A Systematic Survey on IoT-Driven Smart Travel Case: Intelligent Automation, Biometric Security, Autonomous Mobility

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Abstract: People frequently utilize luggage when moving from one location to another. One of the most serious issues while traveling long distances is the protection of our belongings in the luggage. The Smart Suitcase project, the subject of this article, aims to improve the travel experience for its user by improving security elements, adding an auto-following feature, and digitizing the suitcase. The fingerprint unlocking technique, weight, and location monitoring inside the program are all part of the security feature. An additional feature of the program is a safety button that the user can press in case of danger. The Blynk app is the program that allows the user to access the sensor reading. The color-sensing technology is employed to provide an additional feature known as auto-following, in which the suitcase follows the color that the user is wearing. It also features an obstacle detection system and an alert system when it comes into contact with an obstacle.

1 INTRODUCTION

Nowadays, a sizable portion of the population travels two or three times a year for vacations. There are several ways to travel, including by land, sea, and air. But they all have one thing in common: the packaging. Regardless of the mode of transportation, all belongings must be packed appropriately. For each type of travel, the suitcases or travel bags are important components. You cannot overlook the responsibilities that both traveling and storing play since they are equally significant. When it comes to traveling, the suitcase is important. Carrying your possessions in a suitcase is essential when planning a trip.

Suitcases have always ensured we could store our belongings without any problem. However, the security of the items inside the suitcase has always been a major issue while traveling long distances. There are several theft incidents that take place across the globe, and one among them is the luggage thefts. We all have experienced this or seen this mostly happening in airports or railway stations. There are reports from the Indian Railways that say that there were over a total of 55,000+ cases of luggage thefts and robberies of the passengers' belongings. This shows the significance of the protection of the belongings in the suitcase.

The conventional suitcase has a normal design and cannot ensure the security of the belongings of the user inside the suitcase. It has to be locked by using traditional methods such as padlocks and chains; these padlocks or chains can be easily opened with a sharp metal object, and the items inside the suitcase can be stolen. There are many types of luggage and bags available in the market. There are many such drawbacks in a conventional suitcase. Firstly, if the suitcase gets misplaced or lost, you cannot know the weight of the suitcase unless you measure it manually. Thirdly, there is no guaranteed anti-theft protection. The above challenges can be overcome by introducing Smart Suitcase.

2 LITERATURE REVIEW

A survey of various methods for enhancing the functionality of smart travel bags has been carried out, focusing on IoT integration, biometric security, and real-time tracking systems. Researchers have

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proposed multiple approaches to tackle issues such as luggage theft, misplacement, and user convenience. This section summarizes key techniques, highlighting their merits and demerits to guide future advancements in smart luggage technology.

Pavithran B & Ragunath R et al., (Pavithran, Ragunath, et al. , 2024), the paper proposes a smart luggage system integrating IoT and biometric technologies to enhance security and tracking. It addresses issues like theft, loss, and inefficient tracking in traditional systems by combining real-time location tracking with biometric authentication. The IoT-enabled module provides precise tracking through GPS and Bluetooth, while the biometric unit ensures access for authorized users only. A centralized server processes data, and a mobile app offers real-time monitoring and notifications. The system employs secure communication protocols and optimized power management, ensuring reliability during travel. Testing revealed high accuracy in location tracking and robust biometric performance with low false rejection rates. Users appreciated the intuitive interface and extended battery life, making it practical for long trips. The dual-layered approach improves both security and user confidence. Future scalability includes features like weight sensors and advanced biometrics (e.g., facial recognition). The study highlights challenges like network stability and emphasizes secure data handling. Overall, this innovative system sets a new standard for luggage management, providing travellers with peace of mind and an enhanced experience.

Sakshi Jain & Skanda Aithal et al., (Jain, Aithal, et al. , 2023), this paper presents a luggage tracking system leveraging IoT, GSM, and GPS technologies for real-time location tracking and enhanced luggage security. The system integrates a microcontroller, GPS module, GSM module, and IoT platform for seamless communication and precise geographical tracking. IoT enables remote monitoring, providing real-time updates and alerts, while GPS ensures accurate location data and GSM facilitates reliable data transmission. The architecture includes an Arduino Uno microcontroller with NEO-6M GPS and SIM900L GSM modules. The system transmits GPS data via GSM to an IoT platform, which processes and displays luggage location. A Proteus software simulation confirmed system feasibility, showcasing precise location display through latitude and longitude. Key benefits include real-time updates, cost-effectiveness, and enhanced security. Potential applications span airports, hotels, and transportation. Limitations include coverage area and operational costs. Future improvements suggest adding sensors for temperature and motion and developing a dedicated mobile application. This compact, low-power system shows significant potential for revolutionizing luggage tracking in diverse industries.

Mahmood A. Al-Shareeda et al. (Shareeda and Manickam, 2023), this paper outlines the design of a smart suitcase using STM32 microcontrollers integrated with GPS, GSM, and Bluetooth technologies to address common travel issues like lost luggage and security. Key features include smart locking/unlocking, anti-lost alarms, GPS tracking, and automated movement with infrared obstacle detection. The system architecture uses an STM32F103 microcontroller as the core, controlling modules like A7GSM/GPRS/GPS for location tracking and BLE 4.0 for short-range communication. A mobile app interfaces with the suitcase for GPS data retrieval and smart control. The relay module and GPIO ports enable functionalities like alarm triggering and unlocking. Testing and implementation use TCP protocol for reliable communication and Peanut Shell for intranet mapping, ensuring connectivity across networks. The design prioritizes low power consumption, scalability, and robust communication. Future advancements include enhancing security protocols and integrating RFID for seamless tracking. The project significantly improves travel convenience and luggage management by leveraging IoT technologies.

Nikita R. Hatwar, Manisha N. Amnerkar et al., (Hatwar, Amnerkar, et al. , 2023). The Robo-Case Human Following Suitcase is an innovative travel solution that transforms conventional luggage into a smart, autonomous companion. Built with Arduino Uno Wi-Fi, ultrasonic sensors, GPS tracking, and DC motors, the suitcase autonomously follows its user, detects and avoids obstacles, and provides real-time GPS location updates for enhanced convenience and security. The Arduino Uno serves as the central controller, enabling seamless communication with a mobile app, while the ultrasonic sensor ensures obstacle detection in crowded spaces. GPS tracking further secures the luggage, allowing users to monitor its location through their smartphones. Powered by a lithium-ion battery, the Robo-Case includes digital locking, Bluetooth integration, and optional manual or autonomous driving modes. This system's architecture combines hardware components such as ultrasonic sensors, NodeMCU Wi-Fi modules, GPS, and accelerometers with software developed using Arduino IDE, embedded C programming, and Bluetooth communication. The suitcase uses accelerometers and magnetometers to estimate the user's movement, ensuring accurate tracking. The Robo-Case offers hands-free operation, making it especially useful in dynamic environments like airports and train stations. It is designed to cater to diverse user groups, including the physically challenged, elderly, and children, enhancing accessibility and convenience. Testing demonstrated the Robo-Case's adaptability across real-world scenarios, highlighting its potential to address common travel challenges like luggage theft and loss. Future enhancements aim to integrate fingerprint scanners, USB ports, and Wi-Fi connectivity to expand functionality while keeping the product affordable and user-friendly. By combining advanced robotics, IoT, and eco-friendly power sources like solar charging, the Robo-Case sets a new benchmark in smart luggage technology. It simplifies travel, ensures the safety of belongings, and offers an unparalleled user experience, making it a revolutionary innovation in the travel industry.

Prof. Sachin B. Pawar, et al., (Pawar, Patil, et al. , 2023), the paper discusses a human-following luggage-carrying robot, designed to address challenges associated with carrying heavy luggage during travel. This robot employs advanced technologies such as RSSI (Received Signal Strength Indicator), Bluetooth Low Energy, and a combination of sensors to autonomously track and follow a user, maintaining a safe distance while navigating various environments. The system's key components include an ESP-32 microcontroller, ultrasonic sensors, a magnetometer, motor drivers, and DC motors, powered by a lithium-ion battery with solar panel support. These components are integrated into a compact design capable of detecting obstacles and ensuring directional accuracy. The robot's functionality is centered on RSSI technology for accurate distance measurement and human target localization. A smartphone app facilitates user interaction, providing control through a Bluetooth connection while sharing critical data like the azimuth angle. The robot's ultrasonic sensors detect and avoid obstacles, while a buzzer provides alerts. A gyroscopic sensor enhances mobility, and the motor driver controls the movement and speed of the robot. Testing under real-world conditions demonstrated the robot's ability to follow its user and adapt to dynamic environments like airports and train stations. The robot offers significant convenience, particularly for individuals with physical challenges, by automating luggage handling and reducing manual effort. Future improvements aim to include additional sensors, Wi-Fi control, and machine learning algorithms to enhance performance and efficiency. This innovation highlights the potential of human-following robots to revolutionize personal and commercial applications, particularly in travel and logistics, by combining convenience, efficiency, and cutting-edge technology.

Abhishek Jagtap, Ashutosh Kabra et al., (Jagtap, Kabra, et al. , 2022) The paper discusses a smart luggage system designed to enhance the convenience and security of travellers. By incorporating advanced technologies like NodeMCU, ultrasonic sensors, IR sensors, and motor drivers, the system provides both automatic and manual control modes to address common luggage challen.ges. The automatic decision-making module utilizes sensors to detect obstacles and adjust the movement of the luggage autonomously, while the manual mode allows users to control the luggage through a mobile app powered by the Blynk platform. This dual functionality ensures flexibility for users based on their needs and preferences. The hardware includes an ESP8266 Wi-Fi module for connectivity, HC-SR04 ultrasonic sensors for obstacle detection, L298N motor drivers for motor control, and DC motors for movement. Additional features include a solar-powered battery system to ensure extended usability and a mobile application interface for seamless interaction. The ultrasonic sensors maintain a safe distance from users, and the IR sensors handle precise obstacle avoidance. This combination of technologies enables the system to follow users automatically, ensuring a hassle-free experience. The research highlights various use cases, including luggage tracking and theft prevention. GPS integration allows real-time location tracking, while GSM ensures connectivity for remote operations. The inclusion of solar cells provides an eco-friendly charging solution. The system is built to operate efficiently in crowded areas like airports and train stations, ensuring user convenience and security. The paper also explores the use of voice commands and RFID technology to expand functionality. Testing confirmed the system's ability to autonomously follow users, stop when obstacles are detected, and respond effectively in both control modes. Future enhancements could include GPS-based tracking for wider operational ranges, additional utilities like USB ports, fingerprint locks for enhanced security, and larger-scale implementation for mass adoption. This innovative solution addresses traditional luggage challenges by merging IoT, robotics, and automation, offering a reliable and user-friendly alternative for travellers. The system represents a significant step toward smarter, more efficient luggage management, promising a better travel experience for users worldwide.

Prof. Siddhesh Khanvilkar et al., (Khanvilkar, Bhurke, et al. , 2022), The paper introduces a smart luggage system that integrates IoT technologies to enhance convenience and security for travelers. The system incorporates key features such as real-time tracking using GPS and GSM, human-following capability, and anti-theft mechanisms, designed to automate and simplify luggage management. The primary innovation involves a self-propelling suitcase that follows the user autonomously, using IR and ultrasonic sensors for obstacle detection and navigation. These sensors measure the distance between the suitcase and the user, ensuring it maintains a safe following distance. The system employs an Arduino UNO microcontroller to process data and control the movement of wheels based on sensor inputs. When the user moves, the suitcase calculates the relative distance and adjusts its direction accordingly. In addition to its human-following feature, the suitcase includes a mobile SMS system that allows users to interact with it remotely. By sending commands, users can activate the GPS to locate the suitcase in case of theft or loss. Upon receiving a "TRACK" command, the GPS coordinates are sent back to the user via SMS. This functionality is complemented by anti-theft alerts, where the suitcase can notify the user if it is moved without authorization. The inclusion of three IR sensors—placed at the front, right, and left—enables the system to navigate around obstacles dynamically. If an obstacle is detected on one side, the suitcase adjusts its path to avoid collisions while continuing to follow the user. The paper also highlights potential use cases for this system, particularly in crowded environments like airports and train stations, where managing heavy luggage can be challenging. The luggage system is designed to alleviate the physical burden of carrying bags, particularly for individuals with mobility issues or those traveling with significant baggage. A flow diagram in the paper illustrates the decision-making process of the system, showing how it shifts between manual remote-control mode and automatic following mode based on user preference. In manual mode, users can control the movement of the suitcase via a smartphone application, powered by the NodeMCU platform and Blynk interface. Testing results demonstrate the system's effectiveness in real-world scenarios. The suitcase successfully follows users, stops when obstacles are detected, and provides real-time location updates upon request. This innovative approach to luggage management significantly improves the travel experience by addressing common issues such as theft, loss, and physical strain. Future enhancements proposed include integrating solar charging capabilities, biometric locking mechanisms, and advanced navigation technologies like GPS-enabled path planning. This system represents a significant step forward in the evolution of smart luggage, leveraging IoT, robotics, and automation to deliver a practical and user-friendly solution for modern travellers. By addressing traditional challenges and incorporating cutting-edge features, the Smart Luggage System has the potential to redefine how people travel with their belongings.

Sowmya B J, Supriya M (Sowmya and Supriya, 2021), The paper presents a robot-controlled car utilizing voice commands and Wi-Fi technology, showcasing advancements in robotics and automation. The project integrates the ESP32 microcontroller with Google speech recognition technology, allowing users to control the robot using an Android smartphone. Voice commands are converted into text via speech-to-text processing, and the text data is transmitted to the microcontroller via Bluetooth. The robot can execute commands such as forward, backward, left, right, and stop, making it versatile for various tasks. Additionally, an IR sensor is employed to detect obstacles and enable autonomous collision avoidance. The project leverages the Blynk app, a user-friendly Android application, to provide manual controls, ensuring accessibility for users with varying technical expertise. The design includes a comprehensive architecture featuring DC motors, a motor driver (L298N), and Bluetooth and Wi-Fi integration. The robot is equipped with a power supply that includes voltage regulators to support the smooth operation of all components. The ESP32 microcontroller acts as the central hub, coordinating data transmission and controlling motor movements. The system also includes IR sensors for obstacle detection, enabling the robot to autonomously adjust its path when obstructions are encountered. This dual functionality—manual control via the Blynk app and autonomous navigation using sensors—makes the robot adaptable for multiple use cases. One of the project's strengths lies in its use of speech recognition technology, which enhances human-robot interaction by providing an intuitive interface. The voice commands are processed in real time, making the system efficient for applications requiring immediate response. The robot's ability to detect obstacles and avoid collisions autonomously is particularly valuable in environments where manual control may be limited. The inclusion of Wi-Fi technology extends its operational range, allowing remote control even beyond Bluetooth's typical limitations. Testing demonstrated the robot's functionality in various scenarios, including manual navigation via the Blynk app and autonomous operation in obstacle-rich environments. The project also explored the potential of integrating additional technologies, such as GPS for location tracking and IoT applications for enhanced connectivity. Future developments could include expanding the robot's capabilities for industrial, commercial, and research applications. For instance, integrating a camera module for live streaming or implementing solar charging could further enhance its utility. This innovation represents a significant step forward in robotics, blending voice recognition, sensor-based navigation, and wireless communication to create a robust and user-friendly system. The project highlights the growing importance of voice-controlled robotics in automating repetitive and hazardous tasks, showcasing its potential in fields such as security, manufacturing, and healthcare. By combining affordability with advanced features, this robot-controlled car demonstrates the feasibility of developing accessible yet sophisticated robotic systems for a wide range of applications.

Abhilash G, Chetan S, et al., (Abhilash, Chetan, et al. , 2024), The paper presents the development of a multi-secure access smart suitcase that combines IoT technologies with advanced security features such as fingerprint authentication, face recognition, and password verification to ensure maximum security for travellers. This system is designed to allow access only to authorized users, while any unauthorized attempt triggers an alarm and sends notifications to the owner's smartphone via the Blynk app. The suitcase is equipped with a Pi Camera, Raspberry Pi, Arduino Uno, and a fingerprint scanner, making it highly functional and user-friendly. The methodology involves a three-layer security process. First, the system uses fingerprint authentication to verify the user's identity. If successful, it proceeds to face recognition, where the Pi Camera captures an image of the user, and the Raspberry Pi processes the image using feature extraction algorithms to confirm identity. Finally, password authentication is performed for additional security. All authorized user data, including fingerprints, photos, and passwords, are stored securely in a database, ensuring efficient verification. The smart suitcase also includes anti-theft features. In case of unauthorized access or tampering, the system immediately sends an alert to the owner through the Android app, providing real-time updates on the suitcase's status. The Pi Camera captures the image of the individual attempting unauthorized access, further enhancing its security capabilities. Additionally, the suitcase integrates GPS tracking, allowing users to monitor its location in real-time, providing convenience and peace of mind. The architecture incorporates essential hardware components like the Arduino Uno for processing, the Raspberry Pi for image recognition, a keypad for password input, and a fingerprint sensor for biometric authentication. The software stack includes tools such as Arduino IDE, Python 3.5, OpenCV, and PyCharm, enabling seamless communication between the hardware and the Android application. The system's operation is demonstrated using real-world scenarios, showcasing its ability to prevent unauthorized access effectively while maintaining ease of use. The authors highlight the system's practicality, emphasizing its ability to cater to diverse user groups, including frequent travelers, elderly individuals, and business professionals who prioritize security. The suitcase combines innovative features like remote monitoring, automated alerts, and biometric authentication, positioning it as a comprehensive solution for modern luggage management. Testing confirmed the system's ability to operate under varying conditions, demonstrating its reliability and robustness. Future enhancements could include integrating solar panels for power efficiency, expanding storage capabilities, and utilizing AI for improved face recognition accuracy. This smart suitcase addresses common challenges such as theft, unauthorized access, and luggage mismanagement, offering a secure, convenient, and technologically advanced alternative to traditional luggage. By merging IoT, biometrics, and user-friendly interfaces, the project showcases the potential of smart luggage systems to revolutionize the travel experience, ensuring security and convenience for users.

P.L. Santhana Krishnan et al., (Krishnan, Valli, et al. , 2020), The paper introduces a smart luggage carrier system designed to revolutionize travel by integrating advanced IoT and automation technologies. Built using Nano Arduino, the system provides a hands-free luggage management solution that follows the user automatically while ensuring robust security through GPS and GSM tracking. The carrier uses ultrasonic sensors to maintain a safe following distance of approximately 1-2 meters, adjusting its path dynamically to avoid obstacles. The user interacts with the system via a smartwatch that transmits commands, enabling seamless operation even in crowded environments like airports. The system also features anti-theft capabilities, allowing users to locate misplaced or stolen luggage using GPS tracking and GSM notifications. Key hardware components include a Nano Arduino microcontroller, ultrasonic sensors, geared DC motors, and a gyroscope sensor, all powered by a rechargeable 12V battery. The ultrasonic sensors send sound waves to measure distances and guide the luggage's movements, while the gyroscope ensures stability during navigation. The DC motors, equipped with gear reduction for high torque and reduced speed, enable the carrier to handle significant weight with ease. Software tools like Keil µVision and embedded C programming are used to program the microcontroller, ensuring precise control of the system's functionalities. The anti-theft feature is a standout component, leveraging GPS and GSM modules to send location updates to the user's mobile device in case of unauthorized access. If the distance between the user and the luggage exceeds the predefined limit, a buzzer alerts the user, adding another layer of security. The system's dual operation modes—autonomous and manual—make it adaptable to various user preferences and travel scenarios. Users can switch between modes based on convenience, ensuring flexibility and reliability. Testing demonstrated the system's efficiency in real-world scenarios, such as navigating through busy terminals and adapting to dynamic environments. The luggage consistently maintained a safe following distance, avoided obstacles effectively, and provided accurate location updates. Future enhancements could include additional features like fingerprint-based locking systems, USB charging ports, and AI-powered route optimization for improved functionality and user experience. This innovative luggage system addresses long-standing challenges in travel, such as physical strain from carrying heavy bags and the risk of theft or loss. By combining IoT, automation, and advanced tracking technologies, the Smart Luggage Carrier System represents a significant step forward in travel convenience and security. The integration of cutting-edge components and user-friendly interfaces ensures that the system is not only efficient but also accessible to a broad audience, including elderly travellers and individuals with physical limitations. This project underscores the potential of smart technologies to transform everyday tasks, making travel safer, more comfortable, and stress-free for users worldwide.

Sachin Tom, Jacob. P. Oommen, Anoop. P (Tom, Oommen, et al. , 2018), The paper introduces a human-following smart trolley utilizing advanced automation and IoT technologies to enhance functionality and convenience in various sectors, including supermarkets, Medicare, and material handling in industries. The trolley features human-following navigation, auto parking, anti-theft mechanisms, and auto bill generation, aiming to revolutionize the shopping and service experience. The navigation system employs a Kinect sensor, originally developed for Xbox, to track and follow a human by identifying skeletal movements. The trolley maintains a safe distance from the user while dynamically avoiding obstacles. The Mecanum wheels facilitate directional movement, ensuring smooth navigation in confined spaces such as shopping aisles. The system also includes a line-following mechanism for automated parking, where infrared sensors detect the surfaces and guide the trolley to designated parking spots. To prevent theft, the trolley is equipped with Wi-Fi-based theft features using CU. When the trolley moves beyond a defined perimeter, the system detects reduced Wi-Fi signal strength and triggers an alarm. This feature ensures that the trolley remains within its designated area, providing both security and operational efficiency. The trolley's billing system integrates RFID. scanned in the trolley, they are scanned automatically, creating a decentralized billing system that eliminates long checkout lines. ology, where each item has an RFID tag, and the trolley is equipped with an RFID reader. As items are placed in the trolley, they are scanned automatically, creating a decentralized billing system that eliminates long checkout lines. The data is tricorporate an Arduino Mega for processing, motorizing, and saving time with a Bluetooth module for an experience. The trolley also incorporates an Arduino Mega for processing, motor drivers, and a Bluetooth module for wireless communication, making it both intelligent and user-friendly. The paper highlights the potential of this smart trolley in other sectors, such as healthcare, in Industry 4.0. would serve as a nurse-following robot, or in industries for material handling, particularly with the rise of Industry 4.0. Future enhancements could include integrating a mobile app for full control and payment, GPS for outdoor navigation, and additional security features like fingerprint authentication. The implementation of such technologies positions the smart trolley as a transformative tool, combining convenience, efficiency, and security. The authors acknowledge challenges such as crowded environments and potential navigation errors but emphasize the Adephagan-following Smart Trolley and the Mecanum wheel design in addressing these issues. By merging automation with IoT, the human-following smart trolley represents a significant step towards fully automated systems, catering to modern consumer demands and setting the stage for innovative applications in various industries. This smart trolley exemplifies how robotics and IoT can improve daily tasks, offering a glimpse into the future of automated living and smart technologies.

Table 1: Comparison of Survey

Ref	Title Of Paper	Authors	Main highlight of research	Limitations	Prime Benefits
1.	Smart luggage tracking and biometric based security system using IoT	Pavithran B	Integration of IoT and biometric authentication for real-time luggage tracking and secure access	Limited exploration of advanced biometrics and potential network instability in diverse environments.	Enhanced luggage security and convenience through real-time monitoring and dual-layered protection.
2.	Smart luggage tracking using IoT and GPS technology	Sakshi Jain	Utilizes IoT, GPS, and GSM for real-time luggage tracking and location updates.	Coverage area and operational costs can hinder performance in diverse conditions.	Provides cost-effective and reliable tracking for enhanced luggage security
3.	IoT technology and STM32 microcontroller based design of smart suitcase	Mahmood A	Combines STM32 microcontroller with GPS, GSM, and bluetooth for smart luggage automation and tracking.	Limited scalability and reliance on basic communication protocols without advanced integration.	Offers seamless real-time tracking and smart locking features for enhanced travel convenience.
4.	Robocase human following suitcase	Nikita R. Hatwar	Features a human-following smart luggage system with obstacle avoidance and GPS tracking for automation.	Limited weight capacity and dependency on line-of-sight tracking methods.	Provides hands-free luggage management with real-time tracking and theft prevention.
5.	Human following luggage carrying robot	Prof. Sachin B. Pawar	Introduces a voice-controlled robot car with bluetooth and Wi-Fi for navigation and obstacle avoidance.	Limited range of operation due to reliance on bluetooth and lack of advanced autonomous features.	Offers intuitive voice-command-based control for efficient and user-friendly operation
6.	Smart luggage system	Abhishek Jagtap	Combines multi-layer security features including fingerprint, face recognition, and GPS tracking for a smart suitcase.	High dependency on multiple hardware components increases system complexity and cost.	Ensures maximum security and real-time tracking, enhancing convenience for travelers.
7.	Antitheft and multifunctional smart suitcase with real-time tracking system	Prof. Siddhesh Khanvilkar	Introduces a smart luggage system with GPS and GSM for real-time tracking and human-following functionality.	Limited obstacle detection accuracy in complex environments and dependency on SMS-based communication.	Provides hands-free mobility and anti-theft tracking, enhancing convenience and security for users.
8.	Robot controlled car using voice and Wi-Fi module	Sowmya B J	Develops a robot-controlled car with real-time voice control and Wi-Fi module for navigation and obstacle detection.	Limited operational range due to reliance on bluetooth and Wi-Fi connectivity.	Provides intuitive and efficient robotic navigation using voice commands and autonomous collision avoidance.
9.	Development of multi secure access-smart suitcase using IoT	Abhilash G	Features a multi-secure smart suitcase integrating fingerprint, face recognition, and password authentication with IoT.	Complex implementation with high dependency on hardware components and cost.	Provides enhanced security and real-time alerts, ensuring safety for travelers' belongings.

10.	Smart luggage carrier system with theft prevention and real time trackingusing nano Arduino structure	P. L. Santhana Krishnan	Features a smart luggage carrier system with GPS, GSM tracking, and human-following capabilities using Nano Arduino.	Limited weight capacity and reliance on predefined distances for obstacle avoidance.	Provides hands-free luggage management and anti-theft tracking for secure and convenient travel.
11.	Design and fabrication of human following smart trolley using Kinect sensor for diverse applications	Sachin Tom	Features a human-following smart trolley with Kinect sensor for navigation, auto billing via RFID, and theft prevention mechanisms.	Navigation challenges in crowded environments and dependency on specific technologies like Kinect and Wi-Fi.	Enhances shopping efficiency through automated billing, hands-free navigation, and improved theft prevention.

3 CONCLUSIONS

In this paper, we have reviewed recent advancements in smart luggage systems, focusing on integrating IoT, biometric, and autonomous technologies to enhance luggage security, tracking, and user convenience. IoT-enabled systems are commonly used for real-time location tracking and monitoring, with GPS and GSM technologies being the preferred methods due to their accuracy and reliability. Biometric authentication, particularly fingerprint scanning, is widely adopted to ensure authorized access. Autonomous features like human-following capabilities and obstacle detection further improve usability in dynamic environments. Key approaches combine hardware components such as microcontrollers, Bluetooth modules, and sensors with software solutions for seamless communication and intuitive mobile app interfaces. Power-efficient designs, scalable architecture, and secure communication protocols are prioritized to enhance reliability during travel. Techniques like real-time GPS updates, biometric locking, and low-power optimizations have shown significant promise in addressing theft, misplacement, and manual handling challenges. Challenges such as network stability, limited coverage, and operational costs persist, requiring improved scalability and advanced technologies like RFID integration, advanced biometrics (e.g., facial recognition), and eco-friendly power solutions. Future research should focus on addressing these limitations, enhancing sustainability, and integrating more robust security mechanisms to ensure user confidence and expand functionality. Finally, research gaps and future directions were highlighted to guide innovation in smart luggage technology.

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