ONLINE CLASSROOM ATTENDANCE SYSTEM USING FACIAL RECOGNITION

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This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Computer Networking) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I hereby declare that this project report entitled

ONLINE CLASSROOM ATTENDANCE SYSTEM USING FACIAL RECOGNITION

is written by me and is my own effort and that no part has been plagiarized

without citations.

STUDENT : Wong Zhi Shing Date : 02 SEPTEMBER 2021

(WONG ZHI SHING)

I hereby declare that I have read this project report and found

this project report is sufficient in term of the scope and quality for the award of

Bachelor of Computer Science (Computer Networking) with Honours.

SUPERVISOR : _____ Date : 31/8/2021

(ASSOC PROF TS. DR ROBIAH YUSOF)

DEDICATION

I would like to dedicate this thesis to my beloved parents who have always give support and motivation to me unconditionally, my friends who give courage and help to me whenever I stumble into problem and lastly the highest appreciation goes to my supervisor, Assoc Prof Ts. Dr Robiah Yusof for her patience and guidance in this thesis.

ACKNOWLEDGEMENTS

I would like to thank Assoc Prof Ts. Dr Robiah Yusof for giving assistant to complete this project successfully. I highly appreciate her patience in guiding me through out this thesis.

I would also like to thank my beloved parents who have been giving me support and motivation throughout my project. Their endless dedication give me a lot of strength so that I could complete this project successfully.

ABSTRACT

Online classroom attendance system has been implemented in many institutions and places. It helps to enhance the accessibility and increase the efficiency of attendance registration process. Due to the pandemic Covid-19 outbreak, online attendance system are now adopted by every institution as all classes are switched to virtual mode. In Universiti Teknikal Malaysia Melaka, most of the classroom attendance are taken using google form or virtual platform participants. The question raised for virtual attendance is that student identity could not be verified as registration using google form can be easily fake by other person. Legitimate of student attendance is important because study found that there is a positive correlation between attendance of students and their performance in examination and coursework. Another problem of the current attendance registration method is that it does not provide attendance registration record to students. In another word, student register their attendance but they are unable to verify whether their attendance are successfully recorded in the system. This project aim to develop an online classroom attendance system that has capability to verify virtual identity of student and able to provide accurate classroom attendance record to student. Out of many identity verification method, only fingerprint and facial recognition verification are viable for virtual classes as it able to verify a person live, where student must present at the moment of verification. The proposed solution is a web-based attendance system that implemented facial recognition to provide virtual identity verification for attendance registration. This solution opted for a cheaper implementation cost compared to fingerprint verification as it only required digital camera to capture facial image of the students. Students, lecturer and management team of institution would benefit from using this system as it is has high accessibility, convenient and able to verify virtual identity of students.

ABSTRAK

Sistem Kehadiran Kelas dalam talian telah digunakan di pelbagai institusi. Ia membantu meningkatkan kebolehcapaian dan kecekapan dalam proses pengambilan kehadiran. Oleh kerana pendamik Covid-19 berleluasa, kebanyakkan institusi telah mengaplikasikan sistem kehadiran kelas dalam talian kerana semua kelas telah beralih ke mod maya. Di Univerisiti Teknikal Malaysia Melaka, kehadiran kelas maya kebanyakkan diambil dengan mengunakan borang google atau pelantar maya yang lain. Persoalan pertama untuk kehadiran kelas maya ialah pengesahan identiti pelajar tidak dapat dilaksanakan dan kehadiran pelajar dapat dipalsukan oleh orang lain. Persoalan seterusnya ialah cara pengambilan kehadiran kelas maya semasa tidak menyediakan rekod kehadiran kelas kepada pelajar untuk tujuan semak semula. Projek ini bertujuan untuk membangunkan sistem kehadiran kelas dalam talian yang mempunyai kemampuan untuk mengesahkan identiti maya pelajar dan memberikan rekod kehadiran kelas yang tepat kepada pelajar. Daripada pelbagai kaedah pengesahan identiti, hanya pengesahan mengunakan cap jari dan pengesahan mengunakan pengecaman wajah sesuai untuk diaplikasikan dalam sistem kehadiran kelas dalam talian kerana kaedah tersebut mampu mengesahkan identiti seseorang secara langsung, iaitu pelajar perlu hadir pada masa mengambil kehadiran kelas maya. Penyelesaian yang dikemukakan dalam projek ini ialah sistem kehadiran kelas dalam talian berasaskan laman web bersepadu dengan API pengecaman wajah untuk memberikan fungsi pengesahan identiti maya dalam pengambilan kehadiran kelas. Solusi ini dipilih atas kos pelaksanaan yang lebih murah berbanding dengan pengesahan mengunakan cap jari kerana solusi ini hanya memerlukan kamera digital untuk menangkap wajah pelajar. Sistem ini dapat memanfaatkan para pelajar, pensyarah dan pasukan pengurusan institusi kerana sistem ini mempunyai kebolehcapaian yang tinggi, senang digunakan dan berkebolehan untuk mengesahkan identiti maya pelajar.

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UTeM
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF ABBREVIATIONS

FYP	**-**	**Final Year Project**

LIST OF ATTACHMENTS

CHAPTER 1: INTRODUCTION

1.1 Introduction

Class Attendance is a proof for student participation in a classroom. This is to make sure that student is present to the class before taking examination. The requirement for attendance in Universiti Teknikal Malaysia Melaka (UTeM) is student must present for at least 80% of the class time of a particular course throughout a semester. A study found that there is a positive correlation between attendance of students and their performance in examination and coursework. Based on their finding, the general attendance data in 2013/2014 and 2014/2015 for module PHA312, the average attendance across this two years are approximately 80 percent. Student module feedback was excellent across both years. Overall satisfaction for these students are above 90 percent. There is a need for attendance monitoring policies within degree students, especially in most courses are adopting the internet based teaching technologies as the new teaching method. (Irwin et al, 2018).

However, due to pandemic Covid-19 outbreak in our country, all of the classes are switched to virtual mode where student participation in virtual classroom could not be verified as most of the classroom attendance are taken using google form or virtual platform participants. This would cause difficulties in verifying student identity as other student might filling up the form for them and manually checking every class attendance would also burden lecturer and this might lead to human error.

In order to overcome this issue, this project intended to implement a new approach of taking classroom attendance by using online classroom attendance system based on facial recognition. By using this approach, the process of taking

classroom attendance with verification would be more efficient and lecturer can have less worried about attendance of class and focus more in teaching students.

1.2 Project Background

Attendance culture has long been used in worldwide regardless of what field it is apply into. In education field, attendance system is apply for all stages whether it is in primary school, secondary school or universities. Before the pandemic of Covid-19 happen, most class around the world are using face to face method where present of student in classes can be easily verified. However, for current pandemic situation where most classes are held in virtual mode, student participation in class are unable to be verify. This issue will cause a sizable impact to student participation in class.

The most significant problem is complex and inefficient approach for taking attendance in virtual classroom. Class attendance recording are common practice in most educational institution. Sign-in-sheet or roll-call are known as the conventional practices for student attendance recording inside a classroom. Nevertheless, there are few problems for this convolution practices like labour intensiveness, distraction and time wasting, especially for institution which enforce compulsory attendance policy. (Budi, 2018) Various institution are facing problems in maintenance of student attendance. The method of taking attendance varies from one another. Some are using attendance sheet or some using biometric methods. These method are time consuming. (Varadharajan, 2020)

Study shows that attendance management is important for most organization particularly in educational institution. It can control and manage any organization to achieve success by monitoring attendance of people within the organization such as students to improve their performance. Future improvement can be made are to takes the attendance by other methods like face recognition, fingerprint biometrics technique, NFC and RFID technologies. (Jacksi, 2018)

In addition, student identity in virtual classroom are unable to be authenticate automatically. During the class session in virtual mode, verification of student identity are often done in manually which lecturer will call up each student name to ask for their respond. This process is time consuming and sometimes it will interrupt the

atmosphere of study among students inside class. Besides, most student attendance is taken by their friends and authentication of student is difficult to be verified. Furthermore, calculation of attendance is another issue which might contain human error. (Varadharajan, 2020).

An automated attendance system using face recognition which is apply in classroom (not virtual class) is introduce in a study. It proposed that this system can overcome the chances of student making fake attendance. It further conclude that face recognition are a good alternative compared to biometric verification system due to its high accuracy and required minimal human intervention. (Sawhney, 2019)

Moreover, the current attendance recording method used have another problem which is student are unable to acknowledge the status of attendance taken in virtual classroom. In another word, student take their attendance by using google form, WhatsApp, telegram or others method, but they are unable to check whether their attendance is successfully recorded inside the system. The root cause of this problem is because of the process of recording student attendance into the attendance system are perform manually by lecturer and the system is inaccessible by students. There are now a way for student to check the attendance information and take the attendance automatically. To summarize the problems stated, table 1.1 shows the summary of problem on the current attendance taking method used for virtual classroom in the campus.

1.3 Problem Statement

Due to pandemic Covid-19, most of the education platform are switch to virtual mode, in which students participation in virtual classes are extremely important to their academic performance. The students can fake their attendance in classroom by asking classmate to fill up the attendance taking form for them. However, the lecturer are unable to differentiate whether the attendance taken are legitimate one but actually taken by other person. The Problem Statement (PS) is summarized into Table 1.1.

Table 1.1 Summary of Problem statement

PS	Problem Statement
PS1	Difficult to verify the participants in virtual classroom because the identity of participant in virtual classroom cannot be authenticate automatically as current attendance taking approach are inefficient and complex and status of virtual classroom attendance are not given to students.

1.4 Project Question

The purpose of this project is to develop an online classroom attendance system that address to the above research question. Project question are correlate to the problems occur in the problem statement as shown in Table 1.1. Table 1.2 will show the summary of project questions based on the problem statement mention in 1.2.

Table 1.2 Summary of Project Questions

PS	PQ	Project Question
PS1	PQ1	What is the system requirement of online classroom attendance system?
	PQ2	How to develop a attendance system that are able to verify student identity in the attendance of virtual classroom
	PQ3	How to validate the accuracy of online attendance system?

1.5 Project Objective

Table 1.3 Summary of Project Objectives

PS	PQ	PO	Project Objective
PS1	PQ1	PO1	To analyse the system requirement of online classroom attendance system.

	PQ2	PO2	To develop a web-based online classroom attendance system based on facial recognition.
	PQ3	PO3	To provide an accurate student attendance status in online attendance system

PO 1: To analyze the system requirement of online classroom attendance system. A server will be used to host the system and process all the request from virtual classroom participants to record down their attendance. Students login to the online attendance system remotely and record their attendance directly into the system without human intervention.

PO 2: To develop a web-based online classroom attendance system based on facial recognition. The system will utilize facial recognition technology to recognize and verify student identity during every class session.

PO 3: To provide accurate student attendance status in online attendance system. The student attendance detail are recorded in the attendance system. Student are given authority to check their attendance status directly from the server to make sure there is no mistake.

1.6 Project Scope

In this project, the project scope involved is to provide a baseline understanding of the system. Two major scopes for this project are to simplify the process of taking attendance in virtual classroom and enforcing a convenient verification method for online attendance system. This project will be focusing in two parties, the students (client-side) and the system (server-side). Students should be able to login and record their attendance virtually and automatically through the website and identity verification are using facial image during the attendance taking process. Moreover, this system is a standalone web system that will use laptop camera to capture and process the facial image to allow student successfully record their attendance in classroom.

1.7 Project Contribution

For the project contribution aspect, this project will contribute to many parties especially the education sector. The current attendance taking process in virtual classroom are unverifiable and can be enhance by using the mechanism that will be implemented in this project. This project idea is the possibility of students' participation in virtual classes can be verified automatically by utilizing the advancement of current facial recognition technology.

Table 1.4 Summary of Project Contribution

PS	PQ	PO	PC	Project Contribution
PS1	PQ1	PO1	PC1	The system requirement for online classroom attendance system using facial recognition
PS2	PQ2	PO2	PC2	The method to verify individuals automatically in online classroom attendance system using facial recognition
PS3	PQ3	PO3	PC3	A online attendance system that provide accurate attendance status checking for students

1.8 Project Organization

In this project thesis, there are seven chapters which consist of introduction, literature review, methodology, analysis and design, implementation, testing and conclusion. The summary of each chapter will be discussed below.

Chapter 1: Introduction

For the first chapter which is the introduction of the whole project. In the introduction, it can be further divide into few sub topic which are problem statement, project question and objectives, project scope, and project organisation. Each of these topic are presented in this chapter. Generally, chapter 1 is discuss about the purpose of this project system and its benefits to the community. Project contribution and project organisation are provided here as well.

Chapter 2: Literature Review

For the second chapter which is the literature review of the project. In this chapter, it stress more in the clarification of published thesis and other reading materials. Besides using the published thesis, journals and articles that are related to classroom attendance are also being used as reference in analysing the main tool that is used specifically for this project.

Chapter 3: Methodology

For the third chapter which is the project methodology, it emphases on the lifecycle of developing the project. Method and approach of developing the system will be discussed and explained in the later chapter.

Chapter 4: Analysis and Design

For the forth chapter which is the analysis and design of the project system. In this chapter, it consist of few sub topic which are problem investigation, analysis requirement and the overall design of the system. For the problem investigation, it discussed about the details of problem statement provided in chapter 1, for the analysis requirement, it focused on the hardware and software requirement while for the overall design of the system, high level design and detail design are discussed in this chapter.

Chapter 5: Implementation

For the fifth chapter which is implementation, it emphases on how the project execution is carry out. The project system will implement the facial recognition API to verify students present in virtual classroom. Details of the system implementation will be documented in this chapter.

Chapter 6: Testing

For the sixth chapter which is about the testing to the system. In this chapter, it stress on the project testing plan, test design & result, and the analysis of the project. The test plan executed can be further divide into three parts which is the test organization, test environment and the test schedule. Consequently, testing data are used to describe the test design and the testing results are further analyzed in chapter 6.

Chapter 7: Conclusion

For the last chapter which is the project conclusion, it emphases about the summary of the whole project. This chapter includes the project contribution & limitation, reflection on both weakness and strengths, suggestion and improvement can be made for future development are discussed in this chapter.

1.9 Summary

In a nutshell, chapter one is about the general details information regarding to the project aim, purpose, reason and the outcome of conducting this project. The following chapter is literature review that is going to present on the related work done by other researchers and problems correlate to the project domain.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Literature review or narrative review is a kind of article review. A comprehensive literature review are conducted, which will be include with the current knowledge such as substantive finding, theoretical contribution and methodological contribution to a specific subject. In the next section, a study regarding to related work of online classroom attendance system including the classroom attendance system, facial recognition, previous work, critical review and propose solution will be further elaborate in this project.

2.2 Structure Framework

Figure 2.1 shows the structure framework for this chapter. This framework will serve as a guideline of what will be study in this chapter. Aside from that, this framework also very useful in summarizing the title in this chapter.

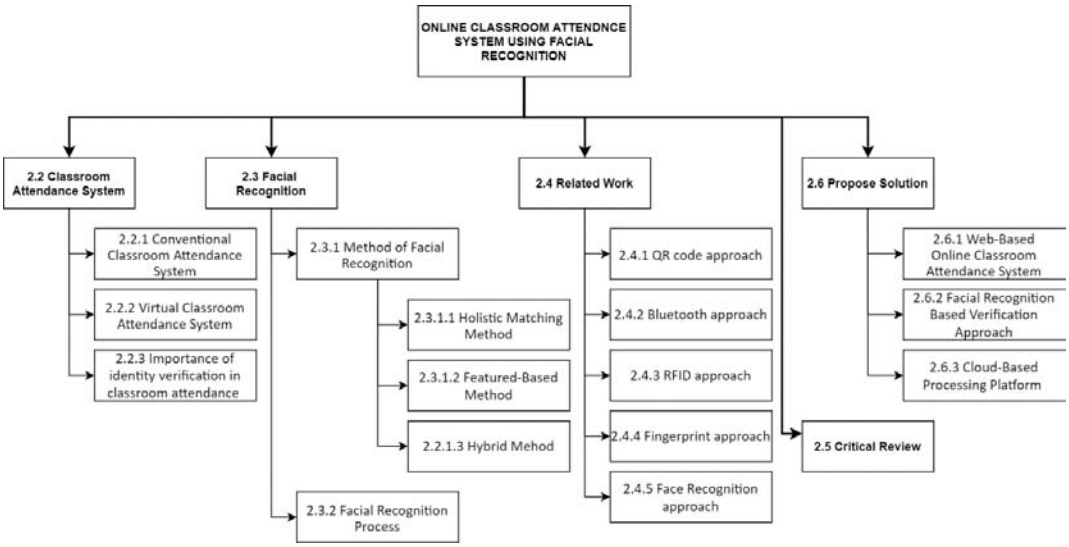


Figure 2.1 Structure Framework

2.3 Classroom Attendance System

For education sector especially in university level, classroom attendance is required and will be checked when student are taking final examination for the particular course. Therefore, there is a system that record these data which widely known as classroom attendance system or class attendance system.

2.3.1 Conventional Classroom Attendance System (Face to Face)

In current technology advancement era, there are various method of taking attendance whether with or without identity verification but in most academic institution still prefer to use paper-based to record classroom attendance. This old school method is very simple where lecturer will pass the name list for student to sign it for student who attended the class. However, false attendance happen frequently and easily. Besides, lecturer need to spent significant amount of time to calculate the report and chance of human error existed in there as stated by (MMT Htar et al, 2019). Lately, there are some institution trying to implements new way of classroom attendance system such as QR code verification for conventional classroom attendance.

2.3.2 Online Classroom Attendance System (Virtual)

Due to pandemic covid-19, most of the academic institution are conducting the classes through online platform which the conventional way of record student attendance need to be changes. The current trend of taking online classroom attendance system is by using google spreadsheet which widely known as Google form. Google spreadsheet is a useful tool for lecturers in managing students' attendance online. The reason is because google form can be published easily on web through unique url generated by google as mention by (AZ Mansor, 2011). Some lecturer uses other platform such as WhatsApp and telegram to record attendance as these method are very similar to google form which both method are unable to verify student identity.

In this project, we are going to develop a class attendance system for virtual class as current trend of academic institution are using virtual teaching method in order to prevent the spread of pandemic Covid-19.

2.3.3 Importance of identity verification in classroom attendance

Prior research have proven a strong relationship between student attendance rate and their academic performance. Therefore, most of the academic institutions have enforce the policy of record student attendance suggested by (A Puckdeevongs, 2020) and students with attendance rate less than 80% are unqualified pass the subject.

Based on a finding of a study in a university in South Africa done by (Amoo, 2020) shows that senior's student in the researched group have more awareness of to the important of classroom attendance with its influence on academic performance compared to first year students. The average attendance of senior students is 55 percent with 63 percent passing rate while first year student average attendance is only about 48 percent with 44 percent passing rate. Another study on the correlation between class attendance and academic performance in the subject digital electronics perform by (Navas-Gonzalez, 2020) conclude that although class attendance cannot be proven as the fundamental success in the subjects, however it does shows that success in the subject comes along by regular class attendance.

Another research according to (Irwin et al, 2018) also found that there is a positive correlation between attendance of students and their performance in examination and coursework. Based on their finding, the general attendance data in 2013/2014 and 2014/2015 for module PHA312, the average attendance across this two years are approximately 80 percent. Student module feedback was excellent across both years. Overall satisfaction for these students are above 90 percent. There is a need for attendance monitoring policies within degree students, especially in most courses are adopting the internet based teaching technologies as the new teaching method.

2.4 Facial Recognition

Facial recognition is a kind of biometric verification method which comparing face image that stored in database with sample images for confirmation. Identical to other biometric verification method such as iris recognition, fingerprint recognition and DNA recognition. It has the ability to authenticate individuals' identity stated by (E Jiang, 2020).

The facial recognition are mainly used for two task which is verification and identification. Verification is a process of one to one matching. A face image of an unknown person with a claim of identity, authenticating whether the person is who he claimed to be. Identification is a one to many matching process. An unknown person facial image are given to determine the identity of the person by comparing image of known person in the database as discussed by (R Jafri, 2009).

2.4.1 Method of facial recognition

Generally, there are three different method used to conduct facial recognition which are holistic matching method, feature-based (structural method) and hybrid method stated by (DN Parmar, 2014).

2.4.1.1 Holistic Matching Methods

By using holistic approach, the full region of face is used as input data into the face catching system. Eigen faces are one of the best example of holistic methods and are used widely for face recognition mentioned by (S. Suhas, 2012).

2.4.1.2 Feature-based (structural) Methods

By using structural approach, it will extract local feature first (eyes, nose and mouth etc.) and their local statistic (appearance and geometric) and location are fed into the structural classifier. There are three extraction method in general. The first one is Generic methods based on edges, lines, and curves. The second one is feature-template-based methods and the third one is structural matching methods.

2.4.1.3 Hybrid Methods

By using hybrid approach, it combined both holistic method and feature extraction method. 3D images are commonly used in hybrid method. The face of a person are capture in 3 dimension, allowing the system to note the shape of forehead and chin, the curvature of the face and eye socket. The system would uses measurement axis and depth in a face profile so that it can have satisfied data to construct a full face according to (DN Parmar, 2014).

Table 2.1 shows the advantages and disadvantages of facial recognition method.

Table 2.1 Advantages and Disadvantages of Facial Recognition Method

Method	Advantages	Disadvantages
Holistic Method	-Easy and time efficient in reducing dimension size of an image -Has good correlation between training set data and the facial recognition data	-The accuracy depends on multiple aspect especially lightning can greatly reduce the accuracy.
Featured-Based Method	-Flexible to image background (size, orientation and lightning) -Has compact representation ability and fast matching speed	-No discrimination ability -No auto detect feature
Hybrid Method	-Combination of both method which can produce better accuracy -Disadvantages of one method can be solve/fix by advantages of other method	-Consume a lot of computational power

Hybrid method is the better option compared to feature-based method and holistic method as it is the latest technology and has better accuracy in facial recognition field. Therefore, this project will implement facial recognition using this approach as the computational power downfall can be solve by cloud computing technology.

2.4.2 Facial Recognition Process

(M Sahu, 2020) stated that facial recognition process involves the four steps in general as shown in Figure 2.2:

- Face detection

  Initially, faces in an image are identified and mark with a bounding box

- Face Alignment

  In this phase, the detected faces are normalized to take in account of faces geometry and photometric

- Feature extraction

  Next, the facial features are extracted separately for next phases

- Face Recognition

  Lastly, classifier are applied in order to recognize the faces by matching image stored in database.

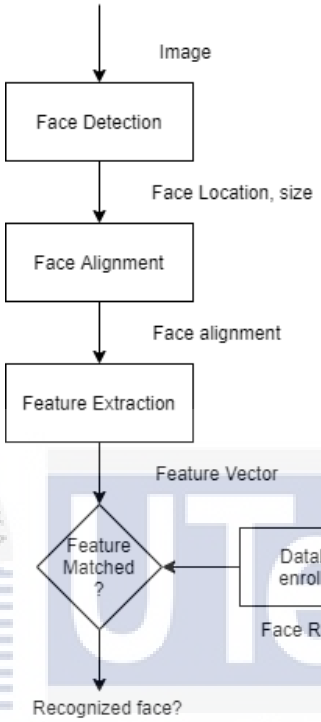


Figure 2.2 Facial Recognition Process

Based on Figure 2.2, it can be seen that the process of facial recognition are very complex and consist of various stages. Each of the stages in image processing will required significant amount of computational power and that is the reason of cloud-processing platform are suggested for image processing platform in this project.

2.5 Related Work

The literature review performed are based on the related domain to this project. Keyword used in this project include, class attendance, online attendance and facial recognition. These keyword are used to find various related journal article reviews and other previous work from certified bibliographic database such as IEEE explore, Research Gate and others.

2.5.1 QR code approach

(YK Hooi, 2018) have design a attendance system that make use of smartphones scanning through a QR code on a projected computer's screen which call "Multi-Factor Attendance Authentication System", the system will record the student attendance by QR code and the lecturer are able to generate and print attendance report. Their system was aimed to prevent current attendance vulnerabilities which is fake attendance. The technique used to is by identifying IMEI of the device as means of identification, QR code as token, GPS are also used to identify student location. The integrity of this system depend very much to the student's device location but not to the student. This system uses the client-server architecture where a local web server is uses to handle client request from mobile application.

2.5.2 Bluetooth approach

"Classroom Attendance Systems Based on Bluetooth Low Energy Indoor Positioning Technology for Smart Campus" (A Puckdeevongs, 2020) have develop a Bluetooth based student positioning framework for student attendance recording purpose in classroom. This system are mainly divided into two components which are the indoor positioning framework inside the classroom and registration of student in attendance system. The author claims that their method successfully achieve satisfactory position accuracy even in high interference environment (classroom). This development is focus in design an attendance system with computational function and integration of indoor devices using Bluetooth technology to increase simplicity and reduce operational cost. This system uses the client-server architecture where a local web server is uses to handle client request from mobile application.

2.5.3 RFID approach

(MJ Almansor et al, 2021) develop a "Student Attendance using RFID System" project which is a secured system that provides student attendance information. The design of framework is by placing the card close to the RFID module, the system will read the card and show the correspond information of the student card. Then, attendance of that student is then stored in a text file

format inside the SD card that is plugged in the RFID system. The data in text file can be used to convert into excel sheet on the computer. This system uses the client-server architecture where a local web server is uses to handle client request from student card with RFID built-in.

2.5.4 Fingerprint approach

"Student Attendance Management System with Fingerprint (Software)" project by (MMT Htar et al, 2019) has develop a fingerprint-based attendance system that used to track student attendance in class session throughout a semester. The proposed system is consisted of fingerprint sensor that is connected through Ethernet (LAN) to desktop. The attendance record is received from fingerprint reader then the corresponding student data are retrieved from database and displayed on monitor screen. Database of the system are constructed to store all required information for this system such as students, course, lecturer, etc. This system was implemented by Java language and query language. This system uses the client-server architecture where a local web server is uses to handle client request from fingerprint scanner device.

2.5.5 Face Recognition approach

"Online Attendance System" done by (Karuppiah et al, 2017) is an attendance system that uses real time face detection algorithms to integrate with existing LMS system (Learning Management System). This system can detect and register students who are attending to the lecture class session automatically. The system is serve as an additional tool for instructor where adaptive method and machine learning algorithm are combined to track facial changes of longer time. Author also claims that there are still much room for improvement in this aspect. This system uses the client-server architecture where a local web server is uses to handle client request from digital camera. This system uses the client-server architecture where a local web server is uses to handle client request from digital camera.

2.6 Critical Review

The critical review for QR code verification approach. This kind of approach is to replace the traditional attendance system where students get a piece of attendance list paper and sign in it, also known as paper-based approach. QR code approach for identity verification are cost effective and easy to be implement as it does not required additional device to operate. However, this creates downside where students can send the QR code to their classmates for those who are absent for the class. Even the QR code system can set the time limit for each QR code but lecturers normally will put at least 30 minutes for the attendance and the probability of students fake their attendance is high. In addition, students cannot sign up for their attendance without the internet access as mentioned by (KS Savita, 2018). Even though universities often claims that most of their building are within Wi-Fi and other service provider coverage, but many still find issue to have good connection to internet. This will eventually lead to the traditional paper-based approach which have eliminate the effort in preventing fake attendance as stated by (Md Rizal et al, 2017). Other limitations include student at the back or corner side of the classroom having difficulty to authenticate the QR code that is displayed on a projector. Moreover, the integrity of the system depend very much on the location of the student's device but not to the student itself, which increase system vulnerability suggested by (AB Yazid, 2019). This mobile application only compatible with android devices which means it has less accessibility as student with IOS device cannot access.

The critical review for Bluetooth approach in attendance system. This type of approach will need to install Bluetooth smart (BLE) and a Raspberry PI in each classroom which is a plenty amount of implementation cost as stated by (S Bhattacharya, 2018). Apart from that, the system required constant Bluetooth connectivity which result in the system will need to run in the device application background. This computational process are eventually performed by students' mobile device which will required significant amount of processing running on students' device. Moreover, an inherent disadvantage of this approach is that it enforce student to install and maintain an additional

application in their mobile device suggested by (A Puckdeevongs, 2020). Another issue raises is that the system will conclude the student absent if the system does not detect or detect lesser period that the system required. Other related concern such as size of the classroom and the battery life of the smartphone can affect the Bluetooth signal strength mentioned by (S Nalintipwong et al, 2019). This system also limited to android users only as it does not support for IOS device.

The next critical review is about RFID approach in attendance system. This type of implementation are widely used in all the institution in recent years. They are useful in identifying student but not in verifying student who used it. When comes to attendance in class which is under aspect of verification. A student can easily sign bogus attendance for his/her classmate using their card. Furthermore, a secret pin number along with RFID that is design specifically to authenticate student could be easily shared or lost by the student suggested by (S Pss, 2016) On the other hand, the implementation RFID often requires to install a dedicated RFID reader in each classroom. This would contribute to a fairly high investment cost, especially for universities with huge number of classrooms mentioned by (S Budi, 2018) Consequently, assuming that there is only one reader installed in each classroom due to high cost, only one student can sign their attendance at a specific time. For mass lecture, there would be a long queue of students waiting to sign their attendance as this will consume a fair amount of time stated by (V. Soniya et al, 2017). According to (A Puckdeevongs, 2020), additional preparation and equipment installation are needed to be done prior before using it. For virtual classes, it is unpractical to implement as every student will required a RFID reader and student can ask other person to scan for them.

The following critical review are towards biometric approach in attendance system. The implementation of fingerprint approach are very similar to RFID approach, it replace the RFID tag with fingerprint. Although this approach could handle fake attendance better, it does share similar drawbacks as in RFID approach which is high investment cost and only one individual can perform this operation at a same time, fail to recognize is another

common issue when dealing with this approach stated by (A Puckdeevongs, 2020). Although many business company have adopted this approach in their staff attendance system but it still not suitable for colleges and institutions. The main reason is because the number of classroom in colleges are scattered and large which will eventually end up with high cost mentioned by (Y Xing, 2019). Furthermore, there are more than five percent of people are born with shallow fingerprints and unable to be identified by using this approach. Besides, fingerprint identification are rely on the scanning environment as it is sensitive to humidity and cleanliness of finger. Any impurities on finger such as dirt, scar oil and even water on finger will lower the recognition rate and this will certainly cause more complexity to the attendance recording process suggested by (J Pu, 2020) Moreover, considering current pandemic situation, using fingerprint approach is indeed not a reliable solution assuming there is only one device and it must have close contact to every student in a physical class according to (SS Pawaskar, 2020). For virtual classes, it is unpractical as every student need to purchase a fingerprint scanner.

Most of the verification approach discussed above have respective problems in portability, authenticity, accessibility or cost. There is one approach stand tall with its unique advantages which is face recognition approach. Every person have different facial identity and it cannot be faked by other people easily. (S Bhattacharya, 2018) There are plenty biometric approach includes fingerprint pattern, face pattern and iris pattern for identity verification but fingerprint and iris would easily mismatch under bad environment condition unlike face recognition mentioned by (V. Soniya et al, 2017) However, (IGC Santillan et al, 2020) stated high cost, limited flexibility and accessibility are some of limitations that faced by current available biometric system including facial recognition based system. For virtual classes, it is best to implement web-based system compared to mobile application based system as it has higher accessibility, flexibility and scalability. Other than that, running a facial recognition algorithm on a desktop or local server would burden the processor as it was resources intensive. The process of this approach can be divided into few stages also known as subsystem which are data collection, transmission, signal processing, decision making, testing and others

suggested by (JL Wayman, 2001). According to (M Altarawneh et al. 2019), these subsystem will certainly consume fairly resources including, computational power, RAM and memory space.

Table 2.2 shows the summary of critical review of previous work

Table 2.2 Summary of Critical Review of Previous Work

Journal Name/ Author	Verification Approach	Verification Level	Usability/ Efficiency Level	Client Accessing Platform	Verification Processing Platform	Cost factor for Virtual Class	Viability for Virtual Class	Capability to verify virtual identity
Multi-Factor Attendance Authentication System (Yew et al, 2018)	QR Code	Low	Low	Mobile Application	Local Web Server	Low	✓	✗
Classroom Attendance Systems Based on Bluetooth Low Energy Indoor Positioning Technology for Smart Campus (A Puckdeevongs, 2020)	Bluetooth	Medium	Low	Mobile Application	Local Web Server	High	✗	✗
Student Attendance using RFID System (M J Al-mansor et al, 2021)	RFID	High	Medium	Student Card	Local Web Server	High	✗	✗
Student Attendance Management System with Fingerprint - Software (M Htar et al, 2019)	Fingerprint	High	Medium	Fingerprint Scanner Device	Local Web Server	High	✗	✗
Online Attendance System (Karuppiah et al, 2017)	Face recognition	High	High	Digital Camera	Local Web Server	Low	✓	✓

To conclude the table, Bluetooth, RFID and Fingerprint approach are not suitable for virtual classroom due to high implementation cost while QR code

approach are not suitable as it is incapable to verify student identity in virtual classroom. Hence, face recognition approach is chosen as the verification method in this project. However, face recognition has a downside which is it consume a lot of computational power, cloud computing is applied to overcome this issue. For virtual classroom, it has only two accessing platform which are mobile application and web-based application. Web-based application is selected for its better accessibility, flexibility and cost effective compared to the other.

2.7 Proposed Solution

The proposed solution is an online attendance system that implemented facial recognition to provide identity verification for attendance registration in virtual classroom. This solution opted for a more cost effective solution which is facial recognition approach to verify individual and at the same time ease the accessibility as it only required digital camera to capture facial image of the students. Image processing will be perform using a cloud-based platform to eliminate the computation intensiveness on computer processor.

2.7.1 Web-Based Online Classroom Attendance System

Web-based system is the most common attendance system that available as it is a more user friendly platform which is accessible by any device. Besides, it has less complexity because it does not required any additional hardware, and more importantly, students cannot simply register fake attendance into the system as mentioned by (K Jacksi et al, 2018). A remote system is best option for achieving a good accessibility result. The recent study in tricycle commuters' web application receive positive result for its higher effectiveness and satisfaction for users stated by (EC Abana, 2019).

The online attendance system can be made in a more efficient and cost effective way by adapting the concept of web-based system architecture. This architecture involves the integration of multiple free (open source) web-based technology like HTML, CSS, PHP, MySQL and Apache Web Server suggested by (M Othman, 2012).

2.7.2 Facial Recognition Based Verification Approach

Biometric-based authentication approach is widely use in identification-based application. Example of biometric-based authentication are fingerprint, iris, retina, face, and even palm dorsal. In the proposed project, facial recognition approach would be used as a factor to identify students. The reason is because this approach is one of the easiest method to apply in identification process in various field as it is a non-contact process and able to give immediate response during authentication stated by (H Zhang, 2019). Face recognition is the champion among identity verification framework for conspicuous confirmation of human. It is appropriate to be implement in school, universities, or other organization mentioned by (S Matilda, 2019).

Facial image are taken from students' laptop's or pc's camera which will ease the process of identification and enhance the accessibility from students to use the attendance system. Currently, mobile phones and laptop are well equipped with good quality camera and it is possible to perform this type of verification from smart device suggested by (Anil K et al. 2016).

2.7.3 Cloud-Based Processing Platform

In general, cloud based services can be categorized into three main type which are Platform as a Service (PaaS), Infrastructure as a Service (IaaS) and Software as a Service (SaaS). Amazon Web Service (AWS) Rekognition are one of the facial recognition engine under SaaS provided by Amazon. It is a software application specifically design for image processing context. This software application consist of a set of computational techniques for image processing such as image analysis, compression, enhancement and reconstruction. Many field are currently using this technology such as medical, remote sensing, forensic analyze, and many others field requires image processing platform stated by (Altarawneh et al. 2019).

Facial comparison feature offer by AWS Rekognition are applying deep learning technique to identify the facial characteristic and background location from a video frame or image. By using integration of AI technique

into facial comparison process hugely improve the accuracy. The Convolution Neural Network (CNN) which is one of the deep learning method used in facial recognition does show a significant improvement in term of accuracy when compared with traditional Holistic method suggested by (DS Trigueros, 2018). Moreover, AWS Rekognition feature integrate well with cloud application and able to produce satisfactory accuracy even for distance faces image mentioned by (HC Kaskavalci, 2019).

2.8 Summary

In a nutshell, this chapter is about literature review of related paper of online attendance system with various authentication method including facial recognition. Each of the previous work are discussed in detail to identify and solve the current facing problem. Hence, the he proposed solution are improve and able to suite with the current trend of virtual classroom teaching approach. For the next chapter, methodology for the system development will be discuss.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter will focusing on the methodology that used to develop the online attendance system using face recognition. There are various type of software development model or method available and choosing an appropriate software development model are crucial as it will hugely impact the system development process. A detail explanation on the software development model chosen will be further elaborate and the project milestones and Gantt chart for this project will be attached in this chapter.

3.2 Methodology

The software development model that is chosen for this project is prototyping model that is categorized under Software Development Life Cycle (SDLC) approach. This model is suitable because it is an iterative, trial and error method that allowed prototype to be built, tested and revamp until it achieved the initial objective of the project.

3.2.1 Software Development Life Cycle (SDLC)

Software Development Life Cycle (SDLC) is a process or framework that is aim to produce a tip-top quality system in a cost-effective way. This SDLC process is very versatile as it is compatible from small to large system development. Besides, there are various software development model which applied SDLC framework such as iterative model, V-shape model, waterfall model, spiral model, agile model, etc.

3.2.2 Prototyping Model

Prototyping model is one of the software development under SDLC framework. Prototyping model consist of six phases which are requirement analysis, system design, prototype development, user evaluation, refining prototype and implementation and maintain. This model is best suit in this project because online attendance system using face recognition have not been develop and the requirements of this project are not known in detail. Figure 3.1 illustrate the flow and sequences of prototyping model phases.

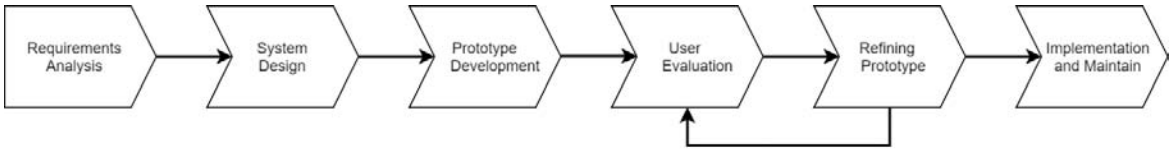


Figure 3.1 Flow and Sequences of Prototyping Model Phases

3.2.2.1 Requirement Analysis Phase

The initial phase of prototyping model is requirement analysis. This phase is crucial as it analyzing and acquire all the project requirements especially for functional requirements. All the functional and non-functional requirements must be match with the project objectives. Any unclear requirements will leads to poor defined project scope that might cause problem later in the development. Therefore, understanding on the basic operation and functionality of the system are perform in this phase. For example, user interface and face recognition implementation of the system can be determined by conducting an interview session with the potential users of the system such as degree students and diploma students. The information and data collected will be present in the next chapter. Figure 3.2 display the context diagram of the system. This context diagram are constructed based on requirement obtained and it serve as a general concept of how the system prototype works.

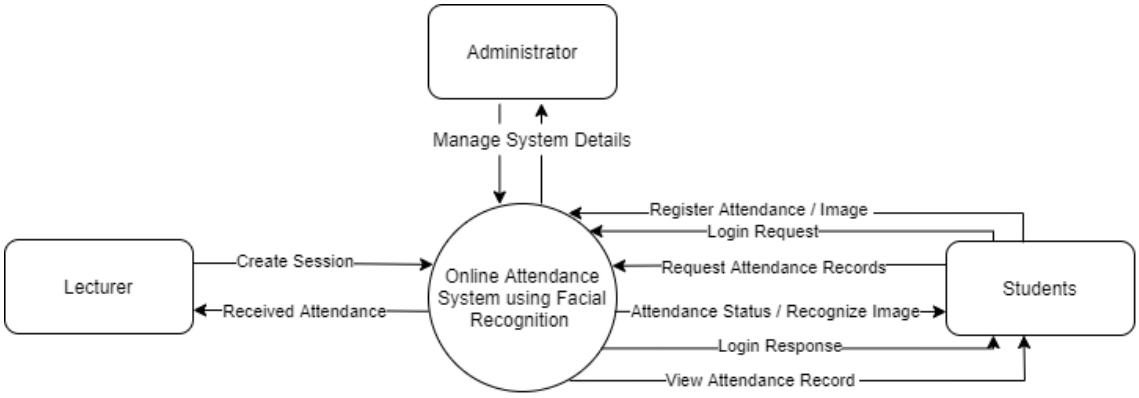


Figure 3.2 Context Diagram of the system

3.2.2.2 System Design Phase

The second phase is system design phase. This phase will utilize all the requirements set in the previous phase including the software and hardware requirements to determine the overall system design and architecture. As this is the initial design phase, most work will be focusing on each and every components in the system such as system database, user interface and functionality of the system. A generic design are constructed in this phase. The design must be aligned with all the requirements determined in the requirements analysis phase. Figure 3.3 shows the physical view of system.

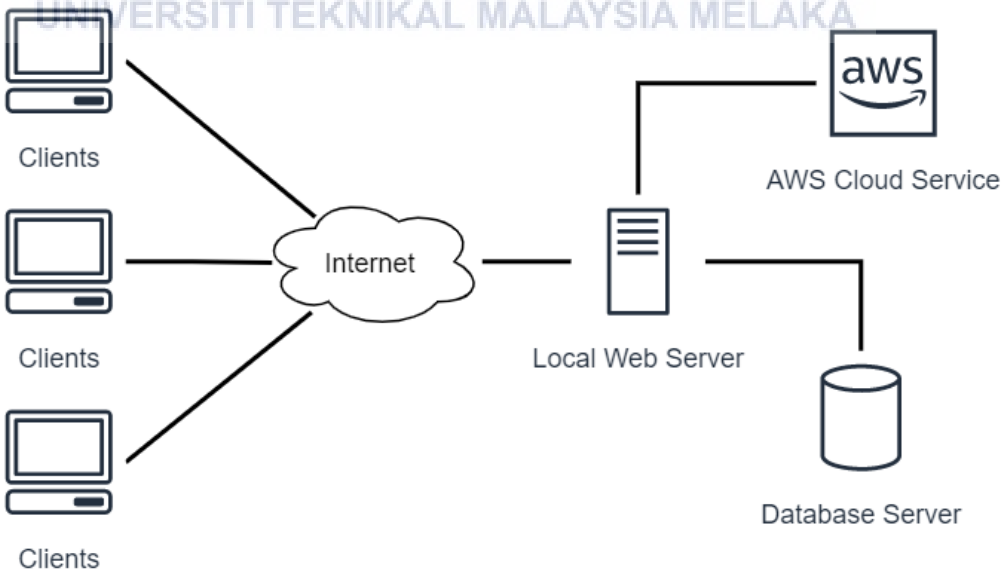


Figure 3.3 Physical View of system

3.2.2.3 Prototype Development Phase

The following phase is the prototype development phase where integration of all components designed in the previous phase are done to create a prototype which able to perform basic and fundamental functionality of the system. The main functional requirements such as login module, attendance registration module, face recognition etc. are being prioritized so that even though the prototype is an incomplete version but still sufficient to be tested by user to login and register attendance using facial recognition. This phase is very crucial as all main functionality must be working properly before being tested and reviewed by users in the user evaluation phase.

3.2.2.4 User Evaluation and Refining Prototype Phase

The next phase right after prototype development phase is user evaluation phase. At this phase, the prototype will be tested by end users. The end users are consist of degree students and project supervisor and their information such as image and id are collected and stored in the database prior before this phase. Right after users tested the system, feedback and response regarding the prototype are collected from them. By referring to the feedback and response of end users, strength and weaknesses of current prototype will be identified and appropriate refinement will be made in the following phase which is refining prototype phase. Most of the changes or modification made are aim to enhance user experience and remove system bug or failure in the prototype. After altering the prototype, it will return to user evaluation phase again until all the user requirements are accomplished then only it will move to the last phase.

3.2.2.5 Implement and maintain phase

The final phase of prototyping model which is the implement and maintain phase. The prototype will only be entering this phase after accomplished all requirements and specification of the system. This is a phase where the system is ready to be develop for actual scenario and more aspect will need to be considered such as system integration and number of users in

the system etc. Maintenance will be required from time to time after the system being implemented in order to make sure that the system function properly.

3.3 Project Milestones

Project milestones will show the progress achievement based on a specific timeline in the project. Each of the task must be complete within the specific time to ensure the whole project can be finish within the given time. The milestones can serve as a guidance for developer to identify whether the project is executed in good condition. Table 3.1 display the milestones of the project.

Table 3.1 Milestone of the project

WEEK	ACTIVITY	NOTE / ACTION
< W0 (< 21/3)	Select a suitable project topic and potential Supervisor	• Action - Student
W 1 (15/3 ➔ 21/3) Meeting 1	Proposal PSM: Discussion with Supervisor	• Deliverable - Proposal • Action - Student
	Proposal assessment & verification	• Action - Supervisor
W2 (22/3 ➔ 28/3)	Proposal Correction/Improvement	• Action - Student
	Proposal submission to Committee via email	
	Proposal Approval	• Action - PSM/PD Committee
	List of Supervisor/Title	
W3 (29/3 ➔ 4/4)	Proposal Presentation & Submission via PSM ULearn	• Deliverable - Proposal Presentation (PP) and Completed Proposal Form • Action - Student
Meeting 2	Chapter 1 (System Development Begins)	• Action - Student
W4 (5/4 ➔ 11/4)	Chapter 1	• Deliverable - Chapter 1 • Action - Student, Supervisor
W5 (12/4 ➔ 18/4)	Chapter 2	• Action - Student
W6 (19/4 ➔ 25/4) Meeting 3	Chapter 2	• Deliverable - Chapter 2
	Project Progress	• Progress Presentation 1 (PK 1) • Action - Student, Supervisor
W7 (26/4 ➔ 2/5)	Chapter 3	• Action - Student
W8 (3/5 ➔ 9/5)	Chapter 3	• Deliverable: Chapter 3 • Action - Student, Supervisor
W9 (10/5 ➔ 16/5)	MID SEMESTER BREAK	
W10 (17/5 ➔ 23/5) Meeting 4	Chapter 4	• Action - Student
	Project Progress	• Progress Presentation 2 (PK 2) • Action - Student, Supervisor

W11 (24/5 ➔ 30/5)	Project Demo	• Action - Student, Supervisor
W12 (31/5 ➔ 6/6)	Project Demo PSM1 Report	• Action - Student, Supervisor
W13 (7/6 ➔ 13/6) Meeting 5	Project Demo PSM1 Report Schedule the Presentation	• Action - Student, Supervisor • Action - PSM/PD Committee • Presentation Schedule
W14 (14/6 ➔ 20/6)	Project Demo	• Deliverable - Complete PSM1 Draft Report • Action - Student, Supervisor
W15 (21/6 ➔ 27/6) Final Presentation	FINAL PRESENTATION Submission of the PSM1 Report onto the PSM ULearn.	• Action - Student, Supervisor, Evaluator, PSM/PD Committee
W16 (28/6 ➔ 4/7)	REVISION WEEK Correction on the draft report. Submit PSM1 Logbooks to PSM ULearn. Submit an EoS Survey form.	• Deliverable - Complete PSM1 Logbooks • Action - Student, Supervisor • EOS Survey • Action - Student
W17 & W18 (5/7 ➔ 18/7)	FINAL EXAMINATION WEEKS	

3.4 Project Gantt Chart

Gantt chart is the simplify version of project milestones that display graphical portrayal of the project point of reference. The Gantt chart serve as a guide for project completion each week using graphical way. Table 3.2 display the project's Gantt chart.

Table 3.2 Project Gantt Chart

ACTIVITY	PERIODS (week)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PSM Proposal Submission														
PSM Proposal Correction														
Chapter 1														
Chapter 1 (Deliverable)														
Chapter 2														
Chapter 2 (Deliverable)														
Chapter 3														
Project Demo & Chapter 3 (Deliverable)														

Project Demo & Chapter 4														
Project Demo & Chapter 4 (Deliverable)														
Project Demo														
Project Demo & PSM Report														
Final Presentation														

3.5 Summary

In summary, this chapter explained about method used in project development, project milestones and project Gantt chart which are crucial element to ensure the project are develop in a structured and ordered manner. Analysis and design of the system will be discussed in detail in the next chapter.

CHAPTER 4: ANALYSIS AND DESIGN

4.1 Introduction

This chapter will focusing on the project analysis details of the online attendance system using face recognition. An in-depth analysis on current attendance system is very crucial to develop an effective, convenience and user-friendly system. The analysis on current system is to identify problem and make necessary improvement to tackle those issue. The aspect that need to be consider in developing the system are fundamental requirement of the current system and necessary changes to meet project objectives. All the requirements including functional and non-functional requirement are identified and documented in this chapter.

4.2 Problem Analysis

The existing attendance registration method implemented for online classes in the campus will be analyze to identify problem faced when applying this method. Figure 4.1 shows the analyzed problem on existing method.

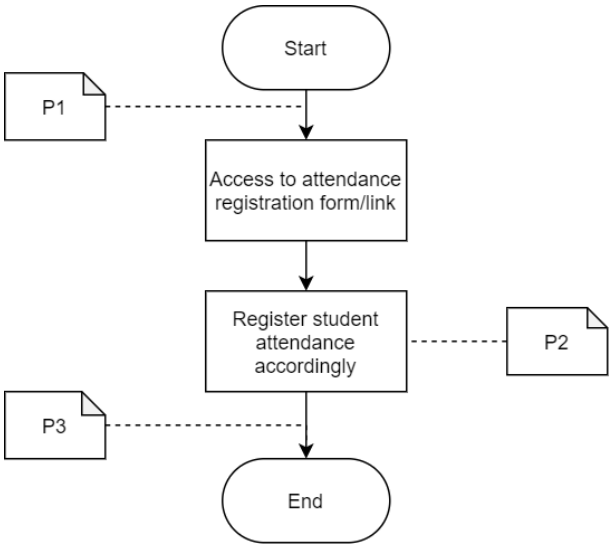


Figure 4.1 Analyzed Problem on Existing Attendance Registration Method

Based on the analysis of existing online attendance registration method as shown in Figure 4.1, there are 3 problems had been identified. The first problem faced is concerning accessibility issue. The second problem is lack of identity verification for attendance registration and the third problem is there is no channel for students to check their class attendance records in the attendance system.

Due to pandemic Covid-19, all institution are force to switch the physical classes to virtual platform to continue the education process which leads to the first problem, the accessibility issue, This is because all the lecturers are using their own method in taking attendance such as WhatsApp, telegram, WebEx, Microsoft teams and google form. There is no unite platform that used in attendance registration which causes students often miss out or forget to fill in their attendance in online classes.

Additionally, the pandemic Covid-19 outbreak also raises another problem which is lack of identity verification in online attendance system. All of the method used by lecturer in recording students' attendance does not have identity verification capability. This causes students fake their attendance by asking friends to register attendance for them. The only way for lecturer to verify students' identity in online classes is to manually ask question to each students and request for their respond. This is extremely time consuming and

inefficient process which also hugely affect lecture progress and study atmosphere in class.

The third problem is lack of channel for students to check their current or live attendance records. In other word, students register their attendance by filling up the form in WhatsApp, telegram or google form but they are unable to check their attendance records in the attendance system unless the lecturer post the attendance records to students and yet is not an up-to-date or real time attendance records. All the problem for existing attendance registration approach are summarized in Table 4.1.

Table 4.1 Problem Statement Summarization

Label	Problem
P1	Accessibility Issues. Variety of attendance registration approaches create confusion and resulting in increasing mistake made by students.
P2	Lack of identity verification capability. Current attendance taking approach does not have any way to verify student identity in online attendance registration.
P3	Lack of channel to check attendance records. Students have no way to validate their attendance records in the attendance system.

4.3 Requirement Analysis

Requirement analysis is a systematic approach that focusing on tasks that help in determine the conditions or needs to meet the new project goals. Requirement analysis play an important role in defining the expectations of user experience in the system that being developed. Moreover, fail or success of a project are determine by requirement analysis as well. Therefore, these requirement must be actionable, measurable, testable and well documented.

4.3.1 Data Requirement

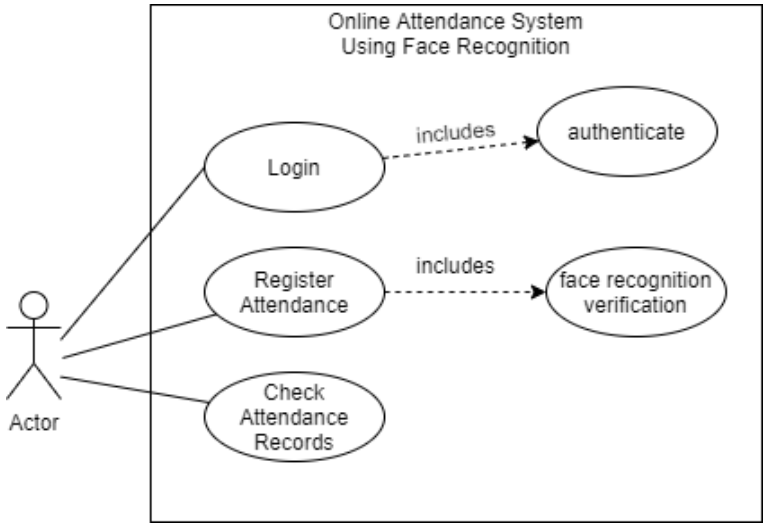


Figure 4.2 Use Case Diagram

The used case diagram is created to identify the data requirement of the proposed system. Input and output data of the proposed system can be identified by referring to the use case diagram. Since the first action is student authentication to login into the system, all the personal data of the students are assume to be inserted or stored in the system prior to the development. These data including student name, student matric, and other personal information which are required for students to login into their account in order to perform the second action, the attendance registration process.

The following action is attendance registration process which required various information. These information can be categorized into student data and administrative data. The administrative data consist of lecturer information, course information, and class session information while the student data consist of student personal information and student enrolment information. All these data are used are critical for attendance register process as it required student information to map with student enrolment class information and class session information in order to function properly.

The next action is checking attendance record action. This action allows students to view their attendance records for every enrolled classes. The data required for this action is student attendance data and student enrolment data. A summarized data dictionary is presented in the database design section to further illustrate the in-depth data requirement specified for proposed system.

4.3.2 Functional Requirement

Functional requirement will describe and define all the functionality of the developed system. For the functional requirement of this project are derived from the 3 action illustrated in Figure 4.2 which consist of login, register attendance and check attendance records. All of the functional requirement and details of its functionality will listed and explained in Table 4.2.

Table 4.2 Functional Requirement List

No	Functional Requirement	Description
FR1	Login authentication	The system must be able to authenticate user when logging into the system
FR2	Attendance registration	The system must allow verified user to register their attendance
FR3	Image recognition	The system must able to verify student identity using image verification method
FR4	Attendance record checking	The system allow students to view their up-to-date attendance records
FR5	Manage system details	The system must allow administrator to manage all data in the attendance system
FR6	Manage class session	The system allow lecturer to add new class session for students to register attendance

To show the relation of functional requirement listed in Table 4.2 to the proposed system. A context diagram which represent a high level overview of the system is displayed to illustrate the system functionality and the entities that assciate with it.

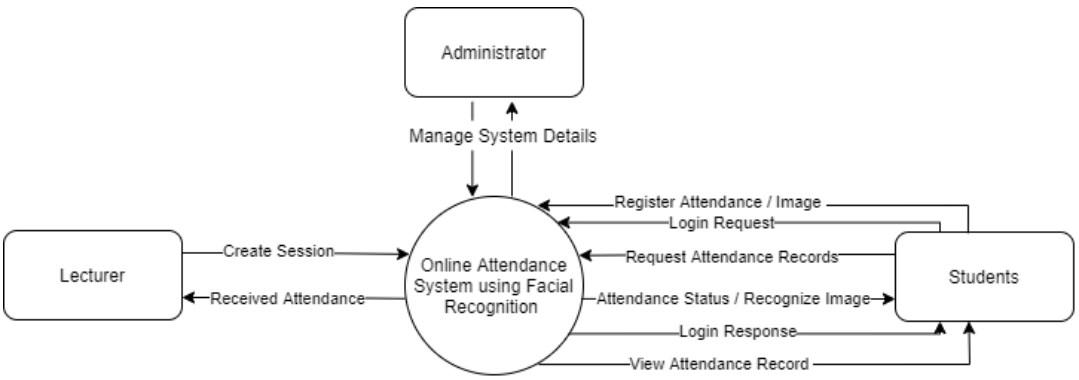


Figure 4.3 Context Diagram of the system

There are three entities in the system which are administrator, lecturer and students. Administrator entity manage the all the information in the system including add new students, new lecturer and courses etc. Lecturer entity is allowed to manage class session related information such as add new session and view student attendance in a particular class session etc. Lastly, student entity can login, register attendance using face recognition identity verification and view their attendance record. Table 4.3 shows the correlation between specified functional requirement in Table 4.2 and context diagram of the system in Figure 4.3

Table 4.3 Correlation of Functional Requirement and Context Diagram

Functional Requirement	Context Diagram
FR1	Login Request/ Login Response
FR2	Register Attendance/Attendance Status
FR3	Image/Recognize Image
FR4	Request / View Attendance Record
FR5	Manage system details
FR6	Create Session/Receive Attendance

4.3.3 Non-Functional Requirement

Non-functional requirement are referring to the performance attribute and properties of a particular system. Below display the list of non-functional requirement for this proposed system.

i. Data Integrity

   Does the system able to retrieve and display accurate data to the user and input correct data into the system?

ii. Accuracy of face recognition

   How accurate can the system recognize student captured image with image stored in the system?

iii. System Performance

   How fast does the face recognition perform during attendance registration process?

4.3.4 Other Requirement

Other requirements are consist of software requirement and hardware requirement. Hardware requirement are controlled by user to access the system while software requirement are commonly used in both system development and accessing the system. There are three fundamentals software requirement used to implement web system which are web browser, web hosting software and programming language. Table 4.4 shows the software requirement while Table 4.5 display the hardware requirement used in this project.

Table 4.4 Software Requirement

Software	Description
Apache HTTP Server	Cross platform web server software that host web based system using HTTP protocol
AWS Rekognition	Cloud based image processing and analysing platform that used for facial recognition based identity verification
JavaScript Programming Language	High level scripting language used in web based system development
PHP Programming Language	Famous scripting language used for web based system development
Structured Query Language (SQL)	Open Source programming language that used to manipulate database implemented using MySQL
Web Browser	A software or medium that allow user to access web based system

Table 4.5 Hardware requirement

Hardware	Description
Camera (Laptop built-in Camera)	Capture student face image for identity verification in attendance registration process
Computer (Laptop)	Used for both developer and user. Developer use computer to write and run system while user use computer to access the web based system

4.4 High Level Design

High level design describe about the overall architecture in system development. It shows the overview of the entire system including what are the main components that used in this system, interfaces of the system, database design etc.

4.4.1 System Architecture

The online attendance system using facial recognition is a web based system. Generally, there are 4 main components for this system which includes client (web browser), local web server, database server and cloud service. The first component is client which consist of student, lecturer and administrator. Each of client uses web browser to access the web system.

The second component is local web server that used to host the online attendance system. The online attendance system must have connection with the client (web browser), database server and cloud services in order to work properly. All the server side scripting are performed in this component. Another component is the database server. This component work as the data storage of the online attendance system. All the information displayed on the system such as student information, course information are retrieve from this database server.

The last component is the AWS cloud services. AWS cloud services provide image processing and facial image recognition services to AWS services subscribers. These recognition services can be access via API call whenever they need to use this recognition for identity verification purposes in attendance registration. Figure 4.4 shows the physical view of online attendance system using facial recognition.

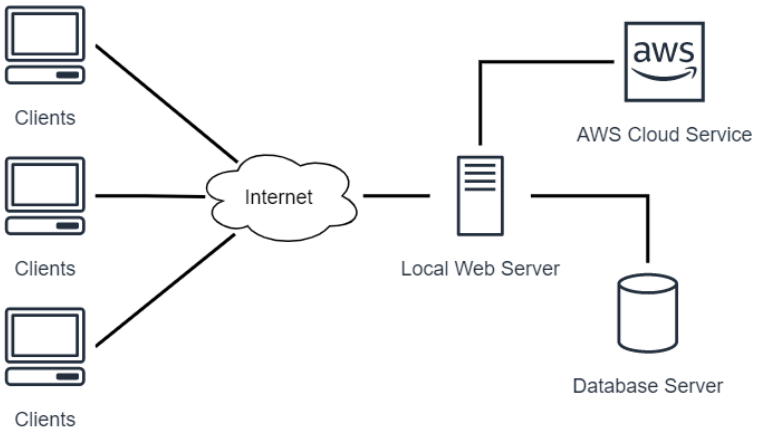


Figure 4.4 Physical view of Online Attendance System using Facial Recognition

4.4.2 Flowchart Design

Flowchart is a graphical representation of steps. In another word, it is a series of symbols that are used to describe the workflow or process of a system/program or algorithm which also known as flow diagram. The following flowchart describe on how the online attendance system using facial recognition works. Since there are two sub module in this system, the flowchart will be illustrate in three part which are the main flowchart of the system, attendance registration module and view attendance record module. Figure 4.5 show the overall flowchart of the system.

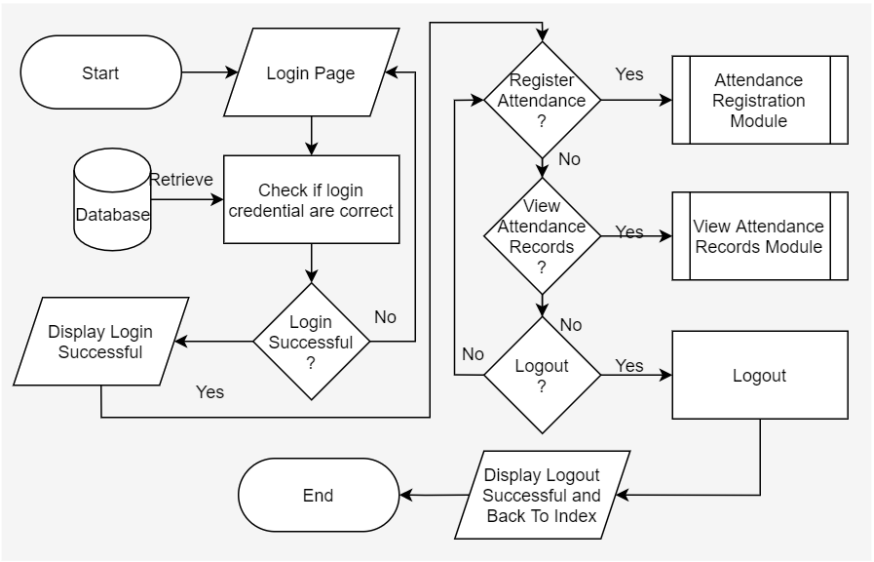


Figure 4.5 Overall Flowchart of the System

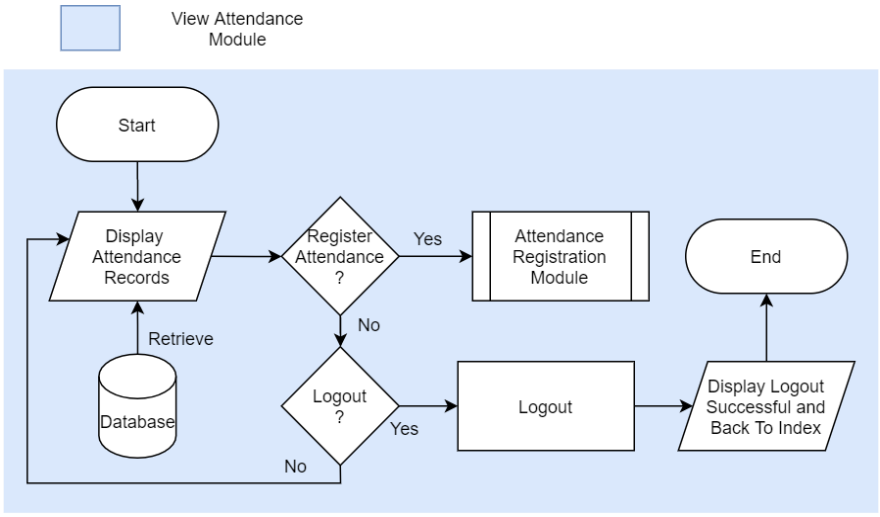


Figure 4.6 View Attendance Module Flowchart

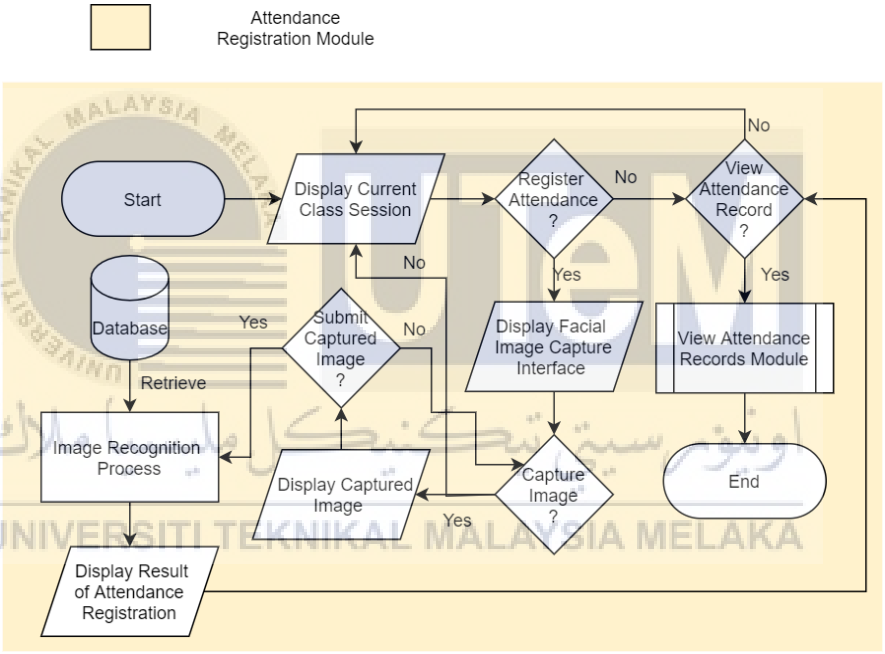


Figure 4.7 Attendance Registration Module Flowchart

4.4.3 User Interface Design

The user interface design of the system are illustrate in this section. The design of the user interface will be focus on making it more user friendly, easy to navigate and control. Hence, minimalist design concept will be applied as this kind of design aim for simplicity and emphasis more on the content of the site which is very suitable for web application user interface. Figure below shows the user interface design in student perspective when they want to access the web system.

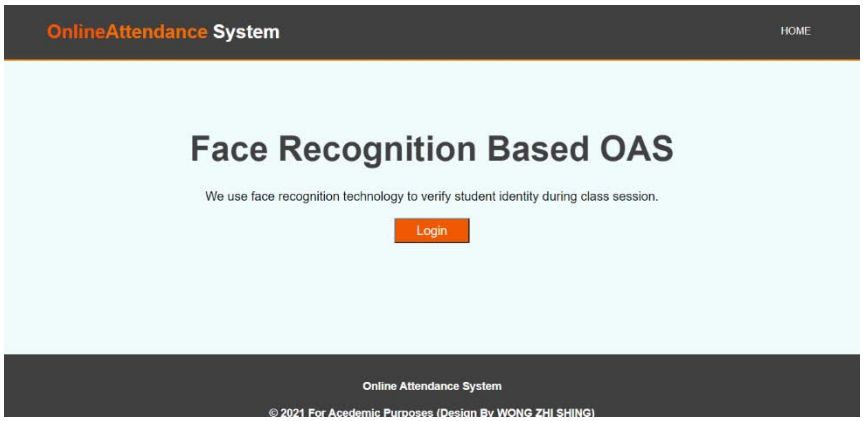


Figure 4.8 Home Page Interface

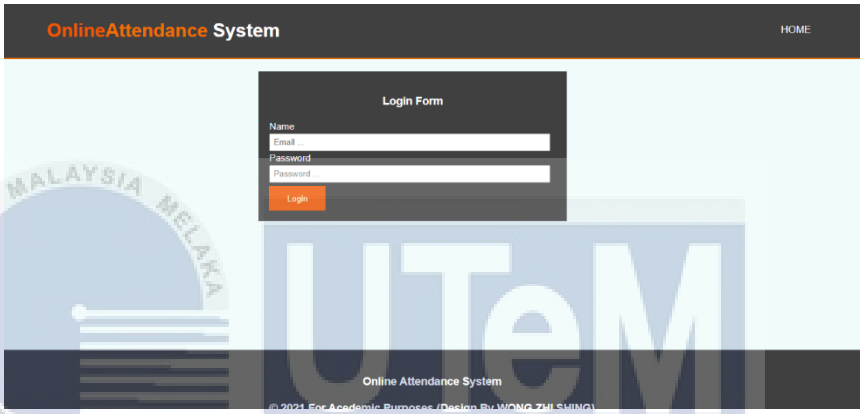


Figure 4.9 User Login Interface

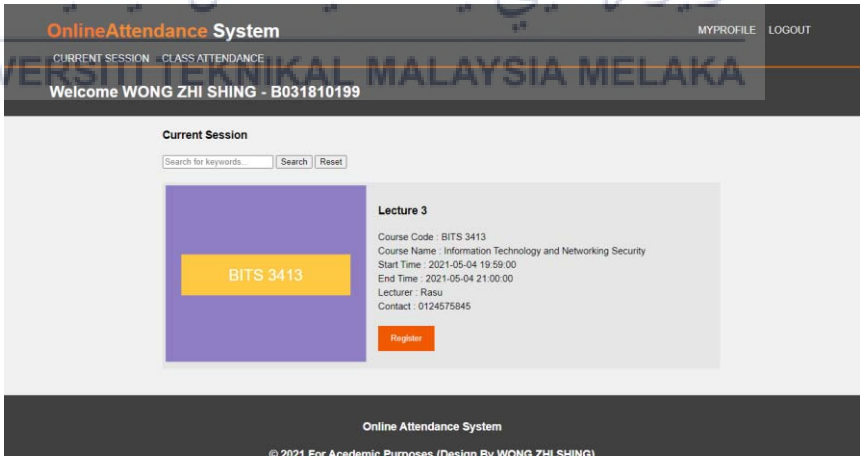


Figure 4.10 User Current Session Interface

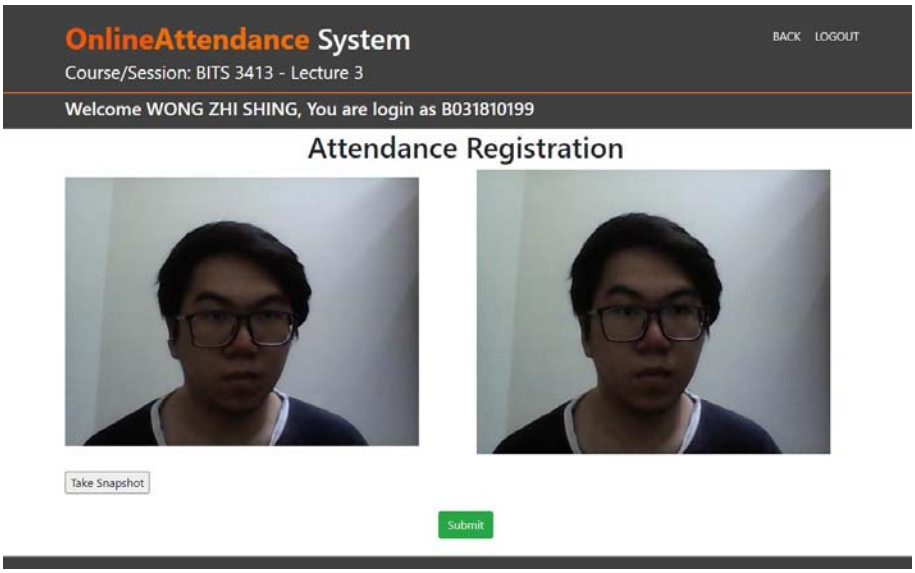


Figure 4.11 User Face Capture and Verification Interface

Figure 4.12 User Attendance Record Interface

4.4.4 Database Design

Database design is crucial stage in system development as the organization of the data will be mostly finalized and any modification of database after this stage will be very tough and time consuming. Therefore, the decision made in this stage must be very careful. For this project, a centralize database is used for Online Attendance System using Facial Recognition. This system has 7 tables in total which are student table, staff table, course table, class table, session table, enrolment table and attendance table.

The first table, student table stored student personal information includes login credential and facial image for verification purposes while the staff table stored lecturer and administrator personal information that use for login authentication and other functionality. Besides, the course table stored course information such as course name and id, class table stored class information such as lecturer handling the class and the session table stored class session information for a particular classes. The sixth table, the enrolment table stored student enrolment to classes' information and the last table, the attendance table stored about student attendance in a particular class session.

Moreover, an Entity Relation Diagram (ERD) will be show in Figure 4.11 to further illustrate the relationship between each of the table and important details such as primary key and foreign key included in the ERD diagram.

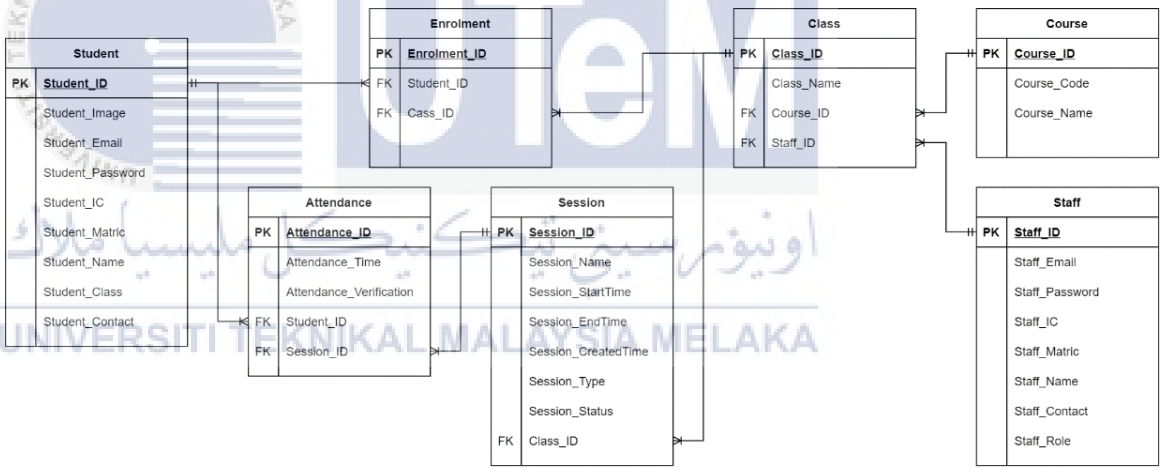


Figure 4.13 ERD Diagram of the system

Consequently, data dictionary for each of the tables will be display in section below. The data dictionary will include with the details description of each attribute in the table.

Table 4.6 Student Table Data Dictionary

Attribute Name	Description	Data Type	Character Length
Student_ID (PK)	Student Identification Number	INT	5

Student_Image	Student Facial Image used for verification purposes	Varchar	200
Student_Email	Student Email	Varchar	50
Student_Password	Student Password	Varchar	50
Student_IC	Student IC Number	Varchar	12
Student_Matric	Student Matric Number	Varchar	12
Student_Name	Student Name	Varchar	50
Student_Class	Student Class	Varchar	50
Student_Contact	Student Contact	Varchar	50

Table 4.7 Staff Table Data Dictionary

Attribute Name	Description	Data Type	Character Length
Staff_ID (PK)	Staff Identification Number	INT	5
Staff_Email	Staff Email	Varchar	50
Staff_Password	Staff Password	Varchar	50
Staff_IC	Staff IC Number	Varchar	12
Staff_Matric	Staff Matric Number	Varchar	12
Staff_Name	Staff Name	Varchar	50
Student_Contact	Staff Contact	Varchar	50
Staff_Role	Staff Role	Varchar	50

Table 4.8 Course Table Data Dictionary

Attribute Name	Description	Data Type	Character Length
Course_ID (PK)	Course Identification Number	INT	5
Course_Code	Course Code	Varchar	50
Course_Name	Course Name	Varchar	50

Table 4.9 Class Table Data Dictionary

Attribute Name	Description	Data Type	Character Length
Class_ID (PK)	Class Identification Number	INT	5
Class_Name	Class Name	Varchar	50
Course_ID (FK)	Course Identification Number	INT	5
Staff_ID (FK)	Staff Identification Number	INT	5

Table 4.10 Enrolment Table Data Dictionary

Attribute Name	Description	Data Type	Character Length
Enrolment_ID(PK)	Staff Identification Number	INT	5
Student_ID (FK)	Student Identification Number	INT	5
Class_ID (FK)	Class Identification Number	INT	5

Table 4.11 Session Table Data Dictionary

Attribute Name	Description	Data Type	Character Length
Session_ID (PK)	Session Identification Number	INT	5
Session_Name	Session Name	Varchar	50
Session_StartTime	Session Start Time	Datetime	-
Session_EndTime	Session End Time	Datetime	-
Session_CreatedTime	Session Created Time	Datetime	-
Session_Type	Session Type (lecture or lab)	Varchar	50
Session_Status	Session Status (available or closed)	Varchar	50
Class_ID (FK)	Class Identification Number	INT	5

Table 4.12 Attendance Table Data Dictionary

Attribute Name	Description	Data Type	Character Length
Attendance_ID(PK)	Class Identification Number	INT	5
Attendance_Time	Attendance Taken Time	Datetime	-
Attendance_Verification	Attendance Verification (success or fail)	Varchar	50
Student_ID (FK)	Student Identification Number	INT	5
Session_ID (FK)	Session Identification Number	INT	5

4.5 Summary

In a nutshell, this chapter discuss about the overview design of the project. Analysis and design are serve as a blueprint for the project implementation. It is a very crucial stage to ensure the project implementation can be done in a smooth and ordered manner. The next chapter will present on the details of the system implementation.

CHAPTER 5: IMPLEMENTATION

5.1 Introduction

This chapter will discuss on the implementation of the project in details. Each of the component that applied in software development of the project will be further explain such as software configuration management, version control and software development environment setup. This is to ensure that the project environment and implementation of the project are in the right path.

5.2 Software Development Environment Setup

The online attendance system using facial recognition required integration of various component in order to make the system function properly. Therefore, software development environment must be set up properly to ensure the every required component are functional so that the system can operate all of its module. Table 5.1 display all of the component that required in the implementation of the system.

Table 5.1 Software Components required for the system

Component	Scripting Language/Tools	Working Environment
User Interface (UI)	HTML and CSS	Client
Server-side Scripting	PHP and JavaScript	Server
Web Server	Apache2	Server
Database Server	MariaDB	Server
Facial Recognition Processing Platform	AWS Rekognition API	Cloud

The environment architecture are setup based on the software component of the system listed above for the implementation phase. Each of the component are crucial in achieving the functional requirement of the system as described in chapter 4. The web server hosted on the server side should be accessible form the client side. The server and client are both located on the same network in this project implementation. However, in order to perform face recognition API call from AWS cloud service, the server must have internet connection so that it is reachable to the cloud service. Figure 5.1 illustrate the environment architecture of the project.

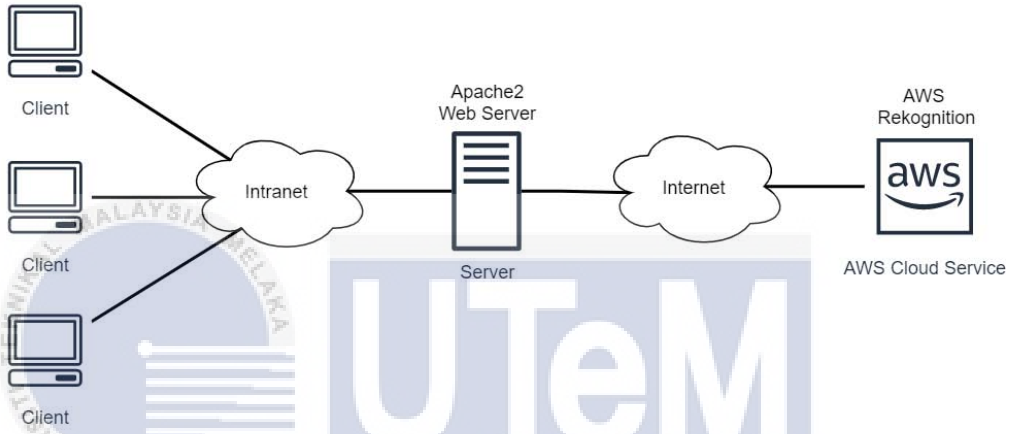


Figure 5.1 Environment Architecture of the System

Aside from the environment architecture, the logical interaction of the system should be determine to ensure each of the requirement specification are possible to be implemented. This first step of implementation is to integrate the client side with the local web server which involve some HTML and CSS scripting. The second step is to integrate the input data and output data operation from the database using the PHP programming language, JavaScript and Structure Query Language (SQL). This operation will required web server to host the server-side scripting and database of the system. The third step is of the implementation step is to integrate the facial recognition API into the system. This is done by using PHP scripting language to call or request the AWS cloud service and receive respond from the called API. Figure 5.2 illustrate the process flow and Figure 5.3 shows the logical system interaction between various components in the implementation phase.

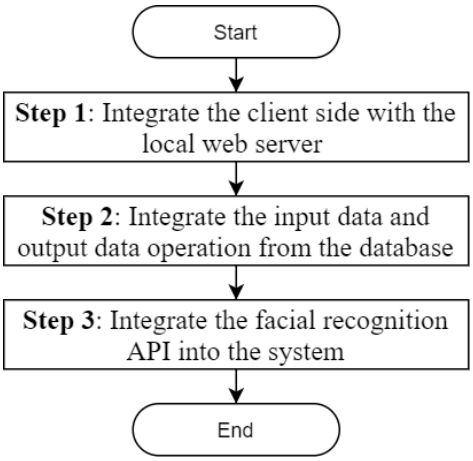


Figure 5.2 Process Flow

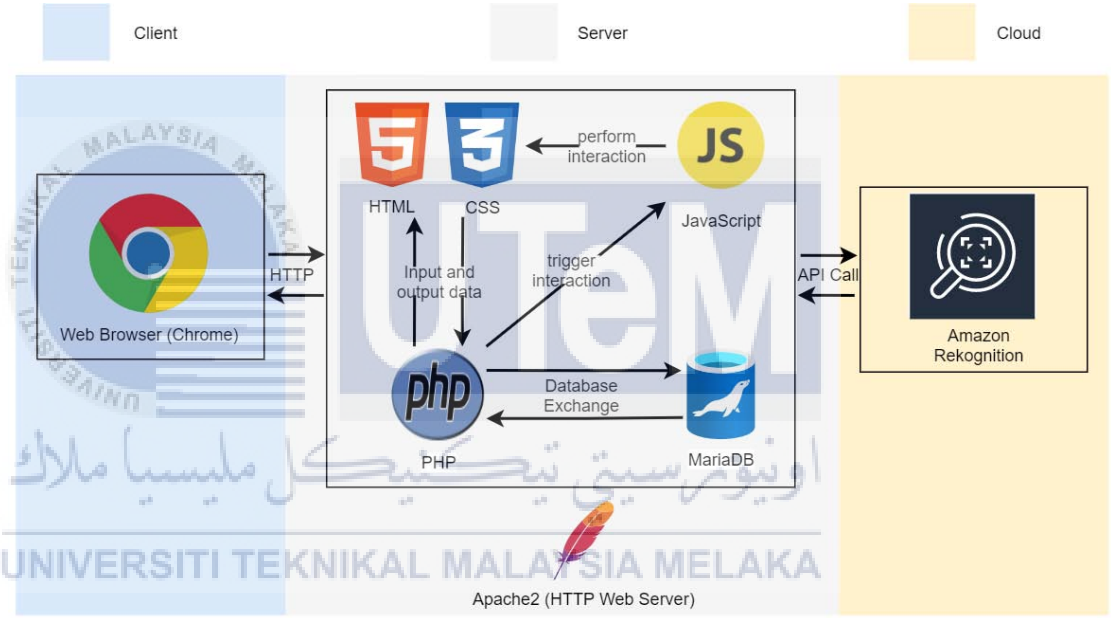


Figure 5.3 Logical Interaction between Various Components of the System

Client uses web browser to access the web server of the system. Google Chrome web browser are chosen to access the system because it is the most commonly used web browser compared to Firefox and Microsoft Edge. Furthermore, HTML and CSS are solely used for the user interface (UI) development where client control and interact with the system. All of the HTML and CSS script are run on the local web server located in the server of the system. Figure 5.3 display the environment of the client-side.

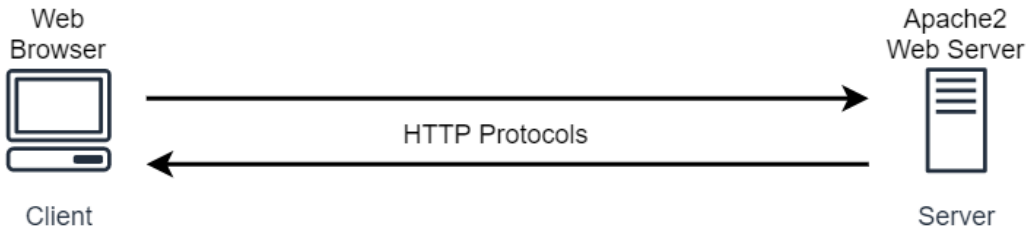


Figure 5.4 Client-side Environment

Oppositely, the server are used to host all the scripting and database of the system. Most of the system component are located in server and all of the web application are run on the server-side. Hence, the implementation of the system are done in the server-side. The system that run in server are develop in a way that it can access the HTTP protocol. The client input data and captured facial image would be process using PHP programming language and for the captured image data would be sent to AWS cloud service for image processing purposes and lastly the result or information received would be stored inside the database server using Structured Query Language (SQL). Other than that, some prerequisite that needed to be notice are the network and the server environment must allow HTTP protocol to transmit. Besides, TCP 3306 must be open and permit on the server to allow database exchange to function properly. Figure 5.4 display the environment of the server-side.

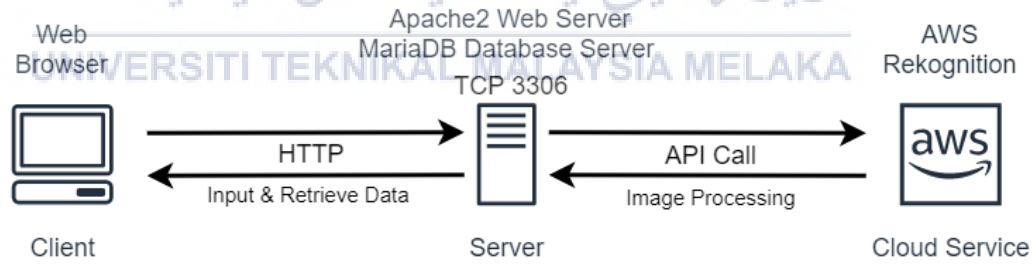


Figure 5.5 Server-side Environment

5.3 Software Configuration Management

Software configuration management (SCM) is a process of trace and control the changes of a software. It involve configuration identification, configuration control etc. SCM is important in software development as it control every item of the configuration and maintenance so that the system are comply or match with the project requirement.

5.3.1 Configuration Management Setup

To update List of Figures, place the cursor on the list that needs to be updated. Next, click on the icon "Update Table" under References tab to list down the updates, as shown in Figure 4.1. The first and the most important steps in software configuration management is identification of configuration item. Configuration item are defined as element or component that needed to be manage, maintain or having changes in the system. Configuration items are consist of both hardware and software. However, in this project, the configuration items that are identified are consist of all software component as this project is a software development which hardware are less involve in the development of this system. All the items that are listed in configuration management of this system need to be carefully control during development of system. Table 5.2 show the configuration items for this project.

Table 5.2 Configuration Items of the Project

No	Item	Software/Hardware
1	Application Module (Functionality)	Software
2	User Interface (HTML, CSS)	Software
3	Server Side Scripting (PHP, MySQL, JavaScript)	Software
4	Facial Image Processing Platform (API)	Software

All of the configuration item in this project are consist of software because web system development are more towards development of software rather than hardware and hardware involved in this project are basically serve as a tool or platform which has very little influence in this project. For the laptop, it used as a platform to host the website using localhost while the camera are used as a tool to capture facial image of user for the identity verification module. Configuration items that are listed in table 5.2 are required to be manage carefully during project implementation, several testing and fixing of these item needed to be carry out to make sure the system are working properly.

The first configuration item listed is the application module. Application module are independent function that are required for a system to perform specific task or functional requirement. Each and every application

module need to be implement, test and reconfigure until all bugs are fixed especially for the face recognition module, which is the core feature of the system. Thus, application module are considered as one of the most important configuration item in this project.

The second configuration item is the user interface of the system. User interface is a very important aspect in term of human computer interaction. Design of user interface in web based system are very crucial as it will determine whether user are convenience when accessing the system. Web based application usually consist of two component which are server side scripting and client side scripting. User interface design is often known as client side scripting. Most of the client side scripting of this project are consist of HTML and CSS coding.

The next configuration item is another component in web based system which is the server side scripting. This is the most important part as it required to handle all the HTTP request perform by client. Most of the scripting done in server side are consist of PHP, JavaScript and MySQL coding. This configuration item are very crucial to ensure the system working accordingly as most of the bug or error occurred in the system are due to wrong coding or typing error done in server side scripting.

Furthermore, the forth configuration item is application programming interface (API). API are used to perform some additional functionality in order to achieve the project specification. Generally, API serve as an interface between local server and cloud server provided by the cloud service provider. In this project, facial image processing platform is the only API that being implemented in this project. The facial image data will be sent to the cloud server for processing and the result or output will be sent back to the local server. This API are classified as one of the configuration item because the transverse of data can only be perform through the API and without it facial recognition functionality will not work.

Lastly, for every modification and changes made to the system will go through the version control procedure which will be explain in the next sub chapter. Configuration management setup is important to ensure all of the configuration items are carefully managed and every alteration to the system are documented and recorded properly for future references.

5.3.2 Version Control Procedure

Version control is an important procedure in the process of software development. This procedure play a crucial role when comes to the update version of a system or software. Version control also known as versioning as it will assign a unique identification number to every updated version of software to distinct it from the previous version. The main function of implementing version control in software development is that it will be much easier to monitor, revise and review the software changes and the benefit of version control will get much clearer when the projects that are develop in teams.

For the development of this project, all of the source code are stored inside a centralized repository and backed up in an external hard drive. This is to ensure the source code are safe if anything goes wrong and by placing the source code in a centralized respiratory it is much more convenience to access during the development and implementation process. Every major update of system will be stored in the repository as a newer version and the newly created version will be copied to the external hard drive as the backup of system. This procedure is to ensure all modification of system are safe and all of the system version can be easily identity by its unique number.

Moreover, another benefit of version control procedure is to prevent the possibility of overwriting or changes made to the existing or current source code. This is because sometimes developer might miss alter or accidentally deleted some of the coding during the development process. The miss operation might result in more bug in the system or failure to operate some module which previously perform well. Figure 5.5 shows the flow of version control procedure. Initially, the developer will download the source code from the centralized repository to access or improve the coding. After modification have been done, the developer will the upload the source code as a newer version name to the centralized repository and at the same time a copy of that source code will be made to the external hard drive as a backup for recovery purposes.

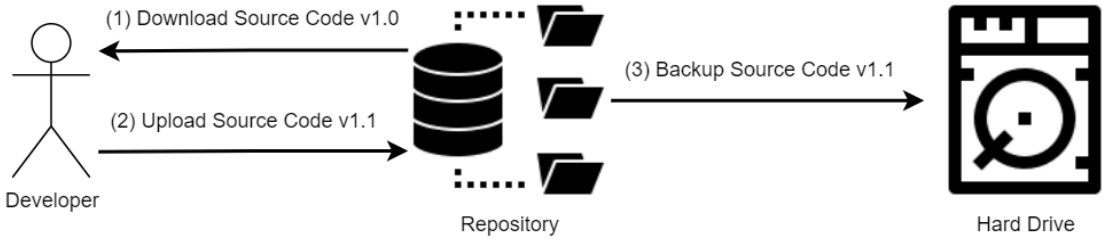


Figure 5.6 Flow of version control procedure

The process of version control are illustrated in Figure 5.5, the edited source code will be named or labelled as a new version before upload to the centralized respiratory. In this project, the naming of version are based on numbering because it is a much easier way to understand the version. Every new version will get an incremental number on the version and all naming are done in manual. This project implement a very simple version control procedure because it is an individual project and does not required collaboration with other person.

Version 1.0 are created as the first version and every modification or update version will get a 0.1 incremental in the numbering of version such as 1.1, 1.2, 1.3 etc. The modification will continue until all stated functional requirement are completed. Next, the system will enter the testing phase and version number will raise to 2.0 and any subsequent modification done in testing phase will be stated as 2.1, 2.2, 2.3 etc. After completed testing phase, the version number will be raise to 3.0 and this mean that the whole project is completed successfully.

5.4 Implementation Status

There are various application module or function expected to be implement in this project. Application module are independent function that are required for a system to perform specific task or functional requirement. Therefore, in order to make the system achieve all of its functional requirement, appropriate module must be integrated into the system. In another word, application module are actually determine by the functional requirement stated in previous chapter which is chapter 4. Table 5.3 display the application module that are needed to be implement in this project.

Table 5.3 Software/Application Module of the System

No	Module	Description
1	Login Module	Allow user to access the system
2	Attendance Registration Module	Allow user to register the class session attendance
3	Face Recognition Module	Allow user to perform live verification during attendance registration
4	Display Attendance Record Module	Allow user to view their class attendance record
5	Management Module (Administrative)	Allow administrator to manage the system
6	Class Management Module (Lecturer)	Allow lecturer to manage class session relevant information

Based on table 5.3, there are total of six modules that are expected to be implemented in this system which are login module, attendance registration module, face recognition module, view attendance record module, management module (administrator) and class management module (lecturer). Figure 5.6 will show the structure chart of the Online Attendance System.

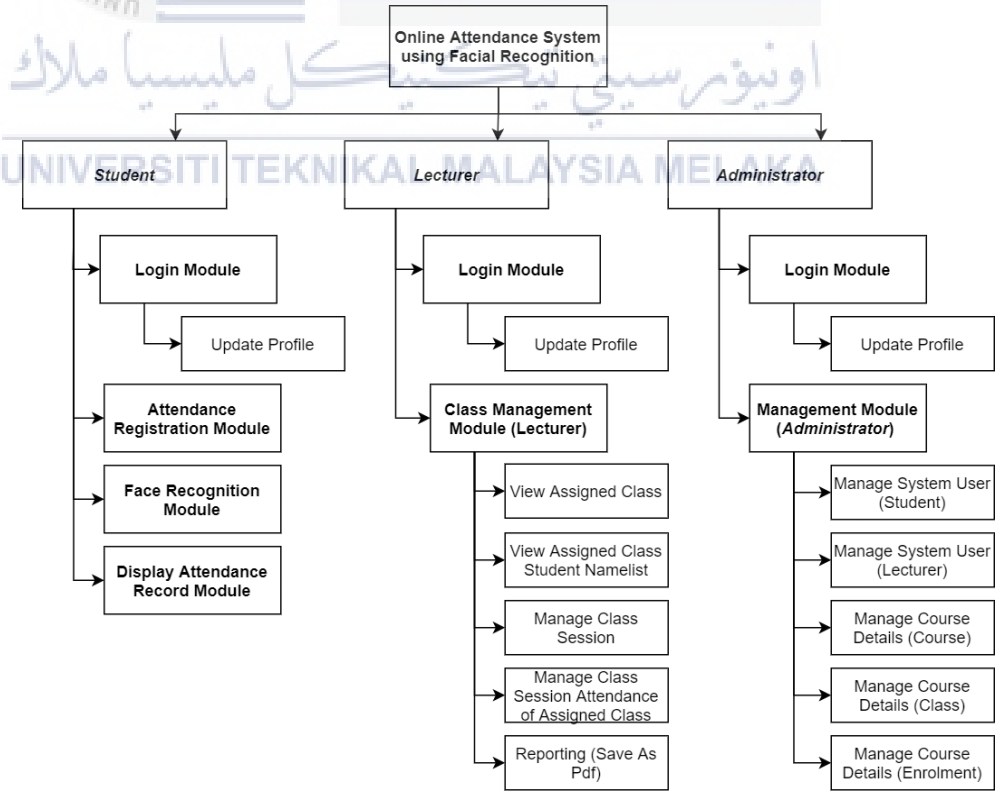


Figure 5.7 Structure Chart of the system

Module 1: Login Module

The first one is login module. This module are very important for web based application which allow user to access the system using specific credential key prevent unauthorised person to access the system. This module is to allow only students inside this institution can have access to the system. The login credential are similar to other web application which are using user email and password. Besides, the login module also include with update profile sub-module which allow student to update their login credential to the system whenever they wanted to. This is to ensure that they can change their login credentials by their self anytime especially if their login credential are exposed or being known by other person, Figure 5.7 show the login module while Figure 5.8 show the update profile module.

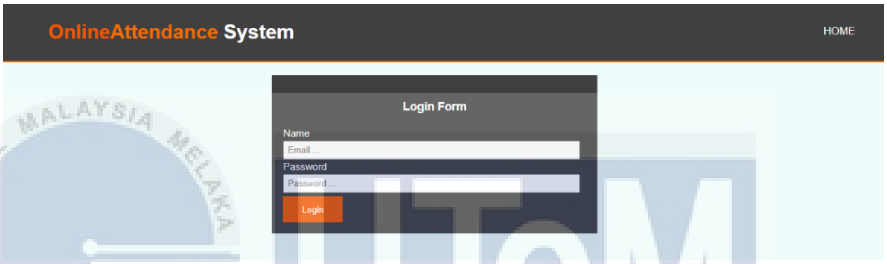


Figure 5.8 Login Module

Figure 5.9 Update Profile Module

Below listed the pseudocode for Module 1: Login Module

Pseudocode: Login Module

1.1. If Login
    1.1.1. Login Input
    1.1.2. Verify which type of user
    1.1.3. If Input verified?
        1.1.3.1. If user type as Admin?

1.1.3.1.1. Display Login Successfully
1.1.3.1.2. Redialling to 2.
1.1.3.2. If user type as Lecturer?
1.1.3.2.1. Display Login Successfully
1.1.3.2.2. Redialling to 3.
1.1.3.3. If user type as Student?
1.1.3.3.1. Display Login Successfully
1.1.3.3.2. Redialling to 4.
1.1.4. Else
1.1.4.1. Redialling to 1.1.1.
1.2. If Update Profile
1.2.1. Display User Information
1.2.2. If Update User Information
1.2.2.1. Update Input
1.2.2.2. If Input verified?
1.2.2.2.1. Display Update Profile Successfully
1.2.2.2.2. Record Saves into Database
1.2.2.2.3. Redialling to 1.2.
1.2.2.3. Else
1.2.2.3.1. Display Update Profile Unsuccessfully
1.2.2.3.2. Redialling to 1.2.
1.3. If Logout
1.3.1. Display Logout Successfully
1.3.2. Redialling to 1.1.

Module 2: Attendance Registration Module

The second module and the third module are the fundamental module in this system. The second module is attendance registration module. This module will display all the ongoing class session for student to register their attendance. The class session will only display to student who enrolled to the class and irrelevant student will not be able to see those class session for unenrolled class to avoid confusion. Besides, each class session can only be register once so that duplication of attendance for selected class session would not occur. Figure 5.9 show the attendance registration module.

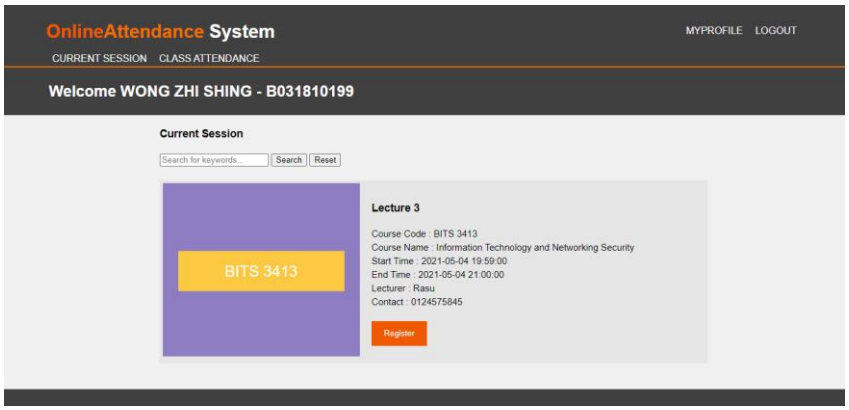


Figure 5.10 Attendance Registration Module

Below listed the pseudocode for Module 2: Attendance Registration Module

Pseudocode: Attendance Registration Module

```
2.1.  View Available Class Session
    2.1.1. If Search?
        2.1.1.1. Search Input
        2.1.1.2. Display Searched Session
        2.1.1.3. If Reset Search
            2.1.1.3.1. Redialling to 2.1.
    2.1.2. If Session Done Registered?
        2.1.2.1. Display Done Button for that Session
    2.1.3. Else
        2.1.3.1. Display Register Button for that Session
        2.1.3.2. If Register Attendance
            2.1.3.2.1. Redialling to 3.1.
        2.1.3.3. Else
            2.1.3.3.1. Redialling to 2.1.
```

Module 3: Face Recognition Module

Subsequently, the third module is face recognition module. The second module allow student to register their attendance inside this web application and the third module will do verification of student using facial recognition API. Student will capture their live facial image to compare and analyse with facial image of student stored in the database of the system. If the verification is successful, the attendance will recorded inside the system with verification stated 'successful'; otherwise, if the verification is fail, the attendance will be recorded inside the system with verification stated 'fail'. Figure 5.10 show the facial recognition module. Figure 5.11 show the popup of successful verification while Figure 5.12 show the popup of fail verification.

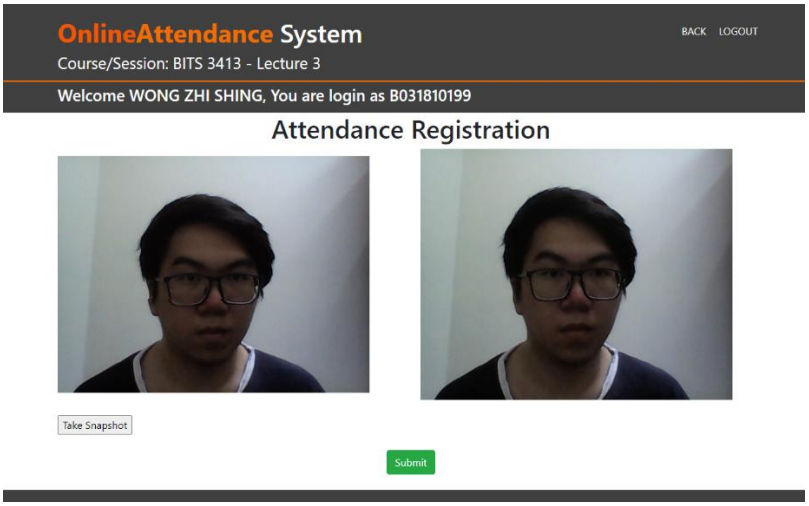


Figure 5.11 Facial Recognition Module

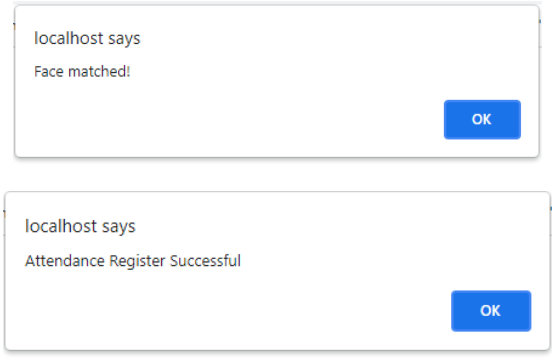


Figure 5.12 Popup of Successful Verification

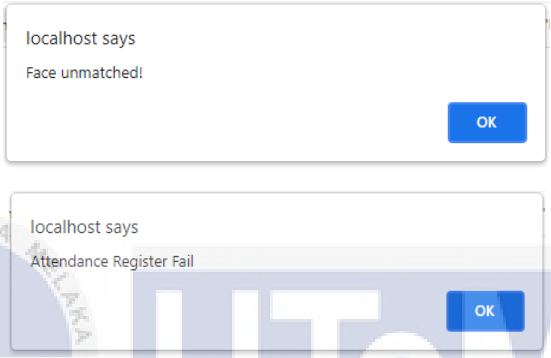


Figure 5.13 Popup of Fail Verification

Below listed the pseudocode for Module 3: Face Recognition Module

Pseudocode: Face Recognition Module

3.1. Display Interface for Face Image Capture
3.2. Click Snapshot
3.3. Display Captured Image
    3.3.1. If Captured Image Satisfied?
        3.3.1.1. Click Submit
        3.3.1.2. Image Sent To AWS Cloud Service to Process using API
        3.3.1.3. If Image Recognise Successfully
            3.3.1.3.1. Display Attendance Registered Successful
            3.3.1.3.2. Record Saves into Database
            3.3.1.3.3. Redialling to 2.
        3.3.1.4. Else
            3.3.1.4.1. Display Attendance Registration Fail
            3.3.1.4.2. Record Saves into Database
            3.3.1.4.3. Redialling to 2.
        3.3.1.5. If Captured Image Not Satisfied
            3.3.1.5.1. Proceed to 3.2 until Satisfied

Module 4: Display Attendance Record Module

Next, the forth module is display attendance record module. This module is allow student to view their up to date attendance record form the system database

which help student to acknowledge whether their attendance is successfully recorded inside the system. This module are extremely important for student to report the problem immediately to the institution if there is any mistake or issue occurred in their attendance record. Figure 5.13 show the display attendance record module.

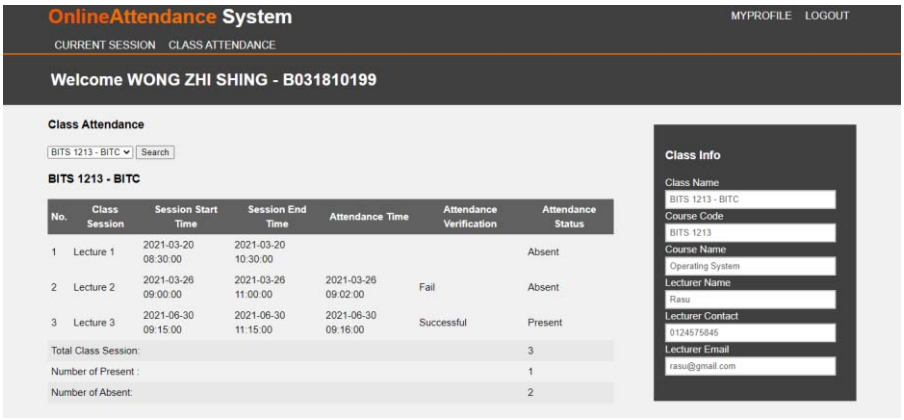


Figure 5.14 Display Attendance Record Module

Below listed the pseudocode for Module 4: Display Attendance Record Module

Pseudocode: Display Attendance Record Module

4.1. Select One of the Course that Being Enrolled
4.2. Click Submit
4.3. Retrieve Selected Information from Database
4.4. Count number of total class session, successful and fail registered attendance
4.5. Display Attendance Record for Selected Course
4.6. Display number of total class session, successful and fail registered attendance

Module 5: Management Module (Administrator)

The last two module to be implement in this project will be the management module of the system. This management team of the system consist of administrator and lecturer of the institution. The administrative level has the authority to control all of the system which include user management and course details management. User management consist of lecturer and student while course details management consist of course, class and enrolment. Section below explain the management module in details.

In management module, the first sub-module is manage system user. It is used to insert new user into the system (student and lecturer). Besides, update and delete option available if there is any changes required to be made or remove. Each of the inserted user can login into the system using credential key given. For the student, it is required to upload an image of student which is used for facial recognition

purposes during attendance registration. Figure 5.14 display the manage system user (lecturer) and Figure 5.15 display the manage system user (student). The image of student can be viewed by clicking the view button in the option. Figure 5.16 show the student profile after clicking the view button.

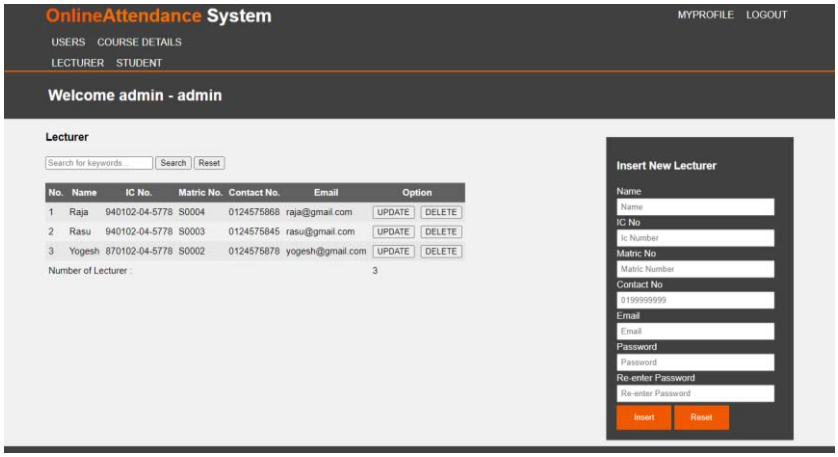


Figure 5.15 Management Module - Manage System User (Lecturer)

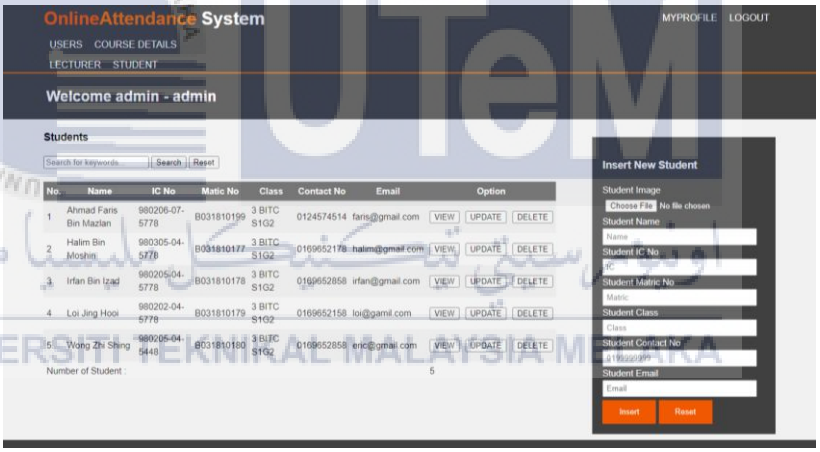


Figure 5.16 Management Module - Manage System User (Student)

Figure 5.17 Management Module – Student Management (Student Profile)

The next sub-module is manage system details. This sub-module consist of three section which are course management, class management and enrolment management. The course management is simply adding new course into the system. These inserted course will be used in class management. This is to stimulate the real scenario where each course can have many classes. Besides, the enrolment management are used to enrol student to a particular class. The restriction for enrolment is that one student can enrol to multiple classes but one class cannot be enrolled by same student twice. Figure 5.17 display the manage course details (course), Figure 5.18 display the manage course details (class) and Figure 5.19 display the manage enrolment details (enrolment).

Figure 5.18 Management Module – Manage Course Details (Course)

Figure 5.19 Management Module – Manage Course Details (Class)

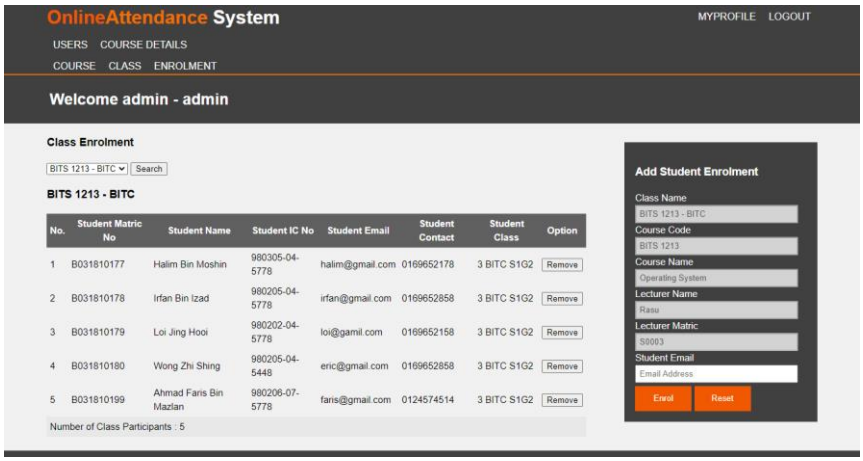


Figure 5.20 Management Module – Manage Course Details (Enrolment)

Module 6: Class Management Module (Lecturer)

The last module is class management module which are mostly about handling class which assigned to each lecturer. The sub-module are view assigned class, view assigned class student name list, manage class session, manage class session attendance and attendance reporting. Section below explain the class management module in details.

In class management, the first sub-module is to view assigned class of lecturer. There are two option provided which are class name list button and class session button. These two button serve as a shortcut and clicking these button can forward straight towards the intended section. Figure 5.17 display class management module (view assigned class).

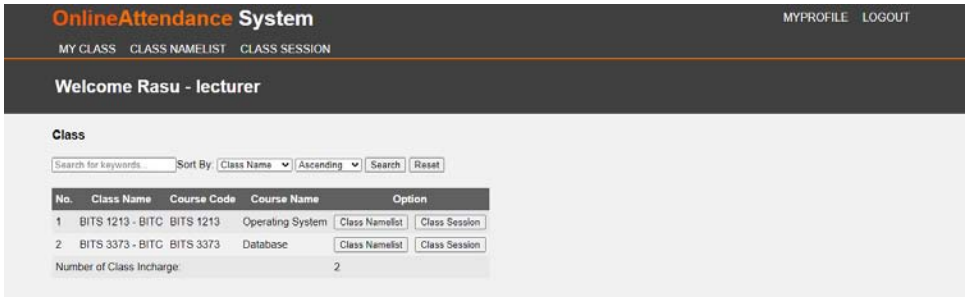


Figure 5.21 Class Management Module (View Assigned Class)

The next sub-module is view assigned class student name list. This sub-module allow lecturer to view the student name list of a particular class and an attendance button is provided to the lecturer to view the attendance of a particular student. Figure 5.18 display the class management module (view

assigned class student name list) while Figure 5.19 display the class management module (student attendance).

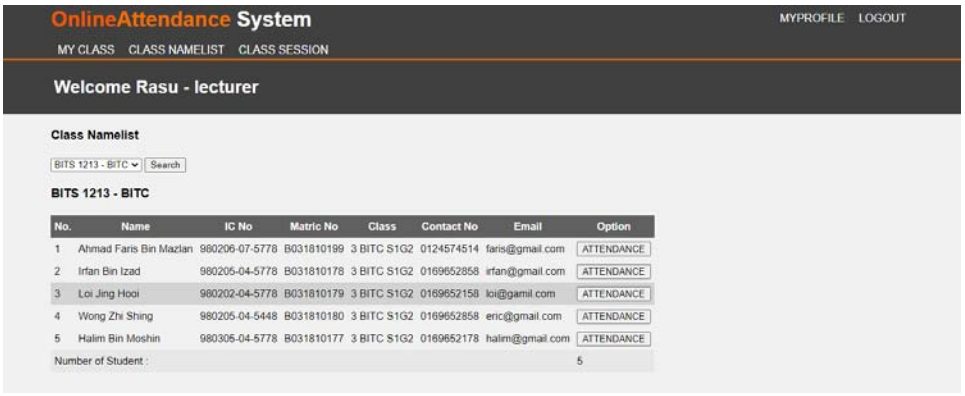


Figure 5.22 Class Management Module (View Assigned Class Student Namelist)

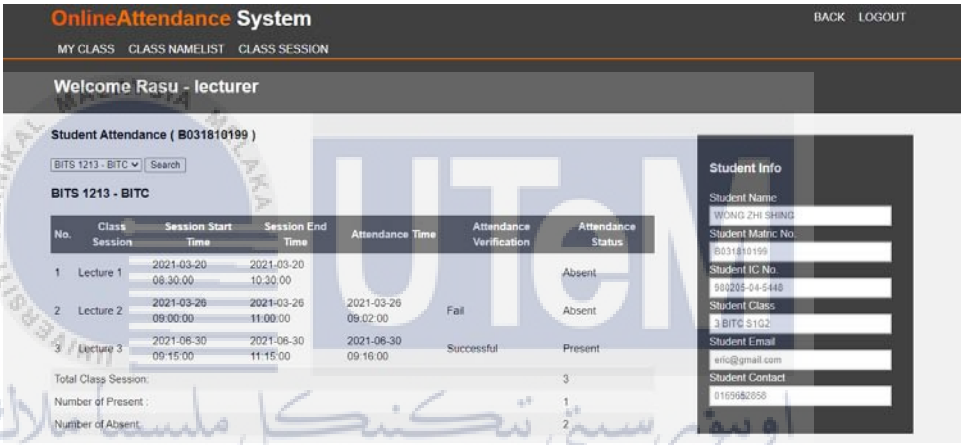


Figure 5.23 Class Management Module (Student Attendance)

The following sub-module is manage class session. This sub-module is allowing lecturer to create new class session for student to register their attendance. Lecturer can select the start time and end time where student can register the attendance. Besides, lecturer can also modify and delete wrongly inserted class session by clicking update button and delete button in option. Moreover, if lecturer decide to close a particular class session, they can also change the status of the session from available to close and student will no longer register attendance for that particular session. The attendance button is to trigger the subsequence sub-module, manage class session attendance of assigned class which would be explain in the next section. Figure 5.20 display the class management module (manage class session).

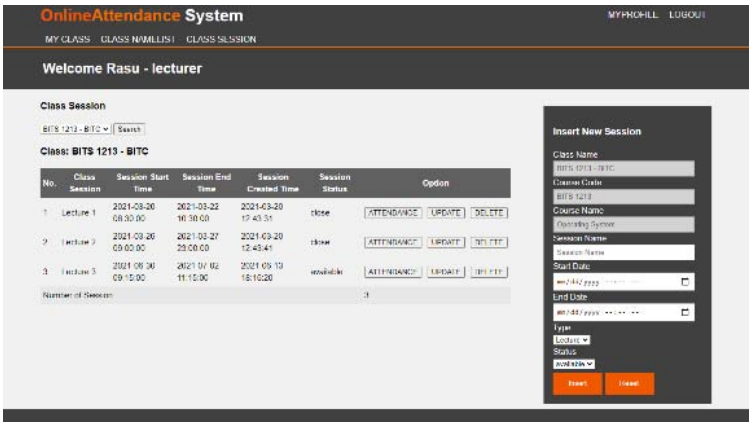


Figure 5.24 Class Management Module (Manage Class Session)

The next sub-module is the manage class session attendance of assigned class. This sub-module allow lecturer to view the attendance registration record for a particular session. Lecturer has full authority to add, update and delete attendance record in this system. This mean that lecturer can register attendance for student in case student cannot access to the attendance system. Besides, if student has fail in face recognition verification during attendance registration, they can contact their respective lecturer so that the lecturer will change the verification status from fail to manual verified. The generate report button is to trigger the subsequence sub-module, attendance reporting module which would be explain in the next section. Figure 5.21 display the class management module (manage class session attendance).

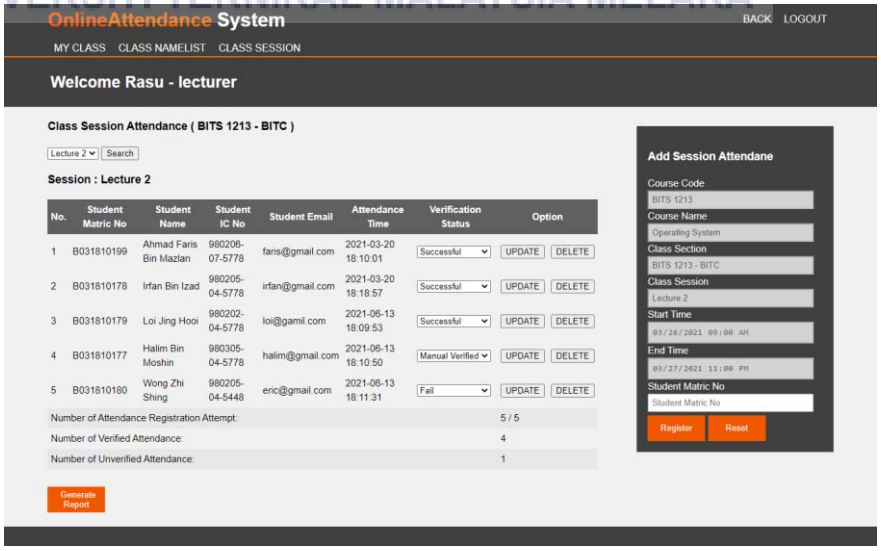


Figure 5.25 Class Management Module (Manage Class Session Attendance)

Finally, the last sub-module is attendance reporting module. This module allowing lecturer to view the attendance report of a particular class session. Besides, this module also provide a save button for lecturer to export or save the attendance record list as a pdf file. The generated attendance report are filled with class information, attendance summary and full attendance record list. Figure 5.22 display the class management module (attendance reporting).

Figure 5.26 Class Management Module (Attendance Reporting)

All of the module described above implemented into the system as scheduled in Gantt chart listed in chapter 3. Complete Pseudocode of the implementation of the system will be attached in the Appendix A. Strict and discipline in performing implementation phase are to ensure the project can be complete within the time period given. Table 5.4 show the implementation progress of each module in this project.

Table 5.4 Implementation Progress of Each Module in this Project

Module	Duration	Date Started	Date Completed
Login Module	1 Week	12/04/2021	18/04/2021
Attendance Registration Module	2 Week	19/04/2021	02/05/2021
Face Recognition Module	2 Week	03/05/2021	16/05/2021
Display Attendance Record Module	2 Week	17/05/2021	30/05/2021
Management Module	2 Week	31/05/2021	13/06/2021
Class Management Module	3 Week	26/07/2021	15/08/2021

5.5 Summary

In summary, this chapter explained about the implementation of this project include software development environment setup, software configuration management and implementation status. The implementation stage is very important to ensure that the project can be develop in a proper manner. The next chapter will discuss about the testing phase of the system.

CHAPTER 6: TESTING

6.1 Introduction

This chapter will focusing on the project testing of the online attendance system using face recognition. It is compulsory to carry out an in-depth testing in software development to ensure the final product are comply with the requirement specified initially. The project testing phase is important to identify, measure and examine the quality of a software system or application so that necessary action or improvement can be taken to tackle those problem or defects. Moreover, testing are conducted to made correctness to software application including each of the system module and system logic to meet project objectives. The aspect that need to be consider in software testing will be discuss and explain later in this chapter.

6.2 Test Plan

Test plan is conducted to ensure the system function properly. For web based system, various type of measures or testing can be used to evaluate the system. There are four type of testing executed in this project and each type of testing are executed by respective candidate. The candidate can be either a developer or user of the system. The developer are refer to person who involve in development of system while user refer to the end user of the system. Therefore, all the alpha testing regarding to system such as unit testing, integrating testing and system testing are executed by developer while the beta testing, user accepted testing are perform by user. Table 6.1 display the type of testing conducted in this project.

Table 6.1 Type of Testing

No	Type of Testing	Classification
1	Unit Testing	Alpha Testing
2	Integration Testing	
3	System Testing	
4	User Acceptance Testing	Beta Testing

6.2.1 Test Organization

There are various type of testing will be carried out in this project as shown in Table 5.1 which are unit testing, integration testing, system testing and user acceptance testing. Hence, each of testing are assigned to respective candidate and later the execution date of associated testing will be determine in test schedule. Unit testing, integration testing and system testing are classified as alpha testing while user acceptance testing is classified as beta testing. Table 6.2 show the type of testing associated with its respective candidate.

Table 6.2 Type of Testing Associated with Its Respective Candidate

Type of Testing	Role of Tester	Tester Name
Unit Testing	System Developer	Wong Zhi Shing
Integration Testing		
System Testing		
User Acceptance Testing	System User	Muhammad Fikri Bin Othman

Based on Table 6.2, alpha testing are being conducted by system developer while beta testing being carried out by end user. System developer have in-depth knowledge of the system logic and all of its functionality because they wrote all the script and codes of the system. Hence, all of the alpha testing are conducted by system developer simply because they are the most appropriate candidate to do this task. On the other hand, user acceptance testing are important criteria in determining whether the system successfully meet the end user requirement and goals. Therefore, it is more suitable to be execute by end user of the system.

6.2.2 Test Environment

Web based system are hosted on a web server and accessed by client using web browser. Therefore, the test environment of web based system can be divide into two part which are server side and client side. The server side consist of a HTTP or web server which process all the request of client and stored the database of the system while for the client side will required a web browser application to access the web system. In this project, the web server are hosted using localhost which mean a virtual web server are hosted on the same computer which client used to access the web application. If the system are hosted and accessed using two computers, it is necessary to ensure both computer must be connected to the same network and both computer are accessible to each other. Table 6.3 display the server side configuration and Table 6.4 display the client side configuration.

Table 6.3 Server Side Configuration

System Configuration	Specification
Operating System	Windows 10 Home
System Type	64-Bit Operating System
Processor	Inter i5 -6200U
RAM	8 GB
HTTP /Web Server	Apache2
Database Server	MariaDB

Table 6.4 Client Side Configuration

System Configuration	Specification
Operating System	Windows 10 Home
System Type	64-Bit Operating System
Processor	Inter i5 -6200U
RAM	8 GB
Webcam	USB2.0 VGA UVC Webcam (640×480)

6.2.3 Test Schedule

All of the four type of testing are carried out once after each module are successfully developed. Table 6.5 shows the schedule of testing for each of the module developed in this project.

Table 6.5 Schedule of Testing

Module	Test Cycle	Duration	Date Started	Date Completed
Login	5	2 Day	19/04/2021	20/04/2021
Attendance Registration	5	3 Days	03/05/2021	05/05/2021
Face Recognition	5	3 Days	17/05/2021	19/05/2021
Display Attendance Record	5	3 Days	31/05/2021	02/06/2021
Management (Administrator)	5	4 Days	14/06/2021	17/06/2021
Class Management (Lecturer)	5	4 Days	16/08/2021	19/08/2021

6.3 Test Strategy

The strategy serve as an outline for the carrying out the testing for a software application. Testing are crucial in identifying the functionality and measuring the correctness of a software application. There are various technique and method used for software testing. This project is an individual project which a general white-box and black-box testing method would be sufficient to test and evaluate the system.

The first testing method used is white-box testing which aim to inspect the system logic and coding algorithms so that all the error and failure of the system would be identify and fixed during the development process. White-box testing which usually conducted by developer because this kind of testing required tester to have full knowledge of the system logic and codes algorithms mention by (Khan and Khan, 2012). In software application development, there are three testing suitable to be conducted using white-box testing which are, unit testing, integration testing and system testing.

The second testing method used is black-box testing which aim to evaluate or measure the system usability and acceptability. Thus, the testing would focus on the fundamental aspect of the system only. Furthermore, this kind of testing

required a tester who does not involve in the project development to ensure the result of testing are justified stated by (Khan and Khan, 2012). In this project, the user acceptance testing are more suitable to be conducted using black-box method and the testing will be perform by end user of the system. This is because an end user normally does not have any knowledge about the system development and in this case a university student will be chosen as the tester in user acceptance test. Table 6.6 show the strategy used in testing in this project.

Table 6.6 Strategy used in Testing

No	Type of Testing	Technique Used
1	Unit Testing	White-Box Testing
2	Integration Testing	
3	System Testing	
4	User Acceptance Testing	Black-Box Testing

6.3.1 Type of Test

In this sub chapter, the four type of testing listed in Table 6.6 will be explain in details. Each of the testing has its own usage and necessity.

6.3.1.1 Unit Testing

Unit testing are the initial testing phase which each and every of the individual component are tested to be working before developer can begin to apply integration between different types of component. This test are focus on the smaller part of coding or function such as loop, user interface and function etc. This phase is crucial in ensuring all of the small component are implemented well so that further development would be much easier to carry out. Table 6.7 show the component that required to be tested for each of the system module.

Table 6.7 Component of Unit Testing

Module	Component	Test Class
Login	Student Login Form	Functional
	Administrator and Lecturer Login Form	

Attendance Registration	Available Class Session	Correctness
	Register Attendance	Functional
Face Recognition	Facial Image Snapshot	Functional
	Facial Image Recognition/Verification	Functional
Display Attendance Record	Selection of Enrolled Class	Functional
	View selected class attendance record	Functional
Management (Administrator)	Manage User Details	Functional
	Manage Course Details	
Class Management (Lecturer)	Manage Class	Functional
	Manage Class Namelist	
	Manage Class Session	

6.3.1.2 Integration Testing

Integration testing is the second level of testing which is used to determine the functionality of integrated components. Integrated components are combination of multiple individual components which aim to perform a specific function. During this testing phase, it is more about identify the interaction between different components and verify whether the coding of integration are apply appropriately. The ultimate goal is to make sure every integration part are running correctly and Table 6.8 shows the components of integration testing.

Table 6.8 Component of Integration Testing

Module	Component	Test Class
Login	Login Credential Authentication with Database Connection	Functional and Correctness
Attendance Registration	Listing available class session for enrolled students with Database Connection	Correctness
Face Recognition	Facial Image Capture using Webcam with AWS Cloud Service Connection	Functional and Correctness
Display Attendance Record	Listing of enrolled class' attendance record with Database Connection	Correctness

Management (Administrator)	Listing User and Course Details with Database Connection	Correctness
Class Management (Lecturer)	Class Participants Count	Correctness

6.3.1.3 System Testing

System testing is the third level of testing which is used to determine the functionality of overall system modules. Overall system module included all of the integrated components. During this testing phase, it is more about testing the system quality, correctness and its compliance to the system requirement and specification. Table 6.9 shows the components of system testing.

Table 6.9 Component of System Testing

Module	Component	Functional Requirement	Test Class
Login	Student Login Form	Login authentication	Correctness
	Administrator and Lecturer Login Form		
Attendance Registration	Available Class Session	Attendance registration	Correctness
	Register Attendance		
Face Recognition	Facial Image Snapshot	Facial Image recognition	Functional and Correctness
	Facial Image Recognition/Verification		
Display Attendance Record	Selection of Enrolled Class	Attendance record checking	Correctness
	View selected class attendance record		
Management (Administrator)	Manage System Users	Manage system details	Functional and Correctness
	Manage Course Details		
Class Management (Lecturer)	Manage Class	Manage class session	Functional and Correctness
	Manage Class Namelist		
	Manage Class Session		

6.3.1.4 User Acceptance Testing

User acceptance testing is the final stage of testing which is more about evaluating the user acceptability to the system rather than fixing of system bug. The testing are perform by end-user which is potential candidate of the system who does not participate in the development of system. This is to ensure that the system achieved its objective and all of the functional requirements. Table 6.9 shows the components of user acceptance testing.

Table 6.10 Component of System Testing

Module	Component	Test Class
Login	Login into Student Account	Functional and Correctness
Attendance Registration	Register Attendance	Correctness
Face Recognition	Facial Image Snapshot	Functional and Correctness
	Facial Image Recognition/Verification	
Display Attendance Record	View selected class attendance record	Correctness

6.4 Test Design

6.4.1 Test Description

Test description is a series of description which include test preparation, test procedure and the test case that being conducted. Test description is useful in evaluating the functionality and quality of the system as it focuses on the features and module of the system. The important note is that the test case must addresses to the system requirement. This is to ensure that the system achieve all of its requirement specification and the system modules are align strictly to the functional requirement stated earlier in previous chapter. Thus, it can be seen that all module are actually derived from the system functional requirements and the test case are conducted based on number of modules.

Next, the following section will explain about each of the test case execution including with the input, action and expected result.

6.4.1.1 Login Module

The login module is tested by user login into the system using given login credentials key. Positive test are test that will get successful result while negative test are test that would give fail result.

Table 6.11 Login Module Test Case

Strategy	Test ID	Input	Action	Expected Result
Positive Test	OAS_01_01_01	Correct User email and Correct Password	Fill email and password and click submit	Success
Negative Test	OAS_01_02_01	Incorrect User email and Correct Password	Fill email and password and click submit	Fail
Negative Test	OAS_01_02_02	Correct User email and Incorrect Password	Fill email and password and click submit	Fail
Negative Test	OAS_01_02_03	None	click submit without filling in anything	Fail (form cannot be submitted)

6.4.1.2 Attendance Registration Module

Table 6.12 Attendance Registration Module Test Case

Strategy	Test ID	Input	Action	Expected Result
Positive Test	OAS_02_01_01	None	Click Register (first time)	Success

Negative Test	OAS_02_02_01	None	Click Registered (second time after first time successfully registered)	Fail
Negative Test	OAS_02_02_02	None	Click Fail Registered (second time after first time register fail)	Fail
Negative Test	OAS_02_02_03	None	Click Register (after class session finished)	Fail

6.4.1.3 Face Recognition Module

Table 6.13 Face Recognition Module Test Case

Strategy	Test ID	Input	Action	Expected Result
Positive Test	OAS_03_01_01	Captured Facial Image	Capture Same Person Facial Image	Success
Negative Test	OAS_03_01_02	Captured Facial Image	Capture Same Person Facial Image with Spectacles	Success
Negative Test	OAS_03_02_01	Captured Facial Image	Capture Same Person Facial Image with Face Mask	Fail
Negative Test	OAS_03_02_02	Captured Facial Image	Capture False Person Facial Image	Fail

6.4.1.4 Display Attendance Record Module

Table 6.14 Display Attendance Record Module Test Case

Strategy	Test ID	Description	Input	Action	Expected Result
Positive Test	OAS_04_01_01	Attendance List Display	None	Refresh Page	Success
Positive Test	OAS_04_01_02	Attendance Status changes	None	Register a class session	Success
Positive Test	OAS_04_01_03	Attendance Total increment	None	Change Attendance Status	Success
Positive Test	OAS_04_01_04	Class Session No. increment	None	Create a new Class Session	Success

6.4.1.5 Management (Administration) Module

Table 6.15 Management Module (Student) Test Case

Strategy	Test ID	Input	Action	Expected Result
Positive Test	OAS_05_01_01	Correctly input	Fill in form and click submit	Success
Negative Test	OAS_05_02_01	None	Empty Form and click submit	Fail
Negative Test	OAS_05_02_02	Incorrect input	Fill in invalid info and click submit (email field, password min 8 character etc..)	Fail
Positive Test	OAS_05_01_02	Correct input	Fill in form and click Update	Success
Negative Test	OAS_05_02_03	None	Empty Form and click Update	Fail
Negative Test	OAS_05_02_04	Incorrect input	Fill in invalid info and click Update (email field, password min 8 character etc..)	Fail
Positive Test	OAS_05_01_03	None	Select and Remove a student from List without constraints	Success

Negative Test	OAS_05_02_05	None	Select and Remove a student from List with constraints	Fail

Table 6.16 Management Module (Class Enrolment) Test Case

Strategy	Test ID	Input	Action	Expected Result
Positive Test	OAS_05_01_04	Email	Fill in available student email and click submit	Success
Negative Test	OAS_05_02_06	None	Empty Form and click submit	Fail
Negative Test	OAS_05_02_07	Email	Fill in invalid email and click submit	Fail
Positive Test	OAS_05_02_08	Email	Fill in duplicate student email and click submit	Fail
Positive Test	OAS_05_02_09	Number, text, etc.	Fill in other type input and click submit (non-email form)	Fail
Positive Test	OAS_05_01_05	None	Select and Remove a student from List without constraints	Success
Negative Test	OAS_05_02_10	None	Select and Remove a student from List with constraints	Fail

6.4.1.6 Class Management (Lecturer) Module

Table 6.17 Class Management Module (Class Session) Test Case

Strategy	Test ID	Input	Action	Expected Result
Positive Test	OAS_06_01_01	Correctly input	Fill in the insert new session form and click submit	Success
Negative Test	OAS_06_02_01	None	Left insert new session form empty and click submit	Fail
Negative Test	OAS_06_02_02	Incorrect input	Fill in invalid info and click submit (start date or end date in the past etc)	Fail
Positive Test	OAS_06_01_02	Correct input	Fill in form and click Update	Success
Negative Test	OAS_06_02_03	None	Empty Form and click Update	Fail
Negative Test	OAS_06_02_04	Incorrect input	Fill in invalid info and click Update (start date or end date in the past etc)	Fail

Positive Test	OAS_06_01_03	None	Select and Remove a Class Session without constraints	Success
Negative Test	OAS_06_02_05	None	Select and Remove a Class Session with constraints	Fail

6.4.2 Test Data

There are generally two type of data used in this project which is synthetic and real life data. Synthetic data is dataset that being made to imitate real life data. This kind of dataset is very close to real life data but it was not the actual or real data. The purpose of choosing synthetic data is because synthetic data is sufficient for most testing to carry out in this project and this approach can accelerate the process or testing. For the real life data only consist of facial image which are obtained from end user to carry out user acceptance testing. This is to ensure that the face recognition module can comply with the system requirement and specification as this data are unable to be tested using synthetic data. Table 6.18 shows the testing data of the system.

Table 6.18 Testing Data

Test ID	Input Data	Data Type
OAS_01_01_01	Email and Password	Synthetic
OAS_01_02_01	Email and Password	Synthetic
OAS_01_02_02	Email and Password	Synthetic
OAS_01_02_03	None	-
OAS_02_01_01	None	-
OAS_02_02_01	None	-
OAS_02_02_02	None	-
OAS_02_02_03	None	-
OAS_03_01_01	Facial Image	Real life
OAS_03_01_02	Facial Image	Real life
OAS_03_02_01	Facial Image	Real life
OAS_03_02_02	Facial Image	Real life
OAS_04_01_01	None	-
OAS_04_01_02	None	-
OAS_04_01_03	None	-
OAS_04_01_04	None	-
OAS_05_01_01	Various Input	Synthetic

OAS_05_02_01	None	-
OAS_05_02_02	Various Input	Synthetic
OAS_05_01_02	Various Input	Synthetic
OAS_05_02_03	None	-
OAS_05_02_04	Various Input	Synthetic
OAS_05_01_03	None	-
OAS_05_02_05	None	-
OAS_05_01_04	Email	Synthetic
OAS_05_02_06	None	-
OAS_05_02_07	Email	Synthetic
OAS_05_02_08	Email	Synthetic
OAS_05_02_09	Number, text	Synthetic
OAS_05_01_05	None	-
OAS_05_02_10	None	-
OAS_06_01_01	Text and Date	Synthetic
OAS_06_02_01	None	-
OAS_06_02_02	Text and Date	Synthetic
OAS_06_01_02	Text and Date	Synthetic
OAS_06_02_03	None	-
OAS_06_02_04	Text and Date	Synthetic
OAS_06_01_03	None	-
OAS_06_02_05	None	-

6.5 Test Result And Analysis

In software development, in-depth testing is compulsory to ensure the final product are comply with the requirement specified initially. According to Table 6.2, user acceptance test are conducted by end user which the result of each module will be summarized in this section. Attendance registration module, facial recognition module and display attendance record module are the three main module in this system which directly relate with the project initial objective. Thus, testing phase will have more focus on these part to ensure the attendance registration using facial recognition feature are operate correctly and student able to check their attendance record accurately.

For the facial recognition module, it is done by comparing and analysing the facial image provided initially with the facial image captured using webcam during

class session. The challenges faced in this feature is that student might be wearing additional facial accessories such as sun glasses, scarf and spectacles that has potential to interrupt the facial recognition result. Other facial occlusion such as hairs, moustaches or even a hat would also cause failure of recognition according to (Min et al, 2011). The best is to avoid wearing any facial accessories during facial image capturing process.

By concerning of these unpredictable scenario during facial recognition, some of the potential facial occlusion are being addressed in the testing phase where tester need to wear spectacles, hat and even face mask during the facial image capturing process. The result of testing for spectacles and hat show positive recognition which proof that the facial image recognition algorithm applied in this project (AWS Rekognition) are able to match the person correctly even with facial accessories. AWS Recongiton significantly improves the performance and accuracy of facial image recognition stated by (Popić, 2018). However, when the face mask is concern, the facial recognition will get a negative verification result as expected because all of the facial features are covered. Figure 6.1 display the image captured with spectacles and hat while figure 6.2 display the facial image used as reference.

Figure 6.1 Facial Image Captured with Facial Accessories

Figure 6.2 Reference Facial Image used for comparison

However, if the reference facial image of a different person is used, the facial recognition would give a negative result as expected even without any facial accessories.

Figure 6.3 Facial Image Captured without Facial Accessories

Moreover, the image processing API provided Amazon Cloud Service are reply on internet connectivity. This mean that the internet speed and stability would also affect the performance of facial image recognition process. The result obtain from testing conducted in this project also observe similar situation which image recognition performance are closely influence by the internet connectivity. Unstable or slow internet connection will interrupt the recognition process and result in long recognition time. Facial recognition API has benefits of excellence recognition algorithms, convenience and able to use remotely but the only drawback is that if the server's internet connection are down then the functionality provided by this API are not reachable in the software application as mention by (Popić, 2018).

6.5.1 Login Module Result

Project Name :		Online Attendance System Using Facial Recognition				
Module Name :		Login				
Created By :		Wong Zhi Shing				
Reviewed By :		Muhammad Fikri Bin Othman				
Date of Review :						
Test ID	**Description**	**Input**	**Action**	**Expected Result**	**Status**	**Comment**
OAS_01_01_01	User try login into	Correct User	Fill email	Success	Pass	Login module

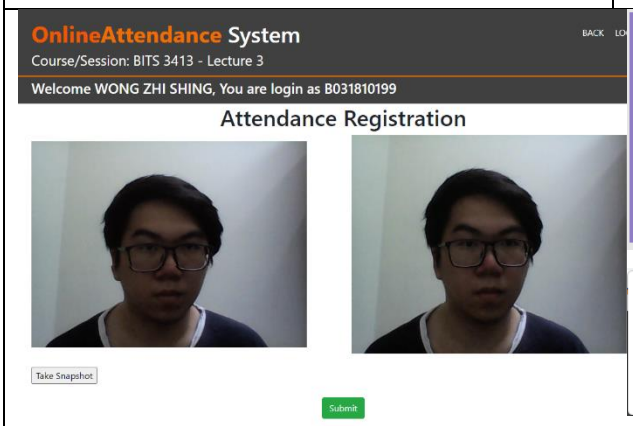
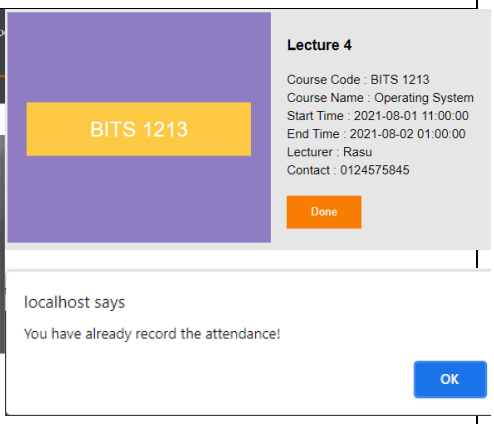
	the system by using correct and false	email and Correct Password	and password and click submit			working fine
OAS_01_02_01	credential to see whether the module can handle various situation	Incorrect User email and Correct Password	Fill email and password and click submit	Fail	Pass	
OAS_01_02_02		Correct User email and Incorrect Password	Fill email and password and click submit	Fail	Pass	
OAS_01_02_03		None	click submit without filling in anything	Fail	Pass	

Successful Output	**Fail Output**
	
Login Successful into System	Fail to login into the system

6.5.2 Attendance Registration Module Result

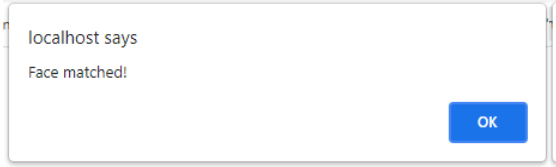
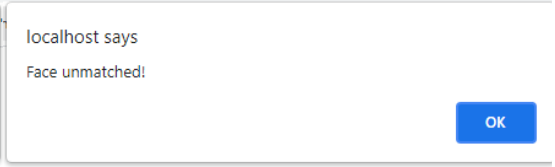
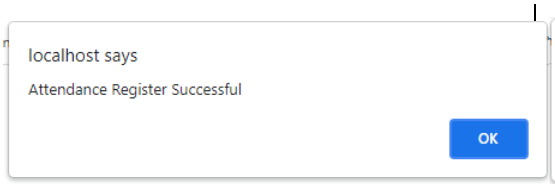
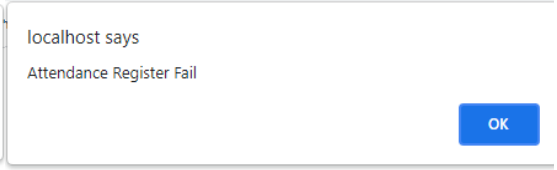
Project Name :	Online Attendance System Using Facial Recognition
Module Name :	Attendance Registration
Created By :	Wong Zhi Shing
Reviewed By :	Muhammad Fikri Bin Othman
Date of Review :	

Test ID	Description	Input	Action	Expected Result	Status	Comment
OAS_02_01_01	User can only register attendance one time for a class session and register after class session finished are not allowed	None	Click Register (first time)	Success	Pass	Attendance Registration module working fine
OAS_02_02_01		None	Click Registered (second time after first time successfully registered)	Fail	Pass	
OAS_02_02_02		None	Click Fail Registered (second time after first time register fail)	Fail	Pass	
OAS_02_02_03		None	Click Register (after class session finished)	Fail	Pass	

Successful Output	Fail Output
	
Click Register (First Time)	Click Register (Second Time)

6.5.3 Face Recognition Module Result

Project Name :		Online Attendance System Using Facial Recognition				
Module Name :		Face Recognition				
Created By :		Wong Zhi Shing				
Reviewed By :		Muhammad Fikri Bin Othman				
Date of Review :						
Test ID	**Description**	**Input**	**Action**	**Expected Result**	**Status**	**Comment**
OAS_03_01_01	User can only register attendance one time for a class session and register after class session finished are not allowed	Captured Facial Image	Capture Same Person Facial Image	Success	Pass	Face Recognition module working fine
OAS_03_01_02		Captured Facial Image	Capture Same Person Facial Image with Spectacles	Success	Pass	
OAS_03_02_01		Captured Facial Image	Capture Same Person Facial Image with Face Mask	Fail	Pass	
OAS_03_02_02		Captured Facial Image	Capture False Person Facial Image	Fail	Pass	

Successful Output	Fail Output
   
Facial Image Verification Successful	Facial Image Verification Fail

6.5.4 Display Attendance Record Result

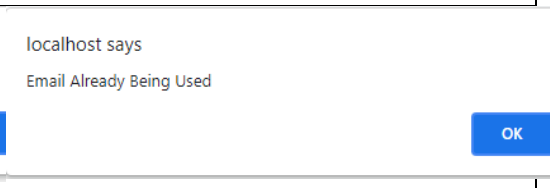
Project Name :	Online Attendance System Using Facial Recognition					
Module Name :	Display Attendance Record					
Created By :	Wong Zhi Shing					
Reviewed By :	Muhammad Fikri Bin Othman					
Date of Review :						
Test ID	**Description**	**Input**	**Action**	**Expected Result**	**Status**	**Comment**
OAS_04_01_01	Attendance List Display	None	Refresh Page	Success	Pass	Display Attendance Record module working fine
OAS_04_01_02	Attendance Status changes	None	Register a class session	Success	Pass	
OAS_04_01_03	Attendance Total increment	None	Change Attendance Status	Success	Pass	
OAS_04_01_04	Class Session No. increment	None	Create a new Class Session	Success	Pass	

6.5.5 Management (Administrator) Module Result

Project Name :		Online Attendance System Using Facial Recognition				
Module Name :		Management (Administrator)				
Created By :		Wong Zhi Shing				
Reviewed By :		Muhammad Fikri Bin Othman				
Date of Review :						
Test ID	**Description**	**Input**	**Action**	**Expected Result**	**Status**	**Comment**
OAS_05_01_01	Adding new student into the system	Correctly input	Fill in form and click submit	Success	Pass	Management Module for (student) is working fine
OAS_05_02_01		None	Empty Form and click submit	Fail	Pass	
OAS_05_02_02		Incorrect input	Fill in invalid data type input and click submit	Fail	Pass	
OAS_05_01_02	Update available student in the system	Correct input	Fill in form and click Update	Success	Pass	
OAS_05_02_03		None	Empty Form and click Update	Fail	Pass	
OAS_05_02_04		Incorrect input	Fill in invalid data type input and click Update	Fail	Pass	

OAS_05_01_03	Remove student from the system	None	Select and Remove a student from List	Success	Pass	
OAS_05_02_05		None	Select and Remove a student from List with constraints	Fail	Pass	
OAS_05_01_04	Adding Student enrolment to particular class and no duplication of student are allowed for a single class	Email	Fill in available student email and click submit	Success	Pass	Management Module for (enrolment) is working fine
OAS_05_02_06		None	Empty Form and click submit	Fail	Pass	
OAS_05_02_07		Email	Fill in invalid email and click submit	Fail	Pass	
OAS_05_02_08		Email	Fill in duplicate student email and click submit	Fail	Pass	
OAS_05_02_09		Number, text, etc.	Fill in invalid data type input and click submit	Fail	Pass	
OAS_05_01_05	Remove student	None	Select and Remove a	Success	Pass	

	enrolment to a particular class		student from List			
OAS_05_02_10		None	Select and Remove a student from List with constraints	Fail	Pass	

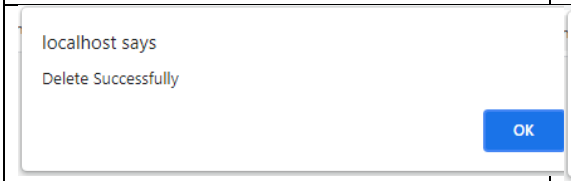
Successful Output	**Fail Output**
	
Add New Student Successful	Fail to Add New Student (Duplicate Email)

6.5.6 Class Management (Lecturer) Module Result

Project Name :	Online Attendance System Using Facial Recognition
Module Name :	Class Management (Lecturer)
Created By :	Wong Zhi Shing
Reviewed By :	Muhammad Fikri Bin Othman
Date of Review :	

Test ID	**Description**	**Input**	**Action**	**Expected Result**	**Status**	**Comment**
OAS_06_01_01	Adding new class session into the system	Correctly input	Fill in form and click submit	Success	Pass	Class Management module working fine
OAS_06_02_01		None	Submit empty form	Fail	Pass	
OAS_06_02_02		Incorrect input	Fill in invalid	Fail	Pass	

			data type input and click submit			
OAS_06_01_02	Update available class session in the system	Correct input	Fill in form and click Update	Success	Pass	
OAS_06_02_03		None	Empty Form and click Update	Fail	Pass	
OAS_06_02_04		Incorrect input	Fill in invalid data type input and click Update	Fail	Pass	
OAS_06_01_03	Remove class session from the system	None	Select and Remove a Class Session	Success	Pass	
OAS_06_02_05		None	Select and Remove a Class Session with constraints	Fail	Pass	

Successful Output	**Fail Output**
	
Remove Class Session Successful	Fail to Remove Class Session

6.6 Summary

In summary, this chapter explain about testing phase conducted in this project including test plan, test result and analysis, test strategy and test design. All of the important procedure has been elaborate with its purposes and in-depth analysis of the result are discussed in this chapter. The following chapter will be the final chapter which conclude about the whole project.

CHAPTER 7: PROJECT CONCLUSION

7.1 Introduction

The Online Attendance System Using Facial Recognition was developed to improve current attendance registration method. The aspects that has been improve are online identity verification for virtual classroom and attendance records checking for virtual classes. This chapter will discussed about the project summarization, project limitation, project contributions and future work in details.

7.2 Project Summarization

This project aim to develop an online attendance system that implemented facial recognition to provide identity verification for attendance registration in virtual classroom. There are three objectives in this project which the first one is to analyse the system requirement of online classroom attendance system. The first objective has been achieved in chapter 2 which the type of system to be develop has been decide and chapter 4 where all kind of system requirement are clearly proposed. Since the project is to develop a remote system, accessibility must be concern. Web based architecture has been chosen for online attendance system because it is a more user friendly platform which is accessible by any device. The project has develop a web application that able to access by client using web browser. The communication between client and server are through HTTP protocol. Besides, this online attendance system would serve a unite platform that used by all classes. Student would no longer confuse about which platform or method used by each lecturer in taking class attendance.

The next objective is to develop a web-based online classroom attendance system based on facial recognition. The second objective has been achieved in

chapter 5 which is the implementation phase. The reason of choosing this approach is because of its unique advantages compare to other verification method as every person have distinctive facial identity and it cannot be faked by other people easily. Facial recognition is able to verify a person live and give immediate response during authentication. This new verification approach able to overcome the problem of fake attendance in current virtual attendance registration method which does not have identity verification capability. Besides, this approach does not required additional device unlike fingerprint verification which required fingerprint scanner. All of this effort made are to ensure the integrity and legitimate of student attendance in virtual classroom as study found that there is a positive correlation between attendance of students and their performance in examination and coursework.

Moreover, the third objective is to provide an accurate student attendance status in online attendance system which current virtual attendance registration method lack of. This objective is achieved in chapter 6 which the system is tested where accurate attendance record displayed to students. This live or real time attendance record are crucial for student to identify whether their attendance are successfully recorded into the system.

7.3 Project Contribution

Online Attendance System using Facial Recognition has contributed to academic institution and private sector. The contribution to these parties are describe in the following section.

- Academic Institution

  All of the academic institution including primary school, secondary school and tertiary education that are implementing virtual teaching method can benefit from this project. For university in specific, this project are useful to student, lecturer and management team of each faculty. This is because the project can improve the current attendance taking method in term of accessibility, integrity and usability. The aim of this project is to provide an alternative way for current attendance registration approach used in virtual classroom. By introducing facial recognition approach to the attendance registration, a new solution of attendance registration with

identity verification capability can be implement and used in all academic institution.

- Private Sector

  This project also can benefit to companies in private sector that implementing work from home due to pandemic Covid-19 or other situation. Similar with academic institution, companies also implementing some way to verify the present and absent of its staff and worker such as punch card etc. Facial recognition type of identity verification can also be suggest and applied in working environment. This project can serve as a foundational source for them to further study, modify and improve so that this verification approach can be integrated into their company punch card system.

7.4 Project Limitation

This project was developed to improvise the current method of attendance registration used in most university. This attendance system is built using web based approach to enhance accessibility and opted with face recognition capability for identification purpose during register attendance. Besides, it also provide up to date attendance record for student to confirm their attendance is being recorded accurately. However, there are some limitation or weakness that could be refine or tackle in future development or research.

In this project, the implementation of system is only focus on computer' web browser compatibility. All the implementation and testing are conducted using computer as well. Thus, the first limitation in this project is that the prototype currently only run through compatibility test in computer. Compatibility of system with other device like smartphone or tablet are currently not supported and will required further configuration and development. Besides, the communication between client and web server are through HTTP protocol as mention in project summarization, All of the client request are perform through the website which data is transmit using HTTP protocol. The downside of HTTP protocol is that all the data is transmit using plain text and the information can easily capture by other person during transmission of data through internet. Hence, a more secure or encrypted approach of data transmission could be implement into the system to enhance security of the system.

Moreover, the face recognition functionality that has been implemented in this project is rely strongly on internet connectivity. Any delay or congestion occurred to the web server would directly affect this feature from working properly. Thus, an alternative or second path that connects the internet are suggested so that in case the primary internet connection having any issue, the system still manage to communicate with the amazon cloud service. Additionally, the facial recognition functionality that has being implemented in this project has limitation of validating facial image pre captured using another device which means that a person can register attendance for another person by using the facial image of another person which captured initially. Furthermore, the facial recognition feature used in this prototype is develop using AWS Rekognition free tier trial package. In order to develop the system for real scenario which involve big scale of user, a significant amount of implementation cost might be required as the service is pay per use service. Increment in operational cost must be considered in long run as AWS cloud service is on monthly subscription basis.

7.5 Future Work

The online attendance system using facial recognition prototype manage to comply and meet all of the user requirement, project goals and objective. However, there are still rooms for improvement. Firstly, the developed prototype only supported access using web browser. The implementation of website that are compatible to cross platform device such as smartphone and tablet can be consider in future work.

Other than that, due to advancement in technology and increasing use of mobile device, there is a new trend of designing system where system can be access directly thought both mobile application and website. Famous application like Facebook, WhatsApp and Instagram have both website and mobile software supported in IOS and Android. Building specific application on android and IOS are certainly require higher implementation and maintenance cost but it has benefit of further enhance usability and accessibility of system as smartphone user are more convenient in using software application rather than website unlike computer user which prefer website than desktop application.

Additionally, the security of the system have not been addressed in this project as the main focus and objective are on integrating facial recognition functionality

into online attendance system. Future work related to security of the system can be done to ensure the system is safe from various kind of cyber-attack such as Man-in-the-Middle attack, Denial of service (DOS), and Brute Force attack etc. To ensure that the system is secure and reliable, the prototype must go through the security assessment test before it can be implemented in real scenario.

7.6 Summary

In summary, the final year project 'Online Attendance System using Facial Recognition' has been successfully completed within the given timeframe and all of the objective stated initially has been achieved. This project has illustrate the possibility of implementing facial recognition verification for virtual classroom. However, improvement can still be made to overcome the limitation aspect in this project. Future work and continuation research are encourage to be conducted to explore and find out the best approach of identity verification in online attendance system.

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APPENDIX A

Pseudocode of System

Module 1: Login Module

1.1. If Login
    1.1.1. Login Input
    1.1.2. Verify which type of user
    1.1.3. If Input verified?
        1.1.3.1. If user type as Admin?
            1.1.3.1.1. Display Login Successfully
            1.1.3.1.2. Redialling to 2.
        1.1.3.2. If user type as Lecturer?
            1.1.3.2.1. Display Login Successfully
            1.1.3.2.2. Redialling to 3.
        1.1.3.3. If user type as Student?
            1.1.3.3.1. Display Login Successfully
            1.1.3.3.2. Redialling to 4.
    1.1.4. Else
        1.1.4.1. Redialling to 1.1.1.
1.2. If Update Profile
    1.2.1. Display User Information
    1.2.2. If Update User Information
        1.2.2.1. Update Input
        1.2.2.2. If Input verified?
            1.2.2.2.1. Display Update Profile Successfully
            1.2.2.2.2. Record Saves into Database
            1.2.2.2.3. Redialling to 1.2.
        1.2.2.3. Else
            1.2.2.3.1. Display Update Profile Unsuccessfully
            1.2.2.3.2. Redialling to 1.2.
1.3. If Logout
    1.3.1. Display Logout Successfully
    1.3.2. Redialling to 1.1.

Module 2: Attendance Registration Module

2.1. View Available Class Session
    2.1.1. If Search?
        2.1.1.1. Search Input
        2.1.1.2. Display Searched Session
        2.1.1.3. If Reset Search
            2.1.1.3.1. Redialling to 2.1.
    2.1.2. If Session Done Registered?

2.1.2.1. Display Done Button for that Session
2.1.3. Else
2.1.3.1. Display Register Button for that Session
2.1.3.2. If Register Attendance
2.1.3.2.1. Redialling to 3.1.
2.1.3.3. Else
2.1.3.3.1. Redialling to 2.1.

Module 3: Face Recognition Module

3.1. Display Interface for Face Image Capture
3.2. Click Snapshot
3.3. Display Captured Image
3.3.1. If Captured Image Satisfied?
3.3.1.1. Click Submit
3.3.1.2. Image Sent To AWS Cloud Service to Process using API
3.3.1.3. If Image Recognise Successfully
3.3.1.3.1. Display Attendance Registered Successful
3.3.1.3.2. Record Saves into Database
3.3.1.3.3. Redialling to 2.
3.3.1.4. Else
3.3.1.4.1. Display Attendance Registration Fail
3.3.1.4.2. Record Saves into Database
3.3.1.4.3. Redialling to 2.
3.3.1.5. If Captured Image Not Satisfied
3.3.1.5.1. Proceed to 3.2 until Satisfied

Module 4: Display Attendance Record Module

4.1. Select One of the Course that Being Enrolled
4.2. Click Submit
4.3. Retrieve Selected Information from Database
4.4. Count number of total class session, successful and fail registered attendance
4.5. Display Attendance Record for Selected Course
4.6. Display number of total class session, successful and fail registered attendance

Module 5: Management Module

5.1. If Manage System Users (Student)
5.1.1. View Student
5.1.2. If Add?
5.1.2.1. Add Input
5.1.2.2. If Input verified?
5.1.2.2.1. Display Add Student Successfully

5.1.2.2.2. Record Saves into Database
5.1.2.2.3. Redialling to 5.1.1
5.1.2.3. Else
5.1.2.3.1. Display Add Student Unsuccessfully
5.1.2.3.2. Redialling to 5.1.2.1.
5.1.3. If Update?
5.1.3.1. Update Input
5.1.3.2. If Input verified?
5.1.3.2.1. Display Update Student Successfully
5.1.3.2.2. Record Saves into Database
5.1.3.2.3. Redialling to 5.1.1
5.1.3.3. Else
5.1.3.3.1. Display Update Student Unsuccessfully
5.1.3.3.2. Redialling to 5.1.3.1.
5.1.4. If Delete?
5.1.4.1. If Deleted Successfully
5.1.4.1.1. Display Delete Successfully
5.1.4.1.2. Record Removed from Database
5.1.4.2. Else
5.1.4.2.1. Display Delete Unsuccessfully
5.1.4.3. Redialling to 5.1.1.
5.2. If Manage System User (Lecturer)
5.2.1. View Lecturer
5.2.2. If Add?
5.2.2.1. Add Input
5.2.2.2. If Input verified?
5.2.2.2.1. Display Add Lecturer Successfully
5.2.2.2.2. Record Saves into Database
5.2.2.2.3. Redialling to 5.2.1
5.2.2.3. Else
5.2.2.3.1. Display Add Lecturer Unsuccessfully
5.2.2.3.2. Redialling to 5.2.2.1.
5.2.3. If Update?
5.2.3.1. Update Input
5.2.3.2. If Input verified?
5.2.3.2.1. Display Update Lecturer Successfully
5.2.3.2.2. Record Saves into Database
5.2.3.2.3. Redialling to 5.2.1
5.2.3.3. Else
5.2.3.3.1. Display Update Lecturer Unsuccessfully
5.2.3.3.2. Redialling to 5.2.3.1.
5.2.4. If Delete?
5.2.4.1. If Deleted Successfully
5.2.4.1.1. Display Delete Successfully

5.2.4.1.2. Record Removed from Database
5.2.4.2. Else
5.2.4.2.1. Display Delete Unsuccessfully
5.2.4.3. Redialling to 5.2.1.
5.3. If Manage Course Details (Course)
5.3.1. View Course
5.3.2. If Add?
5.3.2.1. Add Input
5.3.2.2. If Input verified?
5.3.2.2.1. Display Add Course Successfully
5.3.2.2.2. Record Saves into Database
5.3.2.2.3. Redialling to 5.3.1
5.3.2.3. Else
5.3.2.3.1. Display Add Course Unsuccessfully
5.3.2.3.2.
5.3.2.3.3. Redialling to 5.3.2.1.
5.3.3. If Update?
5.3.3.1. Update Input
5.3.3.2. If Input verified?
5.3.3.2.1. Display Update Course Successfully
5.3.3.2.2. Record Saves into Database
5.3.3.2.3. Redialling to 5.3.1.
5.3.3.3. Else
5.3.3.3.1. Display Update Course Unsuccessfully
5.3.3.3.2. Redialling to 5.3.3.1
5.3.4. If Delete?
5.3.4.1. If Deleted Successfully
5.3.4.1.1. Display Delete Successfully
5.3.4.1.2. Record Removed from Database
5.3.4.2. Else
5.3.4.2.1. Display Delete Unsuccessfully
5.3.4.3. Redialling to 5.3.1.
5.4. If Manage Course Details (Class)
5.4.1. View Class
5.4.2. If Add?
5.4.2.1. Add Input
5.4.2.2. If Input verified?
5.4.2.2.1. Display Add Class Successfully
5.4.2.2.2. Record Saves into Database
5.4.2.2.3. Redialling to 5.4.1
5.4.2.3. Else
5.4.2.3.1. Display Add Class Unsuccessfully
5.4.2.3.2. Redialling to 5.4.2.1.
5.4.3. If Update?

5.4.3.1. Update Input
5.4.3.2. If Input verified?
5.4.3.2.1. Display Update Class Successfully
5.4.3.2.2. Record Saves into Database
5.4.3.2.3. Redialling to 5.4.1
5.4.3.3. Else
5.4.3.3.1. Display Update Class Unsuccessfully
5.4.3.3.2. Redialling to 5.4.3.1.
5.4.4. If Delete?
5.4.4.1. If Deleted Successfully
5.4.4.1.1. Display Delete Successfully
5.4.4.1.2. Record Removed from Database
5.4.4.2. Else
5.4.4.2.1. Display Delete Unsuccessfully
5.4.4.3. Redialling to 5.4.1.
5.5. If Manage Course Details (Enrolment)
5.5.1. View Enrolment
5.5.2. If Search?
5.5.2.1. Search Input
5.5.2.2. Display Searched Enrolment
5.5.2.3. If Reset Search
5.5.2.3.1. Redialling to 5.5.1.
5.5.3. If Add?
5.5.3.1. Add Input
5.5.3.2. If Input verified?
5.5.3.2.1. Display Add Enrolment Successfully
5.5.3.2.2. Record Saves into Database
5.5.3.2.3. Redialling to 5.5.1.
5.5.3.3. Else
5.5.3.3.1. Display Add Enrolment Unsuccessfully
5.5.3.3.2. Redialling to 5.5.3.1.
5.5.4. If Update?
5.5.4.1. Update Input
5.5.4.2. If Input verified?
5.5.4.2.1. Display Update Enrolment Successfully
5.5.4.2.2. Record Saves into Database
5.5.4.2.3. Redialling to 5.5.1.
5.5.4.3. Else
5.5.4.3.1. Display Update Enrolment Unsuccessfully
5.5.4.3.2. Redialling to 5.5.4.1.
5.5.5. If Delete?
5.5.5.1. If Deleted Successfully
5.5.5.1.1. Display Delete Successfully
5.5.5.1.2. Record Removed from Database

5.5.5.2. Else
5.5.5.2.1. Display Delete Unsuccessfully
5.5.5.3. Redialling to 5.5.1.

Module 6: Class Management Module

6.1. If Manage Class
6.1.1. View Handled Class
6.1.2. If Search?
6.1.2.1. Search Input
6.1.2.2. Display Searched Class
6.1.2.3. If Reset Search
6.1.2.3.1. Redialling to 6.1.1.
6.1.3. If Select a Particular Class Namelist?
6.1.3.1. Redialling to 6.2.1
6.1.4. If Select a Particular Class Session?
6.1.4.1. Redialling to 6.3.1.
6.2. If Manage Class Namelist
6.2.1. View Handled Class Namelist
6.2.2. If Select a Particular Student Attendance?
6.2.2.1. Display Attendance Record of that Student
6.3. If Manage Class Session
6.3.1. View Handled Class Session
6.3.2. If Add Specific Class Session?
6.3.2.1. Add Input
6.3.2.2. If Input verified?
6.3.2.2.1. Display Add Class Session Successfully
6.3.2.2.2. Record Saves into Database
6.3.2.2.3. Redialling to 6.3.1
6.3.2.3. Else
6.3.2.3.1. Display Add Class Session Unsuccessfully
6.3.2.3.2. Redialling to 6.3.2.1.
6.3.3. If Update Specific Class Session?
6.3.3.1. Update Input
6.3.3.2. If Input verified?
6.3.3.2.1. Display Update Class Session Successfully
6.3.3.2.2. Record Saves into Database
6.3.3.2.3. Redialling to 6.3.1
6.3.3.3. Else
6.3.3.3.1. Display Update Class Unsuccessfully
6.3.3.3.2. Redialling to 6.3.3.1.
6.3.4. If Delete Specific Class Session?
6.3.4.1. If Deleted Successfully
6.3.4.1.1. Display Delete Successfully
6.3.4.1.2. Record Removed from Database

6.3.4.2. Else
6.3.4.2.1. Display Delete Unsuccessfully
6.3.4.3. Redialling to 6.3.1.
6.3.5. If Manage Specific Class Session Attendance
6.3.5.1. View Student Attendance By Class Session
6.3.5.2. Select One of the Class Session
6.3.5.3. Click Submit
6.3.5.4. Retrieve Selected Information from Database
6.3.5.5. Display Attendance Record for Selected Class Session
6.3.5.6. If Add Student Attendance for Specific Class Session?
6.3.5.6.1. Add Input
6.3.5.6.2. If Input verified?
6.3.5.6.2.1. Display Add Student Attendance Successfully
6.3.5.6.2.2. Records Saves into Database
6.3.5.6.2.3. Redialling to 6.3.5.1.
6.3.5.6.3. Else
6.3.5.6.3.1. Display Add Booking Unsuccessfully
6.3.5.6.3.2. Redialling to 6.3.5.6.1.
6.3.5.7. If Update Student Attendance for Specific Class Session?
6.3.5.7.1. Update Input
6.3.5.7.2. If Input verified?
6.3.5.7.2.1. Display Update Class Session Successfully
6.3.5.7.2.2. Record Saves into Database
6.3.5.7.2.3. Redialling to 6.3.5.1.
6.3.5.7.3. Else
6.3.5.7.3.1. Display Update Class Session Unsuccessfully
6.3.5.7.3.2. Redialling to 6.3.5.7.1.
6.3.5.8. If Delete Student Attendance for Specific Class Session?
6.3.5.8.1. If Deleted Successfully
6.3.5.8.1.1. Display Delete Successfully
6.3.5.8.1.2. Record Removed from Database
6.3.5.8.2. Else
6.3.5.8.2.1. Display Delete Unsuccessfully
6.3.5.8.3. Redialling to 6.3.5.1.