SMART JACKET FOR REAL TIME WOMEN SAFETY MONITORING SYSTEM

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Abstract

Women's safety has become a pressing concern due to the increasing rate of crimes in society. To address this challenge, a smart safety jacket is developed that combines real-time monitoring, communication and self-defense features in a single wearable system. The jacket incorporates multiple components, including a GPS module for live location trackingA GSM module is integrated into the system to transmit emergency alerts in critical situations, a heart rate sensor to detect stress-related abnormalities and an ESP32-CAM to capture images or videos for evidence. An Arduino Uno serves as the central controller, coordinating the operation of all modules, while an alarm and an embedded shock-producing unit provide immediate defense and deterrence in critical situations. This integrated system ensures that the user's location and emergency alerts are promptly communicated to pre-registered contacts, enhancing the chances of timely assistance. Overall, the proposed safety jacket is designed as a practical and effective solution to improve women's security and confidence in vulnerable circumstances.

Keywords-Women Safety, Real Time monitoring, Pulse Rate Sensor, self-defense Technology, Wearable Safety Jacket, Panic Detection, Real time visual Evidence

INTRODUCTION

Women's safety has become a pressing concern in the present era, crimes and harassment cases are rising rapidly, creating major safety challenges. An average of 86 cases is reported daily in India.To address this challenge, the development of smart safety Jacket plays a vital role in ensuring timely protection and response. The smart safety jacket is designed with GPS functionality for real-time location tracking and a heart rate monitoring unit for continuous health observation, Shock producing Unit and image capturing functions provides an effective solution by combining real-time monitoring with emergency alerts. This system integrates advanced components such as a GPS module for live location tracking, a GSM module for sending alerts, A pulse rate sensor is employed to detect sudden variations in heart activity, which are often linked with stress, fear, or panic states, an ESP32-CAM for capturing and transmitting visual evidence, and an Arduino Uno board to coordinate all operations. Additionally, the Jacket includes an alarm and shock-producing unit to provide immediate self-defense support. By merging communication, sensing, and protective technologies, this Jacket offers a reliable means of enhancing personal security and providing timely assistance in critical situations.

OBJECTIVES

The central aim of this project is preventive control of emergencies, ensuring proactive intervention rather than simply reacting after an incident occurs.

- To design and develop a smart wearable jacket that enhances women's safety in real-time situations.
- To integrate a GPS module for live

location tracking and sharing during emergencies.
- To utilize a GSM module for transmitting instant alerts to pre-registered contacts.
- To integrate a heart rate monitoring sensor capable of identifying unusual fluctuations that indicate stress or panic conditions.
- To employ an ESP32-CAM module for capturing and transmitting images or videos as visual evidence.
- To use an Arduino Uno board as the central controller for efficient coordination of hardware components.
- To include an alarm and shock-producing unit for immediate self-defense and deterrence against attackers.
- To merge communication, sensing, and protective technologies into a reliable, user-friendly, and effective wearable safety solution.

BLOCK DIAGRAM REPRESENTATION

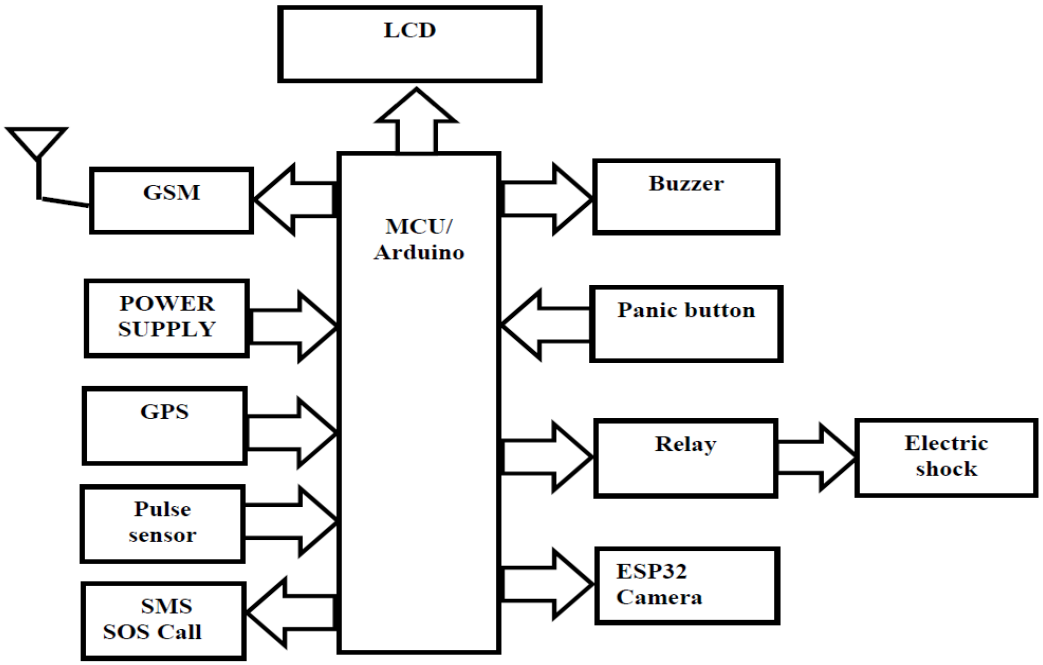

Figure1:*Block diagram.*

The proposed system is built around an Arduino Uno, which serves as the main controller by interfacing with the GPS, GSM, pulse rate sensor, LCD, buzzer, shock unit, ESP32 camera, and an SOS button. Once powered, the pulse rate sensor continuously monitors the user's heartbeat and displays the data on the LCD; if the rate deviates from the normal threshold, the Arduino collects the GPS coordinates and displays them on the LCD while the GSM module automatically sends an SMS and initiates a call to pre-registered contacts with the live location. Simultaneously, The Arduino controller activates the ESP32-CAM module to capture images of the surroundings when abnormal conditions are detectedor suspicious individuals and shares them with emergency contacts via Telegram using internet connectivity. For immediate protection, the shock unit provides self-defense capability, A buzzer provides an audible warning signal to draw the attention of people nearby. Additionally, a dedicated SOS button allows the user to manually activate all these safety functions at any moment of distress, ensuring both automatic and manual modes of operation for enhanced security.

COMPONENTS

Arduino Uno: The Arduino Uno is a widely used microcontroller board built around the ATmega328 chip. The term "Uno," derived from Italian, means "one." This board is equipped with 14 digital input/output pins, 6 analog input pins, a 16 MHz ceramic resonator, a USB interface, a reset button, and an ICSP header. It can be powered through a USB cable, an external AC-to-DC adapter, or a battery. The Arduino Uno serves as the central unit for managing and automating system operations, including tasks like generating alerts and enabling real-time monitoring.

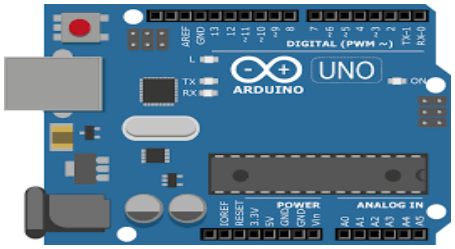

Figure2: Arduino Uno.

Piezo Buzzer*:* The main role of a buzzer is to provide an alert signal that prompts the user to respond quickly. A piezoelectric buzzer works on the principle of the piezoelectric effect, where the application of an electric voltage causes mechanical vibrations.

Figure3:*Piezo buzzer*

Push Button:A push button is included as a manual control interface, allowing the wearer to trigger alerts instantly, initiates a predefined action or event within a system. It is widely used for executing commands, navigating interfaces, and submitting data.

Figure4:*Push button*

GSM Model: The Global System for Mobile Communication (GSM) enables reliable wireless communication for transmitting distress messages. It is a widely adopted standard that supports reliable voice and data transmission over long distances. It is particularly advantageous in regions where internet access is limited or unavailable, making it an essential medium for remote communication. In the context of intelligent systems, GSM enhances operational efficiency by ensuring continuous data transfer and real-time connectivity.

Figure5:*GSM module*

GPS Model: The Global Positioning System (GPS) ensures accurate, satellite-based location identification.that delivers continuous and highly accurate information on geographic location, velocity, and time. By receiving signals from a minimum of four satellites within the GPS constellation, a GPS receiver is able to perform triangulation and compute the precise coordinates of a user or device in real time. This capability ensures global coverage, functioning effectively in both urban and remote environments.

Figure6:*GPS Module*

ESP32 Camera: The ESP32-CAM is a low-cost yet powerful module that integrates the ESP32-S microcontroller with an OV2640 camera sensor, offering both processing capability and image acquisition within a compact form factor. One of its major advantages is the inclusion of built-in Wi-Fi and Bluetooth connectivity, which enables seamless wireless data transmission without the need for external communication hardware.

Figure7:*ESP32 Camera*

Rechargeable Battery: The AKARI sealed lead-acid rechargeable battery is a maintenance-free energy storage device designed for reliable backup and portable applications. Its sealed construction prevents leakage, while the rechargeable feature ensures repeated use, making it suitable for embedded systems and safety devices.

Figure8:*Rechargeable Battery*

PCB Circuit: The PCB integrated into the jacket includes components that convert a low-level DC supply, typically sourced from a rechargeable battery, into a higher voltage output. This elevated voltage is then delivered to a conductive mesh or electrode layer embedded within the jacket. When the wearer activates the system during a threatening situation, the high-voltage electrodes can deliver an electric shock to an aggressor upon contact. This controlled discharge serves as a non-lethal defence mechanism, effectively deterring the attacker and giving the wearer critical time to escape or seek help.

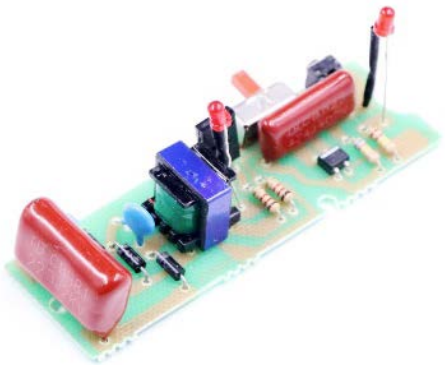

Figure9:*PCB Circuit*

Pulse rate sensor: The pulse rate sensor is an electronic module designed to monitor and record an individual's heart rate. In the context of a women's safety device, it plays a vital role by tracking the user's physiological state. Any abnormal fluctuation in heart rate can be identified, enabling the system to generate alerts and initiate timely protective measures.

Figure10:*Pulse rate Sensor*

Voltage Regulator 7850:A regulated power supply is an electronic system designed to deliver a constant output voltage regardless of variations in input supply or changes in load conditions. The 7805 regulator is a commonly used fixed-voltage regulator that provides a stable 5V output.

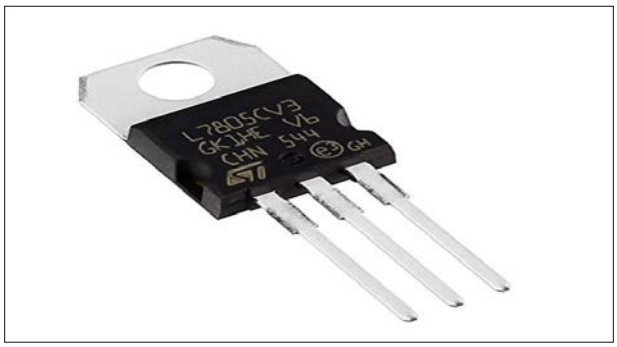

Figure11:*Voltage Regulator 7850*

LCD Display: A 16×2 Liquid Crystal Display (LCD) is one of the most widely used alphanumeric display modules in embedded electronic systems. It consists of two rows, each capable of showing 16 characters, thereby providing a total of 32 characters at a time. Due to its low power consumption, compact design, and cost-effectiveness, it is frequently integrated into microcontroller-based applications for real-time data visualization.

Figure12:*LCD Display*

Figure13: *Working system*

WORKING

The core hardware of the system comprises an Arduino Uno microcontroller, an ESP32 camera, along with GPS, GSM, and heart rate sensors, an LCD, a buzzer, a relay-based shock unit, and a manual SOS button. When power is supplied, the pulse rate sensor continuously monitors the user's heartbeat, and the collected data is first encoded and transmitted to the receiver, where it is decoded and displayed on the LCD screen. If the heartbeat remains within the normal range (below 120 bpm), the system continues monitoring; however, whenever the pulse rate rises above or falls below the predefined threshold, the Arduino retrieves the current latitude and longitude from the GPS module and displays them on the LCD. The GSM module then sends the location details via SMS and also places a call to the pre-stored emergency contact numbers. At the same time, the Arduino activates the ESP32 camera, which captures images of the surrounding area or potential threat and sends them to the emergency contact through Telegram using internet connectivity. For self-defense, the PCB circuit is triggered to charge the capacitor up to 300–400V DC, powering the shock-producing unit. Additionally, the buzzer is activated to generate an audible alert, drawing the attention of nearby people. In case of a direct threat, the user can press the SOS button, which manually initiates all safety mechanisms including location sharing, image capture, alarm activation, and self-defense features, thereby ensuring both automatic and manual modes of operation for enhanced safety.

RESULT

The Smart Jacket for Real-Time Women Safety Monitoring System was successfully designed, implemented, and evaluated under different conditions. The system effectively monitored the user's pulse rate and accurately detected abnormal variations. The integrated GPS module consistently provided precise location details, while the GSM module reliably transmitted this information via SMS and calls to pre-registered contacts. The ESP32 camera captured clear images of the surrounding environment and successfully transmitted them through the internet to designated recipients. The shock-producing unit operated as intended, offering an additional layer of self-defense, and the buzzer generated an audible alarm for nearby alerts.Furthermore, the dedicated SOS button enabled manual activation of all safety features, ensuring user control in emergencies. Testing confirmed that the system achieved high reliability, accuracy, and responsiveness, making it a practical solution for enhancing women's safety and security.

OUTPUT

Figure14: *sending location*

Figure15: *Pulse rate monitoring*

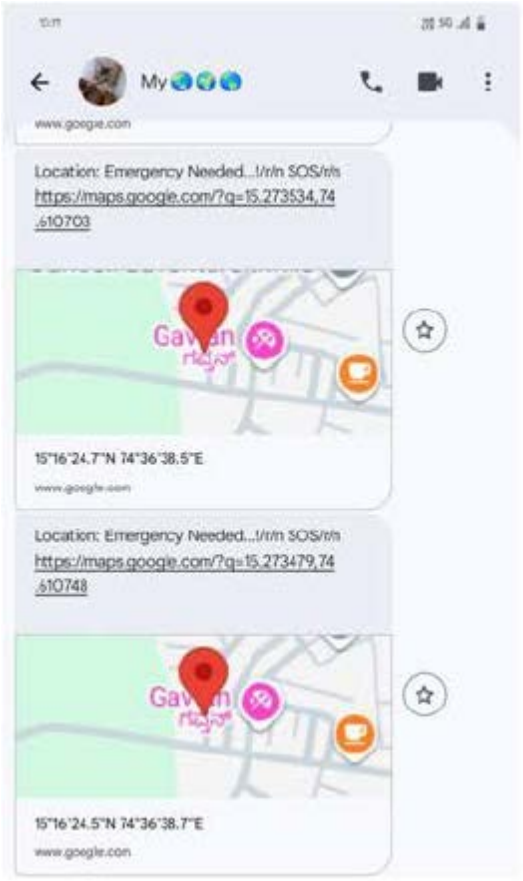

Figure16: *Message is sent to the pre-coded number*

Figure17: *Images sent through telegram during abnormal condition*

FUTURE SCOPE

The Smart Jacket for Real-Time Women Safety Monitoring System can be further enhanced in multiple ways to improve its efficiency and usability. Integration with cloud platforms can enable continuous data storage, real-time monitoring by family members, and long-term analysis of health and safety records. Artificial Intelligence (AI) and Machine Learning (ML) methods can be integrated to improve decision-making may be incorporated to detect unusual behavioral or environmental patterns, thereby providing predictive alerts before critical situations arise. Adding voice recognition or gesture-based controls can simplify operation in high-stress conditions where manual interaction may not be possible. The system can also be integrated with IoT-based smart city infrastructure, enabling faster response from nearby authorities or emergency services. Miniaturization of hardware and the use of flexible, lightweight materials will increase comfort and make the device more practical for daily use. Additionally, the inclusion of renewable energy sources such as solar panels can improve power efficiency and extend operating time. These advancements would make the jacket more intelligent, user-friendly, and capable of offering proactive protection in diverse real-world scenarios.

CONCLUSION

The Smart Jacket for Real-Time Women Safety Monitoring System has been successfully

developed as an integrated solution to address rising concerns about women's security. By combining GPS-based location tracking, GSM-enabled communication, heart rate monitoring, image capturing, shock-based self-defense, and an audible alarm, the system ensures timely alerts and immediate protective responses during emergencies. The inclusion of both automatic and manual (SOS button) activation modes enhances reliability by allowing the system to function under different scenarios. Experimental testing confirmed that the device operates accurately and effectively, making it a practicalapproach to improving personal safety. Overall, the project demonstrates that Smart wearable systems can greatly contribute to supporting and protecting women and providing rapid assistance in critical situations.

ADVANTAGES

- Ensures real-time tracking and rapid emergency response.
- Provides immediate distress alerts to family and authorities.
- Enhances women's personal security through wearable technology.
- Compact, easy-to-use, and always accessible in critical situations.
- Combines monitoring, self-defense, and evidence collection in one system.

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