Design and Development of a IOT based Women Safety Device Using ESP32 Cam and Message Alert

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Abstract — This project proposes a smart, low-cost wearable device for enhancing women's safety using IoT technology. The system includes real-time location tracking via GPS, video capture using ESP32-CAM, and automated alert generation through cloud services or SMS. The device is compact, wearable, and can be triggered manually or automatically based on distress detection.

Keywords: Women Safety, ESP32-CAM, GPS, IoT, GSM, Real-Time Monitoring, Emergency Alert System

I. Introduction

Safety for women is a pressing concern globally. Technological innovations, particularly through IoT, offer promising solutions. This paper introduces a smart device combining image capture, geolocation, and emergency alert capabilities

Existing safety apps often depend on smartphones and internet availability. In many critical situations, victims are unable to use their phones. There is a need for an autonomous, wearable device that works independently.

A. *Objectives*

- To design a compact wearable device using ESP32-CAM and GPS.
- To enable real-time location tracking and image transmission.
- To provide emergency alert mechanisms through GSM and cloud integration.

II. Methodology

This section evaluates existing systems and solutions such as mobile apps, wearable, and previous IoT-based safety devices. Several limitations in battery life, cost, and responsiveness were identified.
Significant references:

- IOT Based Women Safety System (IJRASET, 2023)
- Wireless IoT Device for Women's Safety (BRACU, 2022)
- Wearable Safety Devices with GSM Modules (IEEE, 2021)

III. System Design and Architecture

A. *Block Diagram*

- Input: Emergency push button
- Processing: ESP32-CAM microcontroller
- Output: Image capture, location data, GSM messaging

B. *Functional Overview*

Upon pressing the panic button or detecting abnormal motion, the device captures an image, determines GPS coordinates, and sends data via GSM to predefined contacts or software.

1) *ESP32-CAM*
A low-cost, low-power module with built-in camera and Wi-Fi/Bluetooth support.
2) *GPS Module*
- Provides real-time geolocation with reasonable accuracy.
3) *GSM Module*
- Sends emergency messages and location data over mobile networks.
4) *Software Design*
- Firmware Development
- Programmed using Arduino IDE; includes libraries for camera, GPS parsing, and GSM communication.
5) *Image Capture & Transmission*
- The ESP32-CAM captures images and stores or sends them via Wi-Fi or SMS attachments (MMS).
6) *Location Tracking*
- GPS coordinates are parsed and converted into Google Maps links, sent via SMS.
7) *Mobile Application (Optional)*
  - Device registration
  - Alert tracking
  - Real-time location mapping
  - Telegram

IV. Implementation Details

A. *Hardware Assembly*

All components integrated on a custom PCB or prototype board, encased for wearable use.

B. *Power Management*

Powered by a 3.7V Li-ion battery with charging circuitry; power-saving modes implemented.

V. Testing and Results

To ensure the system works effectively in an emergency, several tests should be conducted:

- Functionality Tests: Test the emergency alert system by triggering the button and ensuring that the system sends the correct location and video feed to emergency contacts.
- GPS Accuracy: Verify the accuracy and reliability of the GPS module in different environments, both urban and rural.
- Battery Life: Evaluate the battery performance under continuous operation to determine the device's endurance.
- Camera Quality: Assess the camera's performance in low-light and bright environments to ensure clear photo feed.

VI. Future Scope

The proposed women's safety device, utilizing ESP32-CAM and GPS modules, provides a reliable, real-time emergency alert system that can improve safety for women in distress. The combination of live image streaming and location tracking offers a comprehensive solution to enhance emergency response times and ensure swift assistance.
Future work will involve:

- Enhancing battery life through better power management.
- Implementing a more robust communication protocol for low-signal environments.
- Adding machine learning for automated threat detection using the camera.

VII. Conclusion

The designed safety device effectively provides real-time surveillance and tracking capabilities. Its compact design, low cost, and real-time data transfer make it a practical solution for enhancing women's safety. Future enhancements include GSM integration for areas without Wi-Fi, AI-based threat detection, and wearable integration.

References

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