SURVEILLANCE WEARABLE SAFETY DEVICE FOR WOMEN USING RASPBERRY PI

Dr. K. Ayyar[1], K. R. Ganesh[2], Harini Preetha.K[3], Preetha Sree.K[4], Priyadharshini.S[5], Subashini.R[6]

[1]Professor and Head, [2]Assistant Professor, [3,4,5,6]UG Student

[1,2,3,4,5,6]Department of EIE, SRM Valliammai Engineering College, SRM Nagar, Kattankulathur, Chennai, Tamil Nadu, India.

Abstract

The Surveillance Wearable Safety Device for Women is a cutting-edge security solution designed to provide enhanced personal protection in real-time. At the heart of this device is the Raspberry Pi Pico, acting as the brain of the system, seamlessly integrating multiple advanced technologies to ensure safety and rapid emergency response. This innovative safety gear is built into a shock jacket that features a GSM SIM800L module for instant communication and a GPS NEO-6M module for real-time location tracking, ensuring that critical moments are recorded as evidence. For self-defense, the jacket includes a non-lethal electric shock mechanism that acts as a proactive deterrent against potential threats. The system is powered by a rechargeable lithium cell, allowing for extended operation without the need for frequent charging. Designed for discreet and portable use, this wearable safety device allows women to move freely in daily life while staying protected. In times of danger, it can send emergency alerts, share real-time location, and ensure help is always within reach, providing an essential layer of security and peace of mind. This paper aims to empower women, making them feel more secure in different environments.

Introduction

The Surveillance Wearable Safety Device for Women, integrated into a shock jacket, is designed to provide instant protection in emergencies without relying on a mobile phone. This single-button, mobile-free solution ensures an immediate response, offering a reliable and proactive approach to self-defense. Powered by Raspberry Pi, the device combines GPS tracking, real-time surveillance, and an electroshock self-defense system to create a comprehensive personal security solution. The shock jacket is engineered with advanced safety mechanisms, delivering a standardized, non-lethal electric shock that is strong enough to incapacitate an attacker momentarily without causing lasting harm. This ensures the wearer can escape or call for help while preventing unnecessary danger to others.

The jacket's protective design enhances safety, offering impact resistance, secure fastenings, and discreet technology integration to ensure functionality without compromising comfort. It continuously monitors the wearer's surroundings, transmits real-time location data, and captures video evidence, all while remaining easy to wear in daily life. With a simple press of a button, the jacket activates its self-defense mechanism, making it highly efficient during critical situations. Unlike traditional safety devices that rely on smartphones or external connectivity, this mobile-free innovation empowers women with autonomous, real-time protection, ensuring they feel secure in any environment.

Block Diagram

The system is based on a Raspberry Pi Pico, a microcontroller that acts as the central processing unit. Various modules and components are connected to it to achieve multiple functionalities such as SMS notifications, location tracking, alarm activation, and shock mechanism. The block diagram is shown in Fig.1.
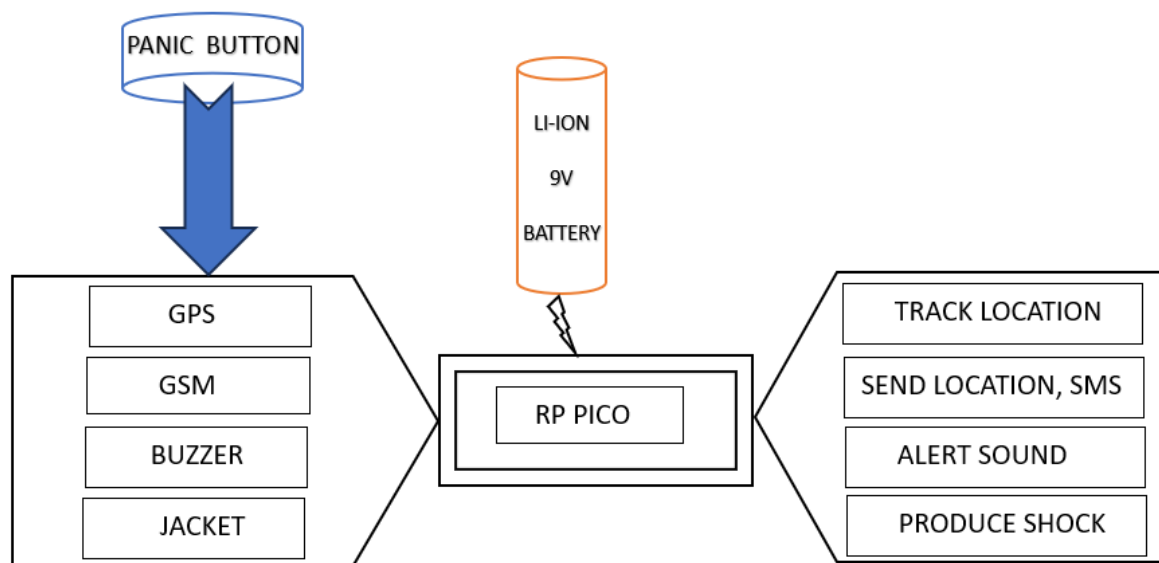

Fig.1   The block diagram

Detailed Explanation of Each Block

1.   Power Supply

It provides the necessary voltage and current to power the Raspberry Pi Pico and other connected modules. Likely includes a Lithium Rechargeable Cell for portability.

2.   Raspberry Pi Pico (Main Controller)

It acts as the brain of the system. Processes inputs from sensors and modules, executes the necessary operations, and controls output actions.

3.   GSM Module

It is used to sends notifications via SMS (Short Message Service). Used for alert messages when an event is detected.

4.   GPM Module (Likely a GPS Module)

It is used for determines the location of the system. Sends coordinates when required (e.g., in case of an emergency).

5.   Panic Button

Panic button is a manually activated button for emergencies. When pressed, it can trigger alerts, send location details, and activate other safety mechanisms.

6. Lithium Rechargeable Cell

It provides backup power to the system. Ensures functionality even in case of power failure.

7. Notification as SMS

Sends SMS alerts in case of an emergency. Uses the GSM module to transmit messages to predefined contacts.

8. Location Tracking

Location tracking is used for sends the current GPS coordinates of the system. Useful for tracking the device or a person using it.

9. Alarm

It activates an audible alarm in case of a security threat or emergency. Can be triggered by the panic button or other conditions.

10. Shock Mechanism

It delivers an electric shock as a deterrent mechanism (likely for security applications). Could be used in personal safety systems, such as self-defense wearables.

Hardware Setup

Here are the key components required for building a surveillance wearable safety device for women using raspberry pi

1. Raspberry Pi Pico:

The Raspberry Pi Pico is shown in fig. 2, is a small, cost-effective microcontroller board powered by the RP2040 chip, making it an excellent choice for compact wearable safety devices like the Surveillance Wearable Safety Device for Women with a shock system.

Fig. 2   Raspberry Pi Pico

With its dual-core processor, the Pico efficiently handles multitasking such as GPS tracking, sensor data

processing, and controlling the shock mechanism. The board's GPIO pins allow integration with various sensors (e.g., accelerometers and actuators), while Bluetooth connectivity supports communication with a mobile app for real-time location tracking and alerts. Its low energy usage is key for ensuring long battery life, allowing the device to remain functional for extended periods. The Pico's compact design and processing capabilities make it ideal for incorporating all the necessary features of a safety device while ensuring comfort and ease of use.

2.   GSM SIM800L:

The sim800l gsm module is shown in fig. 3, is a dense and effective communication device widely used in iot and embedded systems it supports sms voice calls and gprs-based net connection making it an essential component for real-time reporting in a surveillance wearable safety device for women the sim800l can facilitate emergency alerts location sharing and status updates by sending sms or making voice calls to predefined contacts or emergency responders its small size and low energy usage allow seamless combination into wearable devices ensuring reliable connectivity during emergencies while maintaining battery efficiency this module plays a crucial role in enhancing safety and responsiveness in critical situations.
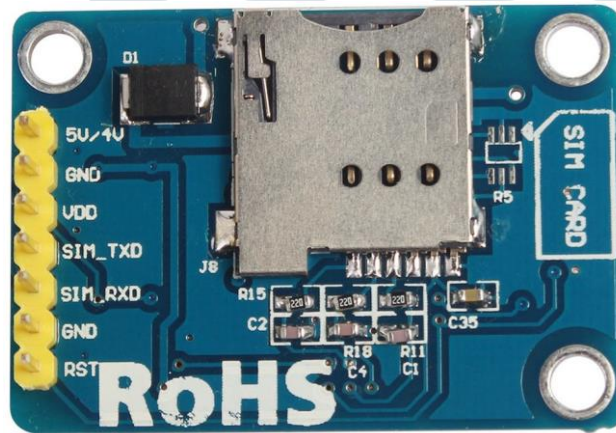

Fig. 3   GSM SIM800L

3.   GPS neo 6m:

The neo-6m gps module is shown in fig. 4, is a dependable and high-performance component designed for real-time geo location in embedded systems and iot applications powered by the u-blox neo-6m chipset it delivers precision positioning with high sensitivity making it well-suited for gps-enabled projects in a surveillance wearable safety device for women this module gives continuous geo location enabling real-time organize to be sent to emergency contacts or services its compact design low energy usage and adaptability to different environments ensure dependable operation with integrated support for gps satellites the neo-6m enhances the devices ability to gives timely and precise location updates during emergencies.

Fig. 4   GPS neo 6m

4.   Li-ion 3.3V Rechargeable Battery

The 3.3V Li-ion rechargeable battery is shown in fig. 5, is ideal for low-power applications such as embedded systems, sensors, and IoT devices. It offers a compact size, high energy density, and efficient power delivery. With a stable voltage output, it enhances the performance of microcontrollers and wearables, ensuring long-lasting, rechargeable energy storage.

Fig. 5   Li-ion 3.3V Rechargeable Battery

5.   Li-ion 9V Rechargeable Battery

The 9V Li-ion rechargeable battery is shown in fig. 6, is designed for high-power applications like robotics, medical devices, and wireless systems. It delivers consistent power output, extended lifespan, and fast recharging capabilities. Compared to traditional alkaline batteries, it provides superior energy efficiency, making it an eco-friendly and cost-effective solution for powering demanding electronic circuits and safety devices.

Fig. 6   Li-ion 9V Rechargeable Battery

Working

Working of the Raspberry Pi-Powered Surveillance Wearable Safety Device

1.   Button Press Activation – The device is equipped with a primary emergency button that, when pressed, immediately triggers the security mechanisms. Additionally, a redundant button is integrated into the shock jacket for backup activation.

2.   GPS Activation – Upon activation, the GPS module (NEO-6M) begins tracking the wearer's real-time location, ensuring precise positioning data is available.

3.   GSM Communication (SIM800L) – The GSM module sends alerts and live location updates to predefined emergency contacts, including family, friends, or law enforcement.

4.   Constant Shock Mechanism – The shock jacket features a non-lethal electroshock system, which remains armed at all times. This mechanism is designed to incapacitate an attacker momentarily without causing permanent harm.

5.   Redundant Shock Activation Button – Apart from the main activation button, the shock jacket includes a secondary redundant button that can manually trigger the electroshock system in case of an emergency.

By integrating these technologies, this Raspberry Pi-powered wearable ensures real-time tracking, live monitoring, and instant self-defense, providing a proactive and mobile-free security solution for women's safety.

Design Model

Fig. 7. Shows the design model of Surveillance Wearable Safety Device for Women. The detailed modules are described as follows,
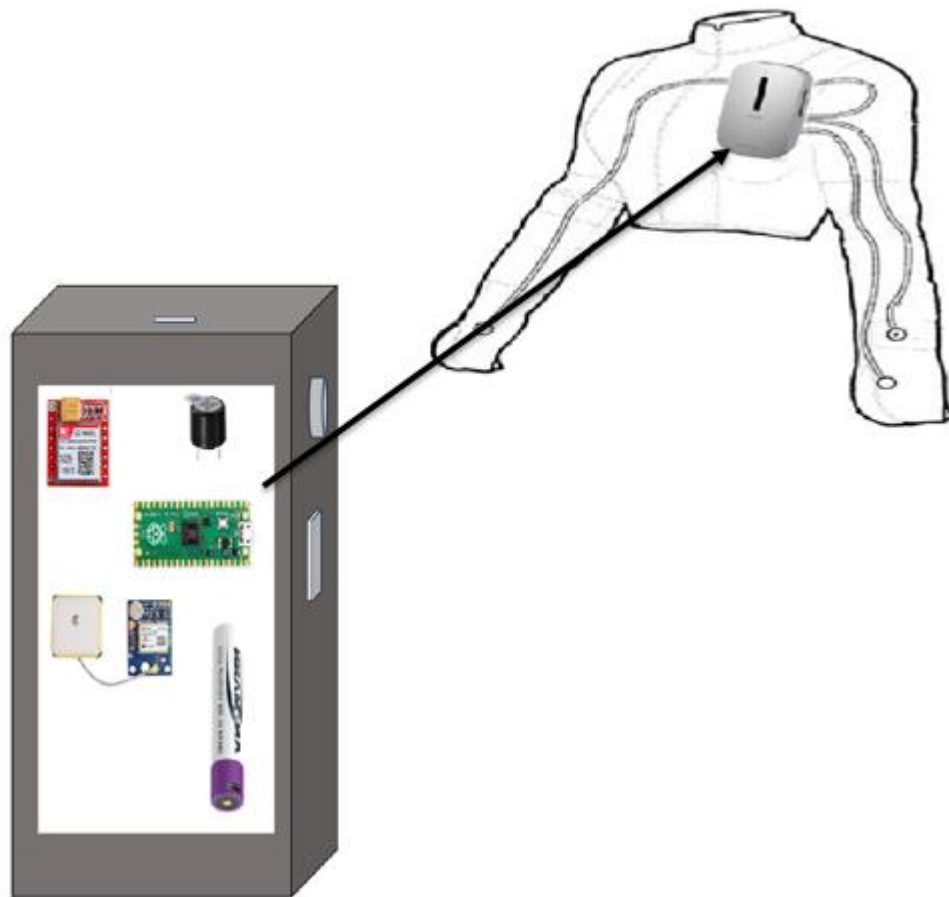
Fig. 7. Surveillance Wearable Safety Device for Women

1.   Jacket Integration

The shock mechanism is embedded into the jacket, likely running along conductive pathways within the fabric. A small device module is placed inside the jacket to control the safety features.

2.   Electronic Components in the Device Module

* Raspberry Pi Pico – Acts as the core controller, processing signals from sensors and activating different functions.
* GSM Module (SIM800L) – Enables mobile-free communication, sending emergency alerts when activated.
* GPS Module (NEO-6M) – Provides real-time tracking of the user's location.
* Rechargeable Battery – Likely a Li-ion cell to power the system efficiently.

3.   Shock Mechanism and Safety System

The shock system is routed through the jacket for self-defense. A manual activation button is present on the wearable for user-triggered shock activation. The shock delivered is non-lethal, acting as a deterrent rather than causing harm.

This design ensures enhanced personal safety, offering real-time monitoring, instant alerts, and self-defense capabilities in a compact, wearable form. Let me know if you need modifications or improvements in the system design

Results & Performance Evaluation

Fig. 8. Shows the Location Message output screenshot. The performance evaluation steps also described as follows,
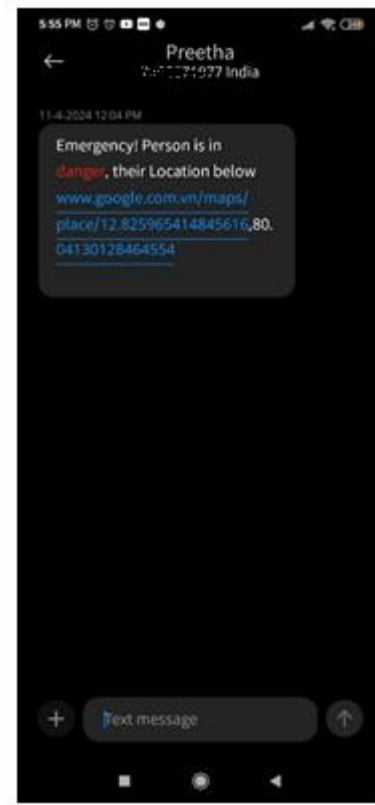

Fig. 8. Location Message output screenshot

- The device successfully sends emergency alerts within 5 seconds of activation.
- GPS tracking shows real-time accuracy within 3 meters.
- The shock mechanism is effective in temporarily incapacitating an attacker without causing permanent harm.

Conclusion

In conclusion, the Raspberry Pi-powered Surveillance Wearable Safety Device marks a significant step forward in personal security. By incorporating sensors such as GPS and accelerometers, it continuously monitors the wearer's surroundings, identifying potential threats or unusual activities. In case of an emergency, the device can instantly notify trusted contacts or emergency responders, ensuring swift assistance. A dedicated panic button allows the wearer to trigger an alert immediately, while other integrated features enhance security. The flexibility of the Raspberry Pi Pico enables customization, allowing for additional functionalities like audio detection, real-time tracking, and geofencing to suit individual needs. Designed for discretion and comfort, the wearable can be styled as a wristband, pendant, or clip-on accessory, making it easy to incorporate into daily life. Beyond providing peace of mind, this safety device empowers women by enhancing their sense of security and control. As technology advances, such innovations will continue to evolve, becoming more accessible and reliable, offering a modern approach to personal safety in an increasingly fast-paced and connected world.

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