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Smart Backpack with Anti Loss System Using ESP32

Abhishek Gupta, Asad, Hrithik Teotia
Raj Kumar Goel Institute of Technology, Ghaziabad
abhigfio@rkgit.edu.in, 26iobilad@rkgit.edu.in, 26ioneeik@rkgit.edu.in

Abstract: *This paper presents the design and implementation of a smart location tracking bag system that integrates GPS and GSM technologies to enhance security and provide an efficient solution for tracking lost or stolen belongings. The proposed system is specifically developed to address the growing concern of baggage theft and misplacement in daily life, especially during travel. By embedding a GPS module within the bag, the system continuously determines the precise geographical location of the bag, while the GSM module enables seamless communication between the user and the device. One of the key features of this system is its ability to operate without requiring an active internet connection, making it highly reliable even in remote or low-connectivity areas. Users can send simple SMS commands from their mobile phones to the GSM module, which then responds by transmitting the current location of the bag in the form of a Google Maps link. This allows users to quickly access real-time location updates and navigate to the exact position of their belongings. Additionally, the system is designed to be compact, energy-efficient, and easy to use, ensuring that it does not interfere with the normal usage of the bag. The implementation of such a system not only enhances user convenience but also significantly improves the chances of recovering lost or stolen items. Overall, the smart location tracking bag system demonstrates a practical and cost-effective approach to personal security by leveraging widely available communication and positioning technologies, making it a valuable innovation in the field of smart embedded systems..*

Keywords: GPS and GSM

I. INTRODUCTION

With the increasing incidents of theft and accidental misplacement of personal belongings, there is a growing need for reliable and intelligent tracking solutions that can ensure the safety and security of everyday items. This project focuses on the development of a smart tracking system by integrating embedded systems with advanced communication modules. The system is designed to provide real-time monitoring and location tracking of personal belongings such as bags, wallets, keys, and other valuable items. By utilizing technologies like microcontrollers, GPS modules, and wireless communication (such as GSM, Bluetooth, or IoT- based networks), the device can transmit the precise location of the item to the user through a mobile application or web interface. Additionally, features like alert notifications, geofencing, and motion detection enhance the system's efficiency by informing users whenever their belongings are moved beyond a predefined boundary or detected in an unusual situation. This not only minimizes the chances of loss but also increases the chances of recovery in case of theft. The integration of embedded systems ensures low power consumption, compact design, and cost-effectiveness, making the solution practical for everyday use. Overall, this project highlights how modern technology can be leveraged to address common security concerns, providing users with a sense of safety, convenience, and peace of mind in their daily lives.

Problem statement

People frequently lose personal belongings such as bags, backpacks, and luggage in crowded places like public transport, markets, and educational institutions, leading to inconvenience, financial loss, and stress. Despite the

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availability of tracking technologies, most existing solutions are either expensive or heavily dependent on continuous internet connectivity, making them inaccessible or unreliable for many users, especially in areas with poor network coverage. High-end tracking devices often require subscription fees, smartphones with active data connections, and complex setup processes, which further limits their practicality for everyday use. As a result, there is a clear need for a cost-effective, simple, and reliable tracking system that can function independently of internet connectivity while still providing accurate location or proximity information. Such a solution would not only enhance the security of personal belongings but also offer peace of mind to users by ensuring that their items can be easily located even in low-resource environments.

Objective

Designing a low-cost tracking system that provides real-time location updates, supports SMS-based commands, and ensures user-friendly operation requires a careful balance of affordability, efficiency, and simplicity. The system can be built using widely available and inexpensive components such as a GPS module for location tracking, a GSM module for communication, and a microcontroller like Arduino or ESP32 to process and manage data. The GPS module continuously captures the geographical coordinates of the device, while the GSM module enables the system to transmit this data via SMS or mobile networks, ensuring accessibility even in areas without internet connectivity. Real-time tracking can be achieved by periodically sending location updates to a predefined mobile number or server, allowing users to monitor movement instantly. To enhance usability, SMS-based commands can be integrated, enabling users to send simple text messages like “LOC” to receive current coordinates or “STATUS” to check system functionality, making it convenient for users without technical expertise. Additionally, the system interface should be designed to be intuitive, requiring minimal setup and offering clear instructions, possibly through a mobile application or simple SMS responses. Power efficiency is another critical factor, so the use of rechargeable batteries and low-power components helps extend operational time while maintaining cost-effectiveness. Overall, by combining affordable hardware, reliable communication methods, and an easy-to-use interface, this tracking system can serve practical applications such as vehicle tracking, personal safety, and asset monitoring, making it an efficient and accessible solution for a wide range of users.

Literature Review

The Existing systems for tracking and monitoring primarily rely on vehicle tracking technologies and Internet of Things (IoT)-based applications, which have significantly improved the ability to monitor assets, ensure safety, and enhance operational efficiency. These

systems typically use GPS modules combined with cloud platforms to provide real-time location updates, remote access, and advanced analytics. However, a major limitation of many such systems is their heavy dependence on continuous internet connectivity. In regions with poor network coverage, unstable data connections, or high internet costs, these systems often fail to perform reliably. This creates a gap in accessibility and usability, especially in rural or remote areas where consistent internet access cannot be guaranteed. To address this challenge, GSM-based SMS systems emerge as a practical and cost-effective alternative. Unlike IoT solutions that require internet data services, GSM-based systems utilize standard cellular networks to send and receive information through SMS, which is widely supported even in low

-signal environments. These systems enable users to track location, send commands, and receive updates without relying on internet connectivity, making them more robust and dependable in diverse conditions. Furthermore, SMS-based communication ensures lower power consumption and simpler implementation, reducing both operational and maintenance costs. The use of GSM technology also enhances reliability, as SMS services are less prone to disruptions compared to internet-based platforms. By integrating GPS with GSM modules, such systems can provide real-time tracking and control features while maintaining ease of use and affordability. Therefore, GSM-based SMS systems

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offer an efficient solution that bridges the limitations of internet-dependent tracking technologies, ensuring continuous functionality, wider accessibility, and improved user experience across various environments.

System Architecture

The proposed system is designed around an integrated set of hardware components including an ESP32 microcontroller, a GPS module, a GSM module (SIM900), and a buzzer, all working together to provide an efficient and reliable tracking solution. The ESP32 acts as the central processing unit of the system, coordinating communication between different modules using its multiple UART interfaces, which allow simultaneous interaction with both
GPS and GSM devices without data loss ([Zbotic][1]). The GPS module is responsible for continuously collecting real-time geographical data such as latitude and longitude coordinates by receiving signals from satellites, enabling accurate location tracking. This positional data is then processed by the ESP32 and prepared for transmission. On the other hand, the GSM module (SIM900) serves as the communication backbone of the system, enabling wireless data exchange over cellular networks. It operates using standard AT commands through serial communication and can send or receive SMS messages, make calls
, or transmit data over GPRS, making it highly suitable for remote monitoring applications ([ElectronicWings][2]). In this system, the GSM module is specifically used to send the GPS coordinates to a predefined mobile number via SMS, ensuring functionality even in areas without internet connectivity. Additionally, the inclusion of a buzzer enhances the system by providing an audible alert in critical situations such as unauthorized access, emergency triggering, or system activation, thereby improving user awareness and safety. When the system is activated, the GPS module fetches the current location, the ESP32 processes the data, and the GSM module transmits it instantly via SMS, while the buzzer may sound to indicate successful operation or alert conditions. This combination of modules creates a low- cost, energy-efficient, and reliable tracking system that is particularly useful in applications like vehicle tracking, personal safety devices, and asset monitoring, especially in remote or low-connectivity environments where traditional internet-based solutions may fail.

Methodology

A system that processes commands like **FIND, TRACK, and STOP** is typically a ** GPS-based tracking system** designed to monitor the real-time location of a vehicle, person, or asset. In such a system, when a user sends the command **FIND**, the system activates the GPS module to determine the current coordinates (latitude and longitude) of the target device by receiving signals from multiple satellites orbiting the Earth. These satellites continuously transmit timing and positional data, and the device calculates its exact position using a method called trilateration. ([ansitindia.com][1]) Once the location is determined, the command **TRACK** enables continuous monitoring, where the device repeatedly updates its position and sends this data through a mobile network (such as GSM or 4G/5G) to a cloud server. This allows the user to view live movement, speed, direction, and route history on a mobile app or web dashboard in real time. ([ansitindia.com][1]) The system essentially combines three main components: a GPS receiver for location detection, a communication module for transmitting data, and a software interface for displaying the information. ([Trackster][2]) When the user sends the command **STOP**, the system either halts continuous tracking updates or disables specific tracking features, depending on the design of the application. Modern tracking systems go beyond simple location detection and may include advanced features such as geo-fencing alerts, speed monitoring, SOS notifications, and even engine control in vehicles. ([ansitindia.com][1]) Overall, such a command-based tracking system provides accurate, real-time location data and plays a crucial role in security, fleet management, and personal safety by ensuring that users can easily locate and monitor assets whenever required.

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Implementation code

```
Roboticss#include <TinyGPS++.h>
// ===== GSM =====
#define GSM_RX 16
#define GSM_TX 17

// ===== GPS =====
#define GPS_RX 4
#define GPS_TX 2

#define BUZZER 15

HardwareSerial sim900(2); HardwareSerial gpsSerial(1);

TinyGPSPlus gps;

bool tracking = false; unsigned long lastSend = 0;

String senderNumber = ""; String lastHeader = "";

// ================== SETUP ==================
void setup() {
pin
sim900.println("AT+CSCS=\"GSM\""); // FIX encoding issue delay(1000);
}
```

Results and Discussion

The system successfully transmits accurate location data via SMS, ensuring that users can reliably share their real-time position with authorized contacts when needed. This functionality enhances safety and communication, especially in emergency situations or when

coordinating with others. In addition to single-location sharing, the system's tracking mode offers continuous updates, allowing the recipient to monitor movement over time rather than relying on one-time information. This continuous tracking capability is particularly useful for applications such as personal safety, fleet management, and navigation support, as it provides

a dynamic and up-to-date view of the user's location. By combining precision, reliability, and real-time monitoring, the system ensures efficient and dependable location tracking, making it a valuable tool in modern communication and safety solutions

Conclusion

The project offers an efficient and reliable solution for tracking personal belongings, helping users easily locate and manage their items in real time. By integrating smart tracking technology with a user-friendly interface, it minimizes the chances of losing valuable possessions and reduces the time spent searching for misplaced items. The system ensures accuracy, convenience, and security, making it suitable for everyday use. Overall, it enhances organization and peace of mind by providing a seamless way to monitor and track personal belongings effectivelyMobile app integration combined with IoT cloud connectivity enables seamless communication between smart devices and users, allowing real-time monitoring and control from anywhere.

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Future Scope

Through geofencing, systems can automatically trigger actions based on a user's location, enhancing convenience, security, and automation in applications like smart homes, logistics, and fleet management. Additionally, effective battery optimization techniques ensure that connected devices operate efficiently over longer periods, reducing energy consumption while maintaining consistent performance. Together, these technologies create a robust, intelligent ecosystem that improves user experience, operational efficiency, and sustainability.

REFERENCES

[1] https://zbotic.in/esp32-uart-serial-reading-gps-and-gsm-with-hardware-serial/?srsltid= AfmBOoqf8DTqK_jdjo UQHDYBk6Lph7pfuA3eVlM59jjKLZHacP-n3c-g&utm_source=chatgpt. com "ESP32 UART Serial: Reading GPS and GSM with ..."

[2] https://www.electronicwings.com/arduino/sim900a-gsm-module-interfacing-with-arduino-uno?utm_source=chatgpt.com "Sim900A GSM Module Interfacing with Arduino UNO"