



Capstone Project Report

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Abstract

AirBooks is an air travel data-logging app that provides airline flight crew (pilots and flight attendants) an easy and effective solution for calculating their annual per diem tax deduction allowance.

The application can automatically identify the location by using the Global Positioning Services (GPS) of the Smartphone during business trips and calculates the per Diem corresponding to that location outside the home perimeter, with the minimum user interaction; usually, the airline flight crew keeps this record manually by filling out a form.

In the airline industry, the annual unreimbursed employee expenses for per diem tax deductions usually make up 80-90% of the total tax deductions available for the flight crew member. For the airline industry, capturing per diem information in real time will allow tax preparation times in excess of 1 hour to be reduced by about 70%.

I. Introduction

Most people typically dread tax time. This is especially true in the airline industry, as confusion and uncertainty usually accompany the term “Per Diem.” Every location in the world has a different IRS designated per day tax deduction allowance for work travel. However, most employees do not understand how their unreimbursed meal and entertainment allowances accrue as an unreimbursed employee expense. They also don’t understand how it is calculated or deducted on their tax return. This generally scares and frustrates most employees during tax season.

Nowadays, smartphones are more commonly used and with the rapid advance of technology, they include more sensors and functionalities that promote the generation of new applications to facilitate the user daily activities. The main purpose of this project requested by the tax preparation company Bookmantax and approved by Dr. Raul Salazar, Ph.D. is to create the ultimate solution for business travelers to track their traveling expenses automatically with the minimum user interface in an accurate manner, to facilitate their tax report and obtain the most accurate reimbursement.

AirBooks is an application for smartphones that will use the available technology of the device, primarily the Global Positioning Services (GPS), cellular towers and mobile internet to find the current location, determine if the user is at home or not, and log the information into a database with the correct per Diem amount that corresponds to the situation, with minimum user interaction.

For the Travel Expense Management (TEM) industry, AirBooks can provide a huge amount of possibilities getting a very close approach to the Artificial Interleague (AI), due to the possible complexity of the application and its potential uses, it will be developed by different phases using the SCRUM approach being this document the report of the first phase.

II. Problem Statement

a. Problem Overview

Nowadays is very common that people have to travel for business purposes. During their travels, they have expenses such as transportation, food, lodging which they can claim in order to be reimbursed. Keeping the receipts for those expenses in order to claim them during tax season is a tedious job, as well as for the accounting personnel who have to manually enter those amounts. In order to facilitate this process, the Internal Revenue Service (IRS), has created a formula that assigns a per Diem value to almost every major city in the world, but every city has their own tax deduction allowance. Not everyone understands how these formulas work and how much of your expenses are subject to reimbursement.

In the Airline Industry, the annual unreimbursed employee expenses for per diem tax deductions usually make up 80-90% of the total tax deductions available for the flight crew members. They usually maintain a manual logging of those expenses, which is not only subject to human error but it is also a tedious labor when filing taxes, because transferring the information into the system and calculate the amount that is really subject to be reimbursed can take hours. With this process currently in place, companies with travel and expense budgets are overpaying taxes by an estimated \$2.75 Billion every year!

b. Project Scope

The AirBooks application for smartphones can provide an automated solution for many business' traveling situations and our possible target is millions of users. Due to the complexity and multiple areas to be solved, AirBooks is going to be developed by phases applying the SCRUM approach. This report will cover only the first phase of the project, which will target primarily the pilots and flight attendants market, which based on the Bureau of Labor Statistics the estimate is that there are currently 119,000 Commercial Pilots and 108,000 Flight Attendants in the US, bringing this market size to approximately 227,000 potential users for this phase only.

The first phase of AirBooks will be completed in a term of 12 weeks. And it will utilize the target customer's smartphones capabilities to discover the location by the use of the Global Positioning Services (GPS) as well as the cellular network and internet services, it will identify if the user is allowed to accrue any per diem amount and log it or discard it based on the location result with the minimum user interaction as possible.

III. Organization

a. Organization

The members of the AirBooks application are:

- Randy Perry, MSc International Accounting, University of London.
 - o CEO, Randy Perry handles all the core business roles including raising capital, accounting, sales, recruiting, networking, and the overall team management.
- Erich Von Hinken, Ph.D. Candidate Information Systems.
 - o Erich Von Hinken, as our certified scrum master, handles all of the project management and the specific team management.
- Rodrigo Escobar, BS Computer Science.
 - o Rodrigo Escobar, participate in the development process of phase one.

b. Project Stakeholders

The following is the list of the project stakeholders:

- Randy Perry – Project CEO.
- Erich Von Hinken – Project Manager.
- Rodrigo Escobar – Participant developer.
- Dr. Raul Salazar PH.D. – Project Advisor.
- Faculty Members – Nova SouthEastern University, College of Engineering and Computing.
- Future Developers.
- Business travelers / Users.
- Investors.
- Corporations.
- Tax Companies.
- Mobile Community – Android, iOS, Windows.

IV. Development process

a. Problem Overview

At the beginning of April 2016, Dr. Salazar, introduced me to Mr. Perry and Mr. Von Hinken during a meeting where they explained to me the need to create an application for smartphones to automatically log the travel expenses for business travelers.

During the meeting, we discussed the multiple options of travel expenses, such as transportation via air, land, and water. We also discussed the common capabilities of the smartphones nowadays and how we can take advantage of them in order to accomplish the purpose of the logging of the expenses based on the transportation mode.

Due to the complexity of the overall project goal, and the short time assigned to me, (twelve weeks for my capstone project), we chose the approach to create this by phases. Therefore the conclusion of the meeting was to begin with the core of the project starting with the traveling by air option, having as primary users the airline flight crew members (pilots and flight attendants) which are the most frequent business travelers.

For many years, the crew members keep manual records of their itineraries that accrued them per diem values. During the tax season, they provide the information to the accountants which have to manually calculate the per diem allowance per city and then enter the information into the system, this process can take hours and usually those values are underestimated affecting up to 80-90% of the total tax deductions available for the flight crew member.

b. Approach

After discussing the problem, I start to brainstorm the list of the minimum requirements needed to solve the problem and what resources are available to accomplish them. The primary one is to apply the knowledge I acquired during my time as a student of Computer Information Science at Nova Southeastern University (NSU), especially in the are of Mobile Development (Android), Databases, Software Engineering, and Java.

In order to be able to successfully log the trips of the user, the application will need to know which is the base airport assigned to the user and where it is located, in order to determine if the user is at home or not; because when the user is at home (75 miles radius of the base airport) it is not considered as a business trip and cannot collect any per diem value. This application will also need to have a database with multiple tables in order to keep a record of the trips, to store the allowed per diem value of the different places around the world, the airports and user information.

In order to detect the location, the date, and movement of the user, the application will require using the different sensors available in the smartphones as the GPS, the accelerometer sensor, and many other services like the calendar by the usage of the Application Programming Interface (API) provided by Google for the Android operating system.

c. General Requirements

The AirBooks application phase one will be created to be installed and used in a smartphone with Google Android operating system 5.0 or higher. The application also creates in the device storage system a database composed of four tables (user_info, airports_info, per_Diem and trip_history) in order to read and store all the information required for the application functionality. During the installation, all the application required files will be copied into the device storage system. Once the application is installed, it can be launched.

During the first launch the application will create the database including the tables and respective fields for each table; then will verify if the airports info table is empty and if it is empty, it will transfer the airports information data from a Comma Separated Values file (CSV) located inside the raw folder of the application, into the airports table. The same procedure will occur with the per_Diem table.

Once the per_Diem and airports_info tables are filled with data, the application will verify if the user info table of the database is empty or not; if it is empty, the application will redirect the user to the add User screen, where the User is forced to add the minimum information required for the application functionality, which is the base airport. The user won't be able to use the application without entering the requested information.

Due to Google restriction to activate / de-activate the GPS programmatically, the AirBooks application requires being open and the location services activated at the moment of requesting the location. In the case of the application to be closed at that moment, the alarm system will open the application automatically in order to obtain the location when the alarm goes off.

d. General Functionality

Once the user opens the installed application, a splash screen will display for 3 seconds, this is for branding purposes, then the application will verify if the user_info table of the database is empty, if it is, the user will be redirected to the addUser screen and prompted to enter the base airport, once the information is stored in the user profile, the application will redirect the user to the main menu. If the user_info table is not empty, the user will be redirected to the main menu by the application.

Once the main menu is displayed to the user, the application will create an alarm to request the current location every day at 23:55. In case the device was turn off or rebooted, the application will set the alarm again using the system intent services once the device system broadcast the reboot status BOOT_COMPLETED. This alarm process is performed internally and doesn't require any user intervention.

Once the location is acquired, the application will calculate the distance between the current location and the base airport stored under the user profile, by using the Haversine Formula ^[1]. If the distance is equal or less than 75 miles, the user is considered at home and will not accrue any per Diem value, otherwise, the per Diem will be queried for that location and then the trip will be stored in the database.

The options located in the main menu are mostly for user information such as checking the per Diem amount for the current location, to find the per Diem amount for a remote location, view

the trip history and view the total tax deduction to date accrued from recorded trips. In order to log the trips, all the user needs to do is having the device on and maintain the location services activated, GPS signal can be on while the device is in airplane mode. Then the application will do everything automatically.

We decide to create the application to be independent and to work with the minimum user interaction as possible to avoid human error and user frustrations.

In the event that the device remains off during the trip and / or no location can be obtained via GPS, Cellular Network or Data Network; the application won't be able to record the trip.

However, there is an option for the user to enter the information manually (City, Landing Date and Departing Date) and the application will calculate the per Diem amount and store the data in the trip history table.

V. Project Development

a. Design

1. Top Level

a) Data Flow Diagrams

(1) Level 0: General View

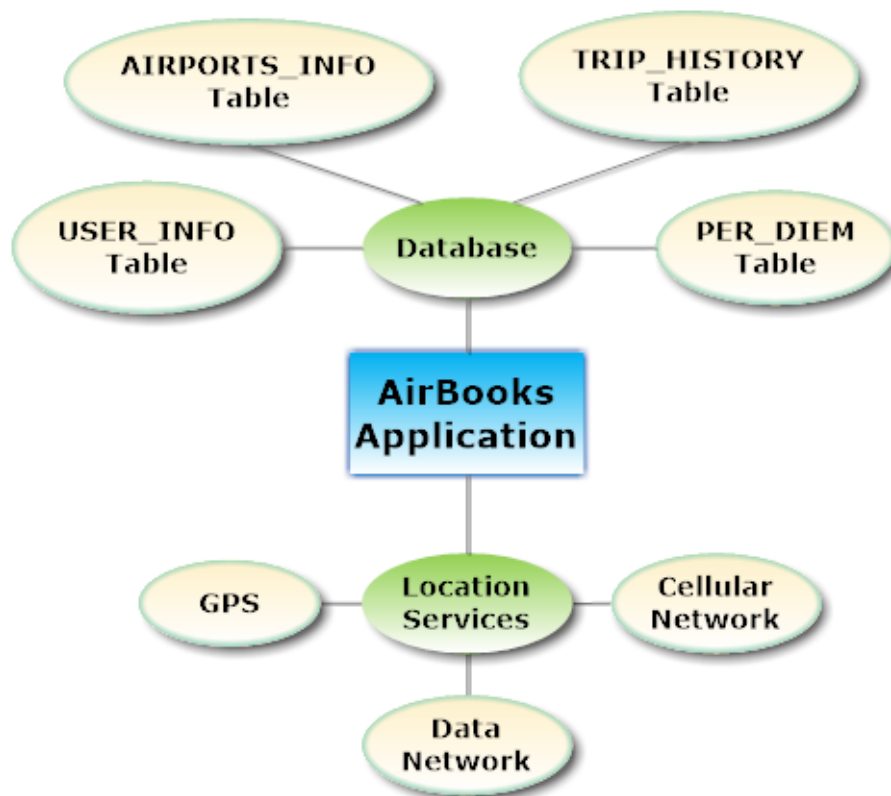


Figure 1 - AirBooks General Data Flow Level 0

(2) Level 1: AirBooks Overview

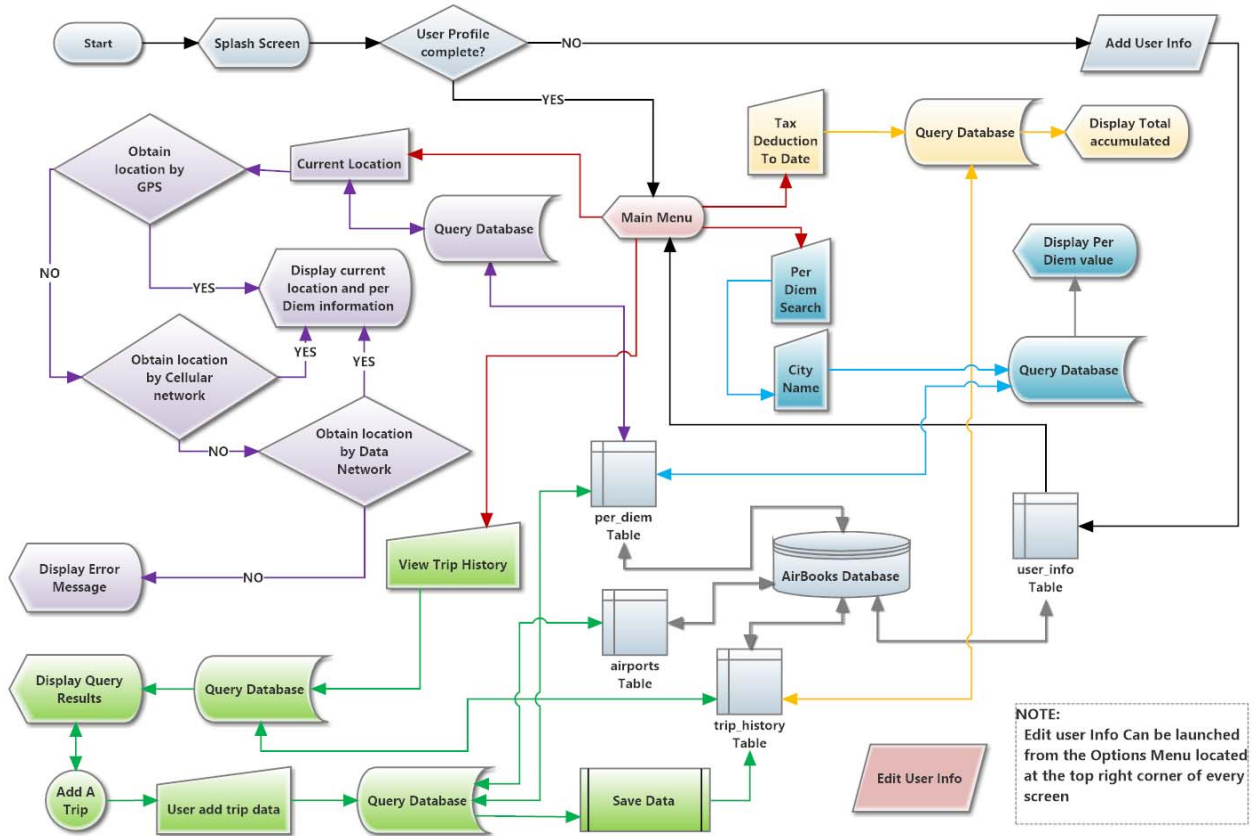


Figure 2 - AirBooks Data Flow Overview Level 1

b) Top Level Use Cases

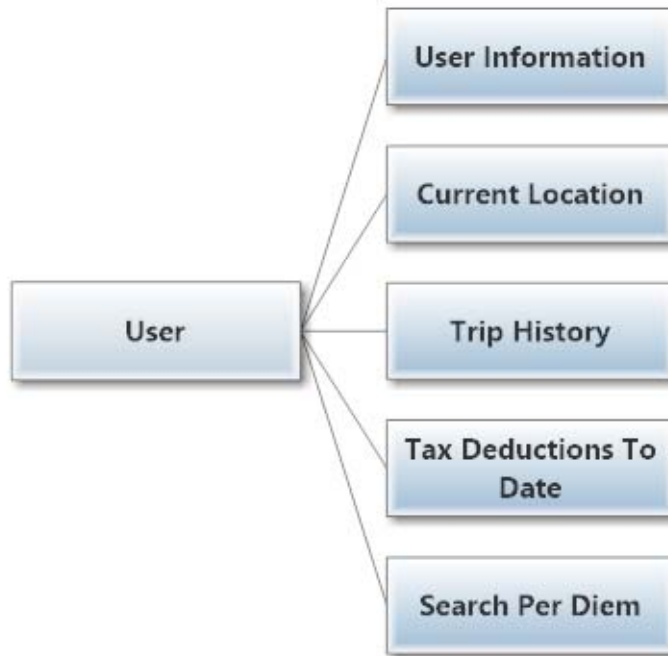


Figure 3- Top Level User Cases

(1) Use Case: Add User

User Case:	Add User
Primary Actor:	User
The goal in Context:	The user will enter the base airport.
Precondition:	User Info table must be empty.
Trigger:	Splash Screen before accessing the Main Menu.
Scenario:	User open the AirBooks application and if the user info table is empty will be prompted to register the base airport.
Exceptions:	Failure to enter the base airport information will stop user to access the main menu screen.
Priority:	Essential, must be implemented.
When Available:	First Increment.
Frequency of use:	First time user opens the application after installation.
Channel to Actor:	Android GUI Interaction.
Open issues:	Display message indication that information must be entered.



Figure 4 - Top Level User Cases - Add User

(2) Use Case: Current Location

User Case:	Current Location
Primary Actor:	User
Goal in Context:	The user knows the current location and the per Diem amount corresponding to that location.
Precondition:	Device location services must be on.
Trigger:	User selection from the main menu.
Scenario:	User open the AirBooks application and select the current location option to know the per Diem amount for the location the user is at that time.
Exceptions:	No location acquired.
Priority:	Essential, must be implemented.
When Available:	First Increment.
Frequency of use:	By user discretion.
Channel to Actor:	Android GUI Interaction.
Open issues:	Display message indication to suggest user to turn GPS on.

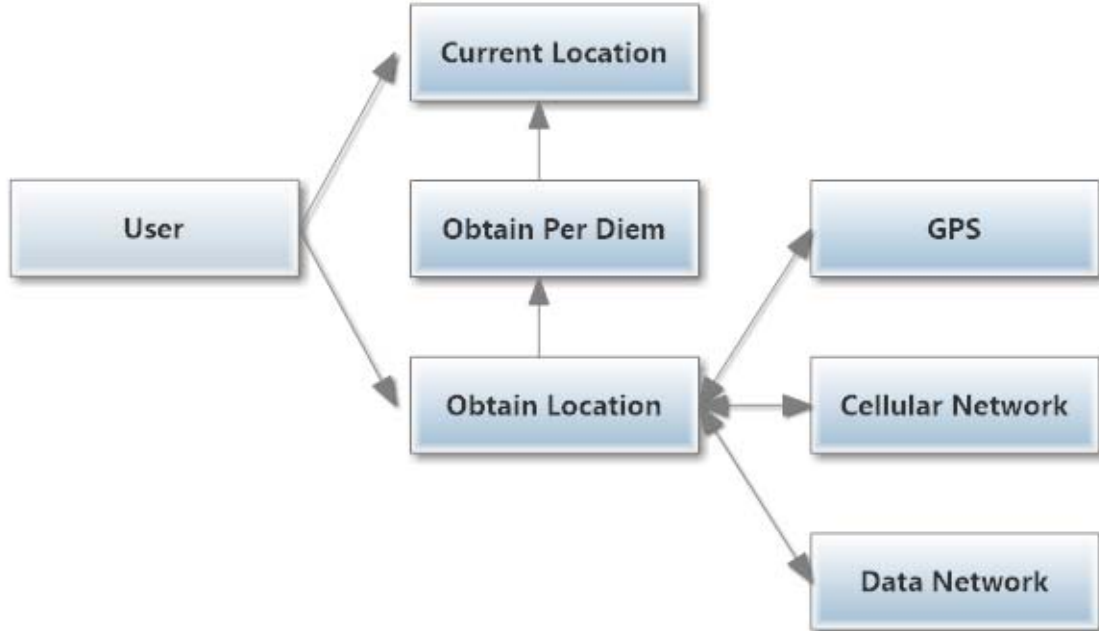


Figure 5 - Top Level Use Cases - Current Location

(3) Use Case: Trip History

User Case: Trip History
Primary Actor: User
Goal in Context: The user will be able to see all the logged trips.
Precondition: None.
Trigger: User selection from the main menu.
Scenario: User open the AirBooks application and select the Trip History option to see all the logged trips and their information.
Exceptions: None.
Priority: Essential, must be implemented.
When Available: First Increment.
Frequency of use: By user discretion.
Channel to Actor: Android GUI Interaction.
Open issues: None.

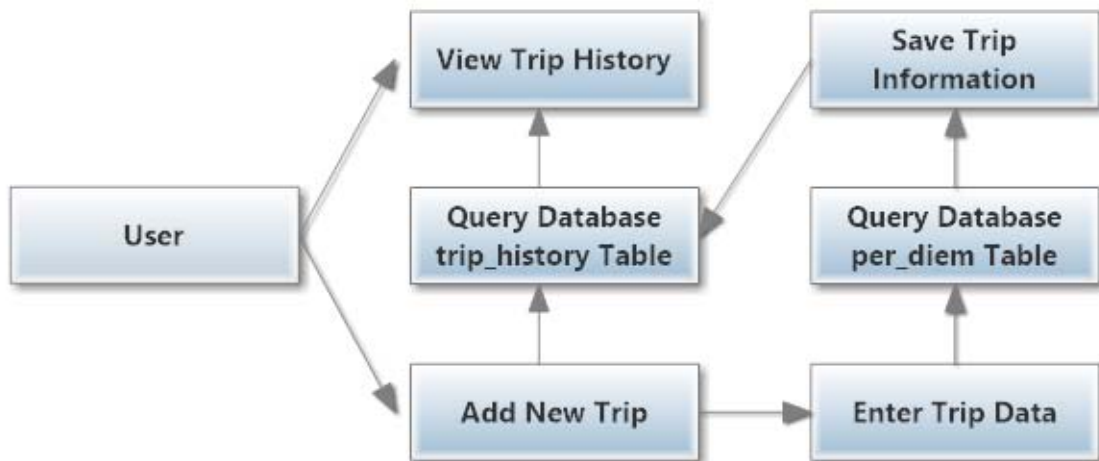


Figure 6 - Top Level Use Cases - Trip History

(4) Use Case: Tax Deductions to Date

User Case:	Tax Deductions to Date
Primary Actor:	User
Goal in Context:	The user will be able to see a total for the per Diem values stored from logged trips.
Precondition:	None.
Trigger:	User selection from the main menu.
Scenario:	User open the AirBooks application and select the Tax Deductions to Date option to see the total value of the per diems acquired from logged trips.
Exceptions:	None.
Priority:	Essential, must be implemented.
When Available:	First Increment.
Frequency of use:	By user discretion.
Channel to Actor:	Android GUI Interaction.
Open issues:	None.

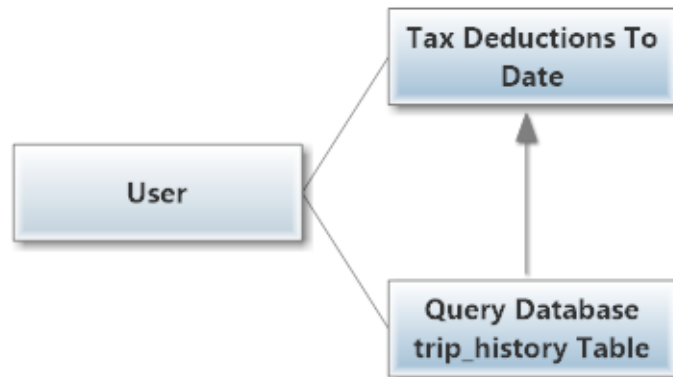


Figure 7 - Top Level Use Cases - Tax Deductions to Date

(5) Use Case: Search per Diem

User Case:	Search per Diem
Primary Actor:	User
Goal in Context:	The user will be able to find the per Diem of a remote location.
Precondition:	User to enter the city name.
Trigger:	User selection from the main menu.
Scenario:	User open the AirBooks application and select the Search per Diem option to see the total value of the per diem for the requested City.
Exceptions:	Misspelled City name or no City entered at all by the user.
Priority:	Essential, must be implemented.
When Available:	First Increment.
Frequency of use:	By user discretion.
Channel to Actor:	Android GUI Interaction.
Open issues:	Autocomplete used to avoid typing errors. Idiomatic accents.

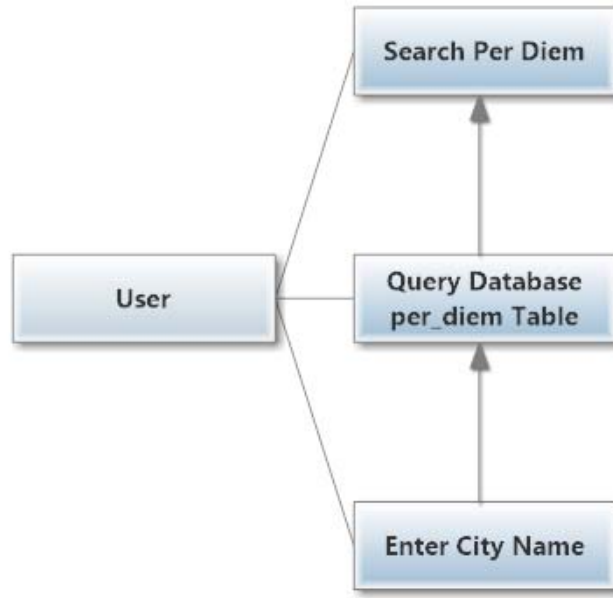


Figure 8 - Top Level Use Cases - Search Per Diem

(6) Use Case: Edit User

User Case: Edit User Profile
Primary Actor: User
Goal in Context: The user will complete the profile information.
Precondition: User Info table must contain base airport information.
Trigger: User selection from the options menu.
Scenario: User opens the AirBooks application and selects the update profile option from the options menu.
Exceptions: None.
Priority: Optional, don't need to be implemented.
When Available: Any Increment.
Frequency of use: By user discretion.
Channel to Actor: Android GUI Interaction.
Open issues: Display message indication that information must be entered.

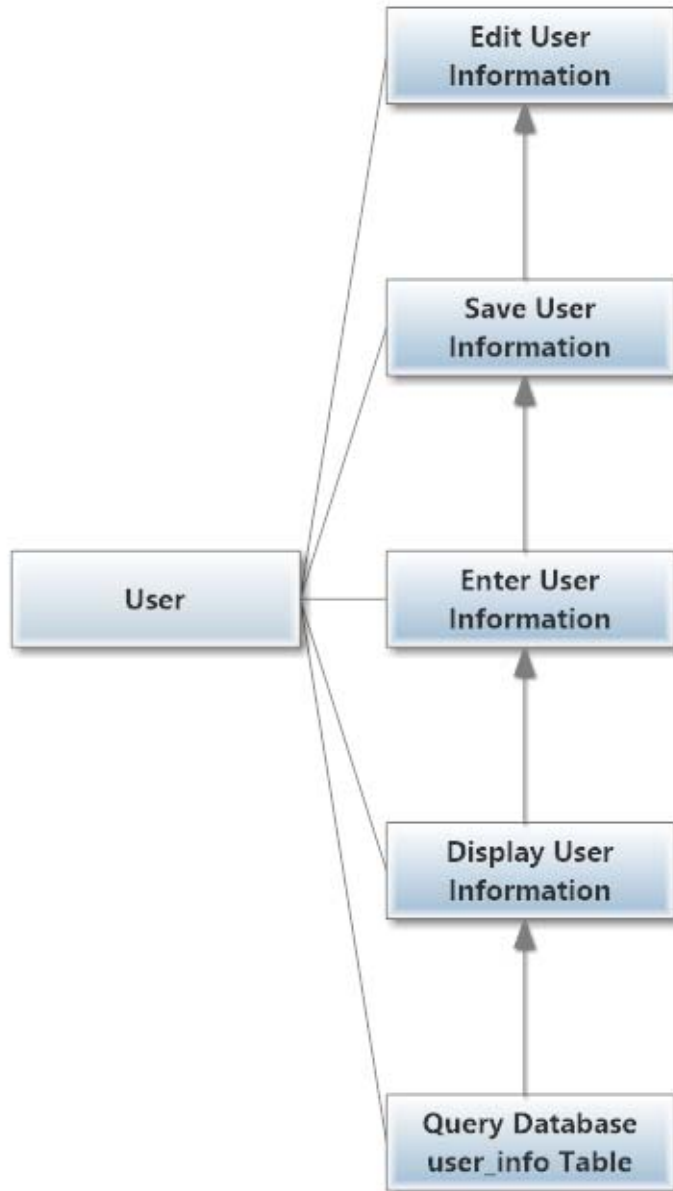


Figure 9 - Top Level Use Cases – Edit User

2. High-Level

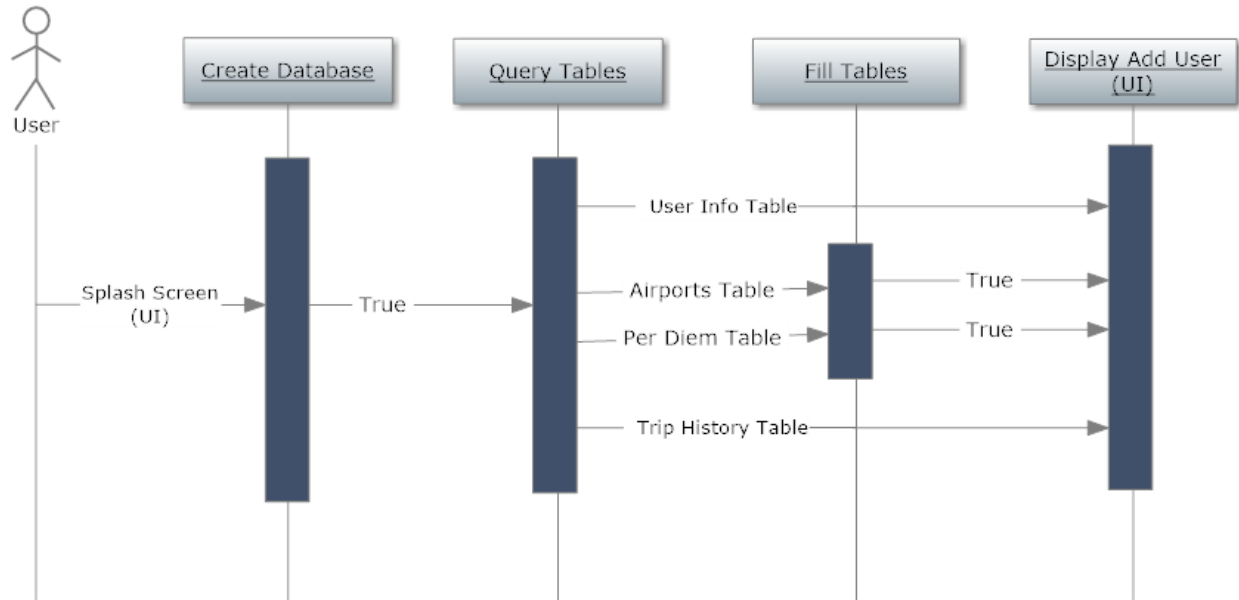
a) *Sequence & Entity – Relation Diagrams*(1) *Sequence Diagram – First Launch***First Launch Scenario**

Figure 10 - High-Level Sequence Diagram - First Launch

(2) Sequence Diagram – User Registration

User Registration Scenario

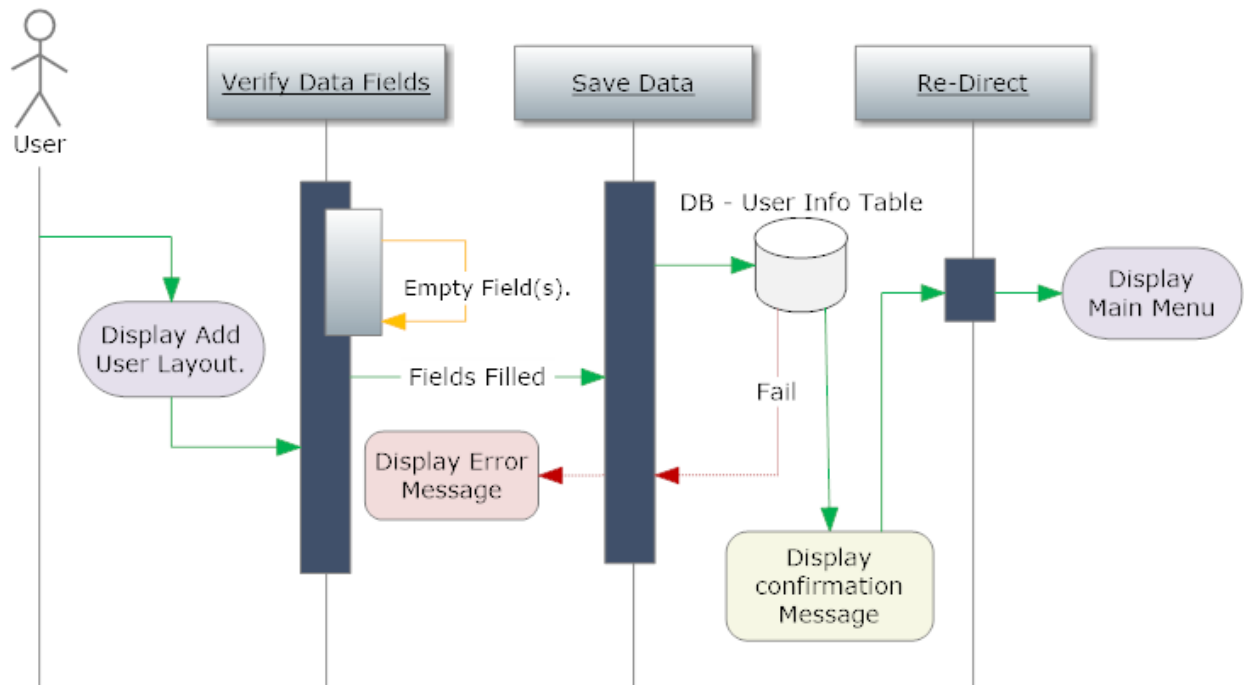


Figure 11 - High-Level Sequence Diagram - User Registration

(3) Sequence Diagram – User Functions

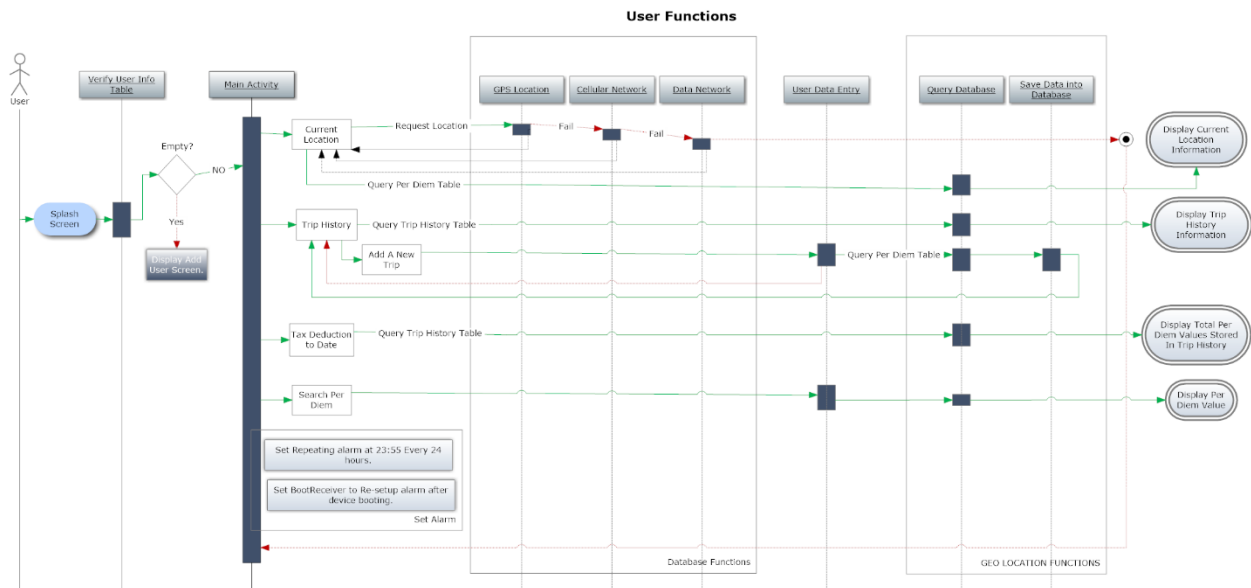


Figure 12 - High-Level Sequence Diagram - User Functions

(4) Sequence Diagram – Alarm Sequence

Alarm Sequence

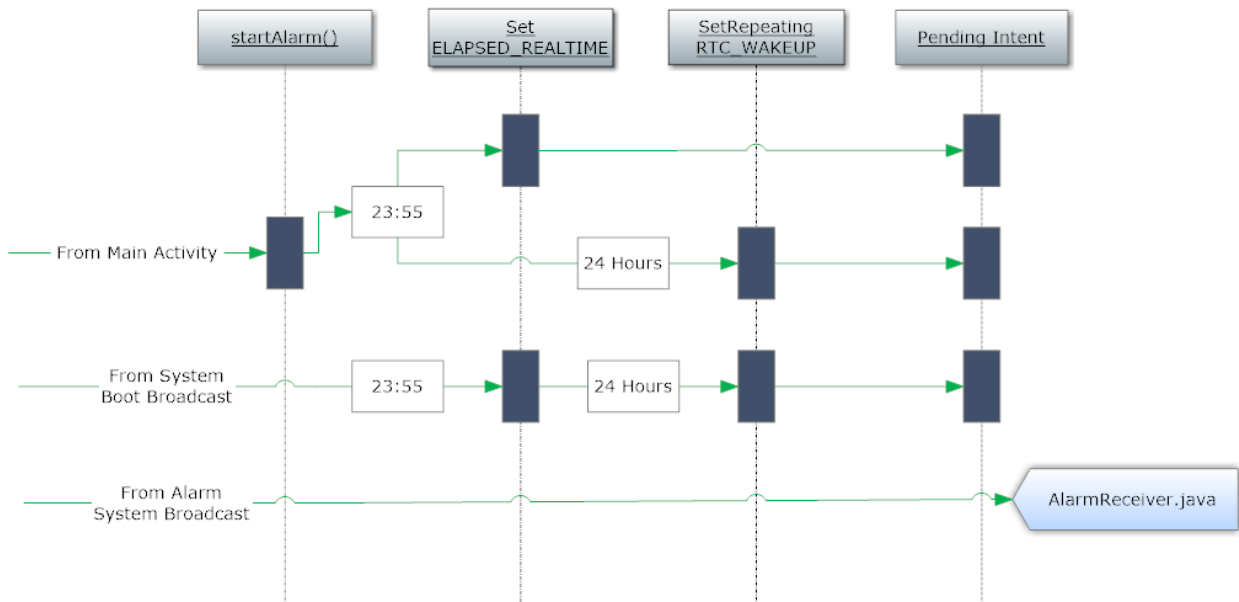


Figure 13 - High-Level Sequence Diagram - Alarm Sequence

(5) Sequence Diagram – Alarm Sequence – Continued

Alarm Sequence - Continued

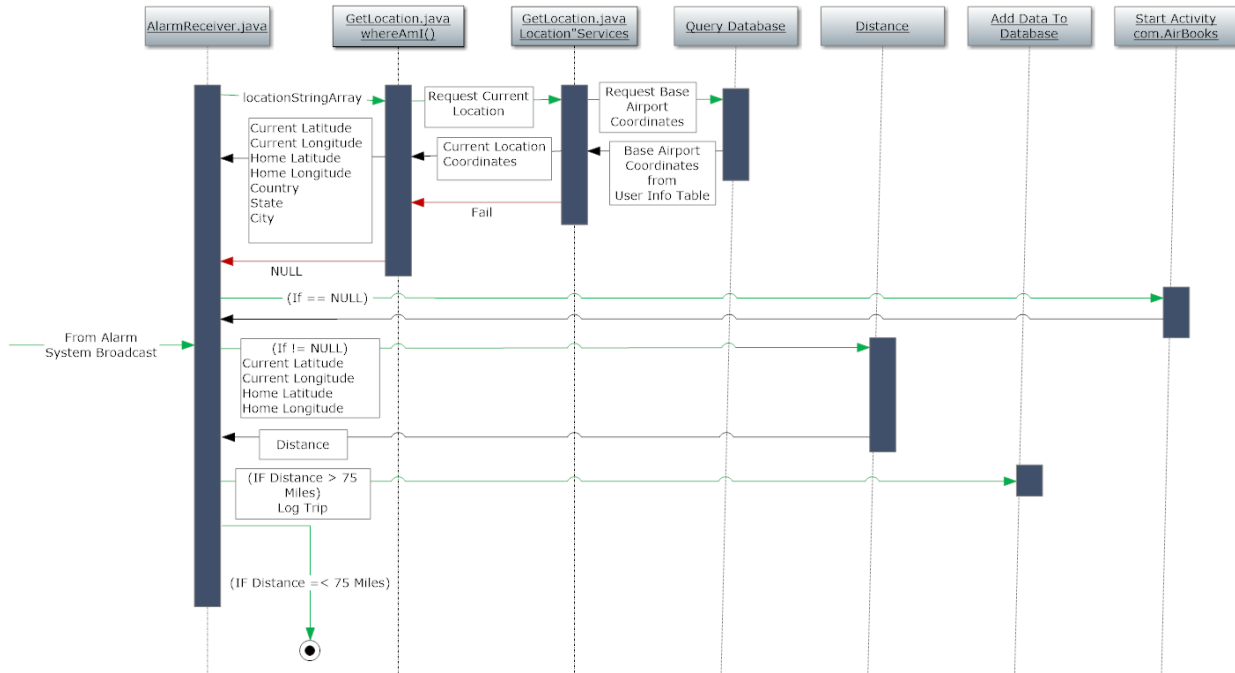


Figure 14 - High-Level Sequence Diagram - Alarm sequence - Continued.

3. Object-Oriented

The object-oriented design diagram will be used to provide a visual perspective of the application classes, their connection, object-relation, and object-behavior. Single directional arrows are used to indicate flow direction. [10]



Figure 15 - Object-Oriented

b. Research

1. Current Environment

Most people typically dread tax season. This is especially true in the airline industry, as confusion and uncertainty usually accompany the term “Per Diem.” Every location in the world has a different IRS designated per day tax deduction allowance for work travel. However, most employees, especially the flight crew members, pilots and flight attendants, do not understand how their unreimbursed meal and entertainment allowances accrue as an unreimbursed employee expense. They also don’t understand how it is calculated, or how it is deducted on their tax return. This generally scares and frustrates most employees during tax season.

Also because most of the flight crew members keep records of their trips manually, when the time comes to file taxes, it will take the tax preparer one to two hours to calculate the deductions.

2. Desire Environment

AirBooks application is an air travel, tracking, and data-logging app, our initial design provides airline flight crew (pilots and flight attendants) with an easy and effective solution for calculating their annual per diem tax deduction allowance. AirBooks application will automatically identify business trips and capture per diem tax data in real time for individuals who fly, by just keeping their smartphones with them and the location services ON 5 minutes prior to midnight.

In the airline industry, the annual unreimbursed employee expenses for per diem tax deductions usually make up 80-90% of the total tax deductions available for the flight crew member. There is a strong need to calculate this number easily and effectively, yet a simple and efficient solution does not exist. As we solve this problem, our strategy is to move vertically through this market and further develop our application features. Our phase two priority will be integrating this technology into a valuable and automated application for all business travelers.

3. Information Gathering

The initial basic implementation of the AirBooks application phase one require having the following data information stored in the database for different usage purposes and interactions throughout the application functions. This primary basic information is:

o **Airports Information:**

The Airports information required for the application to function is:

- Airport coordinates (Latitude and Longitude).
- Airport FAA / IATA (Short four letter code ID) and or ICAO code (Short four letter code ID).
- Airport Country.
- Airport City.

This information was found on an open source online from Openflights.com ^[2] website which provides the required and some extra information for each airport which was also included in the database to be available in the future after further development.

AirBooks have stored into the database information for a total of 6.997 airports around the world

Per Diem Information:

The per Diem information required must be pre-computed due to yearly changes from the IRS, the required fields for AirBooks application to accurately log the per Diem Values are:

- Country.
- State (if apply).
- City.
- Per Diem value.

Due to the complexity and sensitivity of the per Diem values calculations, Mr. Randy Perry, CEO of AirBooks application, provided this information from his Tax service company BookManTax ^[3].

AirBooks has it stored into the database information for a total of 1,747 places around the world.

4. [Technologies and Computing Requirements](#)

The following are the technologies and platforms used for the development and functionality of the AirBooks application.

a) [Google's Android Studio](#)

The Google's Android Studio 2.1 ^[4] Software is the official IDE for Android Development which can be used on multiple platforms. It will be used to write the code, simulation test, and compile the application.

b) [Linux – Ubuntu 16.04.1](#)

The Ubuntu 16.04.1 – Xenial Xerus LTS (Long Term Support) ^[5], is the operating system (OS) of the computer where the Android Studio Software will be installed and executed for the implementation of the application.

c) [SQLite](#)

SQLite^[6] is an embedded SQL database engine. SQLite does not have a separate server process and reads and writes directly to ordinary disk files. It will be used for the creation, manipulation and interaction of the application database.

d) [Google Android Location Services API](#)

The Google's Location Services API ^[7], part of Google Play services, will be used to add location-awareness to the AirBooks application. It offers

a simpler, higher accuracy, low-power, and more methods including the AutoComplete, which will be used to help the user to avoid typing errors during the UI interaction.

e) *Google Android Alarm Services API*

The Google's Alarm Services API ^[8], will be used to set and manage the periodic alarm to execute a command at the specific time.

f) *Java Software Development Kit (SDK) 8*

The Java SDK ^[9] is a requirement of the Android Studio ^[4], in order to develop, debug and monitor, applications for the Android OS platform written in Java programming Language which is going to be the one used to generate the application code.

g) *Android Smartphone*

The AirBooks Application phase one will require a smartphone with Google's Android 5.0 platform or higher in order to operate. A smartphone with these characteristics will be used for testing purposes.

c. **Implementation**

1. **Database Diagram**

The AirBooks application uses an SQLite^[6] local database stored inside the device file system, it is needed for the integral function of the application and consists of four tables. Two of those four tables, the airports_table and per_Diem table, are filled with information from two CSV files located inside the raw folder at the application first launch after the installation.

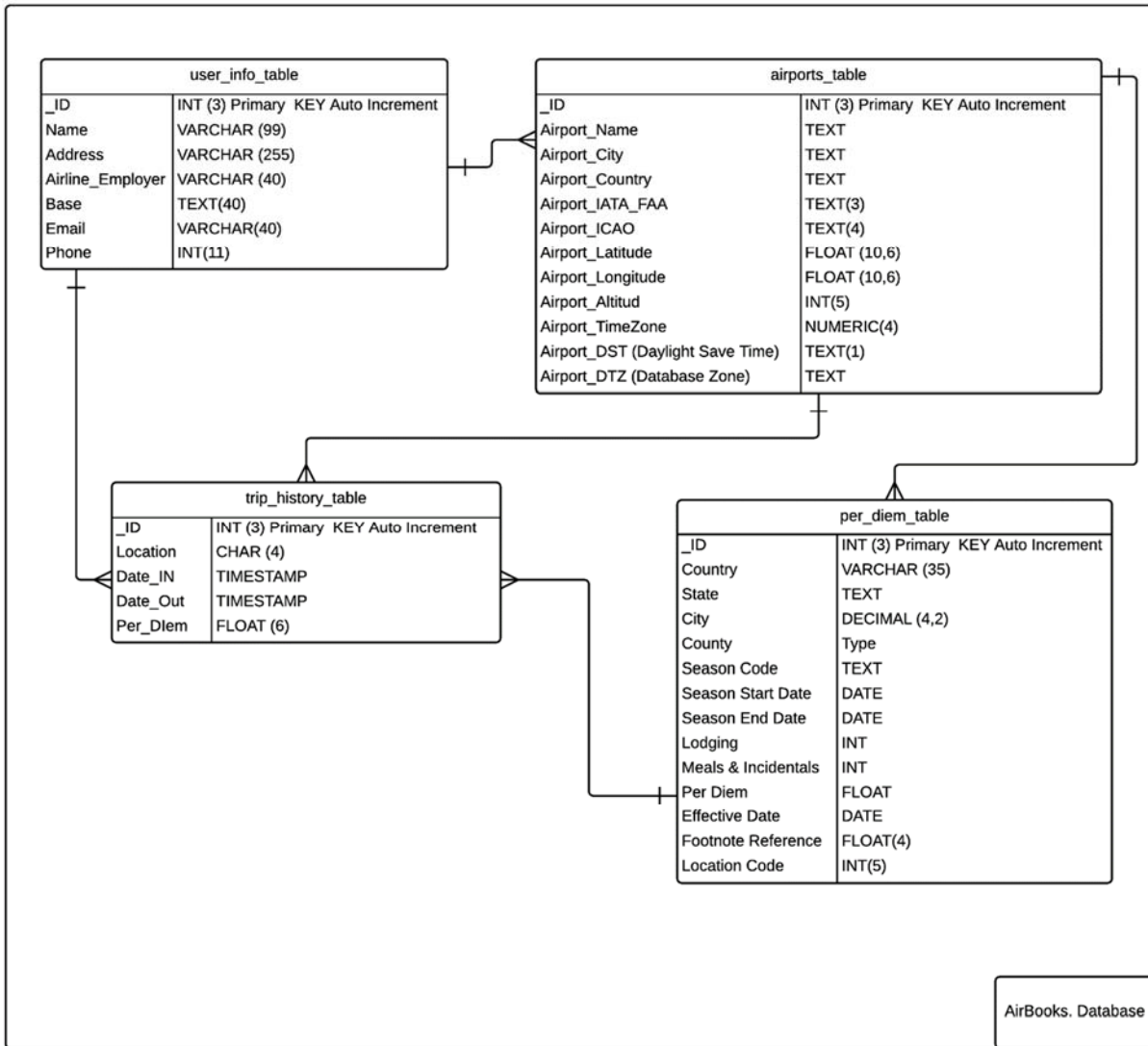


Figure 16 - SQLite Database Diagram

2. Screen Layouts

(1) Splash Screen



Figure 17 - Screen Layout - Splash Screen

(2) Add User Info

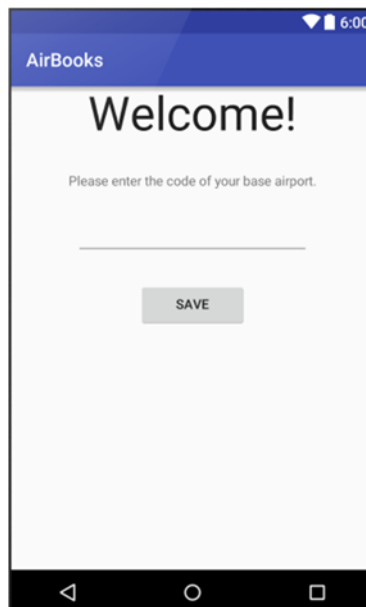


Figure 18 - Screen Layout - Add User Info

(3) Main Menu

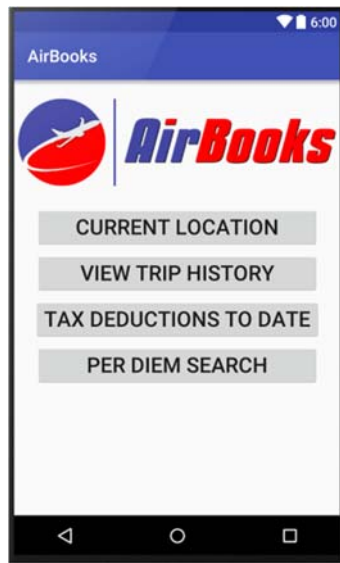


Figure 19 - Screen Layout - Main Menu

(4) Current Location

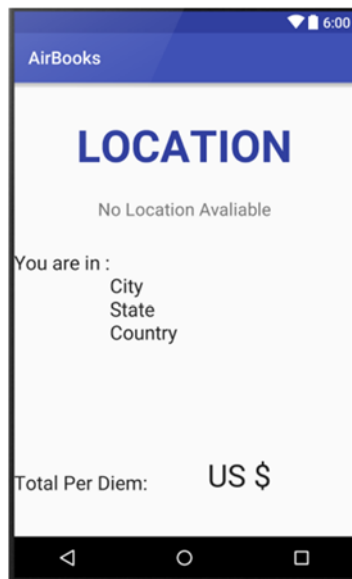


Figure 20 - Screen Layout - Current Location

(5) View Trip History



Figure 21 - Screen Layout - Trip History

(6) Add New Trip

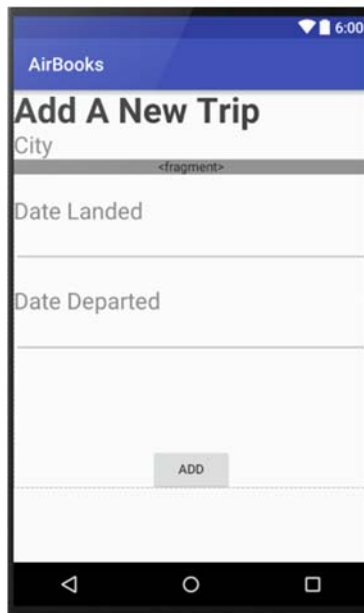


Figure 22- Screen Layout - Add New Trip

(7) Tax Deductions to Date



Figure 23 - Screen Layout - Tax Deductions to Date

(8) Per Diem Search



Figure 24 - Screen Layout - Per Diem Search

(9) Edit User Info

8:51

Edit User info

Edit User Info

Name

Address

Employer

CLO

E-Mail

Phone

SAVE CANCEL

Figure 25 - Screen Layout - Edit User Info

3. Classes Diagram

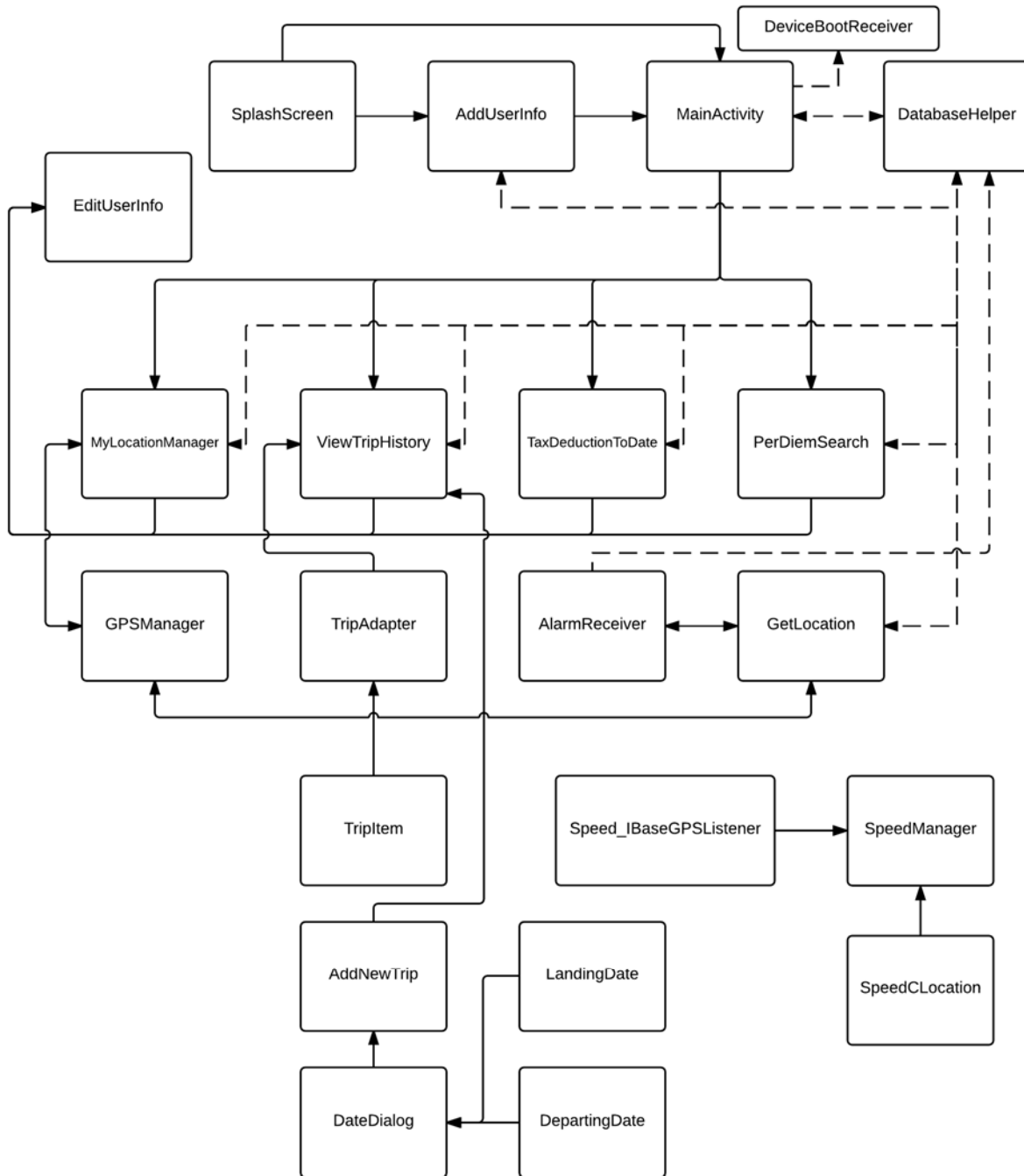


Figure 26 - Classes Diagram

VI. References

- [1] Haversine Formula: <http://www.movable-type.co.uk/scripts/latlong.html>
- [2] Openflights.org: <http://openflights.org/data.html>
- [3] Bookmantax: <http://www.bookmantax.com/>
- [4] Google Android Studio IDE: <https://developer.android.com/studio/index.html>
- [5] Ubuntu 16.04.1 LTS (Xenial Xerus): <http://releases.ubuntu.com/16.04/>
- [6] SQLite: <https://www.sqlite.org/>
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