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FACULTY OF ENGINEERING
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CENG 407

Innovative System Design and Development I

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Decision and Motivation Support System for Real Estate Consultants based on Data Analytics

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Özet

Yöneticiler, çalışanlarından yüksek performans almak ve şirketin hedeflerine daha kolay ulaşmasını sağlayabilmek için çalışanların motivasyonunu yüksek tutmaya çalışır. Serbest çalışılan işlerde çalışanlar aynı zamanda kendilerinin işverenidir. Bu durum her ne kadar rahat gibi gözükse de, zamanın ayarlanması ve görevlerin organizasyonu açısından büyük bir sorumluluk getirmektedir. Emlak danışmanlığı da serbest çalışılan bir meslek olarak değerlendirilebilir. Gelirleri emlak alım satımına doğrudan bağlı olduğu için dolayısıyla motivasyonlarına da bağlıdır. Danışmanların günde birçok kez içinde bulunduğu karar verme sürecinin beraberinde getirdiği sorumluluk yükü ve stres, motivasyonlarının düşmesine neden olabilmektedir. Danışmanlar doğru kararlar verebilmek için tecrübelerinden, teknik pazar bilgilerinden ve çoğu zaman yeterli olmayan istatistiksel veri analizlerinden yararlanırlar. Bu sorunlara çözüm olarak motivasyonlarını arttırmak için oyunlaştırmayı, karar verme süreçlerini desteklemek için veri bilimini kullandığımız "Decision and Motivation Support System for Real Estate Consultants based on Data Analytics" projesi geliştirilecektir. Bu makale, motivasyonun genel tanımından itibaren motivasyonu etkileyen faktörleri incelemenin yanı sıra, özellikle emlak danışmanlarının günlük yaşamda zorlandıkları konulara değinip, günümüz bilgisayar teknolojilerinin bu tür sorunları nasıl ele aldığıyla ilgili bilgilendirip, çeşitli fikirler ve çözüm önerileri getirmeyi hedef almaktadır.

Anahtar Kelimeler: Veri Bilimi, Veri Madenciliği, Makine Öğrenmesi, Oyunlaştırma, Motivasyon, Erteleme Davranışı, Karar Destek Sistemleri

Abstract

Managers try to keep their employees' motivation high in order to improve the performance of them to achieve the goals of the company. In freelance jobs, employees are also their own employers. Although this seems as comfortable, it also has a tremendous responsibility including the arrangement of time and management of tasks. Real estate consulting could also be categorized as a freelance job, they earn when they sell or rent a real estate. The income of the consultant is directly connected with their sales so their motivation. The burden of responsibility and stress caused by the decision-making process which the consultants have many times a day can cause their motivation to decrease. To give accurate decisions consultants benefit from statistical data analysis which could be insufficient in some cases, their experience and technical market knowledge. As a solution to these problems, we will use gamification to increase their motivation and data science to support decision-making processes in "Decision and Motivation Support System for Real Estate Consultants based on Data Analytics" project. This article examines the factors that affect motivation starting from the general definition of motivation, as well as addressing the issues that real estate consultants face

in their daily life, and informing about how these computer technologies handle such problems and proposing various ideas and solutions.

Key Words: Data Science, Data Mining, Machine Learning, Gamification, Motivatition, Delay Behaviour, Decision Support System

1. Literature Review

1.1. Introduction

Business motivation is the most important factor that allows employees to act according to their wishes and desires in the process of achieving the goals and objectives determined in business life. Another issue that employees challenge is the decision-making process because of the consequences of the decision. Real estate consultancy is one of the professional groups that experience this process. As a solution to these problems, project "Decision and Motivation Support System for Real Estate Consultants based on Data Analytics" will be used to encourage real estate consultants to advance their progress by supporting the continuous participation of people, along with the rewarding system and competition elements it brings with the gamification technique. In addition, the models created by data mining and data mining processes will allow individuals and businesses to make more effective decisions by improving their decision-making processes.

In this article, it is considered that the daily life issues and challenges that real estate consultants face. Since the world is keeping on expanding and developing, the count of the data also increases. Because of the difficulty of processing data, it is introduced as a new term "data science". As it is discussed below, the importance of data science and how data-driven applications work to help consultants for decision support and allow them to predict future trends. Besides, it is presented how the companies apply the game mechanics which is called "gamification" into their businesses to keep their target audience motivated.

1.2. Overview of Motivation

Motivation is a process in which individuals behave with their internally generated drive, desires and wishes to accomplish a specific goal [1]. The success of the companies depends on the efficient and effective use of manpower. Motivating an employee is the best way possible for manpower. Individuals who are satisfied with their jobs work more willingly and productively which effects the overall benefit of the organization as well as their creativity and commitment to their work increases [2].

It is also important to consider the theories behind the term “motivation”. One of them is Maslow’s Hierarchy of Needs [3]. It is known as a pyramid consisting of the chain of needs to meet for a person to be motivated. The point of this theory is in the hierarchy of needs, a person will want to perceive and meet the need for a higher level after meeting a lower level need. Another theory is Herzberg’s Two-Factors theory which is affected by Maslow’s theory and describes the factors to make people feel positive about their jobs [4]. He claimed that people’s job satisfaction depends on 2 factors: motivation factors and hygiene factors. Motivation factors can be a success, the quality of the work done, recognition, appreciation. If people feel that their efforts are appreciated, they will feel compelled to continue working hard. Even a simple shared positive feedback like hand-written “Thank you” or “Good job” as a compliment may affect the employee. Meanwhile, hygiene factors are the contributors not as strong as motivators but since the job dissatisfaction is influenced by hygiene factors, they must be present. One of them could be salary. According to the Society for Human Resources Management, employees indicated that with the amount of 30% rise in their salary, they would drop off the current workplace and do the same job in another company [3]. So, the managers must think of especially a bonus or a rise in salary considered as a financial reward to encourage their employees to work harder and help them to face their daily life challenges. Besides that, since the workplace is the place that most of the employees spent their time with, managers must make sure that things are well-kept in order to please them.

Today’s technology also has an impact to gather all the advice for employers or the ones who appear to be a leader. There are many mobile applications to drive employee engagement. One of them is Tap My Back which helps team members to recognize each other. The application also provides valuable information, insights and analytics of the team to team leader to allow him/her to contribute individual or team goals. “15Five” which focuses on feedback, peer to peer recognition with the “weekly check-in” for every employee. Another one is “Slack app” which is known as Facebook for the workplace. Employees are part of “channels” which can be utilized to share thoughts and brainstorm ideas. The idea is to help teams improve their communications to one platform to encourage the spirit of teamwork.

As declared, keeping the motivation high is an issue for most of the people. The people around an individual may help him/her but it is limited, thus most of the responsibility is upon the individual himself/herself. But today’s technology helps people to make a clear action plan and the ability to sidestep negative thoughts in order to achieve their success with a mobile application. “Creative Visualization” is one of these applications that make people balance their life easier. It creates the process of consecutive visual mental images of the desired moment so that people can experience it with an intent which drives them to work harder to achieve. The other application to overcome mental health challenges is “Think Up” which allows users to select affirmations, record a voice that their brain truly trusts and add an image to inspire themselves. The last application to

give as an example is “MotivateMe” which gives random motivation quotes and supports approximately 3000 minutes of audio coaching. It is claimed that “MotivateMe” is especially effective for business owners.

1.3. Challenges on Real Estate Consultants

Being a real estate consultant has too many challenges as in every profession. First of all, there is not any professional education for technical market information like a university education. In order to have comprehensive knowledge of the real estate market, there are courses and seminars that companies provide. Experience is another challenge that consultants face with, for self-improvement they need to do more sales practice. Moreover, having a wide network and specific personal skills like being a persuasive and extrovert person and having self-confident are key points of being a successful expert. Another difficulty in this profession is always being in interaction with humans. Buyers and sellers may have no idea about the market and can disagree with the price of the real estate. Consultants have to know about the physical qualities of the real estate and market in this neighbourhood. With the help of this knowledge they have to guide the clients and after the persuasion and negotiation processes, a real estate is sold. With all of these problems, accepting a portfolio is also hard to decide. Although, they use web applications that provide real estate index and statistical information about the market in that neighbourhood while they are deciding there are insufficient for some decision-making processes.

Working as a real estate consultant is like freelance jobs. Even though they have to visit the office for some paperwork they do not need to go to the office at a certain hour of a day. Consultants do not receive a salary from an employer and do not have any due date or sale limit. They earn when they sell or rent a real estate. As a result, earning money is directly connected with the motivation of the consultant. Although working freelance has advantages, there are lots of disadvantages that cause loss of motivation. Structuring the time periods of a day is the main problem, procrastination is a common behaviour among freelancers. Being your own boss could seem like comfort but the management of the whole process is a tremendous responsibility. In addition, the apprehension of sale cause stress and this may also decrease the motivation. To solve all these problems, consultants may set some sale goals to achieve in different time periods. Moreover, the competition between consultants may increase overall motivation. Management of goals and following of competitors could be implemented into a mobile application that consultants use in their daily life.

1.4. Gamification

Nowadays, employee satisfaction and motivation have gained more importance. So, the companies introduce the gamification to their business concepts [5]. Gamification integrates the game mechanics into a brand, a business or a specific product and creates an

interactive environment. Gamification proved how successful it is to engage people to help them gain skills and solve problems with data-driven techniques. A study developed with the participation of 1021 technology stakeholders and critics by the Pew Research Center's Internet & American Life Project, supports the same idea: 53% of the respondents agreed that by 2020 "there will be significant advances in the adoption and use of gamification" [6].

We can see the influence of gamification in many large companies. For example, LinkedIn, the business-oriented network uses a little motivation statement in each progress bar to encourage the user to complete his/her profile. Besides, LinkedIn quotes that if a task assigned is completed, the user can get a job easier which strengthens the intrinsic motivation towards achieving the goal [2]. On the other hand, eBay, one of the biggest companies in the e-commerce field, has a bidding system that makes the buyers compete against each other. The buyer who gives the highest price claims the item. That is considered as an extrinsic motivation since it lies on an external factor such that a buyer is motivated by outbidding others [7]. From the company point of view, the purpose is to awaken customer's interest and keep in touch with it.

1.5. Mobile Applications in Real Estate Industry

The development of the technology provides the ease in reaching/using data. For instance, mobile applications. They are running on a small hand-held mobile device which is moveable, easy to use and accessible from anywhere and any place [8]. Therefore, mobile applications are important to help consultants in the real estate industry. According to a research, a mobile app for real estate industry is developed which is patented and which has a function as: The user begins with a region where they are interested in acquiring property and select an inner area within this region by using a pointing device such as a mouse to designate boundaries on a map displayed on screen. This is then zoomed in on and a second area is selected within the zoomed region. The second area is then cross-referenced with the database of available properties whose approximate locations are then pictorially displayed on the screen. Information about the properties can then be obtained in the textual form [9]. However, this is not the only usage of mobile apps in the real estate industry. In real estate industry consultants deal with lots of paperwork. Therefore, if it can be done via mobile phones, the time spent on road/workload is lightened for a consultant. These usages of mobile apps in the real estate industry are some kind of decision support system tool.

1.6. Decision Support Systems

According to research, every six months the database expands by more than 650,000 price offers (advertisements) on purchase or rent of flats, houses, commercial buildings and allotments. [10] The volume and variety of data have far outstripped the capacity of

manual analysis, and in some cases have exceeded the capacity of conventional databases [11]. Therefore, data science, data mining and data-driven decision making became a thing since the since the internet was invented.

In the real estate industry, the most important thing is to sell the house rapidly and with a profit. However, the newcomers to the field lack information in order to determine the worth of a house. However, decision support systems are created to help people make decisions by providing access to information and analysis tools, it's a way to model data and make quality decisions based upon it [12]. Therefore, the newcomers can be more precise by getting decision support but a downside of the decision support is that if it's not done properly the decision support may lead to false value estimation which also leads to loss. Therefore, a properly-designed decision support system is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions [12]. There are enough data in order to help consultants in real estate. The decision support in real estate is required mostly after the process is begun such as exorbitance investment in real estate, the rapid rise of house price, the high vacancy ratio on, which require government and relative department to institute reasonable industry policies to channel off the industry development [13]. However, the decision support should be done on a trusted data rather than any data. Fortunately, there are lots of statistic data in the industry, such as the total dimension of investment, floor space started and finished in every year, space of house pre-selling by region, the average house price in a different region and so on [13]. One other must have a trait of the decision support in real estate is to focus on strategic decisions rather than operational one. More specifically, they should contribute to reducing the risk faced by managers when they need to make decisions regarding future options [12]. It is also important to minimize the risk of potential losses due to wrong decisions in real estate which can be prevented by the decision support system since the property managers face everyday critical risk management decisions. [12].

1.6.1. Data Science In Real Estate

Data science is a very broad topic. Therefore, in order for data science to serve business effectively, it is important (i) to understand its relationships to these other important and closely related concepts, and (ii) to begin to understand what are the fundamental principles underlying data science [11]. Therefore, a new occupation was invented because of it which is "Data Scientist". They use data mining and prepare reports to support companies which the action is also called data-driven decision making.

The data science in real estate not only helps the consultants but also to the entrepreneurs and government. It can help governing bodies and enterprises to get some useful information from the collected data. For example, the government can understand the status and development of the industry and institute some reasonable policies, and real

estate developers can find commercial chance and customers to plan for some project as well as carry into execution [13]. Data mining is the most used method for data scientists to help real estate consultants.

1.6.2. Data Mining In Real Estate

Since the world is keeping on expanding and developing, the count of the data also increases. By 2020, every person in the world will create 1.7 MB of data every second [14]. Especially, data mining is a new concept that helps uncover hidden information like future trends, behaviors, and patterns stored in databases. Businesses are using this technology to improve their strategies and to find predictive information to gain business advantage, which is called business intelligence [15]. Data mining and business intelligence work together to support decision-making processes where businesses identify opportunities and risks by processing and analyzing data [16]. Data mining is used in a wide range from planetary geology to marketing to health services [17].

Real estate is one of the different areas that data mining is used for decision support for investment, risk analysis, and pricing decisions. Fortunately, there are lots of statistical data in the industry, such as the total dimension of investment, floor space started and finished in every year, space of house pre-selling by region, the average house price in the different region and so on [13]. One other must-have trait of the decision support in real estate is to focus on strategic decisions rather than operational one. More specifically, they should contribute to reducing the risk faced by managers when they need to make decisions regarding future options [12]. It is also important to minimize the risk of potential losses due to wrong decisions in real estate which can be prevented by decision support system since the property managers face everyday critical risk management decisions [12].

Besides Automated Valuation Model (AVM) that determines the price of a real estate by comparing the values of similar properties by using regression model has been used much in real estate industry as an example of data analysis [18]. Big real estate agencies such as Realtor, Zillow, and Trulia have used AVM for 10 years. Moreover, they provide information about the neighbourhood trends to estimate mortgage payment, cost of ownership, history of the property [19].

The idea of applying data mining into real estate industry is applaudable. It encourages interdisciplinary work but leads to face many problems when it comes to application. One of the problems is there are many different variables that affect the real estate market such as individual income and population. Therefore, it is hard to estimate a value for a house in a different area. Another one is that the data in the real estate industry is abundant and getting bigger. One has to deal with huge sets of data which is important to deduce right inferences. Lastly, the prediction error that happens in every estimation. The data mining methods try to minimize the loss reasoned by prediction error. [13] Therefore, data mining techniques can handle these problems not completely but partially.

The data mining process in real estate is as follows according to research:

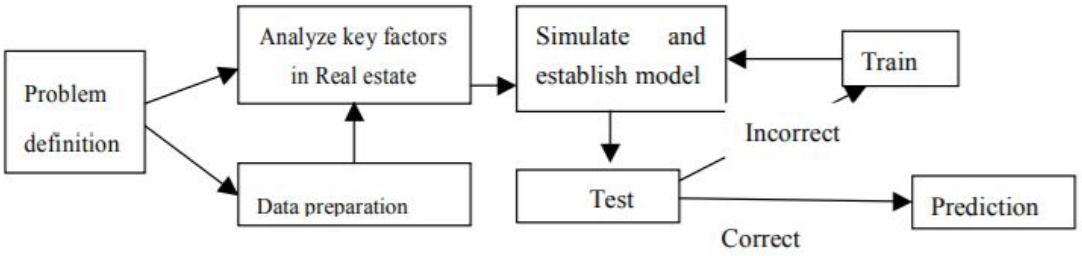

Figure 1. The application flow of data mining technology in the real estate industry

After defining the problem, the data that needs to be mined is determined which leads to the analyze key factors in Real Estate with the problem. After analyzing key factors, a model is simulated and established. After the testing of the model, if it's incorrect, the simulation and establishment of the model are done again after more detailed research. However, if the testing result is correct, the prediction is made to the property.

1.7. Conclusion

As a conclusion, the development of the technology provides the ease in reaching/using the huge amount of data by mobile applications. The companies integrate new techniques that data science brings. As this article mostly deals with, having mobile apps can help real estate consultants while they are on the field or while they are searching for a lot/property by data mining techniques. Also, they deal with lots of paperwork. If it can be done via mobile phones, the time spent on road/workload is lightened for them. Besides, the gamification techniques improve their productivity, strengthens communication processes and therefore increase their motivation. In this article, we see that gamification and data science are mainly used as solutions for employees in many sectors, but since these applications are not enough for the real estate sector, we will make an application that supports motivation and decision-making processes in their daily life.

2. Software Requirements Specification

2.1. Introduction

This document is the software requirement specification document for the Decision and Motivation Support System (DMSS) for Real Estate Consultants based on Data

Analytics Project. This system is a software that real estate consultants can use in order to motivate themselves and to get support for their decision-making processes.

2.1.1. Purpose

The purpose of this document is to outline requirements for the DMSS. This document describes the general concept and explains the required features of the system. It describes the interfaces, user characteristics, functionalities, and constraints of the system to make the specifications confirmed and to make a reference for the development phase of the system.

2.1.2. Scope

Motivation is what increases the efficiency of the worker. Decision making is also important for both the worker and the company since making right decisions increases the motivation of the worker. Moreover, the motivated worker gives the right decisions while trying to reach his/her aim. Therefore, the purpose of this project is to help real estate consultants with the challenges they face with a mobile application.

DMSS is a mobile-based system. DMSS aims to help with their decision-making process while increasing the motivation of the real estate consultant. Moreover, the consultants will be able to see the badges that they earned and the ranking among them in order to see the results and get motivated. Also, real estate consultant will be able to get help while deciding whether to accept the portfolio or not. This process will be done as after the information of the portfolio is entered to the application, the application will give a message to the consultant about whether it is profitable or not. There is also a framework in which consultants cannot see whereas the manager can. In this framework, the manager can see the scores of the consultant. Therefore, the system will hold the portfolios of the consultants.

DMSS also has a web-based module which is for admin. S/he can manage the decision support part of the application by updating or displaying the existing models.

The objective of the DMSS is to help real estate consultants with the decision-making process and to increase their motivation by making decision-making process efficient while easing getting motivated. The users of the DMSS are real estate consultants and managers.

2.1.3. Definitions, Acronyms, and Abbreviations

Term	Definition
SRS	Software Requirement Specification
DMSS	Decision Making Support System
Admin	The person who is in charge of all the decision support models.
Consultant	A consultant who works in the office and also a team member.
Manager	The head of the team in the real estate office
Team	Consists of a manager and many consultants

2.1.4. Overview

This SRS is divided into subsections. Part 2 is Overall Description of the SRS and it has a general concept, user types to understand the project more specifically.

Section 3. Specific Requirements defines both functional and performance requirements of the system in more detail. In order to understand the functions that the different users use, use-case diagrams are shown in the section.

At last, section 4 is the Supporting Information where additional information is stated.

2.2. Overall Description

The following section and subsections present an overall description of the DMSS. In particular, the product has been put into perspective through a detailed assessment of the system, user, and hardware interfaces.

2.2.1. Product Perspective

DMSS is to help real estate consultants with the decision-making process and to increase their motivation with making decision-making process efficient while easing getting motivated.

2.2.1.1. User Interfaces

There are many frames in the system to interact with different user types. In the current process of the project, the interfaces are not defined except the login frame of the application, which all the user types in the system have access as in the same way. The interface flow diagram of the login screen is shown in Figure 2.

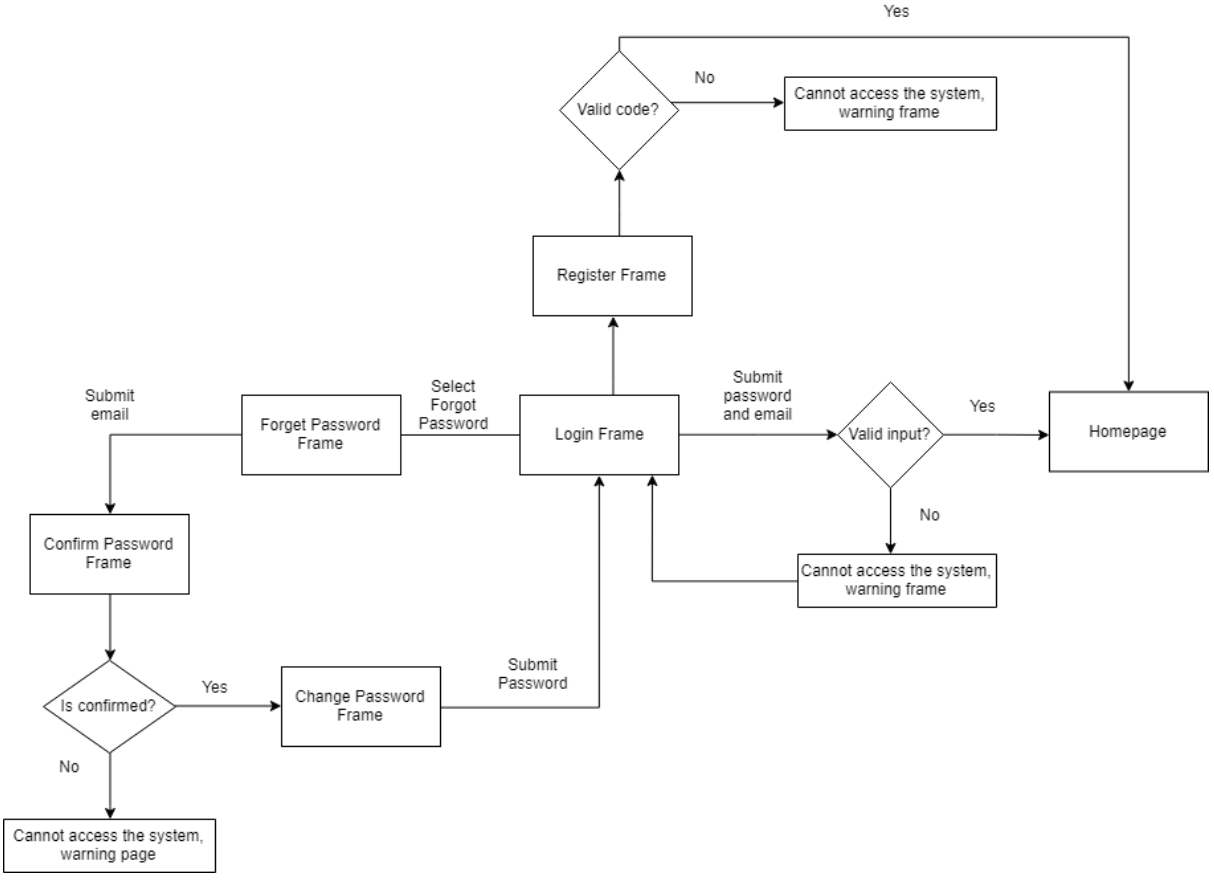

Figure 2. User Interface Flow for Login Screen of DMSS

In the login screen, there are email and password fields for the user to login. In the login frame, the user is expected to enter his email and password, then submit to login. If the email and password are correct, then the home frame is opened to access the functionalities of the home frame. If the input is not correct, then the system gives an error and requests the input again.

If the user is not a member yet, s/he can choose “Üyeliğiniz yok mu? Yeni Üyelik!” frame, the user enters his information and registers to the system after confirmation code is entered to the system that is sent to the mail.

If the user forgets his password, s/he can choose to go forget password frame, the user enters his email address that he is registered to the system and a confirmation email is sent

to the user by the system. After that, if the account is confirmed, the user can change his password and login to the system. Otherwise, an error page is opened to inform the user.

2.2.1.2. Hardware Interfaces

The application will need to work on mobile devices. However, the interfaces on both of the platforms will be exactly the same. Also, there will be a web page for admins which is displayed in browsers like Google, Firefox.

2.2.2. Product Functions

DMSS will be available for two different roles which are consultant and manager. Functions of the application will differ from user type to user type. All user types will be able to login to the application with their estate email and password. Also, all the users will be able to see the ranking frame. The application allows consultants to see adding reminder/event to a calendar, set goals, editing profile, moderate settings.

2.2.3. User Characteristics

DMSS will be used by three different kinds of users which are consultant, manager and admin.

Consultant: The consultants are the people joined to this real estate. They earn scores by completing the weekly/daily goals. And they use the decision support system to decide which real estate s/he may buy.

Manager: The managers are the most authorized member of the application. Every week the manager is determined by the system randomly and in charge of checking the completion of the events of his/her team members.

Admin: The admins can manage the decision support module of the application by updating or displaying the existing models, selecting algorithms and evaluating the accuracy metrics.

2.2.4. Assumptions and Dependencies

DMSS assumes that the application will run on mobile devices. Users are expected to be connected to the internet since the data will be stored on a server. Web module will be run on browsers.

2.3. Specific Requirements

In this section, functional and performance requirements and software system attributes of the system will be investigated in more detail. Use-Case diagrams will be used in order to support functional requirements.

2.3.1. Functional Requirements of Mobile Application

Below, a use case diagram of the DMSS is shown with users of the system and main functionalities they use. Each functionality is explained in the next subsection.

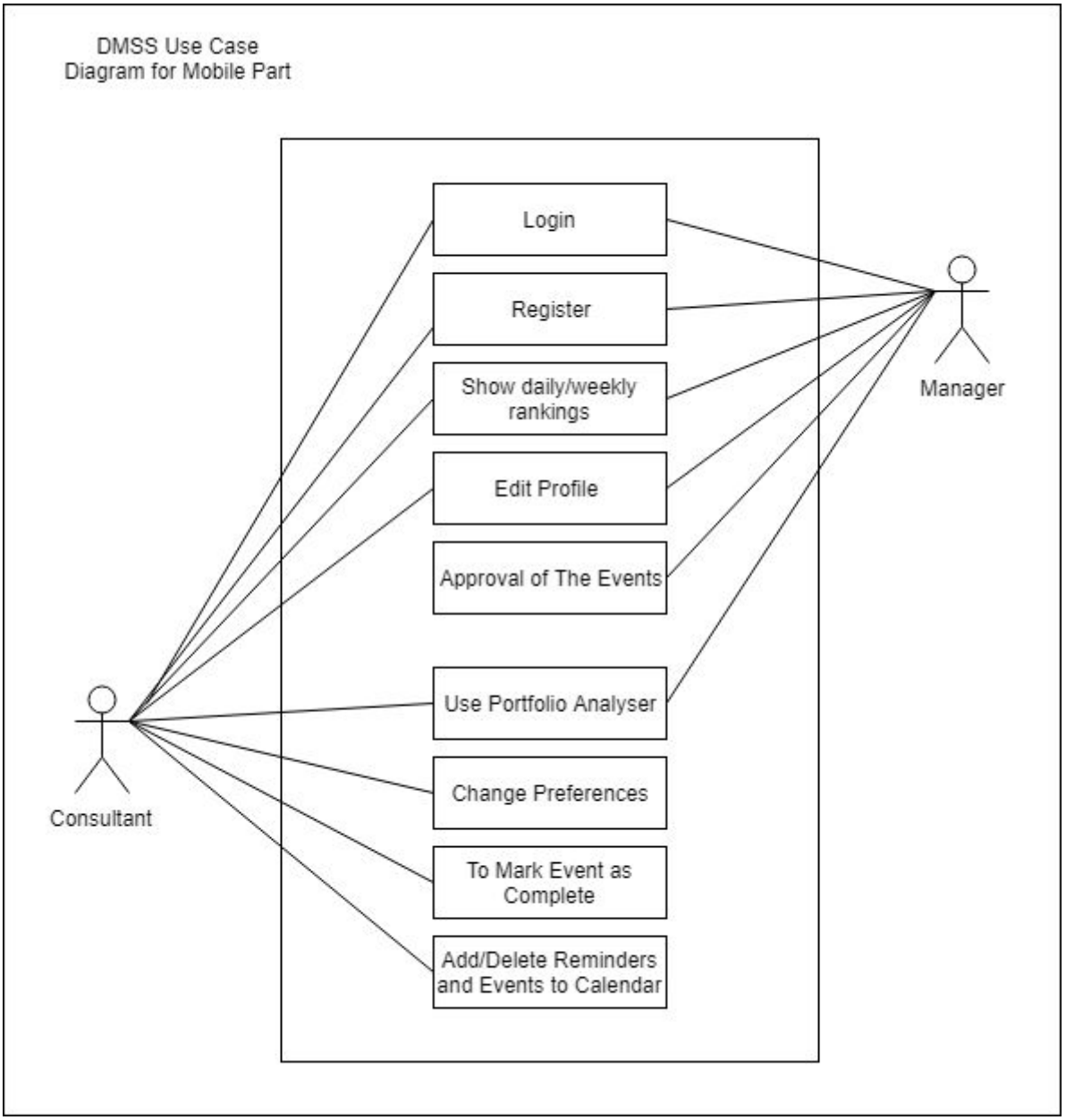

Figure 3. Use Case Diagram for main functions of Mobile Application

2.3.1.1. Register and Login to the System

- The application is available for managers and consultants.
- The account will be verified by the code that is sent to a registering user and asked on

the next frame. If the user enters the correct verification code, the account is verified.

- The user shall login to the system with their estate email address and password.
- The user can change his password when requested.
- The user can ask for his password if he forgets it. The email is asked and the password change mail is sent to the user.

2.3.1.2. Show Weekly/Monthly Rankings

- The user will be able to see the ranking among all the consultants to see who profited at most.

2.3.1.3. Add Reminder/Event to a Calendar

- The consultant will be able to set events on the desired date.
- When the date comes, the application will remind the consultant about the event.
- The calendar will be in interaction with the set goal function. For instance, if the goal of the consultant is to "meet with 5 people", if the calendar has a "meet with …" as an event and if the event is successfully done. The goal will be updated to say "meet with 4 people".

2.3.1.4. Approval of the Events

- The manager who is assigned the team checks whether his/her team members has completed their events. If they have, the manager gives the approval.

2.3.1.5. Edit Profile

- The user will be able to change the information they provided while registering to the account.

2.3.1.6. Moderate Settings

- The user will be able to change the preferences of the application such as; Notifications On/Off.

2.3.1.7. Complete Event

- The consultant will be able to check and mark the event as "completed".

2.3.1.8. Use Portfolio Analyzer

- The portfolios will be evaluated by the application to decide whether on accepting or declining the portfolio to help the consultant.

2.3.2. Functional Requirements of Web Application

Below, a use case diagram of the web module of DMSS is shown with the user of the system and the main functionalities they use. Each functionality is explained in the next subsection.

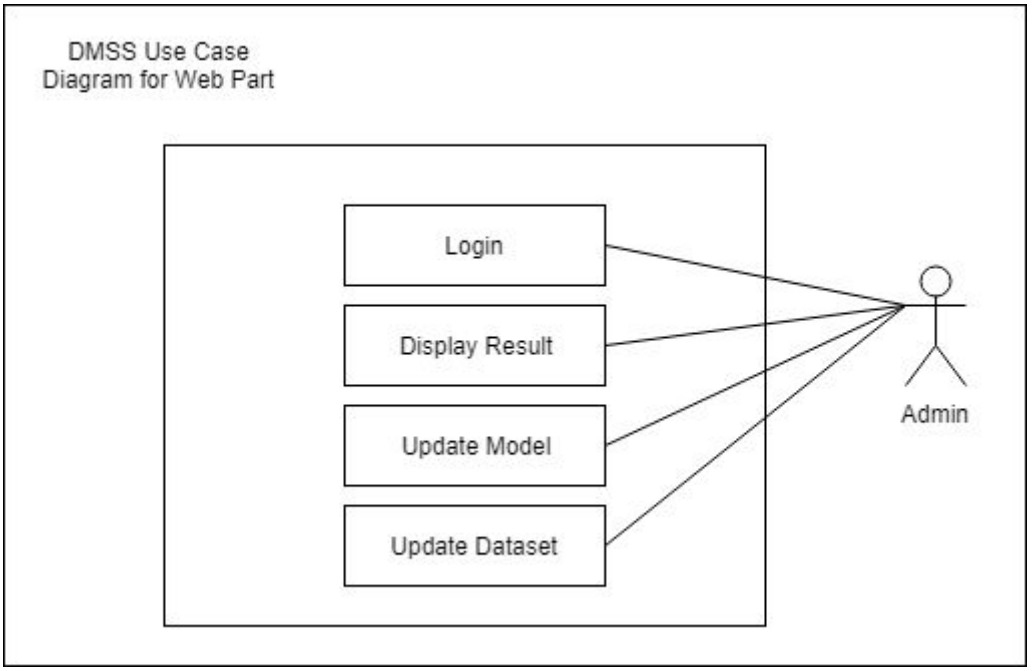

Figure 4. Use Case Diagram for main functions of Web Application

2.3.2.1. Display Results

- The admin can display the statistical results such as accuracy, recall and the precision values of the existing models used for decision support.

2.3.2.2. Update Model

- After displaying accuracies of the models which are constructed with different algorithms the admin can decide whether which model will be used for upcoming data.

2.3.2.3. Update Dataset

- It is nonsense to update the dataset with only one transaction simultaneously with the mobile application. So as the data grows the admin can update the dataset within different intervals of time to improve the accuracy of the model.

2.3.3. Performance Requirements

The data analysis should be done in less than 60 seconds.

2.3.4. Software System Attributes

2.3.4.1. Reliability

Reliability is one of the key elements of DMSS. Therefore, stored data in the system should be available for long-term and the data should be stored in the right way. For instance, since the data will be stored on English based letters, there can be corruption in Turkish names/addresses.

2.3.4.2. Availability

Since the consultants will be doing field searches for possible portfolios the application must be available for them on anywhere in any time.

2.3.4.3. Security

Security is one of the key elements of DMSS. Therefore, the data entered to the system should be stored and backed-up in case of a loss of data. Also, the stored data should not be leaked in any way.

2.3.4.4. Maintainability

DMSS must be open to changes. Since the world is evolving in a fast manner, there are changes occurring in every part of life. Therefore, the application must be updated and adapted to these changes. The admin can improve the model with upcoming data.

2.4. Supporting Information

In this SRS, IEEE Recommended Practice for Software Requirements Specifications template is used as a format reference.

3. Software Design Document

3.1. Introduction

3.1.1. Purpose

The purpose of this Software Design Document is to provide details of the project “Decision and Motivation System for Real Estate Consultant Based on Data Analytics”.

The target audience is real estate consultants. Our project will help real estate consultants in decision making and keeping their motivation up. The real estate consultants will require decision support to whether accept or decline the portfolio. Also, newcomers to the field will require decision support in order to have an idea about the worth of the portfolio. Moreover, motivation is the essential key for the sales department in all companies. Therefore, to be able to sell a portfolio, the consultant should be motivated.

The goal of the project is to offer decision support and help real estate consultants to keep their motivation up in which will help with their portfolio sales.

For a consultant, in order to profit from a portfolio, the consultant should have detailed information about the portfolio. Our project, steps in this stage to help the consultant about whether to accept the portfolio or not after the consultant gives the information about the portfolio to the system. The system will return the approximate value of the portfolio. Moreover, the consultant must be motivated in order to convince the customer to buy the portfolio. Therefore, if the consultant is not feeling motivated, the consultant can use the application to get motivated. The consultant will set goals for a daily and weekly basis. If a goal is completed, the consultant will earn points. At the end of the week, according to the rankings between all the consultants, badges will be given to the consultants.

3.1.2. Scope

This document is the design description of the project “Decision and Motivation System for Real Estate Consultant Based on Data Analytics”. To develop our application we will use Android Studio. In the application, there will be tabs for different purposes. The application will aim to help with decision making and motivation support.

In real estate to sell a portfolio, the consultants need to convince the customer that the portfolio is what they have been searching for. Every consultant has a unique way of selling a portfolio. However, in this process there is one essential thing, which is required, is keeping the motivation up. Moreover, some real estate consultants may need decision support in order to have a more detailed idea about the portfolio’s value. The goal of the project is to help real estate consultants with keeping their motivation up and offering them decision support. Achieving something increases the motivation of a human being. Therefore, in our project, we aim to motivate the real estate consultants by giving them badges according to their weekly rankings of goals completed. Moreover, real estate consultants are working in their specialized fields. However, when they get a portfolio out of their specialized fields, they require decision support to have an idea about the value of the portfolio. Therefore, we also aim to help consultants by offering them decision support for accepting/rejecting a portfolio.

For the development, we have chosen Android Studio. Android Studio is an application development platform for Android devices. For the mobile part of the coding of the project Java language will be used develop a mobile application within the React

Native framework in Android Studio. For web part of the project, Javascript will be used. Also for the data mining part of the project, Python will be used.

3.1.3. Glossary

Term	Definition
SRS	Software Requirement Specification
DMSS	Decision Making Support System
Admin	The person who is in charge of all the decision support models.
Consultant	A consultant who works in the office and also a team member.
Manager	The head of the group in the real estate office
Portfolio	A lot/house that is offered to the consultant to sell.
Team	Consists of a manager and many consultants

3.1.4. Overview of Document

The SDD is divided into subsections. Chapters and brief content of the chapters are explained below.

Chapter 2 is the Architectural Design of System section in which the general architecture of the system is explained by the class diagrams, activity diagrams and the design elements of the system.

Chapter 3 shows the Database Diagram. The section will include tables and the relations between them.

Chapter 4 contains Graphical User Interface Design in which the design of the system is explained.

Chapter 5 is the section where the references that are used in the paper is stated.

3.1.5. Motivation

We are computer engineering students who are willing to learn new technologies and helping people. After our interview with real estate consultants, we saw that consultants need support in order to keep themselves motivated whereas the newcomers to the field or consultants who are working away from specialized fields require decision support to have backed up estimation of the portfolio. Therefore, we researched strategies to motivate a person. We found out that in order to motivate a human being, the easiest way is to make them feel like they achieved something or feel like being in a contest. Therefore we included the badge system in our application. Also, for decision support, we obtained data on previous sales in Ankara with all the information about the sales such as; value, location, size and many more. We used this data in order to offer decision support to consultants. Our aim is to help consultants while they are selling a portfolio.

3.2. Architecture Design

3.2.1. System Design Approach

During the process of this project, we decided to use scrum which is a framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value[20]. To use this framework efficiently, we decided to split the development process into sprints which consist of the specific tasks. The sprint durations are in dynamic length because it is not desired to waste time on a task longer than needed. As predicted, they will last 30 days on average. When a sprint begins, the team starts to take all the responsibility and gathers up to discuss the current progress, brainstorm the solutions. When finishing the sprint, the team presents the part of a product completed to evaluate criteria in overall. Because we are developing a mobile-based system which mainly helps the real estate consultants, we always interact with the consultants. Thus, the requirements always change. It is easier to overcome the changing requirements of the customers with this development process. Because agile methodology is more communication-oriented, we have a chance to gather knowledge about the field we have a lack of experience. So, in the light of these facts, scrum/agile is suitable for our project.

Figure 5. Gantt Chart

The tasks in the Gantt Chart (Figure 5) as follows;

In the Documentation Process, firstly literature research is done. In this process, topics and projects about our project will be investigated. The topics to investigate are mobile apps and decision support, challenges for consultants, data mining in real estate, motivation and gamification. Moreover, meetings with different real estate consultants will be arranged to analyse the needs and functions of the project. SRS and SDD documents are written. Moreover, the web page of the project is designed.

During Sprint 1, the database of the system will be designed and implemented. The tests will be handled to check the errors. At the end of the sprint, the essential part of the system which is database will be ready.

During Sprint 2, the functions that are determined for consultants will be designed and implemented to the system. All of the pages will be improved and designed. Also, the testing of the improvements will be done. At the end of the sprint, we will be having an app that will perform consultant mode.

During Sprint 3, we will be working on the design and implementation of web module that will be used by admin. While doing this part, we will be using Javascript. In this part also data mining functions will be handled with Python.

During Sprint 4, we will be working on Manager mode. This mode is created to manage the registered consultants. We will be designing and implementing Manager mode in this sprint. While doing so, we will be using Android Studio. Therefore, we will be having an android app to perform management mode.

Lastly, we will be testing the code we wrote. Unit tests and improvements of errors will be done. During the delivery stage of the project, the project will be delivered to the real estate consultants after the supervisor’s evaluation.

3.2.1.1. Class Diagram

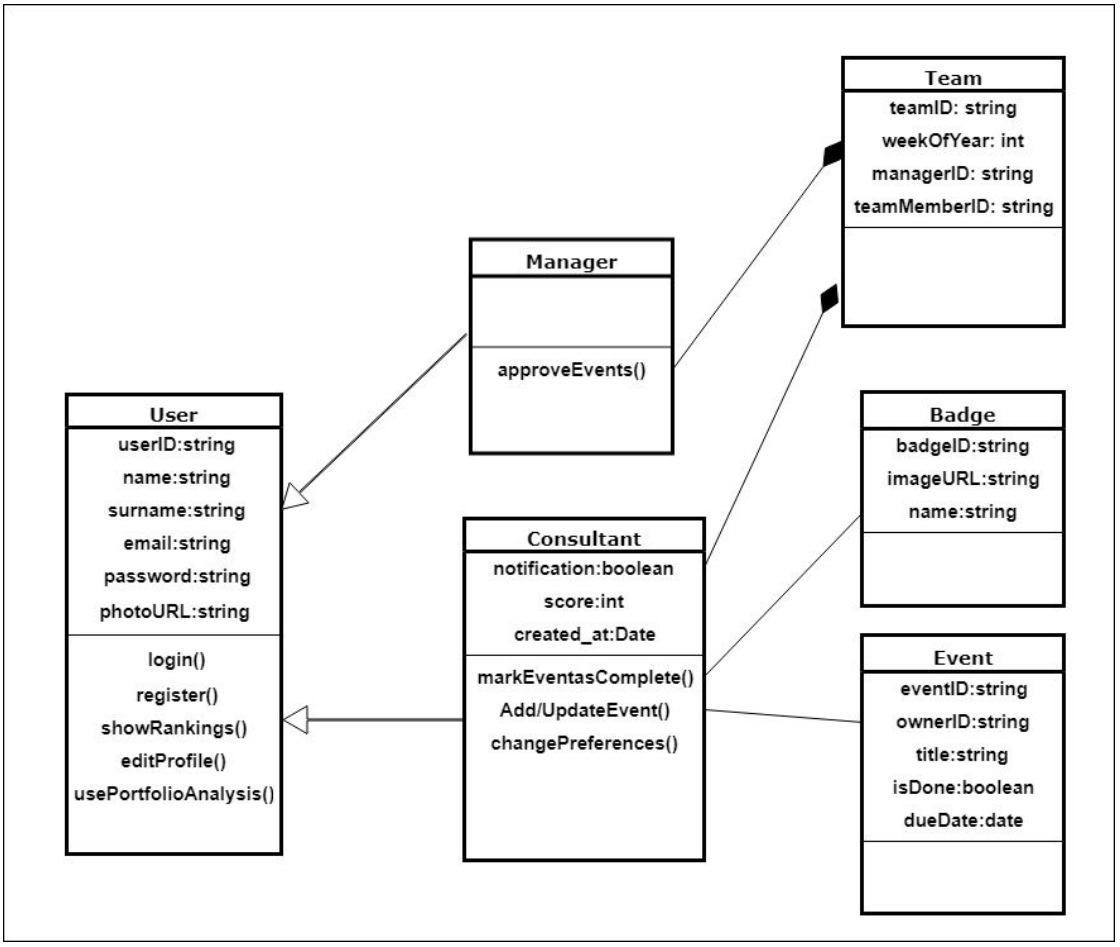

Figure 6. Class Diagram of Mobile Application

Figure 6 shows the class diagram of the mobile application of the system which describes the structure of the system by showing the system's classes and relations between them. The main class of DMSS is User which defines attributes of a user in general. Manager and Consultant classes are specific types of the user which are inherited from User class. Manager and Consultant have all the attributes that User has but they have also specific attributes and functions. For example, Manager and Consultant both use functions login, register, showRankings and usePortfolioAnalysis. Moreover, Manager has a function called approveEvents which provides a manager to confirm the events that marked as completed by team members. The Team class consists of a manager and team members. The Event class is a representation of events that can be added and updated by consultants in the system. The Badge class has badgeID which is unique and the other

attributes name, photoURL to identify badges in the system. The classes Event and Badge have an association relationship with the class Consultant.

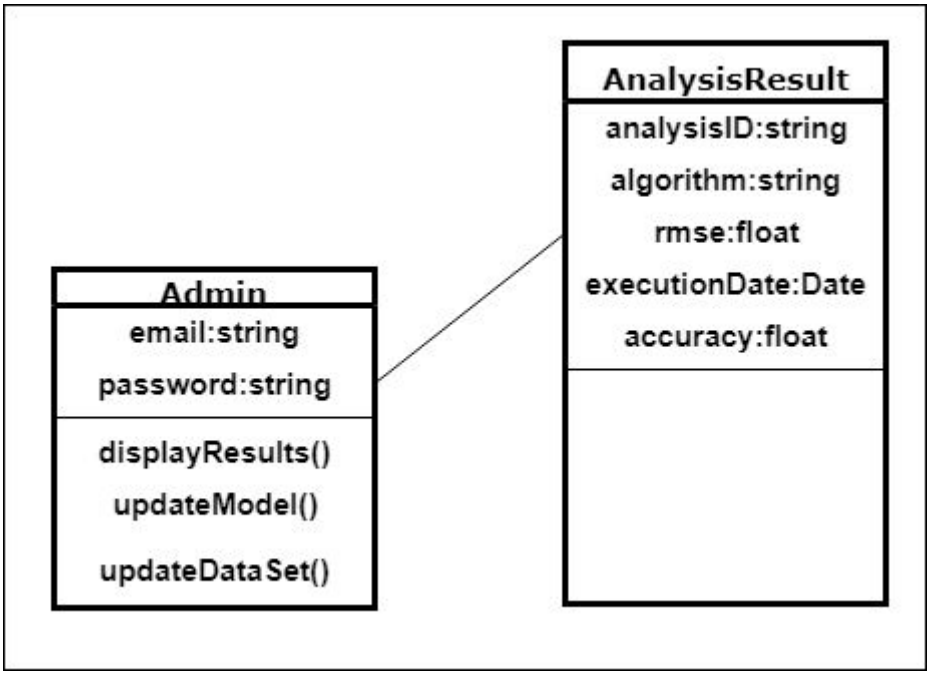

Figure 7. Class Diagram of Web Application

Figure 7 shows the class diagram of the web application. Although the web application is a part of the system, the class diagrams of web and mobile application are shown as separated. Admin is the user of web module of the DMSS project. Admin can use functions displayResults, updateModel and updateDataset which are explained in details in SRS document of the project. The AnalysisResult class will keep the results of data analysis which is done with different algorithms different times. Keeping analysis results will provide trackable analysis to observe improvements of the model. There is an association relationship between Admin and AnalysisResult classes.

3.2.2. Architecture Design of System

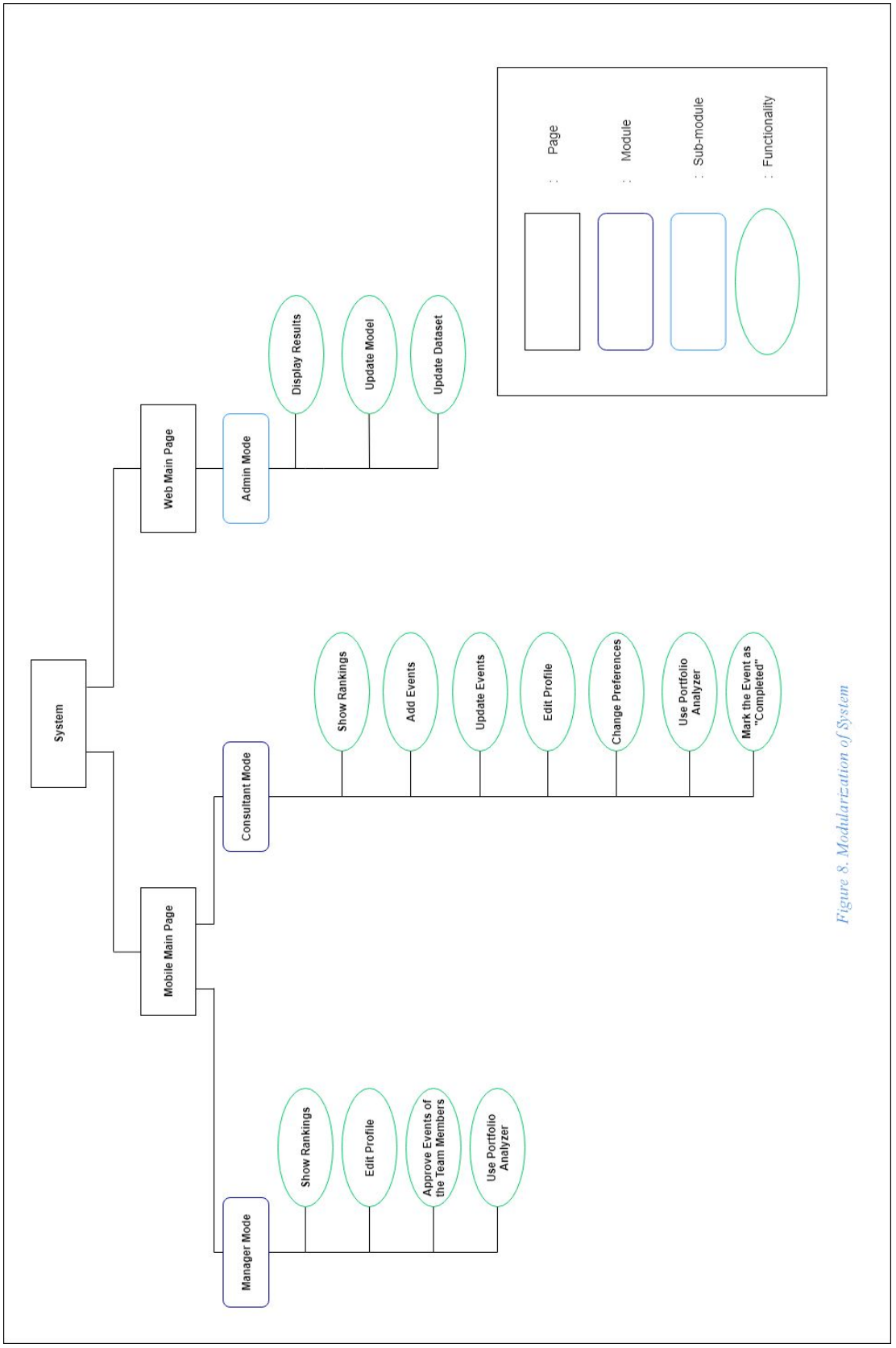

Figure 8. Modularization of System

According to the structured modularity in Figure 8, the system consists of web part for the admin mode, mobile part for manager and consultant mode module. Each one of them has their own functionality as seen. Because our project contains a part of new technology, data mining, the admin mode has a function related to it. The admin can see the results of the models created for portfolio analysis and compare the results of them to choose which one will be next for upcoming records. When a new record comes, the admin also can update the model. We didn't gather all the mutual functions of manager and consultants but in both manager and consultant mode, the users can show rankings, edit profile and use portfolio analyzer. While the consultant can mark the event as "completed", the manager of the team which the consultant belongs to can check whether the event has completed by the consultant or not.

3.2.2.1. User Management

This system is available for any types of users including the manager, consultant, and admin. While the operations of the manager and the consultant are handled at the mobile platform, the operations that concern the admin are handled in the web part. The details are given in the following sections.

3.2.2.2. Mobile Application

When manager or consultant clicks the application icon, s/he is welcomed at the sign in page. If the user is not registered before, s/he must click the "Üyeliğiniz yok mu? Yeni Üyelik!?" button to create an account. After clicking that button, s/he must provide the credentials. Then, the system will send an activation code to his/her email to successful register. Other than that if the user forgets his/her password the system allows setting a new one. If none of these situations occurs which means user successfully logins the system, s/he will be redirected to the page according to his/her authorization rights.

3.2.2.2.1. Consultant Mode

Generally speaking, after the application activates the consultant mode, one of the functions that the consultant can do adding/updating an event. The plans may change in any time and the user must be able to change his/her plans accordingly. The, if the event is done by the consultant, s/he can mark the event as "completed". If the conditions of any time of badges are satisfied, the consultant will earn a badge. The other important functions that the system provides for consultants is allowing them to use the portfolio analysis. That is, when the properties of the real estate are provided by the consultant, the system will estimate a result that is related to the price of the house and how long it will take to sell that house. So that, the consultant can inference whether s/he must buy that portfolio or not. Besides that, the consultant edits his/her profile and change the preferences.

3.2.2.2.2. Manager Mode

Managers can also edit their profiles, show rankings and use portfolio analyzer. But in addition to that, our system will form teams within the office. The team will consist of a

manager and several consultants. The managers will be chosen randomly and in charge of approving the events that have been marked as “completed” by their team members. And every week, the system will refresh itself and maybe new groups will be formed with new managers. The reason behind this logic is that the consultants should not belong to just a team so that s/he can communicate with his/her colleagues.

3.2.2.3. Web Application

By using web applications, the admin can now develop and operate simpler and achieve his/her objectives much faster without idling around.

3.2.2.3.1. Admin Mode

Since the data mining part of the system is being done with different kinds of models, when the admin logins to the system, s/he can keep track of the results of these models and choose the next one based on their accuracies. S/he can also insert a new row(s) to the model and update it.

3.2.2.4. Activity Diagram

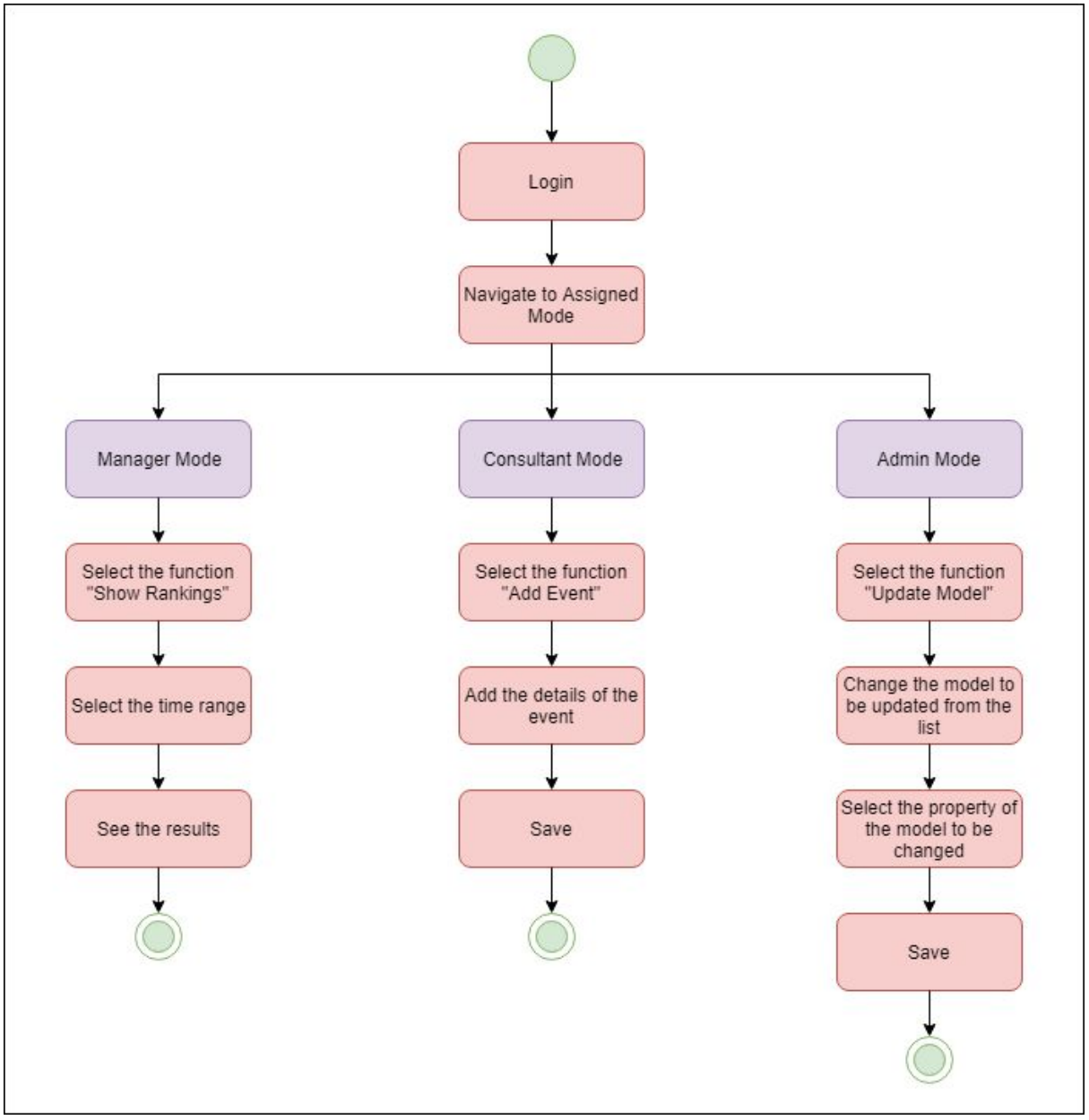

Figure 9. Activity Diagram of DMSS

Figure 9 shows how the system works as an activity diagram. First of all, the users are all predefined in the database as the consultant or the manager. All users are welcomed in the login page when they click the application. After the successful login, the user is redirected to the main page that they are assigned to. For the sake of simplicity, only one of the most important functions of each user is shown in the diagram. For example, the manager can show the rankings within an interval of time. The consultant can add and

save an event after giving details like deadlines and the type of the event. Meanwhile, the admin can update a property of a specific model in the web part of the system.

3.3. Database Diagram

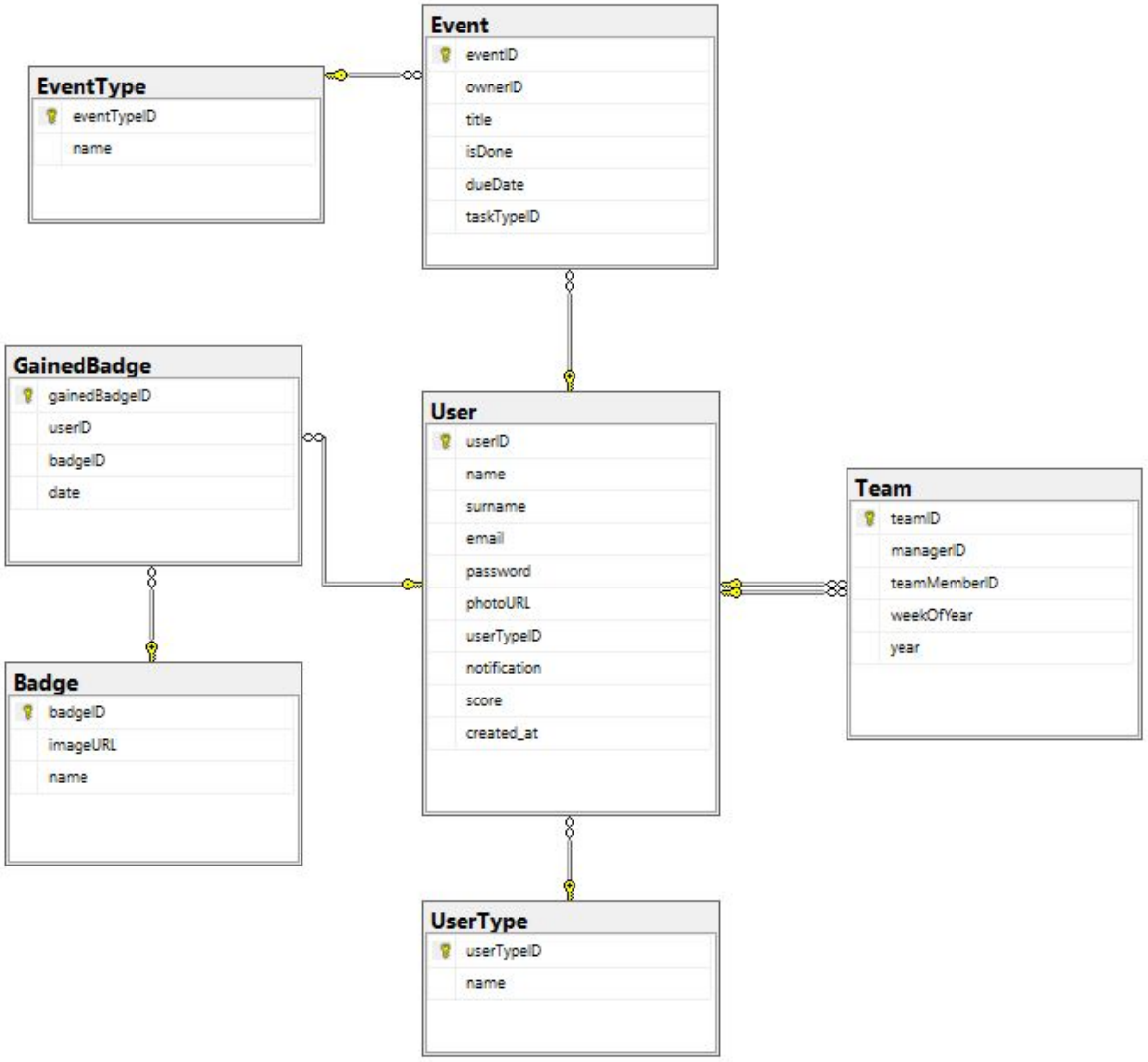

Figure 10. Database Diagram of Mobile Application

This figure is a representation of the database design of DMSS. It is consists of tables that stores information in a structured way and relations between tables. The mobile application of the DMSS system has two different types of user and the main focus of the system is User. All the other tables are associated with the User table from a different perspective. The User table keeps information that defines users with their attributes such

as name, surname, email etc. The userID is a unique key that is assigned to the user by the system in the registration step. The table UserType keeps user types which are shown in the User table as a foreign key. Table Event keeps all events that are created by the consultant. Like UserType the EventType table keeps types that an event can have. Table Team keeps the team information which consists of a manager and several consultants. The table Badge is storage of badge data that consists of image and name of the badge. Lastly, the GainedBadge table will keep records of badges that a user gains.

3.4. Graphical User Interface Design

Designing an interface is a tough part of a system. It is important to design an interface which operates every function without conflict as well as is pleasing to the eye. When we designed this interface for the real estate consultants, we considered many qualifications. We tried to clarify everything by adding descriptions and explanations enough but also tried to keep it concise in order for real estate to spend too much time reading so much text. Also, we tried to implement all the functions in a proper way such that different buttons, tabs, icons, and other interface elements are introduced for real estate consultants to recognize them as they stand for a different context. While we were doing that, we considered the maintainability and did everything in the template form so that when we arrange the whole system with upcoming requirements, it could be easier.

3.4.1. Overview of Interfaces

The user clicks to the application. And when the login page opens, s/he must enter his/her email and password to the according to fields. Then the system navigates to the main page of appropriate mode.

3.4.2. Mock-ups of System

There are many example pages consultants can see:

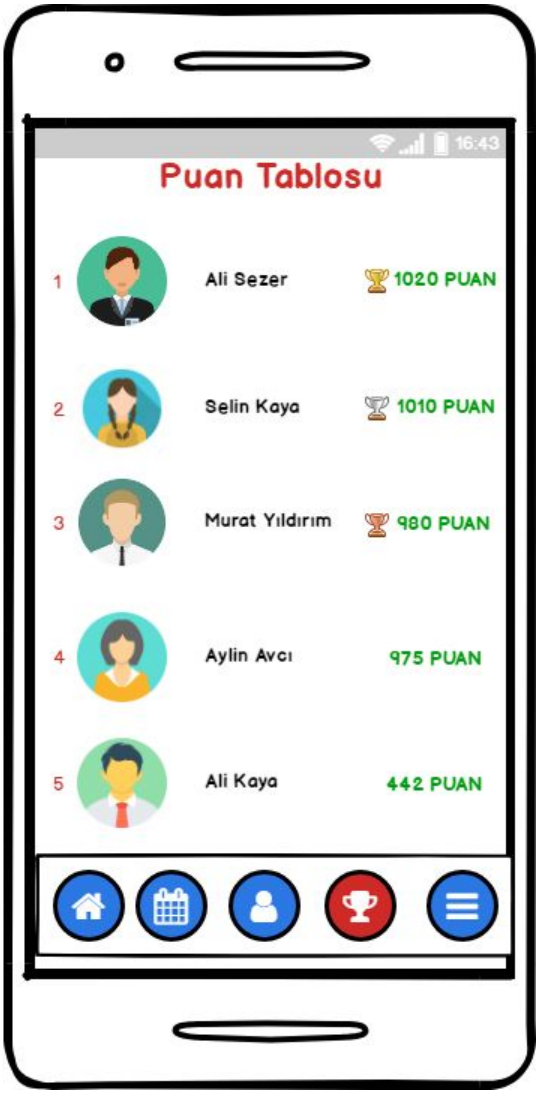

Figure 11. Sample Interface Design for Score Table of All Users

In the score table, the user can see the points and the rankings of the consultants. To get to this page, the user has to click on “Puan Tablosu” from the main page and gets access to the page shown in Figure 11. People who made up to first 3, are given a medal according to their place (1. Gold, 2. Silver, 3. Bronze).

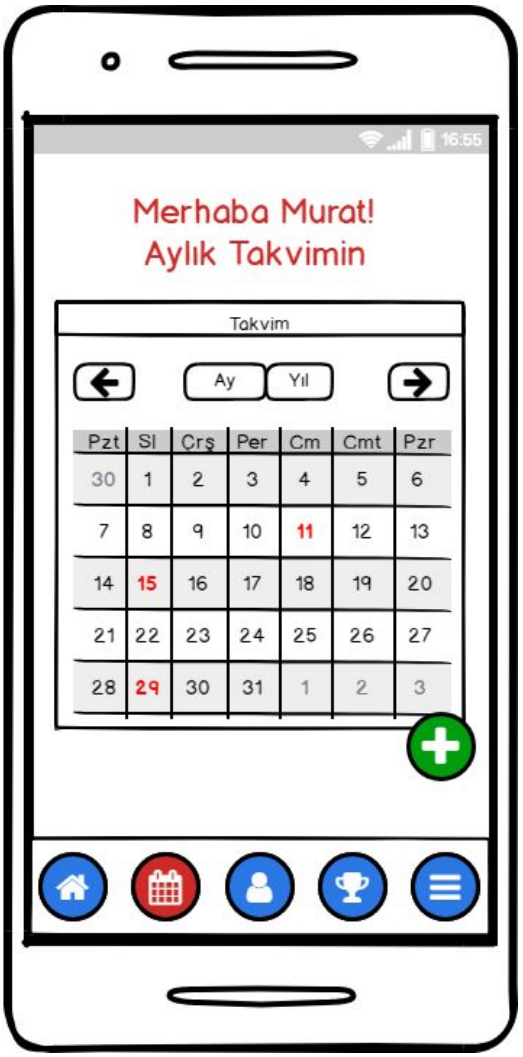

Figure 12. Sample Interface Design for Calendar Page of All Consultants

All the consultants will add the events that required to be done to the calendar that is shown in Figure 12. The user can see the added events to any date and also can add new events to any given date.

Figure 13. Sample Interface Design for Main Page of All Consultants

Consultants will enter their own duty to the system under the “Calendar” page. On the main page, they can see the duties that are entered into the system as shown in Figure 13. At the same time, the consultant will be able to see what needs to be done in order to reach the weekly goal at the top of the screen. The consultant can check the duty if its done and updates his/her weekly points.

3.4.3. Screen Objects and Actions

This part of the document will be determined and completed later.

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