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Airline Baggage Tracking Using Hybrid Sensing and Blockchain Technology

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ABSTRACT

Increasing number of airline passengers and their requirements tends to force the aviation industry to meet the operational challenges. One of the major challenges is rising number of mishandled baggage and its theft. Block chain technology helps aviation industry in handling baggage's in transparent and easily accessible way by storing and processing luggage data in clear and effective way. Blockchain stores the meta-data and manipulates it thus enables the client to receive live tracking information about the baggage. To address the baggage handling challenges blockchain adopts hybrid solution by combining RFID (Radio Frequency Identification) and barcode technology together which provides clear visibility throughout the baggage journey and ease baggage identification and tracking.

Keywords---*Blockchain technology, Radio Frequency Identification, Barcode technology.*

1. INTRODUCTION

Baggage mishandling costs the aviation industry in billions every year and it also a primary reason for the air passengers inconvenience. In the real scenario, a passenger's bag is handled by several actors including the people in airline, airport and ground handling personnel's thus a baggage moves from A to B then C and even to D. However, block chain helps out this situation by using a shared distributed log record of transaction used by all actors within an airport and between the airports contains the bag and ownership details which can be automatically logged on into a blockchain. Baggage data can be shared between actors involved which may help in tracking the bag during their journey. Many technologies have been deployed for baggage mishandling but RFID (Radio Frequency Identification) proved to be effective with its unique features and enabling greater visibility throughout the journey of the baggage. With barcode technology the security agents will manually identify the barcode on the bag which is hectic process and cannot locate the baggage at remote positions. So, combination of RFID and barcode technology will be a better solution for baggage mishandling.

Ahmed et al[1] presented a data warehouse (DW) solution for storing and analysing spatio-temporal Radio Frequency Identification (RFID) baggage tracking data for lost luggage. They also discussed the data warehouse with the appropriate tracking data from the data sources which is defined by Extract-Transform-Load (ETL) flow that loads the data. Zhang et al[2] surveyed similar air baggage handling applications and introduced the IATA RP1740c protocol to recognize the baggage tags. The experiment is carried out with the tags and are sealed in the printed baggage label and the RFID readers are fixed in few positions of the baggage handling systems in the Terminals. They have measured the accurate recognition rate and monitor the real-time situation of the baggage. DeVries[3]examined the state of Radio Frequency Identification (RFID) to the problem of tracking baggage within the

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commercial aviation industry as a solution. The benefits and drawbacks of RFID are also discussed. Though the cost of RFID tags is costlier its implementation will greatly benefit the aviation industry. Also presented an idea for building a business case which involves collaboration of airports and airlines for RFID infrastructure.

Singh et al[4] proposed a design based on cloud server. They have designed a prototype for check in and check out process and also devised an algorithm for generating tags which contains the passenger information that are attached with the passenger baggage for further tracking. The real time position of baggage is tracked and stored in a cloud using IoT[16] and unique ID which is retrieved further by the air passengers whenever needed. The same ID can be used during collection of bags at check-out counters the same ID is used. They have ensured that the proposed model consumes less time and provides greater customer satisfaction. Medeiros et al [5] Presented a passive UHF tag configuration for suitcase identification and tracking in airports. They proposed a tag antenna solution based on conformal geometry, consisting of a folded dipole with orthogonal arms, appropriate for integration into the wall of injection-molded suit- cases during its fabrication process. Tag detection ranges are tested in different scenarios. Sloan et al [6] Proposed a radio frequency identification (RFID) tag which is used with a baggage tracking system that helps in tracking and locating of aviation assets in an airport terminal. Antennas placed at different locations helps to monitor the baggage journey with the local controller can communicate with the passive RFID tags to track the bag.

Collotta et al [7] presented a preliminary study on a distributed system for tracking and monitoring of baggage's using RFID. They have represented a data warehouse for storing and analysing spatio-temporal RFID baggage tracking data records. An RFID reader is placed on the end of the conveyor and baggage handling personnel will maintain a mobile hand-held computer that can receive an instant alert if a bag is misplaced in another flight is identified and located. Ahmed et al [8] presented a detailed step for pre-processing the tracking data record for analysis and addressing the imbalance problem, the datasets are fragmented and finding the valid classifier. Similar works are presented in [9-10]. Kato [11] examined how RFID (Radio Frequency Identification) technology used for advanced shipment tracking in the airlines industry using rewritable passive RFID tags. The airline passenger signs a contract by purchasing a plane ticket which means that airline industry is responsible for all passengers assets. Loss and mishandling of luggage are increasing every year which can be handled by RFID technology.

Cereno and Walsh [12] discussed about the RFID and barcode technology and also presented about the several RFID prototypes for tracking of baggage's. Several test programs for determining the RFID standard are presented in this work. They have also addressed current RFID technology for providing future applications in the aviation industry. Similar work is presented in [13,15] GAO et al [14] proposed, a technique which uses blockchain technology with baggage handling system to analyse the entire process of tracking and real-time monitoring of passenger's baggage. Consortium chain architecture model is presented with baggage tracking system. The model and connection method of data space and physical space are designed based on the Baggage tracking mode. Blockchain data space can identify the change of baggage. Rate of transportation of baggage can be improved by simulation experiments which is also discussed. Muruganantham A and Bino Joseph [17] The RFID baggage tracing solution with blockchain technology enabled platform and smart data management provides an integrated deployment and monitoring service. The collaborative

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technology is implemented to support end-to-end tracing and giving alerts to make the passenger's journey meaningful without disruption.

The rest of the paper is organized as follows section II discusses about the Blockchain Technology With RFID, section III is proposed Hybrid RFID and Barcode technology, Section IV presents a Sample tracking model for mishandled or lost air baggage, Section V is Conclusion

2. BLOCKCHAIN TECHNOLOGY WITH RFID FOR AIR BAGGAGE HANDLING

Every day many numbers of airlines are operating locally and internationally with this air passengers and their baggage's are carried from one point to various locations. Baggage Handling systems is adopted in all international airlines and even with some standard local airlines which helps in check in and check out of passenger's baggage's. Initially getting into the airport the passengers verifies his/her ticket and gets a boarding pass. Baggage which is the passengers load is scanned by the airport personnel and then transported to the destination of the passenger. If the air passenger has more number of bags each baggage is given same label. The conveyer automatically routes the bag to the desired location by using sorting machines at different terminals. Baggage Handling System has improved in recent years and airports are adopting smart technologies thus there is major decline in the lost luggage.

Block chain Technology is one such technology adopted in aviation industry which significantly shows better improvement in tracking the lost luggage and monitoring the entire journey of the passenger's baggage. Blockchain is a distributed register where every transaction is recorded and visible to everyone in the network which makes the third parties difficult to interfere. Blockchain stores all the transactions in blocks and links all the blocks together as a chain thus ensuring utmost transparency and security by not allowing other parties to unblock these transactions. Baggage Handling system in this paper adopts block chain technology where the passenger baggage dropping, storing, conveying, sorting and reclaiming baggage by the passengers all of the air passenger's needs are met.

2.1 Steps involved in baggage handling system

Baggage handling involves various steps which are as follows

Step 1. Get or receive bag from the air passenger,

Step 2. Move the bag and store till the flight is ready,

Step 3. Sorting machines sorts and loads in the right flight,

Step 4. Make sure the bag and passenger are in same flight,

Step 5. If there is connection flight transfer the baggage correctly,

Step 6. Deliver the baggage to the passenger at the destination check out point.

There are high possibilities for change of luggage or loss of luggage during these steps to track and locate the baggage at any point of journey RFID technology is deployed.

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2.2 The RFID TAG

A tag or label is attached to the passenger's baggage and a radio transmitter sends a signal to the tag and receive its response. The tag attached has to respond to signal from the transmitter so that the receiver can get information about the baggage. Tracking devices are used for tracking the movements and location of an object RFID technology works in a similar fashion. RFID baggage identification is helps in error – free monitoring of bags placed in sorting room, in the conveyer belt, baggage collection place, when loading baggage to the plane.

Block chain RFID enables: Automatic baggage scanning and Identification, Locating the baggage and estimating the time of baggage transportation, Alerts when the baggage gets loaded in correct aircraft, With the alerts ensuring there no loss or mishandling of luggage, Identifying and locating the baggage from check in time and tracking its journey until it reaches the checkout, Alerts when the baggage leaves the flight, Identifying the baggage in baggage collection point in the destination.

3. HYBRID RFID AND BARCODE TECHNOLOGY FOR AIRBAGGAGE HANDLING

For baggage identification the airports and airlines no need to choose either RFID or barcode technology. Utilizing both the technology together as hybrid solution which enables and makes use of both barcode label and RFID – tagged baggage in the passenger's baggage may greatly benefit the airports by gaining benefits from both the technologies and results higher read rates. Barcodes are trusted technology easy and simple to use.

3.1 BARCODES

The main obstacle in obtaining greater visibility in air baggage operations is lack of proper tracking data in passengers' individual bags. Adopting barcodes in every baggage of the passenger is considered as better idea for identifying the air baggage's. The commonly used barcode formats are ITF format and code 128.Usage of barcodes are cheap and scanned by automatic barcode readers. A Hybrid barcode/RFID scanner called $ECCO^{+}$ is the fastest and less expensive. The pre-existing hardware can continue to be used and the switch-over can take place without any further additional system or software thus proving to be cost effective. Baggage tags are printed using the printers then these tags are placed and scanned with hybrid barcode/RFID scanner which reads the barcode and encodes the same tracking information in the RFID transmitter. The barcode readers will scan the tracking information and it will get registered in the system when the passenger check-in or check-out the airport. In general barcodes are also available with the default boarding pass of every passenger which includes the full name of the passenger, flight record finder, arrival and departure in airports, the details of the aircraft which passenger flying and frequent flier number.

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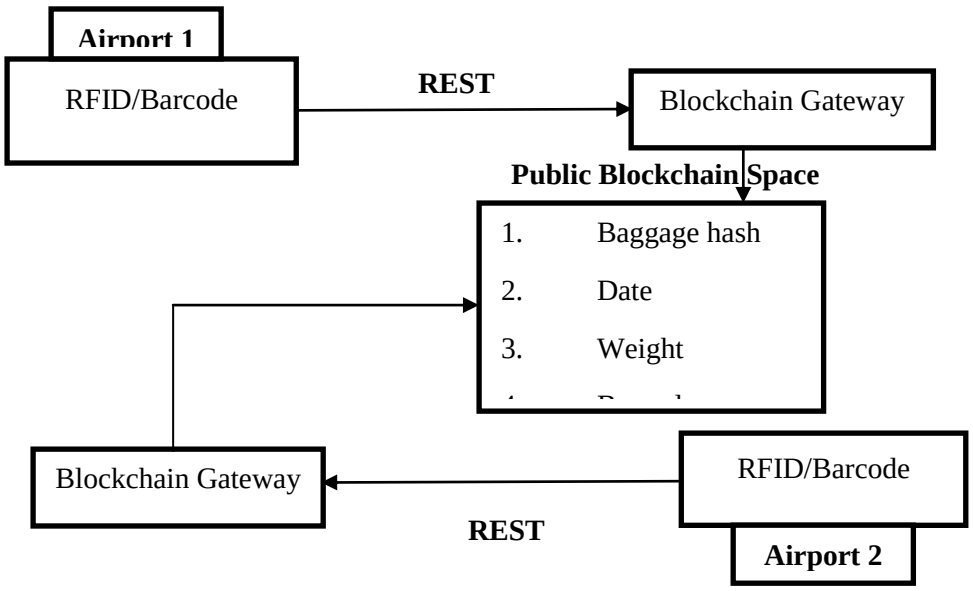

Figure 1: Hybrid RFID and barcode architecture for air baggage handling

The Figure 1 depicts the hybrid RFID and barcode architecture which depicts the scenario of baggage handling system including two terminals. Block chain gateway stores and records the baggage information and makes it transparent and secure between the two terminals.

4. EXPERIMENTAL RESULTS

Reducing the baggage mishandling, lost luggage problem and reduced time delays in locating airbag gages and ensuring greater visibility and customer satisfaction are primary focus of this work which are reasonably achieved by deploying the hybrid RFID/Barcode technology is proven by the below mentioned statistics. The experiment is carried out in the windows environment by collecting the SITA data for ten years from 2002 to 2014.

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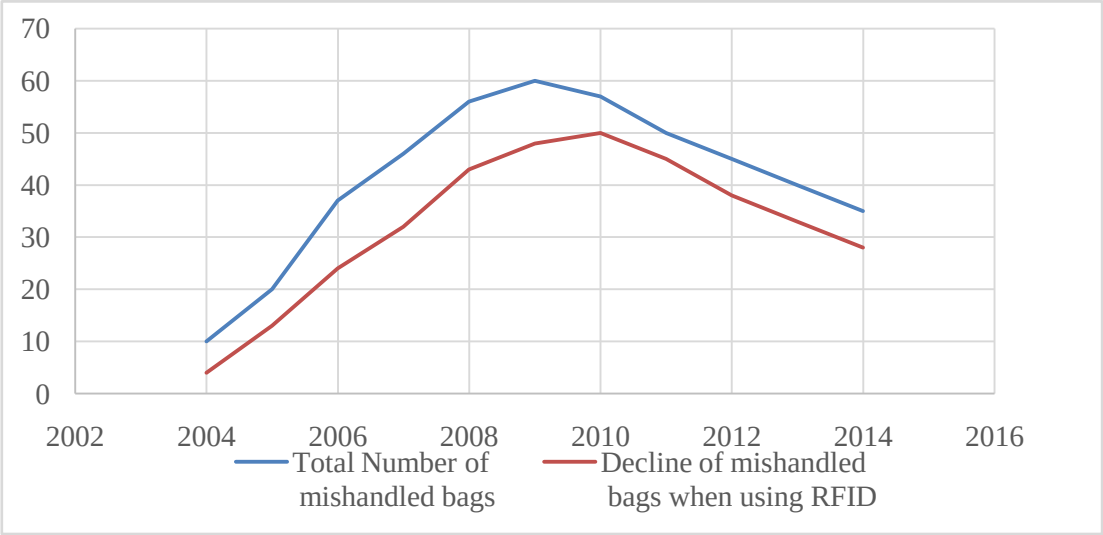

Figure 2. Decline in Baggage mishandling using RFID technology

The Statistics is generated between the Total number of mishandled baggage's in the mentioned years and with the adoption of RFID technology showing the reduction in the mishandled baggage's

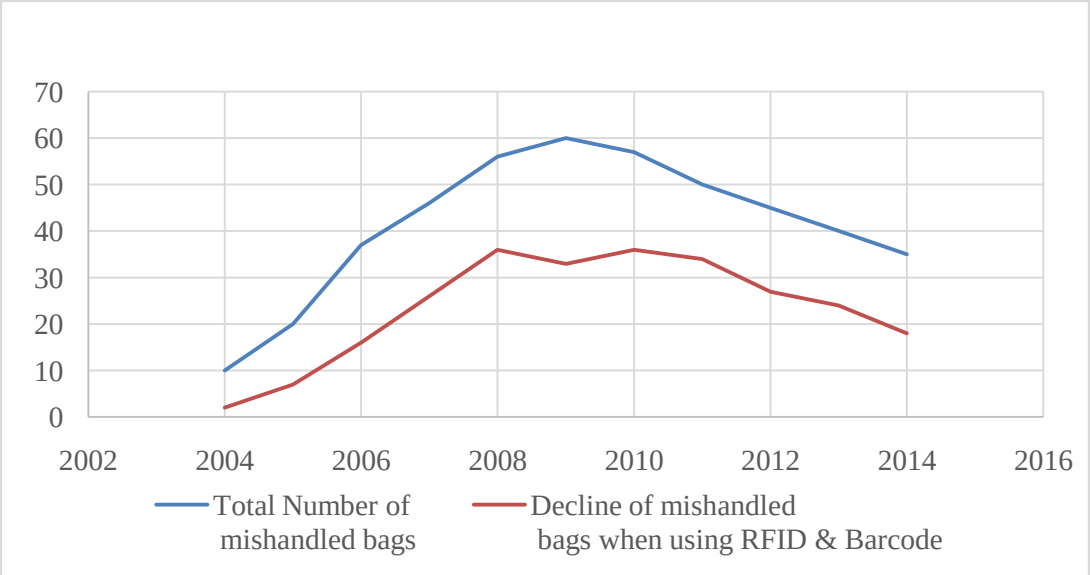

Figure 2. Decline in Baggage mishandling using RFID and barcode technology

The Statistics is generated between the Total number of mishandled baggage's in the mentioned years and with the adoption of Hybrid RFID and barcode technology showing the reduction in the mishandled baggage's. From the above two statistics it is very clear that usage of hybrid RFID and barcode technology shows a major reduction in mishandled baggage's than RFID when used alone without inclusion of barcode.

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5. CONCLUSION

With the increase in mishandling baggage's and lost luggage's in the recent years the aviation industry and air passengers are undergoing greater inconvenience. To address this problem adopting block chain technology with Hybrid RFID and barcode increase customer services, eliminate mishandling, improve read rates and visibility, less maintenance costs, reduce delays in delivers to and from the flight, and improved customer satisfaction. Implementing hybrid RFID and barcode enabled tagging for tracking, monitoring and having control over the entire journey of bags from ticket counter check-in to their final destination check – out.

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