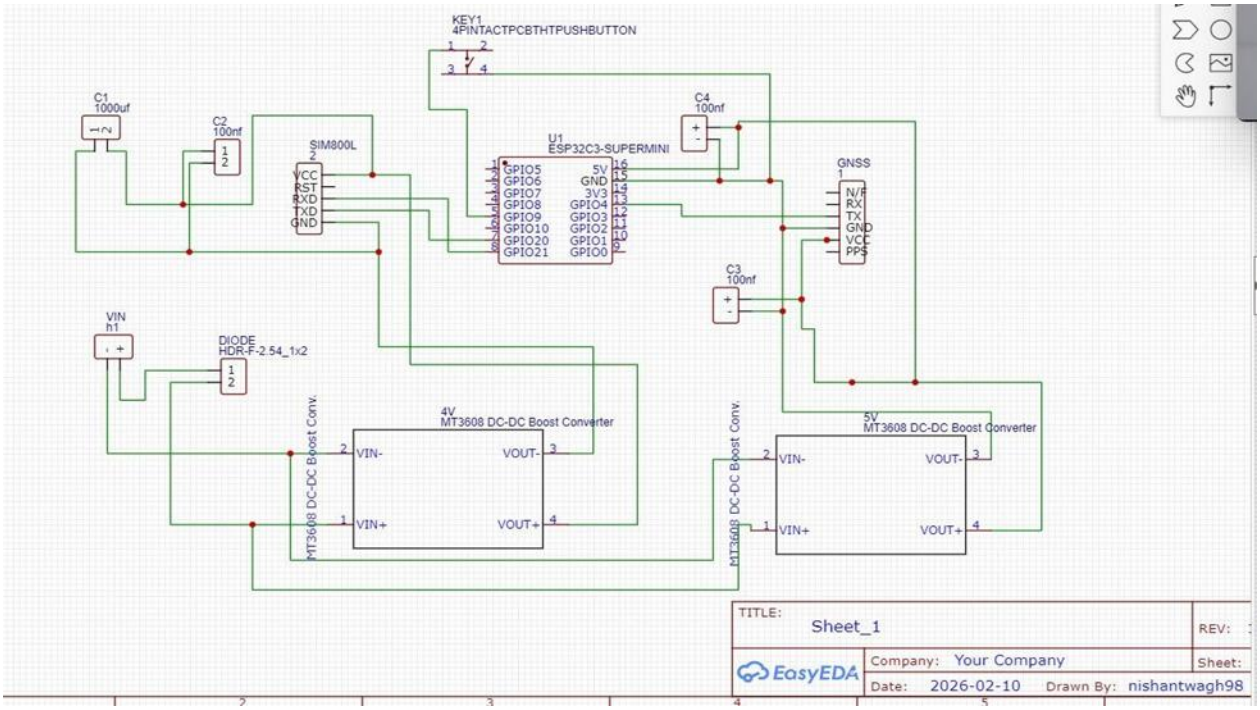

Fig. 3: Circuit Diagram of Prototype 2

3.1 Power Supply Section

The system is powered using a rechargeable battery source. A protection diode is used to prevent reverse polarity. MT3608 DC-DC boost converters are used to regulate voltage levels required by different modules. Capacitors are included to stabilize the voltage and reduce electrical noise.

The GSM module requires a stable power supply with higher current during transmission, therefore additional filtering capacitors are used to ensure reliable operation.

3.2 ESP32 Microcontroller

The ESP32 Mini serves as the main controller of the system. It processes input from the emergency button, reads location data from the GPS module, and sends commands to the GSM module. The ESP32 operates using 3.3V logic and communicates with other modules through UART serial communication.

3.3 GPS Module

The GPS module continuously receives satellite signals and provides geographical coordinates

including latitude and longitude. The module communicates with the ESP32 through UART connections (TX to RX and RX to TX). When the emergency button is pressed, the ESP32 retrieves the latest location coordinates from the GPS module.

3.4 GSM Module (SIM800L)

The SIM800L GSM module is responsible for sending SMS alerts. Once the ESP32 receives location data from the GPS module, it sends AT commands to the GSM module to transmit the user's location to predefined emergency contacts.

3.5 Emergency Push Button

A push button is connected to a GPIO pin of the ESP32 and acts as the emergency trigger. When the user presses the button, the microcontroller immediately initiates the alert sequence by retrieving GPS coordinates and sending an emergency message through the GSM network.

IV. METHODOLOGY AND WORKING PRINCIPLE

The working of the proposed system follows a simple sequence of operations. First, the device is powered on and the GPS module begins acquiring satellite signals. Once the GPS lock is obtained, the system enters standby mode while continuously monitoring the emergency button.

When the button is pressed, the ESP32 retrieves the latest GPS coordinates and constructs an emergency SMS message containing the location information. The GSM module then sends this message to predefined contact numbers. This allows family members or guardians to know the exact location of the user during an emergency. This system ensures quick communication during emergencies and improves the chances of receiving immediate help.

V. CURRENT STATUS

Two working prototypes have been successfully developed and tested. The current prototypes demonstrate reliable GPS location retrieval and SMS alert transmission. The next stage of development will focus on miniaturizing the circuit and integrating it directly into footwear for a fully wearable safety device.

VI. CONCLUSION

This project demonstrates the development of a wearable women safety device using ESP32, GPS, and GSM technologies. The system provides an effective way to send emergency alerts along with real-time location information. Future improvements will aim to further reduce device size and enhance battery efficiency for practical everyday use.

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