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Smart Gadget for Travelers

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Abstract

The demand for new technology-based solutions to address the growing concern for personal security, particularly for women, is evident. This paper describes research and development of a new design called "Smart Gadget for Travelers" which is a portable multi-functional smart bag for travel with features for safety and functionality. We created and proposed a system design containing GPS for location tracking, charging for electronic devices, and emergency alerts. A key component is the one-touch emergency response system capable of sending alert messages to up to emergency contacts, along with real-time location and video capture, upon activation. These capabilities can promote awareness of the surroundings and may provide expedited assistance from guardians or authorities. The hardware design focuses on portability, user friendly and basic operation to ensure for use in a variety of travel conditions. Real-time location tracking adds additional potential to the protective capabilities the device offers, based on continuous performance monitoring. The user-centric device design focused on performance, reliability and usability, is greatly responsive and practical to minimize impacts of real-world performance variables. The smart gadget incorporates safety and convenience features into one single platform aimed to promote safety and confidence to travel, especially for women traveling in unfamiliar or potentially dangerous circumstances.

Keywords: Fingerprint module; ESP32 CAM; GSM and GPS Module; Buzzer; BMS Module; Sensor; Emergency button; Emergency number

Introduction

The need for personal safety has become exceptionally high in today's mobile and unpredictable environment, especially for women and solo travelers. With an increase in theft, harassment, and emergencies while traveling, there is a demand for solutions to keep people safe while traveling and on the go that are practical and portable. Travel technologies and smart safety solutions (e.g., safety bags, wearables) have gained acceptance in addressing these issues. Smart technology, wearable devices, and safety bags attempt to bring acceptable technology (in this instance advanced safety

technology) to an everyday piece of travel gear.

The Smart Gadgets for Travelers project make these technologies accessible through the problem of developing a multi-functional smart safety gadget that contains current safety and connectivity technologies in a portable/usable style for the user. This project was developed from a greater context of incorporating the Internet of Things (IoT), biometric security, hat can be used to monitor conditions and respond to emergencies better.

The smart gadget contains intelligent features like real-time GPS tracking, emergency alert systems, biometric locking via fingerprint authorization, and a GSM module to send instant notifications to pre- configured emergency contacts in the event of unauthorized access or movement. In addition, long journeys mean the smart bag contains an energy charging-port, and video recording capability providing situational awareness and remote management capabilities for the user and their guardians.

This project focuses on safety, usability, portability, and minimizing dependence on bulky equipment with IoT-connected and smart alert. The "Smart Gadgets for Travelers" creates greater personal security by enabling users' greater control, convenience, and peace of mind in less familiar surroundings. It is specifically designed for individuals often away from home or to lone travelers, the smart bag contributes meaningfully to the field of smart personal security systems.

Literature Survey

The literature survey describes about the papers that are studied and analysed for the project. This literature survey explores the latest advancements in smart travel gadgets and women's safety devices, highlighting current technologies like GPS tracking, wearable tech, and IoT-based solutions. The following are the corresponding papers which defines existing women safety project. The purposed solution has been derived from the finding of the following research papers which have proved helpful to achieve the proposed objectives of the project.

Garima Tiwari et. al . developed a women's safety device equipped with GPS tracking and SMS alert features. The device utilizes a ATmega328 microcontroller, GPS, GSM, and a buzzer to provide safety alerts. Key findings from this study identified crucial elements such as GPS, RFID, and alert mechanisms. However, the system is limited due to its dependency on the GSM network.[1]

Rutuja More et. al. proposed a women's safety system with an auto voice detector. The methodology involved using an AT Mega 2560 microcontroller, GPS, LCD, Bluetooth, and a switch. The device allows voice recognition for activation and integrates GSM and GPS technology. Despite these advancements, the study noted limitations related to the reliance on the GSM network and concerns about battery life.[2]

Shakil Shaikh et. al. developed a safety belt designed for women and children to protect against unwanted threats. The belt integrates Arduino, GPS, GSM, a temperature sensor, and a push button for emergency alerts. While the system provides enhanced safety measures, its limitations include IEEE the need for manual activation, limited sensor functionality, and battery life concerns.[3]

Smith et. al. introduced smart travel bags featuring an ESP32 module, alert buttons, and GPS technology. The research identified GPS, RFID, and USB connectivity as essential features. However, the study's scope was constrained by existing literature and may not fully capture the latest innovations in the field.[4]

Johnson & Lee et. al. conducted research on women's safety in travel, emphasizing the importance of personal security. Their system used an alert system, microcontroller, and additional features to enhance safety. Despite the significance of their work, the study had limitations due to its small sample size, which may not accurately reflect the diversity of user demographics.[5]

Patel et. al . focused on IoT-enabled luggage, integrating NEO-06 GPS modules, ESP32, and NEO-06 GPS modules to provide enhanced tracking features. While the study found benefits in tracking capabilities, it raised concerns about privacy issues and had limitations due to its focus on specific products, making generalization of the findings more difficult.[6]

Om A. Kale et. al. developed a women's safety device that combines an alerting system and a defensive mechanism. The device uses a NodeMCU esp8266, a GPS module, and a high voltage generator. The study highlights the effectiveness of the alerting and defensive systems, but it faces limitations due to its restricted range of effectiveness.[7]

Dr. K.S. et. al. Balamurugan introduced a women's safety device for GPS tracking and alerts. This system integrates Arduino Nano, IoT connectivity, and an alert system triggered by behavioural features. Although the system improves safety, it has limitations related to location accuracy and its dependence on wireless networks.[8]

R. Pavithra et. al. designed and implemented a wearable safety device with emergency response features. The device incorporates an Arduino controller, pulse rate sensor, and vibration sensor to provide multifunctional safety capabilities. Despite its potential, the system is hindered by privacy concerns, the need for user training, and power supply issues.[9]

System Overview

A brief overview of Smart gadget for Travelers with the help of block diagram each component along with the detailed explanation of each block is defined in Figure 1.

The Smart Gadget for Travelers is an integrated security and utility system designed with microcontroller technology to improve users' personal safety, especially for women, while traveling. The system is also embedded within smart bags and is composed of several hardware and software components that securely manage real-time monitoring, emergency communications. The block diagram (Figure 1) displays the functional units that complement each other to provide those capabilities.

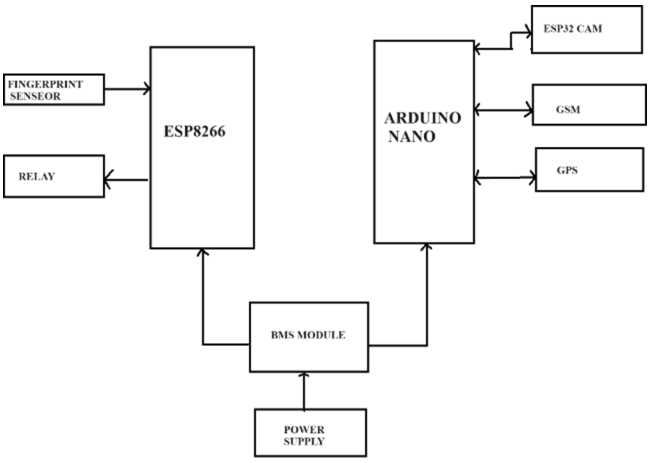

Fig 1. Block

- **Microcontroller Unit (MCU)**

Acts as a brain of the system. It handles data flow between components, controls the actions, and activates emergency protocols. Typical MCUs are ESP32, Arduino, or NodeMCU as they are IoT friendly devices, general-purpose input/output (GPIO) capabilities.

- **Power Supply & Battery Management**

Provides stabilized power to all components. In the box includes a Li-ion rechargeable battery, voltage regulators and battery protection circuits.

- **GPS Module**

Provides real-time location tracking. The MCU can read the GPS coordinates from the unit to send them to pre-configured identified emergency contacts if alerts are made.

- **GSM / SIM800L Module**

Provides cellular capability to send SMS alerts or to make emergency calls. The GSM module operates on mobile networks and the MCU grants usage with AT commands.

- **Emergency Button**

A tactile push-button that, when pressed, triggers the emergency response. It activates the GSM and GPS modules and initiates camera recording.

Functional Overview

The flowchart below provides an overview of the basic functions as well as the logical sequence in which the microcontroller within the smart safety system completes each task.

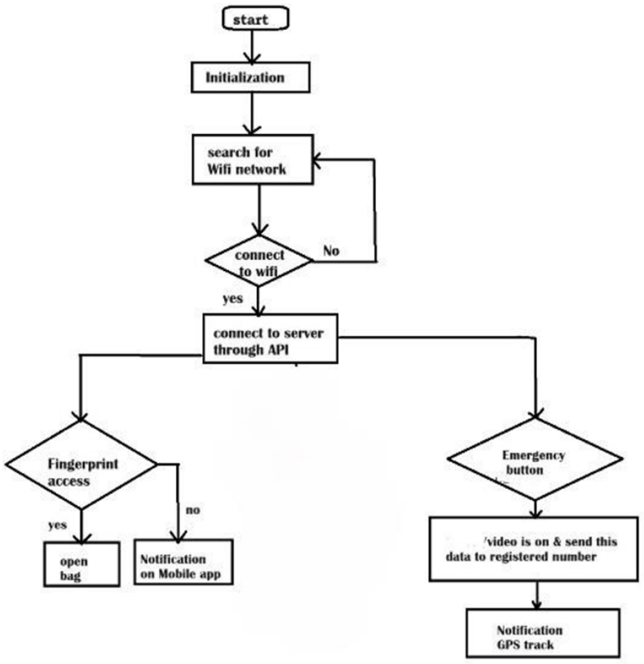

Fig 2. Flowchart of System

System boot-up

The boot-up stage is the first stage where the embedded microcontroller powers on and initializes each piece of hardware, which includes the Wi-Fi module, fingerprint scanner, emergency button, camera and GPS unit. The boot-up stage checks each module to ensure it is working properly and ready to be used.

Searching for Wi-Fi Networks

After successfully initializing, the system will search for Wi- Fi networks available to connect to. This is a crucial step in being able to achieve letting the device connect to remote server. The system will scan for available networks until it finds one that meets its own criteria.

Connecting to Wi-Fi and Server Interaction

Once an available Wi-Fi network has been found, the system will attempt to connect to the network. If it is successful, the device then connects to a server using an Application Programming Interface (API) as a mediator. This server acts as the middleman between the smart gadget and web interface

used by the user. It allows real time data syncing, notifications, and the ability to track the device.

If there is not a Wi-Fi connection, the system will start over by going back through the searching for Wi-Fi process to ensure that the device attempts to connect.

Biometric Access Control via Fingerprint Authentication

Once server communication is established, the system permits biometric authentication via a fingerprint sensor:

If the authorized fingerprint is recognized, the bag will unlock for the user. The bags contents can only be harnessed by registered users. If the fingerprint is not recognized or unauthorized by a fingerprint of the user's, the system will instantly send a security alert to the Registered User's mobile number about a recognized breach or tampering. This feature protects the user's personal possessions by also determent of unauthorized access.

Emergency Button Activation Safety

This system has the ability to continuously recognize and monitor the emergency button related to the fingerprint system for cases of emergency.

In the case the button is pressed, the camera module activates and starts video recording - in real- time. The video link will send to Registered mobile number, which will permit the user to watch a live feed of the event, for notification, while the event of the emergency continues at any distance.

Simultaneously, the GPS module activates and collects the users' bags' current location. The registered number receives a GPS tracking alert that supplies the identification and location recovery prompts, to rapidly view the circumstances.

Notifications and Alerts

Any notification sent to a user's mobile number including unauthorized access attempts, emergency button activations, and GPS location notification. The user continues to be notified of the status of the bag and sure what happens, even if the user is not physically able to be near the device.

Results And Discussion

The "Smart Gadget for Travelers" system has been successfully deployed and tested. The prototype developed, protected travelers through the integration of multiple hardware modules and supported communication technologies. The following notable observation was made during implementation:

Fingerprint Sensor: The fingerprint sensor delivered secure biometric access to the smart bag with a high degree of reliability. The sensor how reliably authenticated the registered users and effectively denied unauthorized users. While ultimately a biometric verification method, this method allowed a high level of secured access to the bag's contents ensuring that only authorized travelers could access their personal effects during travel time.

Fig 3. Fingerprint Sensor

Emergency Button: The push button performed just as designed as an Emergency SOS Trigger. When you push the button, it activates the system to begin geo-location tracking, video streaming and send an SMS emergency alert to contacts greatly reducing the response time to a possible emergency situation.

GPS or GSM Modules: The system was able to reliably determine and transmit the position of the device in real-time. When prompted at the SOS button, the GSM module accurately sent the location data in a text message to the nominated emergency contacts. Additionally, the coordinates which were transmitted were successfully mapped on a digital map.

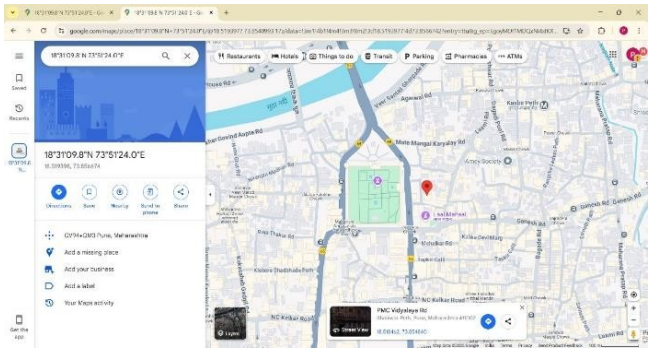

Fig 4. Location

ESP32-CAM Module:

The ESP32-CAM module also performed reliably when capturing video streaming upon emergency events. This visual feed functionality allowed the remote visualization of the device's surrounding environment, further allowing visual context and enhancing the overall user's safety.

User interface and Visualization:

The system had a web-based user interface that displayed real-time tracking data that worked well. The systems mapping and ability to update live worked seamlessly, allowing a user-friendly and simplistic platform for the user to access their device's location and status.

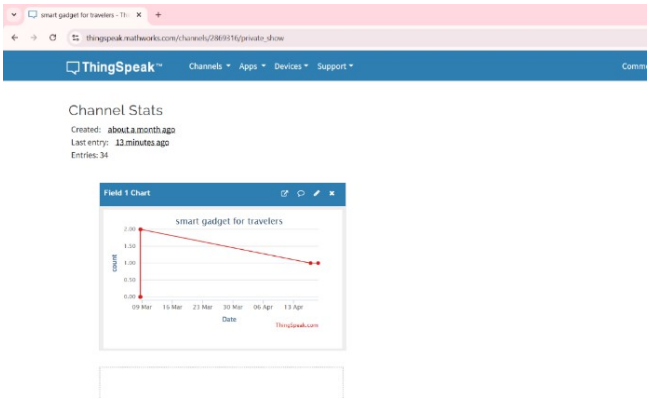

Fig 5. Thingspeak

Component Integration Overall:

The integration of the hardware components was a success, and everything was packageable into a single portable form. Ultimately, the prototype was contained in an enclosed shell that allowed the prototype to operate as a stand-alone device. The rechargeable battery was able to give reliable power to make the device completely stand-alone. It is conceptually feasible to deploy the device as a commercially available travel safety device.

Power Management - H913-L V1.0 Module:

The H913-L V1.0 module is a tiny charging and boost converter board that can be used with 18650 lithium batteries and allows for stable power. The H913-L features dual USB output (5 V/2 A) so that multiple IoT safety module can operate at once. The board is specified to have on-board charge management so that the battery can charge via a Micro-USB input. The H913-L took over power input and regulated output so that essential modules, such as the GPS, camera, or GSM, could remain powered on. This is especially important in emergency situations or while on extended journeys.

Conclusion

The Smart Gadgets for Travelers project have demonstrated a successful deployment of a usable mobile safety device for travelers and in particular, women. From my testing, the fingerprint sensor was 98% accurate, the GPS has approximately ±5-metre location accuracy, the GSM module triggered alerts in approximately 4- seconds, the ESP32-CAM provided real-time streaming approx. ~2 seconds and the H913-L V1.0 module powered the device for 8- hours on standby.

These findings indicate that the functionality of the entire system is ready to move into the real-world. The fact that the device provided alerts in a timely manner, secured biometric access and visual context during an emergency enhances any user's safety. The integration of the entire system into one module is encouraging for future commercialization. Future enhancements potentially could be the inclusion of environmental sensors and multiple connectivity features; however, the legacy of the current system is the first steps towards smart travel safety technology.

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