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Airport Baggage Handling Using RFID and Cloud Technology

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Abstract-Airlines industry is one of the major areas which can be strongly benefitted from RFID and cloud technology. The problems which are frequently faced by passengers at the airports are lost baggage, misplaced baggage or damaged baggage. To provide a better and safer system we have come up with a plan of tracking airport baggage using passive RFID tags and cloud technology. RFID has a lot of benefits over the previously used bar codes. Passive RFIDs are being used here because there is no need of batteries or any sort of maintenance. A paradigm has been designed which includes both the check in and the check out processes. The real time location of the baggage is tracked and stored in cloud. The passenger can obtain the location of the baggage using the unique ID anytime and anywhere. Using the same id one has to collect their respective baggage. The proposed system is very secure, makes sure there is less time consumption and therefore provides customer contentment.

Index Terms – RFID, Cloud technology, Airport-Baggage, Real-time location, Passive RFID

I. INTRODUCTION

The airport is the most significant means of international transport, it is noted that every year more than 31 Million passengers and 34 Million baggage are affected by baggage mishandling which results in a loss of $3,300 Million to the airline's industry. A passenger ruins around 1.7 days of his vacation or business trip waiting for his mishandled baggage. In the recent years, RFID has proven to be a boon for object tracing purpose and is considered to be one of the most assuring areas for research. Radio frequency identification technology has moved from uncertainty into mainstream applications boosting up the handling of manufactured goods and materials. The primary RFID system consists of three components: Tag, Reader, and Backend Application. The tag comprises of a microchip and antenna which is allocated a unique serial number to identify the object and can also store information such as incorporating the name of the Airlines, flight number, bag nature and mobile number of the passenger. The tag is passive and receives both information and energy to work from RF signal. The tag specification is conducted in the UHF range because UHF operates well in the dry non-metallic environment and is mostly used in aviation baggage application.

RFID facilitates identification from a distance, and not like earlier bar-code technology, it does so without any need for a line of sight. RFID tags sustain a larger set of unique IDs than bar codes and can include additional data such as manufacturer, product type, and even measure environmental factors such as temperature. RFID systems can recognize many different tags positioned in the same common area without human assistance. In contrast, consider a supermarket checkout counter, where you need to orient each bar-coded item towards a reader before it is scanned. The RFID technology is being promising not only in supply chain management but also in the aviation logistics industry. It renders a significant improvement in efficiency and security over the barcode that is used in most airports throughout the world. About 10% of the mishandled baggage result from poor barcode read rates. One initiative in the framework of (International Air Transport Association) IATA's Baggage Improvement Program was to assess the potential of passive UHF RFID technology to replace barcodes and reduce mishandlings. Passive RFID is of concern because the tags don't require batteries or maintenance. The tags also have an unlimited operational life and are small enough to fit into a functional adhesive label. RFID collects data wirelessly as the tags are read by the reader, the received data is to be processed and controlled remotely.

The use of RFID brought good results, hardly 1 out of 1000 baggage were lost due to improper input data, but along with these benefits, RFID has some problems such as weak safety function and risk via device/tag damage. This is why Airports use RFID for customs clearance or terminal only, some airlines use RFID for their domestic flights. This paper proposes a cloud-based air baggage tracking system for reducing the cost and improving convenience [1].

II. OVERVIEW OF THE SYSTEM

In this section, we review the data found by study and research that is crucial and have an essential value in the contribution of the whole paper. It also gives some basic information or intellectual base and is used as a framework to successfully attain the main objectives. The RFID is not only a feasible and inexpensive candidate for everyday object identification but it is also acknowledged as a notable tool to render traceable visibility along various stages of the aviation supply chain. In the airport baggage handling application, the RFID tags are used to enhance the ability for baggage tracking, dispatching and transmission so as to improve the management performance and the user's satisfaction.

2.1. RFID Description

The RFID system is used to record and trace the movement of a luggage at the airport through radio frequency communication. This system consists of two parts: the reader and the transponder. The latter is also known as the tag. It is composed of an antenna and a silicon microchip. It has a unique identification number and carries data. This data represents the private information of the passenger or an identity code that is stored in binary format. Tags can be either passive or active. The proposed system uses passive tags due to their extensive use and cheap price. These tags do not have a power source instead they get power from the incident electromagnetic field. The tag reader is capable of powering and communicating with a tag. The tag antenna captures the energy and transfers the tag's ID (the tag's chip coordinates this process). The encapsulation sustains the tag's integrity and shields the antenna and chip from environmental conditions or reagents. When the tag is in the RF field, it draws the power and transmits the stored information in the memory. In this way, the tag transmits the traveller's information to the reader. Then, the reader transforms the reflected waves sent by the tag into digital data for computer processing. Once the data is processed, the database system sends relevant messages to the passengers.

2.2. GSM Technology

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services.

GSM Modem: This GSM Modem accepts any GSM network operator SIM card and acts similar to a mobile phone with its own unique phone number. The advantage of using this modem will be that one can use its RS232 port to communicate and produce embedded applications. Applications such as SMS Control, data transfer, remote control, and logging can easily be developed. The modem can either be connected to PC serial port directly or to any microcontroller. It can send and receive SMS or make/receive voice calls. It can also be used in the GPRS mode to connect to the internet and do many applications for data logging and control. In the GPRS mode, one can also connect to any remote FTP server and upload files for data logging. This GSM modem is a highly adaptable plug and plays quad-band GSM modem for direct and easy integration to RS232 applications.

2.3. Node MCU:

Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.[6] The term "NodeMCU" by default is referred to the firmware rather than the dev kits. The ESP8266, created and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (wifi), and even a modernized operating system and SDK. When purchased in bulk, the ESP8266 chip cost is only $2 USD a piece. Which makes it an excellent choice for IoT projects of all kinds.

The Node MCU project intends to simplify ESP8266 development. It has two key components:

1. An open source ESP8266 firmware that is built on top of the chip manufacturer's proprietary SDK. The firmware provides a modest programming environment based on eLua (Embedded Lua), which is a very simple and agile scripting language with an accepted developer community.

2. A DEVKIT board that consolidates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, wifi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can be plugged into a breadboard [2][3][4].

III.IMPLEMENTATION

3.1 Process on arrival at the Airport

This RFID and IoT system at Airports uses UHF RFID passive tags for storing data and identifying baggage.

a. Input and Registration of Information

When passengers arrive at the Airport they first head to the check-in section to deliver their luggage (Fig 1). At check-in section, the data of each and every passenger is taken and stored in information bank (server). The server consists of 4 important items including the name of the Airline, flight number, baggage nature and mobile number of the passenger along with the identification number which is unique to each person. This identification number is stored in the memory of the RFID tag along with the other details of the passenger for any further investigation and referral to the information about the person and their luggage. The same identification number is sent to the passenger through SMS. After completing all the security protocols the baggage is headed to the conveyor belt for further handling [5][6].

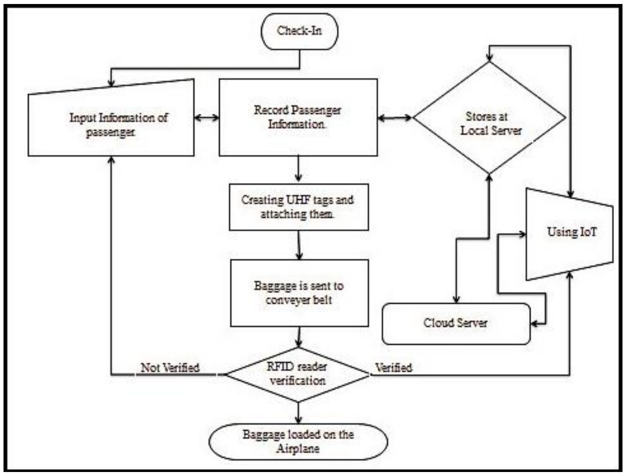

Fig 1. Design for check –in

3.2 The process at the Destination Airport

- Baggage Sorting

After the passengers arrive at their destination and the baggage is ready for offloading, they are passed through the RFID readers, the Identification number of the MR6011 tags read by the readers are stored in the local Server of Destination Airport, which confirms the offloading of baggage at the destination Airport (Fig 2). The baggage is passed through a gate including four RFID readers on the conveyer belt and concurrently will inform the passenger that the baggage has arrived at the airport via SMS [8].

- Conforming Baggage and handing it over to Passenger using IoT

When the passenger reaches the counter, he will have to enter the unique identification number received by him on his mobile on the keyboard installed at the counter gate. Now, the identification number is read by the reader they will try to match the data related to the Identification number on the RFID tag and entered by the passenger, which was already uploaded on the main cloud server by the Arrival Airport. Further, the process of sorting will occur. As soon as the entered identification number is read by the reader the push mechanism will sort the bag to the required counter by opening the gate controlled by a servo motor and the confirmation message about passenger receiving the baggage will send the message to the Server.

We have realized the prototype at 2 locations for the performance analysis of the proposed system, some people with their baggage checked in at 1 location. Since our main focus is on tag generation during check-in and reading ID and verifying the data in the cloud during check-out, the above stages are discussed in more detail[7].

When the passengers arrive at the location 1, their basic information like the number of bags, their mobile number, the serial number (s) of RFID attached at each bag, destination, the identification code is stored on a local server. The passengers are provided with a unique identification code under which the details of all their bags were stored and which they need to claim all their baggage once they reach the destination (or else they can also use the SMS containing Identification number) [9].

The information about passengers is stored on a local server and is uploaded to a cloud in which the server's of location 2 is connected with the help of IoT. When the baggage was ready to be loaded on an airplane it is passed through RFID readers, the readers read that particular serial number and send it to the Raspberry Pi via Ethernet; Raspberry Pi sends it to the local server which will note that the baggage is loaded. If the serial number is not read by the readers then the baggage is sent back to the starting point and checked for any problems.

After the passengers arrive at their destination (location 2), their baggage is loaded on the conveyer belt which will keep rotating the baggage until someone calls for it. The passengers will get a unique identification code when they give their baggage during boarding which will be sent in the form of SMS. The conveyer belt will have four gates (counters) for collecting the baggage. The passengers can go at one of the gates and enter the identification code given to them on the keypad placed on the gate.

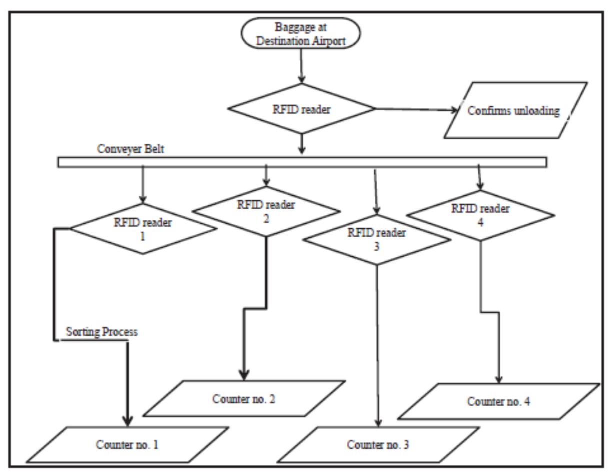

Fig 2. Design for check-out

An independent reader is installed on each gate, as soon as the passenger enters his identification code the identification code will go to the server where it will check the number of baggage and their serial number under that particular identification number entered by the passenger. The serial number(s) will then be sent to the reader and the reader will sort out the bags of that particular serial numbers accordingly. When the serial number(s) of the baggage is detected by the reader, the servo motor opens the gate and a push mechanism installed on conveyer belt pushes the baggage out of the gate. This functioning is achieved with the help of Raspberry Pi. The baggage of a passenger is thus separated from the other baggage on the conveyer belt. In this way, the passenger gets greater accessibility to retrieve his baggage as he needs to enter only 1 code on the keypad [10][11].

IV.CONCLUSION

With the aim of providing stable and effective services to passengers, the introduction of integrated RFID tags along with Cloud technology in the aviation industry will definitely prove to be a boon for baggage handling and tracking. As it is seen that in the 21st century, the high security of luggage is of a big issue in airlines industry due to repeated loosing, delay and stolen baggage of passengers. The proposed system focuses on design to develop a working model of a baggage handling system using RFID tag and Cloud technology which will track baggage, help in locating baggage, alert staff if baggage not loaded rightly and change the flight itinerary on the tag. The major advantage of this system is that it consumes less time as the passengers are not supposed to wait for their baggage to turn up on the conveyer belt instead they are routed to different counters which assure high security due to the unique identification number. Experimental tests in a lab environment shows that the reading score of the proposed tag is 100% when the suitcases are sliding on a conveyor belt in front of two approved RFID antennas, even when suitcases are loaded with travel items and the wall containing the tag is facing down, in the bottom of a two-suitcase stack. It is environment-friendly, as it is paperless, no printing and papers are needed which is a very significant issue currently in the airline's industry. Hence, with the proposed design we tend to make the air travel more passenger-friendly, less time utilizing, hassle free, with less queuing and greater security of the passenger.

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