

An investigation into the use of Radio frequency identification Technology as a security tool

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Abstract: Current Radio Frequency Identification (RFID) technology applications facilitate communication through managing performance accuracy and efficiency. The quality of RFID in identifying objects accurately at low-cost and the advantage of not using line-of-sight brings several new ideas and introduces great application areas making the technology of RFID an essential segment of our daily lives. This research is focused on examining the current practices of RFID by exploring into its use as a security tool in baggage handling. Data were gathered from different and diverse renowned sources providing rich information on the current and future use of RFID in baggage handling and then reviewed for integrity through comparison with similar baggage handling technologies. Results from this research showed that RFID can be effectively used as a security tool in baggage handling though there are some problems due to radio frequency collision. Further research should be done on reducing this interference issue through improved selective identification using RFID system architecture for numerous objects.

Keywords: RFID security; Barcode technology; Baggage handling.

1. BACKGROUND

Radio Frequency Identification (RFID) “is an automatic identification and data capturing technology” [1] used in airports during check-in for travellers’ baggage. It is desirable for several airline passengers to be aware of whether their baggage is on-board the aircraft that they have been entered, or at least that it will be available at the destination airport [2]. The quality of RFID in identifying objects accurately at low-cost and the advantage of not using line of sight brings several new ideas and introduces great application areas making the technology of RFID an essential segment of our daily lives [3]. The current and emerging growth areas of RFID applications includes healthcare, retail, and commercial services but the top among these applications are: baggage handling, point of sale systems, real time location, item tracking, real time location and supply chain management [4]. According to the factors responsible for the core baggage mishandling reasons, the International Air Transport Association (IATA), identified different areas as shown in Figure 1.

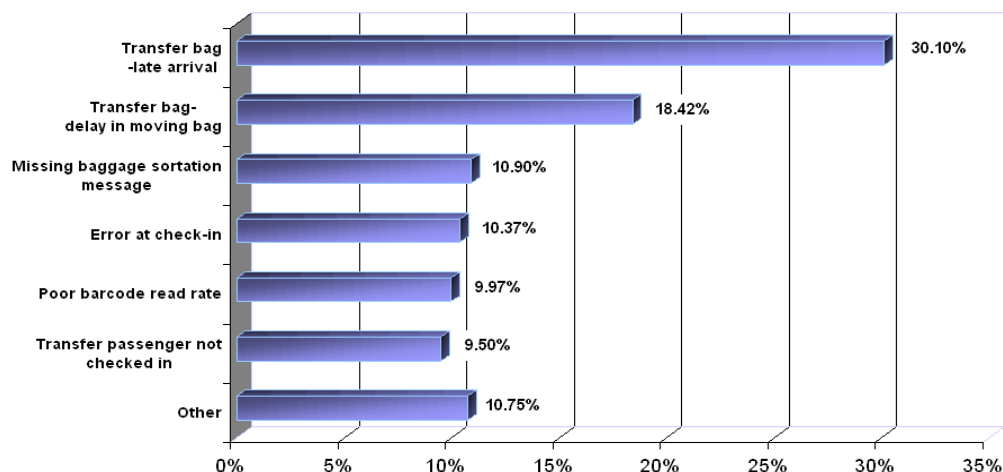


Figure 1: Main Reasons for baggage mishandling (IATA, 2007)

From the above figure, Transfer bag late arrival contributes 30.10%, of the major reasons for baggage mishandling. This area has the highest percentage of mishandling. The Transfer bag delay in moving bag accounting for 18.42%, Missing baggage sorting message carries 10.90%, Error at check-in responsible for 10.37%, Poor barcode read rate causing 9.97%, Transfer passenger not checked-in receive 9.50%, and other problem bring about 10.75% mishandling.

This research will explore into the use of RFID as security tool within these scenarios especially the issue of poor barcode read rate. Although current research into the use of RFID as a security tool is centred on its improvement in baggage handling while effective use of the technology has been given to some extent fewer consideration. As highlighted by the work of [5], "Radio Frequency Identification (RFID) device technology is available to improve baggage handling". Based on this, the current study will try to find out the effective use of RFID technology with particular attention to baggage handling security. This research attempts to answer the following questions;

- a. What are the current practices of RFID in baggage handling?
- b. What are the security issue affecting the use of RFID in baggage handling?
- c. What is the likely future of RFID in baggage handling?

This research is about examining the current practices of RFID and the security issues affecting the use of it, as well as its likely future in baggage handling. Therefore, analysis will go beyond the baggage handling improvement identified by [5] and place that one inside the gap found in the present literature. Current RFID practices will be reviewed based on baggage handling and evaluate their security usage issues.

2. LITERATURE REVIEW

The work of [6] examined RFID trials in various airports and found that some airports have fully implemented after the trial test, such as Heathrow Airport baggage collection, ASTREC and Hong Kong International Airport while some have just closed the project. Whereas [7] finds out the current practice of RFID baggage service in Hong Kong International Airport which is one of the busiest in the world, handling an average of 110,000 bags daily. The airport fixed both RFID and barcode tags on passengers baggage, and the reader scan the tag from not too long distance and keep the information in RFID chips better than that of barcode, the data involves flight details, name of passenger, tag number as well as all other security data [7]. [8] discovered the notable development of "pilot RFID implementation" in baggage read tag achievement to more than 95% as oppose to barcode technology with a success read speed of 85-90%. They further realized that, RFID tags unlike barcodes "carry a univocal ID code and a memory that can store relevant baggage tracking information". Moreover, RFID is considered to be a quick growing technology that allows radio discovery and reading of tags associated with items, with no requiring line of sight compare to barcode technology [8].

According to [9] RFID technology is more efficient and effective in baggage handling than barcode, as a result of many RFID features such as accurate read rates of passengers' tagged baggage to more than 95% compared to barcode with only 90%, real time bag matching, speed of moving objects (baggage), etc. While [10] added to the work of [9] by comparing the benefits of RFID tag and barcode tag in baggage handling and found that, RFID tag is more beneficial over barcode tag with several attributes that includes: the ability of RFID to read bag tag without needing line of sight as oppose to barcode, fully automated and accurate read rate as well as durability than that of barcode technology tagging..

Analysis from the work of [8] and [9] reveals that RFID is more efficient and effective in baggage handling when compared with barcode technology. [10] observed that RFID can be used effectively for passenger and baggage identification. [11] recognized the critical security problem of RFID due to its wide spread deployment. While [12] highlighted more on one of the threats affecting the security of RFID in baggage handling in such that, a malicious traveller or passenger can attach RFID tag on a bag that contain a virus and checks in with it.

Results from the reviewed articles showed that RFID technology can be used as a security tool can reduce the rate of losing baggage at airport for check in, and thereby enabling "ramp" work to be carried out faster and accurately [13].

3. RESEARCH METHODOLOGY

The research methodology of this investigation is a mixture of Secondary source of data collection and literature review. The study is intended to review the use of RFID as a security tool with particular attention to baggage handling. Therefore, the combinations of this methodology were selected in order to flourish a further understanding into the use of RFID in baggage handling.

The literature review in this research is the main approach. Sufficient data was collected pertaining to RFID technology in baggage handling following the available secondary data sources like the university library and online resources which are very relevant covering the research topic. Data were gathered from different and diverse renowned sources providing rich information on the current and future use of RFID in baggage handling and then reviewed for integrity through comparison with similar baggage handling technologies. Facts and information readily available was used to analyse the effective use of RFID in baggage handling at airports.

4. DISCUSSION OF FINDINGS

The results from the critical review of related works showed that RFID and barcodes technologies are the two current practices used as a security tool in baggage handling but RFID technology is more efficient and effective when compared with barcode in baggage handling scenario. Despite the effectiveness of RFID over barcode in baggage handling, RFID associated with some problems. [14] outlined four major types of RFID data readings errors. This includes the following:

- The unreliable data reading which is causing by “environmental interference” in deploying RFID such as metal, or sometimes water can cause unreliable readings, or tags moving are also common issues that cause RFID data readings to be unreliable.
- Problem of Miss-Read: In RFID application, this is very common and usually occurs when many tags are to be traced, “Radio Frequency Collision happens and signals interfere with each other, not allowing the reader from correctly identifying tags.
- Unexpected additional readings which are caused by unknown purposes from the reader or environment that is not inside the normal reading scope of the RFID reader.
- Duplicate Readings: Occurred because raw level of RFID data does not have meaningful information, and the same tags can be captured more than once and it is therefore important to identify and remove those data before they posted in RFID database.

In addition to these problems, there were also discoveries on security bridge issues due to security threats to RFID and the possibility of tag cloning attack. [15] stated that, “*without the correction*” of the problems of incorrect, duplicate and missing data, “the passive RFID architecture will never be utilized to its full potential as a cost effective and efficient means of wireless identification of large sums of items”. Findings show that there are gaps in the areas of RFID security issues such as defective tag reading, collision interfere and duplicate readings of data as identified by [14] then later review by [15]. Also the work of [11] and [12] suggest further research in the region of numerous RFID applications to evaluate and determine the success of the use of RFID for baggage handling.

The main weakness of RFID technology is that of little security stipulation when it comes to its use for security reasons as it makes use of various method of placing the protected information on the chip of the circuit [16]. Security issues have therefore become a problem to extensive implementation of RFID technology and with the wealthy business brainpower that RFID infrastructure might perhaps convey, security is highly importance [17].

Despite the security issues affecting the use of RFID technology, it is recommended in baggage handling as was noted from the work of [18] which described RFID as the most appropriate and recommended technology for identification and tracking in airport during passenger baggage handling processes.

Some of the airports where this technology has been applied can be seen in table 1.0 below which summarizes the trials and implementations of RFID tags using various frequencies at different airports.

Trial / Implementation	Technology Used	Purpose	Status
Las Vegas McCarran Airport	UHF RFID	Security	Ongoing Implementation
ASTREC	UHF RFID	Proof of concept	Ongoing
Auto-ID centre @ HKG	UHF RFID	Proof of concept	Completed
TSA	UHF RFID	Global Interoperability	Completed
Hong Kong International	UHF RFID	Baggage sorting and reconciliation	Implemented, now adopting IATA RP
KLM / AF	UHF RFID	Baggage sorting	Implementing
SFO	UHF RFID	Baggage Security	Ongoing
Asiana Airlines	UHF RFID	Tracking	Completed
Delta Airlines	UHF RFID read only	Proof of concept	Completed
British Airways	HF RFID	Proof of concept	Completed
SIA, SIN, FRA, AUK	HF RFID	Baggage sorting	Closed
Heathrow Airport baggage collection	HF RFID	Baggage collection and delivery services.	Implemented
ASTREC	HF RFID	Baggage collection & Security	Implemented
Seattle Airport SeaTac Terminal	Microwave RFID	Tracking	Closed

Table 1.0 *RFID trials and implementation* (Nguyen, 2009)

The table above examines the use of Ultra-high frequency (UHF), High frequency (HF) and microwave RFID tags by different airports and for various purposes in baggage handling. After completing the test, a lot of airports have embraced the complete execution, such as the Hong Kong International Airport, whereas few have later neglected the project. This efficiency and effectiveness of RFID over barcode technology in baggage handling is possible from its ability to successfully read baggage tags without any limitation like the line-of-sight thereby reducing the need for much human intervention.

The use of RFID as a security tool in baggage handling can ensure the safety and sound condition of passengers' bags as long as the RFID tags are placed on the bags, so that passengers' baggage information takes a trip with the bags and as such there is no doubt that the ability of RFID to identify items benefits many other applications such as "logistics, healthcare, robotics, security, automotive" [19].

5. CONCLUSIONS

In this study, the use of RFID as a security tool in baggage handling at airport has been examined. The problems of baggage mishandling at airport such as late arrival of transfer bags, delay in moving transfer bag, missing baggage message sorting, error at check-in, poor barcode read rate, and transfer passenger not being checked-in have been identified from various renowned sources and through the use of mixed methodology to collect and evaluate data for RFID in baggage handling. The findings from a critical review of related works show that RFID technology when compared with barcode is more effective in baggage handling scenario due to factors like the operational principles of RFID which is not limited to the line-of-sight as seen when using barcode technology. Even with the earlier identified problems of RFID, its operational principle tends to reduce the baggage mishandling caused by barcode technology due to ineffectiveness. Among these problems, miss-reading is the common one and it is caused as a result of collision which makes signal interfere with each other and thereby not allowing the reader the reading access from correctly identifying individual tag. Despite this, RFID has proved to be a cost-effective and efficient means of wireless identification of a large sum of items.

It is highly recommended that the adoption of this technology in the operational airports as a security tool for baggage handling will increase the processing speed and in-turn reduce the cost of operating as the system is automated thereby maximising the airport's efficiency.

Baggage handling through the use of RFID based baggage tags will in the likely future improve passengers technological skills through user participation in tracking their individual baggage's at airports through the use of devices such as Mobile device and M-ticket for check-in and mobile boarding pass for boarding processes. That is to say, passengers can therefore

check-in their bags through technologies like the Short Message Service (SMS), emails and other communication technologies from anywhere they are, not necessarily within the airports premises for their respective flights.

Further research should be done on reducing this interference issue through improved selective identification using RFID system architecture for numerous objects.

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