Smart Tourism

(Dalilak Application)

(Report)

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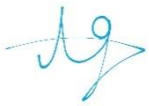
Name: **Ahmed Alghamdi**	Signature: 	Date: 12/13/2021
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Abstract

Nowadays, many people are using smartphones to get information about their needs. In Saudi Arabia, tourism is one of the most important aspects in 2030 vision. Moreover, tourism in Saudi Arabia has been witnessing rapid growth in recent times and opening new horizons for the tourism industry. In this project, we decide to create a tourist application for the cities of the Kingdom of Saudi Arabia since it's needed for tourists who visit the country. The goal of the application is to guide tourists to the best areas in the city then direct them to tourist places such as historical areas, natural places, and events. This application aims to facilitate the scheduling and organization of their trips, the application focuses on the service of domestic tourism in the country by providing opportunities for residents of the city or others to share their tourism experiences as guides. Thus, we conclude that the way we discussed the problem is centered to improving tourism experience in kingdom of Saudi Arabia by developing smartphone application that facilitate domestic tourism and provide guidance services for tourists

Keywords: Saudi Tour; Tourists apps; Travel; Dalilak.

ملخص مقترح البحث

في الوقت الحاضر، يستخدم العديد من الأشخاص الهواتف الذكية للحصول على معلومات حول احتياجاتهم. تعتبر السياحة في المملكة العربية السعودية من أهم جوانب رؤية 2030 لذلك، نلاحظ ان السياحة في المملكة العربية السعودية شهدت نموًا سريعًا في الآونة الأخيرة مما أدى الى ظهور آفاقًا جديدة لصناعة و تطوير السياحة. في هذا المشروع قررنا إنشاء تطبيق سياحي لمدن المملكة العربية السعودية بحيث أنه يكون مفيد و ضروري للسائحين الذين يزورون البلاد. الهدف من التطبيق هو إرشاد السائحين إلى أفضل المناطق في المدينة ثم توجيههم إلى الأماكن السياحية مثل المناطق التاريخية والأماكن الطبيعية والفعاليات النشطة. يهدف هذا التطبيق إلى تسهيل جدولة وتنظيم رحلات السياح، ويركز التطبيق على خدمة السياحة الداخلية في الدولة من خلال توفير الفرص لسكان المدينة أو غيرهم لمشاركة تجاربهم السياحية كمرشدين. وبالتالي، نستنتج أن الطريقة التي ناقشنا بها المشكلة تتمحور حول تحسين التجربة السياحية في المملكة العربية السعودية من خلال تطوير تطبيق للهواتف الذكية ليسهل السياحة الداخلية ويقدم خدمات إرشادية للسياح.

الكلمات المفتاحية: السياحة السعودية؛ تطبيقات السياحة؛ السفر؛ دليلك.

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In the name of Allah the Merciful

Chapter 1: Introduction

1.1 Overview and Problem Background

Tourism is an ancient method people knew to seek knowledge, treatment, economy, business, and religiosity, but people were facing difficulties to reach their destinations and get a guidance. In the past they were infers by the sun and stars then after a period with spread of science the people were know their destinations and locations by using drawn maps and guided by direction panels. Old nations were knowing the tourism is a travel to intended destination for an important private purpose without specify a time for entertainment, but in new tourism, the guidance of tourists is improved, and a new tourism concept appeared that is the tourists look for relaxing and having fun with convenient means for guidance and inference. The main goal of the journey is to manage the most of trip time for entertainment with interest about learning cultures, know about historical places, or visit natural places to relax. The tourism nowadays is an independent science and a social cultural which include the movement of people around the world that gives a purpose for learn about histories, cultures, and religions for some people and nations. Therefore, the tourism science has undergone many changes throughout history, and we clearly notice the interest from developers, managers, governments, and people about tourism and how they trying to improve and apply its systems for it. In view of the importance of tourism for most people around the world, the Dalilak Application will tend to deal with different technologies to facilitate the affairs of tourists and consider a procedure to deal with services of tourism by developing a system that will be compatible with smart tourism.

1.2 Problem Statement

Many tourists have problems with determining the places they want to visit, scheduling and manage their tourist plan, and the lack of experience in tourism. Furthermore, the tourism applications usually focus on solving tourists' problems such as making the agility of people in tourists places easier, manage their trips, locate best places, or provide an information, but most of the applications provide few services in tourism domains and the users must do many operations

manually in multiple apps that's cause to download many applications in users' phones and each app just provide few services. Therefore, some applications lead to amplify the problem but, they solve specific problems, and their targets audience is very specific, or they provide extra services that have no relation with tourism, but they solve public problems that could help the tourists in the destinations. For tourism applications it's good to develop complete application with automate and smooth methods that provide tourism services. Thus, we intend to solve some of tourist's problems by applying scheduling methods which itself an (NP Hard) problem, it requires deep understanding of prediction, data analysis and big data algorithms, it's lead to other problems which it how to analyze the data to get an accurate result that doesn't waste users time and make the trip schedule clear and compatible with user's needs. The application should be with clear user interface and understandable functionalities to prove the performance of the system by simplicity of use the app and quality of the services provided to tourism. Thus, this project will describe the plan to develop an application that could provide solutions to solve the mentioned problems, include automated and manual solutions, and ease of use with coherent system, and good services to make the tourism easier and faster.

1.3 Aim of the Project and Objectives

The system will be a smartphone application, focus on guide people, manage their trips, give information, locate events, natural places, and historical places. The application will be developed using specific methods and tools includes artificial intelligence, data science, and .Net framework. The system will be developed and implemented as a mobile phone application and website related to Smart Tourism works. According to, the application will serve tourists in different four sections, scheduling trips, recommending events, a guide to natural, and historical places. It will provide facilitation the tourism experiences, develop an automation way to plan tours, help people in cities to find the events places, Guide people to good but unknown Natural places, and show historical monuments in the cities of Saudi Arabia. In the other hand of the system, we aim to develop a website to manage the system include database, and users via another user as administrator of the system.

- For the application we intend to develop methods to make scheduling tourist trips more efficient. To let tourists, organize their trips and not waste their time.
    - Develop automated scheduling that depends on users' requirements that are processed and analyzed by applying Artificial Intelligence and Data analysis algorithms, it will give multiple recommendations based on tourists' requirements.
    - Designing an interface to let the user schedule and manage the trip manually that makes the user have unlimited choices.
    - Develop a chat program (or Bot) that allows the users to take guidance from guider or Auto Chat. It's helpful for those who want advice from local guiders or preferences from Bot.
- The system will collect accurate information about events in each city to make track of the events' time and locations.
    - Gather events information and organize them into lists to make browsing them easier for users.
    - By tracking events time, we intend to classify them into two categories (Active, Inactive) to give more reliability.
- To give an information about natural and historical places, that make tourists browse the app and have an insight background about their destination.

- Design an interface to show general data for users about the place as what type of services there, location on the map, and notes from other users and guiders. This information is useful to help tourists with managing their trips.

- To develop a method to give an ability for guiders to add new natural places into the system dynamically as advice for tourists.

- Develop a method that generates a QR Code for historical places, showing historical information about the place when the user scans it.

➢ Design a dashboard to manage the system by the stockholder (Administrator).

- Develop control panel as a website

1.4 Scope

The system boundaries are bounded of three users of the system, they are tourists, guiders, and administrators each type of users will use the system in different situations, and goals. The main deliverable for the tourists is an application to provide services and information in tourism sectors, and tourists is the main target audience for the project with the more important deliverable. Therefore, the guiders will be a part of the system who serve the tourists, the tour guide is considered one of the beneficiaries and service providers within the system, so that he will have some features, abilities, and characteristics that help to provide an assistance and suggestions to the tourists. The administrator is one of the users who is responsible of manage, verify the correctness of the information entered into the application and ensure the efficiency of the tour guide in providing the service to tourists. According to, the final deliverable for the administrators is a website that's make manage and monitor the system easier than the application. Thus, the system have two product as final deliverables which they are an application, and website and only three types of users they are tourists, guiders, and admins, such a way the admin responsible about

the system and guiders inputs, the guider will be responsible about helping tourists and correct the information if there is any mistake, and the last user is the tourist who will be the end user who has the most of the attention.

1.5 Contribution/Significance of the Project

By the end of this project, our system will be delivered as expected, with a lot of advanced, reliable, available, and ease of use techniques which will obtain the following benefits:

- For facilitating the tourists' arrival to their destination in an organized, updatable, easy to manage way.

- For keeping track of who is managing their trips and events by using the system, when the tourist, tourist guides, managers of events and festivals are most likely to be available to combine them all to get the most out of these users, and last in smart tourism how is the system take care of them all.

- For assisting the tourist with problem handling their trips and tourism Scheduling.

- For helping the tourist to determine the places that are on the verge of existence and revive them.

- For helping users to update their knowledge of tourism and become more secure about using smart systems in their regular life in general and secure about their trips organizing and managing that will open a new horizon of the world of tourism.

- For help in identifying the main purpose of tourism in our humble perspective and inject this humble perspective with the smart system to become easy to handle.

1.6 Activity Plan

Work Plan 1

	ACTIVITIES	START	DUE
	Prepare The Project Idea:	**28/Sep**	**07/Oct**
1	Search and collect ideas	28/Sep	30/Sep
2	Disscuss Ideas	01/Oct	01/Oct
3	Choose the project idea	02/Oct	04/Oct
4	Write and review the abstract	05/Oct	07/Oct
	Propose the project:	**11/Oct**	**20/Oct**
6	Plan the initial timeline	11/Oct	11/Oct
7	Search for related works	12/Oct	14/Oct
8	Write proposal introduction	12/Oct	14/Oct
9	Specify proposed objectives	15/Oct	17/Oct
10	Search and write about methodology	15/Oct	17/Oct
11	Specify expected benefits	17/Oct	18/Oct
12	Review the proposal (Revision)	19/Oct	20/Oct

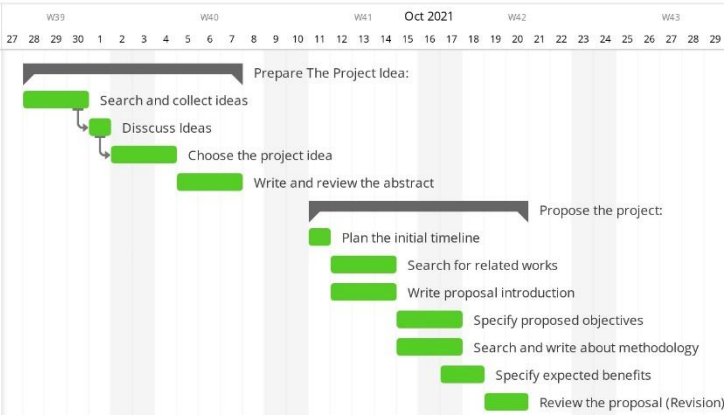

Figure 1: Proposal Work Plan

Work Plan 2

	ACTIVITIES	START	DUE
	Introduction:	**21/Oct**	**28/Oct**
1	Design the gantt chart (Activity Plan)	21/Oct	23/Oct
2	Write an overview and the problem background	24/Oct	26/Oct
3	Define the problem statment	24/Oct	26/Oct
4	Write the aim and objectives of the project	25/Oct	26/Oct
5	Define the Scop of the project	26/Oct	27/Oct
6	Introduction Revision	28/Oct	28/Oct
	Literature Review:	**29/Oct**	**14/Nov**
8	Collect Information of groundwork	29/Oct	01/Nov
9	Collect information about related works	02/Nov	06/Nov
10	Write the summary of the related works	07/Nov	09/Nov
11	Describe Dalilak Application	10/Nov	11/Nov
12	Compare with related works	10/Nov	11/Nov
13	Literature Review Revision	12/Nov	14/Nov
	System Analysis and Design:	**15/Nov**	**06/Dec**
15	Write information about the Methodology (RAD)	15/Nov	17/Nov
16	Discuss System requirements	18/Nov	18/Nov
17	Write users stories (Scenarios)	19/Nov	21/Nov
18	Design Process flows (Scenarios)	20/Nov	21/Nov
19	Discuss System Functionality and non-function...	22/Nov	22/Nov
20	Design use case Diagram	23/Nov	25/Nov
21	Design Sequence Diagram	25/Nov	27/Nov
22	Write Functional and Non-Functional Requirme...	28/Nov	28/Nov
23	Discuss Database entities and relations	29/Nov	29/Nov
24	Design ER Diagram	30/Nov	03/Dec
25	Design relationla Schema	30/Nov	03/Dec
26	Design Database Schema (Class Diagram)	04/Dec	05/Dec
27	Chapter Revision	06/Dec	06/Dec
	Implementation and Test:	**25/Nov**	**06/Dec**
29	Search for environment requirements	25/Nov	28/Nov
30	Write Environment Specifications	29/Nov	30/Nov
31	Design an initial Prototype	01/Dec	05/Dec
32	Implementation and Test Revision	06/Dec	06/Dec
	Conclusion:	**07/Dec**	**13/Dec**
34	Report Revision	07/Dec	07/Dec
35	Conclude the report	07/Dec	07/Dec
36	Design a presentation	08/Dec	13/Dec

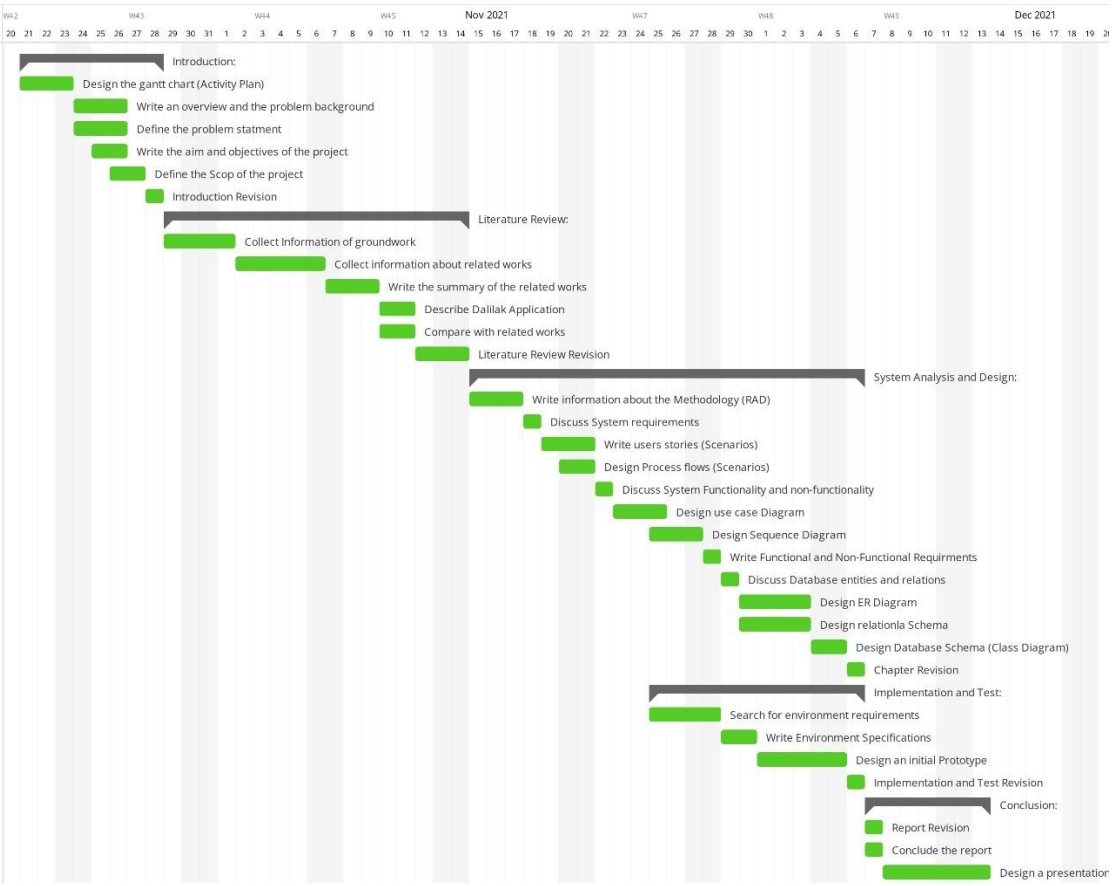

Figure 2: Project Work Plan

1.7 introduction to the next chapters

The next chapters include literature review, system analysis and design, implementation and test, and the last chapter is conclusion of the project. First, we will give an overview of the groundwork of the tourism systems, clarify the difference between two types of tourism systems, give an overview of related works that's improve the horizon of tourism systems, and compare Dalilak application with other related works have same background of the problem. Second chapter will apply the methodology to design Dalilak system and discuss the approach that will be used to develop the system with analyze of the use cases, diagrams, database, functionality, and non-functionality of the system. Therefore, implementation and test chapter will give the bases of the approach uses such as environment requirements and the tools that could help the development staff to develop the system. In the end of the document, we could conclude the project content's and give some advices to what could the community receives of this project.

Chapter 2: Literature Review

2.1 Introduction to Literature Review

The Huge revolution of technologies lead to minimizing the effort and cost of managing tourists by applying several theories such as electronic tourism (**eTourism**) and **Smart Tourism**.

The chapter will contain several topics they related to eTourism and Smart Tourism theories, cover summary of papers and applications that improved the tourism around the world by applying AI, Data science, internet of things and many modern solutions, compare Dalilak application with most used applications in Saudi Arabia and provide a new insight and develop it after evaluating the literature information.

Smart Tourism and eTourism are the major two theories developed parallel with the technologies but notice that eTourism has stopped growing when smart phones appeared, in the other hand Smart Tourism still growth and developed until these day's unlike eTourism.

eTourism

eTourism is a theory aims to query the information and digitalization of tourism industry, it is usually used pre/post the trip and the websites are the major technology to refer this theory by focusing on attract the tourists to their destinations.[*1*] In addition, if eTourism mentioned that's means the system will help the tourists to know more as possible about their destinations and give them an ability to schedule their trip and manage their journey budget.

Smart Tourism

The theoretical of **Smart Tourism** defining as facilitate the digital and physical services to the tourists pre/during/post the trip. Smart phones are the most common technologies to apply the concepts of this theory for example, google map, booking and Saudi airlines applications.[*1*] Smart Tourism systems usually being more complex than eTourism because it serves and guide the tourists during the journey. Most of these systems follow different aspects to make the tourists feel comfortable with no worries about their next steps, how to reach their destinations, and what are the public services near of their locations.

eTourism is a part of Smart Tourism because what is the eTourism provide usually is provided too from Smart Tourism systems. Also, eTourism systems are not popular nowadays because the rapid improvement of technologies and smartphones leaded to make developers focus and highlight Smart Tourism.

Table 1: Compare between e-Tourism and Smart Tourism [1]

	e-Tourism	**Smart Tourism**
Travel Phase	Pre / Post	Pre / During / Post
Sphere	Digital	Digital / Physical
Fundamental Technology	Websites	Sensors and Smartphones
Depends on	Information	Big Data
Structure	Value Chain	Ecosystem
Sharing	Passive	Active

2.2 Summary of Related Works

There are many systems that developed to make the tourism easier around the world and these systems serve tourists based on the previews two theories which they are eTourism or Smart Tourism. These systems have different aspects that improved the tourism for people.

- **eTourism Related Works**

- **iTravel Paper**

In this related paper that develop a system depends on theoretical of ontology, the ontology (one of the investigations of philosophy). The system populates the ontology by execute information-extracting-tool that will gather data from previous information that were posted by tour guides. It is extracted through a set of logical programs to express the information contained in the ontology to choose the holiday packages that suit the tourist. Their system aims to predict packages based on the extracted information, these packages will be compatible with users' needs and accessible via website. [2]

- **Travelocity System**

Is one of e-Tourism agencies that do build the trip system for travelers, the system facilitates some operations pre travel with one click as booking hotels, flights, cars and whatever the tourists want to do. The system is also called a Destination Management System (DMS), they offer a verity of services considering the travelers destination and trip costs, with availability for 24/7, they combine several services of that to produce a reliable, good, and cheap trips for travelers. [3]

- **Tourism India Website**

It is an application shows an information and map location of some places in India to the users, it helps to collect data about specific region or country, there are many applications and websites like it which they provide only querying services and have small target audience. It a basic eTourism systems with simple goal that is collecting some information pre travel. [4]

- **Opening new dimensions for e-tourism (Paper)**

This is a related paper describes a system that virtualize tourists, guiders, and knowledge seeker in 3D environment. Regardless about their implementation which their system was implemented as a 3D game environment, but their idea to make an active and interactive eTourism environment by making different types of people meets with each other to talk about tourism. It's an eTourism system because the system designed to collect and share information. Therefore, the environment represents lively society that exchange travel information, consulting about destinations and communicate with different people to get/give useful tourism or business information. [5]

❖ Smart Tourism Related Works

- **Find Tourist Profile (Paper)**

A paper is related to Smart Tourism systems, it developed using Artificial Intelligence deep learning and fuzzy logic algorithms and techniques to recognize users' preferences based on images and their geolocation. The system focuses on making the accessibility to the collected data, reviews, and experiences about tourism simpler and not complex by categorize the tourists to different five categories then give a preference to them after analyzing the images. What's make the system helpful for tourists is that it minimizes the results of collected information based on the classifying, especially that is the accuracy of result around 82%. We attracted about fuzzy logic topic, and we wondered about how it could help to give an accurate result. In few words we define the fuzzy logic techniques and algorithms, is processes have no relation with statements of binary truth/false, but it deals with all possible truth/false values on the same variable to give a result between absolute false (0) and absolute truth (1), it simulates the human's brain to analyze problems and make decisions, so that's helping to achieve an accurate result. [6]

- **Curumim System**

It's a system that aims to develop users experience by studying their human curiosity. The system is recommending the users depend on their curiosity and the recommendations will be compatible for every person's personality. [7] The system gathering information of users from the social network apps. There are three difficulties that face the system:

- Diversity: This concept is different from similarity. It refers to the diversity of the recommended items.
- Novelty: is a category that shows the recommendations of unknown items. Its popularity is computed by averaging the popularity of the items suggested by the algorithm.
- Serendipity in recommender systems can be difficult to measure and simulate. Usually, the terms are used to describe different interpretations of the same concept.

- **HotCity Application**

It is a platform that exploits the geographically determined social data of circulation by viewing the location of the tourists and the data of the tourists. Tourists' data is very useful to know the opinions of tourism in the areas they visited before and to gives their impression of the site. The system is tracking of tourists' locations by allowing GPS in android application HotCity to notify the users about most liked and rated socialized places in the city. [8]

- **SHCIty**

In view of evolution of technology, and due to of increased use of mobile applications. It exploits this app the rapid growth of tourism to increase the tourist experience, using and integrating between real-time data and routing algorithms. The tourist will use the application to have real time information about all the monuments available for visit, a full set of predefined circuits with different visit times and the possibility to create an optimized circuit combining the user preferences such as the favorite visit time and how many monuments to visit. [9]

- **Smart City Tourism**

As the name suggests you can have a smart travel a telecom company in Belgium called orange have been developing this type of smart travel to their city (Antwerp) they started with developing crowd management that connects to tourists' phones via the Wi-Fi in certain area. The tourists can act before, during, and after the travel, from reservation your flight (if exists) to you travel

evaluation, this related system is almost close to remove something called papers approves, logistics between countries, and more of these time and money consuming formulas. In the smart city tourism, the apps in smart phones the sensers in the streets and tourism places, the services city offers, and the community all of that is activating with the tourists to make their trips easy as possible. [10]

2.3 Comparison of Related Works

The are many mobile applications that focuses to make tourist experience easier, faster, wider, and more comfortable. These applications developed with several aspects of mobile communication, cloud computing, AI, machine learning to build a perfect environment that tourists could count on it.

We compared the proposed system with three applications they are Sowah, Rehlat, and Visit Saudi. Each application has unique design, features, and services to provide them for special target audience.

- **Sowah Application**

Sowah is a mobile application related to smart tourism aims to guide Arabian tourists in several countries around the world by providing information about hotels, cafes, restaurants, entertainment, mosques, and shopping places for some cities in specific country. The application designed to make tourists explore more, gain a good background pre travel and good preferences by browsing during the journey, it guides the tourists to the best places in the city by highlight it within Active Section, Suggested Places Section or by people recommendations in the comments. [11]

The application gives the tourists good experiences that facilitate their trips:

- It provides a map that show the most visited cities.
- Ease of use and good user interface design makes the access of entertainment places easier.
- Shows clear Knowledge about cafes and restaurants with visitors assesses.

- Provide good insight to tourists about active places in the city, and suggested places.
- Detect user location.

➢ **Rehlat Application**

This system is an e-tourism application supported for IOS only. The application provides an information about the most important historical monuments, geographical nature, and tourist attractions in specific cities, it navigates the users to Google Maps or Apple Maps and provide information in interesting ways. Some of the most its important characteristics: [12]

- Browse the application without the Internet.
- Browse the most important halal restaurants
- Important information about obtaining a European Schengen visa
- Serves tourists who want to travel to European countries
- It provides information about the embassies of some Arab countries.

➢ **Visit Saudi Application**

A Saudi tourist application to explore the nature of Saudi Arabia for historical areas and events for mobile phones and smart devices, on the official interactive platform under the supervision of the Saudi Tourism Authority, as it is a tourist guide for all tourist sites and public services such as markets, restaurants, beaches and other recreational places supported by pictures, offering more advantages for the tourist Such as booking hotels and the tourist requirements and arranging services from travel to accommodation, targeting tourists coming to the Kingdom and wishing to visit Saudi entertainment. This application distinguishes the availability of a tour guide or a direct communication box with the tourist and informing him of what he needs. This app is Smart Tourism. [13]

- Adventure
- Nature, sightseeing

- Culture and arts
- Shopping and buying
- Foods

❖ **Dalilak Application**

It is a proposed system that serves tourists and facilitates their arrival to their destination in organized ways without wasting their time. the system is considered a type of smart tourism method, the system achieves the needs of tourists who want to spend their trip in an organized manner and in less time. The system is characterized by several of its advantages considering some important ones:

- Scheduling trips automatically or through a tour guide.
- The system facilitates access to tourist places (historical and nature).
- Organizing and scheduling the trip automatically for the tourist, that way they do not waste their time, the system can also choose a tour guide to organize your trip.
- The system will be adaptive, the QR codes that are going to be widespread between the tourist places giving brief information about that place, such as a description of the place, time of opening/closing, condition (active/inactive), location, the rating of tourists/guides, the history of that place if found, and so on so far.
- The system will allow the users to enter a chat room through an app, in which they can request what they want from the place and to be answered automatically, by a guider, or a reviewer (another user of the systems' chatroom).
- The system will update the tourist places automatically, or with the help of the system users.
- The system will track the best users scheduling trips rating and give suggestions for the users.
-

❖ Comparison Table

Table 2: Comparison between Dalilak System and Related Works

Characteristics	Visit Saudi	Rehlat	Swah	Dalilak
Theory	Smart Tourism	eTourism	Smart Tourism	Smart Tourism
Platform	Ios/ Android/ Website	Ios	Ios/ Website	Ios/ Android
Ease of use	Simple	Simple	Complex	Simple
Events	Yes	No	No	Yes
Natural Places	No	Yes	Yes	Yes
Historical places	No	No	No	Yes
Scheduling	Manual	None	None	Auto and Manual
Guidance	None	None	Guiders	Bot chat and guiders
Location Detection	None	None	Yes	Yes
Machine Learning	No	No	No	Yes

Chapter 3: System Analysis and Design

3.1 Introduction to System Analysis and Design

System Analysis and design have a huge detail about the project, such as the methodology planned to use for this project, methodology roles and phases. This chapter makes everything clear of the project, how the system will be developed through it by explaining some of the users' cases, diagraming the use case, dynamic system operations, and describe the functionality of the system followed by non-functionality specifications, clarify the database entities and relations, and the concepts of machine learning algorithm to prove the efficiency of algorithms for the project.

3.2 Methodology

There are many software development methodologies, such as waterfall model, scrum model, etc. In this project we choose **Rapid Application Development (RAD)** Approach, this is an iterative and Incremental model designed to develop an application with iterative processes that's make the developers repeat the design phase in a cycle to produce many testable and assessable prototypes.[14][15]

This approach focusses on making rapid prototype's which it's the main reason for it to be useful development model because with each iterative cycle the team members could develop a rapid prototype that gives an insight view about the mistakes and problems of the application by testing and assess it via team members, stakeholder, and end users. The developers could deliver an application within short time faster than other models with huge editing and changes of requirements for the benefits of stakeholder.

We will discuss the four main processes of the RAD approach in detail:

- ✓ Write Requirements
- ✓ Design and build the application (Cycle)
- ✓ Testing
- ✓ Implementation

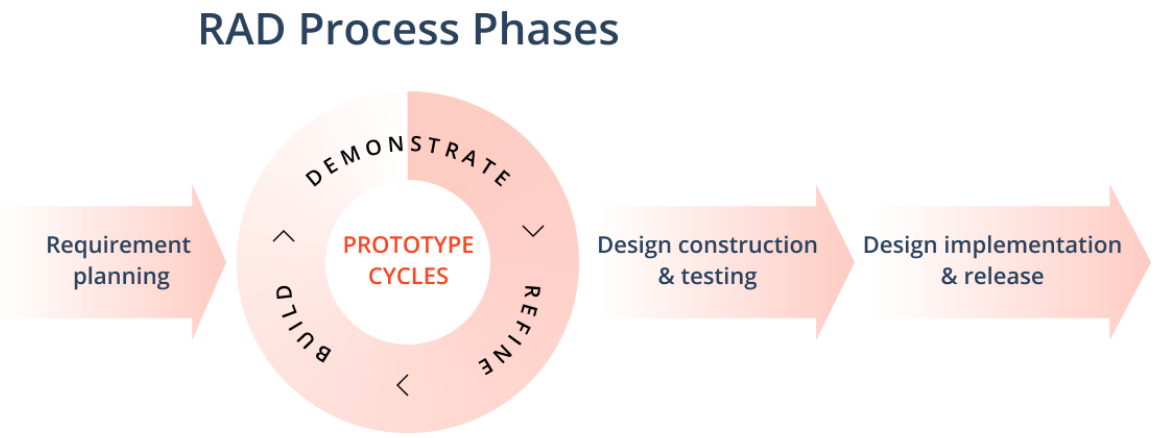

Figure 3: RAD Process Phases [2]

Advantages:

1- It has high flexibility and ability to adjust.

2- Increases the focus on development and iterative design.

3- Helps reduce development time and deliver the project faster.

4- It encourages code reuse. It helps to write the code correctly and reduce errors.

Disadvantages:

1- Not all applications are compatible with RAD.

2 - If developers do not deliver software on time, RAD projects could fail.

3- Depends on a strong team and individual performance to determine the requirements.

4- It requires highly skilled developers/designers.

5- High reliance on modeling skills.

3.2.1 Rapid application Development Phases and Roles

RAD Approach have only four phases will be discussed in detail which they are requirement's analysis, incremental prototype cycle, testing, then implement and release:

- Phase 1: Requirements Planning

During this stage, developers, clients, software owners, and team members, determine the goals and expectations of the project in addition to all current and potential requirements that must be addressed.[16]

1- Analyze users' cases.
2- Defining project requirements and specifications.
3- Everyone can evaluate the goals and expectations for the project and weigh in.

- Phase 2: Design Cycle

This stage depends on the main objectives of deliverables and finalize the design version through various of prototype iterations. During this stage the clients work with developers in each cycle to discuss the system requirements, detect issues, and refine the requirements to build next prototype or acceptable final product. The developers may back to this phase after release first version of the product and continue developing the next version.[16]

- Phase 3: Testing

This phase is represented by placing the prototypes of the design stage in the beta systems then in the work models intended for it. Through the previous iterative prototypes, there are many problems detected, discussed, and edited, which makes the developers can create and test the application quickly.[16]

1- This phase requires unit, integration, and system testing.
2- During testing and developing the final product, the amendment can be made if the customer requests that due to the existence of the opportunity.
3- It is possible to suggest change or ideas that solve problems when they arise during the testing.

- Phase 4: Release and Implementation

At this phase the final product implemented and release to the users and there is no chance to edit the system requirements and refine the system design, the developers should focus to solve the logical issues and bugs and take care about data conversion, testing, getting assesses from users, finalize the system, and clean the errors. [16]

Roles:

RAD environment has about 12 roles with different responsibilities [17], in our case we choose only 5 roles based on the size of the project and team abilities:

- Technical Lead

Technical leader has responsibilities less than project manager, but some of its responsibilities are closely with project manager, for example: the project manager is responsible about overall deliverables of the project, on other hand, the technical leader is responsible to ensure about deliverables of implementation and the tests.[17]

Technical leader responsibilities [17]:

- ✓ Test the prototypes.
- ✓ Ensure that the application development progress is compatible with the environments and architecture.
- ✓ Assist development staff.
- ✓ Assign issues and make decisions about them.
- ✓ Technical leader is a part of testing team, and he is the responsible about the final deliverable and implementation.

- Quality Assurance

Quality Assurance will work with technical leader as a co-leader, in origin he must work with project manager and have responsibilities such as documentation, keep the project within budget, and produce the product, but in our case, the quality assurance responsibilities focus on testing the application as follows [17]:

- ✓ Responsible to design a test plan.
- ✓ Responsible to manage the test phase.
- ✓ Responsible to test the software and ensure the quality of usability and acceptance.

- ❖ Development Staff

Designer, database designer, and coder are the development staff, each role have specific responsibilities:

Table 3: Development Staff

Role	Responsibilities
Designer	1- Design UI and Develop prototypes.[17] 2- Design and link the screens of the application with each other.[17] 3- Design regression and integration testing.[17] **Integration Testing:** Test made after testing more than one sample and those samples passed without failure, then the designer could merge the samples into one sample.[18] **Regression Testing:** Test made after modification on the screens with prospects to reset the design to previous state.[18]
Database	1- Create the database.[17] 2- Modeling the database relations and entities.[17] 3- Administrate and operates the database.[17] 4- Maintenance the database.[17]
Programmer	1- Develop the application.[17] 2- Program the back-end processes.[17] 3- Develop the connection with existing systems.[17] 4- Unit testing, test functionalities.[17] **Unit Testing:** Test each functionality as individual unit, after that the designer must use integration testing to all functionalities.

3.2.2 Requirements Analysis and Planning

Requirement's analysis and planning include:

- ✓ User Cases Stories and process flow
- ✓ Use Case Diagram
- ✓ Sequence Diagram
- ✓ Functional, and non-Functional specification

3.2.2.1 Users Scenarios

1- Use Case for Tourists:

This user case will describe the user process if the user wants to choose automatic scheduling, does the follows:

The user opens the application, the app will determine his location automatically, the home page will show the events and ads of the users' city, to get to the scheduling bar the user should login to the system first by pressing the menu icon, the menu bar will appear, then the user should press the login button, after that a pop-up window will show, asking him to enter the users' phone number, the user will receive a massage contains verification number for more security, then will be asked to enter a Verification number, after the verification is accepted (in case the user had registered his account before, the app will return the user to his account in the home page), after that the register page will ask the user full name and e-mail to be entered, after that the user will press submit button to create an account for the user and log the user to the login page, the scheduling domain will be shown in the home page, the user will press it to navigate to scheduling page which the page contains of two buttons (my schedules, new scheduling), to add a new schedule the user have to press the second button (new scheduling), then the app will ask The user to choose one of the three options (automatic scheduling, manual scheduling, scheduling by preferences) the user will choose the first option (automatic scheduling), time and city are required to create schedule, when the time and city are entered, the AI of the app will gave the user multiple schedules ideas based on time and city, when the user chooses the proper schedule the schedule will be added to (my schedule).

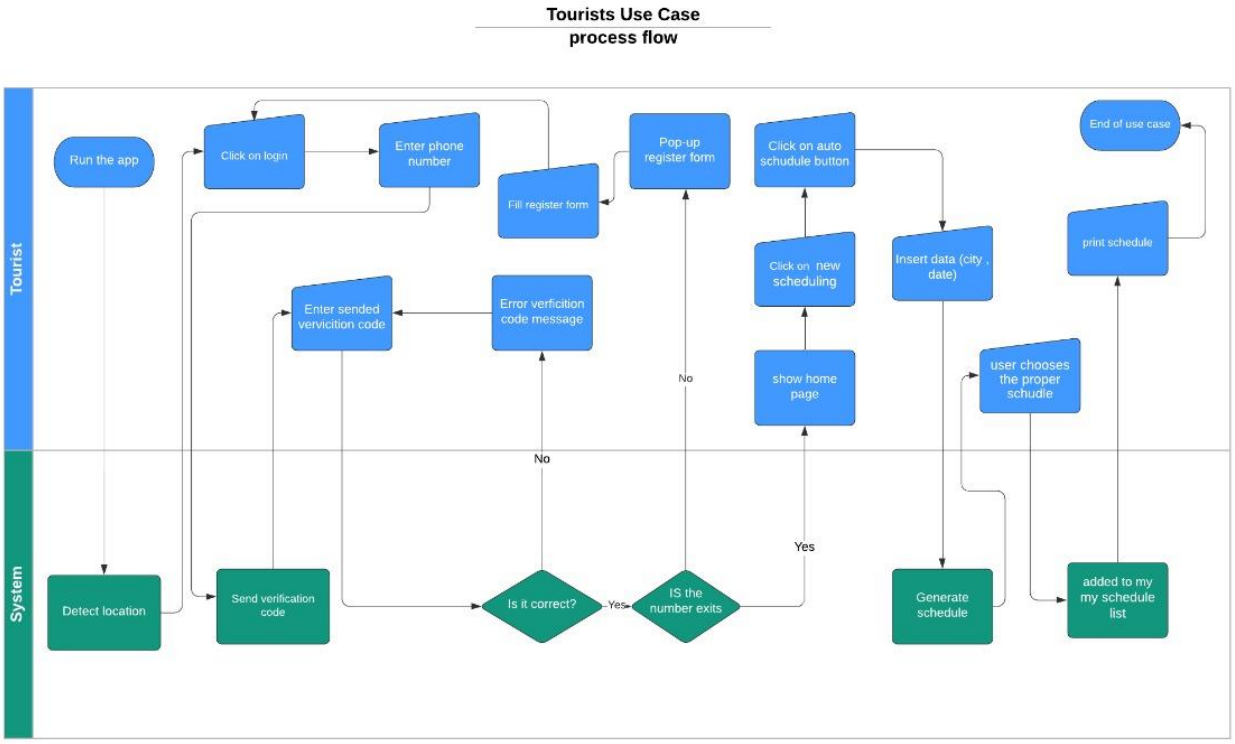

Figure 4: Tourists process flow

2- Use Case for Guiders:

For this use case the user wants to become a guider then help a trip for a tourist by using the application as follows story and process flow:

When login to the system, the user will be normal user as tourist then he must submit a form to the administrator in order to be a guider for specific city. The form includes fields that must be filled by the user information such as, email, full name, location, brief and PDF file to prove its ability and experiences in guidance industry. Therefore, the admin could review the user information then decide to accept or reject the order and confirm the city which the user will be a guider in. in this case the user request accepted by the admin , the user now is a guider and has new validities , The guider comments are highlighted and have priority in order of sorting, add or edit places to the system but the admin should review places information before applied in the system and the last validity is to give advices and design a schedules for tourists. Thus, when any

tourist sends a help request in specific city, all the guiders in the city will be notified by a message to help the tourist, the guider could accept the user request if there is no one accept it before him, in case the guider accept the request, a chat box will appear to the guider with tourist to help the tourist by give advices, guidance information, and design a trip schedule for the tourists.

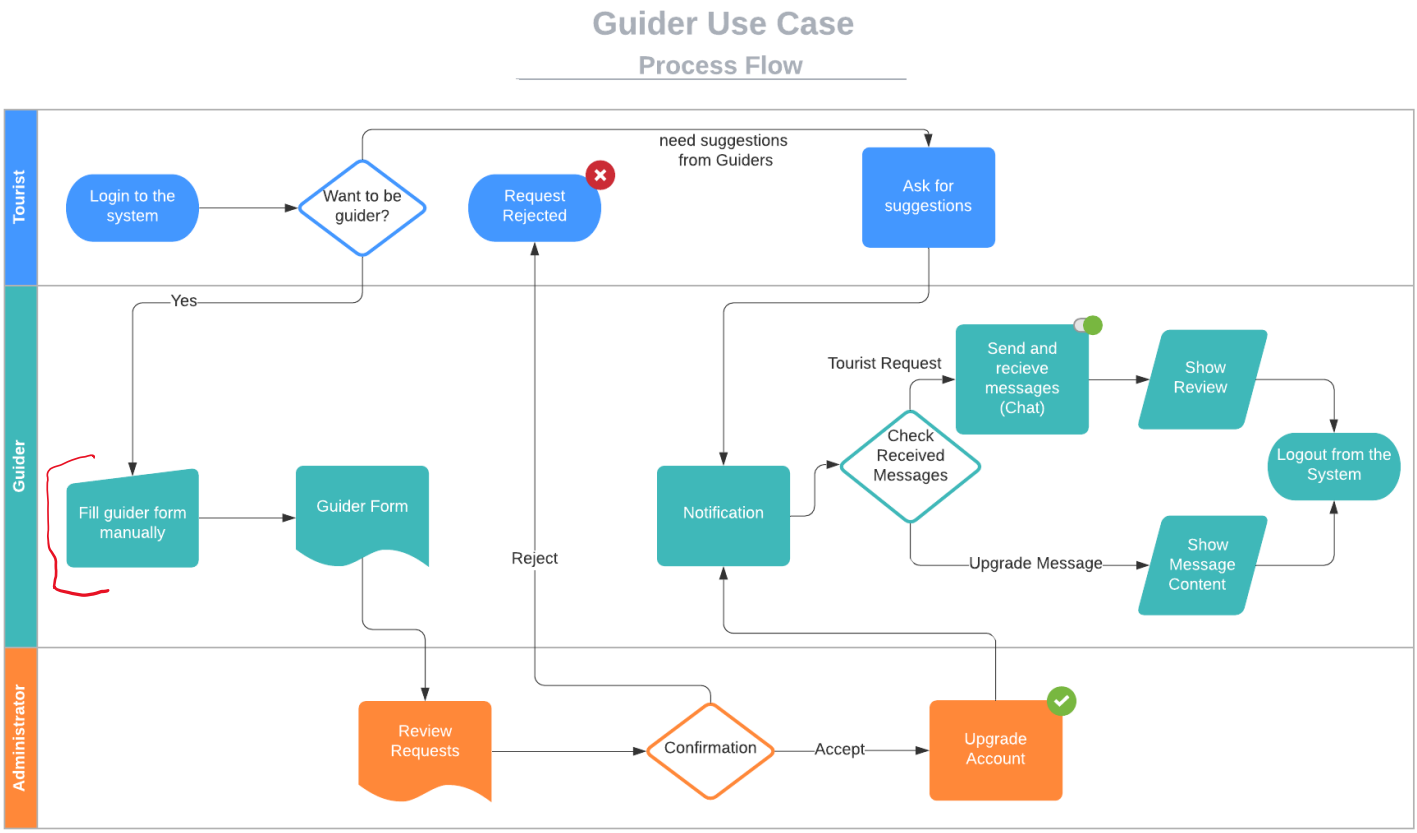

Figure 5: Process flow of Guider Use Case

3.2.2.2 Use Case Diagram

Use Case Diagram describe the functionality of the system for three types of users, Tourist, Guider, and Administrator and two platforms which they are mobile phone application, and website.

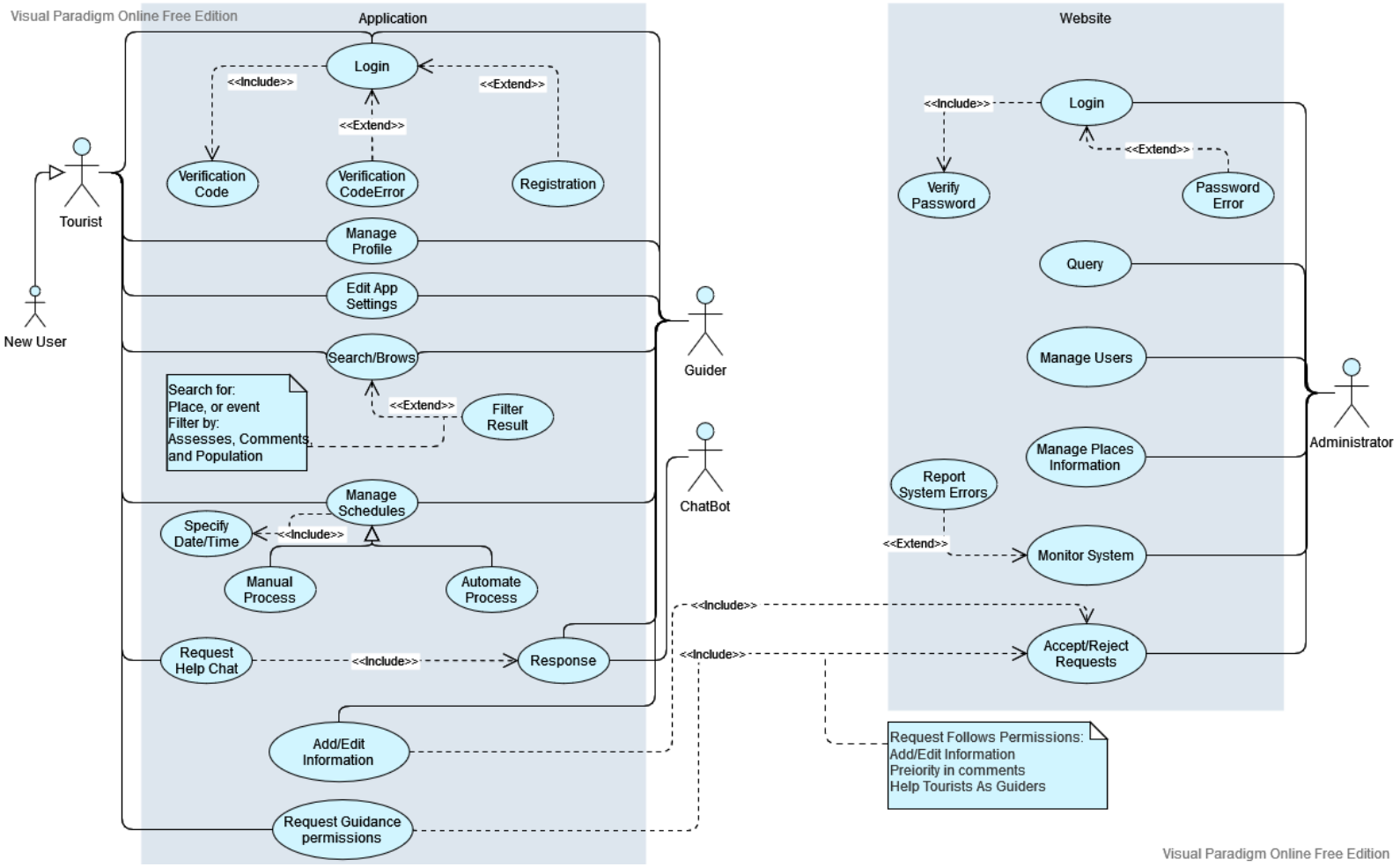

Figure 6: Use Case Diagram

3.2.2.3 Sequence Diagram

Sequence Diagram describe the operations within the system in dynamic form follows the order of the implement time of the process, step by step through the system until the system terminated.

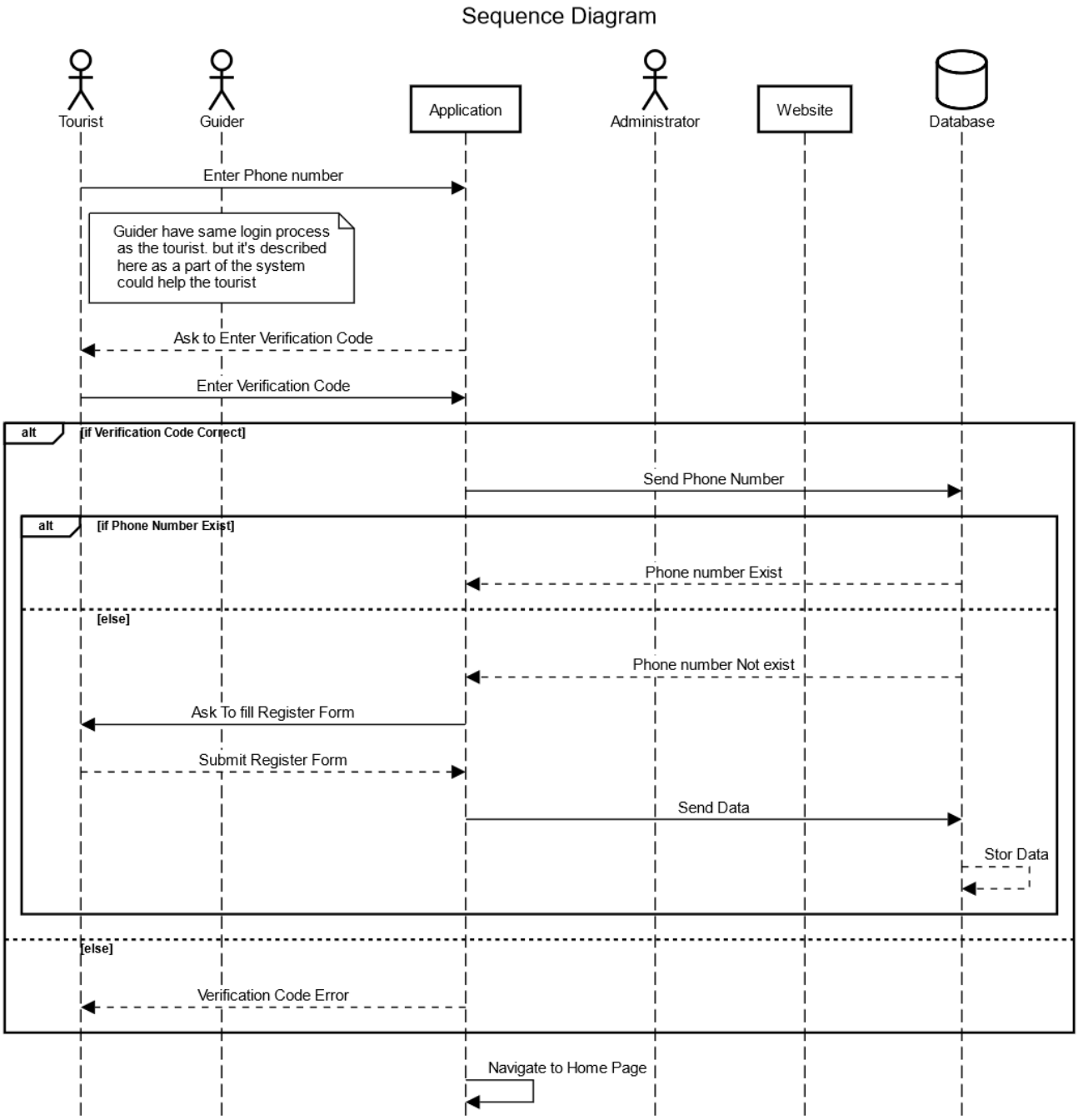

Figure 7: Sequence Diagram Part 1

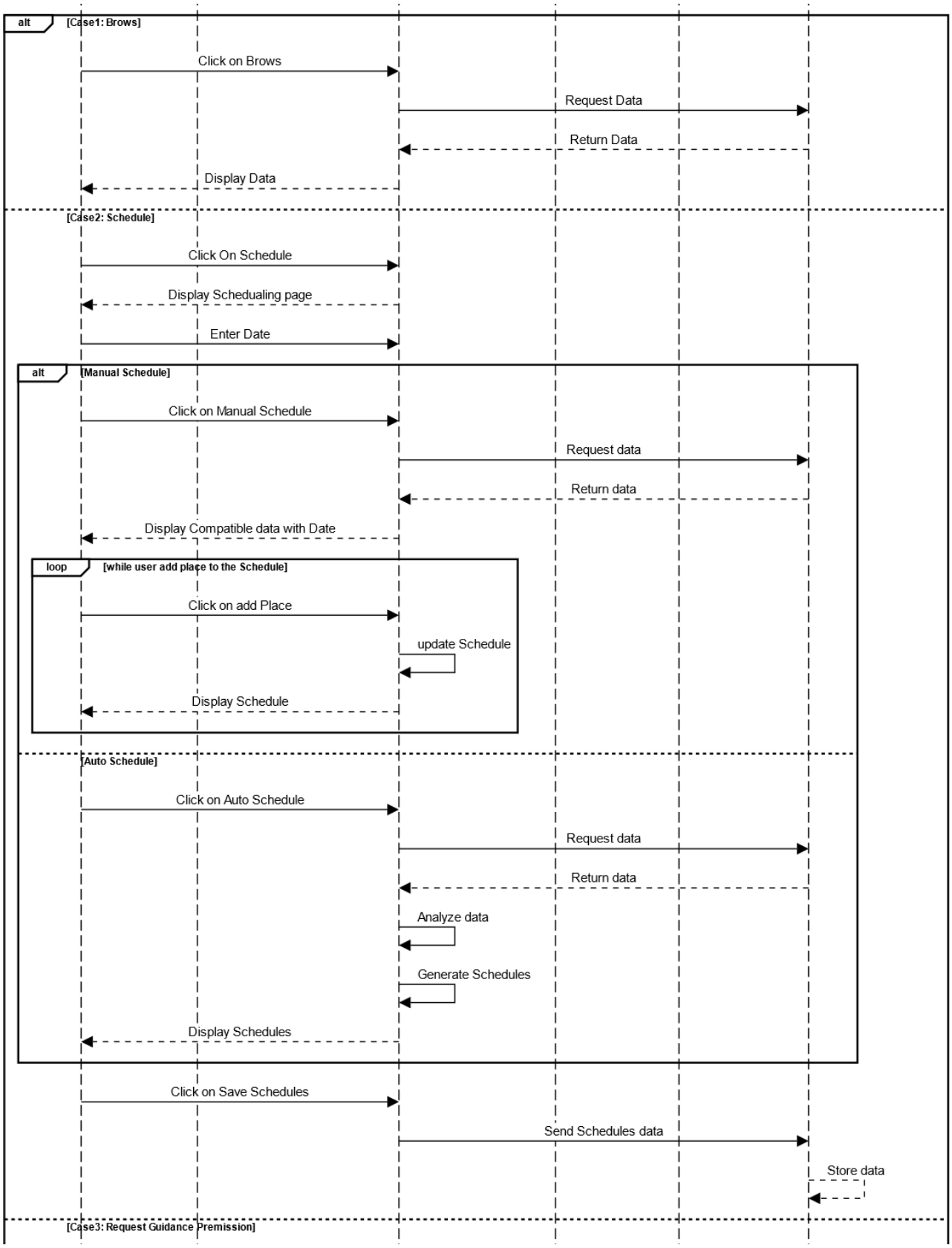

Figure 8: Sequence Diagram Part 2

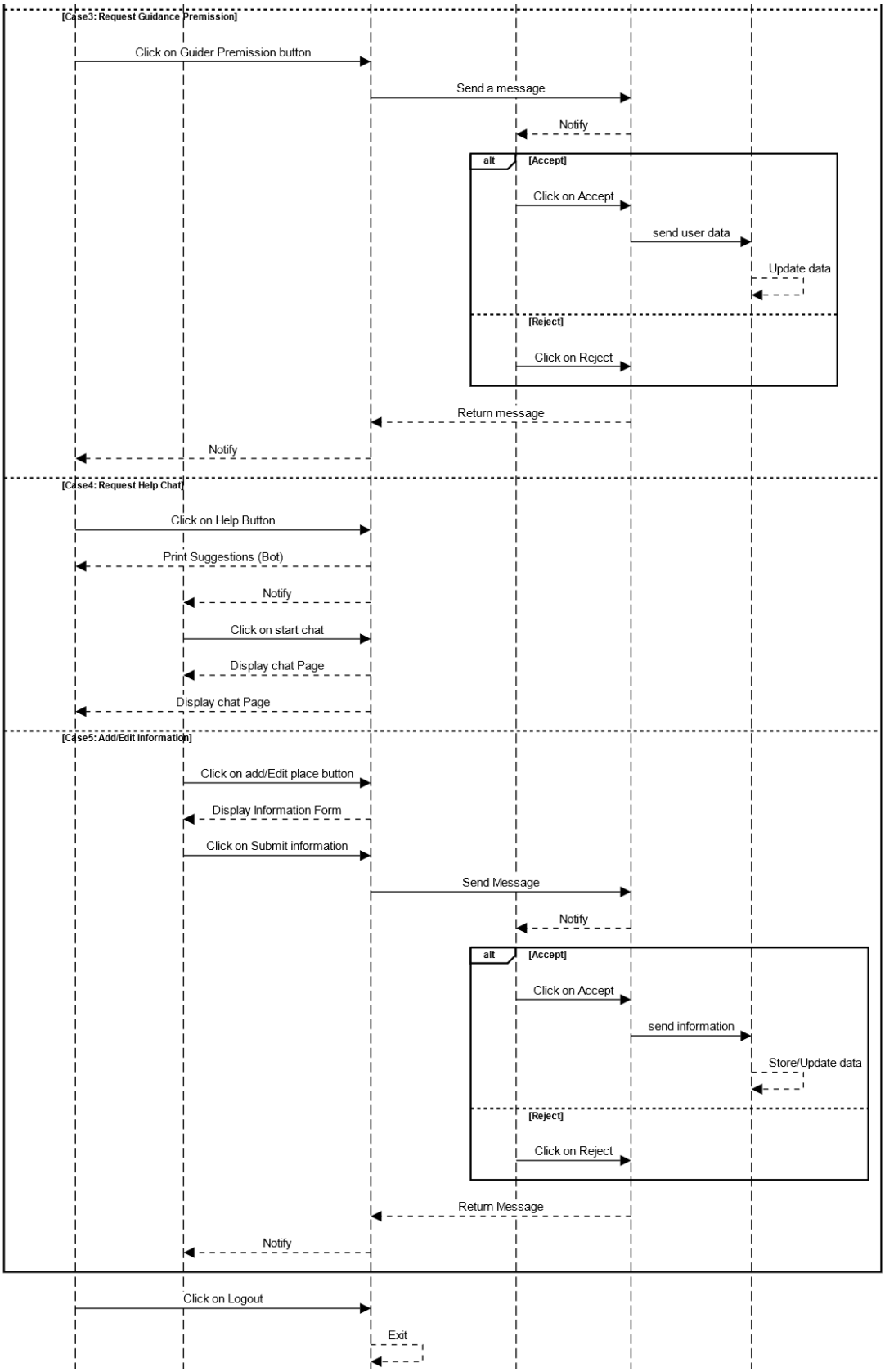

Figure 9: Sequence Diagram Part 3

3.2.2.4 Functional Requirements

Functional Requirements describe how the user will act, deal with the system, and what's the inputs and outputs of the system. Each type of users has list of functionalities and specific needs to use the system.

Tourists Functionalities:

- Login

To use all functionalities of the system the user must login by click on the menu at the header of the main page, then click on login button. Then, the user must fill the field by his phone number to login then enter the verification code that will be sent to the user to access the rest of functionalities of the system.

- Register

If the user tries to login but he has no account, the system will ask him to fill the fields by his name and email, then click on register.

- Manage Profile

After login, the user can click on the menu icon at top of the main page, then click on {Username} to open the profile.

In profile page the user could edit his information by check edit button, review the history of visits after click on history button, and show the favorites places by click on favorites button.

- Request Guidance Permission

In the user profile page, the user could ask to get guidance permission by click on button {Need Guidance Permission}, then provide information of his location, age, brief, profile image, and pdf contains qualifications then click on submit button. This information is optional for normal user but required for guiders.

❖ Edit App Settings

From main menu, the user should click on settings to edit the application font size by choose one option, and to change the application view to night mode or normal mode.

❖ Browse

In the main page, the user could choose a city then fill the search filed to browse the places, or click on one of three options natural places, historical places, or events to get specific result in chosen city. Suppose the user choose one of them, for example the user clicks on events button, the user could filter the result by click on filter button and choose an order of the result by assesses of the places, visitors' population, or prediction system. The user also could change the form of the result by click on list form or table form.

❖ Manage Schedules

By click on Schedules button in the main page the user could review the stored schedules within specific range of days and time, delete schedules by click on delete icon, and add schedules by click on add icon. After click on add icon, the user must choose between two different options:

➢ Manual Schedule

To make a trip schedule, the user will browse the places and click on {add to schedule} button, then enter the date and time of the trip. This process will continue until the user click on save schedule button.

➢ Auto Schedule

The user will specify the range of trip by date, and the destination city then click on generate schedules. Then, the user could save the schedules by click on save schedule button.

❖ Request Help (Guidance)

In the main, click on need guider button, that will display a chat page to the user. The user could ask help from the software (ChatBot) by click on the system questions, or by writing on message field then click on {send message} button. If there any guider accepts the request, the user will chat normally with the guider by write a message then send it.

Guider Functionalities:

The guider has similar functionalities of the user but in addition, the guider can response to the tourists' requests, and add or edit information of the system.

- Response

In the main page, the user will click o notifications icon and review the received messages, any request from tourists' can be accepted by click on accept button.

- Add/Edit information

In profile page, the guider could click on add place, then fill field include place name, images, location, services in the place, date, and cost for events. To edit any place the guider should browse then click on edit button of specific place or event, then fill the description of the place. After fill the information, the guider must click on submit button to send the advice to the admin.

Administrator Functionalities:

- Login

To access the dashboard the user must enter the {username} and password then click on login and there is no option to register, it's a normal login process that can be handled by the owner and developers if there is any problem.

- Query

From the dashboard, the user must fill optional fields to query the system and get specific result about any component within system by querying the city, place name, users' names, phone numbers, emails, dates, comments, assesses, or descriptions of places to get specific result.

- Manage Users

From the dashboard menu, the user could click on {manage users}, the user could filter the result to get either tourists', guiders, or both on table, remove user by click on delete icon, edit user information by click on edit icon, or review the user information within the system.

- Manage Places

From the dashboard menu, the user could click on {manage places} button, the user could filter the result to get places and events in specific cities, remove place / event by click on delete icon, edit place / event information by click on edit icon, or review the place / event information within the system.

- Monitor The System

Form the dashboard, there will be a button to click {Control panel} button wi appear statistics about the system and it's consisting of number of users, number of places, most active cites, number of guiders for each city, most popular places, number of active user and inactive user.

  - Report System Errors

Form the monitoring page, there will be a button to click {report system errors}. after clicking the button, he will write a message consists of information about issues that users face it when they use the system and any update or suggestions that require to the system then click on send button to send an email to development staff to fix it.

- Accept/Reject Requests

From the dashboard, there will be a button {User's request} after clicking the button the admin could review a list of requests from tourists and guiders by click on the request then the admin could accept or reject the request by click on either {Accept or Reject} buttons.

Table 4: Functionality Table

Functionality	input	Output	Sub-functionality	input	Output
Tourists					
Login	Click Menu, Click Login, Phone number and verification code	Main page, register form or error message	Register	Name, email and click on register	Main page
Mange profile	Click on menu then Click on username	Profile page and user information	Edit profile	Click on edit, fill information description, city, age, phone number, name, email, location, and image Click on update (all information are optional)	Profile page and updated user information
			Show history	Click on show history	Print history information
			Show favorite places	Click on favorite places	Print favorite information
Request Guidance Permission	Enter profile, click on request, fill information description, city, age, phone number, name, email, location, and image Click on update	Message (Request sent successfully), and send notification to the admin	/	/	/
QR-code	Click on Camera Icon.	Camera of the phone will be opened, choose from the storge	/	/	/
Edit App settings	Click Menu, Click on Edit, change Font size, View Mode	Entire screen with updated settings	/	/	/
Browse	Choose city and write on search field. or click on one domain button	Browsing page and list of places	Filter	Choose display format, and sort order	Updated browsing page and list of places
Manage Schedules	Click on Schedules, and specify date in range	Stored Schedules page within entered range	Add - Manual Schedule	Click on add, click on manually, check places, click on save button	Updated Stored Schedules
			Add - Auto Schedule	Click on add, click on Auto, check schedule, click on save button	Updated Stored Schedules
			Delete	Click on delete icon	Updated Stored Schedules

Request Help (Chat)	Click on chat, help by Chatbot.	Chatbot auto answering.	Guider Chat	Click on chat, Choose Help by guide	guide Conversion between Tourist and Guider in Chat Room.
Guider					
Response (Chat)	Click on response	Chat with Tourist	/	/	/
Add/Edit Information	Click on Add information	Information Added.	Edit Info.	Click on Edit information	Information Editing page
Administrator					
Login	Insert Email, Password	Main page, register form or error message	/	/	/
Query	By username, place, Phone Num., Email, Comments, etc.	List of searched Items.	/	/	/
Manage Users	Click on Manage Users.	Edit, remove, Options are shown.	/	/	/
Manage places	Click on manage places	Filter results, search, Delete/Edit	/	/	/
Monitoring	Click on Control panel.	System Statics will be shown.	Report System Errors	Write issues/suggestions	Developing staff response
Accept/Reject	Click on users' request	Admins reviews, respond Acc/Rej	/	/	/

3.2.2.5 Non-Functional Requirements

Non-Functionality - Performance factors:

- When the user enters to the application the system immediately detects user location and then the system sends the verification code to the user.

- The system checks on the database whether the number exits or not, if the number exists the system enters the user to the application, if the number does not exit the system will store it in the database, and then the system will pop-up register page, and then store the data in the database, otherwise the system will send verification code error message.

- In browse process the system will collect data and appear it to the user,

- the user add manual schedule system will collect data and appear it to the user, if the user add new place to the schedule the system will store new data and update the schedule, if else the user click on auto schedule the system will collect and analyze then generate schedule and then display schedule to the user, if the user click on save schedule the system will send data and store it in the database.

- When the user asks for guider permission the system will send a message to the website and the website will notify to the administrator, after the admin accept the user website will update user data then send message to the application and notify to the user.

- The chat bot gives user choices, and the bot will appear results depend on user choice. When the guider clicks the start page the system will display chat page.

- When the guider clicks on add/edit place the system will display information form to the guider and the system will send message to website to notify the admin if the admin accepts the system will send information to the database, then return the message to the application to notify guider.

- The system highlighted guiders comment to divide between guider and normal user and that’s gives more reliability to the system

Non-Functionality - Quality factors:

- Usability
    - The **chat bot** gives user choices, and the bot will appear results depend on user choice. When the guider clicks the start page the system will display chat page, the ChatBot will combine the three users of the system (Guiders, Tourists, Admins) to help them all analyzing the problems or needs that need to be processed.
    - The need of using UserName and Password in our system is zero and replaced with phoneNumber, which uses the verification code to have less time and resource consumed in the login process.
    - the user add **manual schedule** system will collect data and appear it to the user, if the user add new place to the schedule the system will store new data and update the schedule, if else the user click on **auto schedule** the system will **collect and analyze then generate** schedule and then display schedule to the user, if the user click on save schedule the system will send data and store it in the database.

- Reliability
    - The system highlighted guiders comment to divide between guider and normal user and that's gives more **reliability** to the system.
    - When the guider clicks on add/edit place the system will display information form to the guider and the system will send message to website in order to notify the admin if the admin accept the system will send information to the database, then return the message to the application to notify guider.
    - While browsing the system highlight places into three different colors that show the population for each place.
    - When the user asks for guider permission the system will send a message to the website and the website will **notify** to the administrator, after the admin accept the user website will update user data then send message to the application and **notify** to the user.

- Efficiency
  - With the use of NoSQL databases, the speed of response time and capacity using will be unimportant.
- Interoperability
  - The system has more than one way to perform itself in case of the interfaces one interface for the users which is the application and controlling the application with website interface used by the admins.
- Security
  - Application
    - When the user enters to the application the system immediately **detects** user location and then the system sends the **verification code** to the user.
    - The system **checks** on the database whether the number exits or not, if the number exists the system enters the user to the application, if the number does not exit the system will store it in the database, and then the system will pop-up register page, and then store the data in the database, otherwise the system will send verification code error message.
  - Website
    - The website asks the users (Admins), Email and Password to verify their accounts.

3.3 Database Design

Clarification of the objects, entities, attributes, and relationships of the database is important to build compatible storage system with the functionalities of the system. The ER diagram give a clear overview of the database components, and relational schema simplify the designing process for the database by convert the ERD to tables columns that's represent the initial form of the tables in the database schema. To store and deal with bigdata, NoSQL techniques are required by designing JSON object and clarify the relations between NoSQL objects and SQL tables by designing class diagram.

3.3.1 Relational Database Schema and ER Diagram

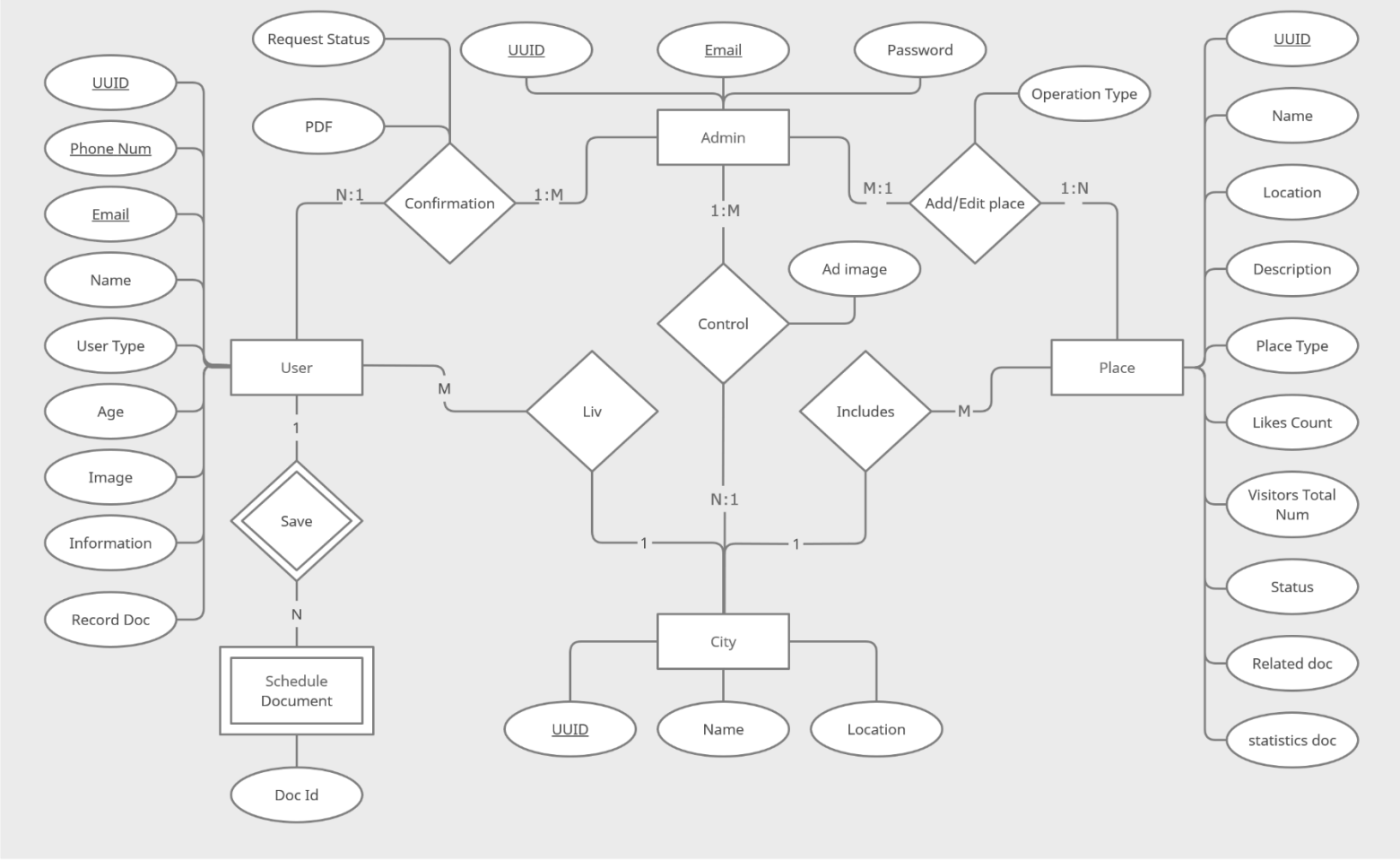

Figure 10: ER Diagram

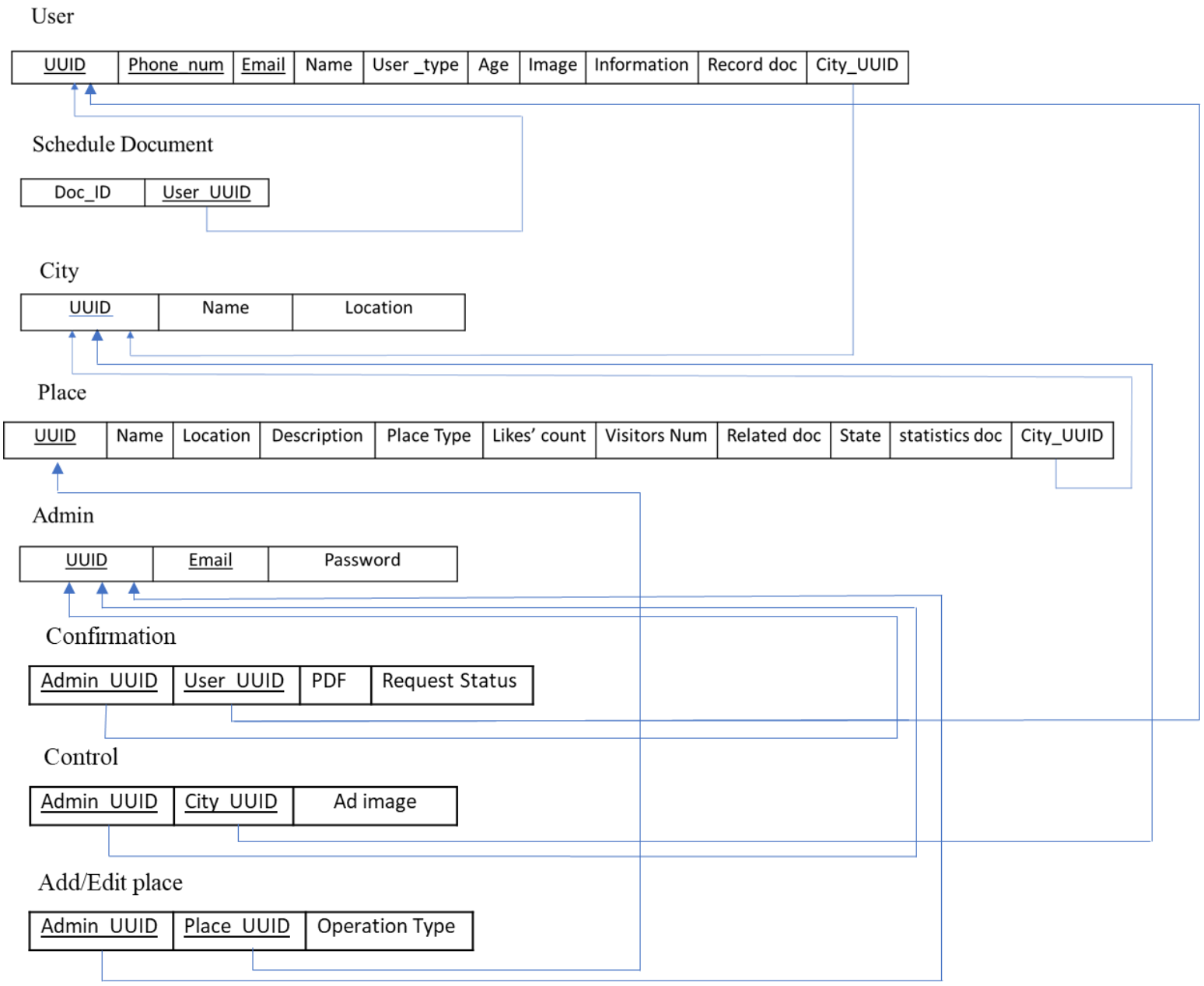

Figure 11: Relational Schema

3.3.2 Json Documents (NoSQL)

Users Documents Structure:

For the normal situation about schedules each user will have different days and destinations for one trip, and many duplicates of user ID to store history and favorites records, that leads to difficulties, waste of memory and time to store the schedules, and records in relational database and read them from the relational database. In Other hand, json files could store data dynamically in dictionaries and arrays format that's helping to create unique schedule for each user with dynamic structure and cancels the duplicates for records.

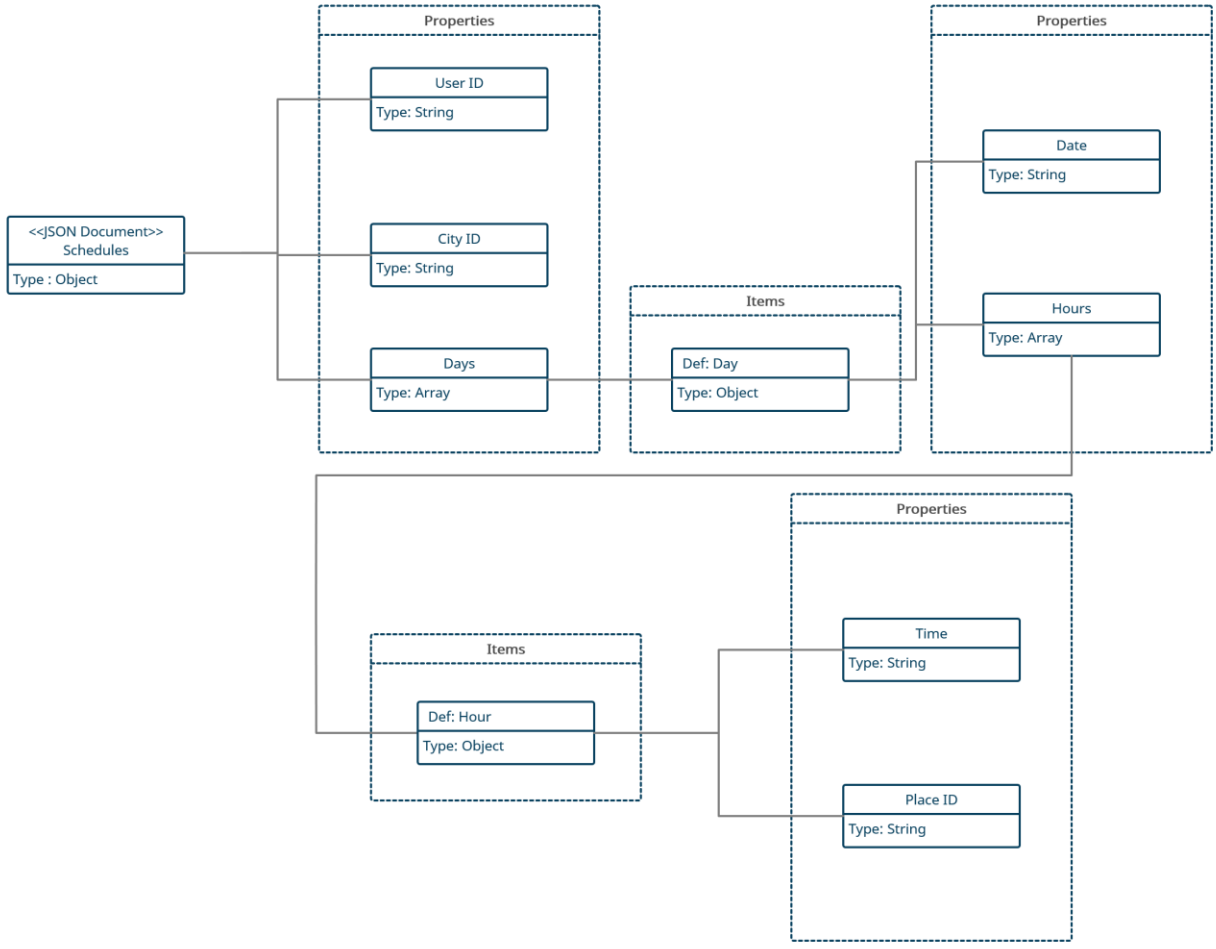

Figure 12: JSON Structure of users Schedules

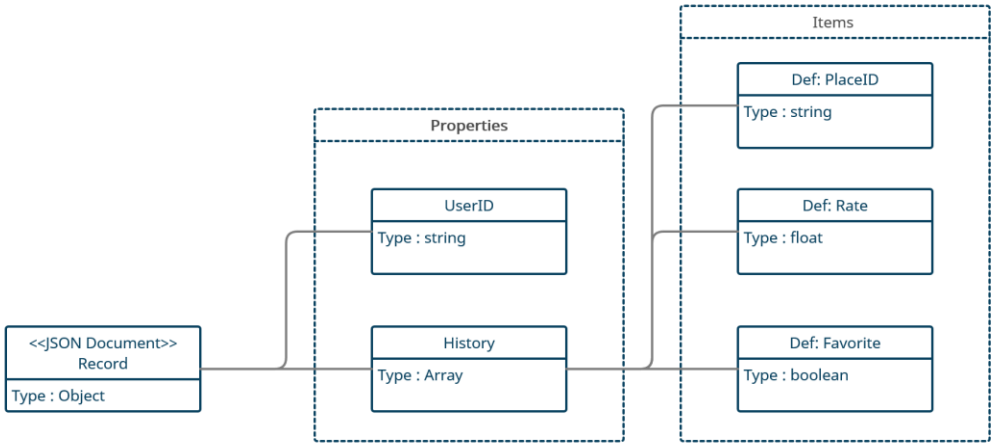

Figure 13: JSON Structure of user's records

Places Documents Structure:

The places in the system have big data such as multiple media, comments of users, and statistics of number of visitors for each place, in json format the duplicate attributes will be decreased using nested arrays, that's lead to store huge data with less memory usage than relational database without many duplicates.

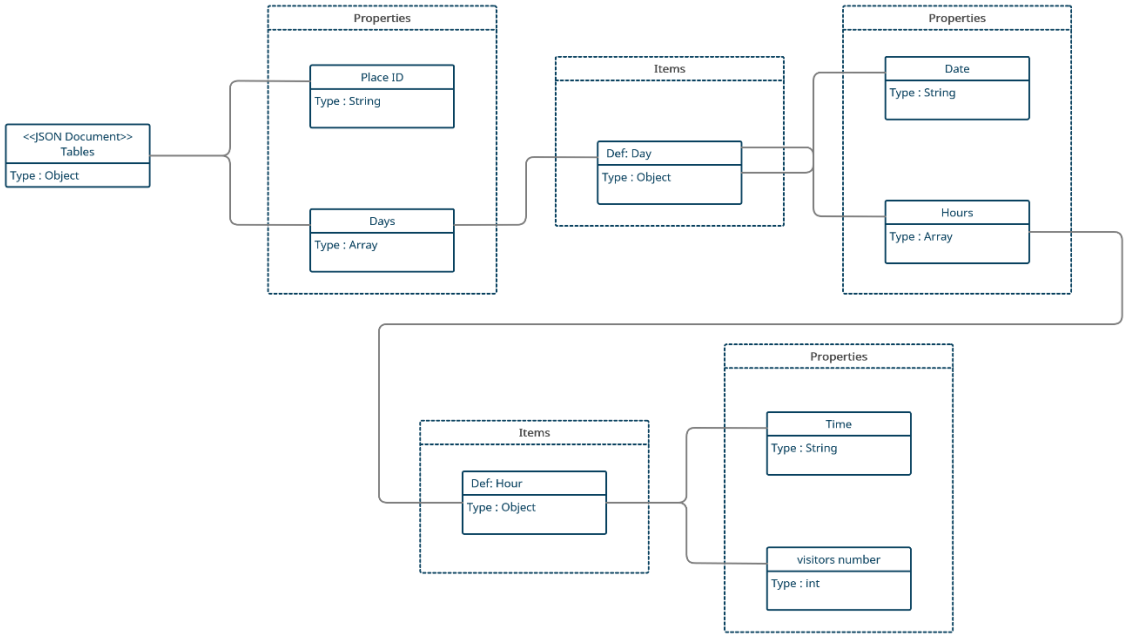

Figure 14: JSON Structure of visitor's number statistics

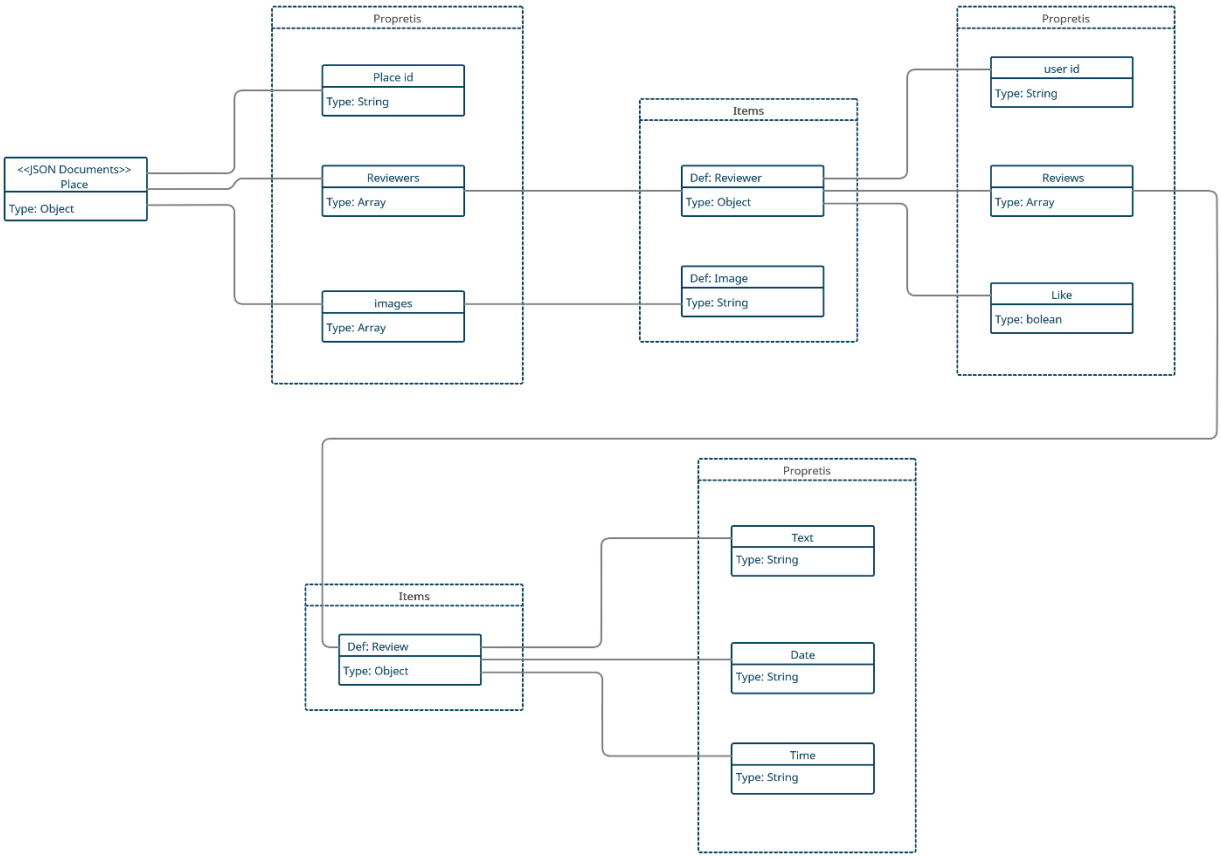

Figure 15: JSON Structure of Related information for Places

3.3.3 System Class Diagram

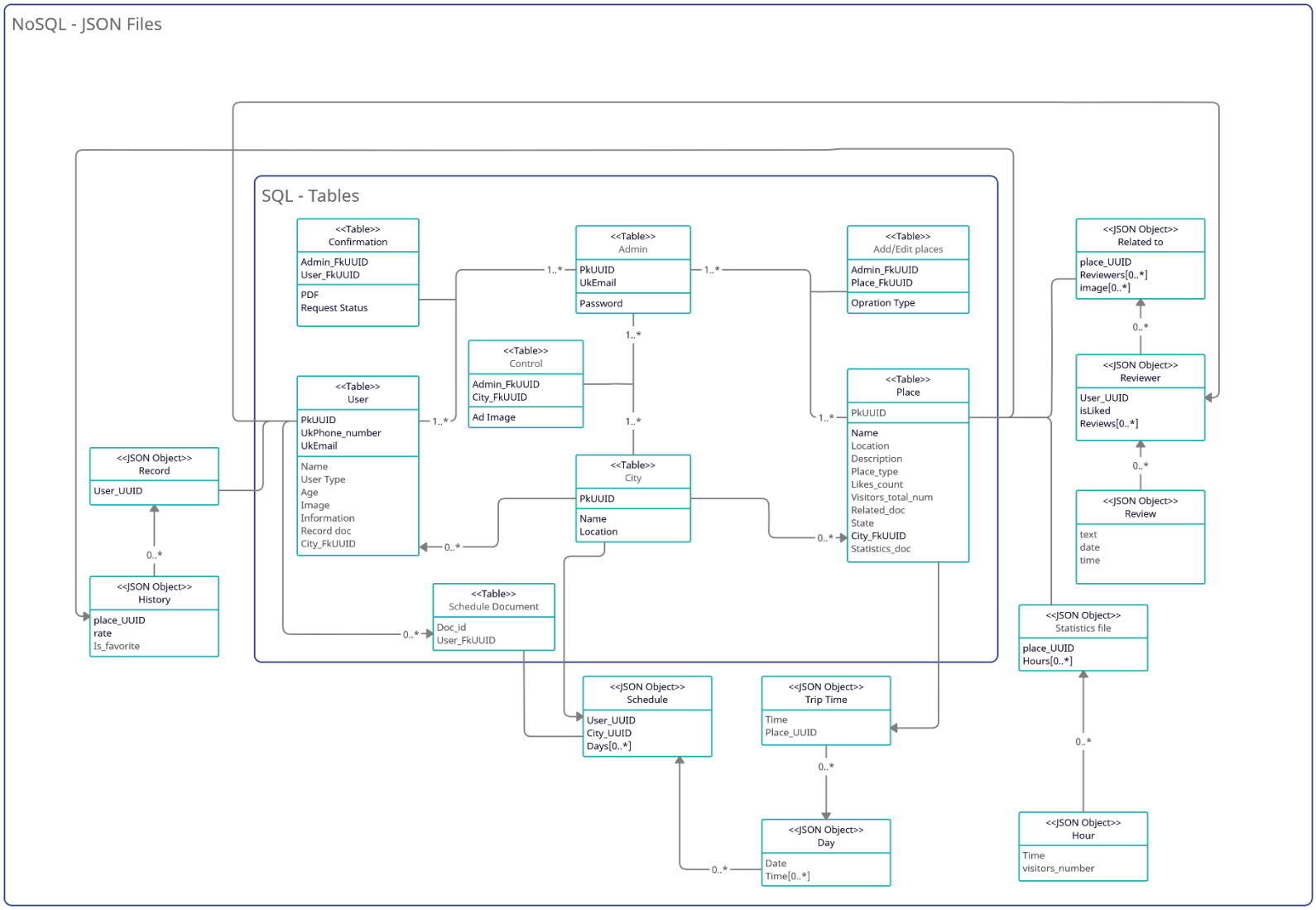

Figure 16: Class Diagram

3.4 Machine Learning Algorithms

3.4.1 Linear Regression Algorithm

- **Predict number of visitors for each hour:**

Linear Regression algorithm is a supervised machine learning mode to predict future actual values based on inputs and outputs that's fitted in linear line as independent and dependent variables. it finds the linear relationship between the dependent and independent variable. [20]

To predict the future actual value, the system needs to apply the following equation:

$$\{f(x) = b1\ x + b0\}$$

Where b1 is the Slope represents the changes in y/x axis, and b0 is the y-intercept point.

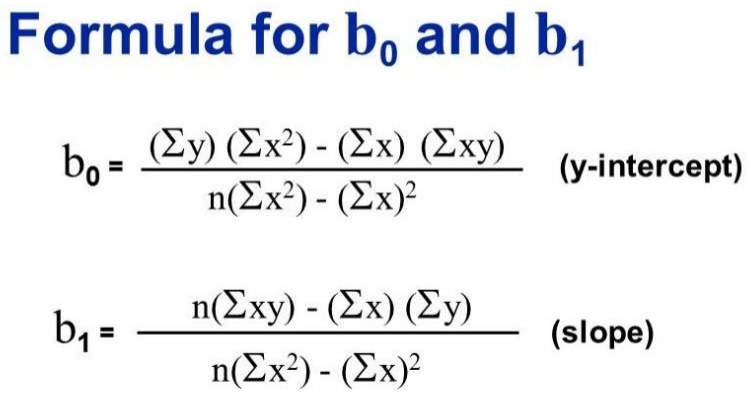

Figure 17: Leaner Regression – Slope and Intercept Formulas [19]

Dataset Sample:

Table 5:Dataset for prediction algorithm – Sample

Dataset for one Place		
X1	**X2**	**Y**
Date (Independent)	Time (Independent)	Num of Visitors (Dependent)
12/9/2021	1:00	185
12/9/2021	2:00	235
12/9/2021	3:00	356
12/9/2021	4:00	498
12/9/2021	5:00	533
12/9/2021	6:00	657
. . n	. . n	. . ?

Analyze Dataset Sample:

Analyze data in case the prediction Independent for **X2,** change the hour to decimal format require to get more accurate result and ability to predict using the formula:

Slope = 97.0286, y-intercept = 71.0667, based in the linear regression formulas

Table 6: Analyzed Dataset - Sample

	X2	Y	X2 Y	X2^2
1	1.0	185	185	1
2	2.0	235	470	4
3	3.0	356	1068	9
4	4.0	498	1992	16
5	5.0	533	2665	25
6	6.0	657	3942	36
Sum	21.0	2464	10322	91

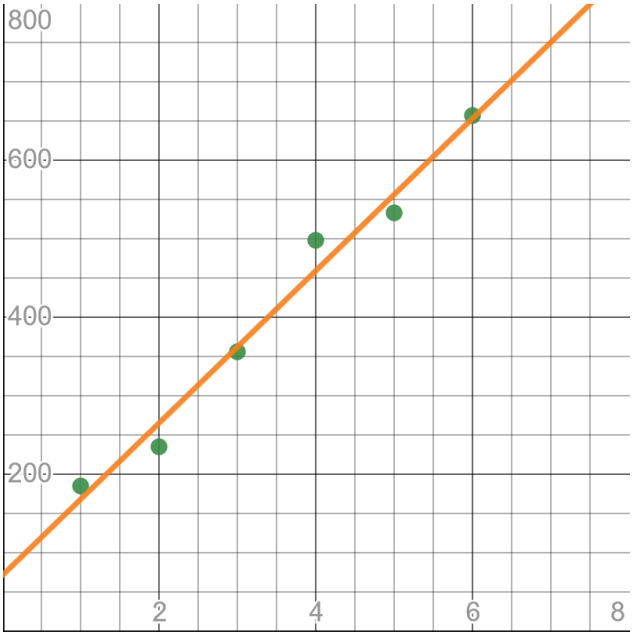

Figure 18: Linear Regression Model

Predict Samples:

Table 7: Predicted Samples

X2	Substitution {f(x) = b1 x + b0}	Predicted Value
7:00	f(x) = 97.0286 (7) + 71.0667	750
8:00	f(x) = 97.0286 (8) + 71.0667	847
9:00	f(x) = 97.0286 (9) + 71.0667	944
10:00	f(x) = 97.0286 (10) + 71.0667	1041

3.4.2 Matrix Factorization Algorithm

- **Predict Recommendation for users:**

Matrix factorization is a supervised machine learning algorithm to predict the rate of specific places for the users based on three features they are, type of the place, likes count, and status of the places which make the model is Content-based model.[21]

The algorithm will train the data model based on user history and favorites records, evaluate the model, and then test the model to give some recommended places for each user.

Dataset Sample:

Table 8: MF - dataset sample

Dataset For one user		
User	**Places**	**Rate**
User_UUID	Place1_UUID	3
User_UUID	Place2_UUID	4
User_UUID	Place3_UUID	1
User_UUID	Place4_UUID	3
User_UUID	Place5_UUID	2
User_UUID	Place6_UUID	4
. . n	. . n	. . m

Analyze Dataset Sample

Rating matrix:

Table 9: MF - convert dataset to matrix

User	**Place1**	**Place2**	**Place3**	**Place4**	**Place5**	**Place6**
	3	4	1	3	2	4

To prove the efficiency of the algorithm, suppose you have the virtual next decimal numbers for each item of users and places:

User features matrix:

Table 10: MF – user features values

User	Feature1	Feature2	Feature3
	1.4	**0.9**	**0.4**

Places features matrix:

Table 11: MF - places features values

	Place1	Place2	Place3	Plcae4	Place5	Place6
Feature1	**1.4**	**0.9**	**0.2**	**1.6**	**0.4**	**0.6**
Feature2	**0.1**	**2.5**	**0.3**	**0.8**	**1.1**	**2.0**
Feature3	**1.7**	**0.4**	**0.7**	**2.3**	**0.1**	**3.5**

The system will apply the dot product formula to test the algorithm and predict recommendation for the user:

{A.B = (A1 x B1) + (A2 x B2) + (A3 x B3)}

Table 12: MF - testing data

User	Place1	Place2	Place3	Place4	Place5	Place6
	2.73	3.67	0.83	3.88	1.59	4.04

If the output doesn't match the inputs data, the system will minimize the error percentage for each iteration to get accurate result.

Predict Samples:

The actual dataset will consist of **M-Users** and **N-Places** not such as our example, so, suppose in the dataset there is extra place and it's trained based on other user rates as **<1.2, 0.5, 2.3>,** the predicted rate for this place based on the user is **(3.05).**

Table 13: MF - predict rate

User	Place1	Place2	Place3	Place4	Place5	Place6	Place7
	3	4	1	3	2	4	?
User	Place1	Place2	Place3	Place4	Place5	Place6	Place7
	3	4	1	3	2	4	**3.05**

Chapter 4: Implementation and Testing

4.1 Introduction to Implementation and Testing

Introduce, this chapter will give general information about the specifications of the development environment which they are tools we will use such as libraries, languages, IDEs, or platforms that could help us to develop our application, and then show a view of the application as an initial prototype of the application.

4.2 Development Environment Specifications

- Plesk Hosting

Web administration interface simplifies project management in which website, database and email server can be managed easily. It is a comprehensive tool available for both Linux and windows system. [22]

benefits:

1- Develop special projects without the need to know the management of the infrastructure.
2- Simplify the way you manage your web servers.
3- Get several tools in the form of an extension such as security tools, database extensions, e-mail, Git support.
4- Create email servers easily.
5- Prepare a regular backup of your data

- .Net Framework

A system for developing software and creating applications and running them on windows, the two main components of this system are the Common language runtime and the .net framework class library, consisting of the common language runtime which provides memory management and other system services, which enable programmers to use these software services to develop applications. [23][24]

the benefits:

1- Create and run applications
2- Run applications on many operating systems using different applications from .net
3- The .net framework is used to run .net applications on the Windows system

❖ Visual Studio

Microsoft Visual Studio is a developments tool (IDE) used to develop web applications, mobile applications and more. Microsoft Visual Studio It is productive, modern, and free, it is use Microsoft software development platforms such as Windows API and Windows Forms.

It can produce both native code and managed code with clear UI that's helping to manage the project in object-oriented structure, it has an ability to facilitate the development process with auto complete of code and download require packages and libraries using NuGet tool.

Microsoft Visual Studio supports 36 different programming languages include c++, c#, and python, support the code editor and debugger for any programming language, support all versions of .Net Framework's, and compatibility of the libraries. [25][26]

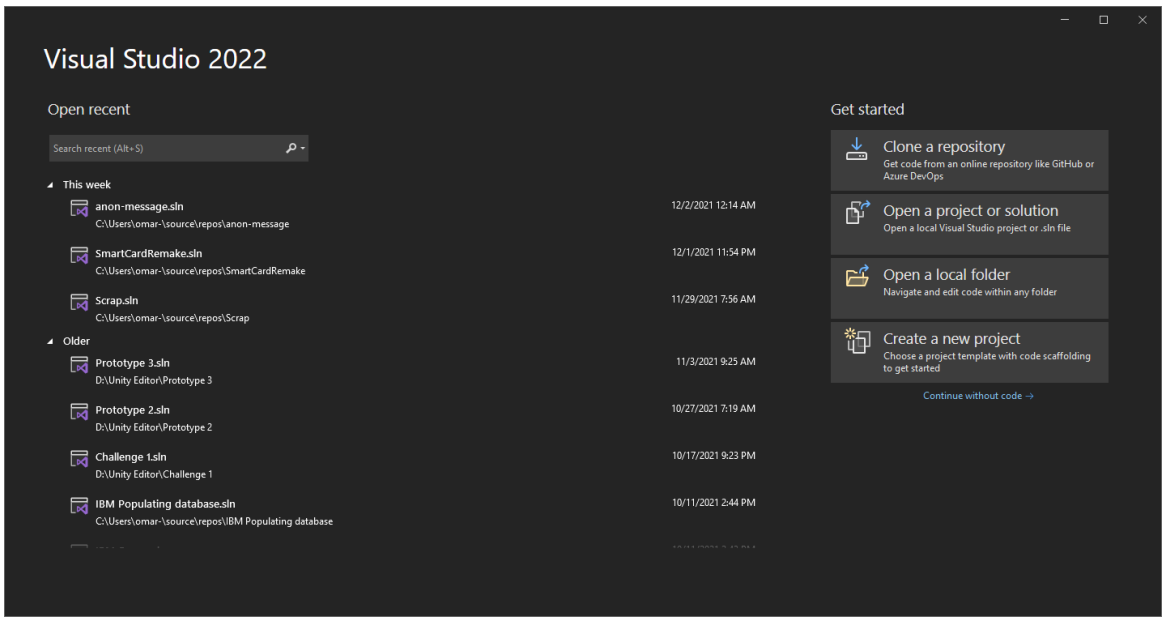

Figure 19: Visual Studio UI, List of projects

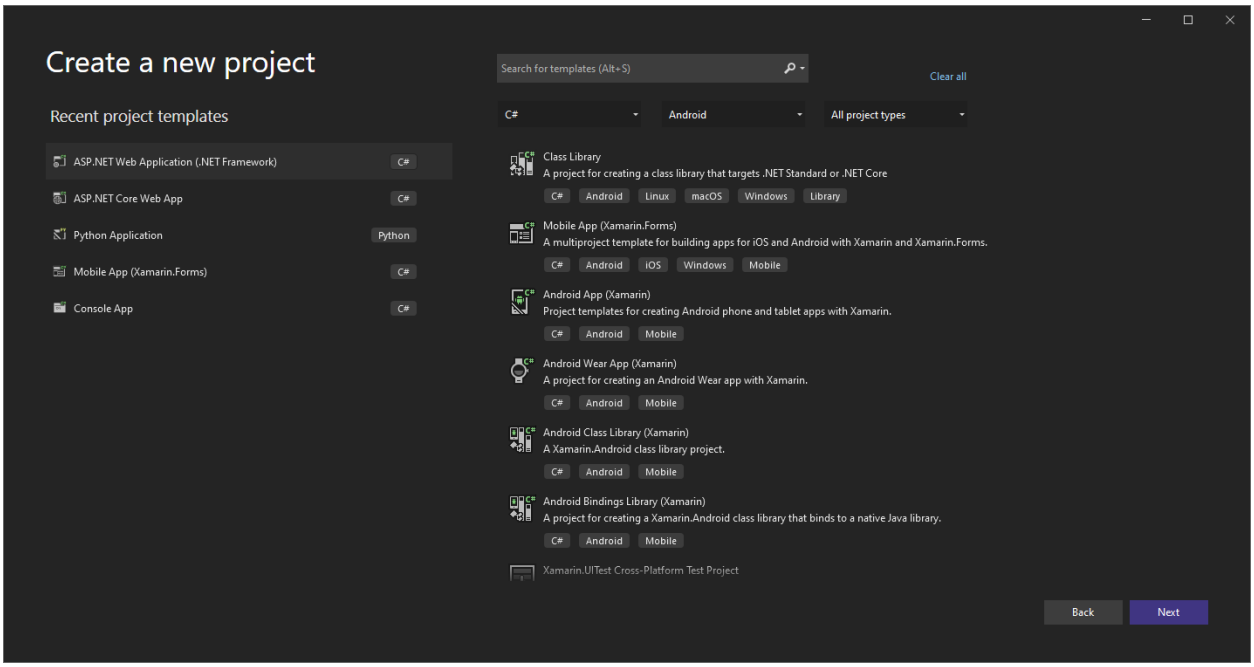

Figure 20: Visual Studio UI, Create New Project

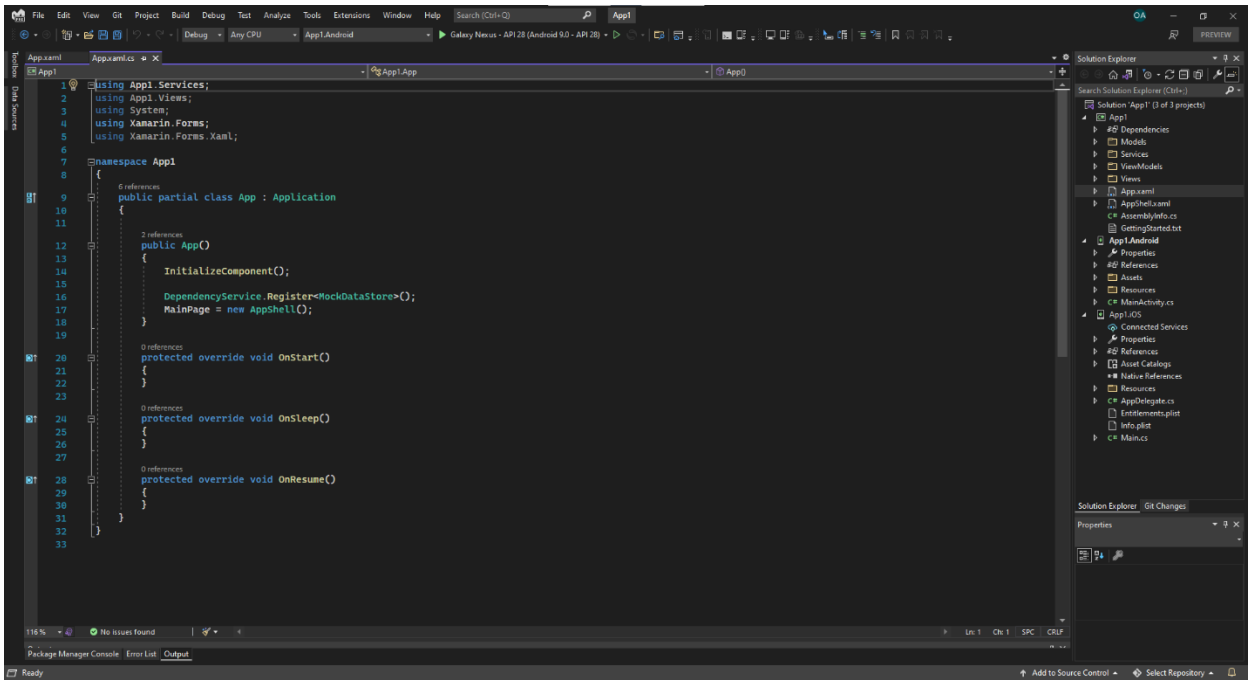

Figure 21: Visual Studio UI, Development space

❖ C# Programming Language

C# is a component-object-oriented programming language have a large community because it supports the general-purpose and multi-paradigms such as object-oriented programming, functional, and component-based programming. [27][28]

C# helps to build an interactive environment and it works in Windows, .NET framework and more of open-source platforms.

C# is supporting several libraries, such as System Libraries (.NET), Xamarin library, and machine learning library.

C# has a unique structure of programming class-based application, suppose you have a huge system with object-oriented structure, in c# you will define a namespace for your projects components, each namespace has its own classes, and each class has its own attributes and functions. For this structure the c# language more accurate and manageable to develop a system with object-oriented techniques, you could manage the components for each name space, share the components between different namespaces.

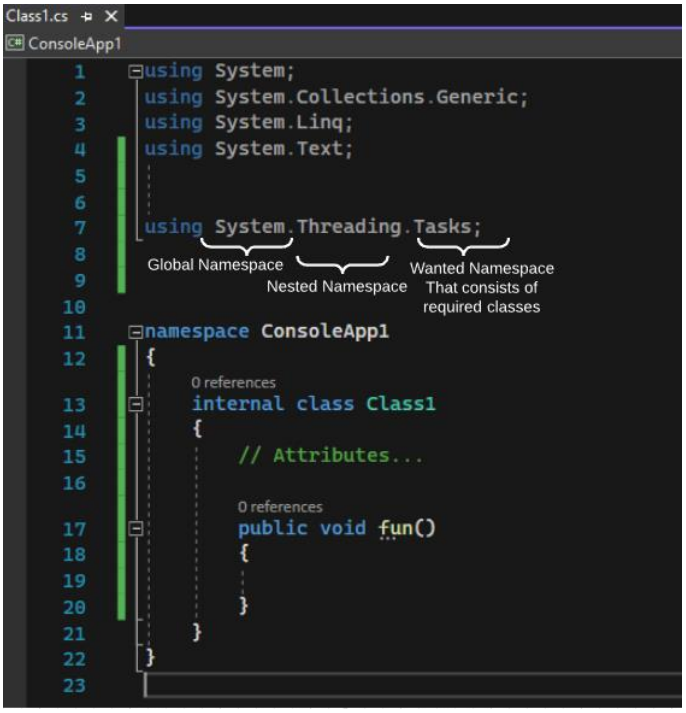

Figure 22: C# Example, Structure of component-object-oriented

❖ XAML Markup Language

Extensible Application Markup Language, like HTML but XAML developed to be compatible with applications in other hand, HTML cannot be used elsewhere except int websites. It's use .Net framework to design user Interface (UI) for desktop and smart phones applications, the most two major libraries that are compatible with both c# and XAML are WPF and Xamarin forms. Xamarin and WPD Forms consists of two main component **XAML** document which must be handled by designer to design the system interfaces, and the other element is .cs file which will be declared in XAML within {ContentPage}tag as a value of {x:Class}, that's make a binding with XAML and CS files to handle events, variables, and logical process between XAML and CS files.[29][30]

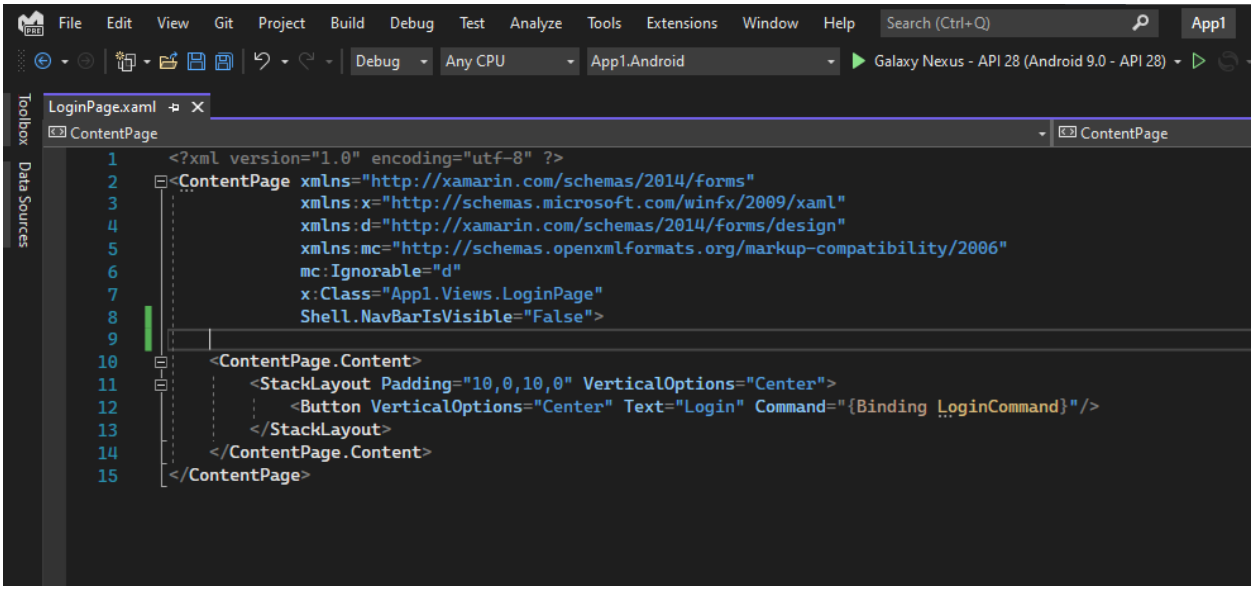

Figure 23: XAML Example

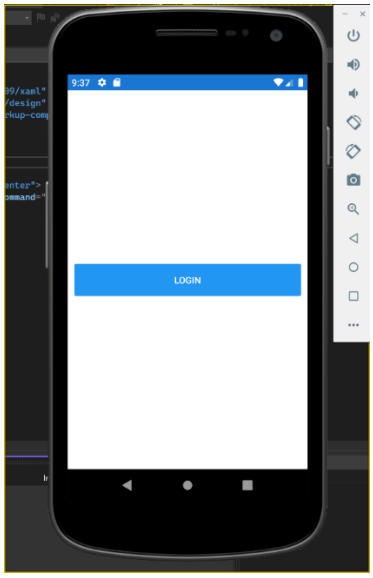

Figure 24: XAML Sample

- Bootstrap Library

Bootstrap is an open-source framework to design web applications, it's built on CSS, HTML and Java Script to make the development of the websites more efficient, responsive, and compatible with different devices. Bootstrap has special concept to keep the interface looks good, and structured in different devices, and page sizes. The page is divided into sections and each section has its own area and spaces, the sections doesn't intersect with each other, and its space will move down of the page while the page get smaller. Each section will be represented as a row, that row have multiple columns, and each column take its own space within the row or the section.[31][32]

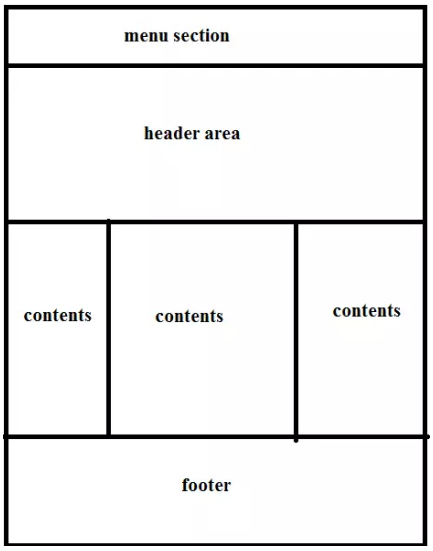

Figure 25: Bootstrap Structure Example [33]

❖ MySQL

Stands for structured query language that stores data in base which called SQL Databases, and communicate with the database, you can also add, delete, update, or query data. [34]

MySQL specifications:

- It's one of the most important languages to learn because everything is a data and how communicate with it is the key to collect or retrieve data.
- SQL can communicate to data in a relational database.
- SQL may have different versions that is slightly differ for each other but has the same concept.

MySQL use in our Project can be summon in:

- What language we use to store data.
- How are the relations between data are written?
- How data are being retrieved or pulled from the data base.
- When the data are changing automatically from the user's interaction with the code.
- Who are the admins that controls the data from the database using SQL?

❖ NoSQL (Raven DB)

Stands or Not Only SQL or Non-SQL, but it's also a query language that stores big data in a not relational databases like SQL, NoSQL uses only keys and values to store data not the type as SQL. [35]

Raven DB specifications:

- Stores a large amount of data.
- Scalable with no restrictions cause it's not relational.
- Fast to retrieve data.
- NoSQL are replica in server's level.

Raven DB use in our Project can be summon in:

- Stores big data to do the AI calculations.
- collect data to do the automatic scheduling.

❖ Xamarin Cross-Platform

Xamarin is a development platform that allows you to write cross-platform yet native-applications for iOS, Android, and Windows Phone in C# and .NET.[39]

Xamarin provides C# bindings to native Android and iOS APIs. This gives you the power to use all of Android and iOS' native user interface, notifications, graphics, animation, and other phone features—all using C#.[39]

Each new release of Android and iOS is matched by Xamarin, with a new release that includes bindings for their new APIs.[39]

Xamarin's port of .NET includes features such as data types, generics, garbage collection, language-integrated query (LINQ), asynchronous programming patterns, delegates, and a subset of Windows Communication Foundation (WCF). Libraries are managed with a linger to include only the referenced components.[39]

Xamarin. Forms is a layer on top of the other UI bindings and the Windows Phone API, which provides a completely cross-platform user interface library.[39]

❖ Android SDK Manager

It's stand for (Software Development Kit) it's an IDE (Integrated Development Environment) it has a set of tools such is, tutorials, libraries, debugger. to help programmers who's want to develop application for the android platform, it's having two parts SDK tools: to develop application no matter what the version of the android in other hand Platform tools is: to develop application in specific version of the android. [36]

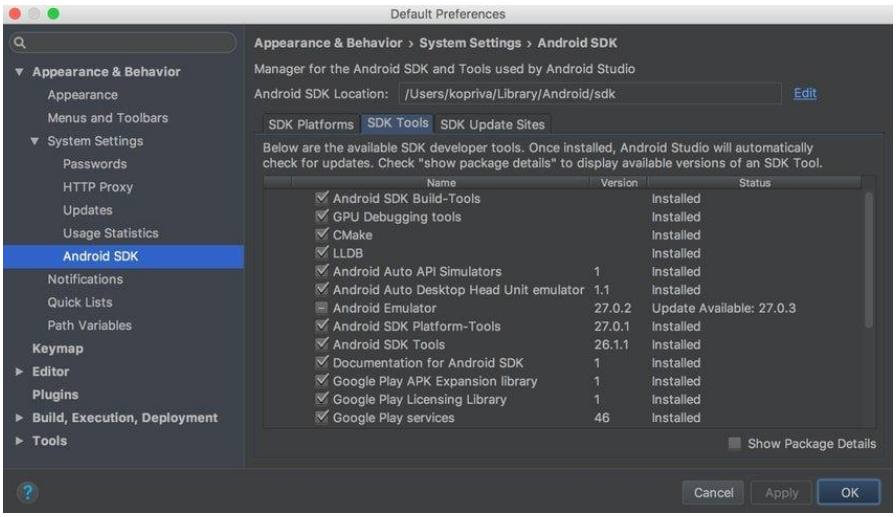

Figure 26: SDK Manager

- ML.NET (Machine Learning)

Machine learning framework built for .Net and c# developers to process machine learning algorithms, and design custom machine learning systems such as, recommendation, prediction, classification, and detection models.

Machine learning builder facilitate the processes of build ML model, and to test your AI system through several stages from analyze the data, train, evaluate, then get results test data accuracy, and best algorithm used through the progress. [37]

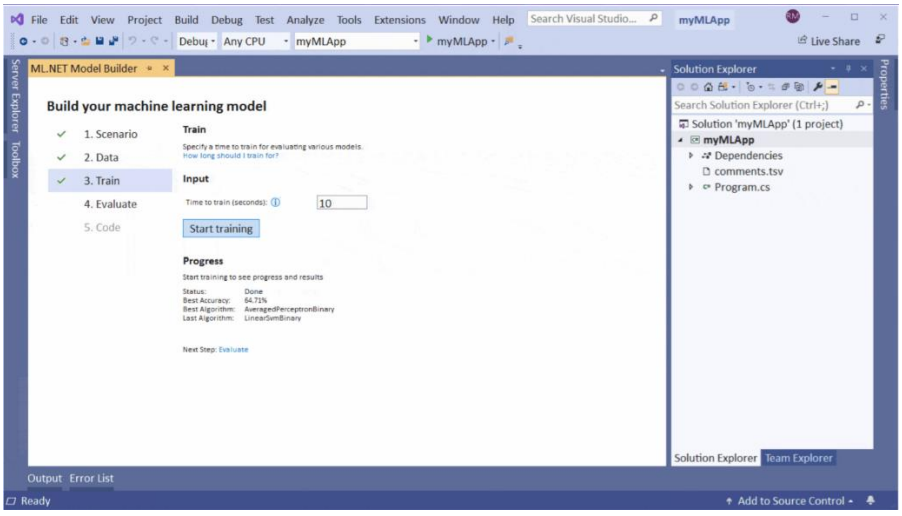

Figure 27: ML Builder UI

❖ Iron Python .Net

It is an open-source library that can execute python script within c# code and return an output of executed code, the power of python language and libraries on solving AI problems is known, have more popularity and larger community. In case if ML.Net doesn't return expected output, we will use {IronPython.net}. [38]

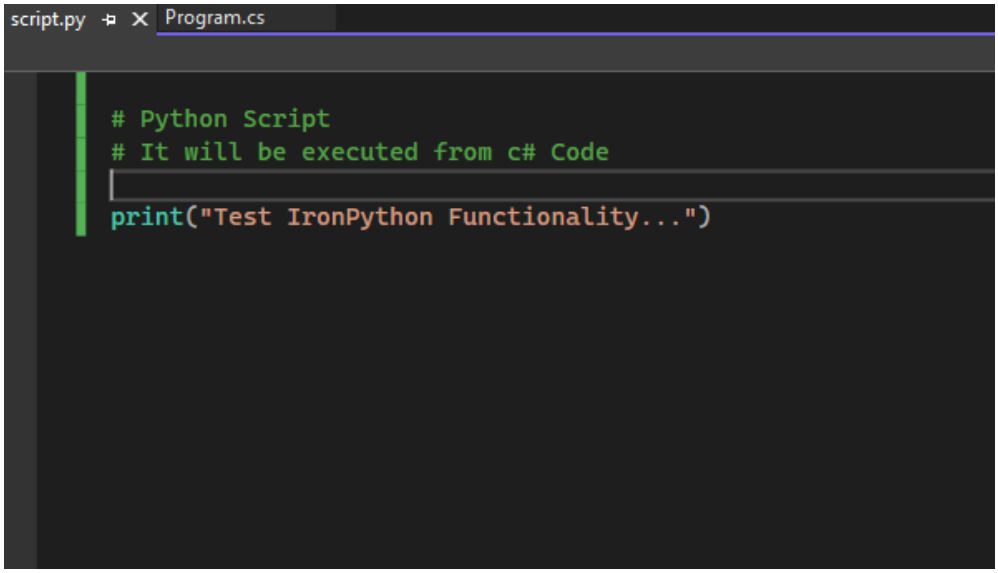

Figure 28: IronPython Library, Sample of python script

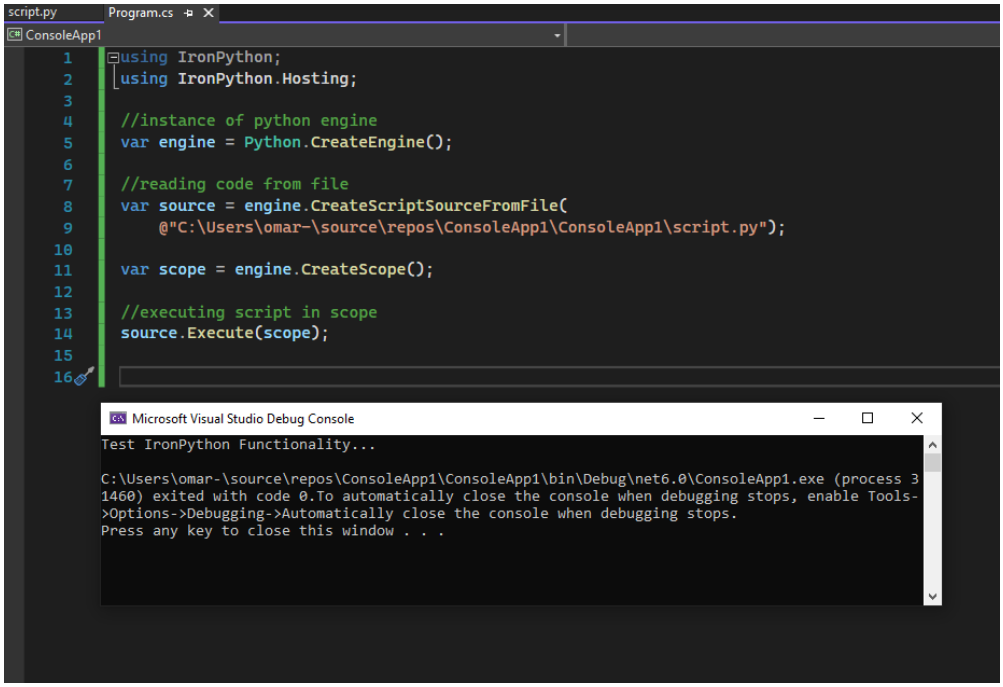

Figure 29: IronPython Library, c# Sample with python output

4.3 User Interface Design (UI)

Mobile Application Design

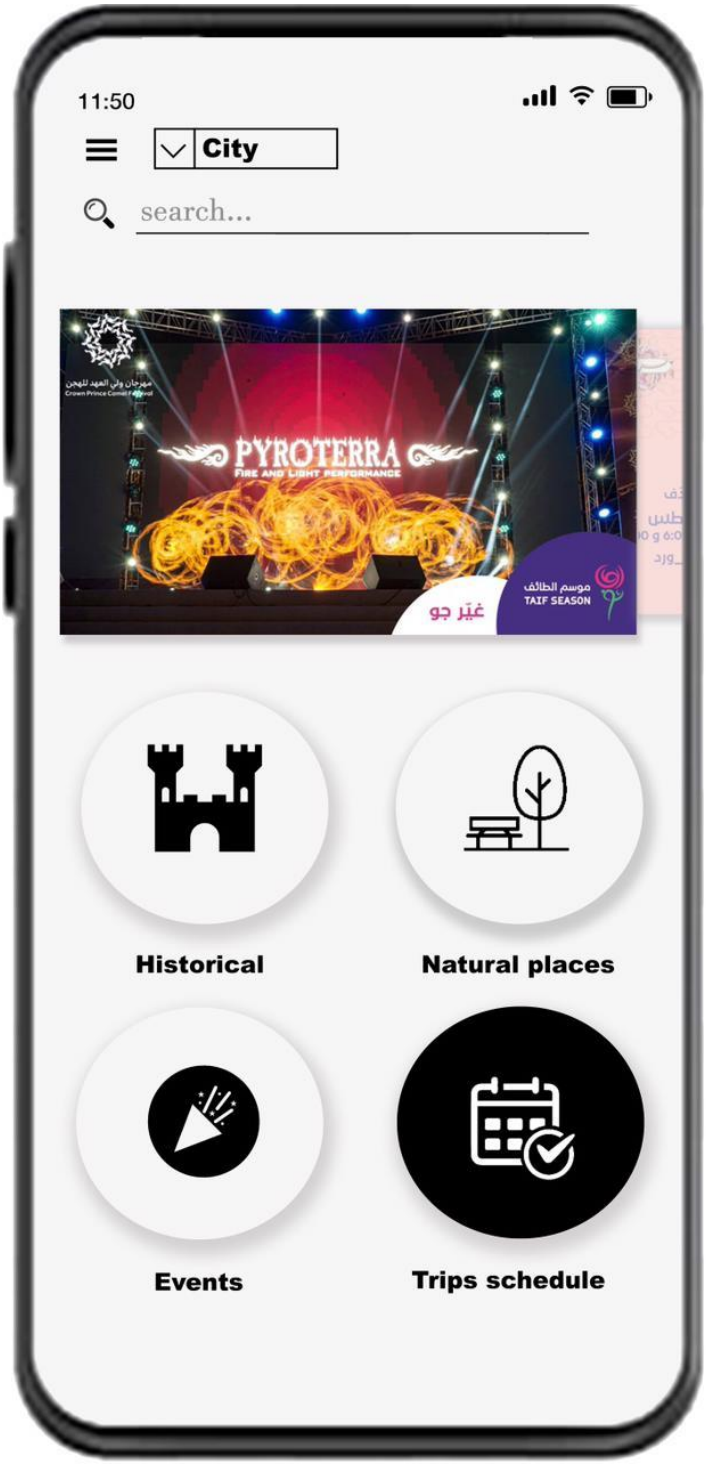

Figure 30: Main Page – UI

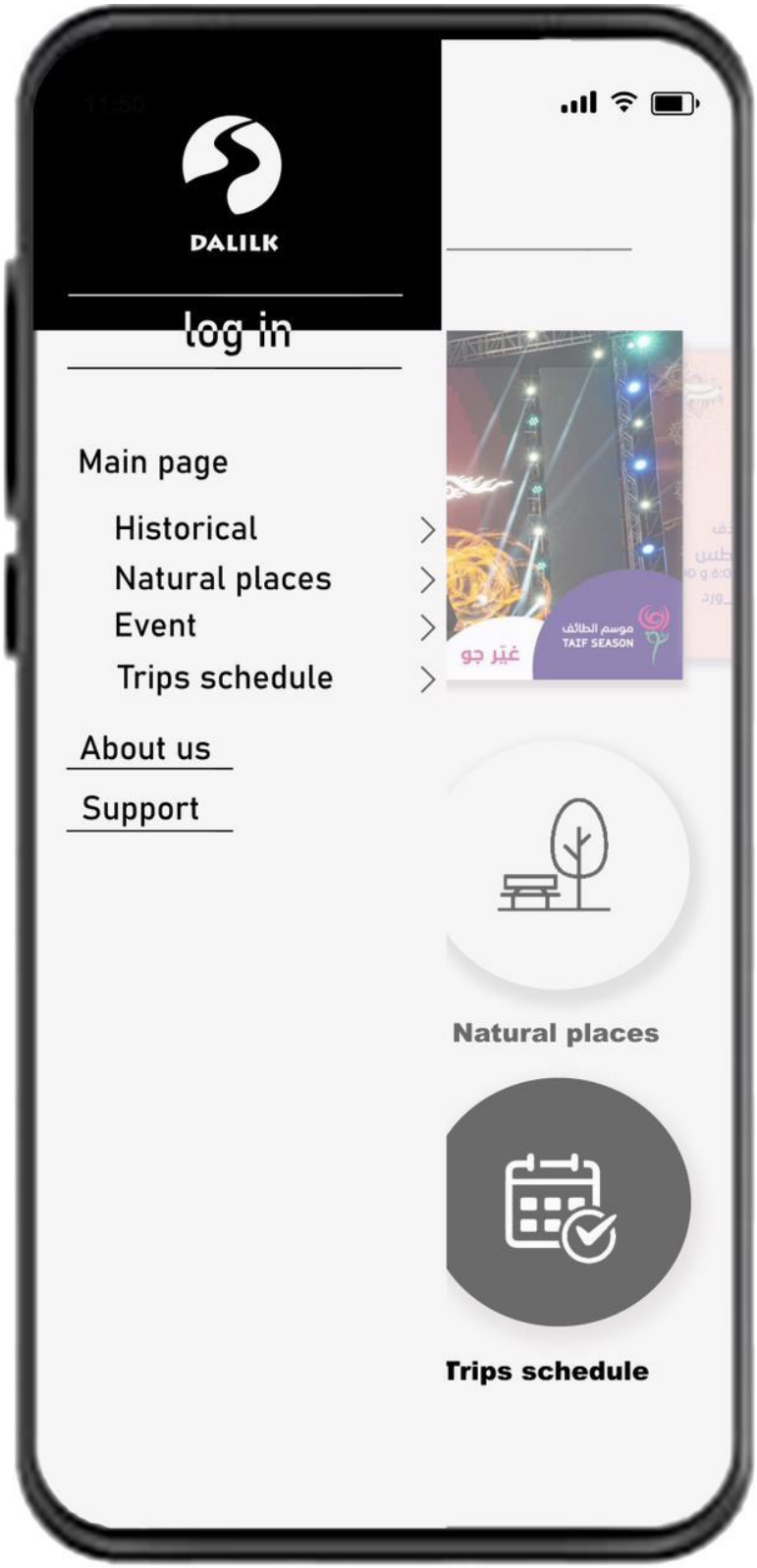

Figure 31: Menu – UI

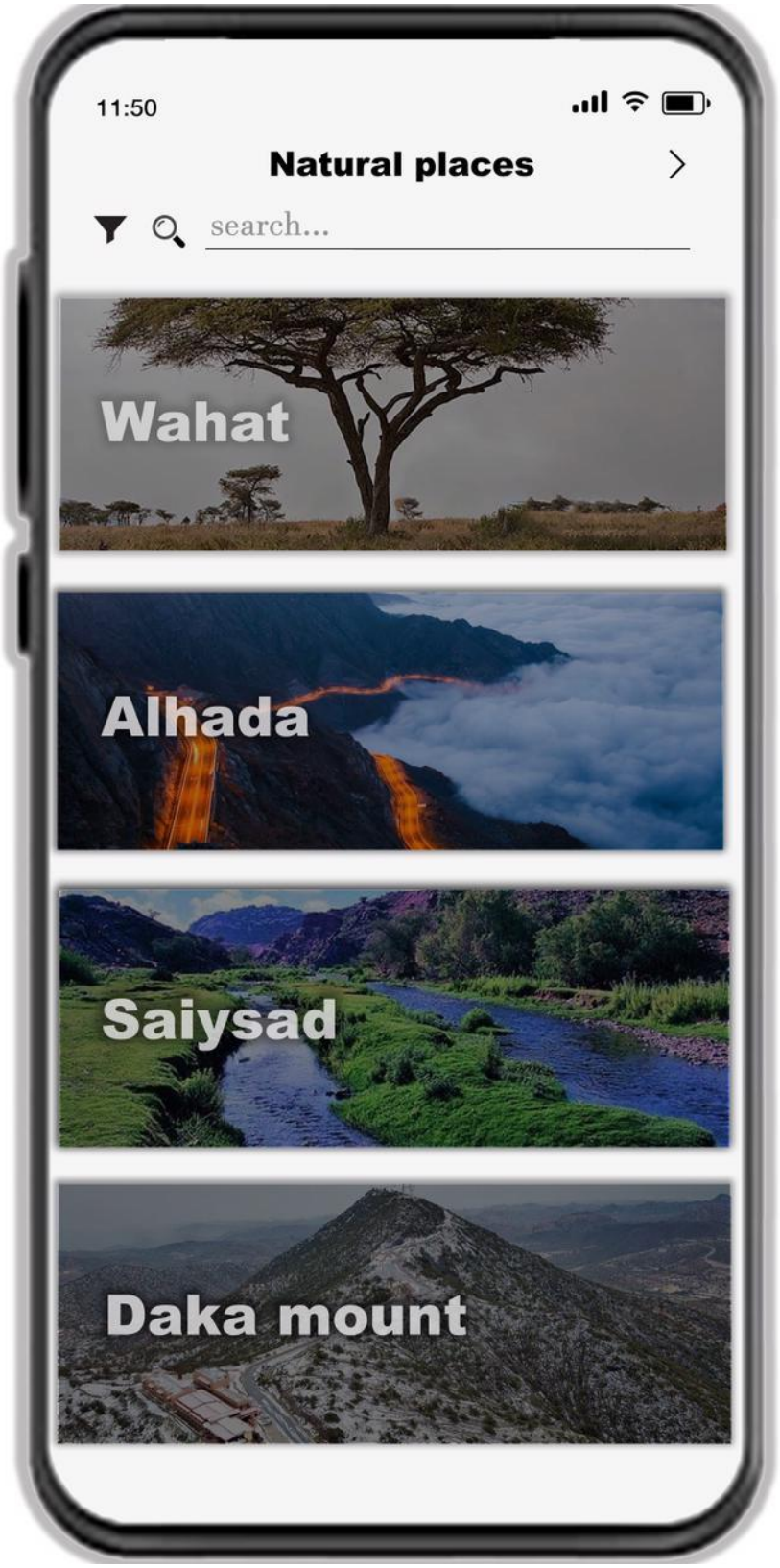

Figure 32: Search Page – UI

Figure 33: Schedule - UI

Website Design

4.4 Implementation of Database (MySQL and RavenDB)

In this project the databases implemented separately for two reasons, to administrate the data using MySQL, and to build a system compatible with big data using RavenDB ecosystem (framework).

In this section we will show the implementation and the efficiency about using two techniques for building the database.

MySQL

RavenDB

C# - Database Mapper

4.5 Implementation of C# Programs (Functions and Codes)

API Program

Machine Learning Program

Website Program

Mobile Program

4.6 Testing of System Functionalities

Chapter 5: Conclusion

As a conclusion for the report, we introduce the system idea as an application that serve the people in tourism with several features such as scheduling trips, recommendation by chat box, contact with guiders, and browse event, natural and historical places. In other hand, the system will serve the other user in different platform which it's a website for the admin to manage the application and monitor it. We define our system as smart tourism application based on the comparison between smart and electronic tourism theories, because our system can be used during the trip as asking guidance from others and get real time recommendation from the system that's help the tourists to get useful information in real time.

System analysis and design describe the methodology in detail initiates from the agile approach RAD definition, advantage, and disadvantage to prove that our application is applicable with RAD approach and could be developed through lifecycles of stages, and several responsibilities for each member of development team. The functionalities are explained in detail after showing the users scenarios in process flows and use case diagram. The non-functionalities of performance and quality as well based on sequence diagram.

The database designed to store tables and objects, in one hand, the tables store in relational database that's make the querying easier, in other hand, the objects store in no relational database that's have more efficiency to minimize the storage usage and reading users information. JSON files have an ability to read/write bigdata such as datasets for machine learning algorithms that will help us to apply high accuracy prediction for recommendations and crowded places.

There are specific tools that are required to design our system such as xaml to design the application, and bootstrap library with web techniques to design the website. To develop the application, we need an environment compatible with .Net framework to reuse some of the framework characteristics and c# language to program the application and the back-end of the website. To manage the database, we need MySQL to design and store the data and RavenDB to manage JSON files and bigdata with many features compatible with .Net framework. To manage the virtual android machine, we need android SDK manager to test the functionalities of the application. For machine learning we need ML.Net to apply the machine learning algorithm such as linear regression and matrix factorization and IronPython library in case if the ML.Net doesn't give expected result and accuracy.

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