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Huna KSA

IT 497: Graduation Project Report
Product Release-2

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Huna KSA

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Abstract:
Ever since Saudi Arabia has opened for tourism, many tourists have started coming from all over the world. This new change allowed tourist sites to be set up all over the country. However, the problem lies with making such sites known to tourists. So, to make the discovery of tourist attractions easy, Huna KSA is a technological solution that has been developed for tourists as well as locals who are interested in touring the country. Huna KSA is an application that uses machine learning algorithms to recommend places for tourists based on their interest. Huna KSA main aim is to help encourage tourism in Saudi Arabia in compliance with the country's 2030 vision.

الملخص:
منذ أن فتحت المملكة العربية السعودية أبوابها للسياحة، بدأ العديد من السياح في القدوم من جميع أنحاء العالم. هذا التغيير الجديد ساعد على زيادة الطلب على الأماكن والمرافق السياحية المنتشرة في جميع أنحاء المملكة؛ لكن ومع هذا التقدم في مجال السياحة الداخلية فقد ظهرت مشكلة تتعلق بالتعريف بتلك الأماكن والمرافق للسياح. لذلك برزت الحاجة لتسهيل اكتشاف أماكن ومرافق الجذب السياحي في المملكة العربية السعودية لذلك فإن تطبيق "Huna KSA" يقدم حلاً تقنيًا، وقد تم تطويره من أجل خدمة السياح من داخل المملكة وخارجها. "Huna KSA" هو تطبيق يستخدم خوارزميات التعلم الآلي لاقتراح أماكن ومرافق للسياح بناءً على اهتماماتهم، كما يهدف بشكل رئيسي إلى مساعدة وتشجيع وتحفيز الزوار على زيارة واستكشاف الأماكن والمرافق السياحية في المملكة، والمساهمة في دعم صناعة سياحة داخلية آمنة ومتميزة تحقيقا لأحد مستهدفات رؤية المملكة العربية السعودية ٢٠٣٠.

Keywords: Saudi Arabia; Tourism; Attractions sites; Tourist; Recommendation system; Interests.

1 Introduction

When we talk about tourism in the Kingdom of Saudi Arabia, only select activities and destinations come to mind. But the fact is Saudi Arabia has a lot more in store. While it is true that the kingdom did not show interest in tourism until recent years, it is undeniable that it has made a great effort to attract visitors -including locals- to visit and discover parts of the country they were unaware of. This steady increase in tourism and entertainment in Saudi Arabia shows that the country is committed to make itself more welcoming than ever before. However, adding more tourist attractions is not enough. There must be a way to promote and showcase the many tourist destinations. Finding places to visit shouldn't be difficult for either foreign tourists or local ones. There should be a trustworthy resource for information on places tourists can access. This is where Huna KSA come into play. Huna KSA is a mobile application that serves as an information guide and is designed to provide tourists and locals in Saudi Arabia a wide range of options for things to do while visiting various cities in the kingdom. This chapter will introduce the problem that inspired this project, the solution, product vision, description of the approach, main contribution, and a summary.

1.1 The Problem

Saudi Arabia has many interesting and travel worthy destinations that a lot of people wish to visit. The challenge here lies in the ability to effectively promote sites based on individual interests. There are not many applications dedicated to advertising tourism in Saudi Arabia and especially recreational sites for minorities (like women and children) in Saudi Arabia. Women, for example, who are discovering a new city might find it difficult to find recreational spots specifically designed for them such as women only cafés, beaches, water parks, etc. There needs to be an application that makes convenient for women who are planning to visit new cities to find places that accommodate them specifically. Moreover, some amazing public tourist spots are not frequently visited due to the apparent lack of promotional pr media coverage. A city like Al-Ula, is home to one of Saudi Arabia's greatest tourist attractions: Maraaya. Yet, it's not as popular of a destination compared to the bigger cities due to the limited amount of information available about its activities. Also, Outdated methods of advertising such as brochures or billboards will not help draw much attention to less popular places since they are advertising methods limited by area. In response to the current issues facing Saudi tourism, we believe there should be an app that focuses on attracting both minorities and the general public who plan to tour Saudi Arabia by presenting them with many activities and attraction sites available in a city they may like to explore.

1.2 The Solution

Our solution is to develop a mobile application that will act as an information guide for all tourists and locals in Saudi Arabia. The app will:

- Enable tourists to view different categories in the city they select.
- Provide tourists with general information regarding a place.
- Recommend places based on interests the tourist will be asked to provide as input.
- Help women and children discover places specific to them.

The application will make use of a recommender system that will suggest places based on the tourist interests (content-based filtering). To do that, we will gather information about each individual tourist. Embedding a recommender system into our app will help tourists of Saudi Arabia enjoy places that cater to their interests. Additionally, the app will have a section dedicated to women where they can view the various places specific to them such as salons, gyms, cafes, etc., as well as a kids' section where parents can view places that suit their kids such as restaurants, playing area, etc. This will add a strong competitive advantage to our app compared to the other competitors.

Moreover, there will be an admin app where admins can log into to add, delete and edit places. The app's aim is to inform tourists of all the activities that the country has set up for everyone to enjoy.

1.3 The Scope

Huna KSA scope targets tourists and locals in Saudi Arabia looking for new and special experiences by tending to their needs and interests when it comes to their outing preferences by offering different categories in each city with many places to choose from. Each place will contain a description, comments section from previous visitors, and directions of the place on Google Maps. The application will be in English and will support Android devices.

To develop the application, we will first gather information about all the cities and the tourist destinations such as photographs, locations, and descriptions from several internet sources such as social media. We will make sure also to gather information about areas that are less frequently visited. The admin application will allow admins to log-in and add, delete or edit places and manage comments, then the changes will appear in the tourist application. We will work on different platforms such as Photoshop, Illustrator, and Adobe XD for UI/UX design, Figma, visual studio, Flutter framework by using Dart programming language, Android Studio, and python. In order to provide the tourists suggestions about other places we will implement a content-based recommendation system which will be available for tourist in the place details page. The recommendation system will list several places that align with the tourist's interests. Location will be provided for each place which we will implement using Google Maps API. The tourist will open the application and select one of the five cities we've listed - Riyadh, Jeddah, Abha, Al-Ula and Al-Khobar. We chose these cities based on their popularity as tourist destinations. To help the tourists more and save their time there will be 3 different categories in each city and they are general, women, and kids categories. The tourist will choose the category they want then a list of places will be shown to them, and they can select different types of places from the filters at the beginning of the page. After selecting a place, the tourist will be able to see the pictures, description, location and comments of the place and other suggestions will appear based on their interest.

1.4 Product Vision

For tourists and locals in the Kingdom of Saudi Arabia who plan to explore Saudi Arabia based on their preferences and interests; Huna KSA is a mobile application that acts as an information guide for tourist destination in the country. Unlike Saudi Tourism Tour, our product will specialize in recommending tourist destinations only meant for women and kids on top of the tourist locations that are available for the public.

1.5 Description of the Approach

In building our application we used Flutter (Dart programming language), we developed two applications with different pages for the admin and for the tourist, they are all linked to the same database in Firebase. After developing the applications, we started embedding Google Map in the code of several pages in the admin and tourist apps, we used an API key to use all what we need in our application from Google Map. After that we started to create the recommendation system using python code and obtained a (.csv) file from the Firebase to feed the model places to suggest to the user places based on their interests. In Flutter code we wrote a function that sends a POST HTTP request to Flask framework which accepts a list of user interests and returns a list of recommendations. These different processes are integrated together in the end to make up the Huna KSA application.

1.6 Main Contribution

Huna KSA app is designed to assist both locals and tourists in finding places in Saudi Arabia. It will save tourists time and effort while searching for places. Dedicating a part of our app to minority groups puts us at an advantage over other competitors because our app is designed to cater to the smaller groups of society and not just the public. Huna KSA offers a modern solution to the lack of promotion since it implements a recommendation system which can be thought of as the technological replacement for brochures and billboards which are now outdated methods of promotion. The inspiration for this application stemmed from the ever-growing need for a single platform that incorporates places from all over the kingdom and is accommodating to different groups such as the general public, women, and kids. Huna KSA aims to make it easier for everyone to find places that are appropriate for them and in turn increase tourism rates in the kingdom and help the country's economy.

1.7 Summary

This chapter introduces Huna KSA application along with the problem that acted as the inspiration for it as well as the proposed solution, product vision, and approach. The document will in delve into the complete development journey starting from the background chapter that explains Google Maps API and the recommender system technology and its different filtering methods. And since Huna KSA has preexistent rivals in the market, we will also explore and compare each rival app with Huna KSA in the literature review section. The necessary requirements to develop our app correctly were also collected and analyzed in the requirements section. Further along this document, Huna KSA's design and implementation will be covered with many graphs illustrating the front-end and back-end code and design nature of Huna KSA. Towards the end of this document, the Huna KSA app is tested, evaluated, and has the results discussed. This document concludes by stating the local and global impact of Huna KSA, future work to be done, and a section to acknowledge all who contributed and had a hand in making this app come to life.

2 Background

2.1 Overview

Huna KSA is an application that enables tourists and locals in Saudi Arabia to learn about attraction sites as well as various recreational sites that are around them based on their interests. The places presented to them will help them explore the entertainment options that fit their preferences the most. Huna KSA takes advantage of recommender system algorithms that will help tourists explore all options that match their interests. Huna KSA will also make use of Google Maps API technology to help tourists see where the place they wish to visit is located.

2.2 Recommender Systems

Recommendation Systems are recognized as a type of machine learning algorithms concerned with predicting a user's habits and preference. This type of information filtering system is powerful as it has been shown to increase companies' revenues as well as greatly improve user experience. Recommender systems are used by different companies to effectively advertise for items that don't get much attention which helps reduce the risk of an application's items or products being prone to the long-tail effect (in which only a small group of items or products get featured and shown to users). Recommendation systems are used in many businesses - big and small - since they keep users engaged, which is a desirable state.[1]

2.3 How Recommender Systems Work

Recommendation systems are powered by data received as input from users so the system's algorithm could analyze and filter the data and output results as personalized and relevant recommendations that can actively engage users.[2] The process recommendation systems undergo can be divided into 4 main stages:

- **Collecting**

  The data collected are of two key types: explicit and implicit.

  1. Explicit data: like ratings or likes given by users.
  2. Implicit data: include data like views or a user's watch history.

- **Storing**

  Choose the database type most suitable to store the data collected from the previous step.

- **Analyzing**

  Different analyzation methods, such as real-time and near-real-time, are used to find similar items or products.

- **Filtering**

  The system filters the data using suitable recommendation system type (or types in case it is a hybrid) to provide personalized and relevant recommendations.[3]

2.4 Recommender System Use-Cases

Some main use-cases of recommendation systems include:

- Personalizing content displayed to users in which the items recommended to each user differ depending on the user's behavior to help improve user experience.
- Optimizing the search experience of products this helps categorize items based on specific criteria or features such as gender, location, etc.[4]

2.5 Types of Recommendation Systems

There are a variety of recommendation systems being implemented in today's market. Each type has qualities that set it apart from other recommendation systems. This section will dive into the 3 main types: collaborative, content-based, and hybrid systems.

2.5.1 Collaborative Filtering

Collaborative filtering is a recommendation algorithm that takes the users' behaviors and activities into account to predict similarities between users and generate recommendations. It recommends items to a user based on users with similar interests. Collaborative filtering is the most implemented method today since it is deemed to have the most effective approach to recommending items.[5] The reason being that it uses historical data (implicit data) from other users to make assumptions about users who share similar interests to suggest items he or she might also like. For example, user X might like shopping, camping, and sightseeing while Y might like camping, hiking, sightseeing. Seeing as user X and Y share an interest when it comes to camping and sightseeing, we can assume that X might be interested in hiking while Y might try shopping. Collaborative filtering has two types of filtering techniques: User-User collaborative filtering and Item-Item collaborative filtering.[6]

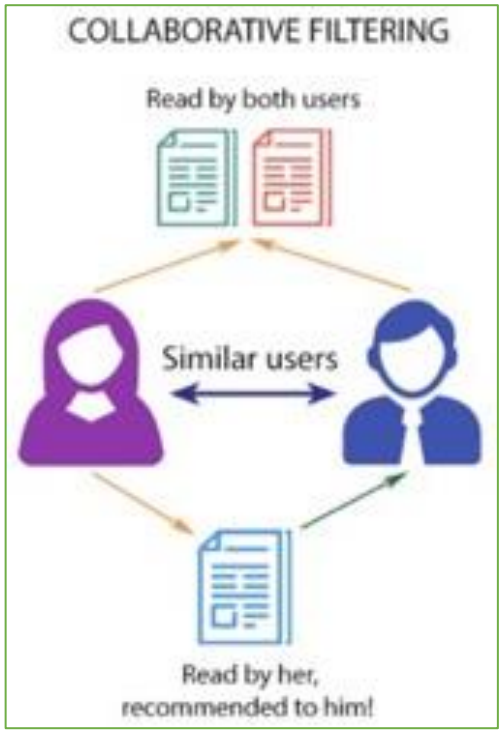

Figure 1 - Collaborative Filtering

Advantages:

- ✓ Can recommend complex items accurately.
- ✓ No need for domain knowledge.

Disadvantages:

- ✗ Cannot handle new items since the model does not get trained when new items are added.
- ✗ Side features are mostly ignored (e.g. Place availability or service).

2.5.2 Content-Based Filtering

In content-based filtering, items are shown to users based on how relevant they are to the past items the user has used. This type of filtering depends on the descriptions and keywords used to refer to the content the user consumes.[7] For example, if the user likes camping then the user will get recommended places and activities that are outdoor ones. Content based filtering learns about each user before it can recommend items he or she will like. Unlike collaborative filtering, content-based filtering doesn't analyze other users' behaviors before recommending items to any given user. When the user is new, he or she will be shown items based on popularity. Gradually, the system will learn about the user through the choices they make so the system can recommend items similar to items the user finds interesting.[8]

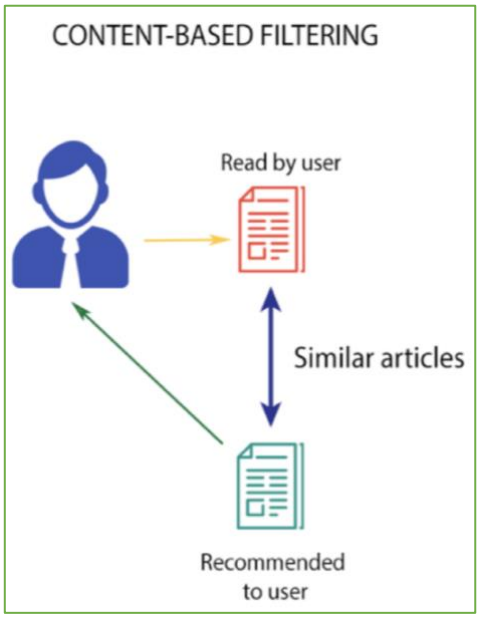

Figure 2 - Content-Based Filtering

Advantages:

- ✓ The model doesn't need data about other users.
- ✓ Easy to scale a great number of users.
- ✓ Can detect distinct interests of a user and recommend items to them that few others might like.

Disadvantages:

- ✗ The presented features are hand-engineered to some extent.
- ✗ Requires a lot of domain knowledge.
- ✗ This method is unlikely to expand on the user's existing interests.

2.5.3 Hybrid Recommender Systems

Each Recommender system has its own advantages and disadvantages. But instead of weighing one's options when trying to figure out what recommender system is best for the data, hybrid systems offer a combination of recommender system types that best suits the data that will be fed to the recommendation model. Hybrid systems combine the strengths of other recommender system types to create a system that is efficient and more accurate which in turn overcomes the weakness of one recommender system. There are seven total approaches taken to construct hybrid systems:

1. Weighted
2. Switching
3. Mixed
4. Feature Combination
5. Feature Augmentation
6. Cascade
7. Meta-level

These different approaches can also be combined to help make models that are most fit for the data type of a given dataset.[9]

2.6 Google Maps API

Google Maps API is a web-based API used to provide geographic information, such as locations, to places all over the globe. It is a way to implement Google Maps into sites and applications to add relevant content that is useful for users. Some of its main features include directions, places, geocoding, roads, and data layers. Huna KSA will make use of the API's directions feature to help tourists get directions to the places presented to them in the Huna KSA app.[10]

2.7 Summary

In this project, we embedded a recommender system model to help tourists find places matching their interests which will in turn keep them engaged with our app. Our recommender system uses content-based filtering to display recommended places to the tourist based on what they have selected from the interests. We chose content-based filtering since its outputs are highly relevant to each individual tourist and that is our desired goal and our priority. Content-based filtering also targets each tourist and recommends to them things they will most likely be interested in therefore increasing the model's benefit to the tourist.[11] We will also use Google Maps API to allow tourists to view place location as a feature in Huna KSA.

3 Literature Review

In this chapter, we will provide a comprehensive review of similar applications to identify their important features and the strengths and weaknesses that differentiate each of them. There are two types of competitors: local competitors and global competitors. During our research, it became clear that the applications in this field are divided into two sections: applications for displaying places, and applications for displaying and booking places.

3.1 Competitive Product Analysis

3.1.1 Applications for Display Places

عيشها | Enjoy Saudi

(عيشها|Enjoy Saudi) is an application that displays a calendar of all events, tourism, recreational and other activities in various cities of the Kingdom of Saudi Arabia, which are suitable for a range of age and social groups.[12]

List of important features:

- Simple to go through the calendar and find events.
- logging in to an application to manage favorite activities.

Some pictures for Enjoy Saudi | عيشها's application:

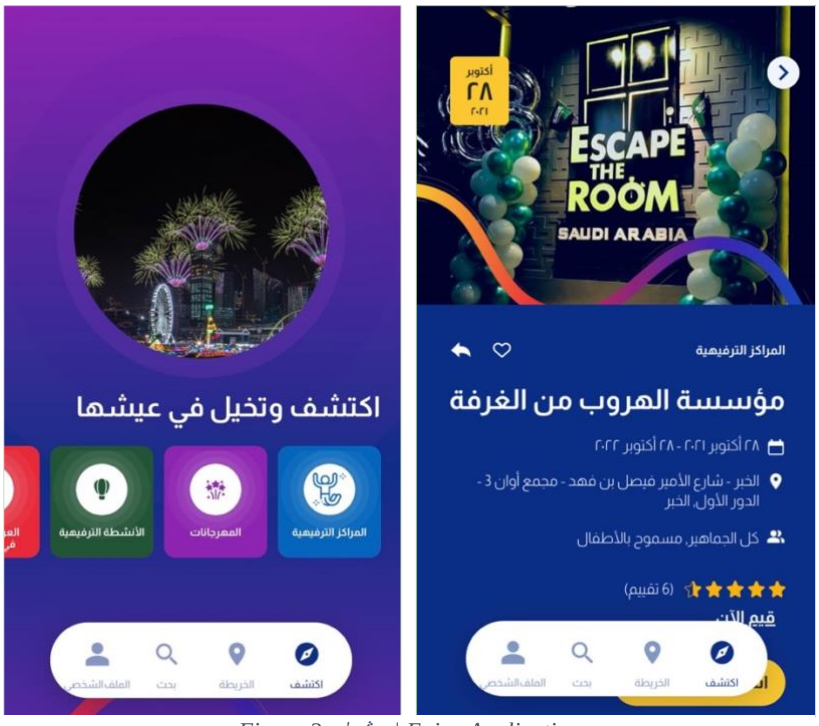

Figure 3 - عيشها | Enjoy Application

جولة السياحة السعودية | Saudi Tourism Tour

"(Saudi Tourism Tour | جولة الســياحة الســعودية) is a service tourism application that provides information about tourist attractions in the Kingdom of Saudi Arabia including all entertainment and service facilities in a simplified and easy-to-use form".[13]

List of important features:

- A list of tourist guides for each city, with the ability to communicate with them via mobile number and evaluating their service on the app.
- Photo library, which includes multiple photos of different places around the Kingdom of Saudi Arabia, including their sources.

Some pictures for Saudi Tourism Tour | جولة السياحة السعودية's application:

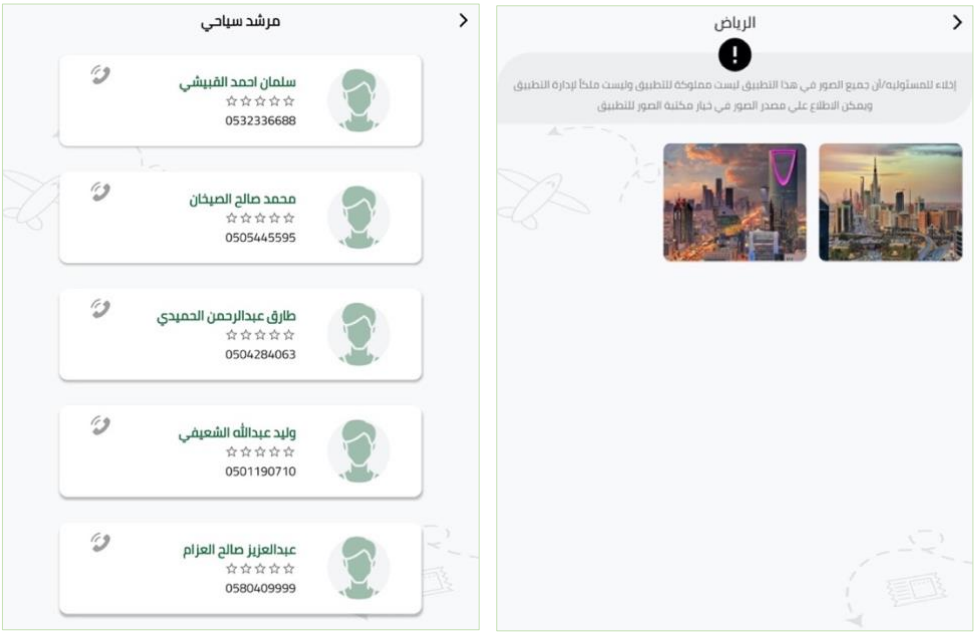

Figure 4 - جولة السياحة السعودية | Saudi Tourism Tour Application

Foursquare

(Foursquare) is an application that is considered to be a guide for different countries around the world, it brings the user closer to a community of people who are similar to him or her in interests such as the love of exploration.[14]

List of important features:

- The user can follow brands, influencers, and friends' accounts by logging into the app, which makes it simpler and faster to find the best experiences.
- The ability to accurately search using a variety of filters, such as distance between the place and the user's location, rating, price, etc.
- The ability to log in with the user's Facebook account.
- The ability to keep a history of the places the user has previously visited with the ability to attach photos.

Some pictures for Foursquare application:

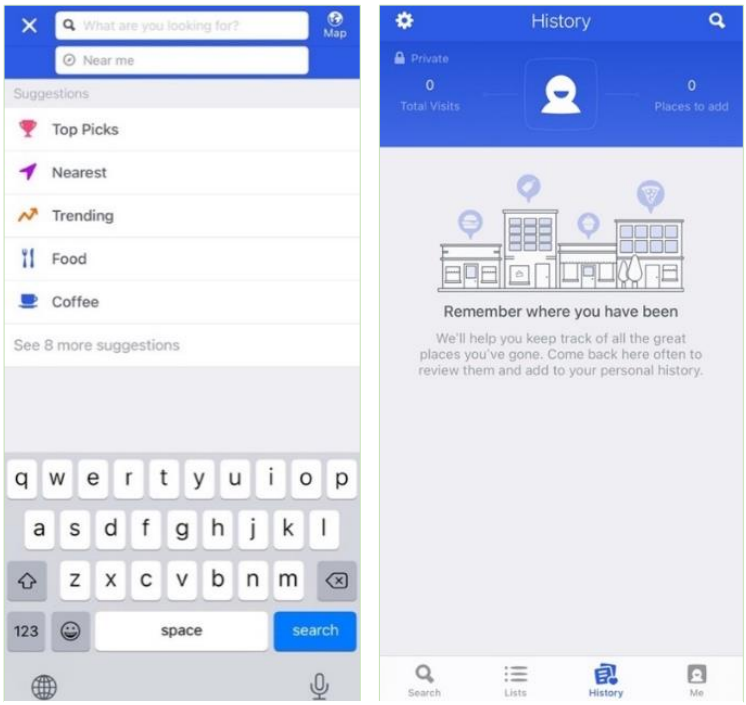

Figure 5 - Foursquare Application

3.1.2 Applications for Display and Book Place

روح السعودية | Visit Saudi

(Visit Saudi | روح السعودية) is an application that displays all the activities, events and tourist attractions in the Kingdom of Saudi Arabia, with an interactive map that displays all the events and tourist attractions.[15]

List of important features:

- A list of experiences that can be experienced with individuals affiliated with the General Authority Tourism, including the price of each experience and details about it, such as: a simplified overview of the experience, the appropriate ages for the experience, its duration and more.
- The ability to book experiences through the application.

Some pictures for Saudi Visit | روح السعودية's application:

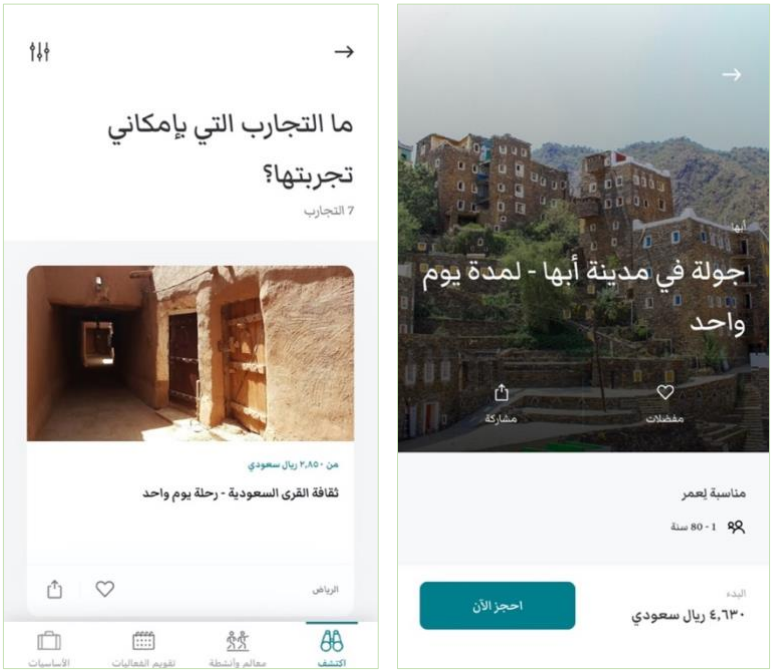

Figure 6 - روح السعودية | Visit Saudi Application

هاو | Hao

(Hao | هاو) is an application that displays experiences and hobbies in various fields that are held in the cities and regions of the Kingdom of Saudi Arabia.[16]

List of important features:

- Competitive booking rates.
- The possibility of gifting an experience.

Some pictures for Hao | هاو's application:

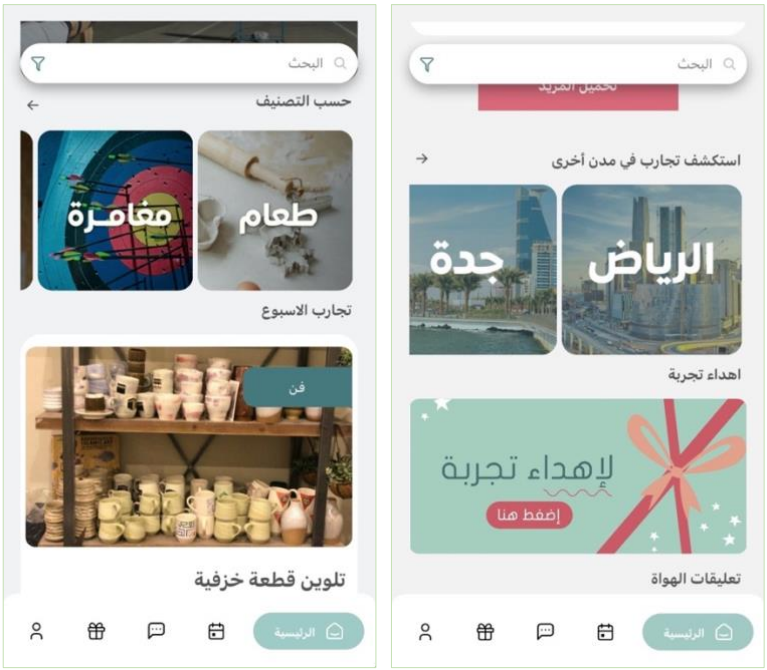

Figure 7 - هاو | Hao Application

TripAdvisor

(TripAdvisor) an application that aims to help you get a better travel experience, through planning and then booking, or even while traveling.[17]

List of important features:

- Get travel tips by accessing millions of reviews about hotels, restaurants, tours and many more from travelers.
- Possibility to participate and collaborate in travel plans created through the application.

Some pictures for TripAdvisor application:

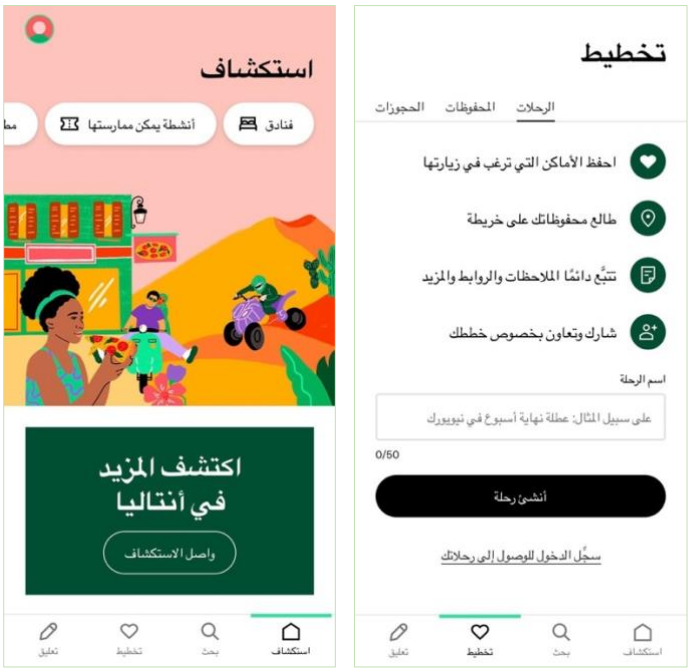

Figure 8 - TripAdvisor Application

3.2 Comparison Between Similar Application

Table 1 - Comparison Between Similar Application

Applications / Features	عيشها Enjoy Saudi	دولة السياحة السعودية SAUDI TOURISM TOUR	ؤ	هاؤ	Tripadvisor	FOURSQUARE	Huna KSA
Support English Language	✓	✓	✓	✓	✓	✓	✓
Filtered Search	✓	✓			✓		✓
Favorite Page	✓	✓	✓		✓	✓	✓
Users Comments				✓	✓	✓	✓
Book a tour guide		✓					
Book a Place			✓	✓	✓		
View location directions	✓	✓	✓	✓	✓	✓	✓
Cities Category	✓	✓	✓	✓			✓
Reservation			✓	✓	✓		
Dedicated to cities of Saudi Arabia	✓	✓	✓	✓			✓
Women Category							✓
Kids Category							✓
Recommender System	✓				✓	✓	✓
Technical Support		✓	✓	✓	✓	✓	

3.3 Summary

In this chapter we looked into several existing applications that share some of our system's criteria. We reviewed and analyzed several applications similar to ours and our competitors found in Google Play. As shown in the last table, Enjoy, Saudi Tourism Tour and Foursquare all show different tourist destination and their information. Visit Saudi, Hao and TripAdvisor are applications that provide different tourist places with their information in addition to the booking feature. Huna KSA combines features from different applications in one system. Huna KSA also offers a unique feature which is a women and kids' category to make it easier for women to find the places designated for them with ease and also for the kids of families. These applications provided us with an insight as to what features we could implement in Huna KSA. The current competitor apps found in today's market will be considered when eliciting requirements and defining functions and features in the next chapter.

4 System Design and Development

4.1 Methodology

The method we used in our project is agile methodology. Agile is an approach to software development that seeks the continuous delivery of working software created in rapid iterations. It is all about delivering small pieces of working software quickly to improve customer satisfaction.[18] Agile has different methods in agile testing but our chosen method is scrum, which concentrates specifically on how to manage tasks within a team-based development environment and based on continuous learning and adjustment to fluctuating factors. It consists of three roles with different responsibilities, and they are: Scrum master, Product owner, Scrum team. There are three artifacts in scrum. A product backlog, a sprint backlog, and an increment or a sprint goal. They are the three constants that we continue to revisit and invest in overtime. Working on the agile methodology using the scrum structure helped us clarify priorities. It forces us only on concrete next steps that are prioritized. It allowed us to continuously improve the project with every sprint, rather than trying to perfect the product right out of the gate. It helped us naturally adapt to changing conditions and user requirements, with reprioritization built into the process and short release cycles to constantly learn and improve.

- **Jira:** Jira is a software application allows teams to track issues, manage projects, and automate workflows.[19] It provided us with scrum boards, which we used to manage tasks, and provide transparency throughout the software development life cycle.[1]
- **GitHub:** GitHub is a website and cloud-based service that helps developers store and manage their code, as well as track and control changes to their code.[20] Using it made it easy to work on the project and merge the changes in the master branch efficiently.[2]

[1] https://2022-1st-gp21.atlassian.net/jira/software/projects/GP/boards/1/backlog
[2] https://github.com/GP1-21/2022-GP1-21

4.2 System Requirements

Huna KSA is an application that targets tourists of Saudi Arabia and offers a variety of places all over the country they could visit. The app will present tourists with sites that cater to their interests to make their experience on the app more engaging. To achieve this, we need to first study and analyze our system and potential users to ensure that users will find the Huna KSA app helpful.

4.2.1 System Users

Huna KSA is an application that is designed for tourists who want to know about places in Saudi Arabia with detailed information about each place, regardless of their educational level. Huna KSA users fall under two categories: tourists and admins.

Tourists are users who will interact with the application's main features (such as viewing places and posting comments). These users usually get on the app to browse through numerous places in search of one they might like and want to visit or post comments under places they have already been to. Tourists should have an Android mobile device and should be familiar with it. To use the application, tourists don't need to be technologically savvy though little technical expertise would be optimal to effectively use and interact with the application.

The second type of Huna KSA users are admins. Admins manage all the places presented in the Huna KSA. They can add, delete and edit places shown to tourists. They are also able to manage comments posted from the tourists if the comments are irrelevant to the place they are posted under. Unlike tourists, admins are required to have relatively more advanced computer skills. Admins should have sufficient technical expertise, knowledge, and experience to properly manage the application. For system management and control, the admins need an Android mobile device.

4.2.2 Requirements Elicitation and Analysis

The information needed for our system to satisfy its users requires us to first get to know and understand the users and their needs. To achieve this, we had different potential users undergo two requirements elicitation methods: interviews and questionnaires. We had users answer several questions revolving around their experience with our domain (tourism in Saudi Arabia) to ensure the system will meet the users' needs once we begin to implement it.

- Interviews

This section summarizes the interviews in Appendix A.

To interact with the users one-on-one, several interviews were held. The interviewees were people who have traveled multiple times and have sufficient experience regarding activities and sites located in the city they live in. Each interview was composed of 5 open-ended questions to allow the interviewees to express themselves as openly and freely as possible. Throughout the interview we focused on what the interviewees' answers had in common and what views they had on certain things while also keeping in mind their different views regarding the topics mentioned in some questions. Interviewees stated that they decide to go somewhere based on various factors such as time, who is accompanying them, whether they are going solo or with a group, or whether the place is suitable for them (crowded, level of interest, open/closed). All interviewees agree that women only places are not advertised enough and in order to find such places they would have to do a lot of web surfing since there isn't a platform dedicated to providing them with information about women only places. When we asked about what tourist sites interviewees would recommend, their answers varied with some recommending cities they find most interesting and worthwhile to visit (Al-Ula, Abha, and Alnmas) and with others listing places they had the most fun in (Escape rooms and Al-Masmak). Additionally, most interviewees reported that finding a place to go is a tedious task because of the time they spend web surfing in search or a place that lines up with their taste. Each interview ended with the interviewees providing their opinion about an app like Huna KSA. In their opinion, Huna KSA would save them time and effort when looking for a suitable place to go to as long as it was to their taste and interest while also being user friendly. Hence, we can conclude from the interviews that Huna KSA is strongly encouraged by potential users

since it provides features that target an overlooked demographic (women) when it comes to the entertainment domain.

- Questionnaire

This section summarizes the first questionnaire in Appendix B.

To get a better idea about our users who are women and men with different backgrounds and ages. We sent out a questionnaire containing 10 close-ended questions regarding what potential users thought about certain topics. The questionnaire brought up questions about if participants plan before taking a trip, whether they face any challenges while on a trip in Saudi Arabia or if they struggle to find women only places or not, along with questions to help us pinpoint which activities they like to do. We also had participants share their whether they would be willing to consider using an application that provides tourist destination in Saudi Arabia. The questionnaire was created using "Google forms" and was posted on social media (e.g. WhatsApp). We have received 66 total responses from both genders.

According to our questionnaire, about 32% of participants search for places before they go on a trip, while 64% search both before and after they go on the trip. 36% of people struggle to find places while they are traveling and 61% of people only sometimes find it difficult to find places. 56% of participants spend more than 30 minutes looking for places in new cities while 35% spend just between 20 to 30 minutes, and the rest spend less time. Interestingly, we learned that people completely differ when it comes to the kinds of places and activities they prefer, some choose cultural places, others prefer recreational places like shopping malls. About 60% of women struggle to find places for women only compared to 27% who have neutral view on the matter. The questionnaire results also show that a whopping 98.5% of participants read reviews of places before they go to visit the city while the rest don't. This means that participants consider comments to be a key feature for an app to have. 92% of female participants have never used an app that displays women only places while only 8% did. The questionnaire concluded with 82% of participants showing interest for an app that provides tourist destinations with a section for women only places with an additional 14% of them reporting that they are at least somewhat interesting. These statistics serve as positive indicators that Huna KSA would be a unique addition to the market.

4.2.3 User Interactions

In our project there are two types of users that interact with the system:

Tourists who need to search for places that match their interests and can read English regardless of their educational level. So, to open the application, Tourists should have internet connection to use it. For the technical experience, it needs a little experience to operate with the system.

Admins who are responsible for managing the application by adding, deleting and editing places. They should be able to read English and they should also have a relatively higher technical skills and education to manage the application. To operate the application, the admin must have an internet connection, and need sufficient experience to work with the system.[21]

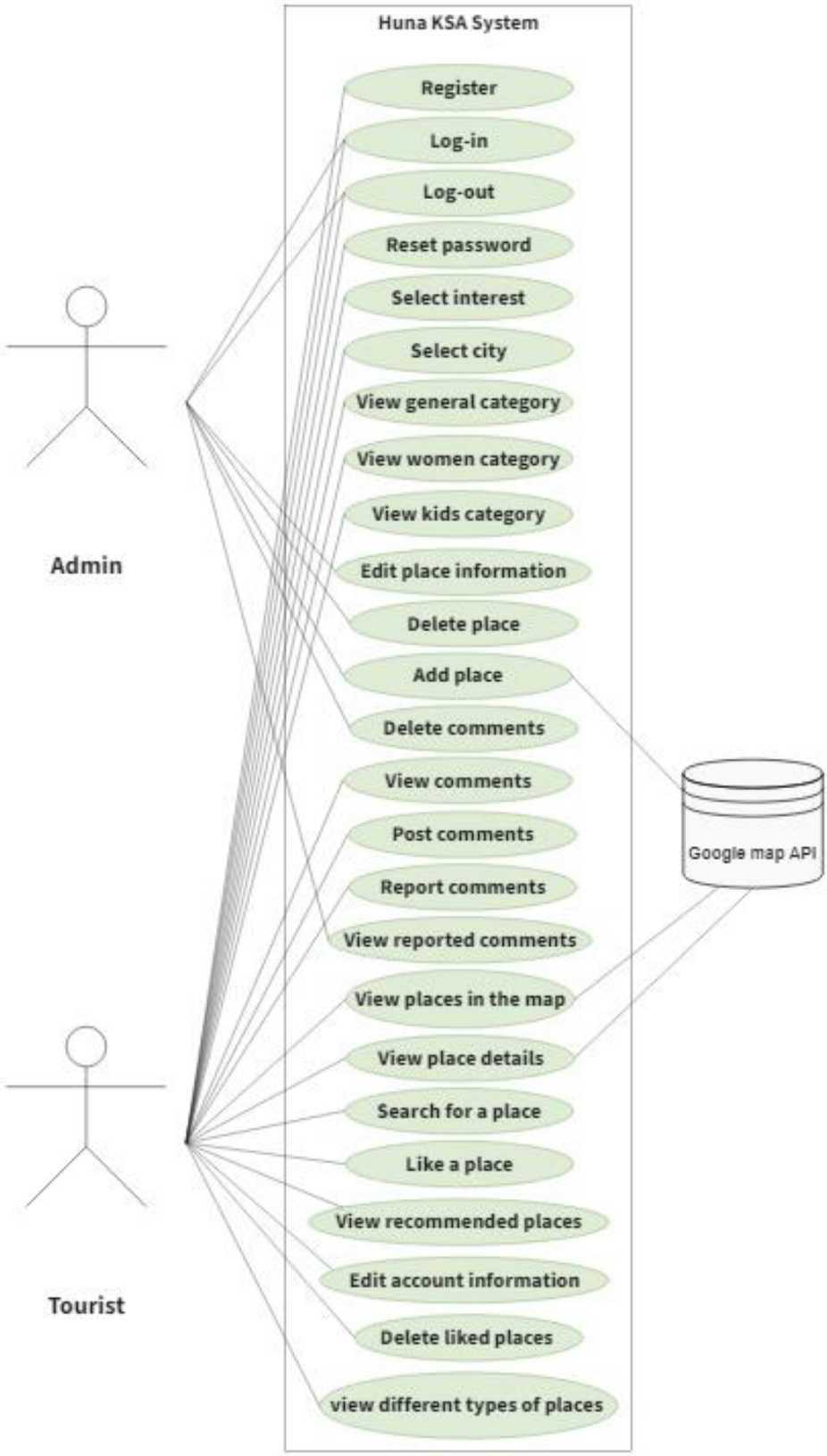

Figure 9 - User Interactions

4.2.4 Roadmap

The roadmap describes how our product will build and released through a series of increments over a given period. Within each increment, the product will undergo important factors as shown in the Figure 10 below.

Sprint 0 is where we set up the essential tools, download the required programs, and setup the environment, such as: Android Studio, Visual Studio Code and Flutter. Sprint 1 is where we begin designing the Tourist app, as well as build a database with tables for Admin, Tourist, Comment and Places, and generating Tourist accounts. Sprint 2 includes new features like the ability to search for cities and places, adding a new comment or report the comments of other Tourists, as well as adding places to the favorites page. Sprint 3 focuses on designing the Admin app, creating an account for it, and enabling it to add, edit, delete places and view, delete or keep Tourists' comments. Sprint 4, focuses on building the Google Map API and Recommendation System, integrating it into our app. Finally, on Sprint 5 we dedicated it to thoroughly testing applications. The roadmap for all of this is shown in the Figure 10 below.[22]

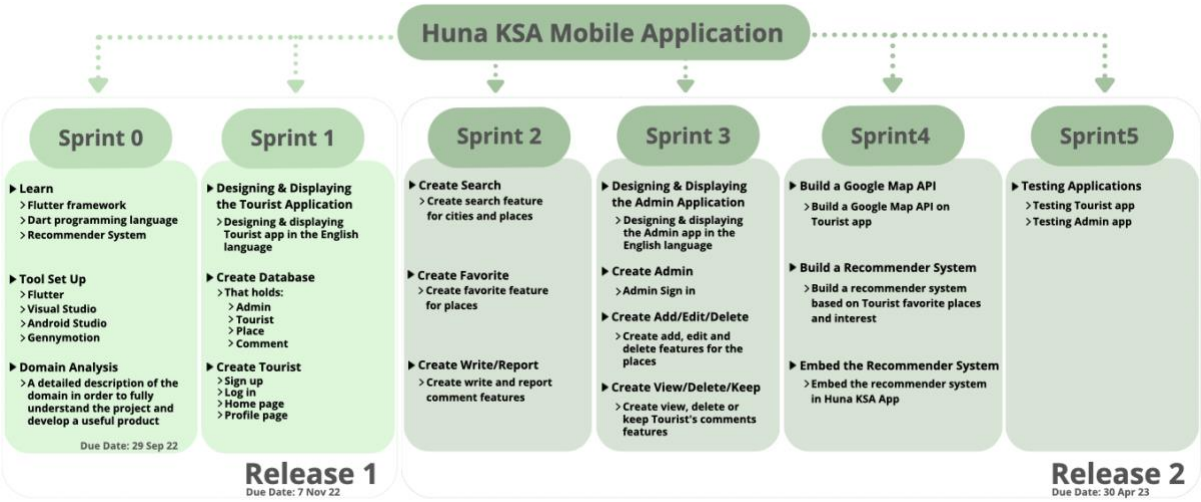

Figure 10 - Huna KSA Roadmap

4.2.5 Product Backlog

The product backlog refers to a prioritized list of functionalities Huna KSA will contain. We first started by writing the acceptance criteria of each user story, then we defined our definition of ready, which is a criterion user stories must achieve in order for them to be ready to add into future sprints.

Table 2 – Product Backlog

ID	**PBI** (User story)	**Size** (Story points)	**Type** (Feature, defect, technical work, knowledge acquisition)	**Status** (To do, in progress, or done)	**Acceptance Criteria** The conditions of satisfaction that must be met for that item to be accepted.
Tourist (user)					
1	As a tourist, I want to register on Huna KSA application so that I can be able to use its functions.	2	Feature	Done	As a new user (Tourist) of Huna KSA, if I register then a new account will be created, and I will be able to use the applications features given that: I filled out all the required fields. I have entered valid credentials.
2	As a tourist, I want to log-in to Huna KSA so that I can access my account.	2	Feature	Done	As a logged-out tourist, I can log into my account when I enter a valid email, and password.
3	As a tourist, I want to be able to log-out when I'm done using Huna KSA so that my account remains secure.	2	Feature	Done	As A logged-in tourist, if I log-out then all my account information will no longer be accessible, and I will be redirected to the log-in page.
4	As a tourist, I want to be able to reset my password in case I forget it so that I can get back to my account.	2	Feature	Done	As a logged-out tourist if I can't recall my previous password, I will be sent an email that will allow me to create a new password.
5	As a tourist, when I register for the app, I want to select my interests from a list of interests so that I can customize my experience in the app.	2	Feature	Done	As a new tourist of the application, when I select my interests, the system will show me places related to my interests in place details page.

6	As a tourist, I want to select a city from a category of cities so that I can view places in the city.	2	Feature	Done	As a tourist if I choose from the city category then the system should display all places in that city.
7	As a tourist, I want to view place details so that I can learn more about it.	5	Feature	Done	As a logged-in tourist, the system should direct me to the place information page when I click on a place.
8	As a tourist, I want to be able to view where a certain place is located so that I know the directions for the place.	3	Feature	Done	As a logged-in tourist, I should be able to press on the directions buttons if I wish to see the place's location on the map.
9	As a tourist, I want to view comments other tourists have left about a place so that I know what others think about this place.	3	Feature	Done	As a logged-in tourist, I should be able to view all comments when I scroll down the place details page.
10	As a tourist, I want to post comments under a place so that others can see what I have to say about this place.	3	Feature	Done	As a logged-in tourist, the system should post my comment in the place details page when the post button is pressed.
11	As a tourist, I want to click like on a place so that I can add it to the favorite page.	3	Feature	Done	As a logged-in tourist, the system should indicate the place has been liked by changing the button color and it also should display the liked place in the favorites page.
12	As a tourist, I want to report other's comments so that admins can delete them.	5	Feature	Done	As a logged-in user, the system should notify the admin about a comment when I click the report button so the admin could see which comment should be deleted.
13	As a tourist, I want to view women category so that I can view places that are designed only for women.	5	Feature	Done	As a logged-in tourist, when I choose the women only category the system should display all the women specific places.
14	As a tourist, I want to view general category so that I can view places that are general.	5	Feature	Done	As a logged-in tourist, when I choose the general category the system should display all the general places.

15	As a tourist, I want to view kid's category so that I can view places that are designed only for kids.	5	Feature	Done	As a logged-in tourist, when I choose the kids only category the system should display all the kid's specific places.
16	As a tourist, I want to be able to search for a place so that I can find it faster.	5	Feature	Done	As a logged-in tourist, when I enter the name of a specific place the system should display the place in the search results if: The name place I search for is in English. The name of the place is spelled correctly.
17	As a tourist, I want to view different types of places by clicking on the filter so that I can find the place that I want.	3	Feature	Done	As a logged-in tourist, I should be able to select from different types of places by using the filter so I can look at other places that match the selected type.
18	As a tourist, I want to view recommended places so that I can view places similar to what I'm interested in.	5	Feature	Done	As a logged-in tourist, the system to show me the recommended places based on my interest.
19	As a tourist, I want to edit my account information so that I can keep my account updated.	3	Feature	Done	As a logged-in tourist, the system should allow me to change my information (e.g., username) if the new information I input is valid.
20	As a tourist, I want to edit my interest so that I can keep my interest updated.	5	Feature	Done	As a logged-in tourist, the system should allow me to change my interests.
21	As a tourist, I want to be able to delete liked places in the favorite page.	3	Feature	Done	As a logged-in tourist, the system should allow me to delete places in the favorite page.
Admin					
22	As an admin, I want to be able to log-in to Huna KSA so that I can manage the app.	2	Feature	Done	As a logged-out admin, I can log-in to my admin account when I enter a valid username and password.

23	As an admin, I want to be able to add places so that tourists can browse them.	5	Feature	Done	As a logged-in admin, if I add a place to the app, then the newly added place should appear on the tourists' interface.
24	As an admin, I want to be able to edit a place's information page so that the information stays up to date.	5	Feature	Done	As a logged-in admin, if I edit the information of a place then a confirmation message should pop up; then once I have pressed the 'save' button the new changes I made should appear on the tourists' interface.
25	As an admin, I want to be able to delete a place so that old/shut down places don't show up to the tourists.	3	Feature	Done	As a logged-in admin, a confirmation message should pop up before I delete a place then once I do press the 'delete' button, the place should disappear from the tourists' interface.
26	As an admin, I want to view the user reported comments so that I can delete comments under any given place to keep the comments posted under each place specific to it.	5	Feature	Done	As a logged-in admin, a confirmation message should pop up before I delete a comment then once I do press 'Yes', the comment should disappear from the tourists' interface. When I click on the keep button the comment will stay in the user interface.
27	As an admin, I want to be able to log-out when I'm done using Huna KSA so that my account remains secure.	2	Feature	Done	As a logged-in admin, a confirmation message should pop before I log-out then all my account will no longer be accessible, and I will be redirected to the log-in page.

4.3 System Design

4.3.1 Architectural Diagram

The client-server architecture is a distributed computing system where jobs are separated between the software on the server computer and the client computer. Web-based applications, mobile apps, or e-commerce are some examples of the client-server architecture. The components of the client-server system are split into two units: physical and logical components. The physical components are servers, computer units, input/output devices, and networking. The logical components are web pages, data, programming scripts, protocols, e.g., HTTP, IP and API.[23] We chose a Client-Server model for our project (Huna KSA) because it uses the same concept where the users request specific data in the application from the server then the server requests the required data from the database and responds to the user with the required results.[24]

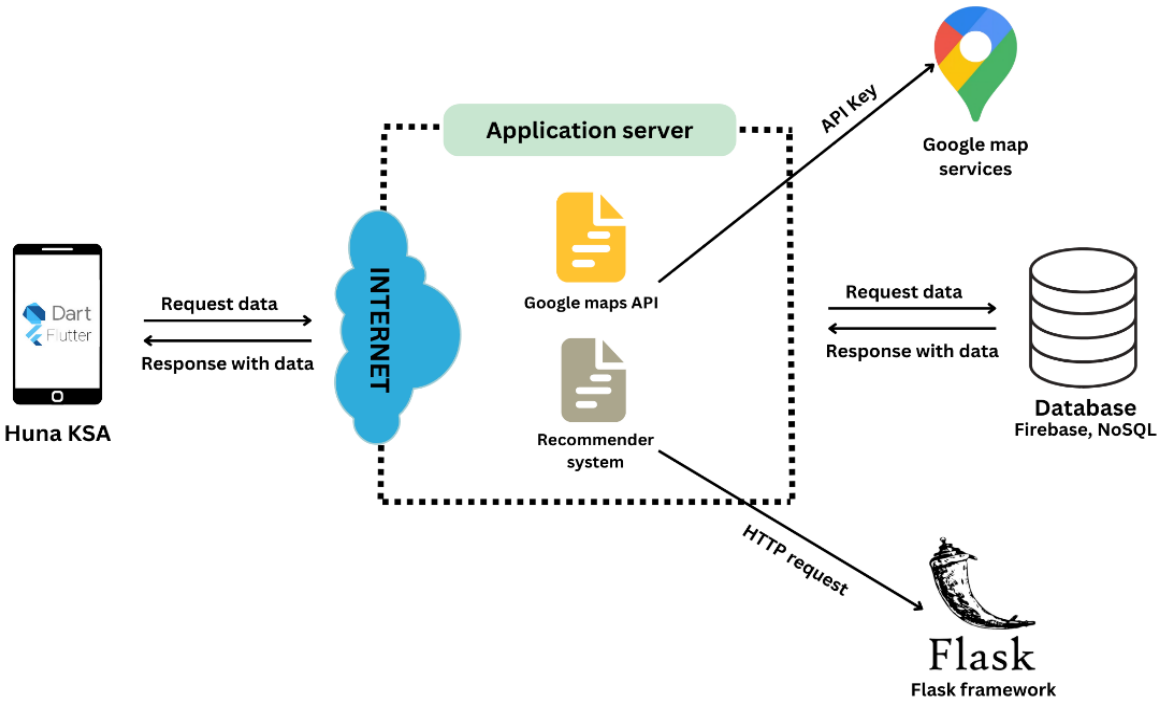

Figure 11 - Architectural Diagram

4.3.2 Class Diagram /DFD

Huna KSA system decomposed into Admin, Tourist, Comment, and Place as shown in the Figure 12 below.[25]

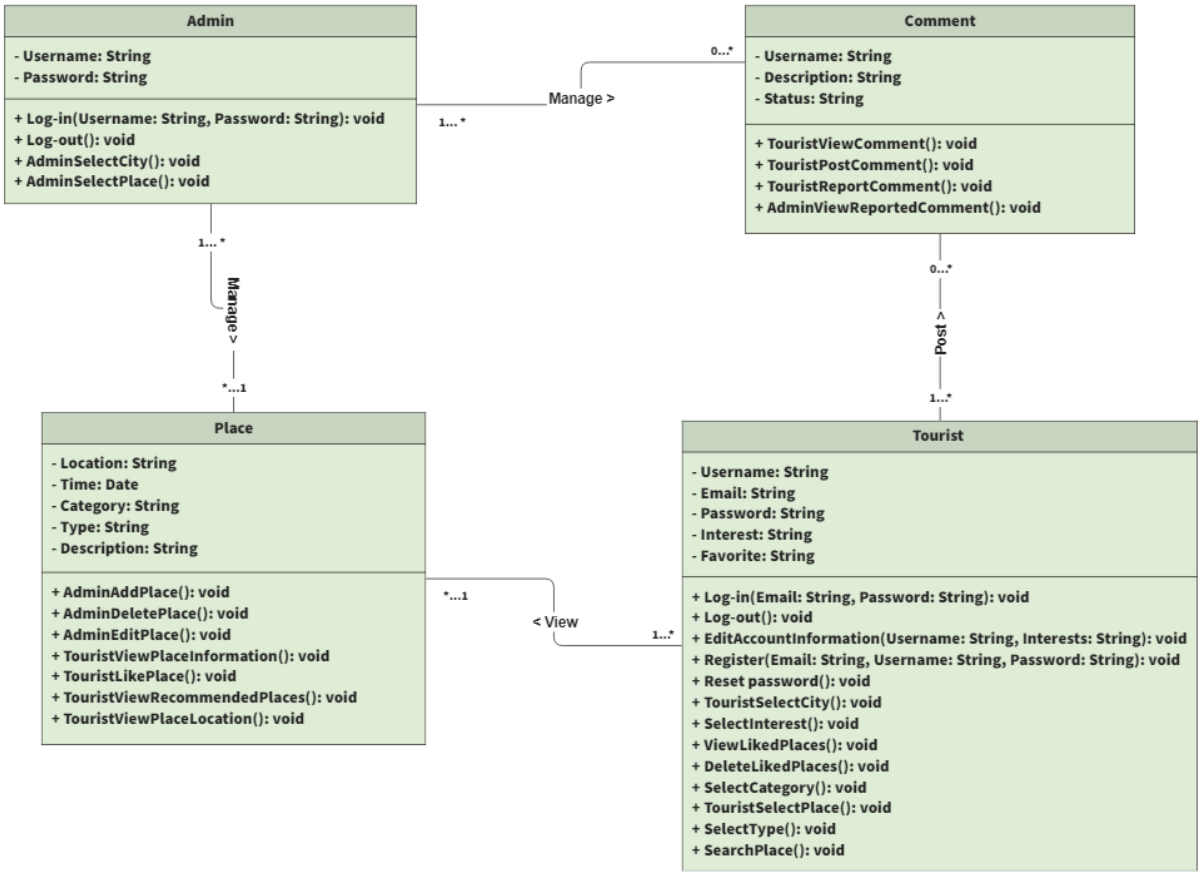

Figure 12 - Class Diagram

4.3.3 Component Level Design

This section includes details of major system component that we worked on in this Sprint, which they are: view place location, view place details, get recommended places, choose interests.

Table 3 – PBI 8th (user story)

ID	PBI (user story)
8	As a tourist, I want to be able to view where a certain place is located so that I know the directions for the place.

Classification:

Function.

Definition:

The tourists should be able to view where a place is located and get the place directions.

Constraint:

Pre-condition: the user login.

Post-condition: the system will place details including the location in the map.

Pseudo code:

1. **BEGIN**
2. **DISPLAY** place details.
3. The tourist clicks on direction or location icons on place map.
4. **IF** the location or direction icons do not appear **THEN**
5. The tourist clicks on marker in the map to show the icons and click on.
6. **DISPLAY** the direction or location in Google Map.

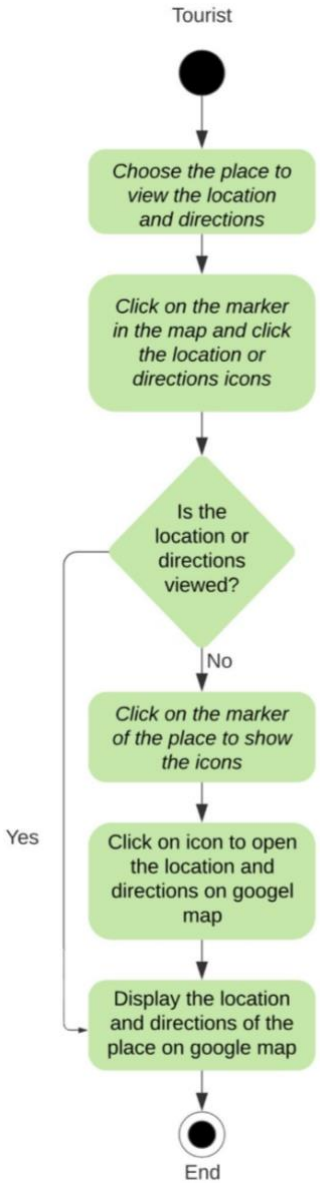

Figure 13 - Location Diagram

7. **END IF**
8. **END**

Another way to view place's location:

1. **BEGIN**
2. **DISPLAY** map screen.
3. The tourist clicks on marker of place to view the name, location and direction icons.
4. The tourist clicks on location or direction icon.
5. **DISPLAY** the direction or location in Google Map.
6. **END**

Table 4 - PBI 18th (user story)

ID	PBI (user story)
18	As a tourist, I want to view recommended places so that I can view places similar to what I'm interested in.

Classification:

Function.

Definition:

The tourist should be able to view recommended places similar to tourist interests.

Constraint:

Pre-condition: the user registered.

Post-condition: the system will recommend places based on each tourist interest.

Pseudo code:

1. **BEGIN**
2. **DISPLAY** interests screen.
3. The tourist chooses at least 3 interests.
4. The tourist clicks on place details and get recommended places.
5. **IF** the recommended place does not match or suite what tourist want any more **THEN**
6. The tourist edits the interests.
7. **DISPLAY** recommended places.
8. **END IF**
9. **END**

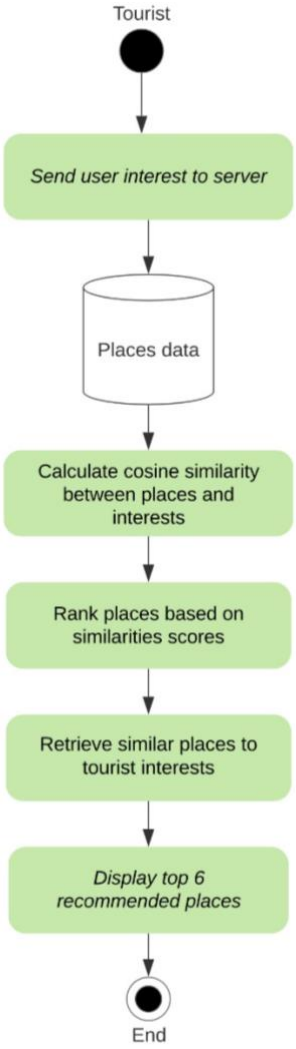

Figure 14 - Recommender System Diagram

Table 5 - PBI 5th (user story)

ID	PBI (user story)
5	As a tourist, when I register for the app, I want to select my interests from a list of interests so that I can customize my experience in the app.

Classification:

Function.

Definition:

The tourist should be able to choose interests from a list of interests.

Constraint:

Pre-condition: the user registered.

Post-condition: the system will view interests' page.

Pseudo code:

1. **BEGIN**
2. **DISPLAY** list of interests
3. The user chooses interests
4. **IF** user choose less than three interests **THEN**
5. **DISPLAY** error message
6. **ELSE**
7. The interests will be saved
8. **END IF**
9. **END**

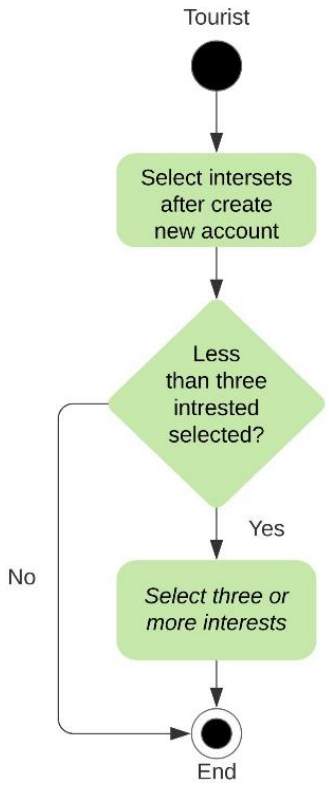

Figure 15 - Interests Diagram

4.4 Data Design

The Huna KSA system relies on data because users of our app use it to gain information about places. We as developers also rely on data from tourists to help us customize their experience and provide them with relevant information. In other words, data in our app has three uses:

1. Display information about places and other relevant information to users.
2. Allow admins to manage data displayed to users.
3. Feed data to our recommender system model.

The first and second uses of our data were the main study of release1. The third use was thoroughly researched, collected data for, and modeled as we were developing our recommender system model throughout release 2.

Huna KSA's data is stored in a NoSQL database called Firebase. Firebase is a NoSQL database developed by Google and it is used by many app developers today.[26] Its NoSQL nature helps increase the app's performance since it is one of its advantages and is a non-functional requirement we aim to incorporate in our app.[27]

We opted to use a NoSQL database because we believe that Huna KSA is a big data app considering the amount of data that the app stores and receives.[28] Data like images, textual data (like comments and place details, user information), and user behavior all need to be stored in our database and will only continue to grow as more users and more places are added to the app.[29] Furthermore, NoSQL works best with unstructured data as opposed to SQL which works best for structured data. Unstructured data is a data type that doesn't have a fixed form or structure which results in data being unpredictable. Images, geospatial data, and social media data (e.g., comments) all fall into this type. Huna KSA deals with a great amount of unstructured data so using a NoSQL database will heed better results and outputs.[30] In addition, Firebase also provides Google services that would help make our app development easier since our app requires us to implement Google Maps into it which is a Google service.

4.4.1 Data Models

This ER diagram illustrates the data flow between entities which represent essential functions of our app. The Tourist table contains the information of tourists, the admin has table is for admin info, the Place table is for all sorts of information regarding different destinations, the Comment table stores comments users leave on a certain place(s) which admins have access to and can manage, and finally the Favorite Place table is used in the recommender system to then generate place recommendations for each specific user.

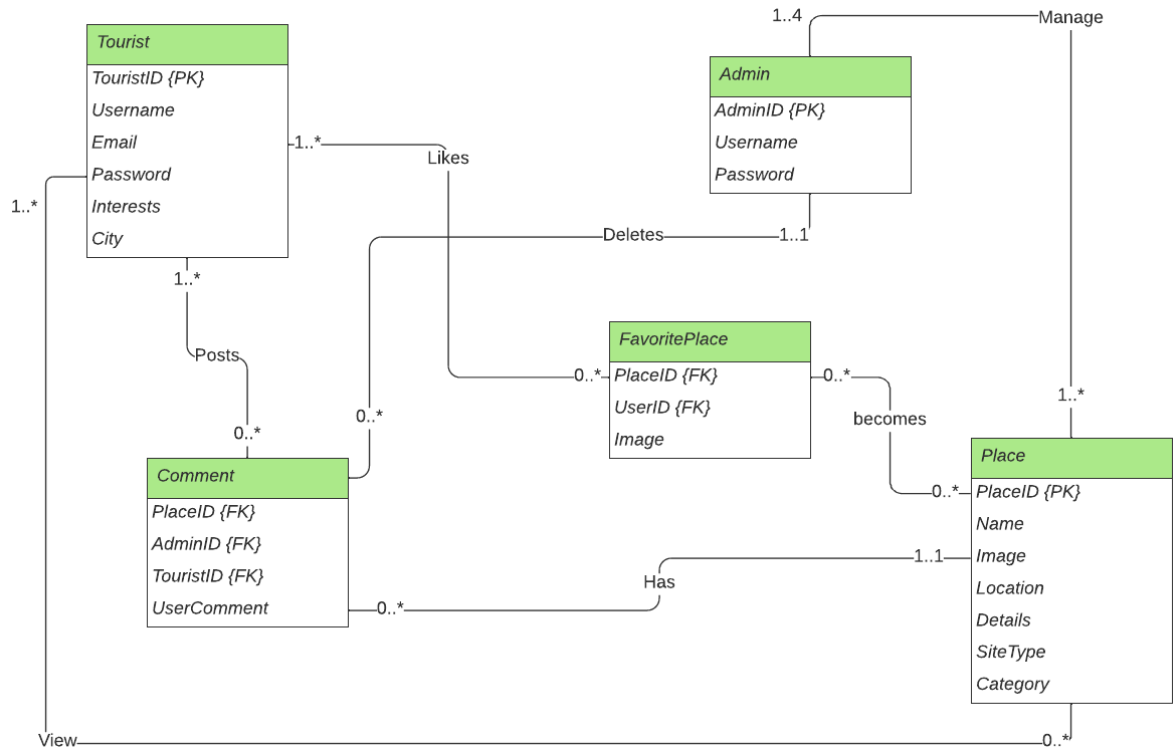

Figure 16 - ER Diagram

Since Huna KSA uses a NoSQL database, the data is represented in a document like structure. Collections in NoSQL illustrations have multiple documents within them. Each document in our database represents an instance in a certain collection. In other words, the Tourist collection stores documents and in each is information about one user is stored. With that said, Huna KSA's database consists of five collections: Tourist, Admin, Place, Comments and Favorite Place. There are multiple documents (instances) in each collection and each document contains data.[31]

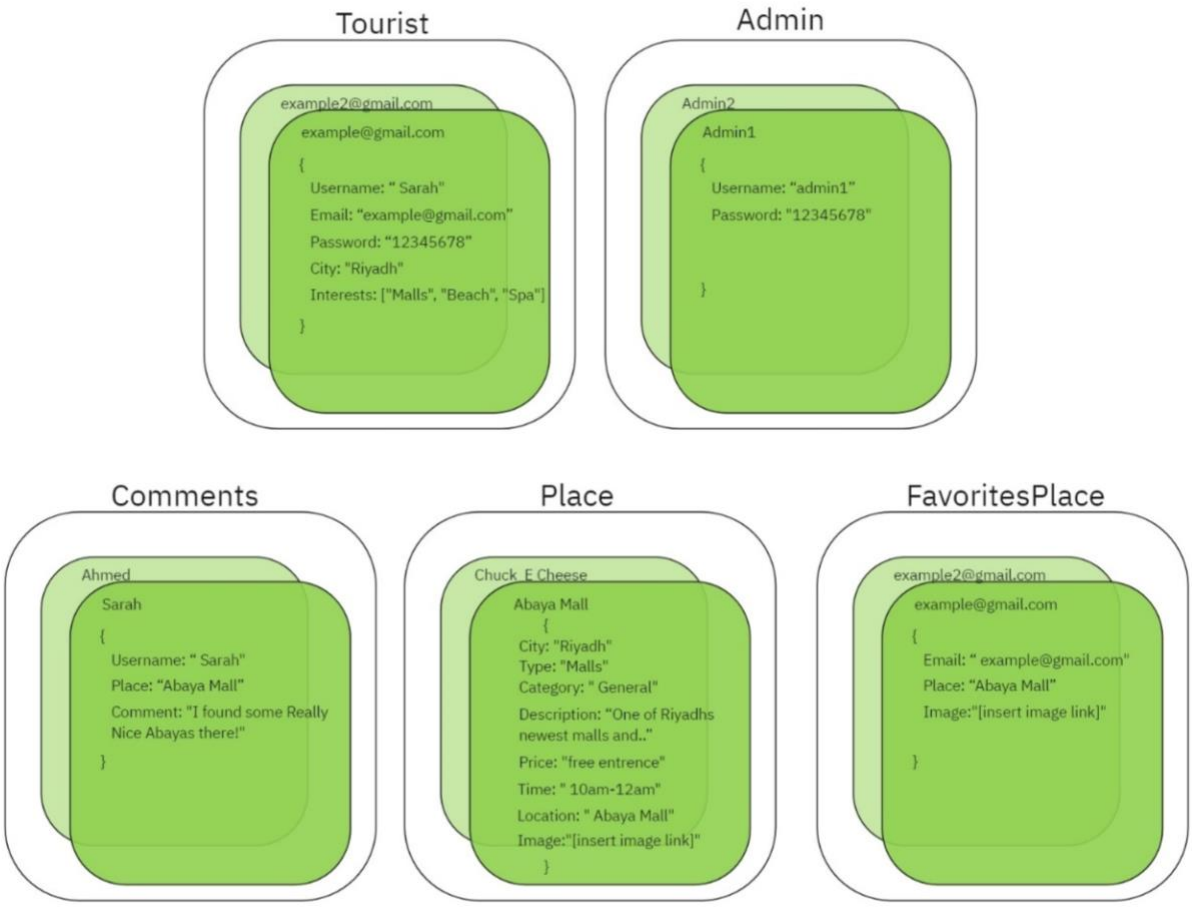

Figure 17 - NoSQL Diagram

4.4.2 Data Collection and Preparation

In the very beginning of the process of collecting the data, we contacted the ministry of tourism in hopes of gaining a dataset we can extract tourist attractions from but unfortunately, we received no feedback.[32] After that, we decided to collect the information we needed using several sources from the internet such as social media platforms (e.g. Twitter and Instagram), Google Maps, and websites. We soon realized that surfing the web for information was very time consuming and we could not continue else we would have ended up behind schedule. So, while we extracted places from the web, we also sent out a questionnaire *(second questionnaire in Appendix B*) to have participants help us collect the information we need at a faster rate. The questionnaire responses were from different people adding in some general, women and kid's sites, the responses were in the form of simple text and links for the places.

After we've conducted both web surfing and questionnaire to get the information we need, it was time to preprocess and clean the data gathered. We began to look at the information that we got for each place and made sure that it contained the right information we need. In case of missing data, we manually filled them in. Some data we collected in the questionnaire did not satisfy our requirements (like responses that had places outside the 5 cities we covered in our app) so we cleaned those out. While we are gathering the information about all the places in the five cities that we included in our application (Riyadh, Jeddah, Abha, Al-Ula and Al-Khobar) we created a dataset to save all the places information in one excel sheet.[33] The dataset consists of 9 columns which are (City, Category, Place name, Description, Opening and Closing hours, Entrance fee, Place type, Website link, and Location link), and 241 rows.

4.5 Interface Design

Interface design is an essential part of the design process as it provides a clear and concise structure of our app's user interface. This section presents two site maps (Tourist UI and Admin UI) and UX guidelines that we incorporated in our design.

4.5.1 Site Map

Our project consists of two user applications: Tourist app and Admin app. Each user of them navigates through the apps differently, therefore site maps are a suitable method of displaying each user app along with the pages that exist in each app.[34]

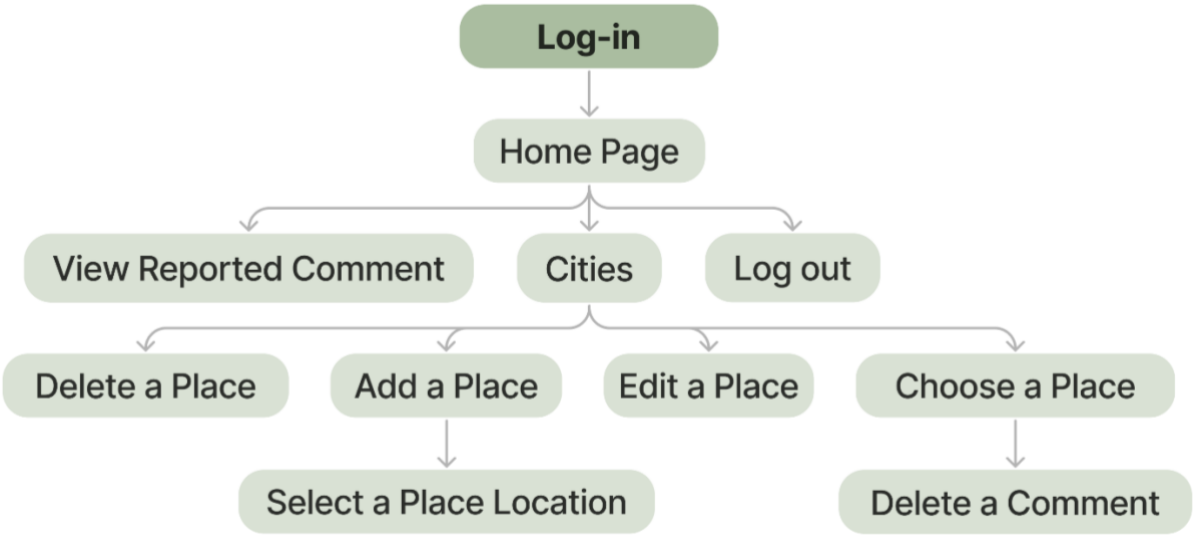

Figure 18 - Admin Site Map

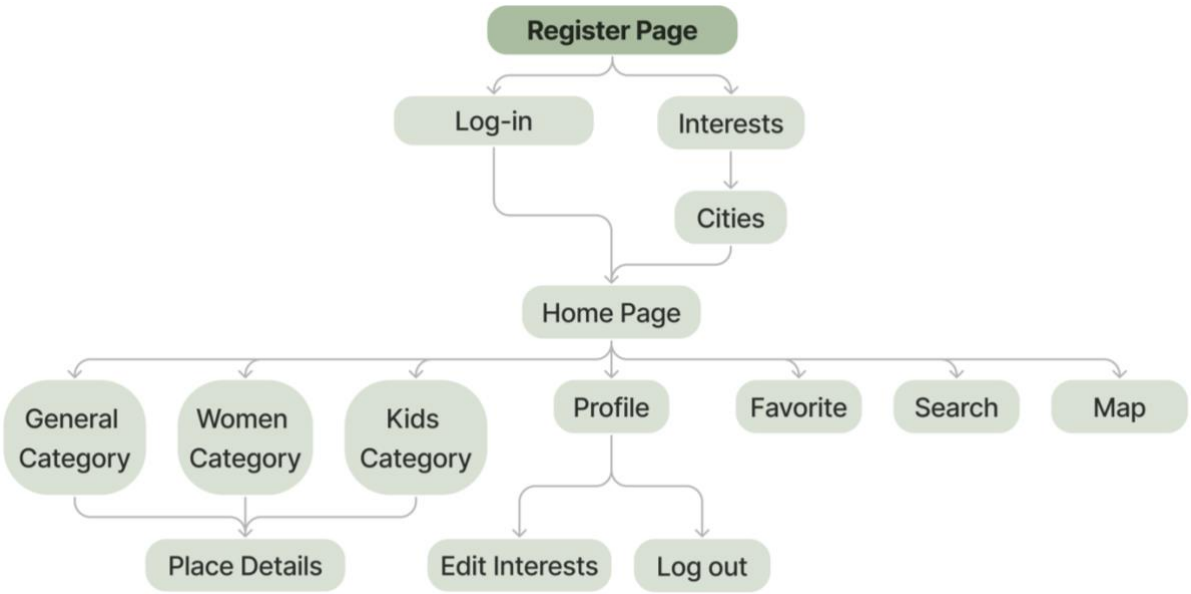

Figure 19 - Tourist Site Map

4.5.2 UX Guidelines

Some UX guidelines we incorporated as we were designing our interface include:

1. Enable users to use shortcuts for convenience.
2. Offer informative feedback after an action has been done.
3. Offer error prevention and simple error handling so users can recover from a mistake easily.
4. Use consistent commands, terminology, and icons throughout the app.
5. Ensure all requirements in a field are met before allowing users to navigate further in the app.
6. Keep confidential information safe and private through the use of secure texts fields.

4.6 Implementation

Major implementation Challenges

Throughout the implementation process, it is no secret that we were faced with many challenges. Some challenges took place during the tool set up stage. We were able to solve the database connection problem once we learned of the correct libraries to import as well as make sure to connect every page to the database first.

```
import 'package:cloud_firestore/cloud_firestore.dart';
import 'package:flutter/material.dart';
import 'package:huna_ksa/Components/constants.dart';
import 'package:firebase_auth/firebase_auth.dart';
import 'package:modal_progress_hud_nsn/modal_progress_hud_nsn.dart';
import 'package:huna_ksa/Components/session.dart' as session;

final _firestore=FirebaseFirestore.instance;
```

Figure 20 - Database Connection and Dependencies

In Release 2, we faced our biggest implementation challenges. We used python to develop our recommendation system model meaning we couldn't just embed our python code straight away into our Dart code, so we had to think of a way to solve this issue. After looking into it, we saw that it would be best to use the Flask framework to work as an intermediary between our recommender source code (python) and our Flutter app. To do that, we downloaded Flask on our device then imported the necessary libraries.[35]

```python
from flask import Flask, request, jsonify
import pandas as pd
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics.pairwise import cosine_similarity
import os

app = Flask(__name__)

# Get the current working directory
cwd = os.getcwd()

# Load the data into a pandas dataframe
data = pd.read_csv(os.path.join(cwd, 'places_data.csv'))

# Create a CountVectorizer object to generate the term frequency matrix
cv = CountVectorizer()

# Generate the term frequency matrix
tf_matrix = cv.fit_transform(data['type'])

# Calculate the cosine similarity matrix
cosine_sim = cosine_similarity(tf_matrix)

```

Figure 21 - Flask Setup

Another challenge we faced while implementing the recommender system was data conversion. We had to find a way to import the place data in our Place collection from the database and into the python code. To do that, we had to convert the data to csv file first. As it turned out, exporting data from Firebase as a csv file was not a straightforward process and it took some trial and error before we were finally able to obtain the needed csv file. Below is a run-down of our attempts:

Attempt 1: export directly from Firebase.

The problem with the direct approach was that the export feature was not available to us unless we upgraded our database. Plus, the exporting process in the Firebase platform is very complex compared to other methods. Therefore attempt 1 was costly and very time consuming.

Attempt 2: export data as a JSON file then convert to csv.

In this attempt we used node.js to extract a JSON file of our database. First, we had to go to our Firebase database settings to generate a private a key. After obtaining the private we typed a node.js command into the terminal in order to extract the data we need as a JSON file.

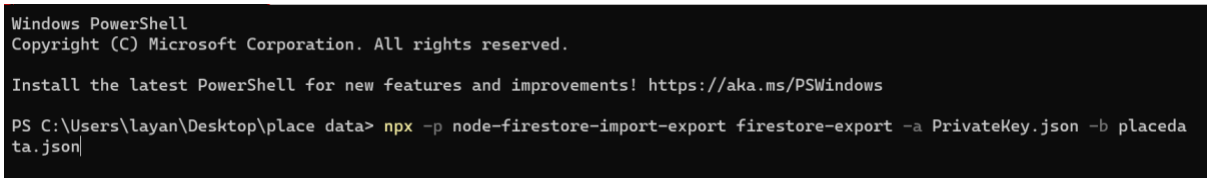

Figure 22 - node.js Command to Extract JSON File

The last step was to convert the placedata.json file into a csv file. Unfortunately, the extracting process was not successful since the data did not convert correctly. Although attempt two was not costly nor as time consuming as the first attempt, the resulting csv file was not suitable for the recommender model.

Attempt 3: use third party tool to export from the database.

In the final attempt, and after a long search, we found a free tool called Firefoo that can export data from Firebase database directly as csv file with quick steps.[36] After installing the tool and allowing it to access Firebase, we only had to select what collection (Place) we wanted to convert into a csv file. The data exporting process did not cost us money and it was much simpler compared to the earlier attempts.

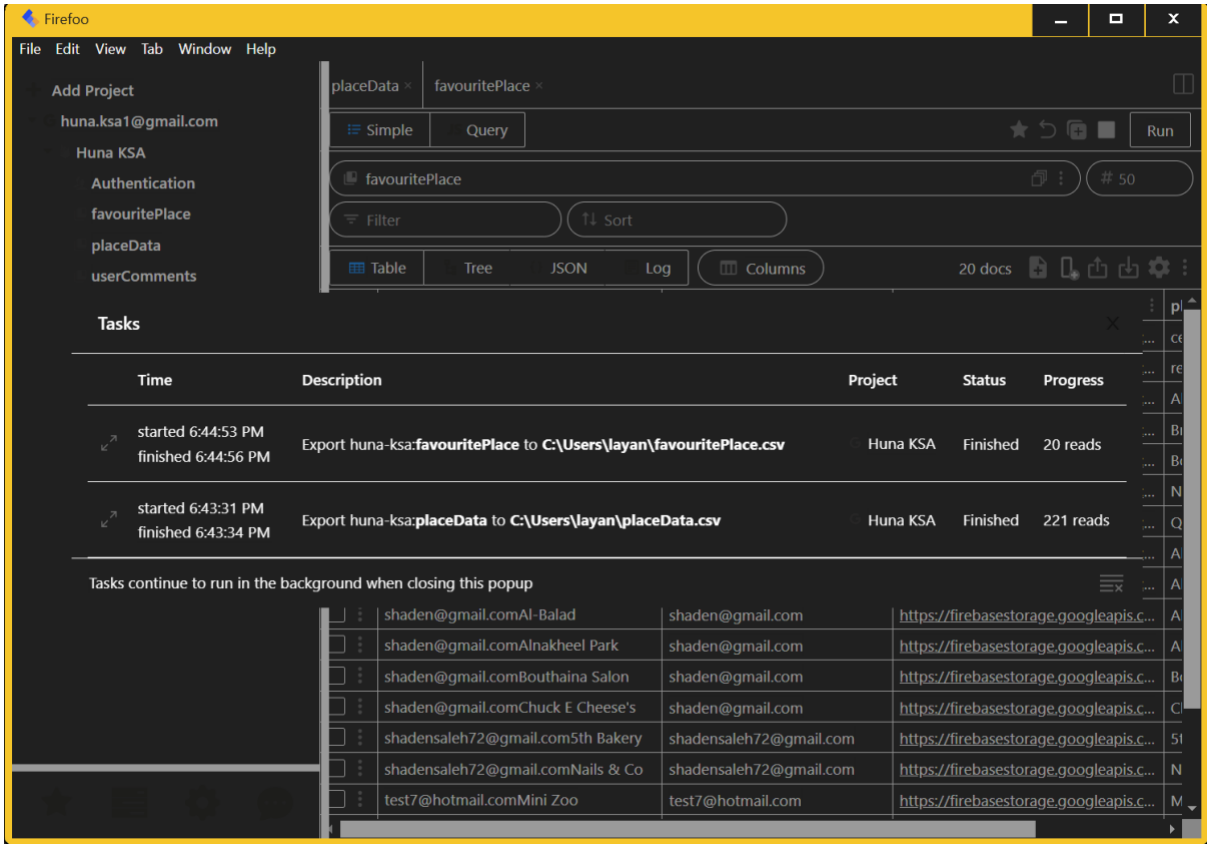

Figure 23 - Firefoo Tool

The last challenge we faced was the sudden expiration of our Google Maps API key. When we first developed our Google Maps API in February, we opted to sign up and use the 3-month free trial. And for those 3 months, the Google Maps in our app worked with no issue. Then, a week before the final submission date (May 15), our 3-month trial period expired. Our first plan of action was to first activate our Google cloud account. When activating our account didn't work, we tried to generate a new API key. When that also didn't work, we looked for different methods to go about generating a new key. The method that worked for us required us to instead of generating a key in Google cloud, we generated a key from Google Maps Platforms service.

Out-of-the-box Components

1. Recommender System:

We deploy the recommender system source code (python) as a web server using Flask app which create an API which is used to connect python code to Flutter app to display the recommended places in the Flutter app.

After deploying the python code in Flask app, we have to run the server using specific command in terminal as shown in the Figure 24, to provide the IP address that Flask app running on and start listening for incoming requests:

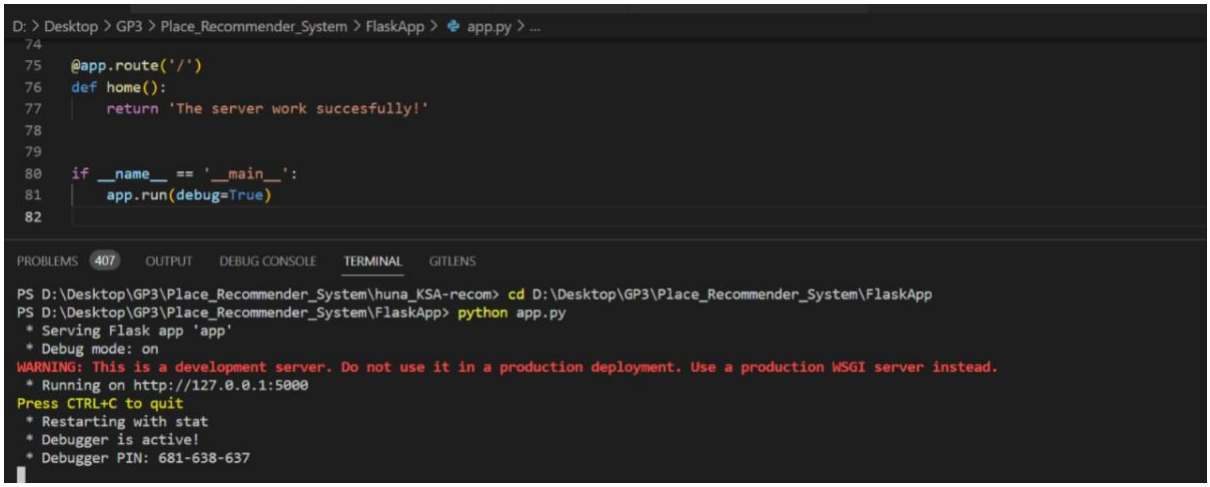

Figure 24 - Flask App

In Figure 25, this part of code shows how we retrieve the data from Firebase in python:

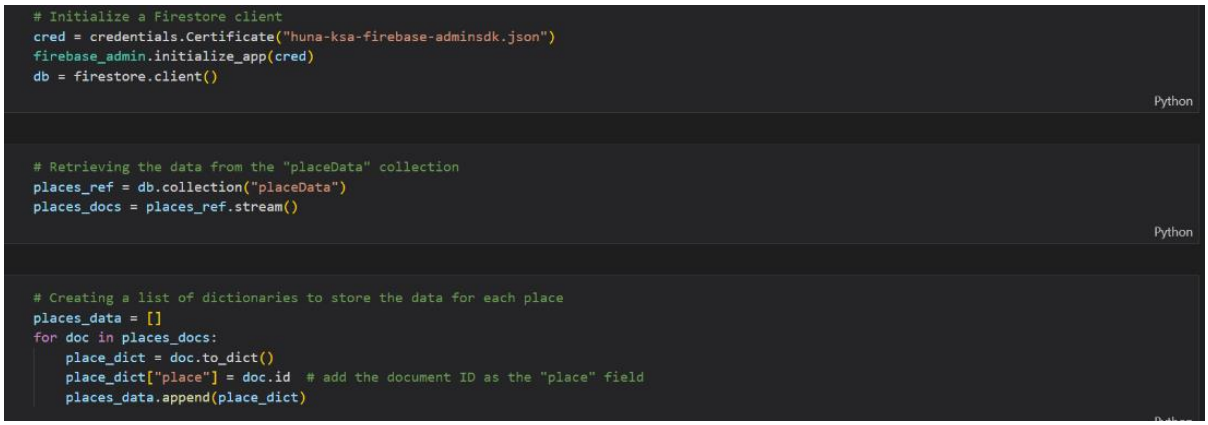

Figure 25 - Retrieve Data from Firebase

In Figure 26, this part of code shows how to run the recommender system as a web server using Flask that expose API endpoint that accepts POST requests with JSON:

```python
# Calculate the cosine similarity matrix
cosine_sim = cosine_similarity(tf_matrix)


@app.route('/recommend_interests', methods=['POST'])
def recommend_interests():
    # Get the list of interests from the request body
    interests = request.json.get('interests', [])

    # Create a list of indices for the places that match the user's interests
    indices = []
    for index, row in data.iterrows():
        if any(interest in row['type'] for interest in interests):
            indices.append(index)

    # Create a list of tuples that contain the index and similarity score for each place
    similar_places = []
    for index in indices:
        sim_scores = list(enumerate(cosine_sim[index]))
        sim_scores = sorted(sim_scores, key=lambda x: x[1], reverse=True)
        sim_scores = sim_scores[1:6]
        place_indices = [i[0] for i in sim_scores]
        similar_places.append((index, place_indices))

    # Create a list of recommended places
    recommended_places = []
    for place in similar_places:
        for index in place[1]:
            recommended_places.append(data.iloc[index]['place'])

    return jsonify({'recommended_places': list(set(recommended_places))})
```

Figure 26 - Endpoint

In Figure 27, this part of code shows how we create the function to get recommended places based on tourists' interests using cosine similarity:

```python
# Calculating the cosine similarity matrix
cosine_sim = cosine_similarity(tf_matrix)
```

Python

```python
# Defining a function to get recommendations based on user's interests
def get_recommendations_based_on_interests(interests, data, cosine_sim):
    # Creating a list of indices for the places that match the user's interests
    indices = []
    for index, row in data.iterrows():
        if any(interest in row['type'] for interest in interests):
            indices.append(index)

    # Creating a list of tuples that contain the index and similarity score for each place
    similar_places = []
    for index in indices:
        sim_scores = list(enumerate(cosine_sim[index]))
        sim_scores = sorted(sim_scores, key=lambda x: x[1], reverse=True)
        sim_scores = sim_scores[1:6]
        place_indices = [i[0] for i in sim_scores]
        similar_places.append((index, place_indices))

    # Creating a list of recommended places
    recommended_places = []
    for place in similar_places:
        for index in place[1]:
            recommended_places.append(data.iloc[index]['place'])

    return list(set(recommended_places))
```

Figure 27 - Recommender System Function

In Figure 28, this code shows the return places that recommended based on tourist interests in Flutter app (editInterest_Screen) by sending a POST HTTP requests to the Flask API endpoint:

```dart
Future<void> getRecommendations() async {
  setState(() {
    showSpinner = true;
  });

  final url = Uri.parse('http://127.0.0.1:5000/recommend_interests');

  final response = await http.post(url,
      headers: {'Content-Type': 'application/json'},
      body: json.encode({'interests': interests}));

  if (response.statusCode == 200) {
    final responseBody = json.decode(response.body);
    final recommendations = responseBody['recommendations'];
    // Display recommendations here in the Flutter app
    print(recommendations);
  } else {
    print('Error: ${response.reasonPhrase}');
  }

  setState(() {
    showSpinner = false;
  });
}
```

Figure 28 - Return Recommended Places

Screens:

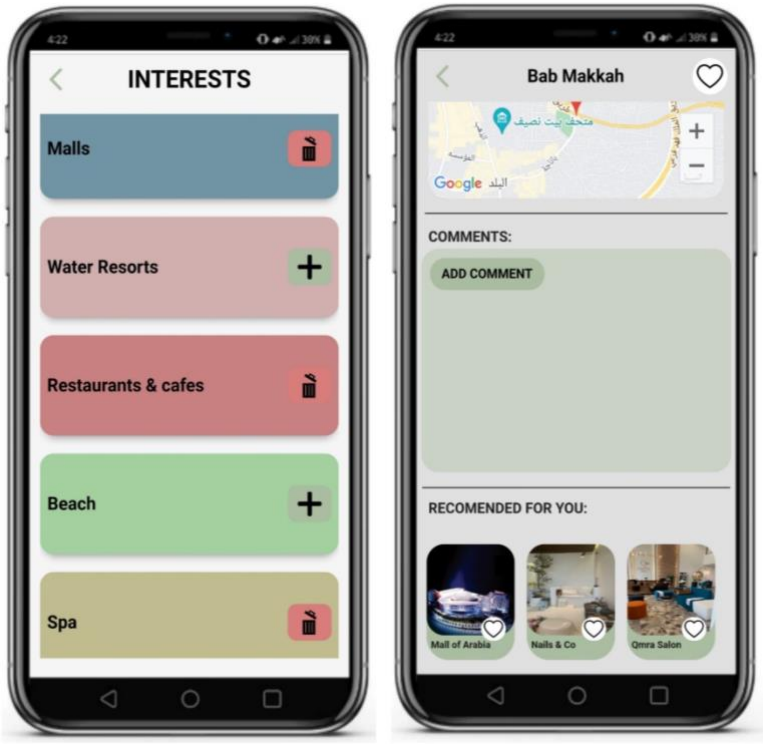

Figure 29 - Recommendation Places in the Tourist App

2. **Google Map API:**

- **Admin:**

In the admin app we implemented a Google Map API in the (add place page) where admin can click on the Select On map button and the map page will appear to the admin, and simply type the name place in the search bar then it will be saved as the location of the place.

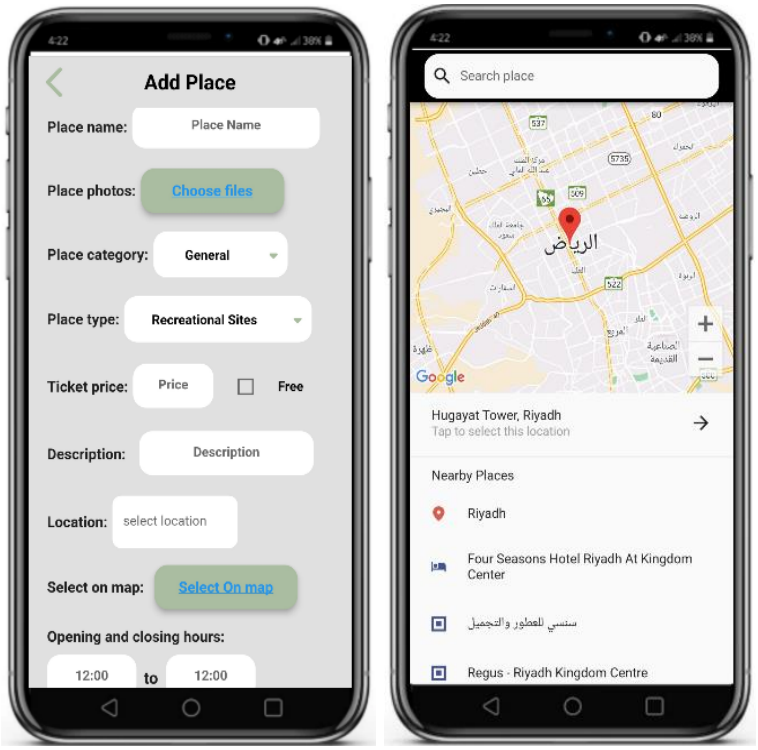

Figure 30 - Add Place's Page in the Admin App

In Figure 31 below the code part of Google Map API in the (add place page). The map will open to the admin after clicking on the Select On map button. We used PlacePicker to add the Google Map API key and the latitude and longitude coordinates to display the map.

```
362                 const SizedBox(height:18,),
363                 Row(
364                   children: [
365                     const Text(
366                       "Select on map:",
367                       style: TextStyle(
368                           fontWeight: FontWeight.bold, fontSize: 18),
369                     ),
370                     const SizedBox(width:6,),
371                     RoundedButton(
372                       decuration: TextDecoration.underline,
373                       title: "Select On map",
374                       color: kPrimaryColor,
375                       onPress: () async {
376                         LocationResult result =
377                         await Navigator.of(context).push(MaterialPageRoute(
378                             builder: (context) => PlacePicker(
379                               "AIzaSyAuJYLmzmglhCpBYTn0BjbJhjWYg0fPEEA",
380                               displayLocation: LatLng(23.8859, 45.0792),
381                             )));
382
383                         lat = result.latLng!.latitude;
384                         lng = result.latLng!.longitude;
385                         locationController =
386                             TextEditingController(text: result.name.toString());
387                         setState(() {});
388                       },
```

Figure 31 - Admin Add Place Function in the Code

- **Tourist:**

In the tourist app we implemented Google Map API in two pages the (place detiels page) and (map page). For the (place detiels page) the tourist can view the marker that indecates the place location, to get the directions to the place, the tourist can click on the direction buttons to transfer him to Google Map aplication. The tourist can zoom in and out to see the full picture of the location.

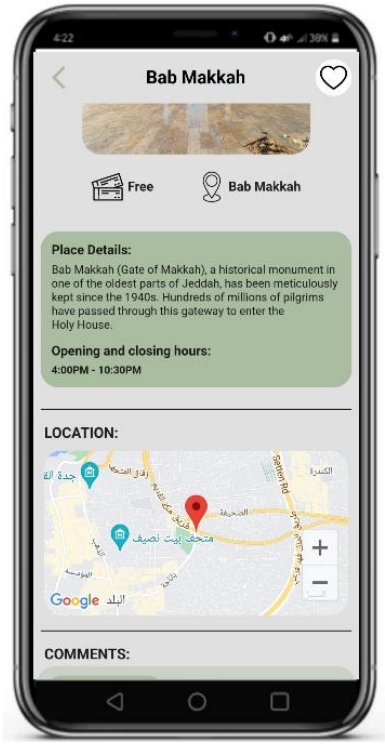

Figure 32 - Place Detailes's Page in the Tourist App

In Figure 33 the code shows how we used the latitude and longitude coordinates to spisify the marker position on the map.

```
345                SizedBox(
346                  height: 10,
347                ),
348                Padding(
349                  padding: const EdgeInsets.symmetric(horizontal: 12.0),
350                  child: ClipRRect(
351                    borderRadius: BorderRadius.circular(20),
352                    child: Container(
353                      height: 180,
354                      width: double.infinity,
355                      child: GoogleMap(
356                        mapType: MapType.normal,
357                        markers: {
358                          Marker(
359                            markerId: MarkerId(data.get("lat").toString()),
360                            position: LatLng(data.get("lat"), data.get("lng"))
361                          )
362                        },
363                        initialCameraPosition: CameraPosition(
364                          target: LatLng(data.get("lat"), data.get("lng")),
365                          zoom: 14.4746,
366                        ),
367                        onMapCreated: (GoogleMapController controller) {
368                          _controller.complete(controller);
369                        },
```

Figure 33 - Place Details' Function in the Code

The Tourist can view all the places location in the (map page). If he/she clicks on the marker of a place the direction buttons will appear and can view the directions of a place in Google Map application.

Figure 34 - Map Page in the Tourist App

Figure 35 shows the code of the (map page) Where we created MapView class and extends StatefulWidget because we need it for the map. After that there is a controller who is responsible for displaying the location on Google Map. Then we declared 2 variables the latitude and longitude given the value 0, then the list of markers that are displayed on the map, last variable is showData that will be true when we get the user location. In the LocationHelper() we will give the latitude and longitude a value after we get the user location. PlacesServices() function will have all the places that are in Firebase and add them to the _marker list so that the places location is displayed on the map as markers, after that showData value will be true so the map can be visible on the screen.

```dart
final _firestore = FirebaseFirestore.instance;

class MapView extends StatefulWidget {
  const MapView({Key? key}) : super(key: key);

  @override
  State<MapView> createState() => _MapViewState();
}

class _MapViewState extends State<MapView> {
  final Completer<GoogleMapController> _controller =
      Completer<GoogleMapController>();

  static const CameraPosition _kGooglePlex = CameraPosition(
    target: LatLng(37.42796133580664, -122.085749655962),
    zoom: 14.4746,
  );

  double lat = 0.0;
  double lng = 0.0;
  Set<Marker> _marker = {};

  bool showData = false;

@override
void initState() {

  LocationHelper().determinePosition().then((value) {
    lat = value.latitude;
    lng = value.longitude;
    setState(() {});

    PlacesServices().getPlaces().then((value) {
      value.map((e) {
        _marker.add(Marker(
            markerId: MarkerId(e.name.toString()),
            infoWindow: InfoWindow(title: e.name.toString()),
            position: LatLng(
              double.parse(e.lat.toString()),
              double.parse(e.lng.toString()),
            )));
      }).toList();
      showData = true;
      setState(() {});
    });
  });

  super.initState();
}
```

Figure 35 - Tourist's Map Function in the Code

Huna KSA GitHub repository (https://github.com/GP1-21/22022-GP1-21).

5 System Evaluation

5.1 User Acceptance Testing

To record user feedback, we have conducted a questionnaire after users were done testing the app to guarantee that the users' responses gathered were anonymous and honest. The questionnaire contained questions about the application to collect the users' reactions to the application interface design, interaction, and the system.

5.1.1 Demographics of Participants

During user acceptance testing, users were able to test the Huna KSA application. We asked 21 users from different ages and backgrounds to test the app to see whether Huna KSA features work well in real-world situations.

5.1.2 Questionnaire/Interview Results

This section summarizes the third questionnaire in Appendix B.

In this section we will present users feedback of our application, we got feedback from 21 users and the results were based on the following:

1. Reaction of the overall system
2. Reaction of the system design interface

The results were based on the degree of agreement or disagreement (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree). We first asked to test if users can get the place's directions from the map page easily and found that 38.1% of users were Neutral while 33.3% Agreed. Next, we tested how easy the interface was to navigate through for users and found that 47.6% of users Agreed and 38.1% Strongly agreed that it was easy and smooth to navigate between pages. In the following question, 33.3% Strongly disagreed about facing issues while editing their interest and 14.3% were Neutral. When we asked about the quality of our recommender model, we found that 47.6% of users agreed that the recommended places that they get were similar to their interests. 57.1% of users Strongly agree that the error messages are clear while only 4.8% Disagree. This indicates that most participants can interact and

respond well to what the system is telling them. 38.1% of users Agreed that the information in the place details page were clear and up to date. When it comes to users' familiarity with icons, 42.9% of users Agreed that they found the icons are well known while 23.8% were Strongly agreed. 52.4% of users found that they can find the place faster by using the filters. We tried to design our interface in a way that is user friendly. So, when we asked how friendly the participants considered our app's design to be, we found that 42.9% of users Strongly agree that the interface design was user friendly. The feedback we received was mostly positive and can allow us to conclude that the app's design makes it easy for its potential users to interact with.

5.2 Quality Attributes (NFR testing)

We tested the Non-Functional requirements on Huna KSA application and all the four NFR (Security, Performance, Useability and Compatibility) and all were successfully implemented as shown in the table below.

Table 6 - Quality Attributes

User story	Quality Attribute	Measure	Results
As a user, I want to use a secure application that is authenticated by my email, and password, so that it handles my information securely.	Security: How the user can have secure information.	Compute the level of application security and the strength of encryption algorithm.	• The system prevent register with a weak password. It must not be less than 6 number/characters. • Huna KSA uses Firebase to store data certified under major privacy and security standard ISO and SOC compliance.[37]
As a user, I want to have the application load in time range between 2 to 30 seconds, so that I	Performance: How much time the user will wait for the system load.	Compute the response time for the application.	• 5 users tested the load of main pages: register, login and main. We found out that for 3 users the load was fast within 5-15 seconds.

will not have to wait long for the application to load.		The application should load within 5-30 seconds.	2 users the load take more the 15 seconds which is affected by the strength of the internet connection.
As a user, I want the application to be easy to use, so that it will take me 15 minutes to learn how to use it.	Useability: How user can learn and use the system easily.	Calculate the average time that users spend on learning and using the app. The average should be 15min max to use the app easily and understand all features.	• We tested 10 users to use the whole app and measure the average time they spend to use the whole app easily. - 7 of users spend 5-10min to use the whole app without getting frustrated about anything. - 3 of users spend 15min and get little frustrated about things.
As a user, I want the application to be compatible with my Android mobile version, so that I can download it.	Compatibility: The ability for a device to interact properly with our app.	Measure, in seconds, how long it takes the Huns KSA APK file to fully load on an Android device.	• We got 10 users of Android devices to load our APK file in and measured how long each device took to load using a stopwatch. The loading time averaged between 1min – 3min the maximum was 3min according to speed of internet and the minimum was 1min. • We also loaded the file the APK file on multiple Android emulators to measure the time.

5.3 Discussion

After conducting user acceptance testing and gathering feedback from all 21 participants, we can conclude that the current tourist app is relatively easy to navigate through especially since 76.2% of participants agreed on it being user friendly. The overall feedback was positive and acceptable at this stage since many users' opinion of the interface shows us that the UX guidelines we listed while designing the interface were well incorporated. It is good to point out that during the user acceptance testing we observed the users that seemed to be struggling with some design choices like having a menu strip instead of a page bar at the bottom. We concluded that it may be best to move pages that were present on the menu and place them in persistent page bar at the bottom of every page. This design choice might help the users that didn’t know how to navigate through pages as well as decrease the number of steps that will be taken to navigate between pages. All in all, the testing in this release helped us determine how smoothly users can navigate through our app. The positive feedback on this aspect will help us further in the future development of the features in our app’s pages.

6 Conclusions and Future Work

6.1 Global and Local Impact

6.1.1 Global Impact

Tourists from outside the country might spend a lot of time and effort searching in different internet platforms for good places in the city they visit during their stay. Huna KSA aims to help tourists that come from all around the world explore Saudi Arabia and find places that match their interest. And Unlike other Tourism apps, Huna KSA displays places that are specific to women as well which helps female tourists find places specific to them. Huna KSA also displays places for children to help tourist families find places for their children. Huna KSA could potentially help increase the rate of tourism in Saudi Arabia which is a goal that aligns with the goals of the 2030 vision for tourism.

6.1.2 Local Impact

Locals in Saudi Arabia often tend to ask around for places to visit since they find it hard to find an attraction site in a city they are visiting. Similarly, female locals might struggle to find a place that is specific to women since there is a lack of sites and apps that focus on female tourist attractions. Also, families with children struggle to find places for their children. Huna KSA aims to help locals in Saudi Arabia find places that match their interest which will help them get to know their surroundings better and enjoy all the entertainment options available to them all year round.

6.2 Problems and Challenges Encountered During the Software Development

Developing Huna KSA was a challenging project to tackle as we faced many challenges. The whole development process was filled with obstacles that we had to overcome. The first problem we encountered was setting up our programming environment. Since Flutter, Android studio, Google map, and recommendation system was new to all members of the team, setting up everything was a process of trial and errors but once we had resolved all issues we started to code. During development we struggled with some functions like integrating Google Maps API. We had to find a way that allows the map to be displayed on the app in the right way to the user and in right side of the map that we focus on which is Saudi Arabia. Also, data collection was one of the biggest obstacles as the collection of place details for each city was very time consuming. We had to obtain data from many different sources and clean it so we have just the information we need for the place. We also struggled greatly with our recommendation system model because we had to choose the algorithm that fits our application the most, and the right way to connect the python algorithm with Flutter code.

6.3 Limitations of the System

Huna KSA goal is to help tourists and locals in Saudi Arabia to find places around the country and get a detailed information about each place in one app, also get comments from others who had visit the place. However, some limitations of Huna KSA is that it only implement five cities in Saudi Arabia which they are Riyadh, Jeddah, Abha, Al-Ula and Al-Khobar. Another limitation is that the app support only English Language and Android devices for now.

6.4 The Main Contribution of the Project

Huna KSA application contribute to advertise tourist places in Saudi Arabia with a detailed information in one platform so that it can save the user time and effort searching for a place to visit. It will help in increasing the number of visitors to these tourist attractions.

6.5 Future Work

As a future work, we aspire to expand to cover more cities in Saudi Arabia. Also, we intend to develop the system to be supporting Arabic language and dark mode as well. Additionally, we plan to keep improving our application, for instance:

1. Connecting places management to the application and perform the places reservation process directly through the application.
2. Adding a live chat to contact the technical support.
3. Developing the search feature by displaying the places according to the closest to the current user's location.
4. Make Huna KSA profile in the Google Play containing all the rates and reviews about the app public for the users to improve the effectiveness and security of the application.
5. Release a version of the application that supports iOS phone.

7 Acknowledgements

As our journey comes to an end, we are thankful Allah to have made this journey possible. Through his guidance and blessing, what we thought was hard became easy. We would Also like to extend our many thanks and gratitude to our supervisor, Dr. Afshan Jafri, for sticking with us and bringing out the best in us through this project. Her helpful advice and recommendations helped us make our app better each time. We are also grateful four our scrum masters throughout the duration of this project, Dr. Rana Al-Kadhi and Dr. Hend Al-Rasheed, for guiding us whenever our team was unsure about which course of action to take for our agile process to keep going smoothly. We are also thankful for Dr. Luluah Al-Dhubayi, Dr. Alaa Al-Tammami, Dr. Khloud Al-Yahya, for helping us when developing our database and recommended system model and overall architecture of our app. We also appreciate all the wonderful suggestions that were made by our inspection committee since they inspired us and had us look at our project from a different angle. Finally, we are very thankful to our friends and families and everyone who believed in us and encouraged us from start to finish.

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9 Appendix

9.1 Appendix A: Interviews

9.1.1 1st Interview

Interviewee:	**Interviewer:**
Noura 29 Years Old Female	Shoug
Location:	**Appointment Date:**
House	September 18, 2022 Start time: 10:00 pm End time: 10:15 pm
Objectives:	**Reminder:**
• Collect information about potential users. • Get to know the users better. • Figure out what features users want in our app.	The interviewees would like to travel or have traveled
Questions	**Approximate Time:** 15 minutes
1) How do you decide where to go on a trip? It depends on the city that I'm going to I prefer to ask friends or family members who went there before.	2 min
2) Do you think that women only places are advertised enough? No, last time I traveled to a city I didn't visit before for a job trip, and I was looking for a nail salon and it took me a long time to find a good one I also asked the reception in the hotel that I stayed in, they didn't have any app or website for the place that woman may need in that city.	5 min
3) What places would you recommend tourists to visit that are not usually visited in Saudi Arabia? I think Abha is a good city to visit special in spring season, Al-ola has a rally beautiful historical landmark's l would recommend visiting it in winter.	3 min
4) When you are visiting new cities, what difficulties do you face in looking for good places?	2 min

I spent a lot of time searching on different platforms or any sources on the internet, for a good tourist destination in a new city. **5) Do you prefer to have an app that will help you find new places? And what features do you want to have in the app?** Sure, it will save me a lot of time. I would like it to be easy to learn and find all what I need as a woman in the city that I'm going to visit.	3 min

9.1.2 2nd Interview

Interviewee:	**Interviewer:**
Raghad 22 Years Old Female	Layan
Location:	**Appointment Date:**
King Saud University	September 19, 2022 Start time: 8:15 am End time: 8:25 am
Objectives:	**Reminder:**
• Collect information about potential users. • Get to know the users better. • Figure out what features users want in our app.	The interviewees would like to travel or have traveled
Questions	**Approximate Time:** 10 minutes
1) How do you decide where to go on a trip? Depends on the interest level, open or closed, crowded or not	2 min
2) Do you think that women only places are advertised enough? No	1 min
3) What places would you recommend tourists to visit that are not usually visited in Saudi Arabia? Escape rooms and sightseeing places	2 min
4) When you are visiting new cities, what difficulties do you face in looking for good places? Not enough info about the place or location or the categories or if we even have it	2 min
5) Do you prefer to have an app that will help you find new places? And what features do you want to have in the app? Yes, categories and suggestions based on my location and searching	3 min

9.1.3 3rd Interview

Interviewee:	**Interviewer:**
Yara 21 Years Old Female	Layan
Location:	**Appointment Date:**
Online Meeting	September 19, 2022 Start time: 8:10 pm End time: 8:20 pm
Objectives:	**Reminder:**
• Collect information about potential users. • Get to know the users better. • Figure out what features users want in our app.	The interviewees would like to travel or have traveled
Questions	**Approximate Time:** 10 minutes
1) How do you decide where to go on a trip? Depending on what I do enjoy at that time but when I want to go with others, I'd consider their interests and comfort.	2 min
2) Do you think that women only places are advertised enough? It used to be but it has become under-advertised these past years and I think it needs more attention.	2 min
3) What places would you recommend tourists to visit that are not usually visited in Saudi Arabia? Traditional local food	1 min
4) When you are visiting new cities, what difficulties do you face in looking for good places? The most important thing for me is cleanness and some other factors such as affordability, enjoyment, distance, crowded places and unique ideas.	2 min
5) Do you prefer to have an app that will help you find new places? And what features do you want to have in the app? Yes!! It'd be so much easier; a tool that helps you know if the place is crowded will be beneficial. - Showing you reviews of the bathrooms will be helpful on day-to-day basis.	3 min

- Reviews on cafes/restaurants but more detailed (name of the waiter, food, bathroom)	

9.1.4 4th Interview

Interviewee:	**Interviewer:**
Weeam 20 Years Old Female	Layan
Location:	**Appointment Date:**
Online Meeting	September 20, 2022 Start time: 6:33 pm End time: 6:43 pm
Objectives:	**Reminder:**
• Collect information about potential users. • Get to know the users better. • Figure out what features users want in our app.	The interviewees would like to travel or have traveled
Questions	**Approximate Time:** 10 minutes
1) How do you decide where to go on a trip? We decided due to us having family members there.	2 min
2) Do you think that women only places are advertised enough? No	1 min
3) What places would you recommend tourists to visit that are not usually visited in Saudi Arabia? I would recommend Alnmas.	2 min
4) When you are visiting new cities, what difficulties do you face in looking for good places? Not finding them easily. I would have to go look in Instagram, TikTok to find them.	2 min
5) Do you prefer to have an app that will help you find new places? And what features do you want to have in the app? Yes, I would, some of the features I'd like to see are photos of the place, lots of rates, preview of the whole place.	3 min

9.1.5 5th Interview

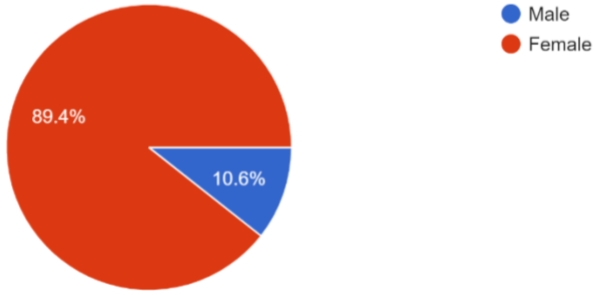
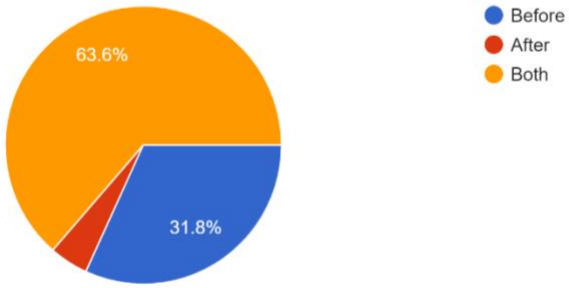
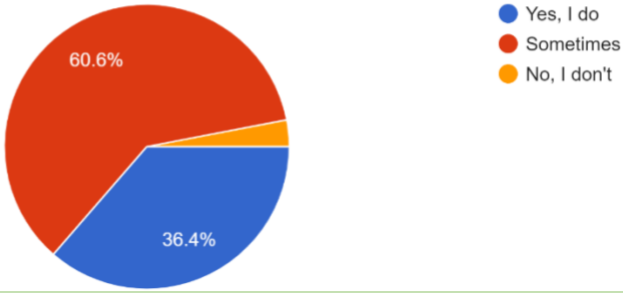
Interviewee	**Interviewer**
Saleha 45 years old Female	Fatimah
Location	**Appointment Date**
House	September 21, 2022 Start time: 4:23 pm End time: 4:36 pm
Objectives	**Reminder**
• Collect information about potential users. • Get to know the users better. • Figure out what features users want in our app.	The interviewees would like to travel or have traveled
Questions	**Approximate Time:** 13 minutes
1. How do you decide where to go on a trip? Depends on the transportation I have available, and the appropriate time (is it the right time to go out or not?), the satisfaction of all the person who will go out with me.	3 min
2. **Do you think that women only places are advertised enough?** No.	1 min
3. **What places would you recommend tourists to visit that are not usually visited in Saudi Arabia?** Archaeological areas, such as: the villages of Jazan region because it has a wonderful nature, I will also recommend Al Masmak Palace, located in the center of Riyadh, because it is a heritage and civilization landmark and has a strong connection to the establishment of our glorious country.	4 min
4. When you are visiting new cities, what difficulties do you face in looking for good places? The lack of easy-to-use applications to identify the tourist places in the city that I want to visit.	2 min
5. **Do you prefer to have an app that will help you find new places? And what features do you want to have in the app?**	3 min

	Yes, easy access to the icons in it, introducing the application when starting to use it for the first time, starts by displaying places in order of priority (highly rated) especially those for families.	

9.2 Appendix B: Questionnaires

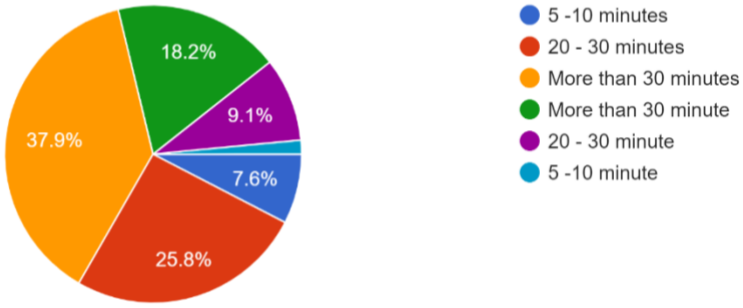
9.2.1 Requirements Elicitation and Analysis

To get a better idea about our users we sent out a questionnaire containing 10 close-ended questions regarding what potential users thought about certain topics. We have received 66 total responses from both genders.

The Questions
1. What is your gender? 66 responses 
2. Do you usually search for places to visit in a new city before traveling or after you reach your destination? 66 responses 
3. Do you struggle to find places while visiting new cities? 66 responses 

4. How much time do you spend searching for places in a new city?

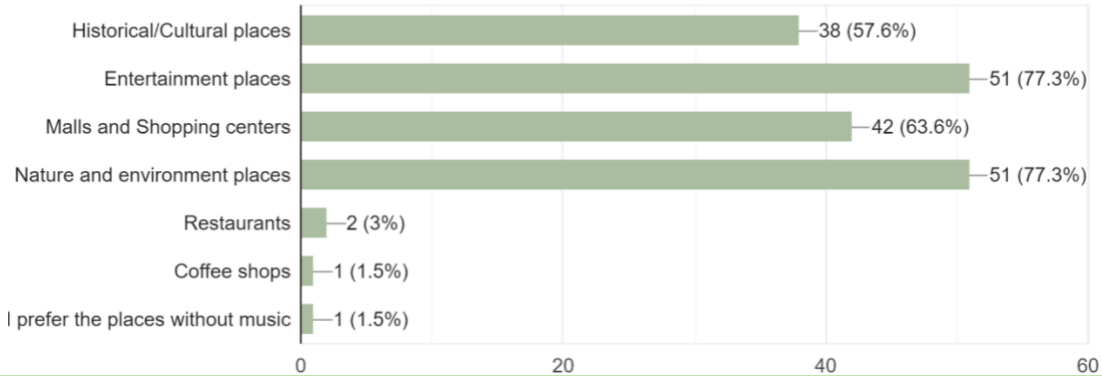
66 responses



Note: *Consider the duplicate time frames as one.*

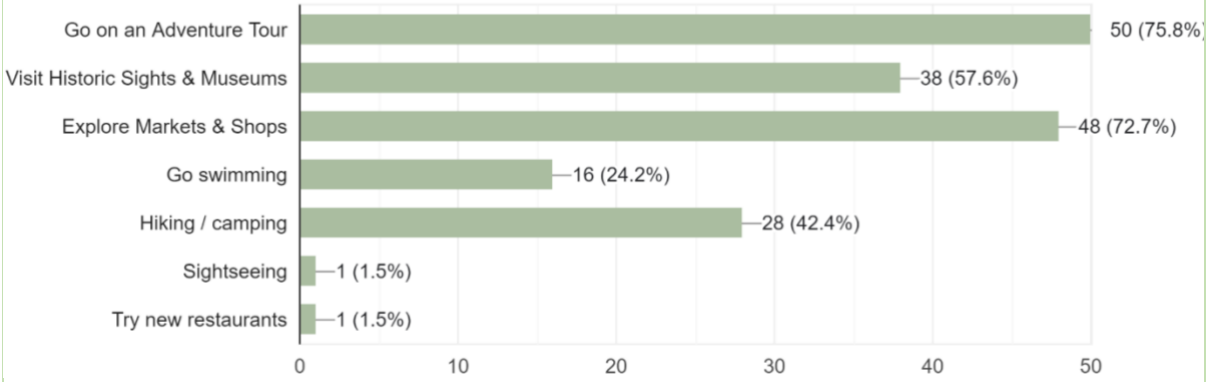
5. When visiting new cities, what kind of places do you like to visit?

66 responses



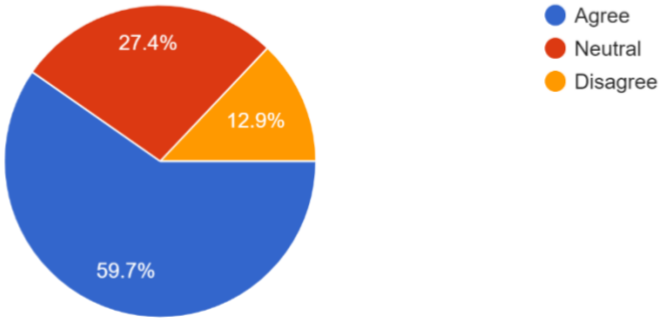
6. When you travel to a new city, what kind of activities do you like to do?

66 responses



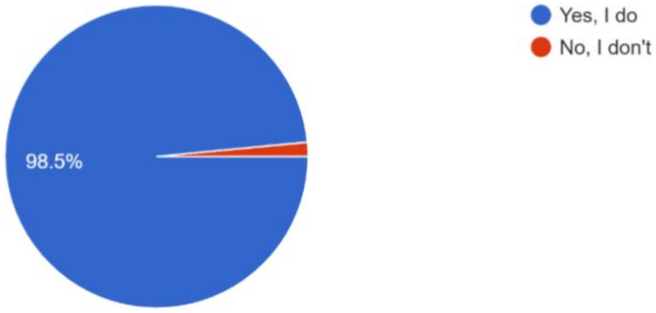
7. Is it difficult to find women only places to visit in Saudi Arabia? (no need to answer if you are male)

62 responses



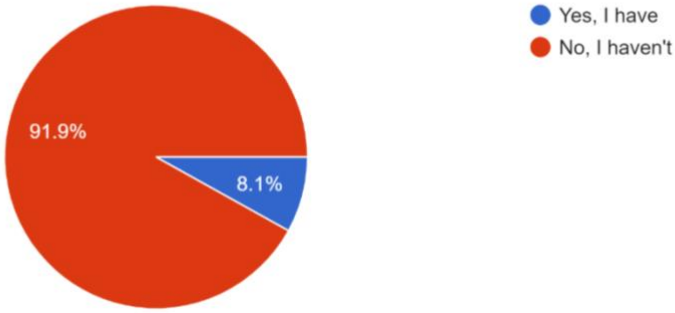
8. Do you prefer to read other people's comments online about the places you plan to visit?

66 responses



9. Have you ever used an application or a website designed to display women only places? (no need to answer if you are male)

62 responses



9.2.2 Data Collection Questionnaire

A questionnaire for participants to help us collect the information we need.

The Questions

Q1:

اولا: اضيف/ي اسماء اماكن سياحية **عامة للجميع** مع ذكر المدينة الموجود بها هذا المكان (الرجاء ارفاق رابط للمكان ان وجد)

27 responses

فقيه أكواريوم
012 606 6144 ext. 202
https://maps.app.goo.gl/R7LhAQSV9mMfH3KT6?g_st=ic

ابها المدينه العاليه ممشي الضباب منتزه السوده حديقه ابو خيال

كورنيش البحر الاحمر في مدينة جدة

سينما vox + muvi ، (in10so) جدة: الدرة ، مطاعم ، العاب

الواجهه البحرية -أبحر الشمالية -شاطئ السيف في مدينة جدة

املج والقنفذة

مول - بحر

Q2:

ثانيا: اضيف/ي اسماء اماكن سياحية **نسائية** مع ذكر المدينة الموجود بها هذا المكان (الرجاء ارفاق رابط للمكان ان وجد)

25 responses

- شاطئ خليج ناكسوس للنساء - جدة

Naxos bay women's beach
054 086 6332
https://maps.app.goo.gl/SMnc8eFX5kzhwXFP8?g_st=ic

نوادي او مراكز الاحياء بمدينة جدة

جدة : شاطئ ناكسوس للنساء

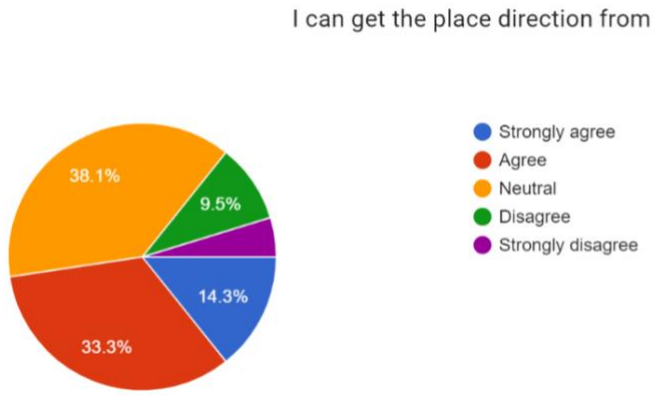
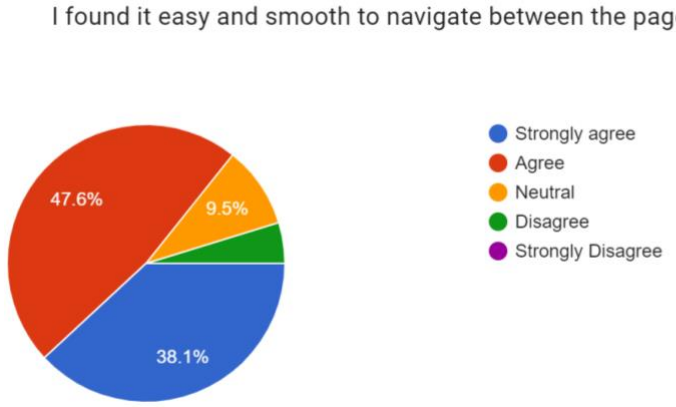
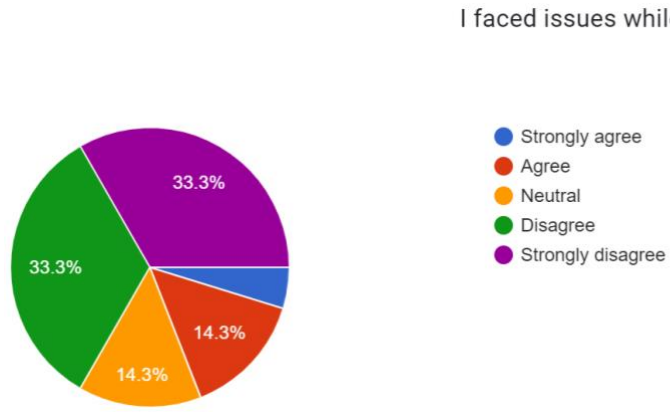
ملاهي الشلال في جدة

لايوجد

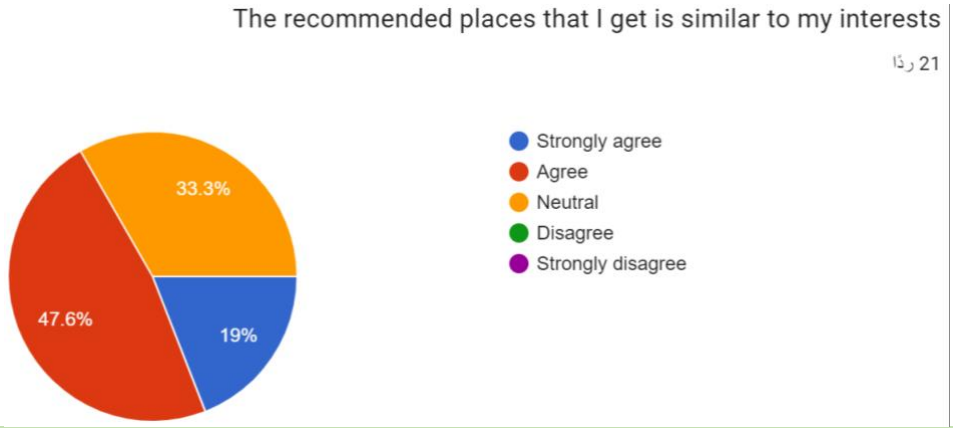
شواطئ نسائيه

9.2.3 User Acceptance Testing Questionnaire

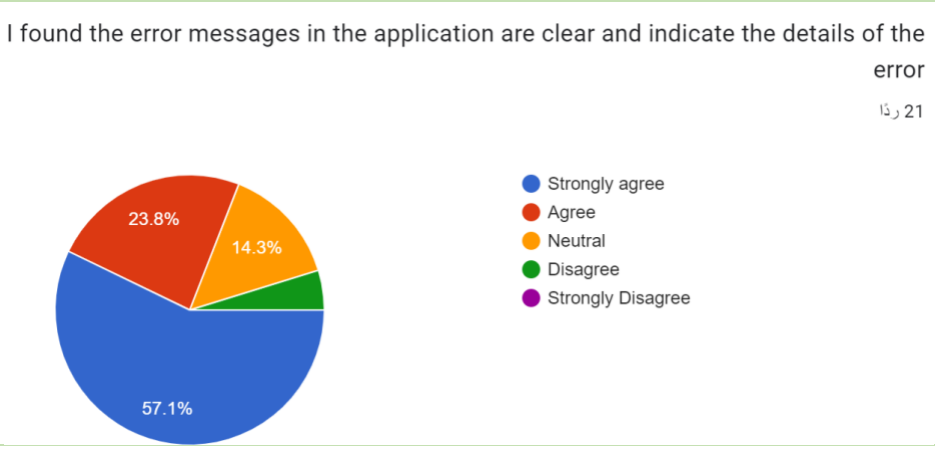
We have conducted a questionnaire after users were done testing the app.

The Questions
Q1:

Q2:

Q3:


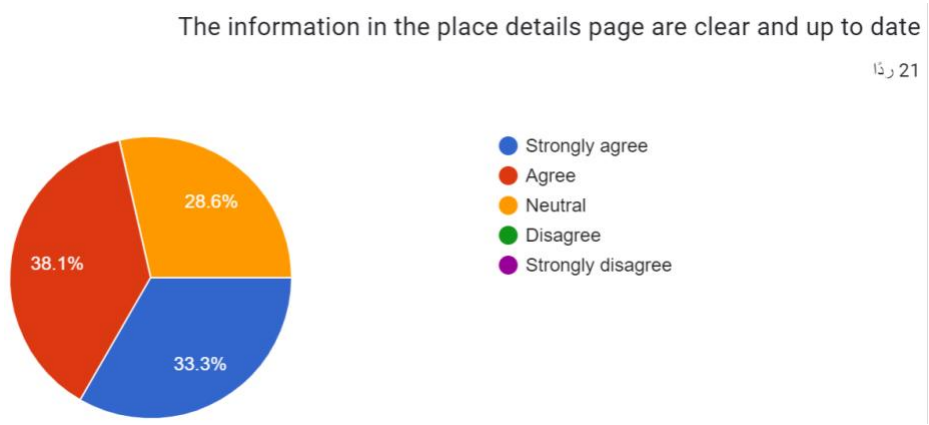
Q4:


The recommended places that I get is similar to my interests
21 ردًا
33.3%
47.6%
19%
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

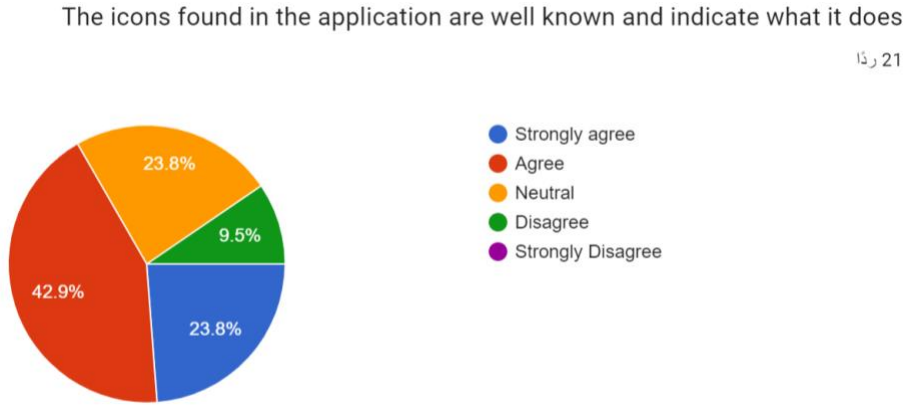
Q5:


I found the error messages in the application are clear and indicate the details of the error
21 ردًا
23.8%
14.3%
57.1%
Strongly agree
Agree
Neutral
Disagree
Strongly Disagree

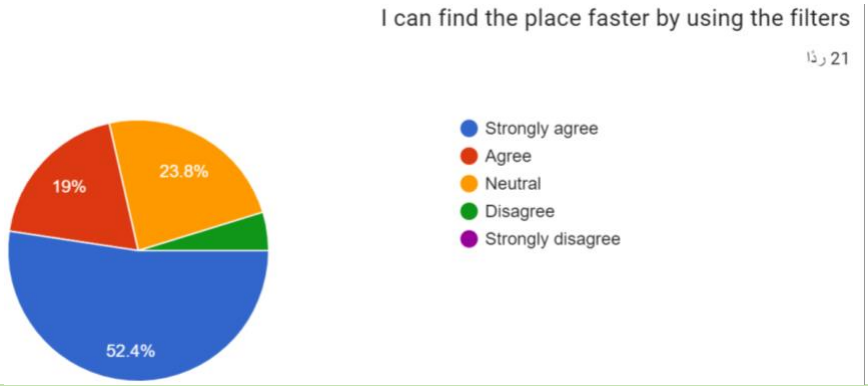
Q6:


The information in the place details page are clear and up to date
21 ردًا
28.6%
38.1%
33.3%
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

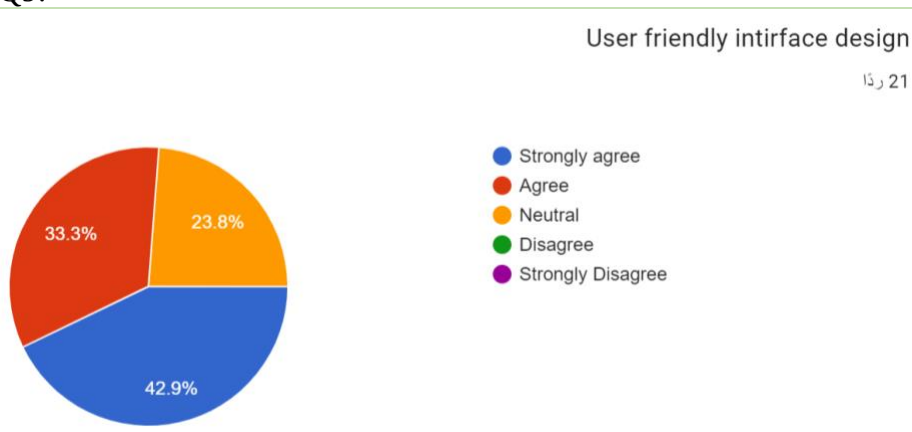
Q7:


The icons found in the application are well known and indicate what it does
21 ردًا
23.8%
9.5%
42.9%
23.8%
Strongly agree
Agree
Neutral
Disagree
Strongly Disagree

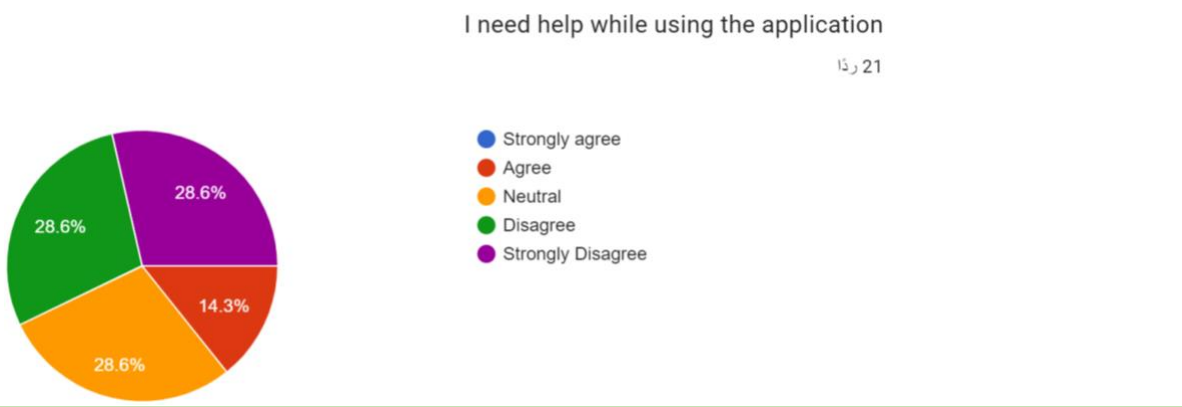
Q8:


I can find the place faster by using the filters
21 ردًا
19%
23.8%
52.4%
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

Q9:


User friendly intirface design
21 ردًا
33.3%
23.8%
42.9%
Strongly agree
Agree
Neutral
Disagree
Strongly Disagree

Q10:


I need help while using the application
21 ردًا
28.6%
28.6%
14.3%
28.6%
Strongly agree
Agree
Neutral
Disagree
Strongly Disagree