Software Requirements Specification

for

Luggage Tracking Application

Version 1.1

Prepared by

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Revisions

Version	Primary Author(s)	Description of Version	Date Completed
Version 1.0	Tam Bui Vadim Goncharuk Binh Hue Hua Leah Ruisenor Norris Spencer	Initial Document Draft	11/01/17
Version 1.1	Tam Bui Vadim Goncharuk Binh Hue Hua Leah Ruisenor Norris Spencer	Version update to match creation of Software Design Specification document	11/20/17

1   Introduction

Universal RFID Inc. has tasked our group, Lüg-er, to create a passenger application that will allow the passenger to effortlessly track the physical location of their baggage. This application will take advantage of the existing tracking system emplaced in airports and aircraft that utilizes RFID technology.

The goal is to provide the passenger with a peace of mind that airline passengers have historically not been able to enjoy. Lüg-er intends to make the interface as user-friendly as possible and, in the process, alleviate a major concern for airline passengers, lost baggage.

1.1   Document Purpose

This document addresses the requirements of the Lüg-er Baggage Tracking Application system for Universal RFID Inc. At the time of the release of the latest version of this document (see revisions), it contains the whole of the requirements for the application.

1.2   Product Scope

Lüg-er's Baggage Tracking Application will allow the user to track their baggage using RFID technology from the point the bag is dropped off with the baggage attendant at the departure airport to the baggage pickup at the final destination. Through the networking of databases between various airports and airlines, as well as Google Maps, the application will relieve stress for the stakeholders concerned in ensuring that baggage arrives with the passenger.

1.3   Intended Audience and Document Overview

This document is intended for Universal RFID Inc. interested investment stakeholders to include software developers, hardware engineers, and other interested parties. Additionally, in the realm of the study of this subject, Dr. Eyhab Al-Masri and personnel deemed by him to be interested are targeted audience members as well.

What follows is a synopsis of the information gathered to assist the stakeholders and interested parties in designing the application as efficiently as possible. The table of contents is the point of reference for the organization of this document and should be referenced for information needed by interested parties.

1.4   Definitions, Acronyms and Abbreviations

The following are terms and abbreviations contained in this document:
- API: Application Programing Interface
- FTP: File Transfer Protocol
- GPS: Global Positioning System
- HTTP: Hypertext Transfer Protocol
- IEEE: Institute of Electrical and Electronic Engineers
- ISP: Internet Service Provider
- Lüg-er: The name of the group tasked by Universal RFID Inc. to design the application

- PII: Personally Identifiable Information
- RFID: Radio Frequency Identification

1.5 Document Conventions

- This document follows IEEE formatting requirements.
- Any reference to the application that is being directly developed by Lüg-er under the direction of Universal RFID Inc. is to be considered the Lüg-er application.

1.6 References and Acknowledgments

Google API terms of service, https://developers.google.com/maps/terms for details Date Last Accessed October 30, 2017

"RFID Systems | RFID Hardware." GAO RFID Inc., gaorfid.com/. Date Last Accessed October 30, 2017

Walker, Alissa. "Why the Hell Is Delta Spending $50 Million on Bag-Tracking Technology?" Gizmodo, Gizmodo.com, 2 May 2016, gizmodo.com/why-the-hell-is-delta-spending-50-million-on-bag-track-1774327898. Date Last Accessed October 30, 2017

"Delta introduces innovative baggage tracking process." Delta News Hub, news.delta.com/delta-introduces-innovative-baggage-tracking-process-0. Date Last Accessed October 30, 2017

2 Overall Description

2.1 Product Perspective

This new application is intended to be operated by the passenger (primarily airline passengers) in maintaining visibility of their baggage. It is intended to augment the existing tracking system emplaced in airports and aircrafts that utilizes RFID technology. While the passenger is the primary focus of this application, there are numerous behind the scenes operations that must work smoothly for the application to work properly. Everything from the RFID tag itself, to the hand scanners that input the tag information into the database and antennas that read the location of the tag, to the database of both the Airport and the Google Maps system is fundamental in ensuring that this application functions smoothly. Any interruption in any aspect of this application will prevent the passenger from being able to effectively track their baggage.

The following is a simple diagram to illustrate the interconnected relations between the components of the system:
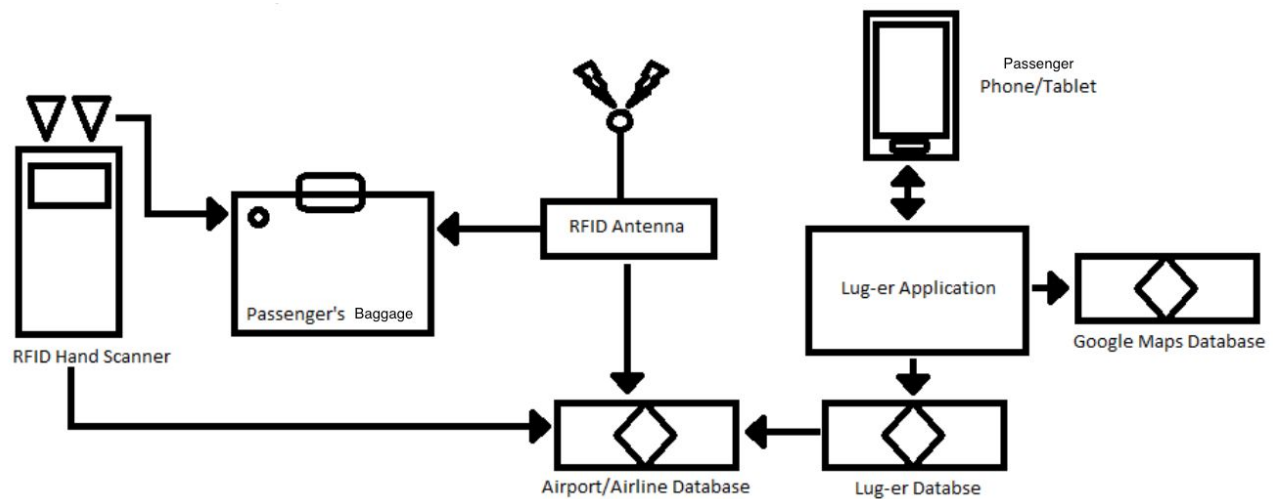
figure 1.2.1 System Relationship Diagram

2.2 Product Functionality

This application is designed to allow the passenger to be able to track the physical location of their baggage at any given time. Through the use of installed RFID antennas within airports and aircraft, the associated airport databases, as well as the interaction with the Google Maps database, this program will prevent the mishandling of passenger baggage. The user interface will be simplistic in design and will allow for quick access to desired information.

The Lüg-er database will maintain a repository of passenger information to enable passengers to create/modify and login to their account. This information will be used to validate against the airline database to ensure that the proper baggage is displayed for the passenger using the application. The collected information from the airline database is used in conjunction with the Google Maps API to display a map that will provide the passenger with a relative position of their baggage to their own location. This way, a passenger is able to track his/her baggage in real-time.

2.3 Users and Target Markets

Type	Description	Examples
Passenger	Mass consumer market	U.S. Airline Passenger for continental flight.

figure 1.2.3 User and Target Market Table

2.4 Stakeholders

Passenger	U.S. Airline Passengers.
Product Team	A design team, developer team, and tester team. A team of developers including software engineers and maintainers. Design team include user experience designers and graphic designers.
Marketer	A team of marketers promoting the end application.
Management	Universal RFID Inc. board, Eyhab Al-Masri
Google Maps	Database access.
Airlines	Major airlines in the United States.
Airports	Airports higher than regional level in the United States.

figure 1.2.4 Stakeholders Table

2.5 Operating Environment

Hardware platform:
- Phone/tablet (IOS/Android) displays the baggage location for passengers.
- RFID tags broadcast long range to RFID readers continuously to update baggage(s) location.
- RFID reader which can read RFID tags from 10 centimeters to 100+ meter away to meet the demands of the business environment.
- RFID Antennas work together with RFID readers to read RFID tags

Software:
- Data will be retrieved from RFID reader using Java language.
- The Application will take RFID data along with the Google Maps data which will then display the location of the baggage.
- GPS Google Maps which will be a cooperative database to support location information.
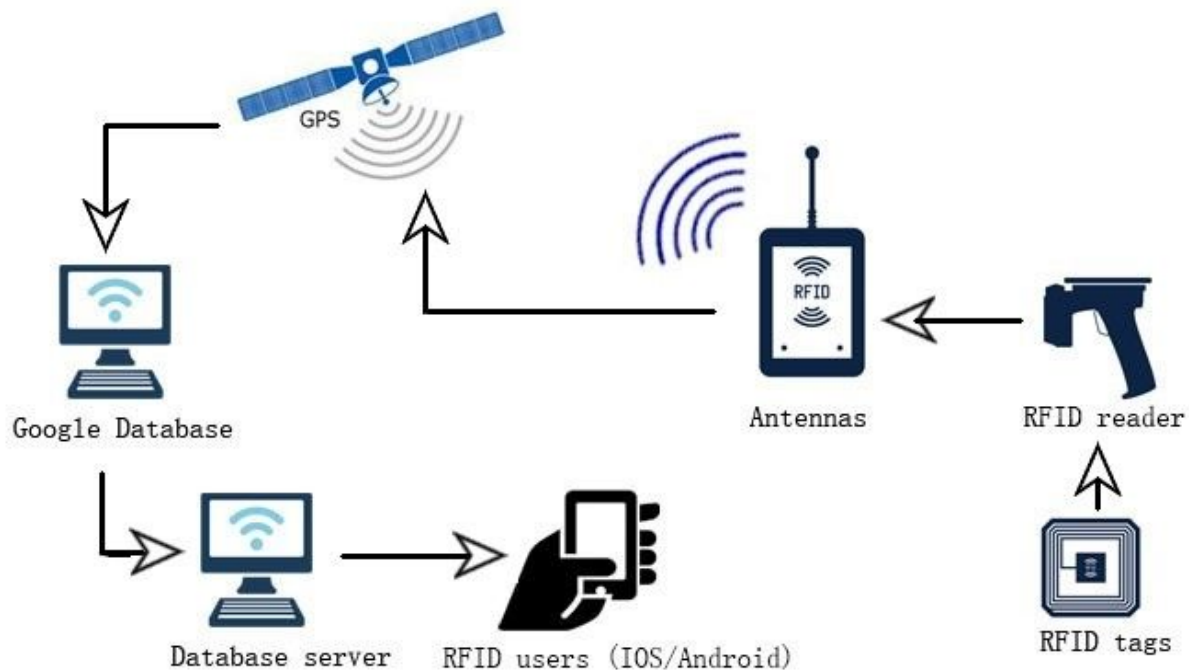
figure 1.2.5 Operating Environment Diagram

2.6 Design and Implementation Constraints

- The Lüg-er application must have access to the airline database to retrieve the flight data relevant to this application.
- This Lüg-er application must have access to the airline RFID tag numbers that are associated with the passenger's baggage.
- The RFID data must be encrypted to ensure the secure transfer of sensitive RFID information.
- The Lüg-er application must have a secure server to store and protect the passenger PII.
- This Lüg-er application will be running in parallel to Google Maps database to ensure real-time tracking.
- The hardware/software of the airport/airline tracking system must be up-to-date.
- The Lüg-er application must include functional RFID handheld readers.
- The Lüg-er application must include functional RFID antennas.
- The passenger's baggage must include functional RFID tags.
- The language requirements include Java 9.0.

2.7 User Documentation

Passengers can access the tutorial through Lüg-er "Help" options in the application. Also, the passenger can contact customer support via email and phone for help with application set-up and technical support relating to the application. In addition, there will be tutorials to help the passenger get familiar with the Lüg-er application. A manual will be provided for airlines' employees.

2.8 Business Requirements

- The Lüg-er application must provide an affordable method to baggage tracking to airline passengers.
- The first version of Lüg-er must be brought to the market within one year of the development project launch.
- Lüg-er must ensure that account management database is maintained at a 98% minimum annual operational status.
- Lüg-er must generate a 20% profit margin from ad revenue.

2.9 Assumptions and Dependencies

- The assumptions that can affect the requirements stated in document involve the use and access of third-party databases and APIs.
- This application will need to have access to its own database in conjunction with access to the airline/airport database and Google Maps database.
- It is assumed that all airports will have RFID hand scanners, RFID antennas and a database that stores the given position of a bag at any given time.
- It is assumed that airplanes will also have RFID antennas installed. The airplane antennas will allow for tracking of baggage away from the airport's fixed antennas.
- It is assumed that all passenger baggage is manufactured with RFID tags.
- It is assumed that the baggage handler will have an RFID reader that can scan the RFID tag of the given bag when the passenger is checking in. The RFID number will be connected to the passenger's flight information which will then be part of the airport/airline database.
- To be able to display this location of the RFID tag (passenger baggage), the application must have access to and take advantage of the Google Maps API. This information, combined with the airport database, will display the passenger's current location and the location of the RFID tag (passenger baggage).
- It is assumed that the Airport database will store and process lost baggage requests.

3 Specific Requirements

3.1 External Interface Requirements

3.1.1 User Interfaces

The following are sample images of the application that the passenger will see and a brief description of each aspect of the given page:
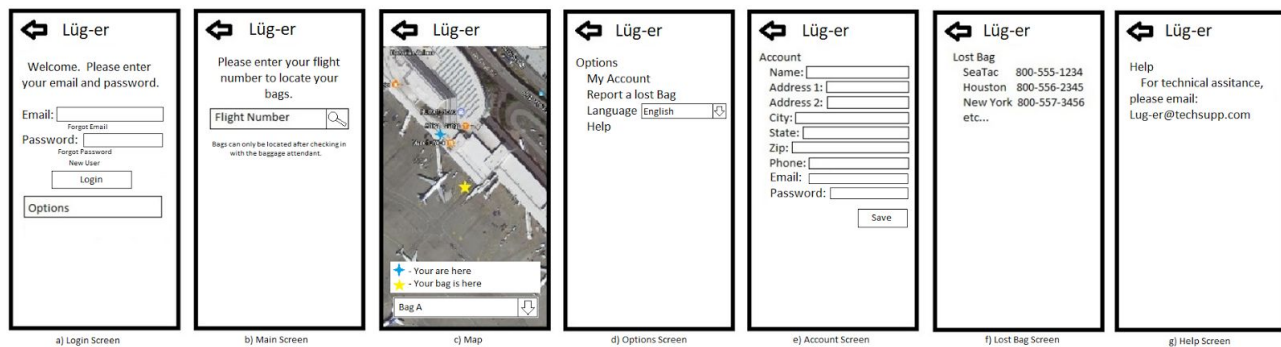

figure 1.3.1 User Interface Sample Screenshots

A. Login Screen
- a. Email: Allocated space to enter user's email address.
- b. Password: Allocated space to enter user's password.
- c. Options: Selectable button that opens the Options screen.
- d. Forgot Email: Selectable link to recover email address.
- e. Forgot Password: Selectable link to recover password.
- f. New User: Selectable link to create new user account.
- g. Login: Executes the login.

B. Main Screen:
- a. Flight Number: allocated space to enter a flight number.

C. Map: Displays the Google Maps image.

D. Options Screen
- a. My Account: Selectable button to access user's account information
- b. Lost Bag: Selectable button that will open a screen listing airports related to departure and destination.
- c. Language: Selectable button the provides drop down box to choose from supported languages.
- d. Help: Selectable button that opens a help screen which provides user with information on how to contact technical support for this application.

E. MyAccount: The information in this screen is all allocated spaces to collect the passenger's PII.
- a. Name
- b. Address 1
- c. Address 2

  d. City
  e. State
  f. Zip Code
  g. Phone
  h. Email: This information is used in conjunction with the password to validate the passenger's account login. It must be verified before the passenger can access the application.
  i. Password: Used in conjunction with the passenger's email address to validate account login.
  j. Save: Saves the entered information for the user.

F. Lost Bag Screen:
  a. Sends a lost bag report to both the departure and destination airline database and lists the contact information for the lost baggage handlers at these airports.

G. Help Screen:
  a. Lists the contact information for the application's technical support team.

3.1.2 Hardware Interfaces

- The passenger's information will be transferred and held into the applications secured server's database.
- Once a passenger account is created, the account will then be able to communicate with the airline server database to retrieve the unique RFID tag information assigned to that flight when the passenger checks in.
- The RFID tags emit a radio signal that matches the baggage that it has been assigned to.
- A private mesh reader network will monitor and track the location of the RFID tag inside of the pre-defined area.
- The pre-defined baggage tracking area will be determined by the airport RFID system standards.
- The RFID readers will be installed throughout the airport terminal, hangar, and on the tarmac.
- The scanners will actively scan for RFID tags while tracking the location of the RFID tags.
- The passenger's mobile device must have the appropriate amount of memory to download and run the software.

3.1.3 Software Interfaces

- The data that will be shared to the software from the airline server must include flight number, name of passenger, RFID tag number, and the location of the RFID tag.
- The application will also connect to the server to send and receive the passenger information to be stored in the database.
- The passenger's information will include: name, email, password, addresses, and phone number.
- The application will run on a mobile device such as a phone or tablet that have a connection to the internet.
- The application will receive the map data and then will combine the RFID tag and GPS location of the baggage and the user on the screen.

3.1.4 Communications Interfaces

- The application will use HTTP/FTP protocol for communicating to the airline server database, application server database, and the Google Maps server.
- All application server communication must be encrypted.
- Data transfer rates will conform to the industry standard.
- The message formatting will be in the form of an email.
- The passenger will be emailed update information, account information and terms and condition changes.

3.2 Functional Requirements

Continuing from section 2.2 the following are specifics classes and functions of this application:

User Account:

1. The Lüg-er application must allow the passenger to reset their password.
2. The Lüg-er application must allow the passenger to create a new account.
3. The Lüg-er application must send the passenger a link to reset the password.
4. The new account must ask for the passenger name, addresses, phone number, email, and password.
5. The Lüg-er application must compare the entered email address to those in the database to ensure that it is not already entered.
6. Before a new account is created, the passenger email must be verified.
7. The passenger must enter email and password to be able to log in.
   7(a). If login information entered is correct, the application should display the Main Screen.
   7(b). If login information entered is incorrect, the application should display a message regarding the mismatch information.
8. The Lüg-er application must allow the user to update/change their account information
9. In the case when the user is not logged in, the application should only allow the user to access the options menu.
10. The Lüg-er application should send an email to the provided email address to allow the passenger to confirm the address.
11. The Lüg-er application must remind the user to complete the login process in order to access the tracking features.
12. The Lüg-er application should keep track of the passenger's information (name, addresses, phone number, email, and password).
13. The passenger must be able to log out.

Baggage(s) Tracking

14. The passenger must log in to track baggage(s) location.
15. The passenger must be able to search for their flight using their flight number.
16. The passenger must log in to report lost baggage(s).
17. The passenger must register their baggage(s).
18. Each baggage must be equipped with an RFID tag.
19. The Lüg-er application must allow the passenger to report lost baggage(s)
20. The passenger must be able to track of their baggage(s) throughout the entire continental flight.
21. The passenger should be able to select which baggage they want to track.
22. The passenger must be able to track all baggage.

Map

23. The Lüg-er application must show a resizable map from Google Maps API.
24. The Lüg-er application must use a four-pointed star representing user location.
25. The Lüg-er application must display stars on the map representing the passenger baggage(s) location.
26. The Lüg-er application must use color to distinguish passenger location and their baggage(s) location.

Miscellaneous

27. The Lüg-er application must have a help option for the technical support.
28. The Lüg-er application must have contact information for the technical support team.
29. The Lüg-er application must contain the appropriate contact information for lost baggage based on flight number and location.
30. Every passenger must have a valid boarding pass.

3.3 Behaviour Requirements
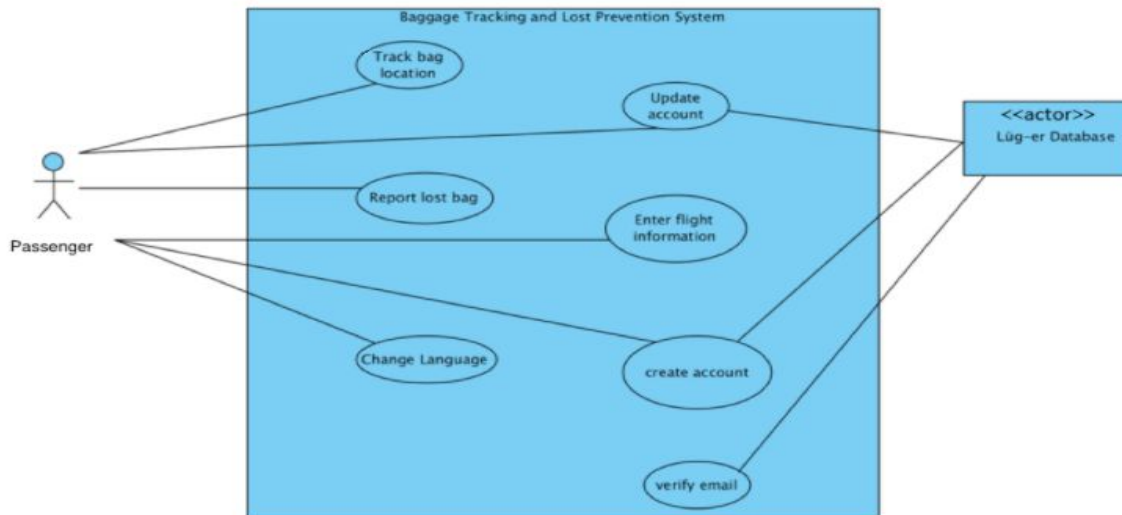
3.3.1 Use Case Diagrams/Descriptions

figure 1a.3.3 Baggage Tracking and Loss Prevention System Use Case Diagram

Use Case Name: Report Lost Bag	ID: 1	Priority: High
Primary Actor: Passenger		
Brief Description: This use case describe how the application direct and assist passenger to report lost baggage(s).		
Trigger: Passenger selects report lost bag button.		
Relationships: Association: Passenger, Airline Database Include: Extend: Generalization:		

Normal Flow of Events:
    1. Passenger selects "Report Lost Bag" option.
    2. Lüg-er database collects passenger information and flight number.		

Subflows:		
Alternate/Exceptional Flows:		

figure 1b.3.3 Report lost Baggage Use Case Description

figure 2a.3.3 Track Baggage Use Case Diagram

Use Case Name: Enter Flt number	**ID**: 1	**Priority**: High
Primary Actor: Passenger		
Brief Description: Describes how passenger enters their flight number.		
Trigger: Passenger enters flights number.		
Relationships: Association: Passenger, Airline Database Include: Extend: Generalization:		

Normal Flow of Events:
    3. Passenger navigate to main screen.
    4. Passenger enter the flight number.
    5. Passenger hit the confirm button.
    6. Application validates flight number against the Airline database.		

Subflows:		
Alternate/Exceptional Flows: 1. Exception error thrown if flight number entered by passenger does not match airport database.		

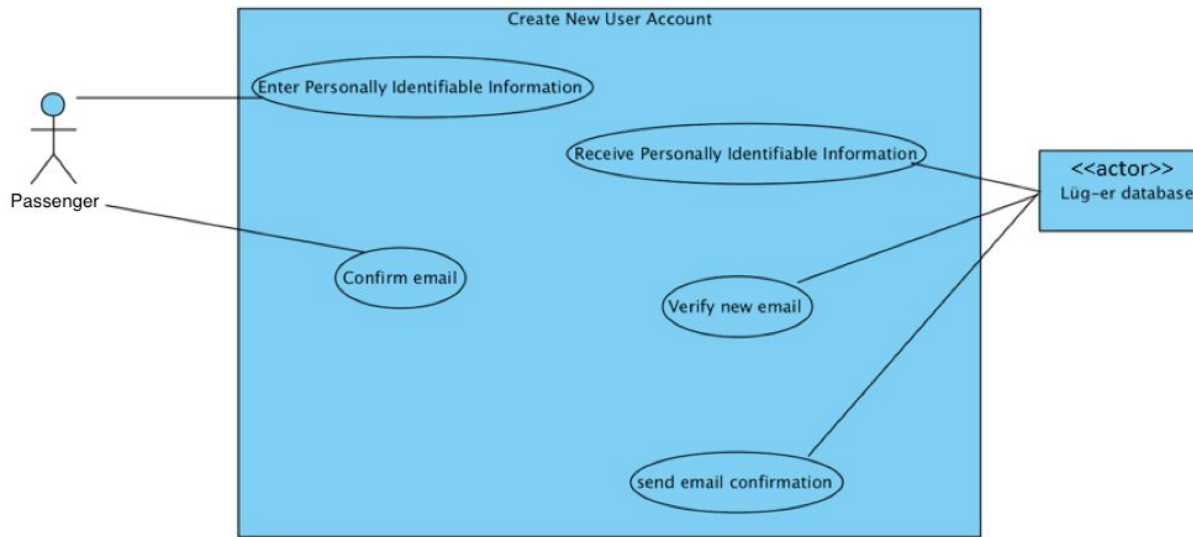*figure 2b.3.3 Enter Flight Number Use Case Diagram*

figure 3a.3.3 Create New User Account Use Case Diagram

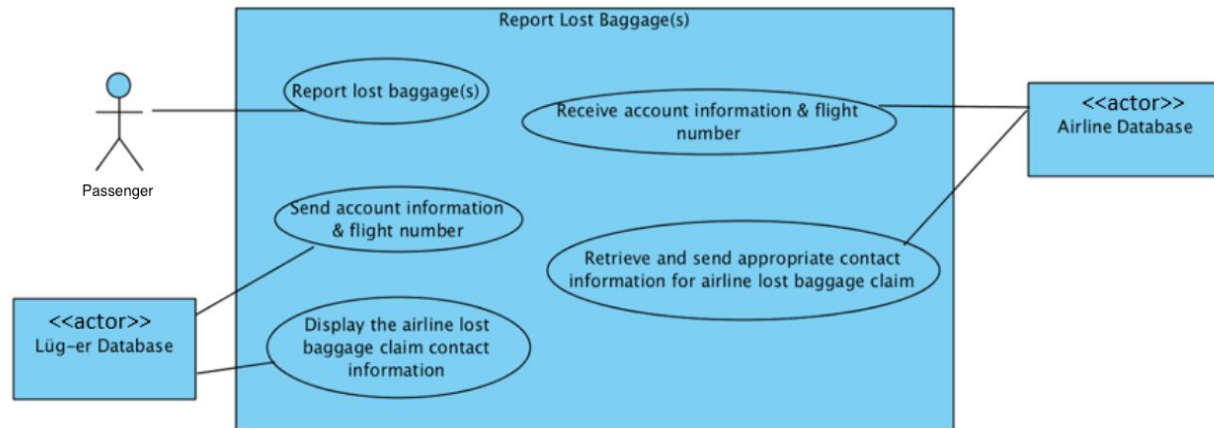| Use Case Name: Confirm email	ID: 3	Priority: High
Primary Actor: Passenger		
Brief Description: this use case describe how email was confirmed before creating a new user account.		
Trigger: Passenger check their email and confirmed the email.		
Relationships: Association: Passenger Include: Extend: Generalization:		

Normal Flow of Events:
   1. Passenger access their email
   2. Passenger confirmed the email by clicking the confirmation link.		

Subflows:		
Alternate/Exceptional Flows: 1. Passenger have not received the confirmation email. Passenger can request for a resend confirmation email.		

figure 3b.3.3 Confirm Email Use Case Description

figure 4a.3.3 Report Lost Baggage Use Case Diagram

Use Case Name: Display the airline lost baggage claim information	ID: 4	Priority: High
Primary Actor: Lüg-er Database		
Brief Description: Send account information and flight number		
Trigger: After passenger enters all lost baggage information		
Relationships: Association: Lüg-er Database, Airline Database Include Extend: Generalization:		

Normal Flow of Events:
    1.   Lüg-er database receives lost baggage flight number and passenger information.
    2.   Lüg-er database sends information the Airline Database
    3.   Lüg-er Database compares passenger information.
    4.   Airline database sends correct contact information to Luger application.
    5. Lüg-er application display the contact information for lost baggage claim for both the departure and destination airport.		

Subflows:		

Alternate/Exceptional Flows:
    1. Passenger attempts to report missing baggage with no baggage in Airline Database. The report is rejected.
    2. Passenger attempts to report missing baggage without previously entering a flight number. The passenger is asked to enter flight number.		

figure 4b.3.3 Display Lost Baggage Information Use Case Description

4 Other Non-functional Requirements

4.1 Performance Requirements

- The Lüg-er application must connect to, and use, an ISP connection to connect to database to show up-to-date information.
- The Lüg-er application must download the most recent information on baggage locations in order for the application to display information when internet access is not available.
- The Lüg-er application must update all users instantly when the baggage location is updating by the airline scanners to keep users up-to-date.
- The Lüg-er application will update the position of the passengers luggage every five minutes.

4.2 Safety and Security Requirements

- The application must provide secure tracking of baggage without allowing users access to unauthorized data
- Lüg-er application must use a secure database to protect database infrastructure.
- PII protection for active and inactive RFID signal.
- Confirmation for account log-in by verify code sending through email.

4.3 Software Quality Attributes

The application must contain the following quality characteristics.
    A. Portability
        ○ Lüg-er application must work on all up to date IOs and Android operating system and in future versions, it must work on all up- to-date browsers to ensure portability.
    B. Intuitive interface
        ○ The application is designed to be easy for all airline passengers to use, to ensure this, the application must emphasize ease of use over ease of learning.
        ○ Lüg-er must have an intuitive interface. To ensure that the application interface is intuitive, testers must be hired and observed to understand the level of ease in the interface.
        ○ The application must provide customers a method to express when a interface characteristic is difficult to understand.
        ○ The application must provide help buttons with information about the interface.
        ○ Optional surveys will be conducted with the customers to understand the level of ease in the application's interface.
    C. Maintainability
        ○ The application must be updated in order to work with work with up-to-date iOs and Android operating systems. Tracked test experiments will be conducted with to ensure that the application does not malfunction.

4.4 Business Rules

- Lüg-er must follow Google API terms of service (refer to the references for the website address that identifies these terms)
- The airline services must cooperate with the customers and ensure that their baggage is scanned.
- The customer must upload accurate information regarding their flight.
- The hardware companies responsible for providing scanners must ensure that the scanners and antennas used by the airlines are functioning properly when installed.
- The airport and airlines must ensure that their hardware is maintained and fully operational to ensure proper operation of the baggage tracking.
- Lüg-er must ensure that customer confidentiality is kept safe. Lüg-er must ensure that the information given to the customers and airlines is accurate.

5 Other Requirements

- The user must accept the terms and conditions before using the application.
- The Lüg-er application should not to be held responsible for loss of baggage.

Appendix A – Glossary

- Application Programing Interface: A set of subroutine definitions, protocols and tools for building application software.
- Figure 1.2.1 System Relationship Diagram: A simple diagram to illustrate the interconnected relations between the components of the system.
- Figure 1.2.3 User and Target Market Table: User and Target Markets.
- Figure 1.2.4 Stakeholders Table: Stakeholders.
- Figure 1.2.5 Operating Environment Diagram: shows the major components of the overall system, subsystem interconnections, and external interface.
- Figure 1.3.1 User Interface Sample Screenshots: Sample images of the application that the passenger will see and a brief description of each aspect of the given page
- Figure 1a.3.3 Baggage Tracking and Loss Prevention System use case diagram: Baggage Tracking and Loss Prevention System diagram of the interactions between the elements of this system.
- Figure 1b.3.3 Report lost Baggage Use Case Description: Representation of the sequence on how the actor will report a lost baggage to the Lüg-er database.
- Figure 2a.3.3 Track baggage use case diagram: Track baggage diagram of the interactions between the elements of this system.
- Figure 2b.3.3 Enter Flight Number Use Case Diagram: Representation of the sequence on how the actor will enter the flight number information to be transferred to the Lüg-er database and Airline database.
- Figure 3a.3.3 Create New User Account use case diagram: Create New User Account diagram of the interactions between the elements of this system.
- Figure 3b.3.3 Confirm Use Case Description: Representation of the sequence on how this use case describe how email was confirmed before creating a new user account.

- Figure 4a.3.3 Report Lost Bag Use Case Diagram: Reporting Lost Bag diagram of the interactions between the elements of this system.
- Figure 4b.3.3 Display lost baggage information Use Case Description: Representation of the sequence on how Luger database will report a lost baggage to the actor.
- FTP: is the network protocol used to transfer computer files between the client and a server on the computer network
- Global Positioning System: Global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
- HTTP: is an application protocol information systems and it is the foundation of data communication for the internet.
- Institute of Electrical and Electronic Engineers: A professional association whose objectives are the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering and allied disciplines.
- Internet Service Provider: is an organization that provides services accessing and using the Internet
- Personally Identifiable Information: this includes user name, addresses, phone number, email, password, and number of baggage.
- Radio Frequency Identification: it is a small electronic devices that consist of a small chip and an antenna.