“GOexp” Landmark Recognition and Retrieval System

Software Requirements Specification

Project Id - 18-107

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DECLARATION

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Signature of the supervisor: Date

1 TABLE OF CONTENTS

List of Tables

List of Figures

1. INTRODUCTION

1.1 Purpose

The software requirement specification is created mainly to identify the requirements of the software implementation. This may specify the functional requirements and non-functional requirement of the project.

The srs states the functionalities and capabilities of the software project that need to fulfill .there will be also some constraints too to be considered are included here. Srs coved

basics of all phases of planning, design, coding, and testing. All the people involved in the project like development team, technicians, customers and other support teams will be relying on the srs. Then this document becomes an important role in the software project.

There are many significant advantages we can achieve from this document like communication with all the parties involved in the software product.

1.2 Scope

This research project is proposed to recognize and retrieve large databases and from a query image to find details on the landmark, duplicates and other images which are containing the same landmark (from different angles by different photographers). This will provide a solution to a database retrieval which is a fundamental problem in computer vision.

The image retrieval based on the content data of the image which will lead to getting accurate output results from the databases. The dataset of more than a million images with 15k landmarks is provided from the kaggle website as an on-going challenge in the research prediction challenge.

Here we are mostly focused on the people who are interested in worldwide traveling and most of them are willing to maintain memories of the past traveled places. When keeping memories they are mostly want to keep the photo collections and also they wish to collect data regarding their future dream spot of destination as well. The image retrieval will help them to maintain their travel diaries as well.

The overall app is providing the organizing image collection and more image retrievals, addition to this we are going to provide some accommodations and dining tracking the location and also through the profiling by connecting to the twitter account of the app user.

Addition to this we are going to give the customers a ranking of the restaurant suggested from the profiling. Then they got a chance on selection the best one for the preferable accommodations or dining

1.3 Definitions, Acronyms, and Abbreviations

1.3.1 Definitions

Terms	Definition
GOexp	Name of the developing system.
Software Requirement Specification	A document that completely describes all of the functions of a proposed application and the constraints under which it must operate

Table 1: Definitions

1.3.2 Abbreviations

Abbreviations	Description
GUI	Graphical User Interface

API	Application Programming Interface
CBIR	Content-based image retrieval
SRS	Software Requirement Specification

Table 2: Abbreviations

1.4 Overview

The goal of implementing this mobile app is to get comfortable experience for the people who are interested in traveling and who make photo collections of their future dream traveling spots and destinations. They can get the others travelers experiences of the significant landmarks from the “GOexp” users who can upload new photos of their journeys to the application too.

As main components of the app are to recognize the landmark in the photo and give the details relevant, Retrieve large database to find duplicates and other images with the same landmark. This will help to have the organized memories and future travel plans.

The people who are traveled to other countries or the hope to travel and if they were so worried about their accommodations and dining, here is the ideal app for their mobile phones. We suggest the preferable accommodations and dining for the particular user. Also, we suggest the best-ranked selection and also the app users most desired places as well.

In this documentation, we have described the details of software requirements, the functionalities, constraints, limitations and additional features on the software project we suppose to implement.

2 OVERALL DESCRIPTION

This section describes the whole overview of the GOexp System. Here describes how this GOexp System compared with other existing solutions. Other than that this section describes

what type of users use this GOexp System and how can they operate this system. Referring to this SRS document, developers and users can easily understand the how this component is going on. This section describes available constraints, assumptions and how this component communicates with other components and so on.

2.1 Product perspective

When we considering the existing system in the marketplace there are only a few mobile solutions available in the world market to,

- Recognize the landmarks of images.
- Retrieve images that contain same landmarks.

The most popular existing landmark recognition applications are google goggles. All these applications are not used only to recognize the landmarks.it also used to recognize products, paintings, popular images etc. Our application focus on only to recognize landmarks in order helps people to save their time that used to find information. Mainly this product is a focus on tourist field. But it can be used in other sectors also.

To provide a perspective idea on the GOexp application, this section compares with other related and competing products available in the market today.

- Google goggles

Google Goggles is a mobile visual search application currently available for Android mobile phones that lets a user submit a search query by taking a picture.[3].google goggles can identify some visual cues or "landmarks" in an image and generate relevant searches. This technology can also recognize barcodes and even some kinds of text in a photo, such as printed text on a captured page. This program can provide information about a photo taken with a handheld device and has been used in various commercial and educational projects.[4]

- Camfind - visual search engine

Camfind is a search engine that can photograph, identify, and provide information on any object, at any angle. It enables visually impaired people to get the information they want, by taking a picture and avoiding typing queries into the browser. Some of the application’s features are:

* Internet search results.

* Related/similar images.

* price comparisons and online shopping.

* Related places and address finder.

* Film poster/DVD recognition.

* Instant sharing to Facebook, Twitter, email, and text.

Additional functions

* Ability to upload and save images to or from the camera roll.

* QR and barcode scanner.

* Language translator.

* Voice search.

* Text search.

User take a picture then the app identifies the picture and not only speaks the result but it proposes on the screen many links related to the picture. The user can also speak anything he-she wants and the app proposes all the related results to the screen.[5]

- Bixby vision

Bixby vision is a new feature on the Samsung galaxy s8 and s8+. You will need to be connected to a Wi-Fi or mobile network, and signed into your Samsung account on your device to use it.

- ❖ Shopping: Bixby vision can recognize products and search for information such as the product name and its price so you can find and purchase products even when you don't know what it is called.
- ❖ Nearby places: Bixby vision can recognize landmarks and share information about it and what's nearby.
- ❖ Text translation: need to know what a sign or menu says? Tap the translate icon to translate it.
- ❖ Wine information: Bixby vision can tell you a wine's vintage chart, food pairing and world ranking from the bottle's label.
- ❖ Similar images: search for images similar to the Bixby vision is looking at.
- ❖ Qr codes: quickly view the information from QR codes.[6]

Features	GOexp	Google goggles	Camfind-Visual Search Engine	Bixby Vision
Recognize landmarks of the images	✓	✓	✓	✓
Recognize various objects of the images. (Such as products, letters)	X	✓	✓	✓
Mainly focused on identification of the landmark of the images.	✓	X	X	X
Use dataset that contains around 30,000 unique landmarks.	✓	X	X	X
Retrieve the similar kind of images based on the given image landmark.	✓	X	✓	X
Suggest Accommodations options based on the area that landmark located.	✓	X	X	✓
suggest accommodation based on user preferences.	✓	X	X	X
Show user accommodation by rating and review.	✓	X	X	X

Table 3: Comparison of applications

2.1.1 System interfaces

From this section of the document covers the whole research area that contributes to the GOexp application. The whole research area covered up by this document is,

- The identification of the landmarks of the given images and retrieve the details of that landmarks.

Once the system recognizes the landmark, it will provide various kind of facilities to the user in this system in order to provide business value for the users. That facility is implemented by other components of the system. The recognition of the landmark will be done by creating a model and train that model using the datasets. In order to implement this system, Android API is used to design the interface.

- Retrieve similar landmark images based on the given image.

Once an image is uploaded, the system will use that image as an input to use under image processing technology. As a result, the system will check that result through the image database and the system itself will provide similar images or duplicate regarding that image which was uploaded as an input

- Predict accommodations based on user preferences
- Predict accommodations based on rating and review

In this sections, the system will predict accommodation near the landmark located. by analyzing the user preferences and also analyzing rating and reviews and provide the best accommodations by matching these two sections.

2.1.2 User interfaces

This section provides the basic sketches of the main interface of the GOexp application. This interface gives the user to access to all functionalities of the GOexp application.

In this interface what we expect to do is get the images from the gallery or by taking an image from the camera in order to proceed the landmark details. Likewise, after the

analysis of the image, if the system recognizes the landmark this interface provides navigation to another page in order to show the landmark details. From that interface, the user can access the other options of the GOexp system.such as accommodation suggestions. In order to provide some idea of this system, the sketched interface is shown in below. The sketched Interfaces may change when the developing is in progress.

Table 4: Main user interface sketch of the GOexp

2.1.3 Hardware interfaces

This System does not require any specific hardware components to function. Yet the system will be developed as a mobile application where an Android enabled mobile phone would be required for the hosting purposes.

2.1.4 Software interfaces

The user will require an Android device to have GOexp android application, therefore a mobile application should be installed on the user's Android device. The application GOexp will be developed using the android studio.

2.1.5 Communicational interfaces

As the "GOexp" landmark recognition & retrieval system is a mobile-based application, the connection to the internet should be established before the execution of the landmark recognition process, therefore, Android enabled mobile phone with 3g/hspda/Wi-Fi connection needed for high-speed connectivity of the internet.

2.1.6 Memory constraints

In order to run this application device should have at least 1 GB ram and 100 MB free space to gain better performance.

2.1.7 Operations

This Whole application is mainly focused on people who need to find places by using images. Also after the Landmark Recognise part done by the system, it functioning user reservations around the area that landmark located. This accommodation is done by predicting user's preferences and also predicting best accommodation reviews of the people. So this recognition and suggestions technology will be very supportive of the people who love to travel over the world without knowing the places.

The main operations

- identify the landmark.
- identify the matching images contain similar landmark.
- identify the user preferences and reviews
- provide suitable accommodations by matching user preferences and reviews

User operation

- uploads an image with the unknown landmark.
- Give access to the twitter account in order to get the user preferences.

Machine operation

- Recognize the landmark (AI part)
- Retrieve the landmark details and showing it to the user.
- Upload the image to the database and add that image to the user history.
- Retrieve similar images from the database.
- Show accommodation suggestions.

2.1.8 Site adaptation requirements

As the GOexp application is mobile application it required android enabled mobile device

The whole System will display the information using in the English Language.

Interfaces of the GOexp developed in a user-friendly manner in order to give the best product satisfaction to the users.

2.2 Product Function

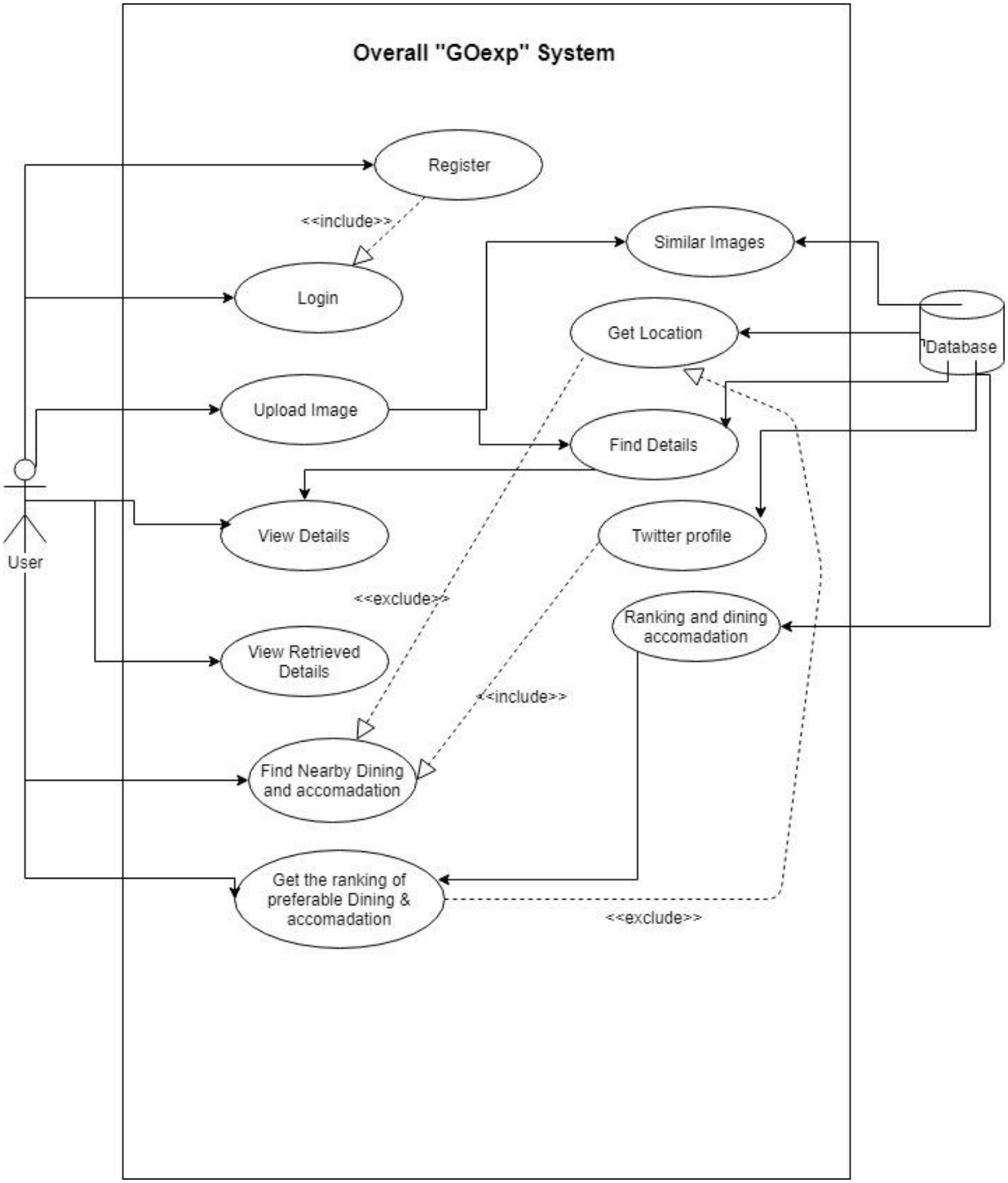

Table 5: Overall Use Case

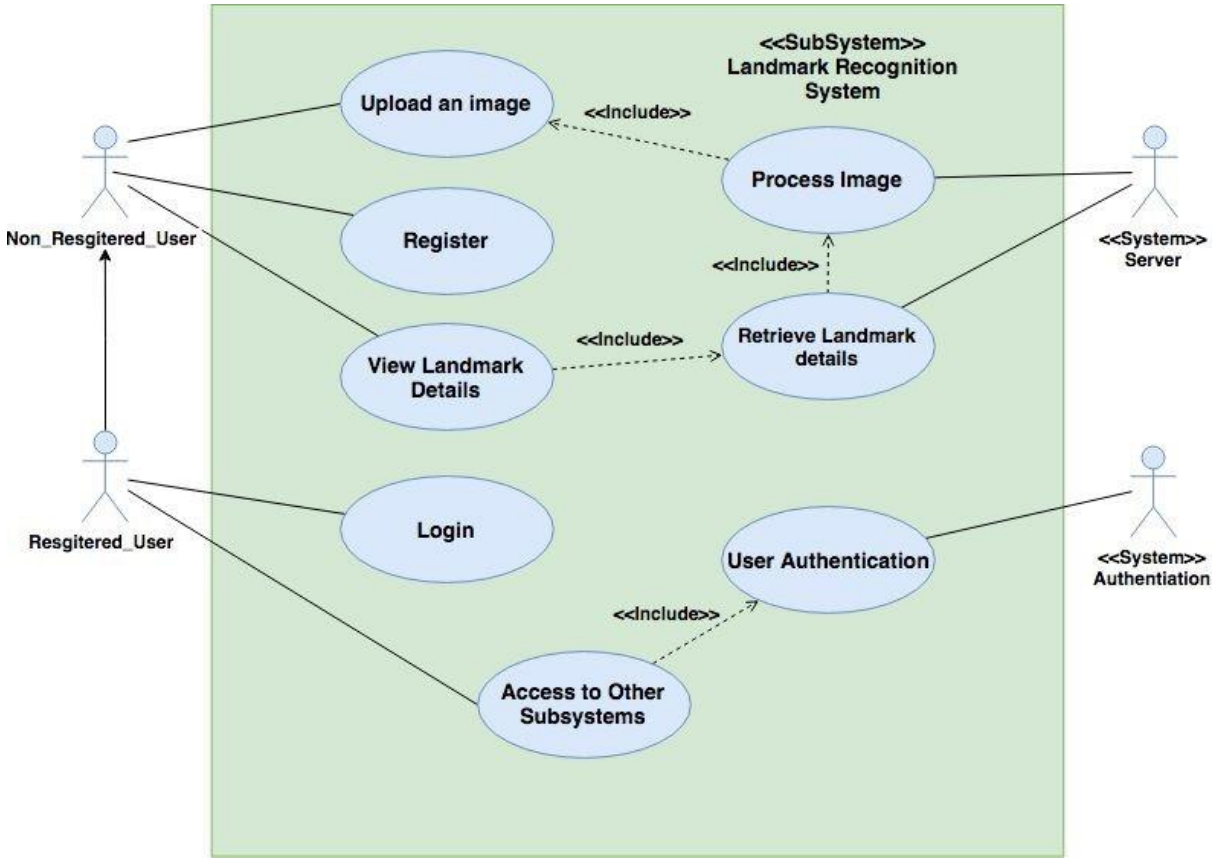

Table 6: Overall use case for landmark recognition component

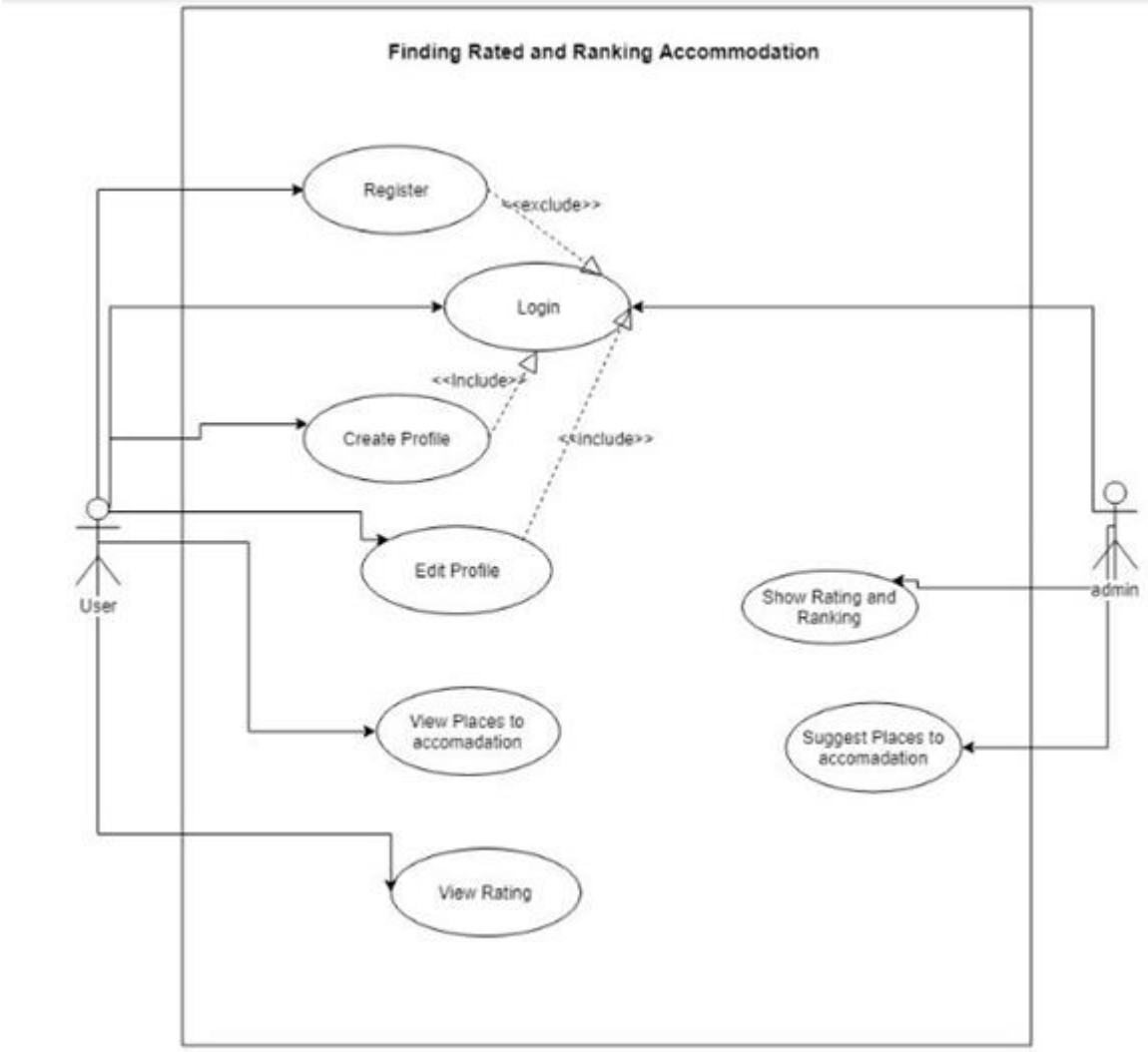

Table 7: Use case diagram for tour planning

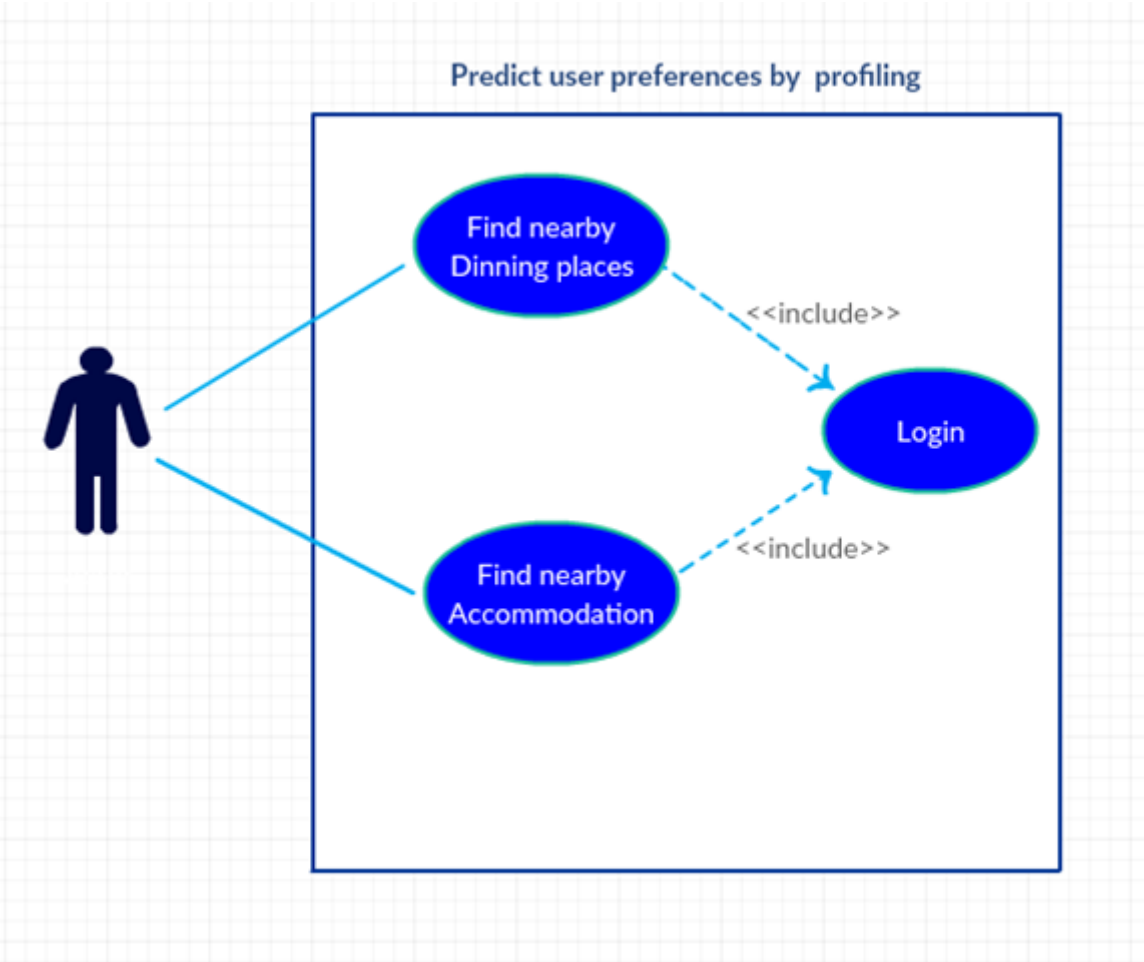

Table 8: Predict User Preferences Use Case diagram

Use case	Register
Preconditions	User should have an email address
Actors	User
Flow of events	1. When user launches the app for the first time. 2. System displays Sign-up interface. 3. System prompts the user to sign-up with GoExp 4. User is navigated back to his "GoExp" profile. 5. Use case ends.
Extensions	3. A. User clicks on sign-up with Have a GoExp. 5. A.1. User enters email and password. 3. A.2.User clicks on sign-up. 3. A.3. User's email address is validated. 3. A.4. User is redirected to his GoExp profile.

Table 9: Use case scenario - Register

Use case	Login
Preconditions	User must be registered in the system.
Actors	User
Flow of Events	1. Use case starts when user launches the app. 2. System displays Login interface. 3. User enters username and password. 4. User clicks on ‘Login’ button. 5. User is validated. 6. Use case ends.
Extensions	5. A. User is not validated. 5. A.1. System displays an error message.

Table 10: Use case scenario - Login

Use case	View profile
Preconditions	User should be logged into the system.
Actors	User
Flow of events	1. Use case starts when the user clicks on profile icon. 2. System lists the user's fiends' activities. 3. System suggests other users to be the user's friends. 4. User clicks on add friend icon to add other users as his friends. 5. Use case ends.

Table 11: Use case scenario - View profile

Use case	Rate the Review
Goal	Get the rating via user’s comments
Scope and Level	General
Primary Actors	Customer, Admin
Pre-Condition	Comment should be in English
Main success scenario steps	1. Use case starts when the user enter comment for place. 2. System analyses the comment and token the words 3.System find the keywords of comment 4. System check the keyword. 5.validate the keywords 6.Divide positive, Neutral and negative keywords 7.Add to keywords to system hierarchy 8.System retrieve the final rating 9.Use case ends
Extensions	4. A. Not available keywords 4.A.1 System ignore the comment

Table 12: Use case scenario - Rating and review

Use case	Suggesting Ranking Accommodations
Actors	Admin
Pre-Condition	User should be logged in to the system
Flow of events	1. user enters starting place 2. click search button 3. System refers user's likes and dislikes and other users' ratings 4. Display what are the higher ranked places 5. User selects places to accommodation. 6. Use case ends.

Table 13: Use case scenario - Suggesting Ranking Accommodations

2.3 User Characteristics

This application is mainly focused on people who familiar with the use of the android application and people who would like to travel and find new places.

When considering to the "GOexp" system there are 2 types of users that will be using the "landmark recognition" system,

- Registered user

In our "GOexp" application there 4 main component. In order to use this 4 components, the user needs to register first. These users can use the entire system including "landmark recognition" component. These individuals can be software professionals. Therefore this proposed system is created for the individual with the good knowledge of computer literacy. These are the type of people who would like to use 1 application to get everything.

- Non registered user

These users can’t use entire system .what they can use is only the “landmark recognition” component. In that component what users can do is identify the unknown landmark details only. In order to use full features of the application, the user has to register first.

2.4 Constraints

This system consists of mobile applications. Therefore mobile application constraints should consider. In order to work with a better level of quality below mentioned memory limits are needed by the application.

Mobile application

- Mobile phone should have an android operating system to run the application.
- The Android version should be 4.0 or above. And must have a most recent version of the application.
- Mobile phone CPU should be 1GHZ or above for optimal performance. So that all the processing tasks would be done faster and the user would gain the output results very faster.
- Mobile phone RAM should be 1GB or above for better performance
- Mobile phone should have a camera with a resolution of 5 Megapixels or above for optimal performance.
- Internet connection is required for the software to function properly. High bandwidth is encouraged for smooth operation.

Implementation Constraints

- Android would be needed for mobile application development.
- Firebase/MongoDB would be used for data storing purposes of mobile application.
- Android Studio IDE should be used as the development environment of Android implementation.

2.5 Assumptions and Dependencies

Assumptions

- There should be a network connection
- The user should be aware of trip planning.
- The entire hardware and software requirement should meet the client and server.
- The database should be secured with passwords and username from unauthorized access.
- The system is developed with the understanding of both the language grammar.

Dependencies

- GoExp system is depended on the network and GPS connection as it is a location-based mobile.
- The user should provide correct details in order to get good suggestions

2.6 Apportioning of Requirements

The SRS document section 1.5 provides the overview of the supposed system requirements and section 2 provides the detailed overall description on the system. Section 3 contains detailed requirements that should be followed while design and implementations. The system GoExp is supposed to be implemented with the preliminary and functional specifications in section 3. There may be few changes in the final product due to time constraint but will be fulfilled in a future release. Implementation of GoExp describes below,

- Landmark Recognition.
- Landmark Retrieval
- Predict user reservations by profiling.
- Show user accommodation by rating and review.

3 SPECIFIC REQUIREMENTS

3.1 External interface requirements

3.1.1 User interfaces

Below UI sketches show how the GOexp application illustrate the ratings, reviews, and details of the places.

Table 14: Interface for Landmark Recognition

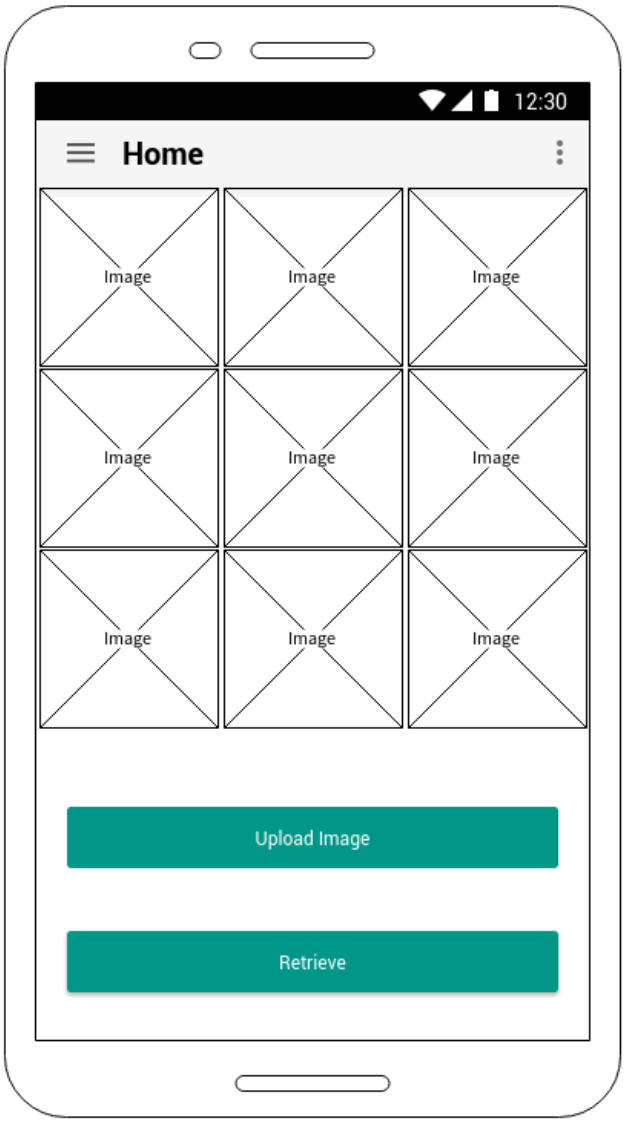

Table 15: Interface for retrieve database for landmarks

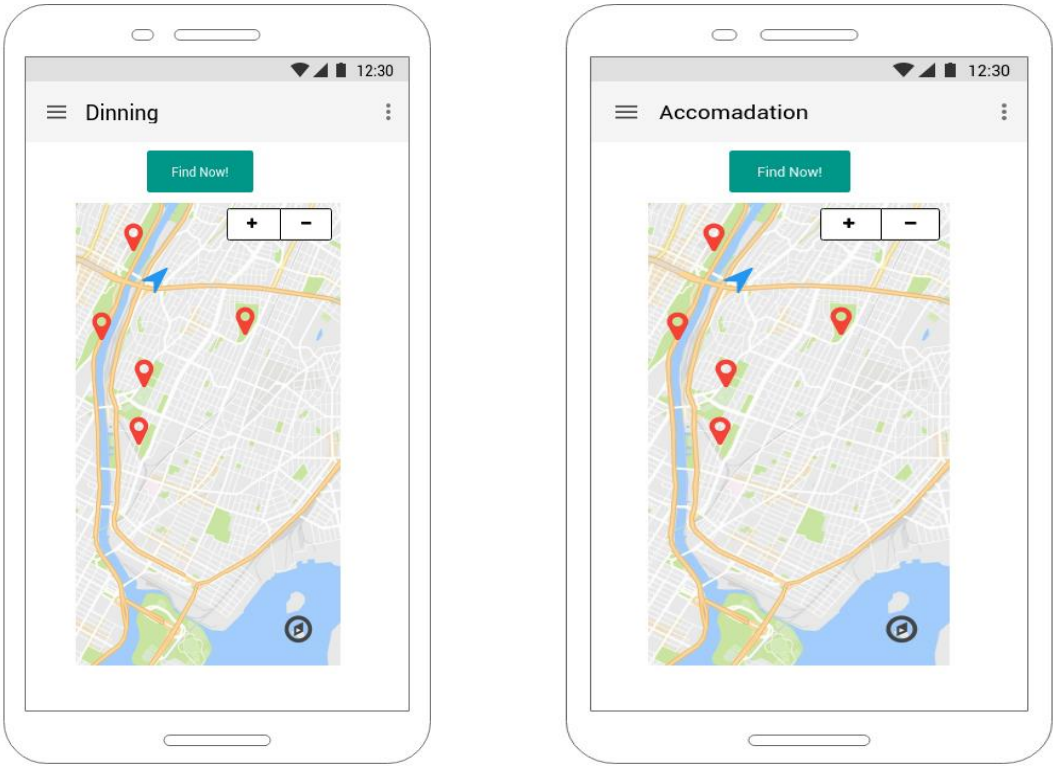

Table 16: View the Accommodations by using Map

Table 17: Interface for Reviews for places

3.1.2 Hardware interfaces

Server Side Hardware Interfaces

- For the server side there should be a server space with minimum 1GB. Also the server should run with Firebase. As the database server DB, firebase must have installed in the server.

Hardware Interfaces for the Development team

- Development team must have a computer that has 1.6GHz processing power in order to do this project. Minimum 10GB of disk space and 5400 RPM hard disk drive also can consider as hardware requirements.

- For the testing purposes development team requires a mobile device to run the mobile application. And also the mobile device must compatible with android.

3.1.3 Software interfaces

Name	Version	Purpose
Android Studio	V.2.3.3 and above Platform	Used for develop the mobile App
Google Maps API	V.3.31	Used to show the map in the mobile application
Android run time Environment		performs the translation of the application's bytecode into native instructions that are later executed by the device's runtime environment.
Firebase	V 5.0.0	Used for database management

Table 8: Software requirements

3.1.4 Communication interfaces

As GoExp system is a mobile based application, it's heavily depended on the network and GPS connection. The client applications are connected to the server through several communication devices and internet.

An internet connection will be needed by the customers as well as for the development purposes. Since the mobile application deal with the web server, there should be an internet connection.

A Wi-Fi connection will be used to communicate in between two applications and the server.

HTTP protocol will be used to communicate between android application and Back End REST Web service

3.2 Classes diagram

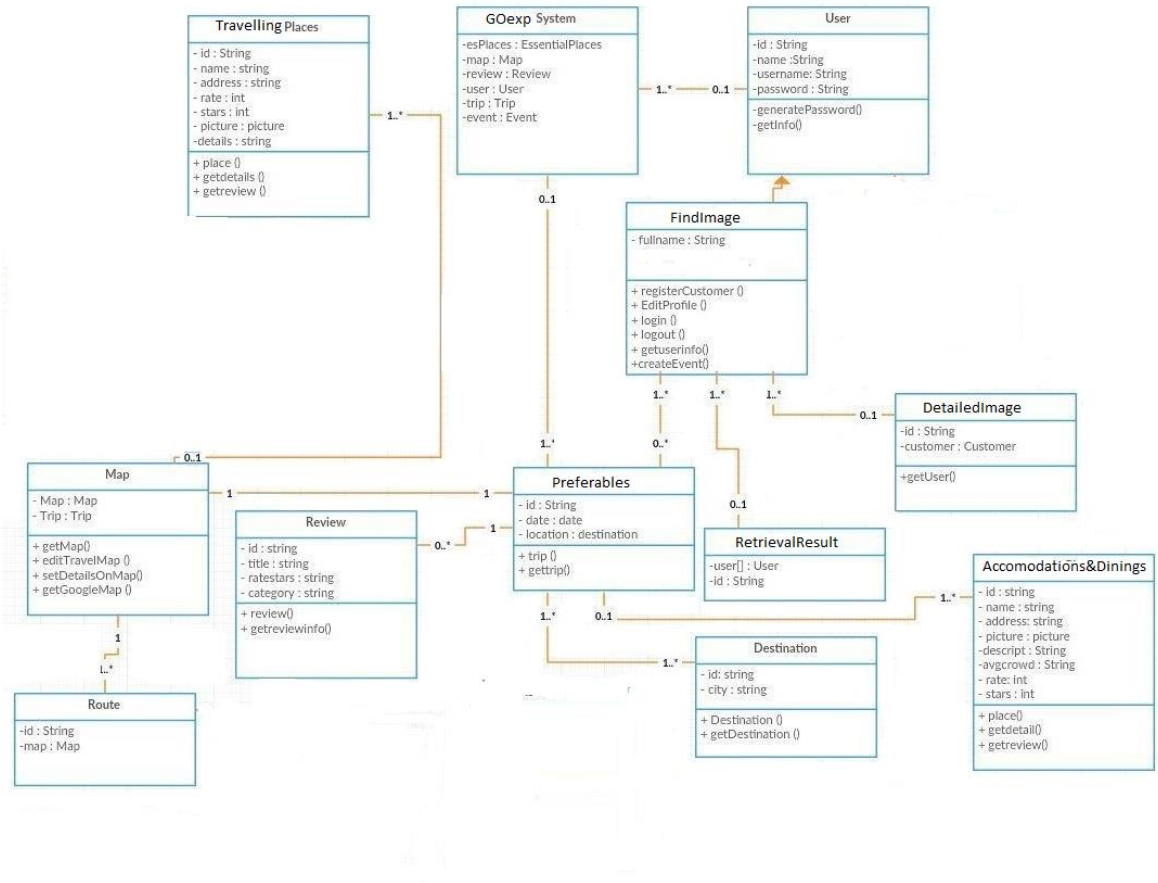

Table 18: class diagram

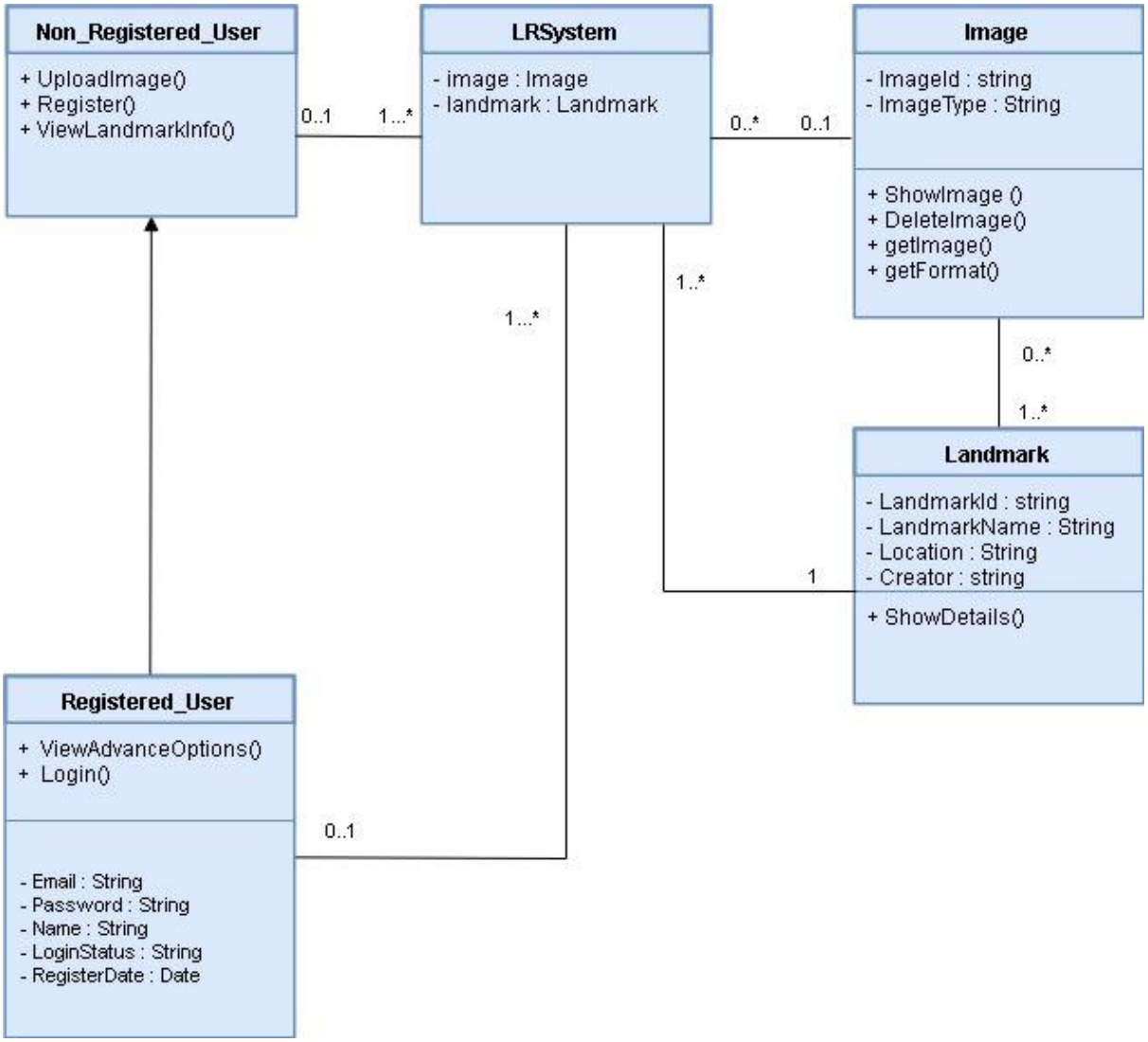

Table 19:Class diagram of landmark recognition

3.3 Performance requirements

The successful output is the ultimate desire of the “GOexp” system. If the system is performing properly without delaying replies then the performance of the system is more than the moderate level.

- The delay between the request from the android application and the response from the web server should be less than 1 second.
  Back End should be able to handle multiple request at a time.

- The mobile device should be contained with a good battery since it uses the internet connectivity.

- User-interface screen should respond within 5 seconds.

- There should be a proper internet connection to work with mobile in the beginning process.

- The server should be equipped with a decent processor and minimum of 4GB RAM which can handle the heavy processes.

3.4 Design constraints

In designing this system, we have to consider about mobile application designing. Travel enthusiasts are the primary users of the mobile application and it means a large variety of audience. This means they are not fond of complex interfaces. Thus all the interface designs have to be simple as well as attractive. Using bright and more colors will drag away user friendliness; therefore, interfaces must be light colored.

3.5 Software System Attributes

3.5.1 Availability

Availability of a system is the possibility that a system will work as required during the point of time and it should be able to deliver the requested service. That is a services should be available with minimal system down time or without having any system failures for longtime.

The application must be available to download and to use at any time without any crashes

3.5.2 Maintainability

Maintainability of a system means handling the system with new requirements in order to enhance the performance and capabilities of the application and making sure that new errors shall not be prone in the system because of the changes. That means the proposed system can be maintained easily if it needs some modification without causing any damage or interrupt to other system functionalities. As well as modifications can be done through low cost solutions. It is also a somewhat important feature to having a high maintainable system. In case of a failure, a re-initialization of the program is recommended.

"GOexp" app does not have a fixed client or a customer. Therefore, the maintenance requirements are handled by the development team by considering the future potential use of the mobile application. The application is designed in a way that it assists for updates of the software in future. The code will comment wherever it is necessary, especially in critical and complex code segments. This will help the developers or the maintaining team for further modifications in future.

3.5.3 Security

Security of a system is an attribute which reveal ability to resist unauthorized usage while still providing its services to legitimate users and it can protect itself from external assaults. In this component any authorize user should be able to use the mobile application

- The development team must consider about the security of the user's data.
- Because all the users provide their private data to the system. There for the database security must be on a higher place.
- The system must use HTTPS protocol. It will give more secure data transaction by considering to other protocols
- Passwords should be stored in database using an encryption method
- Sessions will contain a timeout

- Maintains strong server-side controls

As we are using Firebase as the Database server the security is at an optimum level as firebase provides Real-time Database Security

3.5.4 Reliability

Reliability of a system is the ability to perform its normal operations with minimum failures over a specified time in a given environment.

- The reliability of retrieve landmarks from large databases are doing using CBIR method.
- The reliability of providing and classifying results of nearby dinning and accommodation places to a particular landmark will be achieved by using Naïve Bayes algorithm and the Logistic Regression algorithm.
- The required information by the users should be provide within minimum time without any failure
- The applications will be tested using several testing techniques to make sure it's probability of failure is very low value.
- All the validations should be done to data before entry to the database
- At a time of a failure, there should be a proper mechanism to notify the all users (notifications)

3.6 Other requirements

- The system should not crash
- It should not make the user frustrated, angry or terrified while using the system
- System should run perfectly without any feature limitations
- Functionality should be suitable to all end users
- Extensibility & Modifiability
- Adaptability

4 SUPPORTING INFORMATION

4.1 Appendix

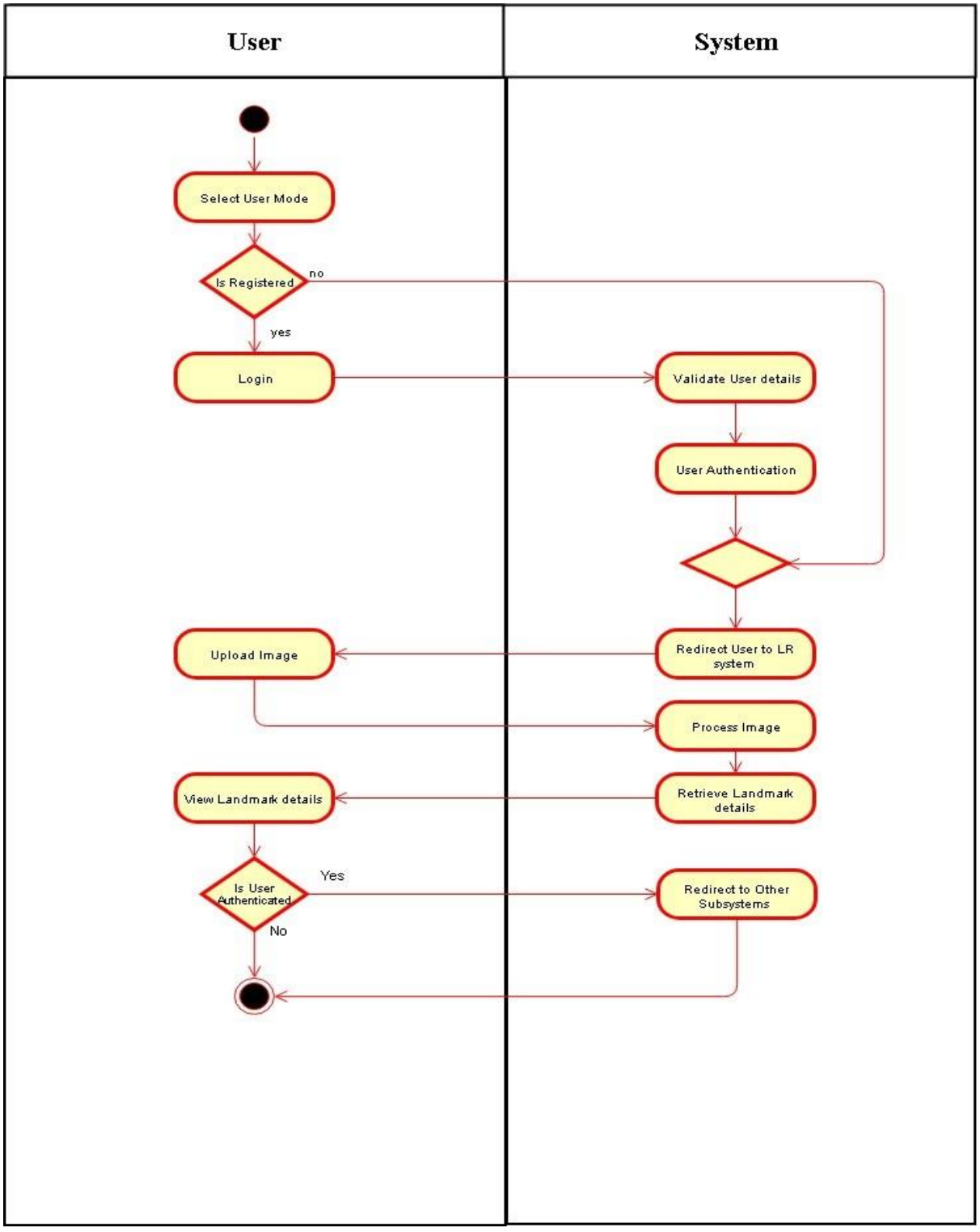

Table 20: Activity diagram for Landmark Recognition component

5 References

[3] D. Petrou *et al.*, “Search by sight: GoogleTMgoggles,” *2010 IEEE Hot Chips 22 Symp. HCS 2010*, 2016.

[4] “What is Google Goggles? - Definition from Techopedia.” [Online]. Available: https://www.techopedia.com/definition/25993/google-goggles. [Accessed: 09-May-2018].

[5] “Blindness : CamFind - Visual Search Engine.” [Online]. Available: http://access.uoa.gr/MOBILE_ATHENA/index.php/en/browse-by-disability/blindness/camfind-visual-search-engine-detail. [Accessed: 10-May-2018].

[6] “What is Bixby Vision and how do I use it? | Samsung Support UK.” [Online]. Available: http://www.samsung.com/uk/support/mobile-devices/what-is-bixby-vision-and-how-do-i-use-it/. [Accessed: 10-May-2018].

[1] “Twython¶,” *Twython - Twython 3.6.0 documentation*. [Online]. Available: https://twython.readthedocs.io/en/latest/. [Accessed: 10-May-2018].

[2] PromptCloud, “Restaurants on TripAdvisor | Kaggle,” *Countries of the World | Kaggle*, 15-Sep-2017. [Online]. Available: https://www.kaggle.com/PromptCloudHQ/restaurants-on-tripadvisor. [Accessed: 25-Apr-2018].

[3] “What is Backend as a Service (BaaS)? - Definition from Techopedia,” *Techopedia.com*. [Online]. Available: https://www.techopedia.com/definition/29428/backend-as-a-service-baas. [Accessed: 24-Apr-2018].

[4] *Google*. [Online]. Available: https://developers.google.com/maps/documentation/geolocation/intro. [Accessed: 18-Apr-2018].

[5] *Google*. [Online]. Available: https://developers.google.com/maps/documentation/geocoding/start. [Accessed: 18-Apr-2018].

[6] “Add Firebase to Your Android Project | Firebase,” *Google*. [Online]. Available: https://firebase.google.com/docs/android/setup. [Accessed: 09-May-2018].

[7] “How the Naive Bayes Classifier works in Machine Learning,” *Dataaspirant*, 19-Feb-2017. [Online]. Available: http://dataaspirant.com/2017/02/06/naive-bayes-classifier-machine-learning/. [Accessed: 28-Mar-2018].

[8] R. Bhatia, “Top 6 Regression Algorithms Used In Analytics & Data Mining,” *Analytics India Magazine*, 21-Nov-2017. [Online]. Available: https://analyticsindiamag.com/top-6-regression-algorithms-used-data-mining-applications-industry/. [Accessed: 07-May-2018].

[9] *Google Landmark Retrieval Challenge*, Kaggle, 12 Mar. 2018, www.kaggle.com/c/landmark-retrieval-challenge.

[10] *NCBI*, PMC, 13 Apr. 2018, www.ncbi.nlm.nih.gov/pmc/articles/PMC3317765/.

[11] https://machinelearningmastery.com/large-data-files-machine-learning/

[12] E. Agichtein, E. Brill, and S. Dumais. Improving Web Search Ranking by Incorporating User Behavior Information. In SIGIR, pages 19–26, ACM, 2006.

[13] http://www.dei.unipd.it/~maistro/papers/SIGIR2017-flmp.pdf

[14] “"City Guides Catalog",” [Online]. Available: https://play.google.com/store/apps/details?id=com.tripadvisor.android.apps.cityguide.catalog.

[15] C. J. C. Burges. From RankNet to LambdaRank to LambdaMART: An Overview. Technical Report, 2010.

[16] D. Petrou *et al.*, “Search by sight: Google™goggles,” *2010 IEEE Hot Chips 22 Symp. HCS 2010*, 2016.

[17] “Foursquare — Best City Guide,” [Online]. Available: https://play.google.com/store/apps/details?id=com.joelapenna.foursquared&hl=en.

[18] “Foursquare,” [Online]. Available: https://en.wikipedia.org/wiki/Foursquare.

[19] [Online]. Available: https://en.wikipedia.org/wiki/Swarm_(app).

[20] “Swarm App review,” [Online]. Available: http://www.apppicker.com/reviews/23493/swarm-app-review.

[21] “Swarm App review by foursquare,” [Online]. Available: http://appadvice.com/review/swarm-by-foursquare.

[22] P. S. M. Tracy Edes, “Getting started with TripCase Connect,” 2013 april 29. [Online]. Available: http://www.sabretravelnetwork.com/files/ttx/TTX%20presentation%20-%20Getting%20started%20with%20TripCase%20Connect.pdf.

[23] “TripCase – Travel Organizer,” [Online]. Available: https://play.google.com/store/apps/details?id=com.sabre.tripcase.android&hl=en.

[24] C. Lucchese, S. Orlando, R. Perego, F. Silvestri and G. Tolomei. Discovering tasks from search engine query logs. In TOIS, 31(3):14:1–14:43, 2013.