

PROCEEDINGS OF ELECTRICAL ENGINEERING CAPSTONE SHOWCASE (EECS 2020)

COMMUNICATION ENGINEERING DIVISION
SCHOOL OF ELECTRICAL ENGINEERING
FACULTY OF ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA
SESSION 2020/2021
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UNIVERSITI TEKNOLOGI MALAYSIA



Electrical Engineering Capstone Showcase
School of Electrical Engineering

**PROCEEDINGS OF
ELECTRICAL ENGINEERING CAPSTONE SHOWCASE
(EECS 2020)
SMART EDUCATION SYSTEM**

**PROCEEDINGS OF ELECTRICAL ENGINEERING CAPSTONE SHOWCASE
2020: SMART EDUCATION SYSTEM
2021**

First Edition 2021

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PREFACE

This publication consists of all the works presented during the Electrical Engineering Capstone Showcase (EECS 2020), which was held on 25th January 2021. Capstone Project is a compulsory course taken by final year students from School of Electrical Engineering, Universiti Teknologi Malaysia. Upon completion of this course, students have successfully applied their creative and critical thinking skills in solving engineering problems.

EECS 2021 provides a platform for students to share and exhibit their ideas and projects, with academicians and industrial representatives to offer valuable feedback for improvements. The publication entitled “Proceedings of Electrical Engineering Showcase 2021: Smart Education System” intends to consolidate all the presented works within the theme, so that it can be used for future reference.

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Smart Course Amendment Website

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Abstract: During the first week of the new semester, the students are allowed to update their course registration either to insert a new subject or change their current course through the course amendment period. One of the requirements for course amendment applications is for the student to get the lecturer's signature. With a limited time given, some students may not be able to complete them and end up failing to register for the course or be fined for a late submission. Instead of filling a paper form and getting approval manually, it will be much easier if the process can be done online. This report explains the findings, the purpose of the project, and the development of the prototype which is the course amendment website.

Keywords: Course amendment; Developing website; University's school; Students; Lecturers; Office staffs

Introduction (Project or Innovation)

A smart faculty uses networked technology to facilitate connectivity, optimize security, use services more effectively, and, of course, save money. Simply put, experience, quality, and education can be enhanced by a smart faculty. A smart faculty would enable an institution to link systems such as lighting and door locks and provide students, lecturers, and staff with a smooth and integrated experience. One essential application that can be enforced to realize smart faculty is smart course amendment. Smart course amendment is a website to help students, lecturers and staff obtain information about a specific course and complete course registration in a particular semester. In order to further productive development of smart course amendment, research and analyze on what the current problems of the current course registration system faced by students, lecturers and staff. The interview is made by interviewing students, lecturers and staff from School of Electrical Engineering, University Technology Malaysia. From the interview finding, the most highlighted problem is hard to find a lecturer to get a signature. From the scenario, a website for course registration is proposed as the alternative solution. Since the framework is built with a web-based interface, the simultaneous proceedings will be taken care of by starting to run the model with parallel executions with the back-end details. System analysis has been carried out to scrutinize the visual image into various processes carried out by a system and their interactions outside the system. To build a decentralized approach that segregates the practical specifications for the system, system architecture has been created. System components are spread around the physical architecture, prototyping and creating functional interfaces. Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), JavaScript (JS), Hypertext Preprocessor (PHP) and Structured Query Language (SQL) are applied in this project using XAMPP for cross-platform, Apache and local web server. This composition furnishes the flow of product development of smart course amendment.

Objectives

- i) To provide a convenient way for the course amendment process especially for students, lecturers, and school staff.
- ii) To create a user-friendly course amendment website with several functional plugins
- iii) To learn and apply the basic skills in developing a website

Data findings

Before starting a project, a survey was held in order to gain information, and get feedback and opinions from the target users, namely students, lecturers, and school staff. This step is to make sure that the website would be able to provide solutions for current problems and give high satisfaction to them on the final product. The platform and method that had been used for the survey are questionnaires through a google form, and direct interview via WhatsApp and Email.

Different surveys were done from time to time to make sure there were enough sources and information for the project. Following are some of the questions and findings that manage to be received from the target users.

Questionnaire from google form

The first questionnaire was made especially for the students, to draw their opinions about the current insufficient system of the faculty as shown in Figure 2.1 until Figure 2.4. The majority respondents were having trouble with the course registration and amendment process. It was said that they need to get signatures for approval. However, sometimes the lecturers are not available and students are also rushing for classes since the time period is too short.

Some of them suggest to use an online system so that the signature would be no longer needed as the lecturer can easily click a button for approval and send notifications via email.

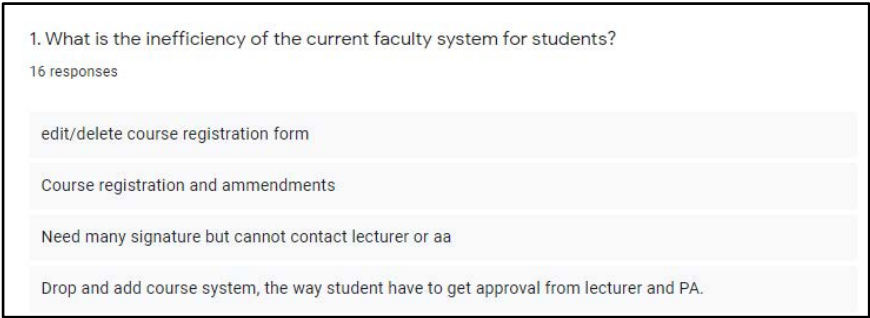


Figure 2.1: Student Questionnaire 1

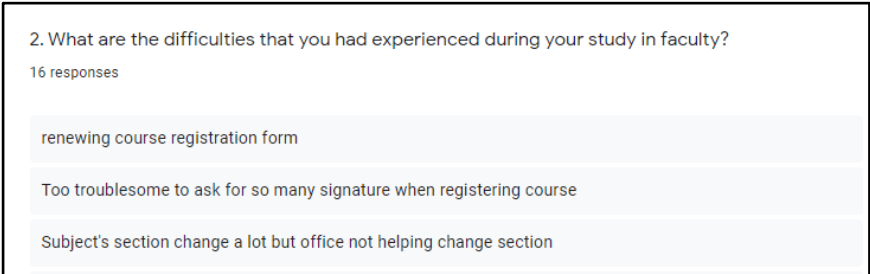


Figure 2.2: Student Questionnaire 2

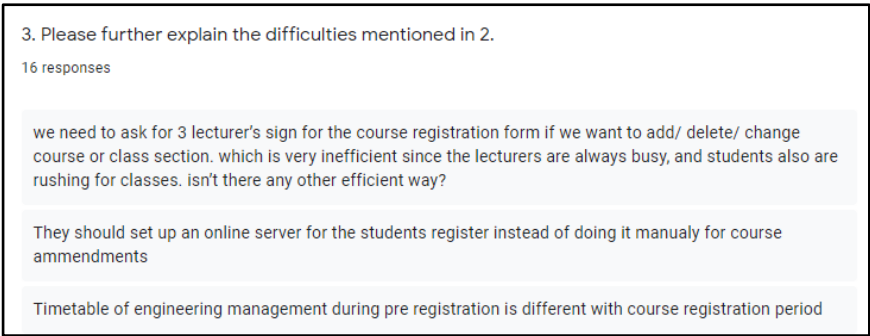


Figure 2.3: Student Questionnaire 3

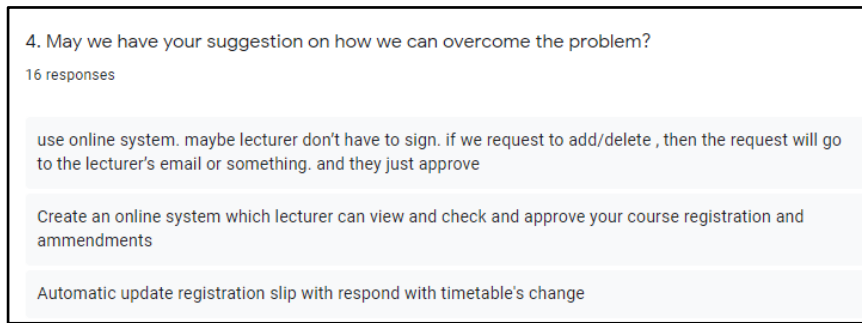


Figure 2.4: Student Questionnaire 4

There is also a survey specifically made for the staff office since they are the one in charge for the course amendment. Figure 2.5 and 2.6 show the results from the survey.

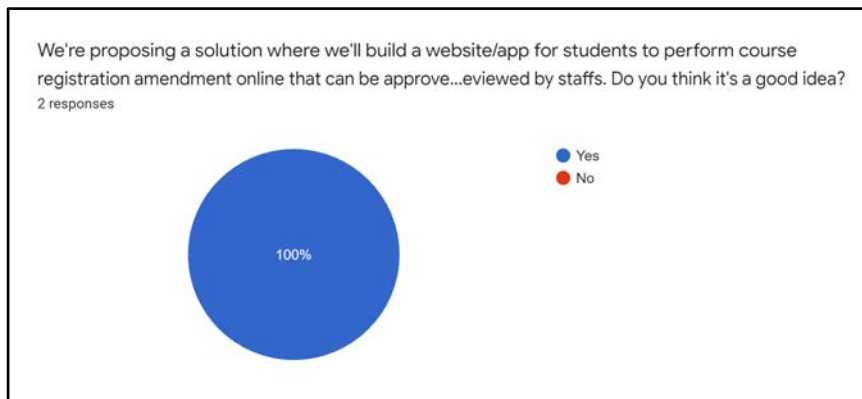


Figure 2.5: Staff Questionnaire 1

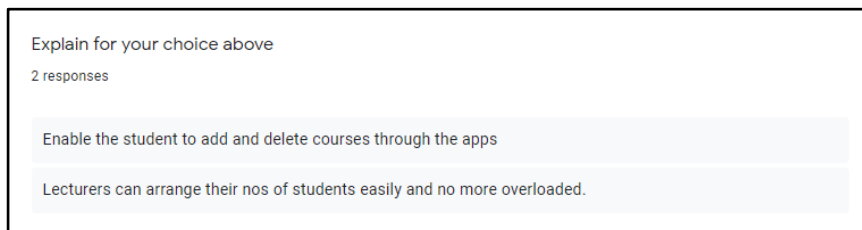
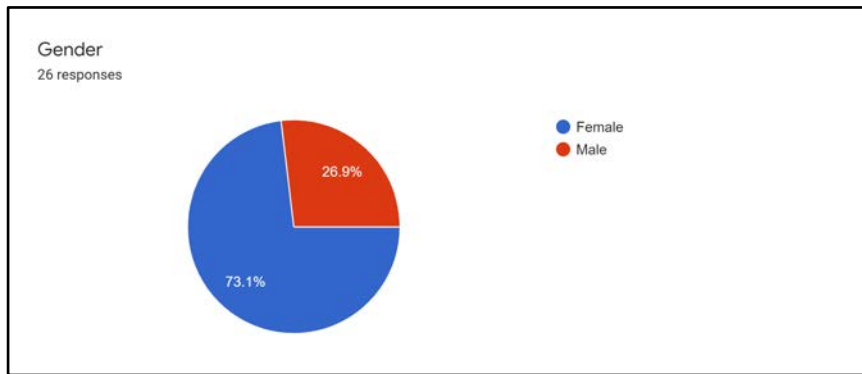
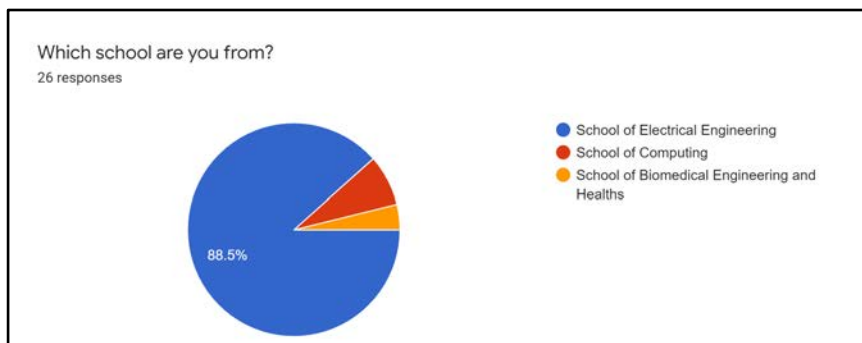


Figure 2.6: Staff Questionnaire 2

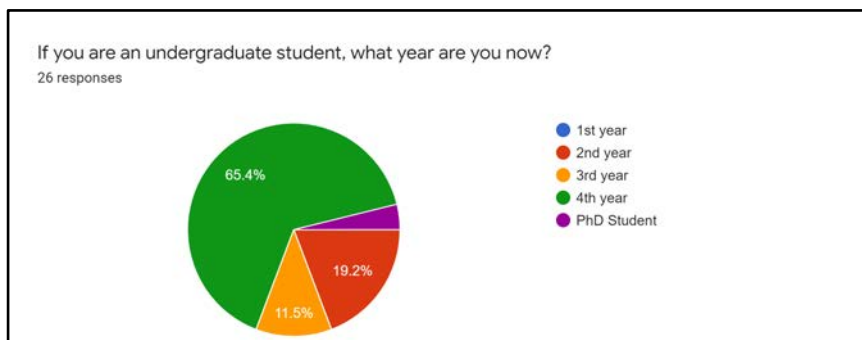
A last survey has been held for the students and it is shown that the majority of the students from every year batch were having difficulties in applying for their course amendment. Many of them agree that it was difficult to find some lecturers for their approval since some of them do not have spare time within the limited time given as shown in Figure 2.7.



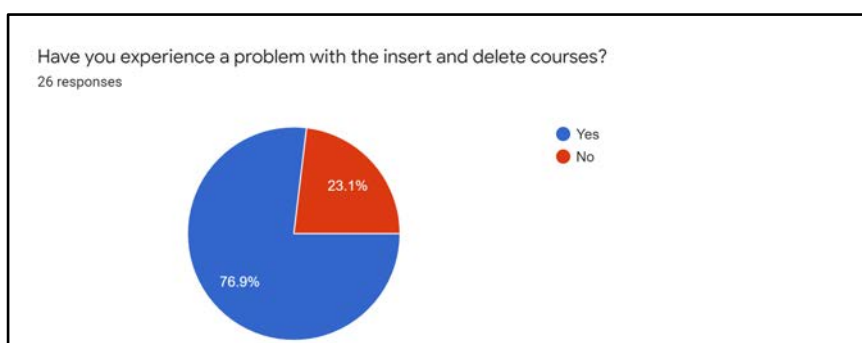
(a)



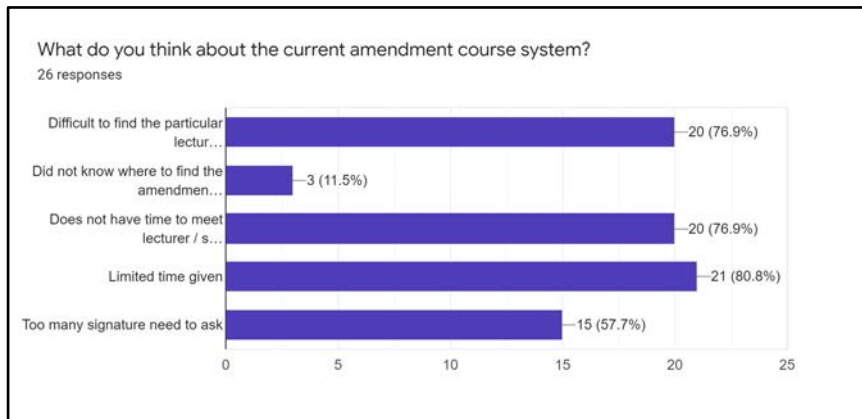
(b)



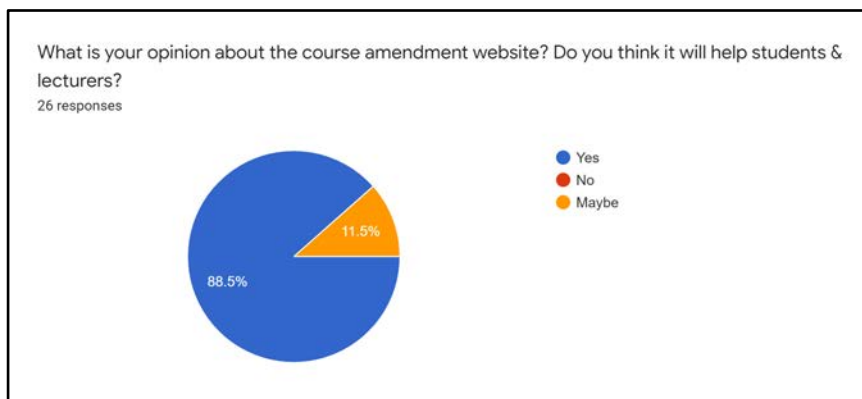
(c)



(d)



(e)



(f)

Figure 2.7: The final survey for students

Email

Some details are asked directly to the staff in charge so the website can function accordingly with the original procedure. The main purpose of the project is to redesign the methods without changing the actual requirement for the course amendment. Hence, it is very important to always refer to the person in charge without making our own assumptions. Figure 2.8 shows the content of the email to one of the school's staff regarding the overcredit matters.

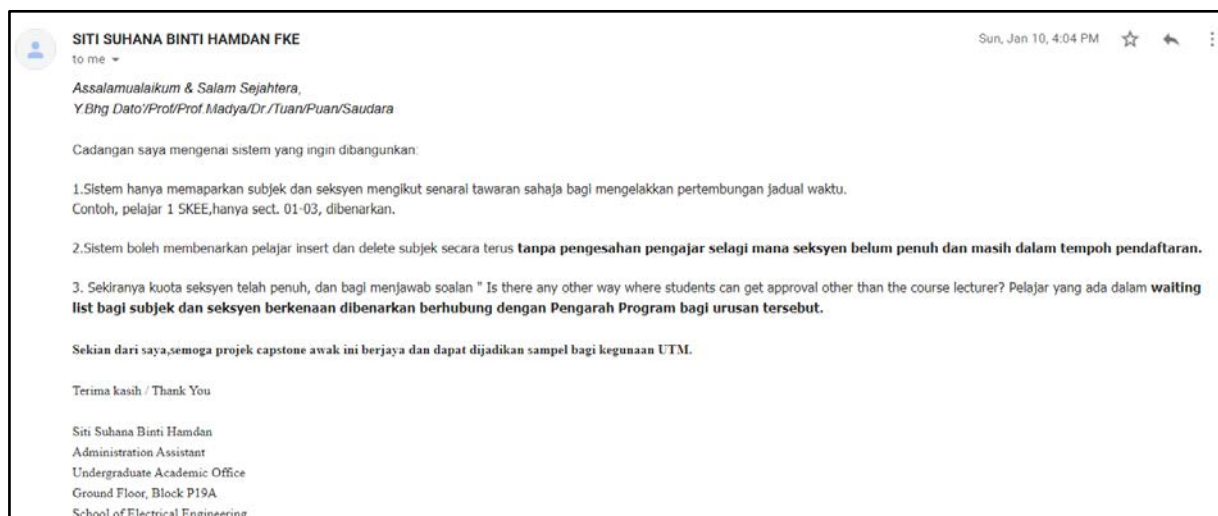


Figure 2.8

Design Statement

The current course amendment for School of Electrical Engineering is quite difficult and troubling as the applications are all done manually. A modern solution is needed to ease the burden for the students, lecturers and staff. The current method is using a lot of paper, since they need to fill in paper forms to perform their application, and time consuming too as they need to rush through the school's building to ask for the lecturer's as well as the academic advisor approval before submitting to office within the limited time given. Hence, to overcome these problems, the proposed solution is to redesign the old methods by building a website that is easy to use, well designed and functional, and ready to access. The website should include a friendly login page, user profile, insert and delete table, approve and reject button, and notification send through email. Before designing a website, there are two main things that are needed. The first one is to create a domain name. The web address can be customised to a familiar name and easy to search up. Next one is a website hosting to host the website so it can be accessed easily through the internet. Figure 3.1 shows the conceptual design for the course amendment website.

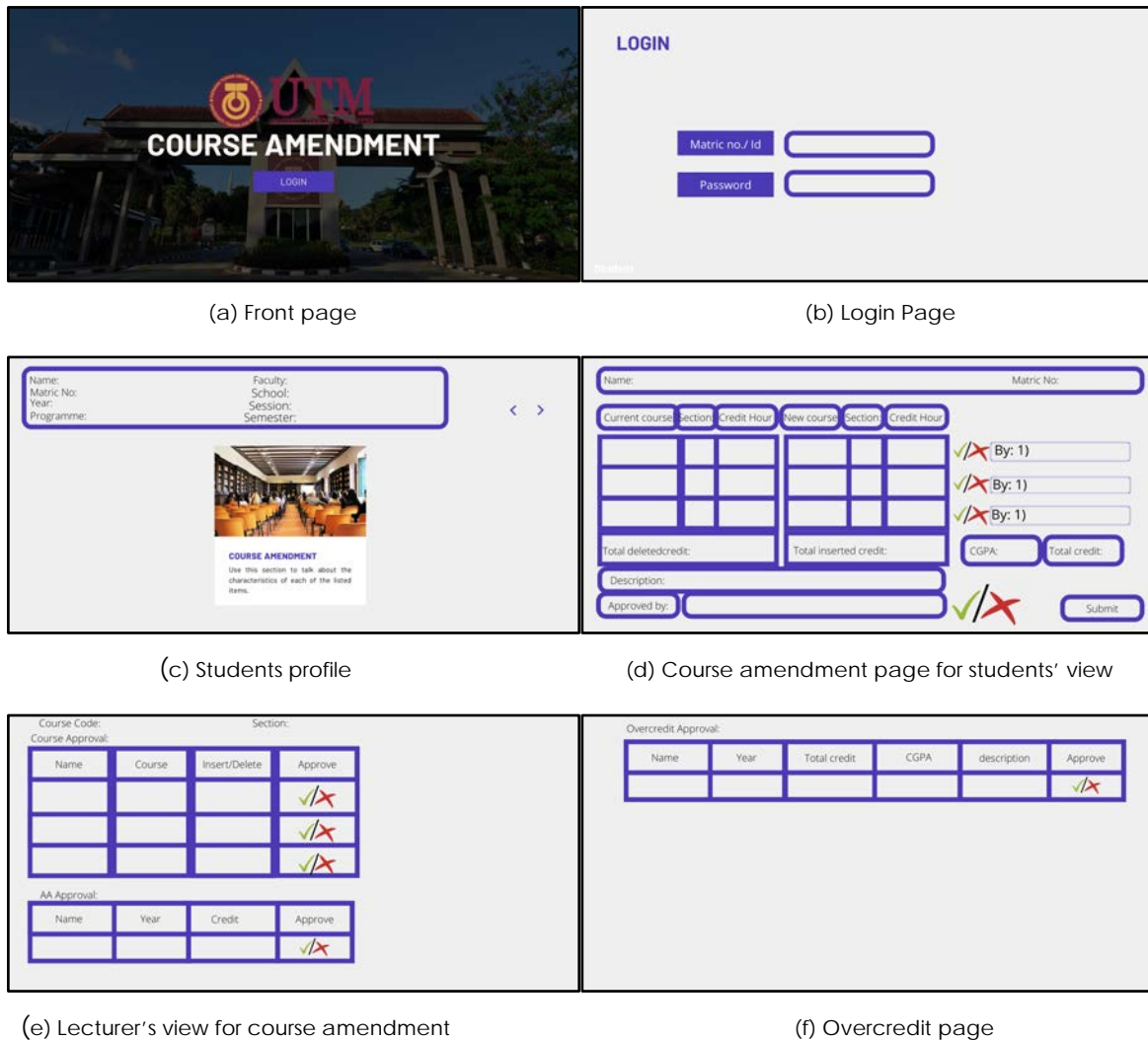


Figure 3.1: Website conceptual design

Methodology

This section will provide discussions on the flow process of the project, explanation of language and software used. Web-based applications are often multi-functional systems. User-oriented systems need to be developed to meet user needs. Before any pledge, one of the essential steps to be taken is to determine the approach for website creation. The most conventional technique for developing websites is Waterfall Method (Analysis, Design, Implementation, Testing). Simply, for its plan-driven method, it has become one of the most common methods for website designs for a few years. The first step is to analyse the target users. Based on the outcome from users' needs analysis, the design of the components and elements will be chosen to serve the website.

For the implementation part, this step is believed to be the most crucial elements in website development. Implementation part is finished by accepted the credence of the proposed design, then continue to the Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), JavaScript (JS), Hypertext Preprocessor (PHP) and Structured Query Language (SQL) and the software to be handed-down on the project. If all developments are finished, the testing process is then proceeded where the website functionality and the project management system are thoroughly examined. In order to structure a web page and its content, HTML code is used. HTML consists of elements that are used to attach or bind a web-page to make it look in a form. HTML is the default web page design markup language. CSS illustrates how to represent HTML elements on the computer or on other platforms. By working with HTML elements, CSS adds elegance to Web pages. CSS is designed to prevent display and material differentiation, including style, colours, and fonts. JavaScript is a scripting or programming language that enables complicated functions on web sites to be introduced. The JS coding language allows you to efficiently construct material notifications, monitor visuals, descriptive methods, and almost everything else. PHP is a normally utilized open source general purpose scripting language that can be merged into HTML and is very useful for web creation. PHP is a scripting language on the server side that is used to create static websites or web apps or interactive websites. In order to access and control databases, SQL is a common coding language. SQL can be used to exchange and handle data, specifically data contained in relational database management systems, which contain data structured into tables.

XAMPP is an abbreviation for which X stands for Cross-Platform, A for Apache, M for MySQL, and Ps for PHP and Perl. XAMPP is a program developed by Apache Friends that is open source. One of the commonly used cross-platform database servers, XAMPP lets developers create and validate their programs on a local web server. It is a platform that can provide a suitable environment through the host's own system to test and verify the work of projects based on Apache, Perl, MySQL databases and PHP. Visual Studio can also be used to develop websites, web applications and web services. Visual Studio Code is a free source code editor developed by Microsoft for Windows, Linux and Mac-OS. Characteristic reckon debugging assistance, syntax highlighting, execution of smart code, code snippets, refactoring of code and embedded Git. Users will modify styles, keys for the keyboard, settings, and establish plugins that provide surplus features. Visual Studio Code is a server-side scripting language for various programming languages, including Java, JavaScript, Go, Node.js, and C++, which can be used. Ngrok [1] is a cross-platform program that helps users, with limited attempts, to vulnerable a local development server to the Internet. The system modify locally hosted web server comes out to be hosted on a ngrok.com subdomain, ensuring there is no need for any public IP or domain name on the local computer. With Reverse SSH Tunneling, comparable features may be accomplished, but this requires more setup as well as hosting of your own remote server. Fig 4.1, Fig 4.2 and Fig 4.3 show the flow of the lecturer, student and staff using the website respectively.

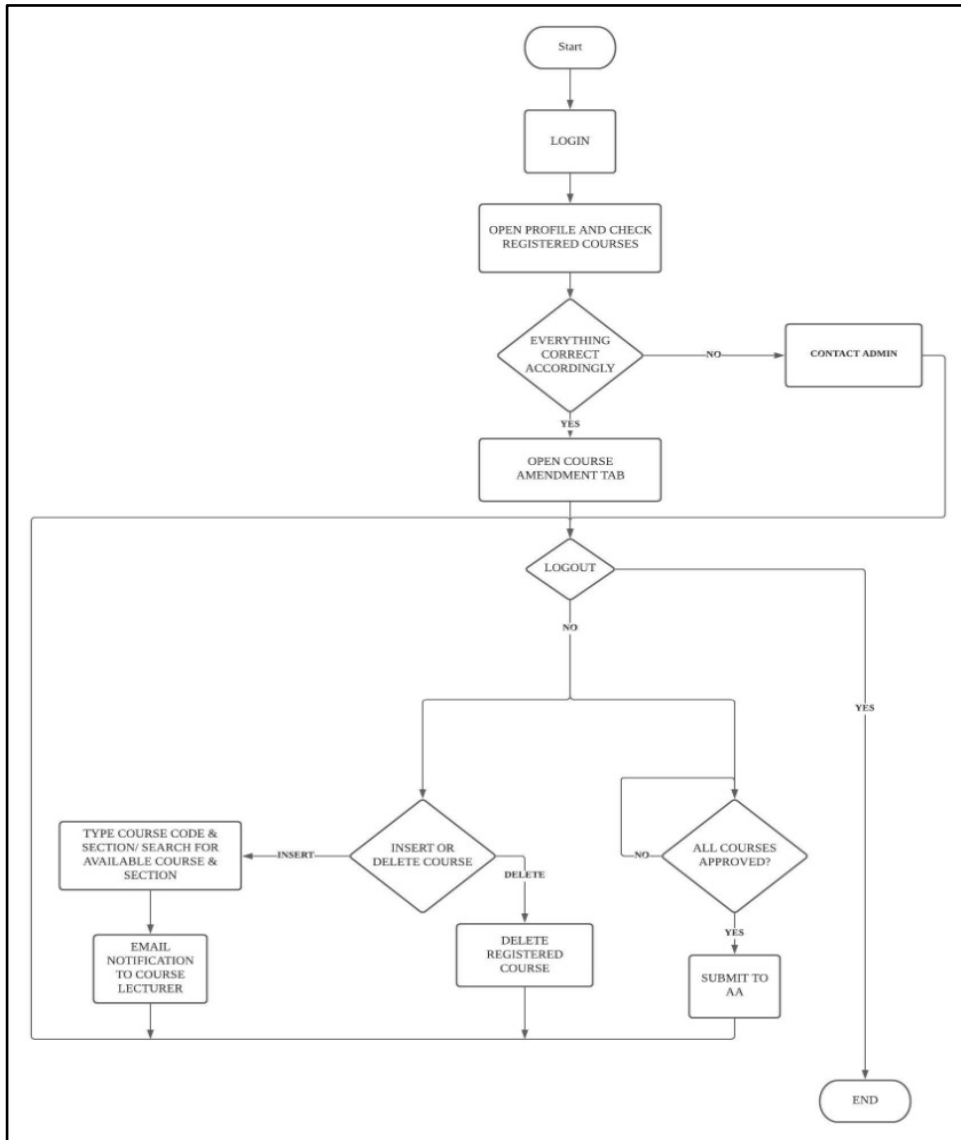


Figure 4.1 The flowchart of the lecturer using the website.

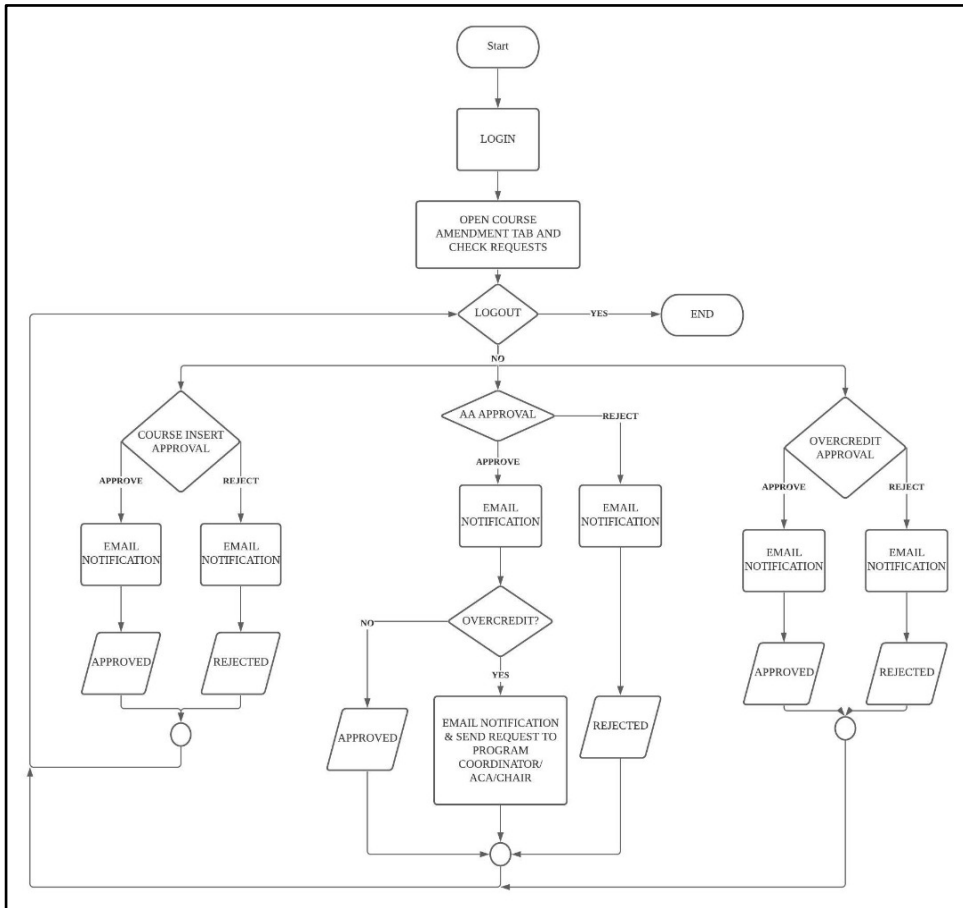


Figure 4.2 The flowchart of the student using the website.

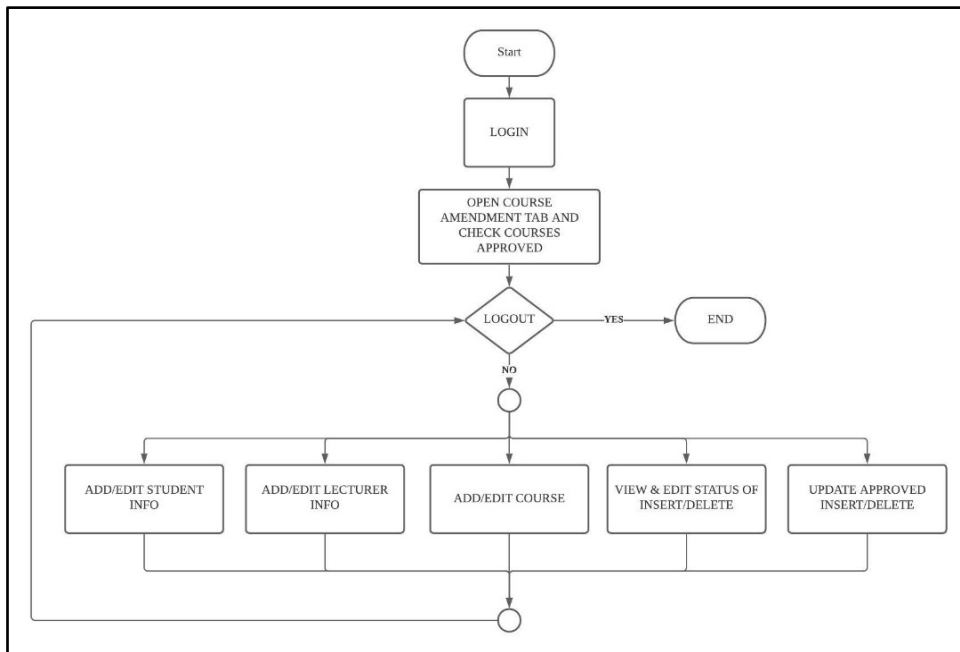


Figure 4.3 The flowchart of office staff using the website.

Developed Product

In this website, most of the class and CSS will be based on the bootstrap template [2]. Bootstrap is used to have a good layout in all devices. A form with "method=post" will be created for processing the data when the submit button is clicked. A button with "type=submit" will send the data to the assigned page once it is clicked. Function isset() is used to check which button is clicked and whether the content is empty. Alert will be sent when there is invalid submission of forms. Responsive tables are used so that it will maintain its size in different window sizes. PHPmyadmin is a MySQL database system which can use SQL language to access and store data into databases. Four types of sql statements which are SELECT, INSERT, DELETE and UPDATE have been used to develop this website. Table 5.1 shows the summary of these functions.

Table 5.1 Summary on SQL statement

SQL statement	Description
SELECT	Used to extract data from the database. For example, displaying the name of the user in profile needs use this statement to get the name of the user.
INSERT	Create a new row in the table of the database. For example, the student inserts a course, a new row with critical information such as matric number and inserted course code will be inserted.
DELETE	The reverse process of insert. Delete the row which match with the statements
UPDATE	Change the existing data in the database. For example, after the student inserts a course, the course lecturer approves. The status will be updated using this statement from pending to approved.

In the PHP library, "time()" is used to determine the current time [3]. The time zone is set at GMT+8 by using "date_default_timezone_set("Asia/Kuala_Lumpur")" [4]. However, the "time()" function will return in the type of timestamp which is not readable by humans. Thus, the time() will be converted to readable datetime by using the "date()" function [5]. However, the time in timestamp format will be stored inside the database.

General functions

Home

A header with navigation bar of class "navbar navbar-expand-xl navbar-dark bg-dark" is created with UTM logo, Home, Guideline, Profile, Course Amendment, input text and button for login. A bootstrap class "jumbotron jumbotron-fluid" is used to create the content of the home page as shown in Figure 5.1.

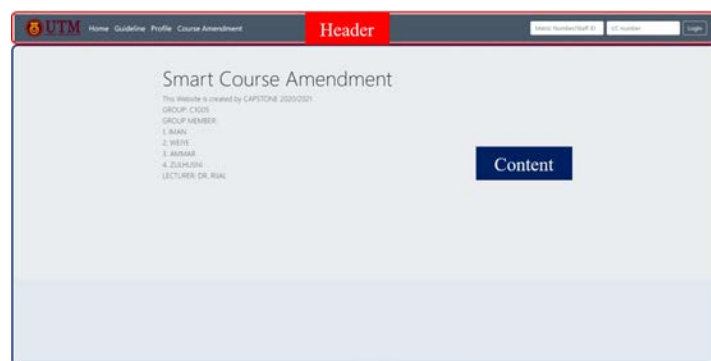


Figure 5.1 Home page

Login

A form is created for login with "method=post" [6]. The input text is given a name and a placeholder [7]. Placeholder is the text that will be displayed when there are no words in the input text. The attribute of the input text is shown in Table 5.2. When the type is password, the word will be replaced by a dot ("•") as shown in Figure 5.2. This ensures that the user can enter their password securely. A button is created with "type=submit".



Figure 5.2 Home page

Table 5.2 Home page

	Class	Type
username	form-control mr-sm-2	text
password	form-control mr-sm-2	password

When the submit button is clicked, it will send the data of the form to the page which has been assigned to the element action of the form. For this login page, the assigned page will be login.inc.php. In login.inc.php, an if-else statement is used to check which button is clicked. In this website, isset() function is used to check clicked buttons. First, the input data which is the username and password entered by the user will be assigned to a variable using "\$_POST". If the username or the password is empty, the user needs to check back which input text is blank and the website will return an alert of "Username or password is/are empty" as shown in Figure 5.3. When they are filled, they will check whether the username exists in the database or does the username match the password. To check whether the password is correct, "password_verify" will be used. However, the IC number store in the database is unhashed while the "password_verify" function needs to have a hashed password from the database, thus the IC number is hashed in order to use this function "password_verify". If the password is incorrect, it will return an alert of "Invalid username or password". If the user enters a correct username and password, the matric number or the staff ID will be assigned to a session variable and now the user is logged in.

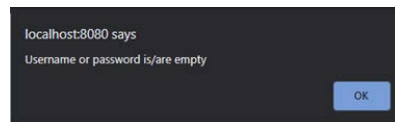


Figure 5.3 Alert when username or password is empty

After the user has logged in, the login form will be replaced by a logout button with "type=submit". When the logout button is clicked, the session will be unset and destroyed. When the user closes this website and re-enter this website, they need to login again. However, if the user did not logout before they close the website, when they re-enter the website, login is not necessary since the session is not destroyed. Different users will be assigned with different authority as shown in Figure 5.4. Students will be assigned with 1, lecturer with 2 and staff with 3. By having this authority, a different interface which is the student view, lecturer view and staff view can be implemented in a single website.

	ID	S_L_ID	ICNUMBER	AUTHORITY
<input type="checkbox"/> Edit Copy Delete	1	A17KE0209	980527085669	1
<input type="checkbox"/> Edit Copy Delete	3	S00301	010101010101	2
<input type="checkbox"/> Edit Copy Delete	5	STAFF001	STAFF	3
<input type="checkbox"/> Edit Copy Delete	21	S00303	981224065040	2
<input type="checkbox"/> Edit Copy Delete	22	S00305	900721013390	2
<input type="checkbox"/> Edit Copy Delete	25	A17KE0001	980321382345	1

Figure 5.4 Database of users with different authority

Email

In order to send an email from localhost, an active email account is needed. By configuring the setting of the XAMPP, an email account is assigned to it and the email will be sent out through the assigned email. The procedure of setting up the email is based on [8]. An email function provided in PHP library is "mail (A, B, C, D)" where A is the destination email, B is the subject, C is the content of the email and D is the headers. The destination email will be extracted from the database.

Guideline

A guideline which is editable by the staff will be displayed to the student about the procedure of the course amendment. The editable features will be explained in the Staff part.

Others

There are some other functions in developing this website. When the internet is slow or system error, the users will try to click a button multiple times and this leads to multiple submission of forms. However, jQuery function will be used to prevent double submission of the forms [9]. When a form is submitted, the next submission will be ignored until the submission is done.

Students

A student will use their matric number as username and ic number as password for login. After login, the matric number will be assigned to the session variable. With that session variable, the data of the user can be extracted from the database.

Profile

The profile will display the course amendment period which is the start date and end date. The date is editable by the staff. Next, the current session and semester will be displayed below the course amendment period. Figure 5.5 shows the database of a student. The basic information will be extracted from this database such as the name, year, programme, CGPA, AA, email and registered courses. The staff ID will be stored in the AA column of the student database. Figure 5.6 shows the profile of the students. The name of the AA displayed in the student's profile is extracted from the lecturer database. The personal information of the student is displayed as shown in Figure 5.6. In the student's profile, there are registered courses which are obtained from the student database as shown in Figure 5.5. From the student database, there are 8 columns which are COURSE1 to COURSE8 beside the EMAIL column which stores the course code and section. SKET4453 section 2 will be stored as SKET44532 in the student database. The course code and the credit of SKET4453 section 2 can be obtained from the course database. The credit is then total up returning the total credit.

ID	MATRICNUMBER	ICNUMBER	NAME	YEAR	PROGRAMME	CGPA	AA	EMAIL	COURSE1	COURSE2	COURSE3	COURSE4	COURSE5	COURSE6	COURSE7	COURSE8
3	A17KE0209	980527085669	NG WEIYE	4	SKEL	4	S00301	nurulimansofi@gmail.com	SKEL48121	SKEL47231	SKET46231	SKET35031				
20	A17KE0001	980321382345	Student A	4	SKEL	3.69	S00301	student1a@gmail.com	SKET35831	SKET45231	SKET46231					
21	A17KE0059	980920075987	Puteri binti Adi	4	SKEE	3.17	S00311	puteriadi8@gmail.com	SKEE44532	SKEE46331						
22	A17KE0234	980331025460	Rorany Zhong Shau Chet	4	SKEE	3.65	S00351	ronnychet@gmail.com	SKEE44532	SKEE46331						
23	A17KE0081	980511015821	Law Bau Lay	4	SKEL	3.46	S00316	lawbau3@gmail.com	SKET35831							
24	A17KE0056	970512055632	Nurul Badrina binti Fauzi	4	SKEM	3.93	S00303	badrinanuru2@gmail.com	SKET35831	SKEE35334						

Figure 5.5 Database of students

Course Amendment date:	Full Name	Puteri binti Adi
From 2021-01-13 00:00	Matric Number	A17KE0059
To 2021-02-1 00:00	I/C Number	980920075987
Session 2020/2021	Programme	SKEE
Semester 2	Academic Advisor	Muhammad Haji Nik Shahfiq bin Saharil Borhan
	CGPA	3.17

NO.	CODE	COURSE TITLE	SECTION	CREDIT
1	SKEE4453	POWER SYSTEM CONTROL	2	3
2	SKEE4633	ELECTRICAL MACHINES	1	3
			Total Credit:	6

Figure 5.6 Profile of students

Course Amendment

There are two ways to insert a course. First way is to enter the course code and section in the insert navigation tab. When the section is full or not available, the student will not be able to insert the course and the website will return an alert which informs the student the course is not available or section full. The second way is to insert through the search section. The course display is the course that the student is able to insert. From Figure 5.8, there is a column FORSTD. When the data in FORSTD is 4SKEE, this course will be open to fourth year SKEE students and SKEL or 3SKEE will not be able to insert this course. The insert button will be displayed when the students are allowed to insert that course. Students can search the available courses through the search bar provided. An email notification will be sent to the course lecturer when there are students inserting the course. Below shows the restriction of insert/delete when using this website:

- i. Students are not allowed to insert any registered course
- ii. Students will not be able to insert a course if the same course but a different section is pending for approval.
- iii. If a student wishes to change sections, they need to delete the registered course before inserting. Cancel the delete course will also cancel the insert course.
- iv. Students will not be able to insert a course when the section is full.

(a)

(b)

Figure 5.7 Student's Course Amendment (a) Part 1 (b) Part 2

Figure 5.7 shows the student's course amendment page. This page will also show the course amendment period and current session and semester.

COURSEID	CODE_SECTION	CODE	CTITLE	CREDIT	SECTION	LECTURER	MAXSTD	REGSTD	FORSTD
2	SKEL47231	SKEL4723	CAPTONE PROJECT	3	1	S00301	30	1	4SKEL
3	SKEL48121	SKEL4812	FINAL YEAR PROJECT PART I	2	1	S00301	30	29	4SKEE
4	SKET35831	SKET3583	DIGITAL COMMUNICATION SYSTEMS	3	1	S00301	30	2	
5	SKET45231	SKET4523	OPTICAL COMMUNICATION SYSTEMS	3	1	S00301	30	1	4SKEE
6	SKET45431	SKET4543	RF MICROWAVE CIRCUIT DESIGN	3	1	S00301	1	0	4SKEL
7	SKET46231	SKET4623	NETWORK PROGRAMMING	3	1	S00303	10	0	
8	UICL230214	UICL2302	THINKING OF SCIENCE AND TECHNOLOGY	2	14	S00301	10	0	

Figure 5.8 Courses database

When students insert a course, the time, matric number, course code, section, action which is inserted and status will be inserted to the pending database. When the student cancels the inserted course, the respective row will be deleted. For example, a student inserts course SKEE3143 section 5, a row as shown in Figure 5.9 will be inserted with insert at action and status pending. Table 5.3 shows the meaning of the status that is stored in the database. The remarks will be explained in more detail in the lecturer section.



ID	TIMEQ	MATRICNUMBER	COURSE	SECTION	ACTIONS	STATUS	REMARK
1611661694	A17KE0175		SKEE3143	5	insert	pending	

Figure 5.9 "Pending" database

Table 5.3 Meaning of status

STATUS	Meaning
Over19	Pending approval from programme coordinator (19 credits)
Over20	Pending approval from ACA (20 credits)
Over21	Pending approval from Chair (21 credits)
pending	Pending approval from course lecturer
Approved	Approved by the course lecturer
Rejected	Rejected by the course lecturer/AA
Done	Pending to update
AA	Pending approval from AA
Updated	The application has been updated in the registration slip

When a student inserted a course, the number of students in that section will be increased by 1 virtually. The term virtually is used because the amount of the registered student in the courses database will not be changed. However, when calculating the registered student in student view, the number of students who insert the course will be counted and added with the registered student in the database. For example, SKET3583 has a maximum space of 30 students. Two students inserted a course of SKET3583 section 1 and 20 students have registered SKET3583 section 1. The number of slots available in the student view shown in Figure 5.7(b) will be 8 instead of 10. Thus, when the section is full, it may be because the students are still pending for approval. By this way, each section will not be overloaded and the student amount in each section will be balanced.

Cancel button will be used to cancel a inserted course or deleted course as shown in Figure 5.10(a). The students only can delete their registered course as shown in Figure 5.10(b). History shown in Figure 5.10(c) is to show the past actions. For example, students insert a course and are approved by the lecturer. In the history will show the date, time and changes of the status from pending to approved.

INSERT DELETE HISTORY						
NO.	CODE	COURSE TITLE	SECTION	STATUS	REMARKS	ACTIONS
1	SKEE4633	ELECTRICAL MACHINES	1	Approved		CANCEL

Course Code Section

INSERT DELETE HISTORY						
NO.	CODE	COURSE TITLE	SECTION	ACTIONS		
1	SKEE4453	POWER SYSTEM CONTROL	2	<input type="button" value="DELETE"/>		
2	SKEE4633	ELECTRICAL MACHINES	1	<input type="button" value="DELETE"/>		

INSERT DELETE HISTORY						
NO.	DATE	TIME	COURSE	SECTION	ACTION	STATUS
1	01/26/2021	19:49:10	SKEE3143	5	insert	pending⇒Approved
2	01/26/2021	20:06:30	SKEE3143	5	insert	Approved⇒AA
3	01/27/2021	15:02:31	SKEE4633	1	insert	pending⇒Approved

Figure 5.10 (a) INSERT (b) DELETE (c) HISTORY

When the inserted course has been approved, the course will be shown in the AA section as shown in Figure 5.11. When the student deletes a course, the course will be shown here directly since deleting a course does not require approval from the course lecturer. By clicking submit, the student will not be allowed to cancel any inserted or deleted course and an email notification will be sent to the student's AA. The status of the inserted and deleted courses will be changed from Approved to AA. However, the students still are allowed to insert or delete other courses.

AA

NO.	CODE	COURSE TITLE	SECTION	CREDIT	DESCRIPTION
1	SKEE4453	POWER SYSTEM CONTROL	2	3	Registered
2	SKEE4633	ELECTRICAL MACHINES	1	3	Registered
	SKEE4463	HIGH VOLTAGE TECHNOLOGY	5	3	Insert
Total Credit:				9	Pending

Submitting to Muhammad Haji Nik Shahfiq bin Saharil Borhan

Figure 5.11 Interface for submitting application to AA

When the students have been rejected by the lecturer or AA, a remark will be shown in the remarks section to let the student know the reason why they have been rejected. The students are allowed to perform insert or delete during the course amendment period only, After the due date, all the insert and delete buttons will be disabled as shown in Figure 5.12.

INSERT DELETE HISTORY						
NO.	CODE	COURSE TITLE	SECTION	ACTIONS		
1	SKEE3533	COMMUNICATION PRINCIPLES	4	<input type="button" value="DELETE"/>		
2	SKEE4443	POWER SYSTEM ANALYSIS	4	<input type="button" value="DELETE"/>		
3	SKEE4633	ELECTRICAL MACHINES	1	<input type="button" value="DELETE"/>		
4	SKEE4663	ELECTRICITY FOR SUSTAINABLE ENER	1	<input type="button" value="DELETE"/>		

Figure 5.12 Disabled cancel button

Lecturer Profile

Lecturer's profile shown in Figure 5.14 is almost similar to the student's profile with course amendment period and current session and semester at the left-hand side. At the right-hand side, the above column shows the personal information of the lecturer while the bottom one shows the list of courses that the lecturer teaches for that semester. The list of courses will show the basic information of that course and the number of students that have been registered. ROLE in the lecturer's database as shown in Figure 5.13 is summarized in Table 5.4.

ID	STAFFID	NAME	ICNUMBER	DEPARTMENT	EMAIL	ROLE
1	S00301	DR XYY	010101010101	ECE		SKEL
2	S00303	Nurul Iman Sofi	981224065040	COMM	nurulmansofi@gmail.com	0
7	S00305	Lecturer A	900721013390	ECE	capstonelecturer1a@gmail.com	ACA
8	S00311	Muhammad Haji Nik Shahliq bin Saharil Borhan	740105055040	POWER	muhammhan5@gmail.com	
9	S00351	Hajjah Dini binti Nik Saiful Mazlan	851203025120	POWER	hajjah486@gmail.com	
10	S00316	D. R. Zabrina	860430105021	POWER	nurulmansofi@gmail.com	CHAIR
11	S00314	Yugendran Navaratnam	791115115423	COMM	yugendrannavaratnam15@gmail.com	
12	S00310	Muhamad Nik Mu'izzuddin Hamizuddin	700901035096	POWER	nikmuizzuddin87@gmail.com	
13	S00302	Goh Yeng Jet	820707055821	POWER	gohyjet@gmail.com	
14	S00332	Nur Shamimie Fitri binti Kamarul Ramlan	760228025020	POWER	nurf390@gmail.com	
15	S00315	Muhamad Che Raja Zulqurnainin	760630065148	COMM	muhamanin@gmail.com	

Figure 5.13 Lecturer's database

The screenshot shows the UTM system interface for a lecturer's profile. On the left, there are fields for 'Course Amendment date' (From: 2021-01-13 00:00, To: 2021-01-31 00:00), 'Session' (2020/2021), and 'Semester' (2). On the right, personal information is displayed: Full Name (DR XYY), Matric Number (S00301), I/C Number (819101010101), Department (ECE), Academic Student (MS WE'RE Student A), and EMAIL. Below this is a table of courses taught:

NO.	CODE	COURSE TITLE	SECTION	NO. OF STUDENTS
1	SKEL4723	CAPSTONE PROJECT	1	1
2	SKEL4812	FINAL YEAR PROJECT PART 1	1	20
3	SKET3363	DIGITAL COMMUNICATION SYSTEMS	1	4
4	SKET4523	OPTICAL COMMUNICATION SYSTEMS	1	1
5	SKET4543	RF MICROWAVE CIRCUIT DESIGN	1	0
6	UNCL2302	THINKING OF SCIENCE AND TECHNOLOGY	14	0
7	SKET3363	DIGITAL COMMUNICATION SYSTEMS	2	2
8	SKET3363	DIGITAL COMMUNICATION SYSTEM	1	4

Figure 5.14 Lecturer's profile

Table 5.4 ROLE description

ROLE	Description
SKEE/SKEL/SKEM	Programme coordinator. Approve students who have credit more than 19. There will be different programme coordinators for different courses. For example, a SKEM student needs approval for registering 19 credits, the student needs to find the SKEM programme coordinator.
ACA	Associate Chair. Approve students who have credit more than 20.
CHAIR	Chair. Approve students who have credit more than 21.

Course Amendment

Figure 5.15 shows the general view of lecturer's Course Amendment. It consists of the course amendment date, current session and semester, a few navigation tabs which are the COURSE, AA and OVERCREDIT. OVERCREDIT tab will be available if the role is not empty which means the user is either the programme coordinator, associate chair or chair.

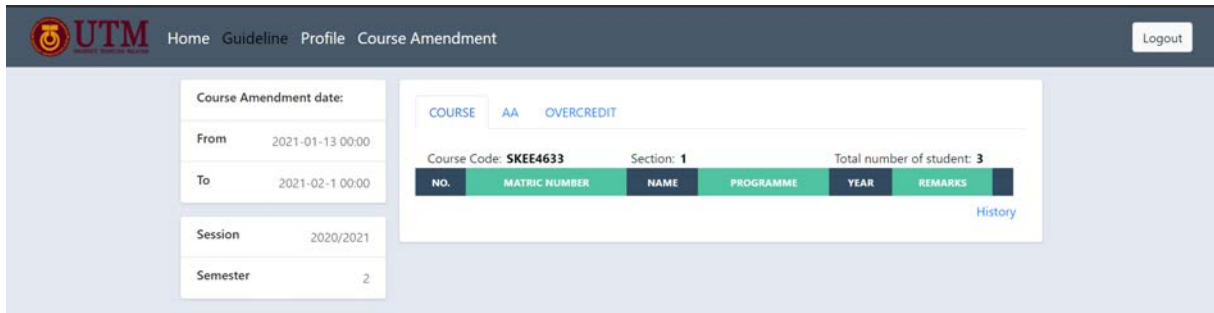
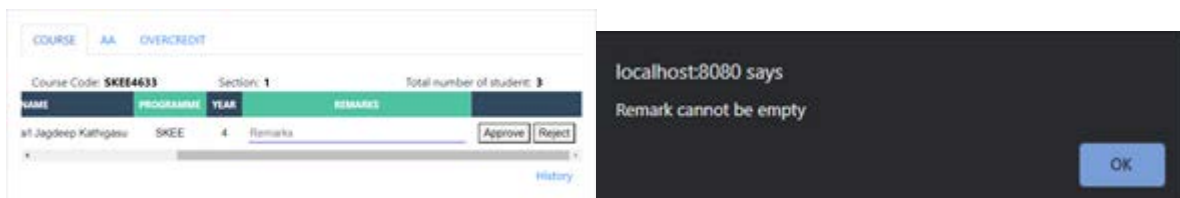


Figure 5.15 Lecturer's Course Amendment

The first navigation tab will show the list of students who wish to enter the class. From the pending database, it will extract the data which the course code and section match and the status is pending. The extracted data will be displayed and two buttons which are approved and rejected will be shown as Figure 5.16(a). Remarks are not necessary for the case to be approved. However, a remark is a must when the lecturer rejects the student by giving some specific reason. If the remark is empty, an alert will be displayed as in Figure 5.16(b). The history will display at another column below the COURSE navigation tab. It consists of the date, time, matric number, course, section and the status. When the lecturer approves or rejects the request of the student, a new row will be inserted to the history database and the status of the in pending database will be updated to Approved. From Figure 5.16(d), PREVIOUS column shows the status before inserting to this history database and NOW column shows the updated status. For example, a lecturer approved a student request to enter SKEE4623 section 1, the history database will have pending in PREVIOUS column and Approved in NOW column and the history shown in Figure 5.16(c) will be displayed in the interface of the lecturer. The cancel button has been assigned as shown in figure 5.16(c) to remove the history column. The cancel button is needed because a session variable has been assigned when the user views the history. Thus, the session variable needs to be unset using this button to hide the history column. Email notification will be sent to the students after responding to the lecturer.



(a)

(b)



(c)

ID	TIMEQ	MATRICNUMBER	COURSE	SECTION	ACTIONS	PREVIOUS	NOW	REMARKS
1	1611661750	A17KE0175	SKEE3143	5	insert	pending	Approved	
2	1611662790	A17KE0175	SKEE3143	5	insert	Approved	AA	
3	1611730951	A17KE0175	SKEE4633	1	insert	pending	Approved	

(d)

Figure 5.16 (a) Approval of course (b) Alert when remarks is empty while rejecting (c) History of the course approval (d) History database

In the AA navigation tab, a list of students which is under the lecturer will be displayed as shown in Figure 5.17(a). There are few statuses which have been summarized in Table 5.5. A button show has been assigned to show the detailed information of the student as shown in Figure 5.17 (b). When the show button is clicked, a session variable is set and hence a cancel button is needed. Lecturers need to view the details of the students before they approve and reject. Thus, the approve and reject button will be shown after the show button is clicked. The remarks cannot be empty when rejected which is similar to the previous explanation about rejecting a student to insert the course. The credit calculation will be based on the course taken. The total credit will be calculated from the registered course and add the inserted credit and deduct the deleted credit. The credit will be based on the course database. When the lecturer approves the application of the student and the total credit after course amendment is less than 19, the status in the pending database will be changed to Done and wait for the staff to update the application. If the total credit exceeds 18, the status will change to Over19 for the case of 19 credits, Over20 for 20 credits and Over21 for 21 credits and students need to wait for the over credit approval. If the total credit exceeds 21, the lecturer cannot approve the application of the student and an alert will be displayed which mentions that too much credit has been taken by the student. Email notification will be sent to the student.

Table 5.5 Meaning of the Status in AA

Status	Meaning
-----	Not performing course amendment
pending for your approval	The student submitted the application to get approval from their AA
Overcredit	The student has total credit more than 19 and pending for overcredit approval
performing Insert/Delete	The student is performing course amendment
Done Insert/Delete	The course amendment of the student has been done

COURSE AA OVERCREDIT

NO.	MATRICNUMBER	NAME	PROGRAMME	YEAR	CGPA	STATUS	
1	A17KE0234	Ronny Zhong Chau Chet	SKEE	4	3.65	Done Insert/Delete	Show

(a)

COURSE AA OVERCREDIT

NO.	MATRICNUMBER	NAME	PROGRAMME	YEAR	CGPA	STATUS	
1	A17KE0234	Ronny Zhong Chau Chet	SKEE	4	3.65	Done Insert/Delete	Show

Student info (AA)

Name	Ronny Zhong Chau Chet
Matric Number	A17KE0234
Programme	SKEE
Year	4
CGPA	3.65

Inserted Credit	3
Deleted Credit	0
Total Credit Before	6
Total Credit After	9

NO.	CODE	COURSE NAME	SECTION	CREDIT	INSERT/DELETE
1	SKEE4453	POWER SYSTEM CONTROL	2	3	Registered
2	SKEE4633	ELECTRICAL MACHINES	1	3	Registered
3	SKEE3143	CONTROL SYSTEM DESIGN	5	3	Insert

CANCEL

(b)

Figure 5.17 (a) AA view (b) Detail information after show button is clicked

In the overcredit navigation tab, it has an almost similar view and function with the AA as shown in Figure 5.18. The difference is that the AA name will be displayed in the detailed information of the student. The list of students with status Over19/20/21 in the pending database will be shown here. Email notification will be sent to the student upon response by the lecturer. Rejects must provide a remark.

COURSE AA OVERCREDIT

NO.	MATRICNUMBER	NAME	PROGRAMME	YEAR	CGPA	TOTAL CREDIT	
1	A17KE0175	Chanturu Sidhu a/l Jagdeep Kathigasu	SKEE	4	3.4	15	Sh

[History](#)

(a)

NO.	MATRICNUMBER	NAME	PROGRAMME	YEAR	CGPA	TOTAL CREDIT	
1	A17KE0175	Chanturu Sidhu a/l Jagdeep Kathigasu	SKEE	4	3.4	15	Sh

[History](#)

Student info (Overcredit)

Matric Number A17KE0175
 Programme SKEE
 Year 4
 CGPA 3.4
 AA Name Nurul Iman Sofi

Inserted Credit 3
 Deleted Credit 0
 Total Credit Before 12
 Total Credit After 15

NO.	CODE	COURSE NAME	SECTION	CREDIT	INSERT/DELETE
1	SKEE3533	COMMUNICATION PRINCIPLES	4	3	Registered
2	SKEE4443	POWER SYSTEM ANALYSIS	4	3	Registered
3	SKEE4633	ELECTRICAL MACHINES	1	3	Registered
4	SKEE4663	ELECTRICITY FOR SUSTAINABLE ENERGY	1	3	Registered
5	SKEE4633	ELECTRICAL MACHINES	1	3	Insert

Remarks

(b)

Figure 5.18 (a) Before and (b) After clicking show button

Staff

Guideline

The content of this page is set with the attribute of "contenteditable=true" to enable the staff to edit the guideline [10]. However, the html file cannot be changed on the website. Thus, the content of the guideline is stored inside the general database as shown in Figure 5.20 and will be updated with a save button. There are few features such as bold, italic, underline, left alignment, centre alignment, right alignment and 4 font sizes. The changing of font size involves a self-defined function called "ColorizeSelection()". This function is used to change a predefined font size. For example, in Figure 5.19, The staff can change the font size to 14, 18, 24 and 28. The other features can be realised by using javascript. The syntax for the underline feature is "document.execCommand('underline')".

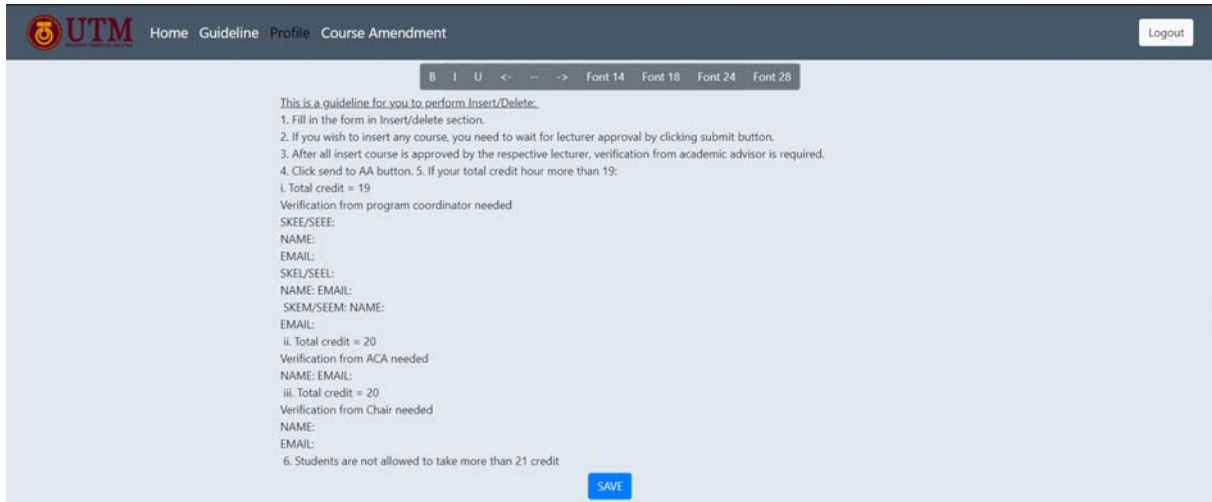


Figure 5.19 Staff interface for editing the guideline

ID	TEXTS	start_dates	start_time	end_dates	end_time	SESSIONN	SEMESTER
1	<div class="container"> <p> </p><...	2021-01-13	00:00	2021-02-1	00:00	2020/2021	2

Figure 5.20 database with name general

Profile

In this page, staff can edit the current session and semester and course amendment period. Since there are only 3 semesters in one session. Thus, an html element, "select" with 3 options will be used for the input for the semester as shown in Figure 5.21. In the course amendment period, the input for the date is defined with attribute "type=date" and time defined with attribute "type=time". By clicking save, the data in the general database will be updated as shown in Figure 5.20. The session, semester and course amendment period displayed in student's and lecturer's profile and course amendment is based on this general database. The staff will not be able to set the end date before today's date. The session input cannot be empty.



Figure 5.21 Staff's profile

Course Amendment

The left-hand side has similar features as the student's and lecturer's page. At the right hand-side, there will be 6 navigation tabs which are Student, Lecturer, Course, INSERT, DELETE and UPDATE as shown in Figure 5.22.

Figure 5.22 Staff's course amendment (a) Part 1 (b) Part 2

The staff are able to add the student into the database by filling the information in Figure 5.23(a). The AA name is not required to be filled because the name of the lecturer will be extracted from the lecturer database. By clicking the ADD button, the information will be inserted into the user database and student database. The matric number is unique thus, if the matric number entered exists in the database, an alert message will be shown which mentions that the matric number exists in the database. The course code and section must match with the course that is available in the course database. Beside adding, staff can edit the student's information except matric number and AA name as in Figure 5.23(b). By clicking the save button, the data will be updated. Cancel button is used to cancel the search since it involves the usage of session variables.

Figure 5.23 (a) Adding student (b) editing student information

The staff also can edit or add lecturer to the database. Figure 5.24(a) shows the information needed to be filled in order to add the lecturer into the database. Figure 5.24(b) shows the searched result of staff id S00301. The editing page will show the list of students which is under the lecturer. This list will be extracted from the student database since the AA related information is stored in the student database only. The other feature will be similar to editing and adding a student.

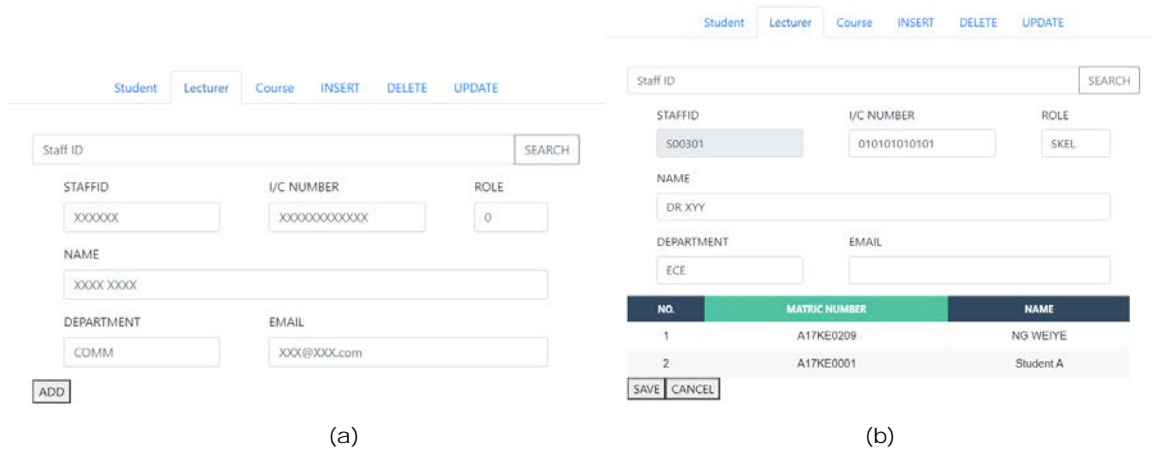


Figure 5.24 (a) Adding lecturer (b) editing lecturer information

In the Course navigation tab, the staff can edit or add courses to the database as shown in Figure 5.25. Course code can be entered in the search bar to search a specific course. When ALL or all is being searched, all the courses will be displayed on this page. All the information can be edited through here except the number of students pending for approval, available places and lecturer's name. By clicking the save button, the course database will be updated. An alert of successfully updated will be shown. To close a course, the staff can simply click the delete button and remove the course from the database. The list of students registering the courses will be displayed when the show button is clicked. Cancel button is assigned with the same purpose as before. The bottom row will be used to add courses into the database. The course code, section and lecturer must be filled. When the course name and credit are empty, they will be extracted from the course database with the same course code. If the maximum number of students is empty, it will be set to 30 by default. If the registered student is empty, it will calculate the amount of students who registered that course from the student database.

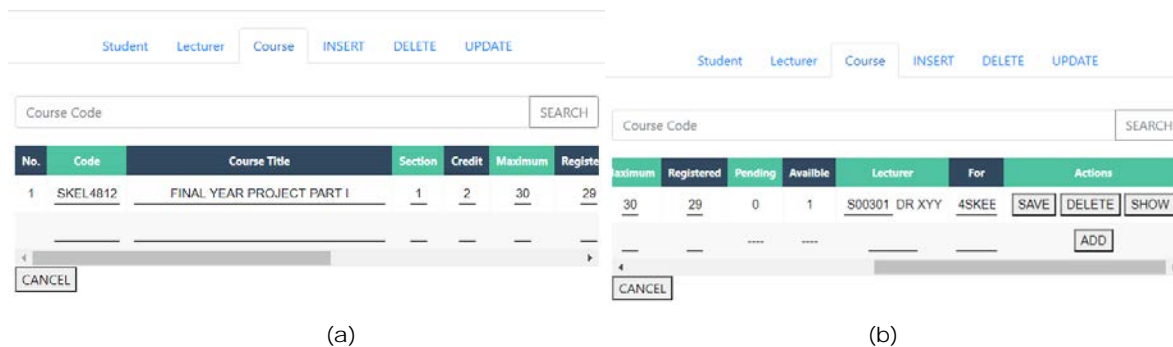


Figure 5.25 Adding and editing course (a) Part 1 (b) Part 2

The staff can monitor and edit the status of the insert and delete. Figure 5.26 shows the interface for editing the information of course amendment. When there is a system error, it may cause some error and the data needs to be edited. Here, the staff can change the matric number of the applicant, the inserted or deleted course code, section and status. The status uses "select" with different options so that the staff are not required to enter a text which is exactly the same with the requirement. For example, Over19 in the database defined that the student has 19 credits and the staff need to enter Over19 in the text to change the status to Over19. If over19 has been entered and updated in the database, error will occur since it is case sensitive. A value need be assigned to each option so that it will have correct data after updating. For instance, the staff choose Overcredit (19) and Over19 is assigned to Overcredit (19). By clicking the save button, the status in the pending database will be updated as Over19 instead of a text entered by the user. Staff can search the students by entering the matric number in the search bar. Staff can also enter the course code for searching the student who is inserting or deleting the course. This table can be sorted by using the self-defined function "sortable()" by clicking the header of the table [11]. The way of sorting the data is ascending order or descending order. When the header is clicked, the data will sort in ascending order. When the header is clicked again, the data will be sorted in descending order.

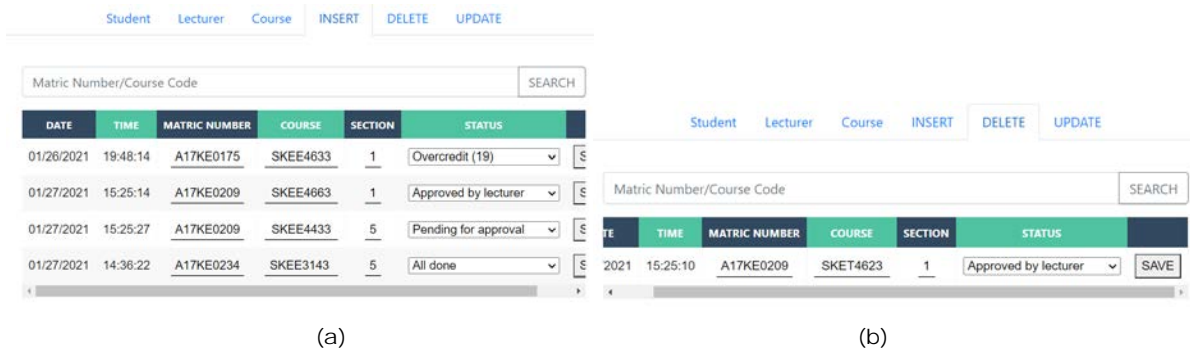


Figure 5.26 (a) INSERT (b) DELETE

Since this one is a standalone system, the staff need to update the student's info into the current system when the student has done their course amendment. When the status in the pending database changes to Done, the matric number and the name will be shown in the UPDATE page. They can use the search bar to search the matric number of the students. By clicking the show button, a table showing the registered, inserted and deleted course will be displayed. The staff will update the information to the existing UTM system. After updating all the details, the staff are required to click the update button as shown in Figure 5.27 to update this system to inform the student their application has been accepted and updated in the registration slip. By clicking the update button, the deleted course will be removed from the student database before updating the inserted course. The student can check their profile when the status changes to updated.

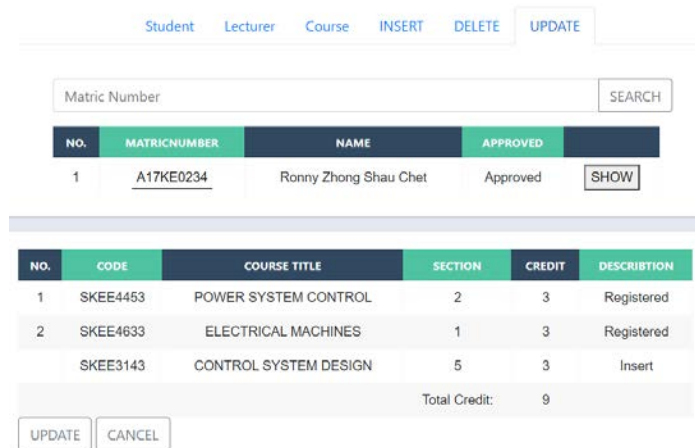


Figure 5.27 UPDATE

Discussion on developed product

Feedback

Along with the development of the product, a lot that has been improved and added after discussion and feedback from the students, panels, supervisor and staff. From the students, they are very happy with the new system proposed. However, some of the comments from the supervisor and from the project presentation, the panels suggest that we notify the lecturers with emails and a contingency steps are needed if the lecturer failed to get the notification email. As part of the staff, they are happy with the software since it's easier for them to update new requests and observe any update from the users.

Future Improvement

Currently, we only use a local database from our personal computer and make the database available for others on the internet. Therefore, for our future improvement if UTM wants to proceed using the developed website, we will engage in paying the online database service and others.

Challenges

The development for the website improvement will be done and the challenge will be where we have to adjust the software according to the services provided. Furthermore, a budget will be planned according to the services we paid and how long we will be using the services.

Conclusion

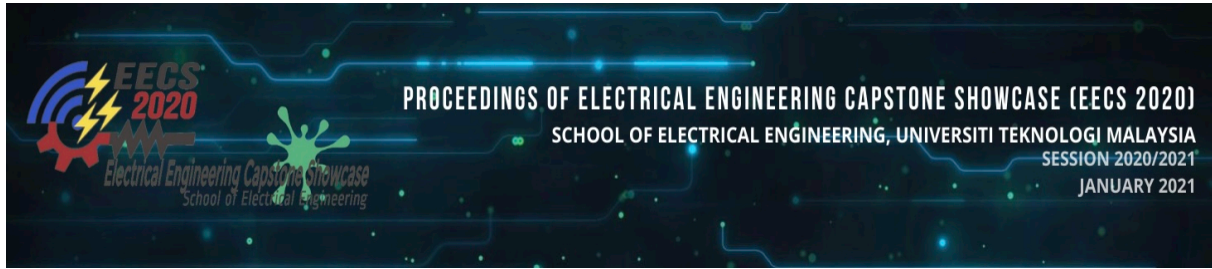
In conclusion, the website that we planned during the early phase of the development is considered a success since we already planned to make a prototype using the local database. Our objectives are achieved by applying CSS Language where we create a user-friendly website and it's convenient for the users to use. Besides, all of the members have learned and applied the basic skills in developing the website. Thus, we are glad to develop website as after it was completed, we mastered the basic knowledge of programming language.

Acknowledgement

First and foremost, we would like to thank Universiti Teknologi Malaysia (UTM) for providing the opportunity to do the Capstone Project as it helps us being innovative and creative in solving one of the problems which is the amendment process in UTM. We would like to express our sincere appreciation to our facilitator, Dr. Mohamad Rijal bin Hamid who is able to spend time understanding our learning growth during the project. This project would have been difficult without his encouragement, support and guidance. In addition, we would like to thank the students, lecturers, staff and panels for their feedback and comments for us to improve during the development of this project. Last but not least, we would also like to express our gratitude to our family and friends who supported and helped us making this project a success in every way.

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UTM Smart File – Auto File Naming

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Abstract: UTM Smart File is an application that provides easier access for targeted user such as student to rename their pdf format file. This application targeted in renaming the file of an assessment like final exam, test, or quiz. It also has consistency in renaming the file in various format that follows either lecturers or faculties choices. Features available from this application are selecting course code, section of the course, student name, type of assessment they provide, naming method and choosing a pdf file.

Keywords: software; application; file; renaming; consistency.

Introduction

Most of the students nowadays had to provide their work progress to their teachers or lecturers in through online platform. One of the big yet always underestimate problem in an event such as final exam, test, and quiz, the student will be giving out their answer in a file. But then when teacher or lecturer download all their students answer file, the inconsistency will be occurred due to certain student might giving lack of information related to their selves for lecturer/teacher to recognize them. To counter this problem, we make a smartphone application that lets student choose their answer file (in this case a pdf file) and rename it according to what and how their lecturer or teacher want to.

Making this application that targeted for student and lecturers, will make them to easily rename their file without having to type and might forgotten and/or typing wrong information as required in naming their file. Furthermore, in this online learning period, having an assessment submission like this helps lecturers, especially in larger classroom, gathering all students answer file of certain subject.

Aside from that, when student was pressured during last minute before they had to submit their answer, another problem they might face during submitting their file are network or server problem, which tends to make them forgot whether they have given proper name for their file, which leave another problem for lecturer to sort out all students answer file.

Project Objective

The problem stated before will be the focus for our project to solve it via software application. With respect to our pledges in Table 1.1, for this project, we want to achieve the following objectives:

1. To provide an easy-to-use application for student to rename their answer file for online submission use.
2. Introducing consistency file name that will be created by their student and submitted to the lecturer for every file name of assessment.

Conceiving

We had our interview session with the Facility Manager of the School of Electrical Engineering, Dr. Kamaludin Mohamad Yusof to identify the issues that may happen throughout the online submission of test or final exam solutions.

Dr. Kamaludin shared about the difficulty of lecturers to track the students' file due to the improper naming of the files or inconsistency of file naming. It would be useful if a mobile app were invented to ease the file naming process in the limited time right after the test or final exam as shown in the Appendix I. A survey was done using google form and the results are attached in Appendix II showed the students and lecturers opened to this innovation of mobile app which can ease file naming.

The inconsistency in file naming from students for online assessment submission causes difficulty for lecturers to sort out the files. We come out with the design statement, "How to rename the file according to the preset format?"

Designing

Our project purposes are submission of assessment for online classroom. Initially, we make a survey focusing on students and lecturers about their method of submitting answer file or assignment through platform that are provided by campus and/or through different platform such as Google Classroom, Google Drive, Telegram, or WhatsApp application. We also asking for their experience of their current method in submitting their work (student) and how they want its format to (lecturer). What we conclude from our survey is that 3 major problem that could happen during submission period (2 problems for both student and lecturer). However, for this project we only focus on problem 1 which is no consistency in file naming (based on Figure 1.1 and Figure 1.2).

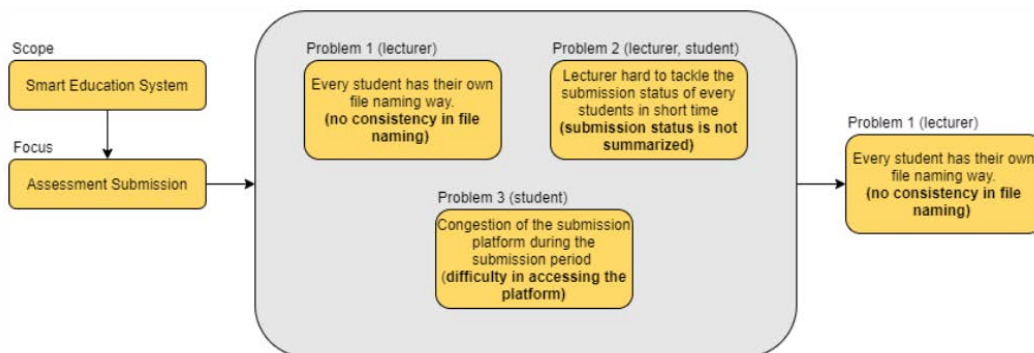


Figure 1.1: Identifying problems for students and lecturers.

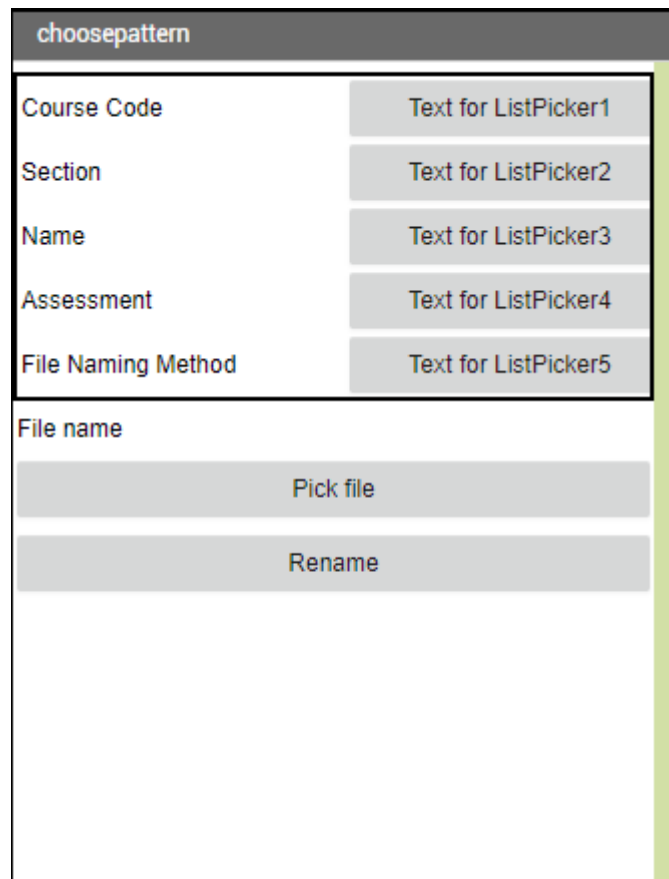


Figure 1.2: Conceptual prototype of UTM Smart File Application.

Table 1.1: The STEEP analysis of the developed prototype.

Aspect	Discussion
Sociological	Giving consistency of received file from student in term of file naming and less typing error.
Technological	Reducing the amount of effort for student to rename their file after compiling their answer sheet digitally just by using their smartphone.

As in Figure 1.3, our software design consists of five (5) categories for student to choose their information such as their name, course code and its section. Assessment type was also provided to indicate whether files are quiz, test, or final exam type of assessment. Naming method gives different format, for example, "Name>course code>section>assessment". This naming method for now provide options such as how faculty or lecturer want to.

1. Name>Matric ID>Course Code>Section (Faculty preferred for final exam naming file)
2. Course Code>Section>Name>Matric ID
3. Name>Course Code>Section>Assessment

Expenses required for this project are totaling to RM 0, this is because we are using a free online platform that provide user to make their software for free from their website, which is MIT App Inventor. Initially, we had used Flutter with Android Studio, which is also free. Unfortunately, due to time constraint and lack of computer power that capable to emulate android software in our laptop using Android Studio, we had to change to MIT App Inventor. For keeping information for our application use such as student name, course code, and section, we use Google Sheet. Not only that, extension that we used in MIT App Inventor is also free, as it was developed by part of the community in online forum of MIT App Inventor.

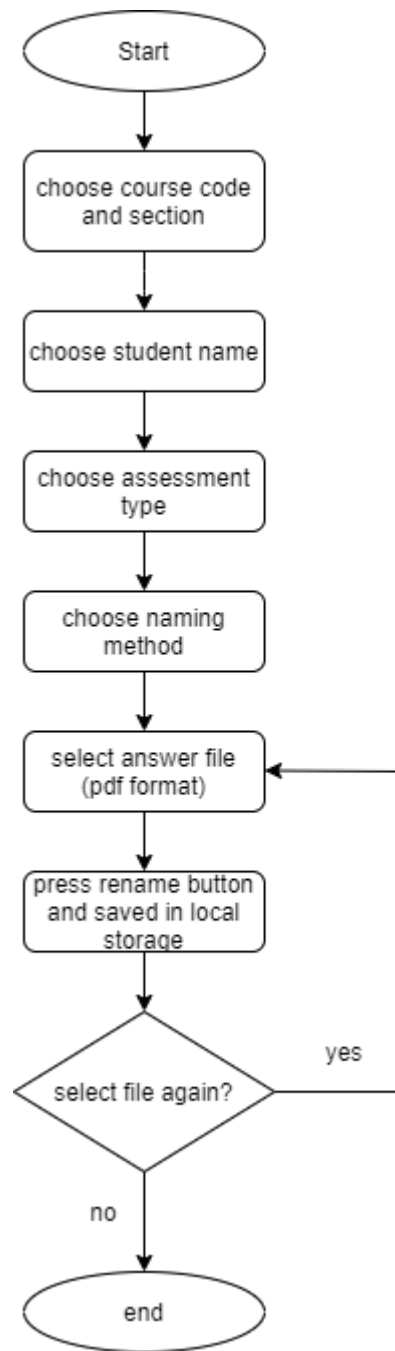


Figure 1.3: Flowchart of conceptual UTM Smart File Application.

Table 1.2: Gantt chart of project development

No.	Activity	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Discussing idea	█	█	█	█										
2.	Conceptual Idea presentation					█									
3.	Finding suitable software				█	█	█	█	█	█	█	█	█		
4.	Developing software				█	█	█	█	█	█	█	█	█	█	
5.	Final Product presentation														█

Based on Table 1.2, we discussed ideas that is suitable for Smart Education System theme, and from initially 5 ideas that we come up, we chose UTM Smart File Application for our project. After that, we choose Flutter as our initial software development program to make our application. However, we face an obstacle which our laptop cannot to run Android Studio properly and facing this problem for almost two weeks. Which then, we had to change it to MIT App Inventor. Until then, we manage to make progress since it is easier to use and less resource-demanding to our laptop.

Implementing

The steps of developing the UTM Smart File app are as the following:

Step 1: Create an account in MIT App Inventor.

Step 2: Start to develop the program based on the task distribution.

Step 3: Test the program using the Mobile phone by scanning the QR code provided.

Step 4: If the features tested give the desired output, and then share the .aia file among other team members.

Step 5: Understanding the working principle of every feature shared by all the team members and starts to compile together.

Step 6: Show the result by screen recording the functionality of the app to all the team members and discuss on the improvised feature.

Step 7: Get the advice or recommendation from our facilitator and start modifying and decorating the app.

Step 8: Present the product.

The implementing part has a lot of detailed works which will be shown in the result and discussion part. However, the general part in developing the app will be explained here. There are three general parts to develop the app which are the extension file required to be used, interfacing between the app with google sheet and main part of the program. The extension file used in developing the app was 'TaifunFile' extension as shown in the Figure 1.4, this extension file was essential in developing the renaming feature of the app which can be known as the heart of the overall program. In addition, the google sheet as shown in the Figure 1.5 contain list of student's full name and matric number which was crucial because their full name will appear to be chosen based on the name list in the google sheet only which was shown in the Figure 1.6. Because of the consideration on the large amount students in one section, therefore, by implementing google sheet to store all the information from the students was appeared to be an efficient alternative. Furthermore, the main part of program developing can divided into three part which was the user's information part, renaming part and notification part. The user's information will become the input to the app as shown in the Figure 1.7, while the renaming part was the main function not only in renaming the file but also create a path to store the renamed file in the user's mobile phone storage as shown in the Figure 1.8. The notification

part was used to guide the new user from the beginning until the end of the process, all the relevant notification statement will be appeared as soon as the user accidentally press the Rename button without fulfilling the prerequisite of the system which is the complete user's information and the PDF file available for renaming. All the notification programs with the purple Lego color with the name of "Notifier 1" as shown in the Figure 1.9.

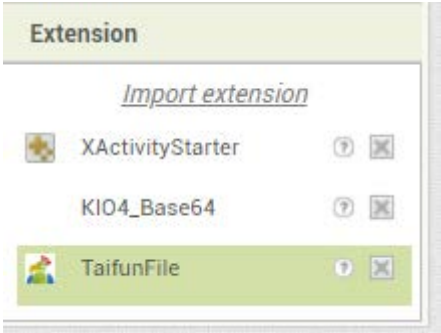


Figure 1.4: 'TaifunFile' extension used to develop the auto file naming feature.

	A	B
1	NAME	MATRIC NUMBER
2	Abd Hafiz Bin Abd Rahman	A17KE1111
3	Muhammad Luqman Bin Roslan	A17KE2222
4	Wong Bai Siong	A17KE0000
5	Yap Han Jie	A17KE3333
6	Mohamad Ali Bin Abu Bakar	A17KE5656
7		
8		
9		

Figure 1.5: Google sheet used to store the user's information.

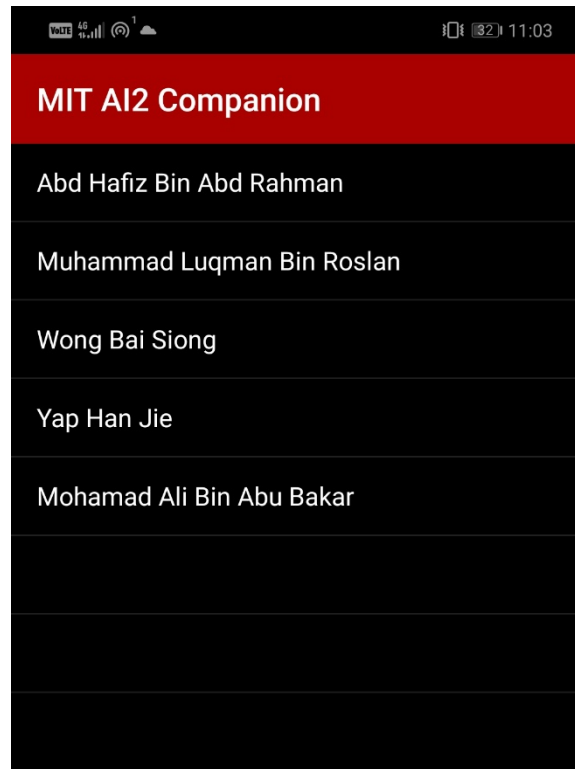


Figure 1.6: The list of student's full name based on the name list in google sheet.

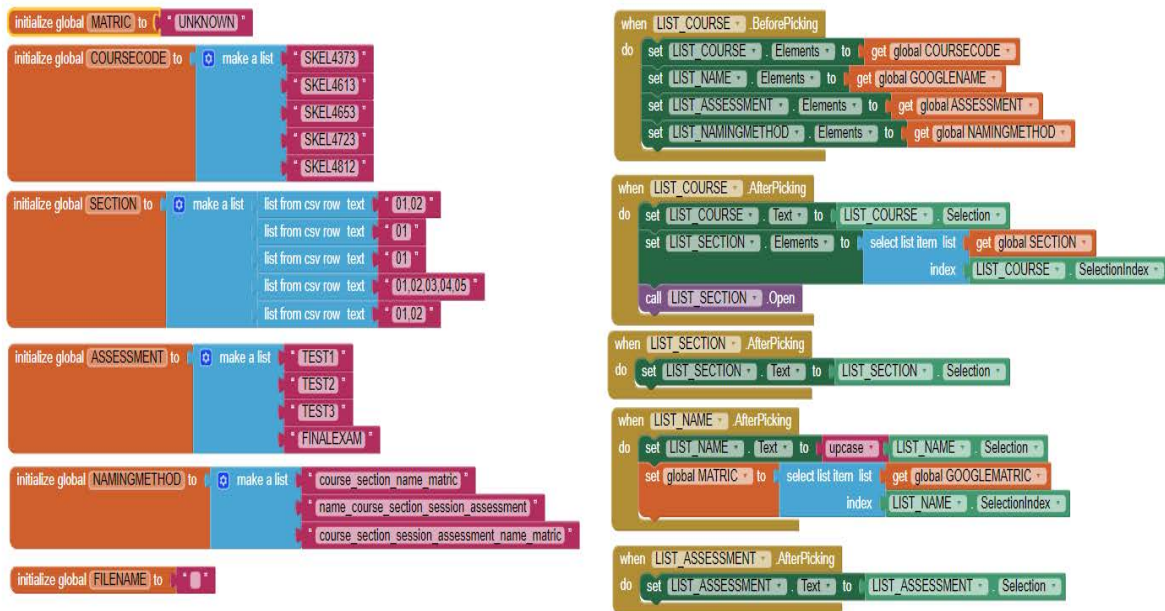


Figure 1.7: The main part of the program to input the user's information.

```

when Rename . Click
do
  if
    LIST_NAMINGMETHOD . Selection = " " and OldFileName . Text = OldFileName
  then
    call Notifier1 . ShowAlert
    notice "No File Naming Method!"
    notice "No File Chosen!"
    set NoFileNamingMethod . Visible to true
    set PleaseChoosePDFfile . Visible to true
  else if
    OldFileName . Text = OldFileName
  then
    call Notifier1 . ShowAlert
    notice "Please Select the File!"
    set PleaseChoosePDFfile . Visible to true
    set NoFileNamingMethod . Visible to false
  else if
    LIST_NAMINGMETHOD . Selection = " "
  then
    call Notifier1 . ShowAlert
    notice "Please Select the File Naming Method!"
    set NoFileNamingMethod . Visible to true
    set PleaseChoosePDFfile . Visible to false
  else
    set NoFileNamingMethod . Visible to false
    set PleaseChoosePDFfile . Visible to false
    set FILENAME . Text to
      replace all text
      call TaifunFile1 . GetFileName
      contentUri XActivityStarter1 . ResultUri
      segment
      segment text call TaifunFile1 . GetFileName
      contentUri XActivityStarter1 . ResultUri
      start 20
      length
      call TaifunFile1 . GetFileName
      contentUri XActivityStarter1 . ResultUri - 19
      replacement
      join
      "/Download/UTMSmartFile/"
      get global FILENAME
      ".pdf"
    set PDF2 . Visible to true
    call TaifunFile1 . Copy
    fromFileName call TaifunFile1 . GetFileName
    contentUri XActivityStarter1 . ResultUri
    toFileName FILENAME . Text
    set RenamedSuccessfully . Visible to true
  end if
end do

```

Figure 1.8: One of the main parts of the program in renaming the file and create a path to store the renamed file and notification part implemented.

```

when PickFile . Click
do
  set XActivityStarter1 . Action to "android.intent.action.GET_CONTENT"
  set XActivityStarter1 . DataType to "text/plain"
  if
    is empty
    call XActivityStarter1 . ResolveActivity
  then
    call Notifier1 . ShowAlert
    notice "Unfortunately there is no file manager installed..."
  else
    call XActivityStarter1 . StartActivity
  end if
end do

when XActivityStarter1 . AfterActivity
result
do
  if
    contains text XActivityStarter1 . ResultUri
    piece ".pdf"
  then
    set PDF . Visible to true
    set OldFileName . Text to call TaifunFile1 . GetFileName
    contentUri XActivityStarter1 . ResultUri
  else
    call Notifier1 . ShowAlert
    notice "No pdf file selected"
  end if
  while test
    OldFileName . Text != OldFileName
  do
    set PleaseChoosePDFfile . Visible to false
  break
end do
end do

```

Figure 1.9: The notification implemented into the program for selecting file to rename

Operating

The UTM Smart File application runs on the website of the MIT App inventor, which is online website. Firstly, the application was started by linking the project with users' interface. In this project, it could be linked with the users' smartphone. The steps to use this application was quite easy whereas it is unnecessary for the user to key in their information manually. All their information was initially stored inside the database (google.docx). Figure 1.10 shows the Graphical User Interface (GUI) of the application. After the GUI of the app pops up, the steps that need to be taken to complete the application of the file are as the following.

Step 1: After the application was ran, the users must choose their details (course code, section, name, type of assessment and desired file naming method).

Step 2: The users clicked on the 'Pick File' button to open the file manager of their smartphone to access the PDF file.

Step 3: When the PDF has been chosen, the users then clicked on the 'Rename' button to rename the file as desired.

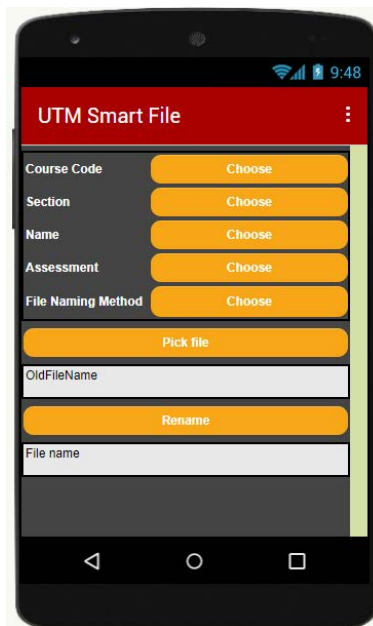


Figure 1.10: The GUI for UTM Smart File.

Step 1: After the application is run, the users must choose their details (course code, section, name, type of assessment and desired file naming method).

Step 2: The users clicked on the 'Pick File' button to open the file manager of their smartphone to access the PDF file. The pop up appears as in Figure 1.11 when the file has been successfully chosen.

Step 3: When the PDF has been chosen, the users then clicked on the 'Rename' button to rename the file as desired. The pop up appears as in Figure 1.12 when the process of renaming the file has been completed.

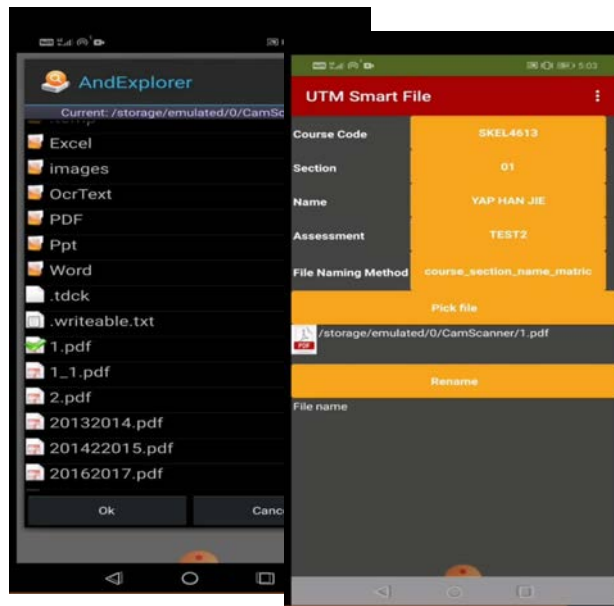


Figure 1.11: The PDF file has been chosen successfully.

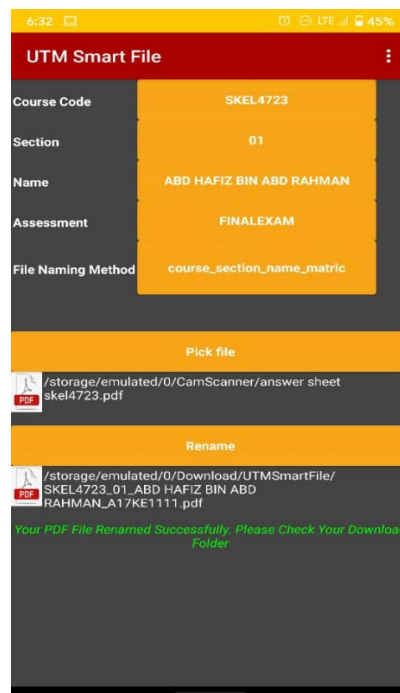


Figure 1.12: The rename of the PDF file after successfully executed.

Result and Analysis

This part will show the program from the user's information until the renaming process is completed (Figure 1.13). There are several useful features created based on the survey conducted. The features includes the course code and section selection, name selection, assessment type selection, naming format selection, pick the file, rename the file, and create a path for the storage of the renamed file. First, the initialization of global variable was required, since the mobile application connect with the online google sheet therefore, there were three global variable names which were GOOGLESHEET, GOOGLENAME and GOOGLEMATRIC had been initialized. When the Screen1 (The main page of the app) was initiate, there were three function call which is Web1.Get (Get information in the online google sheet) and two Screen1.AskForPermission with the permissionName written in "READ_EXTERNAL_STORAGE" and "WRITE_EXTERNAL_STORAGE" respectively. When the Web1.GetText (When google sheet contain text as source of information), then get the content of the text in the table list into the GOOGLESHEET variable but need to initiate the item list to zero first by having the "remove list item" Lego, and two function call which named "SETGOOGLENAME" and "SETGOOGLEMATRIC" was executed. For these two function calls, both added the name and matric number which had been key in into the google sheet in the first column and second column respectively into their own defined global variable.

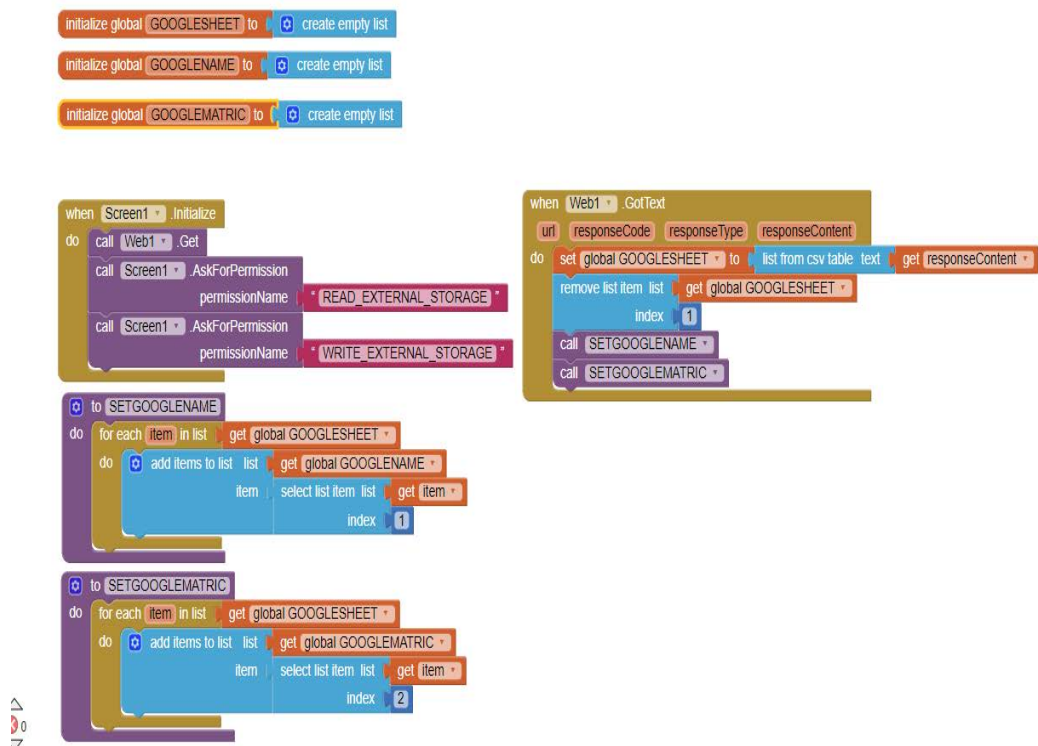


Figure 1.13: The process of renaming the PDF file.

The entire program that relates to the "Choose" button appears in the main page of the app. Since there were 6 information required to include in the file naming, therefore there were 6 global variables required to be initialized which were MATRIC, COURSECODE, SECTION, ASSESSMENT, NAMINGMETHOD and FILENAME. The initialization of the FILENAME and MATRIC were blank or unknown because of the list of data will obtain from the global variable GOOGLENAME and GOOGLEMATRIC. The process is shown in Figure 1.14, Figure 1.5, Figure 1.16, Figure 1.17, Figure 1.18 and Figure 1.19. However, the other variables were initialized with the list of text which will appear on the screen when the user clicks on the Choose button under the specific defined variable. For example, when user click on the Choose button next to the Course Code then list of items such as SKEL4373, SKEL4613, SKEL 4653, SKEL4723 and SKEL4812 will appear on the screen for user to select. The Course Code must be the first information to be selected because all the list of items will be assigned accordingly and displayed out on the screen else it would appear blank page. Therefore, the priority given to Course Code, Section, Name, Assessment and File Naming Method which had been shown from top to the bottom in the main page of the app. After selecting all the information, then it will proceed to the format selection which is known as the File Naming Method.

```

initialize global MATRIC to UNKNOWN
initialize global COURSECODE to make a list
  SKEL4373
  SKEL4613
  SKEL4653
  SKEL4723
  SKEL4812

initialize global SECTION to make a list
  list from csv row text 01.02
  list from csv row text 01
  list from csv row text 01
  list from csv row text 01.02,03,04,05
  list from csv row text 01.02

initialize global ASSESSMENT to make a list
  TEST1
  TEST2
  TEST3
  FINALEXAM

initialize global NAMINGMETHOD to make a list
  course_section_name_matic
  name_course_section_session_assessment
  course_section_session_assessment_name_matic

initialize global FILENAME to

when LIST_COURSE BeforePicking
do
  set LIST_COURSE Elements to get global COURSECODE
  set LIST_NAME Elements to get global GOOGLENAME
  set LIST_ASSESSMENT Elements to get global ASSESSMENT
  set LIST_NAMINGMETHOD Elements to get global NAMINGMETHOD

when LIST_COURSE AfterPicking
do
  set LIST_COURSE Text to LIST_COURSE Selection
  set LIST_SECTION Elements to select list item list get global SECTION
  index LIST_COURSE SelectionIndex
  call LIST_SECTION Open

when LIST_SECTION AfterPicking
do
  set LIST_SECTION Text to LIST_SECTION Selection

when LIST_NAME AfterPicking
do
  set LIST_NAME Text to upcase LIST_NAME Selection
  set global MATRIC to select list item list get global GOOGLEMATRIC
  index LIST_NAME SelectionIndex

when LIST_ASSESSMENT AfterPicking
do
  set LIST_ASSESSMENT Text to LIST_ASSESSMENT Selection

```

Figure 1.14: The process of determining course section and type of assessment.

The File Naming Method was very easy to understand because it will base on the three-naming format provided based on the UTM Online Learning Campaign (OLC) and suggestions from two lecturers. After selecting the naming format had been selected successfully, the system will proceed to the next step which is picking the file, and rename the file based on the format had been chosen as shown in Figure 1.15.

```

when LIST_NAMINGMETHOD .AfterPicking
do
  set LIST_NAMINGMETHOD .Text to LIST_NAMINGMETHOD .Selection
  if LIST_NAMINGMETHOD .SelectionIndex = 1
  then
    set global FILENAME to join
    LIST_COURSE .Text
    LIST_SECTION .Text
    LIST_NAME .Text
    get global MATRIC
  else if LIST_NAMINGMETHOD .SelectionIndex = 2
  then
    set global FILENAME to join
    LIST_NAME .Text
    LIST_COURSE .Text
    LIST_SECTION .Text
    202020211
    LIST_ASSESSMENT .Text
  else if LIST_NAMINGMETHOD .SelectionIndex = 3
  then
    set global FILENAME to join
    LIST_COURSE .Text
    LIST_SECTION .Text
    202020211
    LIST_ASSESSMENT .Text
    LIST_NAME .Text
    get global MATRIC
  while test LIST_NAMINGMETHOD .Selection ≠
  do
    set NoFileNamingMethod .Visible to false
    break

```

Figure 1.15: XActivityStarter1 for naming the file

User required to select the file required to be renaming by clicking the Pick file button. Upon clicking the button, the XActivityStarter1 will carry out action to get the content from the file manager installed on user's smart phone. If the XActivityStarter1 detected no file manager had been installed then a notification will be sending out with the text of "Unfortunately there is no file manager installed", else the XActivityStarter1 will start its activity to get the PDF file.

```

when PickFile .Click
do
  set XActivityStarter1 . Action to " android.intent.action.GET_CONTENT "
  set XActivityStarter1 . DataType to " text/plain "
  if is empty call XActivityStarter1 .ResolveActivity
  then call Notifier1 .ShowAlert
      notice " Unfortunately there is no file manager installed... "
  else call XActivityStarter1 .StartActivity

```

Figure 1.16: XActivityStarter1 checking for user selection of the generated PDF file – Part 1

When the XActivityStarter1 initiated, it will detect any selected file. Since the survey conducted shown most of the students and lecturer prefer to submit and receive the answer script in PDF file, therefore this application only accept pdf file, else it will give the notification "No PDF file selected". Upon selecting the PDF file successfully, the PDF file icon will be visible, and the name of the file will appear beside the icon. The name of the file was including the storage path. Then, proceed to the last step which was the main part of the app Rename button.

```

when XActivityStarter1 .AfterActivity
result
do
  if contains text XActivityStarter1 . ResultUri
      piece ".pdf"
  then set PDF . Visible to true
      set OldFileName . Text to call TaifunFile1 .GetFileName
          contentUri XActivityStarter1 . ResultUri
  else call Notifier1 .ShowAlert
      notice " No pdf file selected "
  while test OldFileName . Text ≠ " OldFileName "
  do set PleaseChoosePDFfile . Visible to false
  break

```

Figure 1.17: XActivityStarter1 checking for user selection of the generated PDF file – Part 2

When the Rename button was clicked, the system will check all the available content such as the complete user's information and PDF file had been selected. After fulfilling all the criteria or the prerequisite of the system, then it will rename the file else a bunch of notification such as "No File Naming Method!", "No File Chosen!", "Please Select the File!", and "Please Select the File Naming Method!" will appear based on the condition.



Figure 1.18: XActivityStarter1 checking for user selection of the generated PDF file – Part 2

Upon fulfilling all the criteria successfully, the name of the file will be changed as well as the storage path of the renamed file, which was under the Download folder, an UTMSmartFile subfolder will appear to store the renamed file based on the format chosen and a notification of “Your PDF File Renamed Successfully. Please Check Your Download Folder”.

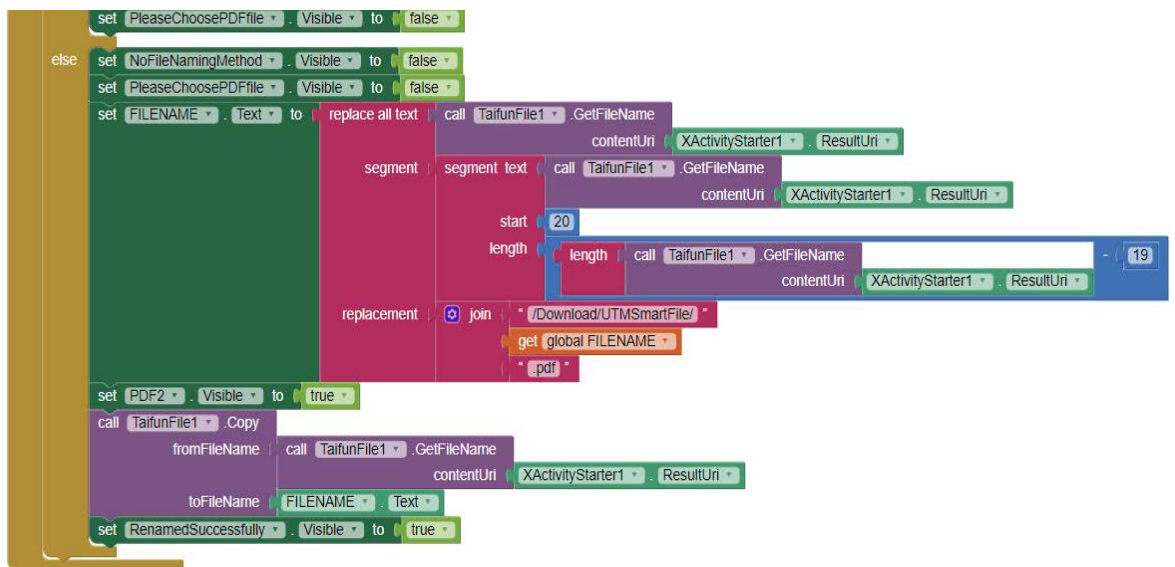


Figure 1.19: XActivityStarter1 – completion of file renaming and destination folder

The focus of this project was to solve the problem of the unorganized files when the students submitted the assessments. The effectiveness of this application can be seen when the files were being organized alphabetically after the renaming method has been executed.

Figure 1.20 shows the comparison when using UTM Smart File for renaming the files. The left figure shows the list of students' submitted Test 2 PDF files in an unorganized manner. However, when the students used this application for renaming the files, it showed consistency in naming and the files were looking organized neatly. The problem where the unorganized naming of the submitted files was being solved by using this application with two beneficial keys, which are: organize and consistent.

The other advantage of this application was the twenty percent reduction of time taken to rename the file according to the specific format. Table 1.3 shows the comparison between the overall times taken when the students rename the files manually and when using UTM Smart File.

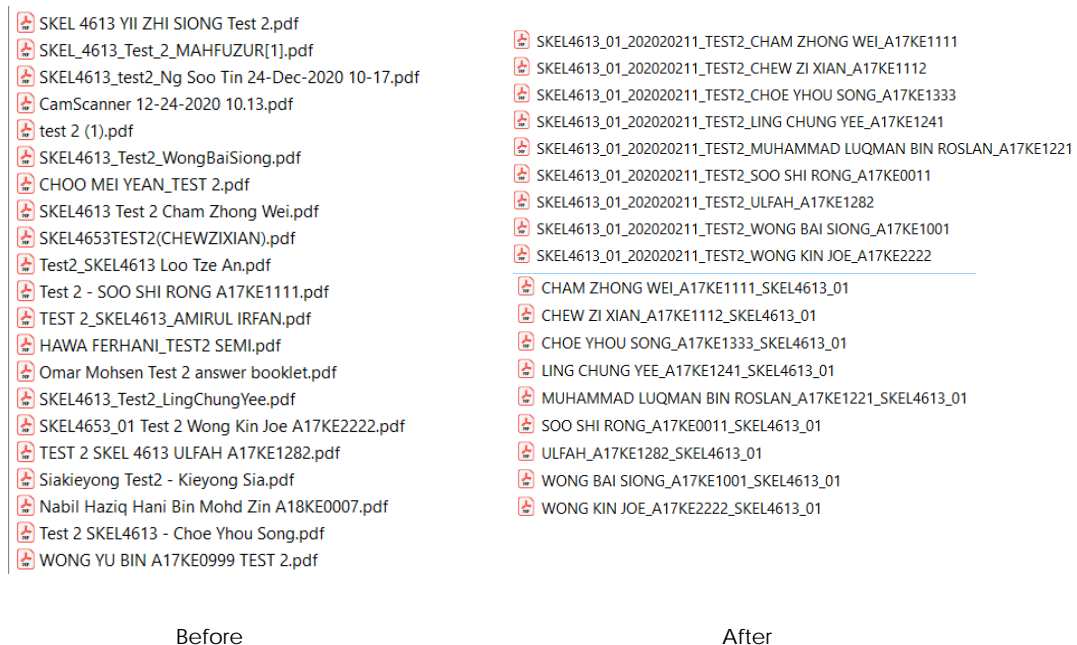


Figure 1.20: The results of file renaming

Based on Table 1.3, the users could save approximately 13 seconds when using UTM Smart File. However, this result that cannot be seen as major advantage of this application as the users still have the choice to rename the files manually. Findings from this performance analysis could be helpful to improve this application in the future.

Table 1.3: Performance analysis between manual naming and using UTM Smart File

Test	Average Time Taken (Seconds)
Students renaming the files manually	39
Renaming the files using UTM Smart File	26

Innovation

Our app can provide consistency and accuracy in the file naming. It can help lecturers to sort out the files. It provides various naming methods. Our potential users, the students, need not type their file name and only need to click on the selection provided as the data was stored at google sheet. There is no other specific application so far, for file naming in the Capstone project.

Conclusion

The prototype has been able to rename the file within a shorter period of time (20% less time compared to the time taken if it is done manually). The output of UTM Smart File - Auto File Naming is more organized and neat. Extra features such as uploading the files to the cloud storage, more variance of the type of files, and the size of files and number of files the system can handle at one time should take into consideration for future implementation.

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Smart Classroom

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Abstract: Smart Classroom is a project that can help students to learn in a productive way. This project is a combination of hardware and mobile applications which can be installed in any Android-based smartphone. For the hardware part, a system with fingerprint scanner to scan attendance, fan sensor and light sensor that switch off automatically when no one is in the classroom, camera to record live lecture video and automated door-lock system has been developed. For the mobile applications part, an apps with attendance record, mobile notification and live video lecture has been designed. In this project, the hardware has been successfully linked with the mobile applications.

Keywords: Fingerprint; Attendance; Lecture

Introduction

Smart Classroom consists of a few features where these features will help students to have a very conducive and smart system. The project is a combination of hardware and mobile applications which can be installed in any Android smartphone. At the beginning of the project, a survey was conducted among some UTM students to find out the problems that they faced regarding the classroom and the features that they wish to have in a classroom. Based on the survey, it can be concluded that some students have problems with scheduling and planning of their studies. In addition, there are a few other concerning issues such as the waste of energy consumption in the building. Some students also prefer recorded videos from live lectures since they have difficulties focusing during the lecture. This is due to their seating position in the classroom where they normally sit at the back of the classroom and would not be able to see the content displayed in front of the class clearly. The videos would also be useful for their revision for tests and final examination. Therefore, the developed smart classroom should have the features that would help students to learn in a more productive way such that it can improve learning and understanding.

Smart Classroom focuses on the importance of the student problems that have been discussed in the research and idea generation stage, as well as from the survey responses. Here are the objectives of Smart Classroom:

1. To develop a smart classroom system that can reduce energy usage.
2. To design a notification system for students via mobile apps for them to keep track of the lecture and important date.
3. To design a system that provides a platform to view the live lecture for better learning and understanding.

Idea Generation

The first step involved the creation of a bubble map for project's ideas from all the team members as shown in Figure 1. Due to few limitations, we decided that only four from all listed ideas will be applied for the Smart Classroom. Besides, features that will be offered for Smart Classroom are shown in Figure 2. Nonetheless, only few features were selected for this project due to the limitation in project timing planning and scope. If all ideas were taken into consideration, it would take much longer for this project to be completed.

In the next step, we blasted a questionnaire to students in UTM as shown in Figure 3. Responses were mostly from the students of the Faculty of Engineering and also the School of Electrical Engineering. The related responses to this project, which mostly agreed with statements from the students, are shown in Figure 4. After analysing all responses, a user profile was created based on the responses of the survey.

User Profile:

- Name : Ali
- Age : 18-23 years old
- Student from Faculty of Engineering
- Taking SKEE programme
- Think that scanning QR code for attendance is difficult due to connectivity issue
- Prefer watching back lecture video for revision

Pain points:

- Always miss to sign attendance sheet or to scan QR code during class
- Constantly forget to submit assignment on time
- Frustrated due to unfavourable environment of study

Needs:

- Advanced facilities- To avoid missing class attendance.
- Multiple functioning mobile application- Help students to keep on track with class and assignments.

Finally, at the end of research and idea development stage, we concluded and agreed on the title SMART CLASSROOM, where this project consists of a few features that will make students study in a more productive learning environment. There are two parts of this project, which are hardware and mobile applications. Hardware and mobile applications will be linked to achieve objectives of the project.

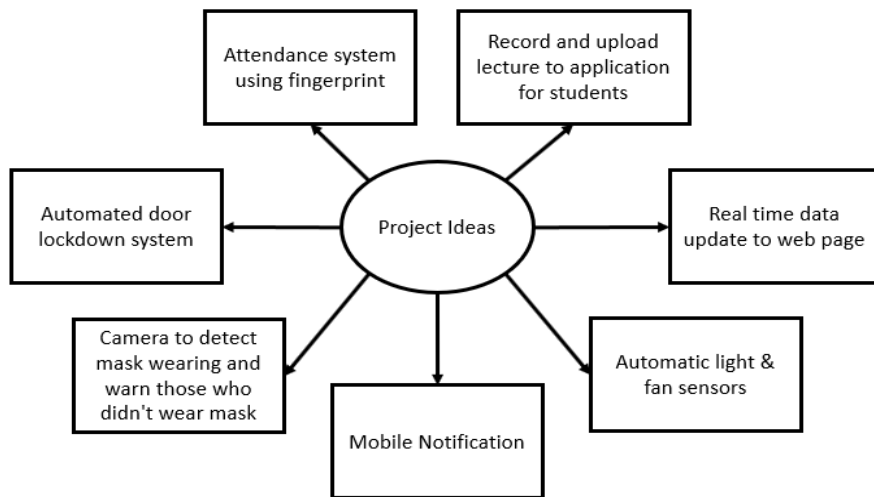


Figure 1: The bubble map of project ideas

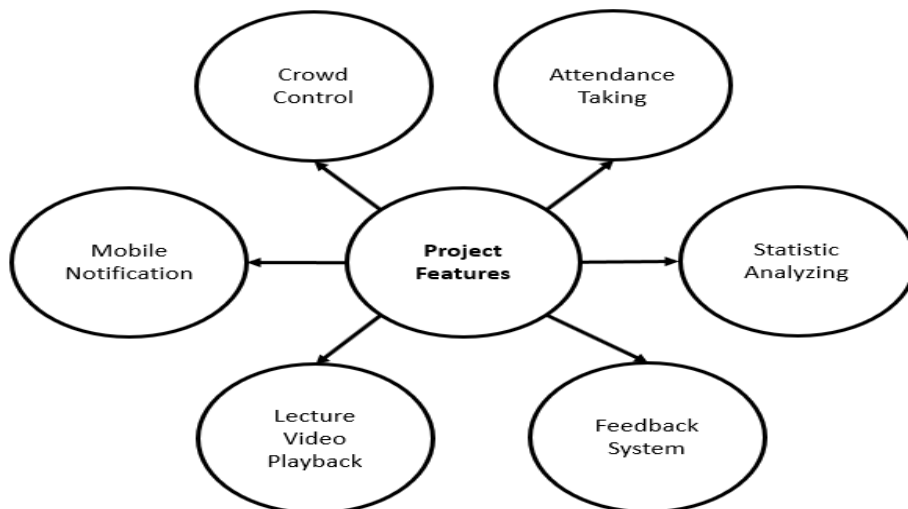


Figure 2: The bubble map of project features

1. In the new era of education, should the traditional classroom be improved to Smart Classroom?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

2. In your opinion, do you agree if fingerprint attendance taking is easier than downloading dedicated application to scan QR code?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

3. In your opinion, during face-to-face learning is streaming lecture video online a good idea?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

4. In your opinion, by adding automated system for light and fan switching will make it more easier to turn off all of the light and fan when not in use?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

5. Some of the basic facilities in UTM classroom for example light, fan, air-conditioner, desk and chair are not in a good condition. Do you think improvement on basic facilities should be made to have a very conducive environment of study?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

6. Do you think that Smart Classroom's fingerprint attendance will help you from miss to sign/scan the attendance sheet during class.
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

7. In your opinion, do you think webpage is necessary to be created in a smart classroom as it can remind student about assignment due date via mobile notification?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

8. To have a conducive classroom, should the door lock when the fingerprint attendance detected 30 person entering the classroom?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

9. Automated door lockdown system, fingerprint attendance taking, real time data update to web page, record and upload lecture to webpage for students to view real time. Do you agree if Smart Classroom ideas mentioned above are implemented in our classroom?
a. agree
b. somehow agree
c. neither agree nor disagree
d. somehow disagree
e. disagree

10. If you have any suggestion on element, features or system of Smart Classroom in UTM, what would it be? Please suggest your answer.

Figure 3: Questions in the questionnaire

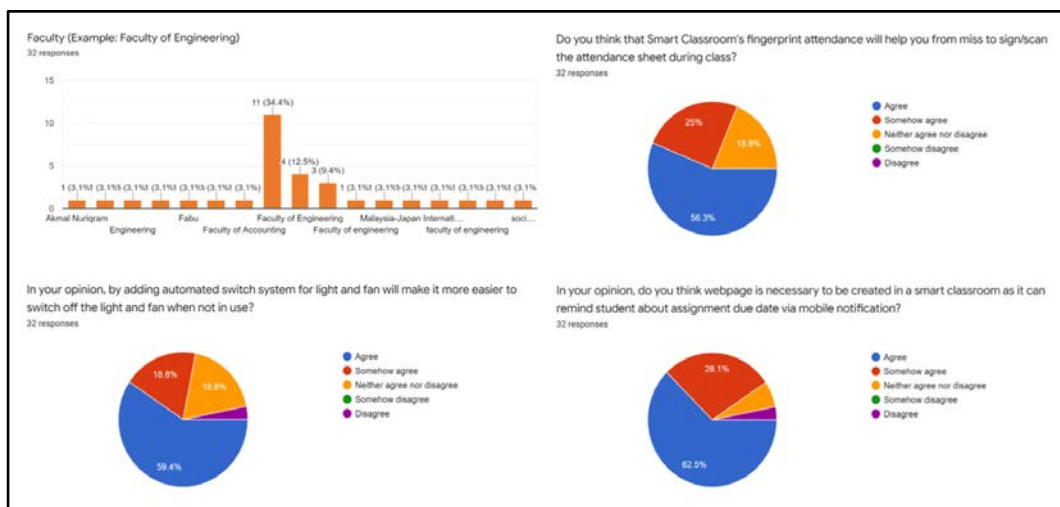


Figure 4: The required and related responses

Project Planning

Overall Process

The project started with the research and ideas development stage before it was continued with the concept of prototype where the team is divided into two. The first team was responsible for hardware development and the second team handled the design of mobile applications. Each student has its own individual task assigned. Figure 5 shows the flowchart of the overall process.

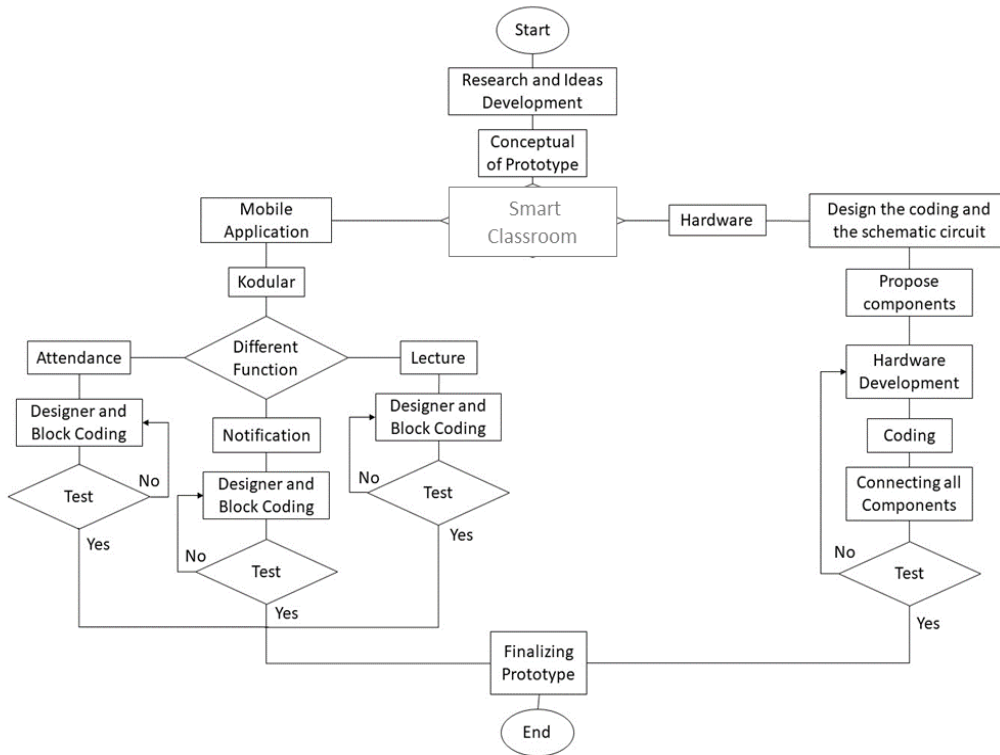


Figure 5: The flowchart of overall process

System Architecture

Figure 6 depicts the architecture of the whole smart classroom system, from the design features, to the software and hardware involved in the development.

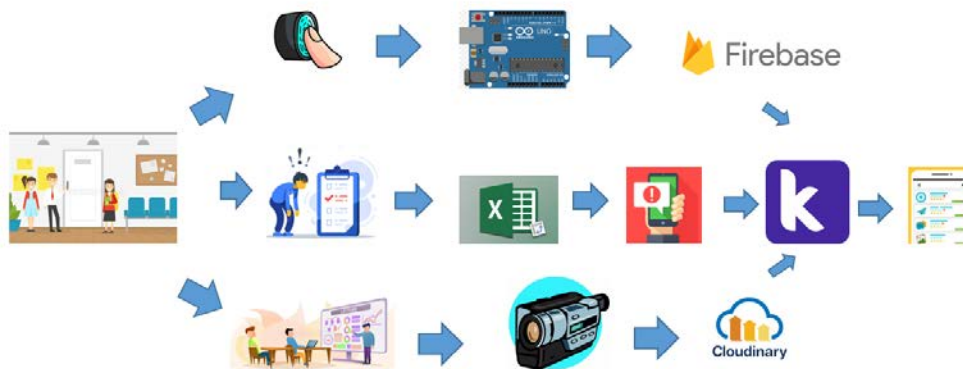


Figure 6: Architecture of Smart Classroom

The process of developing the mobile application is shown Figure 7. This summary process briefly explains the procedures taken to develop the mobile applications. Meanwhile, the process of developing the hardware part is depicted in Figure 8. This summary process briefly explains the procedure taken by the team of hardware. A few precautions and additional steps were also taken in order to make sure the developed hardware works as intended.

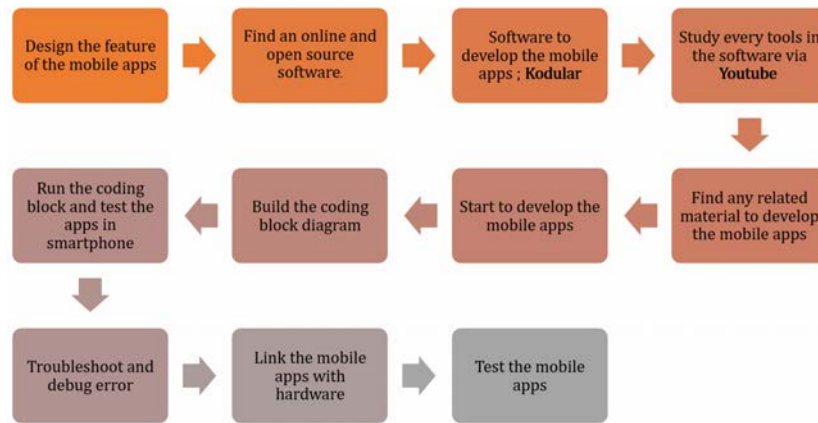


Figure 7: The process of developing the mobile application

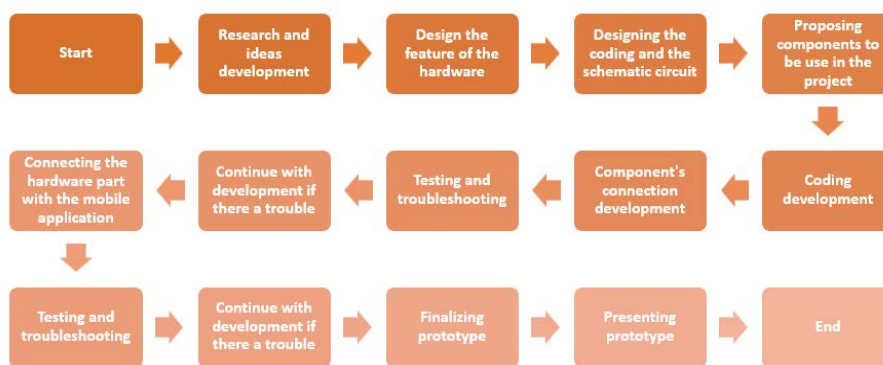


Figure 8: Process of developing the hardware part

Smart Classroom project was conducted in 15 weeks, where specific tasks were allocated for each week as shown in the Gantt chart of our project in Table 1.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
Research & Ideas Development	█	█													
Conceptual Prototype Development			█	█	█										
Conceptual Prototype Presentation					█										
Prototype Development						█	█	█	█	█	█				
Finalizing Presentation												█	█		
Finalizing Technical Report												█	█	█	█
Individual Report					█				█				█		
Prototype Presentation														█	
Technical Report															█

Table 1: Gantt chart of Smart Classroom project

Financial Planning and Spending

The total spending of our project is RM 282.26. The main cost comes from the Arduino Uno which is RM38.80, ESP32CAM which is RM33.70, and fingerprint scanner which is RM54.90. The Arduino Uno is used to act as the main controlling unit for the system. Next, the ESP32CAM is used to record and upload the lecture video. Lastly, the fingerprint scanner is used to identify the identity of the student. Below is the expenses list for this projects:

Table 2: Overall cost of the project

Item	Unit Price	Quantity	Price
Arduino UNO R3 Basic EE RBT School Beginner Learning Starter Kit V1	RM 38.80	1	RM 38.80
Arduino Infrared IR Line Following Tracking Sensor (Single Bit) 4 pin	RM 4.60	1	RM 4.60
DC 12V Solenoid Door Lock	RM 19.50	1	RM 19.50
Rechargeable Lithium battery (18650, 3200mAh)	RM 13.1	5	RM 65.50
ESP32 WiFi cam module (with OV2640 cam)	RM 33.70	1	RM 33.70
Battery Charging and DC-DC boost module (TP4056)	RM 4.20	3	RM 12.60
ESP8266 ESP-01s Industrial Grade Remote Serial Port WIFI Transceiver Wireless Module for Arduino	RM 8.89	1	RM 8.89
LCD (16x2) - Green	RM 4.80	1	RM 4.80
Green / 3mm LED Normal Brightness	RM 0.10	1	RM 0.10
Red / 3mm LED Normal Brightness	RM 0.10	2	RM 0.20
AC-DC Power Supply Module - 5V 700mA	RM 7.10	1	RM 7.10
Songle SPDT Relay SRD DC 10A 5 PINS - DC Voltage - 5V	RM 1.29	1	RM 1.29
RF Transmitter Module (315MHz)	RM 2.60	3	RM 7.80
RF Receiver Module (315MHz)	RM 2.60	3	RM 7.80
Micro Silent Submersible Water Pump DC 3V-5V - Pump Only	RM 4.49	1	RM 4.49
Micro Silent Submersible Water Pump DC 3V-5V - Tube 1M	RM 1.99	1	RM 1.99
AS608 Optical Fingerprint Module Sensor	RM 54.90	1	RM 54.90
SN-PIR: HC-SR501 PIR Sensor Module	RM 3.10	1	RM 3.10
Active buzzer	RM 2.50	2	RM 5.00
1x18650 Battery Holder	RM 0.70	3	RM 2.10
HT12E Encoder Module (self-supply)	RM 0.00	3	RM 0.00
HT12D Encoder Module (self-supply)	RM 0.00	3	RM 0.00
Discount	-RM 2.00	1	-RM 2.00
Total	RM		282.26

Engineering Design

Smart Classroom engineering design consists of two parts, where for mobile application development we used the KODULAR as our platform. As for the hardware, all components were bought from Shopee and these components were connected using the Arduino UNO.

Mobile Application

Smart Classroom mobile application contains four different screens which are login page, main menu, attendance record and notification. Each screen requires different components and variables. For the login screen, it will be the first screen to appear in the mobile application. Some simple components are used to develop the screen. No extension is used in this part. Figure 9 shows all components and the coding block diagram for login.



Figure 9: Block diagram for all components and login coding

For the main menu screen, there will be three options for attendance record, notifications and video lecture. Refer to Figure 10 which shows the overall procedure in a flow chart, and Figure 11 which illustrates the coding block diagram.

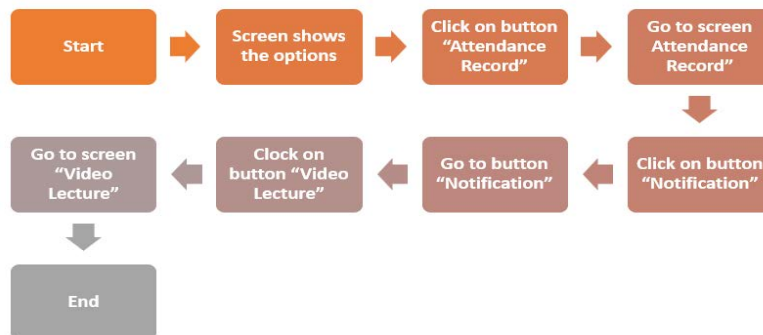


Figure 10: The overall mobile application procedure

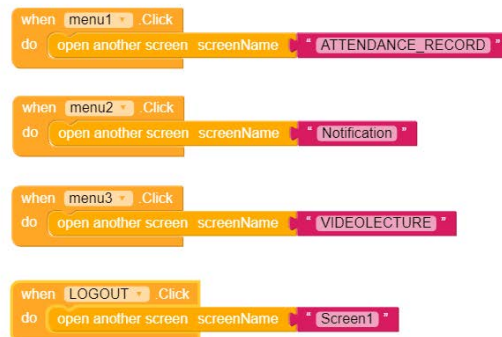


Figure 11: The block diagram coding for menu

For the attendance record screen, Figure 12 visualises the flow of the procedure from scanning the fingerprint to the display of the student database. Firebase is a database system used in this part. The data from Arduino uno (json file) is imported into the firebase. The data is in the form of a real-time database as can be seen in Figure 13. The list of components and the coding block diagram for attendance record application are shown in Figure 13 and Figure 14, respectively.



Figure 12: The flow of procedure for attendance record screen in mobile applications.



Figure 13: The database and list of components used for attendance record application



Figure 14: The coding block diagram of the attendance record screen

For the notification on the mobile application screen, all important information on the procedure were summarized in Figure 15. All components and variables have also been stated in the summarized procedure.

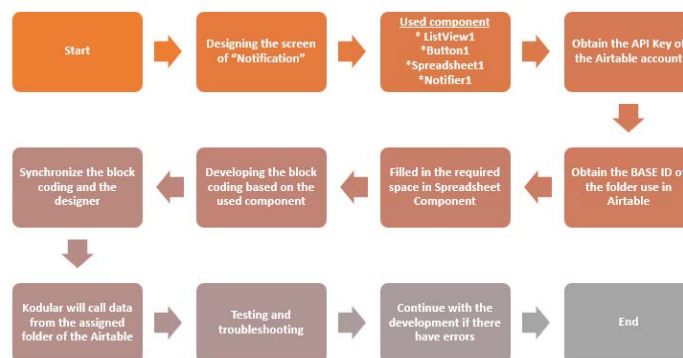


Figure15: The procedure of developing the notification mobile application screen

Figure 16 shows the selected variables. First is the `listview1` where it functions as a space in the mobile screen to show data from the spreadsheet. Then, this is followed by the `Button1`, which functions as a button to return to the main menu screen when the user clicks on it. Third, the `Listview_image1` works as the supporter for the `listview1`. Next, the `Spreadsheet` is the main item for the screen to call data from the airtable. In this spreadsheet, it contains two important things that will be filled. API (Application Programming Interface) key is the first important thing where it can be obtained from the `airtable` folder properties. Next, `BASE ID` is the `airtable` user account base identification.

These two items are very important because it will lead KODULAR to call data from the airtable through the spreadsheet. Lastly, `Notifier1` is used for notifying the user when clicking the data on the screen.

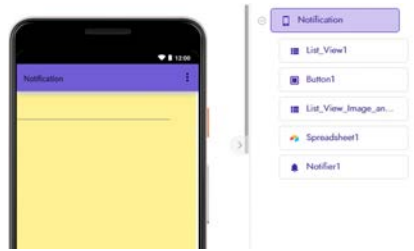


Figure 16: The designer screen for the notification

Figure 17 depicts the connection between each variable used in the design. When the screen notification is initialized, it calls data from airtable using a spreadsheet in the table named `Notification`. Then, the spreadsheet directly calls data based on the API key and BASE ID as shown in Figure 18.

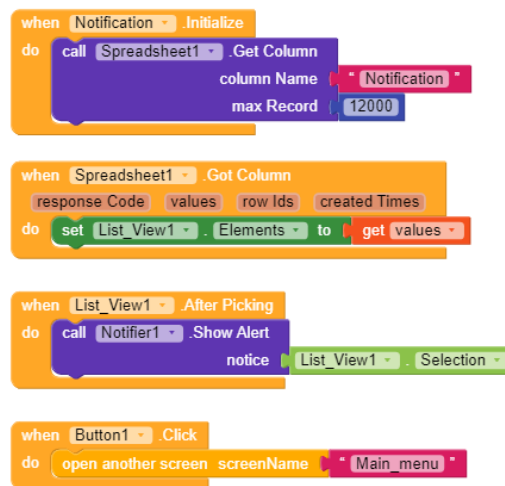


Figure 17: The block coding of the notification screen

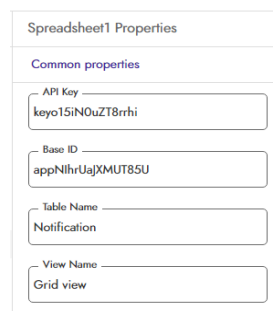


Figure 18: The API Key and Base ID

Lecture Video

For lecture videos, the main idea is to create a mobile page that displays multiple videos which can make students find past videos easily. The lecture video should tally with the hardware(camera). Figure 19 shows the block diagram of the video lecture part.

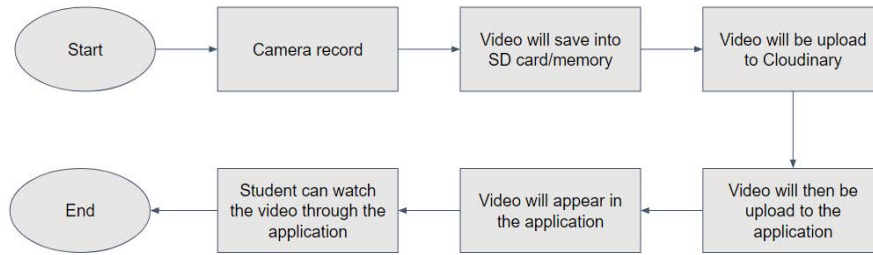


Figure 19: Block diagram for recording of lecture video application

First, the lecturer enters the class and presses the start button on the hardware. Once the lecture is finished, the lecturer needs to press the stop button and the video will be saved into the SD card. The video will then be uploaded into the Cloudinary which is the cloud server that we have synchronized with our software. It can be any video even if it is not from the camera. The purpose of the camera is to help lecturer to record the lecture. Figure 20 shows the Cloudinary program. It is very useful as it is a cloud server which we can upload and delete the files at any time.

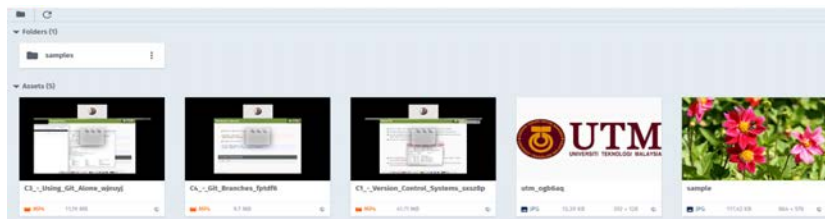


Figure 20. Cloudinary media library

Once it is uploaded into the Cloudinary, the lecturer needs to copy the link of the video and paste it into the coding which is very easy to do. The students can then watch the video through the mobile application. The concept design is depicted in Figure 21. Meanwhile, Figure 22 depicts the real design for this application.

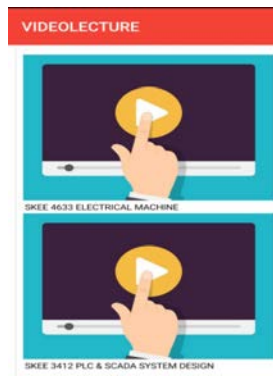


Figure 21. Concept design for recorded videos application

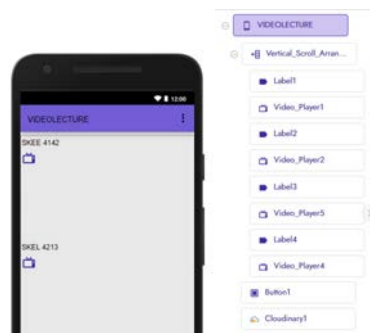


Figure 22: Real design based on the concept

Next is our coding block for the video lecture. It may look simple but the coding block that we have made is already tallied with the Cloudinary using API key. API key is from Cloudinary. From the API key, the video will be called inside the application based on the video link that was pasted into the coding block. Figure 23 illustrates the coding block diagram for this application, meanwhile Figure 24 shows the API key for lecture video application.

```

when VIDEOLECTURE Initialize
do
  set Video_Player1 Source to "https://res.cloudinary.com/duawyeuif/video/uploa..."
  set Video_Player2 Source to "https://res.cloudinary.com/duawyeuif/video/uploa..."
  set Video_Player5 Source to "https://res.cloudinary.com/duawyeuif/video/uploa..."
  set Video_Player4 Source to "https://res.cloudinary.com/duawyeuif/video/uploa..."

when Button1 Click
do
  open another screen screenName "Main_menu"
  
```

Figure 23: Coding block diagram for the lecture video

API Key
898633551257419

API Secret
GQjInkDWhn-cC6fz8fuu59ip2aY

Cloud Name
duawyeuif

Figure 24: API key

Design and Implementation of Hardware

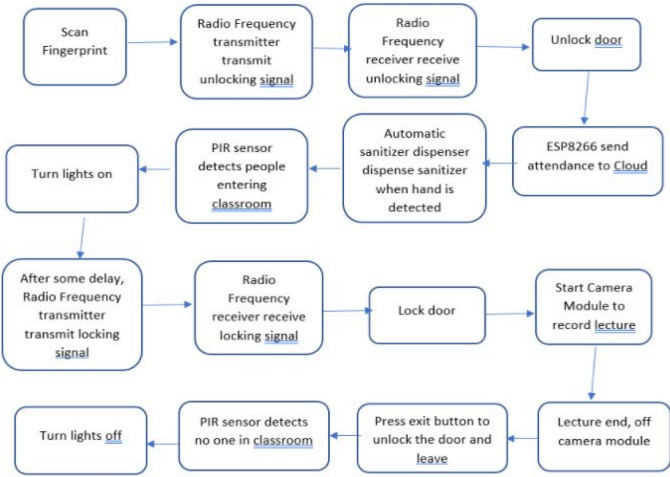


Figure 24: The overall flowchart for hardware part in Smart Classroom

The hardware part of the smart classroom was designed according to the flowchart in Figure 24 which includes fingerprint scanner, attendance uploader, automated sanitizer dispenser, radio signal transmitter, wireless controlled door lock, automated light control system, and lecture video recorder.

The following are the list of hardware used for the power supply circuit for fingerprint scanner and sanitizer dispenser. Meanwhile, the schematic diagram and radio frequency encoder pinout for this application are shown in Figure 25 and Figure 26, respectively.

- On off button for Arduino Uno power supply
- TP4056 battery charging and Boost module used to boost voltage to 9V to provide stable voltage for Arduino Uno Vin.
- Separate battery for Arduino Uno and Sanitizer since the pump in Sanitizer will draw lots of current and cause voltage fluctuation.
- Flyback-diode is added to prevent voltage spikes.

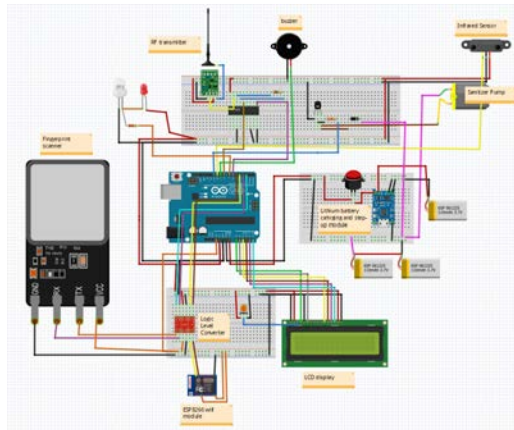


Figure 25: Schematic diagram for fingerprint scanner and sanitizer dispenser



Figure 26: HT12E Radio Frequency encoder pinout

The hardware involved in the development of wireless door lock circuits are listed below.

- Battery charging module output 5V to HT12D and Radio Frequency (RF) receiver module.
- 315MHz RF receiver module to receive locking and unlocking command wirelessly
- Induction Door Lock to lock and unlock the door.
- 7.4V battery for the Door Lock.
- Flyback diode is added to prevent voltage spikes.

Figure 27 shows the schematic diagram for wireless door lock circuit and its RF decoded pinout is depicted in Figure 28.

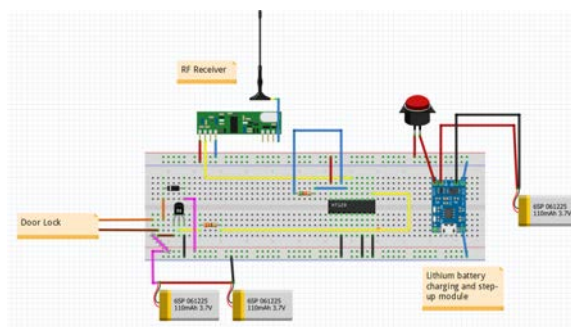


Figure 27: Schematic for Wireless Door Lock Circuit



Figure 28: HT12D Radio Frequency Decoder pinout

The schematic diagram of the camera module circuit is shown in Figure 29, and the hardware involved are as follows:

- Power supply from power bank
- LED to indicate on and off
- On/off switch

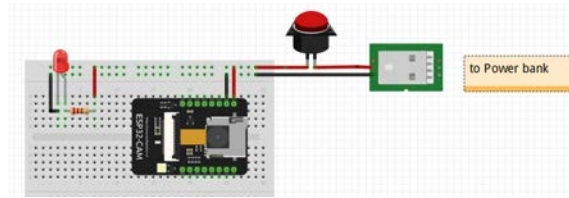


Figure 29: Schematic diagram of Camera Module Circuit

Figure 30 depicts the schematic diagram for the automated light control circuit. The process is explained as follows:

- Light is automatically turned on when a student is detected.
- Light is automatically switched off when no one is in the room.

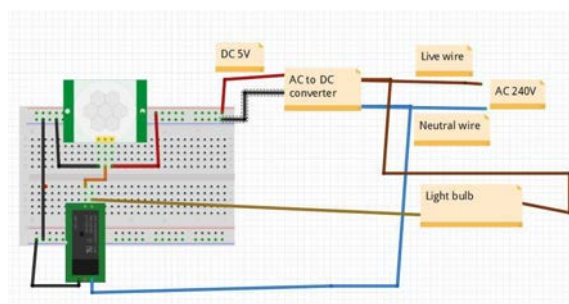


Figure 30: Schematic Diagram of the Automated Light Control Circuit

Product Realization

Mobile Apps Graphical User Interface (GUI)

The finalized look of mobile application screens for different purposes that are developed using KODULAR and other additional components are depicted in Figure 31 to Figure 34. Students need to install the mobile application from the Playstore and the login screen will appear after the installation of the applications succeed. For the login screen, some simple components and commands are used to develop the screen. Students will enter their username and password to get access to the mobile application. Figure 21 shows the login screen view in smartphone.



Figure 31: The login screen view in Smartphone.

After entering username and password, the main menu screen will appear. There are three options in the main menu screen which are "Attendance Record", "Notifications" and "Video Lecture". When the "Attendance

Record” button is clicked, the screen of “Attendance Record” will appear and the process will be the same for other options. Figure 32 shows the main menu screen and the main menu options.

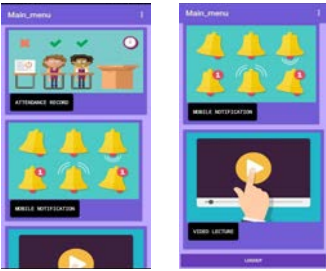


Figure 32: The main menu screen and the main menu options.

The attendance record process involved two parts. First is when the fingerprint is scanned by a fingerprint scanner. Then, students' data, for example, name, matric number, fingerprint id, time-in to class and subject appeared on the screen. This part will be automatically displayed right after the fingerprint is scanned. Figure 33 shows the recorded data in the designed mobile applications. For the second part, when the attendance record option is clicked, the Attendance Record screen will appear. The screen will show the list of present/absent days, subject and date. Figure 33 shows the list of attendance records for present/absent days.



Figure 33: The recorded data in our mobile applications.

ATTENDANCE_RECORD		
Absent		Present
SKEE 4463 ELECTRICAL MACHINE	13/12/2020	SKEE 4463 ELECTRICAL MACHINE 15/12/2020
SHAS 4412 ENGINEERING MANAGEMENT	13/12/2020	SKEE 2121 CAPSTONE PROJECT 16/12/2020
SKEE 3133 PLC & SCADA SYSTEM DESIGN	14/12/2020	SKEE 4463 ELECTRICAL MACHINE 16/12/2020
SKEE 2122 INSTRUMENTATION	20/12/2020	-
SKEE 4463 ELECTRICAL MACHINE	20/12/2020	-
SKEE 3133 PLC & SCADA SYSTEM DESIGN	22/12/2020	-

Figure 34: The list of attendance records for present/absent days with subject.

Meanwhile the screen notification can show the data call from the airtable through the spreadsheet. Appearance of the notification screen is as shown in Figure 35.



Figure 35: The Notification screen on the mobile applications

Video Lecture

This is the product realization of the video lecture which can be referred to in Figure 36. On the subject courses, the lecturer can put multiple videos. It all depends on the lecturer.

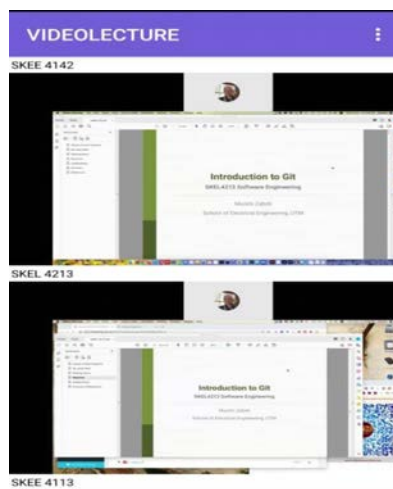


Figure 36: The list of video lecture from the apps

Hardware and Circuitry

After designing the hardware on a breadboard, the hardware was then soldered on the printed circuit board and tested as a whole system. The actual connection of fingerprint scanner and automatic sanitizer is shown in Figure 37.

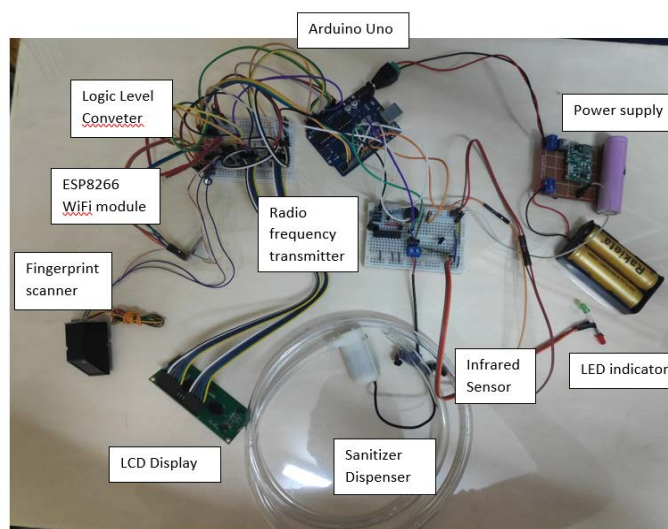


Figure 37: Actual connection of fingerprint scanner and automatic sanitizer

The items were then put into a box and hooked it on outer side of the door as shown in Figure 4.8.

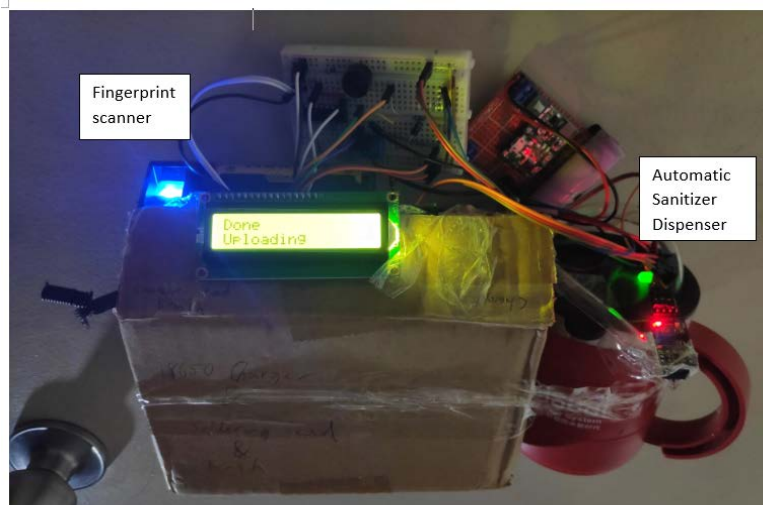


Figure 38: Items were arranged in a box and hooked on the outer side of the door.

The process for the hardware shown above is explained below:

- Once the Fingerprint Scanner detects a valid fingerprint, the LCD display will welcome the student and display his or her name.
- The ESP8266 will then upload the identity of the student to Cloud and record the attendance.
- The Radio Frequency Transmitter will then send an unlocking signal to the receiver that is connected to the Door lock to unlock the door.
- After some delay, the Radio Frequency Transmitter will send another locking signal to the receiver so that the door will be locked again.

Meanwhile, the actual circuit for an automated door lock system is shown in Figure 39. The items were then put inside a box and hooked to the inner side of the door as shown in Figure 40. The door will be unlocked when the unlocking signal is transmitted by the fingerprint scanner outside the door. For a person to exit the classroom, one can simply press the green button to unlock the door.

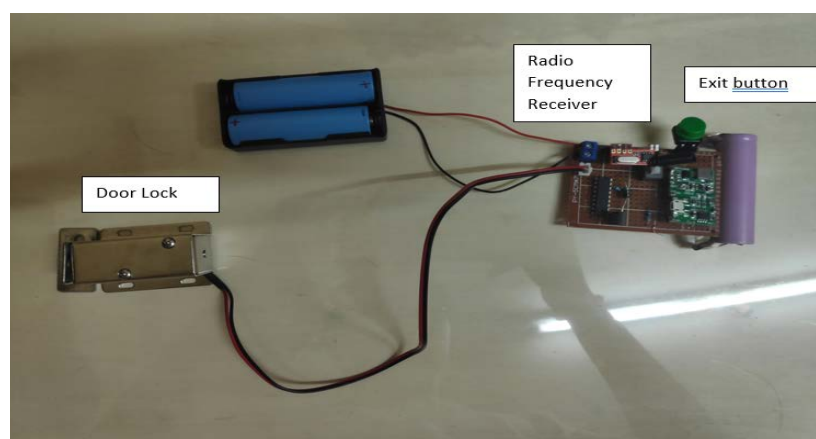


Figure 39: Actual connection of automated door lock system



Figure 40: Putting the items inside a box and stick to the inner side of the door:

Figure 41 shows an actual connection of a camera module that is used to record the lecture video. The camera will start streaming when the button is pressed. The video will then be recorded and uploaded to a mobile application so that students can study back what had been taught in the class

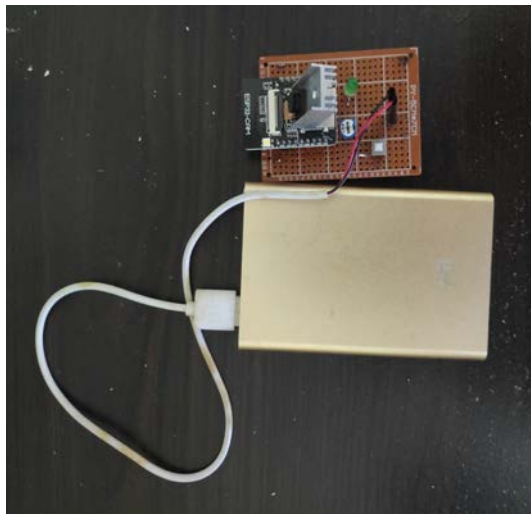


Figure 41: Actual connection of Camera Module

Figure 42 depicts the actual circuit of an automated light control system. The light will be turned on through the relay when the Peripheral Infrared Sensor (PIR sensor) senses that there are people in the room and switched off when no one is in the room. Thus, the issue of students forgetting to turn off the light can be avoided.

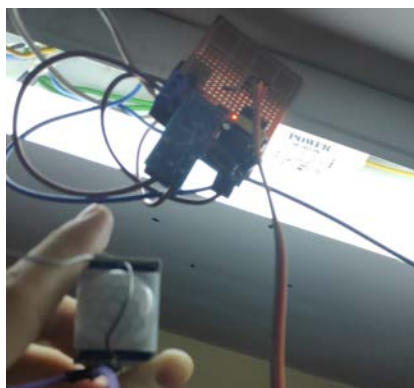


Figure 42: Actual connection of automated light control circuit

Discussion

Smart Classroom project is successfully completed within the 15 weeks period provided. Other than that, all features that were planned for mobile application and the hardware have been successfully developed within the time. Smart Classroom mobile application was built using the online and free platform, KODULAR. The idea of developing the mobile application as a platform for students is to make it more convenient to keep track of the assignment due date, record of attendance and playback video lectures to do revisions. There are selections on the main menu screen which are attendance record, notification and video lecture.

For the attendance record part, the data is fetched from the firebase by using the API key. There are several problems in order to fetch the data. It takes two weeks to troubleshoot the error and to come out with another approach to solve the problem. A lot of references were found on the YouTube platform to get some ideas to solve the problem. After several attempts, the data finally can be fetched from the database. In this part, students can easily check on their attendance record.

There are few approaches that were used for the notification on screen page. First, data is called from the entire first column only, using the `listview` variable in Kodular. Second, data is called from the airtable, using the `list view image` variable in KODULAR. If using the `list view image`, the variable requires a `url` for the picture to be displayed, so it is not suitable. Therefore, different variable is used which is the `tableview extension` instead of the `listview` variable in KODULAR. Lastly, a simple data called is stored in one column in `airtable`. The notification mobile page just shows a simple list due to the complex required step for other variables such as `tableview extension` and `list view image`.

For video lectures, the original idea is to create a live video streaming based on real time. But after testing the hardware, it has been discovered that the hardware developed based on the available hardware could not support the size when live streaming. Thus, the decision is to record the lecture instead of live streaming. In addition, the approaches for this part depend on the cloud server. The main concern is to synchronize and link the cloud with the application. After some research, the key to solve the synchronization and linking problem is getting the API key. Out of all the cloud servers that have been considered, Cloudinary is chosen as it has the ability to solve the problem and it is easy to use. Thus, the lecture video is a success as what had been planned for apart from the changes that have been made.

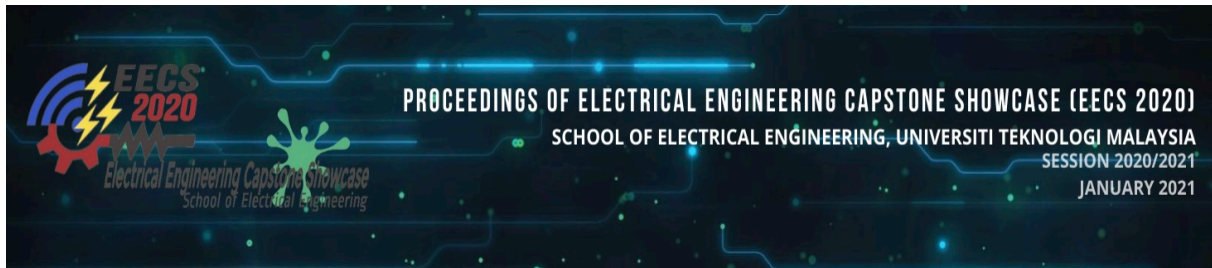
On the other hand, the hardware parts of the smart classroom were developed and tested to be working fine. When the Fingerprint Scanner detects a valid fingerprint, the ESP8266 WIFI Module will upload the attendance to the Cloud. At the same time, the radio frequency transmitter will transmit an unlocking signal to the receiver to unlock the door for the student to pass through. After some time, the transmitter will transmit another locking signal to the receiver to lock the door again. The automatic light controlling circuit can turn the light on and off depending whether there are people in the classroom. When it is turned on, the camera module will start streaming the lecture video, then, the lecture video will be recorded and uploaded to the Cloud. The hardware was then integrated with the mobile application that let the students track their attendance as well as access the lecture videos.

Conclusion

In the nutshell, we have successfully achieved the proposed objective, where this Smart Classroom project focused and prioritized on the importance of the student problems that have been discussed in the research and idea generation stage, as well as from the survey responses. First, the developed applications can make sure students will be always on track of their study planning due to the updated information on the assignment, quizzes, tests and final examination from the mobile application features. Second, students will also always be updated to the important dates. Third, the mobile application provided the live lecture video and recorded video lecture. This helps students to focus more on their study. Fourth, Smart Classroom makes the learning experience more meaningful to the students. Therefore it is anticipated that the outcome of this project will be helpful to all students, in order to keep them on track or updated. Besides, this application can help to maintain student's performance on their study based on the live lecture video features. Lastly, the main target where students can easily record their attendance on the system efficiently is achieved. In the future, this project also needs some improvements along with the technology's advances.

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ACTIVE LEARNING USING METAVERSE AND HANGMAN GAME

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Abstract: This project is proposed to improve the teaching method in the present education system. Structured interviews were conducted with the lecturers from different subject backgrounds and surveys using online google form has been distributed. As many as 52 students from different courses have answered the survey. The analysis shows that both lecturers and students strongly support the improvement in teaching method using active learning. In conclusion, a pre-lesson assessment using Metaverse and after class activities based on the Hangman Games concept has been developed. The games are implemented using Microbit for offline class and using online application for online class.

Keywords: Education; Active learning; Metaverse; Microbit; Hangman game;

1.0 Introduction

The theme of this capstone project is a smart education system. Teaching and learning are included in the process of education. Learning is a process of understanding and acquiring new skills in life. This process involves two parties which are educators and learners. Educators can be school's teachers and university's lecturers while students will be a passionate learner. Problems are identified after interviewing several lecturers which have a background in conducting active learning. Nowadays, some lecturers are still using traditional teaching methods in our education system. The students undergo a passive learning process in which they are just listening to the lecture with minimal interaction between each other and the lecturers. Students often feel bored, subsequently failing to focus on the lecture.

Active learning is a student based centered education which the process of learning is via engaging with the content (Felder, Brent, 2009). It means students are interacting with the material via 'activities' for learning or via re-framing the note-taking process to encourage thinking about the material rather than transcribing the content. The environment of active learning is mostly active and happy where there will be interaction among students and between students and educators.

Traditional learning is a lecturer based centered education. In this type of learning, mostly the educators will act as the master of the subjects and only one-way communication occurs in the learning environment (Lumpkin, Achen, & Dodd, 2015). These 'delivery mode' lectures are draining for the lecturer and demotivating for students. Lectures tend to bore students as there is no activity going so students only have to sit and listen.

As a result from both interviews and surveys conducted, an idea to attract the interest of students and lecturers in practicing active learning methods are carried out in this project. Our project is to prepare the pre-class assessment using Metaverse applications and to invent interesting games which will involve all students participating actively in class after lecture course. The games are prepared for students to play in both online and face to face class. In this project, the Hangman Games is implemented in an online application for online class. Whereas Hangman Games for face to face class is designed using Microbit.

Metaverse is a powerful augmented reality (AR) programming app for classrooms that provides teachers of all levels of expertise with sufficient professional development (Callum, & Parsons, 2019). This application allows users to create an experience such as simple games or education content in a few minutes. Meanwhile, Hangman Games is a game in which one player has to guess the answer. Each time the students guess the wrong answer, part of a person being hanged is drawn starting from the head until the legs. Also, students will lose the game if the picture of the person drawn is completed.

In general, the pre-lesson module using Metaverse will consist of videos and simple quizzes. The main objective in building this module is to give an initial idea towards students on what they will learn in class before the lecture begins. As for the after class activities, the quiz or question given will be more complex compared to the quiz in

Metaverse. The quizzes and questions given can be in multiple choice or in-text questions for pre-class and online games using online application while for offline games using Microbit, only multiple choice questions are supported. As an addition, a module for each product has been prepared as a guide for users to apply the active learning method.

2.0 Objectives

There are few objectives that should be accomplished in completing this project:

- To encourage lecturers to start teaching using active learning methods.
- To improve traditional assessment in lecture.
- To implement pre-class assessment activity by using Metaverse.
- To develop after class activity based on the Hangman concept.

3.0 Data Collection and Analysis

3.1 Data Collection

In order to get the idea in implementing the project, a few sources of data were collected. For the purpose of collecting data, two approaches have been made. The first approach is by interviewing the lecturers that have a background in conducting active learning. The other approach is by conducting a survey through Google Form for the students. The outcomes of these two approaches gave a great impact on implementation of the product.

There are several lecturers who have been interviewed in collecting the data for this project. Most of them are involved in Future Ready Educator (FREE). Basically, FREE is a campaign that encourages lecturers to conduct active learning, cooperative learning, project-based learning and problem-based learning. It is very helpful to interview these kinds of lecturers since they have a lot of knowledge on implementing active learning. Besides, there are some students who have been interviewed to get their feedback on preferred methods either active or passive learning. Other than that, the feedback on their current learning method is also taken into consideration.

Due to the Movement Control Order (MCO), a face to face interview cannot be conducted. To overcome this problem, an online interview by using Google Meet has been performed to contact the interviewee. Apart from that, a Google Form has been made and distributed among the students. From these data, the detailed explanation of data clustering is provided in section 2.3.

3.2 Data Analysis

There are few interviews have been made to get some ideas on learning methods. There are 3 students and 3 lecturers who have been interviewed before this project is implemented. From the interview session with the lecturer, they stated some points regarding active learning, interactive communication, and also their teaching method. From their perspective, active learning is where an activity such as a quiz is conducted during or after the class lesson while interactive communication is any tool that is being used to make the lectures more interesting for example, Kahoot and Socrative. Implementation of active learning can help students as the student will have more understanding of each topic while interactive communication can help lecturers to attract more students to hear the lecture. The lecturers who have been interviewed are involved with Future Ready Educator (FREE). This platform trains lecturer to use the recent teaching method, motivates the lecturer to use an active learning method while showing the effectiveness of it, and also supports and makes students involved in the class session.

On the other hand, the lecturers state their opinion on offline and online lectures. For offline lectures, an activity can be made as an interlude to build engagement in class. From the lecturer's perspective, online lectures are quite challenging as they are unsure if the student understands the lectures well. One way to avoid this is the use of Jamboard and Padlet to get feedback from the student. Besides that, E-learning is a ready-built platform used by students and lecturers in Universiti Teknologi Malaysia (UTM). It is an easy platform to use because all students have an e-learning account. In the lecturer's view, they can make the use of E-learning more attractive by using existing resources, organize classes/learning methods so that the contents are more structured and have various elements. By organizing the content inside E-learning, students can develop their knowledge and be more attracted to enter the lecture.

There are some methods used by the lecturer to conduct the class lesson. One way is using interactive video. By doing this way, it can give motivation to students and they will not get bored easily. Other than that, the usage of easy-to-access platforms such as Padlet and E-learning. It is also suggested to use a low bandwidth platform such as Whatsapp as it can cater everyone's needs like slow internet connection.

From the student's perspective, they cannot participate well in class and have less understanding of each subject. They said that the content of a few subjects is boring and they cannot understand well. The class activity such

as quizzes is not implemented by the lecturer thus, leading them to lack of understanding. In their opinion, they need a platform to approach active learning and can involve all the students in the class.

3.3 Data Clustering

The surveys are conducted among the students to obtain the students' favourite learning method, students' behaviour in class and lecturers' teaching method in class. The data are analysed and discussed for the development of the project.

Students' favourite learning method

From the students' response analysis shown in Figure 1.0, it is observed that the majority students prefer an active learning teaching method compared to the conventional method. And 65.4% among the respondents like to have mini games during lecture. Other than that, students also agree that active learning allows students to apply and transfer knowledge better. Next, they are more likely to study in a class with a relaxed atmosphere than the class with a serious atmosphere. Besides, the students also prefer to have some in-class activities such as mini games.

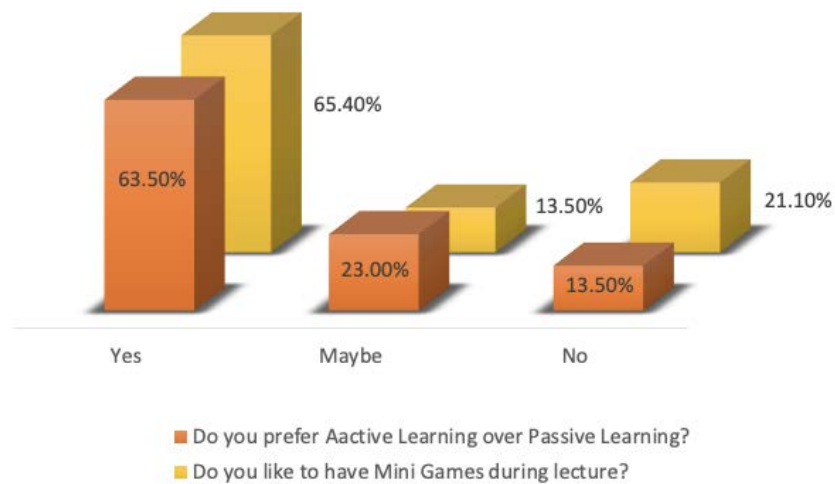


Figure 1.0: Students Response Analysis

Students' behaviour

From the students' responses. It is found that there are 50% passive learners and 50% active learners in class. Two additional feedback obtained from the responses are shown in Figure 2.0. Out of 52 responses, 50% of the responders sometimes participate actively in class. Next, most of the responders cannot always pay their full attention to the lecture.

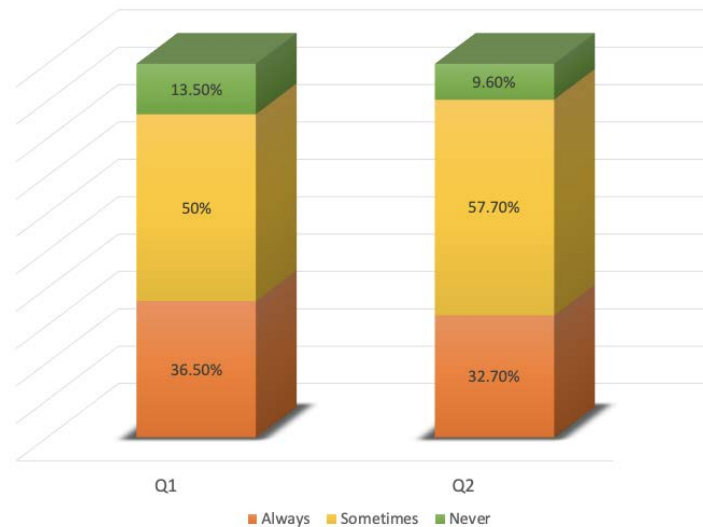


Figure 2.0: The bar chart responses for students' behaviour in class. Q1: Do you participate actively in class?, and Q2: Are you able to pay your attention fully to the lecture?

Lecturers' teaching technique

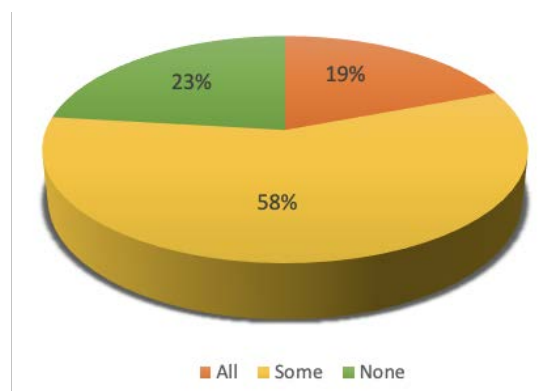


Figure 3.0: The lecturers' teaching technique in class

From the students' response analysis shown in Figure 3.0, Out of 52 responses, 58% of the responders say some of their lecturers apply active learning in class. Besides, we can observe that 23% of the responders say none of their lecturers apply active learning in class. This result shows that there are students who never experience active learning in their classes. Next, only 19% of the responders say that all of their lecturers apply active learning in classes. From the result, we can conclude that not all the lecturers and students are familiar with active learning.

4.0 Design statement

From the survey among the students, it shows that only some of the lecturers apply active learning in classes and there are some lecturers who never apply active learning in class. They are just using the traditional teaching method where they are just explaining the lecture slides and there is no interaction between lecturers and students. The students will lose their focus on the lecture as they may feel bored or tired in attending the long hour lectures. Hence, we come out with some design statements for our project.

First design statement is how to encourage lecturers to implement active learning in classes. Some lecturers who did not implement the active learning in class may be due to they are not familiar with the active learning. They have no idea about what is active learning and how to apply the active learning in class. Hence, in this project, we prepared the module of active learning with Metaverse and hangman games which can be used as the examples to show that what active learning is to the lecturers who are not familiar with it. We design the pre-lesson activities with Metaverse and some in-class mini games with Thinkable and Microbit. From this project, lecturers will obtain the ideas about the active learning and they can implement active learning by themselves by referring to the guidelines that we prepared for them.

Second design statement is how to involve students in active learning. From the survey among students, it shows that 23.1% of the responders say none of their lecturers apply active learning in class. These students have no idea about active learning and don't know the advantages of active learning. Hence, we have to introduce active learning to them by showing them about the products of the project to let them become familiar with the active learning. Besides, many students like to play games or watch drama instead of studying. In studies, they have to understand the theory, memorize the formula or equations, do the exercises and so on which don't have fun for the students. In this project, we combine the games and the studies in which the students can study while playing some games through Metaverse and hangman games.

Third design statement is how to save lecturers' time to prepare for active learning in classes. Some lecturers want to implement active learning in classes but they do not have time to prepare for it. As we know, many lecturers are busy with their stuff such as meetings, research, projects, events and so on. Hence, they do not have much time to prepare for the active learning as they have to spend some time thinking about what can be used for the active learning in classes. Besides, they also have to spend some time designing and debugging the products for the materials of active learning which will be used in classes. In this project, we prepared an active learning project template for the lecturers which they can just use directly and change some parameters in it. Next, we also prepared the modules for the lecturers which they can use as the guidelines to prepare for the active learning. With the modules, lecturers do not need to spend a lot of time learning to use the software or hardware by themselves.

Fourth design statement is how to involve all the students to participate actively in classes. During the lecture, some students are sleepy, playing handphones or talking with their friends instead of focusing on the lecture. It is because they feel bored as there is no interaction between lecturers and students. The students are just sitting on the chair and listening to the lecture. When the lecture is too long, the students lose their focus and they will start to play handphones to let them stay awake during the lecture. In this project, we design some pre-lesson activities and in-class mini classes which can involve all the students to participate actively in lecture. It is because the students can study while playing some games and they will not easily lose their focus on the lecture.

5.0 Methodology

5.1 Project Flowchart

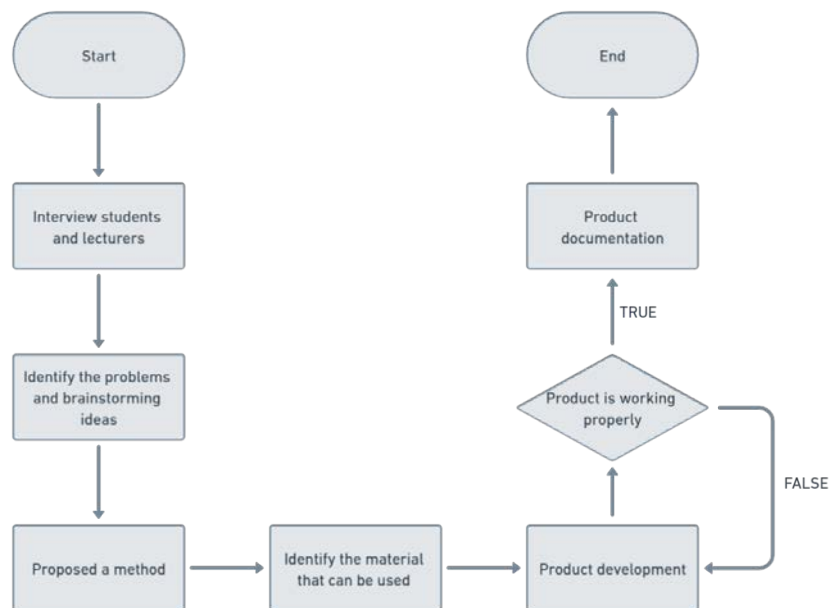


Figure 4.0: Complete flow of the project.

The overall flow of this project is shown in Figure 4.0. The first part of the project, interview session with the lecturer and student is carried out. The purpose of this interview is to identify the common problem that has been faced by lecturers and students during the lecture. A few issues have been identified from this interview, such as a boring class environment, lack of understanding on each topic, and lack of time to prepare material for active learning. The details of the data collection, analysis and clustering have been explained in Section 2.0.

From these problems, the brainstorming session is held to overcome these issues. There are several ideas that have been discussed such as developing a new website with the same concept as Facebook but in terms of education, smart facility in the classroom, automatic whiteboard cleaner and module for active learning.

After several discussions with the supervisor, the project of implementing a module for active learning has been chosen because it can give a lot of benefits to students and lecturers. The benefits are improving educator's

teaching skills, creating two-way communication during the learning process and allowing students to practice essential skills, such as collaboration, through pair and group work.

Several mediums and platforms have been surveyed in order to choose the best and effective way to conduct active learning. From the survey, the Metaverse platform has been selected as a medium to conduct the pre-class activity. Metaverse has been picked because it has some exciting features such as powerful augmented reality (AR). This app allows users to create an experience such as simple games or education content in a few minutes. Besides, the Hangman concept is chosen to be applied for the after-class activity because it can be used to trigger competitiveness among students. Therefore this will help students to solve the problem given fast and correct. Due to the outbreak of pandemic Covid-19 globally, the lecture can conduct Hangman game by using an online platform. So, to cater to this issue, two types of material which is a Hangman game by using Thinkable apps and also Microbit has been proposed.

For product development, scenes in Metaverse are constructed to perform several pre-class activities. Besides, coding for offline Hangman games has been developed in Microsoft Makecode, and its performance has been tested on mobile phones. Finally, for the online Hangman game, the coding has been programmed in Thinkable.

Several conditions have been considered for testing the performance of the product. Each of the products has been tested on both android and IOS systems. Besides, the performance of the product also has been tested when operating with several mobile devices.

The documentation has been prepared for each product. This document consists of the user's manual and the details on how to develop the project.

5.2 Product Flowchart

Based on the interview analysis, a project named Active Learning using Metaverse and Hangman Game has been introduced. The project consists of three parts which are Metaverse and Hangman games for online and offline. The flow of implementing active learning is shown in Figure 5.0.

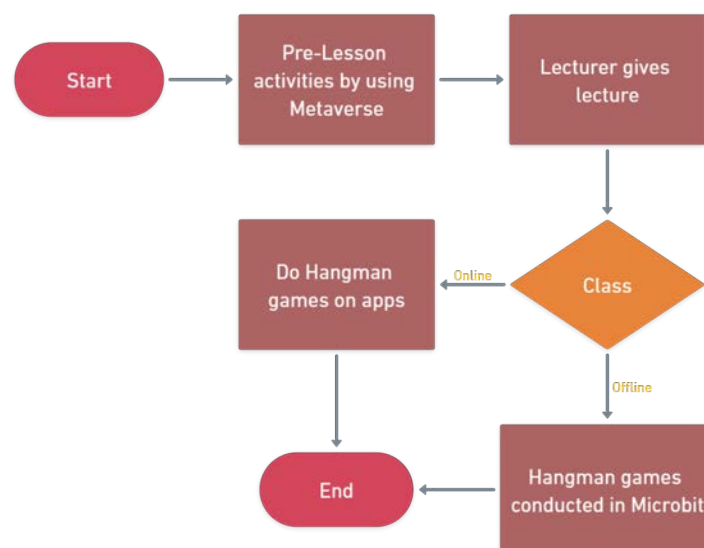


Figure 5.0: Flowchart for the implementation of active learning.

Based on Figure 5.0, students will undergo their pre-lesson activities on Metaverse. This activity will be conducted before starting the lecture. In this step, they can watch some videos and also have to answer some simple questions. Then, the lesson will be conducted by the lecturer as usual. At the end of the class, the quiz game will be conducted based on the Hangman concept. For an online class, the game will be carried out through the developed application named Quizje while for offline class, Microbit will be applied in conducting games.

6.0 Product development

6.1 Metaverse

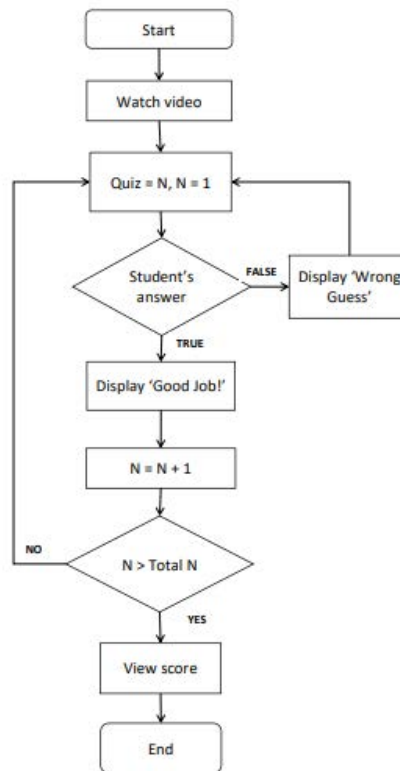
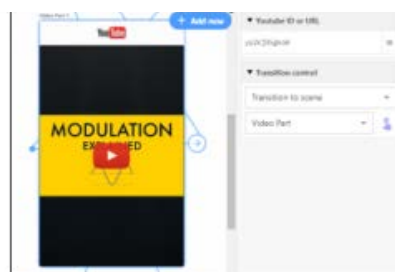


Figure 6.0: The flow chart of pre-lesson activity.

Figure 6.0 shows the overall flow in preparing pre-lesson activity in Metaverse. Metaverse is an augmented reality application that can be downloaded for free in all operating systems existing in smartphones. One of the main reasons Metaverse has been chosen as the pre-lesson activities is because the provided features are interesting and able to entertain students while learning by making the students move around with their smartphone to find the words, stickers and images using the augmented reality technology.

An account of Metaverse must be made in order to initiate any experience either creating a new experience or clone the experience. Experience refers to the site that is used to organize all the process flow of a user's project. In this project, the main objective is to give an initial idea to students on what they will learn about, a short introduction video and a simple quiz to test their understanding is enough. For the videos, it can be taken from Youtube by inserting the code at the end of the URL websites as shown in Figure 7.0. The amount of videos that can be inserted in the experience is unlimited as well as the duration of the video. However, it is advisable to upload a video with a short amount of duration as the summaries of the topic.



- i. Go to Youtube page and find your video lesson.
- ii. Copy the highlighted part of the link only (Youtube ID = yp2kjdSgko0)
Example: <https://www.youtube.com/watch?v=yp2kjdSgko0>
- iii. Paste the Youtube ID into the space provided in Metaverse.
- iv. A preview of the video will be shown.

Figure 7.0: An example to insert Youtube ID in Metaverse.

There are many online references especially on Youtube that can be used to do an interactive quiz such as a trivia quiz, multiple choice question and in-text quiz. Users can search any experience made by another person and clone it. Then, users can start editing according to their desired style. In order to save lecturer's time to build a game that can test their students' understanding, the most suitable choice is the quiz with multiple choice and in-text questions. Lecturers can insert as many questions as they want since the question given can be answered in one click or type in short phrases.

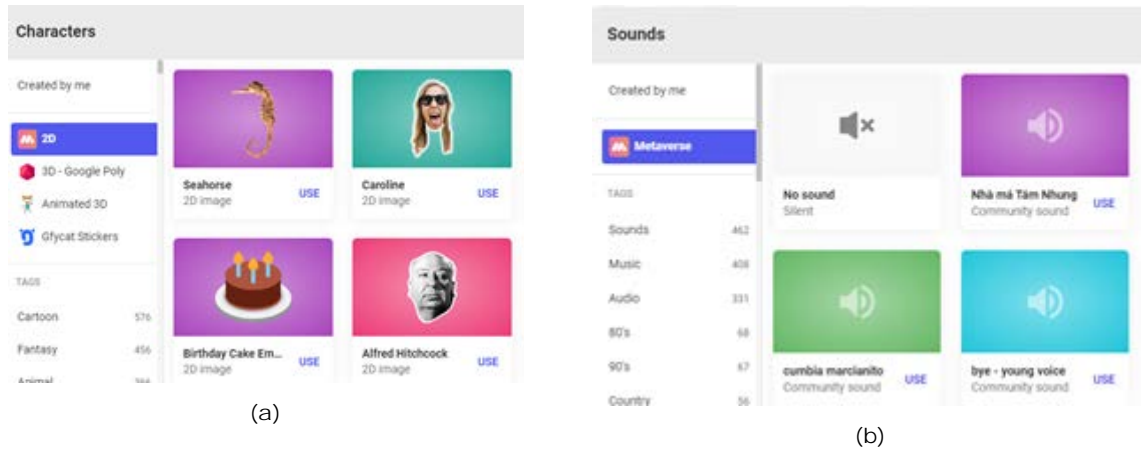


Figure 8.0: Features provided by Metaverse (a)characters and (b)sounds.

Despite having videos and quizzes, Metaverse also provided a website for users to create leaderboards which will display the player's score at the end of the quiz. Referring to Figure 8.0, Metaverse provides background sounds, animated 3D and stickers characters of different kinds of background style. All of the features can be used for free after users signed up and logged in.



Figure 9.0: An example of character scene

To start making interactive quizzes, users need to add a character scene first as shown in Figure 9.0. A character scene allows users to add text, character, response and sound in that scene. The first example is multiple choice quizzes. These quizzes allow users to give as many choices as he or she wants for students to choose. Usually, only three or four choices of answer are provided. According to Figure 10.0, users can add the number of choices by adding the response button. They can insert the question in the space provided at the upper side of the screen.

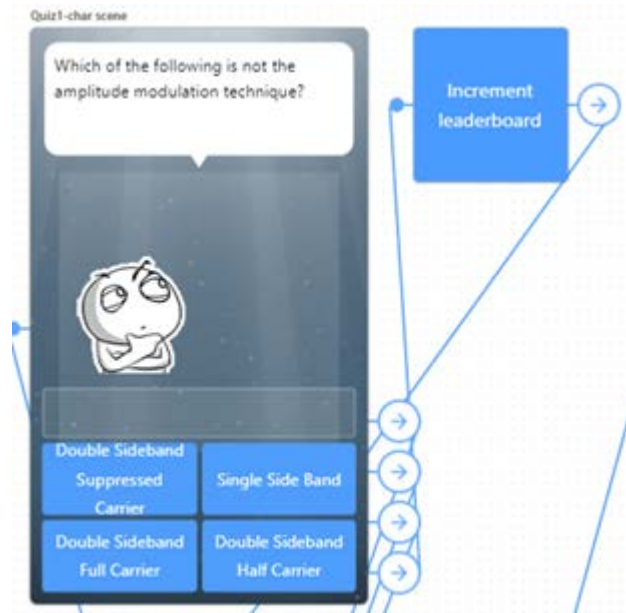


Figure 10.0: The example of multiple choice quiz.

In Figure 11.0 (a) shows the example for in-text quizzes. These kinds of quizzes need students to answer in text or phrase form. The user, which means the teacher or lecturers need to insert the keyword for the answer in the space given known as check text response block based on Figure 11.0 (b). As long as the students manage to get the right keyword, it can be considered as the correct answer. The keyword can be set to be in case sensitive or not. For case sensitivity, the application will analyze the answer as well as the type of letter whether it is small or capital letter. The answer also can be in numerical form. This form of answers are suitable for mathematical and calculation questions.

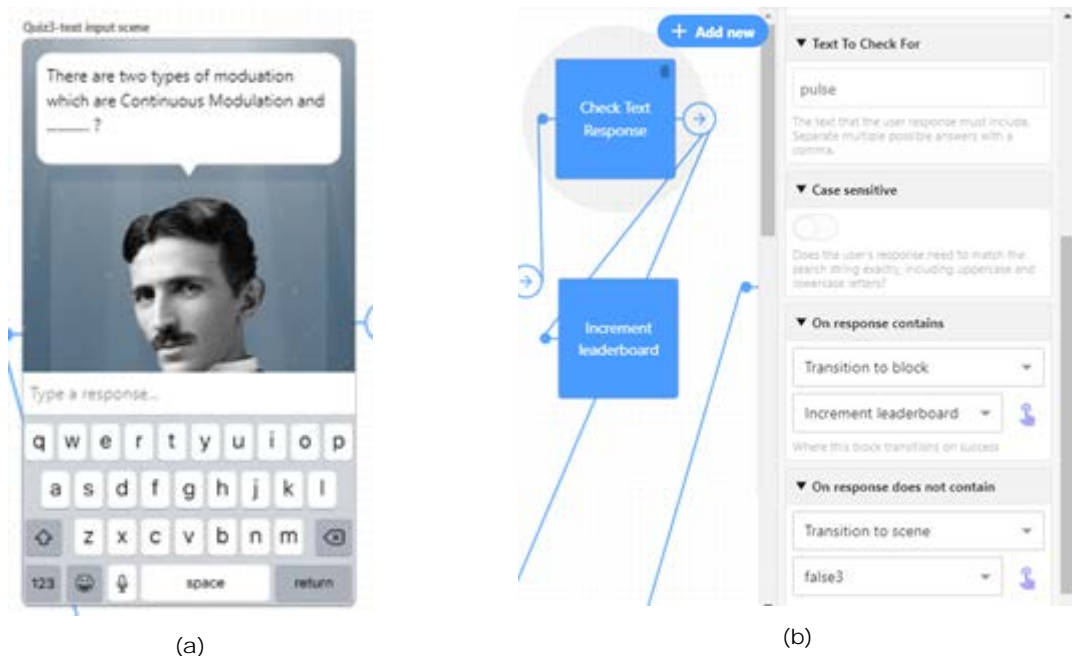



Figure 11.0: (a)Example of in-text quiz (b)Check text response block

The most interesting part for students is the leaderboard score. This can increase the self-esteem in students as well as providing a healthy competition among them. Fortunately, the leaderboard score has been provided by Metaverse. Users can make their own leaderboard score from the leaderboard website based on Figure 12.0 using the link given in the module. All the scores will be kept there and lecturers can monitor which students need to be given more attention. By viewing the leaderboard, lecturers can trace whether the students understand the introduction or summary of the topic or not.



Create new leaderboard

[How to use leaderboards](#)

Leaderboard name

URL of a logo image

Description of the leaderboard

Figure 12.0: The website to create a leaderboard score

6.2 Online Hangman Games

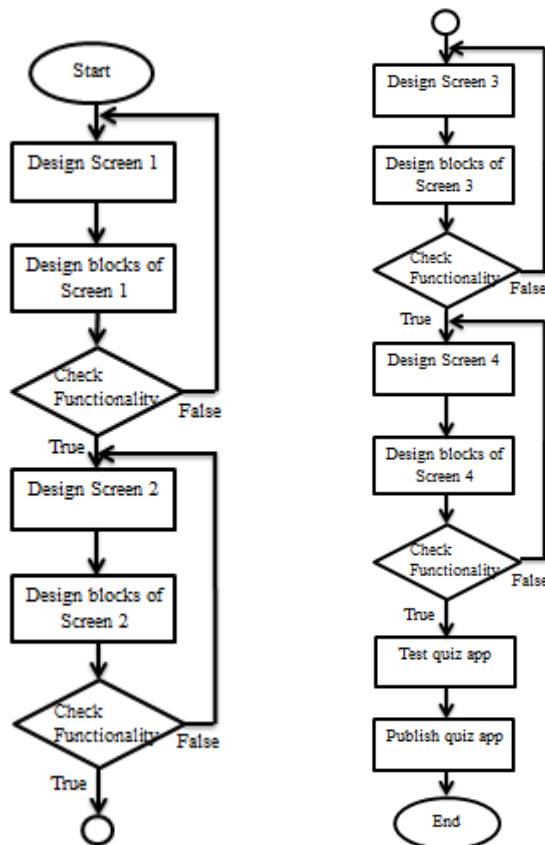


Figure 13.0: The flowchart on developing the online hangman game on Thinkable

By referring to Figure 13.0, the quiz app consists of 4 screens, which are Screen 1, Screen 2, Screen 3 and Screen 4. Every screen has different functionality on quiz app. Besides, the processes in designing the quiz app are divided into design of screen and design of block. Screen is the component to show the pictures and information to the users while the blocks are used to set the operation of the screen.

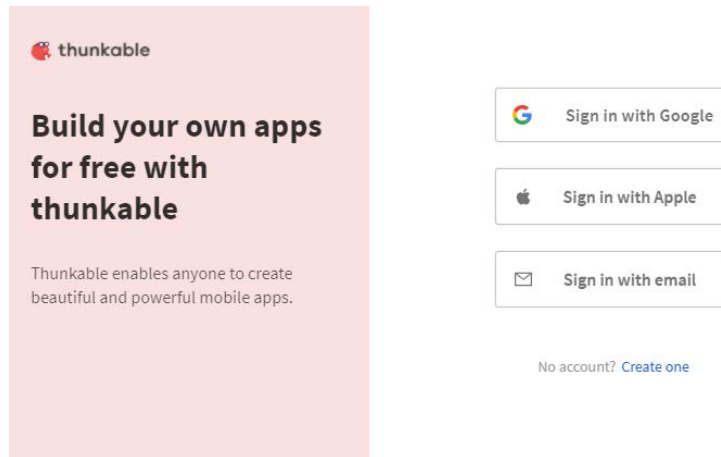


Figure 14.0 : Registration of Account on Thinkable

By referring to Figure 14.0, the users are required to create an account on Thinkable in order to design the quiz app. They can choose to use google account, personal email or Apple ID to register for the account on Thinkable.

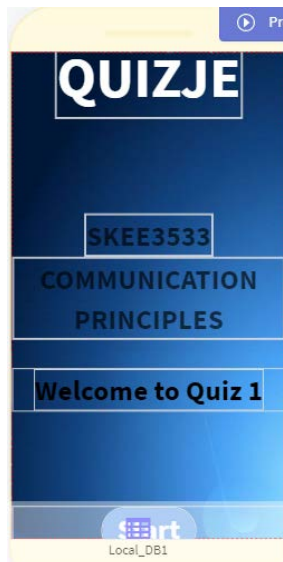


Figure 15.0 : Designed Screen on Screen 1

For Screen 1, the start screen which is the main page of the quiz app is designed as shown in Figure 15.0. In the start screen, the names of the quiz app and course are displayed to inform the students of what course they are taking the quiz. Next, the background image is set to the image that relates to the course. After that, the button is designed to navigate to the next screen after the students click on it. The size of fonts and buttons are adjusted so the students can look clearly on them. After finishing designing the components on Screen 1, the blocks are designed for Screen 1. The function is created so the screen will navigate to Screen 2 when the students click on the button. Furthermore, the functionality of the design is tested.



Figure 16.0 : Designed Screen on Screen 2

The main function of Screen 2 is to show the questions to the students as shown in Figure 16.0. "Local DB" is used to display the questions, multiple choices of answers and type of the answer. In "Local DB", lecturers should type "option" in column "AnswerType" to display multiple choices questions while "text" for displaying the in-text questions. Next, lecturers should type the name of the picture in column "Question" to display the questions in the form of pictures. Lecturers have to upload the pictures before typing the name of the pictures in Local DB. There are four choices for students to select the correct answer. Besides, for in-text questions, the detection for the correct answer is sensitive to the space, small letter and capital letter. Hence, lecturers should be careful in typing the correct answer. After finishing designing the screen, the blocks are designed for Screen 2 to set the operation. A function is created to show a smiley face if the students answer the questions correctly and pictures of hangman will appear if the students answer them wrongly. Moreover, the students will proceed to Screen 4 if they manage to answer all the questions or they will proceed to Screen 3 if they use up all the chances in answering the questions. Furthermore, the functionality of the design is checked.



Figure 17.0 : Designed Screen on Screen 3

In addition, Screen 3 is designed to inform the students that they have used up all the chances to continue to answer the questions as shown in Figure 17.0. In this project, the quiz app is designed to give the students five chances to answer the questions wrongly. The pictures of the hangman will appear gradually if the students continue to answer the questions wrongly. If the complete picture of hangman is formed, the students will proceed to Screen 3

and they will be informed that they have used up all the chances in answering the questions. After that, the blocks for Screen 3 are designed. Furthermore, the functionality of the design is tested.



Figure 18.0 : Designed Screen on Screen 4

Screen 4 is designed as the end screen of the quiz app as shown in Figure 18.0. The students will be informed that they have completed the quiz and the final scores will be displayed on the end screen. The students can choose to redo the quiz by clicking on the “Redo” button. Next, the blocks for Screen 4 are designed to set the operation on Screen 4. Furthermore, the functionality of the design is tested. Moreover, the overall functionality of the quiz app to observe the flow and the operation of the quiz app. Finally, quiz app is published and the generated link is passed to the users.

6.3 Offline Hangman Games

BBC Microbit has been chosen to be part of the offline Hangman game. The BBC Microbit is a pocket-sized device where the software and hardware work together. It has LED display, buttons, sensors and many input/output features that can be easily programmed and interacted. The reason why Microbit is chosen is that it has 25 LED displays, and it is enough to display the desired shape. Basically, the function of Microbit in this game is to navigate the answer by the student. If the student's answer is correct; thus, a smile emoticon will be formed on the Microbit, while the Hangman concept is applied for incorrect answers. Figure 19.0 shows the BBC Microbit used in this project.

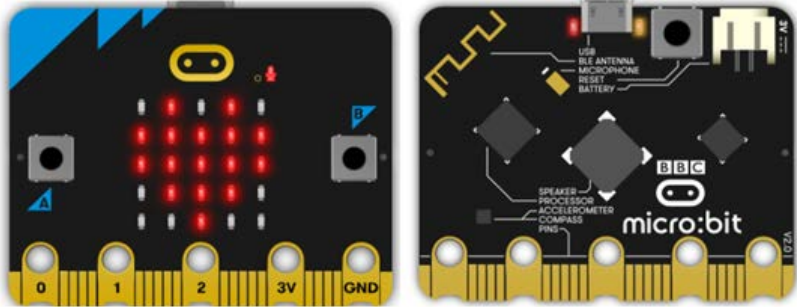


Figure 19.0: BBC Microbit

The Microbit will work based on the coding that has been made. For this project, the coding is developed based on the Hangman quiz game. The figure shows the flowchart of coding for the Microbit. The code is built on software called Microsoft Makecode. Figure 20.0 shows the flowchart of the quiz.

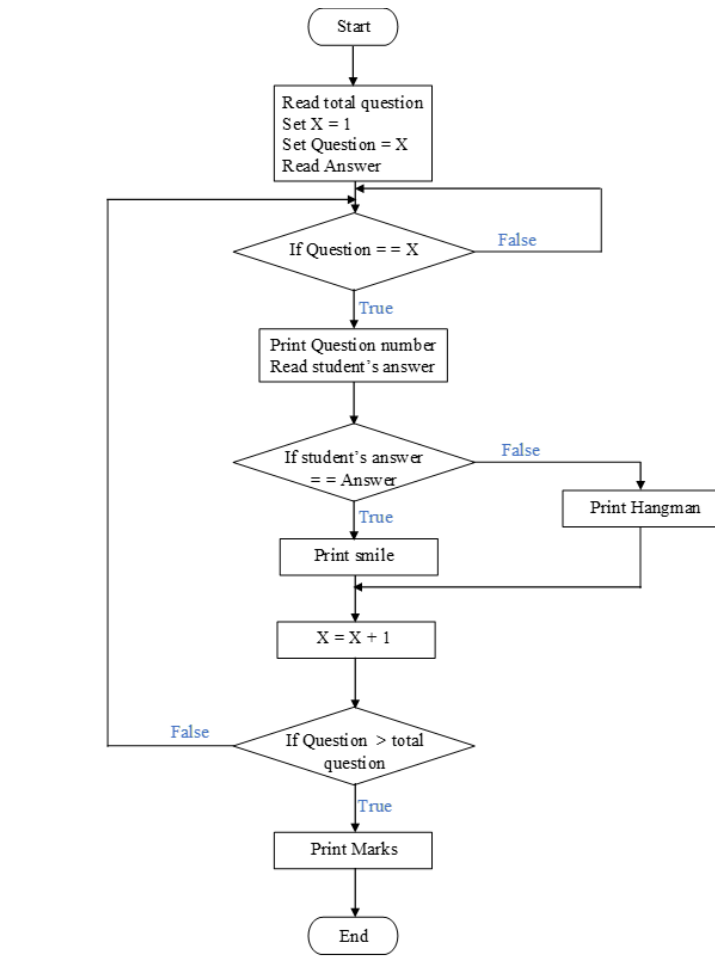


Figure 20.0: Flowchart of the quiz code

First of all, create a new project and name it. Remove the forever block because it is not used in this project. "On start" block is used for running the code when the program starts. Next step is adding the extension device so the gamepad button on Microbit apps can be used. After that, set the number of total questions. The entire question is set to 6 because Hangman got six body parts to represent their lives.

Next step is setting the answer for every question. The code for setting the answer is shown in Figure 21.0. The answer to each question can be changed by using drag and drop. To do this, the call right answer can be dragged from the function block and dropped inside the "If" statement for the respective question. For the wrong answer, the same method is applied.

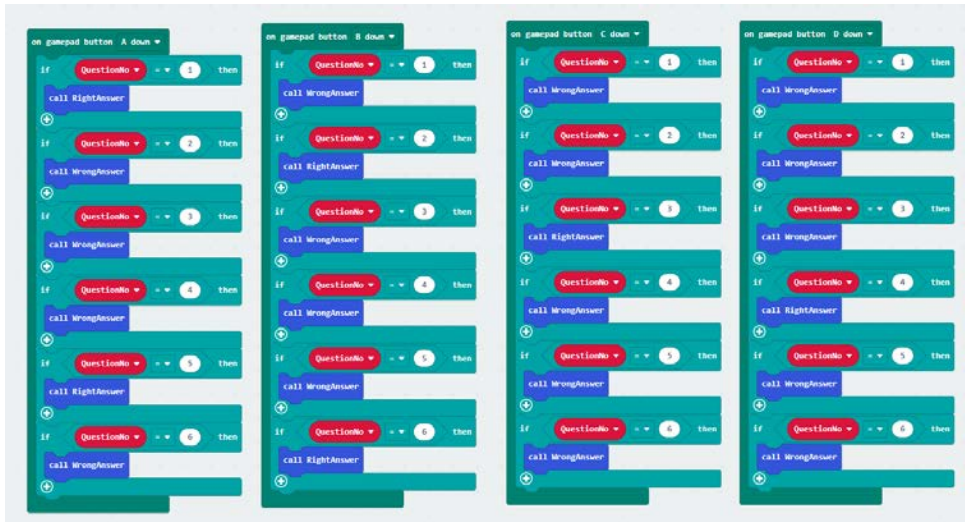


Figure 21.0: Coding for setting the answer (A, B, C, D)

Next step in developing the product is preparing the code for displaying a text for the question number on Microbit. A string will show the question number to help users to know the question they are answering. For example, a string of "Question 1" will be displayed when the user answers the first question. Then, a timer is made to give the user a few seconds to think of each question's answer. In this code, the timer is set to 10 seconds. This timer function is applied to every problem. Figure 21.0 shows the example of coding for setting the answer.

There are several steps in designing the display of the Microbit. Figure 22.0 shows the LED display when the answer from the user is right while Figure 23.0 depicts what to be displayed when the solution from the user is wrong.

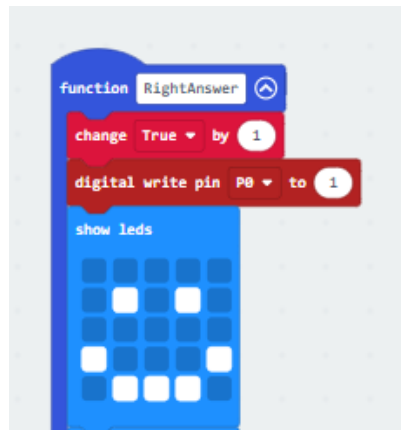


Figure 22.0: LED display for right answer

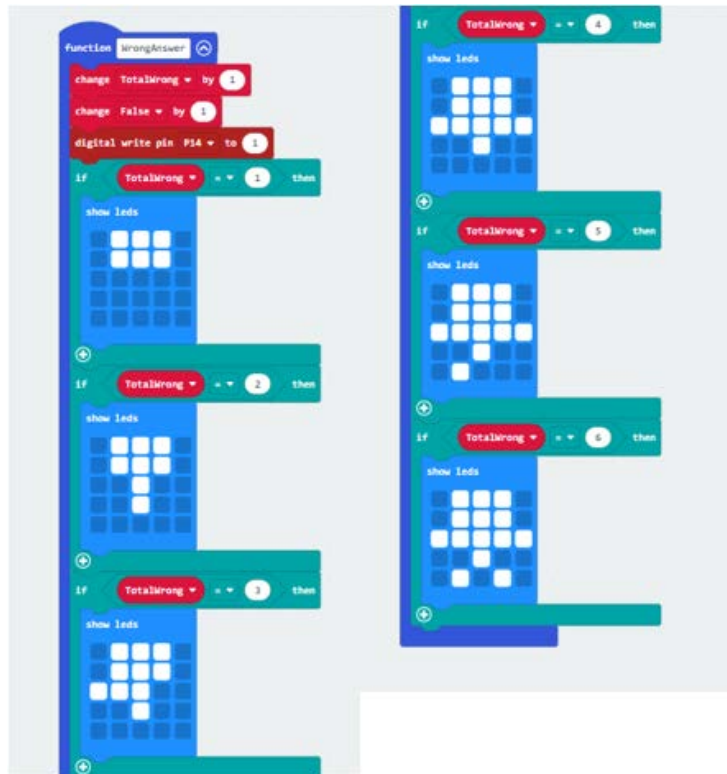


Figure 23.0: LED display for the wrong answer

The Hangman concept is applied for the incorrect answer. For example, if a user's answer is wrong for the first time, the LED will display the Hangman's head. If a user's answer is incorrect for the second time, the body for the Hangman will be formed. This process is continuous when the user does not manage to answer the question correctly. The last step of the codes is to show the marks for the user. The mark of the user is calculated based on the total number of right answers.

After all the coding has been developed, the code needs to be downloaded into the Microbit. The function of the gamepad in the Microbit mobile application is used to control the Microbit. The gamepad's function has simplicity and is able to coordinate Microbit smoothly, and it is suitable for multiple choice quizzes since it is equipped with A, B, C, D buttons. The function of each button explained in Figure 24.0.

- Button A pressed = Indicate the answer is A
- Button B pressed = Indicate the answer is B
- Button C pressed = Indicate the answer is C
- Button D pressed = Indicate the answer is D
- Button 3 = Give coordination to Microbit to move to next question
- Button 4 = Give coordination to Microbit to display the mark that has been obtained

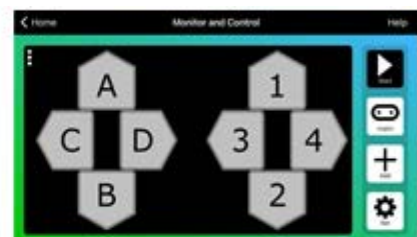


Figure 24.0: Function for gamepad button

7.0 Discussion on developed product


7.1 Metaverse



Figure 25.0: The overview of pre-lesson activity using Metaverse.

Metaverse is suitable to be used for lecturers and students at all ages. This is because the graphic of interface in Metaverse can easily be seen and understood. This application will be a good help to encourage lecturers to start teaching using active learning methods. Also, students can increase their interest in learning if they know how interesting the topic that they will learn by watching short videos and answering simple quizzes using Metaverse.

Lecturers can save time by editing the existing experience in Metaverse instead of creating a new one from scratch. A complete module is prepared to guide the users in making their own pre-lesson activities using Metaverse. The module consists of the tutorial from signing up, adding videos, creating multiple choice and in-text quizzes and displaying the leaderboard scores for players. The part of the module is being shown in Figure 26.0.



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GUIDELINE FOR PRE - LESSON USING METAVERSE

Prepared by:
Farah Syakira binti Kamaruddin


User's Guideline

This guideline is created to ease users to make their own Pre-Lesson Module by editing the experience that have already been made using the Metaverse.

PART 1: METAVERSE ACCOUNT

Creating account

1. First, users need to create an account by signing up at Metaverse main page using this link: <https://studio.gometa.io/landing>



The main page of Metaverse's website.

Pre-Lesson Module

1. To use the the pre-lesson module, users can search 'PRE_LESSON' using the search button.
2. Click the experience and clone it.
3. By doing so, users can edit the experience to make any changes.




Figure 26.0: The module guideline for pre-lesson using Metaverse

The concept of pre-lesson activity is to do the activity before students start to learn the related topic. Therefore, this activity can be done at home or before lectures start to teach the topic. Students can increase their interest in learning as well as create a healthy environment for online or face to face learning. Last but not least, for students to access the activity, they only need the QR code published by the lecturers.

7.2 Online Hangman Games

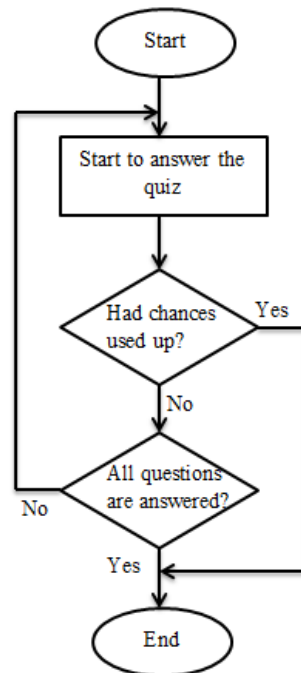


Figure 27.0: The operation of online hangman games.

By referring to Figure 27.0, when the students start to answer the quiz, it will check whether the students have used up all the chances to continue to answer the questions. If the chances are used up, it will navigate to the end screen. If the chances are not used up, it will check whether the students have answered all the questions. If the condition is false, it will proceed to the next question while it will proceed to the end screen if the condition is true.

There are some features of online hangman games that are useful to the users. First feature is the quiz app is easy to develop. It is because the blocks can be used to design the quiz app instead of the codings in Thinkable. Some lecturers may don't have the basis for the certain programming languages to design the quiz app. In Thinkable, the blocks have the same functions with the codings. Second feature is that the students don't need to download any applications. The lecturers can publish the quiz app after finishing designing it to generate the link. The students can enter the quiz app by using the link generated.

Third feature is that the answers are displayed on a quiz app. When the students answer the questions correctly, the smile face will appear on the quiz app and they will score one mark. When the students answer the questions wrongly, pictures of the hangman will appear. If the students continue to answer the questions wrongly, the pictures of hangman will appear gradually and the students will lose the chances to answer the questions if the complete picture of hangman is formed.

Fourth feature is that the lecturers can edit the questions and answers easily. All the questions and answers are inserted in a table called Local DB. To edit the questions and answers, lecturers can edit them directly in Local DB without changing any blocks or features. Fifth feature is the quiz app multiple choice and in-text questions. Lecturers can choose to let the students answer the questions with multiple choices or in-text questions. This can be done by typing "option" for multiple choice questions or "text" for in-text questions in column "AnswerType" in Local DB. The detection of answers is sensitive to the space, small letter and capital letter. Hence, the lecturers should inform students if there is space between the value and the units.



GUIDELINE FOR CREATING QUIZ APP USING THUNKABLE

Prepared by :
Ling Chung Yee

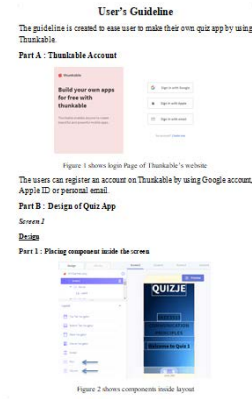


Figure 28.0: The module for online hangman games.

The module of online hangman games has been prepared for the lecturer. With this module, lecturers do not need to spend a lot of time learning and exploring things about Thinkable. Inside the module, all the steps are explained and discussed to develop the online hangman games. Lecturers can learn about the function of the blocks used and the ways to design the screen of the quiz app.

7.3 Offline Hangman Games

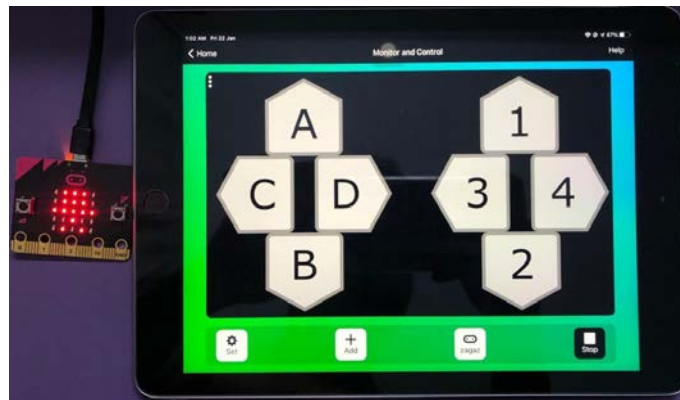


Figure 29.0: Final product of offline Hangman

Microbit is suitable to be used for students either in primary, secondary and the university level. The display of Microbit is interesting and able to attract users. This product will motivate the lecturer in conducting active learning in their lecture. Through active learning methods, the knowledge and skills for innovative and complex problem solving within multicultural and multidisciplinary environments can be acquired. Since the Microbit can be programmed only using a mobile phone, it helps the users prepare the code while saving their time. Besides this product also helps the student increase their level of understanding of the topic learned.

The module of this product has been prepared for the users. With this module, the users do not have to deeply explore Microbit since it provides the complete guidelines to develop the product. In this module, each step to establish the coding is explained in detail. The users are able to modify coding based on their needs.

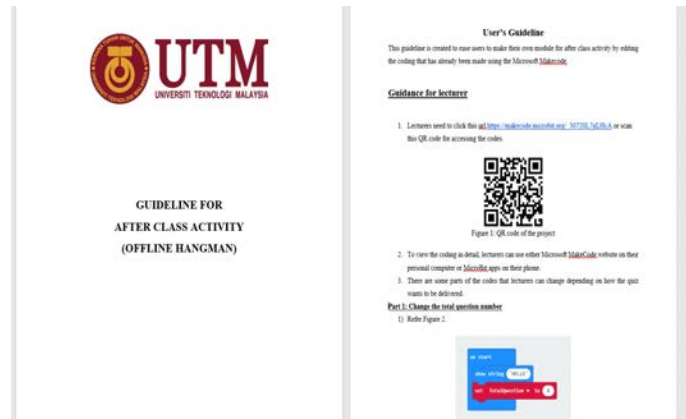


Figure 30.0: Module for offline Hangman

This product will be used for after-class activity. This activity will test the student's understanding of each topic. Students can monitor their degree of knowledge from the marks obtained and might improve their knowledge on that topic. Besides, the class surrounding will become more exciting when an active learning method is used. Finally, for students to conduct the activity, they have to use a mobile phone with Bluetooth features and the lecturer will help them pair the Microbit with their mobile phones.

8.0 Conclusion

As a conclusion, active learning using Metaverse and Hangman games will help in encouraging lecturers to start teaching in active learning method which can give a lot of benefits to students and lecturers. Besides, this project also improvises the traditional assessment which is normally used by the lecturer in the lecture. This is because the project that has been developed is based on the new learning method which makes the class assessment become more interesting and attracts students to do class activity. Furthermore, pre-class activities which are conducted using Metaverse will help students to get an overview about the topic before entering the lecture. Moreover, the Hangman concept which has been developed for after class activity will give students more understanding about the topic that has been learned. All the three materials that have been prepared are also user friendly since the module of each material is provided for the users. For further improvement, the feature of the project can be added such as variety choices of game and involvement of the assessment other than quiz.

Acknowledgement

Firstly, our group like to express our thanks and greatest gratitude to Merciful God, for giving us the strength, the will, the ideas and its blessing to our group to have this successful accomplishment of this report. This success, however, will never be achieved without the support from many parties, who have given their full cooperation in ensuring the success of this project.

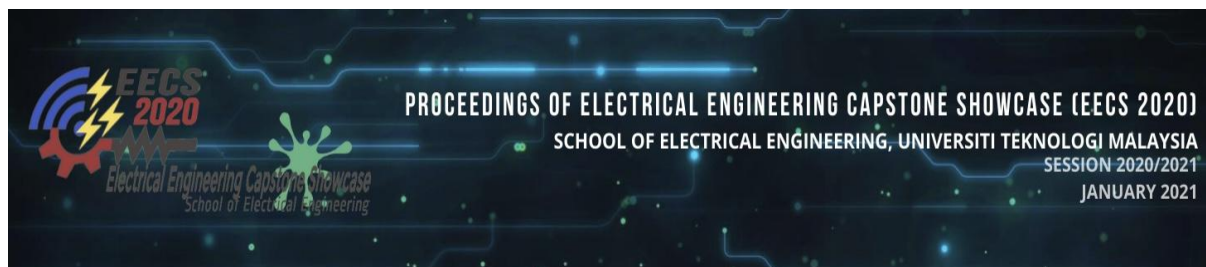
We would like to express our utmost gratitude to our supervisor, Dr Rashidah binti Arsat for her guidance as it is very helpful for us to complete our report. She always gave us suggestions and advice for the improvement. Without her supervision, this project cannot be done successfully.

Once again, our precious gratitude goes to Dr Ezaila, Dr Fauzan and also Dr Zaharah for their unconditional support and contribution since the start of the project. Their advice really helps and motivates our group to successfully implement our capstone project.

Lastly, we would like to express our appreciation to all who are involved or provided guidance and encouragement directly or indirectly in the completion of this report.

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Fun With EMT (Electromagnetic Theory)

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Abstract: This project aims to design an alternative website for Electromagnetic Theory (EMT) subject. Firstly, we found out that EMT is the hardest subject for degree students in the Faculty of Electrical Engineering in UTM from the interview responses via google form and online interview. Besides, the designing and building on the EMT website is aimed to increase the interest of electrical and electronic engineering students towards this EMT subject. This product is accessible at www.funwithemt.com and has many features inside the website such as EMT's application with videos, chapter notes which adheres to the UTM's EMT subject syllabus, past year test paper, past year final exam paper and quiz for each chapter. This paper includes the process of building the website, the platform used in this whole product and discussion on the developed product. Hence, this website can help to improve students' understanding of EMT subject as it is open access and informative.

Keywords: EMT education; educational website

Introduction (Project or Innovation)

Academic qualification is important nowadays especially in developing countries like Malaysia. To be qualified to become a professional, it is essential to have some sort of academic qualification. For example, one has to at least a degree holder in medicine to become a doctor. While becoming an electrical engineer, one should at least have a degree in electrical engineering. However, there are several courses in which one struggles during the degree study phase. Firstly, it was found from surveys and interviews of common problems that they faced during online learning and teaching. Online learning and teaching have been familiar among students and educators since Covid-19 pandemic in Malaysia in the early year of 2020. From these surveys and interviews, it can be seen that students are having problems in gaining and understanding the information received from class while the challenge of educators is to ensure that their students understand clearly the material that has been conveyed. Due to this, another survey was conducted to determine which course is the most difficult for electrical and electronic engineering students. The result shows that electromagnetic field theory (EMT) is the hardest subject in electrical engineering as shown as in Figure 1 below.

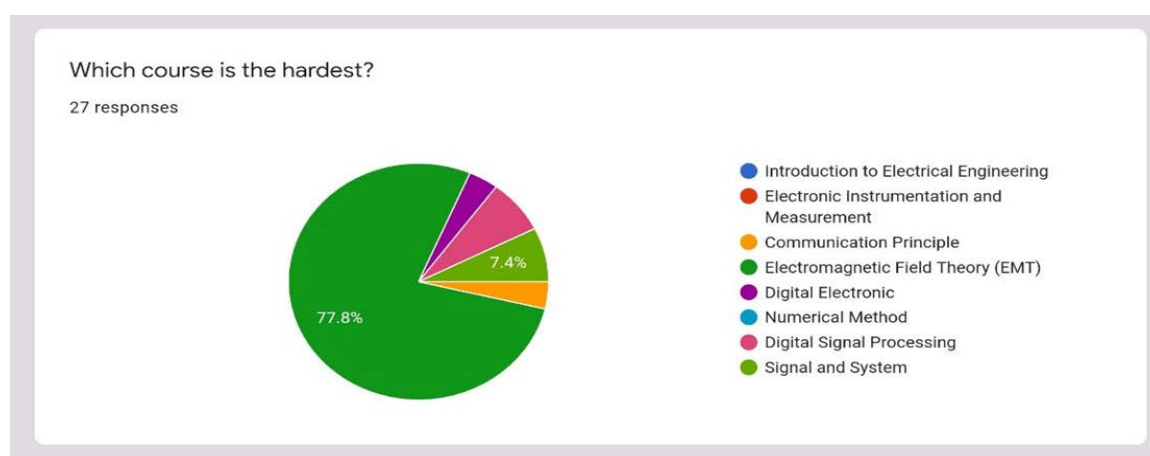


Figure 1: Result of survey on which subject is the most difficult

Therefore, the purpose of our project is to improve students' comprehension in learning EMT, visualize the content and get interest in this subject. Also, this project is to let the UTM's electrical engineering students pass in EMT subject and even pass with flying colours. The product of this project is a website. This website is a non-ordinary website which not only consists of chapters' notes but also has other features that would help students to gain interest and enhance their understanding in this course. It is an alternative to challenge electrical engineering students' stereotypes that EMT is the most difficult electrical course.

Basically, EMT website is designed specifically for electrical engineering students who are struggling to learn and understand this course. Hence, the 7 chapters included in this website must be equivalent to the UTM syllabus. Besides, our website has also included various EMT applications in daily life and industry which provide users with the purpose of learning EMT. Other than that, users can find some simple and fun projects and hand build it if they find out these projects are interesting. Moreover, there are some great features to test users' understanding on this subject such as quizzes for each chapter, past year test and past year final exam paper. Also, this can make them well-prepared for the test and final examination. There is an equation appendix which is the same as the equation sheet given during the test and final exam of UTM. Overall, the content of the EMT website is well organized, user-friendly and freely accessible so that students can access it anytime and anywhere.

Content (Project or Innovation)

1. Project or innovation objectives

The objectives of this project are:

- A tool to visualize challenging concepts.
- To eliminate the common belief among students that electromagnetic field theory (EMT) subject is very difficult.
- To improve students' understanding in EMT.
- To motivate students to be highly interested in the subject.

2. Description and analysis of interview for the project, which can include findings in terms of pie chart, data extract and data clustering.

Interview questions were developed related to Smart Education. The targeted users and respondents are mostly from School of Electrical Engineering in Universiti Teknologi Malaysia (UTM) including lecturers and students. There are 10 questions provided to be answered by respondents. Respondents were filled in google forms or interviews. The purpose of those surveys is to identify the problems and needs during online class.

The 10 interview questions are as in figure below:

1. **During online learning classes due to the COVID-19 pandemic, what are the problems that you face?**
2. **In your opinion, what are the lacks of when teaching and learning classroom?**
3. **In your opinion, how to improve the student and educator to attend class on time? (in term of technology)**
4. **In your opinion, how to filter out background noise from outside the class?**
5. **How to prevent students from imitating during online examination?**
6. **In your opinion, how to ensure students get exact experience as in real lab session, and will they be able to transfer virtual online lab to real one because of different method experienced?**
7. **How to ensure that students understand the subject that have learned same as face to face class during online class?**
8. **In your opinion, how can we improve teaching method in term of communication?**
9. **In your opinion, how to improve the effectiveness of online learning?**
10. **In your opinion, how to improve the effectiveness of delivering contains to student through technology?**

Figure 2: The 10 questions inserted in google form

Based on the survey, it can be seen that students and lecturers are having difficulties in learning and teaching online. This is clearly clarified in Figure 3 below that online class makes students lack focus due to the lack of activity. From all of the response collected, it can be concluded that one of the most factors of students lose interest in learning is no attractive learning and is shown in Figure 3 below.

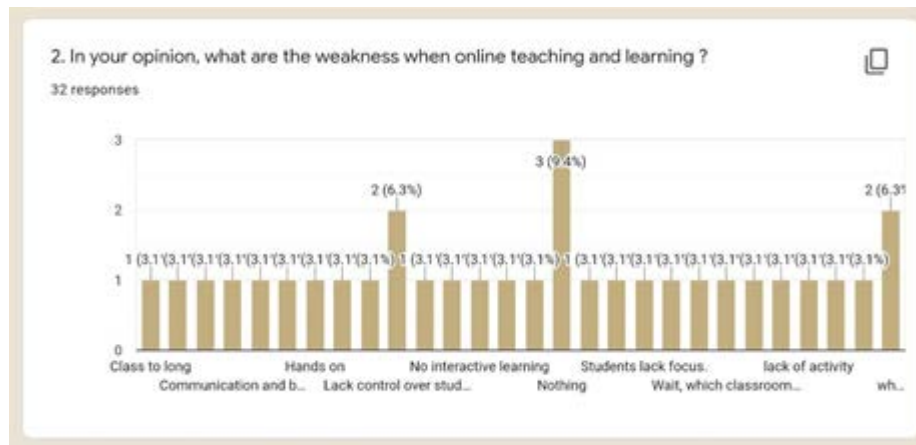


Figure 3: The answer of question 2

From the response regarding these 10 questions, a website was decided to be built that will further assist students in studying. Next, we emerged another survey which has 3 questions to determine the topic of our project:

1. Which subject is the hardest?
2. Why is this subject the hardest?
3. If we come out with a website which can help you understand more in that particular course, will it be helpful?

All the data received from the survey 2 is shown in figure below which represent excel data, pie and bar chart:

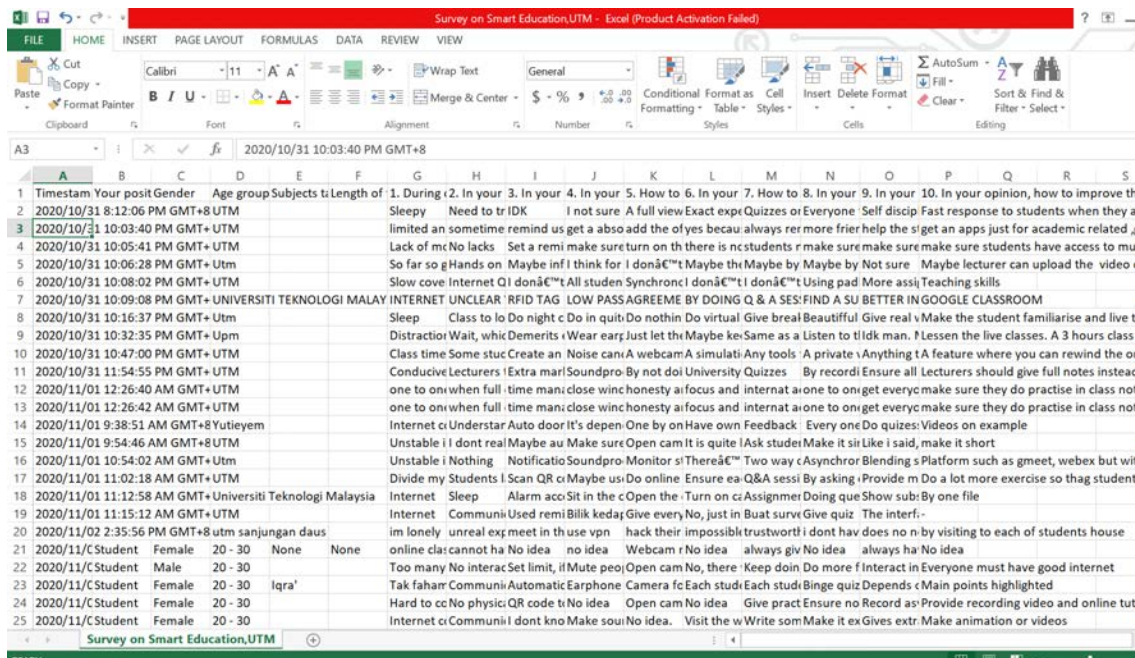


Figure 4: Answers in excel data of survey 2

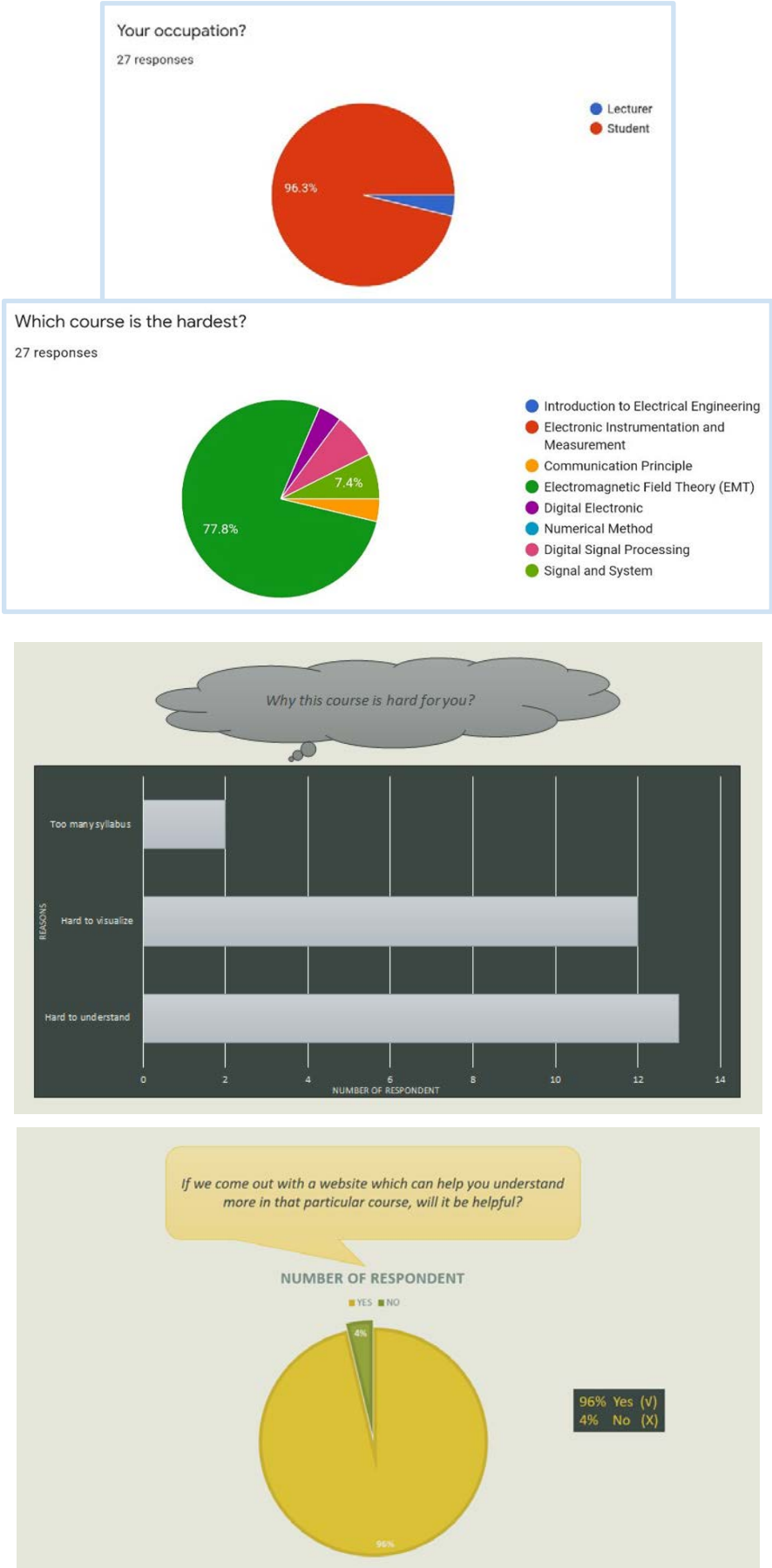


Figure 5: The pie and bar chart

From all the data obtained, the most frequent answers are shown below:

- When there are too many theories, students feel very difficult to understand the message delivered from.
- Instead of formal quiz, do some fun pop quiz to attract students in the learning session, Example do Kahoot
- By asking the students what they have learned or do a mind map. Always monitor students progress through communication or evaluate from their quiz, tests. Different people have different ways to understand.
- Make sure students have access to multiple sources of learning resources
- Hardest subject for electrical engineering is EMT
- Interesting website will be helpful and can increase interest of learning EMT

Therefore, we decided to come out with the title "Fun with EMT" as our website is designed about the knowledge of electromagnetic field theory (EMT) subject based on the data collection that we acquired from the surveys.

3. Design statement

To design a website that contains all resources (course information, notes, videos, applications, experiment, quiz, past year test and exam papers) are put in one place permanently all year around. It is a tool to visualize challenging concepts and improve students' comprehension in electromagnetic field theory (EMT) subject. The design will alternatively challenge electrical engineering students' stereotypes that EMT is the most difficult electrical course.

4. Methodology

Figure 6 shows the overall methodology of the project starting from discussing our topic's theme which is Smart Education. The topic determined and criteria should point toward or revolve around smart education. After that, 10 questions were constructed for survey and interview purposes. Staff and students in UTM were our target of interviewers. All the data obtained from google form of survey and interview script were analyzed and then proceeded with our design statement and project topic. A website called 'Fun With EMT' is proposed by our team. Besides, a conceptual prototype is built to represent the project. Discussion on different types of website builders was done as we need to choose an economically viable and efficient website builder. Next, we created the content needed in our website. The contents are adequately assigned to every member and uploaded in the website as our website development. One of website development is asking feedback from the expert and our supervisor regarding the website, then we evolve and refine the website based on the feedback received from them. Lastly, the website is finalized after receiving the satisfaction from the supervisor and all group members.

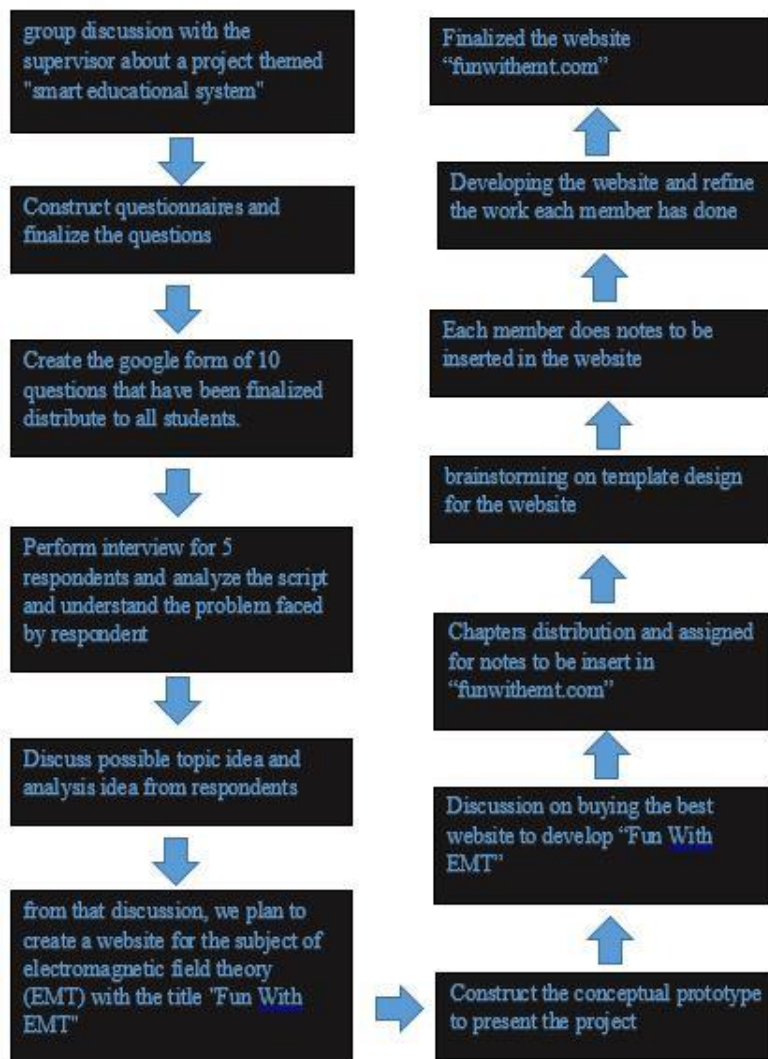


Figure 6: the methodology of the whole project

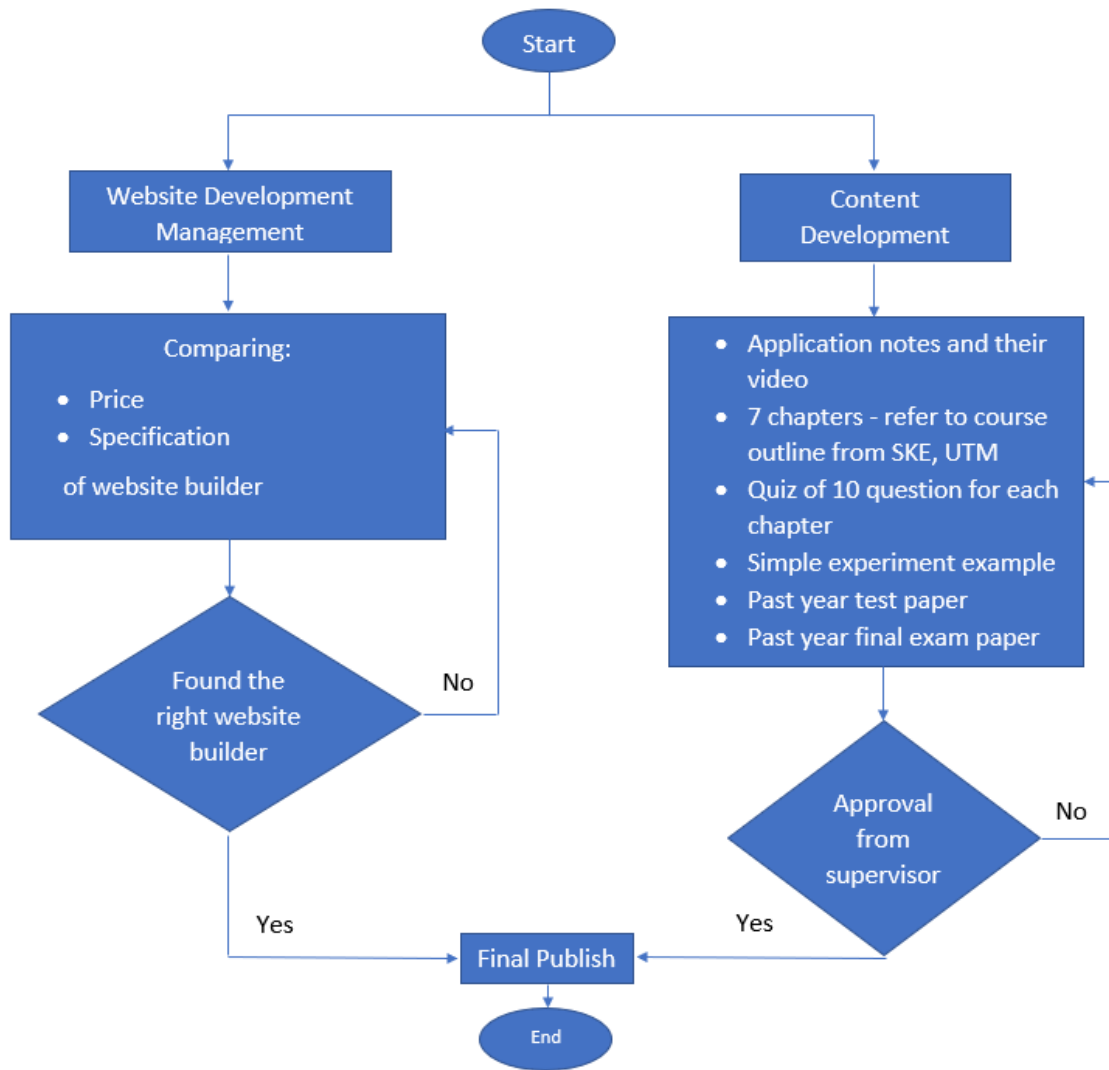


Figure 7: Flow chart of building website "Fun With EMT"

Figure 7 shows the flow chart of building the website. The process is divided into website development management and content development. The process of website development and content development are executed simultaneously. The content in our website includes course information, application notes and videos, 7 chapters' notes, quiz for each chapter, simple experiment, past year test paper, past year final exam paper and equation appendix. After all the content is included in our website, feedback will be given by our supervisor on the website as for our website development. After refining the website, it is finalized to be published as our final product.

5. Product development

Basically, the specifications of the website that we are looking for are the website that can be used for many users, easy to develop, fulfill our requirements and the lowest cost to save our cost as the rest can be used to buy other items. Besides, our product development mostly on the website development as we work on this website together. Firstly, we bought a website domain that costs RM49.81 as it is required for users to find our website. Next, we bought a website and marketing that costs RM33.91. The receipts for domain registration and website marketing basic plan are as figures shown below. After that, figure 9 shows the Godaddy website that we are using to develop and edit the website's contents.

Product	Amount
.COM Domain Registration	RM46.24
funwithemt.com ¹	
Subtotal	RM46.24
Taxes	RM2.82
Fees	RM0.75
Total (MYR)	RM49.81

Figure 4: Domain registration receipt

Product	Amount
Websites + Marketing Basic Plan Intl Renewal	RM31.99
funwithemt.com	
Subtotal	RM31.99
Taxes	RM1.92
Fees	RM0.00
Total (MYR)	RM33.91

Figure 8: Website marketing basic plan receipt

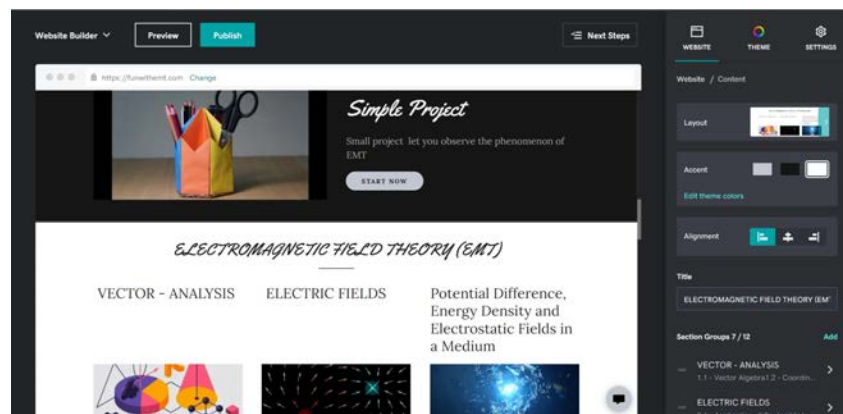


Figure 9: Godaddy website

Weekly Schedule

Week	Topic
Week 1 (18/10 – 22/10)	Mathematical Preliminaries Revisions on vectors, orthogonal coordinate systems and vector calculus.
Week 2 (25/10 – 29/10)	Electrostatic Fields Introduction to electric charge distributions and resultant charge densities. Application of the Coulomb's law in the determination of electric field intensity for line charge and surface charge distributions.
Week 3 (01/11 – 05/11)	Flux Density and Divergence Theorem Introduction to the electric flux density. Application of Gauss's law to calculate the electric field intensity for symmetric charge distributions. Introduction to divergence concept and the Divergence theorem.
Week 4 (08/11 – 12/11)	Potential Difference and Energy Density Introduction to the concept of potential difference and absolute potential. Coverage on the method of calculating energy storage in a field. Introduction to the idea of Energy Exchange, Gradient and Energy within a system of charges.
Week 5 (15/11 – 19/11)	Electrostatic Field in a Medium Introduction to the concept of current and Ohm's law in valuing resistance. Observation on the effect of conductor and dielectric materials under the influence of an electric field. Application of the dielectric – dielectric boundary condition. Introduction to the concept of capacitance.
Week 6 (22/11 – 26/11) TEST 1	Laplace's and Poisson's Equations Introduction to the uniqueness theorem. Solution of electrostatic problems with Laplace's and Poisson's equations.
Week 7 (29/11 – 03/12)	Magnetostatic Field Application of the Biot Savart's law to determine the magnetic field intensity for arbitrary current distributions including filamentary, surface and volume currents.
<i>Mid-Semester Break (06th Dec 2020 – 10th Dec 2020)</i>	
Week 9 (13/12 – 17/12)	Magnetostatic Field Application of the Ampere's circuital law in calculating magnetic field intensity for symmetric current distributions. Introduction to the Curl concept, Stoke's theorem and Magnetic flux density.
Week 10 (20/12 – 24/12)	Magnetic Material and Influence Application of the Magnetic force. Introduction to Magnetisation and effects of magnetisation. Application of the magnetic – magnetic boundary conditions.
Week 11 (27/12 – 31/12) TEST 2	Magnetic Material and Influence Introduction to the concept of Inductances. Application on Energy density and Energy storage within a magnetic field.
Week 12 (03/01 – 07/01)	Electromagnetic Field Migration from time invariant electromagnetic field to phenomena involving dynamic or time-varying electric and magnetic fields. Discussion on Faraday's law and its applications for cases pertaining to static circuit time-varying field, moving circuit static field and moving circuit time-varying field.
Week 13 (10/01 – 14/01)	Electromagnetic Field Application of Maxwell's equation in the explanation of displacement current density. Applications of Maxwell's equation in good dielectric and lossy dielectric materials.
Week 14 (17/01 – 21/01)	Wave propagation Plane wave propagation within free space, lossy dielectric and lossless dielectric.
Week 15 (24/01 – 28/01)	Wave propagation Plane wave propagation within a conductor. Application of the Poynting vector.

Figure 10: Latest Course Outline from SKE UTM

In order to make sure the chapters' notes that we develop match with UTM's syllabus, we refer to the newest course outline from SKE UTM. After the notes for each chapter is created, the quiz is also constructed in the google form with answers feedback.

Other than that, we ask for some feedback from our supervisor Dr Nadiatulhuda and the coordinator in this subject, Dr Rashidi about the organization and content of the website.

6. Discussion on developed product

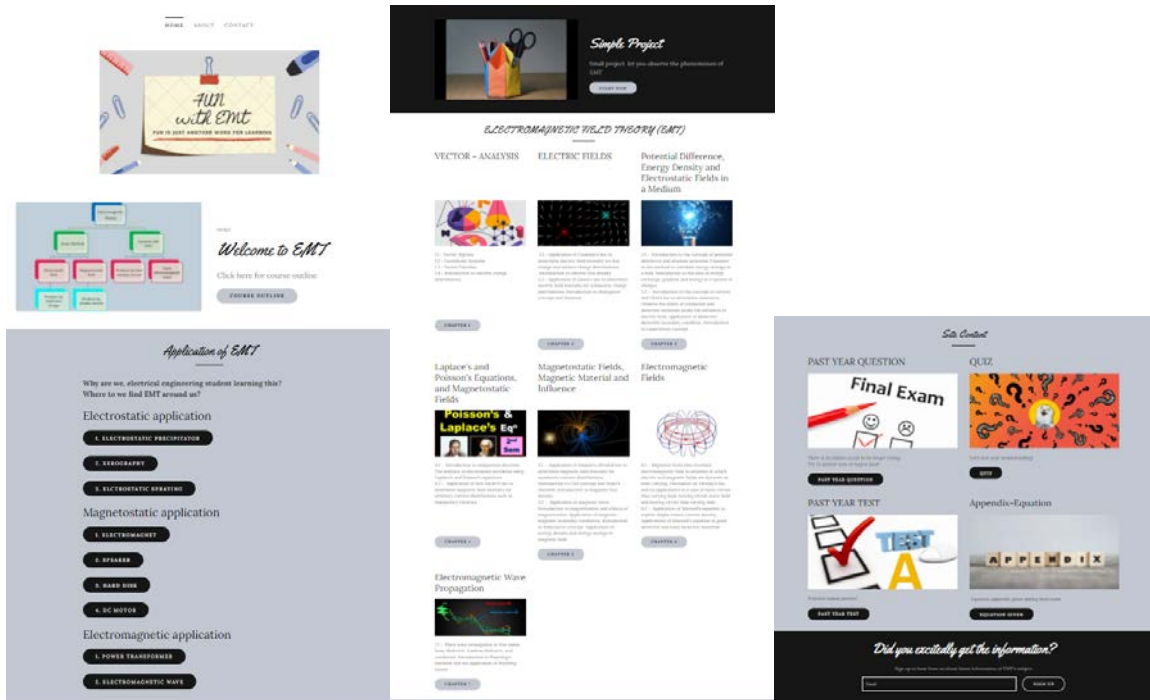


Figure 11: Home page of Fun With EMT

Figure 11 shows the homepage of our website whenever a user searches www.funwithemt.com. This website is easy to find information. From the homepage, users can easily find the course information, application of EMT with the use of electromagnetic theory in real life, simple and fun project, chapter note, quiz with immediate (answer) feedback and past year test and final paper.

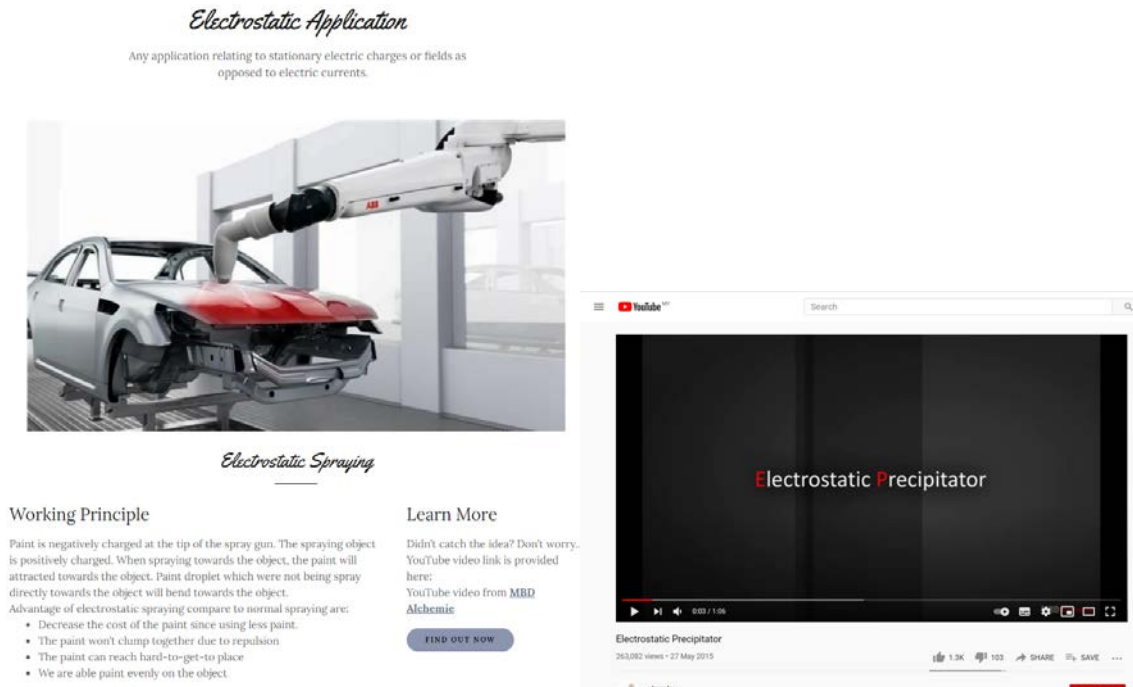


Figure 12: Application notes

From the homepage, users are able to click into an application such as Electrostatic Spraying and it will direct you to a page which explains its working principle with the YouTube link provided. By having applications, it would give the user an idea on how useful electromagnetic theory is.

Simple Electric Motor

Retrieved from Education.com: <https://www.education.com/>
 Electric Motor Project from Science Buddies: <https://www.youtube.com/watch?v=W0p0r2k0MM8>



Faraday's Experiment

Retrieved from Education.com: <https://www.education.com/>



Electromagnetic Induction Experiment

Retrieved from Education.com: <https://www.education.com/>



Faraday's Experiment

Michael Faraday was a 19th century English scientist who is credited with many great discoveries in the realm of physics and chemistry, specifically on the relationship between current and magnets, and electrochemistry.

Current is the flow of electrons from one place to another, and is how electricity is carried. Currents are known to create their own magnetic fields, and the movement of magnets is known to induce, or create, current in a wire. In this lab, you will recreate Faraday's famous experiment by building a **solenoid** (a coil of wire) and experimenting with magnets to produce current.

Objective: Induce current in a wire with a magnet.

Hypothesis:

What will happen when you pass a strong magnet through a loop of copper wire?

Materials

- Bar magnet
- Insulated copper wire
- Galvanometer (sensitive current-measuring device)
- Cardboard paper towel or toilet paper tube

Procedure

1. Wrap the copper wire tightly around the cardboard tube to create a solenoid. Wrap as many times as you can and be sure to leave a few inches at each end to connect to the galvanometer.
2. Connect each loose end of the wire to the positive and negative terminals of the galvanometer.
3. Switch on the galvanometer.
4. Insert the magnet inside the cardboard tube and move it around. What happens? Record your observations.
5. Try moving the magnet faster or slower. What happens?
6. Turn off the galvanometer and disconnect one of the terminals.
7. Reduce the number of turns in the solenoid. Reconnect and switch on the galvanometer.
8. Insert the magnet inside the cardboard tube and move it around again. What happens? Record your observations. Does the number of coils affect the amount of current generated?

Results

The faster the magnet moves, the more current is generated in the loop. The same is true of the coils: the more coils in the solenoid, the more current generated.

Why?

In Faraday's experiment, the magnet exerts a force from a distance (within the tube) and acts on the electrons to move them around. This is easy with copper wire because the electrons move around with little resistance (explaining why copper is such a great conductor). It is important that the wire forms a closed loop (complete circuit) or this will not work! The magnetic field acts on all parts of the loop in slightly different ways, due to the direction of the magnetic field. The field pushes the current in one direction or the other, depending on which pole of the magnet is approaching. This can be figured out with the right-hand-rule.

A "thumbs-up" motion is made with the right hand. The thumb represents the direction of the magnetic field and the curve of the fingers is representative of the direction of the current in the loop.

Motors and generators use magnetic movement to create current and send electricity to do useful work to power machines. Auroras in the sky are caused by particles being electrically charged by the magnetic field of the Earth. Electromagnetism is both useful and beautiful!

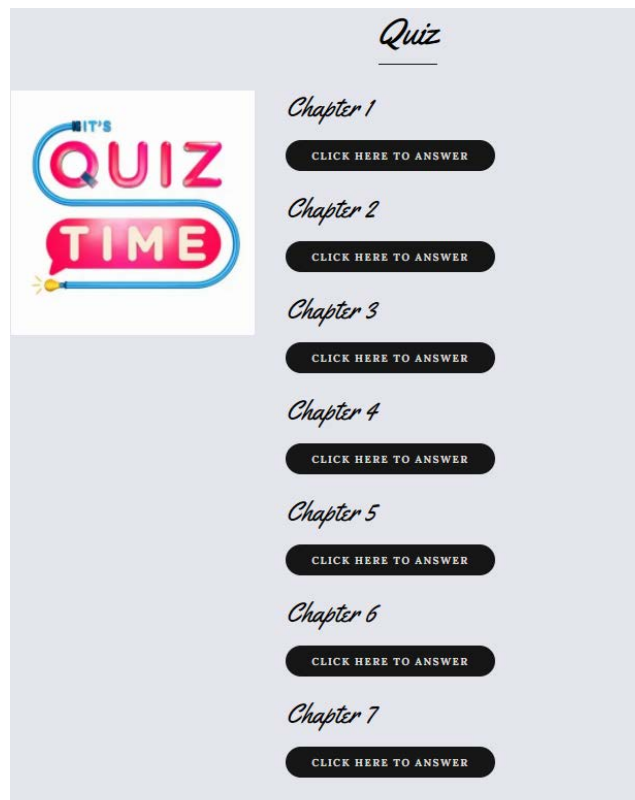


Figure 13: Simple and fun project

This website also provides a few simple and fun projects. The benefit of doing this project is the user is able to visualise the theoretical concept through observing the effect and motion of the product build.

Figure 14: Chapters' note

The main feature of our website is 7 chapters' note is provided for users to refer as shown in Figure 14. All of the notes had been simplified and are based on UTM syllabus. UTM's students would benefit the most. Some of the chapter has other resources such as teaching video.



Quiz: Chapter 3

Q1. If the value of the V calculated is negative what does the negative indicate? 0 points

$$V_{AB} = \frac{W}{Q} = - \int_A^B \mathbf{E} \cdot d\mathbf{l}$$

there is loss in potential energy in moving Q from A to B
 there is a gain in potential energy in moving Q from A to B
 the work is being done by the field
 the work is being done by external agent

Q2 0 points

Two dipoles with dipole moments $-5a_z \text{ nC} \cdot \text{m}$ and $9a_z \text{ nC} \cdot \text{m}$ are located at points $(0, 0, -2)$ and $(0, 0, 3)$, respectively. Find the potential at the origin.

Your answer _____

Q3 0 points

Quiz: Chapter 3

Total points: 0/3

0 of 0 points

X Q1. If the value of the V calculated is negative what does the negative indicate?

$$V_{AB} = \frac{W}{Q} = - \int_A^B \mathbf{E} \cdot d\mathbf{l}$$

there is loss in potential energy in moving Q from A to B
 there is a gain in potential energy in moving Q from A to B
 the work is being done by the field
 the work is being done by external agent

0 of 0 points

Q2

Solution:

$$V = \sum_{i=1}^2 \frac{p_i \cdot \mathbf{r}_i}{4\pi\epsilon_0 r_i^3} = \frac{1}{4\pi\epsilon_0} \left[\frac{p_1 \cdot \mathbf{r}_1}{r_1^3} + \frac{p_2 \cdot \mathbf{r}_2}{r_2^3} \right]$$

where

$$p_1 = -5a_z, \quad \mathbf{r}_1 = (0, 0, 0) - (0, 0, -2) = 2a_z, \quad r_1 = |\mathbf{r}_1| = 2$$

$$p_2 = 9a_z, \quad \mathbf{r}_2 = (0, 0, 0) - (0, 0, 3) = -3a_z, \quad r_2 = |\mathbf{r}_2| = 3$$

Hence,

$$V = \frac{1}{4\pi \cdot \frac{10^{-9}}{36\pi}} \left[\frac{-10}{2^3} - \frac{27}{3^3} \right] \cdot 10^{-9}$$

$$= -20.25 \text{ V}$$

Figure 15: Quizzes

Other than that, a quiz for each chapter can also be found from this website. Each quiz contains 10 questions which build from multiple choice questions, subjective questions and calculation based questions. Each question would be provided with an answer (direct feedback) and even calculation solution after they have done all the 10 questions.

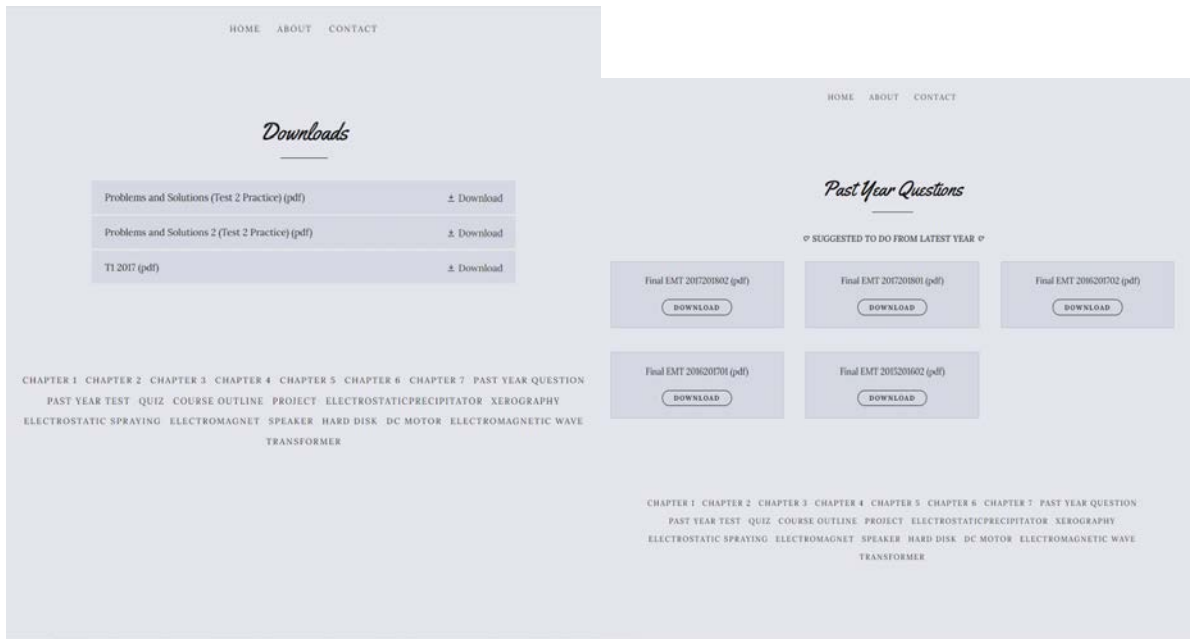


Figure 16: Past year test paper and final exam paper

Past year test papers and past year final exam papers were also provided on this website. This paper not only allows users to test their understanding but also lets users be prepared for their upcoming test and final exam. They will be used to those papers format and question styles and lead to being more confident during tests and final exams.

Appendix Equation EMT

Download PDF >

2
Set 2525/3Set 2525/3KEU 2525

ELECTROSTATIC FIELD	MAGNETOSTATIC FIELD
Coulomb's Law $\vec{F} = \int \frac{dQ}{4\pi\epsilon_0 R^2} \hat{a}_R$	Biot-Savart Law $\vec{H} = \int \frac{I d\vec{l} \times \hat{a}_R}{4\pi R^2}$
Gauss's Law $\oint \vec{D} \cdot d\vec{s} = Q_{en}$	Ampere Circuital law $\oint \vec{H} \cdot d\vec{l} = I_{en}$
Force on a point charge $\vec{F} = E(Q)$	Force on a moving charge $\vec{F} = q(\vec{v} \times \vec{B})$
Electric field for finite line charge $\vec{E} = \frac{\rho_L}{4\pi\epsilon_0} \left[\frac{\vec{r}}{r} (\sin\alpha_1 + \sin\alpha_2) + \frac{\vec{z}}{r} (\cos\alpha_2 - \cos\alpha_1) \right]$	Magnetic field for finite current $\vec{H} = \frac{I}{4a^2} (\sin\alpha_1 - \sin\alpha_2) \hat{\phi}$
Electric field for infinite line charge $\vec{E} = \frac{\rho_L}{2\pi\epsilon_0 r} \hat{r}$	Magnetic field for infinite current $\vec{H} = \frac{I}{2\pi} \hat{\phi}$
Electric flux density $\vec{D} = \epsilon \vec{E}$	Magnetic flux density $\vec{H} = \mu \vec{H}$
Electric flux $\Psi_e = Q = \oint \vec{D} \cdot d\vec{s}$	Magnetic flux $\Psi_m = \int \vec{B} \cdot d\vec{s}$
Divergence theorem $\oint \vec{D} \cdot d\vec{s} = \int_V (\nabla \cdot \vec{D}) dv$	Stoke's theorem $\oint \vec{H} \cdot d\vec{l} = \int_S (\nabla \times \vec{H}) \cdot d\vec{s}$
Potential difference $V_{ab} = \int_a^b \vec{E} \cdot d\vec{l}$	Magnetic potential, $(I, \vec{l}) \rightarrow \vec{H} = \nabla \times \vec{A}$
Absolute potential $V = \int \frac{dQ}{4\pi\epsilon_0 R}$	
Gradient of potential $\vec{E} = -\nabla V$	
Energy stored in an electric field $W_e = \frac{1}{2} \int_V (\vec{D} \cdot \vec{E}) dv$	Energy stored in a magnetic field $W_m = \frac{1}{2} \int_V (\vec{B} \cdot \vec{H}) dv$
Total current in a conductor $I = \int \vec{J} \cdot d\vec{s}$	
Polarization vector $\vec{P} = \vec{D} - \epsilon_0 \vec{E}$	Magnetization vector $\vec{M} = \chi_m \vec{H}$ where $\chi_m = \mu - 1$
Bound surface charge density $\rho_s = \vec{P} \cdot \hat{n}$	Magnetized surface current density $\vec{J}_{ms} = \vec{M} \times \hat{n}$
Volume surface charge density $\rho_v = -\nabla \cdot \vec{P}$	Magnetized volume current density $\vec{J}_m = \nabla \times \vec{M}$
Electrical boundary conditions $\vec{D}_1 \cdot \hat{n}_1 = \rho_s$ and $E_{t1} = E_{t2}$	Magnetic boundary conditions $\vec{B}_{n1} = \vec{B}_{n2}$ and $H_{t1} - H_{t2} = \vec{J}_s$

1/3 Next >

Figure 17: Equation appendix

Furthermore, equation appendix is also provided in this website and it is the same as the equation appendix given during tests and final exam. Students will use it to find equations on this appendix and be able to answer efficiently during tests and final exams.

Table 1: The innovation of EMT website

Features	NOTES2U https://sites.google.com/site/eeenotes2u/courses/electromagnetic-theory-field-theory	UTM E-learning	Fun with EMT https://funwithemt.com
Notes	It does not match with UTM's syllabus	It matches with UTM's syllabus	It matches with UTM's syllabus
Application	No	No	Yes. A few application for those 3 types of field
Quiz	No	Depends on the lecturer and not every chapter may has quiz	Quiz for each chapter with immediate feedback (answer)
Past year test paper	No	Depends on the lecturer	Yes, all students able to access it
Past year final exam paper	No	Depends on the lecture	Yes, all students able to access it
Equation appendix for test and exam	No	Yes	Yes
Other attractive features	No	No	Simple experiments related to this subject

Table 1 above shows the development of our product with the other products such as NOTES2U and UTM e-learning. Basically, we develop our product based on the specification that is already in other websites or platforms. Besides, our target customers are UTM students. Therefore, the notes for each chapter should be equivalent with UTM's syllabus. The privilege of our website is only in our website has some applications for those three types of fields which are electrostatic, magnetostatic and electromagnetic fields.

Furthermore, the quiz in EMT website consists of each chapter which has 7 quizzes in total with immediate feedback. However, the quiz in UTM e-learning depends on the lecturer and not every chapter may have a quiz. Also, there is a past year test and final exam paper on our website that is accessible for all students but in UTM e-learning depends on the lecturer to insert it. In addition, there is also an equation appendix for tests and exams available in our website and UTM e-learning. Last but not least, the special part of our website is there are other attractive features which are simple experiments related to this subject. Hence, it can be seen that our website has many advantages compared to other websites that can be used for students to learn EMT attractively and efficiently.

7. Conclusion

In conclusion, our product of the website www.funwithemt.com works successfully and all the design specifications were achieved. The Capstone Project with title of Fun With EMT is presented in this report. The platform implements Electromagnetic Field Theory (EMT) in which this subject is very difficult and hard for electrical engineering students to pass with flying colours. The [funwithemt.com](http://www.funwithemt.com) is a website that has a collection of notes, fun projects, videos, past year test and final paper and quiz for each chapter in which acts as a significant role to help students in having a better understanding of The Electromagnetic Field Theory's fundamentals. The contents in the website must be equivalent with Universiti Teknologi Malaysia (UTM)'s syllabus as our targeted user is UTM students. In terms of developing the website, designing the frameworks and content in each page play a significant character to attract students' interest in using this website. Furthermore, the purposes of this website are to visualize challenging concepts in order to improve students' understanding in EMT, eliminate the common belief among students that EMT subject is very difficult and motivate students to be highly interested in the subject. The innovativeness and features of EMT website were presented and verified in the discussion shows that this website is better than existing websites such as e-learning as all resources (course information, notes, videos, applications, experiment, quiz, past year test and exam papers) are put in one place permanently all year around. Moreover, EMT website will encourage students to self-learn while immediate feedback from quizzes reduce lecturers' marking tasks. Overall, a validation protocol would be prepared and an ethics committee approval, guidance and improvement would be obtained prior to the development of this website in the future. Thus, a good knowledge in constructing the website is necessary in the future.

Acknowledgement

Firstly, we would like to express our gratitude to God for his blessing because we are able to finish our Capstone's project entitled "Fun With EMT".

Besides, we owe our deepest gratitude to our supervisor, Prof. Madya Ir. Dr. Nadiatulhuda Binti Zulkifli for her generous support, endless knowledge, patience and guidance to help us develop [funwithemt.com](http://www.funwithemt.com) during Capstone's period. Furthermore, we are very grateful that we were able to encroach her precious time freely right from the start until completion of our project. We could not have imagined having a better supervisor in our capstone project.

In addition, We are grateful especially to Dr. Rashidah @ Siti Saedah Binti Arsat, our Capstone's Coordinator for Communication School of Electrical Engineering for her meticulous supervision to carry out the obligation perfectly. Also, we would like to extend our sincere gratitude to our parents for their full support, convictions, and understanding until we are able to develop [funwithemt.com](http://www.funwithemt.com).

Moreover, our sincere appreciation also goes to all my colleagues and others who have provided assistance at various occasions. Their opinions and tips are useful indeed. We also wish to express our sincere thanks to those who have helped us directly or indirectly towards developing [funwithemt.com](http://www.funwithemt.com) towards this Capstone's period.

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QuiZZO (Game Based Learning Platform)

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Abstract: The COVID-19 pandemic has become a worldwide medical problem and significantly affects education. Thus, as part of the way during that time semester of the scholarly year 2019/2020, learning strategies were conveyed through distance learning. This paper aims to introduce an app named "QuiZZO" that enables, encourages, and enforces learning methods in efficient way among the students. This paper will provide a comprehensive background of our product including the basic concepts, objectives, findings from the market survey, product development, product testing and evaluation. We will also discuss the challenges and constraints in implementing social distancing in practice.

Keywords: game; quiz; fun; active learning.

Introduction

Worldwide nations are at various focuses in their COVID-19 disease rates, overall, there are at present more than 1 billion students in 185 nations influenced by education terminations because of the pandemic. COVID-19 has affected almost all country in the worldwide since its introduction because of asymptomatic transmission through the air. Therefore, online learning method which mostly considered as most effective way that ensure the student education in stable condition. While a few people accept that the impromptu and quick change to online based learning without preparation, deficient data transfer capacity, and little readiness will bring about a poor user experience that is uncondusive to supported development, others accept that another mixture model of schooling will arise, with huge advantages.

There is the evidence that learning in the online can be more effective in many ways. Some research and experiments show overall understudies hold 20-50% material when learning on the web contrasted with just 10% in a homeroom. This environment is normally because of the understudies having the option to learn quicker on the web; e-learning requires 40-60% less an ideal opportunity to learn than in a conventional homeroom setting since understudies can learn at their own speed, returning and re-perusing, skipping, or quickening through ideas as they pick. Nevertheless, the adequacy of internet learning changes among age group.

The online based learning method is required because it is very flexible for both lecturers to teach and student for learning. By learning through online, students and lecturers managed to learn the time management skill too. These skills are very helpful for the students after their studies. In addition, the students learn more compared to traditional lecturing method which is followed until now. By this, students are getting many inputs about their studies easily. The online based learning method is let the students learning in their way or in their own pace. The students get more freedom to study in their way in online. By this, students do not undergo very stressful environment as normally students face during face-to-face learning.

Students are more quickly flustered or distracted because of boring learning method. Therefore, to get the optimal advantage of online based learning, there should be a purposeful exertion to give this construction and go past imitating an actual class/address through video abilities or new way of learning. This project introduces a solution that complements the students to learn through gaming apps.

Objectives

1. To promote apps learning method among the students in interesting way.
2. To help lecturers to conduct lecturing in more effective way.
3. To improvise the learning techniques with interesting games.

Design statement

Nowadays, with the advance of technologies, educational games are competing with commercial games between the youth which include the students at university. They have high expectations in today's video games especially when it comes to graphic of the games. So, the educational games should be vibrant, fun and can engage with one another which can meet the expectations. Then, usability is defined as quality attribute that assesses how easy the user interfaces of the games can be use which include the efficiency, learnability, and satisfaction of the design. The important of the usability is a necessary condition for survival in games world. 1) Simple and natural dialogue, 2) Minimize the user's memory load, 3) Clearly marked exits and 4) help documentation are some of usability of games that developed by Jakob Nielsen. Therefore, to see how good the design of the games is the used of usability heuristics. Although this usability of Jakob Nielsen was used for desktop applications, but they still can be used to design a game.

Next, to create a meaningful game experiences for the users are to create a successful game design. Meaningful play comes when the users can easily have interactions with the system and the context of the game which this can produce when the design have the different form of spaces, objects, and narratives. Then, the meaningful play can also be created through Mark Prensky' element games which include the feedback, fun, problem solving, adaptivity, rules and clear goals. According to Mark Prensky, the principal roles of fun in the learning process are to create relaxation and motivation which should have this combination for a game. Relaxation can help user to take or learn things more easily and motivation enables them to play the game without resentment. Therefore, a good or successful game can help to reduces stress of users and can boost the productivity. So, in this application, there are some games which can have interaction between play and learn because after users play of certain game, they can immediately learn something regarding the subject.

After that, story of a game is one of the factors that can be affected to the users to play the games. For a game to have something good, it should have some representation. These representations can be the symbol that encode the information or flow of the game which can make help the educational content become more interesting, and the user can easily interpret the meaning. These can become mental models that have some messages which can help to teach the users. Therefore, the information of the game which the use can get or learned from it can be given when they need them or used the challenges to make it more interesting which foes back to the concept flow of educational game where the difficulty of the task should be balanced with the skill of the user. So, in this application, the combination of the block, pictures, sound or music and movement can produce the game a story which help balanced the game between play and learn.

Then, outcomes and feedback in games are on how the user can measure their progress against the goals. Feedback can come when something in the game where the user plays changes in response to what they do which can make this game more interactive. It can let them know whether they have done can bring positive or negative result. Feedback can have variety of forms including numerical score or rewarding format to user. It is form of feedback where the learning can take place in a game. The user can continuously learn how the game work, how to succeed and can gain more information.

In conclusion, in this QUIZZO games, there are more elements which make this game interesting and useful to the users. This game is specifically designed to teach a subject which also include Shuffle game where it can teach problem solving and Snake games that make this more interesting. These games can help balanced the user between plays and learns.

Methodology

The methodology proposed for this project is to focus on how the education games or this application begins to make the flow of the games smooth that centered on the practice of a serious production of games and considers defining the learning and gaming mechanism into the educational games. This development of the game began with the selection of the subject or topic associated with it for the educational game and learning goals which ends with user interactions or development. At Figure 1 below shows, is the flowchart of the methodology to develop the game. This methodology is described as the starter of the main game and the latter flow is a further mechanism of learning. All the steps represented by the rounded rectangle are connected to the learning process or learning results, while the characteristics of the are defined in the other rectangle.

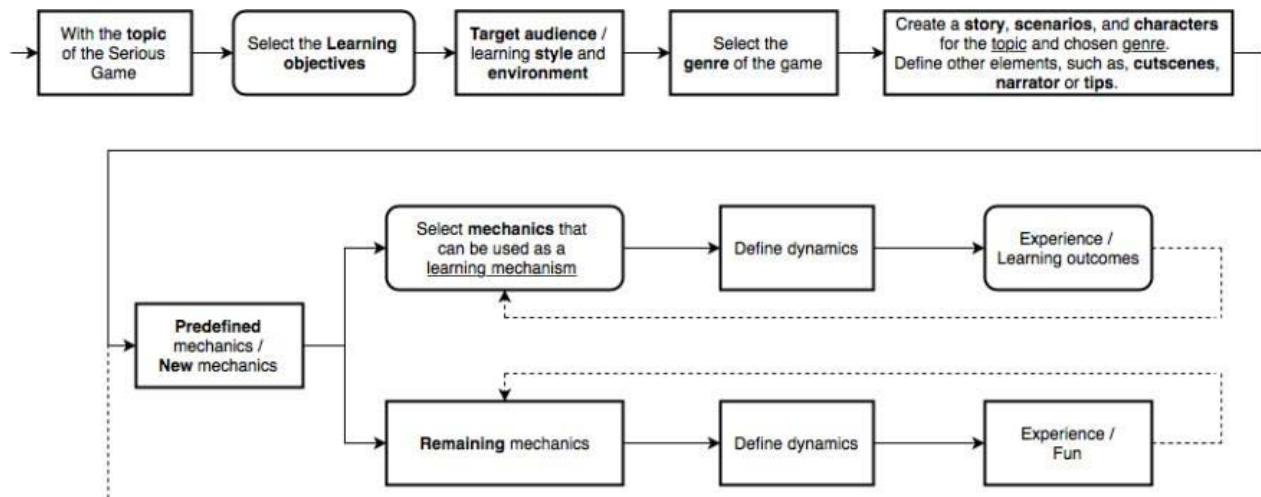


Figure 1: Methodology to start a game.

The first step of the phase is to identify the subject and learning target. To start a program, this step is important as it will determine the appropriate game genre for the given subject and learning goals. Then it is important to consider the target user for the game in relation to their age, gender or occupation since certain genres are more common in different age group depend on the learning styles of an individual. By doing many things which are activists' people can learn and tend to produce many new ideas. Encounters can learn and understand many things by reflecting the experience. These are some of target groups who are known to be educational game consumers.

Next, the relationship between learning strategies, learning activities and game genres which should consider the learning styles for creating an educational game which shown in Table 1 below. The learning conditions in where a game is placed is another aspect should be taken into consideration which a game is used. For example, it must be focused on short sessions if the game has used in the classroom. Whether collective or collaborative, it is main things to consider which surroundings we want. To select a game genre, all these considerations must be evaluated. It is already possible to create a plot for the game after identifying the game genre, considering the topic, learning goals, target user and learning environment.

Learning Techniques	Leaning Activities	Game Genres
Practice & feedback	Questions, memorization, association, imitation	2, 4
Learning by doing	Interaction, practice, drill, imitation	1, 2, 3
Learning from mistake	Feedback, problem	3, 6
Discovery learning	Feedback, problem, creative play	1, 2, 6
Task-based learning	Understand principle, graduated tasks	5, 6
Question-led learning	Question, problem	7
Situated learning	Immersion	1, 2, 3, 4, 5
Role playing	Imitation, practice, coaching	1, 2, 3
Constructivist learning	Experimentation, questioning	5
Learning object	Logic, questioning	5
Coaching	Coaching, feedback, questioning	2, 5
Intelligent tutors	Feedback, problem, continuous practice	2, 6

Figure 2: The relationship between the learning techniques and learning environment.

Now, the design of the game can be advanced since learning goals have been established and the flow has been created to support it as per the genre of the game. Dynamics determines how the player communicates inside the game with mechanics and what it will bring to the experience of the user and their learning. For example, the shuffle game can develop the problem solving of the user and then when they can complete the shuffle there are some set of quizzes that should be answered by the user. To keep the game enjoyable and involve the player, other mechanics that cannot be used as learning mechanism should be used. Therefore, dynamics must be built for certain mechanics to give the user an enjoyable experience.

The method of game design is, of course, iterative, where we have a design, prototyping and play-testing period. With this methodology, all elements of a games can be defined where it is possible to integrate learning mechanisms, making the task of game-design simpler. The methodology proposed for this project is to focus on how the education games or this application begins to make the flow of the games smooth that based on the practice of a serious games development and takes into considerations to define the learning and gaming mechanism into the educational games.

Project Analysis

Aim

The contact between students and lecturers is minimized by the introduction of online learning. The goal of this project is to improve contact between students and lecturers by interactive learning method. Due to the Covid-19 pandemic, it is advised that all educational institutions use an online form of learning to ensure that students can complete the curriculum within the allotted time. It is important to maintain the contact between students and lecturers to make sure the curriculum achieves its target. The project is essential for the time being and future.

Methodology

This project is carried out by building an application that can replicate face to face quiz session. The application has several functions for the lecturers to assess students while students can enjoy the games related to the course. The application is built by MIT Apps Inventor, a website to develop applications for Android phones using a web browser and either the connected phone or emulator. For the development process, some other methods are being used.

First, we use the Thinking Process to identify user needs and problems. Next, Google Form is used to reach the user. To make sure, this project meets the user need, a set of question has been created to make a user profile. This approach is to make sure this project is developed to solve user problems.

Next, the MIT apps Inventor is used to build the application. This website is free and open source. With the help of senior and Google search engine, it took less time for the developer to learn the app inventor. the idea is to make the maximum number of games and quiz within the allotted time.

Lastly, user experience feedback. It is important to evaluate the product by user experience. This is to make sure the product match user needs. The feedback can be useful for the app's development. In this project, several approaches are being used. For example, weekly meeting with the supervisor to get the lecturer user experience and panel to evaluation to get external feedback for the product.

Timing and Duration

No	Tasks	Start Week	End Week	Capstone Week											
				5	6	7	8	9	10	11	12	13	14		
1	Getting started with PLATFORM	5	7	☑	☑	☑									
2	Software Development (50%) (Quiz and 2 Games)	6	9		☑	☑	☑	☑							
3	Troubleshoot	9	9					☑							
4	Software development (100%) (Quiz and 4 Games)	10	12						☑	☑	☑				
5	Troubleshoot	12	13									☑	☑		

Figure 3: Gantt Chart of Project

The Gantt Chart above indicates the timeline of the project. This project took 13 weeks to complete, starting from October 26th, 2020 until January 18th, 2021. It took four weeks to identify user’s problem and create the user profile. This project has their milestone. Below is the milestone of the project:

1. User Profile Completed: November 9th, 2020.
2. Software Development (1st phase) completed: December 25th, 2021.
3. Software Development (2nd phase) completed: January 11th, 2021.

Product Development

MIT App Inventor was proposed as the ideal web application to build our own quiz mobile applications. MIT App Inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to use computer programming to create application. It contains designer setup for user interface and block setup for program the application.



Figure 4 shows the logo of MIT App Inventor.

Mobile Application Design (User Interface)

1. User Registration and Sign In.
- 2.



Figure 5: User Registration and Sign in interface

3. Main Menu.



Figure 6: Main menu interface

4. Types of games.



Figure 7: Type of games interface

5. Game 1: Quiz Elimination.

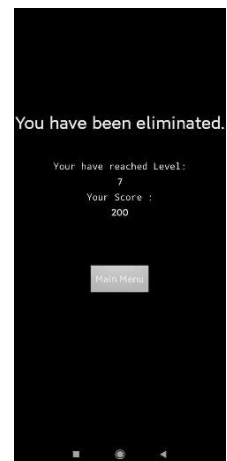
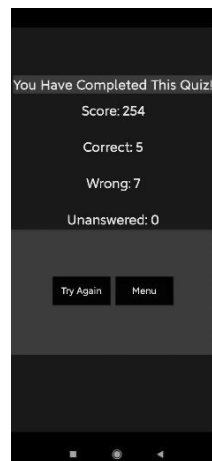
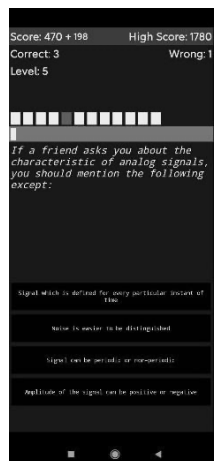


Figure 8: Quiz elimination

6. Game 2: Shuffle Tile

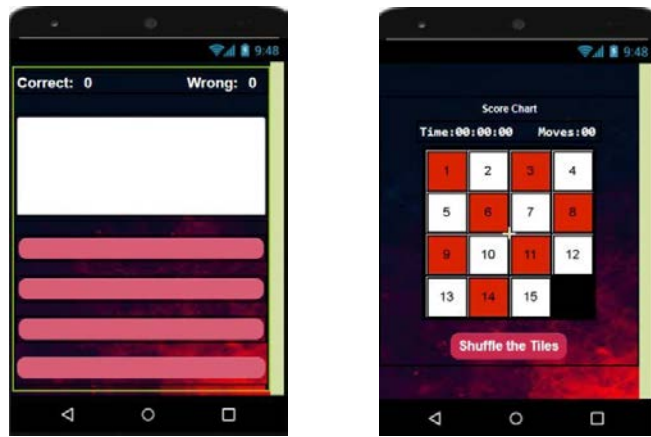


Figure 9: Shuffle tiles interface

Game 3: Snake Game

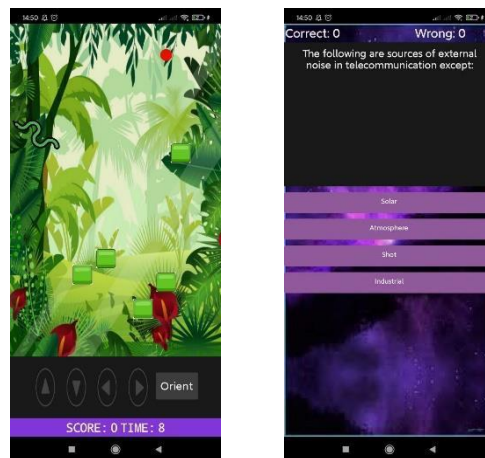


Figure 10: Snake game interface

7. Scoreboard



Figure 11: Scoreboard interface

Figure 11 shows the programming block for main menu interface. When any of the button clicked, it will move to another screen.

8. Additional Functions. (Drawing and notes)

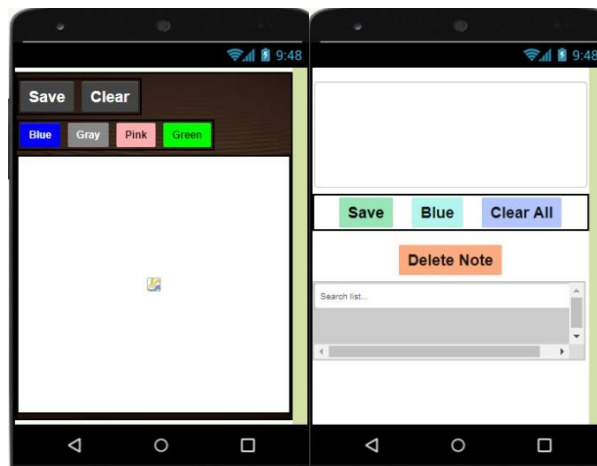


Figure 12: Drawing and notes interface

Figure 12 shows the programming block for type of games interface. When any of the button clicked, it will move to another screen. For example, when ShuffleBtn clicked, it will move to another screen which is Shuffle.

Mobile Application Design (Programming block)

1. User Registration and Sign In.

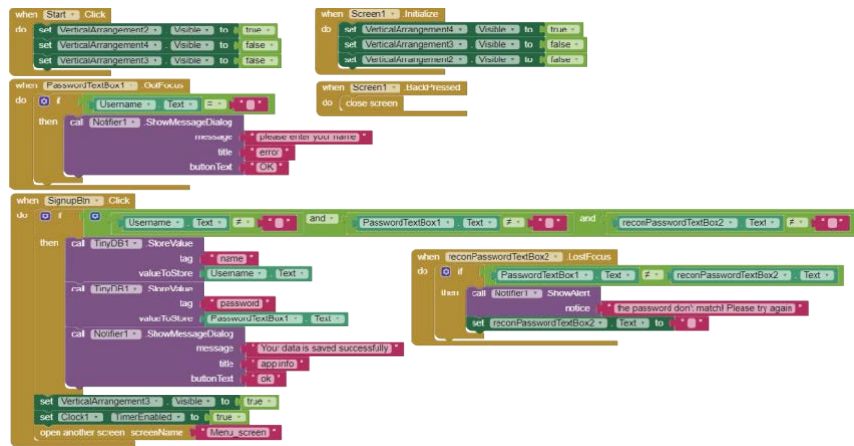


Figure 13: The programming block for User Registration and Sign In

The programming block shows the design of user registration. When Screen 1 which is the user interface initialize, Figure 10 will be appear. When sign up button pressed, the username and password will be recorded and saved to the cloud base which is in TinyDB1. There will be another box to fill in which is rewrite the password to make sure that the password is correct. Therefore, if the rewrite password is incorrect, the user will not be able to sign in.

2. Main Menu.

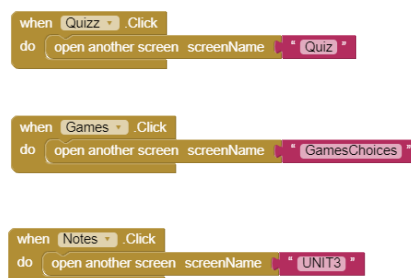


Figure 14: The programming block for Main Menu

3. Type of games.

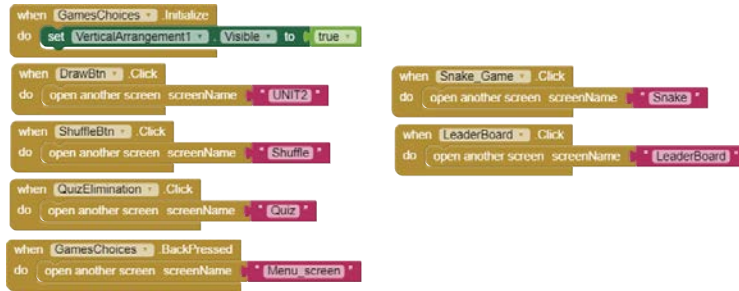


Figure 15: The programming block for type of games

4. Game 1: Quiz Elimination.

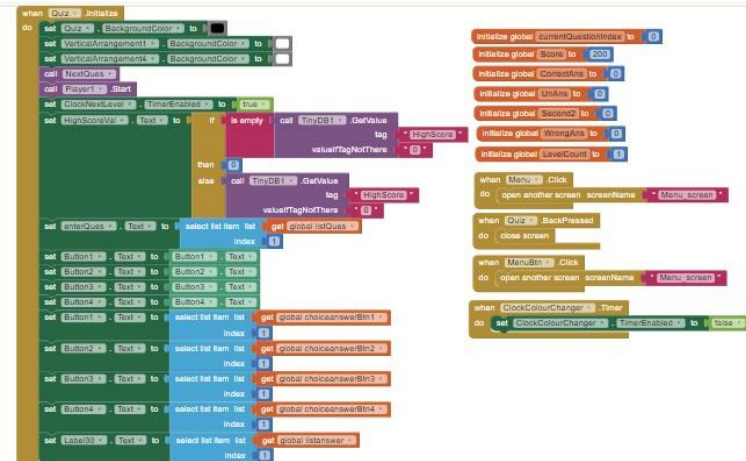


Figure 16: The initialization programming block for quiz elimination game

Figure 13 shows the input initialization for the quiz elimination game and the initialization of the screen of Quiz. There are 7 inputs which are current question index, score, correct answer, wrong answer, unanswered, second2 and level count. The current question index values were used for incrementing the value of questions from 1, 2, 3, ..., 12. The level count values were assigned to make the quiz elimination game progress. When screen Quiz is initialized, the important parts were the high score values which were recorded in the cloud base TinyDb1 and the initialization of the questions and the answers for the quiz elimination game.



Figure 17: The programming block for questions and answers in the quiz elimination game

Figure 17 shows the question lists, choices of answer with the options of 4 buttons and the list of answer. In MIT App Inventor, the make a list block works with following the sequence of the lists. For example, the first screen of question will have the first list of question, choices of answers of each button and the list of answer.

Figure 15: The programming block for answer's buttons in the quiz elimination game

Figure 15 shows the choices of answer with the visual of Button1, Button2, Button3 and Button 4. When any of the button clicked, it will check whether the answer is correct or wrong. If the answer is correct, it will call the correct answer's programming block and if it is wrong, it will call the wrong answer's programming block.

Figure 16: The programming block of correct and wrong answer in quiz elimination game

Figure 16 shows the programming blocks of correct answer and wrong answer. For correct answer, it will increase the value of overall correct answer to be appear after finishing the game. Next, it will increase the score and set the second back to 0 seconds. For wrong answer, it will increase the value of overall wrong answer and reduce the present score for 100 points. Next, it will set the second back to seconds. Lastly, both programming blocks will call the next question's block.

```

to NextQues
do
  if
    get global LevelCount = 13
  then
    call quiz_leaderboard .StoreValue
      tag length of list list call quiz_leaderboard .GetTags
      valueToStore make a list call TinyDB1 .GetValue
        tag name
        valueIfTagNotThere Anonymous
        LabelScore .Text
    if
      LabelScore .Text > HighScoreVal .Text
    then
      call TinyDB1 .StoreValue
        tag HighScore
        valueToStore LabelScore .Text
    set ScoreVal .Text to LabelScore .Text
    set CorrectVal .Text to get global CorrectAns
    set WrongVal .Text to get global WrongAns
    set UnAns .Text to get global UnAns
    set ResultVA .Visible to true
    set GameVA .Visible to true
    set ClockNextLevel .TimerEnabled to false
    set VerticalArrangement4 .Visible to false
    set HorizontalArrangement11 .Visible to false
    set VerticalArrangement2 .Visible to false
    set HorizontalArrangement5 .Visible to false
    set HorizontalArrangement7 .Visible to false
    call Player1 .Stop
  
```

```

else
  if
    get global LevelCount = 3 and LabelScore .Text < 60
  then
    call TinyDB1 .StoreValue
      tag HighScore
      valueToStore LabelScore .Text
    set ScoreVal .Text to LabelScore .Text
    set CorrectVal .Text to get global CorrectAns
    set WrongVal .Text to get global WrongAns
    set UnAns .Text to get global UnAns
    set ResultVA .Visible to false
    set GameVA .Visible to false
    set ClockNextLevel .TimerEnabled to false
    set VerticalArrangement4 .Visible to false
    set HorizontalArrangement11 .Visible to false
    set Resultnotgood .Visible to true
    set levelcounteli .Text to get global LevelCount
    set VerticalArrangement1 .Visible to false
    set scoreeli .Text to get global Score
    call Player1 .Stop
  
```

```
else if (get global LevelCount = 5 and LabelScore . Text < 120)
then
  call TinyDB1 .StoreValue
    tag "HighScore"
    valueToStore LabelScore . Text
  set ScoreVal . Text to LabelScore . Text
  set CorrectVal . Text to get global CorrectAns
  set WrongVal . Text to get global WrongAns
  set UnAns . Text to get global UnAns
  set ResultVA . Visible to false
  set GameVA . Visible to false
  set ClockNextLevel . TimerEnabled to false
  set VerticalArrangement4 . Visible to false
  set HorizontalArrangement11 . Visible to false
  set Resultnotgood . Visible to true
  set levelcounteli . Text to get global LevelCount
  set VerticalArrangement1 . Visible to false
  set scoreeli . Text to get global Score
  call Player1 .Stop
```

```
else if (get global LevelCount = 7 and LabelScore . Text < 240)
then
  call TinyDB1 .StoreValue
    tag "HighScore"
    valueToStore LabelScore . Text
  set ScoreVal . Text to LabelScore . Text
  set CorrectVal . Text to get global CorrectAns
  set WrongVal . Text to get global WrongAns
  set UnAns . Text to get global UnAns
  set ResultVA . Visible to false
  set GameVA . Visible to false
  set ClockNextLevel . TimerEnabled to false
  set VerticalArrangement4 . Visible to false
  set HorizontalArrangement11 . Visible to false
  set Resultnotgood . Visible to true
  set levelcounteli . Text to get global LevelCount
  set VerticalArrangement1 . Visible to false
  set scoreeli . Text to get global Score
  call Player1 .Stop
```

```
else if (get global LevelCount = 10 and LabelScore . Text < 360)
then
  call TinyDB1 .StoreValue
    tag "HighScore"
    valueToStore LabelScore . Text
  set ScoreVal . Text to LabelScore . Text
  set CorrectVal . Text to get global CorrectAns
  set WrongVal . Text to get global WrongAns
  set UnAns . Text to get global UnAns
  set ResultVA . Visible to false
  set GameVA . Visible to false
  set ClockNextLevel . TimerEnabled to false
  set VerticalArrangement4 . Visible to false
  set HorizontalArrangement11 . Visible to false
  set Resultnotgood . Visible to true
  set levelcounteli . Text to get global LevelCount
  set VerticalArrangement1 . Visible to false
  set scoreeli . Text to get global Score
  call Player1 .Stop
```

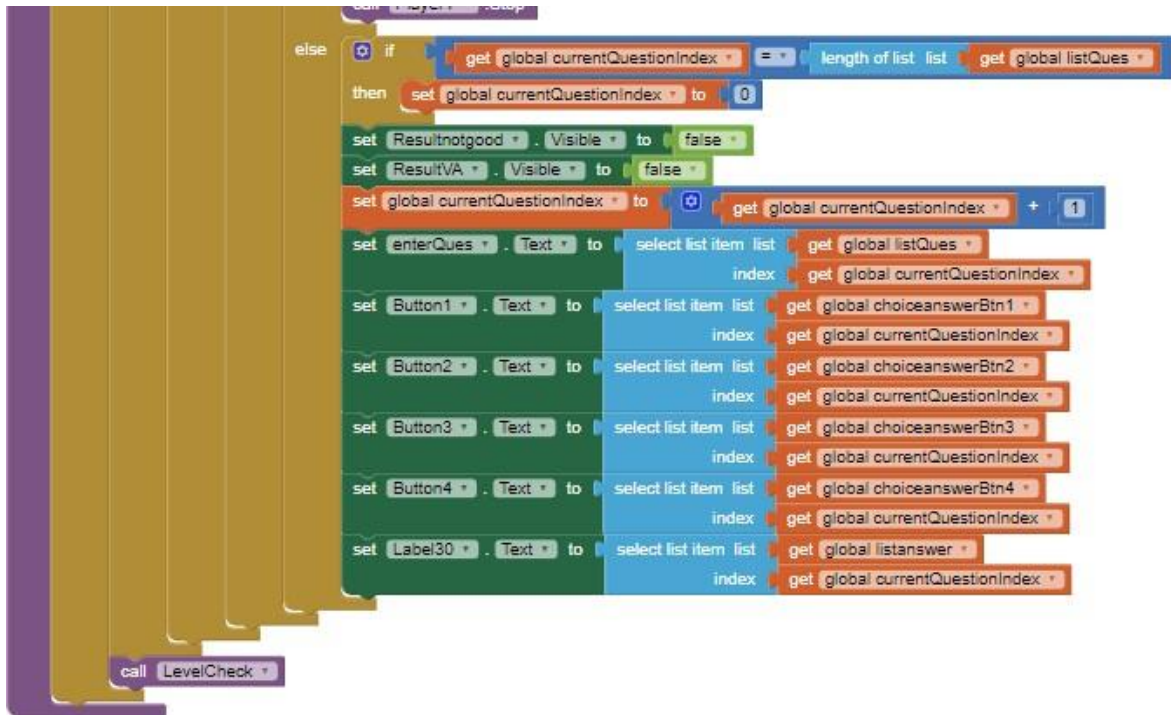


Figure 17: The programming block to eliminate the user from the quiz elimination game.

Figure 17 shows the next question's programming block which is the most important part of the quiz elimination game. It requires a lot of if then else block to complete the elimination sections of the quiz game. It started with if the level count reached the highest level, it will finish the game and shows all the scores and the value of correct and wrong answers. If the level count did not reach the highest level, it will pursuit to the next question as usual. The quiz elimination programming block started when the scores during specific level count is lower than required for example when the scores were 50 but the requirement to reach level 3 is 60, then the user will eliminate from the game. The specific level counts are 3, 5, 7 and 10 according to the programming block.



Figure 18: The programming block for timer in quiz elimination game

Figure 18 shows the programming block for timer conditions in quiz elimination game. The game started with the initial time of 0 second and 59 seconds will be allocated to each question. If the timer reached 59 second, then the question will be taken in wrong answer value.

5. Game 2: Shuffle Tiles

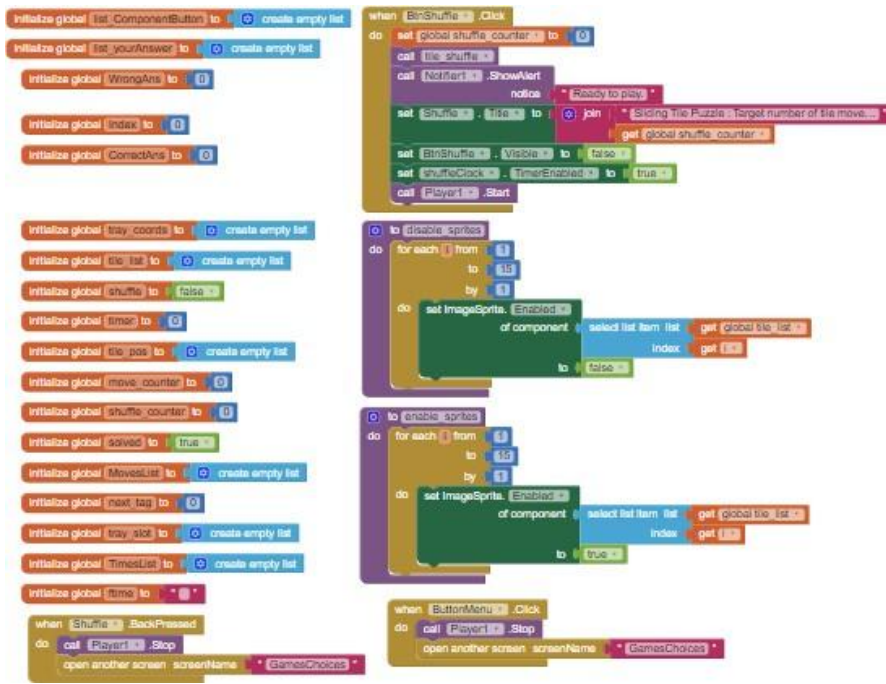


Figure 19: The initialization programming block for shuffle tiles

Figure 19 shows the initialization of shuffle tiles game. When shuffle button clicked, the counter is set to 0 and user can start to shuffle the tiles until it finished. Besides, there were initialization of quiz values to answer when the game finished. Additional function such as sounds and songs to make the game more entertain has been added in the programming block.

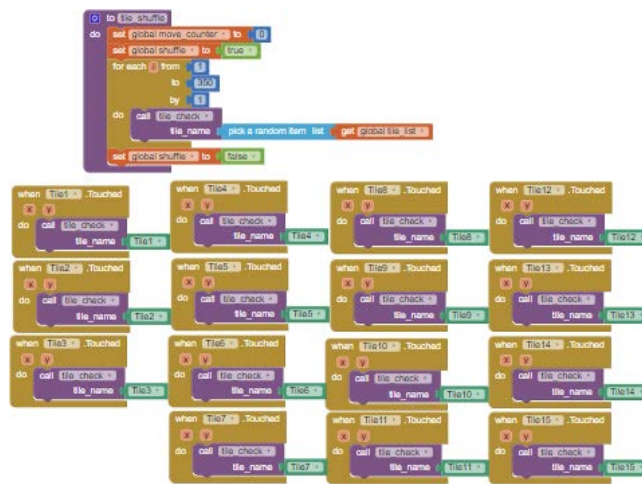


Figure 20: The tile shuffle programming block in the shuffle tiles

Figure 20 shows the total tiles to be played which were 15 tiles. The call function of shuffle tiles helps to navigate the tiles either in the direction of left, right, up, and down.

```

to tile move news file_num tilepos
do
  initialize local coords to create empty list
  initialize local x to 0
  initialize local y to 0
in
  set coords to select list item list get global tray_coords -
  index get news -
  set x to select list item list list from cav row text get coords -
  index 1
  set y to select list item list list from cav row text get coords -
  index 2
  call ImageSprite.MoveTo
  for component select list item list get global tile_list -
  index get file_num -
  x get x -
  y get y -
  replace list item list get global tile_pos -
  index get file_num -
  replacement get news -
  replace list item list get global tray_slot -
  index get news -
  replacement get file_num -
  replace list item list get global tray_slot -
  index get tilepos -
  replacement 0
if get global shuffle -
then
  set global shuffle_counter to get global shuffle_counter + 1
else
  set global move_counter to get global move_counter + 1
  set LibMoves - .Text to join Moves -
  get global move_counter -
if solved -
then
  call Nibiru1 - ShowMessageDialog
  message join Well done, You solved it in -
  LibTimer - .Text -
  with -
  get global move_counter -
  moves -
  title Sidara
  buttonText OK
  call shuffleScoreDB - StoreValue
  tag join Times -
  valueToStore get global next_tag -
  call shuffleScoreDB - StoreValue
  tag join Moves -
  valueToStore get global next_tag -
  call Shuffle_leaderboard - StoreValue
  tag length of list list call (Shuffle_leaderboard) - GetTags
  valueToStore make a list call TinyDB1 - GetValue
  tag name -
  valueIfTagNotThere Anonymous -
  get global move_counter -
  call read_scores -
  set BinShuffle - Visible to true -
  set Shuffle - Title to Sidara Tile Puzzle: Press the shuffle button on it -
  set LibMoves - .Text to Moves 0
  set LibTimer - .Text to time:00:00:00
  set shuffleClock - Timer.Enabled to false -
  set PartQuiz - Visible to false -
  set PartResult - Visible to false -
  set PartShuffle - Visible to false -
  set partQuizQuiz - Visible to true -

```

Figure 21: The programming block for coordination of the shuffle tiles

Figure 21 shows the tile move programming block to set the coordination of the tiles. Next, the global shuffle counter was recorded as the tiles moves, the counter increases. Furthermore, the game was recorded in the cloud base which was in TinyDB and put in the scoreboard.

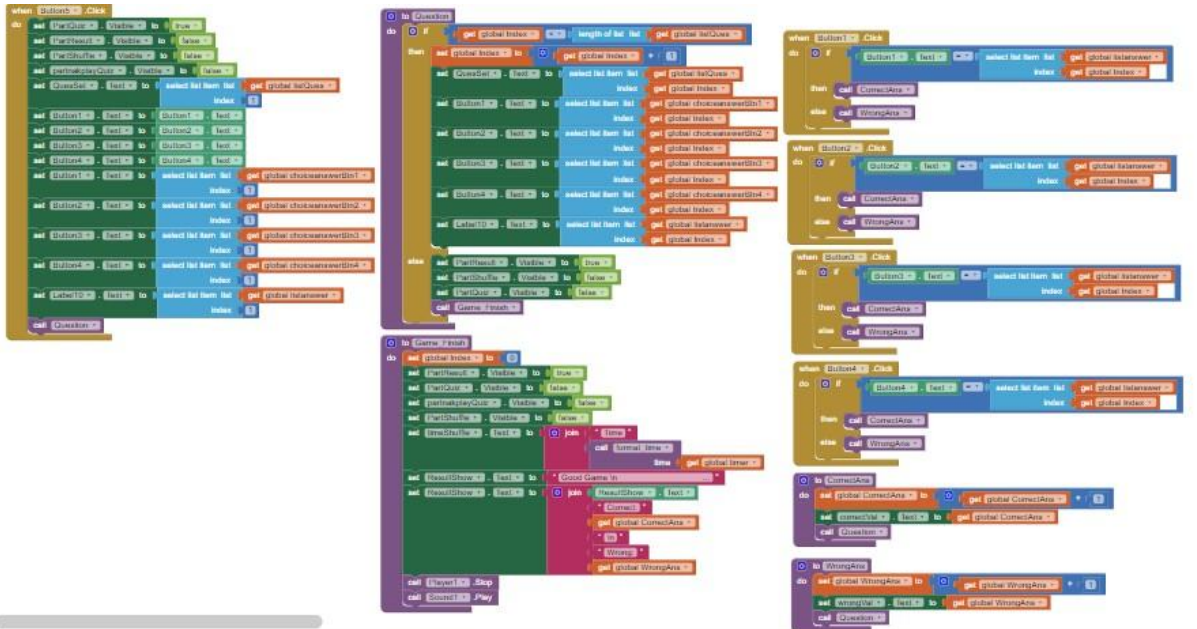


Figure 22: The programming block for quiz in the shuffle tiles

Figure 22 shows the question part in the shuffle tiles game. The initialization block of the question sets, and answers were the same as in Figure 14. When the question has been answered, it will return to the shuffle tiles and the user will be able to continue playing the game.

6. Game 3: Snake Game

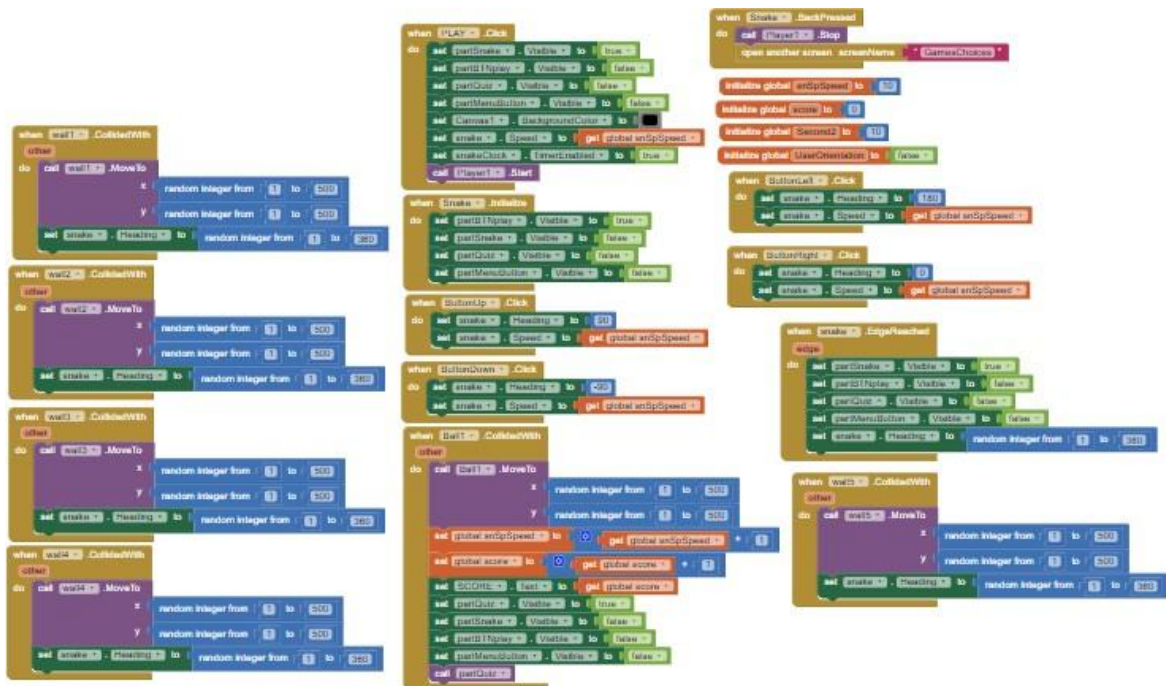


Figure 23: The programming block of initializing the snake game.

Figure 23 shows the programming block of snake game. The snake can be controlled with the direction of left, right, up, and down. There will be a different direction which is oriented direction that user can tilt their phones to move the snake. Walls were introduced to limit the snake's movement as the snake collided with the wall, it will randomly move the snake to other direction.

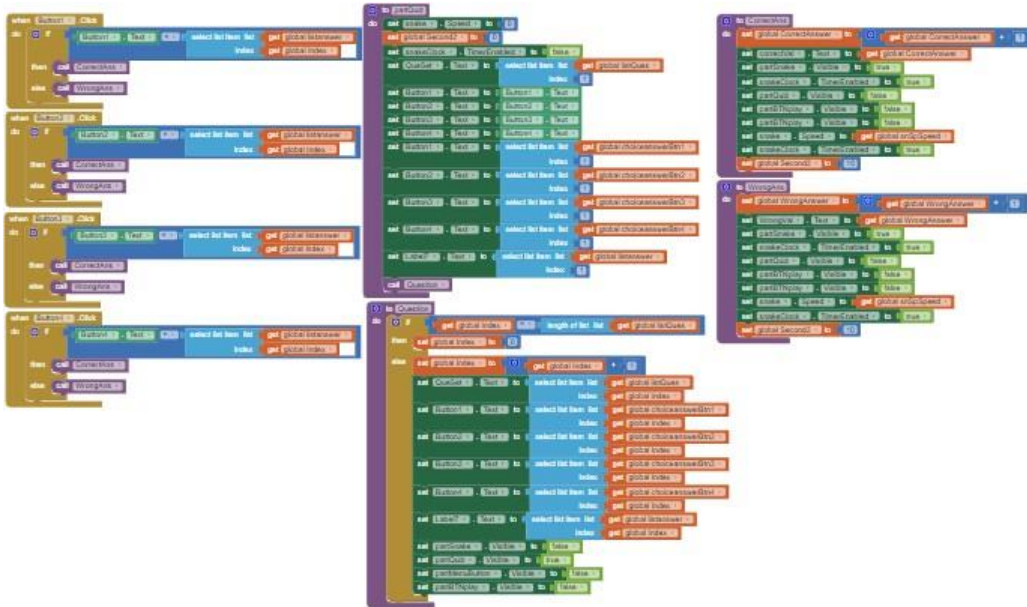


Figure 24: The programming block for quiz in the snake game

Figure 24 shows the quiz programming block for snake game. The blocks were the same as the quiz elimination game but there was a little adjustment on the present of the quiz due to the snake game. The quiz will pop up after the snake has reached the ball and there will be a set of timers for each of the questions.

7. Scoreboard

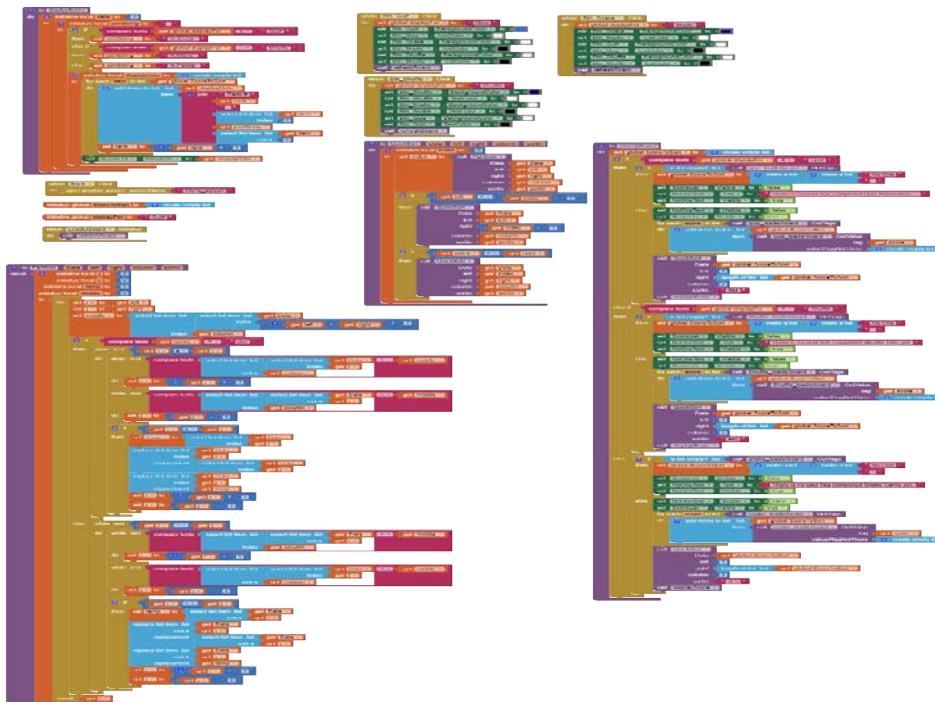


Figure 25: The programming block for scoreboard

Figure 25 shows the programming block for the scoreboard interface. There were three types of games for the scoreboards which were quiz elimination, shuffle tiles and snake games. The scoreboard recorded the user's scores in the game and displayed it the scoreboard table. Bu using call function, which was get value from the programming block, the data from each game will be presented in the scoreboard table with the user's name in the list.

8. Additional Functions. (Drawing and notes)

```

when UNIT2.Initialize
do set VerticalArrangement1.Visible to true

when GreenBtn.Click
do set Canvas1.BackgroundColor to green

when GrayBtn.Click
do set Canvas1.BackgroundColor to gray

when WhiteBtn.Click
do set Canvas1.BackgroundColor to white

when BlueBtn.Click
do set Canvas1.BackgroundColor to blue

when UNIT2.BackPressed
do open another screen screenName GamesChoices initialize global savecount to 1

when ClearBtn.Click
do call Canvas1.Clear

when SaveBtn.Click do eva...
when Canvas1.Dragged st...
  
```

Figure 26: The programming block for drawing function

```

initialize global note_list to create empty list

when UNIT3.Initialize do ...

when DeleteBtn.Click
do if ListView1.SelectionIndex != 0
then remove list item list get global note_list
index ListView1.SelectionIndex
call TinyDB1.StoreValue
tag Notes
valueToStore get global note_list
set ListView1.Elements to get global note_list
call Notifier1.ShowAlert
notice Your Note is deleted.
set ListView1.SelectionIndex to 0

when CleaBtn.Click
do set ListView1.Elements to create empty list
set global note_list to create empty list
call TinyDB1.ClearTag
tag Notes
call Notifier1.ShowAlert
notice All your Notes are deleted.

when UNIT3.BackPressed
do open another screen screenName Menu_screen

when BlueBtn.Click
do set TextBox1.BackgroundColor to cyan

when SaveBtn.Click
do add items to list list get global note_list
item TextBox1.Text
call TinyDB1.StoreValue
tag Notes
valueToStore get global note_list
set ListView1.Elements to get global note_list
set TextBox1.Text to
call Notifier1.ShowDialog
message Your Note is saved Successfully!
title App Info
buttonText OK
  
```

Figure 27: The programming block for notes function

Figure 26 and Figure 27 show the programming block for drawing and creating notes, respectively. It helps adding other functions to help users to add their notes.

Discussion

Education-based apps provide more learning methods to help students in their daily basis study. In QuiZZo mobile application, we created the application by using MIT App Inventor because it is user friendly, and the important part is free. Besides, QuiZZO helps the students to have the interactive learning with the lecturers as the application have the balance between games and quizzes.

QuiZZO brings the alternative method to be presented in online class. It helps students to understand more about the subject which is Communication Principles via quizzes. Quizzes such as trivia questions can help student's understanding for the subject while having fun playing the game such as shuffle tiles and snake game. Apart from that, there is a game called quiz elimination game in QuiZZO where students need to finish a certain level with good scores, or they will be eliminated. This brings more challenges to the students as it provides more adrenaline to the students to understand the questions in a challenging environment. This ensures that the application benefits the students in the form of active learning in an entertaining way.

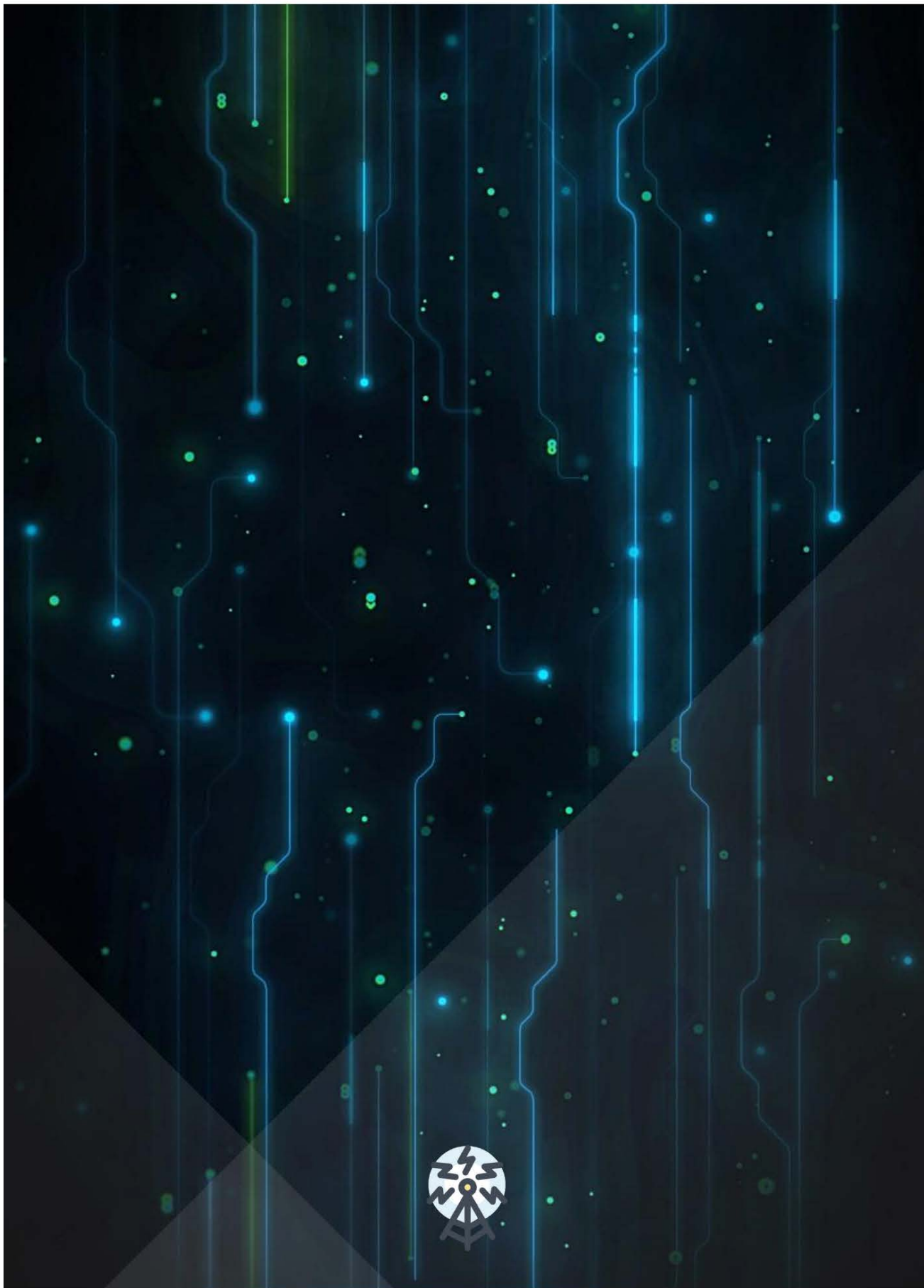
QuiZZO mobile application also provides scoreboard for students to keep track their scores in the games. There will be a scoreboard presenting their scores for each game such as quiz elimination, shuffle tiles and snake games. This helps the students to compete with their friends in a healthy competition as the scores rank from first to last. This increases the entertainment value through mobile application and help the students become better in understanding the content of the subject. QuiZZO also provide extra content to the students via drawing and notes. Students can jot down anything in the notes section and these additional functions helps the application to be friendlier to the user.

Conclusion

In conclusion, QuiZZo would be a useful application for students and lecturers to increase the interaction between them. Workflow models are important to explain how students can communicate successfully with such technologies and how lecturers can create a single collaborative project using the vast collection of software available to them in the app store. As the online learning is a new norm for society, all education institution must adapt to the situation. This application is great to be the steppingstone for the online learning method. We as the developer hope the institution will provide more opportunity for the students and lecturers to interact.

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