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Smart Airport Baggage Tracing and luggage handling system using IOT and Cloud Computing

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ABSTRACT – The internet of Things is a concept that not only has the potential to impact how we live but also how we work. The new rule for the future is going to be, "Anything that can be connected, will be connected." The reality is that the IoT allows virtually endless opportunities and connections to take place, many of which we can't even think of or fully understand the impact of today. As the people travel, during times of international transit, there is always some issues pertaining to mishandling of luggage system. In this paper we propose an efficient way to automate the way baggage are handled in airports. The proposed architecture focuses more on the smart tag based tracking of the passenger baggage and smarter process of check-in and check- out. Furthermore an application is integrated with our hardware tag, which help the passenger to track the location of the bag as the bag moves away from the owner. We also discussed the advantages of the proposed system.

IndexTerms–InternetofThings,Smart tag,BaggageTracing, mishandling of luggage

I. INTRODUCTION

The "Internet of things" (IoT) is becoming an increasingly growing topic of conversation both in the workplace and outside of it. The Internet of things (IoT) is the inter- networking of physical devices, vehicles (also referred to as "connecteddevices"and"smartdevices"),buildings,and other items—embedded with electronics, software, sensors, actuators,andnetworkconnectivitythatenabletheseobjectsto collect and exchange data.

In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society." The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced humanintervention.

The most common Loop holes experienced in Aviation industry for Baggage Handling are mislaid baggage, lost baggage and damage to belongings. So, for providing a better andsecuresystemtothepassengers,wehaveproposeda design ofbaggagetracingandhandlingsystemusingsmarttags and IoT which is based on cloudserver.

1.1. Existing techniques of baggage tracing in airports

Airportsareinvestingintechnologicalinnovationsandsystemsimprovementstoensurethatfewerbagsaremishandledorlost. Most commonly used technique for scanning is using barcode attached to the baggage; that aren't reusable.Airport information and technology company SITA recently announced that while passenger numbers have increased by 65.6%inthelastdecade,reportsofmishandledbagshavebeen cut in half. While that is a great improvement overall, it is still cold comfort for anyone at arrivals stuck at the airline's baggage desk reporting aproblem.

AccordingtothesameSITAreport,81.2%of mishandledbagsweredelayed,15.5%weredamagedorpilfered,and3.3%were eitherlostorstolen.Themostfuturisticdevelopmentisthenew e-Tag and e-Track system introduced by Air France-KLM in collaboration with input from their SkyTeam partner DeltaAirLines. This nifty combination of devices allows you to track your bags throughout the journey directly on your smartphone using GSM, GPS and Bluetooth technology. The e-Tag automatically updates and displays flight details and abarcode when you check-in online from home. All you have to do is drop off the bag at the terminal andgo.

As an alternative to the e-Tag and e-Track devices, Samsonite has developed the Track &

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Trace bag with e-Tag and e-Track devices already embedded, so there's less to lose.

Before we all get too excited, there are some important downsides.WhileAirFrance-KLMclaimthisisaninnovationwhichcould workforallairlines,fornownoairlinehasthesysteminplace. Though Air France-KLM's video about e-Tag and e-Track tells you to go to FlyingBlue and buy it, youcan't.

AirFrance-KLM will deploy the system to a limited group of passengers for trials before deploying the system to a larger marketsegment.Thereisnowaytopredictitssuccessattrials, nordoweknowwhatairlinesoutsideSkyTeamwilltake upthe technology once it's beenproven.AirFrance-KLM'sdecisiontomakethisadevicetied-intotheir Flying Blue frequent flyer program is also problematic. The system only activates when you check in for your flight with your Flying Blue account.

In recent years much has been done in order to track the lost bags, instead video monitoring is a way through which the areas are monitored by human beings and the suspicious bags or robbed activities are monitored. Also some of the bag monitoring techniques has been implemented in order to check the things which are present inside the bag so that they don't pose a threat to the security. Some of the techniques present. Yashar zeinly, Bart De Schutter and Hans Hellendon (2013) had presented a new strategy for control of baggage handling systems in 16th International IEEE Annual conference on Intelligent Transportation Systems. Here three main control issues in baggage handling system, routing and scheduling problem empty cart management, and line balancing are identified and a combined control approach based on model predictive control is proposed. The control approach can be formulated as a linear programming problem that can be solved efficiently, and hence can be extended to large scale handling system.Yuanxin Ouyang and Yao Hou (2008) had proposed design for baggage management in IEEE conference which uses RFID tags to enhance the ability for baggage tracking, dispatching and conveyance, so as to improve management efficiency and the users satisfaction. It uses an intelligent RFID Reader which has the ability of data disposal and provides edge savant service is presented. The prototype readers and its experiment in the airport baggage handling system are also introduced in this proposed model.Vu Thanh Le, James Zhang, and Michael (2012) proposed a paper in IEEE International conference on Systems, Man, and Cybernetics Seoul, Korea, which uses standard set of measures to assess the expected performance of a baggage handling system through discrete event simulation. These evaluation methods also have application in the study of general network systems. Application of these methods reveal operational characteristics of the studied Baggage Handling System, in terms of metrics such as peak throughput, in-system time and system recovery time.P.R Wankhede (2016) had proposed a design of baggage tracing and handling system in International conference on Computing, Analytics and Security Trends (CAST) Pune, India, which uses smart RFID and IoT which is based on cloud server. It has a designed prototype at two locations having both check-in and check-out processes. Amore secured algorithm is used for generating tags that are attached to printed baggage label with the details of passenger and airline stored in it and RFID Readers in the check-out areas facilitate step tracking of baggage which prevent baggage loss. The proposed system ensures less consumption of time, security for baggage.

1.2 Improvement and problems in existingsystems

Of the seven reasons SITA listed for why your bags may be delayed,transfermish and lingisnumberoneat45%.Failureto load comes in second at 16%. Ticketing errors, bag switch, securityholds,andotherfactorsaccountfor15%ofallde layed bagsworldwide.

VisitorsatthePassengerTerminalExpoinBarcelonala stweek were treated to a peek of the best solutions entering themarket to keep these mishandled bag numbers low, and ensure they keep gettingsmaller.

We've ranked the top three according to their direct relationto existing baggage handling issues which most contribute to those 6.96 per thousand passenger bags which were mishandled in2013.

1.2.1 Bag JourneyApplications

Self-service drop-off of luggage is a great time saver and passenger experience enhancement, but no matter who checks the luggage in, success still depends on how it comes out.

The Bag Journey software solution by event host SITA can contribute to system-wide improvements; with end-to-end baggage tracking status updates to the systems of airlines and airports, including smartphone and tablet apps used by operations staff. While a number of firms offer baggage management software solutions, SITA is still at the lead of aviation communications and IT application services.

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1.2.2 Baggage Handling SystemsUpgrades

Software and apps are great, but bags still need to be moved fromthecheck-indesktotheaircraftholdandbackthroughthe arrival's airport's baggage handling system before they reach their owner again at arrivals.

1.2.3 Smart BagTags

Let's face it, losing control of your valuables is one the most angst-inducingelementsofair-travel.Nomatterwhatsoftware operations systems are in place to track and control activities behind the scenes, or how automated the baggage handling systems installed at the terminal, we still need individual assurance that the luggage we check will come out the same way it went in, on time, everytime.

Eliminating baggage mishandling altogether may be near impossible, though some travel regionsaregettingprettyclose. In the meantime, smart tag innovations go a long way to improving theprocess.

Figure 1 Smart tag and software simulation

This smart tag transmits an encoded location obtained from GPS to interrogatethetag. Thesmarttagreceives themessageandthen responds with its identification and other information. This may be only a unique tag serial number given with the bag, or may be a geographical location of the bag, terminal the passenger needs to collect his/her luggage, or other specific information. Since tags have individual serial numbers, thesystem design can discriminate among several tags that might be within the range.

Figure 2 Smart tag Components

II. PROPOSEDARCHITECHTURE

Smart tag have its place in a group of technologies referred to as Automatic Identification and Data Capture (AIDC). AIDC methods automatically identify objects, collect data about them, and write those data directly into computer systemswith littleornohumanintrusion.Our Cloud computingmethodsutilizeand scan open networks toaccomplishthis.SomeThereaderconsistsoftheGPS module, control unit, and coupling element to interrogate tags. It has a secondary interface to communicate with backend systems for the transmission of the information stored in tags. The backend applications not only aggregate, filter,and calculatethe data gathered by smart tagsbutcanprocess the dynamic product data (e.g. geographical location, history, terminal details for bag collecting, navigation in regional languages and current analysis). The tag also virtually creates a remote database which travels with the item by making use of communication to exchange data between tags and backendapplications.

We have designed a prototype at two locations having both check-inandcheck-outprocesses.Amoresecuredalgorithmis used for generating tags that are attached to printed baggage labelwiththedetailsofpassengerandairlinestoredinit. Smart tags in the check-out areas facilitate step tracking of baggagewhichpreventsbaggageloss.Thebaggage'sre altime position is tracked and stored in a cloud using IoT and unique ID can be retrieved by the passengers wherever and whenever necessary. The same ID can be used while collecting bag at check-out counters. The system provided ensures less consumption of time, security for baggage and is economical hence provides customersatisfaction.

We will discuss in detail about the application modules and check-in and check-out process.

2.1 Detailed description of thearchitecture:

2.1.1 Process on arrival at theAirport.

- Input and Registration ofInformation:

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At check-in section, the information of each and every passenger is taken and stored in information bank (server). The information bank consists of four important items including the name of the Airline, flight number, bag nature and mobile number of the passenger along with the identification number which is peculiar to each person. This identification number is stored in the memory of the 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 or via whatsapp in order to keep itpersonal.

- Control System of Baggage Handling(CSBH):

Afterthemakingoftagsandstickingthemonbaggage,it is passed through a gate. All the baggage is passed through EDS (Electronic Data System) to observe their content and sort them according to their flight number. The baggage is then loaded to the respective flights and for conforming that the baggage is being loaded on the flight, baggage is again passed through security at the time of loading and the information is stored at the localserver.

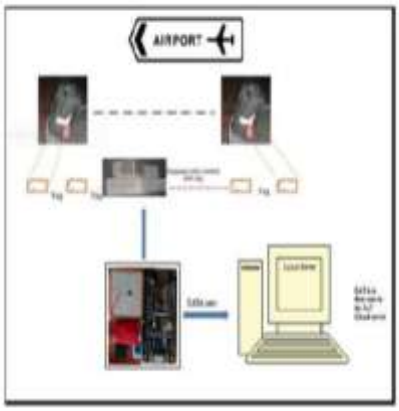

Figure 3 Architecture Diagram

Figure 4 Methodology

- BaggageSorting:

Afterthepassengersarriveattheirdestination andthebaggage is ready for offloading they are passed the Identification number of the MR6011 tags read by thereadersarestoredinthelocalServerofDestinationAirport, which confirms the offloading of baggage at the destination Airport. The baggage is passed through a gate on the conveyer belt and simultaneously will inform the passenger that the baggage is arrived at the airport throughSMS.

- Conforming Baggage and handing it over to Passenger usingIoT:

When the passenger reaches the counter he will have to enter the unique identificationnumberreceivedbyhimonhismobile on the keyboard installed at the counter gate. Now, the identification number is read by the reader they will try to match the information related to the Identification number on our smart tagandenteredbythepassenger,whichwasalready uploaded on the main cloud server by the Arrival Airport.
Furthertheprocessofsortingwilloccur.Assoonasthee ntered identification number is read bythereaderthepushmechanism will sort the bag to the required counter by opening the gate controlled by servo motor and the confirmation messageabout passenger receiving the baggage will send the message to the Server.

2.2. Procedure atcheck-in:

When the passengers arrived at the location 1 their basic information like number of bags, their mobile number, the serial number (s) of each bag, destination, identification code was stored onalocalsever.Theinformation about passengers was stored on local server and was uploaded to a cloud in which the server of location 2 is connected with the help of IoT. When the baggage was ready to be loaded on airplane it was passed through security, the readers read that particular serial number and sent it to the Raspberry Pivia Ethernet; Raspberry Pi sends it to local server which will note that the baggage wasloaded.

2.3. Procedure atcheck-out:

After the passengers arrived at their destination (location 2) their baggage was loaded on the conveyerbelt,whichwillkeep on rotating the baggage until someone calls for it. The passengers will receive a unique identification code whenthey give their luggage during boarding which will be sent in the form of SMS or whatsapp. Passenger enters his identification code the identification code

will go to server where it will check the number of baggage and their serial number under that identification number entered by passenger, the serialnumber(s) will then be sent to the reader and the reader will sort out the bags of that serial numbers accordingly. When the serial number(s)ofthebaggageisdetectedbyreadertheservo motor opens the gate andapushmechanisminstalledonconveyerbelt pushes the baggage out of the gate, this functioning will be achieved with the help ofArduino.

2.2 Implementationplatforms:

- Node MCU Amica module
- Neo-M8N GPS module
- Battery(9V or LiPo 2S)
- Arduino kit and software
- Readers connected viaEthernet
- Cloud-based server
- SMSgateway

Advantages Of Proposedarchitecture

- Our technology can be used for tracking products or productidentification
- Does not require line of sight to read thetag
- It has a longer read range than barcodereader
- Tags can store more data than bar codes.
- Readers can simultaneously communicate with multiple tags
- This feature could allow customers to breeze through grocery store checkout counters while a reader identifies all.

III. CONCLUSION

Through this proposed system, passenger could get better security,reduce baggagelossandmishandling toa greatextent and every baggage will be delivered on time. And because of the counters created passengers got distributed into groups which will also decrease the time consumed atcheck-out.

Themainadvantageofthesystemisthatitcons umeslesstime as the passengers don't have to wait for their baggage to turn up on the conveyer belt instead they are routed to different counters and ensures high security due to the unique identification number. It is following the current trend as it is environment friendly, as it is paperless, no printing and paper are needed which is a very important issue currently in the aviation industry. With this design we tend to make the air travel more customers friendly, less time consuming, hassle free, with less queuing and greater security of thepassenger.

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