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FACULTY OF ENGINEERING
COMPUTER ENGINEERING DEPARTMENT**

Project Report
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CENG 407
Innovative System Design and Development I

TEAM 11
ON-CLOUD PARKING MANAGEMENT SYSTEM

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Abstract

On-Cloud Parking Management System aims to solve the problem of finding parking spaces today with the increasing number of vehicles. This system solution has also adopted the traffic problem, as vehicles looking for suitable parking spaces create additional space in traffic. Municipalities have many solutions such as converting empty spaces into parking lots, building large-storey car parks, building underground parking lots, and opening paid parking lots. It aims to be an easy-to-use, effective and reliable system for these problems, especially in metropolitan areas. With our project, we aim to make people's lives easier and make people find parking places easier and faster by making their own appointments.

Key words:

Cloud Computing, Licence Plate Recognition, Mobile Application, Computer Vision, Flutter API, Django, Python, PostgreSQL

Özet:

On-Cloud Otopark Yönetim Sistemi, artan araç sayısı ile günümüzde park yeri bulma sorununu çözmeyi hedeflemektedir. Bu sistem çözümü, uygun park yerleri arayan araçlar trafikte ek alan yarattığı için trafik sorununu da benimsemiştir. Belediyelerin, boş alanları otoparka dönüştürmek, büyük katlı otoparklar yapmak, yer altı otoparkları yapmak, ücretli otoparklar açmak gibi birçok çözümü var. Özellikle metropol alanlarda bu sorunlar için kullanımı kolay, etkili ve güvenilir bir sistem olmayı hedeflemektedir. Projemiz ile insanların hayatlarını kolaylaştırmayı ve kendi randevularını alarak insanların park yerlerini daha kolay ve hızlı bulmasını hedefliyoruz.

Anahtar Kelimeler:

Bulut Bilişim, Plaka Tanıma, Mobil Uygulama, Bilgisayar Görüşü, Flutter API, Django, Python, PostgreSQL

1. Introduction

1.1 Problem Statement

The problem of not being able to find a parking place easily and quickly is an important issue. In an emergency, we need to find a parking space, but it's not as easy as we thought, and it also wastes time. If we open the way for this situation as soon as possible, we can find a more comfortable parking lot in daily life and make your work more comfortable, and even increase the survival rate of patients or people in emergency situations. By all means, the application is not very common today, but it is expected to be used by everyone in the future.

1.2 Background or Related Work

Big companies do not have any official research on the same problem, but some universities have posted blogs and articles on this topic. To solve the problem, extra-storey car parks were built and empty lands were converted into parking spaces.

1.3 Solution Statement

The project aims to enable users to find a parking lot without wasting time and to know all the detailed information about the parking lot before going to the parking lot; people will be able to find a parking lot nearby and provide easy access, as well as access to the parking lot with exactly the features they want with various filters. While solving the problem of safe parking and time loss, which is our main problem, we will also create various scenarios to provide our more forward goal, such as bringing customers to parking lots by creating various opportunities for users. The ability of the On Cloud Parking System is to give the user the opportunity to save their most valuable and irreversible time, even if it has a small impact on their life.

1.4 Contribution

In this project, we chose one of the most important problems of today's developing cities: Parking. Since there are no previously developed applications in this field, it will be an improvement initiative. We examined similar studies on this problem. In order to keep up with this technology, we followed current developments and developed our knowledge in this field. We aim to be the most effective, safe and user-friendly application in this field.

2. Literature Search

2.1 Abstract

Our project is an idea that has emerged to find a solution to a problem many vehicle drivers complain about. Our goal is to ensure that the driver can easily find a parking space at his destination. Thus, we eliminate stress and waste of time. But it will benefit not only drivers but also parking businesses. Parking lot businesses will both introduce themselves and fill the areas that they cannot fill through our application. In short, it is a lucrative practice for both parties.

2.2 Introduction

Our project will initially be on the Android mobile application system. The main purpose of the project is to enable the driver to easily find a parking place where he will go, and to take an efficient turn with time and stress savings. Our project will be efficient not only for the driver but also for parking facilities. Seeing the car parks in the city where the driver is located or even in its vicinity as a list and making a reservation will pave the way for parking lots with little awareness in the environment. Known car parks, on the other hand, will not be confused in the crowd and will be able to control the vehicle entrance and exit with a certain order. User comments and ratings for car parks will greatly increase reliability.

2.3 Comparision With Current Technologies

If we need to compare our project with current technologies, there is no technology that exactly matches. There may be applications that appear similar, but our perspectives are different. We can give the ParkJet application as an example. Offers parking, valet and car wash reservations. But different from our point of view, the car parks are their own car parks and the valet companies that they have agreed with can be classified as more luxurious. Our application appeals to the public. We will make an agreement with existing parking lots and gain customers, and we will also provide easy parking services to customers in convenient ways. It will be able to list the parking lots according to their comments and points, and find the closest parking garages to the destination, which does not have high reliability. The benefit of the parking companies we will deal with is that it is an application that will guide the customer to himself and even if necessary, it will be able to make campaigns and attract customers.

2.4 Main Findings

We have stated the learning we have gained from the research we have done about the main technologies we intend to use in our project as short definitions and scopes.

2.4.1 Database SQL and NoSQL

2.4.1.1 SQL

POSTGRESQL

PostgreSQL helps developers and project managers manage and store the data they use while developing software, regardless of whether they are big or small. As it is free and open source, PostgreSQL is completely adaptable, unlike many database systems. For example, if you want to determine your own data types, you can create special functions and use the database without needing to compile it again. PostgreSQL helps developers and project managers manage and store the data they use while developing software, regardless of whether they are big or small. As it is free and open source, PostgreSQL is completely adaptable, unlike many database systems. For example, if you want to specify your own data types, you can create special functions and use them without compiling the database again.

Advantages of PostgreSQL

Affordable, no license fees, providing you with manufacturer independence.

You can install and distribute PostgreSQL to as many servers as you want.

It is localized to Turkish and has Turkish support.

It is platform independent. (<http://buildfarm.postgresql.org/>).

It has high security. It has high accessibility.

It has an expandable architecture. It can be scaled, flexible, expanded or shrunk according to each transaction and data size.

ACID is fully compatible.

It is easy to learn and set up. It has extensive documentation that is up-to-date, detailed, open to everyone and easy to access.

It is easy to manage, backup, maintain and monitor.

Error messages and log system are clear and understandable.

Provides low downtime in planned maintenance.

It has a safe structure that prevents making mistakes.

PostgreSQL has a very advanced query planner.

It has drivers for all modern programming languages.

Supports geographic data structures and new NoSQL unstructured data types (JSON, JSONB, XML, etc.).

Specialized open or closed code solutions can be developed using the source code.

Powered by an active community, with developers from around the world and core developers, the community provides solutions to questions and problems with fast feedback. A new version is released almost every year with innovative and up-to-date features that make commercial products jealous.

PostGIS

PostGIS is a PostgreSQL extension that adds GIS capabilities to this RDBMS. Its popularity is not just because it is "free", but because it is accepted among the world's leading GIS applications. Almost every major frontend application, PostGIS, provides hooks for a PostgreSQL enabled backend.

2.4.1.2 NoSQL

MONGODB

MongoDB is a cross platform documentation database. Stores the data in a JSON style document format. It uses internal memory to store working sets. Therefore, it has faster data access capabilities. Each record is expressed as a document in MongoDB. It is one of the most preferred NoSQL systems today in terms of driver support for many programming languages that are actively used today. Query support. While many NoSQL solutions provide access to data only through keys, MongoDB offers the opportunity to query according to the desired fields and specific ranges (range queries), as well as regular expressions. If we want to give examples of applications where MongoDB is used, Uber, Forsquere etc. We can give an example.

MongoDB Infrastructure

Aggregation: Collecting and grouping scattered data and taking necessary actions on them.

Map-Reduce support: Divide, send, collect, send. Here, the data uploaded by the user to the system is divided into parts with mappers and distributed to the required areas, so that transactions are made faster and the load transferred to each area of the system is further reduced, after the necessary actions are taken by the system, these data are brought together with Reducers and transferred to the user.

Text Search: There is a text search support in MongoDB. To do this, you can search for a string expression using the \$ text function. If you ask me, this is one of the most beautiful features of mongodb, you can search and find a text whenever you want without any difficulty, you need to use the Full text search feature to do this in MsSQL in RDBMS systems, sometimes you may even have to do somersaults for this.

Data Models: MongoDB's data retention format is different from SQL. An array can contain string and integer expression. This feature is a feature that we can consider as a difference from RDBMS systems.

Replication: MongoDB to secure itself in case of any server error. There is a backup server next to the main server.

Sharding support: Ability to share large-scale data between servers. We have mentioned that performance is the top priority in MongoDB, so sometimes a single server may become

insufficient for us when the data reaches very large sizes, so by growing horizontally with new servers, the data is distributed to these servers and the load is reduced.

Geospatial Queries

MongoDB can store geospatial data as GeoJSON objects or coordinate pairs. 2D data is kept.

CASSANDRA

There are many advantages to using Cassandra. It is possible to add more hardware to support more customers and data. Therefore, it provides scalability. What's more, it can be fault tolerant and consistently usable for critical business applications. Also, it can perform terabyte data writes faster. Because Cassandra supports big data, it is possible to store structured, semi-structured and unstructured data. Also, the user can distribute data across multiple data centers. Usually we do not encounter network bottlenecks (no network bottlenecks). Data is automatically copied / duplicated on many nodes. Apache Cassandra has flexible scalability, fast linear performance, easy distributed architecture, faster queries and transaction support, faster read and write capabilities. It was originally developed for searching messages in the Inbox on Facebook and later made open source by Facebook. Distributed structure supporting multiple data centers (It can work distributed on several different servers and geographies.) *

In event monitoring applications: Many entertainment and media organizations use Cassandra to track user activities based on movies, music, albums, artists or other parameters.

* In heavy typing systems or periodic applications: Cassandra is perfect for very heavy typing systems. For example, data for each request; browser type, traffic sources, location, behavior, technology, devices, etc. in recording according to

* In Web Analytics, Social media analytics: Cassandra is used by many social media organizations to analyze data and make recommendations to their customers.

* In product catalogs and retail apps: One of the most popular uses of Cassandra is to display quick product catalog entries and searches.

* Messaging: Cassandra serves as the database backbone for numerous cell phones and message providers (Facebook, Twitter) and

* It is a database suitable for applications where data comes from different devices or sensors very quickly.

Comparison between two NOSQL

- MongoDB is a free and open source cross-platform document-oriented database system. Meanwhile, Cassandra is an open source, distributed and decentralized database for managing large amounts of data.

- Although Cassandra is column oriented, MongoDB is document oriented.

- MongoDB is written in C, C++ and JavaScript with Cassandra, and Java in Java.

- Cassandra has triggers, but MongoDB has not triggers.

- While Cassandra uses a selectable replication factor, MongoDB uses a master-slave replication factor.

- While Mongo DB stores data to be stored in BSON files on the disk, Apache Cassandra Node stores data inside and data centers are made up of all nodes.
- In terms of performance scalability and features, Apache Cassandra can be considered the best database in case of large amount of data to process and in terms of query execution speed and optimization.
- The advantages of MongoDB are that complex data can be easily modeled thanks to the JSON format support provided. This provides a lot of popularity for Mongo DB compared to Cassandra. Both MongoDB and Cassandra Performance databases have greater advantages depending on the requirements, and the amount of data to handle in the application decides the choice to make.

2.4.2 API's

2.4.2.1 Django

What is Django and what does it do?

Django is an open source python web framework used to secure rapid development, pragmatic, easy-to-maintain, clean design and websites. The main purpose of Django Framework is to enable developers to focus on the new components of the application rather than spending time on previously developed components. Django has more features than most other frameworks on the market. Many difficulties are encountered with web development; Django allows users to focus on developing the necessary components for their applications.

What is Model View Template-MVT ?

MVT is actually Model -View-Template working principle.

Model: is the working layer that contains database operations. We model the database related to the project we will do in this layer and then use this model where we need it. Another beauty of Django is that we can create a custom database without using any SQL commands.

View: this part is completely the business logic layer. We create a bridge between these layers by accessing the required template and model. Of course, this part is related to what we do with our Python codes.

Template: It is the design presentation layer of the project. This layer contains functions such as how the page should be displayed according to the information it receives from View.

Why should I choose Django?

- 1- Django can be installed and used easily.
- 2- It provides detailed error reports. It is easier to solve the problem easily among the errors given in detail. From this point of view, the detail in the error report is more than the PHP language.
- 3- It has an expandable management panel. When Django is installed, an admin panel of its own comes up. At first, we can develop this panel, which is very useful in basic operations, according to our wishes and desires.
- 4- Django has a template that constantly renews itself.
- 5- Django is a framework that is at a very good level in terms of security.

2.4.2.2 Spring Boot

What is Spring Boot?

Spring Boot is a framework that exists to develop Spring-based applications in an easy and fast way. Thanks to Spring Boot, we get rid of some details and write only the code that works for us, and this makes it very easy for us. One of the most useful aspects of Spring Boot is that it does not require XML configuration. It minimizes time loss and allows us to easily develop the application since it allows us to do your work automatically.

Why Spring Boot?

Spring library provides convenience to us while developing web applications with J2EE (Java 2 Enterprise Edition). Spring takes care of the routine for us at the back, providing speed, performance and ease of use. This gives us speed, simplicity of code and a strong infrastructure. It is very popular in corporate projects. Spring started to be developed in 2003. In applications developed before Spring, the layers were found in separate pieces from each other. Its development and management was very tiring. Thanks to Spring, it became possible to collect these layers under an application roof. Being module-based does not require us to add every sub-library.

Advantages

- It brings us ready HTTP servers to easily develop and test your web applications.
- It shortens development times and increases productivity.
- It offers us a ready-configured option with its default configuration settings.
- It provides a plugin for us to use build tools easily.
- It is very easy to integrate Spring Boot Application with other modules in Spring Ecosystem.

Disadvantages of the Spring Boot Framework

- One of the things that users of Spring Boot do not like most is lack of control. Since Spring Boot loads extra dependencies, it can get out of control.
- The Spring Boot structure is deployed directly to Docker containers and this gives us speed in the micro services section, it is not suitable for monolithic applications as the frame is constructed to be agile and light in order to gain speed.
- Another disadvantage is; Various difficulties may be encountered when we want to update our old Spring code.

Notable Features of Spring Boot

To be able to create independent Spring applications.

Starters provided to facilitate build configuration.

Automatic configuration.

Code generation and no need for XML configuration.

It comes with an embedded web server (Tomcat, Jetty, Undertow).

Customization and management is simple.

What's the Difference Between Spring and Spring Boot?

It allows you to create standalone applications.

Tomcat, Jetty, Undertow come directly embedded (there is no need to deploy their war files.)

Provides starter POMs to simplify Maven configuration.

Configures Spring automatically whenever possible.

Provides production-ready features such as metrics, health checks, and externalized configuration.

There is absolutely no code creation and requirement for XML configuration.

Spring facilitates its dependencies, prevents version conflicts.

An application can be run directly from the command line without a container.

Boilerplate allows us to get rid of the stereotypes and write only the codes we need.

How Does Spring Boot Work?

Some may be asking yourselves how does Spring Boot have auto configurations and what does that really mean? It really comes down to three simple Spring Boot annotations that provide this feature:

- `@SpringBootApplication`
- `@EnableAutoConfiguration`
- `@ComponentScan`

Between each one of these annotations Spring Boot is able to provide default project dependencies as well as allow for defaults to be overwritten.

`@SpringBootApplication`

`@SpringBootApplication` is used in the entry point of the application add the class it resides in needs to have to the application main method. The annotation is needed and will provide each of the other two annotations to your Spring Boot application since the `@SpringBootApplication` includes both inside.

`@EnableAutoConfiguration`

The `@EnableAutoConfiguration` does just that it provides each of the representing class with the Automatic Configuration capability.

@ComponentScan

Lastly the @ComponentScan will at initialization scan all the beans and package declarations.

Spring Starter Dependencies

Not only does Spring Boot include annotations but it also uses Spring Starter Dependencies to ensure that your application starts with the correct dependencies and so you can hit the ground running so to speak.

Many times, as an application grows larger it can be hard to properly configure project dependencies, the Spring Boot Starter plugins will help facilitate the dependency management. An example of a spring starter dependencies is the Spring Boot Starter web dependency.

That can be used so that your application can have Rest Endpoints written into your application. Overall, they help streamline the development of these applications so that a team will start from a more complex point so less holes will be presented especially with larger applications.

2.4.3 Automatic Number-Plate Recognition

License Plate Recognition (Reading) System is the process of detecting and separating the license plate area on the vehicle image obtained from the cameras, and reading the characters on the license plate by optical character recognition (Image Processing) methods.

It has different applications according to the project and is a system created by combining the application-specific algorithm and hardware structure.

- License Plate Recognition Software Algorithms
- Detection and separation of license plate location through camera image
- Repositioning and sizing of the plate in accordance with the next algorithms
- Normalization of image properties such as brightness, contrast
- Extracting characters from the image with character separation
- Optical character recognition
- Country specific syntax and geometric checks

Why License Plate Recognition?

- Accessing and analyzing stolen or violation information of vehicles passing through highways, bridges and toll booths
- Reducing the manpower at the entrance and exit of the parking lot, site, guardhouse and similar controlled crossing points, providing easy, fast and safe entry and exit
- Automatic access to license plate information at scales, vehicle inspection stations and similar places

License Plate Recognition System Application Areas

- Entry & Exit Points of the cities on the highway
- Places where Controlled Vehicle Passage is needed
- Bridges and Toll Booths
- Border Gates
- Highway Checkpoints
- Parking lots
- Sites
- Regulations
- Warehouses and Warehouses
- Universities
- Hospitals
- Hotels
- Scales
- Airports
- Schools
- Bus Station and Terminals

For Controlled Crossing Points:

- Reduces Entry - Exit / wait times
- Prevents traffic jams
- Provides security at entrances and exits
- Entry cards, vehicle tags, remote control etc. eliminates usage needs
- No operating costs
- Can be integrated with barriers and similar access control systems when necessary.
- Automatic barrier is activated for vehicles that are registered or authorized to pass.
- Audible and visual alarms are generated for vehicles that are not registered and whose passage authorization is restricted, if desired.
- Parking lot control, density measurements
- Prevent operator intervention

Main Features of License Plate Recognition System

- 98% recognition rate
- Identification time between 5 - 7 milliseconds
- Recognizing the license plate traveling at a speed of 250 km / h
- Vehicle Speed Detection Feature
- Full compliance with KGYS (MOBESE) projects
- Ability to read square, rectangular, official, military plates
- Recognizing all Latin license plates
- Optional vehicle Brand and Color recognition
- Ability to work in different light conditions day and night
- Automatically recording license plates (Plate, Date, Time and Route)
- Questioning the registered plates and reporting them with pictures
- User authorization and remote management
- Automatic querying from EGM-POLNET and local database

- Automatic barrier triggering and control
- Automatic receipt and label printing
- Parking fee automation
- Providing automatic passage of authorized (subscribed) vehicles and counting vehicles
- Obtaining information about the use of parking spaces of cars
- Integration with any database
- Easy to install and easy to use interface
- Sending and receiving information to all automations
- Mobile plate identification by mounting in the vehicle
- Functions that can be developed according to needs
- IP (Digital) cameras and high resolution operation
- Web server software (database independent)
- Platform independent server software (Linux, Windows)
- IOS and Android supported barrier triggering (Iphone, Samsung etc.)

2.4.4 Computer Vision

The first studies of computer vision date back to 1970s. Computer vision is basically trying to perform tasks or functions that a person can do visually in a computerized environment. It is the process of making a decision based on the results of digital images or video images in a way that the human can decide. Computer vision uses methods of creating, processing, analyzing and making meaningful of the digital image in order to generate information numerically or symbolically on the image.

Computer Vision background covers a wide range. While performing operations on images, due to the models created with the help of statistics, physics, geometry and learning theory, each field of study requires separate expertise.

In general, these branches can be listed as follows:

Recognition

The classic problem in computer vision, image processing, and machine vision is to determine whether the image data contains a particular object, feature or activity after acquisition.

Object recognition: It is called object classification. This technology in the field of computer vision is used to find and recognize objects in any image or video. For example; We can give detection processes such as trees, people, cars and structures as an example.

Identification: It is the recognition process on only one instance of an object to be targeted. As an example, we can call it recognizing the feature of any type of house structures (chimney shapes of drone-drawn houses).

Detection: It is also known as the detection system. Basically, it is the scanning of digital image videos for a specific condition based on simple and fast calculations. As an example, we can give a drone that explores the forest to detect a fire.

Content-based Image Retrieval: It performs the process of finding all images with a certain content in a large set of images. For example, in order to organize a complex dataset according to its content, we can say that it is the process of analyzing and classifying the content such as human, animal, house and car.

Pose estimation: It is the estimation of the position or direction of the target object on the image taken from the camera. As an example of this system, while face recognition systems are used in identity verification, the user is interactively told to close his / her eyes and move his / her head and the accuracy is confirmed by estimating the pose. You can look at the rotation matrix or quaternion for the pose estimation.

2D Code Reading: It is the process of reading 2D codes such as data matrix and QR codes.

Facial Recognition: Face recognition is a technology that can identify or verify a person from a digital image or video source. It is also defined as a Biometric Artificial Intelligence-based application that can uniquely identify a person by analyzing patterns according to the person's facial tissues and shape.

Shape Recognition Technology: It is also known as pattern recognition. It is the automatic recognition of patterns and regularities in data. Pattern recognition is closely related to artificial intelligence and machine learning, with applications such as data mining and knowledge discovery in databases (KDD), and are often used interchangeably with these terms.

Motion:

It is more concerned with the motion prediction in which an image sequence is processed.

Examples of such tasks:

Egomotion: Identification of the camera from a sequence of images produced by the 3D rotation and flip camera. In the field of computer vision, egomotion means predicting the movement of a camera according to a solid scene. Egomotion prediction is important in autonomous robot navigation applications.

Tracking: Usually the process of following the movements of a smaller point of interest or set of objects in the image sequence. These can be vehicles, people or other assets. Tracking systems are widely preferred in areas such as security and surveillance. For example, with border surveillance systems in military UAVs, tracking and monitoring illegal crossings at the border.

Optical Flow: It is used to determine how the point moves according to the image plane for each individual point in the image. It is also used for many areas such as object segmentation, contact time information and brightness.

2.4.5 Cloud Computing

It means the computer that ensures that all kinds of documents and files we need can be accessed from anywhere. It means that information, documents, presentations, files collected on a single server can be accessed from anywhere on the internet. In this way, companies have a more flexible structure. Cloud computing services, which make it possible for personal data and documents to be accessible from anywhere, not only for companies, eliminates material requirements such as hard disks and external carriers.

What's the advantage?

Cloud computing, which eliminates problems such as storing files and accessing files, makes it possible to use smart technologies that come into our lives more actively and efficiently. Presentation files no longer need to be in your bag, computer or on an external disk. Thanks to cloud computing services, the document you want is at hand without being dependent on any device.

Services such as Google Drive, Box.com, and Microsoft Cloud are the best examples of cloud computing. Cloud computing, which makes it possible to eliminate file and data losses, enables you to access your data 24/7 without interruption. Moreover, the fact that this is not a matter dependent on any device expresses the greatest feature of cloud computing.

Firms that invest in cloud computing services attempt to set up this system from a to z within their own structure, making it necessary to meet a great cost and hardware requirement. Therefore, using this service in the form of leasing would be the right behavior in terms of making the costs more affordable.

Information cloud services, which are separated as Public Cloud or Private Cloud, ensure that the information is open to everyone, and on the contrary, it also has a structure that only authorized persons can access. Cloud computing, which will enable companies and individuals to be more flexible, has already taken its place among the technology that makes life easier with its paid and free options.

3. Software Requirements Specification

3.1 Introduction

3.1.1 Purpose

On-Cloud Parking Management System: An application designed for people to easily find parking spaces in daily life. This application aims to help people save time and find parking spaces faster. This document contains detailed information about the project's requirements and the SRS document explains how users interact with the application.

3.1.2 Scope of Project

Most of the people who own a car find it difficult to find parking spaces in crowded places, so sometimes they have to park their cars in remote parking spaces and walk. This causes them to waste too much time. There are not enough apps that fix this problem. This application has been made necessary to remove from these troubles.

On-Cloud Parking Management System project is designed to solve the parking problem that people experience in their daily lives both practically and quickly. This application allows people to interact with a new mobile technology. This interaction puts the closest and best car parks at your disposal. It also offers you many other services as well as parking. This project is easier access, cost efficient etc. It creates opportunities.

After you subscribe to the application, you have your own profile. In addition, the application has a home page. From this home page you can see the most popular parking lots near you. If you wish, you can see the car parks in the district you want from the search section. You can then access the detailed information of the car park you have chosen (Address, Location, Phone etc.) Can make reservations for parking lots. If you want, you can pay in the parking lot or by mobile payment method.

3.1.3 Glossary

Term	Definition
IEEE	Institute of Engineers and Everbody Else - Contributing to the function of enhancing, integrating and sharing creativity of IEEE engineering, electrotechnology and information technology, sciences and expertise areas beneficial to humanity; It is a non-profit technical professional organization.
JWT	Json Web Tokens - It is an RFC 7519 standard designed to securely transmit information between parties as a JSON object.
RFC	Request for Comment

MobSF	Mobile Security Framework - It was created to perform static analysis of mobile applications.
API	Application Programming Interface - This system functions as an interface that allows the capabilities of one application to be transferred to another application.
SRS	Software Requirements Specification - A document that completely describes all of the functions of a proposed system and the constraints under which it must operate. For example, this document.
DevSecOps	It is a concept that arises from the ineffectiveness of old security models on today's continuous deployment processes.
CI / CD	Continuous Integration Continuous Delivery/Deployment - Continuous integration and continuous deployment are two approaches to software development designed to improve code quality and ensure fast delivery
Python	The programming language for the implementation of the machine learning classifier
Admin	The person who supervises the application
User	Any user that has been registered to the application

3.1.4 References

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- [2] SME-Empowering Project's Inception Report, ECORYS.

3.1.5 Overview of Document

On-Cloud Parking Management System: An application designed for people to easily find parking spaces in daily life. This application aims to help people save time and find parking spaces faster. This document contains detailed information about the project's requirements and the SRS document explains how users interact with the application.

3.2 Overall Description

3.2.1 Product Perspective

Parking Management System on Cloud is designed to provide easy, time-saving and reliable vehicle parking for daily parking problems. The project is divided into two parts: park information section and park reservation section. The parking information section shows you the five most popular car parks closest to you and gives you detailed information about the parking lots in your area or area you are looking for. These will be location, address, phone, price, vehicle capacity, rating, reviews and extra services. The second part is the parking lot reservation section, in this section you can reserve the car park you have selected and choose the payment method yourself. Payment methods are divided into two; mobile payment and hand payment.

3.2.2 Development Methodology

We planned to use Python Django Framework, an easy software development methodology, to develop the project. Django Framework, PC, Windows, Mac, Linux etc. It works on any platform. It provides a layer between our developer and the database called ORM (object-relational mapper) that makes it possible to move or migrate our applications to other large databases with a few rows. Django can be installed and used easily. Django is a framework that is at a very good level in terms of security. It has an expandable management panel. When Django is installed, an admin panel of its own comes up. At first, we can develop this panel, which is very useful in basic operations, according to our wishes and desires. It provides detailed error reports. It is easier to solve the problem easily among the errors given in detail. From this point of view, the detail in the error report is more than the PHP language.

3.2.3 Constraints

This section covers system restrictions in terms of application security. The application is designed to help the user park the vehicle easily and the application should always work correctly. There are some situations where the application requires restrictions. In this case, if the person taking the appointment does not arrive on time, the appointment will be canceled and blocked for a short time. By repeating this situation over and over, the duration of the obstacle will be unlimited.

3.2.4 Assumptions and Dependencies

Various assumptions and dependencies went into the creation of project in order to ensure that the system works safely and efficiently.

3.2.4.1 Assumptions

The main assumption in this project is that people are looking for parking spaces for their cars safely and quickly.

It is assumed that all system elements are working properly and there are no abnormal conditions.

3.3 Requirements Specification

3.3.1 External Interface Requirements

3.3.1.1 User interfaces

This section is detailed below.

3.3.1.2 Hardware interfaces

For the application, a smart mobile phone and the mobile phone must contain an android operating system.

3.3.1.3 Software interfaces

It does not require extra software.

3.3.1.4 Communications interfaces

No need for an interface for extra communication

3.3.2 Functional Requirements

3.3.2.1 Functional Requirement 1 (Sign Up Management Use Case)

Diagram :

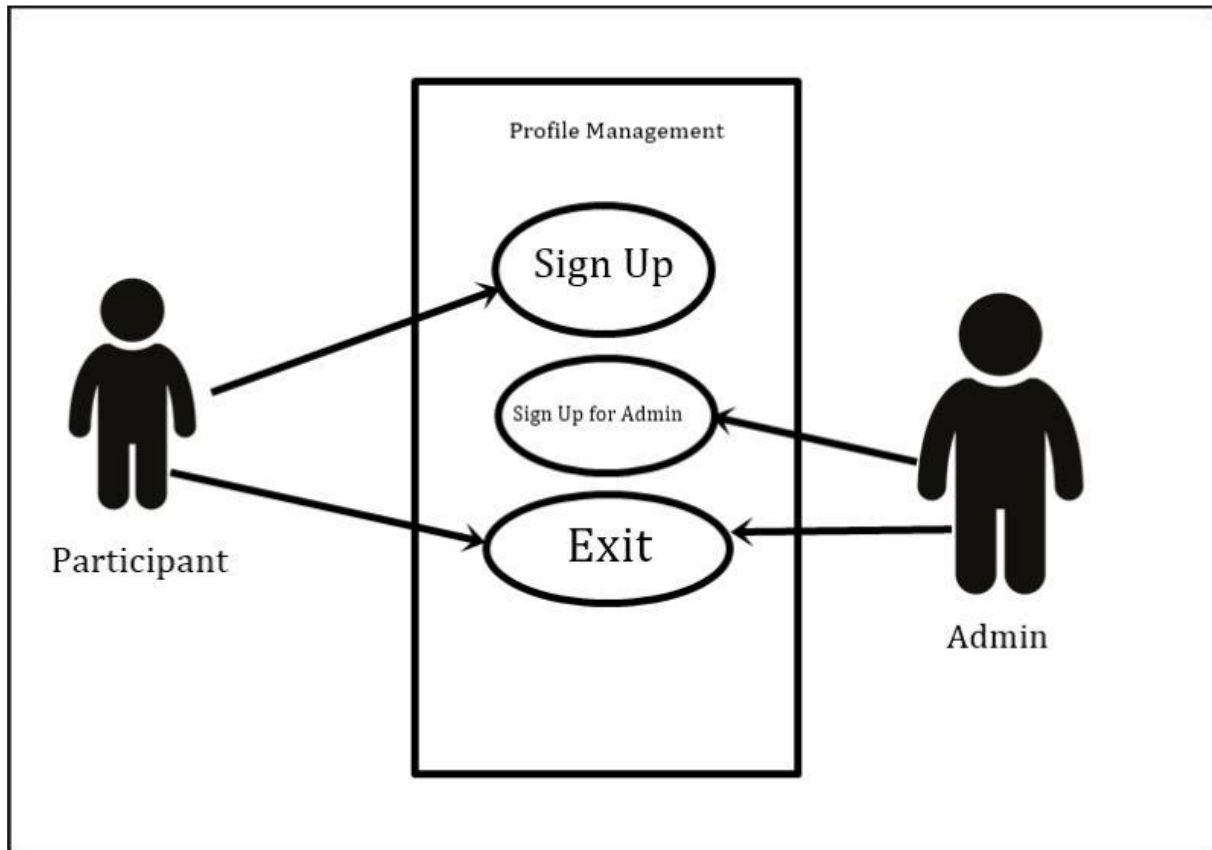


Figure 1 Profile Management Brief

Description :

In the Profile Management diagram (Figure 1), necessary information is given to enter the user's and admin's system. The user and manager can use the following common function: Exit. Apart from these, the user can also use the Sign Up function and the Administrator can use the Login functions as Administrator.

First Step Step Description ;

1. The user will start after logging into the system.
2. The administrator must log in to the system using a password.
3. Administrator and user can leave the system.

3.3.2.2 Functional Requirement 2 (Home Page Management Use Case)

- Search
- Profile
- Past
- Campaign
- Favorite
- Evaluation
- Settings
- Exit

Diagram :

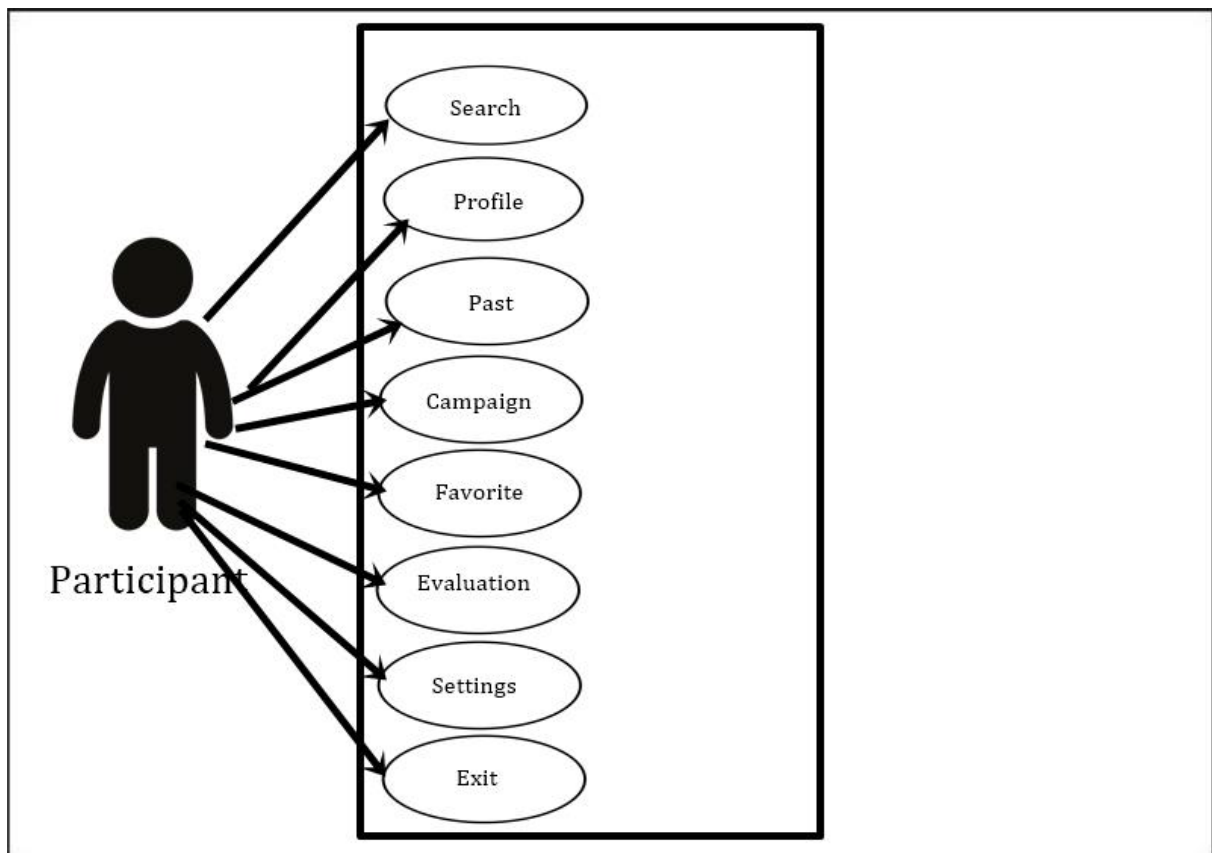


Figure 2 Home Page Management Brief

Description :

Figure 2 main page usage diagram. As shown in this diagram, the user can enter the search section and search for whatever they want there. If the user selects the profile section, they will access their own information. The past section will reach the list of the car parks the user has visited before. The campaign part will be special opportunities for the user. Favorite part, on the other hand, can access the list of parking lots that the user uses, likes and wants to go again. The user can choose and edit this list. Evaluation section is the section where the user

gives one to five stars and comments on the parking lots where they have gone before. Settings section is the section where the user can access their own application settings. Exit part is designed for those who want to log out of their account.

First Step Step Description ;

1. If the user selects the search section, they can search for the desired address or select one of the available districts.
2. If the user selects the profile section, they can access their information in the application.
3. If the user chooses the past section, he / she will get the list of the car parks they have visited before.
4. If the user chooses the campaign section, he / she will get special discounts or opportunities.
5. If the user selects the favorite section, they can access your list of car parks that they often use, like and want to go back to.
6. If the user selects the evaluation section, they can give a rating between one and five to the car parks they have visited previously and write comments if they wish.
7. If the user selects the settings section, his / her own application can access the setting section. If he wants, he can make changes in these settings.
8. If the user selects the exit section, they can log out from their own account.

3.3.2.3 Functional Requirement 3 (Settingd Menu Management Use Case)

- User Settings
- Registered Vehicle Information
- Password
- Delete Account

Diagram :

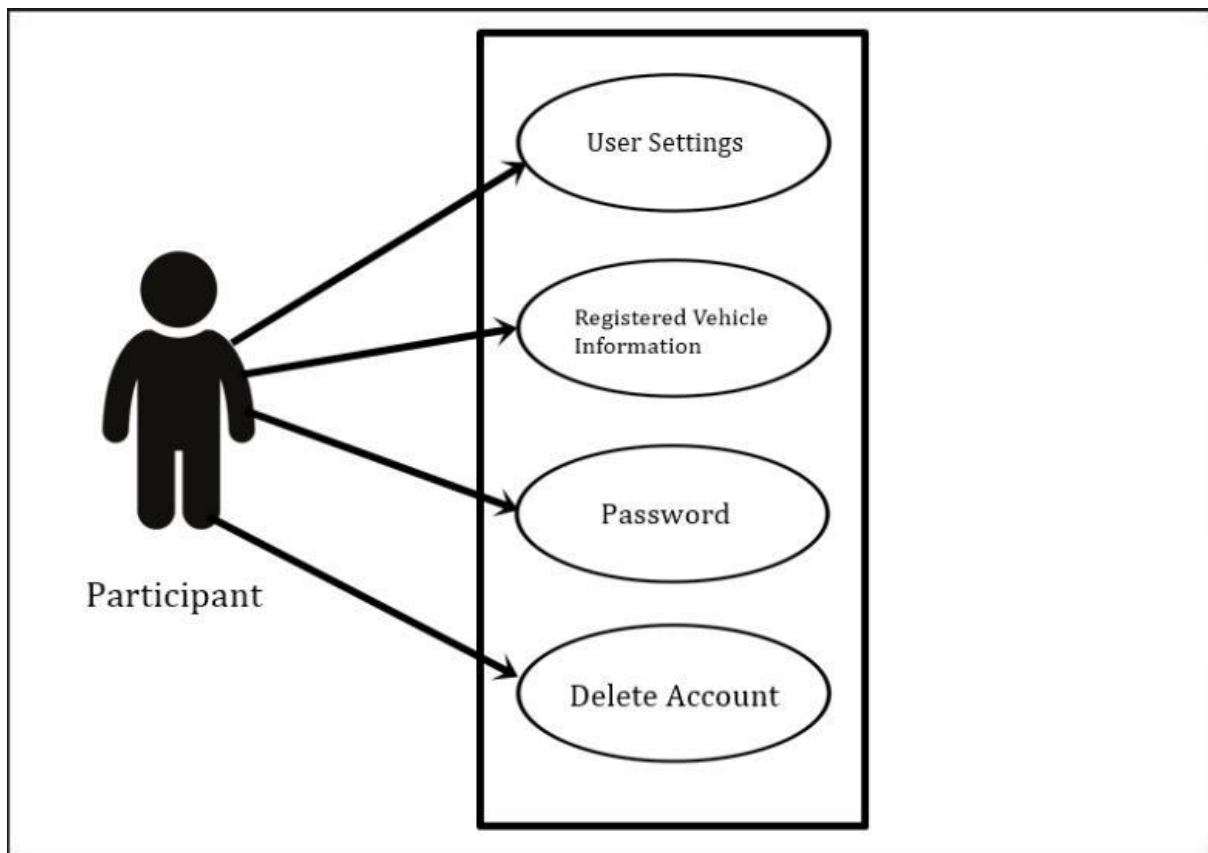


Figure 3 Settings Menu Management Brief

Description :

Figure 3 shows user option menu use case diagram. The user can change her/his personal information in the User settings section. You can enter or correct the information of the vehicle or vehicles from the Registered vehicle information section. The user can change her/his password in the Password section. In the Delete Account section, the user can delete their account permanently or temporarily.

First Step Step Description ;

1. The user can access their personal settings from the user settings section and make changes if they wish.
2. The user can add their vehicle or vehicles from the registered vehicle information section and then change them if they wish.
3. The user can change her/his password from the password section.
4. The user can delete her/his account temporarily or permanently from the delete account section.

3.3.3 Performance Requirements

Since the application is still in the design phase, no detailed information is provided, but the user must have a smart android phone that can connect to the internet as a first step.

3.3.4 Software system attributes

3.3.4.1 Portability

On-Cloud Parking Management System is designed for android phones using Django

3.3.4.2 Performance

The user should not make a reservation without entering vehicle information.

The user must enter the card information when making mobile payments.

To become a member, the detailed contract must be read and approved.

3.3.4.3 Usability

After the user makes a reservation, a warning notification is sent at certain time intervals, if she/he still does not go, it will be temporarily then blocked.

3.3.4.4 Adaptability

There is no need for adaptability as no data is received and recorded since the run time

3.3.4.5 Scalability

There is no need for Scalability as no data is received and recorded since the run time

4. Software Design Description

4.1 Introduction

4.1.1 Purpose

The On-Cloud Parking Management System aims to find reliable parking spaces for their vehicles in the shortest time and easily where they want to go. When the vehicles wandering to find a parking space can easily find a parking space, it will have a little effect on the reduction of the traffic problem in big cities. In addition, it will create a tracking and management system for parking lot owners.

4.1.2 Scope

The Software Design Document will include the general description and features of the project, design constraints, overall system architecture and data architecture, our current progress, and a brief description of the project's schedule. The design of the system and its subsystems will be explained visually with the help of UML diagrams to help the programmer understand all the information stated in this document accurately and easily

4.1.3 Glossary

Table 1 Glossary of SDD

SDD	Software Design Document
UML Diagram	Unified Modeling Language
IEEE	Institute of Electrical and Electronics Engineers
Use Case Diagram	Represents user's interaction with the system.
Sequence Diagram	A sequence diagram is the most commonly used interaction diagram.

4.1.4 References

IEEE. IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications.
IEEE Computer Society, 1998.

4.1.5 Overview of document

The Overview section, of this document gives an overview of the functionality of the product. It describes the formal requirements and is used to for the technical support in the next chapter.

4.2 Design Considerations

4.2.1 Approach

Important points were taken into consideration while designing the WWTMS project. This project is aimed at resolving the requests of the user in the fastest and most reliable way. One of the most important points discussed in the user section is that when the user starts using this application, the screen description is detected without difficulty. As shown in section 5.2.1, the implementation is understandable and simple for people of all structures. Every effort has been made to keep the personal data entered by the user securely and to work without errors. The structure shown in 5.2.2 was designed with the necessary conditions in order to facilitate the work of the working chief for this system. The structure shown in 5.2.3 is designed so that there is no business complexity between teams and different teams do not work on the same problem.

4.2.2 Tools Used

- Django for framework
- PostgreSQL for database
- Python
- Flutter For GUI

4.2.3 Constraints

Since it is a mobile application for application visuals presented to the user, there will be maximum efficiency on the restricted screen. The user will be kept busy in order not to lose the user during delays in the application. (ex. transition from blurry to sharp image.)

4.2.4 Assumptions and Dependencies

We assume that users will provide correct and complete data to be entered while signing up for our application. If there is an incorrect login, it is the user's duty to make the necessary corrections with the guidance of our system.

Our application will first be designed for Ankara parking lots. Our first version is not available for potential users in other provinces.

4.3 System Interfaces

4.3.1 External System Interfaces

Our system interacts with the external system called Google Map Platform API. Within the parking service to be offered to the user, the closest parking lot to the user, the parking lot information arranged according to the districts, the location information of the parking lots will work on this platform.

4.4 Process Design

4.4.1 Use Cases

Use Case Name:	Sign In
Use Case ID:	UC1
Included Use Case(s):	Sign Up
Primary Actor(s):	User
Description:	The user logs in here to use the application.
Precondition:	Must have downloaded the application and must be a registered user.
Main Scenario:	<ol style="list-style-type: none">1. The Application should be entered. If not registered user must be registered.2. He must enter his registered phone number.3. He must enter his password. If they forgot it, they should click Forgot Password and get a new password.4. In the Forgot My Password section, he / she should update his / her password with the password renewal e-mail received.5. Finally, the application is entered by pressing the Sign In button.

Use Case Name:	Sign Up
Use Case ID:	UC2

Included Use Case(s):	-
Primary Actor(s):	User
Description:	It is for the new user to complete the membership form and become a member.
Precondition:	The user must have downloaded and run the application.
Main Scenario:	<ol style="list-style-type: none"> 1. The user must first enter their full name. 2. The user must set himself a username. 3. User must enter their email. 4. The user must set himself a password and enter it, and re-enter the same password in the control password section. 5. Finally, by entering the phone number and clicking the sign up button, the member form is completed. 6. Membership is completed with the verification code sent to your phone.

Use Case Name:	Check Out the Main Menu.
Use Case ID:	UC3
Included Use Case(s):	-
Primary Actor(s):	Customer
Description:	The main menu is the first part that opens when you log in to the application. Popular parking lots are listed here and access to everything that the application provides is provided here.
Precondition:	It must have installed and run the application and logged in as a member.
Main Scenario:	<ol style="list-style-type: none"> 1. The highest rated popular car parks are listed in the main menu. Parking can be selected here. 2. In the upper left there are three line icons. With this icon, can switch to the menu section. This is an option. 3. There are 5 options in the menu section.

	<p>4. Looking at the settings in the Settings section.</p> <p>5. The user can access the car parks he added to his favorites from the My Favorite Car Parks section.</p> <p>6. Occasion, discounts or packages offered by the car parks are found in the "Occasion" section.</p> <p>7. In the My Coupons section, the coupons offered by the car parks or the application, if any, are displayed.</p> <p>8. In the History section, the parking lots where the user has booked in the past are listed.</p> <p>9. Profile information can be accessed as an option from the top right of the main menu.</p> <p>10. Profile information can be updated or viewed from the Profile Information section.</p> <p>11. In the Registered Plates section, registered plates can be changed, deleted or a new one can be added.</p> <p>12. There is a search box at the top of the main menu. You can search with this box.</p>
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Use Case Name:	Search Box
Use Case ID:	UC4
Included Use Case(s):	-
Primary Actor(s):	User
Description:	This area is for parking or area search.
Precondition:	It must have installed and run the application and logged in as a member.
Main Scenario:	<p>1. Click on the search box in the main menu.</p> <p>2. As soon as the box is clicked, the districts within the province of Ankara are listed in order. If the user wants, they can choose from the districts and proceed or make the search they want.</p> <p>3. According to the search, the parking lots are listed.</p>

Use Case Name:	Check out the parking lots
Use Case ID:	UC5
Included Use Case(s):	-
Primary Actor(s):	User
Description:	Here, the car parks are presented to the user in order. The user can quickly inspect the parking lots.
Precondition:	It must have installed and run the application and logged in as a member.
Main Scenario:	<ol style="list-style-type: none"> 1. Parking lots are shown one under the other. 2. Important details (parking lot rating, availability, price, etc.) are in the box of the relevant parking lot. 3. Can filter and sort. (Price, location etc.)

Use Case Name:	Select Parking
Use Case ID:	UC6
Included Use Case(s):	-
Primary Actor(s):	User
Description:	The user selects one of the car parks and the user can access detailed information of the selected car park.
Precondition:	It must have installed and run the application and logged in as a member.

Main Scenario:	<ol style="list-style-type: none"> 1. The user selects one car park among the car parks. 2. You can see the detailed information of the parking lot chosen. These are: the exact location, photos, price information, detailed information of the car park, opportunities if there are opportunities, total capacity and the number of available par areas 3. If he likes the parking lot, he can add it to his favorites and reach the parking lot quickly in the next use. 4. If he has decided on the parking lot, he can make a reservation by calling the parking lot directly from the Search button.
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4.4.2 UML Diagram



4.4.3 Sequence Diagrams

Diagram for UC1:

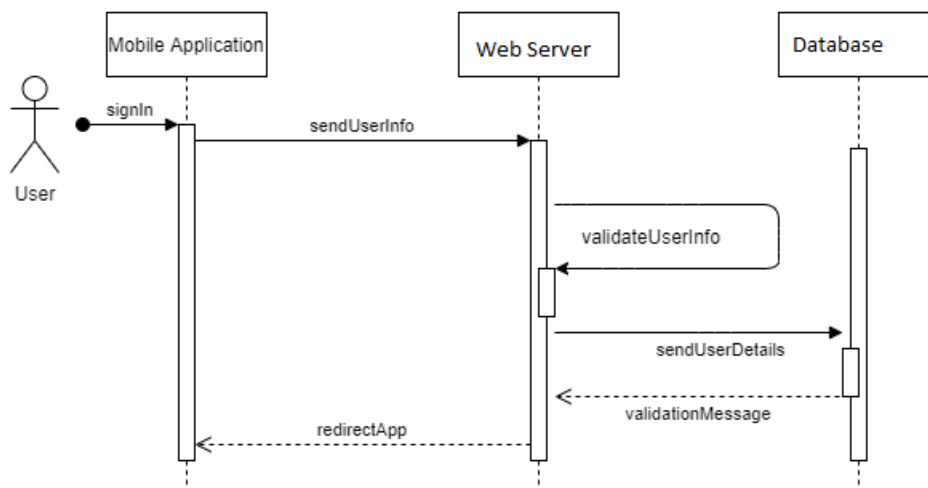


Diagram for UC2:

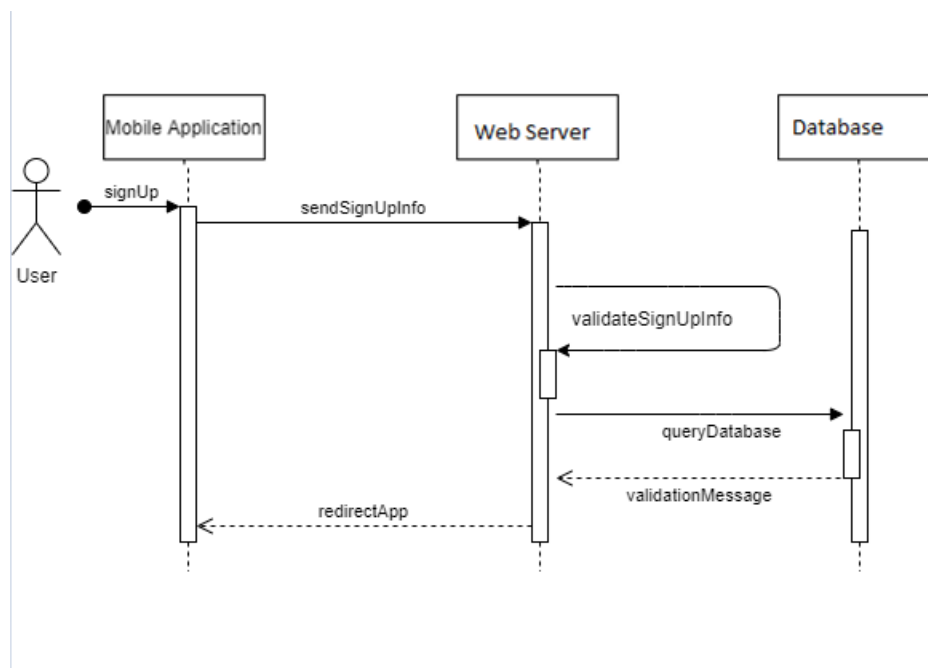


Diagram for UC3:

Sample Coupon Option:

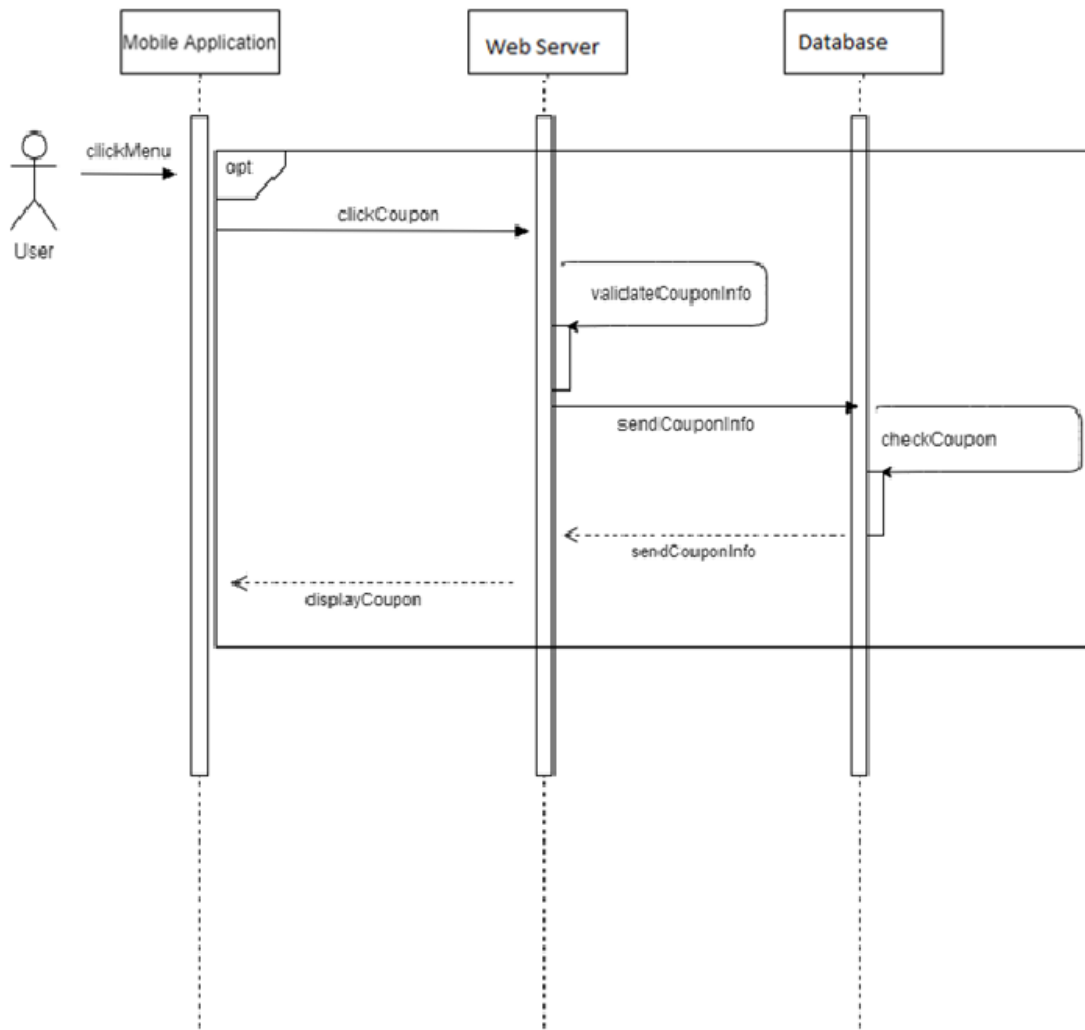


Diagram for UC4:

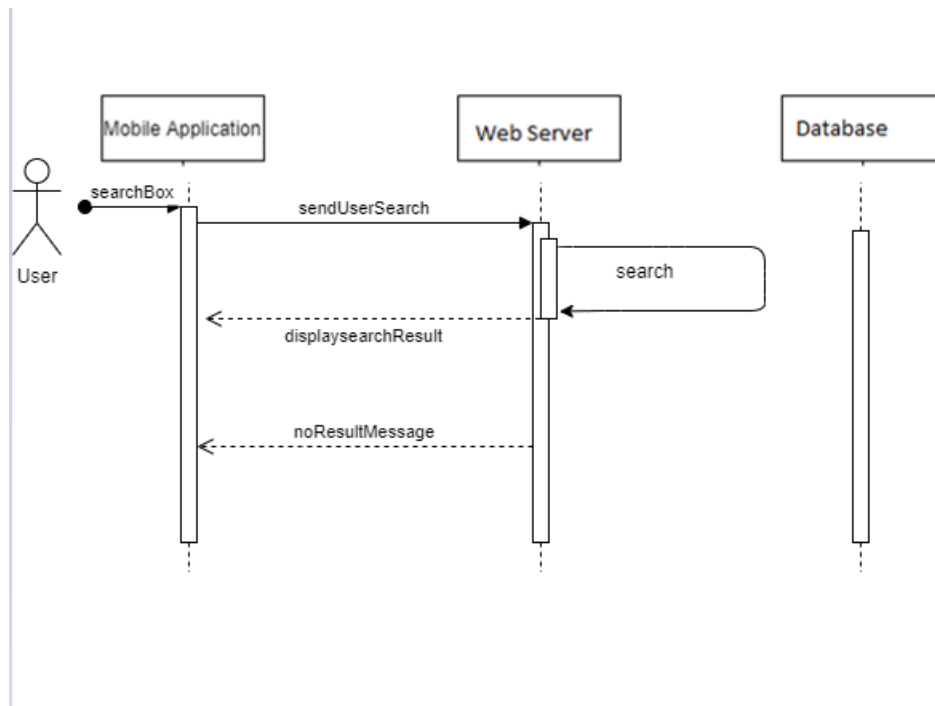


Diagram for UC5:

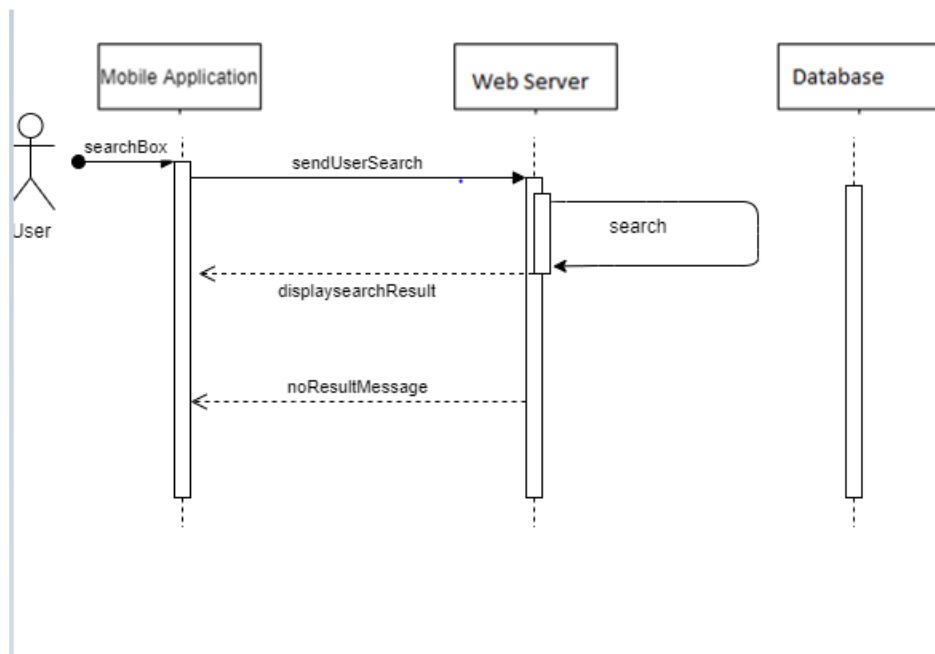
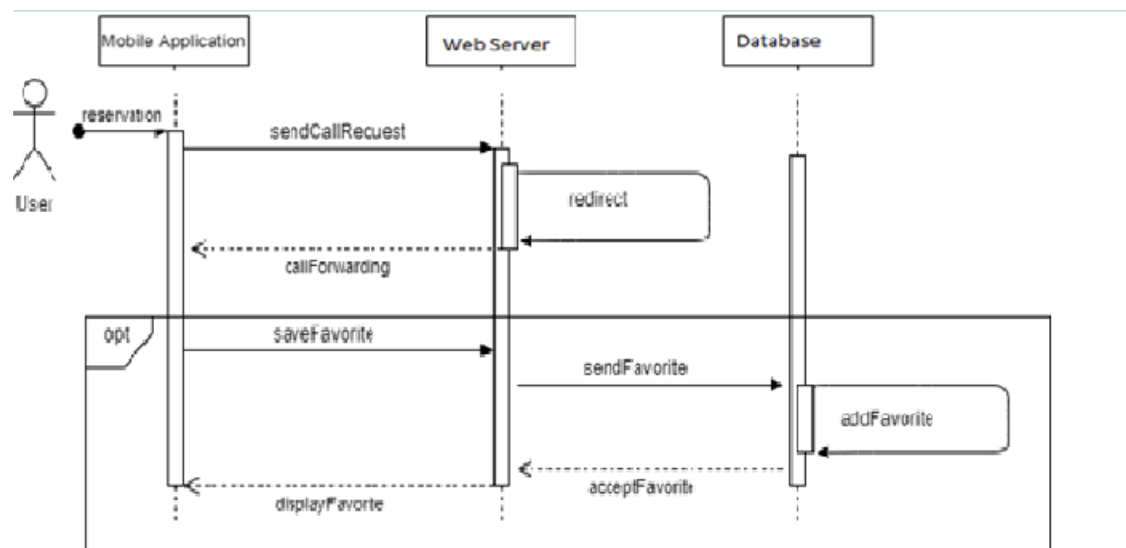
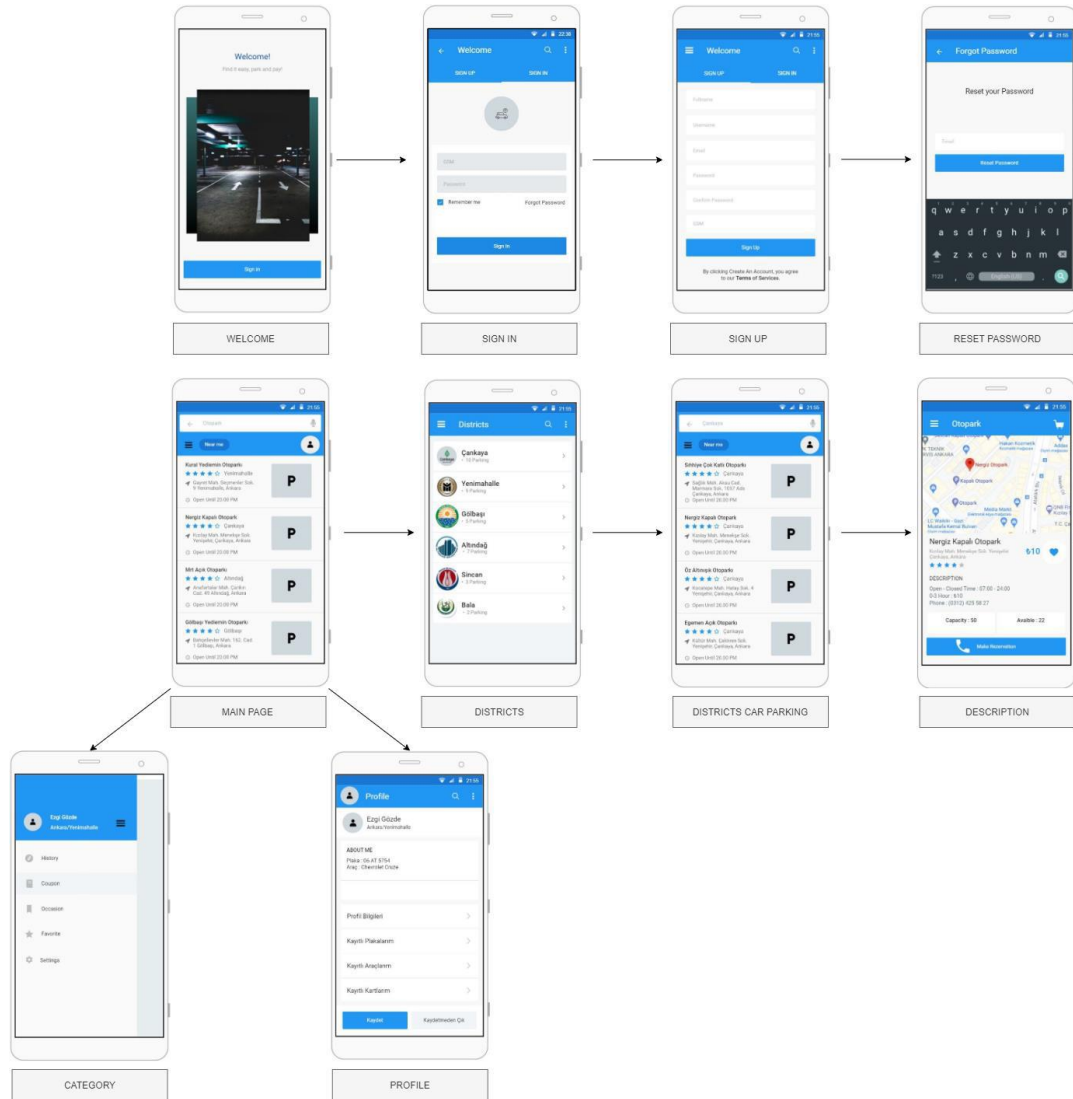


Diagram for UC6:

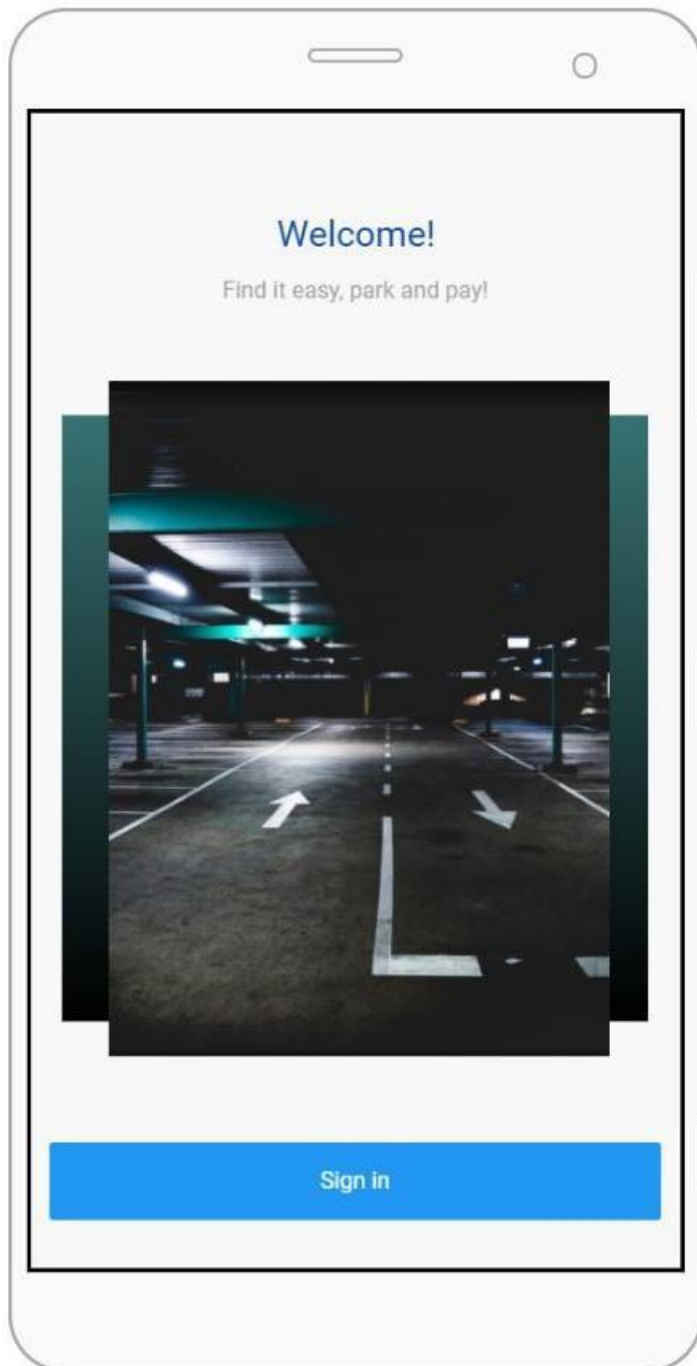


4.5 Interface design

4.5.1 Navigation

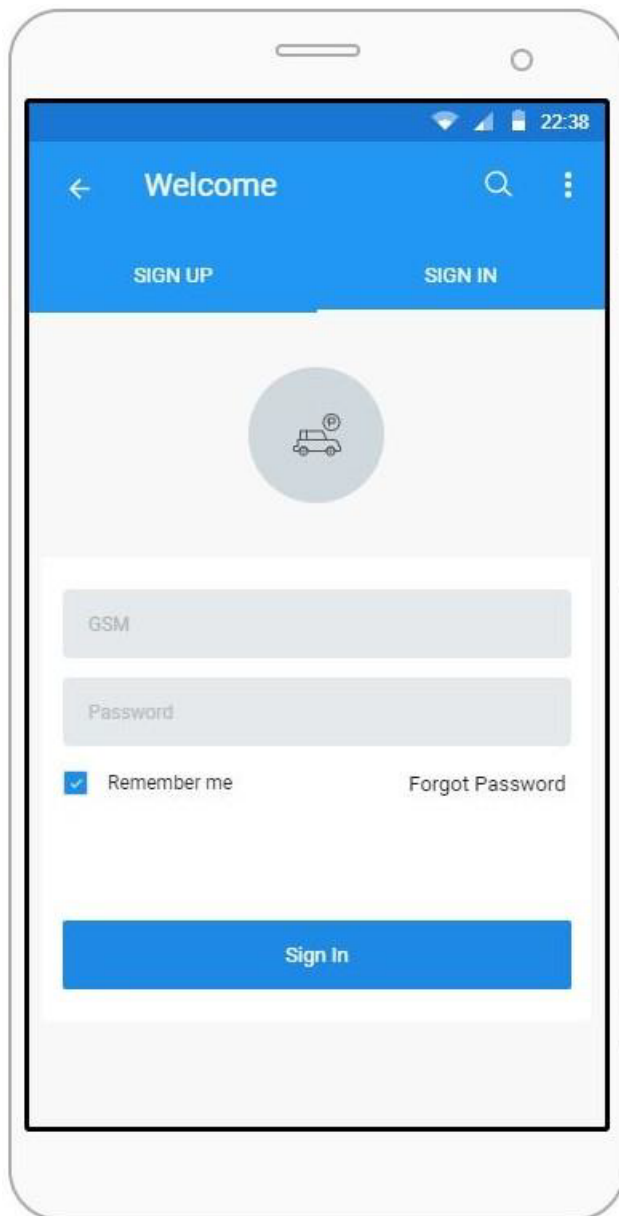


4.5.2 Screen Definitions



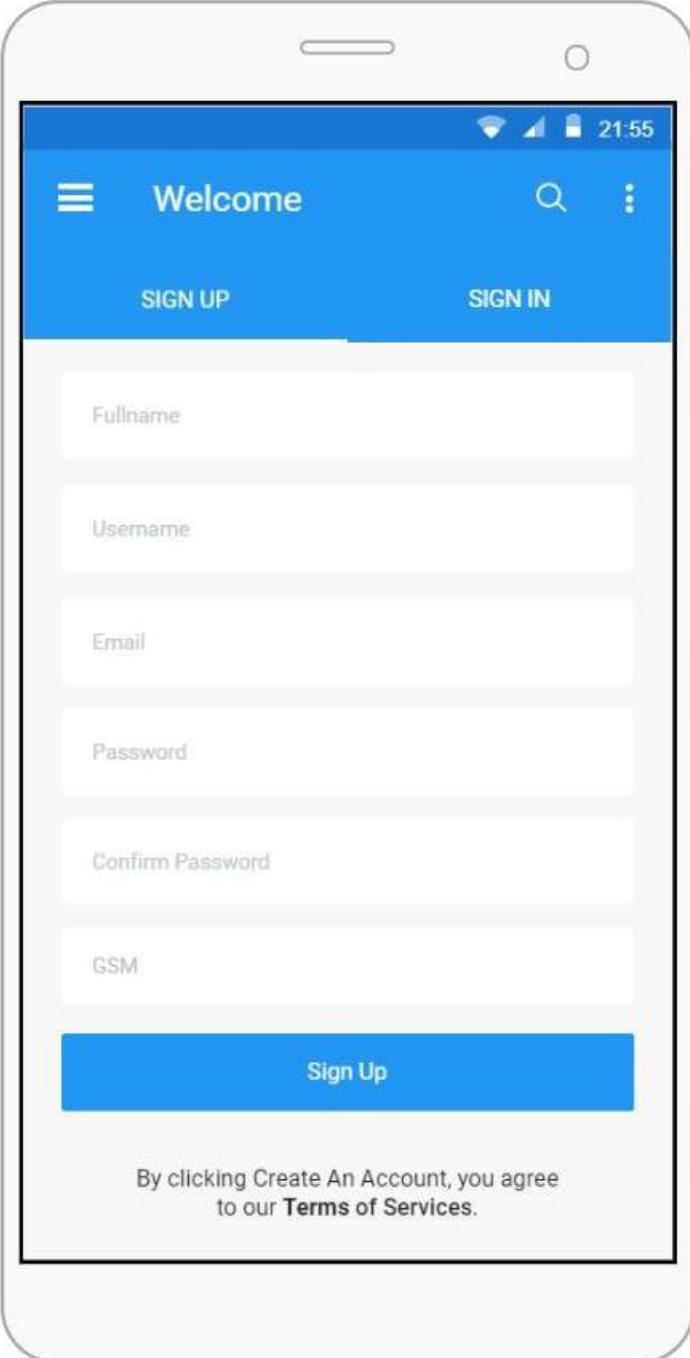
When the application is first opened, the user is greeted with a Welcome page. If he is a registered user, he/she is directed by the 'Sign In' button.

4.5.2.1 Sign In



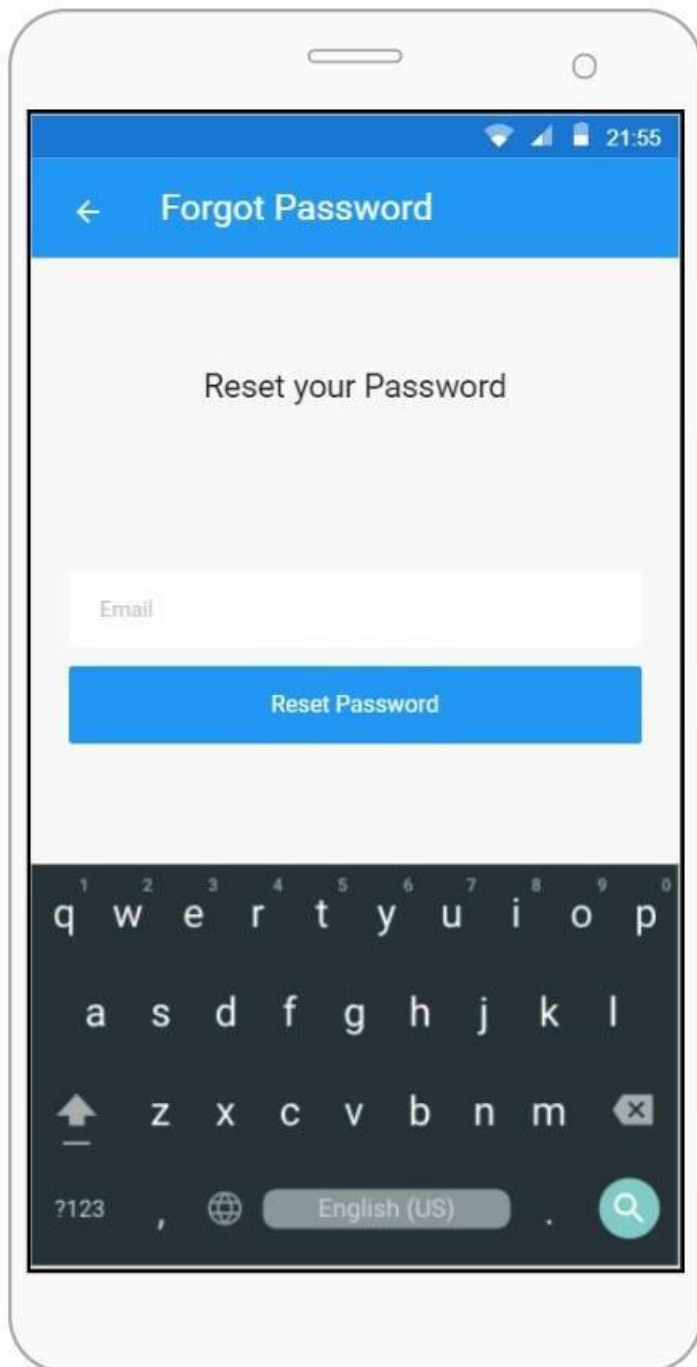
The registered user logs in by entering his/her GSM number and password to log into the application.

4.5.2.2 Sign Up

A mobile application interface for signing up. The screen has a blue header with a hamburger menu icon, the word "Welcome", a search icon, and a three-dot menu icon. Below the header, there are two buttons: "SIGN UP" and "SIGN IN". The main content area is white and contains six input fields: "Fullname", "Username", "Email", "Password", "Confirm Password", and "GSM". Below these fields is a blue "Sign Up" button. At the bottom, there is a line of text: "By clicking Create An Account, you agree to our **Terms of Services**."

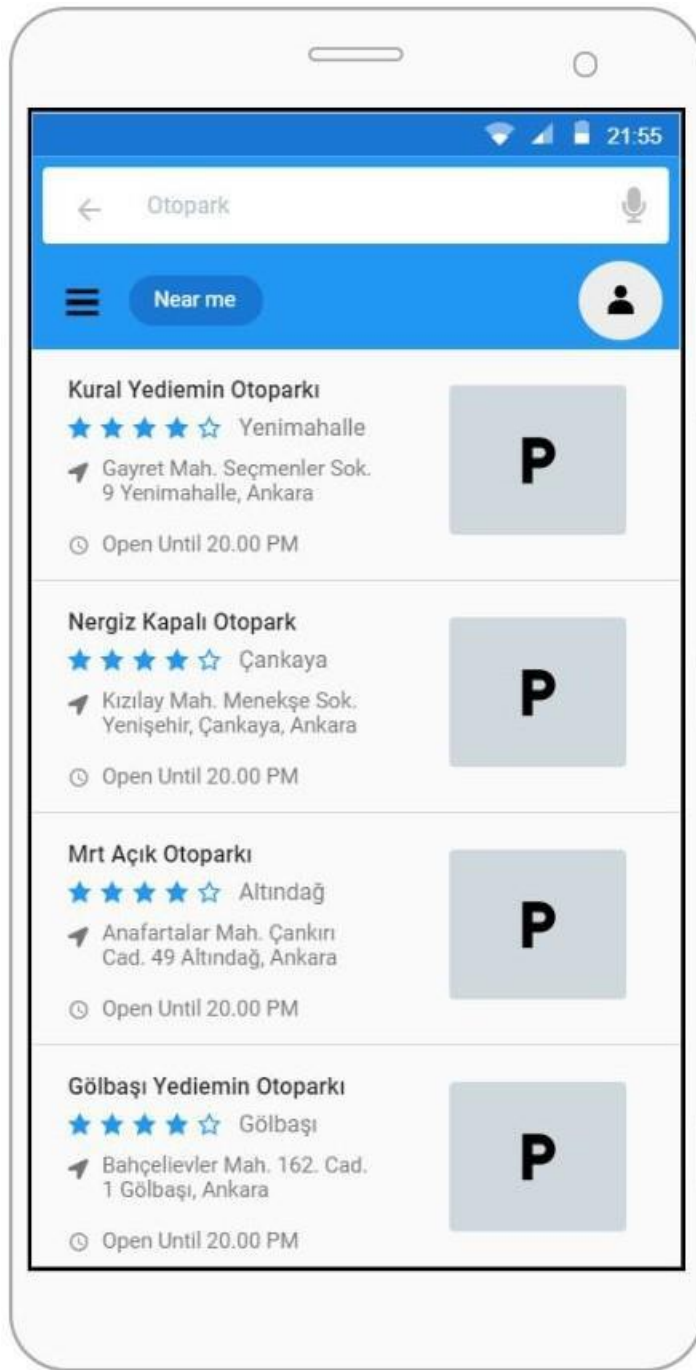
The user who is not registered in the application registers to the system by entering the First name, Last name, E-mail, Password and GSM numbers respectively. To verify the gsm number, an activation code is sent to the number entered, the user activates his registration by entering this code. E-mail information, on the other hand, is prompted for a reliable password reset when the user forgets his password.

4.5.2.3 Forgot Password



When the registered user forgets his password, he is directed to this screen and writes the e-mail address he entered while registering the application. The link to the e-mail is directed to the new password creation section.

4.5.2.4 Main Screen



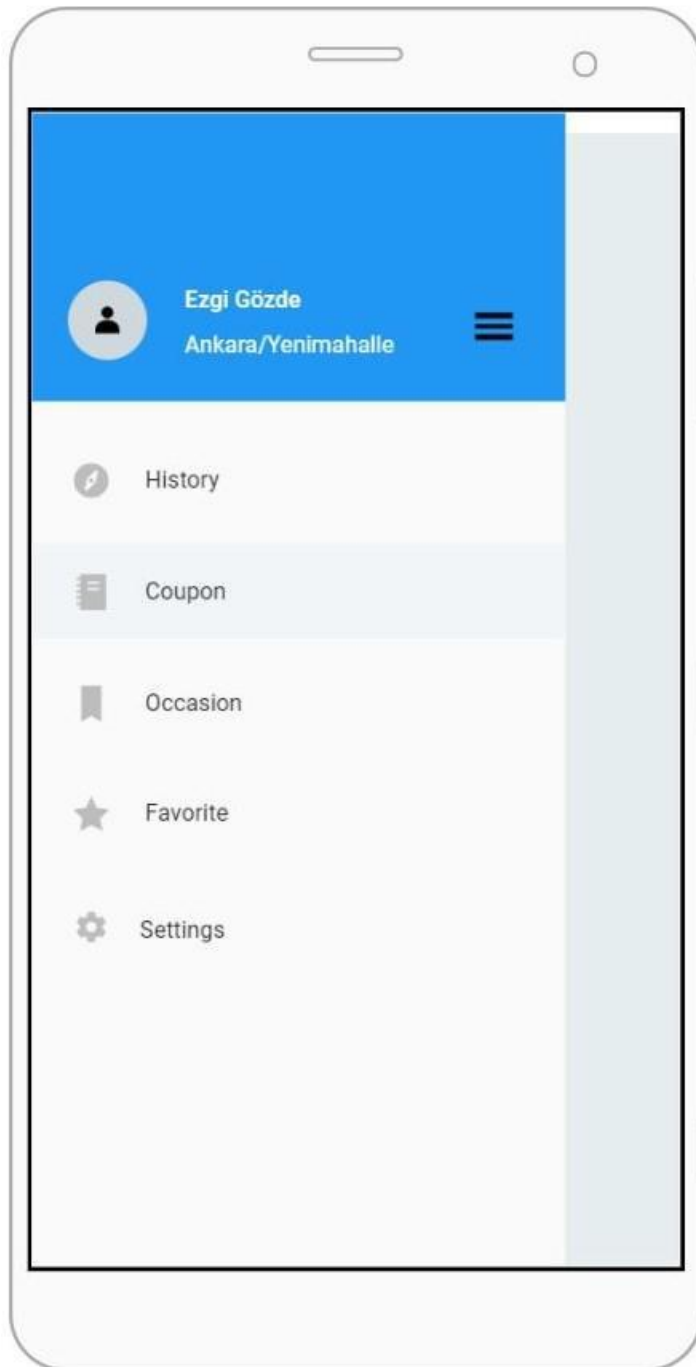
It is the first screen that the registered user will encounter when entering the application. In this section, it is listed with the top 5 parking features that have received the highest appreciation in Ankara. These features include the name of the car park, its photograph, if available, star rate, location and closing time.

With the Near me button, the closest parking lots are shown to the user.

With the selection box on the upper left corner of the screen, the category screen shown in 5.6.2.5 will open.

By pressing the profile box in the upper right corner of the screen, the user will open the profile screen shown in 5.6.2.6.

4.5.2.5 Category



This screen opened with the main screen contains the History, Coupons, Occasions and Favorites.

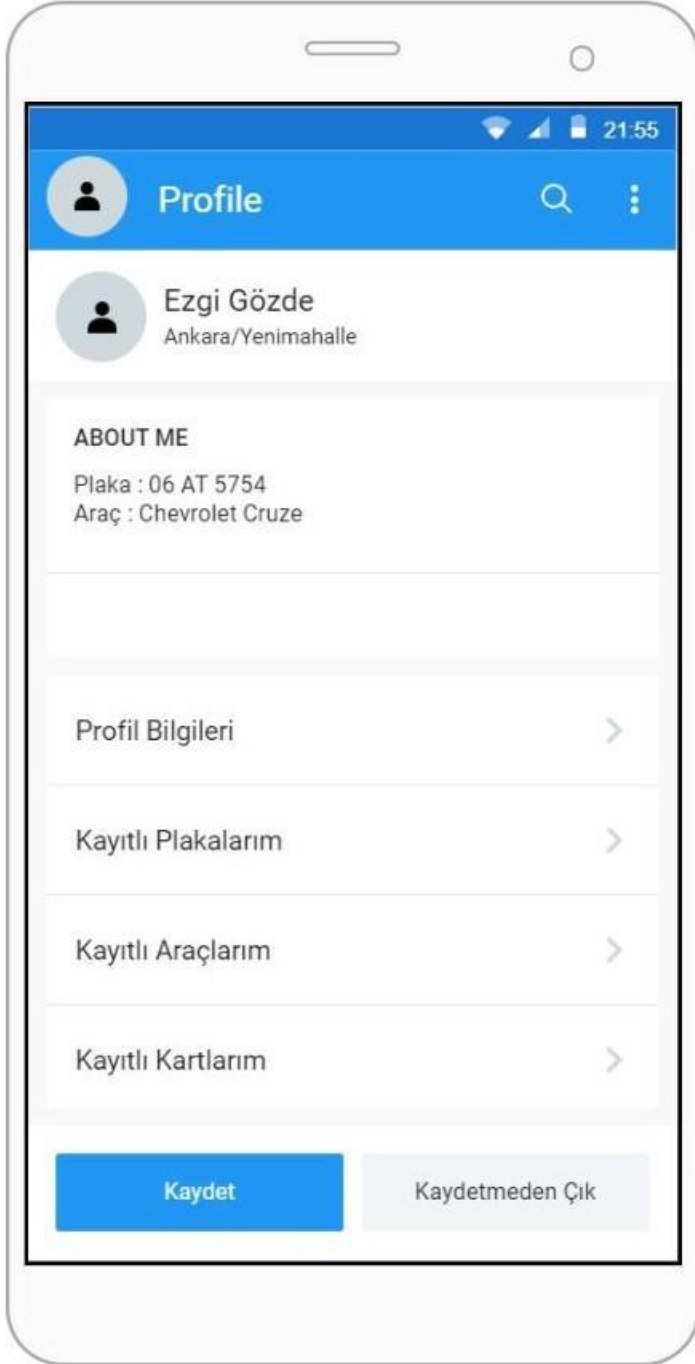
User history searches in the history section,

Discount coupons that can be used as a result of agreements with parking lots in the Coupon section,

Discounts or campaign news about parking lots in the Occasion section,

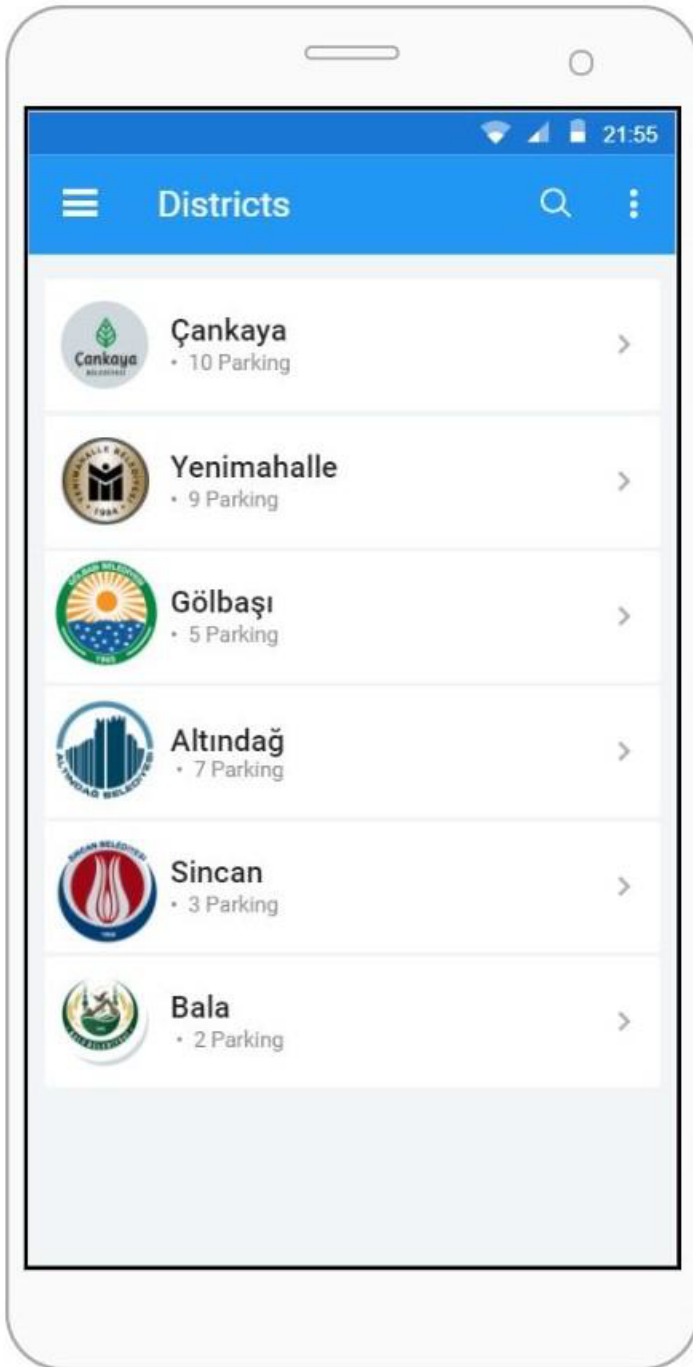
In the Favorite section, it contains user-favorite parking lots.

4.5.2.6 Profile



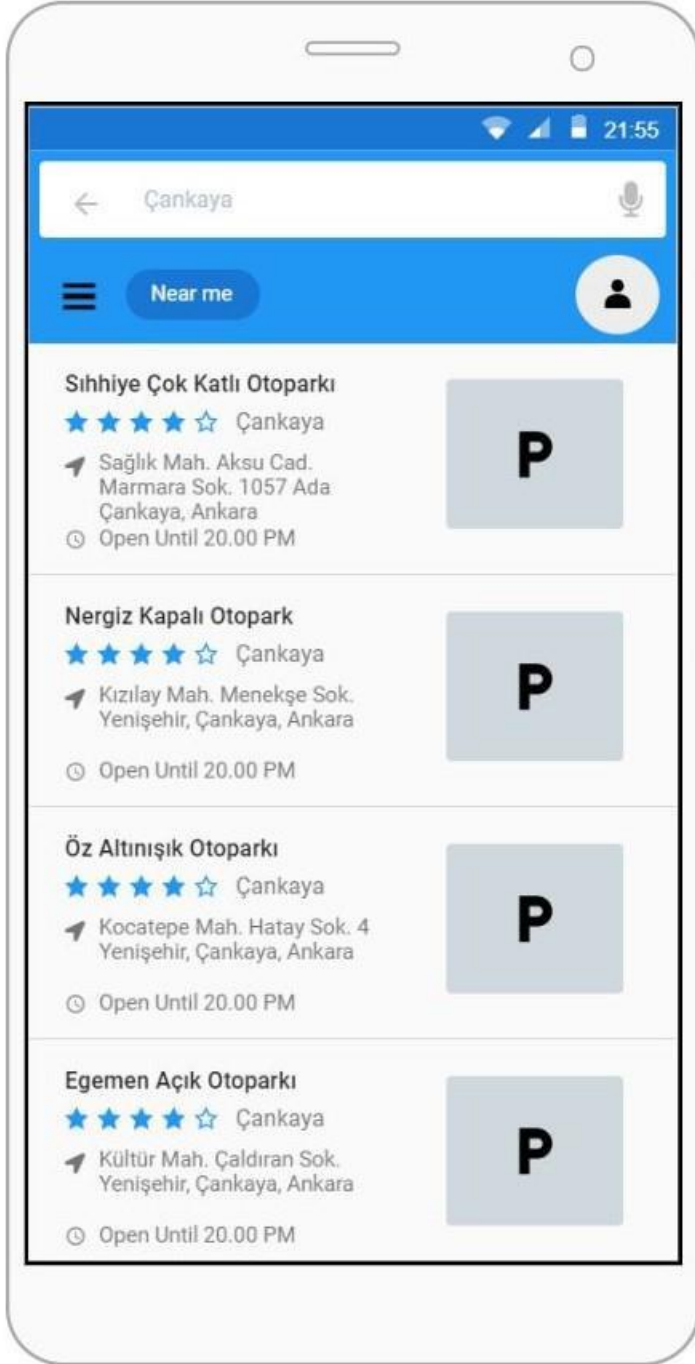
On this screen, the user can view and update their personal information. The information on the screen includes the user's vehicle license plate and model. If the user wants to enter more than one feature for the license plate and model, they can add and update from the recorded information section.

4.5.2.7 Districts



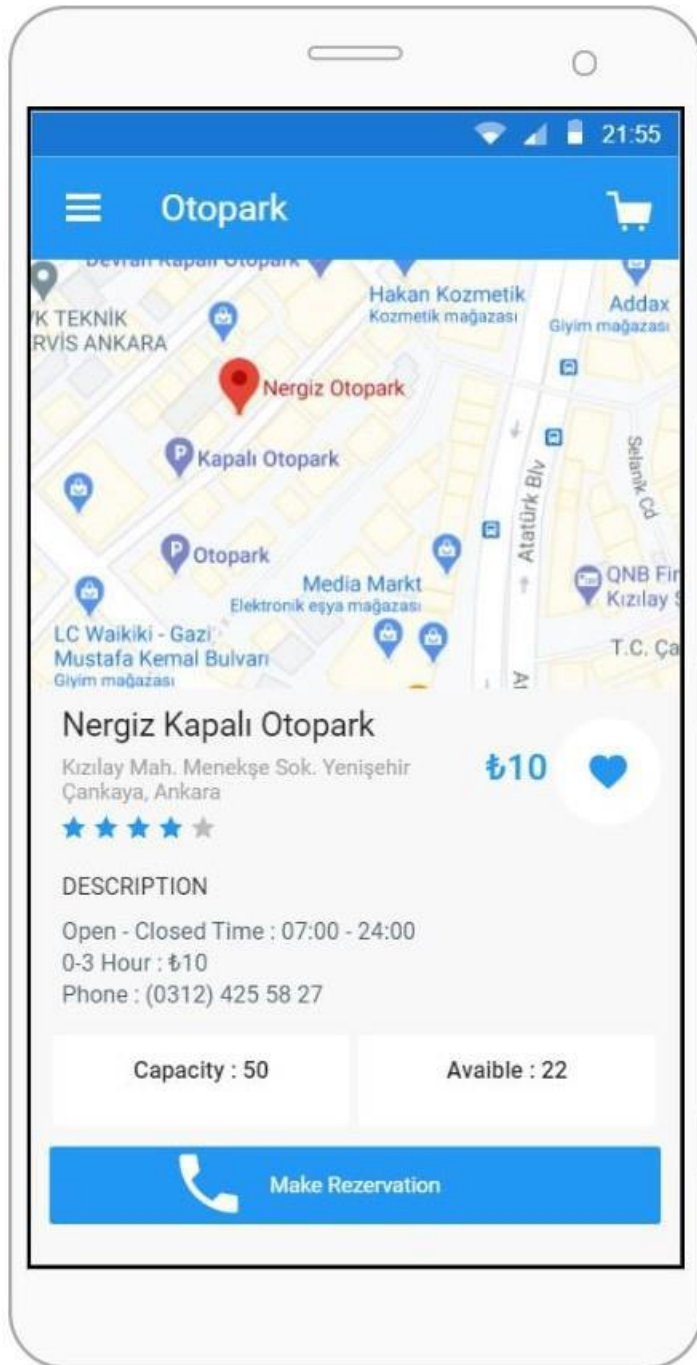
The application has categorized the districts in its first version for ease of use. The user accesses this screen with the search button on the main screen shown in 5.6.2.4. Since the first version is limited to Ankara province, districts in Ankara are listed on the screen. The user can easily choose the area where he / she wants to park his vehicle and limit his choice.

4.5.2.8 Find Car Parking



On this screen, the parking lots in the municipality determined by the user are listed according to the star rate. It has a similar structure with the main screen shown in 5.6.2.4.

4.5.2.9 Car Parking Description



On this screen, the information of the parking lot the user has selected in 5.6.2.8 section is listed. There is a map view of the park at the top of the screen. In the lower part, there is the fee, opening-closing time and number of the parking lot.

The capacity section shows the general capacity of this car park.

With the Avaible section, the user is informed about how many free places are available during the day.

With the easy search section, the user can make a reservation by directly calling the parking lot. This part will be developed by online payment in other versions of the application.

5. Conclusions

This report contains detailed information about our On Cloud Parking System project. Our goal in this project is to find up-to-date parking lots that create stress for people and which we think are a problem in our lives, and to save time spent searching for parking lots. Our main goal in the application is to be a useful and practical application. Besides, the most important thing is to give up-to-date and correct information. Since we will be using mobile applications and maps to develop this application, we have done research on geographical systems. In order to learn how to be the most successful in mobile applications, which applications should we use, we also did detailed research on plate reading and computing vision. We analyzed different documents and projects done and learned the basics to start the scenario implementation. After our research was completed, together with our advisor Hüseyin Temuçin, we determined the requirements for our implementation step by step. We prepared an SRS document according to these requirements. We prepared the SDD document to determine the design of the project and explain the design structures. As a result of our research, we found that there are very few applications related to this subject and that there is no application like ours that shows price, availability and can make instant reservation. We will implement it according to the documents we make in the future. We will create immersive and practical environments for our scenarios in the future. While developing the project, we will revise these documents, so these documents are not the final version. There will be some disadvantages and difficulties for the project we will develop. But the most important thing is to make a practical and quite problem-free application. Because the mobile applications using maps and location are stable and workflow applications, some problems may be encountered. Currently, there are many applications using maps, but there are also unsuccessful applications as well as successful ones. We think our application will be among the successes. As a result, we have learned and will learn a lot in the research we did for our project and while preparing these various documents.

Acknowledgement

The graduation project is an important opportunity for us to combine the knowledge we have learned during our undergraduate education in a project and to freely realize our ideas. Our Supervisor Hüseyin Temuçin, who supported us with confidence while our project was at the idea stage, guided us through his knowledge and experience in the process of turning an idea into reality. Since we had not worked on such a comprehensive project before, it showed us every step we had to do one by one and most importantly, it gave us self-confidence. In addition to the Graduation Project, we are very happy that an educator guides us in this project, who gives importance to the projects in every lesson he teaches and shows that every idea can be developed by asking his students' ideas.

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