On Demand Cleaning Service Recommendation Tool

BY

Liu Jie Wei

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF COMPUTER SCIENCE (HONS)

Faculty of Information and Communication Technology

(Kampar Campus)

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33020 Kuala Kangsar, Perak

Ku Chin Soon
Supervisor's name

Date: __23/4.2020_____ **Date**: 23/04/2020

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BY

Name: Liu Jie Wei

Student ID: 16ACB05321

Course: CS

Supervisor: Ts Ku Chin Soon

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DECLARATION OF ORIGINALITY

I declare that this report entitled "**METHODOLOGY, CONCEPT AND DESIGN OF A 2-MICRON CMOS DIGITAL BASED TEACHING CHIP USING FULL-CUSTOM DESIGN STYLE**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

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First of all, I would like to take this opportunity to express my appreciation and thank sincerely to my supervisor, Mr. Ku Chin Soon who has given me this opportunity to work as his supervisee. Besides, this is also one of my projects that gain me so much knowledge. Truly appreciated it. Last but not least, I will have to thank my parents and my family members for their support and love as well as encouragement throughout the whole course. Thank you.

ABSTRACTS

Nowadays, the mobile application are getting more important and popular for the people. This technology is also getting more advance time by time. Mobile application is usually used to produce users with related services to those penetrated on PCs. On the other hand, the recommender system also getting popular and widely used in many application and website. Recommender system is usually used to predict the eventual choice of a set items for a user, and suggest it to users. In this modern era with a large number of info, it is needed for a system that provide recommendation features to suggest the items to users. In this paper, it is mainly about the recommender system and mobile application for users to call for the janitorial service and recommend user some suitable plans. In order to achieve this goal, a score-based recommendation method will be implemented. Firstly, the system would process the input parameter such as budget and time that entered by the users to calculate the value of preferences with package. After that, the system will calculate the weight for preferences based on the important level entered by user. After that, the system will calculate the score for each package and display the package with higher score as recommendation result to the users.

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LIST OF ABBREVIATION

DSS	Decision Support System
AHP	Analytic Hierarchy Process
OLAP	On-Line Analytical Process
CB	Content-Based
CF	Collaborative Filtering
API	Application Program Interface
JSON	JavaScript Object Notation
UI	User Interface
CBFA	Content-Based Filtering Algorithm
CFA	Collaborative Filtering Algorithm
SDLC	Software Development Lifecycle

CHAPTER 1 INTRODUCTION

1-1 Project Inspiration

In this era of technology, the mobile application had become essentials in the human daily life. Everyone has their mobile device and the mobile application can make use of the functionality of mobile devices. Study by Nah, F. F.-H., Siau, K., & Sheng, H. (2005) stated that portable devices are able to increase the efficiency in organizing the business. This is because the many of the company or organization have their own mobile application to support their business. For example, the Public Bank have their own mobile application to provide some convenient function to the user as they can check their balance or doing some transaction. Therefore, mobile application provides the significance and convenient function to the user.

On the other hand, the number of mobile applications that provided cleaning service had increased at the recent year. However, this kind of applications didn't offer the users the decision-making tools or recommendation engine. The application usually just let the client enter some input such as date, time and service needed, then the application would book the service for client. With the feature of decision-making or recommendation, the application could give some suggestion to the user based on the users' input. This could increase the usability of the application as the application could recommend the package via some filtering algorithms to the users and this could also provide the better service to the users.

Other than that, it is also impossible for the client to choose the package they want when there is a large number of packages. Therefore, the effective filtering algorithms is needed to help the users to make the decision for recommending them the package that is closer to the users' input. Hence, the notion of proposing a score-based filtering algorithm method had been developed.

1-2 Problem Statement

Recommendation engine had been widely used in many fields such as music recommendation in the music player application or food recommendation in the food delivery application. Nowadays, many applications had implemented the recommendation engine to provide better service. However, most of the cleaning service mobile application still lack of the recommendation or decision-making feature. Therefore, the problem statement of this project is lacking of decision-making or recommendation tool in the cleaning service mobile application. Thus, some of the techniques to implement the recommendation engine had been introduced. The most common methods are Content-based Filtering Algorithm (CBFA) and Collaborative Filtering Algorithm (CFA).

CBFA is one of the common methods used to conduct the recommendation engine. CBFA would recommend the users things based on a similarity between the content of items and user preferences. Besides that, it is also based on the user rating, which mean it is needed for the large number of rating from the users. Then, the system would recommend the item that similar to the item that the users had rated. On the other hand, CFA suggest the item based on the rating of similar users. For example, the first user had rated high score on an item whereas second user had also rated high score on similar item, then the system would recommend the similar item that rated by the second user to the first user.

The major problem of these two techniques is cold start problem. It is a problem that unable to suggest the items because of insufficient data. These techniques needed a large number of information such as user rating and user profile at the beginning to recommend the items to the users. Therefore, it is unable to suggest something when there is lacking of user rating. Thus, both techniques are not suitable to use in this project.

Besides that, there are some other techniques to implement recommender engine. In this project, it will mainly focus on proposing a method which is effective and suitable in this cleaning service recommendation mobile application.

1-3 Background and Motivation

In this project, two techniques that mentioned before is not suitable to implement to develop this cleaning service recommendation mobile application. As mentioned before, the mobile application would developed to be a decision-making tool to give recommendation to the users. The decision-making is the action or process of making some important decisions (Merriam-Webster 2019, decision-making entry). As a decision-making tool for mobile application, the system should help the users to decide the most suitable output for the users after the users entered some inputs to the application. In general, the application of this project would recommend the service package based on the users' input but not rating. This project would adopted and modified Analytic Hierarchy Process (AHP). After the user entering the input for the criterions, the user still need to rate the important level for each of the criterions for calculating the weight. Then, the application would calculate the score for each service package based on the user' input, value from package and weight. The package with higher score would be the recommendation package to the user.

In this project, the major concern is the recommendation system in the mobile application. The study (Husain, W., Lam, Y.D., 2012) stated that the role of recommender system is to provide recommendations, and ideas according to the user's organized information or any other essential measures. As mentioned before, the mobile application that used to call for janitorial service is lacking of recommendation tool. Thus, the motivation of this project is to provide recommendation tool to help the users for decision-making in cleaning service mobile application.

1-4 Project Objectives

As stated before, most of the mobile application that provided cleaning service is lacking of the decision-making tool. Therefore, the main objective of this project is to develop a mobile application that enable clients to call for cleaning service and able to make some decision and doing recommendation for the users. At the end of the project, this project will try to achieve the following objectives:

1. **To propose a score-based recommendation method for a recommendation system**. The main objective of this project is to develop a recommender system for mobile application which able to recommend for the user for decision-making when calling for the service. After the users entered the required input for the service, the application shall able to run the recommendation algorithm to help the users make some decision for recommending some suitable plan to the users.
2. **To allow the user to customize recommendation method based on their own preferences**. Most of the technique of recommendation system always need others user's information. By having this method, the system just needs the input from the users. Based on the users' input, the different result will be displayed. Thus, the user could customize their preferences to get the result they want.

1-5 Proposed Approach

In this project, the mobile application would let the users to enter the input for 5 criterions which is budget, duration, date and time, service, building. After that, the users need to enter the important level for 5 criterions that range from 1 which is not at all important to 5 which is very important. Based on this important level, the system would calculate the weight of criterions by using AHP. Then, the system starts to calculate the value of criterions in each of the packages based on the users' input. Finally, the system calculates the score of each package by summing up the multiplication of the value of criterions in each of packages with the weight of criterions. The package with higher score would be the recommendation to the users.

What have been achieved:

1. The mobile application is able to let the clients register for an account and login to the system and finally logout from the system.
2. After that, the clients are able to key in some preferences as input such as budget, duration and etcetera. The clients are also able to enter the important level for the 5 criterions which is budget, duration, date and time, number of services needed, type of building.
3. The mobile application is able to calculate the weight for each criterion based on the important level. Then, the application is also able to calculate the value of criterion in each package. Finally, the application is able to calculate the score of each package based of the weight of criterions and value of criterions.
4. Once the user selected a package, the application would proceed to PayPal gateway to let the users make the payment.
5. Once the payment is made, the calendar would show the event on the booking date.

1-6 Project Scope

The product of this project is a mobile application that able to provide the recommendation based on users' input in calling the janitorial service. The major focus of this project is the algorithm of the recommendation technique. It is a score based algorithm which will calculate the score for each of the packages. Since the two common filtering techniques that mentioned before which is CBFA and CFA have the cold start problem, this proposed techniques will resolve this problem. Since the system will calculate the score for the packages, the user need to enter some input for the calculation.

1-7 Project Impact and Contribution

Mobile application had become an essential thing toward a mobile device. Other than that, mobile application had also become important for the users since it provided useful and convenient functionality to the users. First and foremost, the benefits of the mobile application is that using the mobile application would be faster than browsing in the web browser. As mentioned before, this project will develop an application for calling the cleaning the service. With the app, the users could call for the service with several simple steps. Other than that, the user no need to go through all the packages as the system would give recommendation after the users enter the essential input. This could actually save the time of the users.

On the other hand, the app will make decision for the users after the users entered some input into the mobile app. Thus, the app will suggest some recommendation which is related to the users' input. For example, the system will recommend some service package to the users according to their preferences for the cleaning service. This could actually benefit the users as the plan recommended may be more suitable for the users.

CHAPTER 2 LITERATURE REVIEW

2-1 Literature Review

After discovering some introductory papers about the recommender system and janitorial service, there are some approaches, knowledge and information in developing the recommender system and janitorial service.

2-2 Review on Decision Making Tool

2-2-1 Past, Present, Future of Decision Support Technology

According to study from [18], Decision support systems (DSS) technology and applications had become significant toward individual or organization. This technology had evolved from time to time. So, what is the meaning of decision support systems? According to this paper, DSS is defined as a computer technology solution which are able to help to make decision and also problem solving. The scheme of DSS tools consist of sections for high-level database management abilities by retrieving to internal and external data, great modeling functions retrieved by model organization system and useful and easy design for user interfaces designs. The DSS model is defined as the combination of organizing or managing activities which stated by Anthony and Simon's explanation of decision types. For organization of events, it consists of preparation for method and monitoring of management and operation. Other than that, decision problem is defined as present on continuum from programmed to non-programmed. Anthony and Simon' theory had been merged with usage of terminologies structured, unstructured and semi-structured. On the other hand, Simon's Intelligence, Design, and Choice description is used in order to make the decision.

In this study, four useful approaches had been introduced to construct DSS which is data warehouse, on-line analytical process (OLAP), data mining, and lastly the technology related with World Wide Web (WWW). A data warehouse is a group of data which are subject-oriented, unified, time-variant and stable. OLAP is a technology that enable analysts or manager to get understanding on data by quick access to wide information. Data mining is a conventional of artificial intelligence and statistical instruments which are more powerful compared to data warehouse and OLAP that used to analyze the complex data. The technology related with WWW, also known as web-based DSS, it is a high-tech system that produce decision support info to administrator or analyst by using network browser.

The strength of data warehouse is that it able to integrate data from database for decision making. However, one of the problem of data warehouse is that it leads to high focus in analyzing the historical data. Thus, OLAP is introduced to solve this problem. Other than that, the data mining able to discover patterns in data and deduce rules from data. The strength of the web-based DSS is convenient and simple since it can use the web browser to find the solution or make the decision.

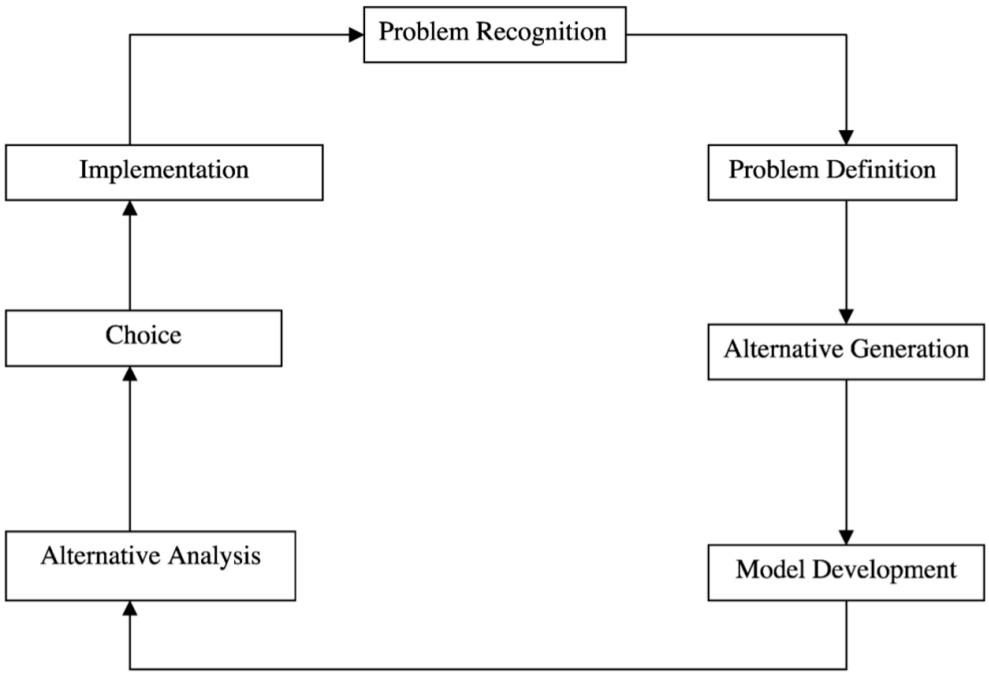


Figure 2-2-1-1: The model of DSS decision-making process.

2-2-2 Sustainable small-scale CHP technologies for buildings: the basis for multi-perspective decision-making

A concept had been introduced from this research paper [2] which is small-scale CHP (Combined Heat and Power). CHP is defined as the heat and power that generated by system is combined with power of electric that fewer than 200 kW. The main advantage of CHP is the general effectiveness. The efficiency of CHP can be achieved as much as 85 – 90%. The recent trend for CHP is towards allocated which means that the power manufacture unit is set adjacent to energy users and smaller units are replaced by large centralized units. The advantage of this technology is to utilize sustainable fuels. Therefore, the study is focused on the issues that can be seen as a substitute energy source for buildings when considering maintainable small-scale CHP. Thus, the study had also concerned about decision-making on energy.

In this article, the key premise is that technology and resources should be accessible at a reasonable price and there should be an adequate amount of dependable info accessible before a decision-maker is prepared to decide causing for investing in a latest small-scale CHP system. Other than that, much remains to be done to acquire technological solutions. For instance, modularity and combination of CHP into building energy systems should be enhanced.

On the other hand, maintainable development is defined as progress that addresses present requirements without undermining upcoming generations ability to encounter their own requirements. Although expenses are typically the only criteria when choosing technological solutions for buildings, however, the maintainability should not be ignored.

In conclusion, this article examines concerns that impact on choices when considering small-scale CHP as a substitute source of energy for buildings, especially from a property owner's point of view. Some of the issues had been discussed such as the availability of technology and sufficient amount on information, flexibility and etcetera. Therefore, different decision-makers need to make a lot of decisions to satisfy these requirements.

2-2-3 Analytic Hierarchy Process: An Overview of Applications

An approach called Analytic Hierarchy Process (AHP) had been introduced in this article [21]. AHP is one of the popular methods of decision-making for multiple conditions. It is an Eigen value method to the pair-wise evaluation. AHP is able to standardize the numeric hierarchy for the measurement of quantitative or qualitative functioning. The range of scale start from 1/9 which is least important than to 9 which is extremely more important than. The AHP introduced some key elements to conduct such as classify the conditions that will affect the result. The reason to classify the conditions is to compare the conditions with the alternatives and then there will come out the decision.

This article had also introduced some of the example of application of AHP. One of the examples is the decision-making. The problem faced is the arrangement of test. To solve this problem, a three-layer hierarchical diagram is drawn. The first layer is the decision assumed. Second layer is the criteria and the last layer is the alternatives. There is some step to make the best decision. Firstly, identify the criteria and alternatives. Secondly, calculate the weight for the criteria. Thirdly, rate the alternatives with a value and lastly, calculate the final score. The alternatives with the highest score will be the best decision.

2-3 Review on Janitorial Service

2-3-1 Deciding who's in charge: Factors driving the choice of decision rights in professional service contracts

From the study [13], this research had derived hypothesis from PRT (Property Right Theory) according to the distribution of decision authority in contracts. This research had studied 361 government-based professional service agreements to classify the core influence of knowledge properties to the work product. The authorization of decision of consequence to the evaluation is reproduced in requirements that specify who must complete the job and how it should be completed. Regression outcomes are mostly reliable through PRT and considered as 3 type. Firstly, a bigger part of decision privileges is assigned to management when management is also classified as a source of knowledge. Secondly, authority is fewer integrated while both parties provide information inputs. Thirdly, negotiating authority leads to a lesser part of decision rights distributed to management.

According to this research, the individual's ability is encompassed by the PRT. PRT is involved with connection between the proprietorship of an asset and switch over any probable profits. Other than that, PRT also assumed privileges project is cost-unreasonable if it is completed to be perfect. It pursues that in building understandings gatherings must contemplate both the expense of detail and the probability increases or misfortunes related with explaining rights. PRT adopts that persons try to raise value; accordingly, contracting parties may explain privileges and attempt to reallocate a prior allocation of rights when doing so would result in significant benefits. On the other hand, PRT offers a few simple ideas for entitlement to optimize surplus. Therefore, the decision-making authority should emphasize incentives and benefits on the individuals responsible for them. In addition, the features of professional service contracts are vital since it suitable for the PRT framework.

For the professional service contracts, it is an agreement for the human capital usage. The contracts included the governments programs or initiative implementation. The need to delegate decision rights depends on the specification challenges in the PRT framework. The principal agreements covered a large variety of services and varying points of specified information by extension. Besides that, the contract also included some sets of decision rights such as rights to reparation, supervising rights, cessation rights and etcetera. Because of focusing on PRT and the vital of uncountable properties in allocating rights, the rights most applicable to this analysis apply to human resource authority. Therefore, the study is focused on contract provisions which will give right to choose who will complete or how to complete the job.

2-3-2 Improving Janitorial Contract Performance with Facility Management Performance Scorecards

According to this research [8], it is stated that the role of FM (Facility Manager) need proficiency in every part of facility maintenance through the diverse job functions. Therefore, a FM need to outsource some of the service that involve distinctive skills. The main reason for outsourcing is to reduce the risk, cost and finally get extra expertise that able to reach an advanced performance. Other than that, the services that FM outsourced can also increase and service quality. The main focus of this research is outsourcing and performance management.

Outsourcing is defined as an approach to manage the delivery of the services for a society. The main pros of outsourcing are it able to improve cost efficiency and productivity. The example of the services that can be outsourced are maintenance, janitorial, transportation and etcetera. According to this research, a well-run internal organization can likely have a 10-15% lower cost than an external organization. However, there is a significant lack of standards that make it difficult to establish specifications due to the organizations do not adequately document internal standards and this led to over-specification and improbable expectations. In addition, exceed specification can result the increasing in cost as the organization is not aware of current costs. On the other hand, the most important factor to confirm the outsourcing to be succeed is a well-considered and efficient contract. An analysis on FM outsourcing found that some possibilities involved with outsourcing are underprivileged in-service quality and vendor amateurishness. Thus, a well-planned contract is necessary to address the specific requirements needed in the contract.

On the other hand, performance measurement system helped managers track, organize, control and develop all aspects of organizational activities. In addition, the measurement provided a company with the basis for evaluating how fine it performs to its predetermined goals, helps categorize parts for improvement and decides on potential enterprises. Same as outsourcing, performance measurement could also improve the quality and service. There is various type of performance measurement frameworks, one of it is strategic performance measurement. It is defined as the monitoring on the planning and success from an organization. Nonetheless, very often organizations have applied quality measurement at lower organizational levels, such as divisions, groups, or even personals, and not to existing suppliers and agreements. Therefore, there should be an expectation from higher management to properly measure the performance or quality in the company.

Figure 2-3-2-1: FM Services Performance Model

2-3-3 Toward an Integration of The Behavioral and Cognitive Influences on The Entrepreneurship Process

According to this study [16], entrepreneurs developed innovations, met consumer requirements, stimulated financial development and improved the general quality of life in organization. The study focused on issues associated to the process by which persons identify, assess and exploit chances to achieve such important socio-economic results. Thus, the main goal of the study is to develop the concept to describe the different ways of identifying, assessing and leveraging opportunities.

Two notions had been introduced from this study which are opportunity conceptualization and solution conceptualization. Opportunity conceptualization is defined as how financiers make sense of the unmet requirements of the consumer that they have ignored. On the other hand, solution conceptualization referred to how businesspersons understand how they progress and generate market value in adopting the strategic demand through venture activities.

Other than that, two theories had also been discussed which are sensemaking and structuration. For the part of sensemaking, beliefs are original opinions or conclusions that are often misunderstood and unformed in the minds of individuals, but that can be the foundation for a better understanding. People can seek to distinguish the significance of the new beliefs with respect to their current knowledge and the effects that the beliefs may have on their upcoming expectations as they develop new beliefs. The result of the sensemaking is an understanding of the novel beliefs that notify the actions of persons subsequently. For the part of structuration, the perspective of structuring addresses more directly the behavior of individuals and their results while the perspective of sensing mainly emphasizes the cognitive activities of individuals activated by new beliefs that successively notify behavior.

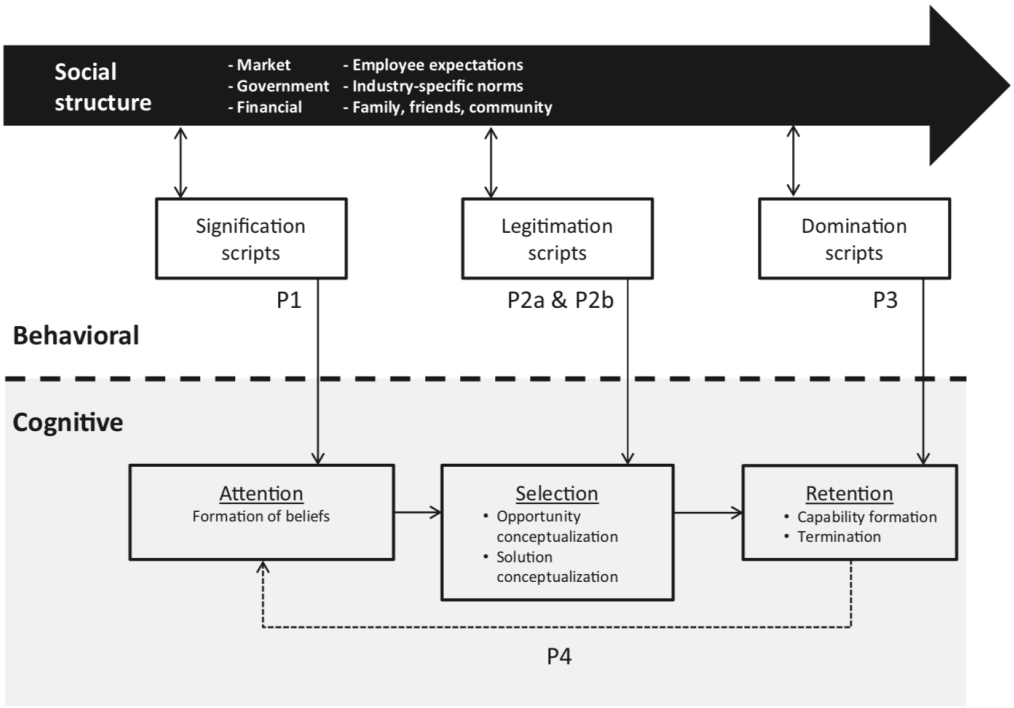


Figure 2-3-3-1: Integrated model of the cognitive and behavioral influences on the entrepreneurship process

2-3-4 Effects of Outsourcing Cleaning Functions on Service Quality in Public Universities in Kenya: A Comparative Study of Outsourced and in-House Cleaning Services

The goal of this study [11] is to figure out the difference of service quality between outsourced and in-house janitorial services. In most cases, companies are unable to cope directly with all facets of commercial procedures and end up divesting them to professional third parties. This outsourcing is a significant feature of any organization's general strategy which outsources certain non-core tasks such as transport and logistics, maintenance, cleaning service and etcetera. In the recent past, outsourcing has gained massive prominence with companies hoping to gain a number of benefits. Benefits include cost consequences by which administration can arrange the outsourcing agreement so that the amount of carrying in latest equipment and technology is borne by a supplier.

Besides that, there is impact of service quality on outsourcing. Quality is an pointer of range or measurement. Other than that, the study also stated that service quality is the degree of compatibility between the requirements of the customer and the service performance. A business with better service quality always met the needs of customers. This goal can be accomplished by understanding and enhancing organizational procedures, easily and consistently identifying problems by developing valid and reliable measures of service quality and evaluating customer satisfaction and other performance outcomes. From the study, outsourced cleaning services have improved the quality of service than in house cleaning services.

In conclusion, it is clear that the process of outsourcing is still in its start in higher education organizations, and a great deal of literature comes from the United States. The most common reason for outsourcing is to save costs. As stated before, the outsourcing of janitorial services results in better quality of customer service than in cleaning services at home. Therefore, the paper mentions that cleaning services should be given to outsourcing precedence.

2-4 Review on Existing Systems

2-4-1 Justmop

Brief introduction

Justmop [10] is a mobile application that provide home cleaning service to the users. After downloaded the application, the users are able to call the home cleaning service by placing the order in the application. The application required the users to enable the location service since the cleaners need to know the location of the users. After that, the users could place the order by entering the cleaning preferences. Then, the system will process the order by matching the well-trained and reliable cleaners to the users who called the service. The application allowed the users to choose the service for one time, every week or every two weeks. Other than that, the users able to choose the duration of cleaner to stay, the date of cleaning and time to start the cleaning process. In addition, the users could also choose the number of cleaner that they want. The system would ask the users whether they require cleaning materials and lastly, the users could fill in any special requirements if they want. After completed the service, the users could rate the cleaner or even ask for a weekly service with the same cleaner.

Strength

One of the strengths of this application is that it has simple but useful design for the user interface. The procedure for placing the order is easy and clear. The users can easily know how to place the order in the application. Other than that, the application also provided last minute home cleaning service for the users. For example, when the users want to call the cleaning service on today, the users can pick the today date and the time of service when choosing the preferences. Then, the system will immediately process the order and matched the users with best-rated service provider in the users' area. In addition, another strength for this application is that if the users don't have cleaning materials, the users could ask for requiring the cleaning material when entering the details. This is really convenient for the users when the users don't have the cleaning materials or the users already used up the cleaning material. On the other hand, the some of the preferences of booking the cleaner service is flexible. For instance, the users can choose to let the cleaner to stay up to eight hours, or the users able to book the service at next week. Next, one of the strengths of this application is that it able to display the fee of service at the bottom left of the application when the users choosing

or entering the preferences for the service. The fee will change immediately after the users choosing another preference.

Limitation

One of the limitations of this application is that the users could only choose the number of cleaner that they want up to four persons. Therefore, this application is not suitable to use when calling the service for the large building. Next limitation is that some of the information that displayed by application is not clear enough. For example, there is a fee displayed at the bottom left. However, the displayed fee is just like "AED 79". This information is not clear enough since the users may not what's the meaning of the fee. In addition, another limitation of this application is that the location to display the fee of the service when booking is not suitable. Since the fee displayed at the bottom left of the application, it may not able to draw the attention of the users.

Recommendation

The recommendation for this application is that the developers could improve the user interface design for the application to become more attractive. The users are always attracted by the beautiful things. Other than that, the developers could adjust some user interface design by changing the location to display the fee from the bottom left to the bottom center and further enlarge the font size to draw the attention of the users. On the other hand, the developers could also improve the user interface design to make the information displayed clearer. For instance, the developers could just change the way of displaying fee to become "Service Fee: AED 79" or "Service Fee before tax: AED 79". These should be clearer to let the users know about the information. Last but not least, the developers could design the application to become a decision-making tool to help the users to make some decision and let the users to choose it.

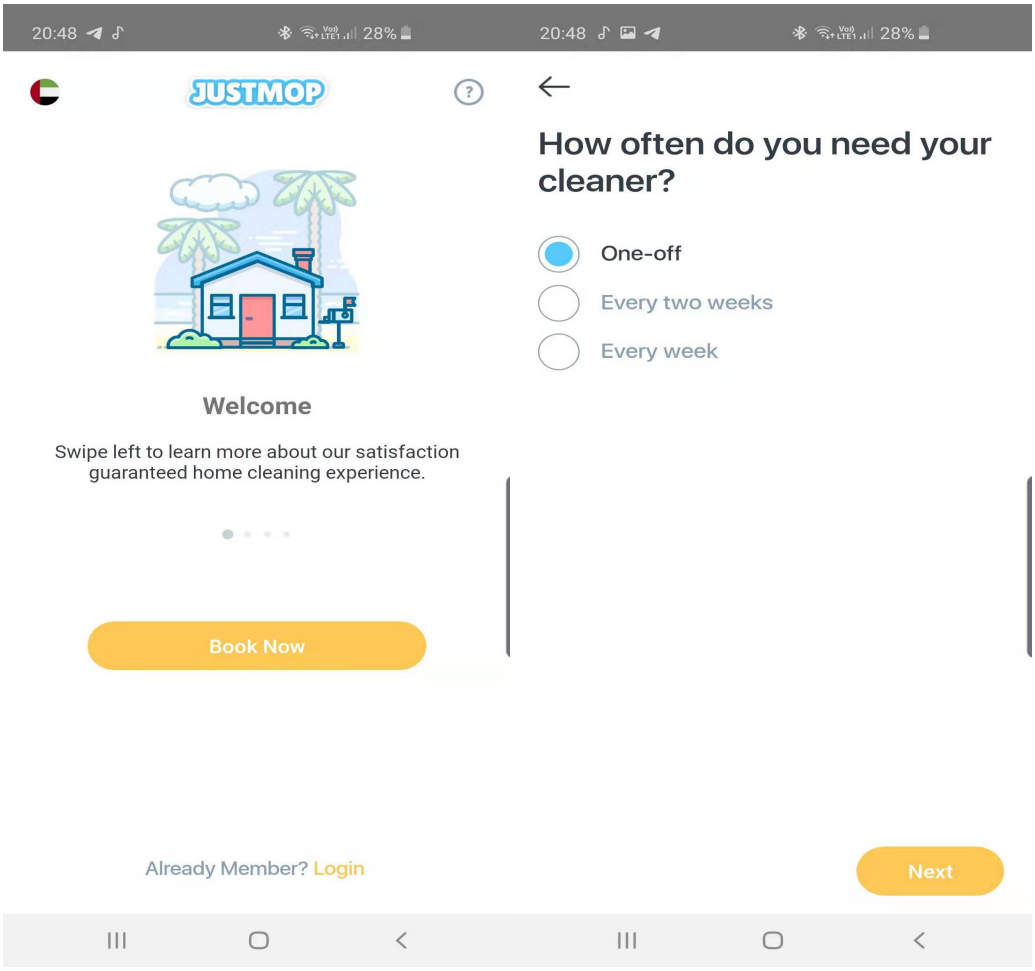


Figure 2-4-1-1: The user interface of the Justmop.

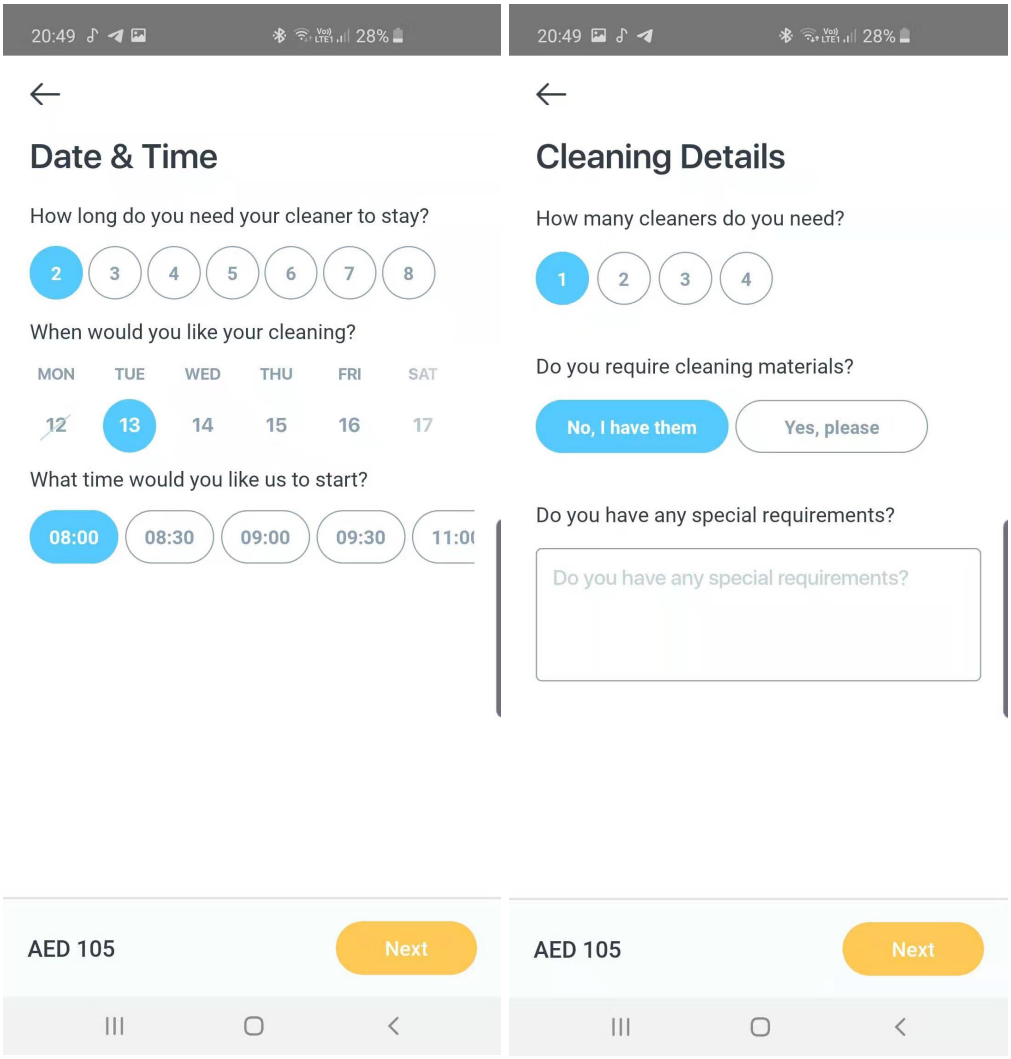


Figure 2-4-1-2: The user interface of the Justmop

2-4-2 Maideasy

Brief Introduction

Maideasy [12] is a mobile application that provided home service to the users. The consumers are able to use this application to call for the home service. The service provided by application is not just for the home cleaning. Other than that, the application also provided the services like basic housekeeping, premium ironing, spring cleaning and move-in/out cleaning. In addition, the users could also call for the kitchen helper, packing or unpacking or event assistance. Firstly, the users need to add an address for calling the service. Same like other home cleaning service mobile application, the users could choose the preferences such as date, time and duration of service. The application only allows the users to make payment by using credit card of online bank transfer when the users placing the order. After that, the system will open the job to hundreds of qualified cleaners. Once the cleaners accepted the job, the users will be notified via short messaging service (SMS). On the other hand, this application had stated clearly that their crew will not accept some of the requests like car wash, outdoor cleaning, cleaning car porch and etcetera.

Strength

After reviewed this application, one of the strengths that had been found from this application is that it has a better user interface design. First and foremost, this application provided a home page that consists of calendar for the users to view whether they had booked for the days. This is convenient for the users since this feature could let the users to view all of the users' past and future bookings easily. Other than that, the application also provided an inbox tab that enable the users to send messages to the crew once the crew had accepted the users' request. This feature is convenient for the consumers as the consumers are able to communicate with the crew. With this feature, the crew or the users could also contact each other if anything happens. In addition, the application also enables the users to manage and track their order or booking status. Therefore, the users could view their booking status with this feature. Other than that, the users could also cancel the booking or reschedule the booking if they wish to do it. In addition, the information displayed by the application is clearer to let the user know what they should do or what the users had done on this application. The application has

a tab called “Help” that able to answer some of the question for the users such as booking support.

Limitation

One of the limitations that had been found from this application is the design for the payment page. The information that displayed on the payment page could be improved to become better and clearer.

Recommendation

One of the recommendations that can be made for this application is adding some new extra features to the application. The features that could be added in is the notification to remind the users. For the users who had already booked the service, the application would send a notification to remind them when the booking date is coming soon. This is one of the features that could add into the application since it is useful for the users as some of the users may not remember the booking dates. In addition, the message of notification should be contained some of the information of the booking details. Another improvement that could be done is the limitation that mentioned just now. The developer could improve the user interface design by making the information clearer.

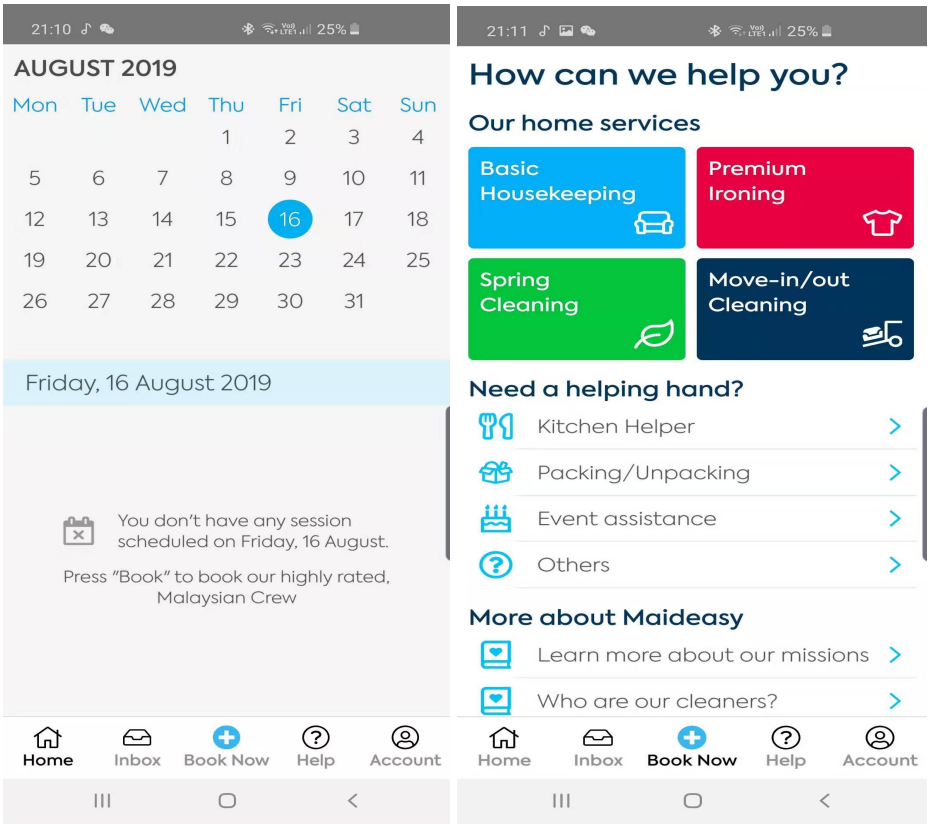


Figure 2-4-2-1: The user interface of the Maideasy.

2-4-3 Mobile Application Recommender System

A recommender system [6] had developed to solve the difficulty of information overload by helping users in the search for related information and helping them identify which items such as product, service and etcetera are worth viewing in detail. This process is also known as information filtering. There are four techniques to deal with information filtering which is content-based (CB), collaborative filtering (CF), social, hybrid. For CB, it is an approach by comparing the content of previously liked items with the content of unseen items and finally suggesting similar ones for the users. However, the limitation for this approach is that it unable to identify the qualities of items. Other than that, the systems would also need attribute data of items and this data may be difficult to collect.

For CF, this approach would recommend item to the users based on how other users have rated items. The main limitation of this approach is it will only recommend item to the users when there is some numbers of users had rated the item.
Hybrid is a method which combining the content-based filtering and collaborative filtering approach.

The recommender system had been proposed with the following design specifications. The client is responsible to collect the data and send it to the server. The server collected the data and it will forward the request for recommendations to the recommender engine and finally return the result to the client. Then, the client will display the result of the recommendation to the users. The main advantage of this system is helping the users to identify mobile application of interest. The recommender system would also recommend popular application nearby based on the users' location. The limitation of this system is the scalability and performances of the system is not good enough since it had not been evaluated.

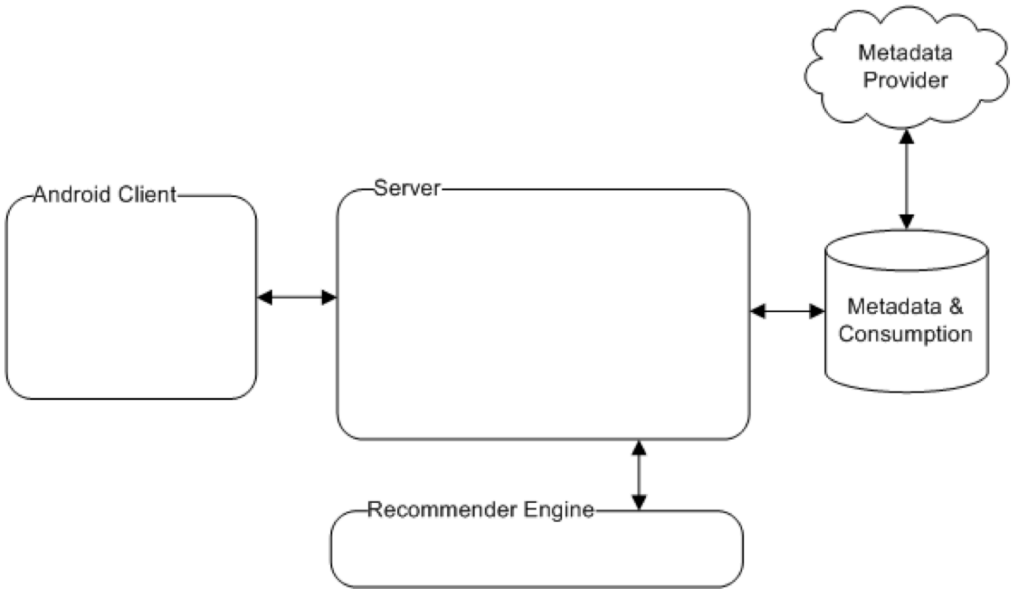


Figure 2-4-3-1: System design overview.

2-4-4 Recommender System for Mobile Applications

A mobile application called AppDetective [20] had been introduced as a recommendation tool. The app will recommend the users based on users' preferences. It shows how the recommendations would impact by constantly changing preferences. It tries to utilize all of the advantages a mobile device offers, like sensors and context and give to the user the most useful recommendations.

This app requires the input of two type of the data which is context data and app usage data. Context data is collected from the information from the mobile devices sensors or by communicating with web services. App usage data is collected by the tracker and stored in the database. After that, the app will show the recommended apps to the users.

The strength of this app is that it solved the problem of the user cannot receive recommendations without some kind of history. However, the limitation is the app can only use the users' context information such as location for recommendations. In addition, the app unable to consider the new items which no users have used.

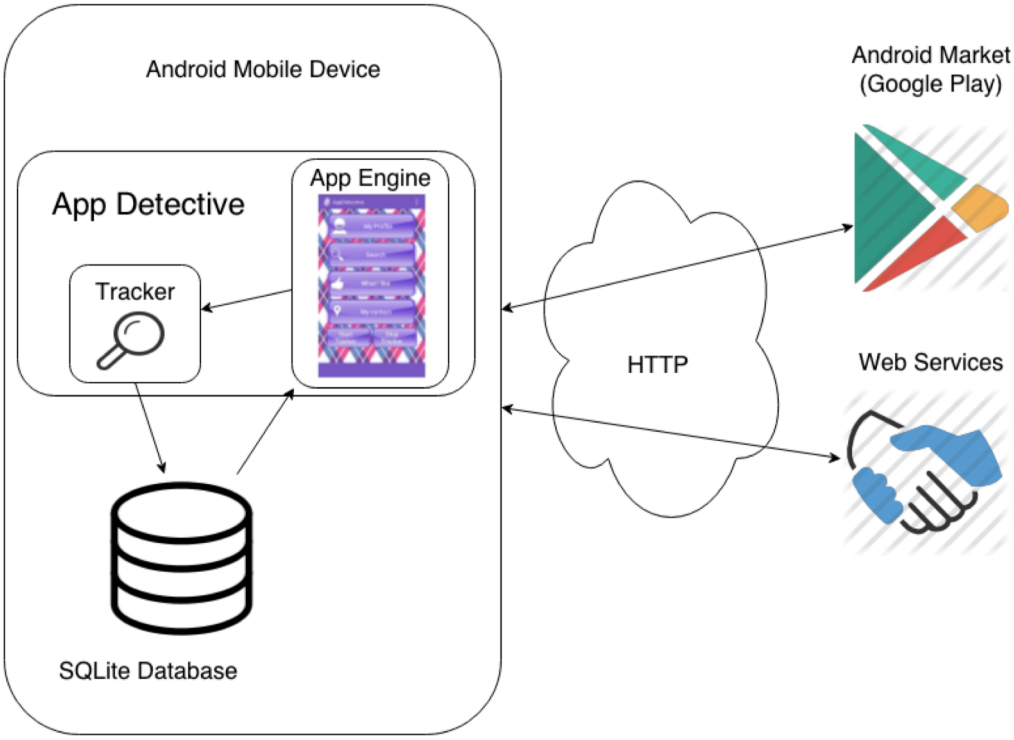


Figure 2-4-4-1: AppDetective's system design.

2-5 Critical Remarks of Previous Works

There are various advantages that can improve and solve the classification problems. On the other hand, there are also several disadvantages in each reviewed approach.

Firstly, In the study from 2-2-1, one of the trends is that the increasing of the Web as a stage to increase the proficiency of DSS to the numbers of user. Web-based DSS can expressively advance enterprises' use of their current infrastructures throughout the rising of capability of decision-making, decreasing of budget and supported requirements. Other than that, there is also rising the usability for DSS. Standard interface design allowed the users to rapidly implement the DSS with more self-confidence. On the other hand, one of the limitations is the accessibility of information from across various data warehouses in a company.

In the study from 2-2-2, some of the concerns have consequences on the willingness of actual property vendor to empower in latest small-scale CHP technology. One of it is the availability of technology and dependable data on the strengths and limitations of the technology. Another limitation is the recognition on the most realistic techno-economic resolutions in the range of small-scale CHP. Other than that, functional proficiencies for prolonged periods have not been available because of the uniqueness of the skill in this field of application.

Next, from the study of 2-3-2, the limitation of corporation is the time needed for organizing and coping with the service providers' performance issues. The option of evaluation and ranking standard is essential in achieving a familiar system to measure performance and this could highly raises the capability to form performance standards and levels of performance assumption. Other than that, the benefits found from the study is the implementation is spread to all outsourced organization that offering services in support of the FM department.

In the study from 2-3-3, there are some limitations are found from the research. One of it is the failure to involve all features of related decision authority. Nonetheless, distinctive organizations considered some decision rights as more significant this caused some effects on the measurement and modeling approach. On the other hand, one of the strengths is a advanced portion of decision rights is distributed to management when management provided significant knowledge properties. Nonetheless, the benefits and weaknesses of integrated and non-integrated decision right are the only aspects cogitated by the contracting parties.

Next, there are some benefits and challenges of outsourcing had been found from the study of 2-3-4. One of it is cost effects whereby organization could manage the outsourcing agreement so that a merchant stands for the cost of producing in novel equipment and skill. Besides that, outsourcing allowed an organization to know about the estimated advantages of reengineering by appealing an outside supplier. Last but not least, the time issue is also a strength. Services may be done by an external provider quicker than in-house. On the other hand, the challenge of outsourcing is it concerned on resource of human where services may be transferred from the university to the supplier presenting the outsourced utility which may cause the reducing in wages, unemployment or retrenchment.

From the study of 2-4-3, one of the limitations that had found from this recommender system is that it has bad effects on the battery power since the user position was determined by using GPS and this was completed frequently in the background of the application to observe user activities. On the other hand, the strength of this system is that a new item that no clients have inspired can be measured during the application filtering. Other than that, a new client without a consumption record can be offered with suitable recommendations.

In the study from 2-4-4, the strength of the system is that it tried to utilize all of the benefiys that a mobile phone provided such as sensors to the user the most useful recommendations. For the limitations, the system could not considered a new item that no users had consumed. Other than that, the system could only use user's context data such as location that could be collected rapidly for determining recommendations. Another limitation is the system is could not generate recommendations if there is no item utilization for this new background.

Factor	**Explanation**
Cost	Is the cost fair or unfair, reasonable or unreasonable?
Service quality	Is it good on service quality/performance
Flexibility	Is it flexible on time
Type of service	Outsourced or in-house
Risk	Is it risk or not
Information/Data	Is it complete/clear for information produced
Usability	Is it usable

Table 2-5-1: Summarization of factors will be considered by the customer used to subscribe the janitorial services.

	Strength	Limitation
Justmop	• Simple UI design • Procedure to place order is easy and clear • Provide last minute home service	• Some information displayed is not clear • Maximum only 4 cleaners can be choose
Maideasy	• Better UI design • Provide home page for user to view booking detail • Enable user to communicate with cleaner	• Some content may not draw the users' attention.
Recommender system from 2-1-9	• A new item that no clients have inspired can be measured during the application filtering. • A new client without a consumption record can be offered with suitable recommendations.	• It has bad effects on the battery power.
Recommender system from 2-1-10 (AppDetective)	• It tried to utilize all of the benefits that a mobile phone provided	• The system could not considered a new item that no users had consumed. • The system is could not generate recommendations if there is no item utilization for this new background.

Table 2-5-2: Comparison Table on System Reviewed

CHAPTER 3 SYSTEM METHODOLOGY

3-1 Methodology Specifications

3-1-1 Methodologies and General Work Procedures

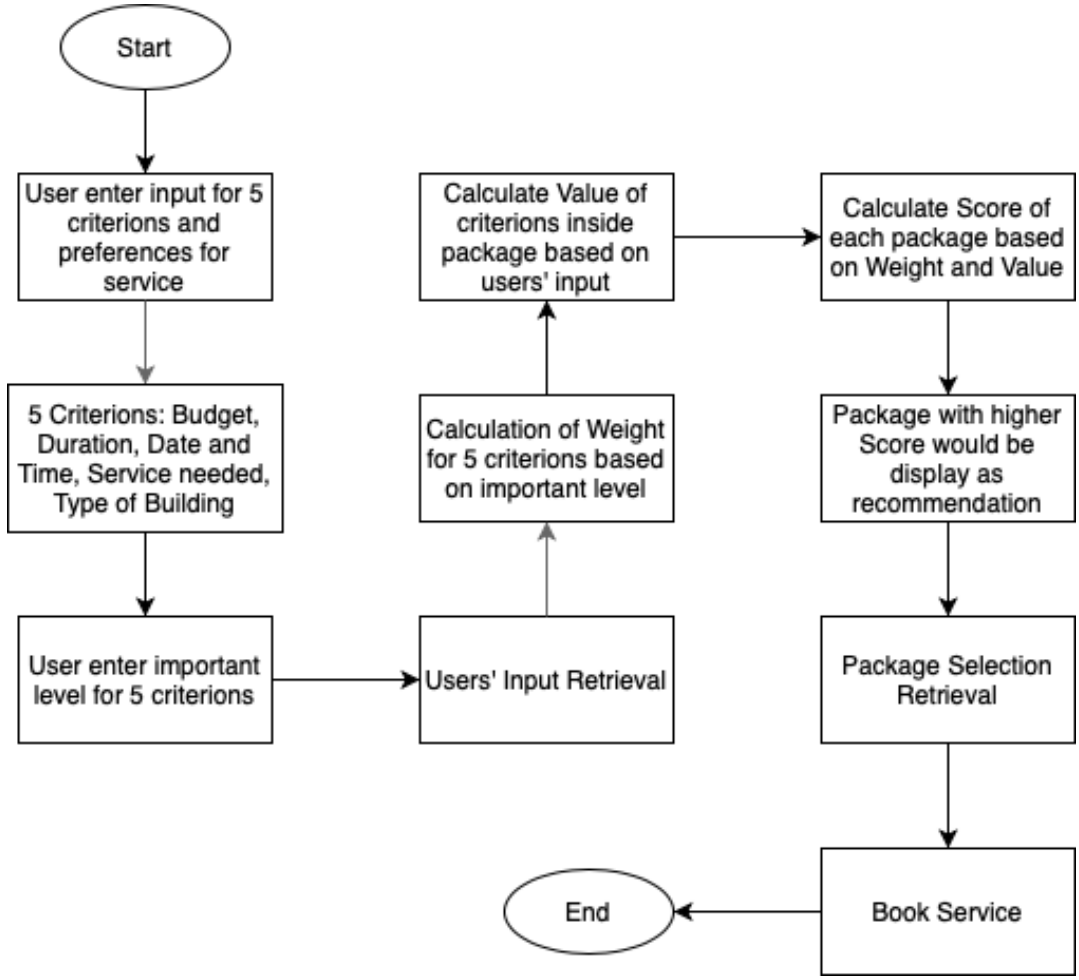


Figure 3-1-1-1: System Flow Diagram.

After the user login, the user need to enter 5 criterions that would be considered in recommendation algorithm and other preferences like session. 5 criterions would be the budget, duration of service to be completed, date and time of service, number of service needed, and type of building. After that, the user also need to enter the important level for 5 criterions which will range from 1 that is not at all important to 5 that is very important.

Based on the important level entered by user, the system will calculate the weight for each criterion by using Principal Right Eigenvector that adopted by AHP. Then, the system will calculate the value of each criterion in each package. Based on the weight and value calculated, the system will calculate score for each package. Package with higher score would be the recommendation and display to the user to select. After the user selected a package and made the payment, the service would be booked for the user.

3-1-2 Tools to use

Hardware

The hardware that requires for developing this system is:

1. Laptop
2. Mobile Phone

Software

The software that has been chosen for developing this system are:

1. Microsoft Visual Studio Code

   Microsoft Visual Studio Code is an integrated development environment (IDE) that included support for debugging, embedded Git control and GitHub, syntax highlighting, intelligent code completion, and code refactoring.

2. Ionic Framework

   Ionic Framework is an open source UI toolkit for developing high-quality mobile and desktop apps using web technologies such as HTML, CSS, and JavaScript.

3. Angular Framework

   Angular is a platform and framework for developing client applications in HTML and TypeScript. It implements core and optional functionality as a set of TypeScript libraries that import into apps.

3-1-3 User Requirements

- User shall able to register, login or logout.
- User shall enter the input for 5 criterions and other preferences for service.
- User shall enter the important level for 5 criterions.
- User shall able to view the result after entering the input that displayed by the system.
- User shall be able to book the service after selected a package and made the payment.
- User shall able to chat with staff if necessary after booked the service.

3-1-4 System Performance Definition

The system performance requires high accuracy, runtime performance, efficiency or so called most suitable in recommending the users in different input. Other than that, the timing for processing might also affected when there is large number of dataset.

The content-based filtering algorithm (CBFA) is an algorithm used to suggest products based on a relation between the content of the products and user profile. It recommends items related to those that the users has chosen in the past. The result is based on initial information which are in the form of sequences with equal length. A content-based recommender processed with data that the user produce, either in rating or clicking on a link. After that, a user profile is created which is used to make suggestions to the user based on the data. As the user produced more inputs or takes actions on those recommendations, the system would become more accurate.

Other than that, there are another filtering method for recommender system which is collaborative filtering algorithm. Collaborative filtering is an method for filtering the items that a user might like based on the support of feedback by other similar users. Thus, this approach need a large number of people to search the items that the users like and similar to some users and generate a list of recommendations.

There are a study had compared different approaches for recommender algorithm on the aspects of runtime performance and query dependency. In the table below, the threshold based and K-means based algorithm are considered as collaborative filtering algorithms.

	Run-time Performance	Query Dependency
Threshold based algorithm	Medium	High
K-means based algorithm	Low	Low
Content based algorithm	High	Medium

Table 3-1-4-1: Comparison of the algorithms

From the result shown from table above, it is found that the runtime performance of content-based filtering algorithm is higher than collaborative filtering algorithm. The query dependency of the content-based filtering algorithm is medium compared to collaborative filtering algorithm.

The proposed system in this project is expected to have medium of run-time performance and query dependency. The processing time for calculation of score for each package should be less than 1 minute.

3-2 Verification Plan

The system is able to recommend the plan of service with high suitability. However, this may affected by different input and it may results in different plan and other problem when performing recommendation. Few situation is explained as below:

a) The user enter any preferred preferences for 5 criterions with fixed important level for 5 criterions, the system should be recommend the suitable plan and display the result.
b) The user enter fixed preferred preferences for 5 criterions with any important level for 5 criterions, the system should be recommend the suitable plan and display the result.
c) The user enter any preferred preferences for 5 criterions with any important level for 5 criterions, the system should be recommend the suitable plan and display the result.

Hence, there will be few verification step to establish the consistency and accuracy while recommending the items. The verification steps are explained at the following table:

a. The user enter any preferred preferences for 5 criterions with fixed important level for 5 criterions, the system should be recommend the suitable plan and display the result.

Procedure Number	P1
Method	Testing
Applicable Requirements	Recommend the service package with any preferred preferences for 5 criterions.
Purpose/Scope	To recommend the plan of the service from entering any preferred preferences for 5 criterions with fixed important level for 5 criterions.
Items Under Test	Service package
Precautions	All of the required input should be entered.
Special Conditions/Limitations	If some of the input hadn't been entered, it would not proceed to next process.
Equipment/Facilities	Mobile Phone
Data Recording	None
Acceptance Criteria	The system displays the results correctly.
Procedure	1. Enter any preferred preferences for 5 criterions. 2. Enter fixed important level for 5 criterions. 3. Display the results of recommendation plan after filtering.
Troubleshooting	Repeat the procedure.
Post-Test Activities	None

Table 3-2-1: Verification P1

b. The user enter fixed preferred preferences for 5 criterions with any important level for 5 criterions, the system should be recommend the suitable plan and display the result.

Procedure Number	P2
Method	Testing
Applicable Requirements	Recommend the service plan with any important level for 5 criterions
Purpose/Scope	To recommend the plan of the service from entering fixed preferred preferences for 5 criterions with any important level for 5 criterions
Items Under Test	Service Package
Precautions	All of the required input should be entered.
Special Conditions/Limitations	If some of the input hadn't been entered, it would not proceed to next process.
Equipment/Facilities	Mobile Phone
Data Recording	None
Acceptance Criteria	The system displays the results correctly.
Procedure	1. Enter fixed preferred preferences for 5 criterions. 2. Enter any important level for 5 criterions. 3. Display the results of recommendation plan after filtering.
Troubleshooting	Repeat the procedure.
Post-Test Activities	None

Table 3-2-2: Verification P2

c. The user enter any preferred preferences for 5 criterions with any important level for 5 criterions, the system should be recommend the suitable plan and display the result.

Procedure Number	P3
Method	Testing
Applicable Requirements	Recommend the service plan with any preferred preferences for 5 criterions and any important level for 5 criterions
Purpose/Scope	To recommend the plan of the service from entering any preferred preferences for 5 criterions and any important level for 5 criterions
Items Under Test	Service plan
Precautions	All of the required input should be entered.
Special Conditions/Limitations	If some of the input hadn't been entered, it would not proceed to next process.
Equipment/Facilities	Mobile Phone
Data Recording	None
Acceptance Criteria	The system displays the results correctly.
Procedure	1. Enter any preferred preferences for 5 criterions. 2. Enter any important level for 5 criterions. 3. Display the results of recommendation plan after filtering.
Troubleshooting	Repeat the procedure.
Post-Test Activities	None

Table 3-2-3: Verification P3

3-3 Timeline

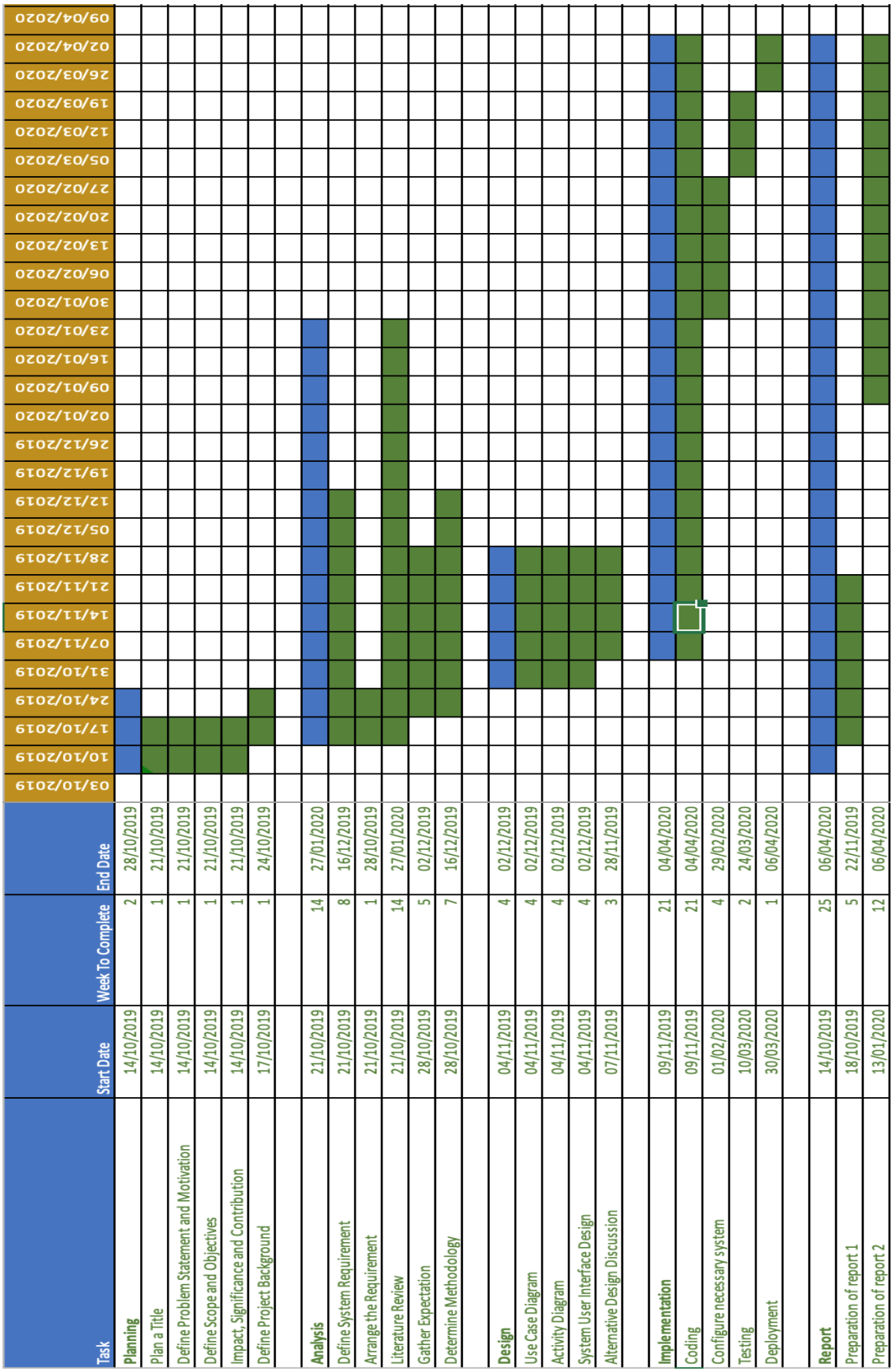


Figure 3-3-1: Timeline for the system

CHAPTER 4 SYSTEM DESIGN

4-1 System Design/Overview

4-1-1 System Flow Diagram

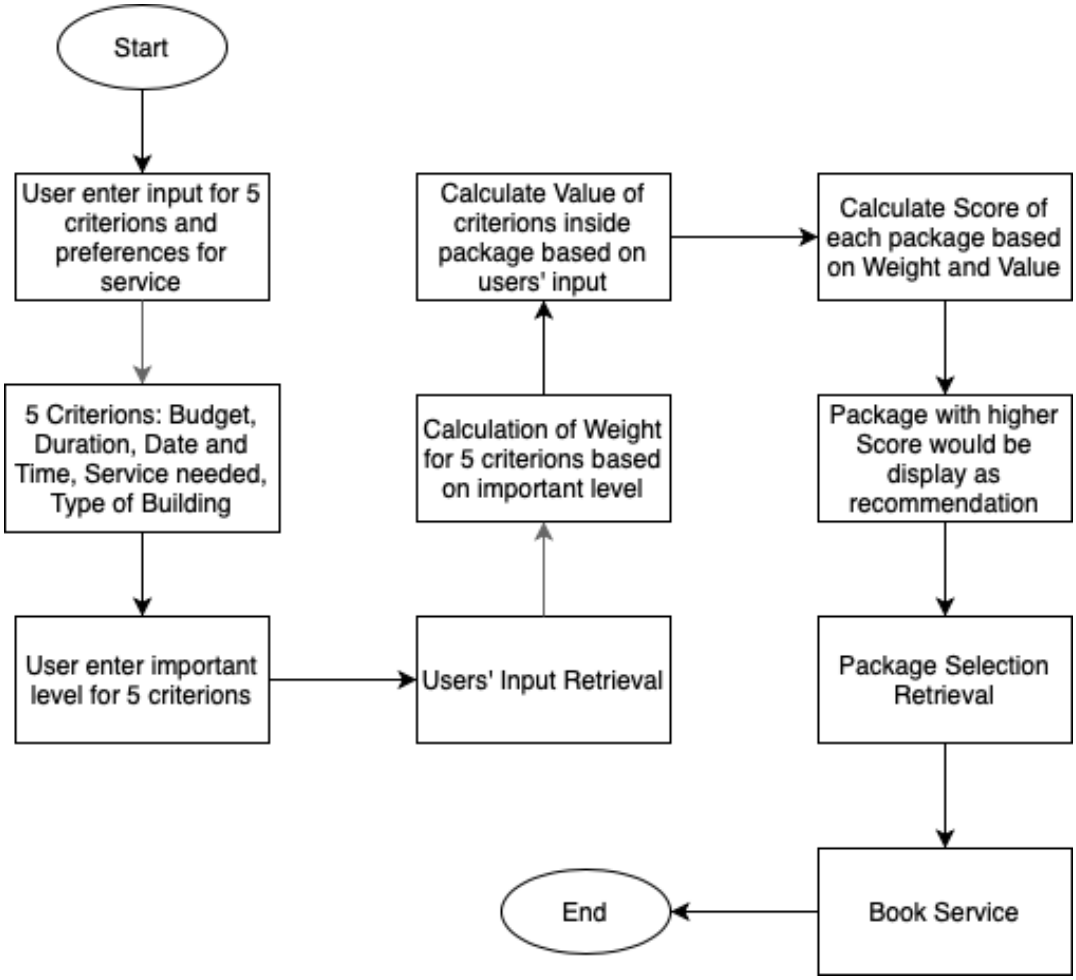


Figure 4-1-1: System Flow Diagram

4-1-1-1 Users' Input Retrieval

Input of 5 Criterions

The user need to input 5 criterions which is the preferred budget, preferred duration for service to be completed, date and time of the service, number of service needed and the type of building. In this project, All of these user interface would be designed by using Ionic Framework and Angular Framework. Some components of Ionic Framework such as Input, Radio, Range, and Selection had chosen to construct for the user interface.

The criterion of preferred budget is designed as an input to let the user to key in amount. For instance, the user could enter RM100 and the input must be in type of number. The criterion of duration is designed as a list of selection that contain 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, and any to let the user to choose. The user could only choose one of it. The criterion of date and time is a datetime picker to let the user to choose the preferred date and time for booking the service.

The date and time picked by user will categorize to 3 type: the daytime in weekday, the night time in weekday or the daytime in weekend, the night time in weekend. Based on these types, the charge for service will be different. The criterion of service is a list of selection that contain several cleaning services such as dusting, vacuuming and etcetera to let the user to choose. It is designed as checkbox means that the user could choose more than 1 service. The criterion of building is also a list of selection that contain some type of building such as apartment, bungalow and etcetera. It is designed as radio button so the user could only choose one of it.

According to the existing application which is Maideasy, the date and time, duration is one of the input parameter collect from this application. Therefore, both of these parameters are important in calling the janitorial service.

Input of Important Level for 5 Criterions

After entering 5 criterions, the user required to enter the important level for 5 criterions. The important level is range from 1 to 5. The number 1 represent not at all important while number 5 represent very important. The number entered for important level can be repeated but there will be an alert for user when the number out of 1 to 5 is entered.

4-1-1-2 Calculation for Weight for 5 Criterions and Value of Criterions inside Package

After retrieving the required input from user, the system will start to calculate weight of 5 criterions. Firstly, it will scale it to the fundamental scale for pairwise comparisons of AHP which is 1, 3, 5, 7, 9 that represent equal importance, moderate important, strong importance, very strong importance, extreme importance respectively. The calculation to scale will be shown as following:

i. (value of differences between the factors divided maximum differentiation between factors) * 8 + 1

After scaling, the system will calculate the weight by using matrix's principal right eigenvector in AHP. The step of calculation as following, X could be any number that larger than 1:

i. There is a X by X reciprocal matrix from paired comparison.
ii. Summing up each column of the matrix
iii. Divide each element in the matrix by the sum of its column.
iv. Summing up the element after division in each row to get weight.

Besides that, the system will also calculate the value of criterion in each package from the database. The 5 criterions would be calculated in each package are the package price, duration of service to be completed, date and time of service package, number of services provided in package, type of building. The value of criterions would be calculated based on the user's input and value inside the package. The calculation will be shown at the following:

i. Value of Package Price: 1 – ((package price – lowest package price) / (user budget – lowest package price))
ii. Value of Duration: 1 – ((package duration – lowest package duration) / (user preferred duration – lowest package price))
iii. Value of Date & Time:
    a. Categorize the user preferred date & time to 3 category which is weekday daytime, weekday night time / weekend daytime, weekend night time.
    b. IF package date & time equal to user preferred date & time, value equal to 1

c. ELSE IF week is same or time is same, value equal to 0.5
d. ELSE IF date & time is not equal, value equal to 0

iv. Value of Service:
a. IF user preferred service – package service == 0, value equal to 1
b. ELSE user preferred service – package service == 1, value equal to 0.75
c. ELSE IF user preferred service – package service == 2, value equal to 0.5
d. ELSE IF user preferred service – package service == 3, value equal to 0.25
e. ELSE IF user preferred service – package service == 4, value equal to 0

v. Value of Building:
a. IF user preferred building equal to package building, value equal to 1
b. ELSE value equal to 0

4-1-1-3 Calculation for Score for Each Package

After calculated the weight and value of each criterions, the system will start to calculate the score for each of the packages. The calculation is as following:
Score of Package: weight of budget*value of package price + weight of duration*value of package duration + weight of datetime*value of package date & time + weight of service*value of package service + weight of building*value of package building.

4-1-1-4 Display Recommendation Package, User's Selection Retrieval, Book Service, Display Success Message

After the calculation of score for each package, the package with higher score would be the recommendation package to the user. The application should get the result and display it to the users. Then, the user would choose the plan that they want. After that, the application would post the plan selected to the server and the server will considered booked and send a success message back to the client application. After that, the application would display the success message to the users.

4-1-2 Use Case Diagram

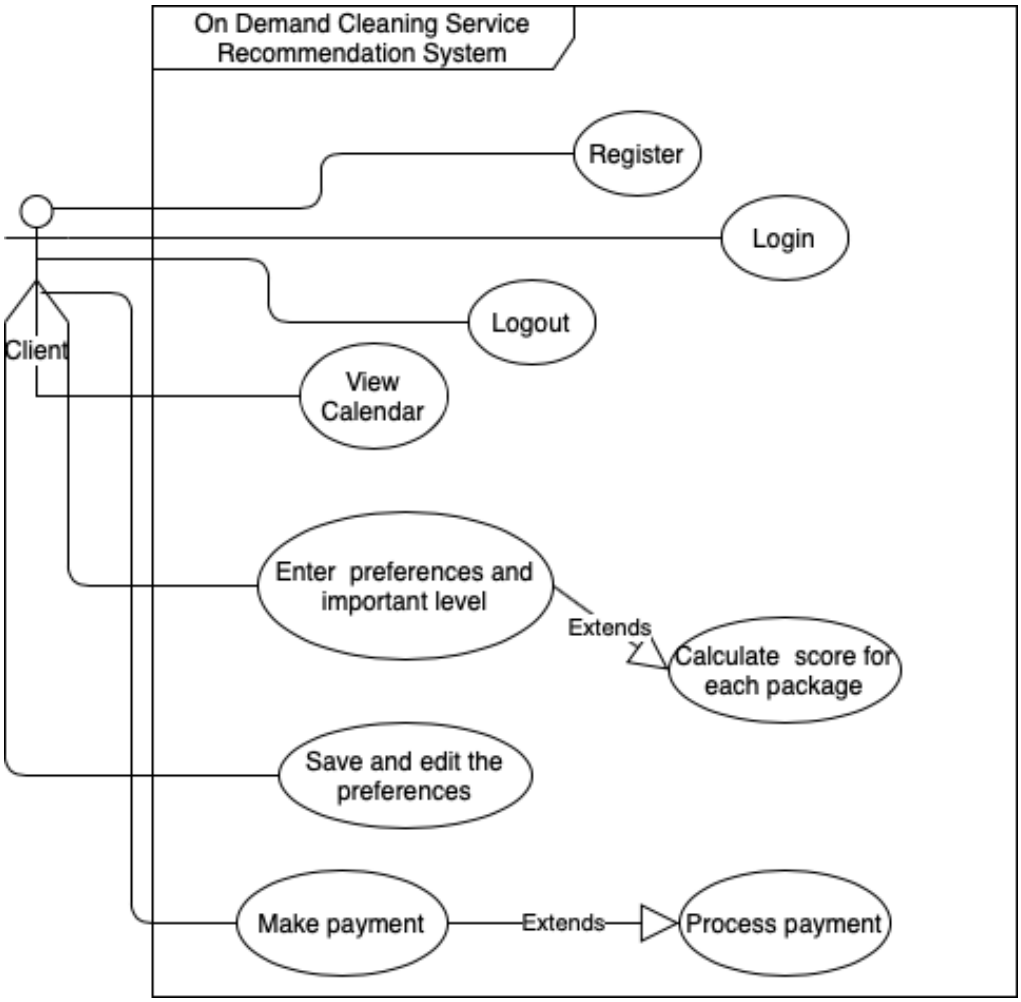


Figure 4-1-2-1: Use Case Diagram for On Demand Cleaning Service Recommendation System

In this use case diagram, the clients could register, login, or logout in this system. Other than that, the users could call the service by choosing the plan that suggested by the system. This action completed by users entered the preferences to the system and then system will process the calculation and finally display the suggestion package to users. The users could also save their preferences and edit it in the future. After the users choosing the plan, the system will proceed to next part which is letting the users to make their payment. Once the payment succeeds, the booking for the service is success.

4-1-3 Activity Diagram

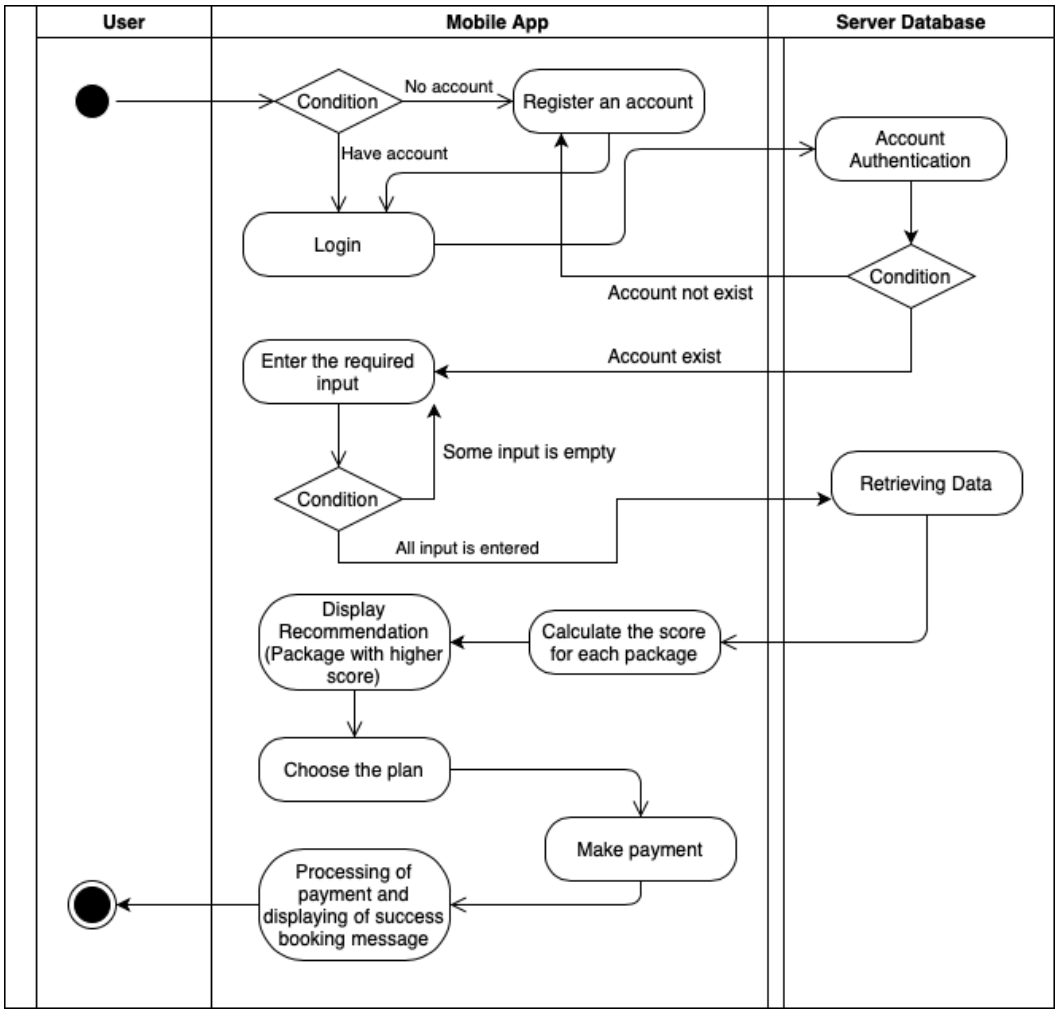


Figure 4-1-3-1: Activity Diagram for On Demand Cleaning Service Recommendation System

When the users first enter to the application, the users need to login to the application. If users don't have an account, the users could register it. When the user login, the application will check the validity of account with the server. After logged in, the users need to enter the required input such as the preferences like budget or duration and the important level to rate for the preferences entered. If all required input is entered, the application will retrieve the data from database which is package and start to calculate the score for each package. The application will display the package with higher score to user as recommendation. After that, the users could choose the service plans among it and make the payment. Once the payment is success, the application will display the booking information to the users.

4-1-4 Sequence Diagram

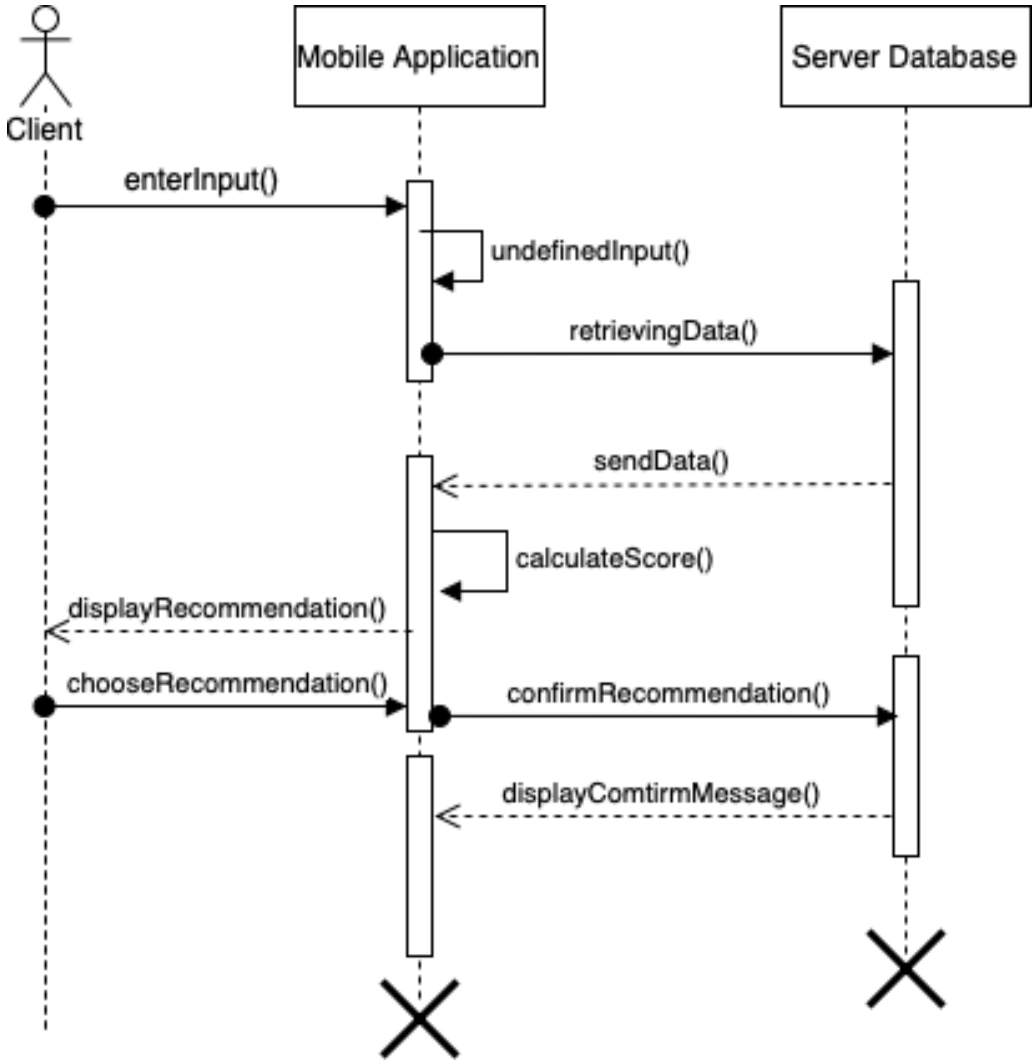


Figure 4-1-4-1: Sequence Diagram for On Demand Cleaning Service Recommendation System

In this sequence diagram, the client will first enter all of the required input for the calculation of score of each package. As mentioned before, the required input are 5 criterions which are budget, duration, date and time, service needed and building and the preferences like the session such as once, weekly, or monthly. Another required input is the important level for the 5 criterions and this is used to calculate the weight of criterions. After that, the application will check if there is any problem toward the input such as missing of input. If this condition happens, the application will alert the users to input it again. Then, the application will get the information of package from the server database. Then, the application will start to calculate the score of each package based on the information get from database, the user's input and the calculated

weight. After that, the application will display the package with higher score as recommendation to the users. The users will choose among the packages and the application will send the result to the server. Once server confirm the booking status, the server will send success message to the application and application will display to the users.

4-1-5 System Model

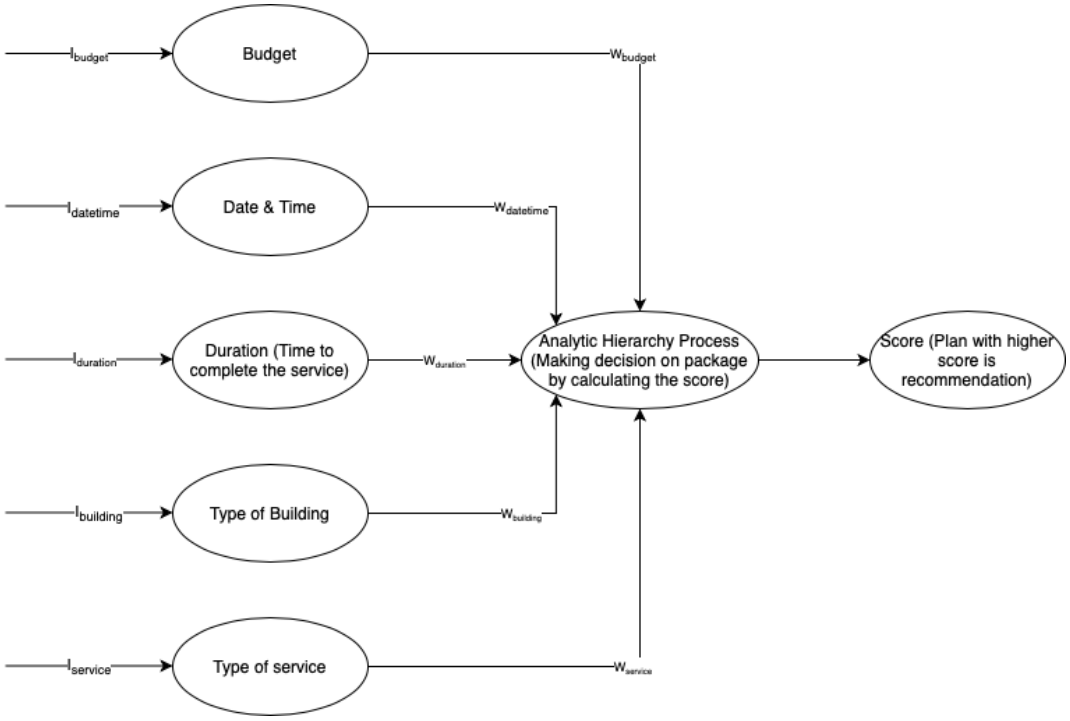


Figure 4-1-5-1: System model for recommendation system

Figure above showed the system model for this recommendation system. The I and W from the figure represent Input and Weight respectively. The user needs to enter the input for 5 criterions that shown at figure above. Then, the weight of each criterion would be calculated based on the important level mentioned before. Based on the inputs and weight, the system calculates the score of each package that retrieved from the database by using Analytic Hierarchy Process to make the decision on packages for the user. After that, the system will display the package with higher score as result to the users.

4-2 System Architecture

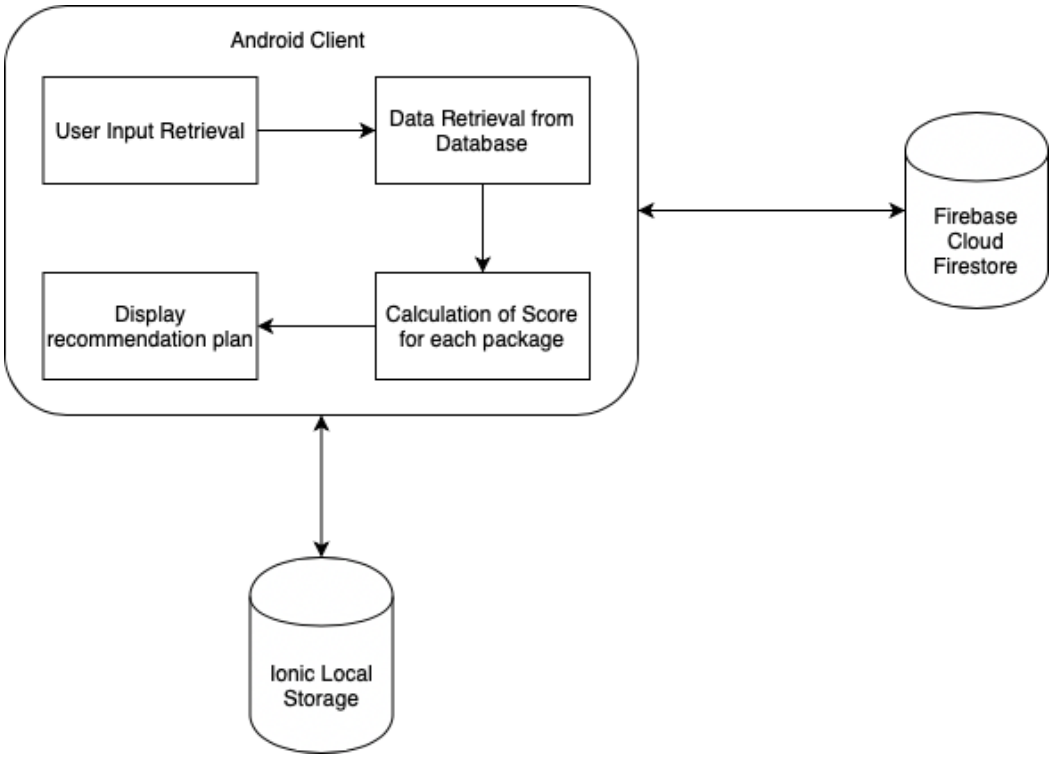


Figure 4-2-1: System Architecture Design

The Figure 4-2-1 showed the system architecture design of the system. The android application will mainly have 4 important part which is retrieving the users' input, getting data from database which is Firebase Cloud Firestore, calculating the score for each package and finally displaying the recommendation package. In this project, the system implemented the Firebase Cloud Firestore and Ionic Local Storage as data storages. The Firebase Cloud Firestore mainly stored the data about the package and Ionic Local Storage to store some small data such as login state of user and other information.

4-3 Interface Design

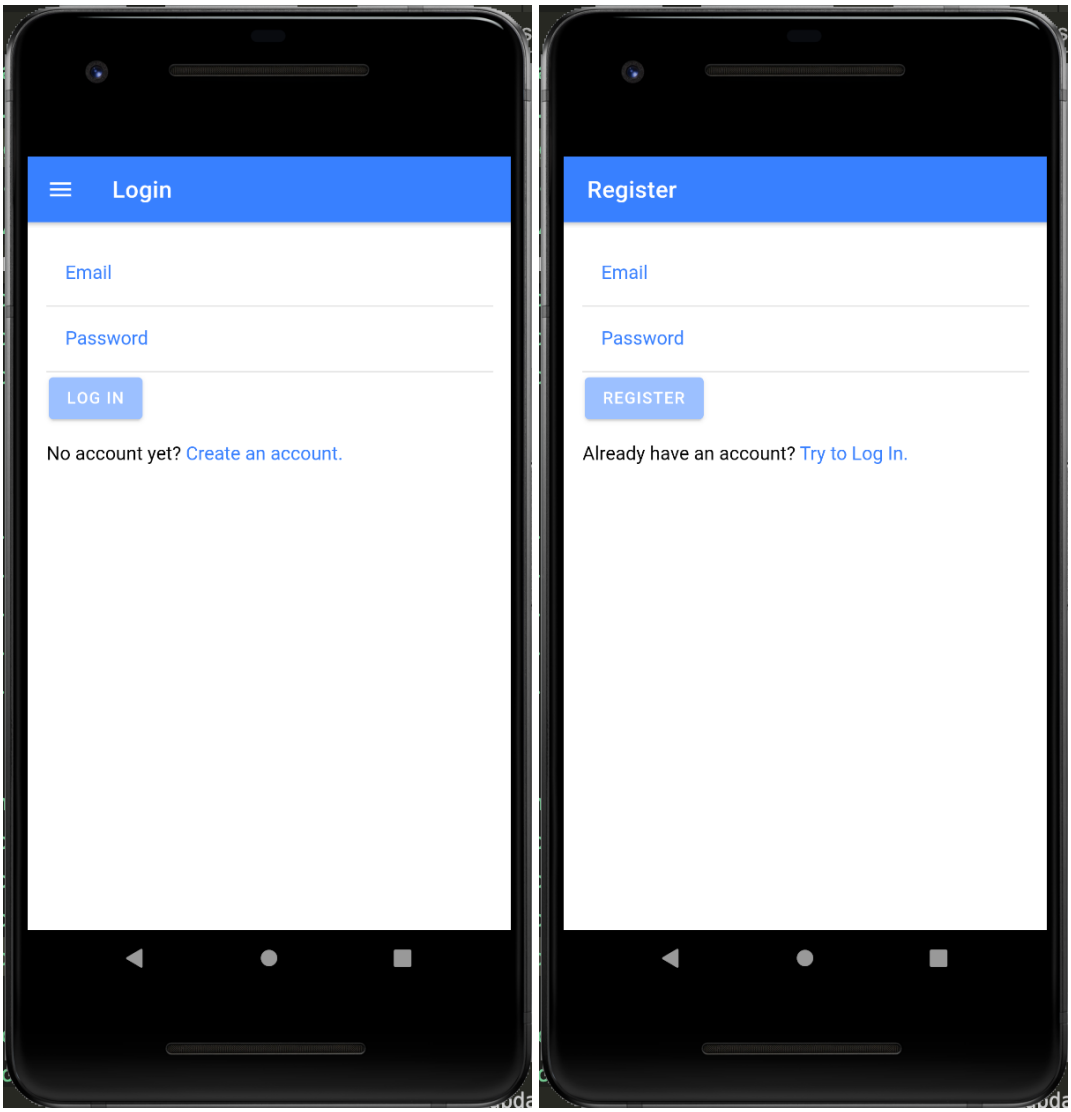


Figure 4-3-1: Login and Register Page Interface Design

Figure 4-1 are showing the interface design of login and register page. There are 2 input for email and password. If the email or password is incorrect, the application will alert the user or else the application will proceed to home page. If user don't have an account, the user could click on the 'Register' button below to register for an account. When the user clicking the part "Create an account", the login page will navigate to register page. Figure 4-2 are showing the example of registering an account. After clicking the 'Register' button, it will send the register information to the server which is Firebase. The reason to use Firebase is that the firebase will secure the user information. The server will store the information into database. When field to input is empty, the users would not able to click the 'Login' or 'Register' buttons to proceed.

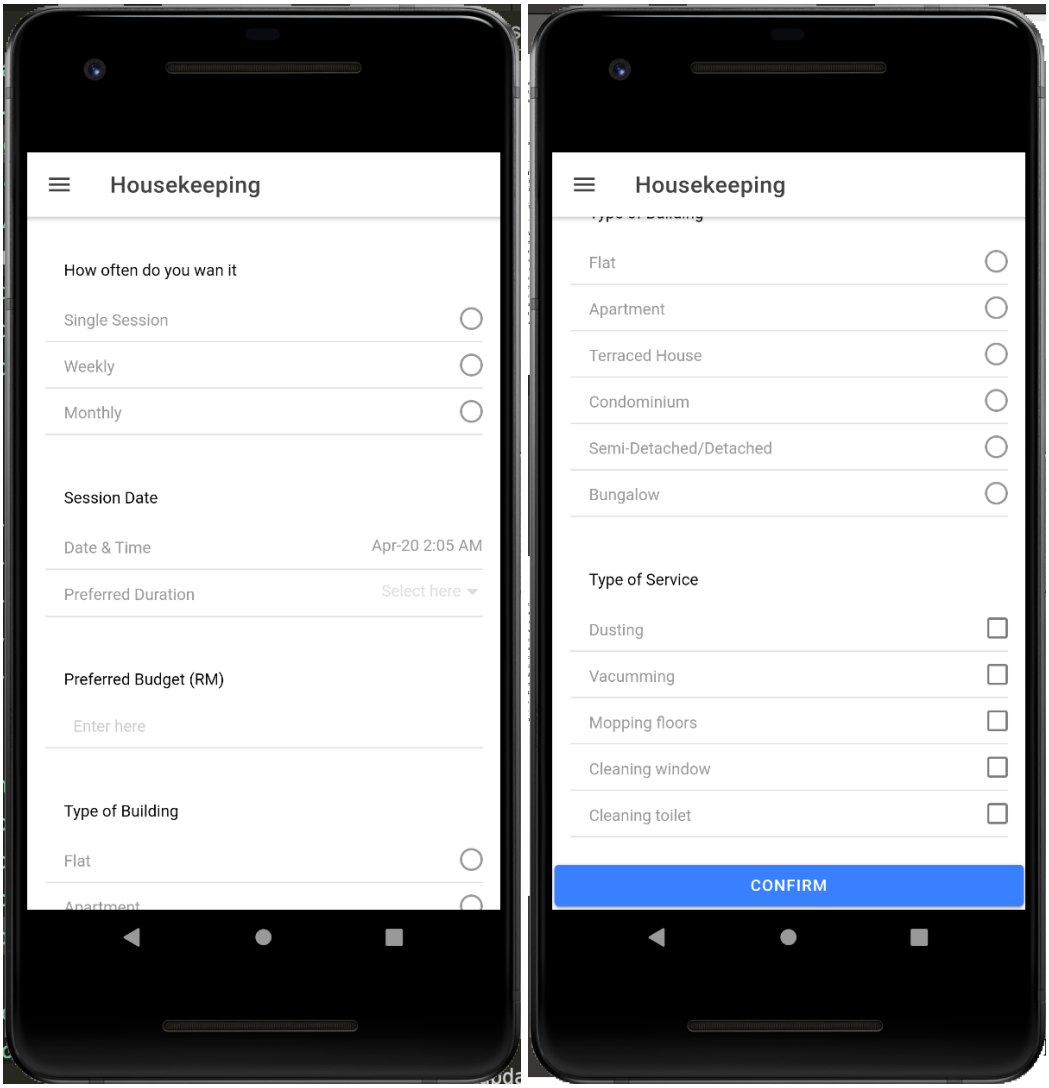


Figure 4-3-2: Home Page Interface Design

Figure 4-3 showed the page after the user logged in. The session part is a group of radio button to let the user to choose whether the user want the service for single session, weekly or monthly. In the part of session date, there are two input which is the date and time and the duration to complete the service. There is a date time picker for input of date and time and there is a list of selection for input of duration. The part of budget is actually a column to let the user to enter their preferred budget. The part of type of building is also a group of radio button and finally, the part of type of service is a group of checkbox. When the users didn't enter any required input shown in Figure 4-3-2 and press the 'Confirm' button, the application will alert the users with the message of 'Invalid Input'. This is to tell the users that there are something wrong in the process of the entering the preferences. This condition occurred either all preferences or some preferences had not been entered.

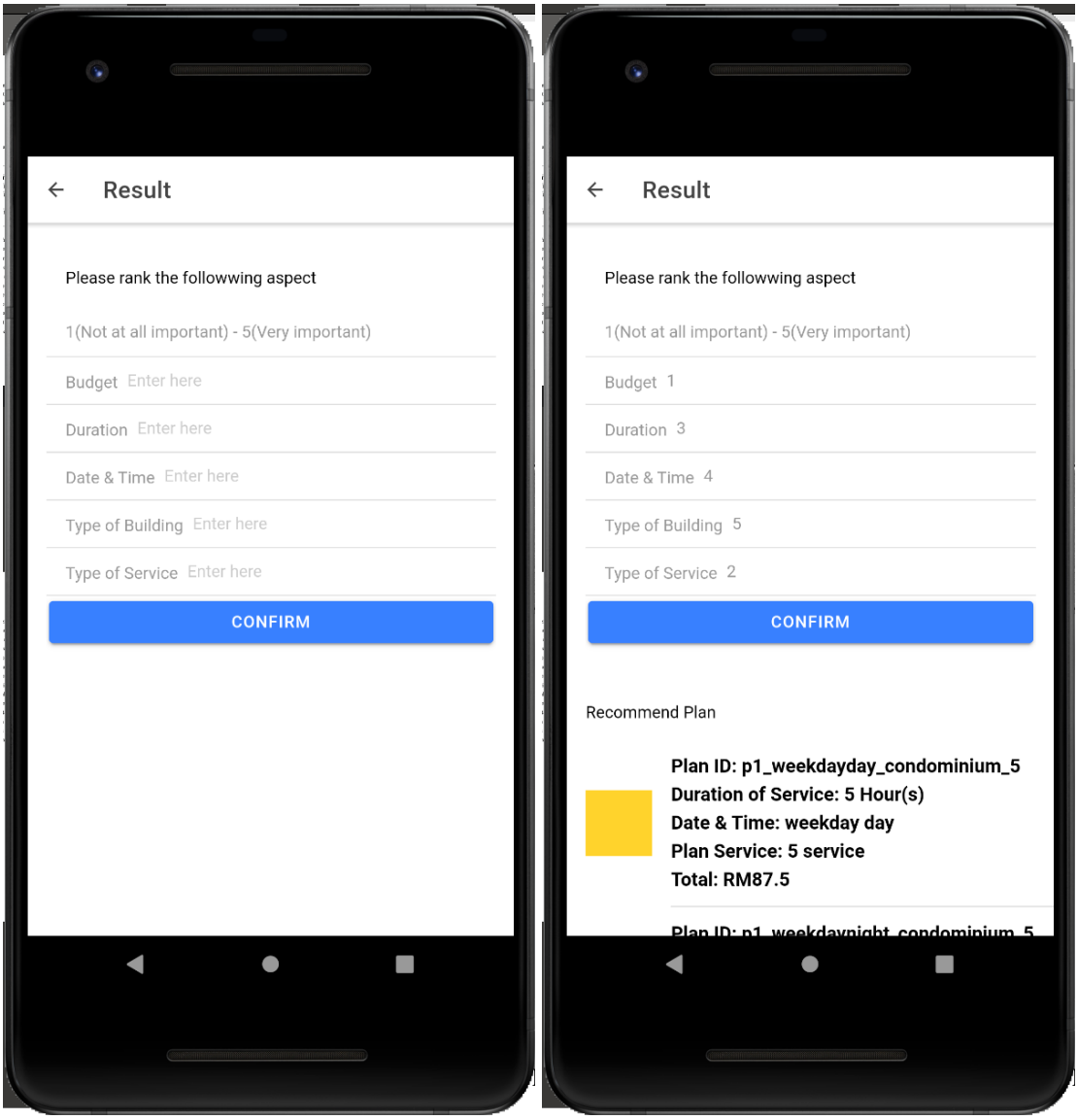


Figure 4-3-3: Result Page Interface Design

Figure 4-4 are showing the page after the user entering the preferences. There are 5 input that needed to let the user to enter which is the important level. After the user enter the valid important level, the page will show some of the recommend plan to the user by calculating the score. The information consisted of plan ID, duration of service, date and time, plan service and total charge for the service. After that, the user could choose one of the package to proceed.

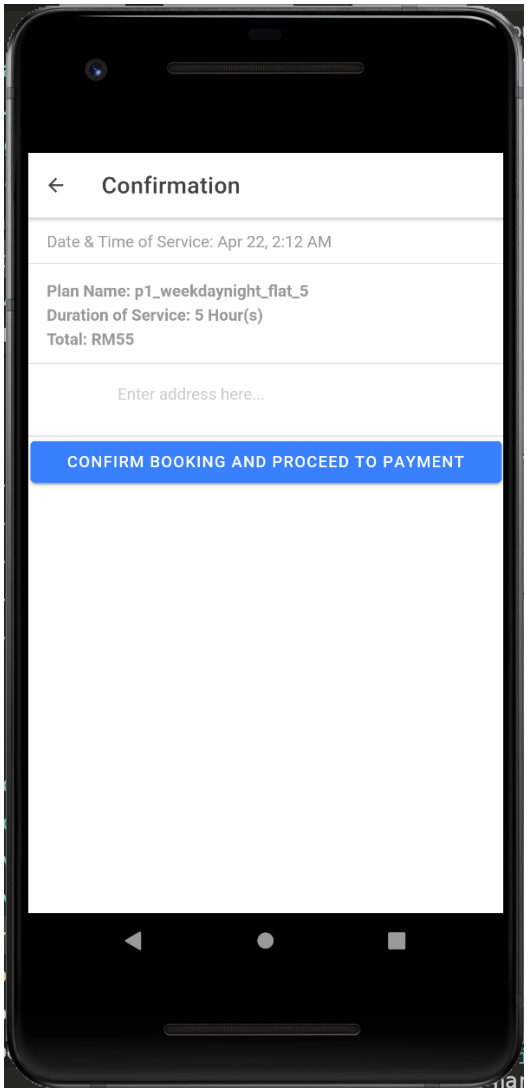


Figure 4-3-4: Confirmation Page Interface Design

The figure above showed the page after the user chose a package. This page will show the booking details and the package details. Once the user enter the address, the user could press the button to proceed.

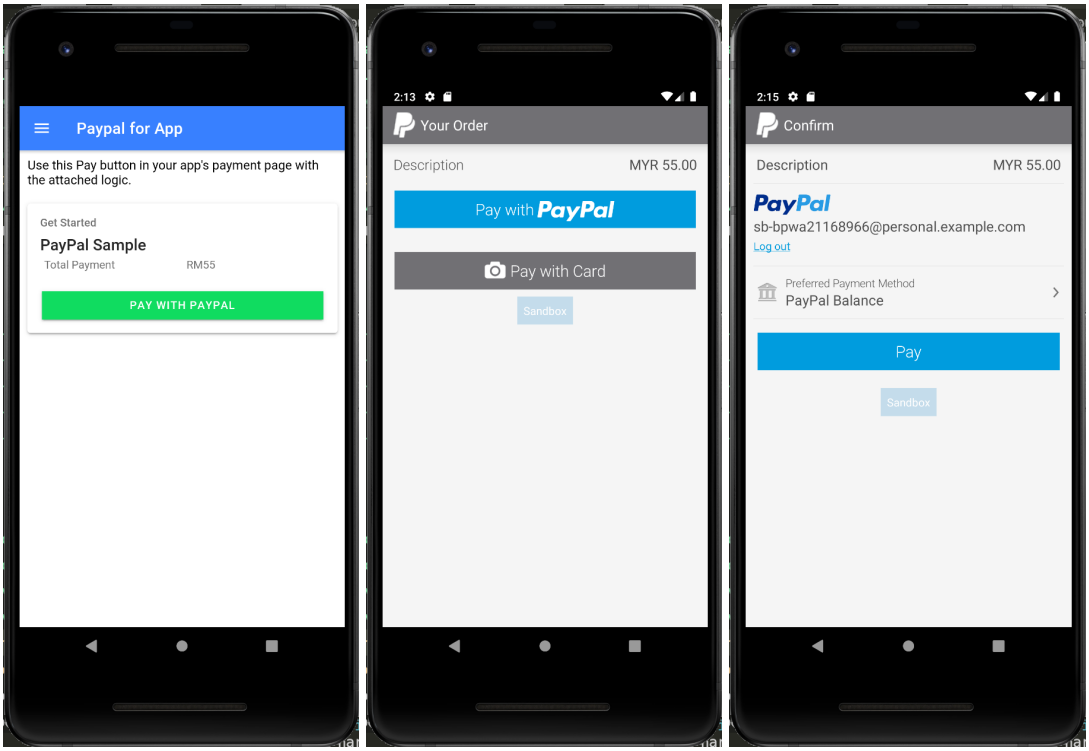


Figure 4-3-5: Payment Page Interface Design

After the confirm the details of service and proceed, the application will navigate to the payment page which will adopt PayPal for the user to make payment. The application will navigate to the gateway of PayPal.

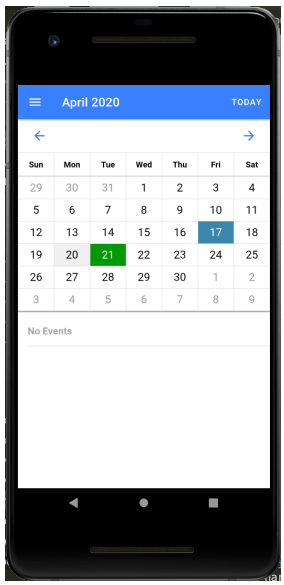


Figure 4-3-6: Calendar Page Interface Design

After the user made the payment, the application will redirect to the calendar page which is letting the user to check their booking details and status. The user can always open the menu at upper left corner to go to calendar page for viewing the details.

4-4 Database Design

As mentioned before, the information of the system will be stored in Firebase Cloud Firestore and Ionic Local Storage. According to the documentation of Firebase, Cloud Firestore is a flexible and scalable No SQL database for mobile, web, and server development from Firebase and Google Cloud Platform. On the other hand, Ionic Local Storage is a cross-platform data storage system that works on iOS and Android. It makes it easy to add offline storage to Ionic apps that is secure, highly performant, and provides advanced NoSQL data querying. All of the information about package would be stored in the Cloud Firestore. The information of package would be stored in the Cloud Firestore are package ID, number of staffs, status, price, duration, date and time, service and building. The Ionic Local Storage is used to store some information like token ID when user login to let the user always stayed in the login state otherwise user choose to logout.

planID	**noOfStaff**	**planStatus**	**planPrice**	**planDuration**
p1_weekdayday_flat_1	1	true	10	1
p1_weekendday_flat_2	1	false	20	2
p2_weekdaynight_flat_4	2	true	75	2.5

Table 4-4-1-1: Example of Data of Package Stored in Cloud Firestore

planDatetime	**planService**	**planBuilding**
weekday day	1 service	flat
weekend day	2 service	flat
weekday night	4 service	flat

Table 4-4-1-2: Example of Data of Package Stored in Cloud Firestore

CHAPTER 5 IMPLEMENTATION AND TESTING

5-1 System Implementation

In this project, some of the important function such as the recommender function had been implemented as planning. However, some functionality hadn't been implemented due to the time constraint. Below is the list of features that implemented in this system:

i. Register
ii. Login
iii. Logout
iv. Calculate weight for each criterion based on important level
v. Calculate value of each criterion in the package
vi. Calculate score for each package based on weight and value
vii. Display the recommendation package (package with higher score)
viii. Select package
ix. Make payment by PayPal
x. View calendar

5-2 System Testing

After the implementation of system, the next phase is testing the system. Thus, some test techniques such as equivalence partitioning or boundary value analysis will be implemented to test the system. Since the product of this project is recommendation system, therefore some of the main features such as calculate the weight, value and score would be tested.

5-2-1 Calculate the weight for 5 criterions

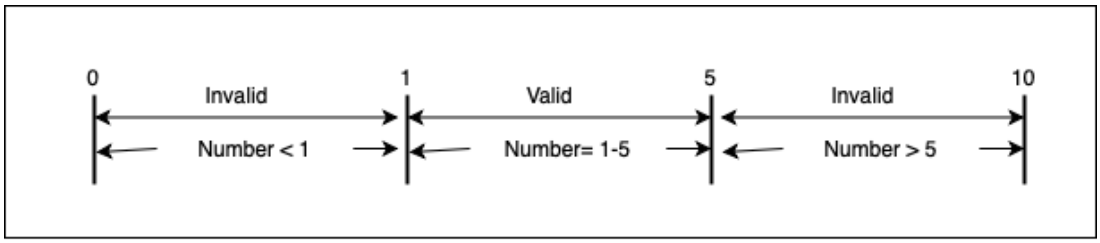


Figure 5-2-1-1: Important Level Equivalence Partitions for Calculate Weight

Figure above showed the equivalence partitions for calculate weight. To calculate weight, the user needs to enter the important level for 5 criterions. The important level is range from 1 to 5 which mean the users can only enter the number from 1 to 5 and the system should not allow the entering of number out of 1 to 5. Since there is 5 criterions, there will be 1 set of input that contained 5 number. The example of important level to be entered could be 1, 2, 3, 4, 5. The IL will represent important levels at the following table.

Test ID	Test Condition	Example of Test data	Intended Result	Actual Result
TID_W_1	IL < 1	1,2,4,3,0	Error alert	Error alert
TID_W_2	1 <= IL <= 5	1,3,4,5,2	Weight calculated	Weight calculated
TID_W_3	IL > 5	1,3,2,4,7	Error alert	Error alert
TID_W_4	Valid IL	1,2,5,4,3	Weight calculated	Weight calculated
TID_W_5	Invalid IL	0,1,7,6,10	Error alert	Error alert

Table 5-2-1-1: Test for Important Level Equivalence Partitions for Calculate Weight

Table above showed the Test for Important Level Equivalence Partitions for Calculate Weight. For TID_W_1, the test condition is important level less than 1. There is a number that less than 1 which is 0 from the test data. Therefore, the application will show alert message to tell the user and let the user enter again. In TID_W_2, the weight is calculated as the numbers entered are correct.

5-2-2 Calculate the value of criterions in package

To calculate the value of criterions in package, the user need to input some value for 5 criterions which is budget, duration, date and time, service and building. The budget criteria could be any number. The duration criteria is a list of selection that consisted some value such as 1 hour, 2 hour, and etcetera. The input of date and time is a datetime picker. For the service criteria, there will be a list of checkbox that contain several services. The building criteria is a group of radio button that contain several building. The value can only be calculated when all of the criterions is entered correctly. If one of the criterions hadn't been inputted and the users wish to proceed, the system will show an alert message to the user. If some of the criterions is entered wrongly, the system will also show an alert message.

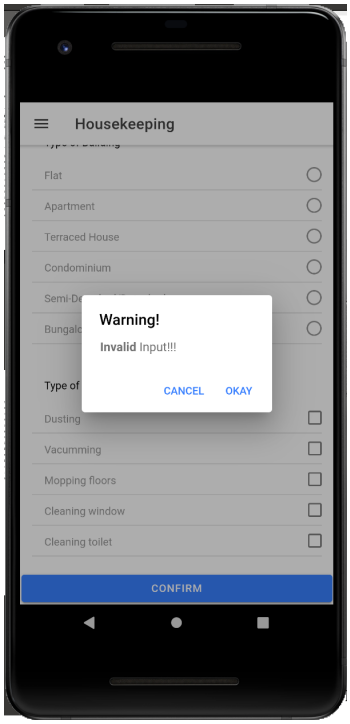


Figure 5-2-2-1: Testing when some of the input is not entered

Figure above show that the system will show alert message when some of the input is not entered by the users and the user wish to proceed by clicking "Confirm" button.

5-2-3 Calculate the score of each package

If all the required inputs are entered well, the weight and value could be calculated correctly. After that, the score will be calculated successfully.

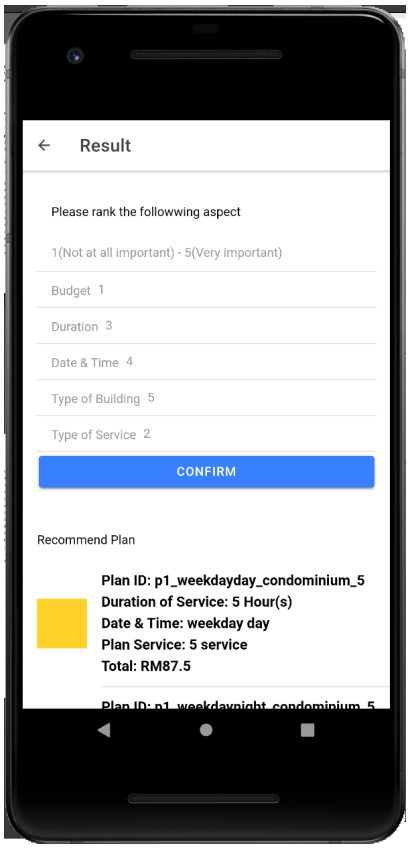


Figure 5-2-3-1: Testing on calculation of score

From the figure above, it showed that when all the required input is entered, the system will calculate the score for each package and the package with higher score will display to the user as suggestion package. In this project, the three highest score of package will be displayed.

5-2-4 System Testing of Objective 1

As stated in Chapter 1, the objective 1 is to propose a score-based recommendation method for a recommendation system. It will calculate the score for each package. The following part showed the scenario 1 for calculating score and the result from mobile application:

The following par showed the example of input entered by the user.

- Date & time: 23/04, 3:30 PM
- Duration: 3 Hours
- Budget: RM75
- Building: Condominium
- Service: 3 Services

The following part showed the example of important level entered by the user:

- Date & time: 4
- Duration: 2
- Budget: 3
- Building: 1
- Service: 5

To scale it to the fundamental scale for pairwise comparisons of AHP, use the calculation to scale will be shown as following:

i. **(value of differences between the factors divided maximum differentiation between factors) * 8 + 1**

For example, budget compare to duration. The value of difference is 3 – 2 = 1 and maximum differentiation is 5 – 1 = 4. Thus, the calculation would be ((1 / 4) * 8) + 1 = 3. Therefore, we can say that budget is 3 times more important than duration.

Following will showed the example of calculate the weight:

Budget	3	Duration	1/3
Budget	1/3	Date & time	3
Budget	1/5	Service	5
Budget	5	Building	1/5
Duration	1/5	Date & time	5
Duration	1/7	Service	7
Duration	3	Building	1/3

Date & time	1/3	Service	3
Date & time	7	Building	1/7
Service	9	Building	1/9

Table 5-2-4-1: Table of scaling the important level.

Based on the value from the table 5-2-4-1, then put in the value to table below.

	Budget	Duration	Date & time	Service	Building	Weight
Budget	1 => (1 / (9/8/15)) = 0.105	3 => (3 / (16/1/3)) = 0.184	1/3=> 0.071	1/5=>0.111	5=>0.2	(0.105+0.184 +0.071+0.111 +0.2)/5=0.134
Duration	1/3=>0. 035	1=>0.06 1	1/5=> 0.043	1/7=>0.08	3=>0.12	0.068
Date & time	3=> 0.315	5=>0.30 6	1=>0. 214	1/3=>0.187	7=>0.28	0.26
Service	5=>0.5 24	7=>0.42 9	3=>0. 642	1=>0.56	9=>0.36	0.503
Building	1/5=>0. 021	1/3=>0.0 2	1/7=> 0.031	1/9=>0.062	1=>0.04	0.035
Total	9/8/15	16/1/3	4/71/1 05	1/248/315	25	1

Table 5-2-4-2: Table of calculating the weight

Since the number of data in the database is too large, therefore there is 3 alternatives package is chosen from the database.

1. Package 1
    a. planID: p6_weekendnight_bungalow_5
    b. planPrice: 177.5
    c. planDuration: 0.5
    d. planDatetime: weekend night

e. planService: 5 service
f. planBuilding: bungalow

2. Package 2
    a. planID: p6_weekdayday_bungalow_5
    b. planPrice: 175
    c. planDuration: 0.5
    d. planDatetime: weekday day
    e. planService: 5 service
    f. planBuilding: bungalow
3. Package 3
    a. planID: p6_weekdaynight_bungalow_5
    b. planPrice: 180
    c. planDuration: 0.5
    d. planDatetime: weekday night
    e. planService: 5 service
    f. planBuilding: bungalow

After calculated the weight of criteria, we need to calculate the value of criteria inside the package based on user's input.

i. **Value of Package Price: 1 – ((package price – lowest package price) / (user budget – lowest package price))**

    Value of package 1 price: 1 – Math.abs((177.5 – 175) / (75 – 175)) = 0.975

    Value of package 2 price: 1 – Math.abs ((175 – 175) / (75 – 175)) = 1

    Value of package 3 price: 1 – Math.abs ((180 – 175) / (75 – 175)) = 0.95

    Total value: 0.975+1+0.95=2.925

    Scaling the value of price:

    Value of package 1 price: 0.975/2.925 = 0.33

    Value of package 2 price: 1/2.925 = 0.34

    Value of package 3 price: 0.95/2.925 = 0.33

ii. **Value of Duration: 1 – ((package duration – lowest package duration) / (user preferred duration – lowest package price))**

    Value of package 1 duration: 1 – ((0.5 – 0.5) / (3 – 0.5)) = 1

    Value of package 2 duration: 1 – ((0.5 – 0.5) / (3 – 0.5)) = 1

Value of package 3 duration: 1 – ((0.5 – 0.5) / (3 – 0.5)) = 1

Total value: 3

Scaling the value of duration:

Value of package 1 duration: 0.33

Value of package 2 duration: 0.33

Value of package 3 duration: 0.33

iii. Value of Date & Time:

   a. **Categorize the user preferred date & time to 3 category which is weekday daytime, weekday night time / weekend daytime, weekend night time.**
   b. **IF package date & time equal to user preferred date & time, value equal to 1**
   c. **ELSE IF week is same or time is same, value equal to 0.5**
   d. **ELSE IF date & time is not equal, value equal to 0**

User preferred date & time: 23/04, 3:30 PM (weekday daytime)

Value of package 1 date time: weekend night != weekday day, value = 0

Value of package 2 date time: weekday day == weekday day, value = 1

Value of package 3 date time: weekday night != weekday day but weekday == weekday, value =0.5

Total value: 1.5

Scaling the value of date & time:

Value of package 1 date time: 0

Value of package 2 date time: 0.67

Value of package 3 date time: 0.33

iv. Value of Service:

   a. **IF user preferred service – package service == 0, value equal to 1**
   b. **ELSE user preferred service – package service == 1, value equal to 0.75**
   c. **ELSE IF user preferred service – package service == 2, value equal to 0.5**
   d. **ELSE IF user preferred service – package service == 3, value equal to 0.25**

e. ELSE IF user preferred service – package service == 4, value equal to 0

Value of package 1 service: Math.abs(3 – 5) = 2, value = 0.5

Value of package 2 service: Math.abs(3 – 5) = 2, value = 0.5

Value of package 3 service: Math.abs(3 – 5) = 2, value = 0.5

Total value: 1.5

Scaling the value of service:

Value of package 1 service: 0.33

Value of package 2 service: 0.33

Value of package 3 service: 0.33

v. Value of Building:

a. IF user preferred building equal to package building, value equal to 1

b. ELSE value equal to 0

Value of package 1 building: 0

Value of package 2 building: 0

Value of package 3 building: 0

Score of package 1: 0.33 * 0.134 + 0.33 * 0.068 + 0 * 0.26 + 0.33 * 0.503 + 0 * 0.035 = 0.233

Score of package 2: 0.34 * 0.134 + 0.33 * 0.068 + 0.67 * 0.26 + 0.33 * 0.503 + 0 * 0.035 = 0.411

Score of package 3: 0.33 * 0.134 + 0.33 * 0.068 + 0.33 * 0.26 + 0.33 * 0.503 + 0 * 0.035 = 0.318

Therefore, the package 2 will be the recommendation since it was the highest. The package 2 should be in the list of recommendation.

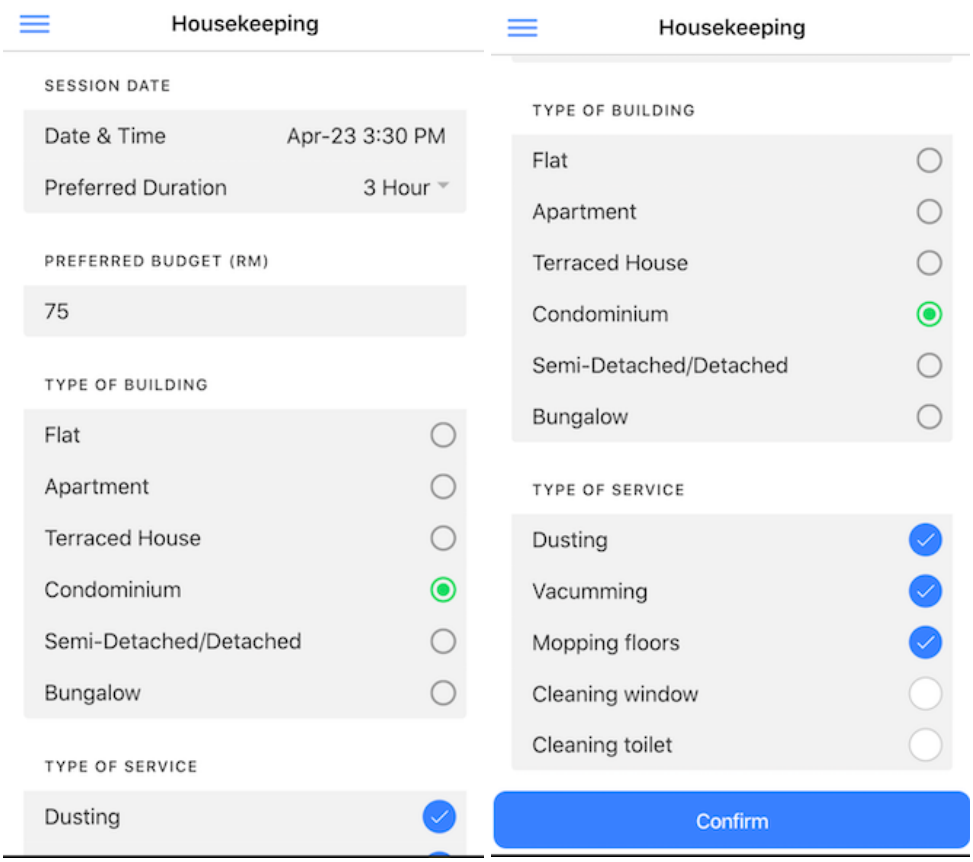


Figure 5-2-4-1: Diagram of user entering the input of preferences in app

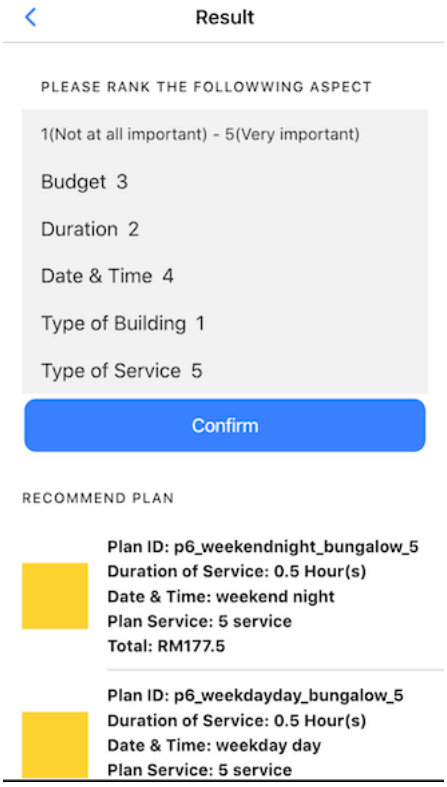


Figure 5-2-4-2: Diagram of user entering the important level in app

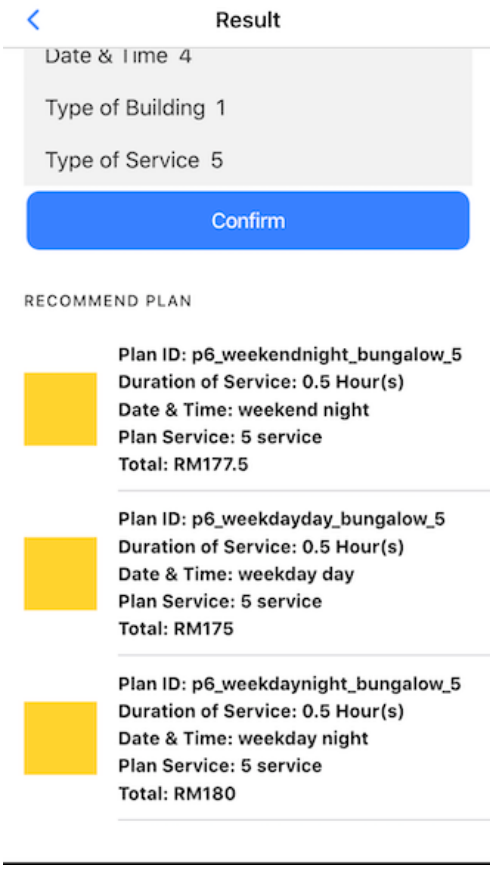


Figure 5-2-4-3: Diagram of result in app

Recall the plan ID of package 2 is p6_weekdayday_bungalow_5, therefore it is proved to be in the recommendation list in system.

The following part showed the scenario 2 for calculating score and the result from mobile application:

The following part showed the example of user's input.

- Date & time: 25/04, 7:30 PM
- Duration: Any
- Budget: RM55
- Building: Terraced House
- Service: 2 Services

The following part showed the example of important level entered by the user:

- Date & time: 5
- Duration: 4
- Budget: 3
- Building: 1
- Service: 2

To scale it to the fundamental scale for pairwise comparisons of AHP, use the calculation to scale will be shown as following:

ii. **(value of differences between the factors divided maximum differentiation between factors) * 8 + 1**

For example, budget compare to duration. The value of difference is 3 – 4 = |-1| and maximum differentiation is 5 – 1 = 4. Thus, the calculation would be ((1 / 4) * 8) + 1 = 3. Therefore, we can say that budget is 1/3 times less important than duration.

Following will showed the example of calculate the weight:

Budget	1/3	Duration	3
Budget	1/5	Date & time	5
Budget	3	Service	1/3
Budget	5	Building	1/5
Duration	1/3	Date & time	3
Duration	5	Service	1/5
Duration	7	Building	1/7
Date & time	7	Service	1/7
Date & time	9	Building	1/9

Service	3	Building	1/3

Table 5-2-4-3: Table of scaling the important level.

Based on the value from the table 5-2-4-1, then put in the value to table below.

	Budget	Duration	Date & time	Service	Building	Weight
Budget	1=>0.105	1/3=>0.071	1/5=>0.112	3=>0.184	5=>0.2	0.134
Duration	3=>0.315	1=>0.236	1/3=>0.187	5=>0.306	7=>0.28	0.265
Date & time	5=>0.524	3=>0.642	1=>0.56	7=>0.429	9=>0.36	0.503
Service	1/3=>0.035	1/5=>0.043	1/7=>0.08	1=>0.061	3=>0.12	0.068
Building	1/5=>0.021	1/7=>0.031	1/9=>0.062	1/3=>0.02	1=>0.04	0.035
Total	9/8/15	4/71/105	1/248/315	16/1/3	25	1

Table 5-2-4-4: Table of calculating the weight

Since the number of data in the database is too large, therefore there is 3 alternatives package is chosen from the database.

4. Package 1
    a. planID: p6_weekendnight_terraced_5
    b. planPrice: 140
    c. planDuration: 0.5
    d. planDatetime: weekend night
    e. planService: 5 service
    f. planBuilding: terraced
5. Package 2
    a. planID: p6_weekdayday_bungalow_5
    b. planPrice: 175

c. planDuration: 0.5
d. planDatetime: weekday day
e. planService: 5 service
f. planBuilding: bungalow

6. Package 3
    a. planID: p1_weekdaynight_bungalow_5
    b. planPrice: 165
    c. planDuration: 5
    d. planDatetime: weekday night
    e. planService: 5 service
    f. planBuilding: bungalow

After calculated the weight of criteria, we need to calculate the value of criteria inside the package based on user's input.

vi. Value of Package Price: 1 – ((package price – lowest package price) / (user budget – lowest package price))

Value of package 1 price: 1 – Math.abs((140 – 140) / (55 – 140)) = 1

Value of package 2 price: 1 – Math.abs ((175 – 140) / (55 – 140)) = 0.588

Value of package 3 price: 1 – Math.abs ((165 – 110) / (55 – 140)) = 0.353

Total value: 1+0.588+0.353=1.941

Scaling the value of price:

Value of package 1 price: 1/1.941 = 0.52

Value of package 2 price: 0.588/1.941 = 0.30

Value of package 3 price: 0.353/1.941 = 0.18

vii. Value of Duration: 1 – ((package duration – lowest package duration) / (user preferred duration – lowest package price))

Value of package 1 duration: 1 – ((0.5 – 0.5) / (6 – 0.5)) = 1

Value of package 2 duration: 1 – ((0.5 – 0.5) / (6 – 0.5)) = 1

Value of package 3 duration: 1 – ((5 – 0.5) / (6 – 0.5)) = 0.182

Total value: 2.182

Scaling the value of duration:

Value of package 1 duration: 0.46

Value of package 2 duration: 0.46

Value of package 3 duration: 0.08

viii. Value of Date & Time:

a. **Categorize the user preferred date & time to 3 category which is weekday daytime, weekday night time / weekend daytime, weekend night time.**
b. **IF package date & time equal to user preferred date & time, value equal to 1**
c. **ELSE IF week is same or time is same, value equal to 0.5**
d. **ELSE IF date & time is not equal, value equal to 0**

User preferred date & time: 25/04, 7:30 PM (weekend night time)

Value of package 1 date time: weekend night == weekend night, value = 1

Value of package 2 date time: weekday day != weekend night, value = 0

Value of package 3 date time: weekday night != weekend night but night == night, value =0.5

Total value: 1.5

Scaling the value of date & time:

Value of package 1 date time: 0.67

Value of package 2 date time: 0

Value of package 3 date time: 0.33

ix. Value of Service:

a. **IF user preferred service – package service == 0, value equal to 1**
b. **ELSE user preferred service – package service == 1, value equal to 0.75**
c. **ELSE IF user preferred service – package service == 2, value equal to 0.5**
d. **ELSE IF user preferred service – package service == 3, value equal to 0.25**
e. **ELSE IF user preferred service – package service == 4, value equal to 0**

Value of package 1 service: Math.abs(2 – 5) = 2, value = 0.25

Value of package 2 service: Math.abs(2 – 5) = 2, value = 0.25

Value of package 3 service: Math.abs(2 – 5) = 2, value = 0.25

Total value: 0.75

Scaling the value of service:

Value of package 1 service: 0.33

Value of package 2 service: 0.33

Value of package 3 service: 0.33

x. Value of Building:

   a. **IF user preferred building equal to package building, value equal to 1**

   b. **ELSE value equal to 0**

Value of package 1 building: 1

Value of package 2 building: 0

Value of package 3 building: 0

Score of package 1: 0.52 * 0.134+ 0.46 * 0.265 + 0.67 * 0.503 + 0.33 * 0.068 + 1 * 0.035 = 0.586

Score of package 2: 0.3 * 0.134 + 0.46 * 0.265 + 0 * 0.503 + 0.33 * 0.068 + 0 * 0.035 = 0.185

Score of package 3: 0.18 * 0.134 + 0.08 * 0.265 + 0.33 * 0.503 + 0.33 * 0.068 + 0 * 0.035 = 0.234

Therefore, the package 1 will be the recommendation since it was the highest. The package 1 should be in the list of recommendation.

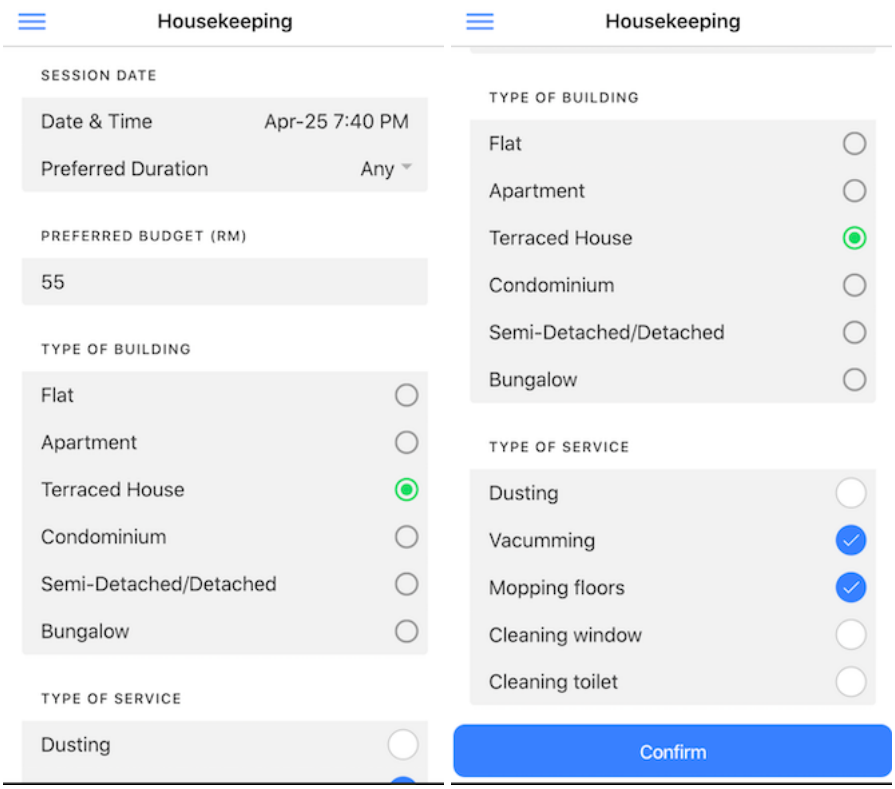


Figure 5-2-4-4: Diagram of user entering the input of preferences in app

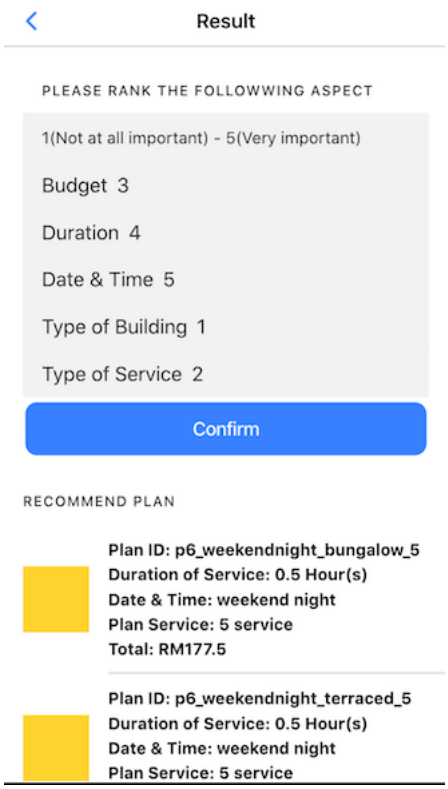


Figure 5-2-4-5: Diagram of user entering the important level in app

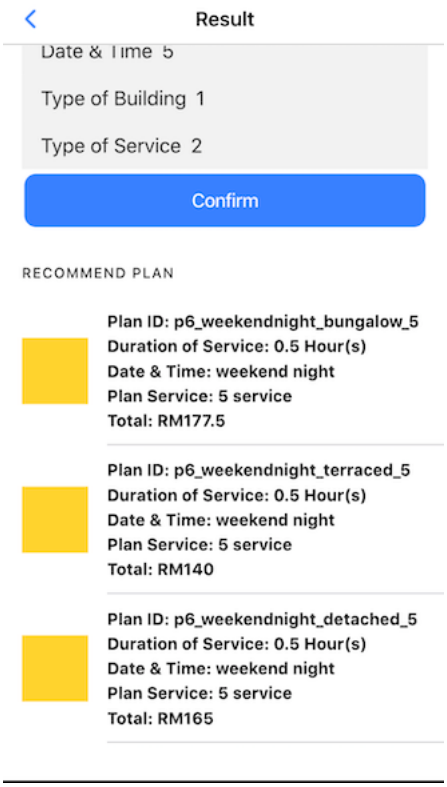


Figure 5-2-4-6: Diagram of result in app

Recall the plan ID of package 1 is p6_weekendnight_terraced_5, therefore it is proved to be in the recommendation list in system.

5-2-5 System Testing of Objective 2

The objective 2 is to allow the user to customize recommendation method based on their own preferences. The user can always customize their preferences to get the expected result.

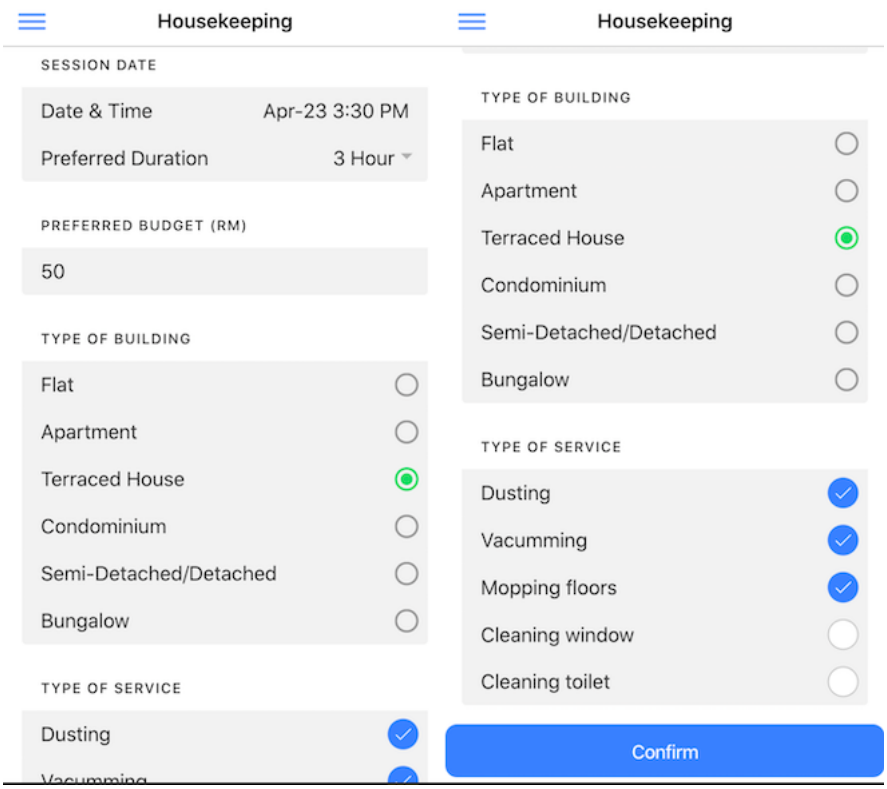


Figure 5-2-5-1: Diagram of user input in app

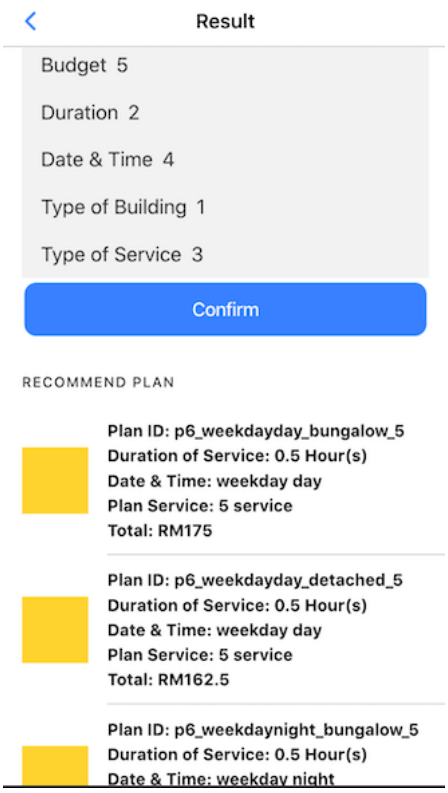


Figure 5-2-5-2: Diagram of result 1t in app

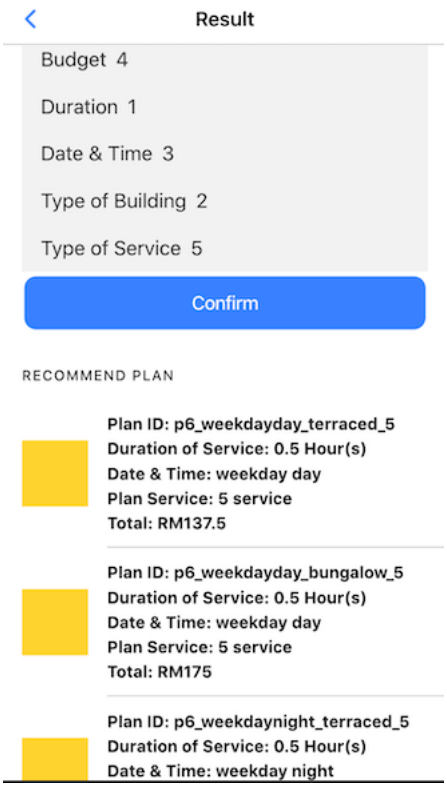


Figure 5-2-5-3: Diagram of result 2 in app

From the figure 5-2-5-1, 5-2-5-2, 5-2-5-3, it showed that the same user preferences but with different important level, it will show different result. Therefore, the user could customize themselves until to get the result that the user needed

CHAPTER 6 DISCUSSION

Ability to Achieve Project Objectives

The objectives stated in this project are proposing a score-based recommendation method in the mobile application that used to call for cleaning service and allowing the user to customize the recommendation method based on their own preferences. The first objective is to develop a recommendation system to give suggestion to the user by calculating the score of package of the service. The package with the higher score will be the suggestion plan to the user. The second objective is to allow the user to customize the result by changing the input. The different input will result different recommendation. Therefore, the user can customize it to reach their expected result. Fortunately, this project had achieved both objectives stated.

System Strength and Limitations

The strength of the system is the system never need the information of other user profile for recommendation since it is based on calculation of score. Therefore, the common problem of a recommendation engine which is cold start problem will never happen on this system. Other than that, another strength is the user can always change their preferences to get the different result. However, the system still have some limitations. If user want to change the important level and run the system again, they need to return to previous page and enter again. On the other hand, the calculation of score is implemented in the mobile application instead of server. Therefore, the mobile phone that with moderate performance may need to load longer time to get the recommendation result. In addition, the system may not able to package that the user expected. However, the result is always based on the input that entered by the users. For example, the user preferred the budget is the most important, the system will considered. However, the other criteria may not is the expectation of users and this will depend on the important level entered by the users.

Future Enhancement

For the future enhancement for this system, some of limitation that stated above will be solved. Other than that, there would be admin site to manage the package and booking order. On the other hand, more techniques of recommendation such as user-based, content-based filtering techniques maybe added into the system. With this enhancement, the system are able to provide the more suitable plan or information to the user and this would actually benefits the people. In order to achieve this target, the system have to combine the all of the approaches.

CHAPTER 7 CONCLUSION

In conclusion, this project is to develop a mobile application with the implementation of recommendation system in cleaning service. The system is implemented with the score-based recommendation method. The main feature of this project is to help the user to make a decision when there is large number of information. The application is able to calculate the score based on the user's input. With this calculation, the application is able to give suggestions of package to the user.

The motivation of this project is to provide recommendation tool to help the users for decision-making in cleaning service mobile application. In this modern era that have large number of information, the recommender system become more and more important since it able to filter out the unused information and recommend the items that the users might like to the users. By having this system, it will save the time and work from the users with just inputting some parameter such as time and duration to the system to call for the janitorial service.

BIBLIOGRAPHY

1. Ajitsaria, A., 2019. Build a Recommendation Engine With Collaborative Filtering. Available from: <https://realpython.com/build-recommendation-engine-collaborative-filtering/>. [Accessed 19 October 2019]

2. ALANNE, K. (2004). Sustainable small-scale CHP technologies for buildings: the basis for multi-perspective decision-making. Renewable and Sustainable Energy Reviews, 8(5), 401–431. doi:10.1016/j.rser.2003.12.005

3. Alpaslan, G., 2016. COMPARISON OF THE EFFICIENCY OF DIFFERENT ALGORITHMS ON RECOMMENDATION SYSTEM DESIGN: A CASE STUDY. Available from: <https://arxiv.org/pdf/1701.05149.pdf>. [Accessed 27 October 2019]

4. Angular.io. (2019). Angular. [online] Available at: https://angular.io/guide/http [Accessed 1 Nov. 2019].

5. Brandon, J. (2019). 5 apps to help you make better decisions. [online] CIO. Available at: https://www.cio.com/article/3015220/5-apps-to-help-you-make-better-decisions.html [Accessed 24 July 2019].

6. Davidsson, C. 2010, Mobile Application Recommender System. Available from: < https://uu.diva-portal.org/smash/get/diva2:428092/FULLTEXT01.pdf >. [24 July 2019].

7. Expressjs.com. (2019). Express - Node.js web application framework. [online] Available at: https://expressjs.com [Accessed 2 Nov. 2019].

8. Gajjar, D., Smithwick, J., Sullivan, K., 2018. Improving Janitorial Contract Performance with Facility Management Performance Scorecards. Available from: < https://jfmer.org/doi/10.22361/jfmer/94925>. [Accessed 19 October 2019]

9. Husain, W.,Yih Dih, L., 2012. A Framework of a Personalized Location-based Traveler Recommendation System in Mobile Application. Available from: <https://www.researchgate.net/profile/Wahidah_Husain/publication/267975777_A_Framework_of_a_Personalized_Location-based_Traveler_Recommendation_System_in_Mobile_Application/links/54b5d6d40cf28ebe92e79c1a.pdf>. [Accessed 17 October 2019]

10. Justmop.com, 2019. Justmop: Home Cleaning Services & Part-Time Maids. Mobile app. Version 5.1.2. Available from: https://play.google.com/store/apps/details?id=com.mobile.justmop&hl=en. Accessed 25 July 2019.

11. Kagure Muraguri, E., I. Ng'ang'a, S., R. Omondi, H., 2015. Effects of Outsourcing Cleaning Functions on Service Quality in Public Universities in Kenya: A Comparative Study of Outsourced and in-House Cleaning Services. Available from: < http://karuspace.karu.ac.ke/bitstream/handle/20.500.12092/2012/Humphrey%20R.%20Omondi.pdf?sequence=1>. [Accessed 21 October 2019]

12. Maideasy Sdn Bhd, 2019. Maideasy. Mobile app. Version 4.6.3. Available from: https://play.google.com/store/apps/details?id=com.maideasy.app&hl=en. Accessed 25 July 2019.

13. Malatesta, D., & Smith, C. R. (2015). Deciding who's in charge. Journal of Strategic Contracting and Negotiation, 1(1), 65–84. doi:10.1177/2055563615569921

14. Nah, F. F.-H., Siau, K., & Sheng, H. (2005). The value of mobile applications. Communications of the ACM, 48(2), 85–90. doi:10.1145/1042091.1042095

15. Pandey, A. K., & Rajpoot, D. S. (2016). Resolving Cold Start problem in recommendation system using demographic approach. 2016 International Conference on Signal Processing and Communication (ICSC). doi:10.1109/icspcom.2016.7980578

16. Pryor, C., Webb, J. W., Ireland, R. D., & Ketchen Jr., D. J. (2015). Toward An Integration of the Behavioral and Cognitive Influences on the Entrepreneurship Process. Strategic Entrepreneurship Journal, 10(1), 21–42. doi:10.1002/sej.1204

17. Rouse, M. 2005, TechTarget. September 2005. Margaret Rouse: Blog. Available from: <https://searchcio.techtarget.com/definition/intermediary>. [24 July 2019].

18. Shim, J. P., Warkentin, M., Courtney, J. F., Power, D. J., Sharda, R., & Carlsson, C. (2002). Past, present, and future of decision support technology. Decision Support Systems, 33(2), 111–126. doi:10.1016/s0167-9236(01)00139-7

19. Techopedia.com. (2019). What is a Mobile Application? - Definition from Techopedia. [online] Available at: https://www.techopedia.com/definition/2953/mobile-application-mobile-app [Accessed 1 Nov. 2019].

20. Viljanac, V. 2014, Recommender System For Mobile Applications. Available from: < https://www.fer.unizg.hr/_download/repository/Master_Thesis_-_Vanda_Viljanac.pdf>. [25 July 2019].

21. Vaidya, O. S., & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. European Journal of Operational Research, 169(1), 1–29. doi:10.1016/j.ejor.2004.04.028

22. Firebase Documentation. (2020). Cloud Firestore. Available from: <https://firebase.google.com/docs/firestore> [21 April 2020]

23. Ionic Framework Documantation. (2020). Data Storage. Available from: < https://ionicframework.com/docs/angular/storage>

FINAL YEAR PROJECT WEEKLY REPORT

(~~Project I~~ / Project II)

Trimester, Year: Year 3 Trimester 3	**Study week no.: 2**
Student Name & ID: Liu Jie Wei, 16ACB05321	
Supervisor: Ts Ku Chin Soon	
Project Title: On Demand Cleaning Service Recommendation Tool	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Discuss the project objectives with supervisor.
- Continue coding on the project.
  - Create confirmation page
  - Designing database
  - Designing dataset

2. WORK TO BE DONE

- Studying the research paper that suggested by supervisor.

3. PROBLEMS ENCOUNTERED

- No problems encountered this week.

4. SELF EVALUATION OF THE PROGRESS

- Moderate Performance.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(~~Project I~~ / Project II)

Trimester, Year: Year 3 Trimester 3	**Study week no.: 5**
Student Name & ID: Liu Jie Wei, 16ACB05321	
Supervisor: Ts Ku Chin Soon	
Project Title: On Demand Cleaning Service Recommendation Tool	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Finish summarization of paper that suggested by supervisor
- Coding on the project.
  - Designing dataset
  - Implement Ionic Local Storage
  - Modify the features of register, login, logout by using Firebase
  - Trying neural network

2. WORK TO BE DONE

- Proposed system model

3. PROBLEMS ENCOUNTERED

- No problems encountered this week.

4. SELF EVALUATION OF THE PROGRESS

- Moderate Performance.

Supervisor's signature

Liu

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(~~Project I~~ / Project II)

Trimester, Year: Year 3 Trimester 3	**Study week no.: 8**
Student Name & ID: Liu Jie Wei, 16ACB05321	
Supervisor: Ts Ku Chin Soon	
Project Title: On Demand Cleaning Service Recommendation Tool	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Proposed system model to supervisor
- Coding on the project.
  - Add gateway of PayPal for payment
  - Add feature of calendar
  - Able to let user stay in logged in state
  - Implementing system model in program.

2. WORK TO BE DONE

- Implemented system model in program.

3. PROBLEMS ENCOUNTERED

- No problem encountered.

4. SELF EVALUATION OF THE PROGRESS

- Slow Performance.

Supervisor's signature

Liu

Student's signature

Poster

ON DEMAND CLEANING SERVICE RECOMMENDATION TOOL

Student: Liu Jie Wei **Supervisor: Ts. Ku Chin Soon**

Introduction

This project is to propose a score-based recommendation method in mobile application to provide suggestion to user by calculating score of each package. The user can customize the input preferences such as budget and duration to get the different result.

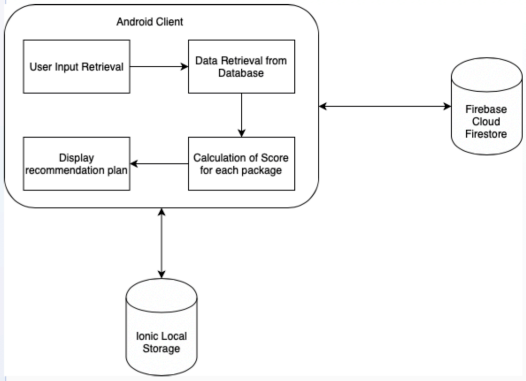
Discussion

- User enter the preferences such as budget, date and time.
- User enter the important level for each preferences.
- System calculate the weight based on the important level and value of preferences based on users' input.
- System calculate the score for each package based on the weight and value calculated.
- Display the package with higher score as suggestion to user.

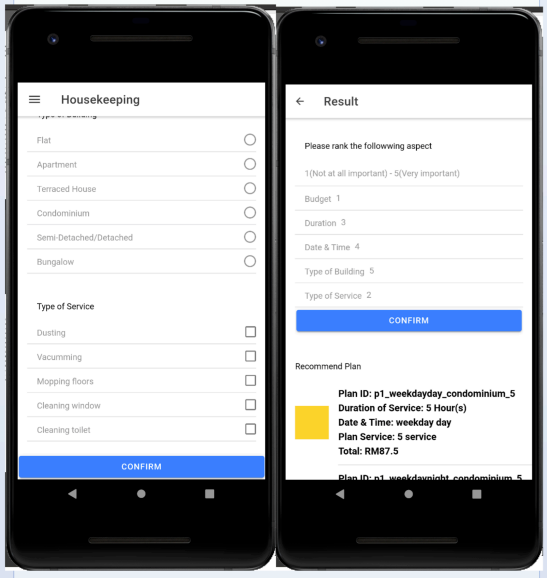
Conclusion

This project had developed a mobile application with the implementation of score-based recommendation. The score of package will calculate based on the users' input.

Framework



Result



FYP2 On Demand Cleaning Service Recommendation Tool

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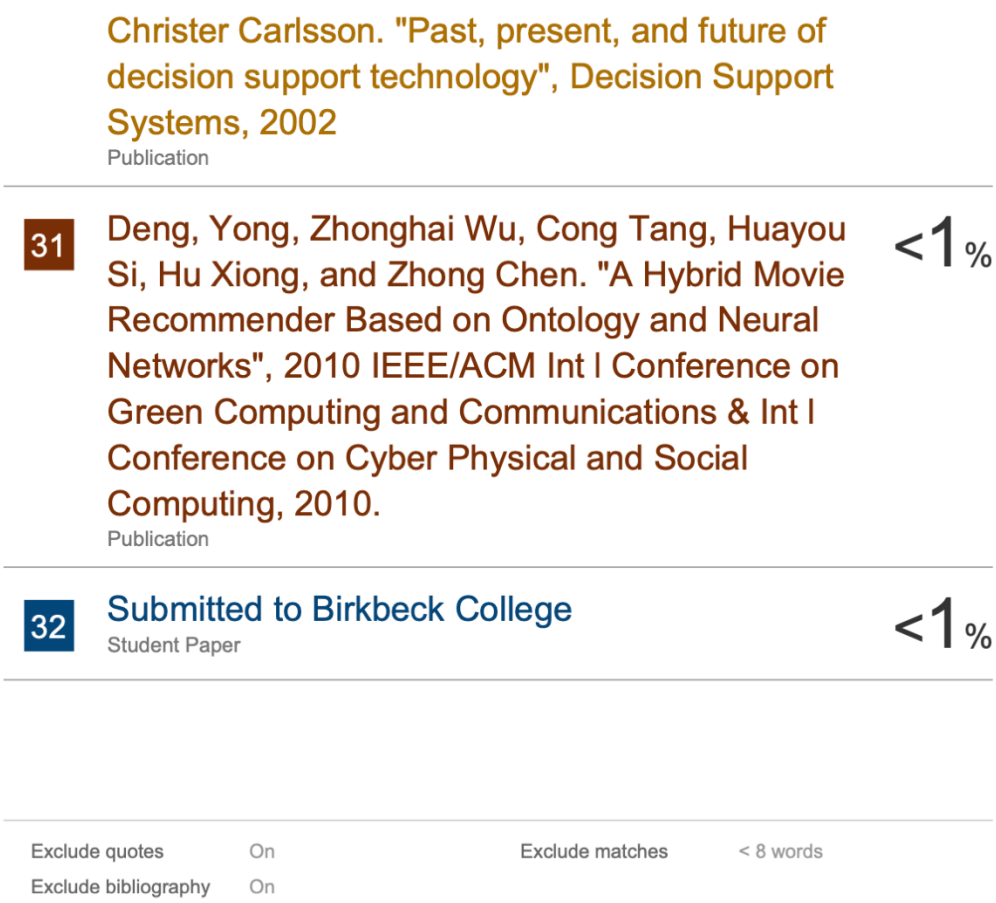
Christer Carlsson. "Past, present, and future of decision support technology", Decision Support Systems, 2002
Publication
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Deng, Yong, Zhonghai Wu, Cong Tang, Huayou Si, Hu Xiong, and Zhong Chen. "A Hybrid Movie Recommender Based on Ontology and Neural Networks", 2010 IEEE/ACM Int l Conference on Green Computing and Communications & Int l Conference on Cyber Physical and Social Computing, 2010.
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