

Second Semester 1445H (Spring 2024)



IT 497: Graduation Project Report

Product Release-2

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Riyadh Guide | دليل الرياض

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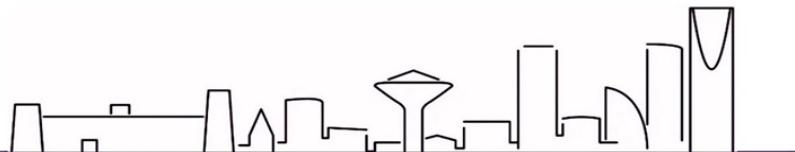
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Abstract (English): In line with the 2030 vision of the Kingdom of Saudi Arabia, Riyadh has become one of the targeted cities to visit by tourists and explore by locals. One common problem encountered by both residents and tourists is the lack of a centralized application that offers all the necessary information for visitors. Additionally, individuals seeking entertainment options in Riyadh often find themselves navigating through numerous websites and social media platforms to gather reviews and determine the worthiness of visiting a particular place. This process can be time-consuming and cumbersome. To tackle these challenges, Riyadh Guide will integrate a machine-learning model this model is trained based on real Arabic data that is gathered and analyzed using Natural Language Processing techniques to help in sentiment analysis of the data and to provide users with insights into the quality of various places, helping them save time and effort that would otherwise be spent searching through multiple platforms. By leveraging machine learning, Riyadh Guide will offer reliable evaluations of different establishments. Furthermore, Riyadh Guide will feature a comprehensive listing of places of interest, accompanied by a calendar of upcoming events. This will enable users to plan their weekends and trips more efficiently, ensuring they don't miss out on exciting events happening in Riyadh.

الملخص: نوافقاً مع رؤية المملكة العربية السعودية 2030، أصبحت الرياض واحدة من الوجهات السياحية المستهدفة لزيارتها من قبل السياح والسكان المحليين، أحد المشاكل الشائعة التي يواجهونها هي عدم وجود تطبيق شامل يقدم جميع المعلومات اللازمة للزوار أثناء زيارتهم لمكان معين، وبالتالي يجد الأفراد أنفسهم يتلقون بين العديد من المواقع الإلكترونية ومنصات التواصل الاجتماعي لجمع كل المعلومات ومعرفة آراء الناس وتحديد ما إذا كانت تلك الأماكن تستحق الزيارة أم لا، مما يؤدي إلى هدر الوقت والجهد. حل هذه المشكلة "دليل الرياض" سوف يقوم باستخدام نموذج تعلم الآلي والذي يهدف إلى إعطاء المستخدمين نظرة شاملة عن جودة المكان الذي يزورونه لتحديد ما إذا كان يستحق الزيارة، هذا النموذج تم تدريبيه باستخدام بيانات حقيقة باللغة العربية تم جمعها وتحليلها باستخدام تقنيات معالجة اللغة الطبيعية لتحليل مشاعر الأشخاص من خلال آرائهم حول هذه الأماكن.علاوة على ذلك، يتضمن "دليل الرياض" الأماكن السياحية والترفيهية، بالإضافة إلى تقويم يحتوي على الفعاليات القادمة. هذه الميزة ستمكن المستخدمين من تحديد عطالتهم ورحلاتهم بشكل أكثر كفاءة، وضمان عدم فوتهم الفعاليات. يعد "دليل الرياض" تطبيقاً مهماً للأفراد الذين يسعون إلى الاستمتاع بوقتهم في الرياض واستكشاف جميع المعالم السياحية في الرياض.

Keywords: Riyadh Tourism, Riyadh Attraction, Vision 2030 of Riyadh, Machine learning, Natural language processing on Arabic, Arabic Sentiment analysis, Riyadh Events.

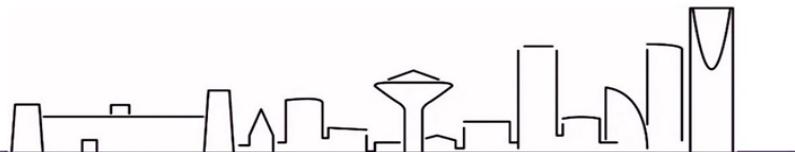


1. Introduction

Vision 2030 aims to make the Saudi capital Riyadh a unique and attractive tourist destination. Offering a rich array of cultural heritage, historical sites, natural wonders, and modern landmarks. Vision 2030 also aims to have Riyadh become among the world's most prominent cities in terms of quality of life, tourism, and services in one way or another. The Kingdom has set an ambitious goal to attract 100 million visitors annually. Crown Prince Mohammed bin Salman said "This plan recognizes the great potential to attract international visitors and reflects its commitment to creating an enabling environment for the development of tourism"[1]. The transformation of Riyadh tourism is not only about attracting visitors but also about ensuring a high quality of life for its residents. With Riyadh EXPO 2030, Riyadh City is inviting the world to share how we all imagine a different future, improving the tourism in Riyadh becoming now more important than ever [2].

We noticed the effort exerted by the General Entertainment Authority in attracting tourists and citizens by holding entertainment seasons with a calendar of events and establishing places and international restaurants and coffee shops. With this development and a large number of places and tourist attractions, we notice that people suffer during the process of searching for an interesting place to spend time whether on social media or Google map and face a hard time getting all the information easily and efficiently about the place such as their services and people opinion about it, with the noticeable lack of city guide applications. To avoid wasting time while seeking reviews and information about the place and obtaining an honest opinion, our technological solution is a user-friendly application that helps to save time and effort while searching for places in an efficient way. Our application will help entertainment seekers obtain all the information on events and things to do in Riyadh easily. It will also play a role in promoting tourism and highlighting the events and places of attraction.

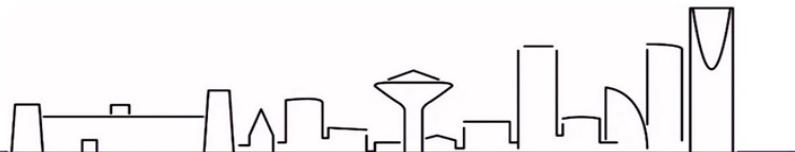
This document will provide a comprehensive view of the Riyadh Guide Application. It starts addressing the problem, our proposed solution, the product vision, the roadmap, the project objectives, and the scope. In addition, we will discuss the hardware/software tools we will be using to estimate the cost of the application development and scrum team. In addition



to covering the background part which introduces supervised machine learning and its different types, the API we will use to collect data, as for the literature review, we compare applications that are in the same domain as our application.

In the system design and development section, we started explaining our methodology in this project then we talked about how we collected the user requirements. We also added a description of users in the Riyadh Guide application, a use case, and the system architecture that the application will follow, and the product backlog containing user stories and their acceptance criteria. In addition, we have outlined the key components of our system design, covering architectural, class, and data design aspects. The last part of this section provides system implementation, detailing the coding and development processes. Moreover, Section 5 focuses on system testing, user acceptance and quality attributes(Non-functional requirement) testing details, and a comprehensive discussion.

Concluding our project release document, Section 6 provides a summary of our findings and discusses potential areas for future work and system enhancements. By examining user feedback and system performance. We ended up this document with the acknowledgement section where we expressed our gratitude and appreciation to those who have contributed to this project, references, and lastly the appendix.

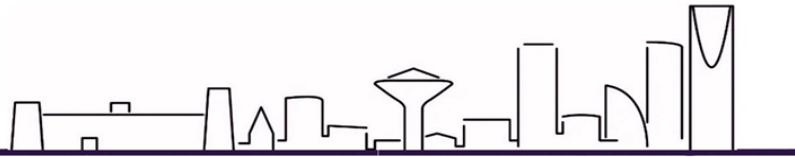


1.1. The Problem

In line with the 2030 vision of the Kingdom of Saudi Arabia, Riyadh has become one of the targeted cities to visit by tourists and explore by locals. But there exists a common problem that affects both residents and tourists which is the lack of convenient applications that contain all events and places in Riyadh including shopping centers, restaurants, coffee shops, entertainment, and activities places. Currently, entertainment seekers looking to explore Riyadh must navigate a lot of websites, social media, and Google Maps. This approach consumes their time and causes frustration. For example, finding and collecting reviews about places is a problem especially for foreign tourists since they can't understand Arabic reviews. In addition, there is no application that finds the real evaluation of places after analyzing people's reviews and then displaying it in a simple way.

Furthermore, these days individuals often find themselves enrolled in various loyalty programs with each offering discounts. These programs can be for bank cards, companies, and government institutions. Some people have a hard time keeping track of which loyalty program or card to use at a particular place. This confusion leads to missing the opportunities for getting discounts. Additionally, the user can be overwhelmed when trying to keep track of the discount percentage in each place.

In summary, The challenge faced by people to find places to visit with their rating and things to do easily while having multiple loyalty programs and cards is complex. A user-friendly solution must be introduced to enhance the overall experience of living and traveling to Riyadh. making the process of discovering and visiting Riyadh easy and appealing.

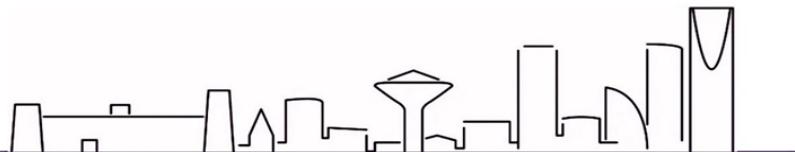


1.2. The Solution

Riyadh Guide application is concerned with resolving challenges and problems associated with exploring Riyadh city. Firstly, we will get an overview of the application functionality, and then we will get into more detail about the application solution. The application aims to help users explore Riyadh places in an efficient way to avoid wasting time and effort. It allows users to search for a specific place. If the user doesn't know where to go but has a specific type of place that he wants to visit, then he can choose among several place categories in the application such as tourist attractions, restaurants, coffee shops, activities, and events to facilitate the search process.

The application will gather all the helpful information about the places and display it to the user such as photos, work hours, and a brief description of their services. It will allow admins to add all the necessary details for places and events and to edit or delete them when needed. To ensure that the description written by the admin is creative and well syntaxed, the application will have an AI text generator option that uses chatGPT API that is provided from open AI [3] so the admin can write a prompt that have brief description about the place and then the AI generator will generate a description that is well formed and appealing for the users to view. In Addition, The application employs sentiment analysis on user reviews to provide users with a clear evaluation of a place's quality. Through machine learning algorithms, the system classifies reviews as either positive, negative, or neutral. The application then presents a percentage indicating the overall sentiment towards the place. This feature assists users in making informed decisions about whether the place is liked by people or not, helping them determine if it's worth visiting.

Another helpful feature is that the application will also allow users to select among available bank cards and loyalty programs they have, then the application will compare the offers that the cards and loyalty programs provide, and display the best offer for each place for them, In our application, we gather information about available offers from bank cards through their official websites, as referenced by examples for Alinma and STC pay cards [4] [5]. We also provide coverage for loyalty programs such as "Nafea" which offers various discounts and promotions in different areas for all members of the King Saud University community, including faculty, staff, and students [6]. Additionally, we have "Walaplus" , a program designed to improve the financial well-being and happiness of



employees by providing them with special offers in various sectors [7]. If a user of our app is a member of any of these loyalty programs, we save them the effort of searching for offers at the places they want to visit. Our app will automatically check if there are any offers available through the user's loyalty program at the desired location. This feature aims to enhance the user experience by conveniently providing information about relevant offers based on their membership in these loyalty programs. the names of the bank cards will be saved in the application after registration.

Also, the application will help the users to know about the daily news about activities, events, and new openings of places to be updated about the latest popular places, After an extensive search for a reliable resource on events in Riyadh, the team has decided to use the WeBook website [8] as the primary source for gathering information about events happening in riyadh. This is a well-thought-out decision that will provide a solid foundation for the project since WeBook provides comprehensive event listings, allowing us to stay updated with the latest happenings in the city. For new openings of places such as restaurants and cafes, we rely on the official social media accounts of these establishments. By monitoring their accounts, we can gather information about new openings and include them in our application. By utilizing these sources, we aim to provide our users with up-to-date and accurate information about events and new openings in Riyadh, enhancing their experience and keeping them informed about the vibrant entertainment scene in the city.

The application also will provide a service to the users that allows them to add a place to their favorites and save it for future use if they like the place and want to visit it later. Finally, if the user has visited a place, he can add comments /reviews about his opinion and experience of that place. The application also includes enabling admins to add places and their details, edit them, and delete places or events. Making the process of expanding our database easier.

The Riyadh Guide Application will employ a supervised machine learning approach to analyze and classify user reviews, ultimately presenting a definitive classification and a percentage indicating the quality of a place. Our process involves designing and building a machine-learning model that will undergo testing with various algorithms such as support vector machines, Gradient boosting, and logistic regression. The selection of the most effective algorithm will be based on performance measures. Additionally, for analyzing



Arabic reviews, we will implement natural language processing (NLP) techniques. We will gather reviews about various places through web scraping from Google Maps. The process of Web scraping involves automatically extracting information from websites. It involves retrieving and parsing data directly from web pages and converting unstructured data into a structured form that will be stored in a CSV file and used to train the model.

Our preprocessing approach also involves rigorous Data Pre-processing on the collected data, which includes manual removal of advertisements and spam. Furthermore, we will filter out mentions, hashtags, emojis, numbers, and non-Arabic content, ensuring that the resulting dataset is refined and focused for effective sentiment analysis. It's essential to highlight that the data privacy and security of reviews will be paramount. To ensure the completeness and validity of the data, we will conduct preprocessing techniques such as Tokenization, Removing Punctuation, and Removing Stopwords.



دليل الرياض



1.3. Product

1.3.1. Product Vision

Product Vision:

For entertainment seekers

Who are looking for entertainment and exciting places to spend time

The Riyadh Guide

Is a mobile application

That gathers all the information about entertainment places in Riyadh

Unlike other entertainment Applications (foursquare)

Our product compares available offers and then displays the best offer from bank cards that you have and loyalty programs. The application performs the classification of reviews to either positive, negative, or neutral associated with the percentage of how the people like the place and displays it to save the user time.



1.3.2. Product Roadmap

Riyadh Guide Roadmap

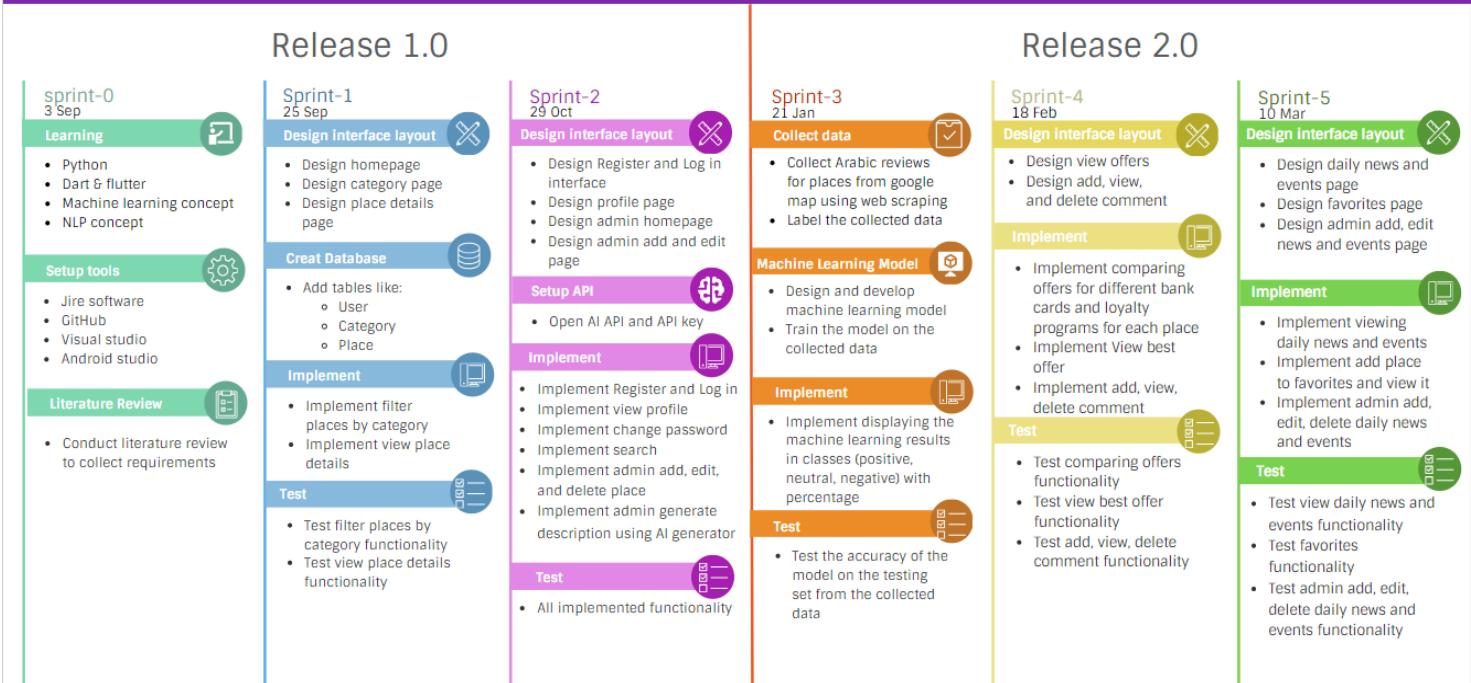


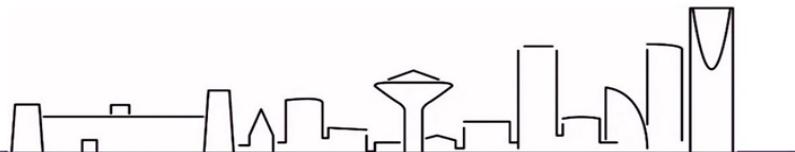
Figure 1: Product Roadmap

1.3.3. Objectives

- Product (customer focus-value):**

This project is built to provide all needed information about entertainment sectors in Riyadh to facilitate identification of the places and ease of exploring them before their visit. As there is no application that gathers all the information needed by the tourists and the ones who are interested in discovering new places, here we are building an application that provides all the information about the possible activities in Riyadh. Our focus is on the entertainment seekers in Riyadh. The application has the ability to analyze and guide them to suitable areas where they can enjoy. Moreover, it compares available offers and then displays the best offers from bank cards that you have and loyalty programs. The application includes the following features:

1. Log in and Log out for both users and admins.



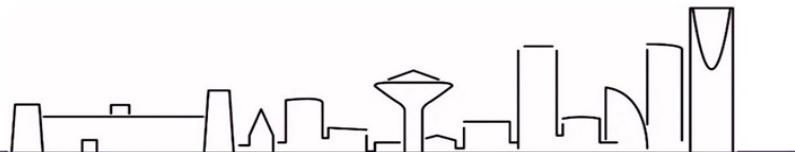
2. Register for users.
3. Allow users and admins to search for places to find specific places faster.
4. View the percentage of how people like the place.
5. View the classification of the place reviews as either positive, negative, or neutral.
6. Explore Daily News of events and new opening places in Riyadh.
7. Display the best offer by comparing Loyalty programs and bank card offers for each place.
8. View Place details such as photos, opening hours, and a description of the place.
9. Filter Places by categories such as restaurants, coffee shops, and places of attraction.
10. Allow users to add places they like to favorites for future use.
11. Allow users to add comments and view other user's comments.
12. Allow users to delete their comments
13. Allow users and admins to view their profile information
14. Allow users and admins to change their password.
15. Allow admin to add new places and events.
16. Allow the admin to edit a place or delete place or event information.

17-Generate a description of a place given a prompt from admin using chatGPT API when admin is adding a new place.

- **Project (solution focus-plan):**

For building this project we need to follow the next steps:

1. Understand user needs through interviews and questionnaires.
2. Define the problem.
3. Find a solution.
4. Define the Product Vision.
5. Define the Product Roadmap.
6. Describe the objectives.
7. Define the Scope of our product.



8. Collect data using web scraping from Google Maps.
9. Implement data validation and cleaning.
10. Implement data security and privacy techniques.
11. Train the AI model.
12. Track the progress.
13. Develop the application.
14. Test the application.
15. Register for App hosting.

- **Learning (student focus):**

Upon completion of this project, we anticipate gaining certain skills like

- Building software applications using an open-source framework Flutter[9].
- Learn a new programming language which is Dart.
- Gain more knowledge and practice in NLP sentiment analysis.
- Gain more knowledge on debugging the application.
- Learn how to use web scraping on google map to collect data.
- Learn how to use Firebase.
- Learn how to use google map API to display location.

1.3.4. Scope

Riyadh Guide is a mobile application that will be accessible through the IOS and Android platforms. The application will be in the Arabic language and will be developed using Dart programming language. Our application aims to explore Riyadh City in an efficient manner to help entertainment seekers and tourists find out about tourist attractions, restaurants, coffee shops, events, and activities. The application will contain several functions and methods:

- Search for a specific place.



- Display all the details about the place such as photos, work hours, and a brief description of the services they provide, website, and other information.
- Filter places by categories to facilitate the search process.
- Design and build a supervised machine learning model to help classify reviews about a specific place as either (positive, negative, or neutral) for each place.
- collect reviews about places in Arabic using web scraping on Google Maps.
- Train the model on collected data about the places in Arabic until we get more than 75% accuracy.
- Use Natural Language Processing (NLP) to analyze reviews for a specific place in Arabic to help in the classification process.
- Use the machine learning model to display the result of classification for each place.
- Use the machine learning model to display the percentage of how people like the place.
- Evaluate the model.
- Add a place to the favorites to save it.
- Compare the available offers for the users based on bank cards and loyalty programs they have then display the best offer for them for each place so that they can use that card when they decide to go.
- Know about daily news of events, activities, and new opening places.
- Add comments/reviews to a place
- Log in, log out, and register.
- Database using firebase that will hold our tables such as:
 - User
 - Place
 - Category
 - Review

And some functionalities that are available for the admins:

- Add new places
- Edit existing places



- Delete places
- Add news
- Edit news
- Delete news
- Search for places and news to edit or delete.
- Using an AI generator to write creative and well-sentaxed descriptions for the place.
- Add offers
- Edit existing offers
- Delete offers

However, our application will not include the following feature:

- reservation

1.3.5. Hardware/Software Tools and Cost

Hardware Tools	
Name and Description	Cost
Laptops with a good processor	Free
Software Tools	
Name and Description	Cost
Jira	Free
GitHub	Free
Google map scraper	Free
Android Studio	Free
Visual Studio	Free



Flutter	Free
Firebase	Free
Google map API	Free
Chat GPT API	19 SAR

Table 1: Hardware\Software Tools and Cost

1.4. Scrum Team

1.4.1. Skill Set Requirements

Technical Skill Required	What is the current level of the team
Python	<i>intermediate</i>
Machine Learning (ML) basic concepts	<i>beginner, self study the concept through the available resources</i>
programming Skills	<i>Advanced</i>
UX design	<i>Advanced</i>

Table 2: Skill Set Requirements

1.4.1.1. Learning

Riyadh Guide is a mobile application that will developed using flutter framework and Dart programming language, we first learned about flutter by taking course in satr(سطر) platform that we learned about basic concepts of dart language and flutter projects structure, we are learning an advance subjects by watching educational channel through youtube. We will learn about building a database using firebase and how to connect it to flutter projects through youtube channels.



1.4.2. Roles and responsibilities

Scrum Team	
Product Owner:	Dr. Lama Alsudais
Developers:	Raneem Alhabib Aljawhrah Bin Turayki Sarah Alshehri Dana Alotay
Scrum Master (SM):	Dr. Maha Alyahya
Stakeholders:	Graduation Project Committee Entertainment Seekers Tourists

Table 3: Roles and Responsibilities



2. Background

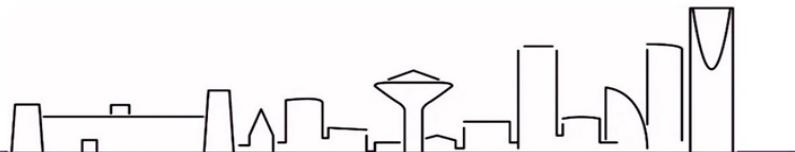
2.1 Overview

In the past people knew about entertainment places and restaurants by browsing newspapers and forums. There is no doubt that they struggled to search for more information about these places, such as location and work hours. Nowadays, social media has become the primary source for exploring cities and finding out about new places. The Riyadh Guide is a mobile application meant to help people explore Riyadh city in terms of tourism and entertainment places, international and local restaurants, cafes, and new opening places. The application offers a feature that allows users to measure other users' sentiments about places by presenting a percentage indicating the overall quality of the place and classifying reviews as either positive, negative, or neutral.

We will gather Arabic reviews about places through web scraping from Google Maps, then we will build a supervised machine learning model and train it by NLP on the collected data until we obtain 75% accuracy. We will use the supervised machine learning model to obtain the final classification of the place quality (Positive, Negative, Neutral) and a percentage of how people like the place to decide whether it is worth visiting or not. The application also offers a competitive feature, which informs the user about the best offer according to the bank cards and loyalty programs he/she has for each place. The admin side of our application will be responsible for managing and providing the system the information through their admin side functionalities specified in section 1.3.3.

2.2 Supervised Machine Learning

Supervised machine learning is a subcategory of machine learning and artificial intelligence. It is defined by its use of labeled datasets to train algorithms to classify data or predict outcomes accurately[10]. In supervised learning, the training data provided to the machines work as a supervisor that teaches the machines to predict or classify output accurately. It applies the same concept as students learn under the supervision of the teacher. In supervised learning, models are trained using labeled datasets where the model learns



about each type of data. Once learning is completed we will test the model by using test data which is a subset of train data then it predicts the output. steps involved in supervised learning:

- First determine the type of training dataset.
- Collect and labeled training data.
- Split the training dataset into a training dataset, test dataset, and validation dataset.
- Determine the input features and characteristics of the training dataset in which the model should have enough knowledge so that the model can predict output accurately
- Determine the suitable algorithm for the model such as support vector machine, or naive Bayes.
- Execute algorithm in the training dataset
- Evaluate the accuracy of the model by providing the test set[11].

Supervised learning models can be used to build and advance a number of business applications, including the following:

- Image and object recognition: supervised learning algorithms can be used to locate, isolate, and categorize objects out of videos or images, making them useful when applied to various computer vision techniques and imagery analysis.
- Predictive analytics: a widespread use case for supervised learning models is in creating predictive analytics systems to provide deep insights into various business data points. This allows enterprises to anticipate certain results based on a given output variable, helping business leaders justify decisions or pivot for the benefit of the organization.
- Customer sentiment analysis: using supervised machine learning algorithms, organizations can extract and classify important pieces of information from large volumes of data—including context, emotion, and intent—with very little human intervention. This can be incredibly useful when gaining a better understanding of customer interactions and can be used to improve brand engagement efforts.

There supervised learning can be separated into two types of problems that will be described in the section below:



2.2.2 Classification

Classification is a supervised machine learning algorithm used when the output variable is categorical, which means there are two classes such as yes-no, male-female, and true-false. In the classification algorithm, the model tries to predict the correct label of a given input data. In addition, the model is fully trained using the training data, and then it is evaluated on test data before being used to perform prediction on new unseen data[12]. Since in our application, we will be using a categorical classification, we will be focusing on the types of the classification algorithms and we will determine which one to use based on performance measures.

- Support Vector Machine Algorithm

Support Vector Machine (SVM) is one of the most popular supervised learning algorithms that sorts data into two categories. It is trained with a series of data already classified into two categories, building the model as it is initially trained. The task of an SVM algorithm is to determine which category a new data point belongs in. This makes SVM a kind of non-binary linear classifier. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. Consider the below diagram in which there are two different categories that are classified using a decision boundary or hyperplane[13].

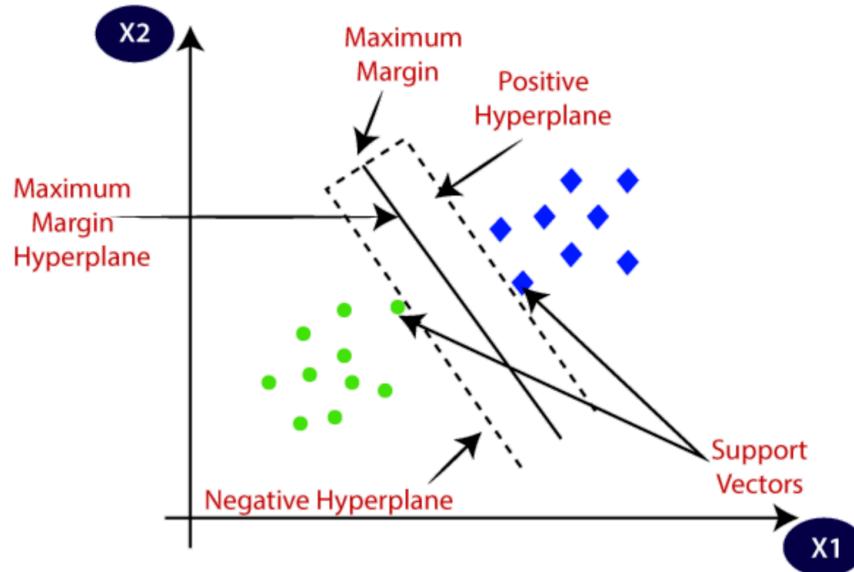


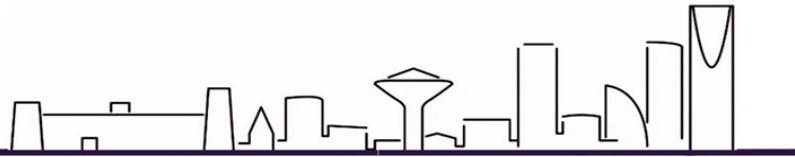
Figure 2: SVM [13]

- Logistic Regression

Logistic regression is another powerful supervised machine learning algorithm used for binary classification problems (when the target is categorical). This type of statistical model (also known as the logit model) is often used for classification and predictive analytics. Logistic regression estimates the probability of an event occurring, such as voting or not voting, based on a given dataset of independent variables. Since the outcome is a probability, the dependent variable is bounded between 0 and 1. Logistic regression has become an important tool in the discipline of ML, it allows algorithms used in machine learning applications to classify incoming data based on historical data. As additional relevant data comes in, the algorithms get better at predicting classifications within data sets[14].

2.3 Natural Language Processing

Natural language processing (NLP) refers to the branch of computer science and more specifically, the branch of artificial intelligence concerned with giving computers the ability



to understand text and spoken words in much the same way human beings can[15]. NLP models work by finding relationships between the constituent parts of language, for example, the letters, words, and sentences found in a text dataset. NLP architectures use various methods for data preprocessing, feature extraction, and modeling. NLP is used for a wide variety of language-related tasks, including answering questions, classifying text in a variety of ways, and conversing with users. Here are some tasks that can be solved by NLP:

2.3.1 Sentiment Analysis

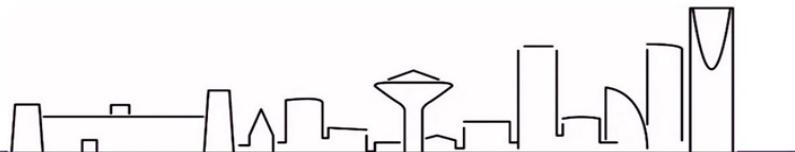
Sentiment analysis is the process of classifying the emotional intent of text. Generally, the input to a sentiment classification model is a piece of text, and the output is the probability that the sentiment expressed is positive, negative, or neutral. Typically, this probability is based on either hand-generated features, word n-grams, TF-IDF features (term frequency-inverse document frequency) is a statistical measure that evaluates how relevant a word is to a document in a collection of documents, or using bag of words model. Sentiment analysis is used to classify customer reviews on various online platforms like in our application Riyadh guide we will use Sentiment analysis to classify people's reviews on the quality of places, another use case is for niche applications like identifying signs of mental illness in online comments.

- Bag Of Words

We have used bag-of-words to represent the words before feeding them in the machine-learning model. A bag of words is a simple way to convert words into numbers that the model can understand and learn from. The bag of words model considers the whole document as a “bag” of words, rather than a sequence. We represent the document simply by the frequency of each word [16].

2.4 ChatGPT API

OpenAI's Chat GPT API is a revolutionary tool for building conversational AI. It uses natural language processing (NLP) to understand and generate human-like responses, making it perfect for building chatbots, virtual assistants, and other conversational applications. Chat GPT API is a product of Open AI, a company specializing in AI research and development. It



is a cloud-based API that provides access to Open AI's advanced language models, including GPT-3 and GPT-4. It allows developers to integrate natural language processing (NLP) capabilities into their applications [17].

In our application, we will use an AI Text generator using the gpt-3.5-turbo model on the admin side to facilitate adding place functionality, especially in writing the description of that place and the services that they provide. Since ChatGPT uses NLP it suits our need in writing a description in Arabic, giving more than one suggestion, also we can benefit from it in correcting grammar and choosing appropriate vocabulary, this provides the admin with a great capability to add places efficiently without wasting time during thinking of the perfect place description. ChatGPT uses the user input known as a prompt and then replays with the response, the prompt consists of keywords and phrases meant to spark a reply. You feed ChatGPT a question or instruction and it will respond as though in a conversation. As much as the prompt is clear and specific the response will match your expectations.

2.5 Google Map API

The Google Maps Platform offers a suite of APIs, including the Places API, that empowers developers to retrieve location data and resources for places of interest. This API facilitates the search for various locations, including establishments, prominent landmarks, and even geographical points. Developers can retrieve results that include formatted location data and imagery. Furthermore, the Places API allows you to delve deeper by providing details like a place's complete address, contact information, user ratings, and reviews – all through a unique place identifier.

2.6 Grid Search

In machine learning, grid search is an organized approach to hyperparameter optimization that finds the ideal set of parameters for a particular model. It involves creating a grid of potential hyperparameter values and using cross-validation to fully evaluate the



model's performance for every possible combination. Grid search ensures that the best set of hyperparameters is chosen to improve the predictive accuracy of the model by examining the whole parameter space. Grid search is a powerful tool for enhancing model performance even though it requires a lot of processing power, particularly for complicated models and big datasets.



3. Literature Review

3.1. Overview

In this chapter, we will illustrate and compare similar systems by conducting a literature review on related systems. Our objective is to refine our project requirements.

3.2. Competitive Product Analysis

3.2.1. International Cities Guide Applications



Foursquare

Foursquare is a city guide mobile application. The app provides information about places including restaurants, coffee shops, shops, and other places to visit. Foursquare is also used as a location-based social networking application. Users can check in to the location they visit, which shares their location with followers. In addition, Foursquare provides personalized recommendations for places to visit based on past check-ins. Users can rate and review places and view other user's reviews. Also, users can create a list of places. However, Foursquare has a varied user experience based on location. In some locations, it may have a poor database of reviews and recommendations[18].

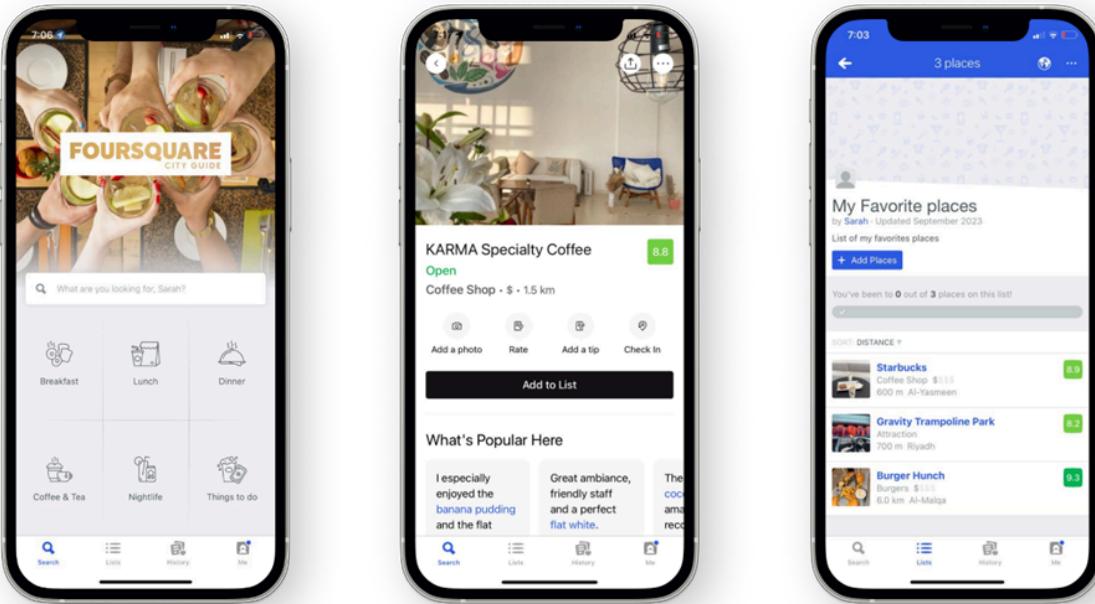


Figure 3: Foursquare interface



Tripadvisor

Tripadvisor is a well-known application that provides information, reviews, and things to do for travelers. TripAdvisor was created in 2000 by Stephan Kaufer and Langely Steinert. The application offers a wider range of features than Foursquare application for travelers. Users can discover hotels, restaurants, and landmarks and review them. Users can book hotels by redirecting the user to booking.com website. In addition, The app provides an interactive discussion area called a forum for members to ask and share their experiences as travelers. Tripadvisor provides personalized recommendations based on interests and travel history. a disadvantage is that the application revenue is through ads, which leads to commercialized or biased recommendations[19].

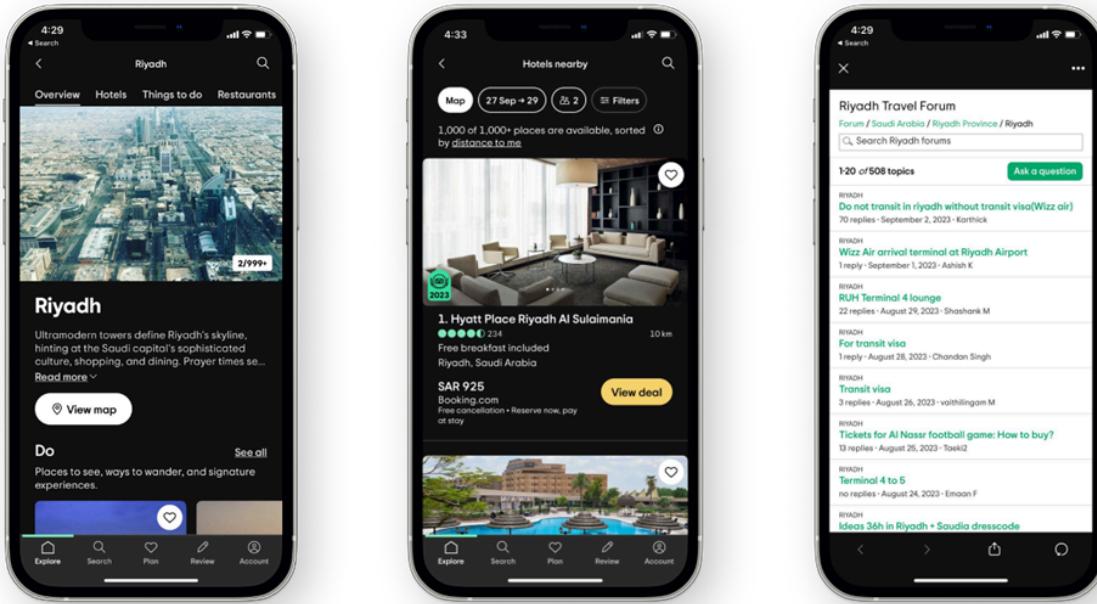


Figure 4: TripAdvisor interface

3.2.2. Middle East Cities Guide Applications



Sawah

Sawah is an application that started in Saudi Arabia in 2016. The application is a city guide application that covers some cities in the Middle East and a few worldwide cities. Sawah provides a list of places and things to do, including restaurants, cafes, shopping centers, and entertainment places. However, The application does not provide the upcoming events in the cities. In addition, Users can view the place details, photos, and rate and review. The application also recommends similar places and allows users to add places to their favorites list. Also, The application allows users to filter places by categories and sort places. Users can have their own profiles and follow other users[20].



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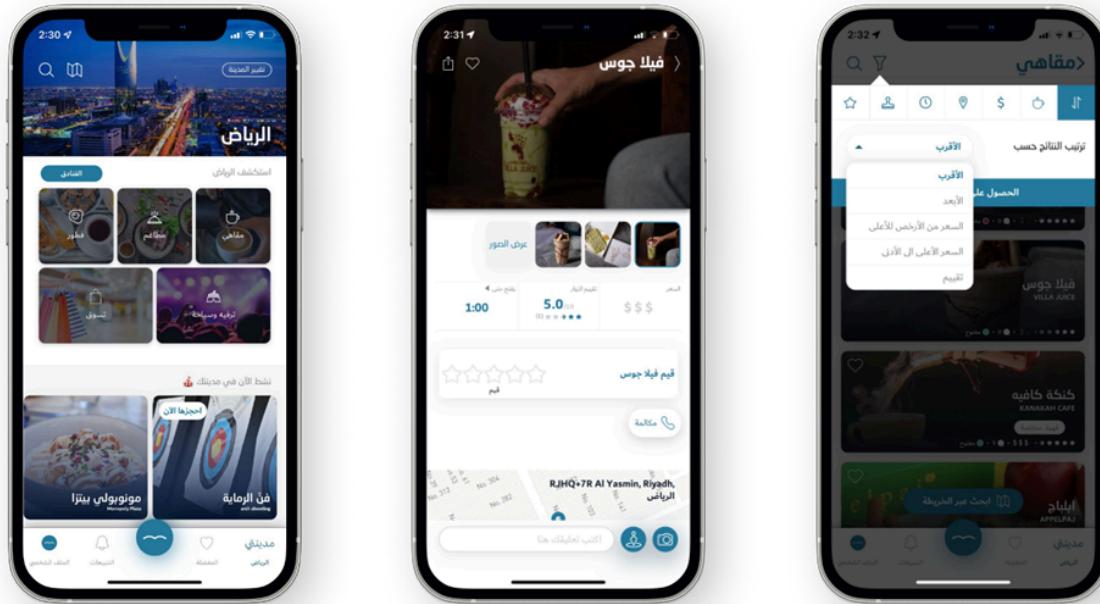


Figure 5: Sawah Interface



Saudi Events

Saudi Events is an application for events in the main cities of Saudi Arabia. The app was published by the National Events Center in Saudi Arabia. The application's main focus is events, theater, and shows. Users can discover events and book them directly in the app. In addition, users can view the event details and share them with friends. Also, the user can view his tickets in their profile after booking[21].

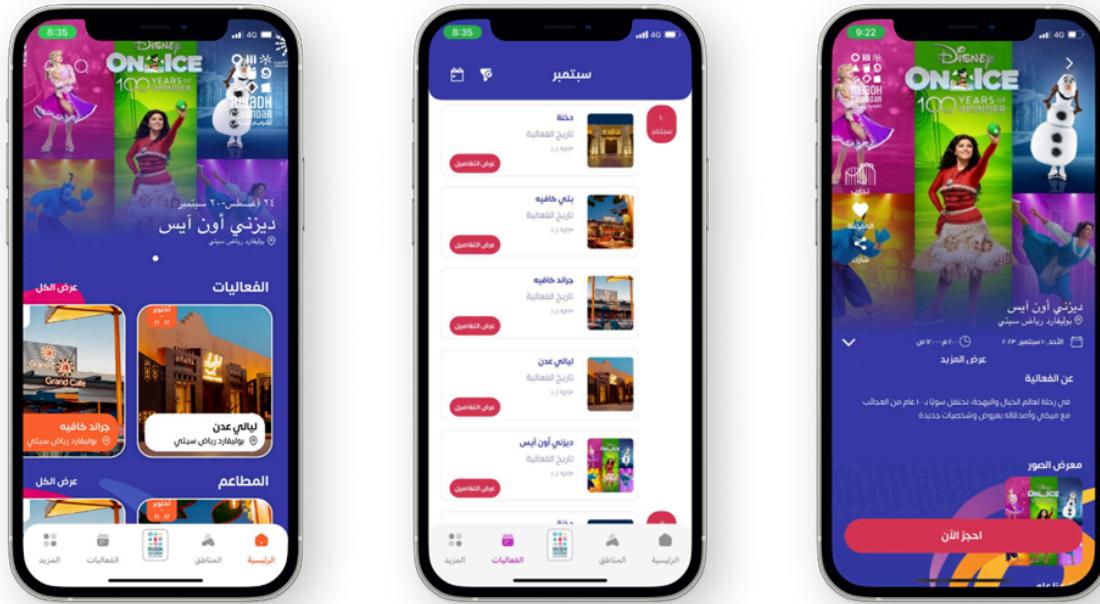


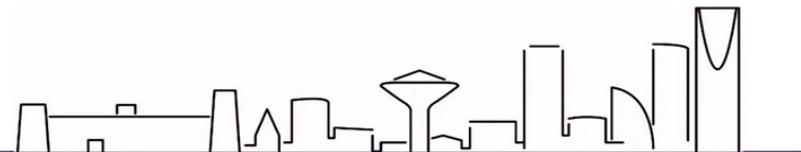
Figure 6: Saudi Events Interface

3.2.3. Comparison between similar applications

Features	Foursquare	Tripadvisor	Sawah	Saudi Events	Riyadh Guide
View place details such as opening hours and location.					
Filter places by categories.					



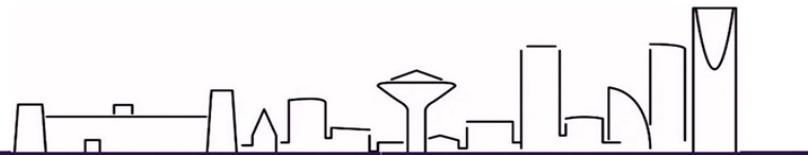
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Features	Foursquare	Tripadvisor	Sawah	Saudi Events	Riyadh Guide
Review and Rate places and read reviews from other users	✓	✓	✓		✓
View the best discounts for bank cards and loyalty programs.					✓
Inform the user about events and occasions happening in the city.				✓	✓
Book and make reservations through the app.		✓		✓	
Connect with people with the same interests. Including following users with the same interest,	✓	✓	✓		



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checking-in, and communities.					
Create lists or favorites to save places for future use.	✓	✓	✓		✓
View the overall satisfaction of other users' reviews.					✓
Sort places by price, location, and rating	✓	✓	✓	✓	

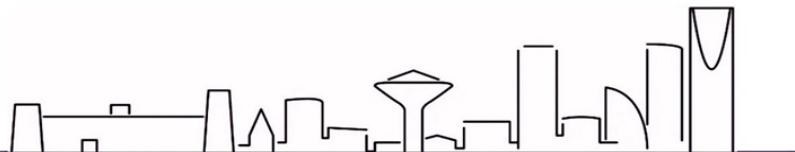
Table 4: Comparing similar applications

3.3. Conclusion

In conclusion, after conducting a literature review of four similar systems, including Foursquare, Tripadvisor, Sawah, and Saudi Events, we gained a good insight for our project. Each system offers unique features, serving various aspects of city guidance and travel. Foursquare stands out for combining both city guidance and social networking. Tripadvisers is a better choice for travelers but relies on advertising, potentially causing biased recommendations. Sawah focused on the Middle East and provided good city guidance. Saudi Events application is a more specialized platform for event discovery and booking in Saudi



Arabia and doesn't provide as many functionalities. By comparing these systems, we have identified opportunities for improvements and innovation. We gained more understanding of the strengths and weaknesses of existing similar systems. Our objective is to take advantage of these insights to develop a system that addresses gaps and delivers a unique value by refining our project requirements, ensuring it meets the needs of our target audience.



4. System Design and Development

4.1. Methodology

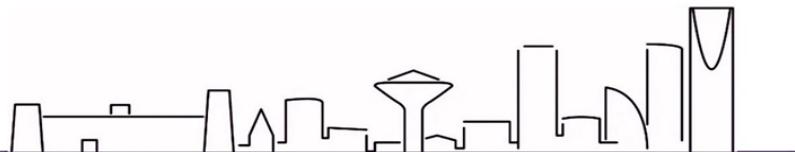
This project was developed using the agile methodology. The Agile methodology is a project management approach that involves breaking the project into phases and emphasizes continuous collaboration and improvement. Teams follow a cycle of planning, executing, and evaluating [22].

Scrum is a framework of agile that outlines a set of values, principles, and practices that scrum teams follow to deliver a product or service. It is based on 11 components ($3 \times 5 \times 3$) structure which are 3 roles, 5 events, and 3 artifacts.

Firstly, the three roles in our project are: the scrum master (Dr. Maha Alyahya), the product owner (Dr. Lama Alsudias), and the Development team (Raneem Alhabib, Aljawharah Bin Turayki, Sarah Alshehri, and Dana Alotay). The Scrum Master is in charge of ensuring that the team is following the proper Scrum structure. The Product Owner is responsible for upkeep of the product backlog and is in charge of prioritizing the Product Backlog items according to their value in addition to coordinating the development team and communicating with stakeholders. The main concern of the Development team is working on their Sprint Backlog and ensuring that they are done in most efficient ways.

As for the events, there is the sprint where it is the time that the Scrum Team creates work and provides value to the business. Each sprint has a different time frame and value for the project. Next the Sprint planning includes planning for the next sprint by both the development team and product owner to decide what to focus on, and design a plan on how to get their job done efficiently. The Scrum event is a 15-minute approximate daily meeting of the development team to discuss the progress so far, and how the next 24 hours is going to be spent. The Sprint Review event showcases the work that has been done within the Sprint to the stakeholders. And lastly Sprint Retrospective is where the Scrum Teams get together to talk about how a Spring went and discuss ways to improve the next Sprint.

Lastly, the three artifacts are: The Product Backlog which contains the vision of the Product Owner for the product. The sprint backlog which consists of tasks that the



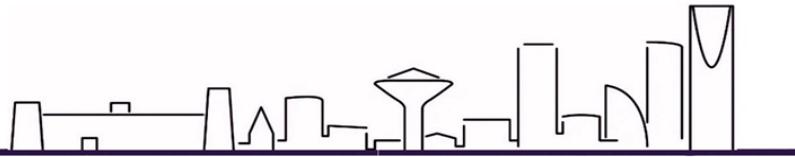
Development Team thinks can be done in the current Sprint. And the product increment which is considered the end goal of each sprint [23].

In our project, we practiced as a team the agile principles by achieving sprint planning on each sprint and held up daily meetings between the development team to discuss our progress and plan the next 24 hours. We also held weekly meetings with the product owner so that she can monitor the progress of the project and if it meets the product backlog and get feedback. We used the Scrum framework that was monitored by the scrum master as a guide to ensure that we are meeting the project requirements.

Two important tools helped us achieving this project: Jira¹ which is an agile project management tool used by teams to plan and track the project. Jira helped us to organize and manage the sprint by showing what user stories are being worked on and what is left to be done in the sprint, with providing a report for our progress and the timeline of each sprint which helped us keep on track. And GitHub² which is used for storing, tracking, and collaborating on software projects. It makes it easy for developers to share code files and collaborate with fellow developers on open-source projects. GitHub was a helpful tool in our project by providing a centralized storing location to store and share codes that made it easy to integrate the work between the team members without any conflicts, easily access the other members work, and efficiently manage the code.

¹ Jira :<https://2023-1st-gp9.atlassian.net/jira/software/projects/GP/boards/2>

² GitHub: <https://github.com/DanaAlotay/2023-GP1-9>



4.2. System Requirements

4.2.1. System Users

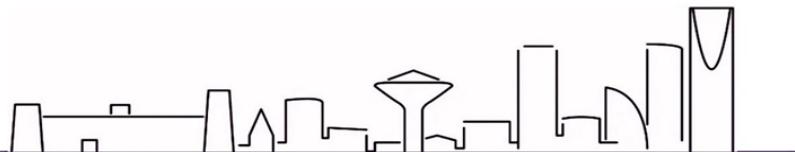
Our application is aimed to be used by entertainment seekers who are looking for places in Riyadh to explore, visit, and spend some time in. There are no restrictions on the user's educational level or age. But to navigate through the application's interface and use all the functions provided, users must know how to read Arabic. The application is intended to be easy to use for all types of users, but users must have basic technical expertise on how to download and use mobile applications and be familiar with IOS or Android devices. No other technical expertise or previous experience is needed. In addition, the application will have admin user who will be responsible for managing the add, edit, delete functionalities, and other administrative roles. The admin must be an adult who has basic technical expertise, like being familiar with mobile applications to be able to control the admin's functionalities. No other experience is needed.

4.2.2. Requirements Elicitation and Analysis

Our source of information in requirement elicitation was potential users who are considered stakeholders. We used two methods, interviews and questionnaires to collect requirements for developing the application to meet the users needs.

- **Interview**

We interviewed 3 people who have an interest in visiting places in Riyadh and who we believe are the best representative of all users. We started by giving a brief introduction about Riyadh guide application then asked them four open-ended questions. Based on the answers we collected and observed from these interviews, we summarized the results and findings to help us to define the requirements.



To begin with, all interviewees liked to visit different types of places in Riyadh. Therefore, Riyadh guide application must have different types of places to satisfy different types of users. Most of the interviewees said that they searched for information about places on social media, but some had difficulties finding the place they searched for, and they would like to have an application where they can find new places in. In addition, all interviewees agreed that reading short reviews represented in short informative words or percentage, is the easiest and simplest way to view reviews about a place.

Finally, we noticed that different people want to know different information and details about the place depending on their needs. So, we need to consider having all possible details about places that could benefit the user.

More details about the questions and answers are provided in appendix A section of this document.

● Questionnaire

We have conducted a questionnaire using Google forms with 11 close-ended questions and got 73 responses from various people. Based on the responses we have collected; we summarized the results and findings to help us define more requirements.

According to the results of the questionnaire, we found that 84.9% of the participants were females and almost all ages were interested in our application. All ages above 18 had almost the same percentage and only 8.2% were under 18, and that will help us to have more places that are suitable for these ages and gender in our application. 90.4% of people who responded to the questionnaire have tried an application to find information about places before visiting it. And from those who have tried, the majority of people which are 36.4% rated the quality and recency of information related to Riyadh places 3 (neutral), which shows that they need more detailed and recent information about places in Riyadh. 87.7% of the participants showed interest and liked the idea of seeing information about Riyadh events and places in Arabic. We found out that 42.5% of the participants don't find it easy to know what bank card or loyalty program gives them the best offer for a place and 20.5% were not sure and answered "maybe" for that question. 76.7% of the participants supported the idea of seeing the daily events in Riyadh.



and what is the news about places in our application and only 11% were not interested in that idea. Also, the response showed that 82.2% would like to save a place they like in their account so that they can find it later, 12.3% were not sure if they would like it and 5.5% were not interested in that idea. Majority of the participants agreed that the best and easiest way to view reviews about a place is by showing percentage about how much people like the place (56.2%) or showing one word representing how good the reviews are (ex. Positive, negative, neutral) and some of them liked both ideas.

To know which bank card and loyalty programs offers we should add to our application, we have asked the participants what bank card do they use and what loyalty program are they in. The response showed that the most used bank cards are: Alrajhi bank card (57.5%), Alahli (SNB) bank card (30.1%), Alinma bank card (12.3%), Alawwal(SAB) bank card(6.8%). From those who are in a loyalty program, the participants were in Wala plus and/or Nafae (نافع) only.

More details about the questions, answers, and percentages graphs are provided in appendix B section of this document.



4.2.3. User Interactions

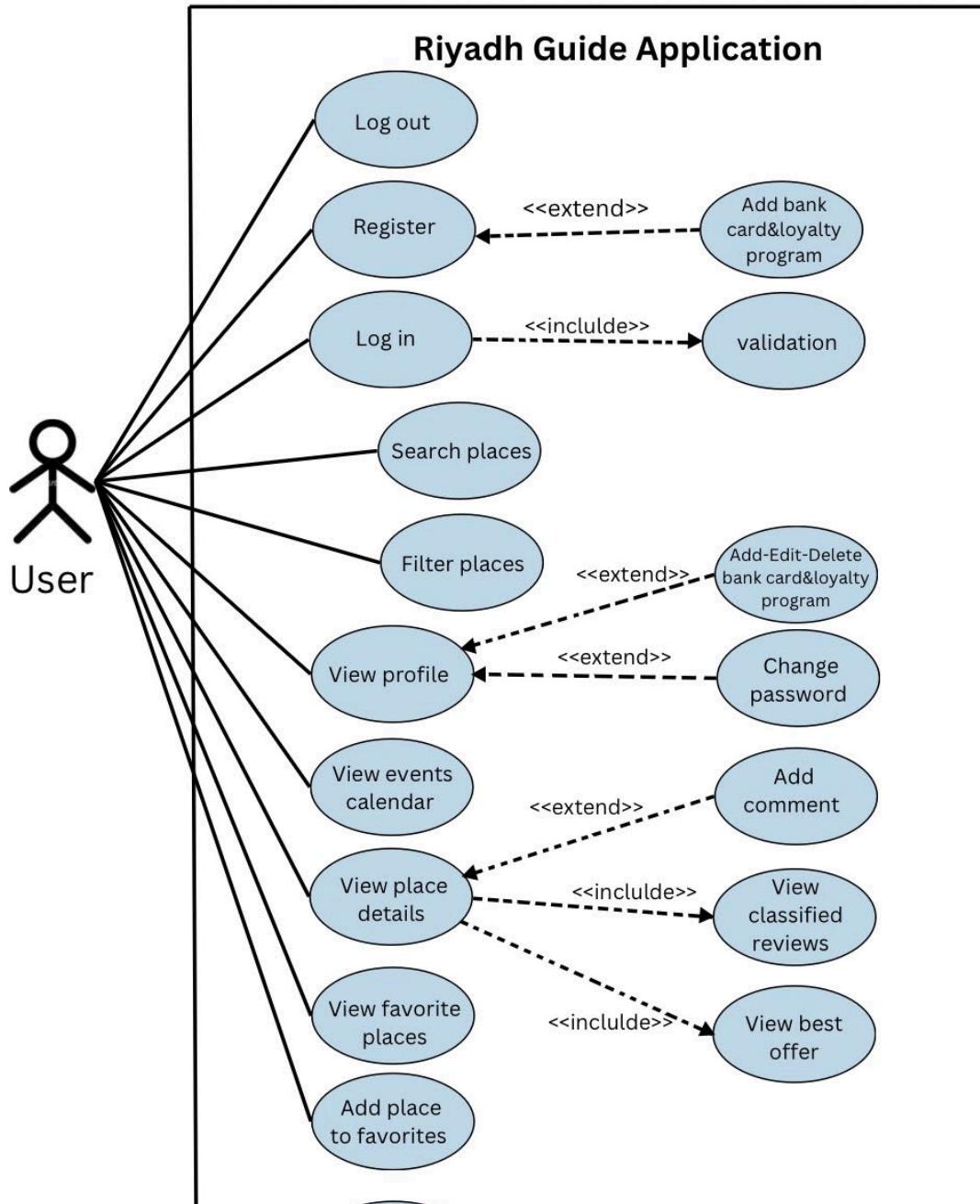


Figure 7: Use case diagram

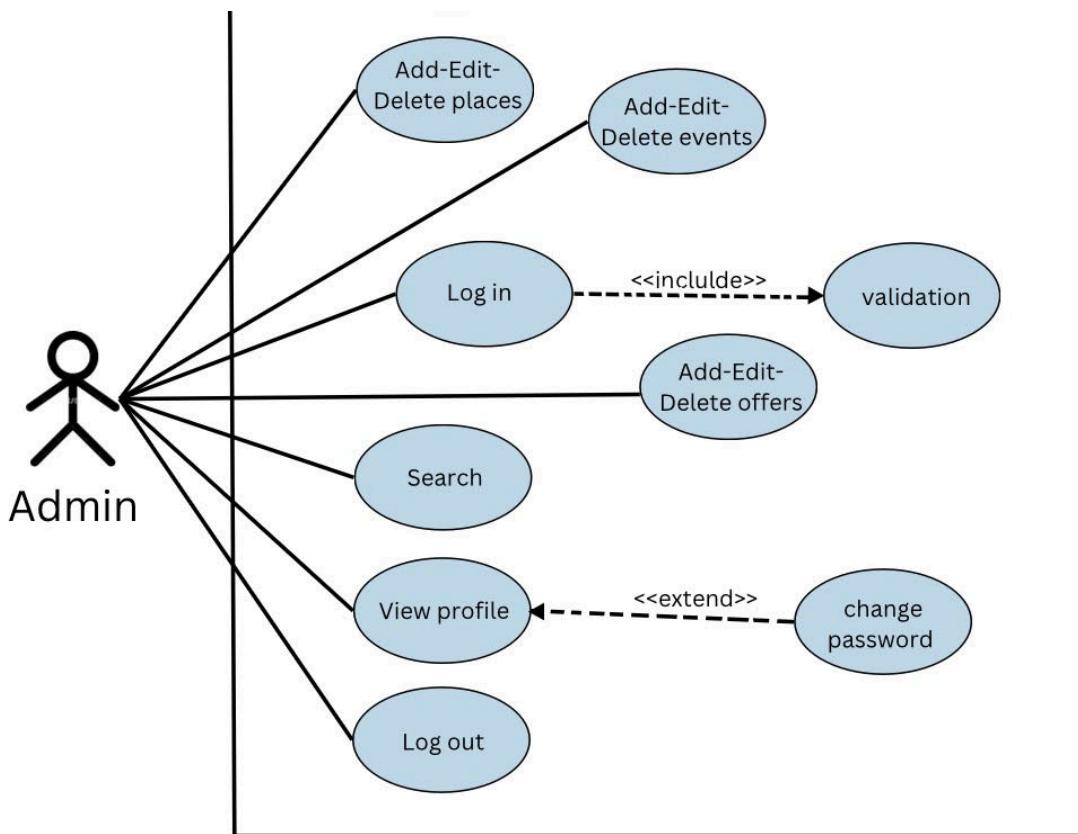
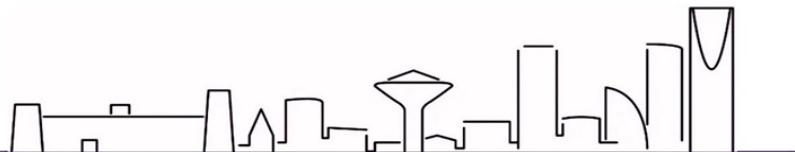


Figure 8: (continue)-Use case diagram

4.2.4. Roadmap and Product Backlog

4.2.4.1. Overview

We will recognize the definition of ready which is used to determine whether the feature is ready to be started. Also, we will create the product backlog table, where used to guide the development team in planning and executing the work. The product backlog is a list of product backlog items (PBI) written as user stories that include functional and non-functional requirements that describe who's the user, what they want, and why, for each PBI there is also the size of the story measured by points, type of the story, the status weather done, in progress or to do and the acceptance criteria which are set of conditions that software product must satisfy to be completed and accepted.



Definition of Ready

<input type="checkbox"/>	User story is well-defined.
<input type="checkbox"/>	Estimated and small enough to be implemented within one sprint.
<input type="checkbox"/>	Clear and understandable by all the team members.
<input type="checkbox"/>	Not contain any external dependency.
<input type="checkbox"/>	Clear acceptance criteria and testable upon completion.

Table 5: Definition of ready

4.2.4.2. Product Backlog Table

ID	PBIs (User Stories)	Size	Type	Status	Acceptance Criteria
1	As an entertainment seeker, I want to be able to filter places by categories, so that I can discover places matching my expectations.	2	Feature	Done	<ul style="list-style-type: none"> - As an entertainment seeker, If I like to do a specific activity, then I have to choose the category which provides the service. - As an entertainment seeker, If I choose a specific category, then the



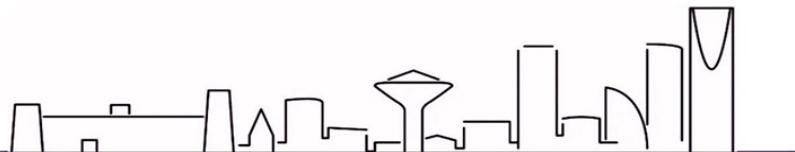
					list will be filtered to display only matching places.
2	As an entertainment seeker, I want to be able to view place details, so that I can get insight about the place.	2	Feature	Done	- As an entertainment seeker, If I click on the place I prefer to visit, then the place details will be displayed.
3	As an admin, I want to be able to add new places, so that entertainment seekers have an expanded range of place options.	3	Feature	Done	- As an admin, if the aim is to offer entertainment seekers a wider selection, then I will add new places to achieve an expanded range of options.
4	As an admin, I want to be able to edit existing places in the application, so that I can make necessary updates and improvements to enhance user experience.	3	Feature	Done	- As an admin, if there are modifications to the information of an existing place, then I have to edit the necessary details



					ensuring reliability and accuracy within the application.
5	As an admin, I want to use AI text generation when adding places, so that I can streamline and enhance the process of writing descriptions for each place.	3	Feature	Done	- As an admin, if I aim to improve the efficiency and quality of writing descriptions for each place, then I seek to use AI text generation when adding places.
6	As an admin, I want to be able to delete an existing place so that the application remains responsive to evolving user needs and preferences.	2	Feature	Done	- As an admin, if a place no longer exists, then I have the authority to delete it from the application.
7	As an entertainment seeker, I want to be able to log in by entering my username and password, so that I	2	Feature	Done	- As an entertainment seeker, if I want to get access to my profile, then I



	get access to my profile.				should enter a valid username and password. - As an entertainment seeker, If I enter invalid username or password, then an error message will be displayed to explain the reason for the error. - As an entertainment seeker, If I click "Log in" button without filling all needed information, then an error message will be displayed to explain that there is a missing field.
8	As an admin, I want to be able to login with my	2	Feature	Done	- As an admin, If I go to the log in



	email and password so that I will be able to perform my functions.				page and enter a valid registered email and a valid password and click on ‘Log in’ button, then the system will navigate to the admin home page.
9	As an entertainment seeker, I want to be able to enter the Riyadh guide application as a guest, so that allows me to decide later whether to create an account for a more personalized experience.	2	Feature	Done	- As an entertainment seeker, if I want to explore the functions offered by the Riyadh guide application without creating an account, then I have the option to enter as a guest.
10	As an entertainment seeker, I want to be able to enter the Riyadh guide application using my Google account, so that I can simplify the login process using a secure authentication method without the need to create	2	Feature	Done	- As an entertainment seeker, if I seek a simplified login process for the Riyadh guide application, then I can use my Google account.



	a separate account within the application.				
11	As an entertainment seeker, I want to be able to log out from my profile, so that I prevent others from accessing my account.	1	Feature	Done	<ul style="list-style-type: none">- As an entertainment seeker, if I want to end the login session, then I have to click the "Log out" button..- As an entertainment seeker, if I click the "Log out" button, then a confirmation message will be displayed to indicate the success of logging out.
12	As an admin, I want to be able to log out so that I can protect my account from unauthorized users.	1	Feature	Done	<ul style="list-style-type: none">- As an admin, if I click on the "Logout" button, then the system will navigate to the welcome page.
13	As an entertainment seeker, I want to be able	3	Feature	Done	<ul style="list-style-type: none">- As an entertainment seeker, if I want



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	to register, so that I can create my account.				<p>to explore new places in Riyadh, then I have registered with the Riyadh guide application.</p> <ul style="list-style-type: none">- As an entertainment seeker, if I want to create an account in the Riyadh guide application, then I must fill all the fields of the form correctly.
14	As an entertainment seeker, I want to be able to view my profile, so that I can easily see my account details.	2	Feature	Done	<ul style="list-style-type: none">- As an entertainment seeker, if I want to view my information, then I have the ability to view it in my profile.
15	As an admin, I want to be able to view my profile, so that I can see my information.	2	Feature	Done	<ul style="list-style-type: none">- As an admin, if I need to check my information, then I can do it by viewing my profile.



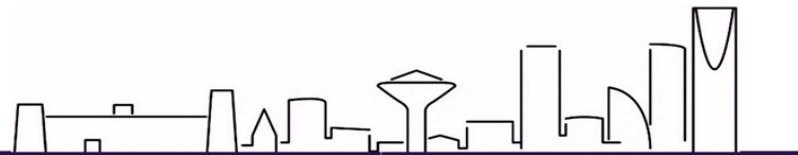
16	As an admin, I want to be able to view the dashboard, so that I can effectively monitor the application.	2	Feature	Done	- As an admin, if I want to effectively monitor the application, then I can view the dashboard in my homepage.
17	As an entertainment seeker, I want to be able to change my password, so that I can enhance the security of my account.	2	Feature	Done	- As an entertainment seeker, If I have to enhance the security of my account, then I can change my password with a valid password.
18	As an admin, I want to be able to change my password so that I can protect the application information from unauthorized access.	2	Feature	Done	- As an admin, if I need to protect the application information from unauthorized access, then I can change my password regularly.
19	As an entertainment seeker, I want to be able to reset my password so that I can regain access to my account.	1	Feature	Done	- As an entertainment seeker, if I forgot my password, then I have the



					option to reset it by sending a reset link to my email.
20	As an admin, I want to be able to reset my password so that I can promptly regain access to the system in case of a forgotten password.	1	Feature	Done	<ul style="list-style-type: none"> - As an admin, if I forget my password, then I have the option to reset it by sending a reset link to my email.
21	As an entertainment seeker, I want to be able to use search, so that I can find a specific place faster.	3	Feature	Done	<ul style="list-style-type: none"> - As an entertainment seeker, if I want to look for a specific place faster and easily, then I have to enter the place name in the search bar. - As an entertainment seeker, if I enter the place name that is not found, then a message will display to inform me that the place is not available.



22	As an entertainment seeker, I want to be able to view the sentimental analysis result of the place reviews, so that I can know if it is a recommended place or not.	13	Feature	Done	<ul style="list-style-type: none"> - As an entertainment seeker, If I want to visit a recommended place, then I can find the sentimental analysis of the classification result of reviews as either (positive, negative, natural) associated with each place. - As an entertainment seeker, If I want to visit a recommended place, then I can find the sentimental analysis of the percentage of how much people love
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					this place.
23	As an entertainment seeker, I want to be able to find the comparison of bank cards and loyalty program discounts, so that I can use the bank card or loyalty program that gives me the best offer for each place.	8	Feature	Done	<ul style="list-style-type: none">- As an entertainment seeker, If I choose a place to visit, then I will find which bank card will give the best discount based on my cards added to my profile.- As an entertainment seeker, If I want to know the discount provided for each place, then I have to be logged in to my profile and add the cards I used.
24	As an entertainment seeker, I want to be able to delete my expired cards so that I can discover better offers and recommendations for the places.	2	Feature	Done	<ul style="list-style-type: none">- As an entertainment seeker, if I change my bank cards or loyalty program, then I have the option



					to delete the cards that are no longer in use from my account.
25	As an entertainment seeker, I want to add new cards to leverage the benefits of more accurate and tailored recommendations.	2	Feature	Done	<ul style="list-style-type: none">- As an entertainment seeker, if I obtain new bank cards, then I can add them to my profile.
26	As an entertainment seeker, I want to be able to add comments, so that I can share my experience.	3	Feature	Done	<ul style="list-style-type: none">- As an entertainment seeker, If I want to share my experience with a specific place, then I have to find the “add comments” to write in.- As an entertainment seeker, If I visit a place and I want to share my opinion about it, then I have to be logged in to my profile and add it



					in “add comments”.
27	As an entertainment seeker, I want to be able to delete my comments, so that I can remove them if I think they are unnecessary.	2	Feature	Done	- As an entertainment seeker, If I regret what I said in the comments, then I can delete it from the comments list.
28	As an entertainment seeker, I want to be able to view my and other users' comments so that I can gather insights and make informed decisions about the place.	2	Feature	Done	- As an entertainment seeker, if I care to gather insights and make informed decisions about a place, then I want to view other user comments that appear in place details.
29	As an entertainment seeker, I want to be able to view the calendar of events or news in Riyadh, so that I can decide which events to visit.	3	Feature	Done	- As an entertainment seeker, If I want to be hanging out in Riyadh without having any decision, then I can take a look at the



					calendar of events or news that appear on the homepage or daily news page.
30	As an admin, I want to be able to add new events or news to the calendar, so that entertainment seekers can stay informed about daily events in Riyadh.	3	Feature	Done	- As an admin, if new events happen in Riyadh, then I can upload them to the calendar.
31	As an admin, I want to be able to edit the events or news that appear in the calendar, so that entertainment seekers can receive accurate and up-to-date information.	3	Feature	Done	- As an admin, if modifications arise in the events or news, then I can edit the events or news details accordingly.
32	As an admin, I want to be able to delete the events or news from the calendar, so that the application only displays the right ones.	2	Feature	Done	- As an admin, if the events or news are canceled, then I can delete them from the calendar.
33	As an entertainment seeker, I want to be able to save places that	2	Feature	Done	- As an entertainment seeker, If I want



	I like, so that I can visit them in the future.				to add places I like to visit in the future, then I can save it in my favorite page.
34	As an entertainment seeker, I want to be able to filter the calendar, so that I can access the news or events related to that classification.	2	Feature	Done	<ul style="list-style-type: none"> - As an entertainment seeker, if I want to view a specific category of events, then I can filter the events or news that appears in the calendar according to that category.
35	As an admin, I want to be able to add new offers, so that entertainment seekers will be informed about the offers available to them.	3	Feature	Done	<ul style="list-style-type: none"> - As an admin, if the banks or loyalty programs start new offers, then I can add them to the related place.
36	As an admin, I want to be able to edit offers so that I can update information or correct any mistakes.	2	Feature	Done	<ul style="list-style-type: none"> - As an admin, if banks or loyalty programs make changes to their existing offers, then I can modify any relevant



					information.
37	As an admin, I want to be able to delete existing offers, so that I can remove outdated or incorrect deals from the platform.	1	Feature	Done	- As an admin, if any mistakes occur with an existing offer, I can remove it from the database to maintain data integrity and prevent users from seeing incorrect information.
38	Security: [24] As an entertainment seeker, I want my password not to be less than 8 characters, so that it cannot be cracked from cyber threats and hackers.	2	Feature	Done	- As an entertainment seeker, If I try to create my password, then it must be 8 or more characters.
39	Usability: As an entertainment seeker, I want the error rate of using the Riyadh guide application to not be more than 10%, so that I can use it easily without errors.	2	Feature	Done	- As an entertainment seeker, if I am going to use the application, then I want the error rating to be 10% or less.
40	Availability: As an entertainment seeker, I want the Riyadh	2	Feature	Done	- As an entertainment seeker, if I want



	guide application available 99% of the time, so that I can access it without obstruction or interference.				to use the application at any moment, then the application must be available 99% of the time
41	Speed: As an entertainment seeker, I want the page load time to be within 3 seconds, so that I can move through the pages without wasting my time.	3	Feature	Done	- As an entertainment seeker, If I choose to go to a specific page, then the page should display in 3 seconds.
42	Maintainability: As an entertainment seeker, I want the application to be able to correct faults within 24 hours, so that I can use the application with accurate information.	3	Feature	Done	- As an entertainment seeker, if any faults occur while using the Riyadh guide application, then the faults should be corrected within 24 hours.
43	User-friendliness: As an entertainment seeker, I want to be able to use the Riyadh guide application with 90% of familiarity, so that I can	3	Feature	Done	- As an entertainment seeker, if I navigate through the application, then I should be familiar with



navigate through it without ambiguity.				90% of the icons, buttons, and terminologies.
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Table 6: Product Backlog

4.3. System Design

4.3.1. Architectural Diagram

This section will describe Riyadh guide system organization, it will present each major and subcomponent of the system and the database and their integration and responsibilities.

Riyadh guide application uses Client-Server architecture because it allows for the scalability of applications. The server can handle multiple client requests concurrently, enabling the system to accommodate a large number of users or increase workload. Also, it offers Centralized data management, the server acts as a centralized repository for data storage and management. This allows for better data integrity, security, and consistency across multiple clients.

The client is responsible for the user interface user experience and data access to the Database, in our system we have two types of users, normal users who are seeking the system functionality and are concerned about final results such as knowing about popular places and the latest activities and events held in Riyadh.

The second user of the system is the admin who is responsible for providing the normal user the information to use the system as intended, such as adding a place or an activity, editing, deleting, and monitoring the system.

In our application, the admin can be individuals or authorities that aim to develop tourism in Riyadh city through a unified platform and a seamless user experience. Based on these requirements we have chosen for the admin to control the application and perform his tasks through a mobile platform. This is because it facilitates easy access to information and allows the admin to perform administrative tasks simultaneously from anywhere.



The server side is responsible for authentication and authorization for users, protecting sensitive data from unauthorized use, storing and retrieving data that the system needs to access, in addition, the server manages integration with API, and handles communication, requests, and responses to provide the desired functionality to the application users. In our system, we use Firebase Firestore on the server-side to enhance and simplify these responsibilities as shown in Figure 9.

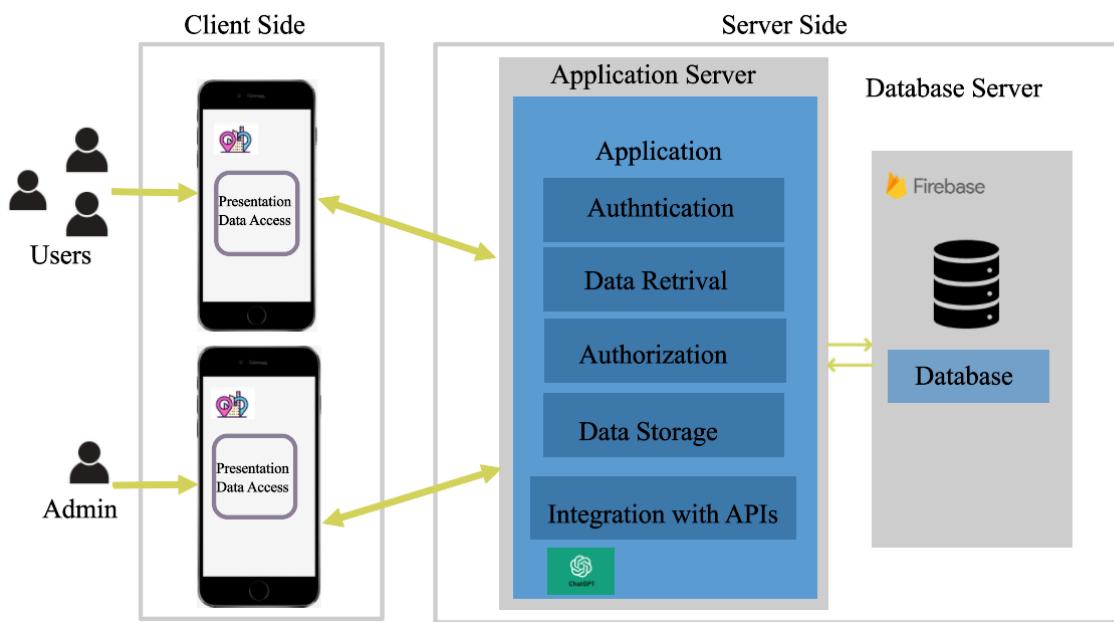


Figure 9: Riyadh Guide System Architecture

4.3.2. Class Diagram /DFD

In this section we will present the Riyadh guide class diagram, which shows all the components of the system and how they interact with each other for a better understanding and visualization of the structure of a system. It helps in analyzing, designing, and documenting the system's architecture by providing a high-level overview of the classes, their attributes, methods, and relationships as shown in Figure 10.

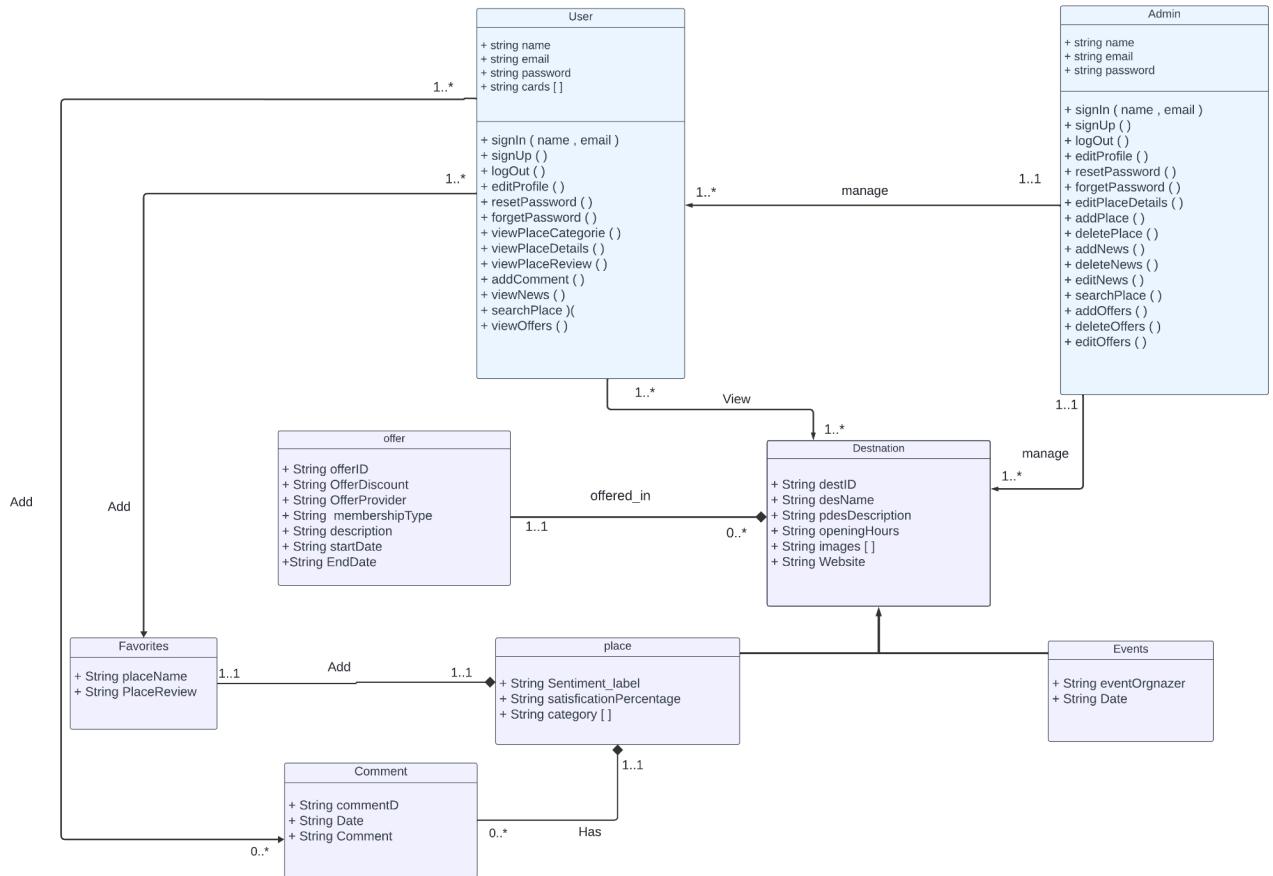


Figure 10: Riyadh guide class diagram



4.3.3. Component Level Design

This section includes three of the key components of our system using Pseudocode. Pseudocode is an informal way of programming description that does not require any strict programming language syntax or underlying technology considerations and it is used to summarize the flow of the components [25]. In addition, we provided a flowchart of one key component in our system

1- Edit place pseudocode:

Classification: Function

Precondition: Non

Postcondition: The system should update the place information in the database with the new information

Pseudocode:

1. **BEGIN**
2. Admin selects a place to edit
3. Admin clicks on edit icon
4. **DISPLAY** place information(category, name, opening hours, description, images)
in a form
5. **READ** form information
6. **IF** admin clicks on preview place details page **THEN**
7. **DISPLAY** a page with place information
8. **END IF**
9. **IF** admin clicks on save **THEN**
10. **IF** there is an empty field **THEN**
11. **IF** place name is empty **THEN**
12. **DISPLAY** "ادخل اسم المكان"



13. **END IF**
14. **IF** place description is empty **THEN**
15. **DISPLAY** "ادخل الوصف"
16. **END IF**
17. **IF** place opening hours is empty **THEN**
18. **DISPLAY** "ادخل ساعات العمل"
19. **END IF**
20. **END IF**
21. **ELSE** update place information in the database
22. **END IF**
23. **END**

2- Forget password Pseudocode:

Classification: Function

Precondition: Non

Postcondition: The system should update the user's password

Pseudocode:

1. **BEGIN**
2. User clicks on forget password
3. **DISPLAY** field for email
4. **READ** email
5. **IF** user clicks on reset password **THEN**
6. **IF** field is empty **THEN**
7. **DISPLAY** "يرجى إدخال بريدك الإلكتروني"
8. **ELSE IF** the email is in wrong format **THEN**



9. **DISPLAY** "البريد الإلكتروني غير صالح"
10. **ELSE**
11. Send reset password link to the email entered
12. **IF** user clicks on the link **THEN**
13. **DISPLAY** field for new password
14. **READ** new password
15. **IF** user clicks on save **THEN**
16. Update the user password in the database
17. **END IF**
18. **END IF**
19. **END IF**
20. **END IF**
21. **END IF**
22. **END**

3- Delete place Pseudocode:

Classification: Function

Precondition: Non

Postcondition: The system should delete the selected place from the database

Pseudocode:

1. **BEGIN**
2. Admin select place to delete
3. Admin clicks on delete icon
4. **DISPLAY** confirmation message



5. IF admin clicks on delete THEN
6. Delete selected place from database
7. END IF
8. END

4- Offers Flow Chart

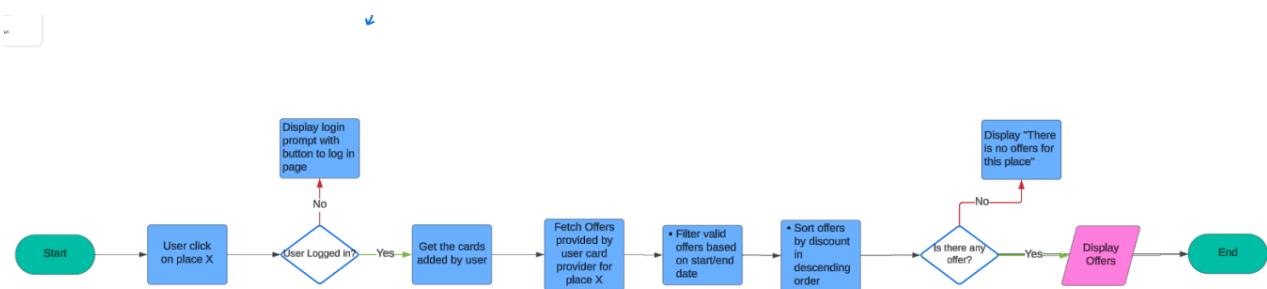


Figure 11: Offers feature flow chart

4.4. Data Design

Riyadh Guide application uses a NoSQL database offered by Firebase. The data is organized into collections where collections correspond to a table in a relational database. Each collection contains documents that correspond to rows in a relational database. In this section, we represent data models including an ER model and a Document-Oriented Data Model. In addition to describing how we collected the data.

4.4.1. Data Models

- The ER model

The Riyadh Guide application utilizes Firebase as its NoSQL database. The Entity-Relationship (ER) diagram illustrates relationships between the tables and the attributes of each table as shown in Figure 12

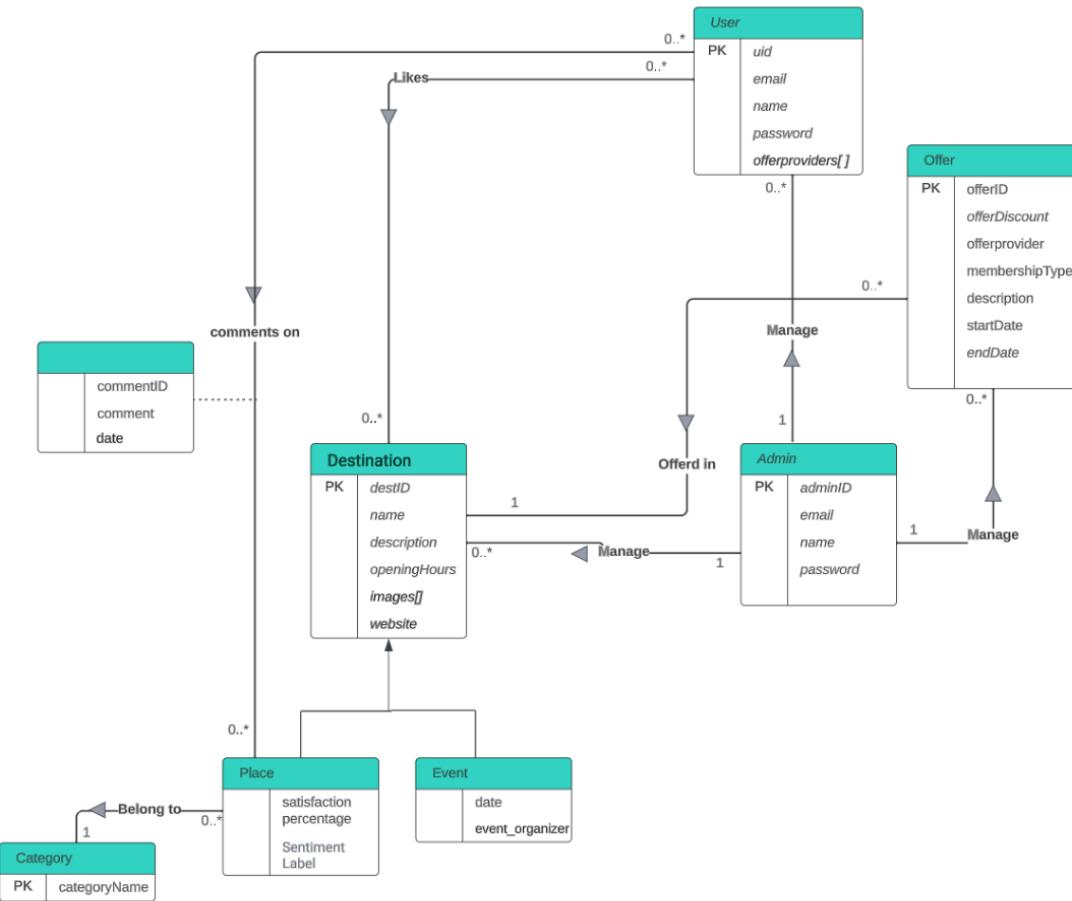


Figure 12: Riyadh guide ER model

- Document-Oriented Data Model (Tree-Like Structure)

For the non-relational data model, we used a tree-like structure to represent the organization of data within the Firebase database, as shown in figure 13.

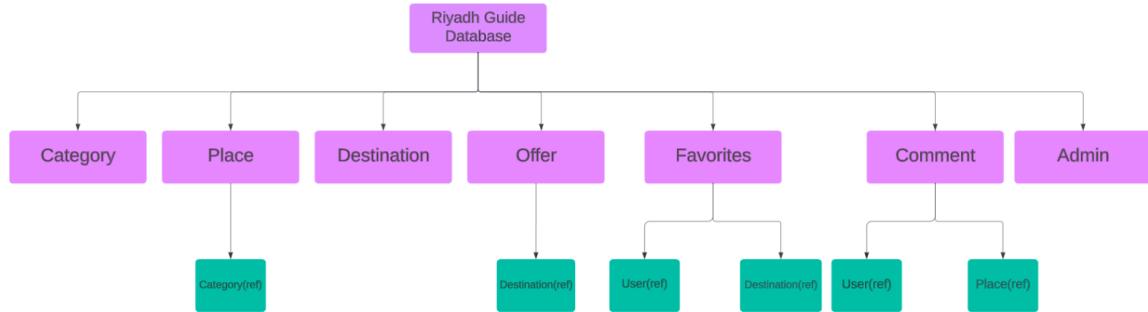


Figure 13: Riyadh guide Data model

4.4.2. Data Collection and Preparation

In our application, we gather reviews on places within our app to train our model. The data is gathered by using Google Maps scraping tool. This is a link to our collected data [click here](#), comprising a total of 10,785 entries after removing irrelevant comments. After collecting the data, we embarked on the process of labeling it. Each review was assigned a label of either -1 for negative reviews, 0 for neutral reviews, or 1 for positive reviews. After completing the labeling phase, we moved on to the data preprocessing stage. This crucial step involved applying various Natural Language Processing (NLP) techniques such as Stopword Removal, tashkeel removal, tokenization, Bag-of-words representation, to improve the quality and relevance of the collected data..we performed several operations on the collected data:

- Dropped rows with missing values to insure data integrity.
- Duplicate rows were removed to avoid redundancy.
- English letters were deleted, as they are not relevant to the Arabic language.
- Tashkeel and harakat were removed to simplify text.
- Emojis were removed from text as they may not contribute to sentiment analysis.
- Prefixes and suffixes were removed from words to focus on core content.



- Repeated characters were reduced to a single occurrence to enhance words readability.
- Stopwords and punctuation were removed from text as they don't carry a significant meaning to the text.
- Tokenized text, breaking it down into individual words or tokens for further analysis.

By applying these preprocessing steps, the next stage involves converting the text into a bag-of-words representation. This transformation simplifies the text data by assigning numerical values based on the frequencies of words.

By doing so, it reduces the dimensionality of the data, leading to improved efficiency in subsequent analysis and modeling steps. Moreover, the bag-of-words representation highlights the significance of individual words in the text, with higher weights assigned to words that occur more frequently.

After that, we split the dataset into two portions: 20% for testing the accuracy of our model and 80% for training the model. We opted to utilize logistic regression as our chosen model, as it gives us higher accuracy based on our experiments. To enhance the accuracy we use the Grid search technique which works by creating a grid of all possible combinations of parameter values and testing each combination to find the best one, the best hyperparameters will be used in the model for label prediction.

Once we were satisfied with the performance of the trained model we utilized it to conduct sentiment analysis and predict labels for new, unseen data. By applying this approach, we obtained an overall quality expectation and a final classification for each place within the app, [click here](#) to see how the trained model will perform sentiment analysis and predict label on unseen data or reviews about Wadi hanifah , then the model will use this prediction to provide a final classification of the place based on the sentiment expressed in the text. This classification could be positive, negative, or neutral, indicating the overall sentiment associated with the place, Additionally, the model can also provide a percentage or score indicating how much people like the place. This score represents the degree of positivity or likability associated with the place based on the sentiment analysis results. A higher percentage indicates a stronger positive sentiment and a greater level of liking for the place.



4.5. Interface Design

In the development of Riyadh Guide application interfaces, we adhered to various UX guidelines aimed at enhancing user experience [26]. This section will delve into some of these guidelines, providing illustrative examples. At the end of this section, we will present site maps, figure 20 for the Riyadh Guide application users and figure 21 for the admin, that illustrate the navigation layout for each.

The following user experience guidelines are used to design the application:

- System Match to the Real World:

We opted for icons and images that users are familiar with and that mirror real-world elements such as magnifying-glass icon for search and heart for favorite places, aiming to improve learnability and make user interactions more intuitive. Figure 14 shows an example.

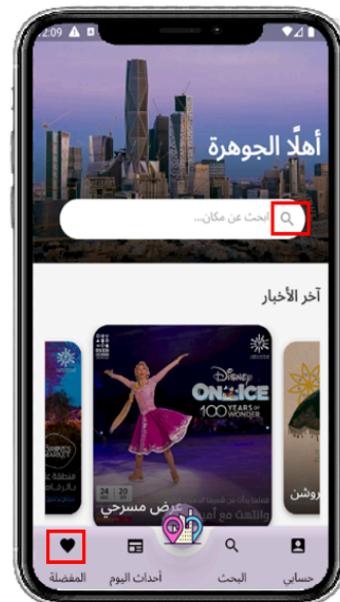
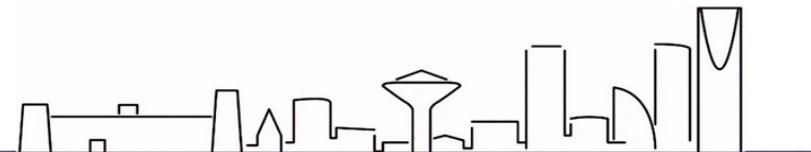


Figure 14: Riyadh Guide App-user home page



- User control and freedom:

Our application allows users to navigate between pages using the bottom bar. Additionally, users can return to the home page through the center button in the bottom bar from any page such as when user in category page can come back to the home page, providing them with the power to explore and interact at their own pace. This feature enhances the user experience, fostering a positive and satisfying interaction with the application. Figure 15 shows an example.



Figure 15: Riyadh Guide App-user category page

- Error prevention:

Recognizing that users may inadvertently make errors, so our user interface design includes clear alerts and confirmation messages. These messages serve to guide users when they make a mistake, encouraging them to rectify their actions or backtrack from unintended



steps, ensuring a smoother and more error-resilient user experience such as when trying to create a password it must satisfy the condition in order to become green to prevent an error occurring. Moreover, a confirmation message is shown to the administrator when attempting to delete an already existing place, prompting confirmation of the action. Figure 16 and Figure 17 show examples.



Figure 16: Riyadh Guide App-user sign up page



Figure 17: Riyadh Guide App-admin edit page

- Aesthetic and Minimalist Design:

We incorporate aesthetic and minimalist design principles in our interface, as we use a sleek hour icon to seamlessly show the opening hours for each place. This approach not only enhances visual appeal but also ensures a straightforward and efficient user experience. Figure 18 shows an example.



Figure 18: Riyadh Guide App-user place details page

- Help users recognize, diagnose and recover from errors:

To assist users in recognizing, diagnosing, and recovering from errors, our design prioritizes clear and informative error messages. These messages are crafted to provide users with the necessary guidance to understand the issue, diagnose its cause, and take appropriate corrective actions such as when a user tries to create a new account with an email already used an appropriate message will display. Figure 19 shows an example.



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Figure 19: Riyadh Guide App-user sign up page

- User Sitemap:

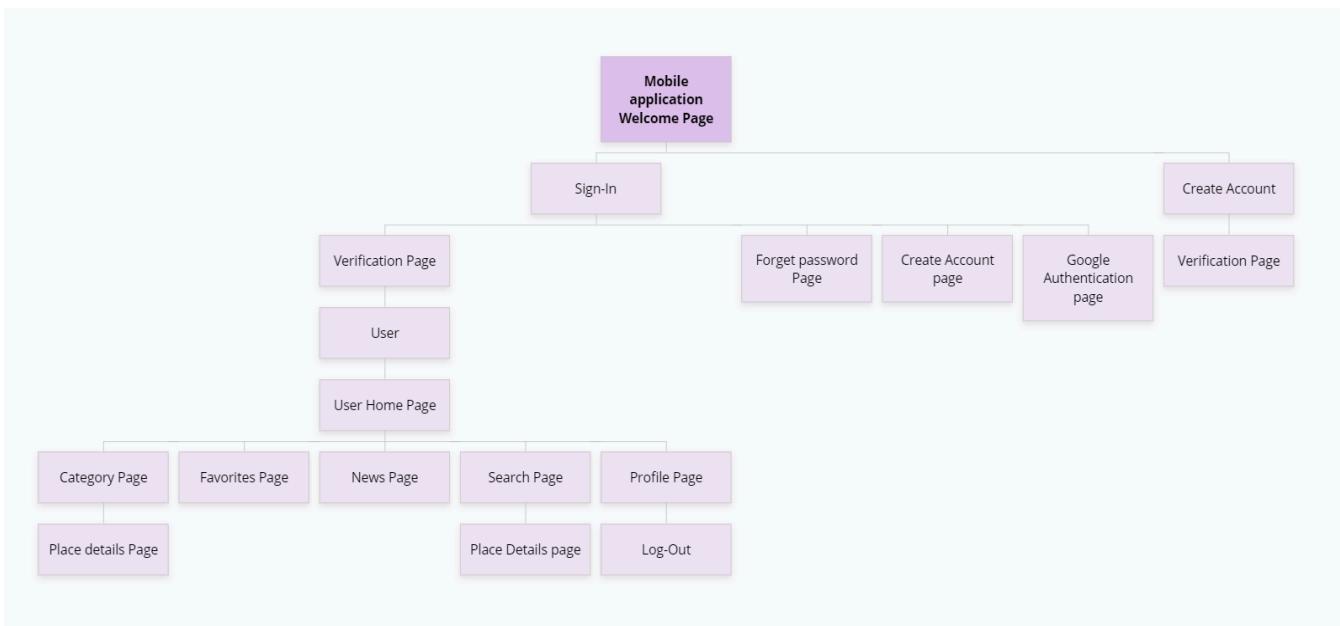


Figure 20: Riyadh Guide App user sitemap



- Admin sitemap:

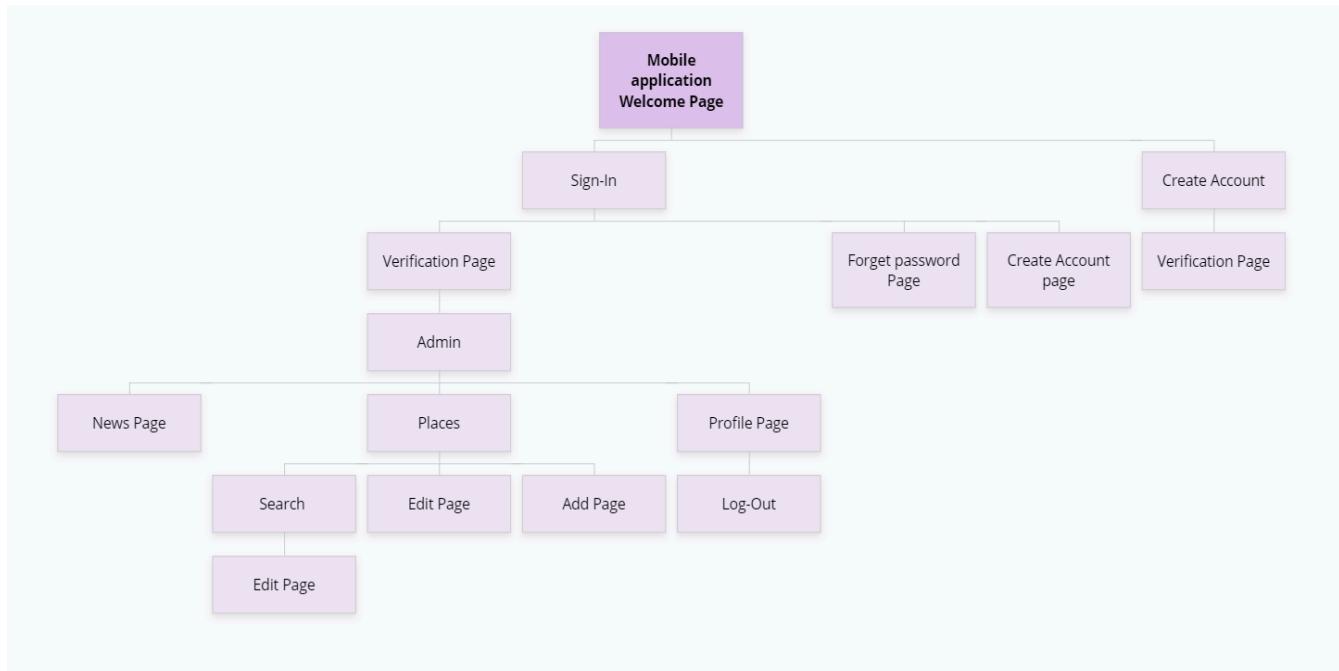


Figure 21: Riyadh Guide App admin sitemap

4.6. Implementation

• Database

The database is an important component of our application since almost all functionalities depend on the information stored in the database. We used Firebase which is Google's mobile application development platform that helps to build, improve, and grow applications [27]. We have mainly used the cloud Firestore that provides NoSQL database services to store the collections(tables) that we need in release-1 which are categories, places, and users. For the information of the place, first we added some manually to test the interfaces then after implementing the admin functionality of adding places, we can now add places from the admin page. Besides the cloud store, we have used other services from Firebase which are the storage to store place's images directly in Firebase and the authentication to ensure secure registration and login for the users. Figure 22 shows the collections and firebase services that we used.



The screenshot shows the Firebase console interface for the 'Riyadh-guide-database'. On the left, there's a sidebar with project navigation options like 'Project Overview', 'Storage', and 'Authentication'. The main area is titled 'Cloud Firestore' and shows the 'Data' tab selected. A banner at the top right says 'Protect your Cloud Firestore resources from abuse, such as billing'. Below this, the 'place' collection is displayed with its documents: p11, p12, p13, p14, and p15.

Figure 22: Firebase collection and services used

One of the challenges that we faced in implementing the database is connecting Firebase with our Flutter application. Although there are plenty of resources on how to use Firebase in Flutter, there are limited resources on how to connect them since the method is updated. We downloaded Firebase CLI and node.js to run some commands and have successfully connected Firebase with our Flutter application.

There was some dependencies that we needed to add in pubspec.yaml file as shown in figure 23 to use the Firebase services:

```

dependencies:
  flutter:
    sdk: flutter
  firebase_core: ^2.17.0
  cloud_firestore: ^4.9.3
  firebase_storage: ^11.2.8
  firebase_auth: ^4.10.1
  carousel_slider: ^4.2.1
  path_provider: ^2.0.9
  image_picker: ^1.0.4
  http: ^0.13.4
  uuid: ^4.0.0

```

Figure 23: Flutter Firebase dependencies



And we ensured that the flutter framework with the connected Firebase is properly initialized before executing any other code and before running the app as shown in figure 24.

```
12
13     Run | Debug | Profile
14 Future<void> main() async {
15     WidgetsFlutterBinding.ensureInitialized();
16     await Firebase.initializeApp(
17         options: DefaultFirebaseOptions.currentPlatform,
18     );
19     runApp(MyApp());
20 }
```

Figure 24: Ensuring flutter connection with firebase

● Admin Side

We have implemented features on the administrative side that allow administrators to easily add new places to the database. The interface is designed to be user-friendly and efficient, making the process faster. Administrators also have the ability to edit place details when needed, and they can immediately see the changes they make to simulate how it will appear to users.

- Add place page

Now we will explain some of the implementation steps in add place page as shown in Figure 25 it shows a part of Addplace page code , `_submitForm()` this function is triggered when the “اضافة التعديلات” button is pressed it starts with validating the form data, saves it, and then proceeds to save the form data to the database, then initiate a reference to the collection “Places” in the database then add data to each field where it belongs, because we need to store place images in the database we need to know what is the placeID that generated automatically when adding a document we stored it in placeId variable, then uploading the



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images associated with the place to Firestore using uploadImages() function shown in figure 26 It takes the placeId as a parameter and iterates through the _images list containing the selected image files. For each image, it generates a unique filename, uploads the image to Firebase Storage, retrieves the download URL of the uploaded image, and adds it to the imageUrl list. Finally, the list of image URLs is returned to imageUrl List. Since we can upload images either from the camera or gallery, we need to use the pickImage() function which accepts an ImageSource parameter, which determines whether the image should be selected from the camera or the gallery. Once an image is chosen, the function creates a temporary copy of the selected image file. It generates a unique filename using the current timestamp to ensure uniqueness. Finally, the temporary image file is added to the _images list, which keeps track of the selected images in the application's state.



```
void _submitForm() async {
  if (_formKey.currentState!.validate()) {
    _formKey.currentState!.save();
    // Save the form data to the database
    final placeData = {
      'categoryID': _selectedCategory ?? '',
      'name': _nameController.text,
      'description': _descriptionController.text,
      'opening_hours': _workingHoursController.text,
    };
    // Add the place data to Firestore and get the document ID
    final DocumentReference placeRef =
        await FirebaseFirestore.instance.collection('place').add(placeData);
    String placeId = placeRef.id;
    // Upload the images to Firestore
    List<String> imageUrls = await uploadImages(placeId);
    // Update the place document with the image URLs
    await placeRef.update({
      'images': imageUrls,
      'placeID': placeId,
    });

    // Show a snackbar message indicating successful addition
    ScaffoldMessenger.of(context).showSnackBar(
      SnackBar(
        content: Text('تمت الاضافة بنجاح'),
      ), // Snackbar
    );
    // Reset the form After adding
    _formKey.currentState!.reset();
    _categoryController.clear();
    _nameController.clear();
    _descriptionController.clear();
    _workingHoursController.clear();
    setState(() {
      _images.clear();
    });
  }
}

699 DEBUG CONSOLE OUTPUT
```

Figure 25: Submit form function

```
Future<List<String>> uploadImages(String placeId) async {
  List<String> imageUrls = [];

  for (var i = 0; i < _images.length; i++) {
    File image = _images[i];
    // Generate a unique filename for each image
    String fileName = 'place_${placeId}$i.jpg';
    // Upload the image to Firestore
    Reference storageRef =
        FirebaseStorage.instance.ref().child('images').child(fileName);
    UploadTask uploadTask = storageRef.putFile(image);
    // Get the download URL of the uploaded image
    TaskSnapshot storageSnapshot = await uploadTask.whenComplete(() {});
    String downloadUrl = await storageSnapshot.ref.getDownloadURL();
    imageUrls.add(downloadUrl);
  }
  return imageUrls;
}

Future<void> pickImage(ImageSource source) async {
  final pickedImage = await ImagePicker().pickImage(source: source);
  if (pickedImage != null) {
    final imageFile = File(pickedImage.path);
    // Get the temporary directory path
    Directory tempDir = await getTemporaryDirectory();
    String tempPath = tempDir.path;
    // Generate a unique filename for the image
    String fileName = 'place_${DateTime.now().millisecondsSinceEpoch}.jpg';
    // Create a new File object with the temporary path and filename
    File tempImage = await imageFile.copy('$tempPath/$fileName');
    setState(() {
      _images.add(tempImage);
    });
  }
}
```

Figure 26: Upload images function



In the Add place form we provide the admin with a feature that he can use ChatGPT functionality when trying to write a description of the place he will add, he has the option of writing it by himself or using AI text generator to help him correcting grammar or terminology or writing the full description. By clicking on the button “إنشاء الوصف بالذكاء الاصطناعي” the admin enters a clear prompt of what he needs then the Ai text generator will respond to his query, see the example below for more clarification.

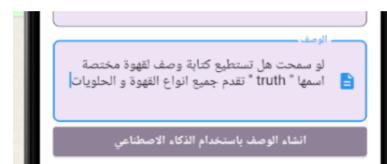


Figure 27: Send prompt



Figure 28: first response choice

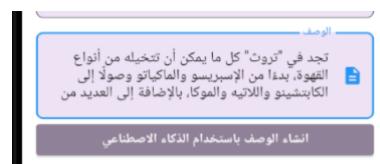


Figure 29: second response choice

The admin now can choose between the responses or try to modify the description by entering another prompt to the AI text generator, then submit the form to add a place in the database. The implementation of this functionality is started by obtaining an OpenAI key from their website storing the key in the database to enhance security, then interacting with the OpenAI GPT-3.5 model to generate a response based on a given prompt which typically the user input, one on challenges that face us is that we try to use a different model that now is not supported by OpenAI and it wasn't response to any prompts, another problem was by default when writing a prompt in Arabic the response was unknown symbols then we



discover that we need to decode the response using UTF-8, is important to ensure that characters are interpreted correctly.

```

Future<String> chatGPTAPI(
    TextEditingController _descriptionController) async {
  final String prompt = _descriptionController.text;
  final OpenAiKey = await getApiKey();
  final List<Map<String, String>> messages = [
    {
      'role': 'user',
      'content': prompt,
    },
  ];
  try {
    final res = await http.post(
        Uri.parse('https://api.openai.com/v1/chat/completions'),
        headers: {
          'Content-Type':
              'application/json; charset=UTF-8', // Specify UTF-8 encoding
          'Authorization': 'Bearer $OpenAiKey',
        },
        body: jsonEncode({
          "model": "gpt-3.5-turbo",
          "messages": messages,
        })),
    if (res.statusCode == 200) {
      String content = utf8.decode(jsonDecode(res.body)['choices'][0]
          ['message']['content']
          .codeUnits); // Decode the response using UTF-8
      content = content.trim();
      return content;
    }
    return 'An internal error occurred';
  } catch (e) {
    return e.toString();
  }
}

```

Figure 30: chatGPT API connection

- Edit place page

The main function here is `_fetchPlaceData()` Figure 31 that aims to fetch place details information and then provide the user the ability to edit information such as description or even add more images or delete some images, it first starts with firestore query that retrieves the document from the 'place' collection using the `doc()` method and then updates the state by assigning the retrieved place data to `placeData` and then populating data to other variables, after admin enters all the changes to place data he can see all the updated information as it will appear to users when he clicks on “معاينة صفحة التعديلات“ that open place details page for the same place if he satisfied with results he can press on “حفظ التعديلات“ that trigger a `_submitForm()` function Figure 32 It first validates the form using the



`_formKey.currentState.validate()` method. If the form is valid, the data is saved using `_formKey.currentState.save()`. The function retrieves the collection and documentId from the variables and creates a DocumentReference using the retrieved collection and document ID. It then updates the Firestore document with the new values Finally, it shows a success message using a SnackBar.

```

}
Future<void> _fetchPlaceData() async {
  // Fetch place data from Firebase Firestore based on the placeID
  final placeDocument = await FirebaseFirestore.instance
    .collection('place')
    .doc(widget.placeID)
    .get();

  setState(() {
    placeData = placeDocument;
    imageUrls = List<String>.from(placeData['images'] ?? []);
    _selectedCategory = placeData['categoryID'] ?? '';
    name = placeData['name'] ?? '';
    description = placeData['description'] ?? '';
    hours = placeData['opening_hours'] ?? '';
    _nameController.text = name;
    _descriptionController.text = description;
    _workingHoursController.text = hours;
    isLoading = false;
  });
}

List<String> oldImageUrls = [];

```

Figure 31: Fetch place data function

```

Future<void> _submitForm() async {
  if (_formKey.currentState!.validate()) {
    _formKey.currentState!.save();
    String collection = 'place';
    String documentId = widget.placeID;
    DocumentReference documentReference =
      FirebaseFirestore.instance.collection(collection).doc(documentId);
    String newCategoryID = _selectedCategory;
    String newName = _nameController.text;
    String newDescription = _descriptionController.text;
    String NewOpening_hours = _workingHoursController.text;
    List<String> newImageUrls = await uploadImages(documentId);
    await documentReference.update({
      'description': newDescription,
    });
    await documentReference.update({
      'name': newName,
    });
    await documentReference.update({
      'opening_hours': NewOpening_hours,
    });
    await documentReference.update({
      'categoryID': newCategoryID,
    });
    await documentReference.update({
      'images': newImageUrls,
    });
    ScaffoldMessenger.of(context).showSnackBar(
      SnackBar(
        content: Text('تم التحديث بنجاح'),
      ),
    );
  }
}

```

Figure 32: Edit and update place data function



● User Side

During the development phase, one of the challenges we encountered revolved around extracting data from the database based on the specified category type. The provided code segment implements the body of a Flutter widget representing a category screen, dynamically fetching and displaying a list of places from Firestore based on a specified category ID. The FutureBuilder widget takes a Future which is in this case, a Firestore query for documents with a specific category ID, and a builder function that defines what should be rendered based on the state of the future. The future here is a query to Firestore using the placesCollection collection, filtering documents where the 'categoryID' is equal to the value passed through the widget's categoryID property. Employing a FutureBuilder, the code handles various asynchronous states: it displays a loading indicator while fetching data, shows an error message if the query encounters an issue, and presents a message when no data is found for the category figure 33 .

```

nyadh_guide-main1 > lib > screens > category.dart > _CategoryScreenState > build
20   class _CategoryScreenState extends State<Category> {
109   Widget build(BuildContext context) {
271     body: FutureBuilder<QuerySnapshot>(
272       future: placesCollection
273         .where('categoryID', isEqualTo: widget.categoryID)
274         .get(), // Fetch documents with categoryID equal to the category ID send from homepage
275       builder: (context, snapshot) {
276         if (snapshot.connectionState == ConnectionState.waiting) {
277           return Center(child: CircularProgressIndicator());
278         }
279
280         if (snapshot.hasError) {
281           return Center(child: Text('Error: ${snapshot.error}'));
282         }
283
284         if (!snapshot.hasData || snapshot.data!.docs.isEmpty) {
285           return Center(child: Text('No data found for this category.'));
286         }
287       },

```

Figure 33: Firestore Query and FutureBuilder for Category Screen

Upon successful data retrieval, a scrollable list of place cards is generated using ListView.builder figure 34 Each card contains a set of images, place name, a "more" icon that navigates to place details page, an emoji indicating the classification type, and an opening hours icon. The cards are tappable via the InkWell widget, facilitating navigation to a detailed view (PlaceDetails) for each place. The code's modular structure ensures a seamless and visually appealing user experience throughout different states of the data-fetching process figure 35.

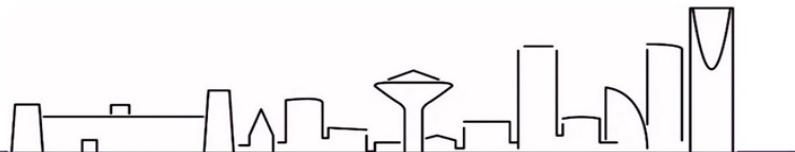


```
287     return SingleChildScrollView(
288       child: ListView.builder(
289         shrinkWrap: true,
290         physics: NeverScrollableScrollPhysics(), // Disable scrolling of the ListView
291         itemCount: snapshot.data!.docs.length,
292         itemBuilder: (context, index) {
293           DocumentSnapshot placeDocument = snapshot.data!.docs[index];
294           String placeName = placeDocument.get('name').toString();
295           String classification = placeDocument.get('classification').toString();
296           String classText = '';
297           String face = '';
298           if (classification == "1") {
299             classText = 'ممتاز';
300             face = 'lib/icons/happiness.png';
301           } else if (classification == "2") {
302             classText = 'جيد';
303             face = 'lib/icons/neutral.png';
304           } else if (classification == "3") {
305             classText = 'سيء';
306             face = 'lib/icons/sad.png';
307           } else {
308             classText = 'لم يحدد بعد';
309             face = 'lib/icons/empty-set.png';
310           }
311
312           String placeID = placeDocument.get('placeID').toString();
313           List<dynamic> imageArray = placeDocument.get('images') ?? [];
314           String placeImage =
315             (imageArray.isNotEmpty) ? imageArray[0].toString() : '';
316           String openingHours =
317             placeDocument.get('opening_hours').toString();
318           return InkWell(
319             onTap: () {
320               Navigator.push(
321                 context,
322                 MaterialPageRoute(
323                   builder: (context) => PlaceDetails(placeID: placeID),
324                 ), // MaterialPageRoute
325               );
326             );
327           );
328         );
329       );
330     );
331   );
332 }
```

Figure 34: Scrollable List of Place Cards

```
1   child: Card(
2     shape: RoundedRectangleBorder(
3       borderRadius: BorderRadius.circular(15),
4     ), // RoundedRectangleBorder
5     elevation: 7,
6     margin: EdgeInsets.all(10),
7     child: Column(
8       children: [
9         Stack(
10           children: [
11             ClipRRect(
12               borderRadius: BorderRadius.only(
13                 topLeft: Radius.circular(15),
14                 topRight: Radius.circular(15),
15               ), // BorderRadius.only
16               child: Image.network(
17                 placeImage,
18                 height: 250,
19                 width: double.infinity,
20                 fit: BoxFit.cover,
21               ), // Image.network
22             ),
23             Container(
24               height: 250,
25               alignment: Alignment.bottomRight,
26               padding: EdgeInsets.symmetric(
27                 vertical: 10, horizontal: 20), // EdgeInsets.symmetric
28               decoration: BoxDecoration(
29                 gradient: LinearGradient(
30                   begin: Alignment.topCenter,
31                   end: Alignment.bottomCenter,
```

Figure 35: User-Friendly UI for Place Cards



● Model building experiments

After preprocessing the collected data we started building our model. We did multiple experiments on different models to see which model will give us the best result. We tried 4 different models: Logistic Regression, Gradient Boosting, Support Vector Machine (SVM), and Convolutional neural network (CNN). With these experiments we saw that the SVM gave high training accuracy but not as much in test accuracy so it has overfitting behavior. With Logistic Regression, we noticed that it had the highest precision and recall values and it had the highest test accuracy so we chose it as our model. We also tried splitting the data into training and testing sets with different percentages, but the best results were achieved by splitting the data into 80% training and 20% testing. We will present the results of each experiment in section 5.1 of this document.

After choosing the model we started searching for the best hyperparameter tuning technique for our model we noticed that after implementing Grid Search the performance of our model improved and gave us more accurate predictions so we used Grid Search.

```
riyadh_guide-main1 > lib > ML > classification.py > ...
1/1
172 # Create logistic regression model
173 logistic_model = LogisticRegression()
174
175 # Define hyperparameter grid
176 param_grid = {'C': [0.001, 0.01, 0.1, 1, 10, 100], 'max_iter': [100, 200, 300]}
177
178 # Create GridSearchCV
179 grid_search = GridSearchCV(logistic_model, param_grid, cv=5, scoring='accuracy', n_jobs=-1)
180
181 # Convert the text data into Bag-of-Words representation
182 vectorizer = CountVectorizer()
183 X_train_bow = vectorizer.fit_transform(X_train_str)
184 X_test_bow = vectorizer.transform(X_test_str)
185
186 # Fit the grid search to the data
187 grid_search.fit(X_train_bow, y_train)
188
189 # Print the best hyperparameters found by grid search
190 print("Best Hyperparameters:", grid_search.best_params_)
191
192 # Use the best model found by grid search for predictions
193 best_model = grid_search.best_estimator_
194 y_pred = best_model.predict(X_test_bow)
```

Figure 36: part of used Grid Search code



We tried to improve the accuracy in different ways. First, we tried to balance the data and train the model with equal numbers of 0, 1, and -1 classes. The accuracy didn't improve so we tried another way which is training the model on 2000 data only. We tried to take 2000 different rows from our data each time to get the best 2000 rows of data.

```
[ ] class_counts = new_df['Class'].value_counts()

# Print the count of each class
print("Class Counts:")
print(class_counts)
```

→ Class Counts:

1	1300
-1	385
0	315

Name: Class, dtype: int64

Figure 37: training the model with 2000 data points

Additionally, we tried to train the model with data of one category of places only. We tried on the restaurant category, so we trained the model with only the restaurant reviews to see if it is better to separate each category.

Figure 38: part of all restaurants reviews dataset



For feature extraction, we tried both Bag-of-Words and Term Frequency-Inverse Document Frequency (TF-IDF) representations. Both methods gave us almost the same accuracy, so we decided to use the Bag-of-Words representation since it has faster execution.

```
# Logistic regression model with bag of words
# Import necessary libraries
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import GridSearchCV

# Assuming 'Review' and 'Class' are columns in your DataFrame
texts_train = new_df['Review']
labels_train = new_df['Class']

# Convert labels to numerical representation
label_encoder = LabelEncoder()
encoded_labels_train = label_encoder.fit_transform(labels_train)

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(texts_train, encoded_labels_train, test_size=0.2, random_state=42)

# Convert the tokenized words back to strings
X_train_str = [' '.join(tokens) for tokens in X_train]
X_test_str = [' '.join(tokens) for tokens in X_test]

# Convert the text data into Bag-of-Words representation
vectorizer = CountVectorizer()
X_train_bow = vectorizer.fit_transform(X_train_str)
X_test_bow = vectorizer.transform(X_test_str)
```

Figure 39: Logistic regression with bag-of-words



```
# Logistic regression model with TF-IDF
# Import necessary libraries
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import GridSearchCV

# Assuming 'Review' and 'Class' are columns in your DataFrame
texts_train = new_df['Review']
labels_train = new_df['Class']

# Convert labels to numerical representation
label_encoder = LabelEncoder()
encoded_labels_train = label_encoder.fit_transform(labels_train)

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(texts_train, encoded_labels_train, test_size=0.2, random_state=42)

# Convert the tokenized words back to strings (if needed)
X_train_str = [' '.join(tokens) for tokens in X_train]
X_test_str = [' '.join(tokens) for tokens in X_test]

# Convert the text data into TF-IDF representation
vectorizer = TfidfVectorizer()
X_train_tfidf = vectorizer.fit_transform(X_train_str)
X_test_tfidf = vectorizer.transform(X_test_str)
```

Figure 40: Logistic regression with TF-IDF

- GitHub Link:

<https://github.com/DanaAlotay/2023-GP1-9.git>

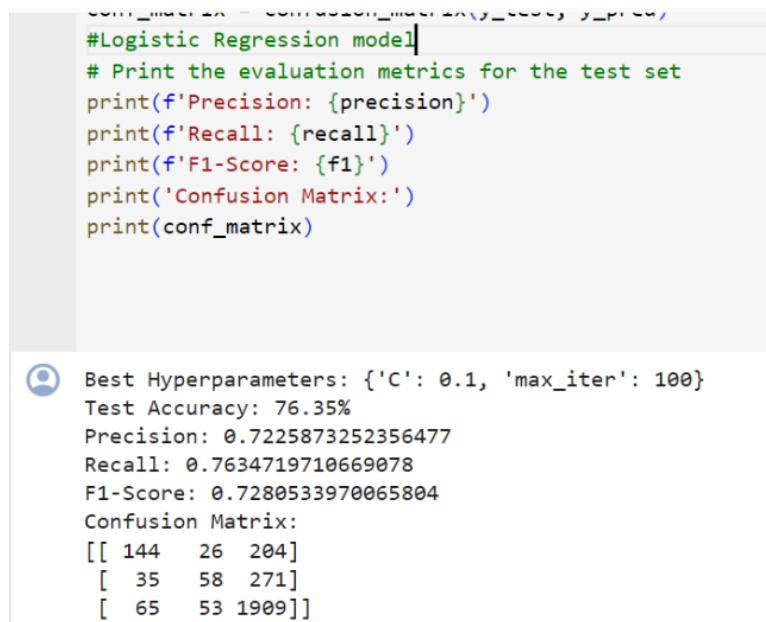


5. System Evaluation

In this chapter, we will test our system to assess the functionality of our software. This process checks for errors and whether the outcome of the application matches the desired expectations. Using User Acceptance Testing we will present key components such as the participants' demographics, questionnaire results, and a discussion of the findings.

5.1. Experimental Results

The test accuracy of each of the models we tried was 76.35% with Logistic Regression (shown in figure 41), 74.65% with Gradient Boosting (shown in figure 42), 73.51% with SVM (shown in figure 43), and lastly 71.28% with CNN (shown in figure 44).



```
conf_matrix = confusion_matrix(y_true, y_pred)
#Logistic Regression model
# Print the evaluation metrics for the test set
print(f'Precision: {precision}')
print(f'Recall: {recall}')
print(f'F1-Score: {f1}')
print('Confusion Matrix:')
print(conf_matrix)
```

Best Hyperparameters: {'C': 0.1, 'max_iter': 100}
Test Accuracy: 76.35%
Precision: 0.7225873252356477
Recall: 0.7634719710669078
F1-Score: 0.7280533970065804
Confusion Matrix:
[[144 26 204]
 [35 58 271]
 [65 53 1909]]

Figure 41: Accuracy of the logistic regression model



```
# Gradient Boosting Model
# Print the evaluation metrics for the test set
print(f'Precision: {precision}')
print(f'Recall: {recall}')
print(f'F1-Score: {f1}')
print('Confusion Matrix:')
print(conf_matrix)

@ Training Accuracy: 76.71%
Test Accuracy: 74.65%
Precision: 0.6830810492309568
Recall: 0.7464737793851718
F1-Score: 0.6782112438088996
Confusion Matrix:
[[ 74   12  288]
 [ 25   18  321]
 [ 37   18 1972]]
```

Figure 42: Accuracy of the Gradient Boosting model

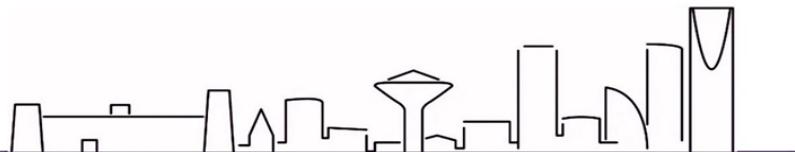
```
#SVM
print(f'Precision: {precision}')
print(f'Recall: {recall}')
print(f'F1-Score: {f1}')
print('Confusion Matrix:')
print(conf_matrix)

@ Training Accuracy: 98.29%
Test Accuracy: 73.51%
Precision: 0.7207661861991935
Recall: 0.7350746268656716
F1-Score: 0.7255987828912266
Confusion Matrix:
[[ 133   26  122]
 [  52   66  155]
 [ 130   83 1377]]
```

Figure 43: Accuracy of the SVM model

```
139/139 12s 87ms/step - accuracy: 0.9973 - loss: 0.0118 - val_accuracy: 0.7197 - val_loss: 1.8274
Epoch 12/15
139/139 13s 96ms/step - accuracy: 0.9977 - loss: 0.0084 - val_accuracy: 0.7143 - val_loss: 1.9094
Epoch 13/15
139/139 12s 88ms/step - accuracy: 0.9977 - loss: 0.0108 - val_accuracy: 0.7134 - val_loss: 2.0484
Epoch 14/15
139/139 12s 84ms/step - accuracy: 0.9962 - loss: 0.0111 - val_accuracy: 0.7120 - val_loss: 1.9756
Epoch 15/15
139/139 21s 87ms/step - accuracy: 0.9970 - loss: 0.0089 - val_accuracy: 0.7152 - val_loss: 1.9143
87/87 1s 10ms/step - accuracy: 0.7138 - loss: 1.9610
Test accuracy: 71.28%
```

Figure 44: Accuracy of the CNN model



The best accuracy we got after only choosing 2000 rows of data was 68.75% which was worse than the original accuracy so this method was not considered.

```
→ Best Hyperparameters: {'C': 0.1, 'max_iter': 100}
Test Accuracy: 68.75%
Precision: 0.6508705357142859
Recall: 0.6875
F1-Score: 0.6274932209709897
Confusion Matrix:
[[ 30   6  41]
 [ 10   8  58]
 [  8   2 237]]
```

Figure 45: Accuracy of training the Logistic regression model with 2000 data points

Training the model on one category of reviews slightly improved the accuracy but since each category has almost 2000 data, we believe that it's better to train the model on all collected data and this method might be considered in the future if more data in each category is available.

In conclusion, the final model was a logistic regression using Bag-of-Words for feature extraction. Grid Search was used as the hyperparameter tuning technique, and the model was trained on 10,785 data points, which were split into 80% training and 20% testing.

5.2. User Acceptance Testing

Testing is a critical phase in the software development lifecycle. In this section, we will conduct User Acceptance Testing (UAT), a form of system testing that validates whether the system aligns with users' expectations. Additionally, we will test the admin side to ensure that the system's back-end functionalities are not only technically sound but also user-friendly for those managing and overseeing system operations.



The testing process involves asking users and admins to perform tasks they are expected to do. Participants are then asked to fill out a questionnaire to assess their experience. The questionnaires are designed with 10 questions to capture user experience. The first set of questions focuses on participants' age groups, gender, and their familiarity with mobile applications. Subsequent questions focused on the users' and admins' experience with the application, ranging from their rating of comfort with specific functionalities to their need for assistance while performing the tasks. The participants also provided ratings on the overall performance of the application's features, their likelihood of recommending the app, and their design evaluation. The questionnaire questions are added to Appendix D of this document. Additionally, open-ended questions to get qualitative feedback on potential challenges faced, areas of confusion, and suggestions for enhancing the application's functionalities and design.

5.2.1. Demographics of Participants

The testing team, selected based on specified criteria outlined in Section 4.2.1, consists of 20 participants, with 10 focusing on testing the user side and the remaining 10 focusing on evaluating the admin side of the application.

Among the participants surveyed, The majority of age distribution, constituting 45% of the respondents, fell within the age range of 18 to 24 years. Additionally, 35% of participants were categorized as between 25 to 40 years, Another 10% belonged to the more than 40 years age bracket, while the remaining 10% were less than 18 years old as shown in Figure 46 and Figure 47.



Users Side:

How old are you? كم عمرك؟

10 responses

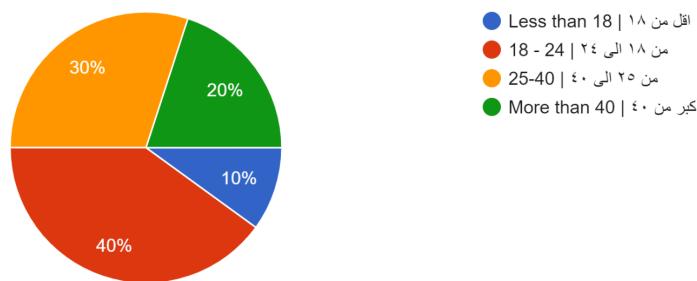


Figure 46: Pie chart of Users' age distribution

Admin Side:

How old are you? كم عمرك؟

10 responses

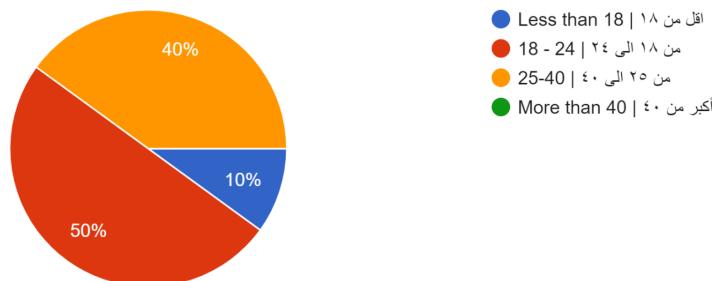


Figure 47: Pie chart of Admins' age distribution

In addition, gender distribution showed that 60% of the total respondents were females. On the other hand, males made up the remaining 40% of the participants.



Users Side

What is your gender? الجنس؟
10 responses

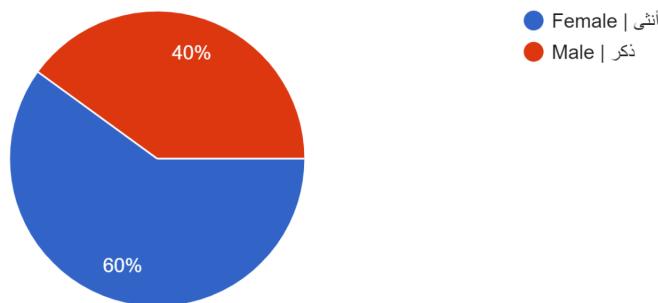


Figure 48: Pie chart of users' gender distribution

Admin Side:

What is your gender? الجنس؟
10 responses

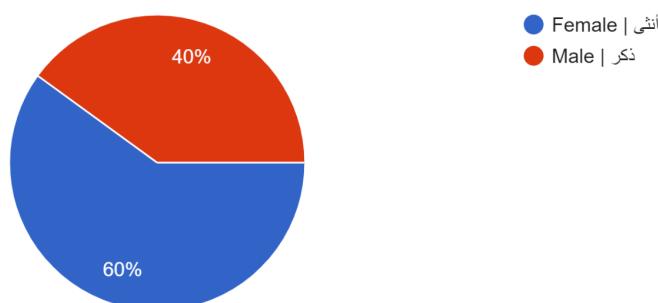


Figure 49: Pie chart of admins' gender distribution

The majority of responses indicated a high level of experience, with ratings of 4 and 5 being the most prevalent, collectively accounting for 75% of the responses. This suggests that a significant portion of the participants feel confident and well-versed in navigating mobile applications. However, it's worth noting that two participants rated their experience at 2 as Figure 50 shows, reflecting a lower level of confidence or familiarity with mobile applications. This variation in responses shows the importance of considering participants'

varying levels of experience when evaluating their interactions and feedback on the application.

User Side:

كيف تقيم مستوى خبرتك في تطبيقات الجوال؟
How would you rate the level of experience you have in mobile applications?

10 responses

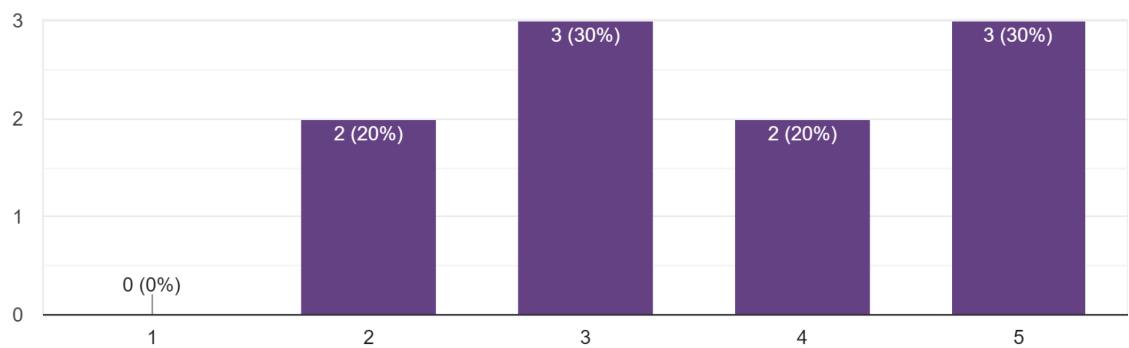


Figure 50: Bar chart of Participants' Ratings of their Experience on Mobile Application

Admin Side:

كيف تقيم مستوى خبرتك في تطبيقات الجوال؟
How would you rate the level of experience you have in mobile applications?

10 responses

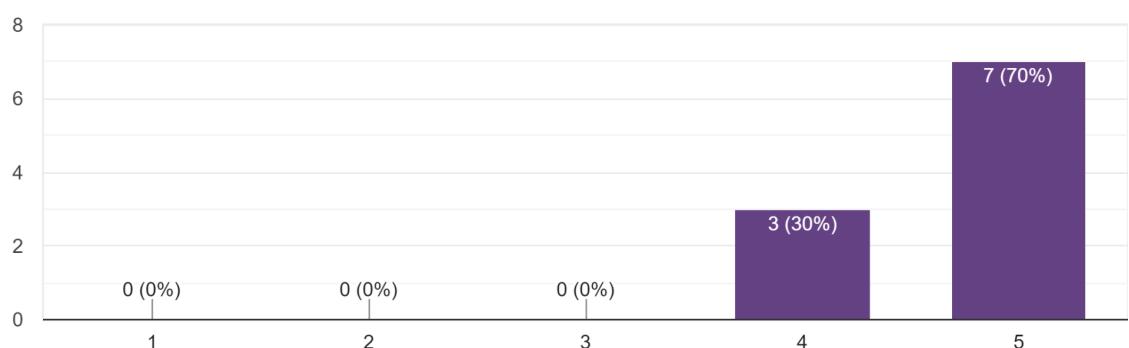


Figure 51: Bar chart of Participants' Ratings of their Experience on Mobile Application



5.2.2. Questionnaire/Interview Results

In our User Acceptance Testing approach, participants were assigned specific tasks corresponding to their user type, whether they acted as administrators or regular users. Subsequently, participants provided feedback by responding to a questionnaire designed to assess their overall user experience based on the tasks performed. In this section, we will show the results of the questionnaire responses.

- For the **admin** we have asked them to perform the following tasks
 - Register a new account.
 - Log in.
 - View the admin dashboard.
 - View profile information.
 - Add, Edit and Delete a new place.
 - Add, Edit and Delete events or news.
 - Add, Edit and Delete offers.
 - Use artificial intelligence in adding place details and events.
 - Log out.
- For the **user** we have asked them to perform the following tasks
 - Register for a new account.
 - Log in.
 - Reset password.
 - Sign in using google.
 - View profile.
 - Change password from the profile.
 - Search for a place.
 - Filter place by category.
 - Read place details.
 - Add place to favorite.
 - Add a comment.
 - Add, delete bank cards.
 - View available offers based on his cards.
 - View calendar of events.



- Filter calender based on event type.
- View event Details.
- Log out.

Evaluation of Help Need Using the Application

Admins

أحتاج الى المساعدة لاستعمال البرنامج I need some help to using the application

10 responses

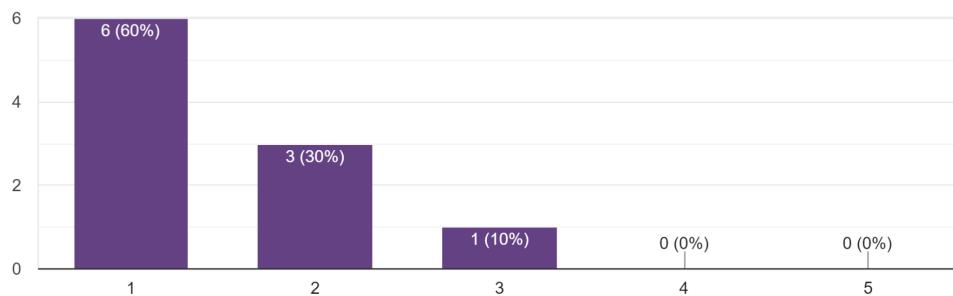


Figure 52: Bar chart of admins Responses to the Question 'I need help using the application'

(Scale: 1 - Strongly Disagree, 5 - Strongly Agree)

Users



أحتاج الى المساعدة لاستعمال البرنامج I need some help using the application

10 responses

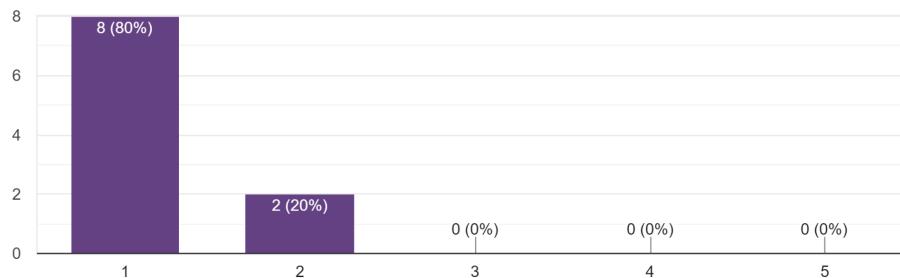


Figure 53: Bar chart of users Responses to the Question 'I need help using the application'

(Scale: 1 - Strongly Disagree, 5 - Strongly Agree)

Evaluation of Expected Functionality

Admins

جميع الوظائف تعمل كما كنت أتوقع All features are working as I expected

10 responses

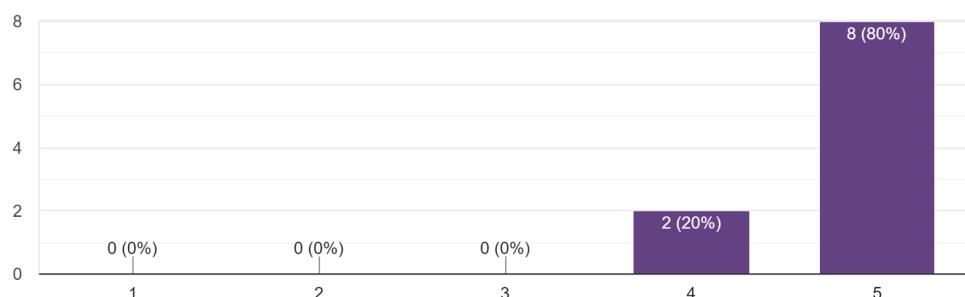


Figure 54: Bar chart of admins Responses to the Question 'All features are working as I expected'

(Scale: 1 - Strongly Disagree, 5 - Strongly Agree)



Users

All features are working as I expected جميع الوظائف تعمل كما كنت أتوقع

10 responses

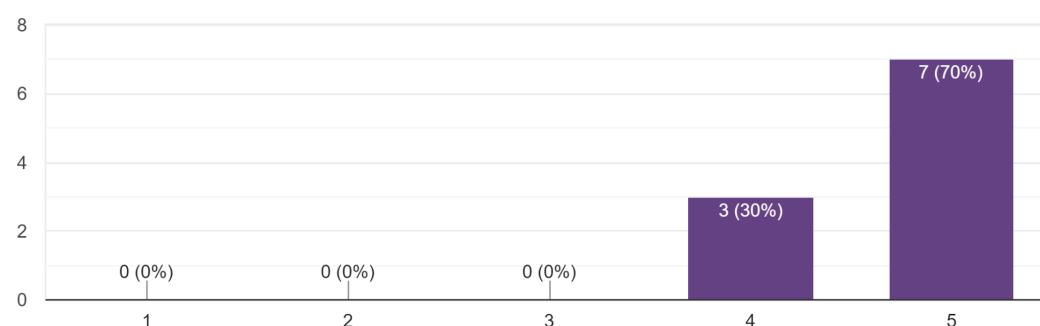


Figure 55: Bar chart of users Responses to the Question 'All features are working as I expected'

(Scale: 1 - Strongly Disagree, 5 - Strongly Agree)

Evaluation of Visual Design and Aesthetics and Opportunities for Improvement

Admins



Considering the Admin's services for operating the Riyadh Guide and striving to collect the necessary information and display it effectively, what improvements do you think will be beneficial for the application's development?

بالنظر إلى الخدمات التي يوفرها مشرف التطبيق لتشغيل دليل الرياض والسعى في جمع المعلومات المطلوبة وعرضها بشكل فعال ما هي التحسينات التي تعتقد أنها ستساهم في تطوير التطبيق؟

10 responses

لا يوجد

معلومات الموكيل تعيا بشكل مباشر من التطبيق

Add more places.

إضافة أماكن جديدة

التعديل على سرعة استجابة التطبيق

مسكن ان تكون اضافه الوقت من خلال فورم للساعات

يمكن التعديل على طريقة عرض الاحصائيات واضافه رسوم بيانية اكبر وفترات زمنية متلا لمزيد من المعلومات المفيدة للادمن

اضافة dark mode

لا توجد تحسينات

Figure 56: Admins evaluation of visual design and improvement suggestions

Users

Considering the colors and fonts used, how would you rate the overall design aesthetics of the app? Any specific suggestions for design improvement?

بالنظر إلى الألوان والخطوط المستخدمة، كيف تقيم جماليات التصميم العام للتطبيق؟ هل هناك أي اقتراحات محددة للتحسين التصميم؟

10 responses

رائعة واختيار اللون الموف مميز وغير مكرر

ماشاء الله فكرة مميزة وتنفيذ مره جميل وابعدنا من جميع النواحي، لكن اقترح تعديل وتكبير الخط في تقويم الفعاليات ليصبح اكبر ووضحا

مرحبا للنظر وغير مكررة متميزين عن باقي التطبيقات المنافسة

ممتازة والوان وتصميم تلبيق بتطبيق سياحي

جميل ودرج الالوان في التطبيق جعلها مرحبا للنظر

الوان جميلة ومرحبا وتصميم جميل

الألوان المستعملة تساعده في تحسين تجربة المستخدم الوان هاديه وجميلة اختيار موفق

أعجبني تصميم التطبيق باللون زاهية لا أرى اي احتياج لتغيير التصميم

صراحة اول تطبيق اجرية يكون باللون مرحة وغير معتادة ويعكس هوية التطبيق السياحية

الألوان جميلة لكن مكررة في كل الواجهات ممكن لو كان فيه تنوع اكتر بالألوان كان افضل

Figure 57: Users evaluation of visual design and improvement suggestions



Assessing Ease-of-Use and Opportunities for Improvement

Admins

Have you found any aspects of the app to be confusing or difficult, or would you like them modified?

هل وجدت أي جوانب في التطبيق مربكة أو صعبة أو تفضل أن يتم التعديل عليها؟

10 responses

لا

يفضل ترتيب العروض حسب التاريخ الأحدث

No

لا يوجد

مستلزم لكن يفضل ان يكون ادخال الموقع من خلال رابط

في البداية او تعليمات بسيطة للادمن يقدر يرجع لها tour اغلب الاشياء واضحه لكن افضل وجود

لا كل شي واضح

لا تطبيق جميل بالتنفيذ

لا جميعها مألوفه

Figure 58: Admins evaluation of ease of use and improvement suggestions



Users

Were there any aspects of the app that you found confusing or challenging? Do you have any suggestions to improve the application's functionalities?
هل وجدت أي جوانب في التطبيق مربكة أو صعبة؟ هل لديك أي اقتراحات لتحسين الوظائف والخدمات التي يوفرها التطبيق؟

10 responses

لا يوجد
اقتراح ان يتم اضافة خدمات و مميزات لاصحاب الهمم مثلا اضافة خوار البحث باستخدام التسجيل الصوتي
لا يوجد
اقتراح ان يتم اضافة خوارث مربكة او صعبة؟ هل لديك أي اقتراحات لتحسين الوظائف والخدمات التي يوفرها التطبيق؟ Good luck
اقتراح ان يتم اضافة مدن المملكة العربية السعودية جميعها ولا يكون مقتصر على مدينة الرياض
لا يوجد
لا التطبيق سهل واستطعت تجربة جميع خدمات التطبيق بسهولة
الوصول لجميع الخدمات كان سهل وواضح من خلال الشرح السفلي وكل الخدمات واضحة
لا التطبيق سهل جدا في التعامل. ممكن اضافة بطاقات بنكية اكبر

Figure 59: Users evaluation of ease of use and improvement suggestions



Evaluation of User's Familiarity with Interface Elements within the Application

Admins

Were there familiar elements (buttons, icons, etc.) that helped you understand the system?
هل كانت هناك عناصر مألوفة (الأزرار والأيقونات وما إلى ذلك) ساعدتك على فهم البرنامج؟

10 responses

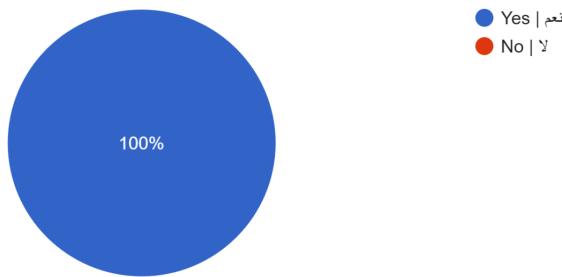


Figure 60: Pie chart of admins Responses to the Question 'Were there familiar elements that helped you to understand the system?'

Users

Were there familiar elements (buttons, icons, etc.) that helped you understand the system?
هل كانت هناك عناصر مألوفة (الأزرار والأيقونات وما إلى ذلك) ساعدتك على فهم البرنامج؟

10 responses

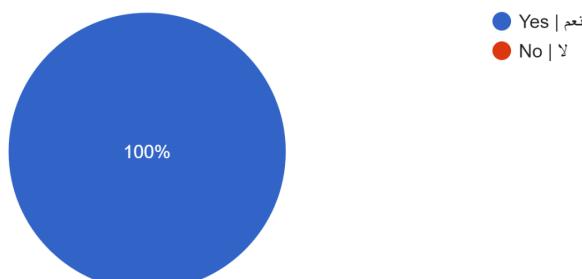


Figure 61: Pie chart of users Responses to the Question 'Were there familiar elements that helped you to understand the system?'



Evaluating Accomplished Tasks

Admins

اختر جميع المهام التي أجزتها بسهولة: Choose all functionalities that you easily accomplished:

10 responses

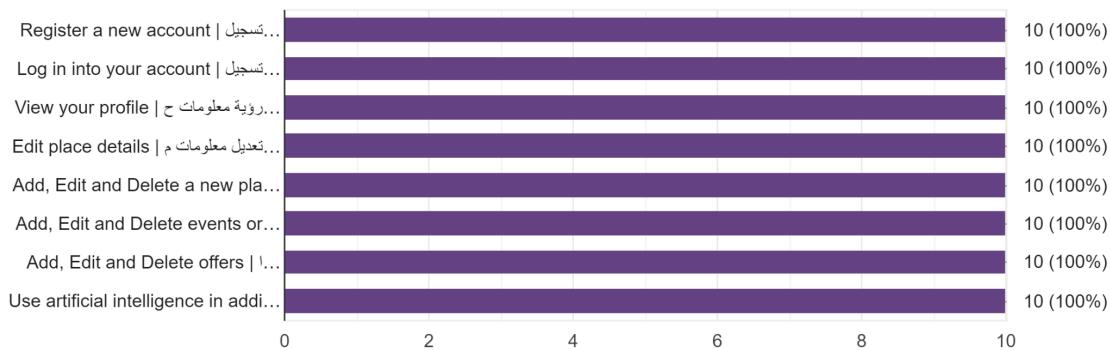


Figure 62: Bar chart of admins Responses to the Question 'Choose all functionalities that you easily accomplished'

Users

اختر جميع المهام التي أجزتها بسهولة: Choose all functionalities that you easily accomplished:

10 responses

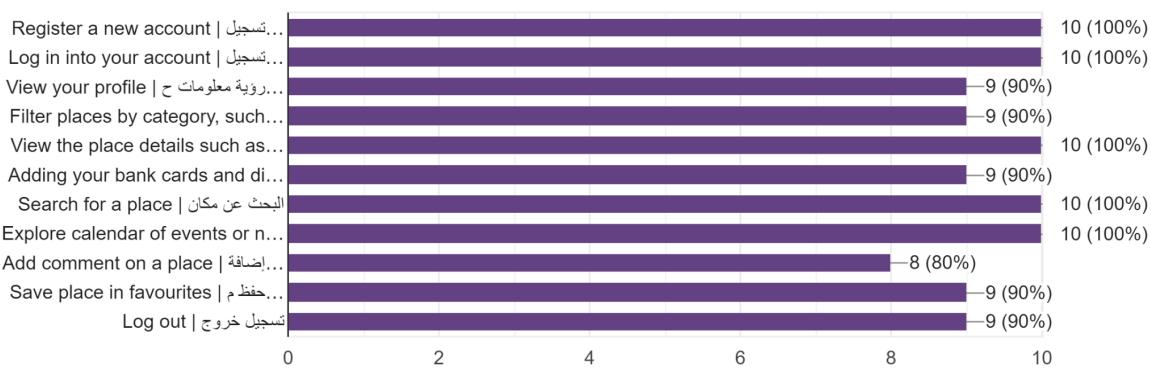


Figure 63: Bar chart of users Responses to the Question 'Choose all functionalities that you easily accomplished'



Assessing User Confidence and Satisfaction

Admins

من الممكن أن أكون أحد المشرفين على هذا التطبيق؟

10 responses

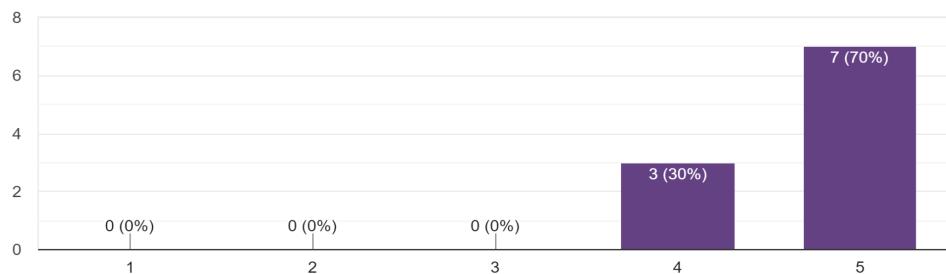


Figure 64: Bar chart of admins Responses to the Question 'It is possible for you to be one of the administrators for this application?'

(Scale: 1 - Strongly Disagree, 5 - Strongly Agree)

Users

أود أن أوصي بهذا التطبيق للأشخاص الذين أعرفهم

10 responses

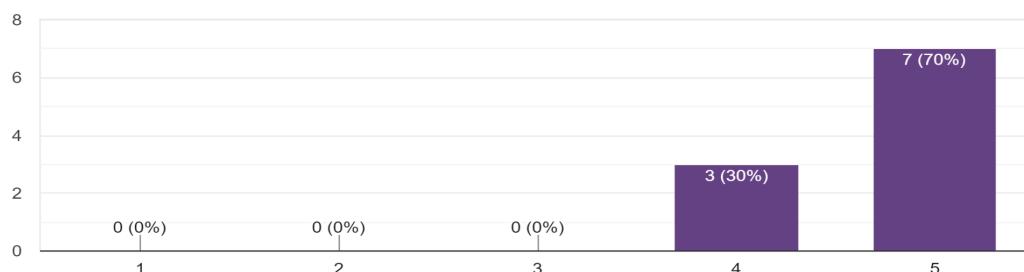


Figure 65: Bar chart of users Responses to the Question 'I would recommend this application to the people I know'

(Scale: 1 - Strongly Disagree, 5 - Strongly Agree)



5.3. Quality Attributes (NFR testing)

User story	Quality Attribute	Measure	Results
As an entertainment seeker, I want to be able to use the Riyadh guide application with 90% of familiarity, so that I can navigate through it without ambiguity.	User-friendliness: How the system is easy to use and understand by users. Are the interfaces intuitive and self-explanatory. Is the system designed with a logical flow?	calculate the average time that users spend to explore and use the application. The average time should be 15 minutes to use the application easily and understand each feature.	- We tested with 10 users. We asked them to use the whole app to measure the time they take. - 8 users complete the required actions in 12 min which is below average. - 2 users spend 15 min which is considered the average time since they face difficulties in some aspects.
As an entertainment seeker, I want my password not to be less than 8 characters, so that it cannot be cracked from cyber threats and hackers.	Security: How can we guarantee that the password is implemented securely?	Calculate how secure the application is and how strong the password algorithm is.	- The system prevents user registration with a weak password, so according to NIST best practices, the minimum length of a password is 8 characters [28] for that we tested with 20 users while registering to provide a password with at least 8 characters, capital and small letters and special character. - To safeguard account passwords, Firebase Authentication uses a customized script to hash them [29].



<p>As an entertainment seeker, I want the Riyadh guide application available 99% of the time, so that I can access it without obstruction or interference.</p>	<p>Availability: How long can the system be available in a month?</p>	<p>See the service level agreement of the firebase hosting server since they will ensure the system availability.</p>	<p>According to firebase service level agreement, the server will be available at least 99.95% of the time each month [30].</p>
<p>As an entertainment seeker, I want the page load time to be within 3 seconds, so that I can move through the pages without wasting my time.</p>	<p>Speed: What is the average page load time measured during performance testing?</p>	<p>Average page load time measured during performance testing.</p>	<p>Average page load time for 5 pages is 1 seconds. All pages meet the 3-second target.</p>

Table 7: NFR testing

5.4. Discussion

After conducting User Acceptance Testing, we can conclude that the Riyadh Guide application is easy to use and understandable Since 70% of participants didn't need any help to perform their tasks. 80% of participants were satisfied with all features since they work as expected and 100% of them answered yes when we asked them to evaluate their familiarity

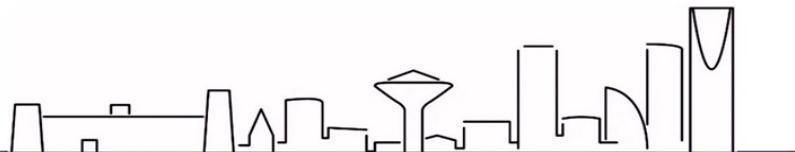


with the interface icons and buttons. This indicates that the interface is clear and contains easily recognizable visual elements that convey their function or purpose.

Both the admin and user testing team executed their tasks easily, as shown by the bar graph illustrated in Figures 62 and 63. When asked about the likelihood of serving as administrators for the application, 60% of the admin testing team responded with a strong agreement, as shown in figure 64. This indicates The effectiveness of the application while the admin performs their tasks. In addition, when the user testing team was asked if they would recommend the application to people, 60% of users strongly agreed and 20% agreed. This indicates that the application is working as intended, as users perceive it to be useful for people. Furthermore, it keeps them informed about the latest entertainment and recreational venues.

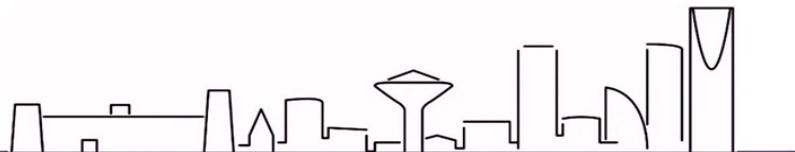
We have evaluated the overall visual design satisfaction by asking them about any design improvement suggestions. 60% of the answers were happy with the design. This reflects a high level of satisfaction with the interface design, praising its user-friendly nature and its ability to facilitate easy navigation and interaction and indicated their joy and appreciation for the well-designed interface, which enhanced their overall user experience, while 40 % of them suggested minor modification suggestions regarding fonts and colors, aiming to further enhance the overall visual experience as shown in figures 56 and 57

The last question shown in figures 58 and 59 and figure measures the system functionality and ease of use by asking participants if they encountered any difficulties during the application's testing, and if they have any suggestions regarding the system's features. 70% of the total, expressed their satisfaction with the results obtained from the testing. They were pleased with the performance of the application and found it to meet their expectations effectively. Additionally, their lack of suggestions indicates that the application has successfully fulfilled their needs and provided a seamless user experience without any major areas of concern or improvement, while 30% provided valuable suggestions for improving the system. Their suggestions included expanding the system's coverage to include more cities, as well as incorporating additional details for each place. These details could include information on pricing, accessibility for individuals with special needs, and suitability for children. We appreciate the suggestions provided by the respondents, and we will certainly



consider implementing them to enhance the system's functionality. However, the feasibility of incorporating these suggestions will depend on the available time and resources. Our team will assess the implementation timeline and prioritize these suggestions accordingly, aiming to provide an improved experience for our users in the future.

For non-functional requirement testing, as shown in Table 7, all the non-functional requirements are met and have yielded good results, indicating that the application performs well. We aim to further enhance user-friendliness and speed by improving the interfaces and optimizing the back-end to provide better overall user experience.



6. Conclusions and Future Work

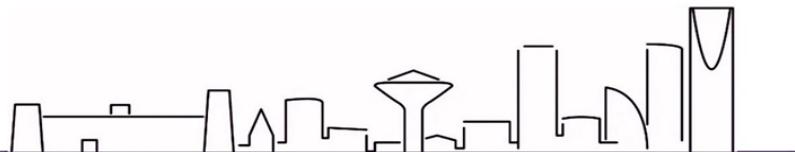
In this section we will provide a summary of the achievements and impact locally and globally of the Riyadh guide application, address any limitations or challenges encountered, the main contribution of the application , and the future directions for improvement and expansion of our application features.

6.1. Global and local impact

With all the development happening in Saudi Arabia, including the Vision 2030 initiative and the upcoming Expo 2030, the Riyadh guide application becomes even more crucial. These ambitious projects aim to transform the country and position it as a global hub for business, innovation, and tourism.

As Saudi Arabia opens up to the world and welcomes international visitors, the tourism application will play a significant role in attracting tourists to Riyadh. Its impact will extend globally, as it showcases the city's unique cultural heritage, modern infrastructure, and exciting opportunities. Through our user-friendly interface that ensures ease of use for visitors. The application will feature intuitive navigation and clear categorization of places based on tourists' preferences, such as tourist attractions, shopping districts, entertainment activities, and latest events. By providing these categories, tourists can easily explore the city based on their interests and preferences. The application will also include an extensive database of tourist places and local businesses, ensuring that visitors have access to a wide range of options.

In addition to its global impact, the Riyadh guide application will have a significant local impact by supporting and promoting local businesses within the city. The application will feature a comprehensive database of local cafes, restaurants, shops, and other establishments, encouraging tourists to explore and patronize these businesses. In addition, the application will help people in maximizing the advantages of their bank cards. Through the app, individuals can conveniently access the offers and discounts available across various destinations in Riyadh. This not only enhances their overall experience but also enables them to make the most of their bank cards by enjoying valuable savings while exploring the city. With all the offers and discounts conveniently displayed in one place, users can easily browse through the options and select the ones that best suit their preferences and interests.



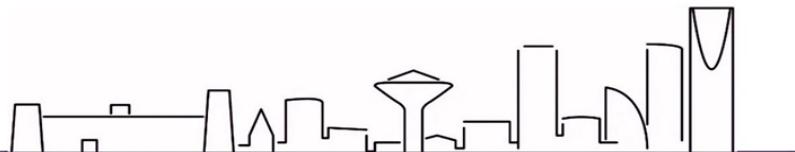
In conclusion, the Riyadh guide application will be an invaluable tool in promoting Riyadh as a prime tourist destination and capitalizing on the opportunities presented by the Vision 2030 and Expo 2030. Its global impact will attract tourists from all corners of the world, fostering a positive image of Riyadh as a must-visit city.

6.2. Problems and challenges encountered during the software development

As we progressed through the project lifecycle, challenges emerged that demanded our attention and problem-solving skills. This section is dedicated to a comprehensive exploration of these hurdles.

We encountered a significant challenge when opting to gather our data using the X API. After obtaining the necessary codes for data collection and comprehending the underlying mechanism, we discovered that X application had altered its permissions and overall system. Undeterred, we made concerted efforts to swiftly identify an alternative approach that aligned with our plans, ensuring a seamless continuation of our work without hindrance. To address this setback, we conducted thorough research and identified Google map scraper as a viable solution, enabling us to collect data from Google Maps.

The development of a calendar feature has presented a second challenge, as we have encountered the unavailability of APIs or updatable datasets that provide comprehensive information about new events and openings in Riyadh. In an effort to overcome this obstacle, we reached out to a member of the General Entertainment Authority about the possibilities of giving us a resource or an updatable calendar of events. However, their response indicated that they are not aware of events in their early stages and only update their website on a weekly basis. As an alternative solution, we have decided to utilize the Webook website, which has proven to be a reliable source of information regarding events and happenings in the region.



The third challenge that we encountered in the process of adopting Flutter for our development endeavors was a steep learning curve. We embarked on a journey of both learning and coding, investing significant time in extensive searches and hands-on exploration within the Flutter framework and Dart programming language. Throughout this immersive experience, we actively sought and experimented with various alternatives, all in the pursuit of attaining the specific results we aimed for in our development efforts.

6.3. Limitations of the system

Riyadh guide application is focused on exploring Riyadh places and events, so it has limited geographic scope and only limited in Riyadh city. In addition, we wanted the app to be attractive to the people in Saudi Arabia and all the middle east. Due to this focus, the app is currently available only in Arabic, which may limit its accessibility for non-Arabic speakers or tourists who may not be fluent in the language. Lastly, due to the project time, we had to eliminate some functionalities that might be available in other applications such as reservations.

6.4. The main contribution of the project

The Riyadh Guide makes a significant contribution to transforming the tourism landscape in Riyadh. It efficiently addresses the challenges faced by tourists and residents in discovering cultural, historical, and modern attractions in Riyadh. Additionally, it doesn't only streamline the information retrieval process but also aligns with Vision 2030's goal of making Saudi capital Riyadh a prominent global destination for quality of life and tourism. The project demonstrates a progressive and innovative approach by leveraging advanced technologies, such as supervised machine learning and APIs. Its comprehensive system design and implementation underscore a commitment to delivering a high-quality and user-centric solution, ultimately enhancing the overall urban experience in Riyadh.

6.5. Future work

For the Riyadh Guide application, we are considering adding more features and functions to better help users in the future, such as:



- Supporting the English language.
- Have contracts with some places to provide special discount cards for our users.
- Add reservation feature for places and events.
- Add more bank cards and loyalty programs so it can serve as many users as possible.
- Add more places in the application.
- Allowing place owners to manage their place details.
- Adding place recommendation system.
- Having the option to make the user's favorite places public and allowing people that have the same interest to see each other's favorites.
- Filter places based on the closest to the users' location.
- Adding notification system to notify the user with the news and events in Riyadh.



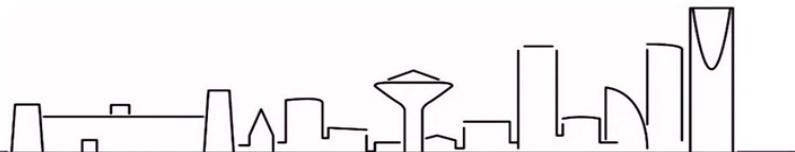
7. Acknowledgements

We extend our heartfelt gratitude to Allah for granting us the strength and capability to successfully complete our Riyadh Guide project. We would like to thank Dr. Lama Alsudias, our supervisor, for providing us with valuable guidance, constant support, and insightful feedback that has enhanced our journey. Through her mentorship, the Riyadh Guide application has been refined and improved with each iteration. Additionally, we express our sincere appreciation to L. Abeer AlDrees for her assistance in enhancing the design of our system database. Her contributions had a significant impact on the functionality of our application. We are also deeply thankful to our scrum master Dr. Maha Al-Yahya, whose expert guidance and unwavering support have facilitated the seamless execution of our agile process, enabling us to navigate challenges effectively. Furthermore, we gratefully acknowledge the insights and suggestions provided by the committee members, which have expanded our perspectives and enriched the quality of our project. Finally, thanks to our families, friends, and all those who have supported us throughout this endeavor. Their unwavering belief in our abilities and encouragement have been a constant source of motivation driving us towards success. We recognize that our achievements would not have been done without their steadfast support and encouragement.



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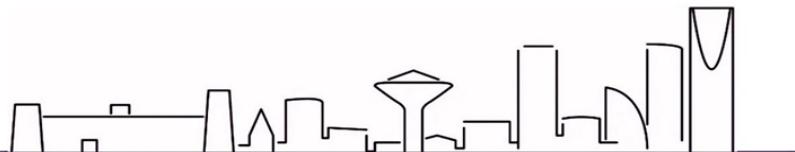
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9. Appendices

9.1. Appendix A: Interviews

Interviews' Transcriptions:

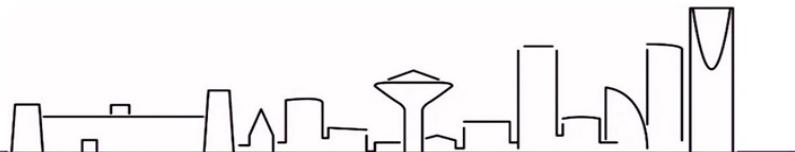
Interview 1 Outline	
Interviewee: Ameerah	Interviewer: Dana
Medium/Location: phone call	Date: 7/Sep/2023
Objectives: Requirements elicitation and identifying user's needs.	Reminders: The interviewee has interest in visiting new places in Riyadh
Agenda: Introduction Background of project Overview of interview Each question Question from the interviewee Closing	Approximate Time: 1min 2min 1min 3min 2min 1min
Question1: What kind of places do you like to visit in Riyadh?	Answer1: There are a lot of good places in Riyadh, but I mostly like to visit and try new restaurants and cafes. Not only for the food, but I also like studying in cafes that have calming vibes.
Question2: Where do you usually search for information about places you are interested in	Answer2: I usually search for new places on social media. I also use some applications but usually the



Interview 1 Outline	
visiting in Riyadh?	applications only have famous places and it's hard to find new places on them.
Question3: If you want to see some reviews about a place, what do you think is the easiest and simplest way to view them?	Answer3: Some people write long reviews and I simply want to know if the place is good or not. So, I think if the reviews can be shortened to good or bad it would be easier.
Question4: What are the details you need to know about a place before deciding to visit it?	Answer4: An overview about the place and its location and whether it needs reservation or not.

Table 8: Interview 1

Interview 2 Outline	
Interviewee: Saud	Interviewer: Dana
Medium/Location: House	Date: 8/Sep/2023
Objectives: Requirements elicitation and identifying user's needs.	Reminders: The interviewee has interest in visiting new places in Riyadh
Agenda:	Approximate Time:
Introduction	1min
Background of project	2min

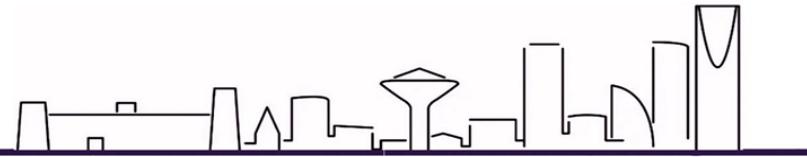


Overview of interview	1min
Each question	3min
Question from the interviewee	none
Closing	1min
Question1: What kind of places do you like to visit in Riyadh?	Answer1: I like to go to entertainment places and events where there are some activities and games so that me and my friends can hang out and have fun.
Question2: Where do you usually search for information about places you are interested in visiting in Riyadh?	Answer2: I mostly know about places when a friend recommends it to me and sometimes, I search on social media
Question3: If you want to see some reviews about a place, what do you think is the easiest and simplest way to view them?	Answer3: I think showing a percentage of how much people liked the place would be a very simple way and everyone would understand it
Question4: What are the details you need to know about a place before deciding to visit it?	Answer4: Knowing the opening and closing hours for a place would be important. And for activities, I want to know the number of people that can enter the activity so I can decide if it is suitable for me and my friends or not.

Table 9: Interview 2



Interview 3 Outline	
Interviewee: Nawal	Interviewer: Dana
Medium/Location: House	Date: 8/Sep/2023
Objectives: Requirements elicitation and identifying user's needs.	Reminders: The interviewee has interest in visiting new places in Riyadh
Agenda: Introduction Background of project Overview of interview Each question Question from the interviewee Closing	Approximate Time: 1min 2min 1min 3min 1min 1min
Question1: What kind of places do you like to visit in Riyadh?	Answer1: I usually go to malls and kids' entertainment places for my children. And I also love to go to salons and spas from time to time.
Question2: Where do you usually search for information about places you are interested in visiting in Riyadh?	Answer2: On social media but sometimes I don't find the place that I'm looking for. And sometimes the place itself has an application where it has information, so I use it.
Question3: If you want to see some reviews about a place, what do you think is the easiest and	Answer3: I think seeing short reviews like the place is good, fun, not worth the visit, or any other short



Interview 3 Outline	
simplest way to view them?	but informative reviews would be easy and simple.
Question4: What are the details you need to know about a place before deciding to visit it?	Answer4: Since some places don't allow children, I would like to know if the place allows children or not. Also, the location of the place and opening hours.

Table 10: Interview 3



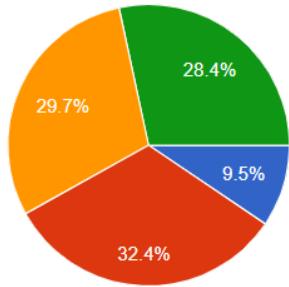
9.2. Appendix B: Requirements Questionnaire

?How old are you

كم عمرك؟

رداً 74

- أقل من 18 | ١٨ من إلى ١٨ | ٢٤ من إلى ٢٥ | ٤٠ من إلى ٤٠ | أكبر من ٤٠
- 18 - 24 years old | ١٨ إلى ٢٤
- 25 - 40 years old | ٢٥ إلى ٤٠
- More than 40 | أكثر من ٤٠



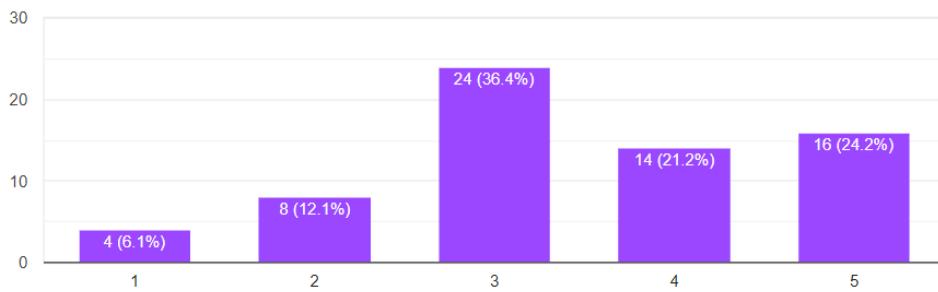


نعم

If yes, how would you rate the quality and recency of information related to Riyadh places in the applications you have tried

إذا نعم، ما تقييمك لجودة وحداثة المعلومات المتعلقة باماكن الرياض في التطبيقات التي قمت بتجربتها؟

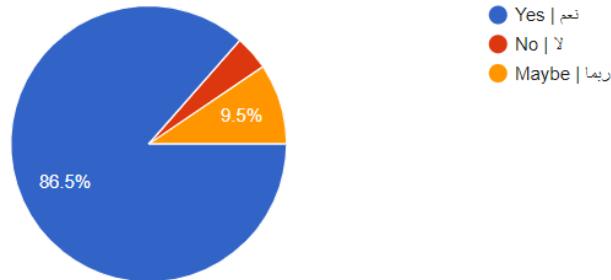
رداً 66



?Would you like to see information about Riyadh events and places in Arabic

هل ترغب في الاطلاع على معلومات عن فعاليات و أماكن الرياض باللغة العربية؟

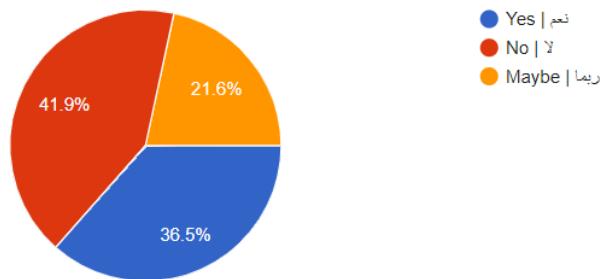
رداً 74



Do you find it easy to know what bank card or loyalty program gives you the best offer for a place

هل تجد أنه من السهل معرفة أي بطاقة مصرفيه أو برنامج الولاء يقدم لك أفضل عرض لمكان ما؟

رداً 74



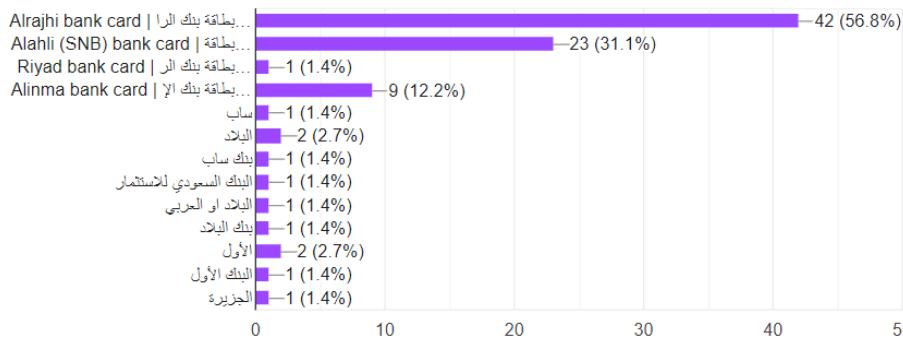


نسخ

?Which bank card do you use

ما هي البطاقة المصرفية التي تستخدمها؟

رداً 74

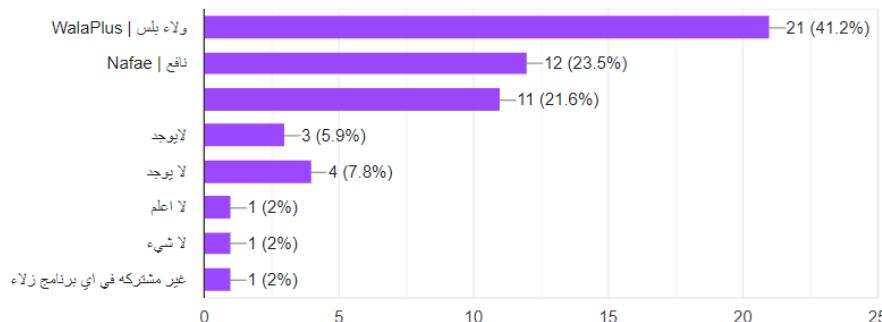


نعم

?Which loyalty program are you in, if any

في أي برنامج ولاء أنت مشترك، إن وجد؟

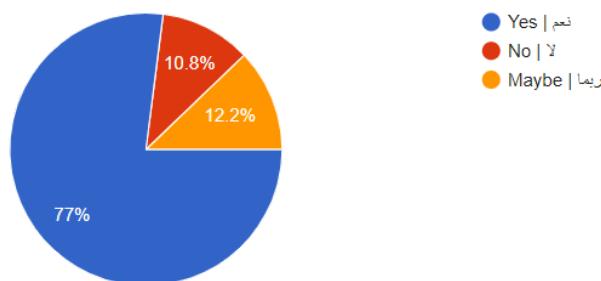
رداً 51



Would you like to know about the daily events in Riyadh and what is the news about
places

هل ترغب بمعرفة الفعاليات اليومية في الرياض والأخبار الجديدة عن الأماكن؟

رداً 74



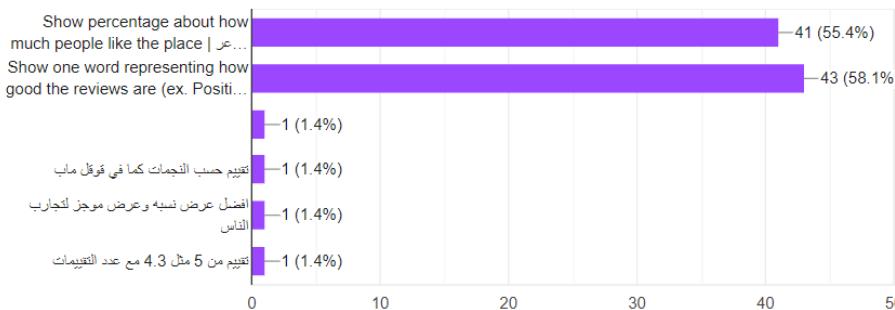


لمسة

?What do you think is the best and easiest way to view reviews about a place

ما هي الطريقة الأفضل والأسهل في رأيك لعرض التقييمات حول مكان ما؟

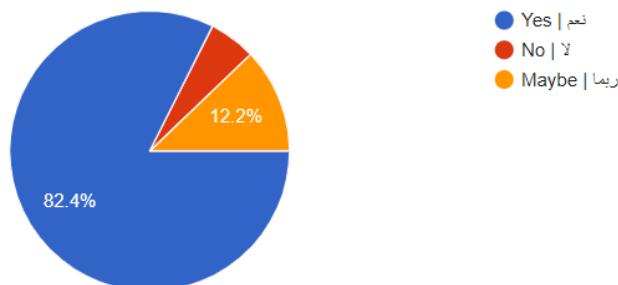
رداً 74



?Would you like to save a place you like in your account so you can find it later

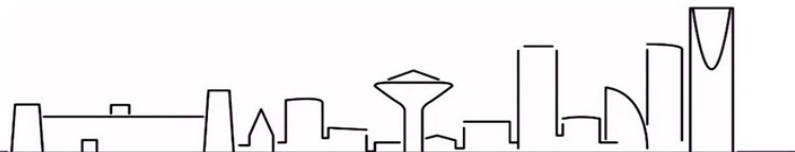
هل ترغب في حفظ المكان الذي اعجبك في حسابك حتى تتمكن من العثور عليه لاحقاً؟

رداً 74



Link to the questionnaire:

https://docs.google.com/forms/d/e/1FAIpQLScKCokqNaTdl90PxicBD1deV7tGJyTp0SzInQidxDLEF1Drg/viewform?usp=sf_link



9.3. Appendix C: Jira and Github

- Jira

<https://2023-1st-gp9.atlassian.net/jira/software/projects/GP/boards/2>

- Github

<https://github.com/DanaAlotay/2023-GP1-9.git>

9.4. Appendix D : UAT Questionnaire

- Q1 : How old are you?
- Q2 : What is your gender?
- Q3 : How would you rate the level of experience you have in mobile applications?
- Q4 : Were there familiar elements (buttons, icons, etc.) that helped you understand the system?
- Q5 : Do you need some help using the application?
- Q6: All features are working as I expected
- Q7 : Considering the colors and fonts used, how would you rate the overall design aesthetics of the app? Any specific suggestions for design improvement?
- Q8 : Were there any aspects of the app that you found confusing or challenging? Do you have any suggestions to improve the application's functionalities?



- Q9 : Choose all functionalities that you easily accomplished :
- Q10 Admin specific : What is your level of interest in tourism and entertainment? and your desire to share tourist attractions and entertainment places with people ?
- Q11 Admin specific : It is possible for you to be one of the administrators for this application?
- Q12 User specific : I would recommend this application to the people I know

Link to Admin questionnaire:

https://docs.google.com/forms/d/e/1FAIpQLSer0U5taY_3dG4OT2rJlaifrnjfsZ7AvTwBAV_fRInDy0NFw/viewform?usp=sf_link

Link to User questionnaire:

https://docs.google.com/forms/d/e/1FAIpQLSc8deBS52Yhc-5AxtVJ9f3g2LYEW1TwsEiP_DDS6ovCTzlEPg/viewform