PROCEEDINGS OF ELECTRICAL ENGINEERING CAPSTONE SHOWCASE (EECS 2020)

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Electrical Engineering Capstone Showcase
School of Electrical Engineering

**PROCEEDINGS OF
ELECTRICAL ENGINEERING CAPSTONE SHOWCASE**

(EECS 2020)

AGILE FACILITY MANAGEMENT SYSTEM

**PROCEEDINGS OF ELECTRICAL ENGINEERING CAPSTONE SHOWCASE
2020: AGILE FACILITY MANAGEMENT SYSTEM
2021**

First Edition 2021

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PREFACE

Capstone Project is a compulsory course taken by final year students from School of Electrical Engineering (SKE), Universiti Teknologi Malaysia. Since the course for Capstone Project started in 2016, our students and lecturers have benefited many supports from industries and communities. The participation mainly in term of discussion of needs and requirements for their works and environment.

This year we are thrilled to have our projects that we conducted virtually for the first time due to the outbreak of Covid-19. The projects were presented during Electrical Engineering Capstone Showcase (EECS 2020), which was held on 25th January 2021. And the "Proceedings of Electrical Engineering Showcase 2021: Agile Facility Management System" is a report of collaboration work during Capstone Project this year.

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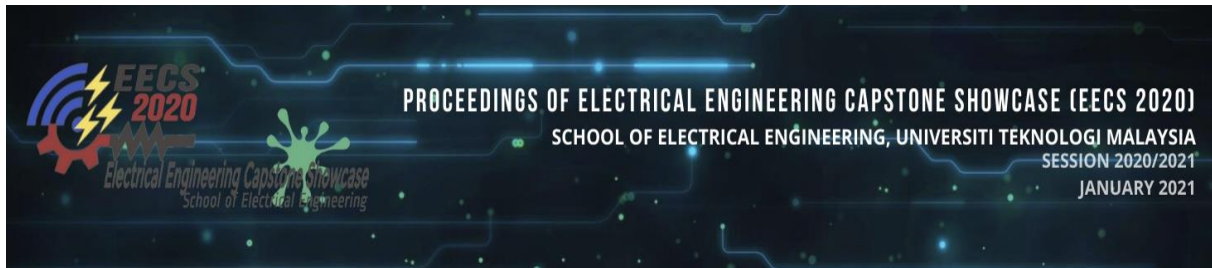**Dr. Lim Cheng Siong**
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Chemical Management System

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Abstract: The management system is important for every institute to operate systematically especially on the aspect of the facility, human resource, and work schedule management. In most institutions, managements are done manually which is time-wasting and prone to human error. In this paper, an agile chemical management system is introduced to increase the effectiveness and efficiency in managing chemicals substances and facilities in a chemical laboratory. The chemical management process is converted from manual to via online database through a mobile application which is generated through a free application maker, "Mobincube".

Keywords: chemical; management; application.

Introduction

Laboratory activities is one of the most important activities for the students. This is because laboratory work allows the students with conceptual and theoretical knowledge to learn more about the scientific concepts through scientific method and to understand the nature of science. The aim for this project is to design an application which consists of various functions that can help both students and also the lab assistants. The functions include laboratory booking, chemical usage record, emergency button, chemical disposal and chemical substances.

First of all, the development of this system is to assist students on availability of the chemical at the laboratory and the usage of the laboratory. Students can check whether the chemical needed are available at the laboratory before doing the experiment. Student quite often too could not finish their lab activities at the time given and they are force to continue their lab activities at other time. Therefore, students can use the application to check the available slot and book the specific slot for their lab activities so that the lab work can be finish up without any obstacle.

In designing our project, we consider STEEP analysis which are social, technology, environment, economy and political. In case of social analysis, we ensure the safety of both students and lecturers as well as to make sure lab assistant able to manage the chemical systematically with proper system requirement. There are safety features included in our project such as accident reporting button and precaution handbook to ensure the accident case can be reported immediately and make student aware with the precaution that should be taken when handling the chemicals. The system via online data base can help lab assistant to manage the data regarding the chemicals more effective and efficient.

Next, in term of technology, we introduce a new way managing the chemicals using technology. The new way of managing the chemical will help the lab assistant to check on which chemicals are on low amount and finished. The lab assistant can check the chemicals with just a click and all the chemicals detail will be listed out. This will allow the lab assistant to monitor the amount of chemicals in the laboratory at anytime and anywhere.

Besides, in terms of environment, we make sure that the system can track the disposal of chemical which is harmful to the environment by the proper record. All chemical usage and disposal are recorded with important information such as date, time and person who carry out the action. Therefore, in the event of environment pollution due to chemical substances, that important information will be useful for authority to know the actual situation and make the best decision in solving the problem.

In terms of economy, the system can make sure that the lab users only take the required amount for their experiment to avoid wastage of chemical substance. The system will record the amount of chemical left after the usage. By doing so, this will reduce the amount of money spend on the chemical substances.

Last but not least, in terms of the political, we are confidence that the system could reduce the possibility of misuse of the chemical substance which on the edge towards illegal actions by having proper and details chemical usage record. Before the start of any activities or project, the students or lecturers are required to fill in the chemical usage form.

Content

Objectives

The objectives of this project are outlined as follows:

- o   To record all chemical that are being stored.
- o   To allow user to check the availability of the chemical and laboratory.
- o   To classify the chemical based on the level of hazard.
- o   To record the activities of the laboratory.

Description and Analysis of Interview

Problem Statement

Before the development of this applications, students who wish to continue carry out their laboratory activities have to go in person to the laboratory to check on the available time. What is worse is that there will be a lot of students at the laboratory at that time since the laboratory does not have the booking system. There also will be a time where the chemicals needed for the experiment has been used up and the students end up going to the laboratory for nothing.
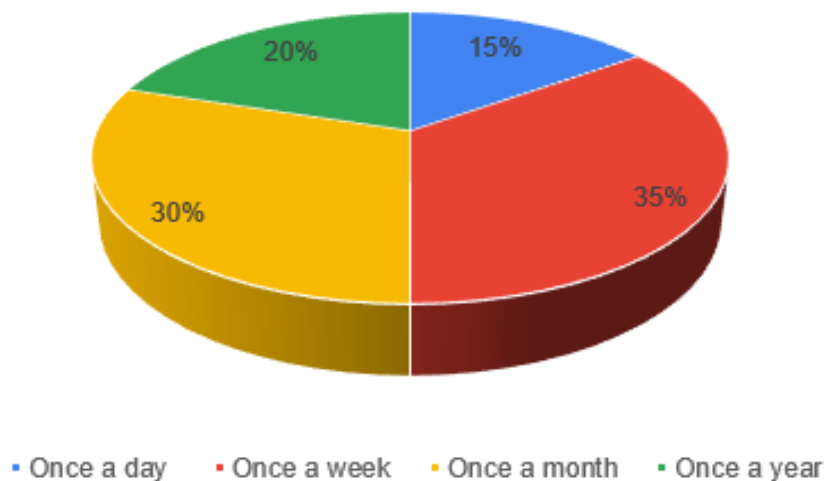

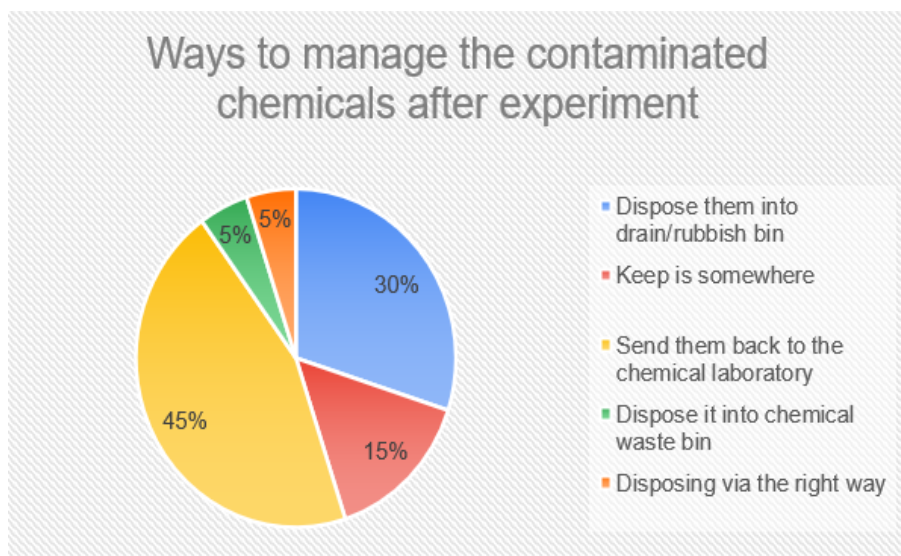Figure 1: Usage of Chemical Substances

Figure 2: Ways to Manage the Contaminated Chemicals After Experiment

Based on survey conducted on UTM students and lecturers (stakeholders), it can be seen that most of the students and lecturers are using the chemical substances quite often. 35% of the stakeholders are using the chemical substance once a week and 30% are using the chemical substances once a month. Besides, the awareness of stakeholders on managing the contaminated chemicals is high. 45% of the stakeholders would send the chemical substance back to the chemical laboratory but 5% do not aware of the dangerous of disposing the chemical into waste bin.
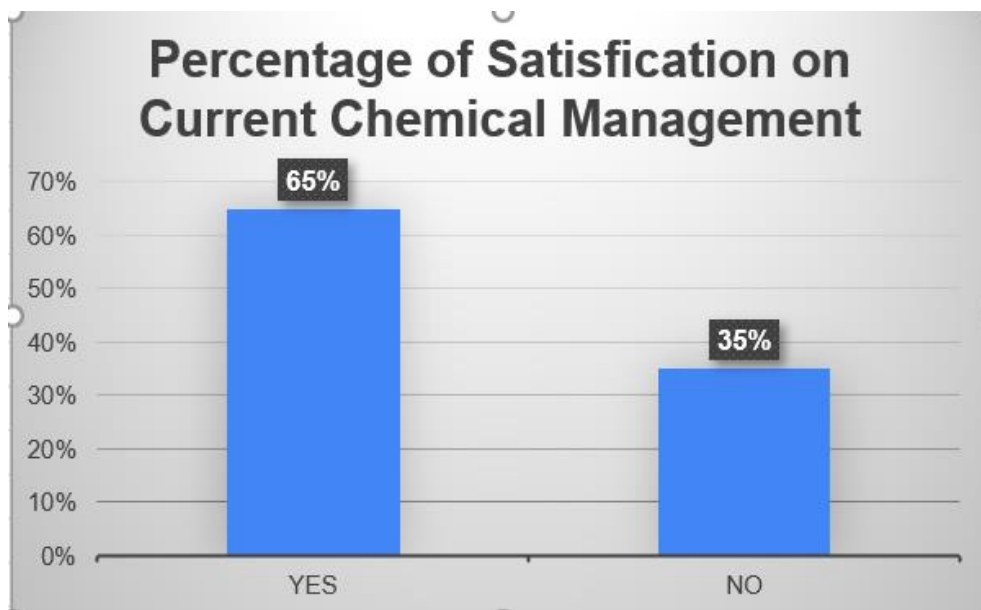

Figure 3: Percentage of Satisfaction on Current Chemical Management

Figure 4: Wishes on Having Smartphone App or System for Chemical Management

Based on the bar chart above, it shows that 65% of the stakeholders are satisfied with the current chemical management. Even though a high percentage of the stakeholders are satisfied with the current management, 80% of them would also like to have a smartphone system or an application for chemical management. From the pie chart above, 80% of the stakeholders are hoping to get a system for the chemical management to make the process more systematic and ease the process in accessing the facilities and chemicals.

Figure 5: Percentage of Preferences Function on The Chemical Management System
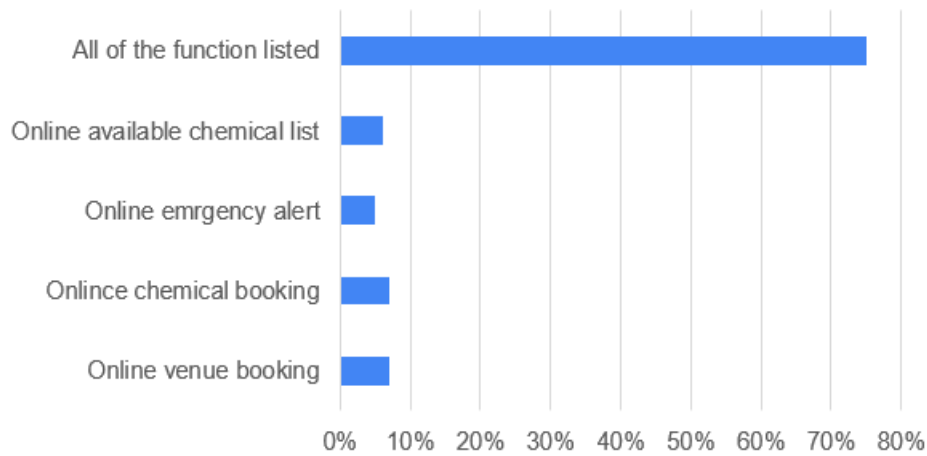
Last but not least, 75% of stakeholders are hoping that online available chemical list, online emergency alert, online chemical booking and online venue booking functions are available in the new chemical management system. In short, all stakeholders agreed that the existence of the chemical management system would be convenient for them.

Design Statement

The strengths and weaknesses of having Chemical Management System App are described below:

Strengths:

- o   Able to maintain an up-to-date inventory of all chemical used.
- o   Able to improve the current chemical laboratory management system by creating an app.
- o   Able to ensure users are given sufficient information and guidance about the chemical.
- o   Able to achieve the safe use of chemicals

Weaknesses:

- o   a stable Internet connection is essential
- o   only android users are able to download the App

Methodology

To complete this one semester group project, first, we need to identify the problem. We have been given a theme, "Agile Facility Management System" by the school. We did a discussion among our group members with the help from our Supervisor. Finally, we decided to choose "Chemical Management System" as our project title.

After choosing our project title, we need to do background research about our project to understand the concept. We did a survey and questionnaire through google form to find the solutions requirement and constraints for this project. From the survey result, we constructed a hypothesis for our project. We defined our objectives of this system which were to record all chemical that are being stored, allow user to check the availability of the chemical and laboratory, classify the chemical based on the level of hazard and record the activities of the laboratory. Then we did a planning on our program and schedule.

Then, we started to design our product, "Chemical Management System", by listing the main feature we wanted to include in our application system. After that the flowcharts of the main system and all of the features involved were designed and created. Then, we designed and developed a prototype of this system by using the Mobincube application developer. A lot of testing were done before the application was launched. We did an improvement to our product after every testing. After the product was launched, we asked some end user to test our application to get some feedback.

Product development

In our project, we choose Mobincube apps developer as our main platform to create and develop the Chemical Management System application. The flow of our application was designed and developed. User need to create an account before log in into our application. There were four main features with two additional features added in our application. The four main features were chemical substance record, chemical disposal record, chemical usage record and booking, and laboratory usage record and booking, while the two additional features were accident report and precaution handbook.

For the chemical substances feature, we inserted the list of chemical substance names and their hazards into the Mobincube. This feature is achieved by using Data View Screen. We inserted the list into database and adjusted the data visualization for user display. Thus, the user can access the information about the available chemical substances list in the laboratory and also be aware about its hazard for safety precaution. The step to use this feature was shown in Figure 8.
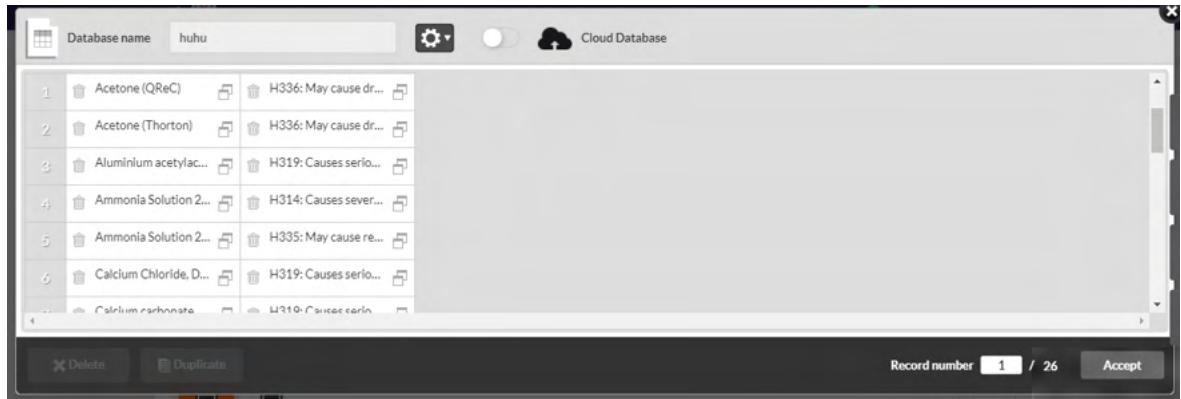

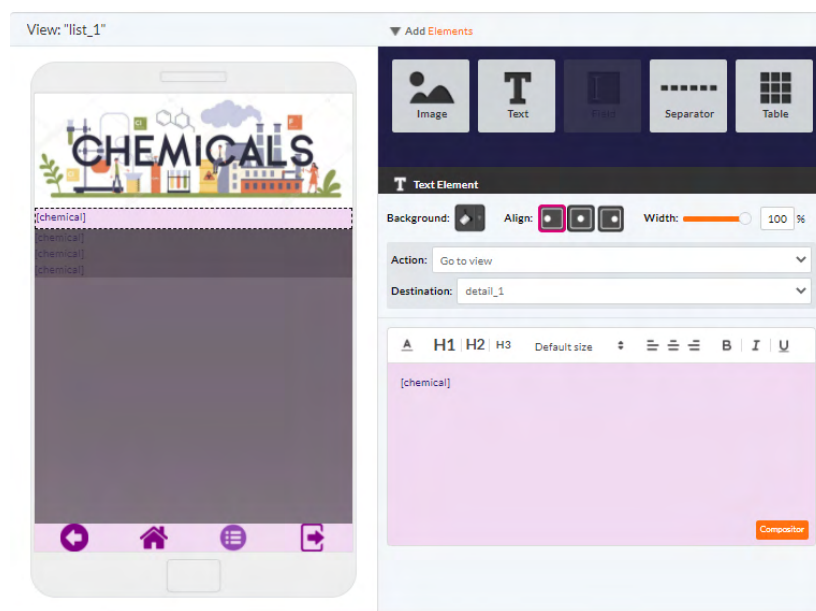Figure 6: Database in Data View Mobincube

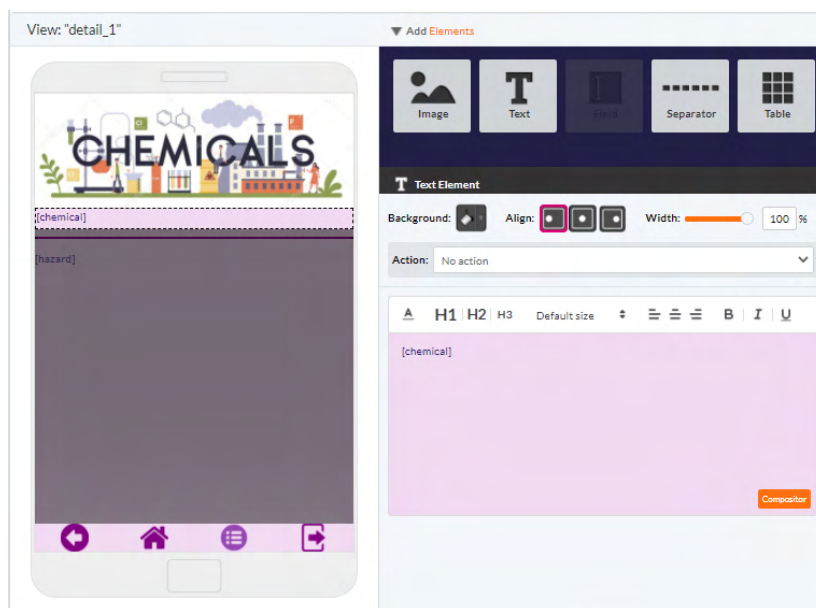Figure 7: Data visualization for Chemical Substances List

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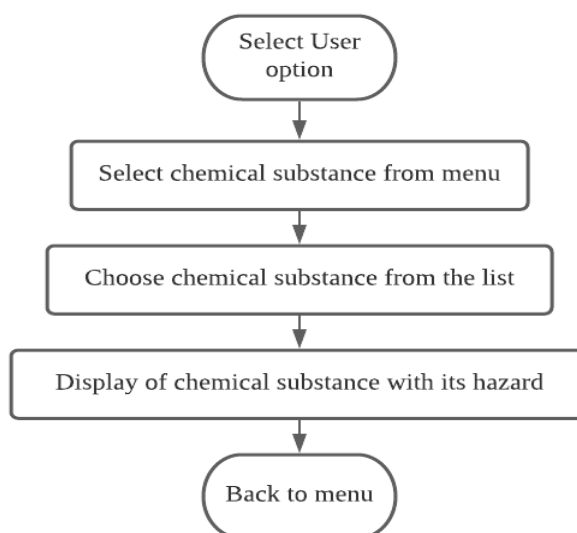Figure 8: Data visualization for Chemical Substances and its hazard detail

Figure 8: Flowchart of Chemical Substance Feature

For the chemical and apparatus booking feature, we used Google Form and Mobincube as our platform. This feature is achieved by using Online Web Screen. The list of question about the chemical and apparatus booking was created in the Google Form and be linked to the Online Web Screen. The data of the chemical and apparatus booking was saved in Google Drive and can been shown through Google Sheet. Therefore, admin can check the record of bookings through the Google Sheet anytime and anywhere without any disruption on sorting documents manually. The flow for chemical and apparatus booking was shown in Figure 10.
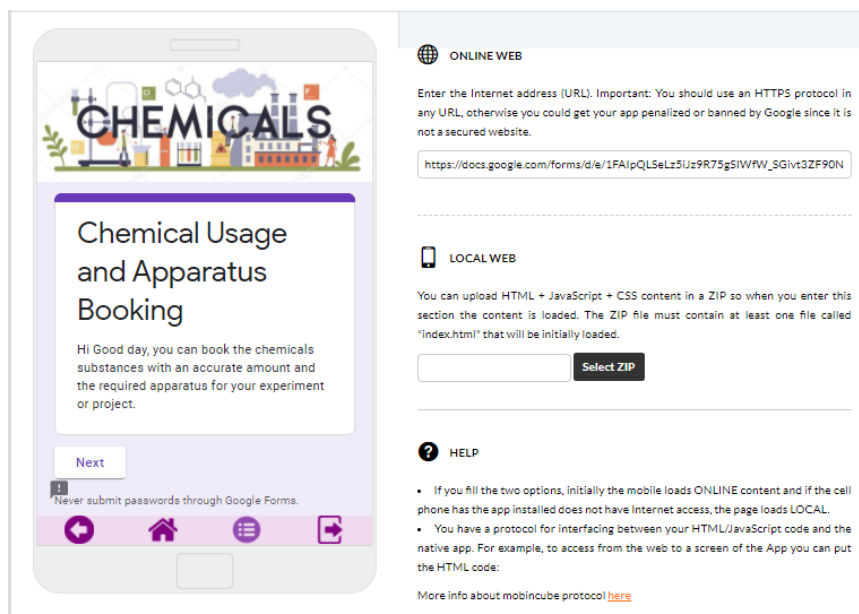
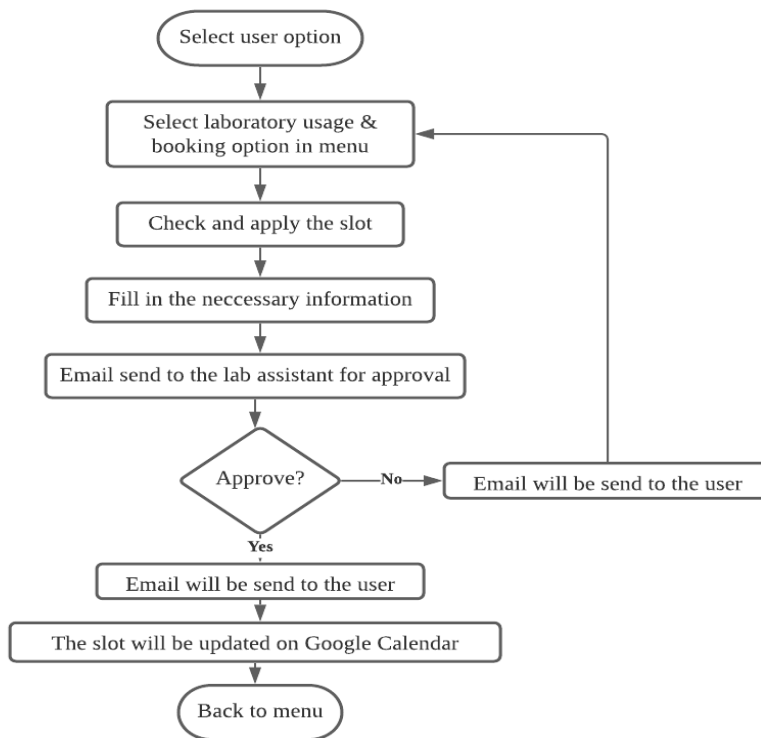Figure 9: Google Form linked to Online Web Mobincube

Figure 10: Flowchart of Chemical and Apparatus Booking Feature

We used Mobincube, Google Form and Google Calendar as our platforms to develop a laboratory usage record and booking system. This feature is achieved similar like chemical apparatus booking which is by using Online Web Screen. The Google Form attached with Google Calendar was created and have been linked with Online Web Screen. The calendar will update the user's booking slot if the slot already been approved by admin via email. So, user can check the availability of the laboratory and also update with the approval of lab booking from the admin via the app. Figure 13 illustrated the process of lab booking.
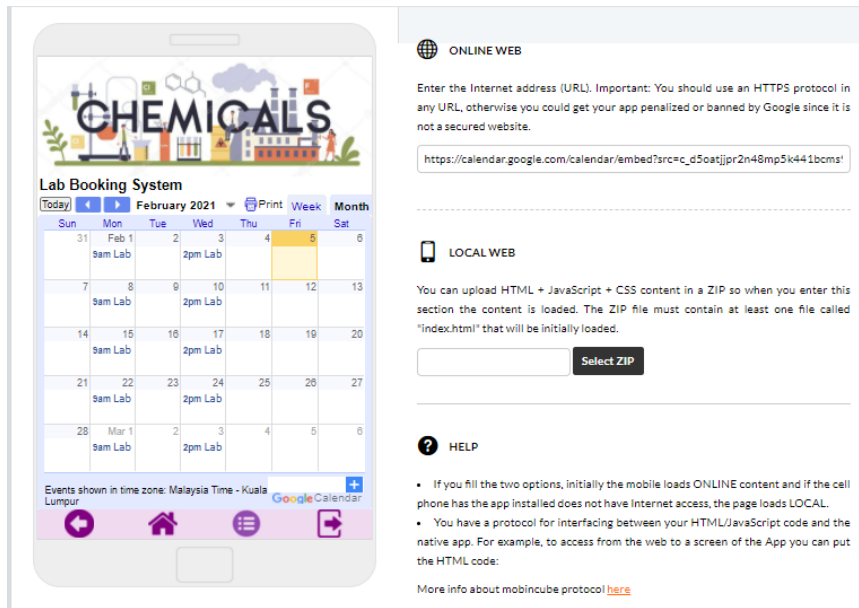
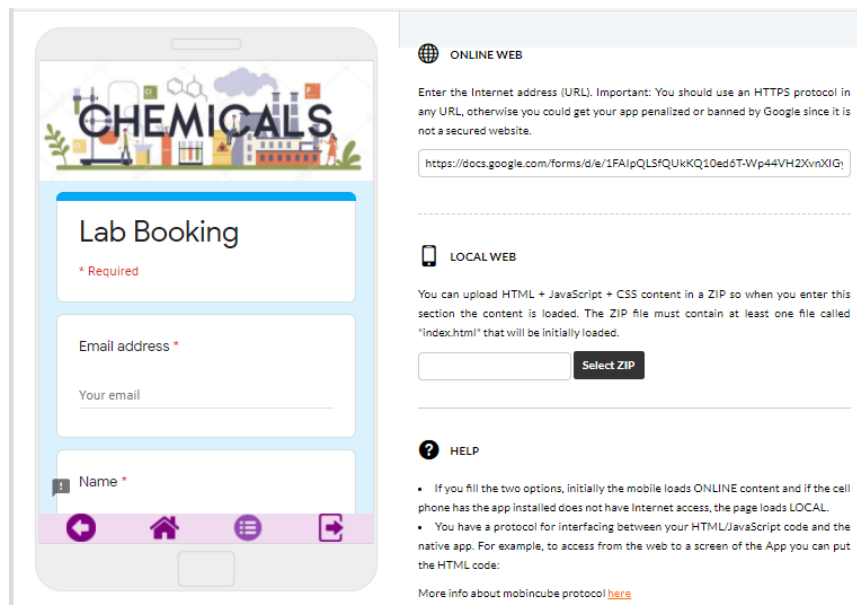Figure 11: Google Calendar linked to Online Web Mobincube

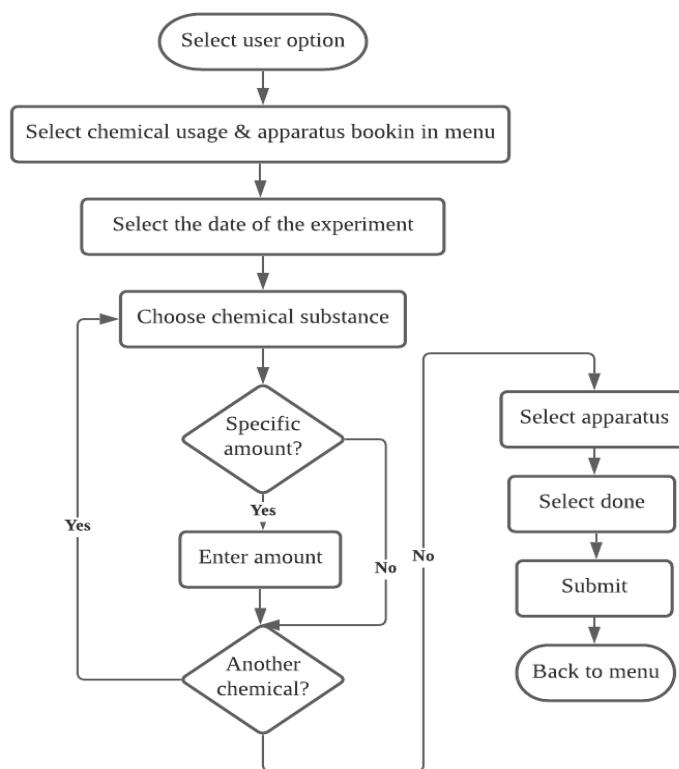Figure 12: Google Form linked to Online Web Mobincube

Figure 13: Flowchart of Laboratory Usage and Booking Feature

For our last main feature, we used Mobincube and AppSheet as the platform to create the chemical usage, disposal and stock feature. This feature was created for an admin or laboratory assistance use. This feature is achieved by using Option Screen. We set open URL as its action to run the app directly because AppSheet is also another mobile app generator not similar like Google Form and Google Calendar which we can embed and deploy it easily into mobile app generator. So, admin will access directly the AppSheet whenever he/she click the chemical usage, disposal and stock feature button. We inserted the initial stock and also chemical usage of chemical substances into the AppSheet. The AppSheet can update the total number of chemical inventories in real time and can also be accessed in Google Sheet. Figure 16 illustrated the process for chemical usage, disposal and stock.
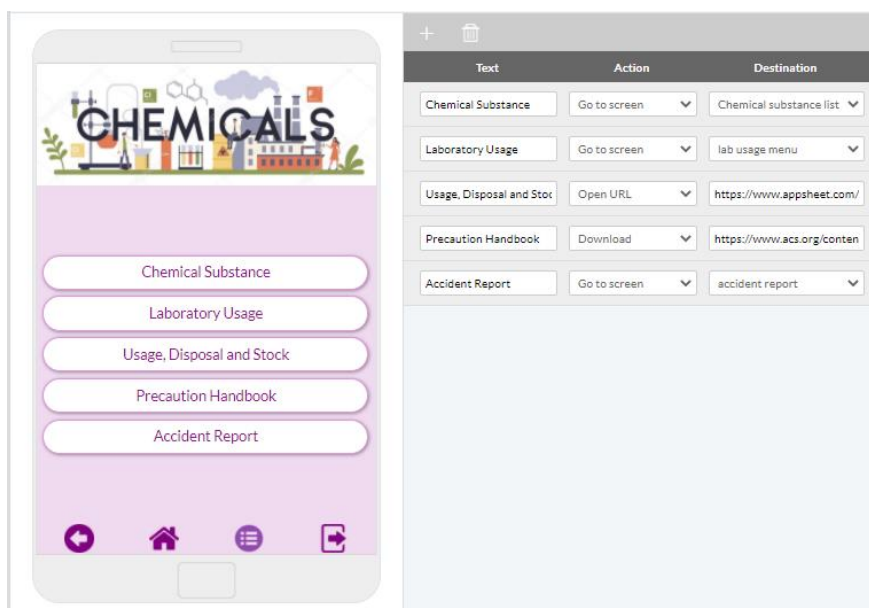
Figure 14: AppSheet browser link on Option Screen Mobincube
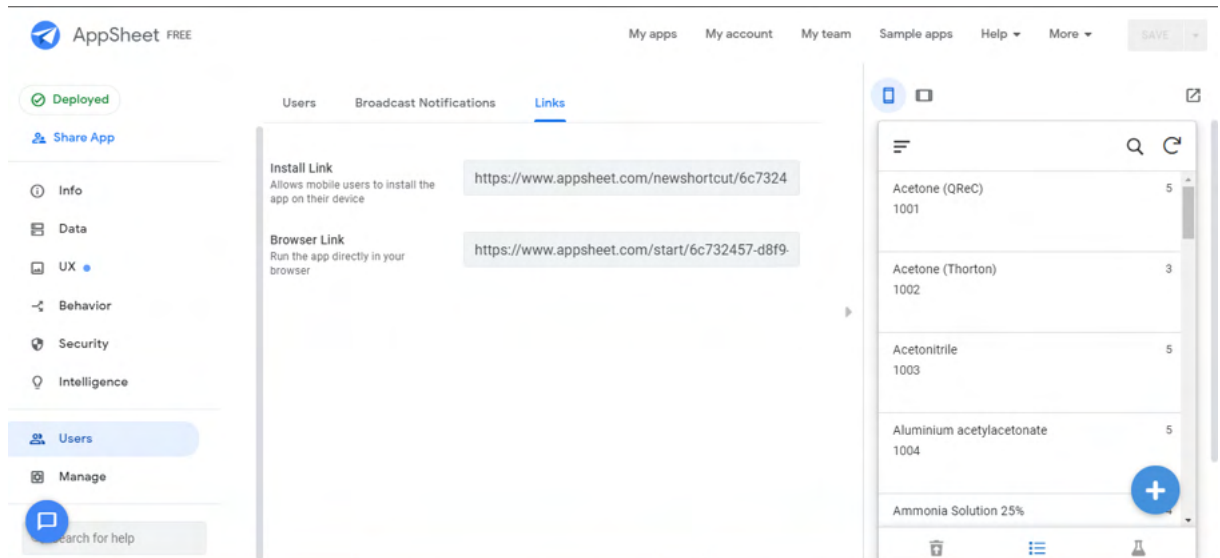
Figure 15: AppSheet Interface
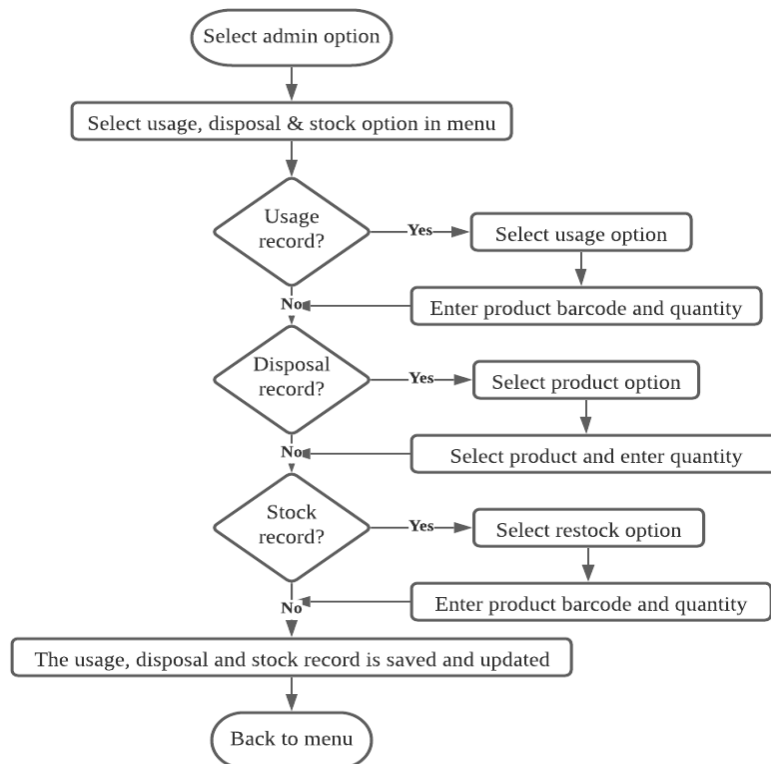
Figure 16: Flowchart of Usage, Disposal and Stock Feature

For the additional features, we added the precaution handbook into the Chemical Management System application for safety precaution before entering the laboratory. The user just needs to enter the button and the precaution book will be automatically downloaded. For the accident reports feature, the email of the accident report will automatically generate to the admin after the user enter the report buttons. This feature is achieved by e-mailer. There are three levels or types of report which were apparatus damage, minor injury and major injury.

Figure 17: Precaution Handbook download link on Option Screen Mobincube

Figure 18: Accident Report e-mailer link on Option Screen Mobincube

Discussion on Developed Product

Discussion and Result:

The Chemical Management System which is a mobile application for chemical management in terms of recording and booking was achieved merely by software. We develop the application mentioned through a free mobile application maker which is known as Mobincube. All required features for Chemical Management System are successfully achieved through Mobincube.
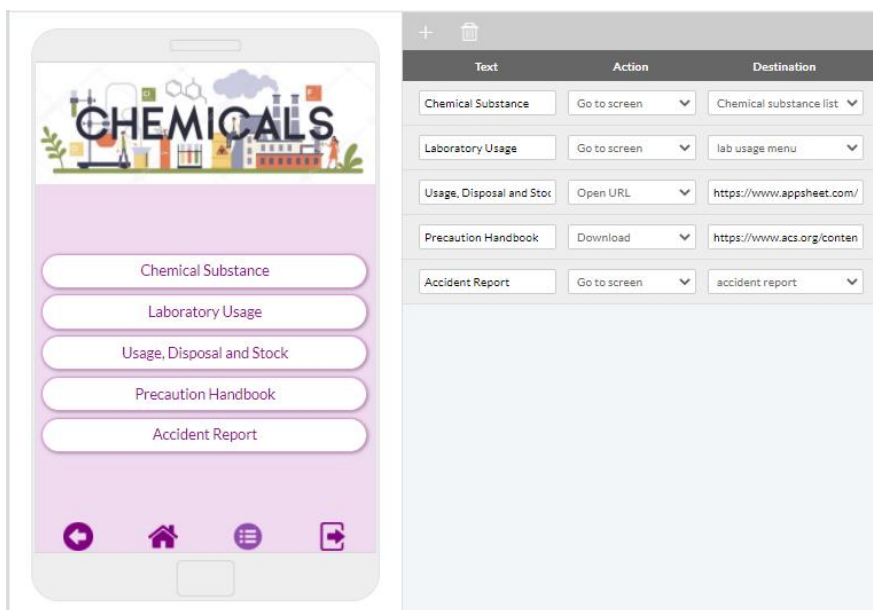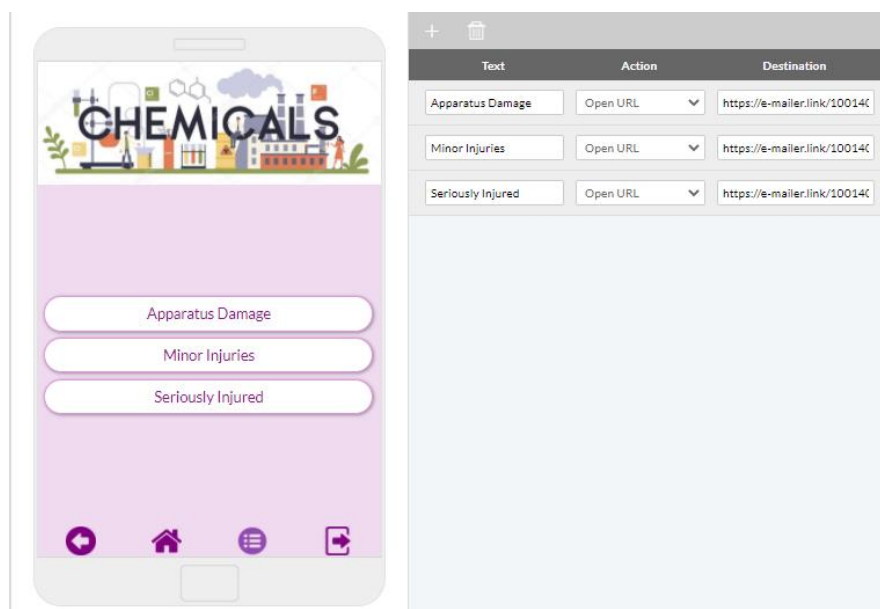
The main purpose of creating Chemical Management System mobile application is to increase the effectiveness and efficiency in managing the chemicals substances. By converting the routine chemical management process from manual to via online database through mobile application, the process such as laboratory booking, laboratory booking approval, chemical substances and apparatus booking, chemical usage, disposal and stock update as well as accident reporting can be done in shorter time. The results shown in Table 1 below are obtained by experimenting the listed process by using Chemical Management System mobile application. The manual procedure that currently been utilized in UTM usually take more than five minutes or even more. Therefore, the Chemical Management System mobile application has the potential to increase the effectiveness and efficiency of chemical laboratory management.

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Process	Time Taken
Laboratory Booking	< 40 s
Laboratory Booking Approval	< 30 s
Chemical Substances and Apparatus Booking	< 60s
Chemical Usage, Disposal and Stock Update	< 80s
Accident Reporting	< 40s

Table 1: Time Taken for Each Process

The advantages of Chemical Management System mobile application are not only reducing the time taken for routine chemical laboratory process. It also allows the laboratory assistant to have proper and systematic record of the usage, disposal and type of chemical substances.

Figure 19 below is the end user feedback on the Chemical Management System mobile application. From the result shown in Figure 19, it proves that majority of the end user are satisfy with the features of Chemical Management System mobile application. Majority of the end users rate the feedback categories (experience, easy to use, all-in features, reliable and fast and responsive) at 4 and 5, few of them give a rate at 3. Overall, the end users are satisfied with the Chemical Management mobile application but improvement is also needed to fulfil all end user's requirement.
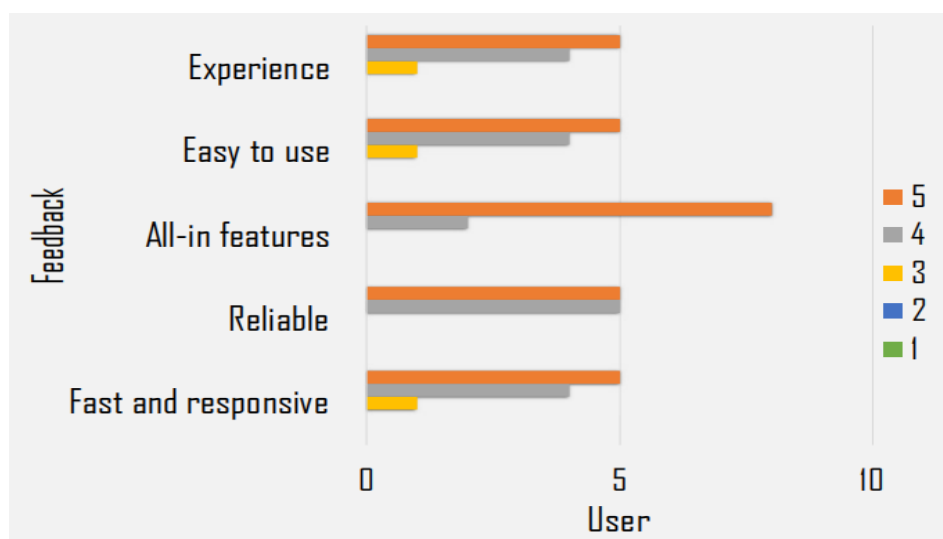

Figure 19: End User Feedback

Innovation:

The Chemical Management System mobile application is solely developed base on the creativity and innovative without referring to others works. The main innovation we would like to highlight here is converting the process in managing the chemical substances information regarding its classification, disposal record and usage from manual to online. This innovation makes the chemical management process become easier and more systematic. Other than the chemical management related features, the innovation also done on the way in reporting the accident cases and preventing the accident cases. The accident reporting button and precaution handbook were embedded inside the Chemical Management System mobile application.

Student are able to report the accident case through the accident report button in very short time for reporting purpose and getting advice and help from laboratory assistant. The precaution handbook embedded in the Chemical Management System mobile application allow student to access it at anytime and anywhere. Overall, the innovation is mainly focus on improving the efficiency and effectiveness for the students in accessing the chemicals and laboratory assistant in managing the chemical substances.

Conclusion

The final prototype, Chemical Management System mobile application is working properly as expected and able to improve chemical management in UTM. Chemical Management System which manages chemicals via online database through mobile application is more convenient compare with the current chemical management system are manually managed by different procedures. The Chemical Management System mobile application we created

is fulling the STEEP. In term of social, chemical management system will ensure the safety of the chemical user especially students and lecturers and also manage the chemical systematically with proper system requirement. The application that we created is able to introduce a new way of managing the chemicals using technology.

In addition, Chemical Management System can track the disposal of chemical which is harmful to the environment by the proper record. Therefore, the action to be taken for solving environmental pollution due to chemical substances will be more efficient. In the economy aspect, Chemical Management System can make sure laboratory users only take the required amount for their experiment or project to avoid waste on a chemical substance. Cost-saving due to more effective in using chemical substances. Last but not least in term of political, Chemical Management System mobile application can reduce the possibility of misuse of the chemical substance which on the edge towards illegal actions by having proper and detail chemical usage record. For future improvement, Chemical Management System can be integrated with UTMSmart so that only single mobile application is needed to be downloaded by students.

Acknowledgement

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SKE ONLINE BOOKING SYSTEM

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Abstract: This paper will cover the implementation of the current booking system by emphasizing the criteria that will be included based on the surveys that have been done in order to improve the current booking system by focusing on the practical web-based system to perform the facilities booking in SKE for the students and lecturers as well. Although, the surveys are done by distributing the google forms and questions form in email to the students, lecturers and staff as they will be selected in order to recognise the real problem and solution that need to be implemented.

Keywords: Online booking system; time consuming; XAMPP environment; SKE

Introduction (Project)

School of Electrical Engineering (SKE) has a current traditional booking system which the manual booking system that need to fill in the forms that has long been troubling the users which are the lecturers and students in which the process for booking are time consuming, non- users friendly, and the availability of the room is not easily known to the users. Although, all of those problems really need an action in order to improve the system that can be beneficial to all the users as well as the practical booking system.

Nevertheless, the proposal had been done which to propose a booking system that would be internet based in which the users will be provided the opportunity to view the availability of the rooms, directly apply for the desired room and also be able to complete and know their request has been approved with only a few clicks as easy as on fingertips. Therefore, the web-based system is introduced by emphasizing all of the important components to be implemented by the current booking system which will be creating the practical and smooth booking system that can ease the end-users (lecturers and students), and admin (staff) that can create the win-win situation.

After that, by looking at all the common problems as stated above, the research and analysis will be done by distribute the surveys from google forms and softcopy forms to the selected lecturers, students and staff in order to find out the real problems from the current booking system and get the suggestions for improvement from the users itself from both party itself which are the users and admin. Then, all the survey information will be analysed and arranged

by the majority of the problems occurring in order to have a good solution and find the best tools for the proposed booking system.
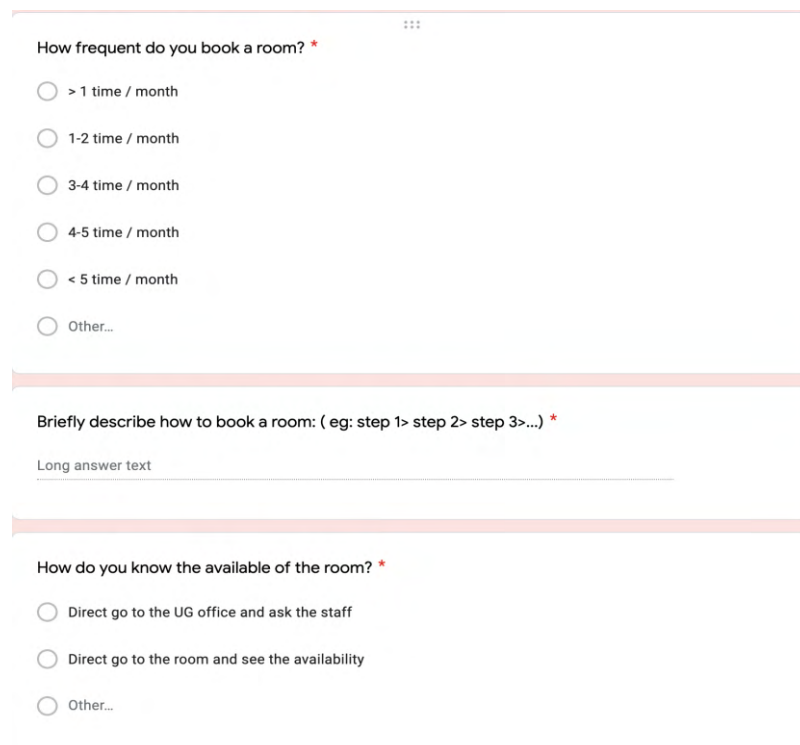
Next, the tools used for our proposed system are the use of the environment XAMPP software which will include MariaDB as a database, the PHP as a language and Apache for the web server. XAMPP is the most popular PHP development environment which are easy-to-install, totally free Apache distribution that includes MariaDB, PHP, and Perl.[1] To be extremely easy to install and to use, the XAMPP open-source package has been set up. XAMPP is periodically updated with the new Apache, MariaDB, PHP, and Perl updates. It also comes with a number of other modules, including OpenSSL, phpMyAdmin, MediaWiki, Joomla, WordPress, and more. There can be several self-contained XAMPP instances on a single computer, and any given instance can be copied from one computer to another (Smaller version).[2]

Objective

The objective for this project will included to provide the simple process of booking applications with the best end user's interface, to create a web-based that can easily be accessed by users and admin and lastly to provide the easy booking system with zero costs of investment.

Description and analysis

In order to find a solution for the booking system, we undergo a simple interview through google form and one-by-one question interview by questioning the person who experiences the problem such as students, lecturers and the secretary of Electrical school itself. The interview questioned is divided into two categories which is for students or lecturers and for secretary of the school.

Figure 1 Questionnaire for respondents.

Figure 2 Questionnaire for respondents.

As we can see in the Figure 1 and 2, the example of the question ask is how frequent the booking has been made, how the process of the booking, how long the process takes, difficulties in booking the room, etc.

Figure 3 Questionnaire for staff in soft copy.

Figure 3 shows an example of the interview question for the school's secretary. How the process flows, Specific problems for every room, improvement for the booking system and etc were stated clearly in this problem.

From this interview, some information about the difficulties of the booking process have been discovered.
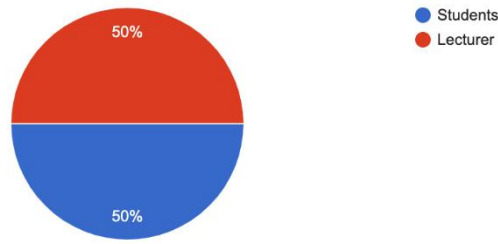
Figure 4 Percentage number of the respondents.

Figure 5 Percentage for the respondents' position.

From Figure 4 and Figure 5, a total of 10 people which 50% of both are lecturers and students. The students interviewed are the students who experience booking rooms such as current and former Student Representative Council, Member of a club (Jurutek) and Secretary.
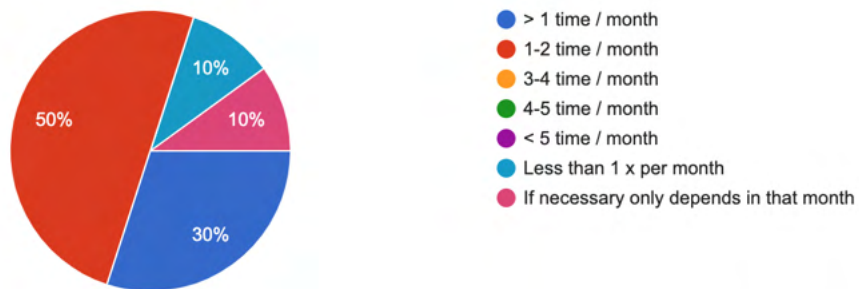
Figure 6 Percentage of booking time of the respondents.
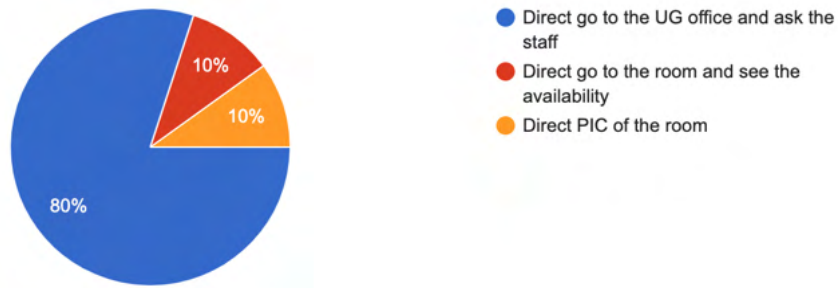
Figure 7 Percentage of the ways of knowing the available room.

From Figure 6, booking rooms are very often made, eighty percent of them made a booking every 1 or 2 months while the others only made the booking infrequently. From Figure 7, the problem faced when to do a booking. It is necessary for them to go to the office or room to make a booking which consumes more time.
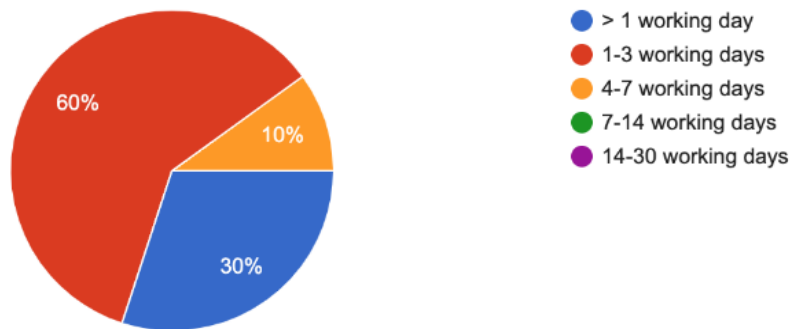
Figure 8 Percentage of booking process time.
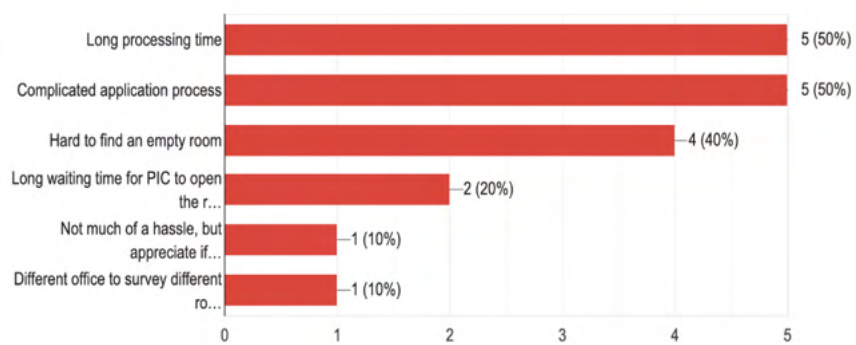
Figure 9 Percentage of difficulties and current problem from the current booking system.

From Figure 8, the results of the interview shows that the average time for the booking process is 3 to 4 days. Only few of the results got more than one day. It gives a hard time for users who want to make a booking immediately. From Figure 9, all of the students and lecturers complained about the booking process which took a long processing time and complicated application process. Other problems faced by few of them were hard to find empty rooms, different procedures for different rooms, etc.

We are currently devising an application, is there any feature that you wish to see us implement?
10 responses

Smart Faculty online booking system

Online booking system

Can view available dates and room occupancy (how many can fit), picture of room

As mentioned above

Make it easy by putting it in the menu for booking room in UTMSmart Apps

can look at the room that had been booked

Online booking system.

Implement room booking, payment, and receipt

Yes, a fair system that allows booking. A person not allowed to hoard all rooms for the entire semester. Only allows booking max 2 weeks ahead. This way it is fair.

Figure 10 Suggestions on the recommendations and improvement from current booking system.

In Figure 10, some of the improvements and features suggested by the students and lecturers were an online booking system which can show the availability of the room, limited booking per students/lecturers, etc.

Design statements

The online booking website prototype is designed specifically for all the students and lecturers in the School of Electrical Engineering faculty. It features a login page, profile page, available room in real date and time, etc.

Login Page	Second Page	Users profile	Booking Page
● Faculty logo /booking logo. ● Login ID ● Password	● Booking page/layout ● User's profile	● Details of profile ● Details on the user's booking	● Name and venue ● Time ● Occupied status ● Design in timetable form

Figure 11 Characteristic and features of online website.

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From Figure 11, the first page when you browse the website is the login page. The login in page will show a booking/faculty logo and contain a login form which users need to fill in the login ID and password to log in to their profiles. On the second page, it contains the user's profile button and booking page/layout button. By clicking the user's profile button, it shows the user details which can be edited and shows the details on the user's booking. On the booking page/layout, the page will show the specific name and venue with real time and date. The page was designed in a table form which can show the occupied status and also can book/cancel any empty booking slot.

Methodology

This capstone project starts with research and identifying user's needs by interviewing users through google form and direct interview. After the result had been obtained, this project continued with literature review and research to find the solution. By doing some research, some idea on developing an online system has been obtained. After doing the research and deciding for the solution, the project proposal is proposed to our supervisor to confirm the continuation of the project. After the project proposal was confirmed, the development of the project started with study and research on creating an online website. The development of the website was then continued with the development of the software using an open-source application which is free and tolerable to understand. The development of the software takes 5-6 weeks of study. A troubleshooting process was proceeded after the completion of the online website. Finally, the project and the documentation were finalized by our supervisor and finished with the project submission and presentation for the faculty's seminar program.
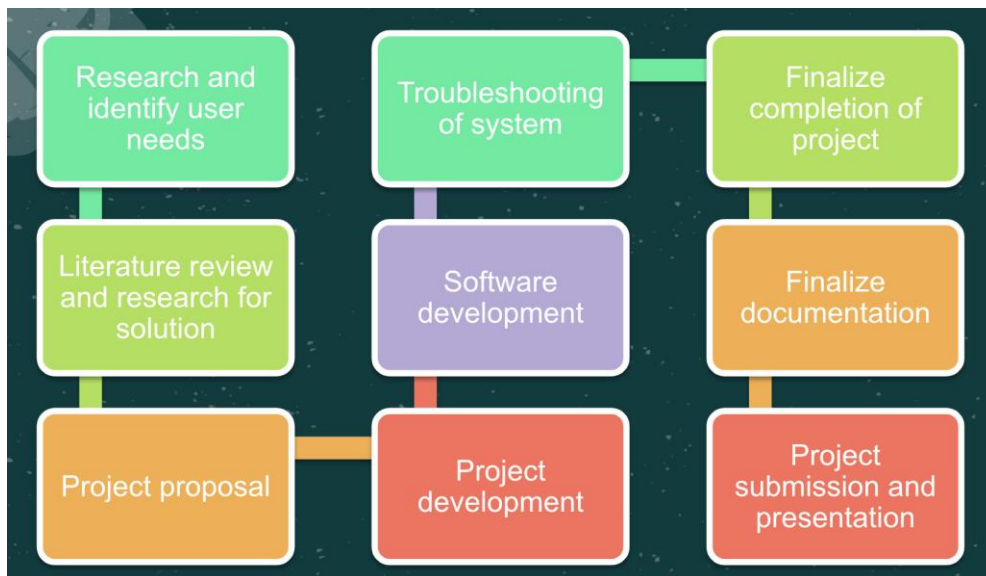

Figure 12 Simple flow of our project throughout the semester.

Tasks	Start Week	End Week	Capstone Week									
			5	6	7	8	9	10	11	12	13	14
Set up Laptop enviroment	6 ▾	6 ▾	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
Webpage development start	7 ▾	8 ▾	☐	☐	☑	☑	☐	☐	☐	☐	☐	☐
Login interface and development layout for user	8 ▾	10 ▾	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐
Navigation design	9 ▾	11 ▾	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
Website content (Graphics, Images, Calender)	9 ▾	12 ▾	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
Database content and link	8 ▾	12 ▾	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐
Development layout for admin	9 ▾	12 ▾	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
Validate and test the webpage	8 ▾	12 ▾	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐
Documentation	12 ▾	13 ▾	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Presentation	13 ▾	14 ▾	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 13 Gantt chart on development of the project.

Product development

- *Tools for web page development*

The booking system is done by using XAMPP. XAMPP is a free and open-source web server package developed by Apache Friends. The package contains MariaDB, Apache, PHP and Perl. XAMPP is the best environment for web page development using PHP and Apache.

Figure 14 XAMPP control panel.

- *The webpage*

The login pages

The login page is the first page of the webpage that requires users or admins to login before proceeding to the next page.

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Figure 15 View of login page.

The user interface for users

When login as a user, the page will direct to the control panel for the user.
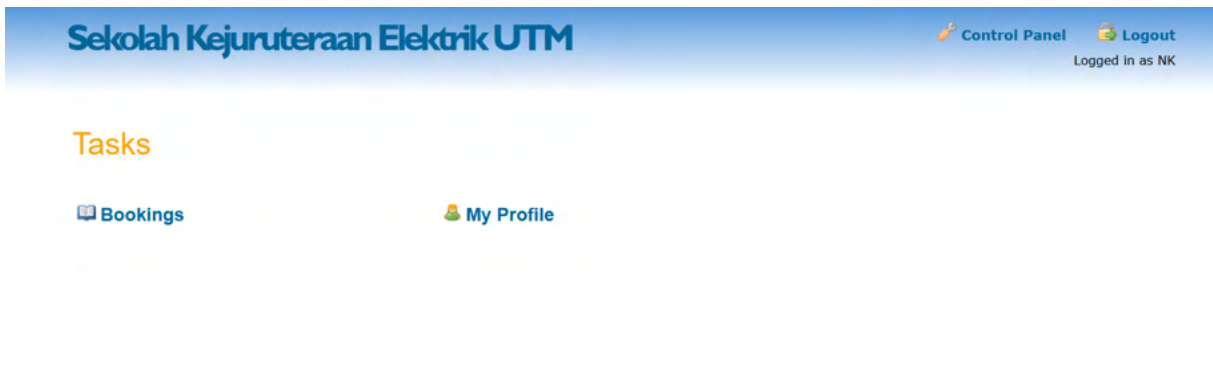
Figure 16 Control panel for the user.

There are two main buttons in the control panel. When a user wishes to book a room, click "Bookings". Then the webpage will be directed to the booking page.

Figure 17 Booking interface for users.

The periods in pink are the timetabled lessons which could be set by the admin and the periods in blue are the bookings by the users.

When a user wishes to view his past booking history or current active bookings, click "My Profile" to enter the user dashboard. The user also could make changes of his details by clicking the "Edit my details" button in the user dashboard.

Figure 18 User's Dashboard.

The user interface for admins

When login as an admin, the page will be directed to the control panel for the admin.

Figure 19 Control panel for the admin.

Admin can handle all bookings by clicking "Bookings" in the Tasks.
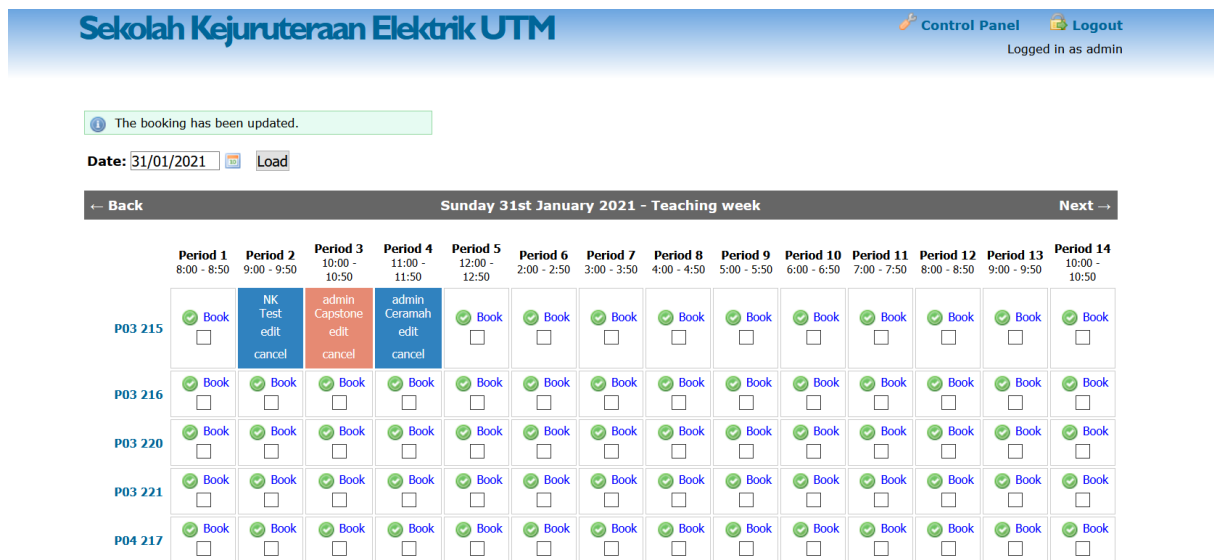
Figure 20 Booking interface for admin.

Admin can edit or cancel all kinds of bookings including users' bookings. Admin can also arrange the scheduled periods for timetable and book a room as a user.

Figure 20 shows the dashboard for the admin. The dashboard of the admin is similar to the dashboard of the users.
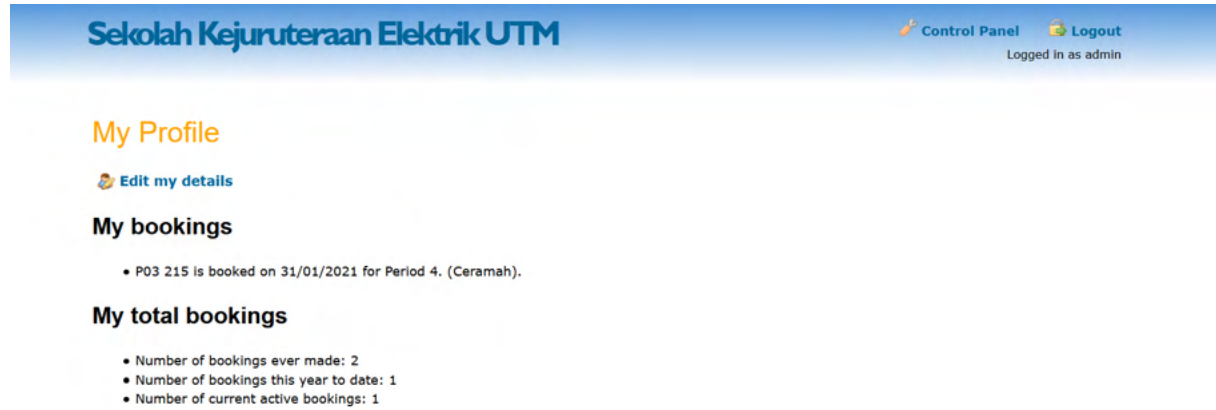
Figure 21 Admin's dashboard.

Admin also can set the time of period in the "The School Day".
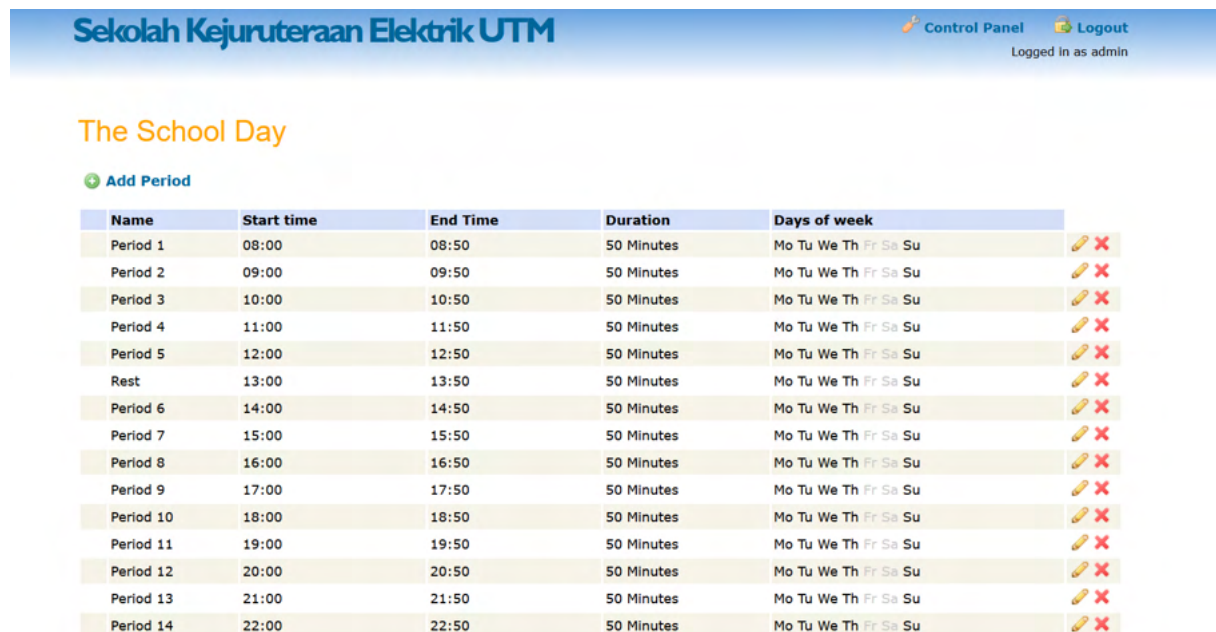
Figure 22 School Day interface page.

Admin can set the category of week in "Week Cycle". This will let admin easier to set the timetable schedule.

Figure 23 Week Cycle interface page.

Admin can set the holidays when clicking the "Holidays" button. When a day is defined as a holiday, nobody can book a room on that day.

Figure 24 School Holiday interface page.

Admin can add, delete or edit a room when clicking "Rooms". Admin could insert descriptions, photos and directions to the rooms.

Figure 25 Rooms interface page.

For the management part, admin can manage the users who use the web page when clicking "Users". Admin can add, delete or edit the users and admins. Admin also can import the users from .csv files when there are a lot of users to be added at one time.

Figure 26 Interface for admin to manage users.

Admin also can do some basic settings when clicking "Setting". Admin can customize the bookings page as shown in Figure 27. Admin also can customize the date format, set login message and enable maintenance as shown in Figure 28.

Settings

Figure 27 Setting page (first part).

Figure 28 Setting page (second part).

Discussion on develop product

The webpage is developed to fulfil the theme "Agile Facility Management System". The purpose of this webpage is to ease the booking process of the school. The webpage contains two parts, which is the users' part and the admins' parts. The difference between the two parts is the admins' part contains more authorities than the users' part.
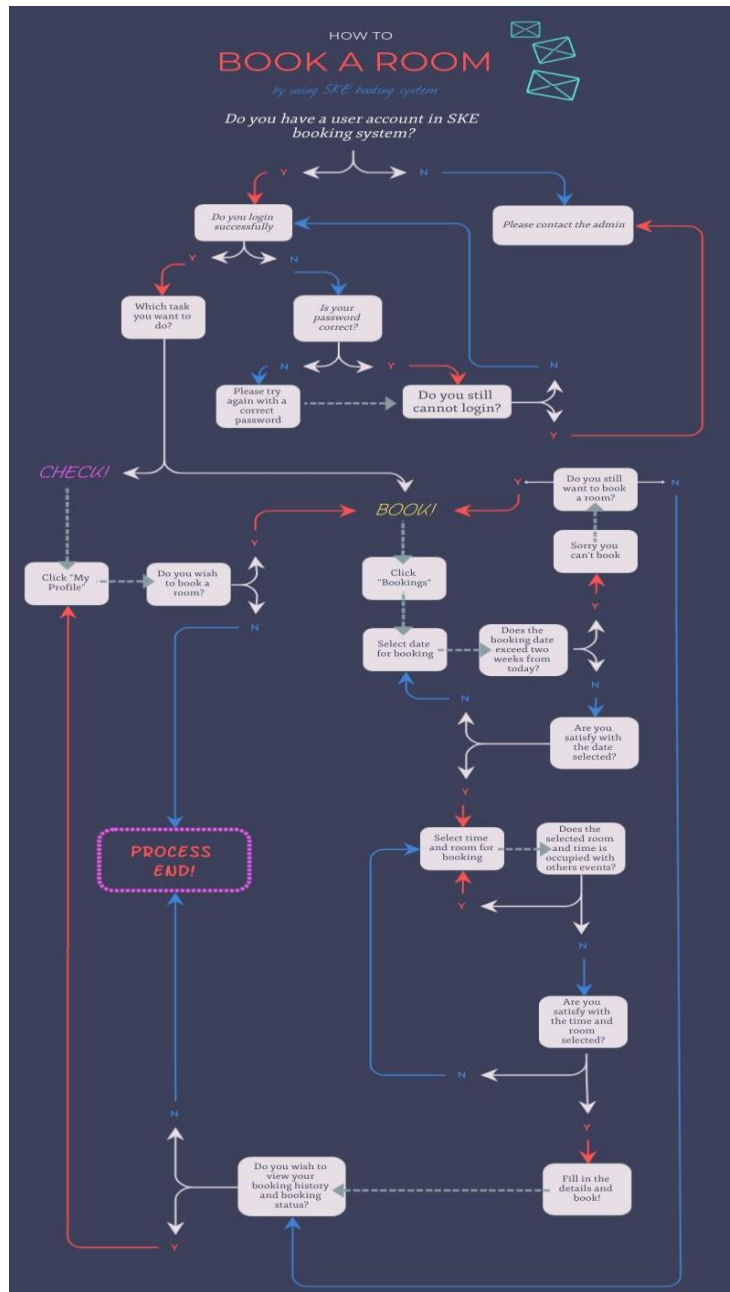
Figure 29 Flowchart for the booking process for the users.

The website is user-friendly as booking a room requires just a click on the webpage. Users also can view other users who booked a room within the same booking page. This will let the users negotiate among themselves when there is a conflict with the needs of the rooms. Furthermore, admins could set the number of days for booking in advance so that there are no users who could occupy the same room for a long period of time. This will let the booking procedure be fair for the users.
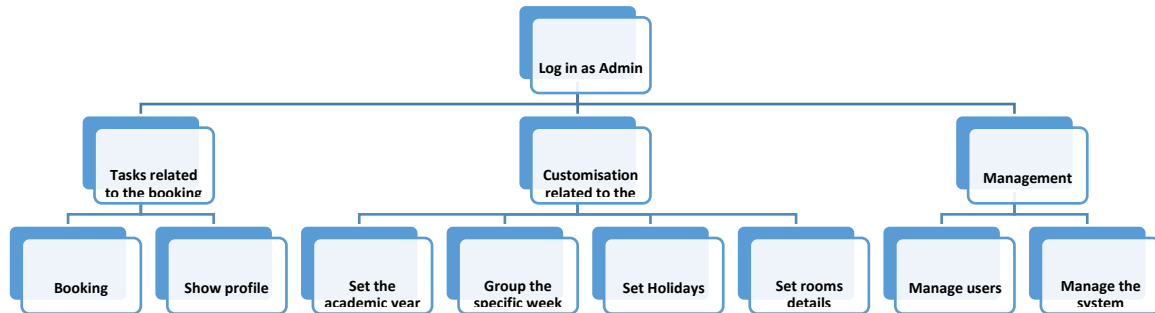
Figure 30 Authorities of admin.

Admin has more authorities than the users. Admin can manage bookings in the booking page, set up the timetable period, set up the duration of the academic year, set up the holidays throughout the academic year, and manage users and the systems. The admin also can customize the display format of the date and time, the login page and the booking page in the settings. When there is maintenance needed, admin can enable maintenance mode to prevent users from booking a room at that period of time.

Conclusion

In conclusion, an automated booking system for SKE is successfully built. This system is a web-based system and synchronize system which gives a quick response to the booking process and is easy to use. It solved the pain points of the respondents, who feel that the current booking process is a long and complicated process. The users are given the authorities to book a room and view the booking status only while the admin of the booking system is given the authorities to edit the bookings. This will let the admin have more flexibility when using the webpage. Future work can be done such as developing an app version of the booking system or linking the web page to the MyUTM webpage can be done to make this system more convenient and user-friendly.

Acknowledgement

In performing the capstone group project, we had to take the help and guideline of some respected persons, who deserve our greatest gratitude. The completion of this project gives us much Pleasure. We would like to show our gratitude to our capstone group project lecturer, Dr. Arnidza binti Ramli, Universiti Teknologi Malaysia for giving us a good guideline for this group project throughout numerous consultations. We would also like to expand our deepest gratitude to all those who have directly and indirectly guided us in solving this project.

Many people, especially our classmates and team members themselves, have made valuable comment suggestions on this methodology which gave us inspiration to improve our project. We thank all the people for their help directly and indirectly to complete our project.

Nevertheless, this group project really gave us the positive impacts throughout the solution process which will meet us with the new knowledge and understanding of handling the project that can be applied after graduation which in the real world as an employee. Lastly, we would like to develop this knowledge through the working environment and the real world as the positive impacts really give us good understanding throughout the process.

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Smart Scheduler System for Lectures

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Abstract: The platform that is currently used by the School of Electrical Engineering to deliver timetables and reserve a classroom is not efficient and is time consuming. In this project, we tend to solve this problem by introducing a smart scheduler system to the school for resource optimization. The system will provide functions such as timetable display, room booking and navigation to the users. Our endeavor through this capstone project is to develop a smart scheduler system to the School of Electrical Engineering to solve the mentioned issues. In order to develop the system, we had conducted a Google form survey to collect the opinion of many on which features should be included in the system. The tools that are used to develop the smart scheduler system is WampServer which consists of PHP programming language and MySQL database. Finally, this system was evaluated and tested. Although this project is yet to achieve its completion, a further development plan will be included.

Keywords: Timetable; Scheduler; Room Booking; Navigation

1.0   Introduction

Currently, the platform that is used by the School of Electrical Engineering to deliver the timetable to students is through the online media such as Facebook page. However, this has caused a lot of inconvenience to the students because some of the students may not receive the timetable as they did not subscribe to the Facebook page or they do not have any Facebook account. Next, there is also no convenient platform for lecturers to search for their timetable as normally lecturers need to get their timetable from the office. Other than that, the platform that provides the user to do room reservation is through a phone call or filling a booking form in the office. Hence, the lack of a good management system had led to problems like time consuming and less efficiency during the process of getting the timetable and booking a room. Therefore, in this project, a more convenient online platform known as a smart scheduler system for lectures will be proposed to address the problem.

1.1   Objective

The objective of this project is to create a platform or website that can help users (students and lecturer) to get class or subject timetables easily, provide navigation to the user and provide a room booking system.

1.2   Scope

The scope of this project is the system will provide 5 features to the user which are:-

1. Student timetable - Allow users to check the class timetable by just choosing course and section. (Example: 1SKEE SEC 01).

2. Subject timetable - Allow users to check for the subject timetable by choosing the subject's code. (Example: SKEE 4723 Capstone Project).

3. Lecturer timetable - Allow lecturer to check for lecturer's timetable by choosing the lecturer's name. (Example: Dr. Mohammad Hafiez).

4. Navigation - Provides navigation function to the user. Users can choose for the building block number such as P16, then the system will direct the user to Google Maps and navigate the user to the correct place.

5. Room booking - Allow users to make reservations for any available room for extra classes or activities.

6. Admin login - Allow admin to insert the information of lecturer, class timetable, subject timetable and lecturer timetable. The system provides the import file function which can help the admin to insert the information to the database easily.

2.0   Description and Analysis for Survey Form

Figure 2.1 illustrates the distribution of participants participated in the problem and solution survey before starting the system design. This analysis is based on 75 responses of first, second, third- and fourth-year undergraduates and also lecturers; 64 of the students were from faculty of engineering consisting of 6 different schools which are, School of Electrical Engineering, School of Mechanical Engineering, School of Civil Engineering, School of Computing, School of Chemical and Energy Engineering and School of Biomedical Engineering and Health Sciences. Meanwhile, 98.41 percent of the lecturers were from the faculty of engineering while only 1.59 percent of the lecturers were from the faculty of science.

Figure 2.1 Distribution of Participants in Problem and Solution Survey

Figure 2.2 shows that the majority of the students (90.5%) and lecturers (90%) face difficulties during course registration. This indicates that the majority of the students and lecturers are recognising the inefficiency of the current course registration system which can be due to several reasons. From the analysis of reasons given by the stakeholders, more than half of the students (55%) and lecturers (73%) believe that clashes between subjects taken are the main reason why they faced difficulties during course registration. A slightly high portion of students (24%) and lecturers (18%) continued to struggle with course registration due to insufficient capacity of the desired subject. Other than that, the difficulty of class registration stem from the preference of students (19%) and lecturers (9%). However, a slight number of students (9.5%) and lecturers (10%) believe that the current registration method is agreeable and leads to no problem for the group.

Figure 2.2 Distribution of Problems Faced during Class Registration Process

Figure 2.3 illustrates the percentage of class schedule preference for lecturers and students. Two options were given in the questionnaire, which includes self-making a schedule or using an assigned class schedule. Based on the questionnaire, more than half of lecturers (54.5%) prefer using an assigned class schedule while almost half of the other lecturers (45.5%) prefer making their own schedule. For students, it was found that almost half of them (49.2%) prefer making their own schedule, while 50.8 percent of them would like to use an assigned schedule for daily class purposes. As we analyse the data, we can see that the opinion of lecturers and students regarding class time schedule are quite similar.
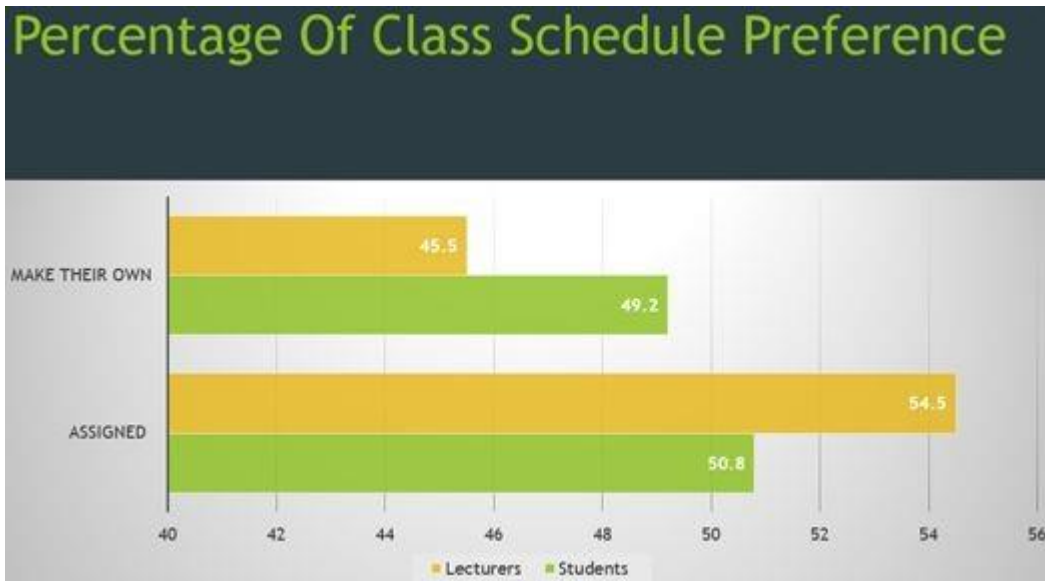
Figure 2.3 Preference of Class Schedule Design

Figure 2.4 Opinion on Scattered Class Location

Figure 2.4 shows the opinions of students and lecturers regarding the scattered class location in their daily class schedule. Scattered class locations are a situation where the class location of subjects is not planned strategically. Based on the data obtained, Majority of students believe that the scattered class location is troublesome for them, while 14% of them think oppositely. For lecturers, all of them believe that the scattered class location is troublesome.

It is notable that online platforms are the primary key to achieve agile facility management, as shown in the survey data in Figure 2.5. Online platforms intermediate information and communication flows on the Internet. They increase consumer choice and convenience, improve efficiency and can enhance civil participation in faculty. In the figure above, all the stakeholders agreed that the existence of an online platform for facility management purposes would be convenient for them.

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Figure 2.5 Opinion on The Convenience of Online Platform

3.0 Methodology

Our system is subdivided into five features for the users (lecturers and students) and one admin login function as shown as the Figure 3.1. The five features in our system are Student Timetable, Lecturer Timetable, Subject Timetable, Navigation and Room Booking respectively. All these features have their specific function.

Figure 3.1: Dashboard of Smart Scheduler System

First of all, the Student Timetable is to allow students to check for their own timetable for location of classes and check upcoming classes, as shown in Figure 3.2. Next, the Lecturer Timetable allows the lecturers to check on which class they are having for that day or where to have their class, as shown in Figure 3.3. The Lecturer Timetable feature can also allow students to find their lecturers whenever lecturers are not present to class without notifying the class or allow staff to know about the lecturers' whereabouts when they need to find them for emergency meetings and etc.

STUDENT TIMETABLE
2020/2021/1

Select Student Groups

VIEW TIMETABLE

SCHOOL OF ELECTRICAL ENGINEERING 1(KEL SEC4a

WEEKDAYS	8:00-8:50	9:00-9:50	10:00-10:50	11:00-11:50	12:00-12:50	1:00-2:00	2:00-2:50	3:00-3:50	4:00-4:50
SUNDAY	*	*	SKE4310 SEC01 P18A BT01	SKE4310 SEC01 P18A BT01	*	LUNCH	UICL2002 SEC06 P03 320	UICL2002 SEC06 P03 320	*
MONDAY	*	SKE4723 SEC01 P07 411	SKE4723 SEC01 P07 411	SKE4723 SEC01 P07 411	*	LUNCH	*	*	*
TUESDAY	SKE4455 SEC02 P18A BT08	*	*	*	*	LUNCH	*	*	*
WEDNESDAY	*	*	SKE4310 SEC01 P18A BT01	*	SKE4453 SEC01 P18A BT07	LUNCH	*	SHA4040 SEC01 P03 306	SHA4040 SEC01 P03 306
THURSDAY	SKE4453 SEC01 P18A BT07	SKE4453 SEC01 P18A BT07	*	SKE4455 SEC02 P18A BT08	SKE4455 SEC02 P18A BT08	LUNCH	*	*	*

Figure 3.2: Student Timetable Feature

LECTURER TIMETABLE
2020/2021/1

Select Lecturer

VIEW TIMETABLE

Dr Hamid Madni

WEEKDAYS	8:00-8:50	9:00-9:50	10:00-10:50	11:00-11:50	12:00-12:50	1:00-2:00	2:00-2:50	3:00-3:50	4:00-4:50
SUNDAY	SC554213 P18A BT1	-	-	-	-	LUNCH	-	-	-
MONDAY	-	-	SC554213 P18 BT4	-	-	LUNCH	-	-	-
TUESDAY	-	-	-	-	-	LUNCH	-	-	-
WEDNESDAY	-	-	SC554213 P18A BT1	-	-	LUNCH	-	-	-
THURSDAY	-	SC554213 P18A BT1	-	-	-	LUNCH	-	-	-

Figure 3.3: Lecturer Timetable Feature

The Subject Timetable is a beneficial feature for students especially at the beginning of the semester, as shown in Figure 3.4. As we know, some students might want to take an extra subject in some semester, but it is troublesome for them to check out the timetable for that particular subject that can fit into their original timetable. With the help of this feature in the Smart Scheduler System, students can easily get access to the subject timetable and find out which section can be taken and ease their registration process.

Figure 3.4: Subject Timetable Feature

Next is the Navigation feature, students and lecturers sometimes get into trouble when finding classrooms for class especially for new students when they first start their semester, as shown in Figure 3.5. Therefore, the navigation function can help them to locate the building of their classroom and redirect the location in google maps to lead them to class. Last but not least, the Room Booking feature, the room booking is done manually most of the time which actually leads to waste of paper as well as energy and time, as shown in Figure 3.6. With the help of this feature, the lecturer can reschedule the class and book any vacant room at any time and anywhere provided there is Internet connection. This way, we can ease the staff's job as well as saving the lecturer's time to go to office to make any booking of rooms.
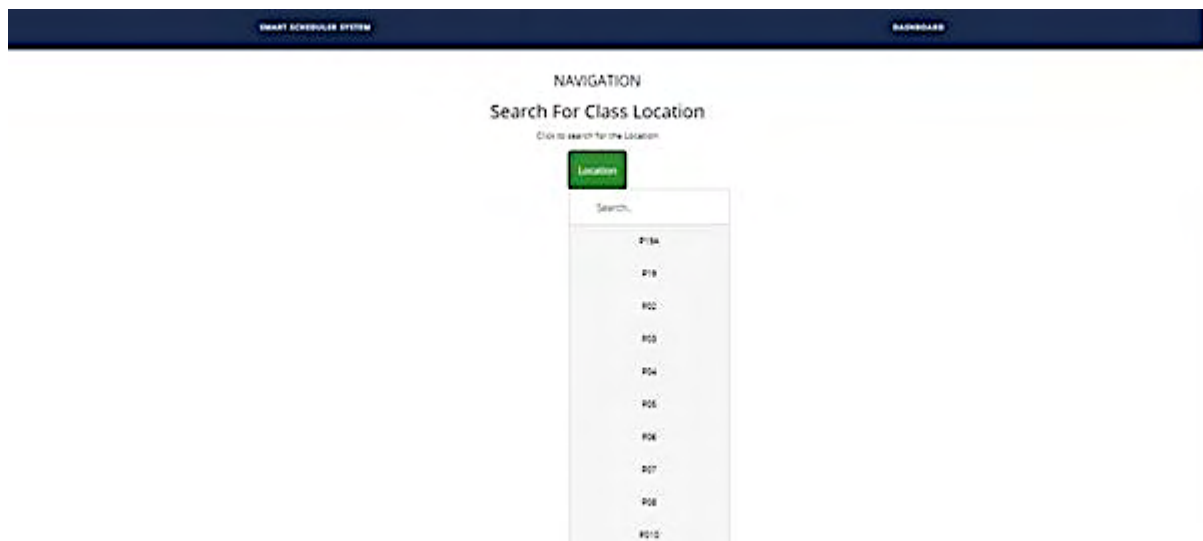
Figure 3.5: Navigation Feature

Now, we have the room booking system, it is mostly meant for lecturers who wanted to book a classroom for a replacement class or additional class. The current system is not convenient to the lecturers as they need to do the booking manually which consumes a lot of time. Therefore, by using the system, lecturers can book the rooms for classes instantly and inform the class by time without wasting time to present himself or herself to the office.
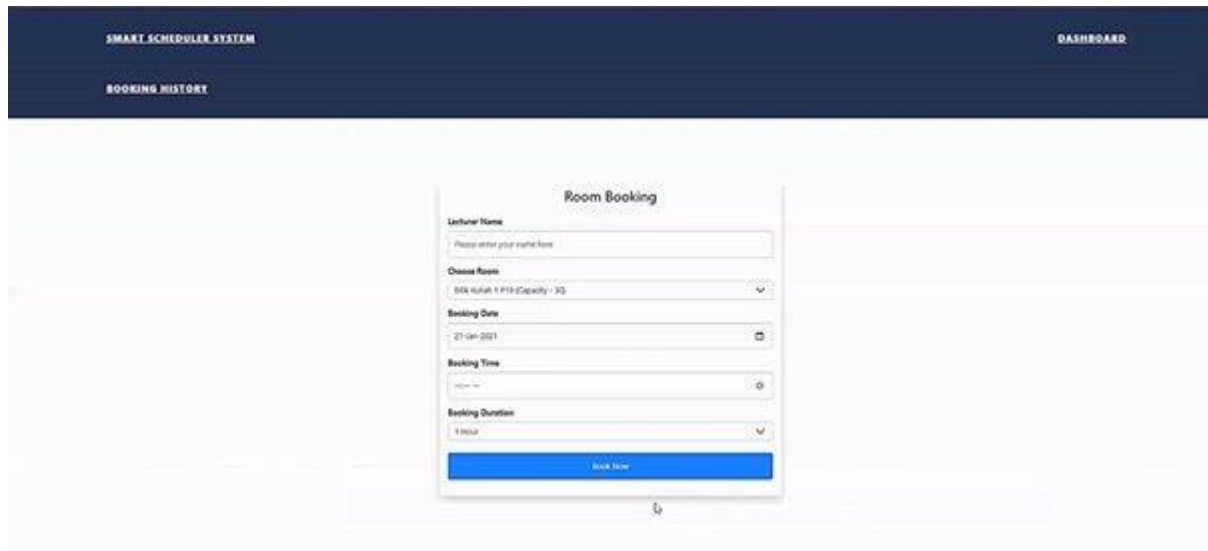
Figure 3.6: Room Booking feature

In this section, we are going to talk about the admin login feature, in our case, the admin will be one of the staff in the office who are going to handle the arranging of timetables, as shown in Figure 3.7. After having the generated timetable, the admin can upload the timetable csv files into the system by using the import function under each section which can link to the features stated above. This way, users do not need to approach the office to look up for their timetables, they can just access through the system and get whatever information they need.
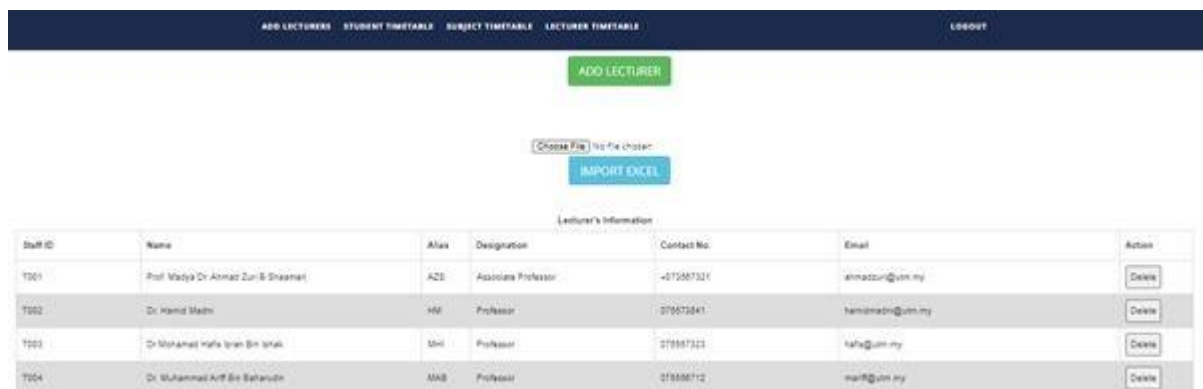
Figure 3.7: Admin dashboard
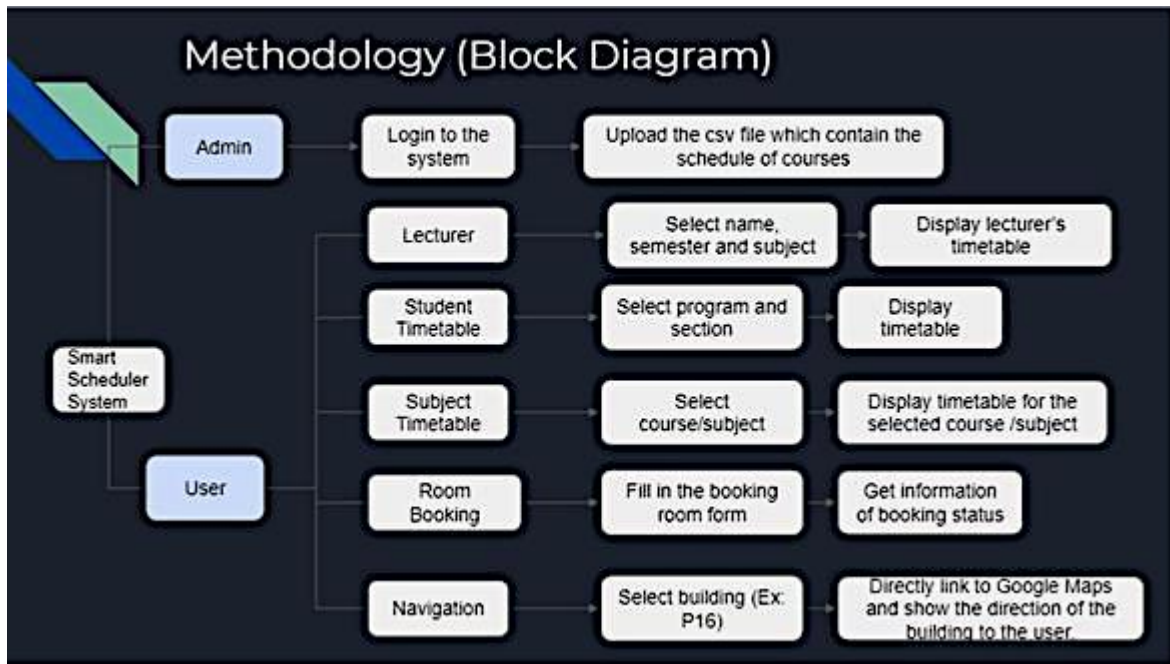
Figure 3.8: Overview for each feature

4.0   Design Statement & Product Development

Good system comes from the proper planning in developing this system. Based on our designation, our systems are used by three different users which include lecturer, students and admin. Before this system is designed, there are several important things that need to be considered. Our system is mainly focused on displaying timetables for students and lecturers, timetable for each course, search for location and make the reservation for any available vacant room. Previously, these methods in getting the timetable make a reservation and navigation is done manually. Hence, our system is able to meet the entire requirement for users. Our interface system is designed as shown in Figure 4.1.

Figure 4.1: The main interface for this system

In order to store the entire database, the systems are linked to MySQL server under the phpMyAdmin. PhpMyAdmin is a free software tool written in PHP to handle the administration of MySQL. MySQL is a freely Open-source Relational Database Management System (RDBMS) that is used to Structured Query Language (SQL). MySQL is the language that is used for adding, accessing and managing content in the database. The MySQL file based on our system will be imported into the MySQL database. Figure 4.2 shows the main interface to store the data in MySQL homepage from our system.
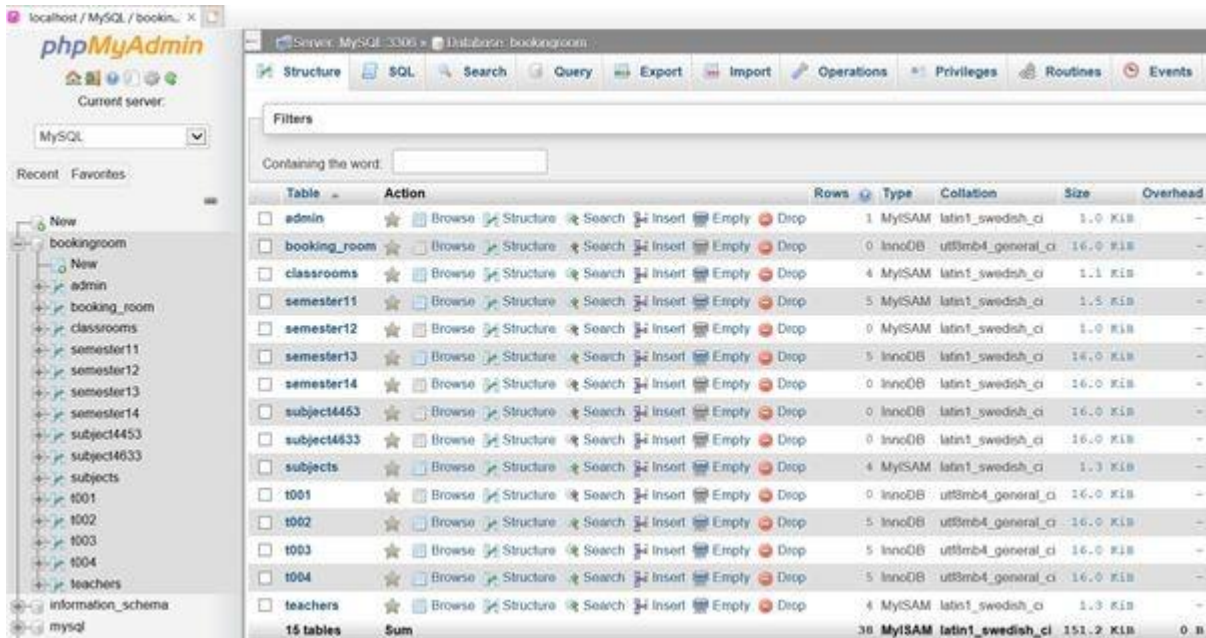
Figure 4.2: The database in MySQL server

The PHP language is used in developing this system. Then, WampServer are used to host our local host. WampServer is a Web development platform on Windows that enables users to host dynamic web with PHP and MySQL. Figure 16 has shown the main interface for WampServer before it is used to host our system. In order to host our website, we must write its syntax 'http://localhost/filename'.
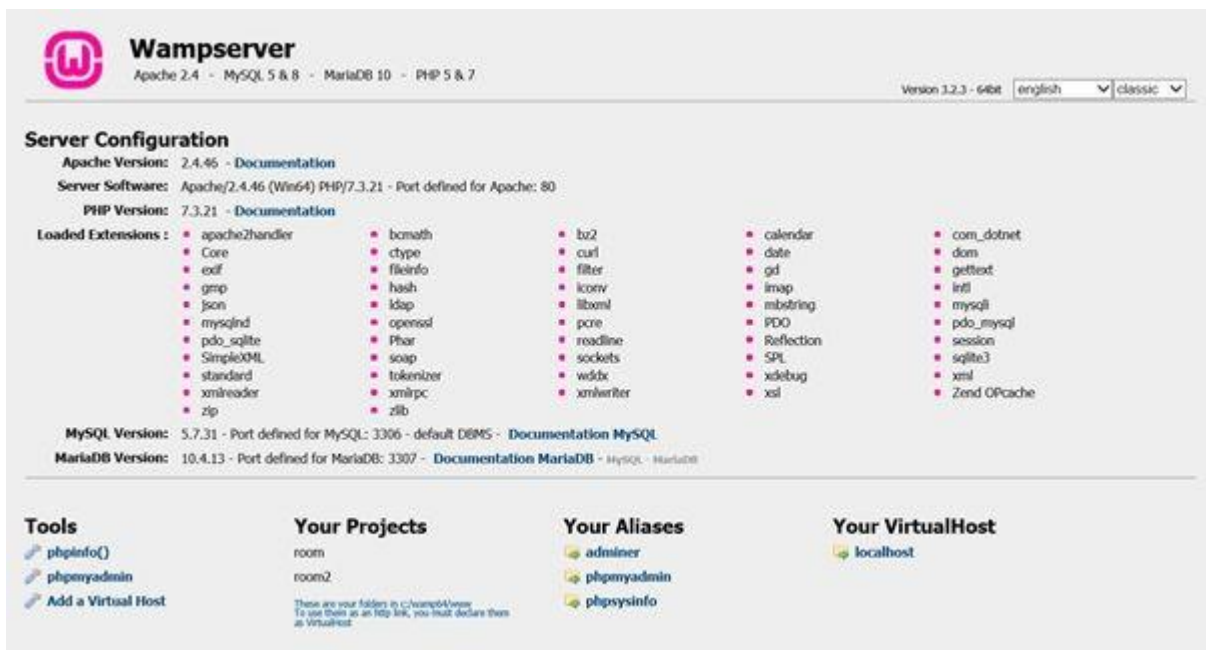
Figure 4.3: The WampServer localhost

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The software and component used for developing this system was shown in Table 1.

Table 1: List of Components

No	Component	Remark
1	Web-server wampserver	Open-source windows web development environment
2	Programming Language-PHP	Open-source scripting language
3	Database service-MySQL (PHPMyAdmin)	Open-source database system

5.0   Discussion

Our group initially planned to include the automation timetable table function in our system. However, on our way in developing the system, there are problems that arise. One of the problems is regarding the algorithm that we wanted to use to build the automation feature. It is one of the Artificial Intelligence algorithms known as Genetic Algorithm but throughout the literature review and research process, we decided to revise the scope due to time limitations but this feature is advisable to implement in future studies if the system is to be published. The next problem is regarding the file importing function for the admin feature. There are some limitations where the admin needs to import the file one by one at each time. The system currently still cannot support multiple files import at a time. Therefore, that is also included in the future studies to make the system more functionable especially for the sake of the staff. However, regardless of the challenges mentioned above, the system itself is already capable with its function and is able to be used by users.

6.0   Conclusion

In a nutshell, we manage to develop the system successfully called Smart Scheduler System for Lectures. This system enables users to check their own timetable, search for the class location and lead them to the destination, check the course schedule for any additional course that they want to take and check for any vacant room's timetable to make a reservation for the selected room. Furthermore, this project is done by starting to do a set of questionnaires in order to know the problems faced by students, lecturers and staff in this faculty. Throughout this project, there has a lot of problems that we faced however we managed to solve the problem and were able to complete this project. During developing this project, we manage to build our teamwork, develop leadership skills, learn how to cope with pressure and increase communication skills. Last but not least, after all the hard work that we give during completing this system we manage to get the 'Best of the best' awards in this capstone project.

Gantt Chart

No	Tasks	Start Week	End Week	Capstone Week
1	Brainstroming and discussion on Capstone Topic	1	1	
2	Questionaire Survey	1	2	
3	Design Prototype	3	5	
4	Prepare Prototype Presentation Slides	3	5	
5	Presentation on Prototype	5	5	
6	Finalize design specification for final product	5	5	
7	Development of front page of websites	6	6	
8	Development of timetable generator	6	10	
9	Development of navigation feature	6	8	
10	Development of room booking feature	8	12	
11	Development of student timetable, subject timetable and lecturer timetable features	9	11	
12	Simulation and verification	10	12	
13	Modification and Improvement	11	12	
14	Preparation for final product presentation	12	12	
15	Evaluation 2 (Final Prodcut Presentation)	13	13	
16	Report Writing	5	14	
17	Report Submission	14	14	

Bill Of Material

UTM

SKEE 4723 CAPSTONE PROJECT
BILL OF MATERIAL (BOM)

SKE-4723-2020-10

Present the BOM to your supervisor to get it endorsed on Week 6. Finally, file it in the BOM folder in the Student Project File. Manually update the purchase and remark from week to week.

Signature (Student)

Fariz

Date: 27.11.2020

Checked by (Facilitator)

Chua Tien Han

Date: 14 Dec 2020

No	Component	Estimated Cost			Actual Cost	
		Unit Price (RM)	Qty.	Subtotal (RM)	Purchased Price (RM)	Delivery Week and Remark
1	Web server-Wampserver	0.00	1	0.00	0.00	Open source windows web development environment
2	Programming Language-PHP	0.00	1	0.00	0.00	Open source scripting language
3	Database service-MySQL(PHP MyAdmin)	0.00	1	0.00	0.00	Open source database system
4						
5						
		Total		0.00	0.00	

Acknowledgement

Management System. It helps us to learn how to do research and complete our project as a team. We also would like to convey our utmost appreciation and gratitude to our lecturers and friends for their guide and co-operation in completing this project.

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SKE FACILITY BOOKING SYSTEM

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Abstract: Online booking system is a booking service through wireless handheld devices such as cell phones. There are many applications in the real world that implement this system to enable a faster interface for the end-user as the world is growing in this technology era. For such applications, we want to ease the students, staff and lecturers specifically in the School of Electrical Engineering to book the available facilities. This can be time consuming when doing this on our own and data was not recorded for further action if something happened. So based on this we here proposed "SKE Booking Hub" application. We will be using Android Studio to develop this app that can improve the speed of booking activities.

Keywords: Online booking system; Android Studio; Java; time consuming; application development

Introduction (Project or Innovation)

Booking activities is one of the major piece of work in university. It is crucial especially when to do extra class or class replacement. Many individuals will be affected by the difficulties of the current manual booking system. To overcome this is by developing an automatic booking system which will work online. This project will be focusing on SKE citizens as this is a beta version or in trial mode. The system will require users to register their username and password only to get access to the main menu to start booking. We want to secure the users privacy and ease the process of registration. Furthermore, there are choices for available room or facilities, time and date selection. It is very user-friendly since all the steps are straightforward and does not require any assistance. The booking database can be observed by the developers. In this project we will entitle our booking app as "SKE Booking Hub".

Problem Statement

1. Time consuming

   Manual booking system that has been practised by SKE citizens is a troublesome method because it took a long processing time since students or lecturers need to go to the SKE office to request for available room from the staff. After that, they have to wait for the staff to bring the room key before entering the room. This whole process is time consuming.

2. Lack of care line

   It always happens that when students or lecturers want to book facilities, there is no staff in charge to be contacted or pass the key.

3. Booking is not recorded

   Most of the time the existing booking system is by verbal request which is not a professional method because if damage or vandalism happened, it is difficult to trace who was involved.

Objectives

1. To reduce manual workload
2. To ease the process of facility booking in SKE

Survey Findings & Analysis

A Google survey form is spreaded among UTM citizens and other universities' students to gather information of what to be included into the creation of our facility booking application.
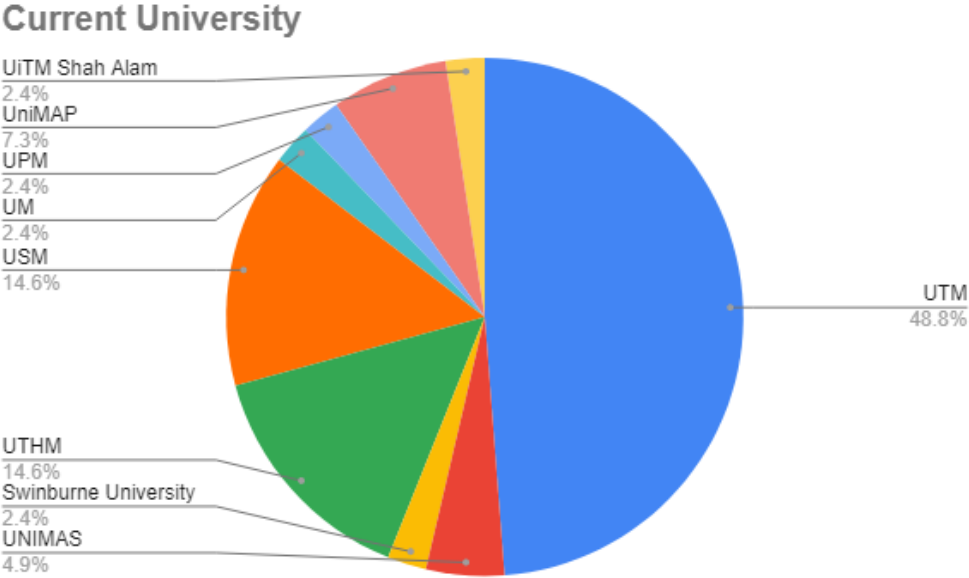
Figure1: Variety of universities taken part in the survey form.
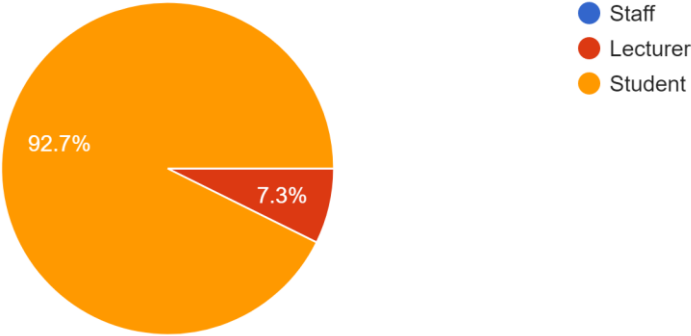
Figure 2: Identity of the respondents in respective universities.

How often do you have to book any facility in the campus? (Throughout a semester)
41 responses

- 3 times and below
- More than 3 times
- More than 5 times
- More than 10 times

9.8%

9.8%

75.6%
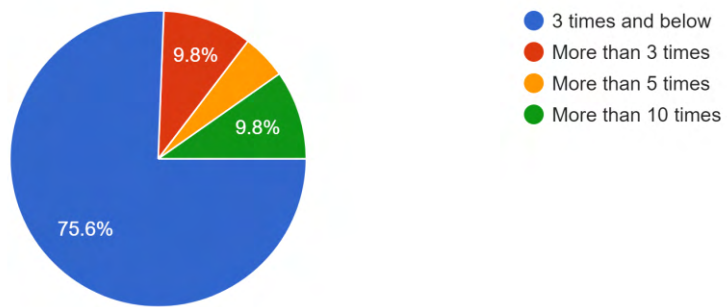
Figure 3: Frequency of booking a facility inside campus.

What are the facilities that you had booked before inside campus? (Can be more than one option)
41 responses

Lab	16 (39%)
Classroom	22 (53.7%)
Meeting room	23 (56.1%)
Sport venues (badminton court, basketba…	23 (56.1%)
Studio and equipment for shooting/recor…	1 (2.4%)
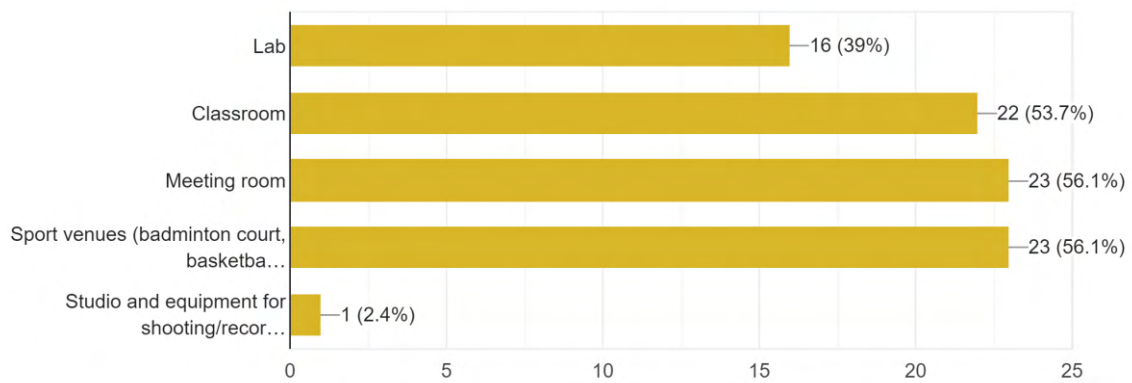
Figure 4: Percentage of facilities that have been booked before inside campus.

How is the existing booking system in the campus works? (Can be more than one option)
41 responses

Face-to-face with the person in charge	32 (78%)
Email/Whatsapp/Call for booking	17 (41.5%)
Fill in forms at the venue that you wis…	24 (58.5%)

47
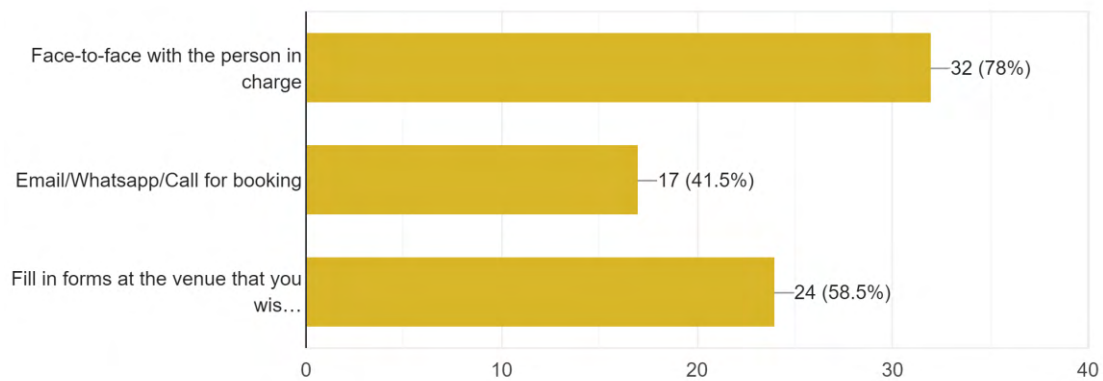
Figure 5: Ways of how the booking takes place inside campus.

What do you think of the existing system for facility booking in campus?
41 responses
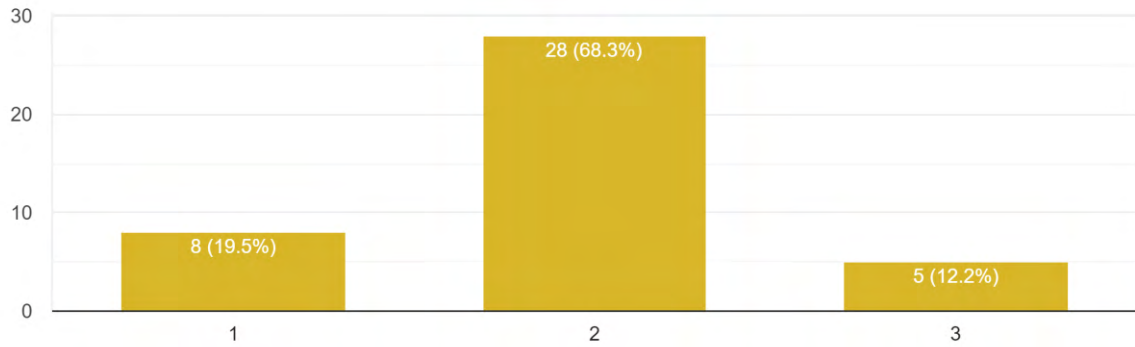
Figure 6: Satisfaction on the existing facility booking experience inside campus, where 1=unsatisfied, 2=neutral and 3=satisfied.

What are the problems faced when using the existing booking system? (Can be more than one option)
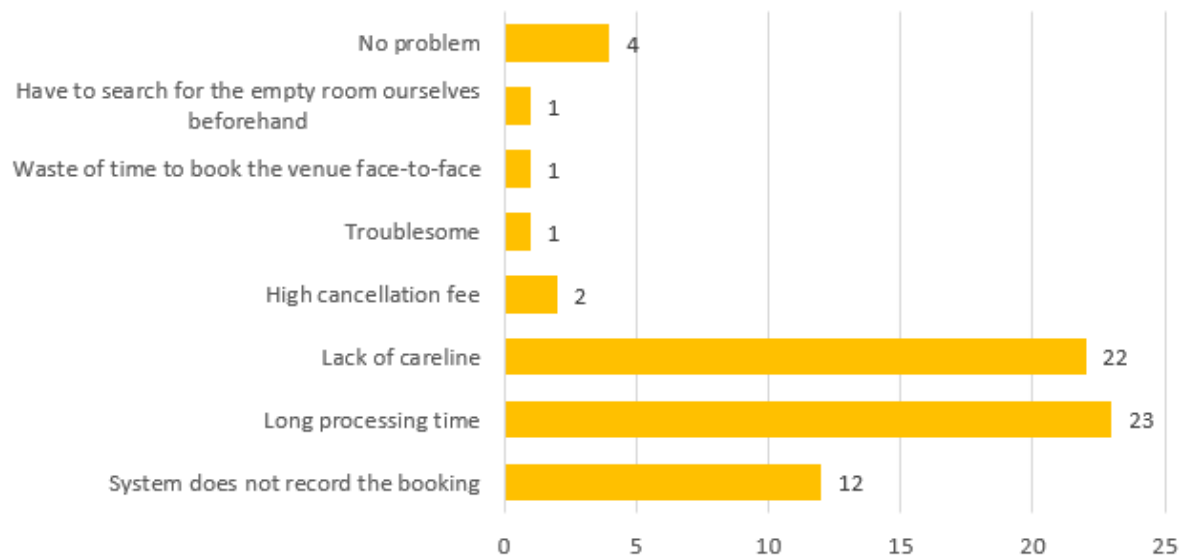
Figure 7: Problems faced during the facility booking experience.

What are the facilities outside campus that you had booked before? (Can be more than one option)

41 responses

Hotel	30 (73.2%)
Transportation tickets (flight, bus, tr...	36 (87.8%)
Movie tickets	36 (87.8%)
Entertainment venues (Karaoke etc.)	21 (51.2%)
Sport venues	20 (48.8%)
Restaurants	26 (63.4%)
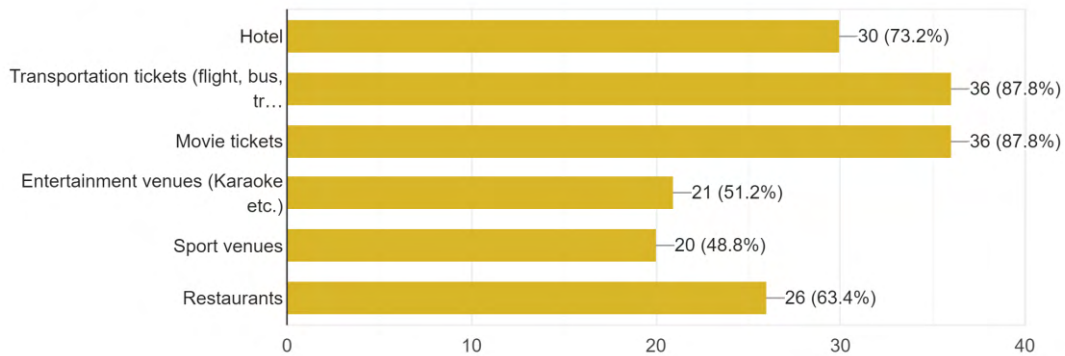
Figure 8: Percentage of facilities that have been booked before outside campus.

What are the experience of facility booking outside of campus (hotel, transportation tickets, movie tickets etc)? (Can be more than one option)

41 responses

Online (website) booking	37 (90.2%)
Direct call	24 (58.5%)
Using their apps	22 (53.7%)
Through agencies	11 (26.8%)
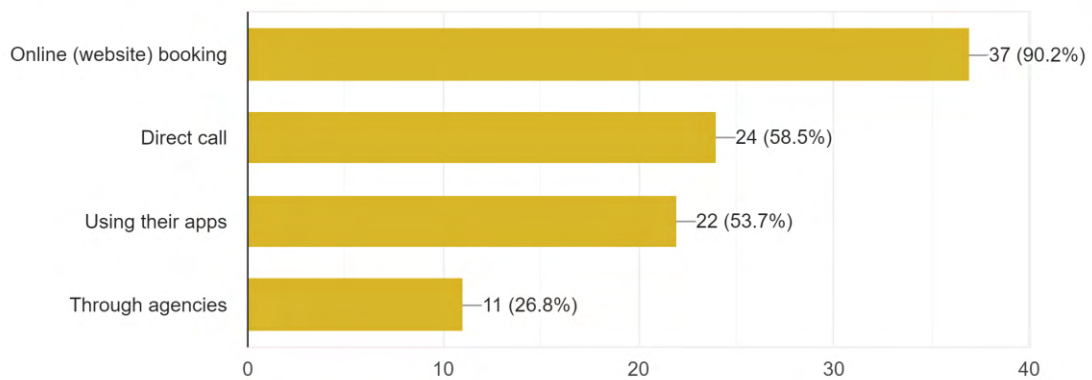
Figure 9: Ways of how the booking takes place outside campus.

What do you think of the booking system outside of campus?

41 responses
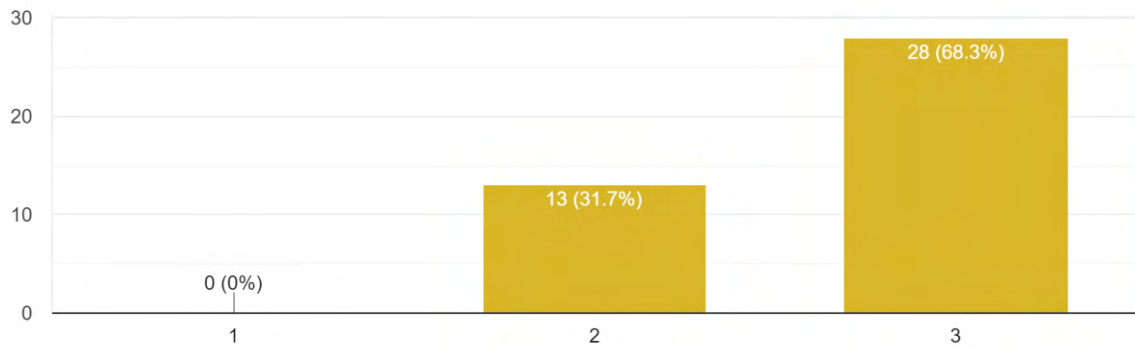
Figure 10: Satisfaction on the existing facility booking experience outside campus, where 1=unsatisfied, 2=neutral and 3=satisfied.

What is the preferable facility booking method?

41 responses
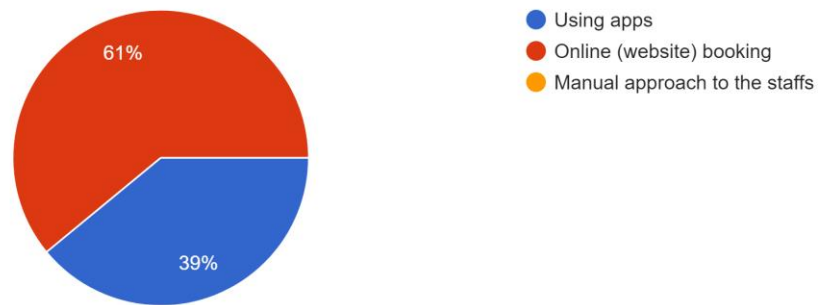
Figure 11: Percentage of the preferable method for facility booking.

Design Statement

The finalised design of the application is as below:
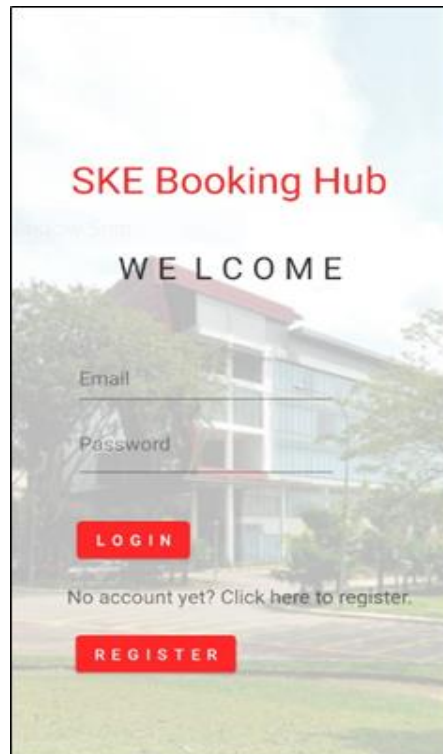
Figure 12: The welcome page once the application is clicked on the phone

Figure 13: Registration page where one can register an account to have access in the application.
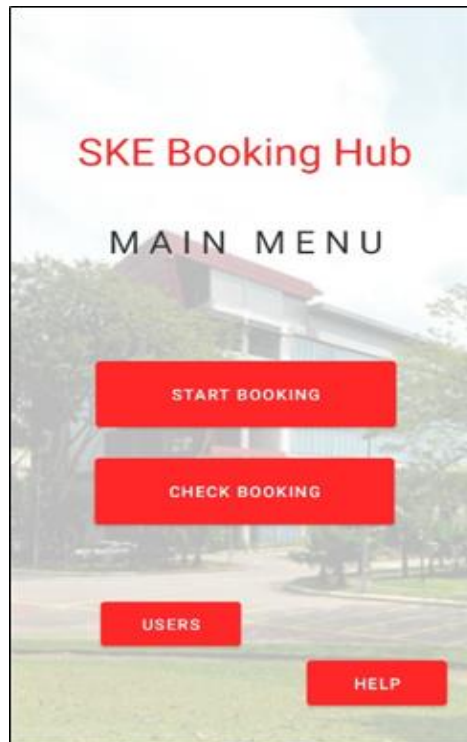
Figure 14: The main menu page upon successful login, where one can choose the next step.
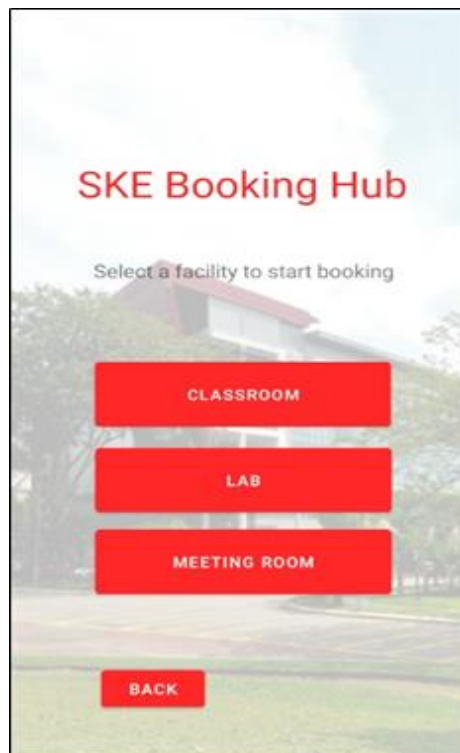
Figure 15: This page is directed after clicking on 'Start Booking' to choose on the desired facility
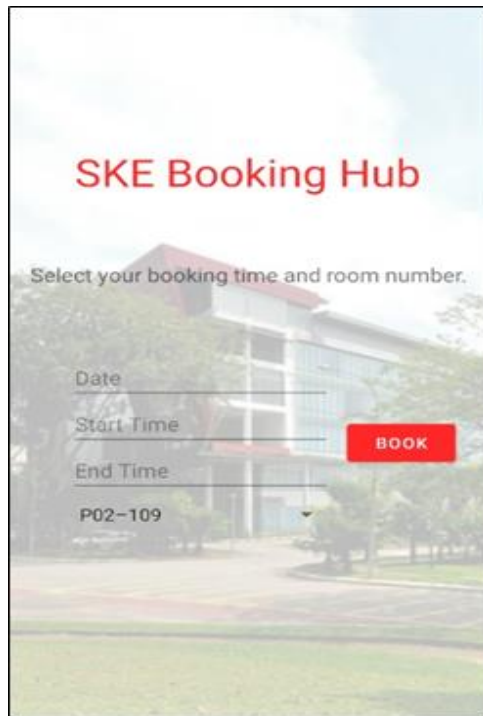
Figure 16: This page is directed after choosing a facility from the picture above.
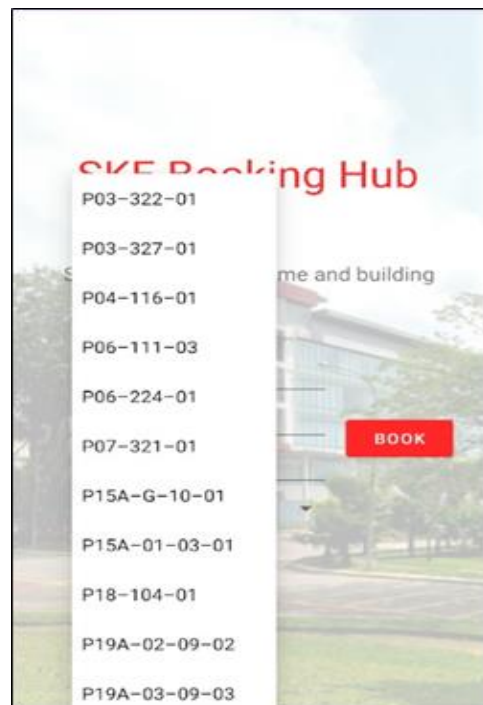
Figure 17: Room selection is to be chosen
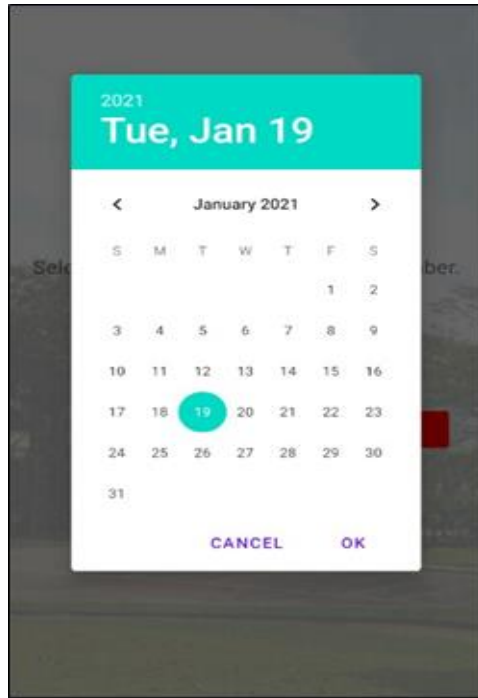
Figure 18: Choose the desired date.
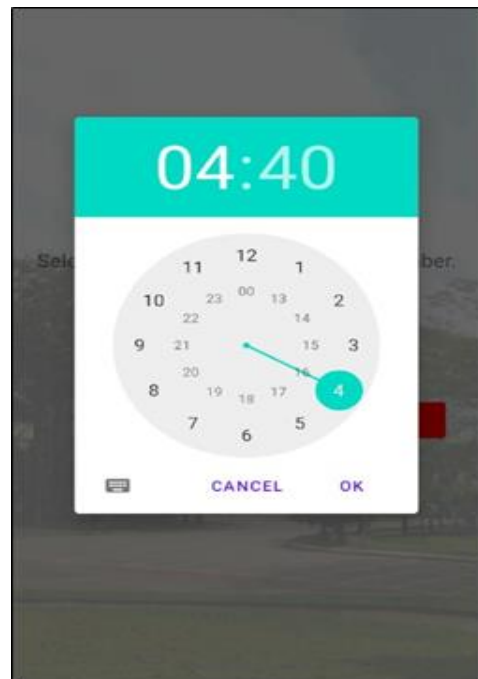
Figure 19: Choose the desired time

Figure 20: This page is directed when 'Check Booking' is clicked on the main menu page
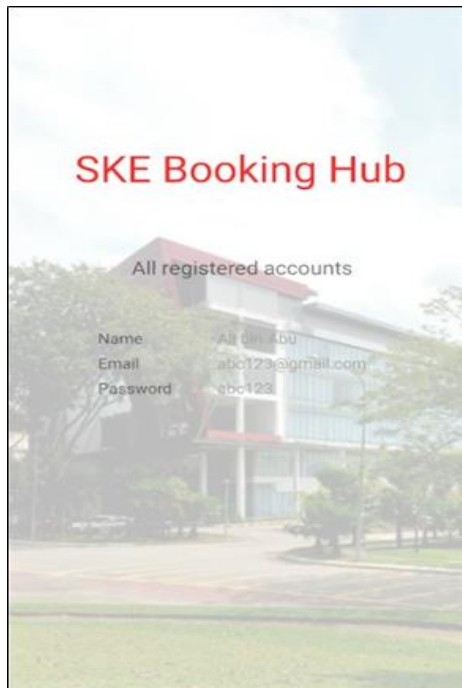
Figure 21: The 'Users' page that shows the registered account on the device
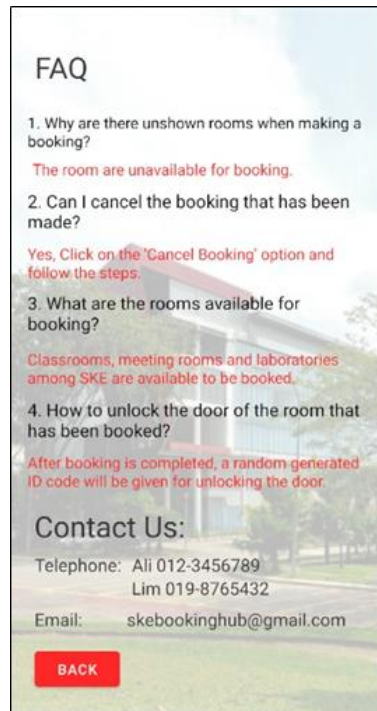
Figure 22: The 'Help' page that displays some Frequently Asked Questions (FAQ) and contact support.

Methodology / Product Development

The SKE Facility Booking System used the Conceive-Design-Implement-Operate (CDIO) initiative as the methodology in the product development. The software used to develop the "SKE Booking Hub" apps is Android Studio, powered using Java language for apps programming. Since the development is only software-based, the budget of this project is RM0.

Conceiving

The project started by understanding the issue faced in the faculty management system. A survey is carried out to understand the satisfaction of students, lecturers and staff towards the current booking system in faculty. The questions allow us to understand the weaknesses of the system and suggestions by users on improving it. After receiving enough responses, all info is extracted and clustered accordingly to identify the problems and what are the most needed features to include. To describe the conceptual prototype, a STEEP analysis is carried out.

Designing

The design process is the realization of conceptual ideas to become a prototype. With various ideas introduced, several sketches for the product were proposed. Ideas that would give benefits to the users or enhance the system are adapted collectively to propose a final sketch. The sketch will only be used as a reference as future modification is unpredictable. In order to start designing, several items need to be prepared, which is explained in the table below:

Table 1: Items needed to carry out the design of application.

Items	Purpose
Laptop	To run the software and emulator
Android Studio	To develop the apps
Android Smartphone Emulator	To test and run the developed apps

The initial conceptual design is sketched with various functions and will be modified accordingly by following the restrictions met during the development. During the process, references on a common booking website are taken. The basic features of a booking system include:

- Login and registration
- Facilities selection
- Date, time and room number selection
- Check-through for availability of room
- Help and service

After discussing and confirming the idea, the initial sketch for several apps interface is finalized as shown below:
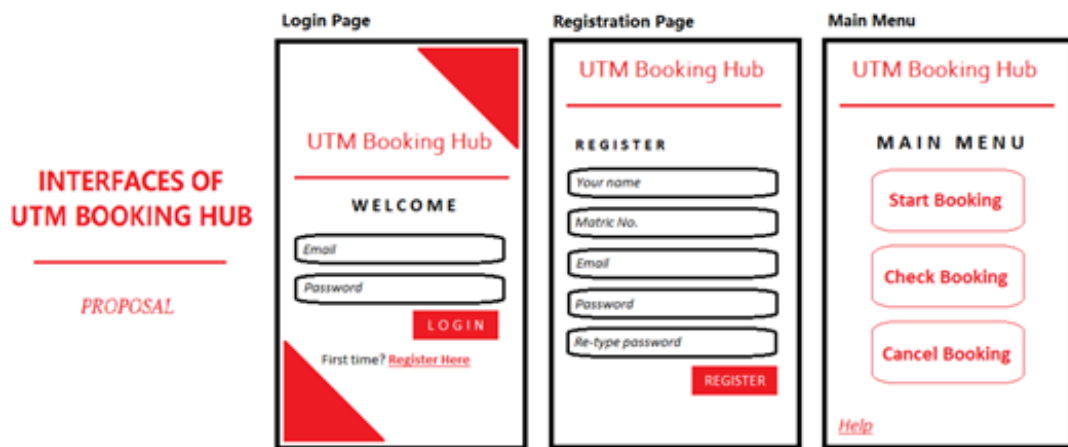
Figure 23: Initial sketch of the app interface (Login page, Registration page and Main Menu).
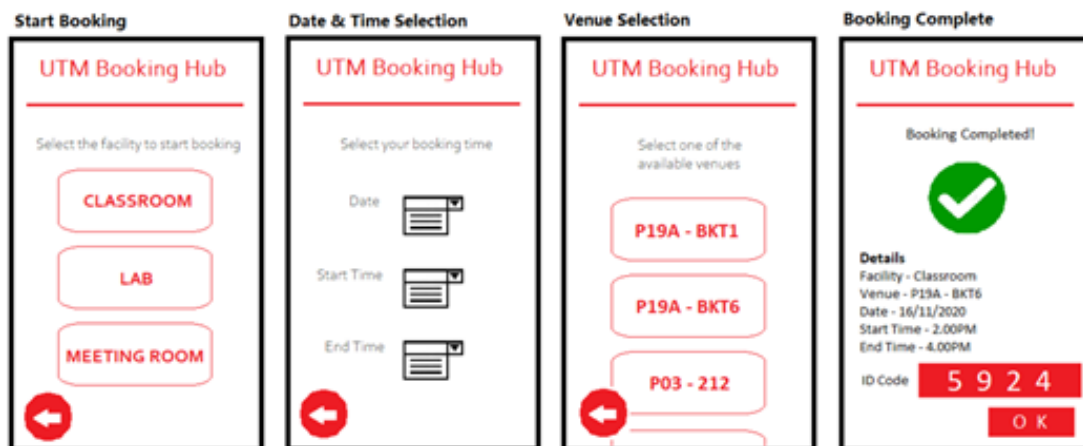
Figure 24: Initial sketch of the app interface (Start Booking, Date & Time Selection, Venue Selection and Booking Complete).
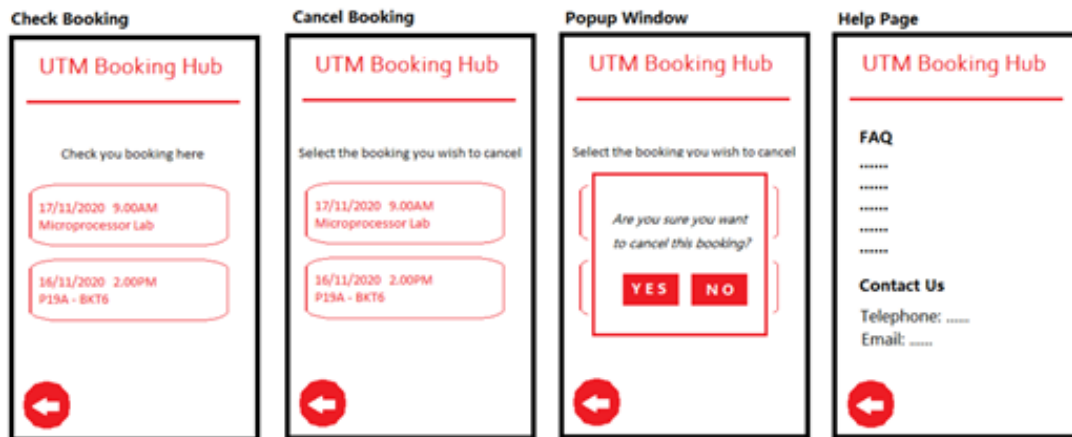
Figure 25: Initial sketch of the app interface (Check Booking, Cancel Booking, Popup Window and Help page).

Implementation

The implementation step is where all programming works are done. In order to ensure the programming process went smoothly, the first step to do is to draw out a flowchart of apps activities to identify how they connected. For example, the login will validate users' email and password before entering the main menu. If the input data is wrong, it will prompt error messages. The flowchart of the apps operation is shown below:
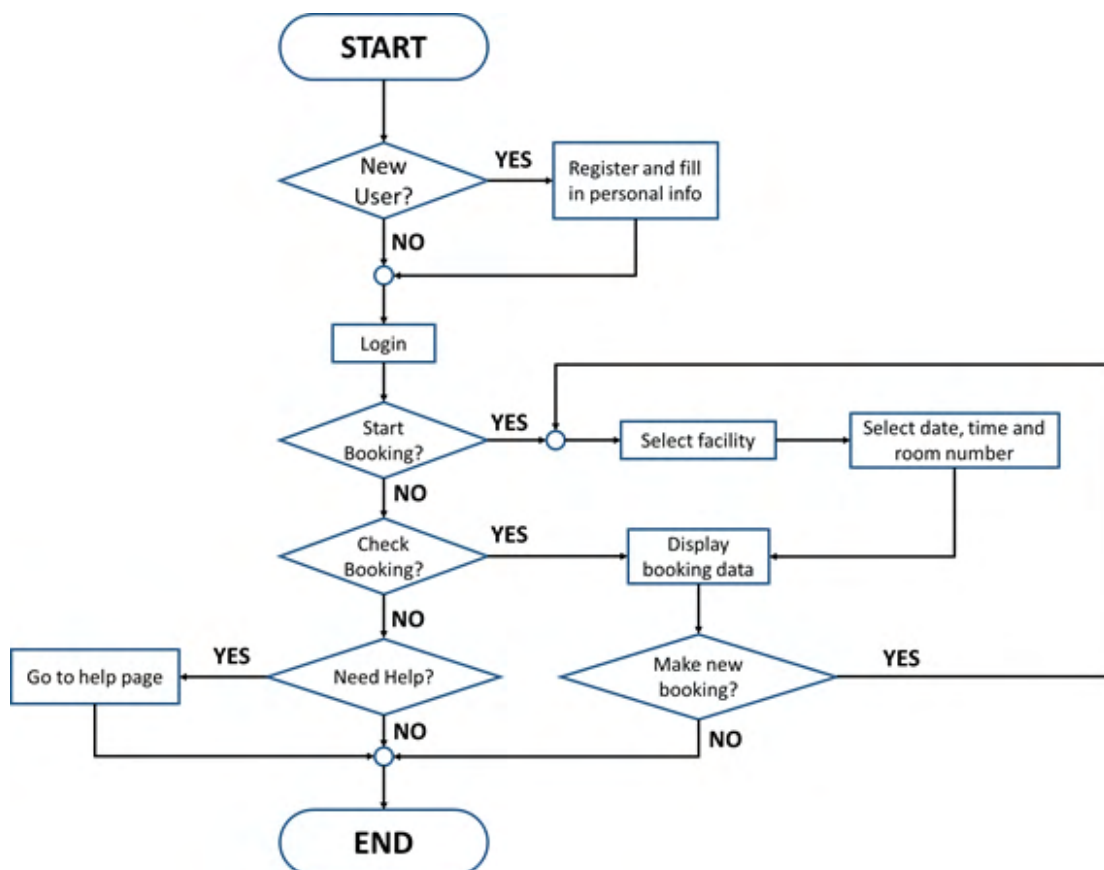
Figure 26: Flowchart of the process in the application.

The first set of programming is written to implement the login and registration activities. If the user is new to the apps, they need to register before login to book the room. Users need to key in their personal information which will be processed and stored in SQLite database, which is a built-in feature in Android Studio.
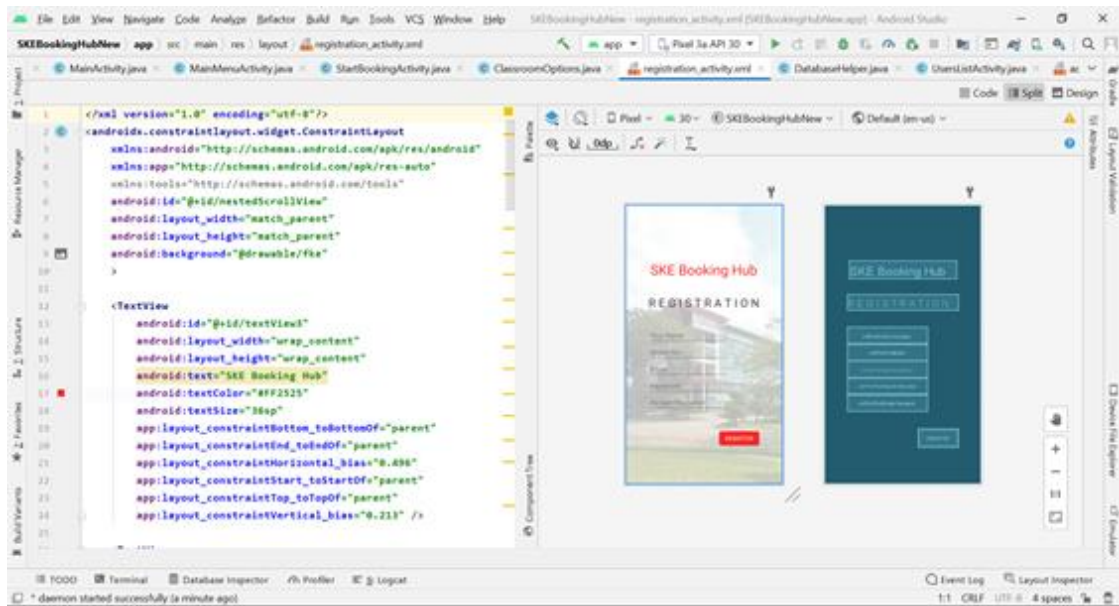
Figure 27: Programming for Registration page.

The second set of programming is to program the main menu layout as well as the help page for those users who faced difficulty when using the apps. In the main menu, users can either choose to start booking or to check booking. In the help page, there are several FAQs and contact so that users can get further assistance.
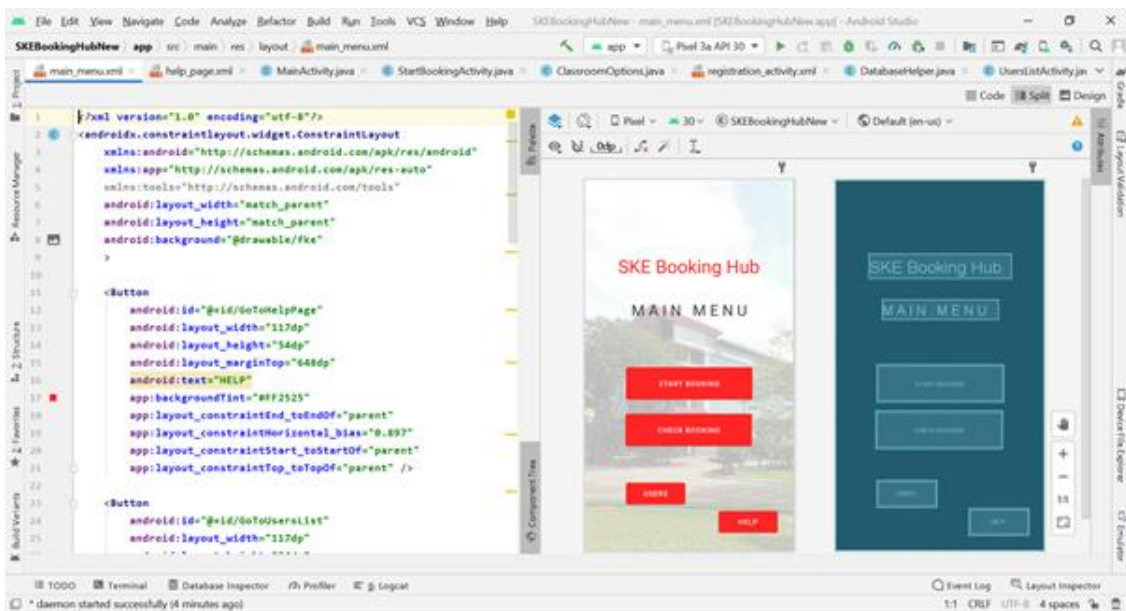
Figure 28: Programming for Main Menu page.
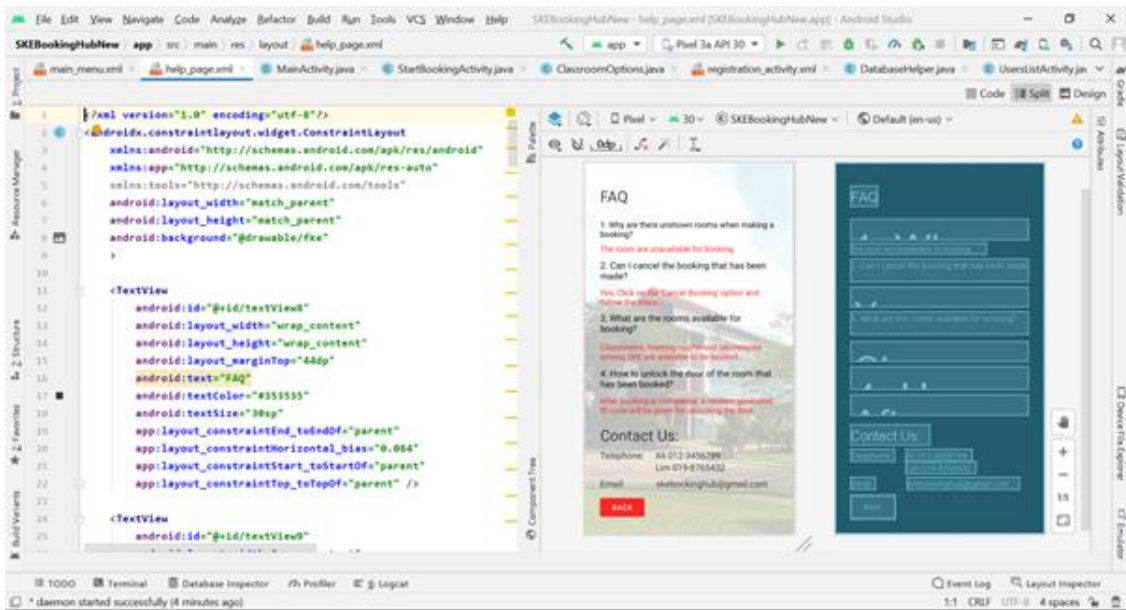
Figure 29: Programming for Help page.

After selecting the "Start Booking", users will be given 3 main facilities to book in SKE, which are classrooms, labs and meeting rooms. It will then direct users to the activity of selecting booking date, time and room number. The facilities' room numbers are searched through the faculty official website beforehand in order to give users more choices. The date and time are implemented in DatePicker and TimePicker libraries, where they will display the calendar and clock widget similar to those in smartphones. For the room numbers, they are listed in the drop-down menu, implemented by Spinner library.
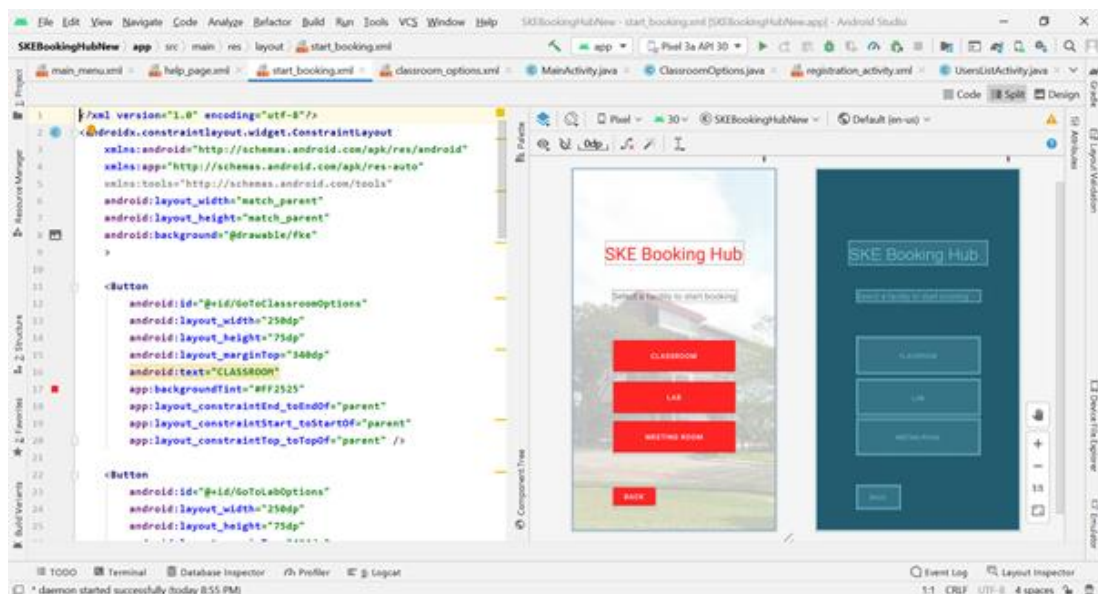
Figure 30: Programming for Start Booking.
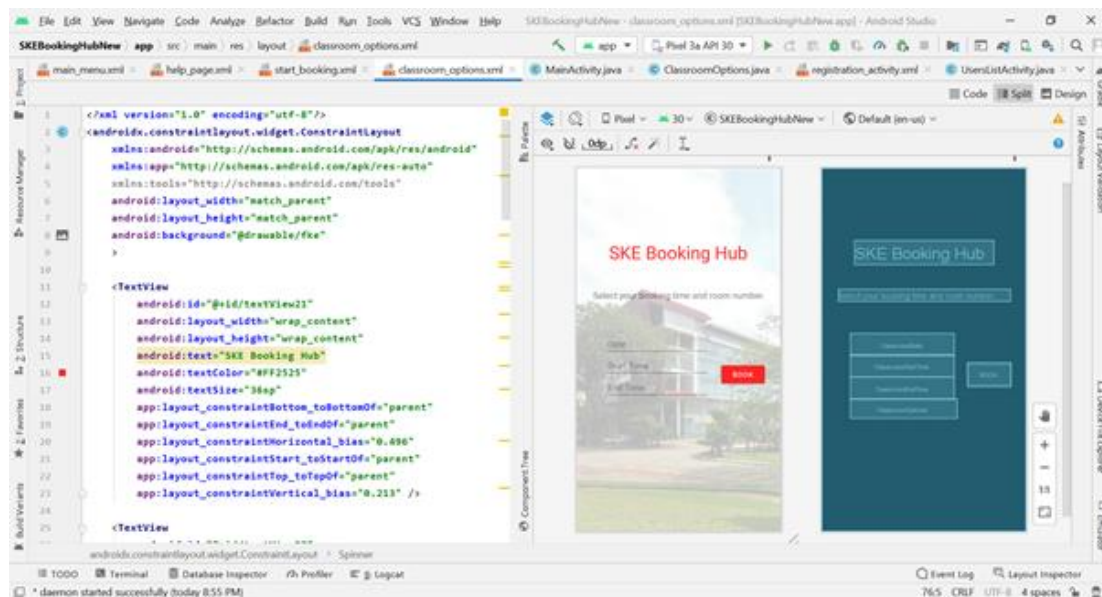
Figure 31: Programming when booking takes place by choosing the date, time and room.

The booking is successful after all data has been input. The page that shows stored booking data will be displayed along with an ID code generated. The ID code is generated by using a random number generator in programming. It will be used to unlock the door of the booked room for that specific time. However, due to the limited time given, the hardware part is not implemented and this idea will be reserved for future progress if possible.

Operation

To simulate the apps and test the programming results, the operation approach is using the Android Studio built-in emulator. There is a wide selection of models available. In this project, Google Pixel 3A API 30 is selected. Before installing the apps into the emulator device, the emulator needs to be converted into "Developer Mode", which can be done in the "Settings" menu. All other settings are retained as default to ensure all spaces are reserved to install the apps.

After a quick installation of the apps, the apps will auto run in the emulator environment. If a bug is met, the apps need to be uninstalled before programming. The emulator can be switched off, which is not affected by any changes made in programming. After the bug is fixed, the apps need to be reinstalled and the emulator is switched on. Overall, these processes will be continuous until all proposed functionalities work successfully.

Results

The app developed, "SKE Booking Hub" to manage facilities' booking system, has effectively operated to store users' info and booking data. The ID code generated proved random and able to be used for future development in hardware for unlocking the door. Although there is a lack of timetable to check the availability of rooms, the overall performance of this app reached the minimum requirement and can be improved.

The benefits of this product are user friendly and able to help students, lecturers and staff to book rooms within seconds. Moreover, the idea of using ID code to unlock doors also improves security to prevent unauthorized access.
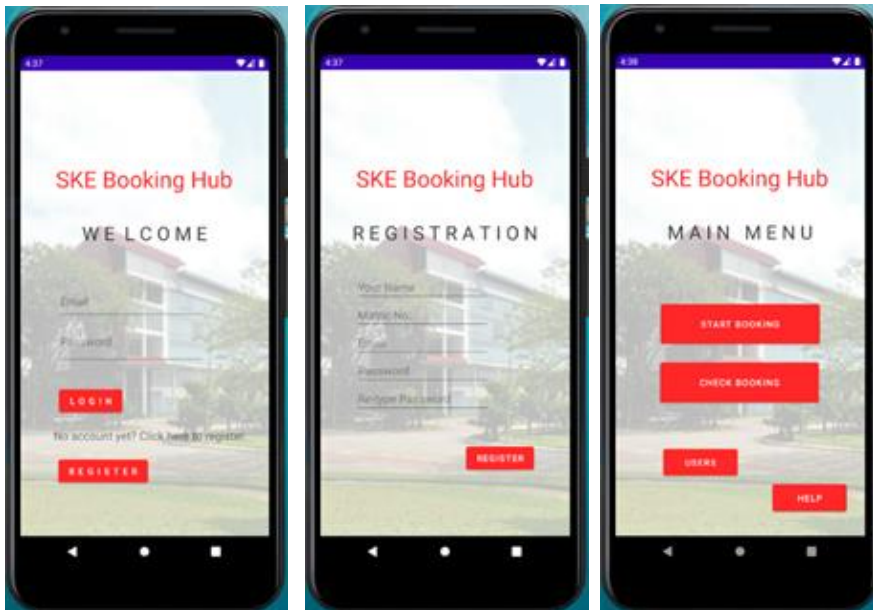
(a)　　　　　　　　(b)　　　　　　　　(c)

Figure 32: (a) Login / Welcome page, (b) Registration page and (c) Main Menu after login.
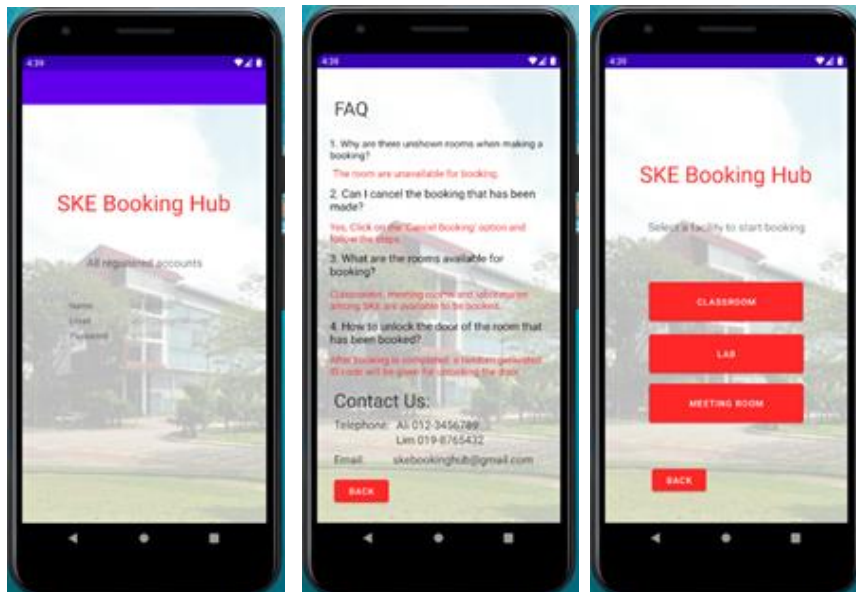
(a)　　　　　　　　(b)　　　　　　　　(c)

Figure 33: (a) Users list, (b) FAQ page and (c) facilities selection in "Start Booking".

(a)   (b)   (c)   (d)
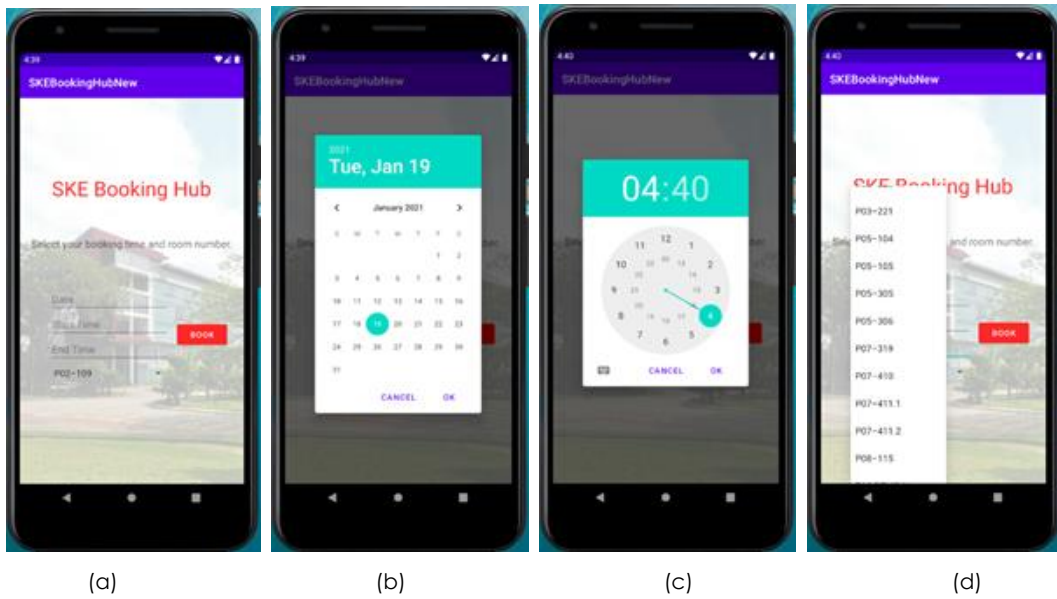
Figure 34: Selection of (b) date, (c) start and end time and (d) room number for classroom on the (a) booking page.

(a)   (b)   (c)
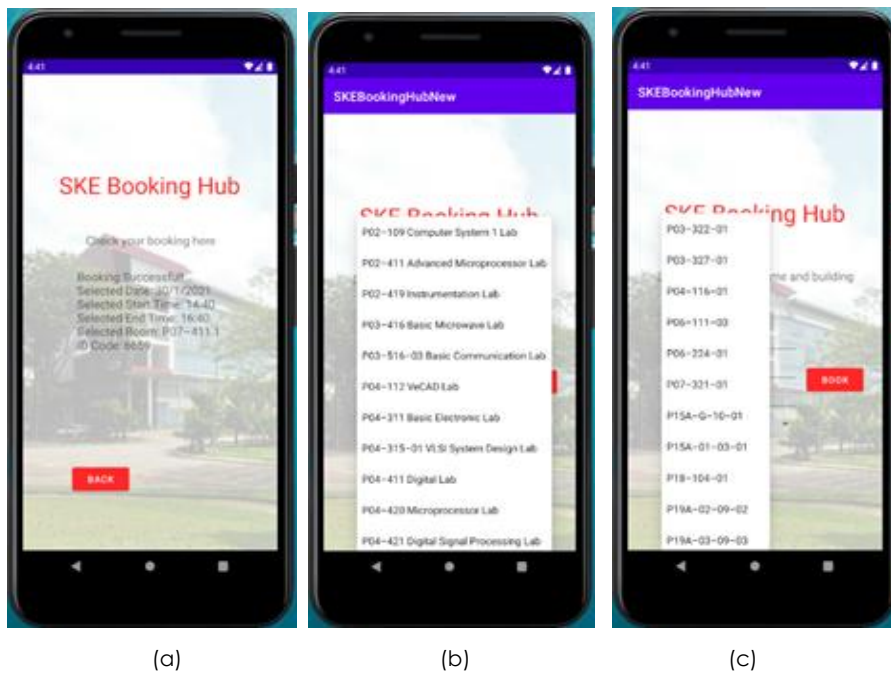
Figure 35: Showing the (a) booking data stored with respective ID code after booked successfully, the room selections available for (b) lab and (c) meeting rooms.

Discussion

Starting from the first phase, the proposal to build an agile facility management system quickly decided to improve the booking system. This phase included running a survey to identify problems, deciding system approach and preparation for proposal seminar.

Questionnaires are generated to identify key problems regarding the current booking system in the facility using Google Forms. Originally, the idea covered the whole UTM campus, but due to large coverage, the focus is switched towards SKE only. The survey is run for 1 week to collect responses. At the same time, preferable booking methods are discussed, either through websites or mobile apps. Several web servers are analyzed such as Wix,

Hostgator etc. However, due to lack of engineering methodology and modification features, mobile apps development is decided since it gives higher flexibility, more convenient and process can be completed faster on fingertips. Android Studio is identified to be the main software to create the booking apps. After discussion, the general sketches of the apps are drawn as proposals for the seminar.

In term of STEEP analysis, the details are written as shown below:

Table 2: STEEP analysis.

ASPECT	DISCUSSION
S – Social/culture analysis	Reduce the hassle of management which improves efficiency.
T – Technological analysis	Technological analysis: Everyone is holding a phone so it is convenient to book through apps.
E – Economic	It is free and can be integrated with UTM Smart apps in future, less update is required which reduces maintenance cost.
E – Environment	No manual work is needed; therefore, it could reduce paper usage to save the environment.
P – Political/legal/ethical	Encourage collaboration with the government to implement similar technology in all universities.

After receiving feedback from the seminar, phase two of the project is started by learning Android Studio. Since no one has experience on developing apps and the Kotlin language is new to us, it will need more time to complete all necessary tutorials. While learning how to use Android Studio, the apps interface is edited to accommodate the requirements. Besides, all available rooms in SKE for booking are searched. The targets are classrooms, labs and meeting rooms. Each of us used different approaches to identify the room numbers, including browsing the school official website, past year timetables and asking staff to obtain all room spaces in SKE.

As the tutorials are getting advanced, more time is needed for each member so that the apps could be developed for users' satisfaction. However, as Kotlin is complex, we decided to change to Java language as Java is much easier to implement and globally accepted. With all the info shared, the apps interfaces are built as similar as possible to the proposal. However, there are restrictions met. Certain shapes cannot be customized as the software only recognized images. Besides, buttons' shapes are also difficult to be changed accordingly. We decided to keep all appearances minimalistic as long as the functionality is able to be completed.

The last phase of app development involved making connections between app's activities, database setup for users' data, debugging and apps verification. The connections between activities are done basically with button action. The setOnClickListener library operates the clicking action to get context of next activity by finding the respective ID. The similar programming codes are modified on other interfaces that have buttons as well. For the implementation of database setup for users' data, there are two choices to use, which are SQLite and Firebase. Both methods are tried from each member. The findings from both database server is that Firebase is easy to implement but difficult to be modified as there are limitations. For SQLite, it is complex but since Android Studio has a built-in coding template, modifications can be done accordingly. With that case, we decided to use SQLite database to record users' data.

The main operation of this app is largely related to the booking section, within classrooms, labs and meeting rooms booking. To implement the selection of date and time, Calendar, DatePicker and TimePicker libraries are used. These libraries also have built-in templates to display the calendar and clock widget similar to those in smartphones. The selection of rooms is created in the form of a drop-down menu using the Spinner library. Once users select the date, start time, end time and room number, they can click the "Book" button inside and they will be given an ID code to unlock the door. This ID code is generated randomly.

Debugging and verification process took the longest time throughout the programming phase. Problems such as the emulator not being able to open apps, graphic problems, interfaces connection problems etc. became the challenges. Some functionalities are limited by the features of Android Studio such as unable to draw shapes, lagging responses etc. caused the apps development slowed down. However, the maximum effort is later on focused on the booking operations on one facility, then it can be modified down for other facilities as well. Due to the limited time given, the hardware implementation is not applied here.

Conclusion

In conclusion, we managed to build a booking app that generated random id numbers successfully. We faced many challenges and difficulties especially during this pandemic situation as we cannot physically meet. Hence,

we always overcome the problems by having online meetings in Google Meet and Whatsapp. The app that we have built by referring to the feedback of surveys that we had done in the first place to ensure the functions of the app will satisfy the end user. On the other hand, STEEP analysis plays an important role for us to produce the product that we want to design. Modifications and improvement always can be done in the future to increase the quality of our app. Many things we learned throughout the journey of the capstone especially everything can be done if we put our 110% efforts on the task no matter how difficult the task is. We hope that knowledge and experience we gained from this capstone can help us in the real job situation in the future.

Acknowledgement

We would like to express our special gratitude and thanks to our supervisor, Dr Osman Ayop and School of Electrical Engineering for their opportunity, support and guidance to be involved in the Capstone Project on the theme of agile facility management system. We learned things regarding building an app which is more to computer science course but we managed successfully. We also learned that teamwork in the team is important to ensure the success of the project. We also would like to thank our lecturers and friends for their guidance and help in completing the capstone project.

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SKE Smart Directory Application

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Abstract: An application directory facilitates automated and standardized entry of information on an application. The application directory provides a series of browser-rendered interfaces that collects data about the application. These various kinds of information are coordinated by a coherent information model that characterizes numerous progressive degrees of information types and connections among the various hierarchical levels. Overall, for developing this application we have used some programming languages using Android Studio and some features like floor view have provide the 3D-Maps video as guidance for user. Basically, this application is about to help people that new to School of Engineering (SKE) find a place in easy way.

Keywords: SKE; UTM; STEEP; CO;

INTRODUCTION

1.1   Introduction

As a new student or as outside people who have urgent matter to do in School of Engineering (SKE) area, it is very difficult to find a classroom, office or lecturer room in a large area like SKE area. From this problem statement, we come out the solution that give a lot benefit to SKE staff, lecturers, students and newcomers. SKE Smart Directory design is based on the user needs from the data clustering that demand easy application that help to locate a place. This SKE Smart Directory will provide a map view of all the buildings in the SKE. Also, this application has provided the information of all laboratories provided in school, the lecturers information included contact number, email and room number and all the facilities that SKE have.

This application easy to access by installed it by Google Play Store but this only applicable for android user but will upgrade so that IOS users also can used it. Moreover, this application has GPS that can show the road if the person is from outside the SKE location. It will be connected to Google Maps if the user use button searches in this application. SKE Smart Directory is a free access for users and easily located unknown destination which save more user time and reduce stress.

In designing our project, we consider the STEEP analysis in order to develop this project. The STEEP contains social, technology, economy, environment and politic. For the social analysis, we make sure SKE Smart Directory design is based on the user needs and pain. The application will help user to overcome the pain and fulfill their needs. Next, in term of technology, as everyone has own handphone instead of having a static terminal which help user to transfer routing information from one routing protocol to another. Since everyone have own smartphone, we can leverage the technology in our pocket and have a mobile terminal everywhere we go.

Furthermore, in economy term, SKE Smart Directory is a free access for users and easily located unknown destination which save more user time and reduce stress. The destination information is more accurate and the application has stable performance. Other than that, for the environment analysis, air pollution may be reduce since users directly go to destination instead of wasting fuel and causing more Carbon Monoxide (CO). We make sure that this application is environment friendly. Last but not least, in term of politic, we are working together with School of Electrical Engineering to design SKE Smart Directory for getting good feedback users that might raise our university name, Universiti Teknologi Malaysia (UTM) and also can help country one day in tourism industry which may help tourist have guidance application when they in the university area.

PROJECT OR INNOVATION

2.1   Objectives

SKE Smart Directory have three main objective of project that create to fulfil user wanted. Firstly, how we may help new student or outside people to have convenient SKE Smart Directory to help by give direction in easy and simple way. Secondly to create an application in smartphone that people easy to use and can understand easily. Lastly, we want to innovate the maps application better that GOOGLE MAPS which are the application is more accurate and have some clue. These three are our project innovation objective that we want to fulfil and accomplish at the end of project.

2.2   Description and Analysis Of Interview For The Project
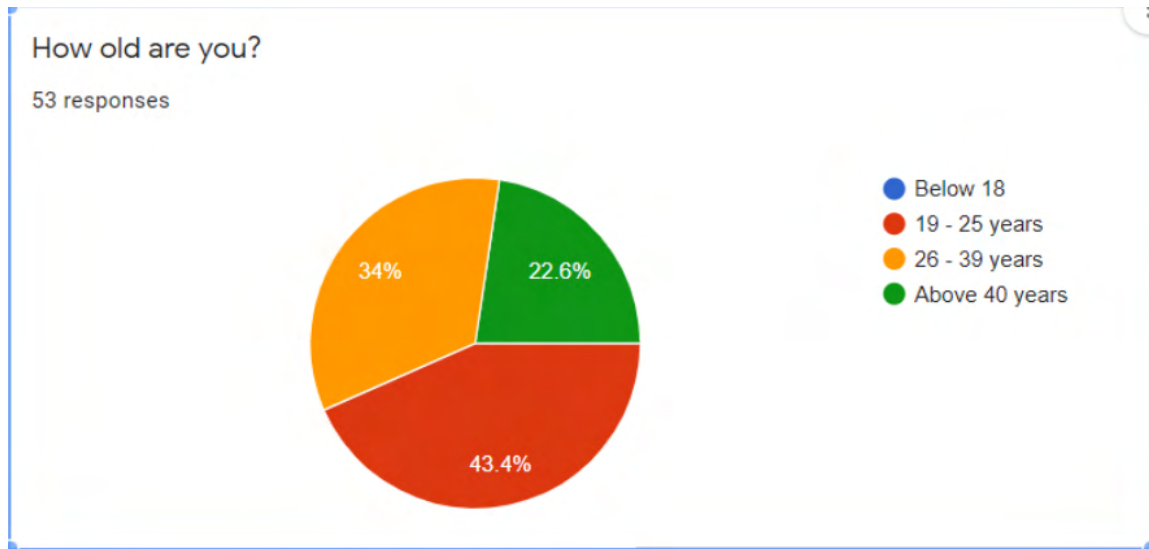
Figure 2.2.1: Pie chart 1 from data clustering

Figure 2.2.1 shows our first survey wants to know age of people so that we will know which group of people who always have a business in UTM.
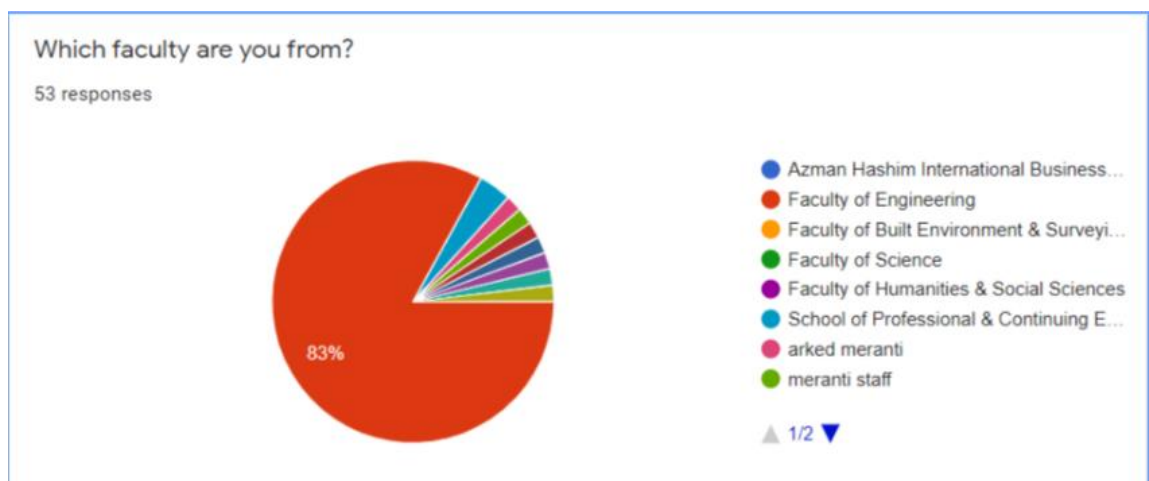
Figure 2.2.2: Pie chart 2 from data clustering

From Figure 2.2.2, this we decide to specific the location of application concentrate in Faculty of Engineering which is School of Electrical Engineering for the targeted location of our application.
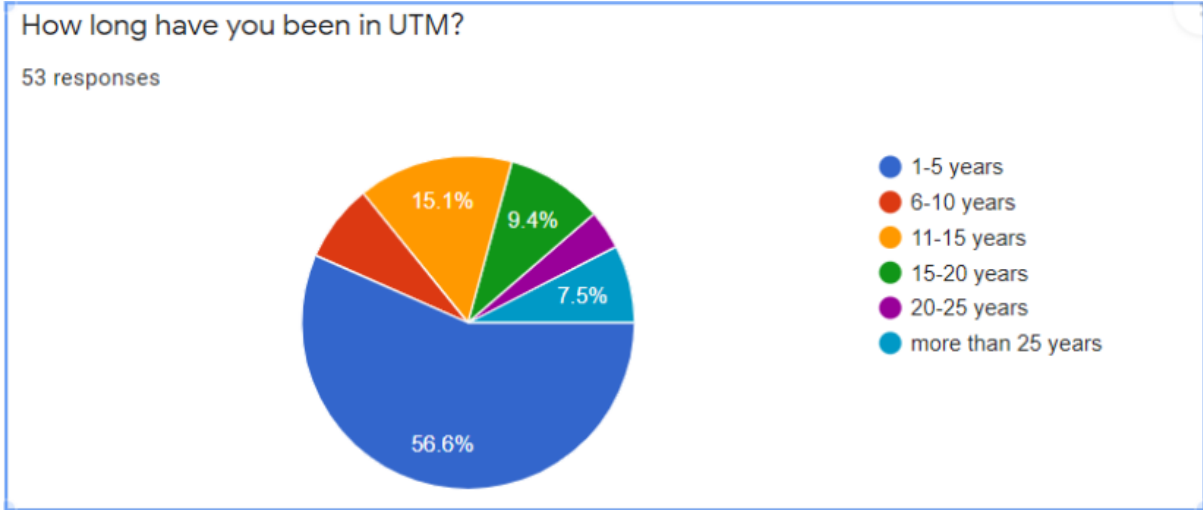
Figure 2.2.3: Pie chart 3 from data clustering

From Figure 2.2.3, this data we know the majority of people are from student category which has been in UTM around one to five years.

Figure 2.2.4: Pie chart 4 from data clustering

We survey the people who has been using directory application before this to know it helpful or not to them to allocate the location properly and specifically in UTM.
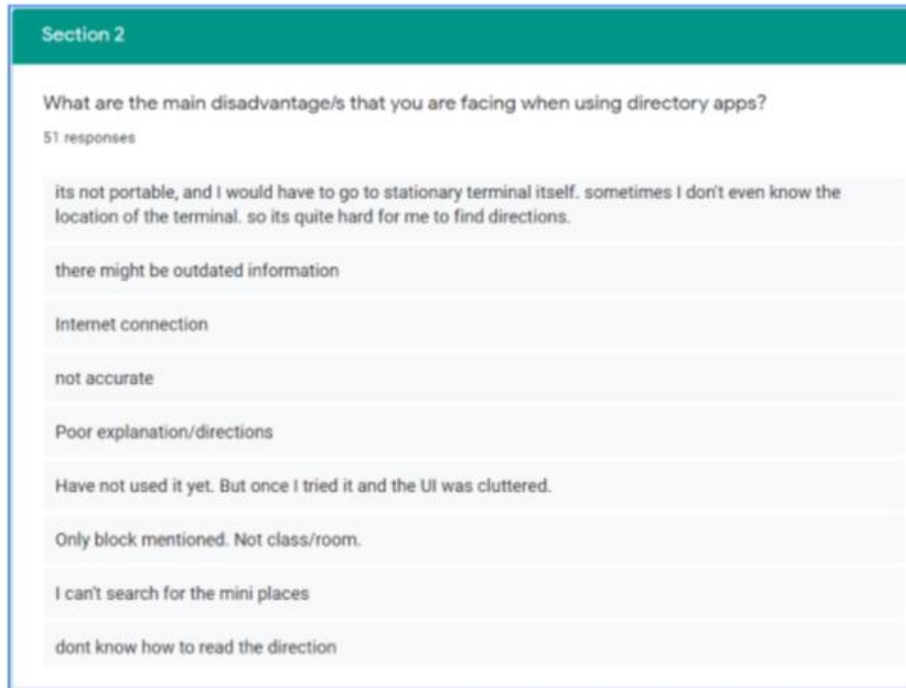
Figure 2.2.5: Questionnaire from data clustering

We also ask them what disadvantage the directory application that make them difficult or confusing to use.
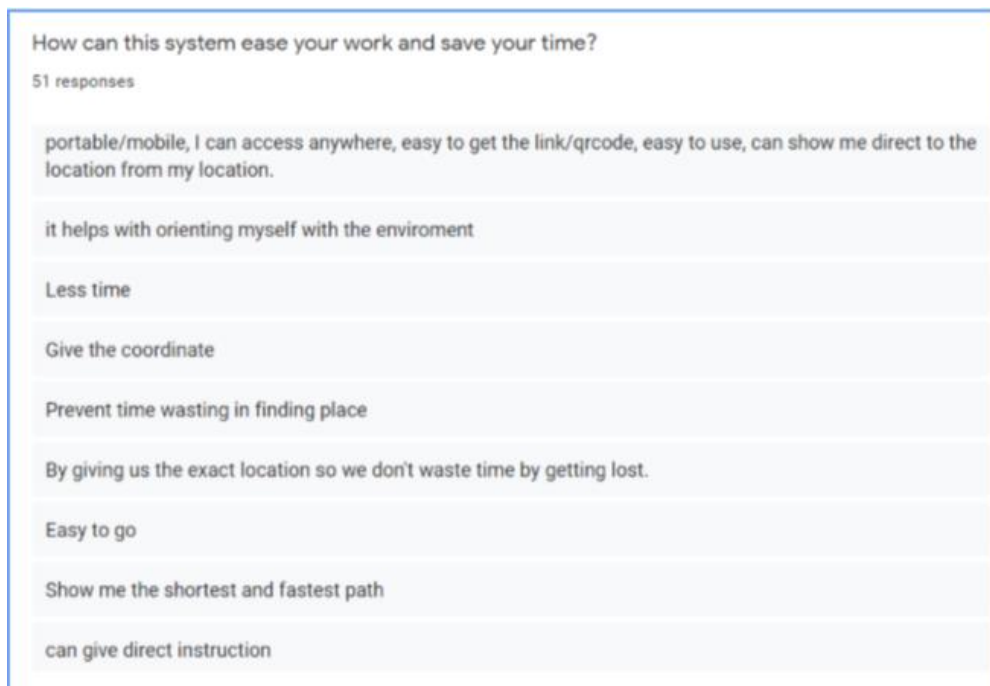
Figure 2.2.6: Questionnaire from data clustering

From these data we know people who in UTM need somethings who help them to allocate the places which give them benefit by saving their time and can be access easily anywhere.

What kind of information you needed/ expectation when you using this application?

51 responses

Lecturer's Office	37 (72.5%)
Classroom	40 (78.4%)
Toilets Male/ Female	32 (62.7%)
Laboratories	36 (70.6%)
Prayer Room	35 (68.6%)
Cafeteria	32 (62.7%)
Vending Machine	25 (49%)
	1 (2%)
Block	1 (2%)
All of the above	1 (2%)
	1 (2%)
all above	1 (2%)
	1 (2%)
Elevator	1 (2%)
dewan tempat buat majlis	1 (2%)
office	1 (2%)
hostel blocks, faculty buildings	1 (2%)

Figure 2.2.7: Questionnaire from data clustering

Figure 2.2.7 data shows what kind of information the user want search in UTM so we can know places we want to do for the floor direction of building and the map around SKE.

In your opinion, is this system eligible to be applied in your organization or in this School? state reasons.

52 responses

Yes. Because we dont know which blocks we're in

Yes, because it helps to reduce the time consume

yes, one is for the residents, two is for the visitors. this app will absolutely help me in finding my way, and will make me feel more welcomed.

yes because it will help people who are new to the enviroment

Yes easy for us

Yes, will be very handful

It's a good idea, but it needs a lot of work.

Yes. Good for newbie or first year

Yes, because for the first time coming to UTM, you will be lost

Figure 2.2.8: Questionnaire from data clustering

Figure 2.2.8 data shows user very needed this directory application to help them which give positive affect to them.

70
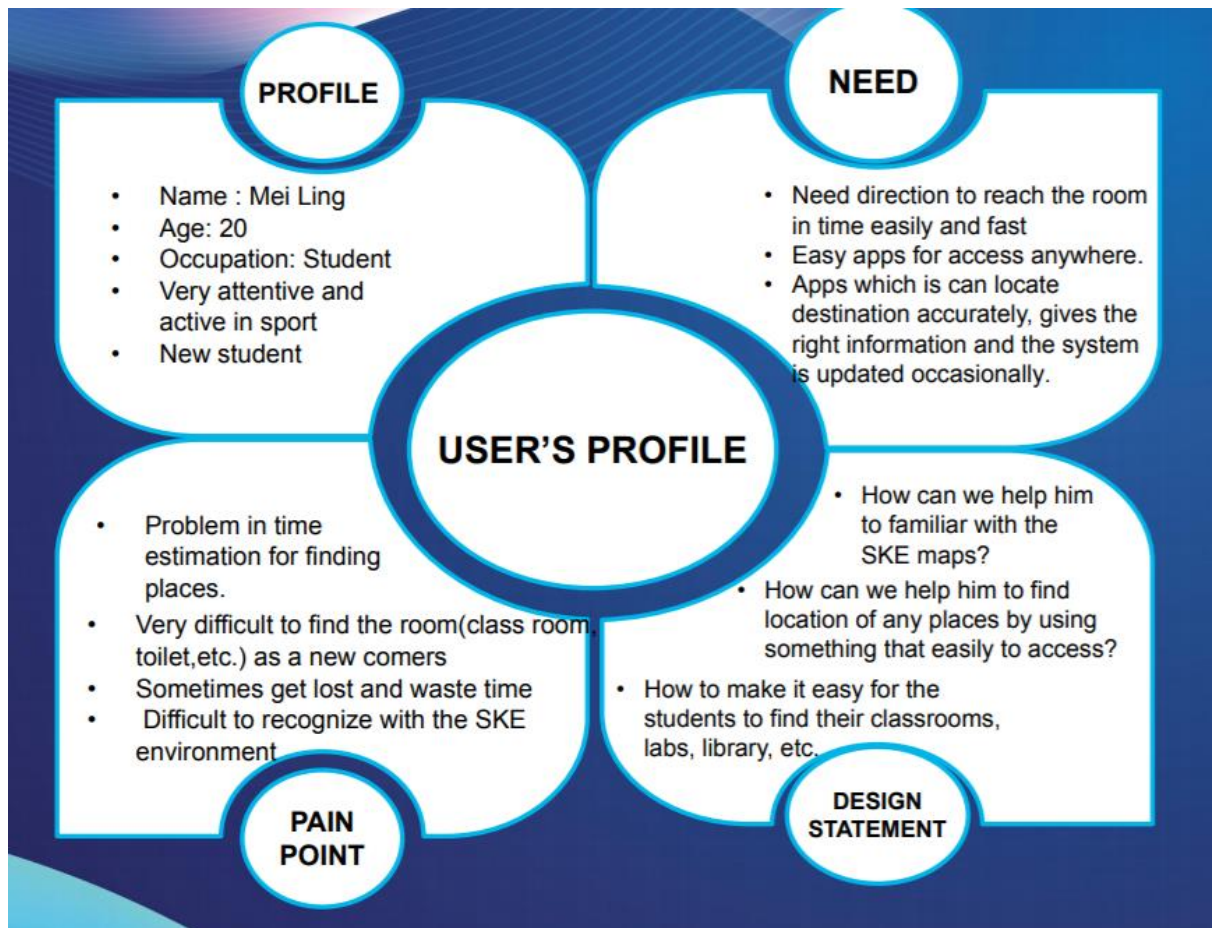
Figure 2.2.9: Persona of User's profile

Figure 2.2.9 shows our targeted user which new student in UTM who under SKE.

2.3   Design statement

An application that specifically function to help consumer in SKE specifically new student for the information of SKE places. These firstly give an information of place located in SKE block. We provide the GOOGLE MAPS in our application which can detect where the people located and conduct them to the building in SKE. Secondly give information who conduct the room such as laboratory. We design floor directory in 3D which can see the whole floor and where they can locate the room specifically. We also include the info the lecturer or people who conduct the room such as name info, telephone number and their email. Furthermore, we provide the clue or info around the room to help user can detect correct place if they still confuse. As relevant to the project, thirdly identified from the analysis and problem that their faced to build easy and simple direction application without sign in and free to use.

2.4   Methodology

2.4.1: Android Studio Methodology

```
         ┌─────────────────┐
         │     Create      │
         │     Android     │
         │     Studio      │
         └────────┬────────┘
                  │
                  ▼
    ┌──────────────────────────┐
    │  Getting information about│
    │   School of Electrical    │
    │  Engineering. (places,    │
    │      lectures info)       │
    └──────────┬───────────────┘
               │
               ▼
      ╱────────────────────╲
     ╱   Design User         ╲
    ╱  Interface the page     ╲
    ╲   at the coding area    ╱
     ╲────────────────────────╱
               │
               ▼
    ┌──────────────────────────┐
    │  Embedded Google Maps     │
    │   into the application    │
    └──────────┬───────────────┘
               │
               ▼
      ╱────────────────────╲
     ╱   Create coding at    ╲
    ╱  java layout foy any    ╲
    ╲  activity on the page   ╱
     ╲────────────────────────╱
               │
               ▼
      ╱────────────────────╲
     ╱  Run to troubleshoot   ╲
    ╱  any error in coding     ╲
     ╲────────────────────────╱
               │
               ▼
    ┌──────────────────────────┐          ┌─────────────┐
    │  Embedded Sketchup video  │─────────▶│     END     │
    │  movement for floor view  │          └─────────────┘
    └──────────────────────────┘
```
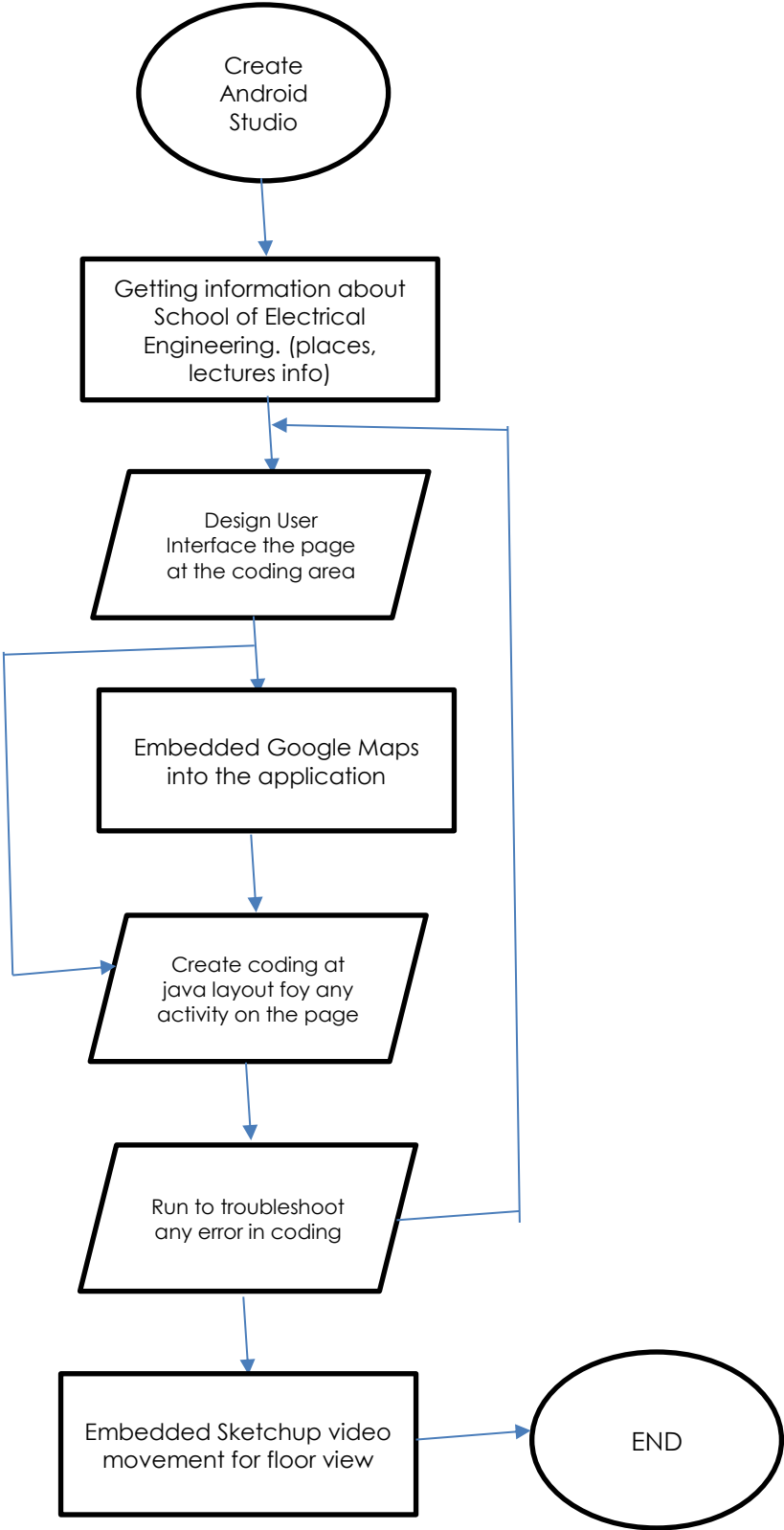
2.4.2: Sketchup Methodology

```
          ╭───────────────╮
         (   Create        )
         (   Sketchup       )
          ╰───────┬───────╯
                  │
                  ▼
        ┌───────────────────┐
        │ Getting information│
        │   of the floor view│
        └─────────┬─────────┘
                  │
                  ▼
          ╱───────────────╱
         ╱  Design the floor╱
        ╱    view          ╱
        ╱─────────┬───────╱
                  │
                  ▼
        ┌───────────────────┐
        │ Edit and improve   │
        │   the design       │
        └─────────┬─────────┘
                  │
                  ▼
          ╱───────────────╱
         ╱  Create video    ╱
        ╱  animation of user╱
       ╱  movement in the  ╱
      ╱    floor          ╱
      ╱─────────┬───────╱
                │
                ▼
      ┌───────────────────┐
      │ Review video of    │
      │  animation floor   │
      │  plan              │
      └─────────┬─────────┘
                │
                ▼
        ╱───────────────╱
       ╱  Import the video ╱
      ╱   into the android ╱
     ╱    studio          ╱
     ╱─────────┬───────╱
               │
               ▼
        ╭───────────────╮
       (     END          )
        ╰───────────────╯
```
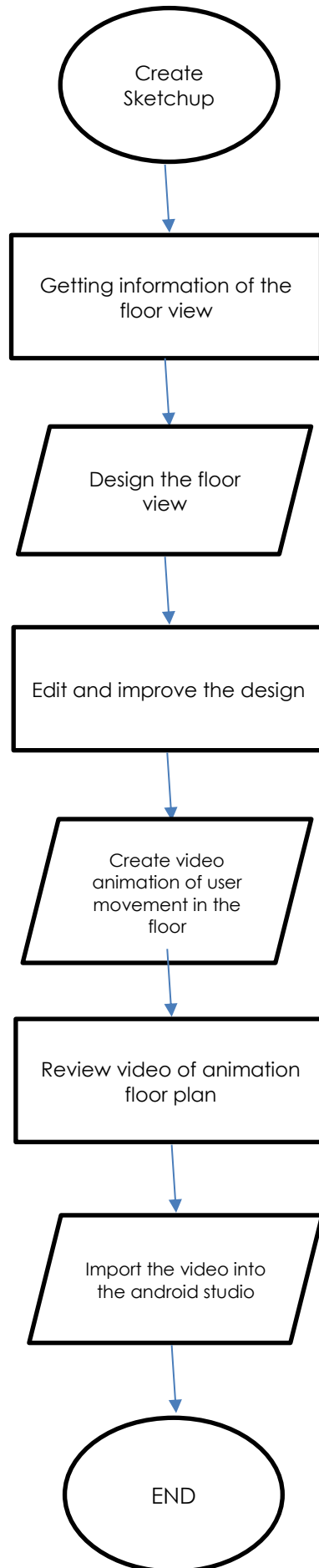
2.4.3: Gantt chart

ID	Task Description	Start Date	End Date	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
1	Decide project title	26/10/2020	29/10/2020	■														
2	Preparing 10 interview question	29/10/2020	1/11/2020		■													
3	Distribute question using google form	1/11/2020	5/11/2020			■												
4	Data clustering from respondents	5/11/2020	6/11/2020				■											
5	Conceptual sketch of proposed design	6/11/2020	9/11/2020				■											
6	Conceptual prototype development	9/11/2020	20/11/2020					■										
7	Prepare slide and video for design proposed	20/11/2020	23/11/2020						■									
8	Presentation design	23/11/2020	23/11/2020						■									
9	Starting software program	24/11/2020	1/1/2020							■	■	■	■	■				
10	Final testing of product	1/1/2020	19/1/2020												■	■		
11	Prepare slide and video for product	20/1/2020	24/1/2020														■	
12	Final product evaluation	25/1/2020	25/1/2020															■

Figure 2.4.1: Gantt chart

Figure 2.4.1 shows our planning throughout this project. Task were carried out one by one based on the Gantt chart until the last task which is final product evaluation.
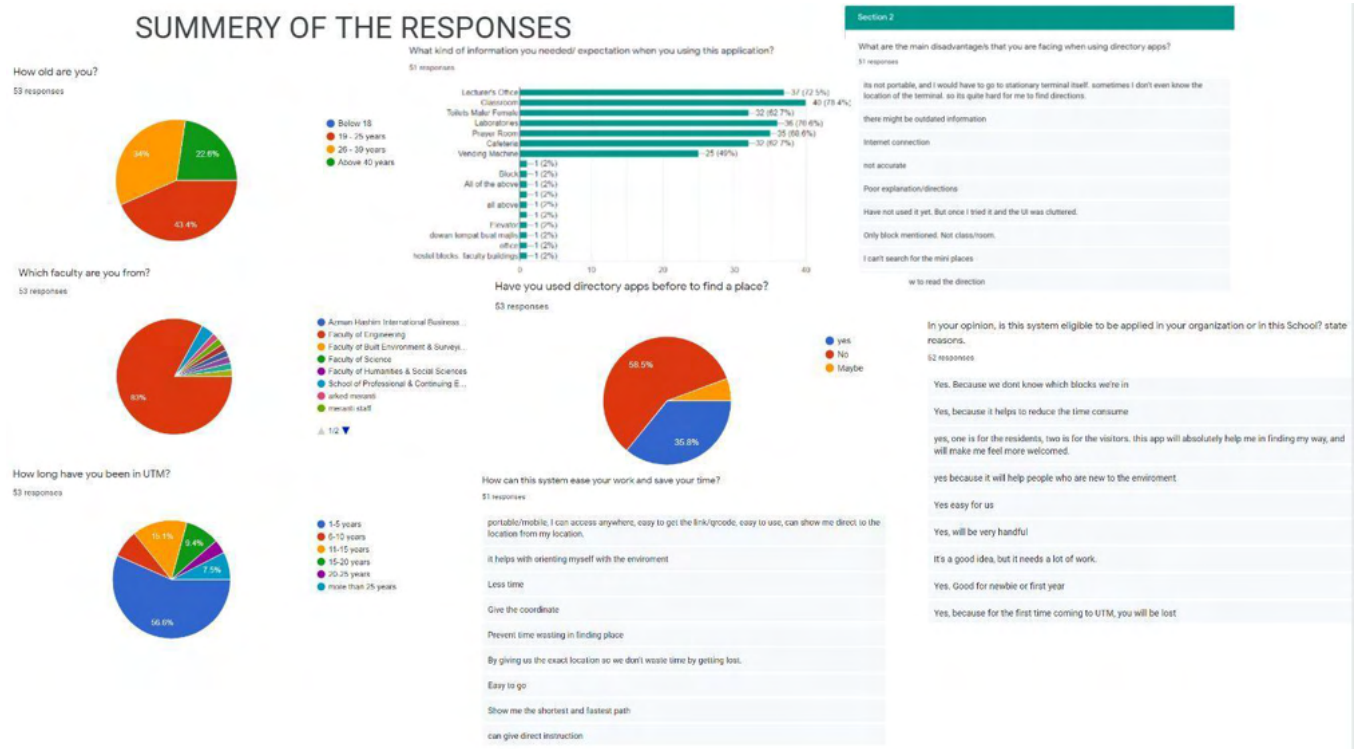
2.5 Product Development

Figure 2.5.1: Application development from data clustering

Based on the figure 2.5.1, we collect the data randomly from the students, lecturers and non-UTM users. We found that, some of the users which is UTM and non-UTM having a hard time to locate the location in this School of Electrical Engineering. We also noticed that there are a lot of users never used directory application. Hence, our group C2G07 carry out design of the application as in figure 2.5.2 and figure 2.5.3 which is consist the information of the places of SKE, information of whom that assigned to the room or the facilities at SKE, direction to the destination and simple application that easy to use or access for the users.
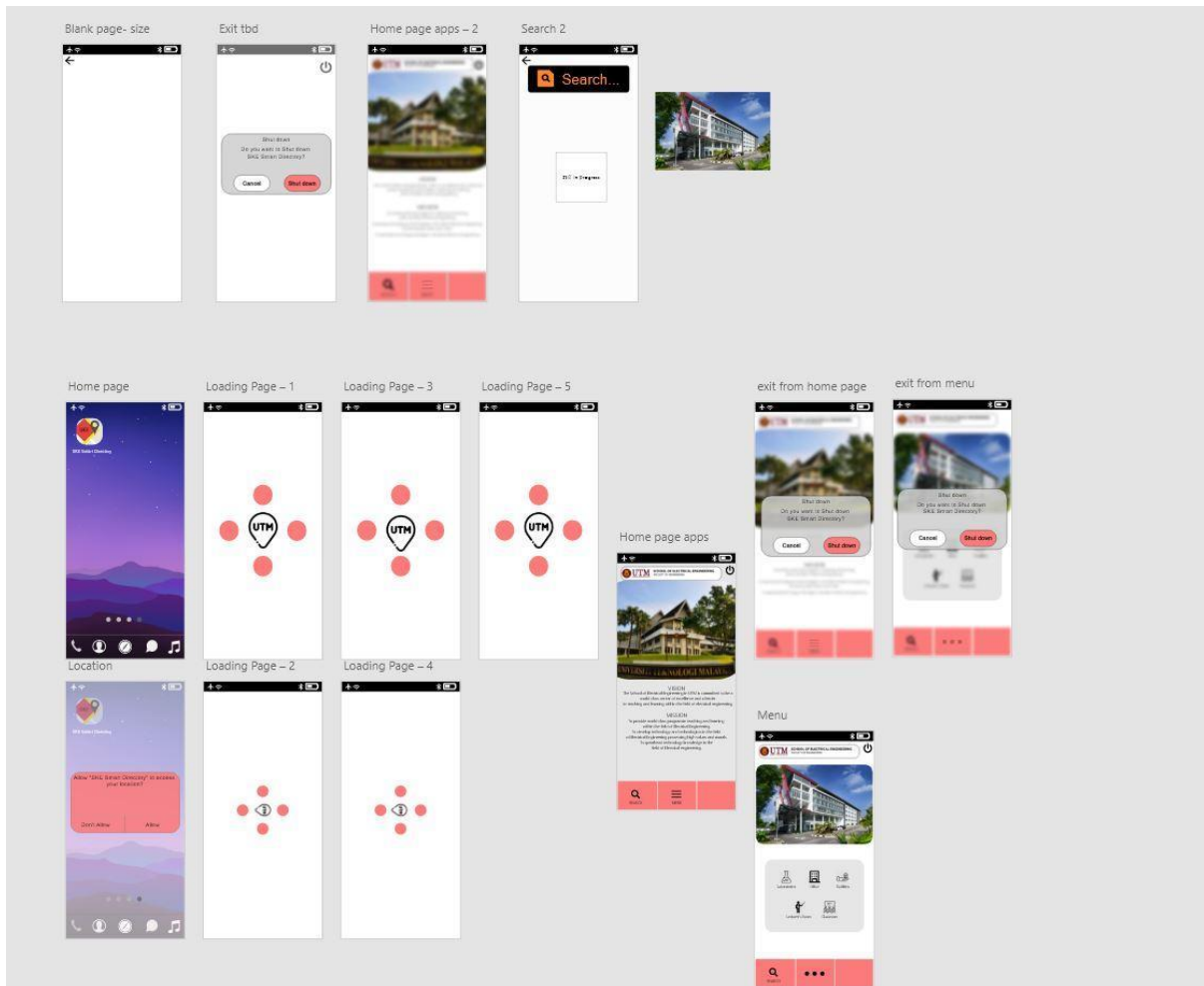
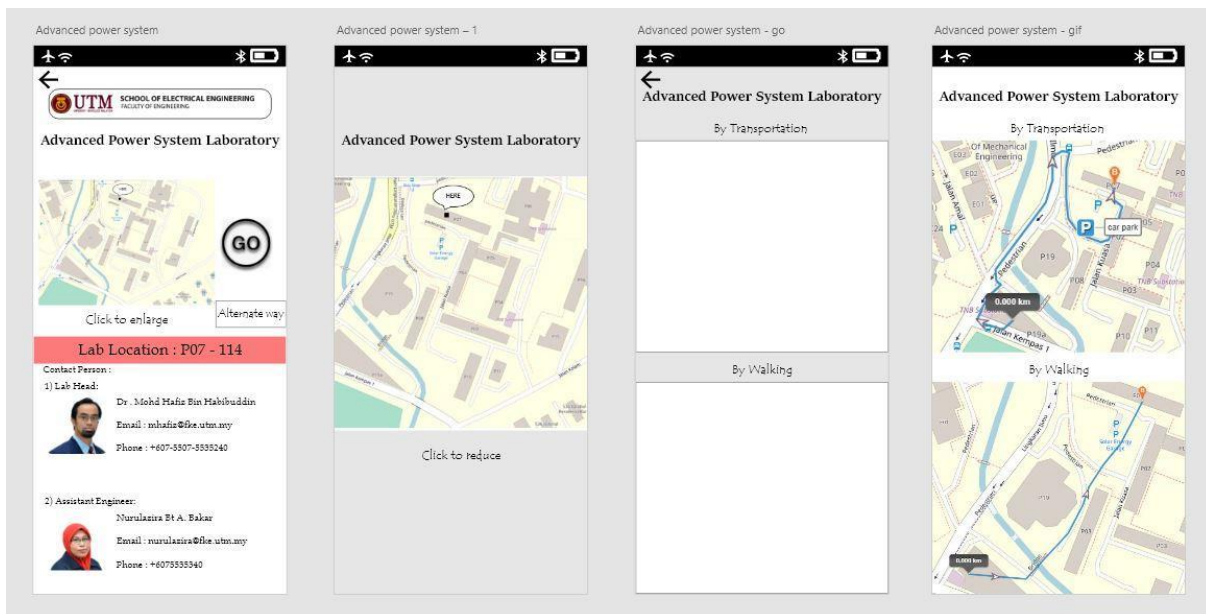Figure 2.5.2: Prototype development using Adobe XD

Figure 2.5.3: Prototype development using Adobe XD

Next, we create a prototype design using Adobe XD as in figure 2.5.2. As our early idea, we consider that there is need to be direction for users that having a transportation and users that don't have transportation as in figure 2.5.3. In future development which is using software for real application, we carry out the application to using Google Maps that included both of this action that cover for transportation and walking directions.
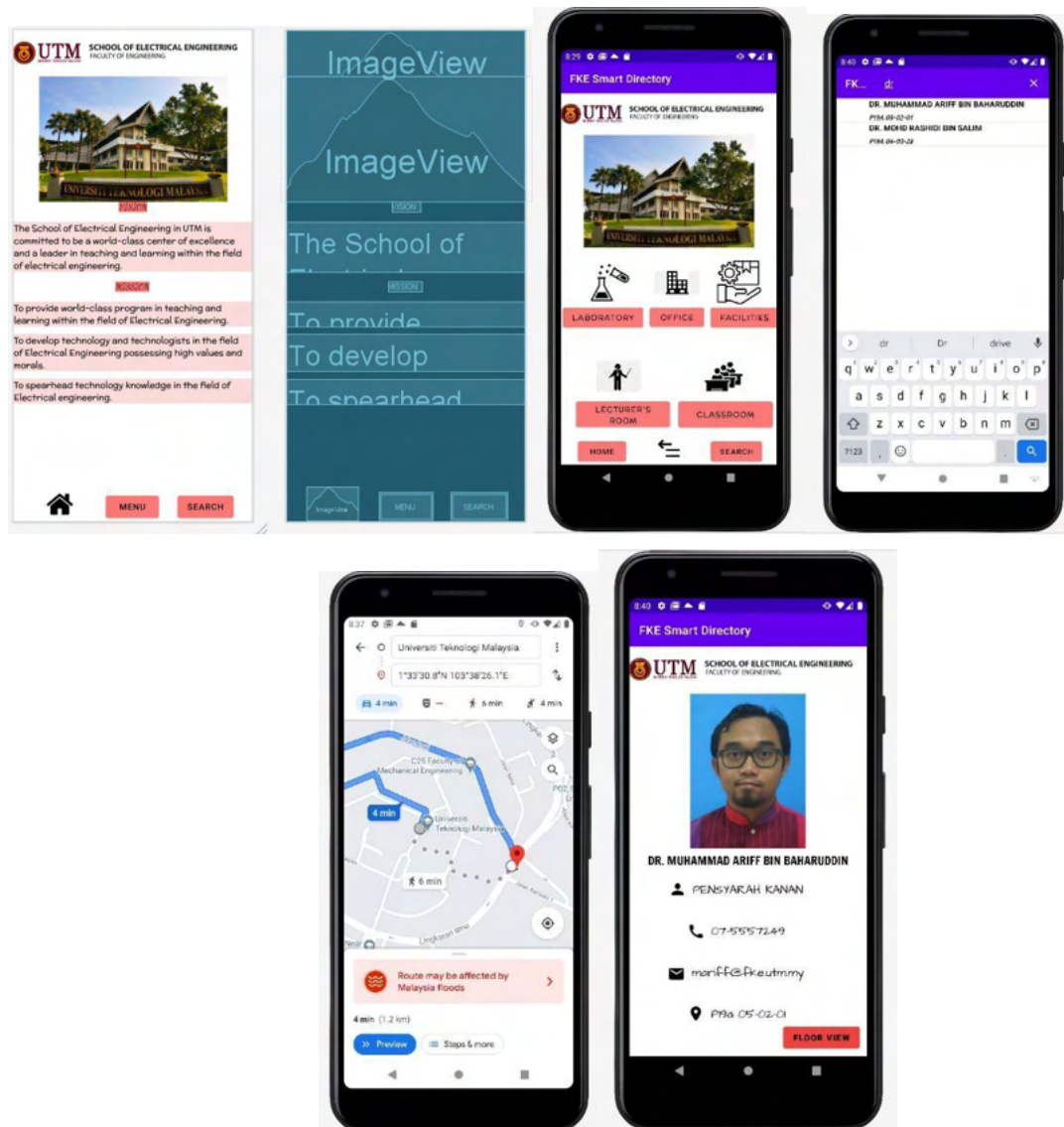

Figure 2.5.4: User Interface of SKE Smart Directory

Figure 2.5.4 shows that our real application development using Android Studio. As state in the design statement, the design of this application is simple and easy to use. In this software, we come out with search feature is to make the users to locate the location easier and faster if the users know the name of the targeted location or name of the building. Plus, if the user doesn't have any information of the building, we sorted out the category in the menu page for the users to access to the destination. List of coding is attached in the appendix.

As for the improvement of our application, we come out with the clue of the surrounding of the location such as right side or left side view and video movement of a user from one point to the destination as in figure 2.5.5.

Figure 2.5.5: Clue for the destination.

Table 2.5.1: STEEP analysis of the application development

Aspect	Discussion
Social	FKE Smart Directory design is based on the user needs from the data clustering that demand easy application that help to locate a place.
Technology	As everyone has own handphone instead of having a static terminal which help user to transfer routing information from one routing protocol to another. Instead, everyone has their own handphone, we can leverage the technology in our pocket and have a mobile terminal everywhere we go.
Economy	FKE Smart Directory is a free access for users and easily located unknown destination which save more user time and reduce stress.
Environment	Air pollution may be reduced since users directly go to destination instead of wasting fuel and causing more Carbon Monoxide (CO).
Political	Working together with School of Electrical Engineering to design FKE Smart Directory for getting good feedback users that might raise our university name, UTM.

Our group carry out the project with minimal amount of cost. We estimate that, the only cost that we need to pay is to convert our application from android studio to Play store. The cost is as below:

Table 2.5.2: Total cost of project

NO	Description	Price
1	Application available on Play Store	$25

2.6   Discussion on Developed Product

Table 6.1: Comparison of similar products

Features	SKE Smart Directory	Google/Google Maps	UTM Smart
Contain info of assigned lecturers	✓	✓	✓
Navigation to destination	✓	✓	
Floor view of building	✓		

SKE Smart Directory is easy to access to obtain the info of the lecturers or the assigned workers to the room or facilities. Same goes to UTM Smart and google is consists info of the lecturers but both of the application lacks info for the assigned places or targeted room such as laboratories.

Navigation to destination is easily access with SKE Smart Directory and google maps. In our application, we used Google maps as our navigation system to navigate the users to the destination. This is because we want to implement the walking and transportation method in this application. For UTM Smart, there is no navigation features to the destination.

As our unique of the application, we focus more on School of Electrical Engineering. We provide the floor view of the building in application so it will be easier for the users to getting information of specific location in the building. For the floor plan direction, the design was build using Sketchup Software which the software provides the floor building plan. In this design of floor, we also provide an animation of the floor plan which video movement of person from one point to destination or specific room as in figure 2.5.5.
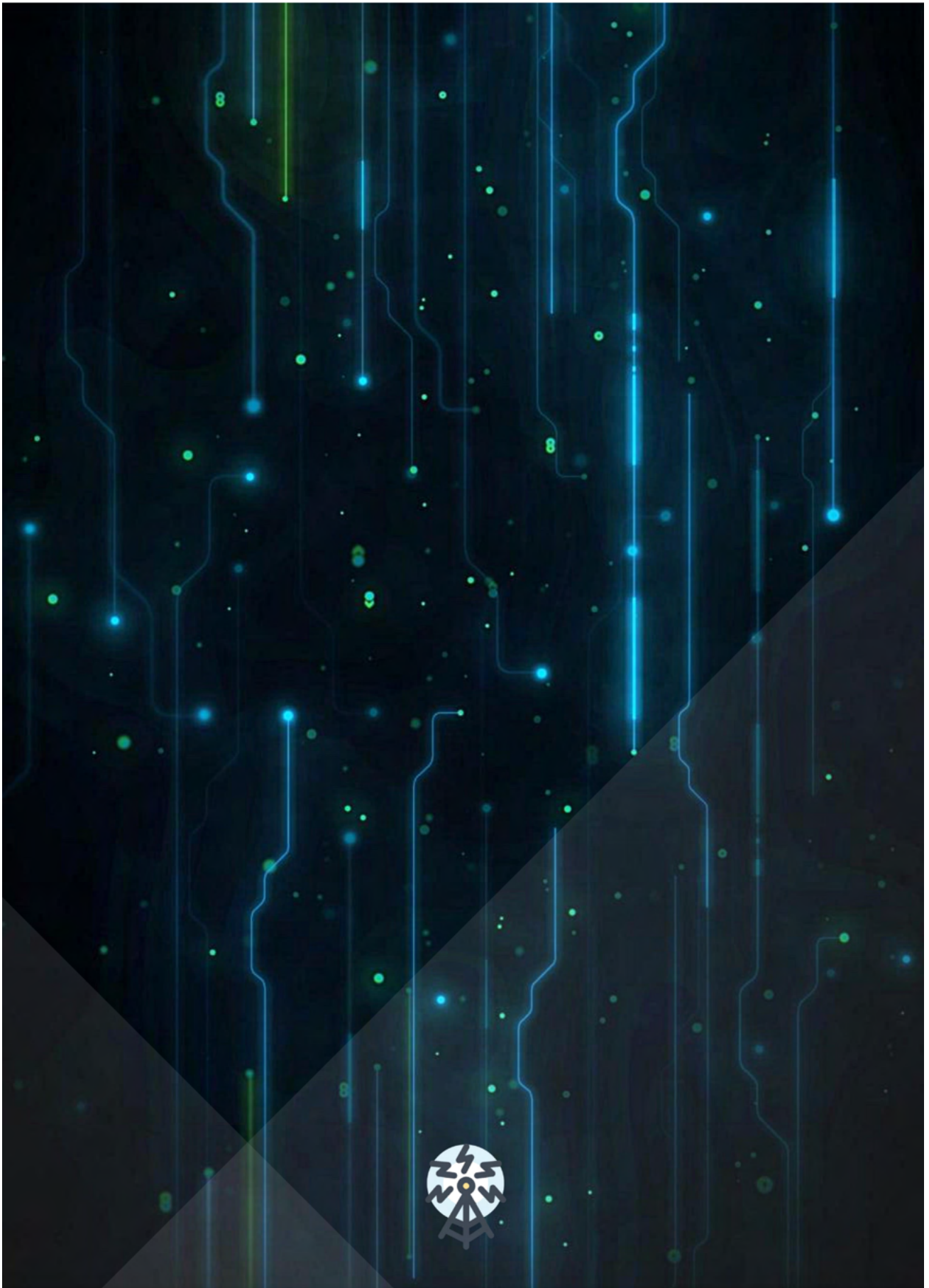
2.7   Conclusion

From the above information, we can conclude that our project successfully run since we can open the application and try run by show the road to go the P19a building and then show 3D maps video that shown the lecturer room at level 4 which is Dr Rashidi's room. Generally, this application can operate as expected and perform the good result. However, we encountered some limitation in our project. Firstly, we have limitation on the for the targeted location by GPS which is the user need to copy the longitude, latitude (do it normally) because needed API key that connected with google maps platform cost a lot around two hundred dollars ($200). Next, we only have three targeted location in this project because limitation of time to cover all the buildings in SKE. There is some improvement can be done such as if the project has sponsor in term on budget, we can add API key so that may easy use the GPS. Other that than, can add budget on the 3D maps for the animation movement so it can be smooth and clear. Lastly, can improve by adding the database so the data can be organized and also it can improve concurrency, security, backup and recovery, integrity and data descriptions.

Acknowledgment

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[4]   https://www.youtube.com/watch?v=uJMLXXPxi44&t=28s

[5]   https://www.youtube.com/watch?v=e2iujgNFkpo&t=1s

[6]   https://www.youtube.com/results?search_query=how+to+change+direction+of+movement+object+in+sketchup

[7]   https://www.youtube.com/results?search_query=sketchup+floor+plan+design