



سُهيل



IT 496: Graduation Project Report
Product Release-2

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S'hail

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Abstract (English):

Saudi Arabia's tourism sector is a focal point of the nation's 2030 vision, with ambitious goals to enhance GDP contribution, attract millions of visitors, and create numerous job opportunities. However, accessing comprehensive information about tourist attractions, malls, and dining options within the Kingdom remains a challenge for both locals and travelers. To address this, we propose the development of an Android mobile application, "S'hail," aimed at simplifying the process of identifying and exploring attractions, malls, and restaurants in Saudi Arabia. This solution seeks to overcome existing limitations by providing users with easy access to relevant information, thereby enhancing the overall tourism experience and supporting the country's economic growth objectives.

We chose Agile for this project because it allows for adaptability and promotes ongoing development and testing throughout the software development process. By dividing the project into multiple sprints and delivering a usable portion of the product after each sprint, we ensured steady progress. We thoroughly assessed the features we implemented, confirming their functionality and user-friendliness. Overall, the project succeeded in meeting all its primary goals. We can further improve the project to strengthen its competitive edge in the future.

Abstract (Arabic):

قطاع السياحة في المملكة العربية السعودية يشكل نقطة محورية في رؤية 2030 للبلاد، حيث تهدف إلى تعزيز إسهام الناتج المحلي الإجمالي، وذبح ملايين الزوار، وخلق فرص عمل عديدة. ومع ذلك، يظل الوصول إلى معلومات شاملة حول الأماكن السياحية والمرافق التجارية وخيارات الطعام داخل المملكة تحدياً للمحليين والمسافرين على حد سواء. لحل هذه المشكلة، نقترح تطوير تطبيق لنظام أندرويد ، "سهيل" ، والذي يهدف إلى تبسيط عملية تحديد واستكشاف الأماكن السياحية والمرافق التجارية والمطاعم في المملكة العربية السعودية. يسعى هذا الحل للتغلب على القيود الحالية عن طريق توفير إمكانية الوصول السهل إلى المعلومات ذات الصلة للمستخدمين، وبالتالي تعزيز تجربة السياحة العامة ودعم أهداف النمو الاقتصادي للبلاد.

تم اعتماد منهجية "أجайл" لتطوير تطبيق "سهيل" ، والتي تعتمد بدورها على تقسيم دورة حياة بناء التطبيق إلى مراحل تكرارية، ويتم في نهاية كل مرحلة تسليم جزء ملموس من التطبيق ليتم تقييمه ومراجعته من قبل العملاء. وب مجرد الانتهاء من بناء التطبيق بالكامل، تم إجراء عدة اختبارات مختلفة له، وأظهرت النتائج رضاً عالياً على المزايا المقدمة وسهولة الاستخدام. وبناءً على ذلك، يمكن استنتاج إن المشروع كان ناجحاً حيث تم تحقيق جميع الأهداف الرئيسية بجودة عالية. ويتوقع أن يتم اتخاذ إجراءات وتطويرات مستقبلية لتعزيز تنافسية التطبيق بشكل أكبر.

Keywords:

Attractions; Malls; Restaurants; Content-based recommendation system; Interactive map.



سهيل



Introduction



1 Introduction

Saudi Arabia's tourism sector has set ambitious targets for growth and transformation through its 2030 vision. According to statistics provided by the National Tourism Strategy on the Saudi Ministry of Tourism's website [1], the goal is to significantly boost the contribution of tourism to the country's GDP by 10% by 2030, attract over 100 million visitors, and generate more than one million job opportunities. However, both locals and travelers from distant regions face the challenge of accessing relevant information about tourist attractions and dining options within the Kingdom. Easy access to such information is crucial for ensuring a great experience and promoting the country's tourism industry. When it comes to tourism in Saudi Arabia, there are a few available apps to help people discover the region's attractions and restaurants. However, these apps have limitations in terms of their functionality as well as their user experience. This can prevent people from fully exploring all the amazing experiences that Saudi Arabia has to offer. Therefore, we will develop a solution that will improve the overall user experience of visitors and make finding restaurants and attractions in Saudi Arabia much faster and more efficient. As our first step in planning the solution, we first propose this document that addresses the key questions surrounding the project. First, we will go through the problems it intends to solve and the solution. Continually, we will show our product vision, the roadmap for implementation, the objectives and scope, the hardware and software tools needed, cost considerations, and the Scrum team responsible for this project's success.

1.1 The Problem

The 2030 vision includes improving Saudi Arabian tourism as one of its goals. As the Minister of Tourism of Saudi Arabia, Al-Khateeb, said, "We're expecting 2024 to be another record year in travel and tourism. We plan to move forward to reach a growth of 130 percent of the current level by 2032". Saudi Arabia's position as a global tourist destination and investment hub is strengthened by the sector's ongoing expansion, which boosts the country's GDP [2].

As technology advances and so do ideas, new applications are created to make life easier. When it comes to tourism, people need applications with varied functions that allow locals and visitors to fully experience these expanding activities and restaurants because it is becoming more difficult for people to become aware of or obtain sufficient information about them. There are a limited number of apps that help find restaurants and tourist attractions in Saudi Arabia. For instance, "Trip Advisor" [3] is a global app that supports a variety of languages and nations and aims to help make users better



travelers, from travel planning to booking to taking a trip. They can also get their favorite places and businesses listed in the app. Yet, the lack of a recommendation system that disregards what the user is currently viewing, or their favored restaurants or activities is a problem that would negatively impact the user's experience and does not allow them to explore their best options. Another app called "VisitSaudi"[4], is a local app for locating restaurants and activities in Saudi Arabia, A fairly small selection of restaurants and tourist attractions is offered through the app. It lacks a number of elements, including the capability for users to add places of interest as well as a system for rating and commenting on these places. "Enjoy"[5] is another local app that provides users with all the knowledge regarding activities and events, but there is no commenting system, only a rating system. Similar to "VisitSaudi", this app does not allow users to add new places if they are not found in the app. All applications mentioned above lack the option for users to use their current location or drop a pin on a map and view nearby attractions or restaurants, which would be very helpful and significantly reduce searching time. "Google Maps"[6] is a popular app and a website developed by Google that offers detailed maps, real-time traffic, directions, and navigation. Users can search for locations, explore businesses, read reviews, and access public transportation information, but it does not provide an immersive and tailored experience for travelers, such as unique insights into local culture and experiences. It falls short in providing certain crucial features such as immersive planning capabilities according to the time and date the user wants, which are essential for enhancing travelers' experiences and fostering a deeper connection with local culture and attractions. Users typically need to proactively search for restaurants and attractions, which can be a time-consuming process and may not always yield the most personalized results. Due to this, some crucial elements that would enhance users' experiences, assist users in making decisions with confidence, and save them time and effort are missing in each of the existing apps. As a consequence, merging all of these features into one application would be incredibly beneficial.



1.2 Objectives

The main objective of this project is to improve the overall tourism experience in Saudi Arabia by resolving existing issues within current systems, as described in the previous section. By addressing these challenges, the goal is to create a smoother and more enriching experience for both travelers and locals. By the completion of the project, and hence once it is complete, S'hail should be able to:

- Provide detailed information about each restaurant and attraction, making it easier for users to decide where to visit.
- Allow users to add new restaurants or attractions to the application and have them approved by the administrator.
- Allow users to rate and write comments about the restaurants and attractions they have visited.
- Provides a content-based recommendation system based on what types of restaurants or attractions the user has added to the favorite list.
- Provides a content-based recommendation system based on what the user is currently viewing according to the type of restaurant or attractions.
- The interactive map feature allows users to navigate different locations, utilize their present location, or drop a pin to identify nearby attractions.
- The application supports multilingual functionality, allowing users to switch between Arabic and English.
- Provide an auto Filtering to delete Inappropriate comments.
- Implement a place approval process to allow the admins to review and verify the accuracy of the added places.
- Providing a calendar for planning, including the ability to add attractions and restaurants to schedules based on user preferences.



1.3 Scope

"S'hail" is a comprehensive and user-friendly mobile application for locals and visitors who need guidance and support to experience Saudi tourism. The Android-based application will only support Arabic and English languages and will not include a reservation or payment service. S'hail will focus on covering attractions, restaurants, and malls in Riyadh and Jeddah cities. The application contains three types of users. The first is the registered user, who can use all the features such as Explore nearby places on the map, adding restaurants or attractions to the favorite list, searching for attractions or restaurants, rating and writing comments, adding attractions or restaurants for interest after the admin approval, update user profile, add attractions and restaurants to schedules and switching between two languages. The second is the guest user, who can view and filter the restaurants, attractions, and malls. The third is the admin, who approves the places that the user wants to add.

1.4 Product vision

For tourists and locals who need assistance and guidance and are looking forward to completely enjoying Saudi tourism, "S'hail" is a mobile application that efficiently offers a variety of options for restaurants and activities in Saudi Arabia. Unlike the current tourism apps, such as Tripadvisor, VisitSaudi, Enjoy, and Google Maps. Our product provides an interactive map so that users can explore nearby restaurants and attractions by using their current location; a content-based recommender system that suggests similar attractions and restaurants based on the user's current viewing or favorite list; and it also provides a customized calendar according to the user's preferences

1.5 Approach

We adopted the Agile methodology for our project, focusing on delivering small, functional software components in iterative cycles to ensure prompt improvements and enhance customer satisfaction. We began by conducting interviews and surveys to understand our users' needs and gather requirements. Then, we organized these requirements into a product backlog and split them into manageable sprints and releases. Throughout development, we delivered incremental product updates at the end of each sprint for evaluation by our supervisor (product owner) and scrum master. Before the final release, testing was conducted, including User Acceptance Testing (UAT) and Non-Functional Requirements (NFR) evaluation. These tests helped us identify areas for improvement and considerations for future iterations.



1.6 Solution

The solution involves developing an Android mobile application called "S'hail" that will make identifying and exploring attractions and restaurants in Saudi Arabia simpler and more efficient for anyone interested in visiting the country. Our app will help tackle the limitations and problems with the existing apps described in the previous section. Our app will allow users to add places of interest and have them approved by app administrators. Second, the app will provide a content-based recommendation system based on what the user is currently viewing according to the type of attraction or restaurant; for example, if the user is currently viewing an Italian restaurant, the app will recommend Italian restaurants under the current post they're viewing. Also, the app provides another content-based recommendation system based on the types of attractions and restaurants the user has added to their favorite list. Third, users can rate and comment on the attractions they've visited based on a number of criteria, such as price, location, atmosphere, services, and experience, helping other viewers choose the ideal option for them. Their comments can also help business owners provide real-time insights into consumer needs and expectations. Fourth, our app will include an interactive map on which a user can utilize their present location or drop a pin to identify nearby attractions, making it easier for the app users to discover and minimize their time. Finally, the user can plan their days by designating the attractions they wish to see using the calendar that our application will provide, which is organized in accordance with their preferences. Our app will also provide two options for languages, Arabic and English, to serve both local and foreign users. Hopefully, these features will satisfy users, improve the user experience, and contribute to the country's tourism development and economic progress.

1.7 Summary

In the upcoming sections, we will present our background and conduct a literature review. Subsequently, we will outline our system design and implementation. Following that, we will proceed with the system testing. Finally, we will provide the conclusion, suggestions for future work, and acknowledgments.



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Background



2 Background

In this section, we will discuss the definition of tourism and its types. The differences between previous and present-day tourism, Saudi tourism, as well as the functionality that users expect in a tourism application, will all be covered before we talk about the API and algorithms that will be used in our product.

2.1 Definition and History

"Tourism is a social, cultural, and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes" [7]. There are two types of tourism: international tourism, where people visit other countries, and domestic tourism, where people visit places in their own country. So, tourists can be either residents or non-residents.

Back in the day, it was frequently difficult for tourists to locate restaurants and sights. Tourists relied heavily on guidebooks, paper maps, and recommendations from locals or fellow travelers. Hours were spent reading, turning through pages, and traveling unknown streets in an effort to find undiscovered gems. However, the procedure for locating attractions and restaurants as a tourist has significantly improved with the development of smartphone apps. These days, there are an abundance of travel apps available that give immediate access to thorough information about many different locations.

2.2 Saudi Tourism

Saudi Arabia is more receptive than ever to visitors from around the world since the introduction of Vision 2030. Millions of tourists have been attracted to the Kingdom since the e-visa was introduced in 2019, which has contributed to job creation and local economic expansion. As the studies indicated, " Saudi achieved 93.5 million visits in 2022. It now aims to reach 100 million visits annually by 2030 " [8]. Saudi Arabia therefore worked hard and spent billions of SAR to enhance the tourism industry, starting with Riyadh season, NEOM, and AlUla, by offering numerous new attractions and dining options.

2.3 Expectations for Tourism-Related Apps

When it comes to tourism, it is getting more challenging for people to become aware of or obtain adequate information about the new activities and restaurants; thus, people require applications with a variety of functionalities that allow locals and visitors to fully experience them. People frequently seek a variety of features in tourism applications that improve their trip experiences and give them essential information. The following are some typical features people search for in tourist applications: A user



can use an interactive map to use their current location or drop a pin to locate nearby sights. They can also plan their trip by adding the destinations they want to visit to an organized calendar, along with destination details, the addition of locations they've been to, and feedback.

2.4 Google Maps API

When creating customized interactive maps, the Google Maps API will be the way to do it. The Google Maps API offers developers the ability to seamlessly integrate Google Maps functionality into their applications, websites, or services. By utilizing this API, developers gain access to a wide range of features and services, including geocoding, routing, place search, and map visualization. This integration empowers developers to enhance their offerings with robust location-based capabilities, allowing users to benefit from functionalities such as converting addresses to coordinates, obtaining optimal routes, searching for places of interest, and displaying visually appealing maps. The Google Maps API serves as a valuable resource, enabling developers to harness the full potential of Google Maps within their own digital projects.

The Google Maps Platform now provides a number of APIs for different aspects of its service. For standard Google Map embeds, there is a Maps Static API; for interactive and customized maps, there is a Maps JavaScript API; for data about points of interest, there is a Places API; and for directions to a location, there is a Directions API, to name just a few [9]. To develop a customized interactive map in a mobile application, the Maps SDK for Android or the Maps SDK for iOS will provide the required tools and APIs to customize and integrate Google Maps in your mobile app. It includes features such as adding markers, displaying maps, modifying map styles, handling user interactions such as panning and zooming, and implementing numerous map-related functionalities [10]. Maps SDK also provides a "drop a pin" feature, which allows users to choose a specific point on a map by placing a pin or marker at that spot. This functionality is often utilized in a variety of applications to allow users to mark points of interest, determine destinations, and perform other location-based actions. In the implementation of the map feature for "S'hail," we integrated a customized interactive map using the Google Maps SDK for Android. The integration involved the Places API for the auto-complete search, enhancing user experience by providing location suggestions as users type. Additionally, the Google Maps SDK was employed to add markers to the map.



2.5 Profanity Cleaner API

When it comes to maintaining a clean and respectful digital environment, the Profanity Cleaner (Bad Word Filter) stands as a crucial tool in ensuring that text-based content remains free from offensive language. The Profanity Cleaner offers support for more than 20 languages, making it versatile and accessible to a wide range of users worldwide.

By utilizing advanced algorithms and language processing techniques, the Profanity Cleaner scans text inputs and compares them against a predefined list of offensive words, phrases, or patterns. When it detects such content, it replaces or masks the flagged words with special characters, ensuring that the offensive language is not displayed or conveyed to the intended audience.

2.6 Recommendation System

A useful algorithm that we will be using in our app is the recommendation system, which is an artificial intelligence (AI) algorithm commonly linked to machine learning that uses big data to propose or recommend additional products to customers. These can be determined by a number of parameters, including previous purchases, search history, demographic data, and other elements [11]. This will be helpful to make the user experience more personalized and enjoyable. There are three primary types of recommender systems:

2.6.1 Collaborative-Based Recommender System

A collaborative-based recommender system that suggests items or content to users based on their preferences and similarities with other users. This kind of recommendation system does not use the features of the item to recommend it; instead, it groups users into clusters of similar types and makes recommendations for each one based on the preferences of its cluster [12]. One of the key benefits of this recommender system is its ability to adapt to changing user preferences while also being highly efficient at offering personalized content.

2.6.2 Content-Based Recommender System

A content-based recommender system that considers user data gathered over time as well as similarities in products, services, or content features when suggesting items to the user. Various algorithms are generally used by content-based recommender systems to produce recommendations, such as Cosine Similarity, it measures the similarity between items by calculating the cosine of the angle between their attribute vectors. It captures the alignment or similarity in the direction of their content attributes [13].



Neural networks, content-based recommender systems can make use of deep learning models like convolutional neural networks (CNNs) or recurrent neural networks (RNNs) [14]. Neural networks offer advantages in recommender systems, including improved accuracy with more data, flexibility in handling multiple objectives and multimodal data, and compatibility with optimized deep learning frameworks for processing large datasets [15].

Clustering algorithms, this algorithm can be used as a preprocessing step or as a component of a hybrid recommendation system to improve the recommendation process, even if they are not normally used for content-based recommendation directly. Clustering algorithms group related things or users together based on specific features, which can enhance the recommendation process in a number of ways [16].

Euclidean Distance, Using the attributes of two items' content, this algorithm determines the separation between them. By considering the overall differences in their attribute values, it calculates how similar two items are [17].

Another algorithm is Matrix factorization, although it is frequently used in collaborative filtering, matrix factorization may also be utilized in content-based recommendation by factoring the user-item interaction matrix and including content features in the factorization process [18]. This allows for the integration of both user-item interactions and content attributes to generate recommendations.

These are some of the common algorithms used in content-based recommendation systems. The selection of an algorithm is based on the particular system requirements as well as the nature of the content attributes being considered. In "S'hail", we are going to implement a content-based recommender system, as it comes with several advantages, including making recommendations doesn't require any information from other users, and recommendations are highly relevant to the user.

2.6.3 Hybrid Recommender System

The last main type of recommender system is a hybrid recommender system, which is a special type of recommendation system that combines collaborative filtering, content filtering, and potentially other methods as well. Combining content-based filtering, which takes into account the characteristics and features of items, with collaborative filtering, which is based on user behavior and preferences, may assist in overcoming the drawbacks we are experiencing when employing them separately and may even be more effective in certain cases [19].



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Literature Review



3 Literature Review

Understanding earlier-established similar systems is the goal of the domain study approach. The market offers several tourism applications comparable to ours. In this chapter, we did extensive research on our competitors, which we classified into the following two sections:

- 1- Local applications that offer tourism-related features for Saudi Arabia are regarded as our direct rivals because we all work toward the same objective.
- 2- Global applications that are accessible in the majority of large cities worldwide, some of which include Saudi Arabia and some of which do not, will serve as a model and our source of inspiration.

To conduct a thorough analysis, we selected nine tourism applications that had intriguing qualities and some functions that were similar to those of our app. The key elements of each application are emphasized, and an evaluation of the complete application is done while highlighting the main features and drawbacks of each application. By identifying key features that the application must have, this procedure was done to make the requirement definition process easier. Gaps and potential improvements to already-existing tourism applications were also examined in order to offer a user-friendly and more dependable application and guarantee the greatest possible user experience for our intended consumers.



3.1 Competitive Product Analysis



1- TripAdvisor [3]: Is a global platform that is considered the most popular travel application and website in the world. It can be accessed through a web browser. TripAdvisor helps users plan their own trips and enjoy the ideal vacation by providing many features such as reviews and ratings, destination information, hotel and accommodation search, flight booking, showing similar items to the ones currently viewing sites by a recommendation system, and travel booking [As shown in Figure 1].

Drawbacks:

- Commercial influence: Businesses listed on TripAdvisor can respond to reviews and may have the ability to promote their listings. This can lead to biased or overly positive representations and impact the visibility and ranking of establishments.
- Lack of personalized recommendations: Despite providing a wealth of information, TripAdvisor might not offer recommendations that are specifically catered to each user's preferences and interests. Users may need to spend some time looking through reviews and filtering them to get recommendations that are relevant to their individual travel needs.

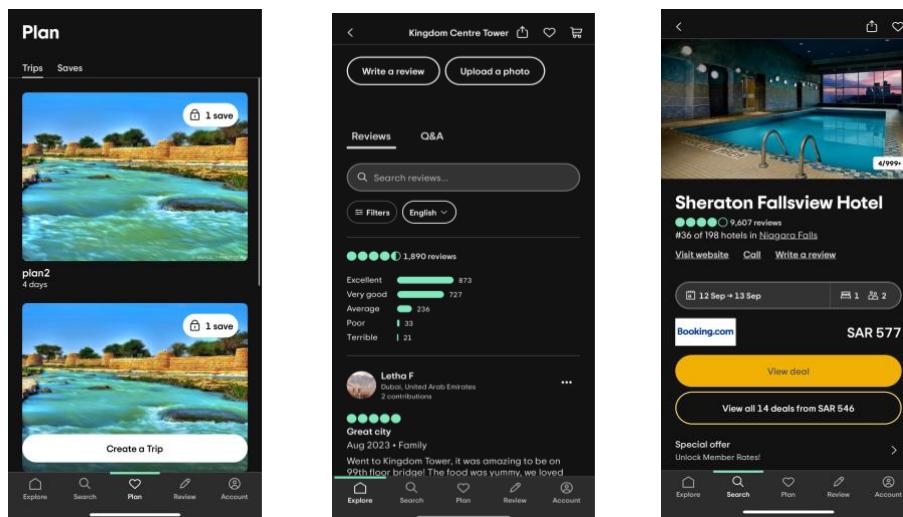


Figure 1 Tripadvisor.



2- Google Maps [6]: Is a comprehensive mapping and navigation service offered by Google. Users can access it through the web or mobile app and benefit from its most interesting features, like detailed maps, directions for various travel modes, real-time traffic updates, a recommendation system based on the user's currently viewing locations, and alternative route suggestions. Google Maps also offers Street View, allowing users to virtually explore streets and locations. It provides information on local businesses, including reviews and ratings, and offers satellite imagery for a bird's-eye view. Additionally, users can download maps for offline use, making it a valuable tool for travelers. Google Maps continues to evolve, providing an indispensable resource for navigating and discovering the world around us [As shown in Figure 2].

Drawbacks:

- Dependence on Google Services: Due to Google Maps' close integration with other Google services, users who do not utilize or choose not to use these services may find their options limited.
- Manual Search Requirement: Users typically need to proactively search for restaurants and attractions, which can be a time-consuming process. Despite the app providing a wide range of information, users must invest effort in searching and exploring to find specific places of interest.

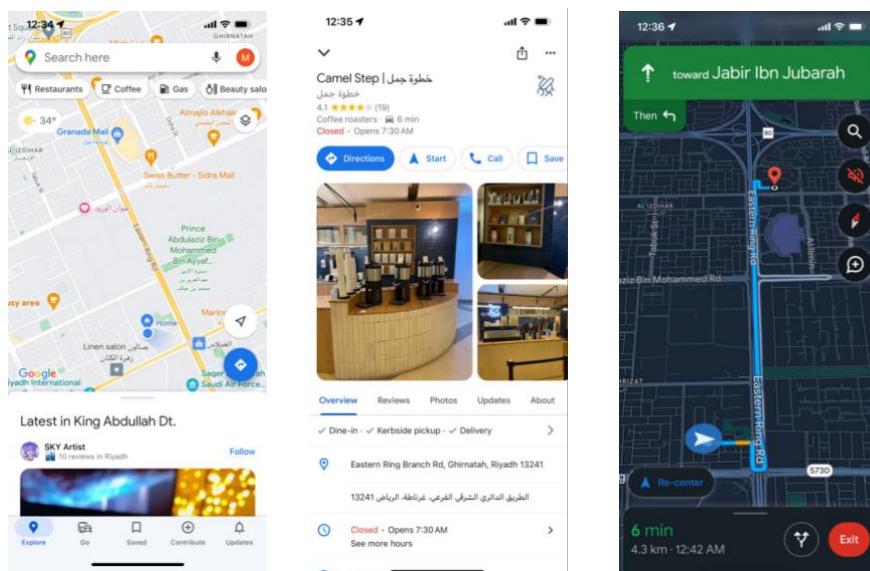


Figure 2 Google Maps.



3- VisitSaudi [4]: The Saudi Tourism Authority established the VisitSaudi program in December 2021, which is a local application also available as a website, with the goal of attracting tourists. The program included activities to highlight the culture and heritage of the Kingdom of Saudi Arabia. It offers several features, such as a customized calendar, planning trips, and an interactive map that checks nearby attractions and restaurants using the user's current location; furthermore, it provides a recommendation system based on the user's currently viewing sites. [As shown in Figure 3].

Drawbacks:

- Limited selection: It offers a small selection of restaurants and tourist attractions, which may restrict users' choices and limit their exploration options.
- Lack of user-generated content: The app's lack of user-generated content may result in a less comprehensive and diverse collection of recommendations due to the absence of local knowledge and lesser-known attractions.
- Absence of a rating and commenting system: The app lacks a rating and comment feature, hindering user engagement and comprehensive reviews and limiting the app's community's ability to share experiences and insights.
- Lacks a recommendation system based on the favorite list.

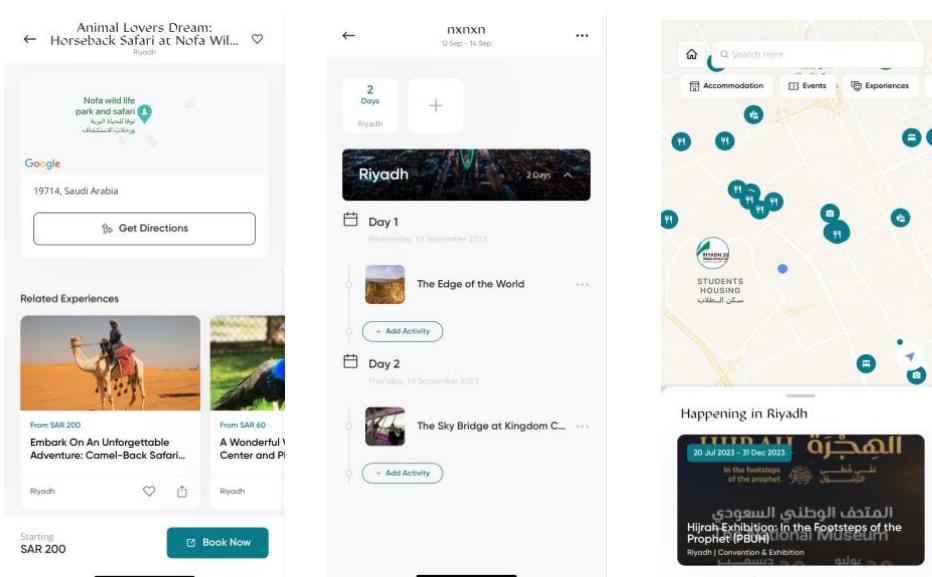


Figure 3 VisitSaudi.



4- Enjoy Saudi [5]: Is one of the General Entertainment Authority's (GEA) initiatives, which can be accessed through the web or mobile app. With the help of Enjoy Saudi, users will be fully informed about all year-round activities and events taking place around Saudi Arabia by providing their main features, such as a calendar for recreational activities across the Kingdom, allowing users to easily browse and manage their favorite activities, facilitating communication, and applying a recommendation system based on the user's current viewing of attractions and restaurants [As shown in Figure 4].

Drawbacks:

- Limited selection of attractions and restaurants (As previously defined in the 'VisitSaudi' drawbacks section).
- Lack of user-generated content (As previously defined in the 'VisitSaudi' drawbacks section).
- Absence of a commenting system.

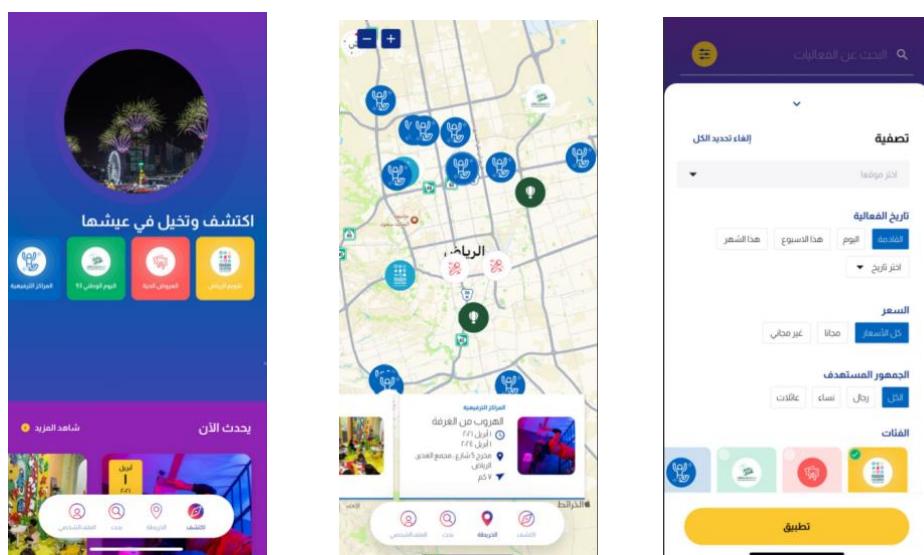


Figure 4 Enjoy Saudi.



5- Sawah [20]: Is a global application and website that unlocks a world of possibilities by offering a wide selection of cities from across the globe, captivating users with diverse destinations to explore. One of the main features of the app is that users can follow each other and post their check-ins, which refers to the procedure of registering one's arrival at a specific place or event. It also recommends a few unique locations that may offer family-friendly options. Along with reviews of other areas, they also enable people to discuss their favorite places. [As shown in Figure 5].

Drawbacks:

- Limited functionality: An app may not offer all the features or capabilities that users desire, such as the app's ability to search for attractions and restaurants through an interactive map using drop-pin functionality and provide recommendations based on user favorites.

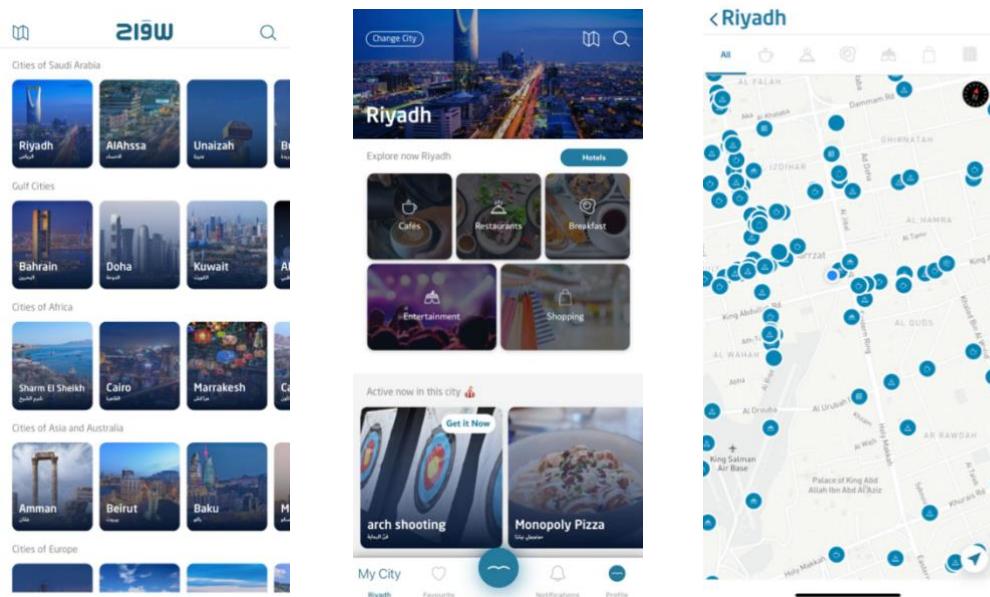


Figure 5 Sawah.



6- Saudi Events [21]: Is a local application and website that shows the seasons and events and supports the responsible authorities by giving them a platform that meets their demands for online presence, helping to quickly reach several different categories, and delivering a simple, flexible, and understandable user experience. The most interesting features of the app are that it provides detailed information about events, including location, time, and ticket details. Users can filter events based on interests and save favorites for future reference, as well as recommend similar items to those they are currently viewing through a recommendation system. Also, the event calendar allows easy sorting and filtering by date. [As shown in Figure 6].

Drawbacks:

- Limited selection, while it only covers the restaurants and attractions for Saudi Arabia's events and seasons.
- Lacks interactive map: It will hinder the essential function of delivering dynamic, user-centered experiences that enable users to engage with and gain valuable insights from geographic information.
- Lack of user-generated content (As previously defined in the 'VisitSaudi' drawbacks section).
- Absence of rating and commenting system (As previously defined in the 'VisitSaudi' drawbacks section).



Figure 6 Saudi Events.



7- Hala Yalla [22]: Is a local, all-inclusive app and website for sports, entertainment, culture, dining experiences, and much more. Additionally, it promotes a healthier, more active, and happier way of life for locals and residents. The app offers ticket booking, activity organizing, online event hosting, and full control over privacy, allowing users to create, share, and make events public for friends and new acquaintances. Additionally, it recommends similar items to those they are currently viewing through a recommendation system. [As shown in Figure 7].

Drawbacks:

- Limited dining alternatives: A relatively modest selection of restaurants, which may limit user's selections and their ability to explore.
- Absence of a rating and commenting system (As previously defined in the 'VisitSaudi' drawbacks section).
- Lacks interactive map (As previously defined in the 'Saudi Events' drawbacks section).

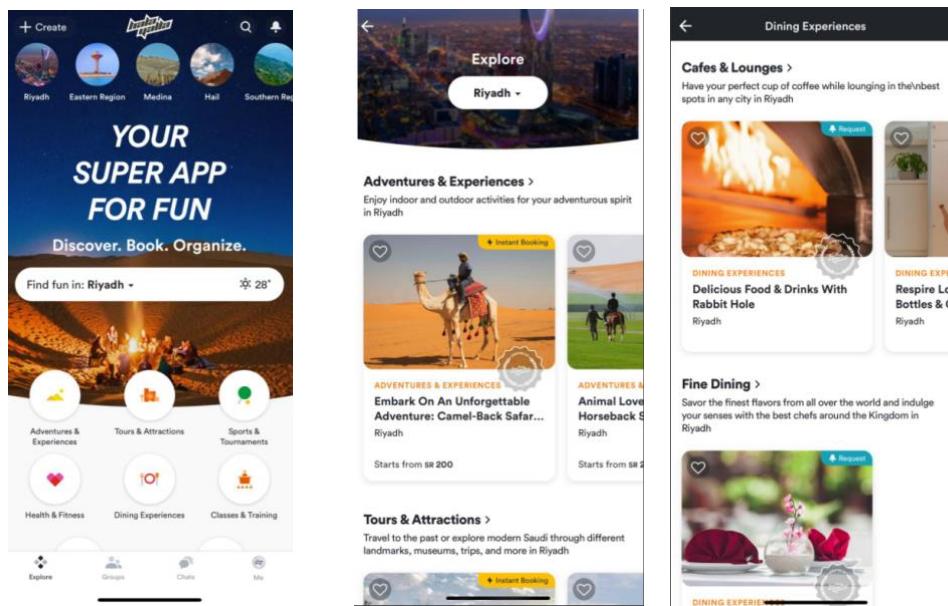


Figure 7 Hala Yalla.



8- Visit a city [23]: Is a global app and website for traveling that helps users schedule city tours. Users can benefit from the main features of the app, which are the ability to book trips and activities and rapidly construct a customized itinerary. Additionally, users can discover the must-see landmarks, important sites, and hidden gems in their destination. [As shown in Figure 8].

Drawbacks:

- Lack of user-generated content (As previously defined in the 'VisitSaudi' drawbacks section).
- Lacks interactive maps (As previously defined in the 'Saudi Events' drawbacks section).
- Lacking recommendation system: It can result in lowered personalization, information overload, missed cross-selling chances, discoverability, user dissatisfaction, potential revenue loss, and missed content promotion opportunities.

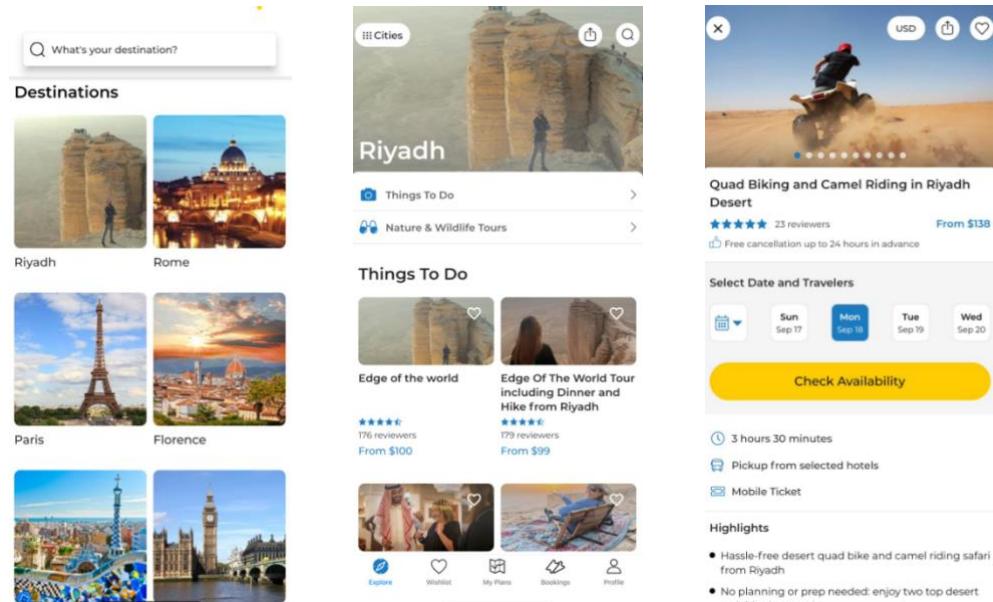


Figure 8 Visit a city.



9- Foursquare City Guide [24]: Is a global app that assists consumers in discovering the top dining options and more. Anywhere in the world, Foursquare City Guide will direct users to their ideal location. Some of the interesting features of the app are, joining a community of travelers; short tips; lists; hyper-personalized recommendations; following friends, brands, and influencers; a history of experiences; faster search for desired locations; allowing users to discover hidden gems and make memorable experiences. [As shown in Figure 9].

Drawbacks:

- Limited Coverage: Particularly in regions with fewer individuals or where there are fewer active Foursquare users, Foursquare's coverage of places and businesses may be constrained. Finding thorough information and suggestions for certain sites may be difficult for users.
- User Interface Complexity: Some users may find the Foursquare app confusing and overwhelming, especially those who are less tech-savvy or are not familiar with the program's user interface. There may be difficulty exploring the app due to the quantity of features and options.
- Supports no Arabic-language content.

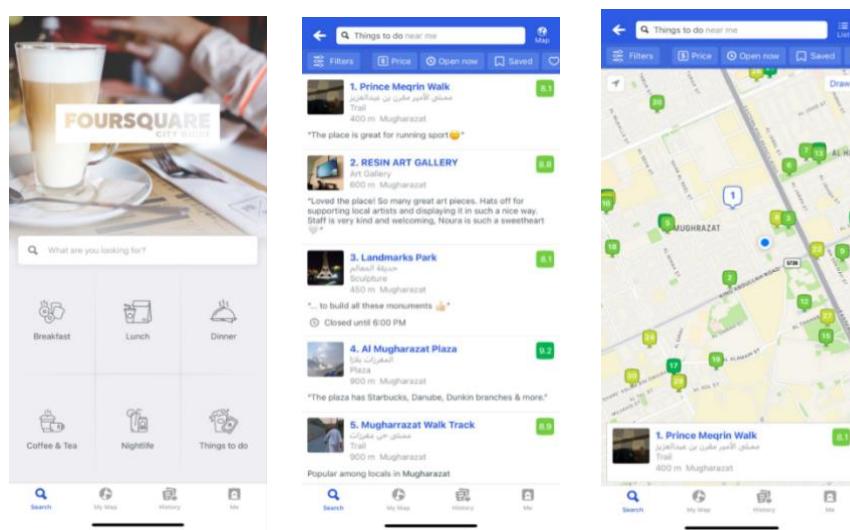


Figure 9 Foursquare City Guide.



3.2 Comparison Between Similar Applications

| Features | Applications | | | | | | | | | |
|---|--------------|-------------|-------------|-------------|-----------|--------------|--------------|------------|-------------|---|
| | Tripadvisor | Google Maps | Smart Guide | ENJOY Saudi | Traveloka | Saudi Events | Visit a City | Foursquare | Smart Guide | |
| Offers restaurants and attractions | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Offers hotels | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | |
| Add places of interest | ✓ | ✓ | | | ✓ | | ✓ | | ✓ | ✓ |
| Interactive map using current location to search for attractions or restaurants nearby | | ✓ | ✓ | | ✓ | | | | ✓ | ✓ |
| Interactive map using drop a pin to search for attractions or restaurants nearby | | ✓ | | | | | | | | ✓ |
| Recommends attractions and restaurants based on what the user is currently viewing. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Recommends attractions and restaurants based on what the user added to their favorite list. | | | | | | | | | | ✓ |
| Customized calendar | ✓ | | ✓ | | | | | ✓ | | ✓ |
| Support Arabic | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| Ratings | ✓ | ✓ | | ✓ | ✓ | | | ✓ | ✓ | ✓ |



| | | | | | | | | | |
|-------------------------|---|---|--|--|---|--|--|---|---|
| | | | | | | | | | |
| Comments | ✓ | ✓ | | | ✓ | | | ✓ | ✓ |
| Auto Filtering comments | | ✓ | | | | | | | ✓ |

Table 1 Comparison between similar applications.

3.3 Summary

After completing the evaluation of the present tourism applications on the market, the overall structure of the application to be produced may be acknowledged more clearly. There are some features that are shared by all the programs, as shown in the comparison table above (Table 1), while others are comparatively unique.

In order to determine the essential elements for tourism applications that must be included in our application, we looked at the features that at least five applications had already supplied as well as the characteristics that made sense to be provided. Using the "offering restaurants and attractions" feature as an example, a tourism application without a feature that enables users to locate options of restaurants and attractions is an inadequate application since it prevents users from carrying out even the most basic functions necessary.

The fact that none of the apps for tourism offer some of the special features we have, like recommending restaurants and attractions based on what the user has added to their favorite list, further drew our attention. Additionally, "Google Maps" is the only program that provides an interactive map that allows users to drop a pin to search for nearby restaurants or attractions. Furthermore, neither of the local applications except VisitSaudi provides a customized calendar, so we developed one since we were inspired by global applications as a result of their great value in saving customers' time and effort, and because of this, we feel that it will help us stand out and be in demand on the market.



Finally, it can be said that the characteristics and functionalities listed below should be included in our application that we will create:

1. Offering restaurants and attractions
2. Allowing users to add places of interest.
3. Providing an interactive map using the user's current location to search for attractions or restaurants nearby.
4. Providing an interactive map using a drop-pin to search for attractions or restaurants nearby
5. Providing a recommendation system that recommends attractions and restaurants based on what the user is currently viewing.
6. Providing a recommendation system that recommends attractions and restaurants based on what the user has added to their favorite list.
7. Offering a customized calendar that allows users to allocate each day to a certain activity or restaurant they want to try.
8. Providing bilingual information (in English and Arabic), allowing the user to choose the language they prefer for the application's user interface.
9. Allowing users to rate and comment.
10. Providing an auto filter to delete Inappropriate comments.



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System Design and Development



4 System Design and Development

4.1 Methodology

The Agile software development methodology was chosen for our project due to its inherent adaptability and iterative nature, making it well-suited for managing the continuously evolving requirements we anticipated encountering. This methodology prioritizes flexibility, communication, and rapid iteration. Agile development involves a continuous feedback loop that allows for frequent adjustments and improvements. Within the Agile framework, we specifically embraced Scrum, a methodology known for its collaborative approach and emphasis on incremental progress.

In embracing the Agile approach, we structured our team around three primary roles:

Product Owner: Our supervisor, Dr. Nouf Alrumaih, took on the role of Product Owner. Her responsibilities encompassed defining project priorities, managing the product backlog, and ensuring that our development efforts remained aligned with the overarching project objectives.

Scrum Master: Dr. Maha Alyahya served as our Scrum Master, providing guidance and support as we navigated through the Scrum process. Her responsibilities included ensuring that everyone comprehended and adhered to the framework and addressing any obstacles that emerged along the way.

Development Team: consisting of us, held the responsibility for delivering the product increment.

Throughout the project lifecycle, we followed the key principles and practices of the Agile methodology, including:

Sprint: This phase is a time-limited period, typically lasting between two to four weeks. Here, the development team concentrates on achieving a specific product increment. Throughout our project, we completed a total of five sprints.

Sprint Planning: At the beginning of each sprint, the team gathers to strategize and organize the tasks for the upcoming period. This involves a comprehensive review of the product backlog, during which



the team selects the tasks to prioritize. These planning sessions, lasting approximately an hour, were conducted under the guidance of our project supervisor.

Daily Scrum: This brief 15-minute meeting acts as a daily checkpoint for the team to regroup, discuss progress made, and plan tasks for the day ahead.

Sprint Review: At the culmination of each sprint, the team presents the completed product increment to stakeholders and collects feedback. This review process allows us to assess our progress and make any necessary adjustments for future sprints.

Sprint Retrospectives: Following each sprint, we held retrospective meetings to reflect on the team's performance, discuss what went well, what could be improved, and identify actionable steps for enhancing future sprints.

Within the Scrum framework, three essential artifacts are utilized:

Product Backlog: This serves as a comprehensive catalog detailing all necessary features, enhancements, and bug fixes imperative for the product's completion. It dynamically evolves to accommodate changing requirements.

Sprint Backlog: A focused subset of the product backlog, the sprint backlog comprises specific items selected by the team for completion during a particular sprint. It aids in prioritizing and organizing tasks within the sprint duration.

Increment: This represents the cumulative outcome of all completed product backlog items throughout the sprint. It signifies tangible progress achieved by the team toward realizing the project's objectives.



We relied on two essential tools, Jira¹ and GitHub², to support our Agile practices and Scrum framework. Jira facilitated sprint planning, note-taking during meetings, and efficient management of the product backlog. Meanwhile, GitHub provided a platform for monitoring team members' contributions and tracking changes made throughout each iteration, enhancing transparency and accountability in our development process.

¹ https://jira.external-share.com/issue/126282/latifa_alawwad @_ board share

² <https://github.com/LatifaAlawwad/2023-GP1-8>



4.2 System Requirements

4.2.1 System users

"S'hail" is designed for anyone interested in exploring attractions and restaurants in Saudi Arabia with an easy-to-use Android mobile app. No advanced technical skills are required. regardless of their educational level, Users should have basic technical skills, using an Android mobile application and the ability to understand Arabic or English would be all that's needed.

There are 3 types of users that interact with our application:

- An admin in S'hail is an expert in Saudi Arabian tourism with high technical skills. The admin should have the ability to understand both Arabic and English to manage the application and assist users effectively.
- A Registered User in S'hail is the heart of our community. They actively interact with the attractions and restaurants, rate them, and arrange their schedule based on personal preferences.
- A Guest Users in S'hail can view attractions and restaurants without an account which is perfect for quick overviews. However, guest users have limited functionalities compared to registered users. They can view and filter restaurants and attractions but are unable to perform actions such as adding places to their favorites, providing ratings, or writing comments. While guest users can access basic information about attractions and restaurants, the full range of interactive features and personalization is reserved for registered users.

4.2.2 Requirements Elicitation and Analysis

For requirement elicitation, we utilized a combination of user interviews and questionnaires as shown in Table 2 below. Interviews help in obtaining in-depth insights and understanding of stakeholder perspectives. Through interviews, we can have direct interactions with stakeholders, ask follow-up questions, and clarify any ambiguities. This enables us to gather detailed information, uncover implicit requirements, and gain a deeper understanding of user needs, goals, and challenges. On the other hand, questionnaires are designed in a structured format to gather responses from a larger sample of users. They provide a standardized approach for collecting data and opinion [25].



| Method | No.Of Question s | No.Of Response | Age | Female/Male | Status in Saudi Arabia |
|---------------|------------------|----------------|--|------------------------------|------------------------------------|
| Interviews | 9 | 3 | 23-45 | 1 Man 2 Women | They all citizen |
| Questionnaire | 13 | 54 | 72.7% (18-29) 20% (30-50) 3.6% (less than 18) 3.6% (more than 50) | 87.3%(Female) 12.7%(Male) | 90.9% (citizen) 9.1% (Resident) |

Table 2 Requirements elicitation information.

Based on our interviews, we found that many interviewees utilize a range of global tourism applications, including Google Maps, TripAdvisor, and Sawah, as well as local applications such as Visit Saudi and halaYalla. The interviewees highlighted several key features that our application will incorporate, including personalized recommendations based on their preferences and comprehensive information about each restaurant or attraction, including user comments and ratings, location details, photos, type of cuisine, working hours, and contact information. They explained the importance of this information to enable them to make informed decisions and meet their preferences. However, the interviewees also encountered challenges when using existing applications, such as outdated and insufficient information, limited search filters, navigation between applications to collect all important information about restaurants and attractions, lack of reliability of user-generated reviews and ratings, and the absence of commenting and rating features. To address these difficulties, they proposed implementing features such as the ability to comment, rate, and display comprehensive information, stricter checks to keep information up-to-date, review verification methods, and more detailed search filters.

Based on the responses collected from the questionnaire, most participants highlighted the importance of having various features that our application will cover. These features include a recommendation system based on recent activities and preferences, The ability to use the application in Arabic since all participants are native Arabic speakers, the availability of ratings and comments to assist in decision-making, the utilization of an interactive map to drop a pin and to identify nearby places, the use of the WhatsApp application for communication in case of any issues, and the inclusion of a scheduling feature to effectively organize visits to restaurants and tourist attractions. Some participants faced difficulties in using existing applications, including finding an app that combines all attractions and



restaurants, the absence of a recommendation system and the display of recent trending places, outdated information, the lack of comprehensive information for the displayed restaurant or attraction places, unappealing user interfaces, and slightly complex navigation within the application.

Our application will focus on solving most of the problems mentioned in the interview and questionnaire by providing the recommendation feature to display personal preferences and recent activity, comments, and ratings, display comprehensive information for each restaurant or attraction, display more search filters, and provide an attractive interface and easy navigation within the application.

Finally, we received several suggestions that we might consider adding later in the project. These suggestions include a plan-sharing feature, Expanding the selection of restaurants and attractions within the covered city to offer a broader range of options, and providing a reservation service.



4.2.3 User Interactions.

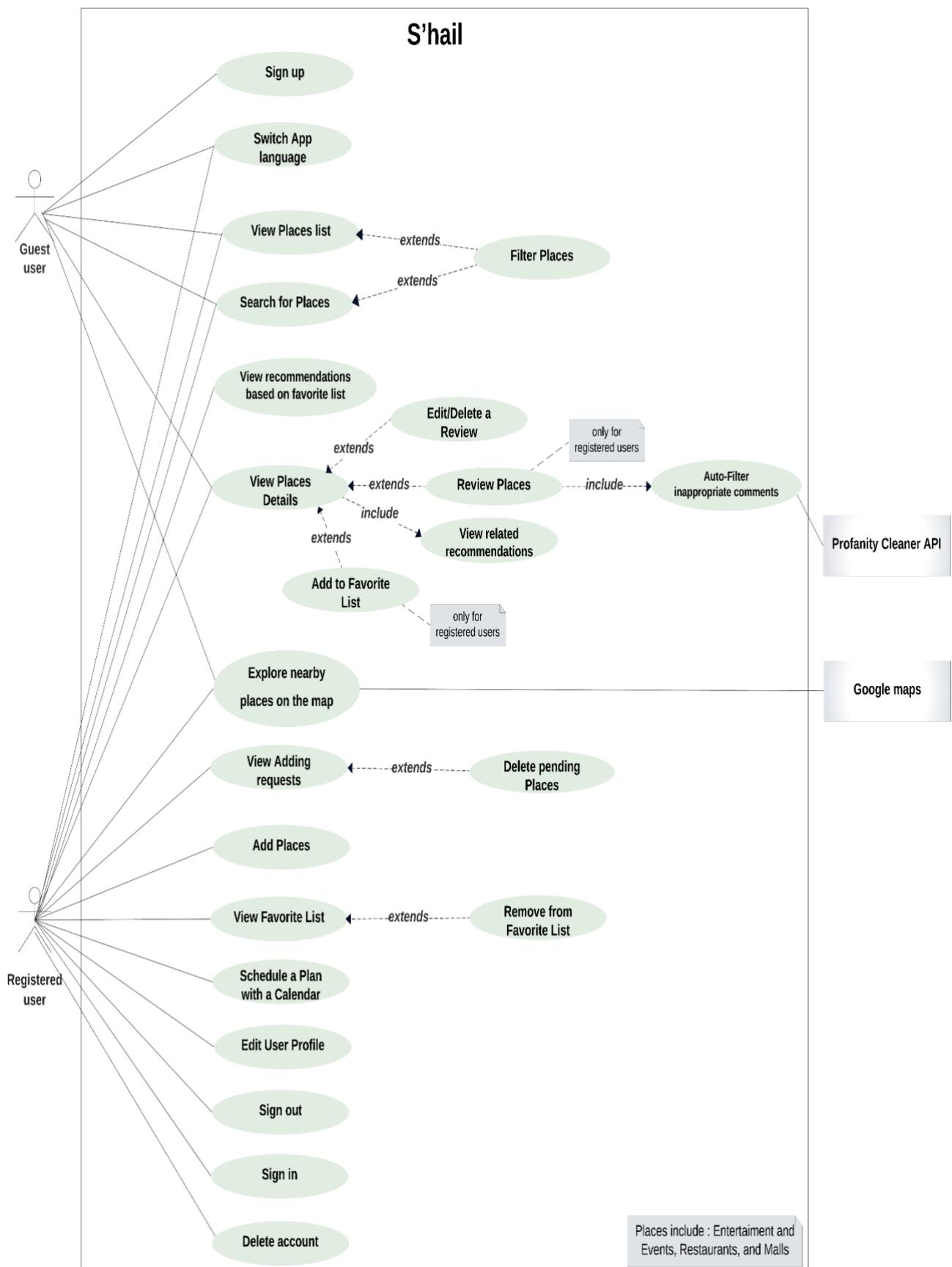


Figure 10 Guest and registered user use case diagram.



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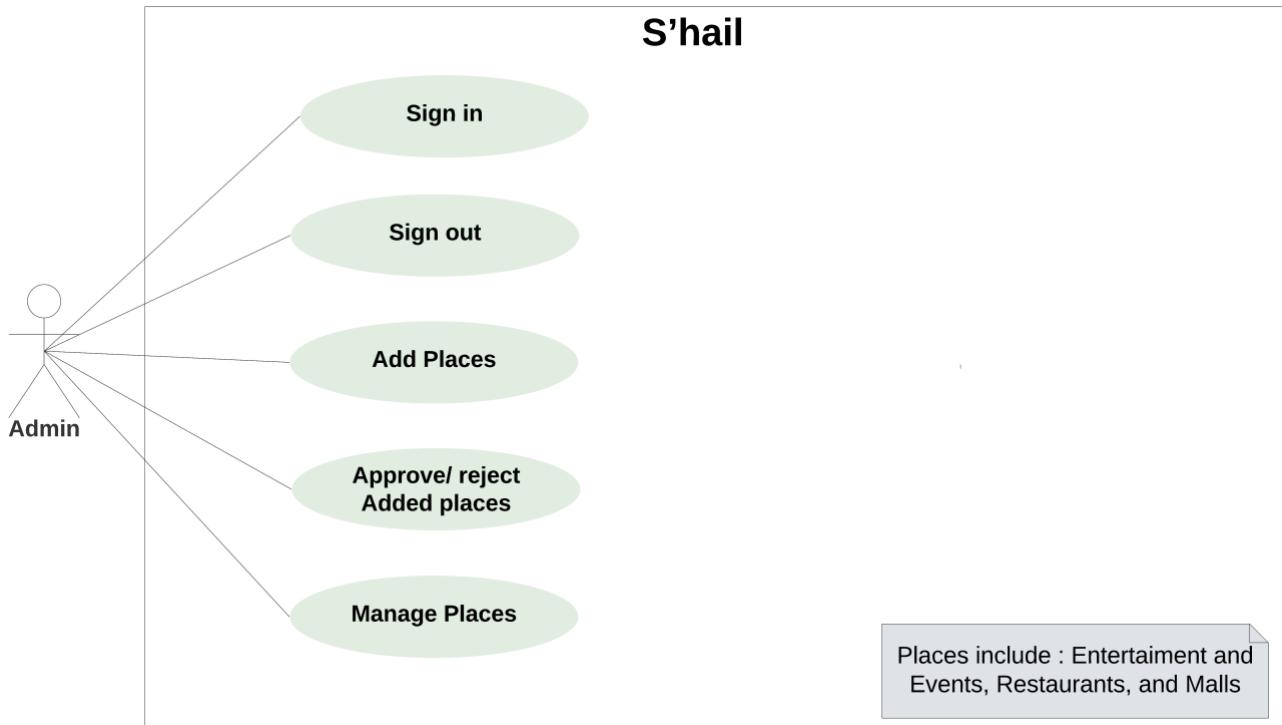


Figure 11 Admin user use case diagram.

4.2.4 Roadmap and Product Backlog Table

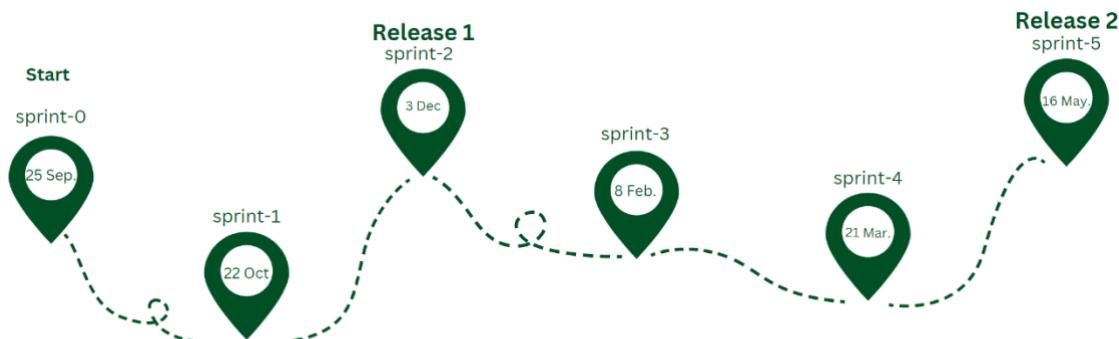


Figure 12 Roadmap.



| Release-1 | | |
|---|---|---|
| Sprint0 | Sprint1 | Sprint2 |
| <ul style="list-style-type: none"> -Domain and requirements analysis -Tools setup -Learn about flutter framework and Dart language by implementing the registration and the login functions. - Literature review -Background | <ul style="list-style-type: none"> -Database creation -Collecting data manually -Design system interface/theme -Adding attractions, malls, and restaurants of interest -Approving attraction, malls, and restaurants by Admins - Search for attractions, malls, and restaurants | <ul style="list-style-type: none"> -Providing an interactive map and using current location or dropping a pin to explore nearby places. -Rating and commenting on a particular place -Update/Delete a comment -Managing attractions, malls, and restaurants by admins (Update information / Delete) -Auto-Filtering inappropriate comments |

| Relese-2 | | |
|---|--|--|
| Sprint3 | Sprint4 | Sprint5 |
| <ul style="list-style-type: none"> -Filter search results according to some criteria. -Provide a content-based recommender system that displays attractions, malls, and restaurants similar to the ones the user is currently viewing | <ul style="list-style-type: none"> -Create a favorite list page and add attractions, malls, and restaurants to it -Provide a content-based recommender system that displays attractions, malls, and restaurants similar to the ones the user added in the favorite list. -Edit profile by users | <ul style="list-style-type: none"> -Providing an option to switch the language. -Providing a calendar for planning, Including the ability to add attractions, malls, and restaurants to schedules based on user preferences. -Delete user account |

Table 3 Product roadmap.



| ID | PBI | Size | Type | Status | Acceptance Criteria |
|----|--|------|---------|--------|---|
| 1 | As a guest user, I want to be able to sign up, so that I can have an account that give me access to all application's features | 2 | Feature | Done | <ul style="list-style-type: none"> - As a guest user, if I go to the sign-up page and enter my name, email, and password then click on sign up, then I should have an account in the app that gives me access to all the featured. After signing up, I should be redirected to a page where I can select my preferences. - As a guest user, If I go to the sign-up page and omit any information or enter it incorrectly, then the sign-up process will fail, and an error message will be displayed explaining what's wrong. (The minimum password length is eight characters, and it must include at least one capital letter and one special character, also the email should be valid) |
| 2 | As a registered user I want to be able to log in, so that I can access my account. | 2 | Feature | Done | <ul style="list-style-type: none"> - As a registered user, if I go to the login page and enter my email and password and click on log in, then I should be able to access my account with all registered user features on the app. - As a registered user, if I go to the login page and enter incorrect email or password or wrong email format, then log in fails with an error message that says that the Email or password or the email format was wrong. |
| 3 | As a registered user I want to be able to reset my password, so that I can access my account when I forget my password. | 2 | Feature | Done | <ul style="list-style-type: none"> - As a registered user, if I forgot my password and I click on the “forgot password” link that is in the login page and enter my new password that match the password policy (length is eight characters, and it must include at least one capital letter and one special character), then this password should be my new password and allow me to access my account. - As a registered user, if I forgot my password and I click on the “forgot password” link that is in the login page and enter my new password that doesn't match the password policy, then an error message will be displayed explaining what's wrong. (The minimum password length is eight characters, and it must include at least one capital letter and one special character). |
| 4 | As a registered user, I want to be able to log out, so that I can exit my account and prevent any unauthorized access to it. | 2 | Feature | Done | <ul style="list-style-type: none"> - As a registered user, if I click on log out, then I should have no access to all registered user features on the app. |
| 5 | As an Admin I want to be able to log in, so that I can access my account. | 2 | Feature | Done | <ul style="list-style-type: none"> - As an Admin, if I go to the login page and enter my email and password and click on log in, then I should be able to access my account with all administration functionalities. |



| ID | PBI | Size | Type | Status | Acceptance Criteria |
|----|--|------|---------|--------|---|
| | | | | | <ul style="list-style-type: none"> - As an Admin, if I go to the login page and enter an incorrect email or password, then log in fails with an error message that says that the Email or password was wrong. |
| 6 | As an admin, I want to be able to log out, so that I can exit my account and prevent any unauthorized access to it. | 2 | Feature | Done | <ul style="list-style-type: none"> -As an admin, if I click on log out, then I should have no access to all administration functionalities. |
| 7 | As a guest or registered user, I want to be able to view attractions of the selected city in a list, so that I can view all available attractions in that city. | 5 | Feature | Done | <ul style="list-style-type: none"> - As a guest or registered user, if I go to the home page, then I should be able to view all available attractions of the selected city. - As a guest or registered user, if I go to the home page and no attractions were found in the selected city, then a message will be displayed indicating that there are no attractions available in that city. |
| 8 | As a guest or registered user, I want to be able to view restaurants of the selected city in a list, so that I can view all available restaurants in that city. | 5 | Feature | Done | <ul style="list-style-type: none"> - As a guest or registered user, if I go to the home page, then I should be able to view all available restaurants of the selected city. - As a guest or registered user, if I go to the home page and no restaurants were found in the selected city, then a message will be displayed indicating that there are no restaurants available in that city. |
| 9 | As a guest or registered user, I want to be able to view the details of the selected attraction, so that I can learn more about it and make decisions about whether to visit or explore other options. | 5 | Feature | Done | <ul style="list-style-type: none"> - As a guest or registered user, if I go to the home page and click on an attraction place, then I should be able to view all that attraction details. |
| 10 | As a guest or registered user, I want to be able to view the details of the selected restaurant, so that I can learn more about it and make decisions about whether to visit or explore other options. | 5 | Feature | Done | <ul style="list-style-type: none"> - As a guest or registered user, if I go to the home page and click on a restaurant, then I should be able to view all that restaurant details. |
| 11 | As a registered user, I want to add attractions and restaurants of my interest, so that it could be listed on the app and viewed by other users. | 8 | Feature | Done | <ul style="list-style-type: none"> - As a registered user, if I click on the Add place button, and fill up the form and submit it, then a message will appear indicating that my request is on hold to be added. - As a registered user, if I click on the Add place button, and leave any required field empty, then an appropriate error message should appear, and the request won't be completed. |
| 12 | As an admin, I want to be able to approve or decline user requests for adding places, so that all attractions and restaurants will be appropriately displayed to users. | 8 | Feature | Done | As an admin, if I receive an add place request from a user, then I should be able to check and view all the place details and approve or decline the request. |



| ID | PBI | Size | Type | Status | Acceptance Criteria |
|----|---|------|---------|--------|---|
| 13 | As a registered user, I want to be able to view all my adding requests in my profile page, so that I can be informed and track my request status. | 3 | Feature | Done | <p>-As a registered user, if I go to my profile page and click on the adding requests, then I can view their status.</p> |
| 14 | As a registered user, I want to be able to delete attractions or restaurants that I requested to add to the app list, so that I can easily remove listing them from the application when I no longer want to keep them. | 5 | Feature | Done | <p>-As a registered user, if I click on one of my added attractions or restaurants that is in pending state and press the 'Delete' icon button, then a confirmation message should appear, and deletion should only occur if I confirm.</p> <p>-As a registered user, if I click on one of my added attraction or restaurants that in pending state, press the 'Delete' icon button, and confirm deletion, then this attraction or restaurant should no longer appear in my list of pending attractions or restaurants.</p> |
| 15 | As a guest or registered user, I want to be able to search for attractions and restaurants by their name, so that I can find the desired place faster. | 5 | Feature | Done | <p>-As a guest or registered user, if I am viewing the attractions and restaurants, then click on the search bar, and enter my desired place name, then the matching results will be displayed.</p> <p>- As a guest or registered user, if I am viewing the attractions and restaurants, then click on the search bar, and enter my desired place name and no results were found, then a message will be displayed indicating that no available matching is available.</p> |
| 16 | As a registered user, I want to be able to comment and rate on the restaurants and attractions listed in the app, so that I can share my experience with other users. | 8 | Feature | Done | <p>-As a registered user, if I visit a restaurant or an attraction listed in the app, then I should be able to share my feedback and experience by commenting and rating.</p> <p>-As a registered user, if I attempt to send a second comment and rating, then an error message will appear, indicating that I have an existing comment and rating and I can modify it in the comment section.</p> |
| 17 | As a registered user, if I encounter a mistake or require modification for any reason in my comment and rating then, I should be able to delete and update my comment. | 3 | Feature | Done | <p>-As a registered user, if I have a previous comment and press on the 3 dots icon and click on update review and updated then, a message will appear indicating that the review is updated successfully.</p> <p>-As a registered user, if I have a previous comment and press on the 3 dots icon and click on delete review then, a message will appear indicating that the review is deleted successfully.</p> |
| 18 | As a guest or registered user, I want to be able to use my current location on the map, so that I can | 5 | Feature | Done | -As a registered user, if I open the interactive map, then markers of nearby restaurants and attractions from my current location will be displayed. |



| ID | PBI | Size | Type | Status | Acceptance Criteria |
|----|---|------|---------|--------|--|
| | explore nearby markers of the restaurants and attractions. | | | | |
| 19 | As a guest or registered user, I want to be able to drop a pin in the map, so that I can explore nearby markers of the restaurants and attractions in the pinned location. | 8 | Feature | Done | -As a registered user, if I open the interactive map, and I pin a specific location, then nearby markers of the attractions and restaurants from the pinned location will be displayed. |
| 20 | As a guest or registered user, I want to see a list of nearby restaurants and attractions from my current location or the dropped pin, so that I can view all available restaurants and attractions nearby. | 5 | Feature | Done | -As a registered user, if I open the interactive map and press on the list icon, then a list of nearby restaurants and attractions from my current or the dropped pin location will be displayed. |
| 21 | As a guest or registered user, I want the comments to be auto filtered, so that I don't get bothered by inappropriate comments. | 8 | Feature | Done | -As a registered user, if I submit a comment, then the system should automatically employ content filtering to mask offensive content. |
| 22 | As an admin, I want to be able to delete restaurants or attractions, so that only the available ones will be listed in the app. | 8 | Feature | Done | -As an admin, if any attractions or restaurants are not available for any reason, then I should be able to delete them. |
| 23 | As an admin, I want to be able to update restaurants or attractions information, so that I can keep them all up to date. | 8 | Feature | Done | -As an admin, if any attractions or restaurants information has been changed and is not up to date, then I should be able to update their information. |
| 24 | As a guest or registered user, I want to be able to filter restaurants and attractions based on some attributes, so that I can find my interest faster. | 8 | Feature | Done | <p>-As a guest or registered user, if I click on the filtering option, and I fill the attributes of filtering, and press "apply", then only the restaurants or attractions with the chosen filter attributes should be displayed in the list.</p> <p>- As a guest or registered user, if I modify any of the filter attributes or select different filtering options, then the displayed list should be updated accordingly to reflect the new filtering criteria.</p> |
| 25 | As a guest or registered user, I want to be able to get recommendations for what I am currently viewing, so that there are more options available that are relevant to what I am looking at. | 13 | Feature | Done | -As a guest or registered user, if I am viewing a specific restaurant or attraction, then similar ones will be suggested. |



| ID | PBI | Size | Type | Status | Acceptance Criteria |
|----|---|------|---------|--------|--|
| 26 | As a registered user, I want to be able to add a restaurant and attractions to my favorite list, so that I can easily access my preferred restaurants or attractions in the future. | 5 | Feature | Done | -As a registered user, if I am viewing a preferred restaurant or attraction, then I should be able to add it to my favorite list to save it for later access. |
| 27 | As a registered user, I want to be able to delete a restaurant or an attraction from my favorite list, so that I can manage my saved restaurants and attractions and keep my list updated to my preferences. | 5 | Feature | Done | -As a registered user, if I am viewing my favorite list, then I should be able to delete a saved restaurant or attraction to keep my list updated. |
| 28 | As a registered user, I want to be able to get recommendations related to what I added to my favorite list, so that I can get more personalized options of my interest. | 13 | Feature | Done | -As a registered user, if I am viewing the home page, then I should get personalized recommendations related to my favorite list. |
| 29 | As a registered user, I want to be able to update my profile information, so that I can keep all my information updated. | 5 | Feature | Done | -As a registered user, if I access my profile page and click 'update profile information', updated my information and I click on 'confirm', then the app should update my information. |
| 30 | As a guest or registered user, I want to be able to have the option to change the app's language between Arabic and English so that I can use the application in a language that is more comfortable or understandable to me. | 10 | Feature | Done | <p>-As a guest or registered user, if I am viewing the app in Arabic language then click the switch button, then the application should switch the content to English.</p> <p>-As a guest or registered user, if I am viewing the app in English language then click the switch button, then the application should switch the content to Arabic.</p> |
| 31 | As a registered user, I want to be able to add restaurants and attractions to a specific date on my calendar, so that I can arrange my schedule. | 8 | Feature | Done | -As a registered user, If I am viewing my calendar, then I should be able to arrange my schedule by adding attractions and restaurants to a future or today date. |
| 32 | As a registered user, I want to have the ability to display my added restaurants and attractions for a specific date from my calendar, so that I can easily access my added restaurants or attractions. | 8 | Feature | Done | <p>-As a registered user, if I select a future or today's date in my calendar, then I should be able to display all the restaurants and attractions I added on that date. Additionally, I will have the ability to search for specific restaurants and attractions and add them to the selected date.</p> <p>-As a registered user, if I select a past date in my calendar, then I should be able to display all the restaurants and attractions I added on that date.</p> |
| 33 | As a registered user, I want to have the ability to remove restaurants and attractions to a specific date | 5 | Feature | Done | As a registered user, if I click the 'Remove' button for a restaurant or attraction on a specific date in my |



| ID | PBI | Size | Type | Status | Acceptance Criteria |
|----|---|------|---------|--------|--|
| | from my calendar, so that I can easily make changes to my schedule and keep it up to date with my plans. | | | | calendar, then it should be deleted after I confirm the deletion process. |
| 34 | As a registered user, I want to be able to delete my account, so that I can permanently remove my information from the application. | 3 | Feature | Done | -As a registered user, if I access my account deletion page and click 'delete account', then I click on 'confirm', then the app should permanently remove my account and all associated information. |

| ID | PBI | Size | Type | Status | Acceptance Criteria |
|----|--|------|---------|--------|---|
| 35 | As a user, I want the app to have an intuitive and user-friendly interface, so that I can easily navigate and use the app without any confusion. | 3 | Feature | Done | - As a user, if I interact with the interface, then I should find it relatively easy to use, and I should not require training time to become familiar with it. |
| 36 | As a user, I want the app to load quickly so that I can have an efficient experience. | 3 | Feature | Done | - As a user, if I open the app, then I expect it to load within 2 seconds or less, ensuring a quick startup. |
| 37 | As a user, I want the app to have a robust access control and permission system, so that only authorized users can access sensitive data and features. | 3 | Feature | Done | -As a user, if I attempt to access sensitive data or features without the appropriate authorization, I should receive a clear and informative error message, and I should not be allowed to access. |
| 38 | As a user, I want the app to handle errors efficiently and provide clear and concise error messages, so that I can understand what went wrong and take appropriate action. | 3 | Feature | Done | -As a user, if I encounter an error while using the app, then I expect to understand the error message that describes the issue. |
| 39 | As a user, I want the application to be available 99% of the time I try to access it, so that I can access the application whenever I need it. | 5 | Feature | Done | As a user, if I try to access the application 10 times, then it should be available at least 9 times. |

Table 4 Product backlog.



4.3 System Design

4.3.1 Architectural Diagram

“S'hail” application architecture is client-server, where the application is divided into two main components: the client, which operates on the user devices, and the server, which runs on a remote server [12]. On the client side, the major component is the user interface which handles the user interactions. We have three types of clients:

The first is the registered user, who can use all the features such as Explore nearby places on the map, adding restaurants or attractions to the favorite list, searching for attractions or restaurants, rating and writing comments, adding attractions or restaurants for interest after the admin approval, update user profile, add attractions and restaurants to schedules and switching between two languages.

The second is the guest user, who can view and filter the restaurants and attractions. The third is the admin, who approves the places that the user wants to add. The user interface handles the user interactions such as searching for specific restaurants or attraction places, rating, and writing comments, switching between two languages, adding attractions and restaurants of interest, adding restaurants or attraction places to a favorite list, add attractions and restaurants to schedules, update user profile. The client side also receives output from the server and displays it. On the server side, the major components include the S'hail database, Google Map API, and recommendation algorithm. The database management module handles data storage, retrieval, and updates using Firebase as the backend service. The Google Map API provides an interactive map experience, allowing users to navigate the map, drop a pin and visualize the restaurants and attractions. The recommendation engine utilizes content-based algorithms to analyze user preferences and current activity to provide personalized recommendations for restaurants and attractions. The server side receives the request from the client, processes the information, retrieves relevant data from the database, and sends the response to the client.



The following diagram shows the system architecture:

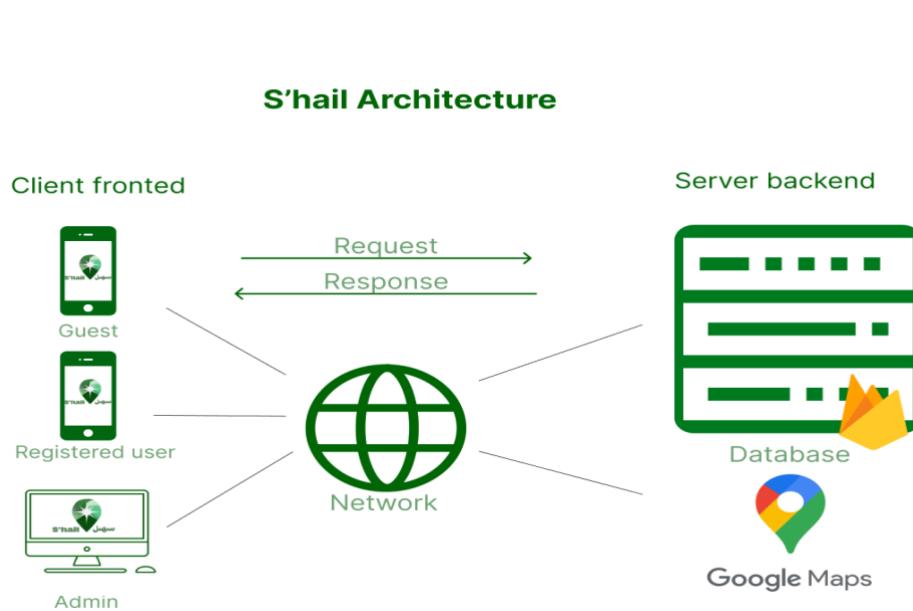


Figure 13 System architecture.

In summary, the client-server architecture of the S'hail application is designed to provide users with a comprehensive platform for exploring restaurants and attractions in Saudi Arabia. The client-side components handle user interactions, display recommendations, and map visualizations. The server-side components process user requests, generate recommendations, interact with the database management module, and deliver responses back to the client-side component.



بيان

4.3.2 Class Diagram

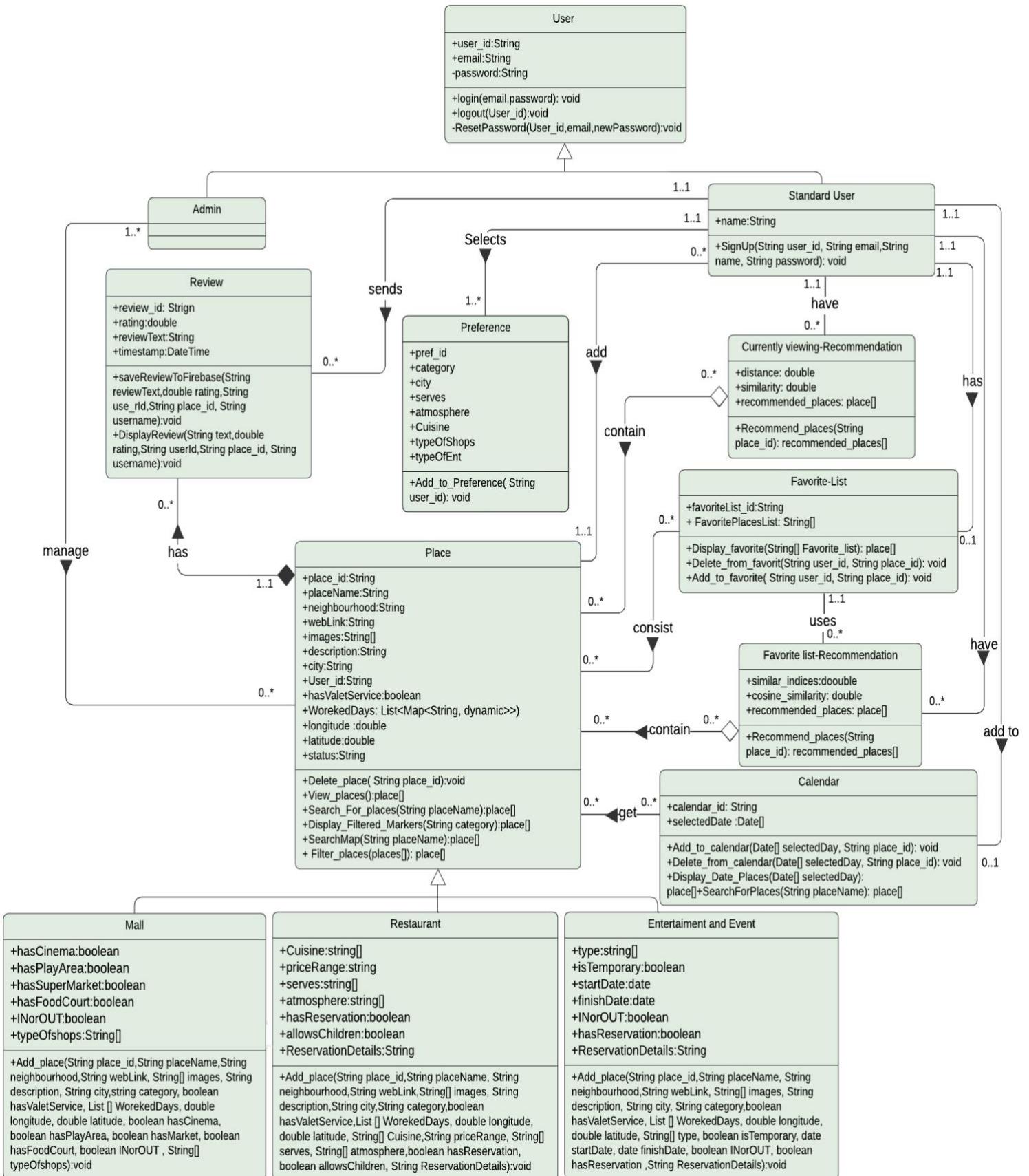


Figure 14 Class diagram.



سهو

4.3.3 Component Level Design

4.3.3.1 Search Feature Flowchart

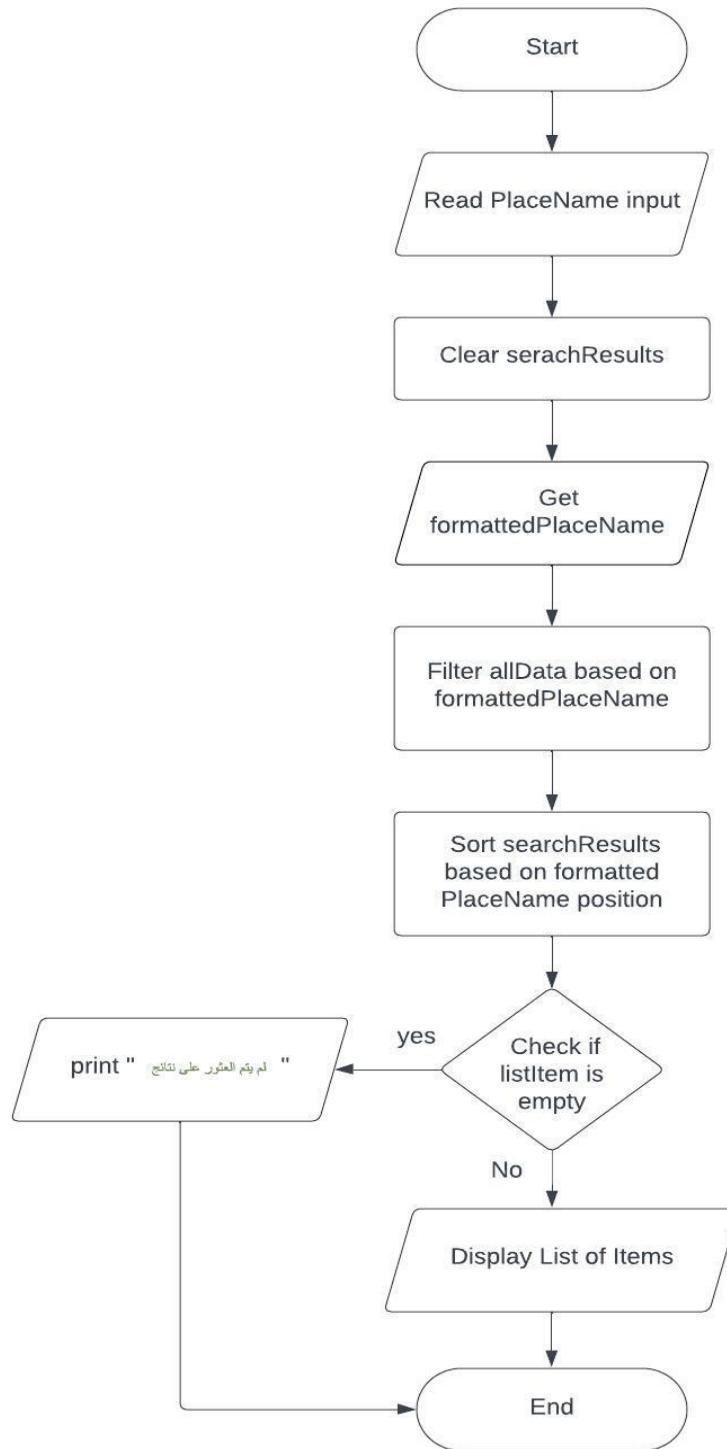


Figure 15 Search flowchart.



4.3.3.2 Submitting a Review Feature

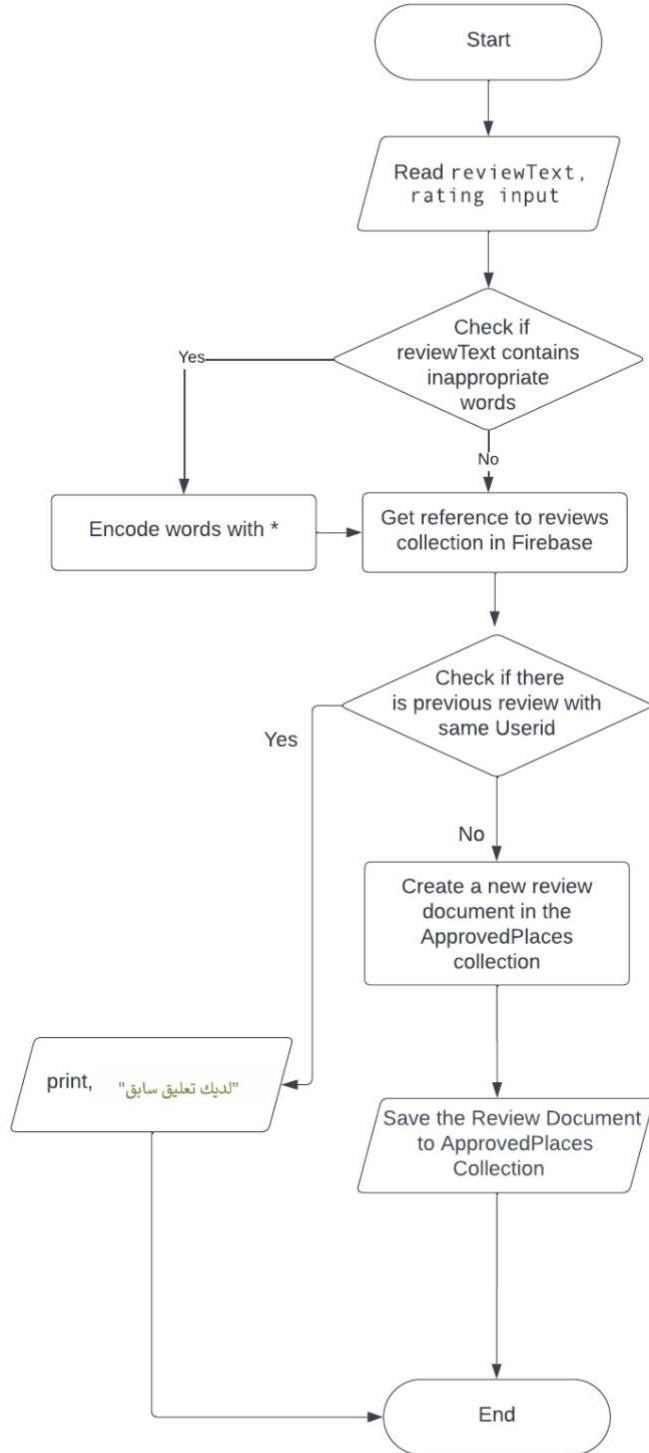


Figure 16 Writing a review flowchart.



4.3.3.3 Currently viewing recommendation system.

The following flowchart is for our content-based recommender system. We built it using the KNN algorithm to recommend similar places to the place the user is currently viewing. The process begins by defining a haversine distance function to calculate distance between two points. Upon receiving a user's request for a place ID, the system fetches relevant data and preprocesses it by dropping irrelevant columns and performing one-hot encoding on categorical variables. Using the Nearest Neighbors algorithm, the system finds similar places and calculates a similarity percentage. It iterates through the recommendations, ensuring they meet a threshold similarity percentage and a maximum of five recommendations. Then, it calculates the distance between specified places and sorts of recommendations based on proximity.

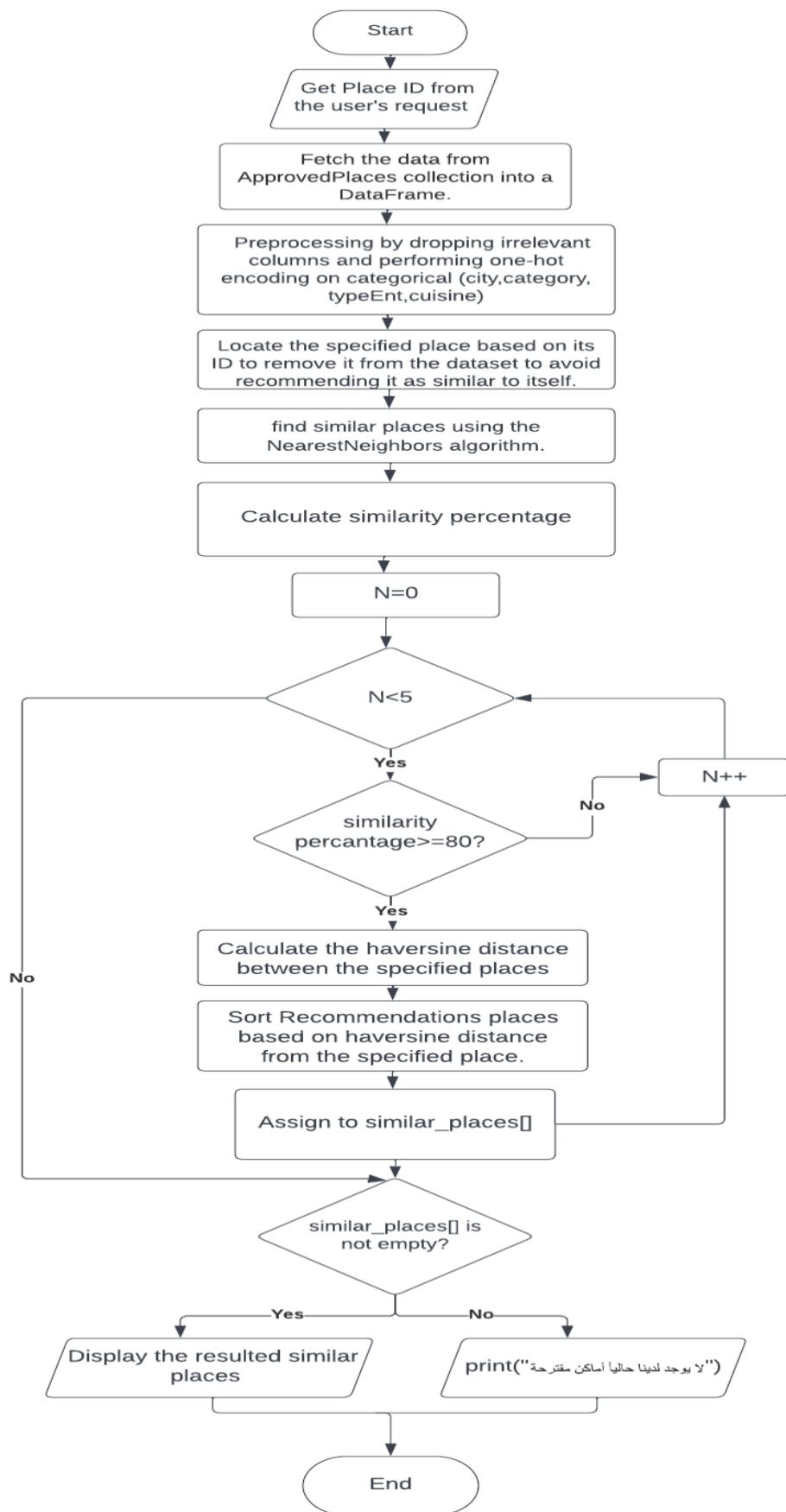


Figure 17 Currently viewing recommender system flowchart.



4.3.3.4 Favorite recommendation system

The following flowchart illustrates the process of generating personalized recommendations for users based on their preferences in the favorite list. It begins by extracting the User ID and city name from the user's request and fetching their favorite places from Firestore using the User ID. Simultaneously, approved places are fetched from Firestore and filtered based on the specified city name. Preprocessing involves iterating through each approved place, extracting its attributes and concatenating these into a single text string. The text is then preprocessed by tokenization, removing non-Arabic characters, eliminating stop words, and creating item profiles for each place. If the user favorites list is empty, an empty list is returned; otherwise, the TF-IDF vectorization and cosine similarity calculations are performed for each favorite place to determine similarity with other places. The top similar items are added to the recommendations set, filtering out those already in the user favorites. Finally, the recommendations list is returned, sorted by score, presenting the user with personalized suggestions aligned with their preferences and interests.

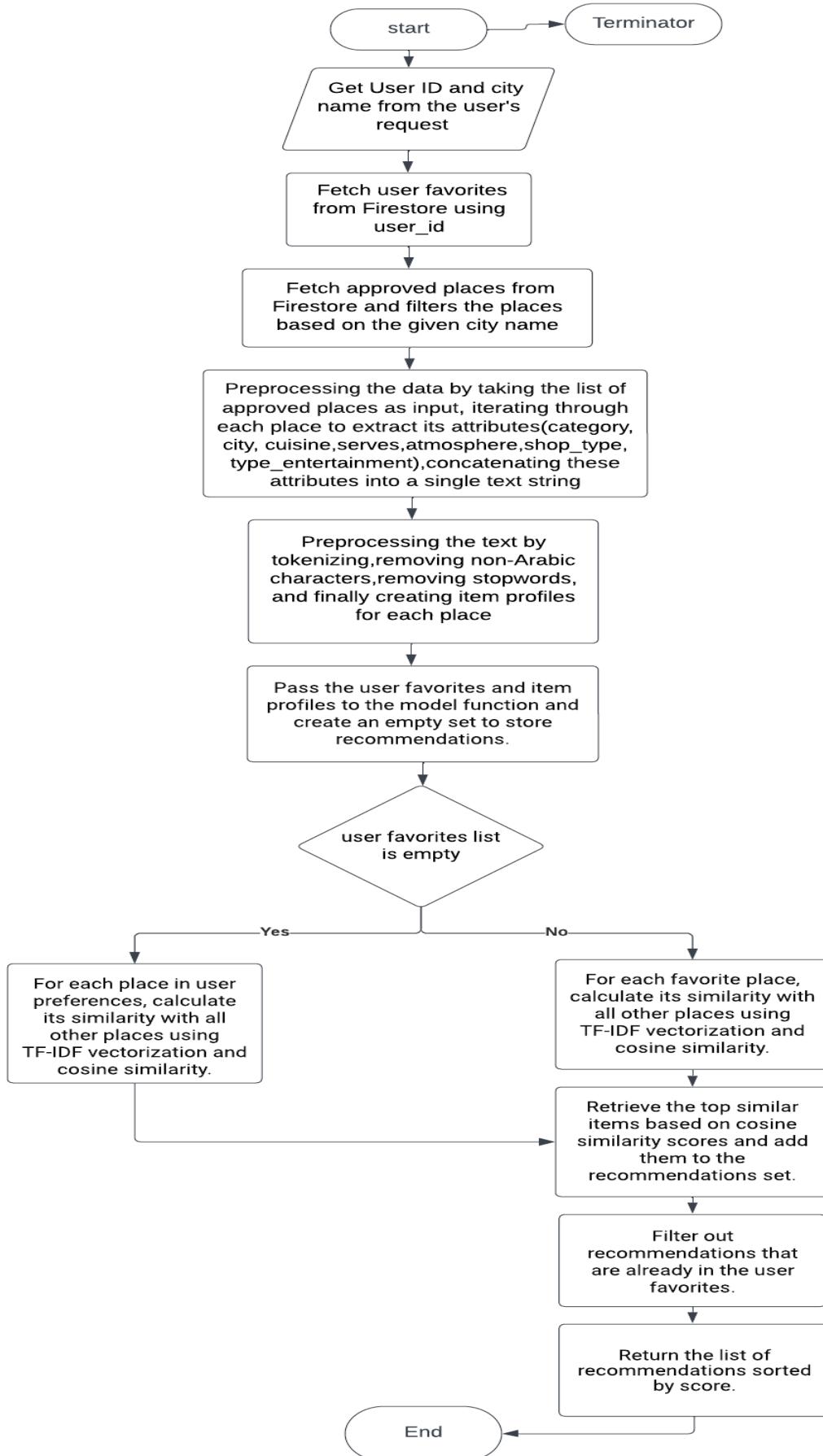


Figure 18 Favorite recommendation system flowchart.



4.4 Data Design

4.4.1 Data Models

4.4.1.1 ER Diagram.

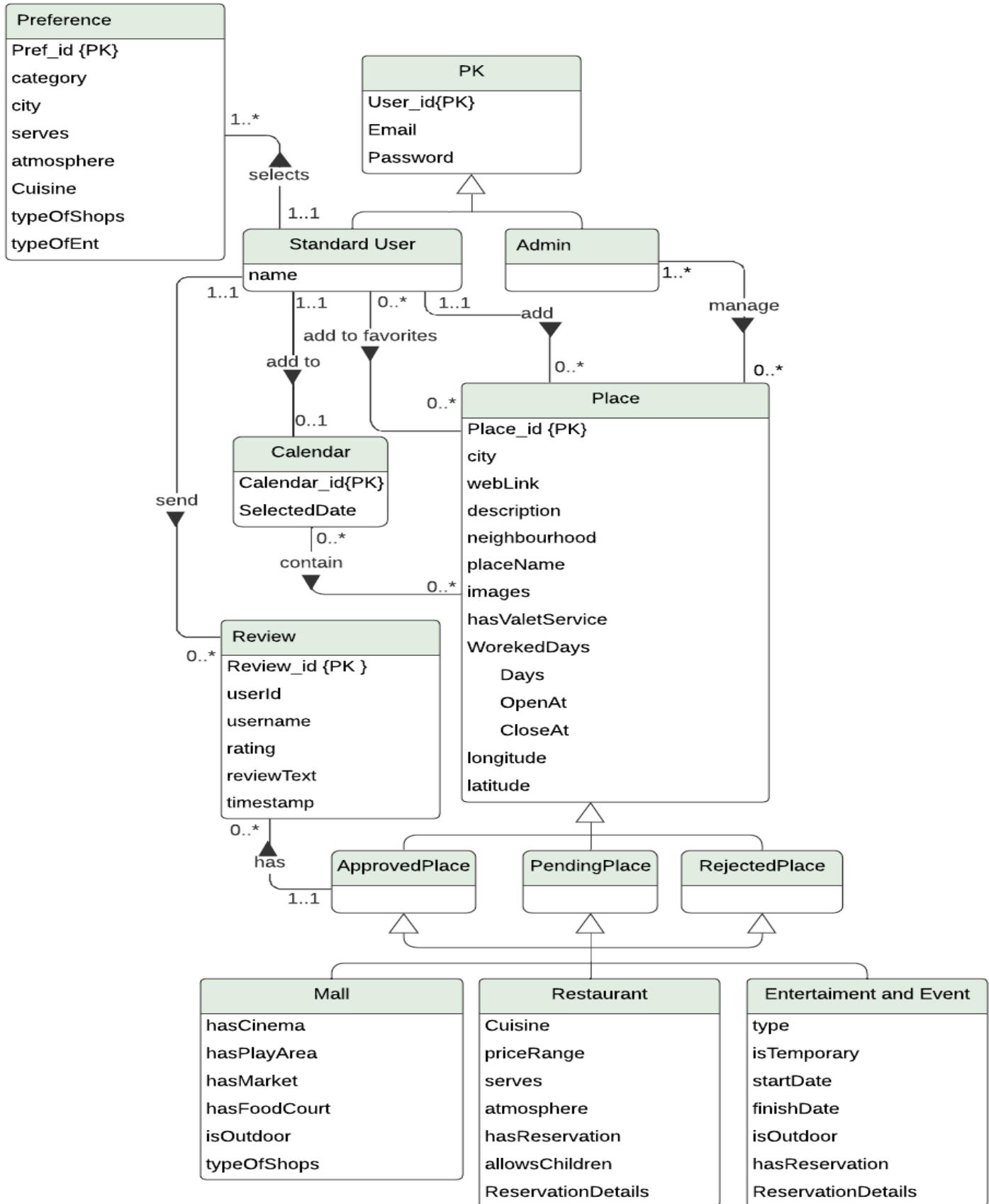


Figure 19 ER diagram.



سُهيل

4.4.1.2 Non-Relational Data Model

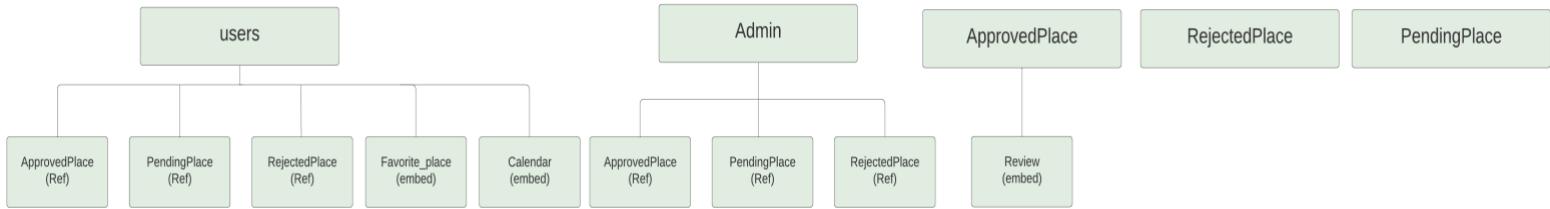


Figure 20 Non-relational data model.

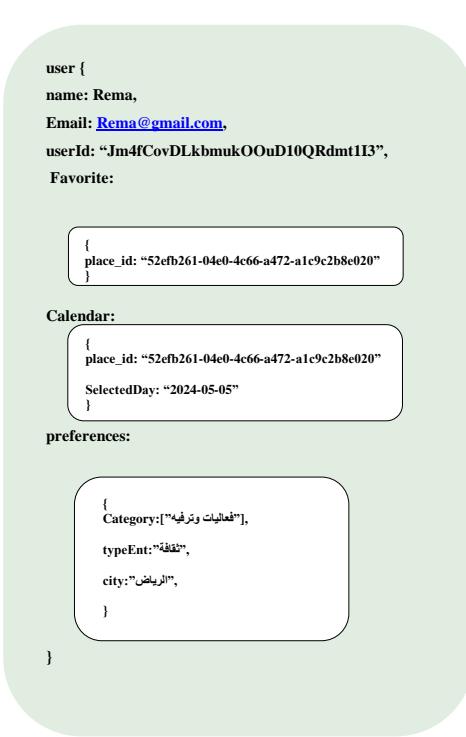


Figure 21 Sample of S'hail user.

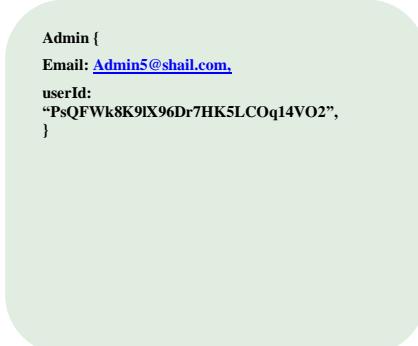


Figure 22 Sample of S'hail admin.



Figure 23 Sample of rejected place with entertainment category.



PendingPlaces{

placeName: "Mode mall",

place_id: "70d4580f-f500-4dc3-80b4-1d63033acffa",

neighborhood: "العلبة",

city: "الرياض",

description: " مجرد دخولك إلى مول ستشعر بالحياة تسري في المكان فأشعة الشمس المنبعثة من القبة

الكبيرة في سقف المول وتصميمه المعماري المعتمد على اللون الأبيض والموسيقى التي تباع من المتاجر،

،والروابط الجميلة المنتشرة ستجعل من تجربة التسوق هنا تجربة متميزة وممتعة"

User_ID: "Jm4fCovDLkbmukOOuD10QRdmtII3",

Images: [<https://firebasestorage.googleapis.com/v0/b/fir-hail-ec5a7.appspot.com/o/images%2FJm4fCovDLkbmukOOuD10QRdmtII3.jpg>],

WorkingHr: [Day: "السبت" openAt: "10:00 AM" closeAt: "10:30 PM",

Day: "الأحد" openAt: "10:00 AM" closeAt: "10:30 PM",

Day: "الإثنين" openAt: "10:00 AM" closeAt: "10:30 PM",

Day: "الثلاثاء" openAt: "10:00 AM" closeAt: "10:30 PM",

Day: "الأربعاء" openAt: "10:00 AM" closeAt: "10:30 PM",

Day: "الخميس" openAt: "10:00 AM" closeAt: "10:30 PM",

Day: "الجمعة" openAt: "2 PM" closeAt: "10:30 PM"],

category: "مراكز تسوق",

Weblink: "<https://mode.sa/>",

hasValetService: False,

longitude: 46.6867455,

latitude: 24.6899662,

hasCinema: False,

hasFoodCourt: False,

hasPlayArea: False,

hasSupermarket: False,

isOutdoor: False,

typeOfShops: ["ملابس", "أحذية", "مجوهرات", "حقائب", "مستحضرات تجميل", "عطور"],

}

Figure 24 Sample of pending place with malls category.

ApprovedPlaces{

placeName: "Aseeb",

place_id: "52efb261-04e0-4c66-a472-a1c9c2b8e020"

neighborhood: "الياسمين",

city: "الرياض",

description: "مطعم عصي بالرياض مطعم شعبي سعودي يمثل المنطقة و الهوية الوطنية في مستوى"

،المرقي بالأجزاء و الخدمة و النمسة الأصلية في الأكل

User_ID: "m4fCovDLkbmukOOuD10QRdmtII",

Images[<https://firebasestorage.googleapis.com/v0/b/fir-hail-ec5a7.appspot.com/o/images%2FJm4fCovDLkbmukOOuD10QRdmtII.jpg>],

WorkingHr: [Day: "السبت" openAt: "1:00 PM" closeAt: "1:00 AM",

Day: "الأحد" openAt: "1:00 PM" closeAt: "1:00 AM",

Day: "الإثنين" openAt: "1:00 PM" closeAt: "1:00 AM",

Day: "الثلاثاء" openAt: "1:00 PM" closeAt: "1:00 AM",

Day: "الأربعاء" openAt: "1:00 PM" closeAt: "1:00 AM",

Day: "الخميس" openAt: "1:00 PM" closeAt: "1:00 AM",

Day: "الجمعة" openAt: "1:00 PM" closeAt: "1:00 AM"]

category: "مطاعم"

Weblink: "<https://aseeb.com.sa/en/>",

hasValetService: True

ReservationDetails: "الحجز عبر الاتصال"

"920028226

HasReservation: True

longitude: 46.6270043

latitude: 24.8125975

Cuisine: ["Saudi"]

priceRange: "متوسط"

serves: ["عشاء", "غداء"]

atmosphere: = "داخلية"

allowsChildren: True

Reviews:

{

rating: 4

text: "المكان جميل والطعام جيد"

Timestamp: 6 November 2023 at 01:32:20 UTC+3

User_ID: "4LXOBRQuBtZUvkJY7rr MJPrZrwqI"

username: "Latifa"}

}

Figure 25 Sample of approved place with restaurants category.



سُبْرِيل

4.5 Interface Design

4.5.1 Admin Navigation

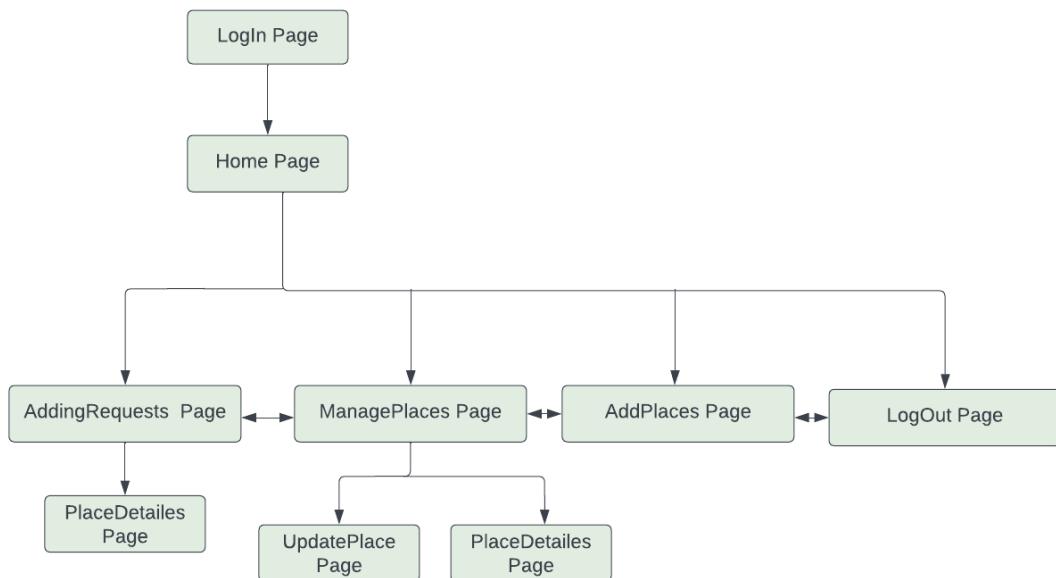


Figure 26 Admin navigation.

4.5.2 Registered User Navigation

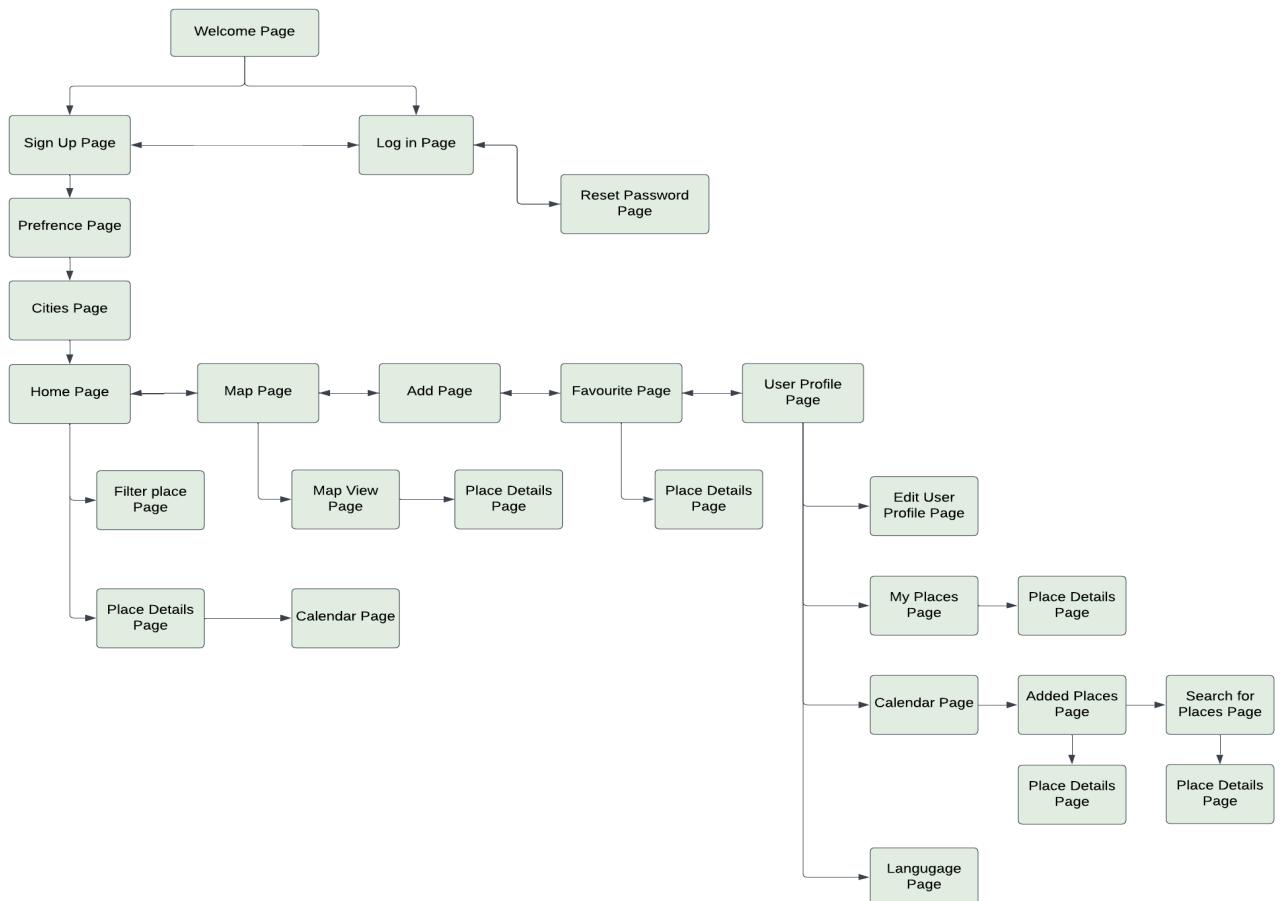


Figure 27 Registered user navigation.



4.5.3 Guest User Navigation

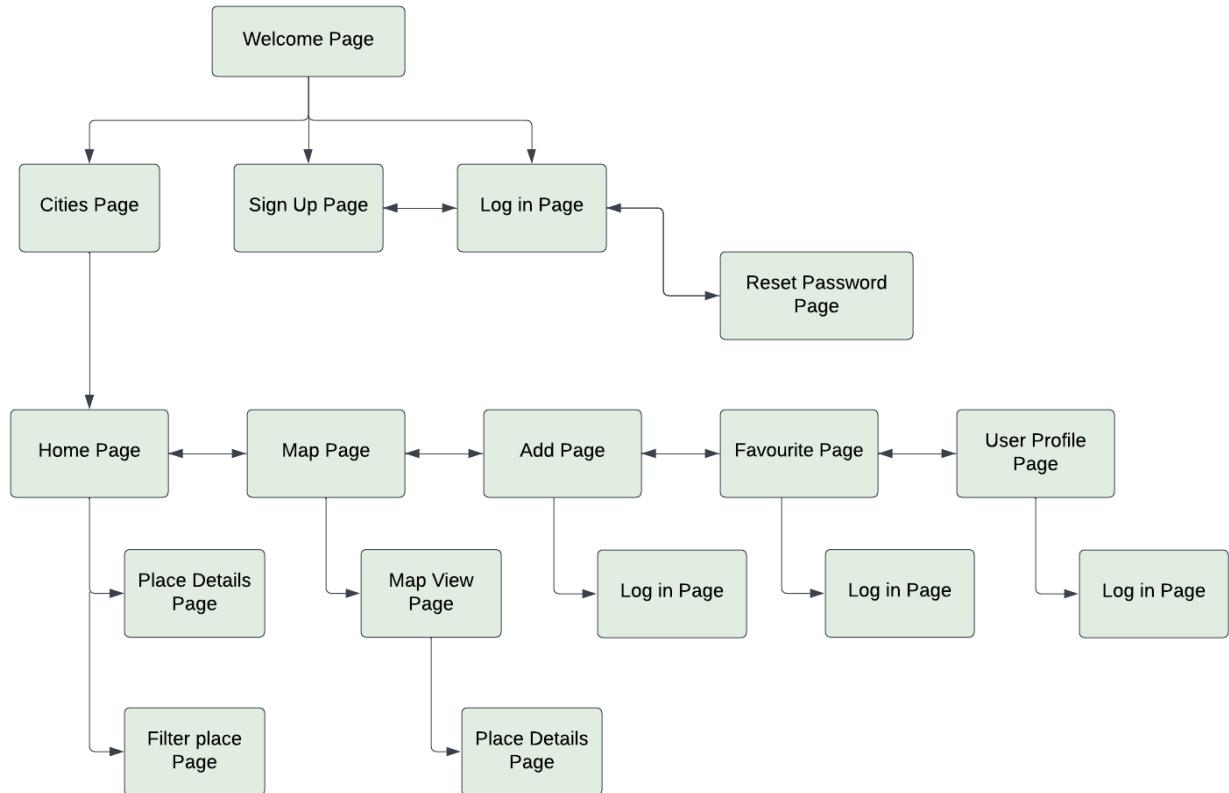


Figure 28 Guest user navigation.

4.5.4 UX Guidelines

In our project, we've embraced the following UX principles to enhance the usability and attractiveness of our product:

- **Consistency**

Consistency is a guiding principle emphasizing the importance of uniformity in the appearance and behavior of interface elements throughout a product. Inconsistencies in the interface can lead to usability issues and negatively impact the overall user experience. For instance, variations in terminology for the same action across different sections of the product can cause confusion and disrupt user workflow. Conversely, maintaining consistent labeling and messaging, extending to elements like typography, color, layout, and interactions, facilitates a smoother user experience [27]. In our application, this principle is evident in the uniform use of color and consistent messaging, menus, labels fostering a cohesive and intuitive user interface that enhances usability and overall user satisfaction.



- **Timely Feedback**

In UI design, feedback is crucial for communicating information to users in a clear and understated manner. By carefully addressing the timing, duration, intensity, and placement of feedback, designers can create an interface that is both user-friendly and efficient [35]. In our application, users receive explicit feedback right after signing up and submitting additional requests, contributing to an effective user experience.

- **Clear Navigation**

Clear navigation is essential for effective user communication. It guides users on where they are, what's available, and how to find what they need [36]. By implementing a user-friendly navigation bar on our app, we've ensured simplicity in guiding the users.

- **Preventing Errors**

Error prevention is a fundamental aspect of user interface design, aiming to anticipate and rectify potential mistakes before they impact user experience. This involves the implementation of strategies to minimize errors, streamline user interactions, and incorporate safeguards against unintended actions [37]. In our app, we have placed a high priority on error prevention by proactively identifying conditions that may lead to errors. A key strategy involves using confirmation messages to prompt users before committing to significant actions. For example, when users click the delete button, a confirmation message appears, ensuring their genuine intention to proceed and reducing the chance of accidental deletions. Moreover, we extend our commitment to error prevention in password-related interactions. During account creation, our proactive password-checking mechanism provides real-time notifications to users, indicating whether they've met password requirements before submitting their information. This approach not only prevents errors but also empowers users with greater control and confidence in their engagement with the application.



- **Familiarity**

The principle of Familiarity underscores the preference for interfaces and designs that users find familiar. It emphasizes the importance of creating user-friendly interfaces without imposing a steep learning curve [38]. In our app, we applied this principle by incorporating standard design patterns, such as recognizable navigation bars and search boxes commonly found in other applications and websites. This strategic use of familiar elements enhances the intuitiveness of our interface, facilitating ease of navigation and usage.



4.6 System Implementation

4.6.1 Software Tools

| Software Type | Version | Description |
|----------------|---------|--|
| Flutter | 3.13.0 | Google's portable UI toolkit for crafting beautiful, natively compiled applications for mobile, web, and desktop from a single codebase. Flutter works with existing code, is used by developers and organizations around the world, and is free and open source [28]. |
| Dart | 3.1.0 | Dart is a client-optimized language for developing fast apps on any platform. Its goal is to offer the most productive programming language for multi-platform development, paired with a flexible execution runtime platform for app frameworks [29]. |
| Android studio | 11.0.15 | official integrated development environment (IDE) for Android application development. It is based on IntelliJ IDEA, a Java integrated development environment for software, and incorporates its code editing and developer tools [30]. |
| GitHub | 3.3.3 | an online software development platform. It's used for storing, tracking, and collaborating on software projects [31]. |
| Firebase | - | a Backend-as-a-Service (Baas). It provides developers with a variety of tools and services to help them develop quality apps, grow their user base, and earn profit. It is built on Google's infrastructure [32]. |



| Software Type | Version | Description |
|---------------|---------|---|
| HTML | 5 | Hypertext Markup Language (HTML) serves as the accepted and widely used markup language for generating and organizing web pages. |
| CSS | - | Cascading Style Sheets is used to style and layout web pages. |
| Java Script | - | JavaScript is a dynamic computer programming language. It is lightweight and most used as a part of web pages, whose implementations allow client-side script to interact with the user and make dynamic pages. It is an interpreted programming language with object-oriented capabilities [33]. |

Table 5 Software tools.

4.6.2 Software Implementation

"S'hail" was built using the "Android Studio" environment and developed with the Dart programming language using the Flutter framework. Thorough testing was conducted on an Android virtual device to ensure a smooth user experience.

To maintain a safe and respectful environment, the app integrates with the Profanity Cleaner API [34]. This API filters out offensive language from user-generated content. When a user submits a review, an HTTP POST request is created, including the review text and a specified masking character to handle offensive words. Authentication headers, including the API key, are included for verification. Upon receiving the request, the Profanity Cleaner API analyzes the review text and detects any profanity based on its extensive database. It then returns a response, which the system interprets by extracting the HTTP status code to determine the success or failure of the request. The sanitized version of the review text, with offensive language replaced by masking characters, is obtained from the decoded response body.

Additionally, "S'hail" connects to the Maps SDK for Android and Places API to enhance its mapping features. The integration includes the utilization of the Places API for the implementation of an auto-complete search function, optimizing the ease of locating places within the application. Moreover, the



Maps SDK is employed to effectively display an interactive map with markers, ensuring a dynamic and user-friendly mapping interface.

For administrative tasks, a dedicated website was developed using HTML, CSS, and JavaScript. This website establishes a robust connection to Firebase, enabling efficient communication with the "Suhail" app's database. It serves as a user-friendly interface for managing the app's content, including editing, deleting, and accepting/rejecting places.

4.6.3 Major Parts of the System & Implementation Challenges

4.6.3.1 Auto-Filtering Inappropriate Comments

The comment filtering feature faced challenges in handling both English and Arabic text while integrating the Profanity Cleaner API. The code addressed these issues by accurately constructing HTTP POST requests, interpreting API responses, and ensuring precision in filtering inappropriate words. It detects the language of the comment and utilizes the Profanity Cleaner API to filter content. The results are then saved to Firebase, enhancing accuracy for both languages.

The implementation to Filter the comments is as follow:

1- Detects the review language:

```
String language = detectLanguage(string: reviewText);
String detectLanguage({required String string}) {
    String languageCode = 'ar'; // Default to Arabic

    final RegExp english = RegExp(r'^[a-zA-Z]+');
    final RegExp arabic = RegExp(r'^[\u0621-\u064A]+');

    if (english.hasMatch(string)) {
        languageCode = 'en'; // Set to English if the string contains English characters
    } else if (arabic.hasMatch(string)) {
        languageCode = 'ar'; // Set to Arabic if the string contains Arabic characters
    }
}

return languageCode;
```

Figure 29 Method to detect the review language.



- 2- Define the endpoint (URL) of the Profanity Cleaner API and set up headers, including the content type and an API key for authentication:

```
final uri = Uri.parse('https://profanity-cleaner-bad-word-filter.p.rapidapi.com/profanity');

final headers = {
  'Content-Type': 'application/json',
  'X-RapidAPI-Key': 'f3c39b2fbamsh9dd5600086c2bd6p11cd83jsn3b07a4b3724c',
};
```

Figure 30 Profanity check API request setup.

- 3- Send a POST request to the specified URI with a JSON-encoded body containing review-related information (text, maskCharacter(*), and language). It then decodes the response, extracts the 'clean' field from the response body, prints it, and saves this cleaned review along with other parameters to Firebase:

```
Map<String, dynamic> body = {
  'text': reviewText,
  'maskCharacter': '*',
  'language': language,
};

String jsonBody = json.encode(body);
final encoding = Encoding.getByName('utf-8');

var response = await http.post(
  uri,
  headers: headers,
  body: jsonBody,
  encoding: encoding,
);

int statusCode = response.statusCode;
Map responseBody = jsonDecode(response.body);
print(responseBody['clean']);

// Save the cleaned review to Firebase Firestore
await _saveReviewToFirestore(responseBody['clean'], rating, userId, placeid, username);
```

Figure 31 Profanity filter integration in flutter application.



4.6.3.2 Map Markers

A key feature of the app is its real-time marker updates for approved places, adjusting to user-selected categories and either a dropped pin or current location. It calculates distances and shows markers within a 5 km range.

- 1- Clears the existing markers in the filteredPlacesInfo list to refresh the map and Iterates through each document in the 'ApprovedPlaces' collection.

```
Future getMarkers() async {
  setState((){ filteredPlacesInfo = [] ;});
  await for (var snapshot in _firebase.collection('ApprovedPlaces').snapshots())
    for (var place in snapshot.docs)
```

Figure 32 Retrieving markers from firebase firestore in flutter.

- 2- Checks if the place's category matches the selected category or if 'الكل' (All) is selected.

```
setState(() {
  |   |   String category = place['category'] ?? '';
  |   |   if (selectedCategory == 'الكل' || category == selectedCategory){
```

Figure 33 Updating state based on selected category.

- 3- Calculates the distance between the current location or dropped pin and the place and adds a marker for places within a distance range (**5 km**).

```
LatLng placeLatLng = LatLng(place['latitude'], place['longitude']);
double distance = calculateDistance( droppedPin ?? currentLatLng , placeLatLng);

if (distance <= 5.0) {
  markers.add(Marker(
    markerId: MarkerId(place['placeName']),
    position: placeLatLng,
    icon: myIcon,
    infoWindow: InfoWindow(
      title: place['placeName'],
```

Figure 34 Adding markers within a 5-kilometer radius.



4.6.3.3 Current View Recommender System

Our Current View recommendation system operates on k-nearest neighbors (KNN) algorithm, influenced by successful similar recommender systems [39] [40] [41]. The KNN algorithm functions by classifying an item through its association with the nearest matches in the database. This involves constructing a similarity matrix and calculating distances, typically utilizing methods like Euclidean distance. Instead of assigning the item to a predefined group, KNN identifies its most similar neighbors within the database. The algorithm evaluates the proximity between items, underscoring their inherent similarity. This approach proves particularly effective in recommendation systems, where KNN suggests items that closely resemble the one under consideration. We employed a built-in KNN function in Python to implement our recommendation system, focusing on analyzing similarities between places. Our implementation refines suggestions by utilizing a Haversine distance function, which accounts for geographical proximity. Specifically, the function returns the top recommendations that are most similar to the user's current view. In our approach, a k-value of 6 was chosen, meaning that we considered the top 5 nearest neighbors for each recommendation.

The implementation of our recommender is as follows:

1. Connect to Firestore, retrieve place data, and perform data preprocessing by dropping unnecessary attributes.

```
db = firestore.client()
places = list(db.collection(u'ApprovedPlaces').stream())
places_dict = list(map(lambda x: x.to_dict(), places))
df = pd.DataFrame(places_dict)

df = df.drop(columns=['placeName', 'User_id', 'images',
                      'description', 'allowChildren', 'WorkedDays',
                      'hasParking', 'hasValetServiced', 'serves', 'atmosphere'])
df = df.drop(columns=['hasCinema', 'hasFoodCourt', 'hasPlayArea',
                      'hasSupermarket', 'startDate', 'neighbourhood', 'finishDate',
                      'WebLink', 'hasReservation', 'reservationDetails', 'shopType',
                      'isTemporary'])
```

Figure 35 Dropping unnecessary attributes



2. Manage cuisine data by extracting the first element in the list. Subsequently, conduct one-hot encoding for categorical attributes such as 'city,' 'category,' 'priceRange,' 'typeEnt,' 'INorOUT,' and 'cuisine. Originally, we prioritized checking the place category before considering its attributes, we did that for all three categories. However, we've optimized the process by directly focusing on existing columns of the target place. This involves removing unnecessary codes and ignoring non-existing columns based on the target place category. this approach produces the same results as our initial code.

```
df['cuisine'] = df['cuisine'].apply(lambda x: x[0] if isinstance(x, list) and x else None)

df_copy = df.copy()
encoded_data = pd.get_dummies(df_copy, columns=['city', 'category', 'priceRange', 'typeEnt', 'INorOUT', 'cuisine'])
```

Figure 36 Encoding categorical attributes.

3. Select the target place, remove it from the dataset, and utilize a K-nearest neighbors (KNN) model with a k-value of 6 to calculate distances and indices for the chosen place.

```
place1 = encoded_data.loc[encoded_data['place_id'] == id]

encoded_data = encoded_data[encoded_data.place_id != id]

nbrs = NearestNeighbors(n_neighbors=5).fit(encoded_data.drop(columns=['place_id']))
distances, indices = nbrs.kneighbors(place1.drop(columns=['place_id']))
```

Figure 37 Applying K-nearest neighbors (KNN) algorithm with $k=6$



4. Compute similarity scores as percentages based on distances, generate recommendations for places with similarity scores above 80, considering geographical proximity, and finally sort the recommendations by distance in ascending order. We went with the 80% similarity because similar systems, like the one mentioned in [42], suggested to use it. Choosing 90% or higher gave us too few recommendations, limiting variety. Going below 80% led to less relevant suggestions. The 80% strikes a good balance.

```
similarity = [(1 - dist) * 100 for dist in distances[0]]
recommend_item = []
for i, index in enumerate(indices[0]):
    if similarity[i] >= 80:
        place_id_value = encoded_data.iloc[index]['place_id']
        distance_value = haversine_distance(place1['latitude'].values[0], place1['longitude'].values[0],
                                             encoded_data.iloc[index]['latitude'], encoded_data.iloc[index]['longitude'])
        recommend_item.append({'place_id': place_id_value, 'similarity_score': similarity[i], 'distance': distance_value})

# Sort recommendations by distance in ascending order
recommend_item.sort(key=lambda x: x['distance'])
```

Figure 38 Compute similarity scores.



4.6.3.4 Personalized Favorites Recommender System

Our personalized favorites recommender system operates on the TF-IDF (Term Frequency-Inverse Document Frequency) algorithm along with cosine similarity calculations, chosen for its effectiveness in providing optimal results and its wide use in recommendation systems [42] [43]. TF-IDF is widely used as a weighting factor in various applications such as information retrieval, text mining, and user modeling. It weighs the significance of words within documents relative to their frequency across the entire dataset. It consists of two main components: Term Frequency (TF) and Inverse Document Frequency (IDF), where TF quantifies word frequency within a document and IDF measures word uniqueness across documents. The TF-IDF value of a word is determined by multiplying its TF value by its IDF value. Consequently, words that are both frequent within a document and rare across the dataset will have higher TF-IDF scores, thus emphasizing their importance in describing the content of that document. The algorithm initiates by collecting and preprocessing relevant textual attributes associated with each place in the dataset. This involves tasks such as tokenization and stop-word removal to enhance the quality of the input data. Once the data is prepared, TF-IDF vectorization is applied to transform the textual data into numerical vectors. During this process, each word in the documents is assigned a weight based on its TF-IDF score, reflecting its significance in describing each place. Following vectorization, cosine similarity calculations are performed between the user's favorite places and all other places in the dataset. Cosine similarity measures the cosine of the angle between two vectors and determines the similarity between them. It quantifies the resemblance between the TF-IDF vectors of the user's favorite places and those of other places in the database. By analyzing the cosine similarity scores, the algorithm identifies places that closely align with the user's preferences. Places with higher cosine similarity scores are prioritized as recommendations, indicating a greater degree of similarity to the user's favorite places.



The implementation of our recommender is as follow:

1. We define a set of Arabic stop words to filter out common words that do not carry significant meaning in text analysis. Stop words are words like "من", "في", "و", "عن", etc., which are frequently occurring but don't provide valuable information about the content.

```
stops = {"و", "في", "من", "عن", "إلى", "هذا", "هذه", "هنا", "على"}  
Figure 39 Definition of stop words.
```

2. We defined functions to retrieve data from Firestore:

- The first function retrieves a user's favorite places and preferences from Firestore.
- The second function fetches approved places, with an option to filter them by city.

```
# Function to fetch user data from Firestore
def fetch_user_data(user_id):
    favorites_ref = db.collection('users').document(user_id).collection('Favorite')
    preferences_ref = db.collection('users').document(user_id).collection('preferences')

    try:
        favorites = [favorite.to_dict() for favorite in favorites_ref.stream()]
        preferences = [preference.to_dict() for preference in preferences_ref.stream()]
    except Exception as e:
        print("Error fetching user data:", e)
        favorites = []
        preferences = []

    return favorites, preferences

# Function to fetch approved places from Firestore
def fetch_approved_places(city_name=None):
    places_ref = db.collection('ApprovedPlaces')
    places = [place.to_dict() for place in places_ref.stream()]

    if city_name:
        places = [place for place in places if place.get('city', '') == city_name]

    return places
```

Figure 40 Functions to retrieve data from Firestore



3. We preprocessed textual data by collecting relevant attributes that we want to consider of approved places, such as category, city, cuisine, etc., and then concatenate them into a single string.

```
# Preprocess data
def preprocess_data(approved_places):
    item_profiles = {}
    for place in approved_places:
        place_id = place['place_id']
        # Retrieve attributes with default values if they are
        # missing
        category = place.get('category', '')
        city = str(place.get('city', '')) # Convert to string
        cuisine = str(place.get('cuisine', '')) # Convert to
        # string
        type_entertainment = str(place.get('typeEnt', '')) #
        # Convert to string
        serves = str(place.get('serves', '')) # Convert to string
        atmosphere = str(place.get('atmosphere', '')) # Convert
        # to string
        shop_type = str(place.get('shopType', ''))

        # Concatenate attributes into a single string
        text = ' '.join([category, city, cuisine, serves,
                        atmosphere,
                        shop_type, type_entertainment])
        # Preprocess text
        preprocessed_text = preprocess_text(text)
        item_profiles[place_id] = preprocessed_text

    return item_profiles
```

Figure 41 Function to preprocess and concatenate the attributes into item profiles.

4. We defined a function to preprocess text data. This function performs several steps:

- Tokenization: Splits Arabic text into individual tokens.
- Remove Non-Arabic Characters and Punctuation: remove characters that are not part of the Arabic script and removes punctuation marks.
- Remove stop words: Filters out common Arabic stop words to focus on meaningful content.



```

# Preprocess text
def preprocess_text(text):
    # Tokenize Arabic text
    tokens = text.split()

    # Remove non-Arabic characters and punctuation
    arabic_only = [re.sub(r'[^\\u0621-\\u064A\\s]', '', token) for
                  token in tokens]

    # Remove stopwords
    cleaned_tokens = [token for token in lowercase_tokens if token
                      not in stops and token not in stop_word_comp and len(token)
                      >= 2]

    # Join tokens back into text
    preprocessed_text = ' '.join(cleaned_tokens)

    return preprocessed_text
  
```

Figure 42 Function to preprocess text data.

5. In this step, we iterate over each favorite place provided by the user. For each favorite place, we calculate the TF-IDF matrix using the TfidfVectorizer built in function. This matrix represents the textual attributes of the favorite place and all other places in the dataset. Then, we compute the cosine similarity between the TF-IDF vector of the favorite place and all other places. If the user has no favorite places, we use their preferences instead, following the same process to calculate similarities and recommend places.

```

# Function to recommend places based on item similarity
def model(userFavorites, preference_profiles, item_profiles):
    recommendations = set()

    if userFavorites: # If favorites are found
        # Limit favorites to first 300 places if more than 300
        if len(userFavorites) > 300:
            userFavorites = userFavorites[:300]
        for favorite in userFavorites:
            place_id = favorite['place_id']
            if place_id in item_profiles:
                tfidf_vectorizer = TfidfVectorizer()
                tfidf_matrix = tfidf_vectorizer.fit_transform([item_profiles[place_id], *item_profiles.values()])
                cosine_similarities = linear_kernel(tfidf_matrix[0:1], tfidf_matrix[1:]).flatten()
                similar_indices = cosine_similarities.argsort()[-6:-1] # Get top 5 similar items
                similar_items = [(list(item_profiles.keys())[i], cosine_similarities[i]) for i in similar_indices]
                recommendations.update(similar_items)
            else: # If favorites are not found, use preferences
                print("No favorites found. Using preferences instead.")
                for preference in preference_profiles:
                    place_id = preference
                    print("Processing preference for place:", place_id)
                    if place_id in preference_profiles:
                        tfidf_vectorizer = TfidfVectorizer()
                        tfidf_matrix = tfidf_vectorizer.fit_transform([preference_profiles[place_id], *item_profiles.values()])
                        cosine_similarities = linear_kernel(tfidf_matrix[0:1], tfidf_matrix[1:]).flatten()
                        similar_indices = cosine_similarities.argsort()[-6:-1] # Get top 5 similar items
                        similar_items = [(list(item_profiles.keys())[i], cosine_similarities[i]) for i in similar_indices]
                        recommendations.update(similar_items)
  
```

Figure 43 Function to recommend places based on item similarity.



6. To avoid recommending places that are already in the user's favorites, we filter out any recommendations that have the same place ID as one of the user's favorite places. This ensures that we only provide unique recommendations to the user.

```
# Filter out recommendations that are already in favorites
recommendations = [(place_id, score) for place_id, score in
    recommendations if place_id not in favorite_place_ids]

return list(recommendations)
```

Figure 44 Remove recommendations that are in user's favorites.

Consider the following example to understand how preprocessing and cosine similarity calculations work for two different places:

Place1:

- Category: "مطعم"
- Cousin: "إيطالي"
- Serve: "غداء ، عشاء"
- City: "الرياض"
- Atmosphere: "داخلي، يوجد موسيقي"

1. Preprocessing

- We initiate preprocessing of the textual attributes for Place1, which includes tokenization, removal of non-alphanumeric characters, conversion to lowercase, and elimination of stop words. After preprocessing, the text is represented as ["إيطالي", "مطعم", "الرياض", "غداء", "عشاء", "داخلي", "موسيقي"].

2. TF-IDF Vectorization

- Term Frequency (TF): Each term appears once, leading to TF values of [1, 1, 1, 1, 1, 1].
- Inverse Document Frequency (IDF): IDF is calculated as the logarithm of the ratio of the total number of documents to the number of documents containing the term (in this example the IDF values were assumed)



- The TF-IDF matrix for the place1 is represented as:

| Term | TF | IDF | TF-IDF |
|--------|----|-----|--------|
| إيطالي | 1 | 0.3 | 0.3 |
| مطعم | 1 | 0.5 | 0.5 |
| الرياض | 1 | 0.2 | 0.2 |
| غداء | 1 | 0.4 | 0.4 |
| عشاء | 1 | 0.4 | 0.4 |
| داخلي | 1 | 0.1 | 0.1 |
| موسيقى | 1 | 0.6 | 0.6 |

Table 6 TF-IDF Matrix for place1.

Place2:

- Category: "مطعم"
- Cousin: "باباني"
- Serve: "غداء ، عشاء"
- City: "جدة"
- Atmosphere: " داخلي، يوجد موسيقى "
- The TF-IDF matrix for the place is represented as:

| Term | TF | IDF | TF-IDF |
|--------|----|-----|--------|
| باباني | 1 | 0.3 | 0.3 |
| مطعم | 1 | 0.5 | 0.5 |
| جدة | 1 | 0.2 | 0.2 |
| غداء | 1 | 0.4 | 0.4 |
| عشاء | 1 | 0.4 | 0.4 |
| داخلي | 1 | 0.1 | 0.1 |
| موسيقى | 1 | 0.6 | 0.6 |

Table 7 TF-IDF Matrix for place2.

To compute the similarity between Place1 and Place2 using cosine similarity, we follow these steps:

- Calculate the dot product of the TF-IDF vectors for Place1 and Place2.
- Compute the magnitudes of the TF-IDF vectors for Place1 and Place2.
- Divide the dot product by the product of the magnitudes to obtain the cosine similarity.

For Place1:

- TF-IDF vector: [0.3, 0.5, 0.2, 0.4, 0.4, 0.1, 0.6]
- Magnitude of Place1: $\sqrt{(0.3^2) + (0.5^2) + (0.2^2) + (0.4^2) + (0.4^2) + (0.1^2) + (0.6^2)} \approx \sqrt{1.27} \approx 1.128$



For Place2:

- TF-IDF vector: [0.3, 0.5, 0.2, 0.4, 0.4, 0.1, 0.6]
- Magnitude of Place2: $\sqrt{((0.3^2) + (0.5^2) + (0.2^2) + (0.4^2) + (0.4^2) + (0.1^2) + (0.6^2))} \approx \sqrt{1.27} \approx 1.128$

Now, let's compute the dot product:

- Dot product = $(0.3 * 0.3) + (0.5 * 0.5) + (0.2 * 0.2) + (0.4 * 0.4) + (0.4 * 0.4) + (0.1 * 0.1) + (0.6 * 0.6) = 0.09 + 0.25 + 0.04 + 0.16 + 0.16 + 0.01 + 0.36 = 1.07$

Finally, we compute the cosine similarity:

- Cosine similarity = Dot product / (Magnitude of Place1 * Magnitude of Place2) $\approx 1.07 / (1.128 * 1.128) \approx 1.07 / 1.27 \approx 0.843$

Cosine similarity between Place1 and Place2 is approximately 0.843. Based on this similarity, Place2 would be recommended if one of user's favorite is Place1.



سهيل



System Testing



5 System Testing

5.1 User Acceptance Testing

In this section, we will provide a detailed description of our system's testing procedure.

First, to determine whether the system satisfies business objectives and is usable by end users, we carried out user acceptance testing for both the admin website and the application. To test our application, we recruited twenty participants who fit specific requirements (see section 4.2.1: System Users) and are willing to explore Saudi Arabia. Five volunteers were also recruited to test the admin website. The participants' ages ranged from 15 to 67 for both genders, and they all had basic technical skills as well as the ability to use a website or application, they were also capable of reading Arabic and English, regardless of their educational background.

Once the testing team had accessed the admin website and the application, we used a questionnaire to gather information about the participants' experiences with our system and to check acceptance in terms of the user interface, technical aspects, main strengths, and major weaknesses. For the team conducting the application test, the questionnaire consisted of 25 questions. Moreover, the admin test team was given 15 questions.

The testing procedure was conducted by following a well-defined process. Participants were recruited through local community networks. The testing sessions took place in a controlled environment that replicated realistic usage scenarios. Participants were provided with a clear explanation of the test, including the system's purpose and their role in providing feedback. Detailed instructions were given on how to access and navigate the admin website and application. Throughout the testing process, open communication was maintained, and participants were encouraged to provide honest and constructive feedback. The goal was to gather valuable insights to assess usability and identify areas for improvement.

In conclusion, to provide additional insights into the participants and the questionnaire's findings, we will display the participant demographics, the questionnaire's outcomes, and an analysis that explains the findings in the following sections.

5.1.1 Demographics of Participants

The participants in the application testing were asked about their age, gender, education level, experience with mobile applications, and if they are using the application as tourist, resident, or citizen of Saudi Arabia. Table 8 shows the demographics of the participants (see 11.3 appendix C for the questions)



| Demographic Questions | Number of respondents (Percentage of responses) | | | | | | |
|---|---|---------------|--------------|--------------|---------------|--|--|
| Age | 15-18 | 19-29 | | 30-50 | 50+ | | |
| | 2(10%) | 9(45%) | | 7(35%) | 2(10%) | | |
| Gender | Male | | | Female | | | |
| | 9(45%) | | | 11(55%) | | | |
| Educational level | Primary school | Middle school | High School | Postgraduate | Undergraduate | | |
| | - | - | 2(10%) | 6(30%) | 12(60%) | | |
| Experience in using websites | Basic | | Intermediate | | Advanced | | |
| | 8(40%) | | 10(50%) | | 2(10%) | | |
| What is your current status in Saudi Arabia | Visitor/Tourist | | Resident | | Citizen | | |
| | 9(45%) | | 1(5%) | | 10(50%) | | |

Table 8 System testing - user demographics.

Participants in the admin website testing were also asked about their age, gender, education level, and website experience. Table 9 displays their answers (see 11.3 appendix C for the questions).

| Demographic Questions | Number of respondents (Percentage of responses) | | | | | | |
|------------------------------|---|---------------|--------------|--------------|---------------|--|--|
| Age | 15-18 | 19-29 | | 30-50 | 50+ | | |
| | 20% | 20% | | 60% | - | | |
| Gender | Male | | | Female | | | |
| | 60% | | | 40% | | | |
| Educational level | Primary school | Middle school | High School | Postgraduate | Undergraduate | | |
| | - | - | 20% | - | 80% | | |
| Experience in using websites | Basic | | Intermediate | | Advanced | | |
| | - | | 40% | | 60% | | |

Table 9 System testing - admin demographics.

5.1.2 Questionnaire/Interview Results

We asked the 20 individuals who took part in the application testing about their experiences using our application, specifically to select their responses to the statements in the questionnaire from options such as 'Strongly agree,' 'Agree,' 'Neutral,' 'Disagree,' and 'Strongly disagree. Table 10 provides a summary of the participants' responses (For the questions: see (section 11.4): appendix D).



| Questions | Number of respondents (Percentage of responses) | | | | |
|---|---|-----------|-------------|--------------|-----------------------|
| | Strongly agree (5) | Agree (4) | Neutral (3) | Disagree (2) | Strongly disagree (1) |
| I needed previous experience to use the app. | - | - | - | 7 (35%) | 13 (65%) |
| I found the app easy to use. | 14 (70%) | 6 (30%) | - | - | - |
| I found the colors comfortable. | 9 (45%) | 11 (55%) | - | - | - |
| I found the application interface design clear and easy to use. | 10 (50%) | 10 (50%) | - | - | - |
| I found the app to be properly threaded and navigating between pages was easy. | 12 (60%) | 8 (40%) | - | - | - |
| I found the app to have a fast response. | 12 (60%) | 8 (40%) | - | - | - |
| I was able to add a place easily and clearly. | 10 (50%) | 10 (50%) | - | - | - |
| I was able to search for places easily, and clearly. | 12 (60%) | 8 (40%) | - | - | - |
| I was able to use my current location to explore nearby locations easily | 10 (50%) | 10 (50%) | - | - | - |
| I was able to rate and comment easily and clearly. | 13 (65%) | 7 (35%) | - | - | - |
| The feature that prohibited me from posting an inappropriate comment was helpful | 13 (65%) | 7 (35%) | - | - | - |
| I was able to Filter the places based on some criteria easily. | 12 (60%) | 8 (40%) | - | - | - |
| I was able to find recommendations related to the place I was viewing, and it was helpful. | 12 (60%) | 8 (40%) | - | - | - |
| I was able to add my desired place to my favorite list easily and clearly. | 12 (60%) | 8 (40%) | - | - | - |
| I was able to find recommendations similar to the places I added to my favorite list in the homepage, and it was helpful. | 11 (55%) | 9 (45%) | - | - | - |
| I was able to add a place to my calendar and schedule my plans easily and clearly. | 11 (55%) | 9 (45%) | - | - | - |
| I was able to switch the language from Arabic to English and vice versa fast and easy. | 11 (55%) | 9 (45%) | - | - | - |
| I was able to delete my account without having any confusion. | 11 (55%) | 9 (45%) | - | - | - |
| I think I will use the app frequently. | 12 (60%) | 7 (35%) | 1 (5%) | - | - |
| I will recommend this app to my friends and family. | 13 (65%) | 7 (35%) | - | - | - |



| Questions | Number of respondents (Percentage of responses) | | | | |
|--|---|-----------|-------------|--------------|-----------------------|
| | Strongly agree (5) | Agree (4) | Neutral (3) | Disagree (2) | Strongly disagree (1) |
| Suggestions and comments: | | | | | |
| When the place I added gets rejected, I need to know the reason why, so I don't repeat the mistakes. | | | | | |
| The interfaces and colors were clear and pleasing to the eyes. | | | | | |
| It would be very helpful if I could see other schedules and plans made by others. | | | | | |

Table 10 Responses of participants to the application questionnaire.

As for the admin website test, the participants were asked to respond to the statements regarding their use of the website. The participants' responses are presented in Table 11 below (see 11.4 appendix D for the questions).

| Questions | Number of respondents (Percentage of responses) | | | | |
|--|---|-----------|-------------|--------------|-----------------------|
| | Strongly agree (5) | Agree (4) | Neutral (3) | Disagree (2) | Strongly disagree (1) |
| I needed previous experience to use the website. | - | - | - | 4 (80%) | 1 (20%) |
| I found the website easy to use. | 3 (60%) | 2 (40%) | - | - | - |
| I found the colors comfortable. | 3 (60%) | 2 (40%) | - | - | - |
| I found the website interface design clear and easy to use. | 2 (40%) | 3 (60%) | - | - | - |
| I found the website to be properly threaded and navigating between pages was easy. | 3 (60%) | 2 (40%) | - | - | - |
| I found the website to have a fast response. | 1(20%) | 3 (60%) | 1(20%) | - | - |
| I was able to approve or reject requested places easily, and clearly. | 3 (60%) | 2 (40%) | - | - | - |
| I was able to search for places easily, and clearly. | 2 (40%) | 3 (60%) | - | - | - |
| I was able to manage places easily, and clearly. | 2 (40%) | 3 (60%) | - | - | - |
| I was able to add a place easily, and clearly. | 3(60%) | 2(40%) | - | - | - |

Table 11: Responses of participants to the admin web questionnaire.



5.2 Quality Attributes (NFR testing)

| User story | Quality Attribute | Measure | Results |
|--|---|---|--|
| As a user, I want the app to have an intuitive and user-friendly interface, so that I can easily navigate and use the app without any confusion. | Usability: how the application is easy to learn and user-friendly.[45] | The System Usability Scale (SUS) was used which is a reliable and quick tool that measures the usability of a system [46]. SUS consists of 10 questions (see appendix E for the questions) and the overall usability is calculated by finding the mean score for the responses of the participants. | We tested our application with 20 users, and the average score was 90.125, which is higher than the average system usability scale (SUS) score of 68 [46], indicating that our application is highly usable. |
| As a user, I want the app to load quickly so that I can have an efficient experience. | Performance: how the speed and responsiveness of an application holds up under a given workload. [47] | Compute the response time for opening the application. The application should open all the pages within or less than 2 seconds.[48] | We tested 20 users individually, and a timer was used to compute the time of the application response. The average response time to open all the pages was 0.80 seconds which is less than 2 seconds. |
| As a user, I want the app to have a robust access control and permission system, so that only authorized users can access sensitive data and features. | Security: How authorized access to protected data is granted and unauthorized access is restricted in the application. [49] | The software is only accessible to authorized users. Measure adherence to password policies to determine the strength of user passwords. Not all of the application's features will be accessible if the user continues to use it as a guest; they must first sign up or sign in. | S'hail relies on Firebase Authentication for user authentication. It has been observed that Firebase Authentication utilizes a customized script internally to hash user account passwords [50]. Moreover, the application enforces strict password requirements, mandating that passwords contain at least one uppercase letter, one lowercase letter, one special character, and one numeric digit, with a minimum length of 8 characters. |
| As a user, I want the app to handle errors efficiently and provide clear and concise error messages, so that I can understand what went wrong and take | Reliability: How well the software can perform in a particular environment for a specified period of time without failure. [51] | Measure the clarity of error messages displayed to users when they input incorrect data. | When a user submits information that doesn't meet the specified criteria, like entering a password with fewer than 8 characters, the S'hail will display a clear message: 'Password must be at least 8 characters long.' Similarly, if a user attempts to change their password without filling in the 'Current Password' field, S'hail |



| User story | Quality Attribute | Measure | Results |
|--|--|---|--|
| appropriate action. | | | will provide guidance: 'To change the password, please ensure the Current Password field is filled'. |
| As a user, I want the application to be available 99% of the time I try to access it, so that I can access the application whenever I need it. | Availability: how likely it is that a user will be able to access the system. [52] | Compute the percentage of application availability. The application should be available 99% of the time. | S'hail depends on Firebase for authentication and data storage, and this is what affects its availability. According to the Firebase website [53], we found that Firebase's availability is at least 99.95% of the time, which means our application's availability is greater than 99%. |

Table 12 Quality attributes (NFR testing).

5.3 Discussion

We can conclude that the system evaluation was fairly well based on the results of the questionnaire. When the twenty application users and five website administrators who participated in the user acceptance testing were done. Regarding the UX/UI design, all participants found the interface colors were comfortable and the design was clear. They also agreed that the system was easy to use and navigate, requiring no prior knowledge, and that the feature that prevented them from leaving offensive comments was helpful. Furthermore, most of participants were able to successfully and effortlessly use every feature. In addition, nearly every user indicated that they would recommend the app to others and that they would use it frequently, with the exception of one who gave a neutral response, since he lives in Saudi Arabia, presumably thinking that he knew about all the attractions in it. Therefore, we could improve our app by including more features, such as the ability to make reservations directly through the app. Regarding the website administrators, one of them gave a neutral response to the fast response question, citing a network issue that the participant was having rather than a website-related issue.

As for NFR testing, based on the results we can conclude that the performance of the application is great, as the response time for home page was less than 1 second. And it has a high level of security, since it puts restrictions when choosing a password, and uses firebase authentications to hash the passwords. S'hail also has high availability, since it depends on firebase for authentication and data storage, and firebase is available 99.95% of the time [53]. As for the usability, S'hail scored 90.125 in the SUS, which exceeds the average score of 68, thus it can be concluded that it is highly usable.



Additionally, S'hail demonstrates high reliability by efficiently handling errors and providing clear and concise error messages to users, ensuring they can easily understand what went wrong and take appropriate action.

S'hail showed a very high degree of acceptance, and overall, the feedback was effective. At this point, the positive characteristics of the application are evident. Many participants complimented the application's and website's UX/UI and their ability to use its features accurately and simply. The results also show that most of the application's main features, such as adding, searching, rating, and commenting on places easily, exploring nearby areas, filtering places, finding recommendations, adding to favorites, scheduling plans, and language switching, were well received. Additionally, the website features, where admins could add, manage, search, approve, or reject places, were also positively noted. However, participants proposed some modifications, such as explaining the reason for rejecting a place so that the user does not repeat it, as well as sharing the plans made by others. Their suggestions will be taken into consideration for further releases, just as we took into consideration an earlier adjustment that one of the participants proposed, which was to add a button (both) for the indoor and outdoor question in the form when adding a mall, and we actually did so.



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Conclusion and Future Work



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6 Conclusions and Future Work

In S'hail Journey, we identified and addressed the problem of limited tourism information in Saudi Arabia by developing a mobile application to address these problems. We defined a clear product vision, roadmap, objectives, and scope to guide our development process. Through a thorough literature review, we conducted a competitive product analysis and compared similar applications to inform our system requirements. The system design phase involved creating architectural and component-level designs and data design. We implemented the system using appropriate software tools, overcoming implementation challenges. System testing was conducted to ensure the reliability of the application. In this section, we will focus on the global and local impacts. We will address the problems and challenges encountered throughout the development process, highlight the limitations of the system, discuss the main contribution of the project, and outline future prospects for further advancement.

6.1 Global and Local Impact

The tourism industry in Saudi Arabia plays a crucial role in the country's economy. As technology continues to advance and integrate into the travel sector, S'hail mobile application makes an impact both locally and globally.

Local impacts:

1. Enhanced Exploration: S'hail can enhance the experience of discovering local attractions and restaurants by offering comprehensive information, different reviews, and personalized recommendations.
2. Service Improvement: The app's rating and commenting features can still provide valuable insights to other users and potential visitors. Users can share their experiences, recommendations, and feedback, which can help improve the quality of services and offerings of local establishments.
3. Empowering Local Businesses: The ability for users to add new restaurants and attractions, subject to approval by administrators, empowers local businesses to showcase their places. This

exposure can help small and local businesses gain visibility and attract more customers, thereby supporting entrepreneurship and economic development at a local level.

Global impacts:

1. Increased Tourism Awareness: By providing detailed information about attractions and restaurants, S'hail contributes to increasing global awareness of tourism offerings in Saudi Arabia. The app's display of this information enables potential international visitors to learn about the country's diverse attractions and consider it as a travel destination.
2. Cultural Exchange: S'hail facilitates cultural exchange by displaying information about local attractions and restaurants. Through the app, users can explore and learn about Saudi Arabian culture, fostering a deeper understanding and appreciation among global users.
3. Positive Perception: As users share positive reviews on S'hail about their visits to attractions and restaurants, it can contribute to a positive global perception of Saudi Arabia.

In summary, S'hail mobile application has an impact both locally and globally. It drives economic growth, enhances travel experiences, promotes local culture, raises global awareness, facilitates cultural exchange, and shapes a positive perception of Saudi Arabia as a highly desirable tourism destination.

6.2 Problems and Challenges Encountered During the Software Development

During the development of S'hail, we encountered challenges such as learning a new programming language and integrating with Firebase and Google Maps API. These tasks required a thorough understanding of the respective documentation. Furthermore, the simultaneous implementation of the app and website added complexity, demanding effective coordination and time management.

6.3 Limitations of the System

The S'hail mobile application has certain limitations. These limitations include language options being limited to Arabic and English, a geographic focus primarily on Riyadh and Jeddah cities, the absence



of reservation and payment services, and the application being exclusive to Android devices, which may restrict accessibility for users relying on alternative operating systems.

6.4 The Main Contribution of the Project

The "S'hail" application revolutionizes the tourism experience in Saudi Arabia by providing a comprehensive and personalized platform for users to discover and explore attractions and restaurants. Users can access detailed information, receive personalized recommendations, contribute their own additions, rate and comment on attractions and restaurants, utilize location-based search and interactive maps, switch between languages, benefit from a content-based recommender system, create favorite lists, utilize advanced search filters, plan their trips with a calendar feature, and manage their user profiles. The app empowers users to make informed decisions, fosters community engagement, and enables efficient exploration and planning, revolutionizing tourism in Saudi Arabia. Throughout the development of "S'hail", we have gained knowledge and skills that have contributed to our growth and expertise. This journey allowed us to apply and expand upon our theoretical knowledge, improving our information-searching abilities and deepening our understanding of software development processes. We encountered various challenges during development, which we effectively resolved, further strengthening our problem-solving skills, and enriching our experience in overcoming obstacles.

6.5 Future work

As we look ahead to future work, it's clear that perfection remains an ever-moving target, with continuous updates and innovations driving the evolution of S'hail towards new horizons. In line with this vision, a significant step forward involves resolving the limitations mentioned earlier, such as expanding support to other operating systems like iOS. Additionally, S'hail aims to enhance collaborative travel experiences among users by introducing a plan-sharing feature. Considerations will also be made to incorporate a reservation service and payment functionality, streamlining the booking process for attractions and restaurants. Ultimately, S'hail seeks to extend its reach to cover all cities across Saudi Arabia, providing a comprehensive guide to attractions and restaurants nationwide.



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Appendices



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9 Appendices

9.1 Appendix A: Requirement Elicitation: Interviews

Interview questions:

1. What is your name?
2. How old are you?
3. What is your status in Saudi Arabia?
4. What applications do you use to search for restaurants and attractions?
5. What difficulties did you encounter when using these applications? What do you suggest dealing with these difficulties?
6. What information would you like displayed for each restaurant or attraction?
7. Why would you like to see this information for each restaurant or attraction?
8. What features would you like to have or want to improve in the existing tourism application?
9. Do you have anything else you would like to add?

Interviews transcriptions:

| Interview 1 | |
|--|---------------------------|
| <i>Date: 17/9/2023</i> <i>Duration: 17 minutes</i> <i>Location: campus</i> | |
| | |
| Interviewee: Shahad Alhelal | |
| Interviewer: Layan Altaleb | |
| Reminders: - The interviewee has experience with many tourism apps. -the interviewee age is 23. | |
| Questions | Answers |
| 1. What is your name? | My name is Shahad Alhelal |
| 2. How old are you? | I'm 23 years old |
| 3. What is your status in Saudi Arabia? | Citizen |



| | |
|--|--|
| 4. What applications do you use to search for restaurants and attractions? | I usually use Google Maps to search for restaurants and attractions, and I also use the Visit Saudi and halaYalla apps. |
| 5. What difficulties did you encounter when using these applications? What do you suggest dealing with these difficulties? | The most difficult thing I face in Google Maps is that some of the information is old and not up to date, such as working hours and knowing whether a store is open or closed. This can be frustrating and time-consuming to deal with, especially when I've already made my way to the place only to find out that it's closed or moved. As for the visit Saudi and halaYalla applications, I cannot know the visitors' reviews of the place because the user is not able to comment and rate them. To address the issue with Google Maps, I propose implementing more rigorous checks to ensure the accuracy and timeliness of information. As for the Visit Saudi and halaYalla apps, provide the ability to rate and comment so that I can know people's opinions about the place and whether it is worth visiting. |
| 6. What information would you like displayed for each restaurant or attraction? | The information I want to display is the name of the neighborhood, description of the place, comments, reviews, and pictures of the place. |
| 7. Why would you like to see this information for each restaurant or attraction? | Because This information helps me compare between other places and make the right decision for me. |
| 8. What features would you like to have or want to improve in the existing tourism application? | I would like to see a feature that provides personalized recommendations based on user preferences. This would make it easier for me to discover new and tailored experiences that fit my interests and needs. |
| 9. Do you have anything else you would like to add? | No, Thank you. |

Table 13 Interview 1.



Interview 2

Date: 18/9/2023

Duration: 15 minutes

Location: through a zoom meeting

Interviewee: Turki AlShathri

Interviewer: Layan Altaleb

Reminders:

- The interviewee has diverse experience in local and global tourism apps.
- The interviewee's age is 45.

| Questions | Answers |
|--|--|
| 1. What is your name? | Turki AlShathri |
| 2. How old are you? | I'm 45 years old |
| 3. What is your status in Saudi Arabia? | Citizen |
| 4. What applications do you use to search for restaurants and attractions? | I typically use a combination of applications. When searching for restaurants and attractions, such as Visit a City, TripAdvisor, visit Saudi, Sawah, and Google Maps. |
| 5. What difficulties did you encounter when using these applications? What do you suggest dealing with these difficulties? | <p>I have encountered certain difficulties when using these applications. One major challenge is the lack of a comprehensive application that encompasses all the features I need. Each application has its strengths and limitations, which means I often must switch between multiple apps to gather all the necessary information. This can be time-consuming and cumbersome.</p> <p>Additionally, I have found that many of these applications have limited information and limited search filters.</p> <p>To address these difficulties, I would suggest the development of a comprehensive application that brings together the best features from various existing platforms. This application should aim to provide a one-stop solution for users searching for restaurants and attractions.</p> |



| | |
|---|--|
| 6. What information would you like displayed for each restaurant or attraction? | I would like to display the location, description of the place, hours of operation, comments, reviews, phone number, and pictures or videos of the place for each restaurant or attraction places. |
| 7. Why would you like to see this information for each restaurant or attraction? | I would like to see this information for each restaurant or attraction because it allows me to make informed decisions and have a better understanding of what to expect. It helps me evaluate options based on my preferences, budget, and other specific needs. Also saves my time and effort by providing all the necessary information in one place, reducing the need for additional research or inquiries. |
| 8. What features would you like to have or want to improve in the existing tourism application? | I would like to improve the display of restaurant and attraction information details, as well as provide the search with additional filters to expedite the search process. Furthermore, I would like to incorporate an augmented reality feature to provide users with a more immersive and interactive experience. |
| 9. Do you have anything else you would like to add? | Thank you, I mentioned everything I wanted. I wish you all the best of luck and the success of the S'hail application. |

Table 14 Interview 2.

| Interview 3 | |
|--|------------------------------------|
| <i>Date: 17/9/2023</i> <i>Duration: 20 min</i> <i>Location: Living Room</i> | |
| Interviewee: Sarah Alawwad | Interviewer: Latifa Alawwad |
| Reminders: | |
| <ul style="list-style-type: none"> The interviewee is interested in attractions and restaurants in Riyadh city and has diverse experiences with tourism apps. The interviewee's age is 28. | |



| Questions | Answers |
|--|--|
| 1. What is your name? | My name is Sarah Alawwad. |
| 2. How old are you? | I am 28 years old. |
| 3. What is your status in Saudi Arabia? | I am a Saudi Arabian citizen. |
| 4. What applications do you use to search for restaurants and attractions? | I primarily use Google Maps and TripAdvisor. Google Maps is my choice for navigation and location details, while TripAdvisor helps me discover and decide on restaurants and attractions through user reviews and ratings. |
| 5. What difficulties did you encounter when using these applications? What do you suggest dealing with these difficulties? | When using Google Maps and TripAdvisor, I've encountered a few difficulties. One significant issue, particularly with Google Maps, is the presence of outdated information, such as incorrect business hours or closed establishments. To enhance the user experience, it's important to have stricter checks to keep info up-to-date. Additionally, in both apps, the reliability of user-generated reviews and ratings can be a concern. I recommend implementing stricter review verification methods to ensure trustworthy feedback. Moreover, offering more detailed search filters, allowing users to refine choices based on specific preferences like budget and cuisine type, would significantly improve the apps. |
| 6. What information would you like displayed for each restaurant or attraction? | For each restaurant or attraction, I'd like to see the Opening hours, google map link, Contact details, User ratings and reviews, Photos of the place and Cuisine types and menu options. |
| 7. Why would you like to see this information for each restaurant or attraction? | Having this information available is crucial for making decisions. It helps me understand what to expect and whether the place aligns with my preferences and needs. |



| | |
|---|---|
| 8. What features would you like to have or want to improve in the existing tourism application? | I'd appreciate these features in tourism apps: restaurant and attraction availability updates, reservation, personalized recommendations based on my preferences, notifications for nearby attractions. |
| 9. Do you have anything else you would like to add? | No, Thank you. |

Table 15 Interview 3.

9.2 Appendix B: Requirement Elicitation: Questionnaire

- Questionnaire:



S'hail | سهيل

We are information technology senior students from King Saud University, working on our graduation project, the S'hail application.

S'hail application works to achieve one of the goals of Vision 2030, which is to enhance tourism in the Kingdom of Saudi Arabia by helping locals and tourists find restaurants and tourist places easily and effectively.

We kindly request your participation in this survey. Your valuable feedback will help us to enhance tourism in Saudi Arabia.

layannnn00@gmail.com [Switch accounts](#) 
 Not shared

* Indicates required question

How old are you? *

less than 18

18-29

30-50

more than 50

What is your native language? *

Arabic

English

What is your current status in Saudi Arabia? *

Vistior/Tourist

Resident

Citizen

How often do you use tourism apps that display restaurants and attractions details? *

Frequently

Occasionally

Rarely

Never

Have you encountered any difficulties when using these applications? *

Yes

No

If yes, what difficulties did you face?

Your answer



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What level of importance do you assign to having a recommendation system that * makes personalized suggestions for restaurants and attractions based on your recent activities and preferences?

Very important
 Somewhat important
 not very important
 Not at all important

How likely is it that you would utilize a feature on an interactive map that lets you drop a pin and look up nearby locations? *

Very likely
 Somewhat likely
 Neutral
 Not very likely
 Not at all likely

How likely are you to use the scheduling feature to plan restaurant or attraction visits based on preference ? *

Very likely
 Somewaht likely
 Neutral
 Not very likely
 Not at all likely

Do reviews and comments influence your decision-making in any way? *

Strongly agree
 Agree
 Neutral
 Disagree
 Strongly Disagree

If you have any issues while using the application how would you prefer to contact us? *

Phone call
 Email
 WhatsApp
 Other: _____

Your comments are valuable to us. Do you have any suggestions or anything you would like to add?

Your answer

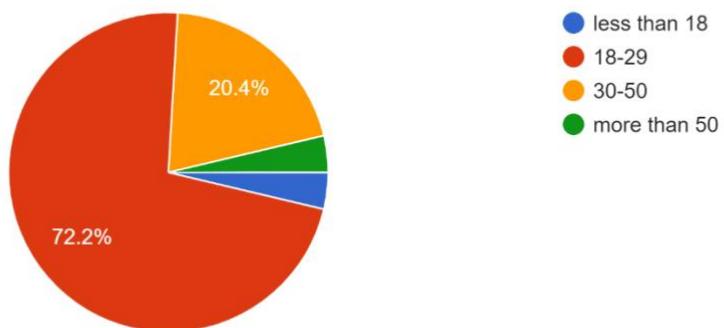
Submit **Clear form**

Figure 45 Questionnaire.

- Questionnaire results:

How old are you?

54 responses

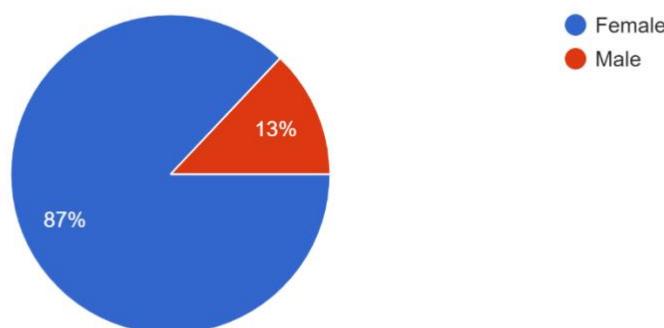




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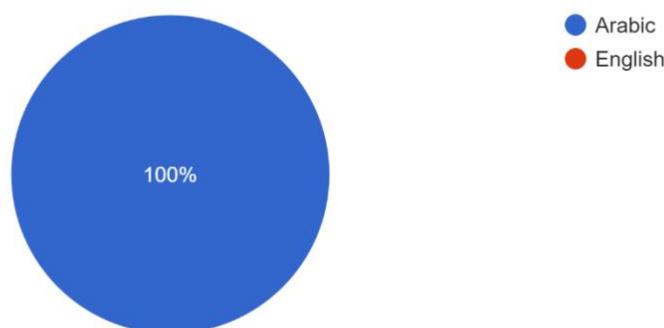
What is your gender?

54 responses



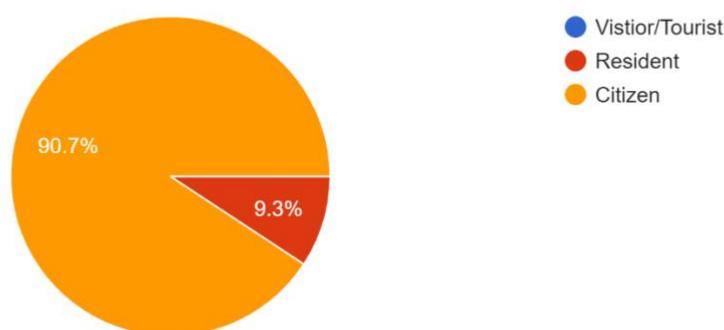
What is your native language?

54 responses



What is your current status in Saudi Arabia?

54 responses

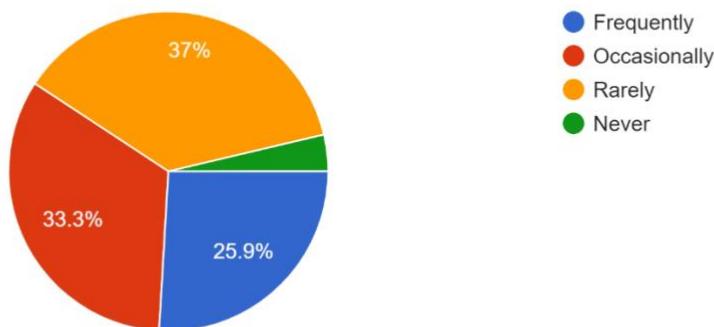




سُبْرِيل

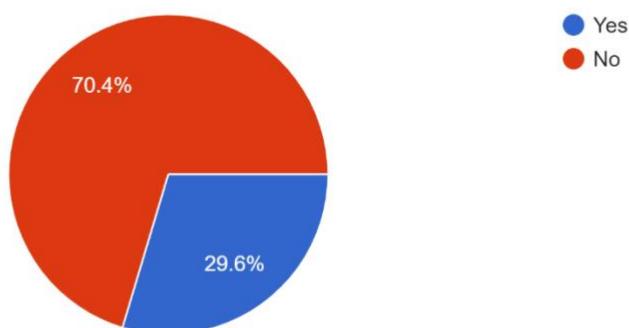
How often do you use tourism apps that display restaurants and attractions details?

54 responses



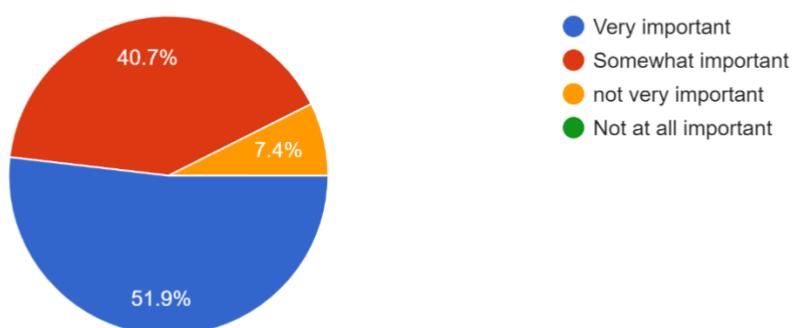
Have you encountered any difficulties when using these applications?

54 responses



What level of importance do you assign to having a recommendation system that makes personalized suggestions for restaurants and attractions based on your recent activities and preferences?

54 responses

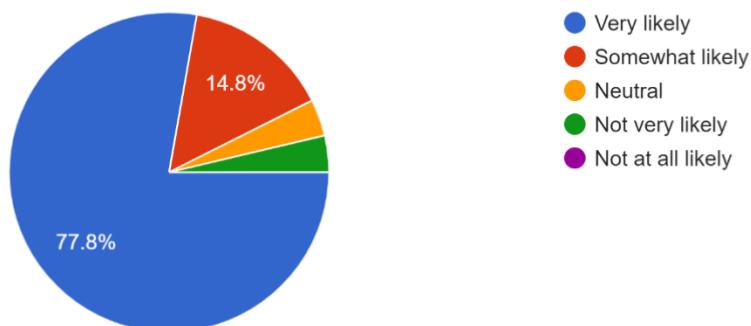




سُبْرِيل

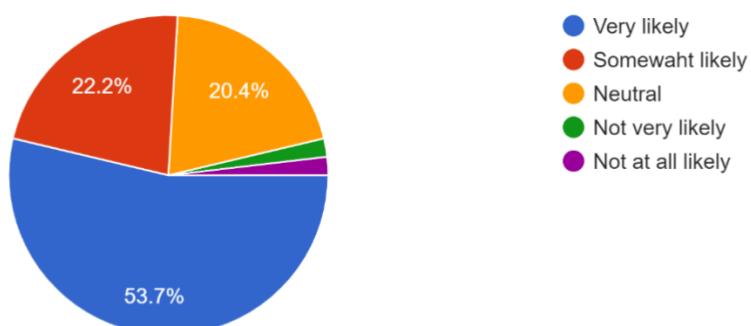
How likely is it that you would utilize a feature on an interactive map that lets you drop a pin and look up nearby locations?

54 responses



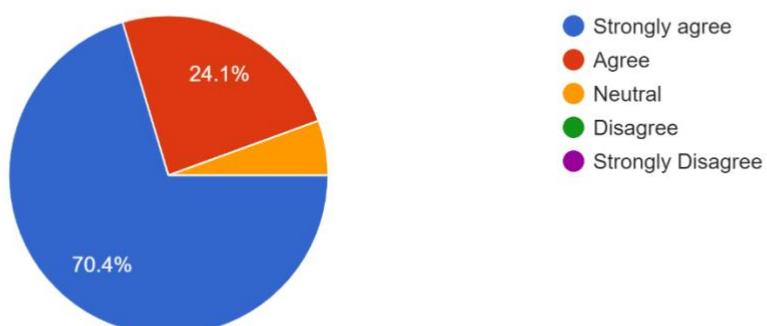
How likely are you to use the scheduling feature to plan restaurant or attraction visits based on preference ?

54 responses



Do reviews and comments influence your decision-making in any way?

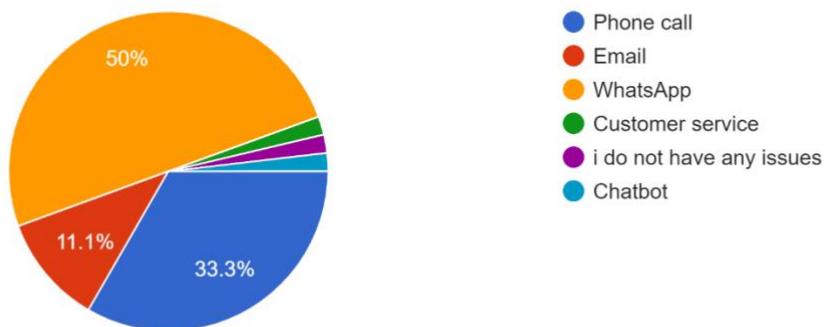
54 responses





If you have any issues while using the application how would you prefer to contact us?

54 responses



If yes, what difficulties did you face?

9 responses

- No recommendations from the app, so hard to find what im looking for
- Finding a platform that gathers all attractions, restaurants and events happening
- Lagging, errors
- There is so many of them and information is scattered between different platforms
- Some of the information is old
- No comprehensive information about activities
- The program's interface is not attractive, the program's navigation methods are little complicated, and the program's services are not integrated.
- No accurate similar places in the recommended areas, if i type a wrong spelling it doesn't show the place
- Usually they don't show the recent trend locations

Your comments are valuable to us. Do you have any suggestions or anything you would like to add?

13 responses

- No
- ان يعمل التطبيق بدون انترنت
- Good luck!!!
- No, good luck ❤
- Thank you and good luck in your project.. wish you luck
- I think it is good idea if there is shard plan feature. So after I prepare schedule I can share it with my family
- Prominently displaying the features of the Riyadh Season on the interactive map, as well as a summary of the event/region services.
- Just focus on the user's experience and that the process is simple to use
- ur application is ever nice
- Try to check a gap with Google and cover it
- I suggest to focus on Riyadh first than you expand later by adding more cities .

Figure 46 Questionnaire results.



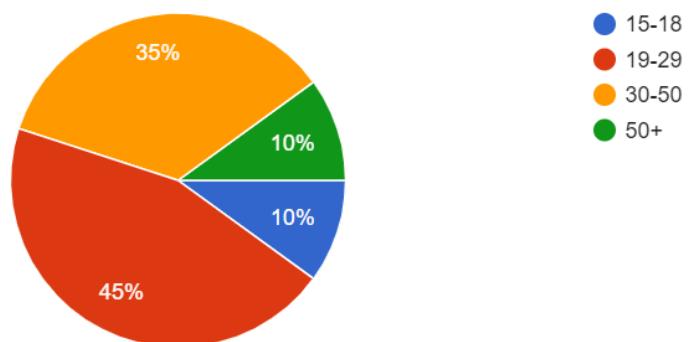
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9.3 Appendix C: System Testing Demographic Questions

- Users' Demographics

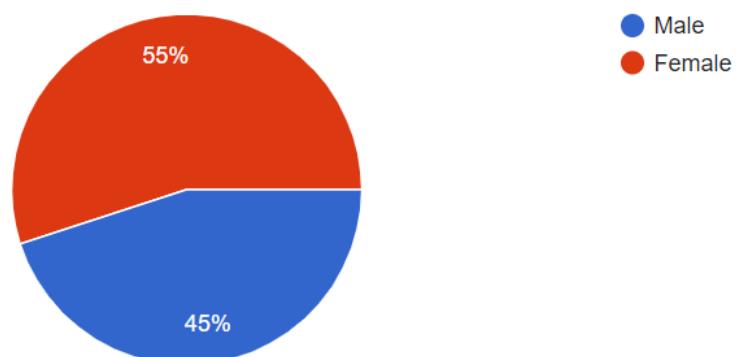
Age

20 responses



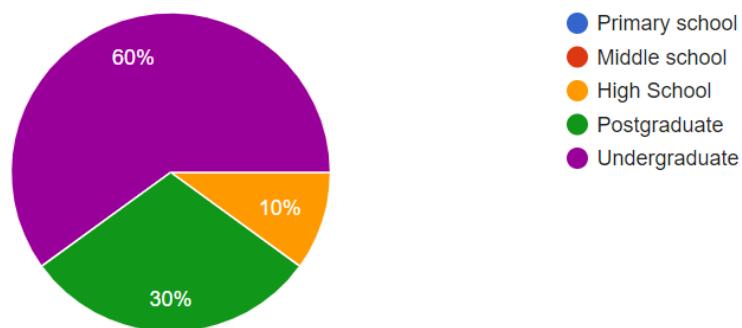
Gender

20 responses



Educational level

20 responses

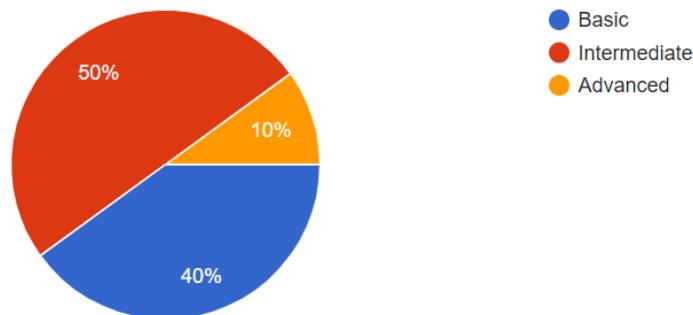




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Experience in using websites

20 responses



What is your current status in Saudi Arabia

20 responses

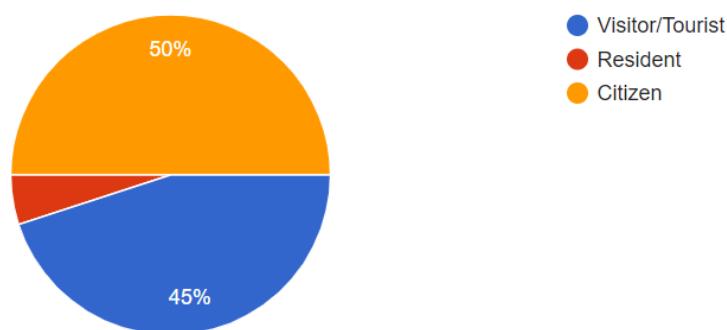
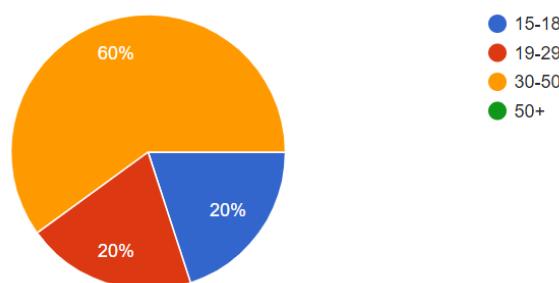


Figure 47 47 Demographic of user's participants.

- Admin's Demographics

Age

5 responses

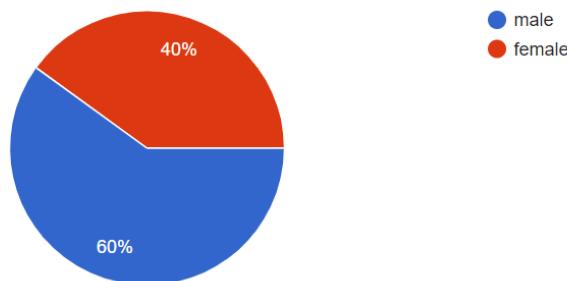




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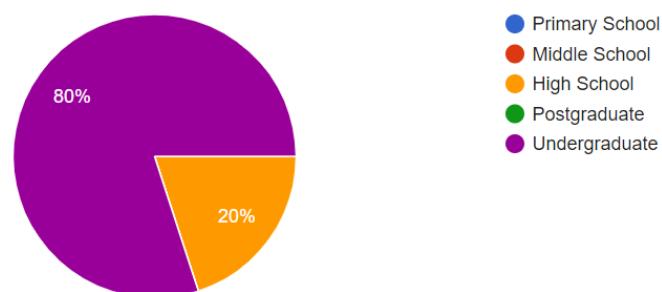
Gender

5 responses



Educational level

5 responses



Experience in using mobile websites

5 responses

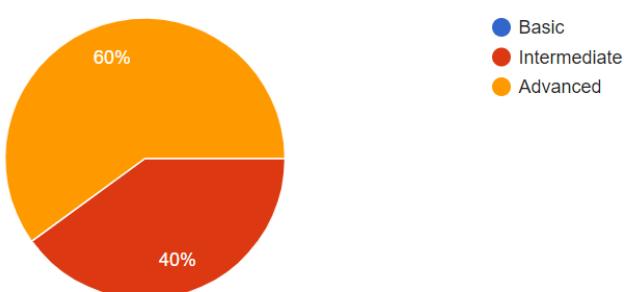


Figure 48 Demographic of admins participants.



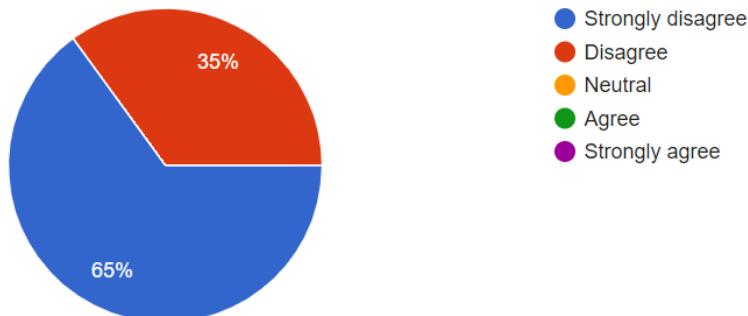
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9.4 Appendix D: System Testing Questionnaire Questions

- Application Questionnaire

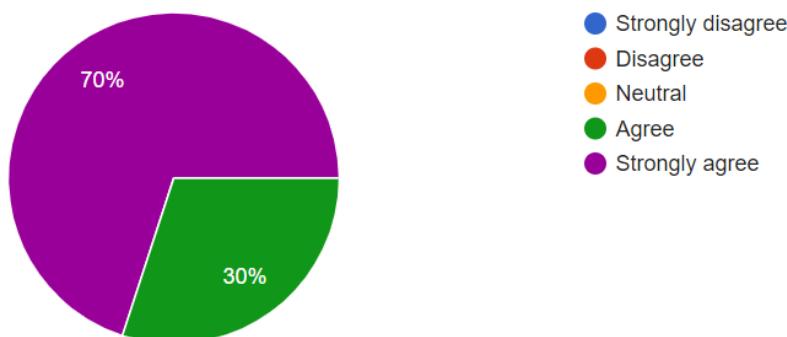
I needed previous experience to use the app.

20 responses



I found the app easy to use.

20 responses



I found the colors comfortable.

20 responses





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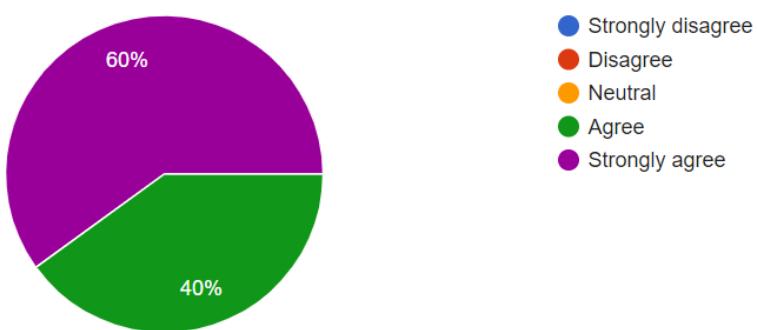
I found the application interface design clear and easy to use.

20 responses



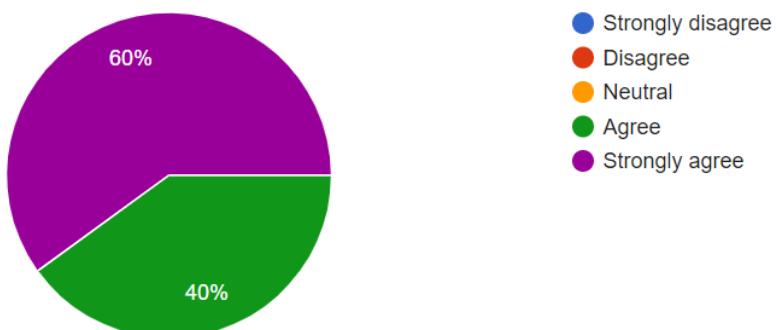
I found the app to be properly threaded and navigating between pages was easy.

20 responses



I found the app to have a fast response.

20 responses

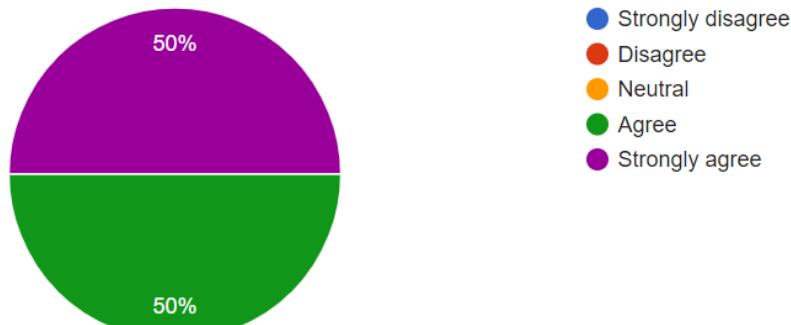




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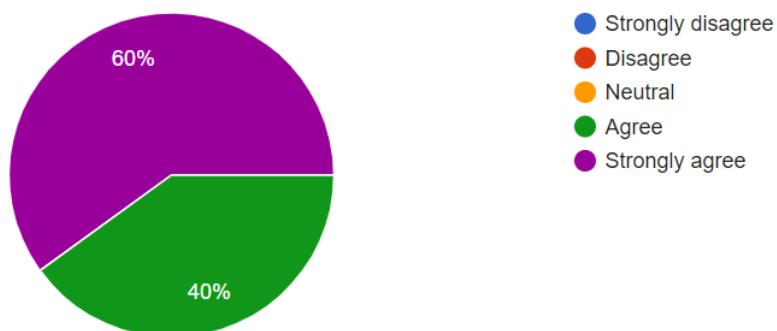
I was able to add a place easily and clearly.

20 responses



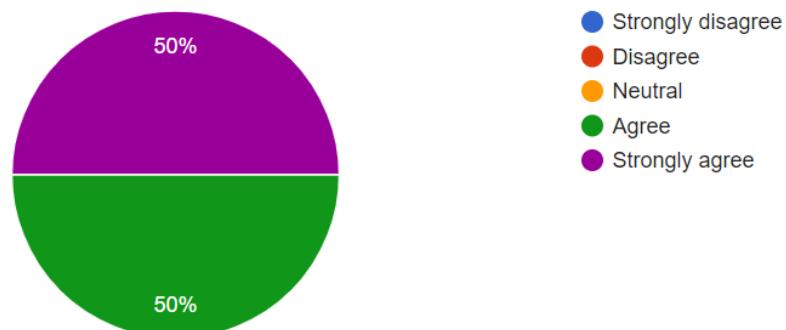
I was able to search for places easily, and clearly.

20 responses



I was able to use my current location to explore nearby locations easily.

20 responses

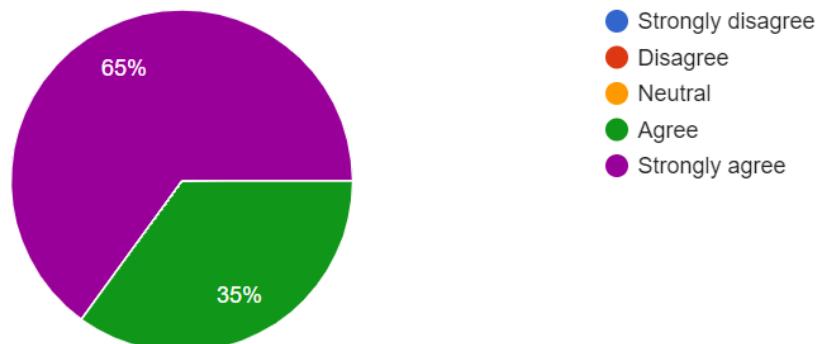




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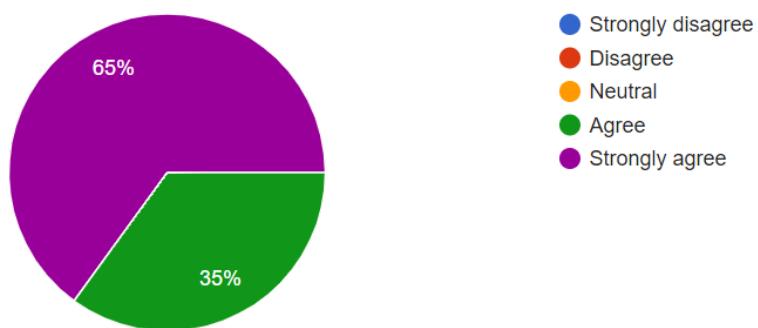
I was able to rate and comment easily and clearly.

20 responses



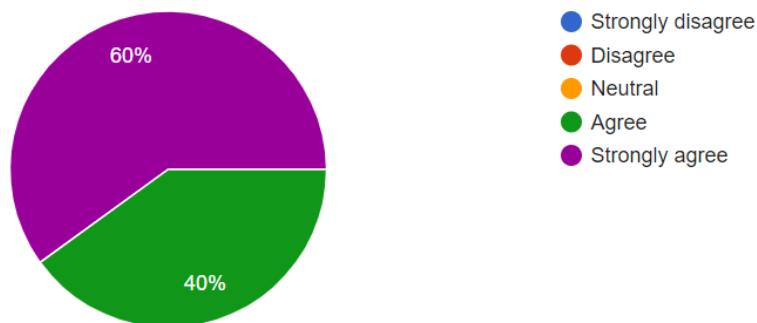
The feature that prohibited me from posting an inappropriate comment was helpful.

20 responses



I was able to Filter the places based on some criteria easily.

20 responses

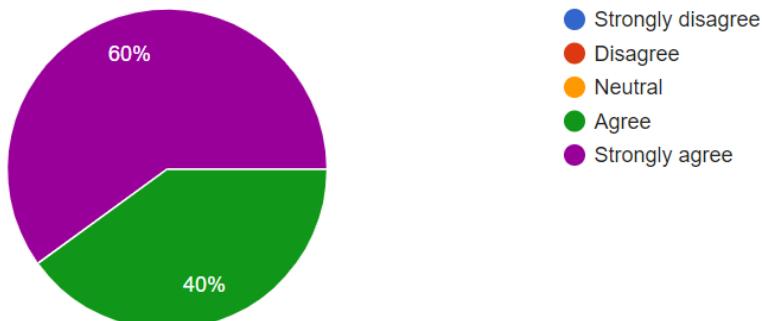




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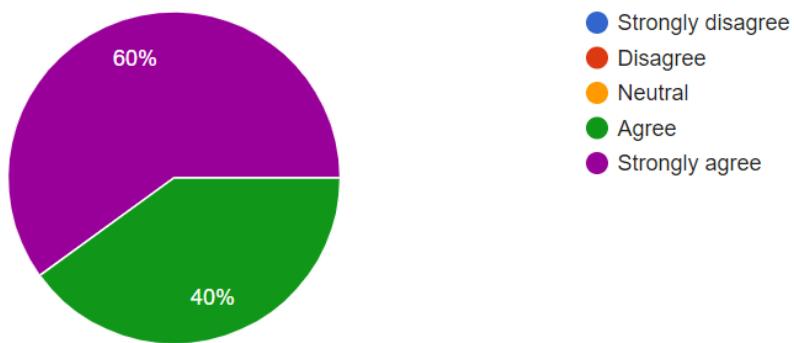
I was able to find recommendations related to the place I was viewing, and it was helpful.

20 responses



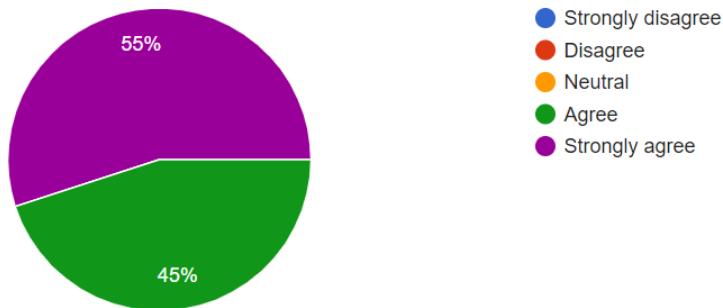
I was able to add my desired place to my favorite list easily and clearly.

20 responses



I was able to find recommendations similar to the places I added to my favorite list in the homepage, and it was helpful.

20 responses

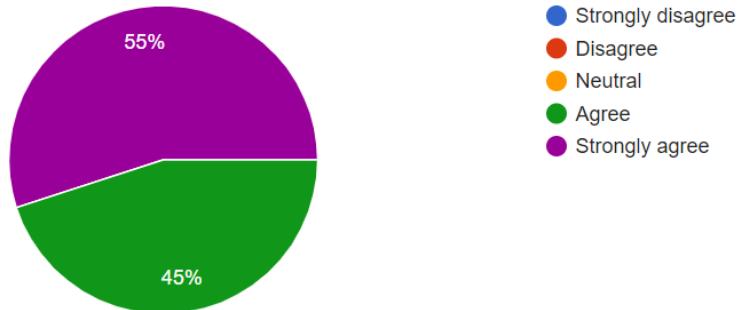




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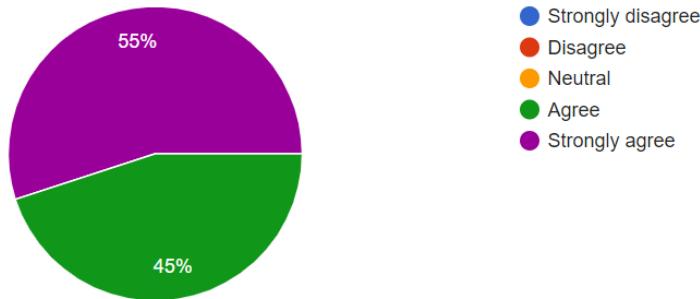
I was able to add a place to my calendar and schedule my plans easily and clearly.

20 responses



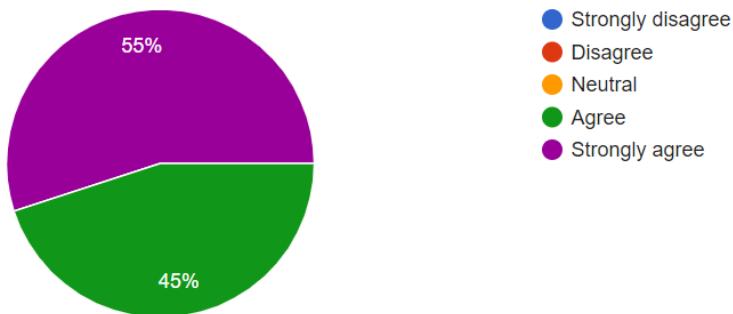
I was able to switch the language from Arabic to English and vice versa fast and easy.

20 responses



I was able to delete my account without having any confusions.

20 responses

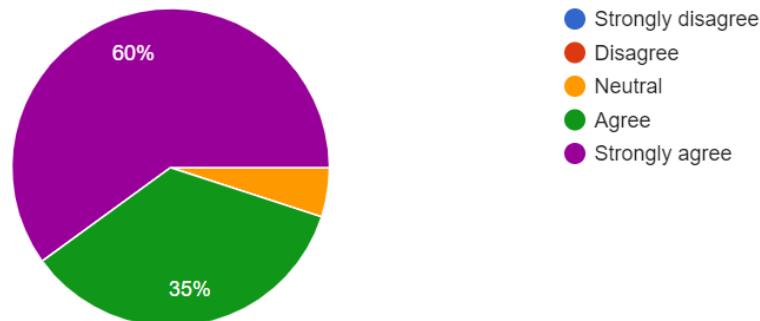




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I think I will use the app frequently.

20 responses



I will recommend this app to my friends and family.

20 responses

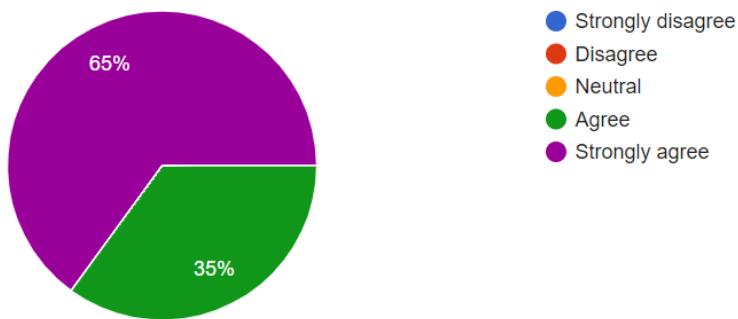
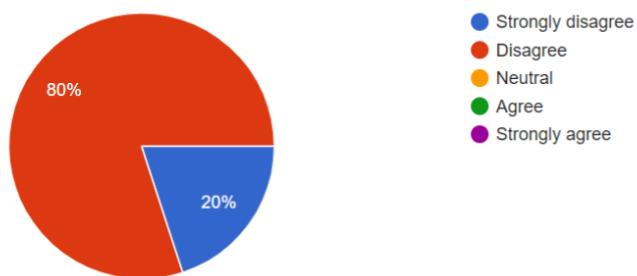


Figure 49 Application questionnaire questions.

- Admin website questionnaire

I needed previous experience to use the website.

5 responses

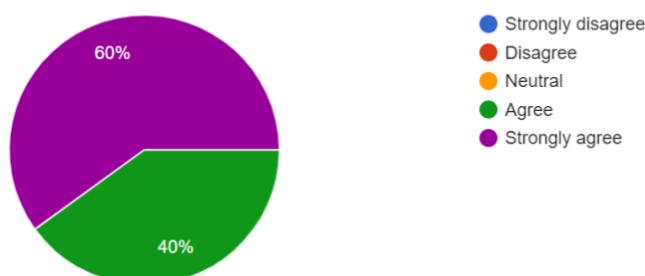




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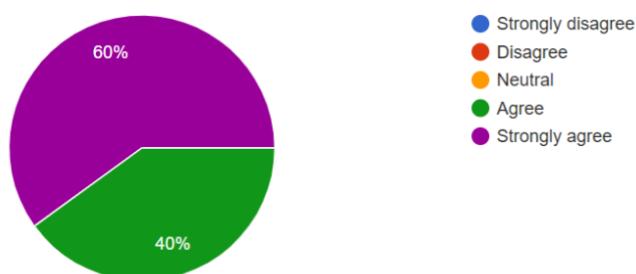
I found the website easy to use.

5 responses



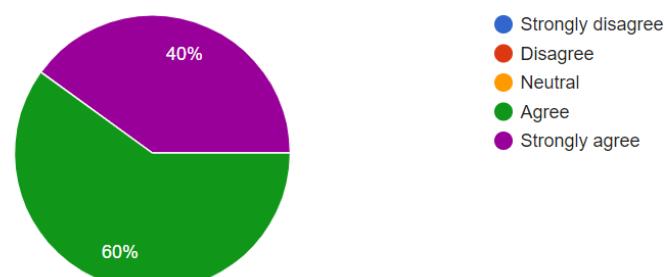
I found the colors comfortable.

5 responses



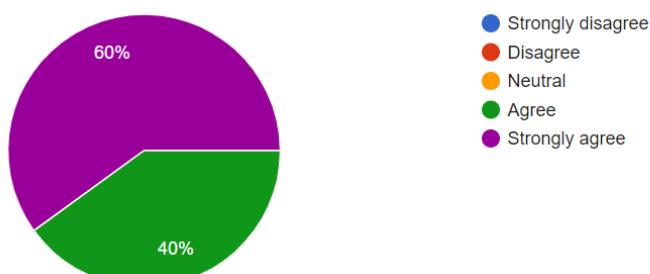
I found the website interface design clear and easy to use.

5 responses



I found the website to be properly threaded and navigating between pages was easy.

5 responses

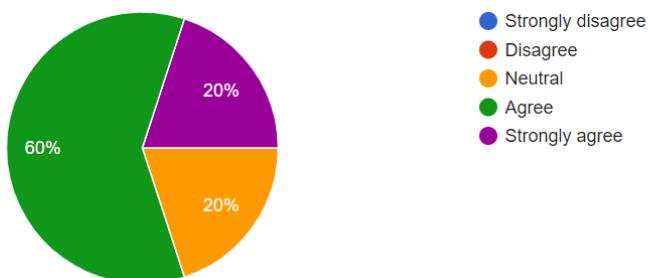




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I found the website to have a fast response.

5 responses



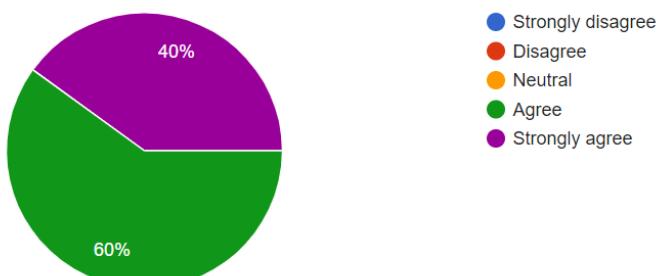
I was able to approve or reject requested places easily, and clearly.

5 responses



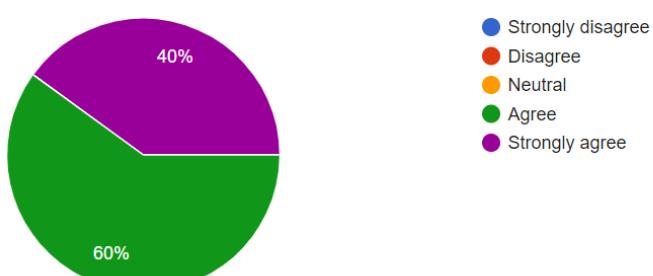
I was able to search for places easily, and clearly.

5 responses



I was able to manage places easily, and clearly.

5 responses





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I was able to add a place easily, and clearly.

5 responses

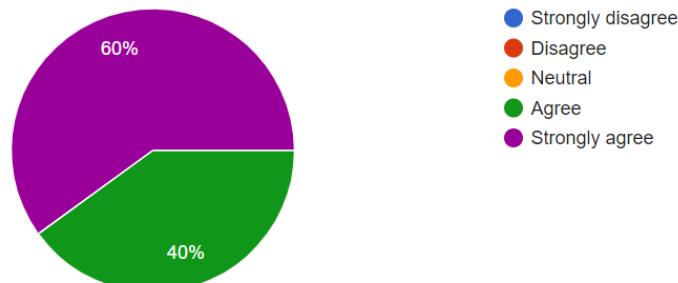


Figure 50 Admin website questionnaire questions.

9.5 Appendix E: NFR Usability Test:

- SUS questions:

I think that I would like to use this system frequently.

1 2 3 4 5

Strongly disagree

Strongly agree

I found the system unnecessarily complex.

1 2 3 4 5

Strongly disagree

Strongly agree

I thought the system was easy to use.

1 2 3 4 5

Strongly disagree

Strongly agree



I think that I would need the support of a technical person to be able to use this system.

1 2 3 4 5

Strongly disagree

Strongly agree

I found the various functions in this system were well integrated.

1 2 3 4 5

Strongly disagree

Strongly agree

I thought there was too much inconsistency in this system.

1 2 3 4 5

Strongly disagree

Strongly agree



I would imagine that most people would learn to use this system very quickly.

1 2 3 4 5

Strongly disagree

Strongly agree

I found the system very cumbersome to use.

1 2 3 4 5

Strongly disagree

Strongly agree

I felt very confident using the system.

1 2 3 4 5

Strongly disagree

Strongly agree

I needed to learn a lot of things before I could get going with this system.

1 2 3 4 5

Strongly disagree

Strongly agree

Figure 51 SUS questions.



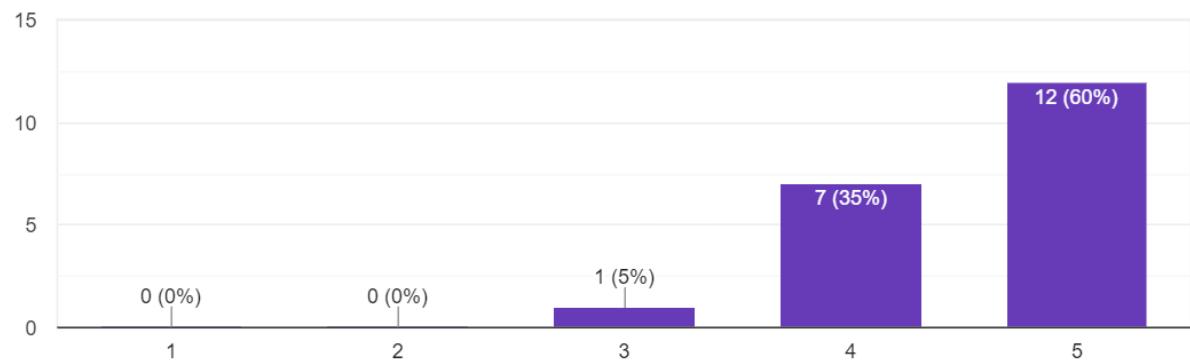
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- SUS results:

I think that I would like to use this system frequently.

Copy

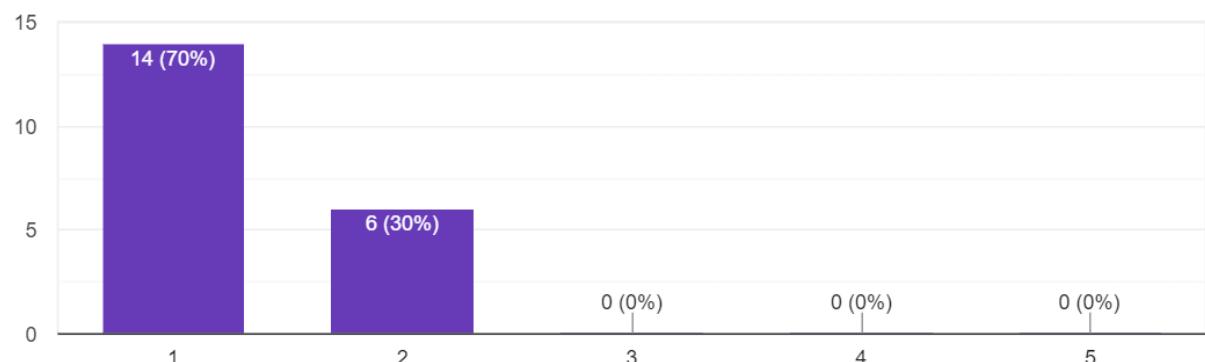
20 responses



I found the system unnecessarily complex.

Copy

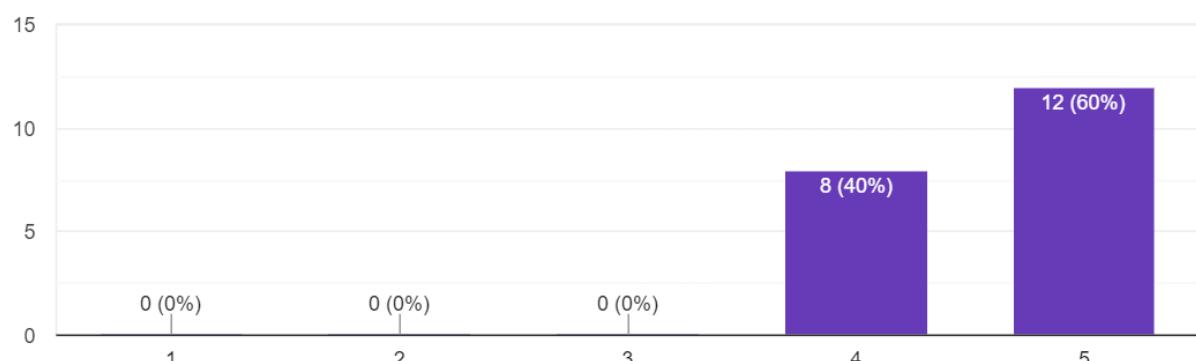
20 responses



I thought the system was easy to use.

Copy

20 responses



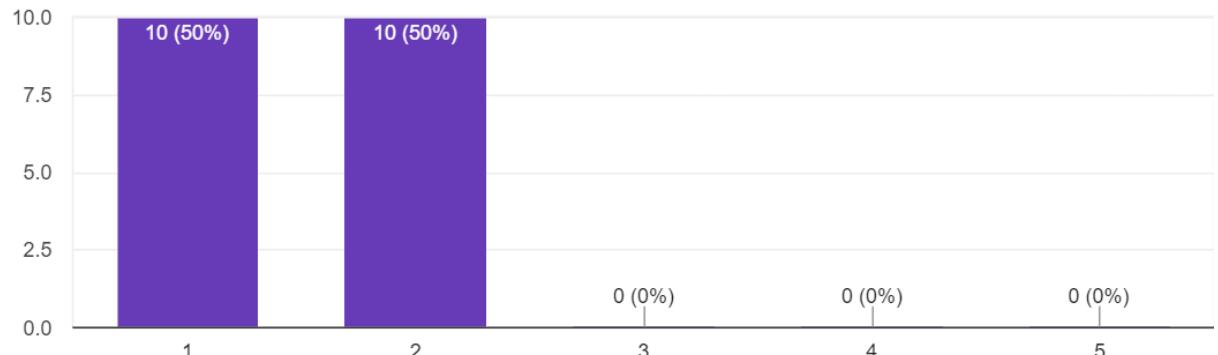


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I think that I would need the support of a technical person to be able to use this system.

Copy

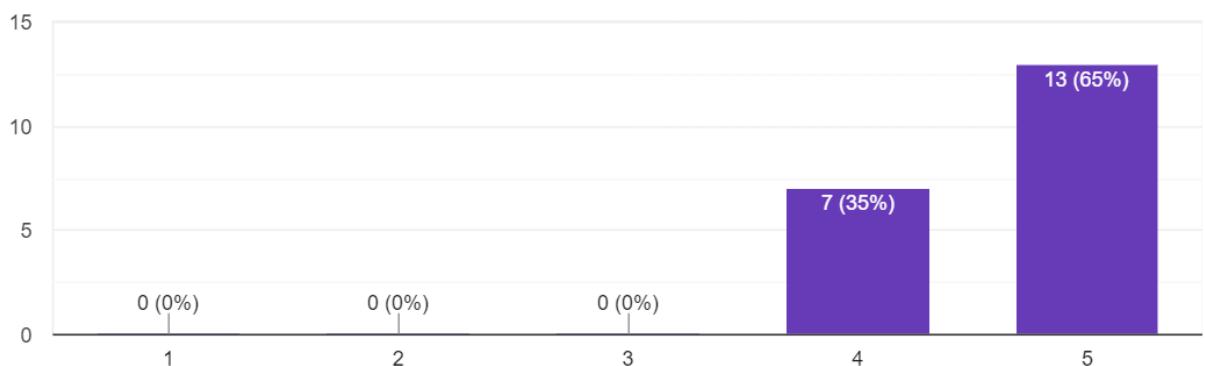
20 responses



I found the various functions in this system were well integrated.

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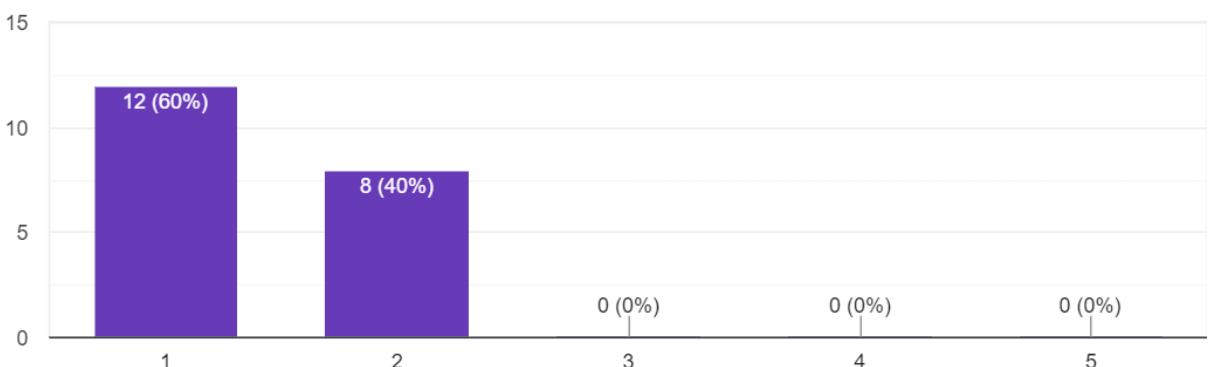
20 responses



I thought there was too much inconsistency in this system.

Copy

20 responses



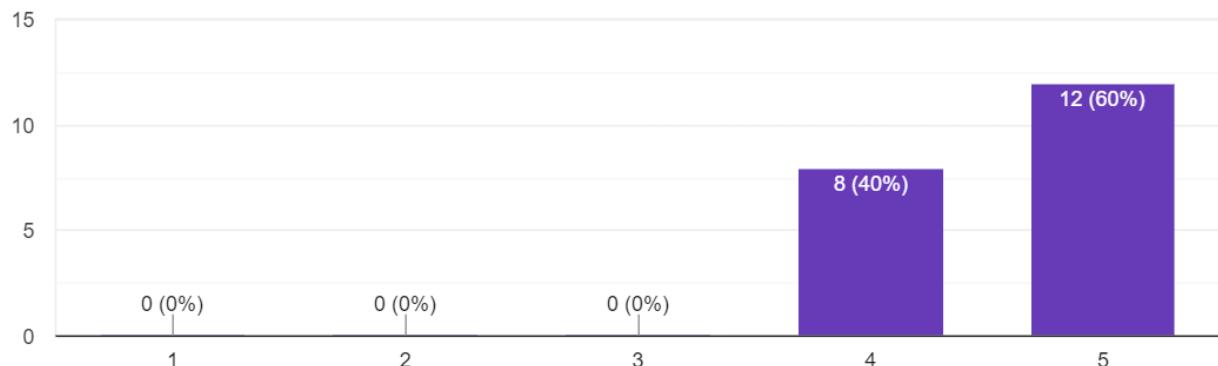


سُبْرِيل

I would imagine that most people would learn to use this system very quickly.

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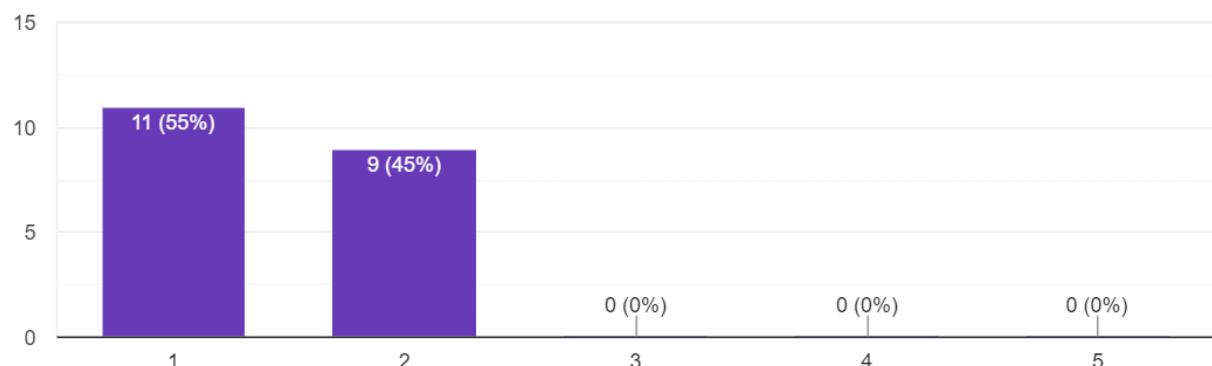
20 responses



I found the system very cumbersome to use.

Copy

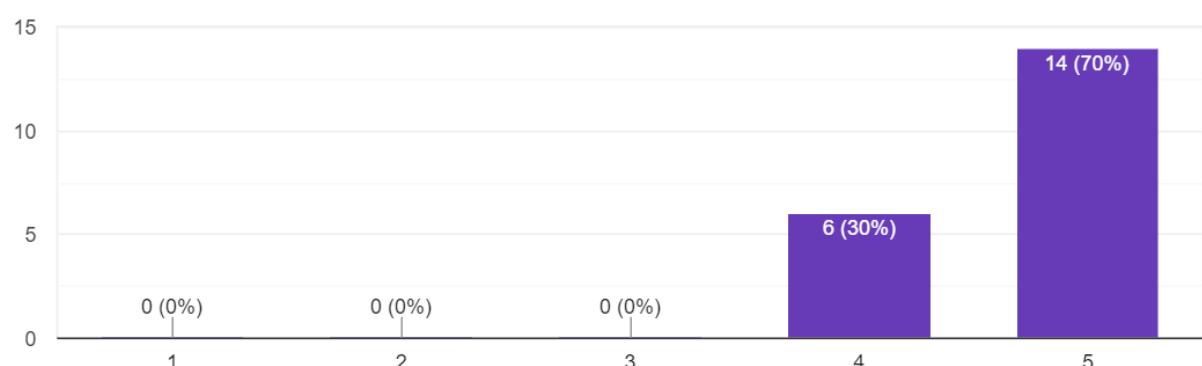
20 responses



I felt very confident using the system.

Copy

20 responses





I needed to learn a lot of things before I could get going with this system.

Copy

20 responses

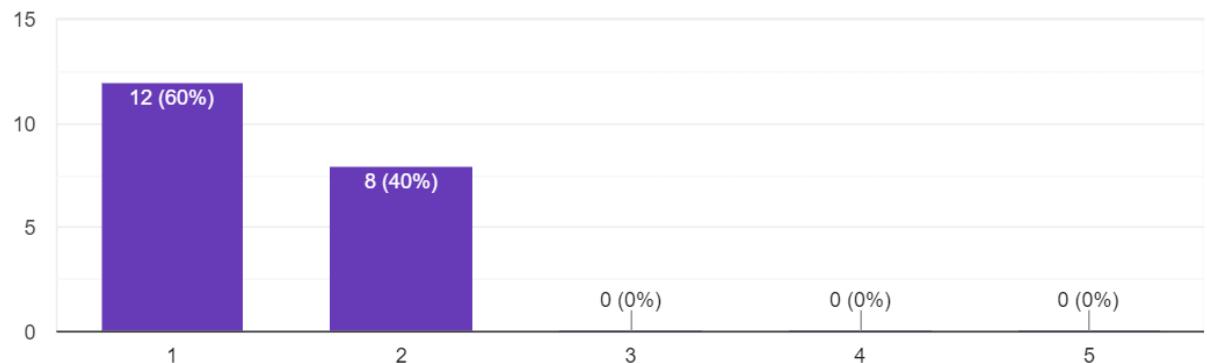


Figure 52 SUS results.