Internet of things enabled smart baggage follower with theft prevention

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Abstract: Innovations are advanced to reduce human endeavors and to ensure security. Mechanical innovations decline manual exertion and make human-machine communication. This paper discusses one such space where enablements result in decreasing endeavour and augmentation in security. A baggage that follows the human is planned, using one of the brilliant advancements in gadgets. It helps auto trailing, lost stuff recuperation through GSM and GPS, void battery gadgets resuscitating, hindrance discovery, alarming and keen opening.

Keywords: GPS and GSM Modules, Arduino UNO, Alarm, Bluetooth Module, Ultrasonic Sensors, Neural Networks, IR and UV Sensors.

1. Introduction
The world is now a place full of automation. Smart work is valued rather than hard work in this fast-moving world. But there are still areas where a lot of efforts are required to get the desired outcome. The paper aims to deal with one such area where technology can give a better alternative. The area focussed here is Travelling and Tourism. The problems encountered during traveling and the possible solutions to those problems are presented here. Traveling is uncommonly notable these days. Issues become unavoidable as we start traveling. Major issues include discharged battery gadgets, baggage misplacement or theft, overloaded baggage carrying, overpassing important things and many more. Baggage misplacement or theft annoys the entire journey. Due to which eminent documents and things might be obscured[1].

Disconnections with the world due to discharged battery gadgets is another important annoying aspect during traveling. Discomfort occurs when significant things are overlooked or for carrying overloaded baggage. Choosing the correct luggage is an important aspect of traveling [2]. The work of baggage can’t be miscalculated or undervalued. The one-stop solution to all the challenges faced during exploring the world or traveling is the SMART BAGGAGE. Consequently, the present inspection is conducted to plot and achieve a baggage that could give the basics of the explorers. This luggage is a smart gadget that ensures the safety of the accessories and gives comfort to the explorers. In this paper, traveler’s wants are surveyed and are added to the baggage.

2. Relevant Work
Sneha Jainwar along with others have introduced an intelligent baggage which comes with a battery unit, ultrasonic sensor to get the distance from the barriers, GPS module to know the location, Bluetooth module for communication with the device, RFID cards for data. The proposed theory has solved most of the problems faced during travel [1]. Ms. Sudha Senthilkumar, Ms. Brindha.K, Mr. Rathi.R, Ms.
Charanya. R and Mr. Mayank Jain through their study suggested a smart luggage system using the Internet of Things which is able to track the bag of theft. Location of the bag which is misplaced can be obtained through the maps [2].

The authors have proposed a concept of building a robot which assists a person who is carrying heavy luggage. The approach aimed to develop a model which could send and receive a signal that provides a simple means to determine a path by a robot. It had an ability to self-localize. Other sensors are used for signal emission and directions [3]. The paper dealt with a luggage system which adds comfort and easy accessibility to the traveller inside an airport. It acts like a follower which follows the borrower while maintaining the distance from other obstacles and doesn’t follow in restricted places like restrooms [4].

The research paper discusses the delayed and lost luggages in airports. It suggests a baggage control system where users can track their baggage using the internet on their mobile phones. A particular pattern is attached to the baggage which can be detected and localized from a long distance using an ordinary camera, which is used to track it [5]. The authors have proposed a technique to detect theft using the PIR sensor and temperature sensor. The PIR sensor detects the motion of objects. When PIR senses movement, the camera triggers and checks for the humans, if a stranger is identified, an alarm is sent. The notifications can also be sent to the owner along with the live streaming [6].

3. Existing Methodologies
It is found that the existing models implement all the features of the proposed model separately. A model that concentrates on security does not efficiently support auto trailing. It is also observed that the existing works do not support tracking of the items kept in the baggage. Many models also do not have the capability of reviving void batteries of electronic gadgets which are considered the most important part of travel for connectivity.

| Existing Work | Features                      |
|---------------|-------------------------------|
| Luggage Tracking system using IoT | Location Tracking             |
| Intelligent Suitcase                  | Location Tracking             |
|                                          | Auto Trailing                 |
|                                          | Void Battery Reviving         |
| Smart Bag                        | Auto Trailing                 |
|                                          | Location Tracking             |
| Smart Bag with Theft Prevention and Real Time Tracking | Auto Trailing             |
|                                          | Location Tracking             |
|                                          | Proximity Detection           |
|                                          | Smart Unlocking               |
| Design and Implementation of 4-in-1 Luggage Bag | Location Tracking |
|                                          | Auto Trailing                 |
|                                          | Void Battery Reviving         |
|                                          | Smart Unlocking               |
| Smart School Bag                   | Location Tracking             |

4. Proposed Model
The baggage is embedded with a controller which receives signals from the smart device which is affixed at the baggage owner’s end. The controller and the tracking device are connected with Bluetooth. The baggage receives serial data from the smart device and sends it to the controller on the baggage. GPS and GSM are used to track the lost baggage. Smart unlocking techniques like fingerprint detection and face detection are used. Object detection techniques and Ultrasonic/IR sensors are used to follow the human. Discharged batteries can be recharged using the in-built power bank in the baggage. For keeping
a track of the accessories of the baggage a smart alert is maintained. Mentioned below is the functionality of each:

![Block Diagram](image)

**Figure 1.** Block Diagram

4.1. *Auto Trailing of the baggage*

*a. Using Ultrasonic sensors:* A notification is sent from the smart device to the baggage to turn it on. Alternatively, a button on the baggage can also be used to activate it. Ultrasonic sensors are set so that it can recognize the presence of objects ahead of the baggage which ensures effortless movement of the baggage. The transmitter part of the sensor is positioned in the center and the receiver part of the sensor is placed in the corners of the baggage. Sound waves are continuously transmitted from the sensors which when strikes an obstacle returns back and these returned signals are received by the receiver at the ends of the luggage bag. Based upon the strength of the signal the movement of the baggage is determined and motors are moved appropriately by the controller. If the strength of the signal is equal on both the sides then the baggage is moved forward. If the strength of the signal is higher in the right-side receiver the baggage moves towards the right side.

Else it moves toward the left side. Along with the signal strength, the distance between the owner and the baggage is also calculated, which is compared with the threshold and if the minimum threshold is reached the movement of the baggage stops.

*b. Using the IR sensors:* IR sensors are placed at the ends of the baggage which detect the movement of the person. The positioning of the IR sensor is also similar to the Ultrasonic sensor as mentioned previously. The data received by the IR receiver is sent to the controller. The controller in turn turns the motors by means of programming.

*c. Object Detection:* The way for the baggage is formed wherever there are no obstacles. Any obstacles in the path of the baggage are detected using the Object detection techniques of Artificial Intelligence.
4.2. Proximity Detection
Bluetooth is used to achieve proximity detection. This is used to know if the baggage is under theft or is moving away from the owner of the baggage. Whenever the luggage bag is a few meters away from the smart device (the distance is based on the threshold set) the alarm adhered to baggage starts to sound. Along with this a notification is sent to the tracking device for easy tracking. If the tracking device is a smart band then the band is set to vibrate immediately when the bag exits the radius of the set threshold. Along with notification location coordinates of the baggage are also sent to the device which ensures easy tracking in case of theft and also acts as a reminder in case of overlooking.

4.3. Location Tracking
GPS and GSM modem are embedded in the baggage to enable location tracking. Whenever prompted by the smart device or when the baggage is out of the radius of the smart device the location coordinates of the bag are sent to the smart device. This is done by using a Lookup Table. The lookup table stores the location coordinates of the baggage. Whenever the baggage moves out of the radius of the smart device the nearest coordinates to the smart device from the lookup table are extracted and sent to the smart device as a response for easy tracking.

4.4. Smart Unlocking
The controller memory is pre-trained with fingerprints of the owner of the baggage. It is used to authenticate the right person and open the baggage accordingly so that the contents of the baggage can be protected from mishandling. Also, when authentication fails many times (as set during training) the baggage locks and an alert is sent to the tracking device. Face detection can also be enabled with a fingerprint.

4.5. Smart Alerting
For assisting the explorers by remembering the significant things this smart alerting system is designed and developed. Here the baggage is equipped with a scanner that has the capacity to remember things which are scanned by the users. Object name is stored using Object Detection technique. Using this the problem of overlooking the important things is solved. The list of items taken out if the baggage is saved in the controller memory. Once the objects are placed back the objects are scanned again which removes the object names from the memory. Whenever the baggage is locked without placing the taken-out accessories immediately the controller will send a text with the list of items left out in the controller’s memory which in turn will remind the person about his belongings.
4.6. Discharged battery reviving
To keep the explorers connected with the world, the discharged battery reviving mechanism is set up in the baggage. It contains an internal power bank which is used to power the embedded controller and also for reviving the electronic gadgets of explorers.

5. Result
The proposed methodology guarantees security and smart features that aid the explorers of the contemporary world. People tend to be attracted to one solution to the challenges rather than separate solutions to each problem. This smart baggage is one such attempt to give one solution to all the challenges faced or encountered. All the complications encountered during traveling are solved using this smart baggage. This baggage is best suitable for constant travelers and travel guides who have a lot more to do apart from worrying about the baggage and getting strained. This baggage can be used as a normal luggage bag or its smart features can be activated using a button or a message(command) sent from the smart device. This system uses ultrasonic sensors to recognize the objects present in front of it for smooth movement, GPS module to track the location and follow the owner, Bluetooth to avoid thefts and maintain a radius in which the baggage should move. Inbuilt power bank for reviving discharged batteries. These features of the baggage ease the explorers traveling.

6. Conclusion
Technology can be a boon or a bane based on how we make use of it. The methodology best shows the ways through which technology can be used to reduce effort, increases security and makes travel days cherishable. The days for the people who tend to be more smart, lazy and delicate rather than being hardworking and strong this baggage is the best alternative and is a travel companion. This makes explorers not to search for charging ports or struggle for lifting heavy loads, rather makes them enjoy their journey and fill the book called life with pages called memories and moments. All the features that best suit the explorers, thinking from their perspective and by surveying are added to the proposed methodology.

7. Future Scope
When technology increases security diminishes. A smart baggage with all the required security is the future scope for the methodology presented in this paper. Security in terms of theft is already an added feature for the proposed methodology where when the baggage is not in the radius of the smart device, it raises an alert to the smart device and sounds an alarm with which the owner can know the whereabouts of the baggage and track it in case of theft or misplacement. Another security issue arises when the baggage containing the important things can be accessed by everyone. This is the future scope of the methodology presented. It can be integrated with a security camera or a fingerprint sensor. With this, the baggage is trained with images or fingerprints of the owner of the baggage. The images or fingerprints can be stored in the controller’s memory. With this, the explorers need not worry about access to baggage by unauthorized users.

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