SMART LUGGAGE TRACKING AND BIOMETRIC BASED SECURITY SYSTEM USING IOT

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***Abstract*— In today's fast-paced world, the security and tracking of luggage are paramount for travelers. This paper introduces a smart luggage system that integrates tracking capabilities and biometric-based security using Internet of Things (IoT) technology. The proposed system ensures real-time location tracking and enhanced security through biometric authentication, significantly reducing the risk of theft or loss. The IoT framework enables continuous monitoring and provides users with instant alerts and updates about their luggage status. This innovative approach not only enhances the travel experience by providing peace of mind but also leverages advanced technology to streamline and secure luggage management.**

***Keywords*— smart luggage, IoT, real-time tracking, biometric security, travel safety, luggage management, theft prevention**

I. INTRODUCTION

In the era of globalization, travel has become an integral part of modern life, with millions of people flying daily for business and leisure. However, the increased volume of travelers has led to a rise in luggage-related issues, such as theft, loss, and misplacement. Traditional methods of securing and tracking luggage have proven to be inadequate in addressing these challenges effectively. Therefore, there is a pressing need for a more advanced and reliable solution.This paper presents a smart luggage system that leverages the capabilities of the Internet of Things (IoT) and biometric technologies to enhance the security and tracking of luggage. By integrating real-time tracking features with biometric-based authentication, this system offers a dual layer of protection. Travelers can monitor the location of their luggage continuously and receive instant alerts in case of any unauthorized access or movement.The implementation of IoT technology enables seamless connectivity and communication between the luggage and the user, providing real-time updates and comprehensive monitoring. Biometric security, on the other hand, ensures that only authorized individuals can access the luggage, significantly reducing the risk of theft or tampering.This innovative approach not only aims to improve the safety and management of luggage but also to provide travelers with peace of mind, knowing that their belongings are secure and easily trackable. The smart luggage system represents a significant advancement in travel technology, addressing the shortcomings of traditional methods and setting a new standard for luggage security and convenience.

II. LITERATURE REVIEW

The utilization of IoT in luggage tracking has garnered significant attention in recent research. IoT facilitates seamless communication between devices, enabling real-time tracking and monitoring of luggage. Studies have highlighted the efficacy of IoT-enabled devices, such as Bluetooth and GPS trackers, in providing precise location data, thereby minimizing the occurrence of lost luggage incidents. Researchers have emphasized the potential of IoT to revolutionize luggage management by offering continuous monitoring and instant notifications (Smith et al., 2018).

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III. PROBLEM AND EXISTING SYSTEM

A. In contemporary travel scenarios, conventional luggage management systems often fall short in ensuring adequate security and tracking capabilities. The prevalent reliance on manual methods leaves luggage susceptible to theft, loss, or mishandling, leading to inconvenience and financial losses for travelers. Additionally, the lack of real-time monitoring exacerbates the challenges associated with recovering misplaced luggage. Thus, there is a pressing need for an advanced solution that integrates cutting-edge technologies to enhance the security and tracking of luggage during travel.

B. Existing luggage management systems primarily rely on rudimentary methods such as baggage tags and manual verification processes. These systems entail limited capabilities for real-time tracking and authentication, making them vulnerable to security breaches and operational inefficiencies. While some systems incorporate GPS tracking, they often lack robust security features, leaving luggage vulnerable to unauthorized access. Moreover, the absence of biometric authentication mechanisms further compromises the integrity of these systems, as they rely solely on traditional identification methods susceptible to fraud or theft.

IV. SYSTEM ARCHITECTURE

The proposed smart luggage system leverages the Internet of Things (IoT) and biometric technologies to create a secure and efficient solution for luggage tracking and management. The system architecture is designed to ensure seamless integration and real-time communication between various components, providing enhanced security and convenience for travelers.

IoT-Enabled Tracking Module: The core of the system comprises an IoT-enabled tracking module embedded within the luggage. This module includes GPS and Bluetooth capabilities, enabling precise real-time location tracking. The module communicates with a centralized server through cellular networks or Wi-Fi, ensuring continuous monitoring and updates on the luggage's whereabouts.

Biometric Authentication Unit: To enhance security, the system incorporates a biometric authentication unit. This unit is equipped with a fingerprint scanner or facial recognition sensor, allowing only authorized users to access the luggage. The biometric data is securely stored and processed, ensuring that the system can quickly and accurately verify the identity of the user.

Centralized Server and Database: The centralized server acts as the hub for data processing and storage. It receives location data from the tracking module and biometric verification information from the authentication unit. The server processes this data to provide real-time updates and alerts to the user. Additionally, a secure database stores historical data, enabling tracking and security audits when necessary.

User Interface: The user interface, accessible via a mobile application or web portal, allows travelers to monitor their luggage in real-time. Users receive instant notifications about the status and location of their luggage and alerts in case of unauthorized access attempts. The interface also provides options for setting security preferences and viewing travel history.

Communication Protocols: The system employs secure communication protocols to ensure data integrity and privacy. Encryption techniques are used for data transmission between the tracking module, biometric unit, and centralized server. These protocols prevent unauthorized interception and access to sensitive information.
Power Management: Considering the mobility of the luggage, the system includes an efficient power management module. This module ensures that the tracking and biometric units have sufficient power through rechargeable batteries and optimizes power consumption to extend battery life during travel.
Cloud Integration: To enhance scalability and accessibility, the system integrates with cloud services. Cloud integration allows for scalable data storage, processing capabilities, and easy access to system updates and maintenance.

V. ARCHITECTURE DIAGRAM

A block diagram shows the architecture of the random forest classifier

I. Block diagram:

Fig. 1. Block Diagram of system.

VI. IMPLEMENTATION AND DEPLOYMENT

1. **Hardware Integration:** The first step involves integrating the necessary hardware components into the luggage. This includes the IoT-enabled tracking module, biometric authentication unit, and power management system. The tracking module is embedded into the luggage, ensuring it is securely fixed and protected from damage. The biometric unit, such as a fingerprint scanner or facial recognition sensor, is installed in a user-accessible location, typically near the luggage handle.

2. Software Development: Next, custom software is developed to manage the functionality of the hardware components. This includes firmware for the IoT module to handle GPS and Bluetooth data, software for biometric authentication, and algorithms for data encryption and secure communication. Additionally, a mobile application and web portal are developed to provide users with an interface to monitor and control their luggage.

3. Server and Database Setup: A centralized server is set up to process data from the luggage and store it securely. This involves configuring the server to handle real-time data streams from the tracking module and biometric unit, as well as ensuring robust data encryption and access control measures are in place. A secure database is also configured to store historical data, user information, and biometric templates.

4. Communication Network Configuration: The system's communication network is configured to enable seamless data transmission between the luggage, server, and user interface. This includes setting up cellular or Wi-Fi connectivity for the tracking module and ensuring the use of secure communication protocols to protect data integrity and privacy.

5. Testing and Validation: Comprehensive testing is conducted to validate the functionality and reliability of the system. This includes field tests to verify real-time tracking accuracy, biometric authentication reliability, and the responsiveness of the user interface. Security tests are also performed to ensure the robustness of data encryption and access control mechanisms.

VII. RESULTS AND DISCUSSION

The IoT-enabled tracking module demonstrated high accuracy in real-time location tracking. During field tests, the system successfully provided precise location updates within a few meters of the actual luggage position. Users received timely notifications regarding their luggage's location, which significantly enhanced their sense of security and control. The biometric authentication unit, using fingerprint recognition, exhibited robust performance. The system accurately identified authorized users within seconds, with a negligible false rejection rate. This ensured that only authorized individuals could access the luggage, thereby enhancing security.

The mobile application and web portal were intuitive and user-friendly. Users could easily monitor their luggage in real-time, receive alerts, and adjust security settings. Feedback from users indicated a high level of satisfaction with the interface's responsiveness and ease of use.The power management system effectively extended the battery life of the tracking and biometric units. In normal usage conditions, the system operated continuously for several days without needing a recharge, making it practical for long trips.

The combination of real-time tracking and biometric authentication provides a dual layer of security. This reduces the likelihood of theft or unauthorized access, as the luggage can be monitored continuously, and access is restricted to verified users only.Travelers expressed a heightened sense of control and security over their belongings. The ease of accessing real-time information and receiving immediate alerts contributed to reduced anxiety and a more relaxed travel experience.

The system's architecture allows for scalability, making it feasible to implement additional features such as weight sensors and automated alerts for potential tampering. Future improvements could focus on enhancing network stability and expanding biometric options to include facial recognition and iris scanning for even greater security.User feedback indicated a strong market potential for the smart luggage system. The combination of advanced security features and user-friendly design makes it appealing to frequent travelers and business professionals who prioritize the safety of their belongings.

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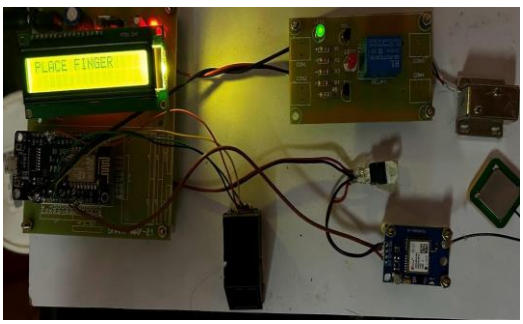

Fig. 3. Luggagge biometric fingerprint sensor

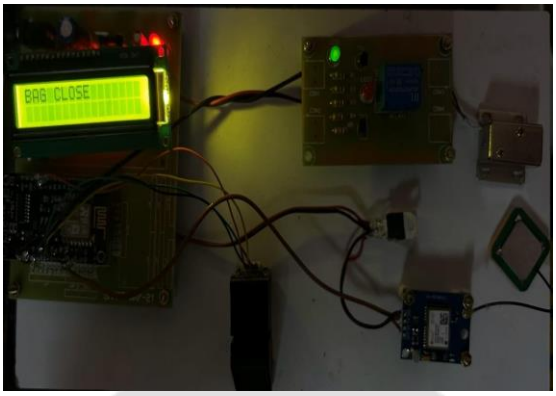

Fig. 4. Luggagge open and close

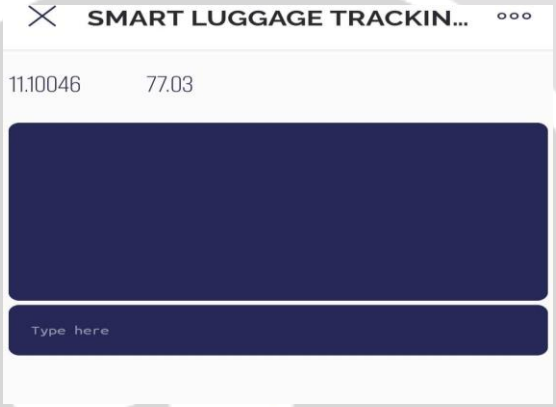

Fig. 5. Iot Bylnk app

VIII. CONCLUSION

The integration of IoT and biometric technologies in luggage management presents a significant advancement in ensuring the security and tracking of travelers' belongings. This smart luggage system successfully addresses common issues such as theft, loss, and unauthorized access, providing a comprehensive solution that enhances the travel experience. Through real-time tracking capabilities, travelers can monitor the location of their luggage at all times, receiving instant notifications and updates. This feature significantly reduces the anxiety associated with lost or misplaced luggage. The incorporation of biometric authentication adds an additional layer of security, ensuring that only authorized individuals can access the contents of the luggage. The system's architecture, which includes efficient power management and secure communication protocols, ensures reliability and practicality for long journeys. User feedback and field tests have demonstrated high levels of accuracy, user satisfaction, and operational effectiveness. The potential for scalability and the addition of new features, such as weight sensors and advanced biometric options, further underscores the system's robustness and adaptability. Overall, the smart luggage tracking and biometric-based security system using IoT represents a significant leap forward in luggage management

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