Baggage Theft Prevention using RFID Technology

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Abstract— This paper provides an advanced method to avert baggage thefts that occur in practically all airports, due to which the passengers and airport authorities face a lot of aggravation. This paper brings light to a new method that copes up with such kinds of difficulties and provides an effectively operational and economic solution that provides a win-win situation to both, the passengers as well as the airport staff.

Index Terms— Aviation Industry, Baggage Theft, Baggage, Cloud Service, Luggage Loss, Luggage Security, Mishandled Bag, Radio Frequency, Sensors, Smart Tracking, Tracking RFID.

1 Introduction

Baggage theft and misplacement is a major concern to passengers travelling via airlines. On an average 40 bags get mishandled every minute according to *Société Internationale de Télécommunications Aéronautiques (SITA)* which liquidates about $2 billion US dollars. Baggage theft has led to an acute ruined reputation of the airline industry. Making use of RFID tags are one very efficient and convenient method to outrightly avoid and reduce this issue as much as possible.

Tracking luggages can be done using numerous methods such as incorporating capsules or mini chips containing GPS, NFC, or RFID chips. The pros and cons of the above suggested technologies are listed below:

Advantages:

- Passengers luggage location can be tracked
- Controls loss or theft of luggages

Disadvantages:

- Time consuming, therefore creating traffic in airports.
- Expensive

Our solution overcomes all the disadvantages of the above-mentioned technologies and makes them quite trivial.

2 Research Findings

RFID stands for "Radio Frequency Identification or Radio Frequency ID". This paper shall unveil as to how this piece of technology can be used to better civil airline passenger travel experience. The RFID tag makes use of a wireless chip to transfer and receive data through an electromagnetic spectrum of radio waves which usually ranges from 30 Hz to 300GHz, with the corresponding wavelength ranging from 10^6 m to 10^{-3} m. Luggage security system for airline travel consists of the following technical details to be focused on:

1) RFID system: As far as tags for these purposes are concerned, high frequency is the safest option, keeping in mind some additional factors that will further be explored in this paper. The principle used for tracking involves the use of radio waves with frequencies in range of few MegaHertz. The array of frequency of radio waves are: 30Hz to 300 KHz with a read range of 10cm; high frequency of 13.5MHz with read range of 30 cm; ultra high frequency of 300MHz to 3000MHz.

2) RFID Tag (usage of passive tag is proposed)

It is an extremely small and portable sensor with negligible surface area. To reduce the size of the RFID modules, to function with less wear and tear due to turbulent usage during luggage movement, RFID capsules, more precisely RFID chips are to be used. These chips/tags can be printed on the boarding pass and similar tags can be attached/ pasted to the luggage of the passenger. An already available RFID tamper proof tag can also be used. RFID tags further consist of two components. These RFID tags are programmable hence they can be reused.

Microchip: A semiconductor device which has a circuit with memory storage of a few kilobytes (KB), where data can be stored. A unique ID number will be stowed here.

Antenna: An antenna is used to transmit the data (electromagnetic waves of the ID number) to its surroundings, in a range of approximately 30 cm. Therefore, when the tag is in proximity to a reader/scanner, it can detect the data stored in those tags and respond accordingly.

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3) RFID Reader (scanner)

A device that scans or reads the data transmitted by the tags and compares both the data in tags of boarding pass and luggage. This device consists of:

Transceiver: A transceiver can be used to perform two operations: both as transmitter and receiver. It consists of an oscillator to generate a continuous radio signal which is modulated to a required frequency and then transmitted into free space or air through an antenna.

Antenna: It is a device that converts electrical signals into electromagnetic signals as radio waves which can propagate via air.

Decoder: When a radio frequency signal is detected by the antenna of the scanner, it decodes the data stored in electromagnetic form of waves in the ID to binary signal that can be read by a computer which can then be converted into decimal numbers.

3.1) Mutual authentication:

The scanner validates whether the data in the tag of the boarding pass and the one in the luggage are both identical. If both the data (ID number) matches the passengers can exit the airport and the tags can be collected from the passengers which can later be reused.

3.2) Trigger alarm:

Given the ID number in the tags of boarding pass and luggage are non identical, it will trigger a low intensity alarm and the respective passenger needs to verify their luggage with the airport service where all the information is stored.

Cloud storage service : The airports shall have cloud service for keeping the log of all the data from each tag in every airport, and sync it to the cloud servers so in case of any deliberate theft it can be verified as to which airport was the luggage brought in, where was the respective passenger's destination, where was the luggage been stolen; and hence can be used to analyse and conclude how and where can the passenger find his/her luggage. The cloud service will have all the data of passengers and the ID number decoded in the tags of respective passengers.

In case of due queries regarding a deliberate theft, in reality any, meticulously all the airports as we propose which have access to the real-time cloud service database can provide information about the passenger's luggage as anybody with an intention as such will have to come across the scanner to exit the airport. And since all the scanners shall be programmed to be directly sending information to the database, the information as to who took the luggage that has the same mutual ID number that the original owner has can be verified.

Working:

When a passenger walks out of the exit gate, the RFID chip printed on the boarding pass will be scanned. The antenna will receive RF signals (transmitted by the tag). The decoder will get the information stored in the tag, which will be stored by a computer. Simultaneously the RFID tag attached to the luggage will be scanned and the information stored in this tag will be stored. If the ID number on the boarding pass and the luggages match, the passenger will be let through the exit gate. If the ID numbers do not match, an alarm will be triggered by the scanner at the exit gate.

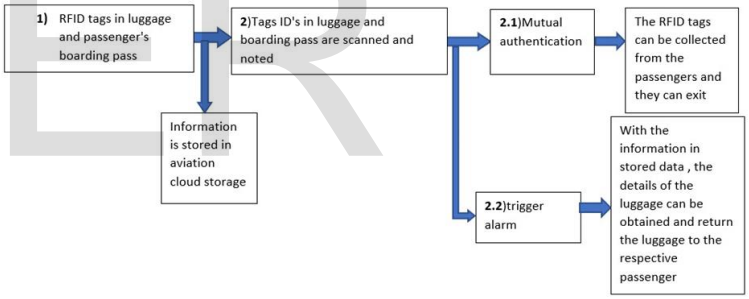


Figure 1- block diagram

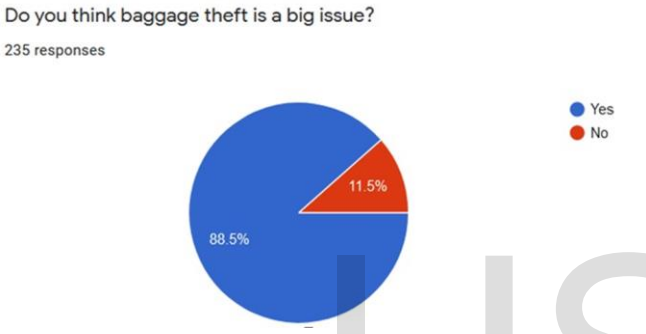
3 STUDY

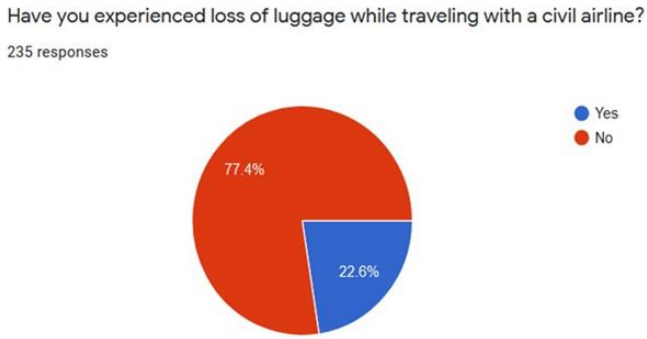
Although there are several existing companies which aim to eradicate baggage theft by using barcodes, here's why RFID would work better:
Studies show that out of 4.3 billion bags in total which come into the airport each year, about 25 million bags get misplaced

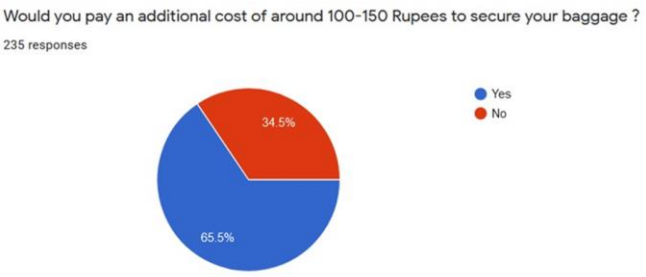
or misdirected every year. US Delta airline attributes its 99%success rate in handling its passengers luggages due to barcoded labels. Despite the success rate being 99%, the left out 1% accounts for 43 million misplaced/ stolen bags every year.
According to an article by IATA in June 2019, use of RFID Tags showed a better success rate of 99.98%

4 SURVEY

According to a survey conducted wherein we were the pollsters; it was answered by over 235 frequent air passengers. The following responses were recorded:







Comprehending these responses amidst the 235 passengers, baggage theft or loss is faced by nearly 20% of the respondents. Despite this being an issue to a lesser number of people, the growing percentage of this is seen as a threat, or rather the percentage of theft occurring is quite obscure. Hence, working towards having a better security system is of utmost importance.

5 CONCLUSIONS

Once the passenger enters the airport as they proceed to obtain the ticket, they must pay an additional fee to purchase a tag which will have its authenticated ID details stored in the server. This tag will be attached to the luggage and the data in the cloud has a record of which passenger is having the luggage. Once the passenger's details are stored, the ID will be linked to the passenger and the arrival and departure of the luggage will be stored to cloud to ensure minimum chances of misplacement. There are two possibilities of things being obstreperous or things going out of hand. One, *baggage misplacement*, incase there are two passengers with similar bags, but the ID number on each bag will be different, hence in case of mismatch in the IDs of the passenger and the luggage, a low alarm will be triggered indicating wrong luggage. Two, *baggage theft*, that can be tracked using the data of the passenger and his provided ID entered in the cloud service.

Therefore, the conclusion that can be drawn from this research is that an RFID tamper proof tag can be used to reduce theft and misplacement of baggages in airports. These tags can be re-used hence proving to be environmentally beneficial and economically feasible.

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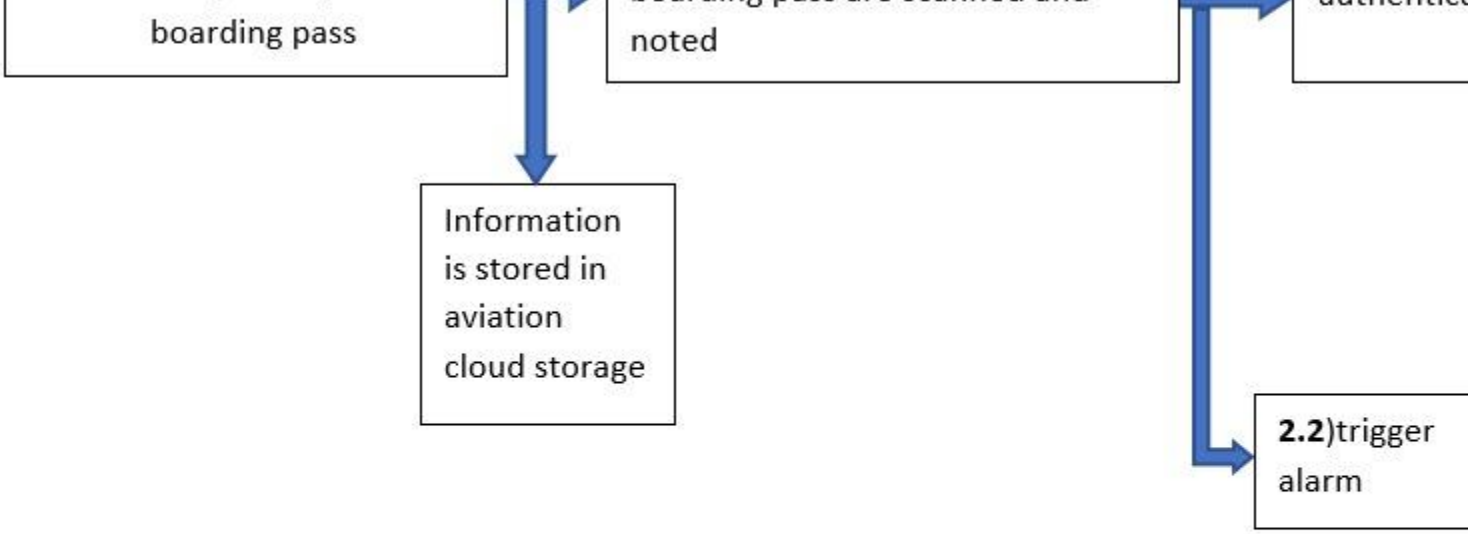
boarding pass
noted
Information is stored in aviation cloud storage
2.2)trigger alarm

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