

Facial Recognition Attendance System

By

Lew Tian Pei

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF COMPUTER SCIENCE (HONOURS)

Faculty of Information and Communication Technology

(Kampar Campus)

JUNE 2023

REPORT STATUS DECLARATION FORM

Title: Facial Recognition Attendance System

Academic Session: Jun 2023

I LEW TIAN PEI declare that I allow this Final Year Project Report to be kept in

Universiti Tunku Abdul Rahman Library subject to the regulations as follows:

1. The dissertation is a property of the Library.
2. The Library is allowed to make copies of this dissertation for academic purposes.

Verified by,



(Author's signature)



(Supervisor's signature)

Address:

VS 3A-18 Vista Saujana,
No 1, Jalan Wangsa 2/6,
Kepong, Kuala Lumpur.

Ts. Phan Koo Yuen

Date: 14 September 2023

Date: 14 September 2023

Universiti Tunku Abdul Rahman			
Form Title : Sample of Submission Sheet for FYP/Dissertation/Thesis			
Form Number: FM-IAD-004	Rev No.: 0	Effective Date: 14 SEPT 2023	Page No.: 1 of 1

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

UNIVERSITI TUNKU ABDUL RAHMAN

Date: 14 September 2023

SUBMISSION OF FINAL YEAR PROJECT /DISSERTATION/THESIS

It is hereby certified that **Lew Tian Pei** (ID No: 20ACB04747) has completed this final year project entitled “Facial Recognition Attendance System” under the supervision of Ts. Phan Koo Yuen (Supervisor) from the Department of Computer Science, Faculty of Information and Communication Technology.

I understand that University will upload softcopy of my final year project in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,



Lew Tian Pei

DECLARATION OF ORIGINALITY

I declare that this report entitled “**FACIAL RECOGNITION ATTENDANCE SYSTEM**” is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature :  _____

Name : _____ Lew Tian Pei _____

Date : _____ 14 September 2023 _____

ACKNOWLEDGEMENTS

I would like to express my sincere thanks and appreciation to my supervisors, Ts Phan Koo Yuen who has given me this bright opportunity to engage in an IT design project on the development of a facial recognition attendance system. It is my first step to establish a career in IT design field. Your guidance, expertise, and support were instrumental in the successful completion of this project. A million thanks to you.

I would also like to extend my appreciation to a very special person in my life, Shee Meng Fun, for her patience, unconditional support, and love, and for standing by my side during hard times. Finally, I would like to acknowledge the sacrifices my family and friends have made to support me in pursuing my academic goals. From offering words of encouragement to helping me with my assignments, your unwavering support has been invaluable.

Once again. I cannot thank my family and friends enough for their support and encouragement. I am grateful to have you all in my life, and I look forward to continuing to make you proud.

ABSTRACT

Attendance had become an important element to record the presence of students in the class so that the students can follow up the learning process. However, it was a drawback for the traditional manual attendance system which used paper and pen to sign attendance. This is due to the reason that traditional attendance system has the potential for error as students may sign for absent friends and the data can be easily manipulated. Therefore, a more reliable and efficient attendance system is needed. Facial recognition technology can be used to address these issues, reducing errors, preventing fake attendance, and saving time. In this project, Haar Cascade algorithm is used in this system to recognize faces. A web-based system was developed to let admin and instructor to manage the class and class attendance while the Android-based system was developed to let students to check their attendance.

TABLE OF CONTENTS

TITLE PAGE	i
REPORT STATUS DECLARATION FORM	ii
FYP THESIS SUBMISSION FORM	iii
DECLARATION OF ORIGINALITY	iv
ACKNOWLEDGEMENTS	v
ABSTRACT	vi
TABLE OF CONTENTS	vii
LIST OF FIGURES	x
LIST OF TABLES	xii
LIST OF SYMBOLS	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER 1 INTRODUCTION	1
1.1 Problem Statement and Motivation	3
1.2 Objectives	6
1.3 Project Scope and Direction	6
1.4 Contributions	8
CHAPTER 2 LITERATURE REVIEW	10
2.1 Introduction	10
2.2 Types of Biometrics	11
2.2.1 Comparison of existing Biometric Technique	11
2.2.2 Summary on Biometric Techniques	14
2.2.3 Face Recognition	16
2.2.4 Summary on facial recognition algorithm	23
2.3 Review on Existing Facial Recognition Attendance System	25
2.3.1 Deep Learning based facial recognition using Haar cascade technique	25
2.3.2 Attendance Management System Based on Face Recognition Using Haar-Cascade	26

2.3.3	Face Recognition using Haar Cascade and Local Binary Pattern Histogram in OpenCV	27
2.3.4	Real-Time Face Recognition System in Smart Classroom using Haar Cascade and Local Binary Pattern Model	28
2.3.5	An Automated Attendance System Using Face Recognition Technique based on Haar Cascade with LPBH	29
2.4	Comparison on The Reviewed Facial Recognition Attendance System	30
2.5	Review on Attendance System Mobile Applications Currently Using Facial Recognition	32
2.5.1	FactoTime	32
2.5.2	Jibble	34
2.5.3	Face Attendance	36
2.6	Comparison on Attendance System Mobile Applications Using Facial Recognition	38
2.7	Conclusion	39
CHAPTER 3 SYSTEM DESIGN		40
3.1	Overview	40
3.2	User Story	40
3.3	System Overview	45
3.4	System Model	46
3.4.1	System Top-Down Design	46
3.4.2	Web-based Features	47
3.4.3	Android-based Features	48
CHAPTER 4 METHODOLOGY AND TOOLS		49
4.1	System Methodology	49
4.2	System Requirement	50
4.2.1	Hardware	50
4.2.2	Software Involved	50

CHAPTER 5 IMPLEMENTATION AND TESTING	53
5.1 Project Screenshot and Explanation	53
5.1.1 Authentication Module	53
5.1.2 View Profile Module	55
5.1.3 Change Password Module	56
5.1.4 Assign Instructor Module	56
5.1.5 Activate Attendance Module	57
5.1.6 Modify Attendance Module	58
5.1.7 Export Attendance Report Module	59
5.1.8 Face Recognition Module	60
5.1.9 View Attendance History Module	63
5.2 Unit Testing	64
5.2.1 Authentication Module (SignUp/SignIn)	64
5.2.2 Change Password Module	66
5.2.3 Assign Admin Module	68
5.2.4 Activate Attendance Module	69
5.2.5 Modify Attendance Module	70
5.2.6 Face Recognition Module	72
CHAPTER 6 CONCLUSION	73
6.1 Conclusion	73
6.2 Future Work	73
REFERENCES	
APPENDIX A	
A.1 Weekly Report	A-1
A.2 Poster	A-7
PLAGIARISM CHECK RESULT	
CHECK LISTS	

LIST OF FIGURES

Figure Number	Title	Page
Figure 2.2.1.1	Percentage of Biometric Authentication Used in Business.	12
Figure 2.2.1.2	FFR and FAR for four example biometric systems.	15
Figure 2.2.3.1	Types of Haar features.	21
Figure 2.3.1.1	Block diagram of the proposed method.	25
Figure 2.3.2.1	Phase Detection of the image using haar cascade algorithm	26
Figure 2.3.3.1	Flow Chart of the Architecture of the Proposed System.	27
Figure 2.3.4.1	Flowchart of Face recognition of students' class attendance system.	28
Figure 2.3.5.1	Architecture of the system.	29
Figure 2.5.1.1.1.	Face Recognition Verify Page	33
Figure 2.5.1.2	Clock in and Clock out Page	33
Figure 2.5.1.3	Admin Managing Dashboard	33
Figure 2.5.2.1	Face Recognition Verify Page	35
Figure 2.5.2.2	Check-in Page	35
Figure 2.5.3.1	Face Recognition Page	37
Figure 2.5.3.2	Managing Staff Page	37
Figure 2.5.3.3	Employee's Timesheet Page	37
Figure 3.2.1	User Stories for Authentication Module	40
Figure 3.2.2	User Stories for Assign Instructor Module	41
Figure 3.2.3	User Stories for Modify Attendance Module	41
Figure 3.2.4	User Stories for Export Attendance Report Module	42
Figure 3.2.5	User Stories for View Profile Module	42
Figure 3.2.6	User Stories for Change Password Module	43
Figure 3.2.7	User Stories for Activate Attendance Module	43
Figure 3.2.8	Face Recognition Module	44

Figure 3.2.9	User Stories for View Attendance History Module	44
Figure 3.3.1	System Overview of the Proposed System	45
Figure 3.4.1	System Flowchart	46
Figure 3.4.2	Features of Web Based Attendance Taking System	47
Figure 3.4.3	Features of Android Based Attendance Taking System	48
Figure 4.1.1	Development Cycle of XP	49
Figure 5.1.1.1	Register Section	53
Figure 5.1.1.2	Login Section	54
Figure 5.1.1.3	Dashboard of the Attendance Management System	54
Figure 5.1.2.1	View Profile	55
Figure 5.1.3.1	Change Password	56
Figure 5.1.4.1	Assign instructor (Admin)	56
Figure 5.1.4.2	Assign instructor (Instructor)	57
Figure 5.1.5.1	Attendance Event Page	57
Figure 5.1.5.2	Alert message for successfully modify the status of class	58
Figure 5.1.6.1	Attendance Report Page	58
Figure 5.1.7.1	Excel for Attendance Report	59
Figure 5.1.7.2	Course Overall Report Page	59
Figure 5.1.7.3	Excel for Course Overall Report Page	60
Figure 5.1.8.1	UI for Face Recognition Module	60
Figure 5.1.8.2	UI for Detecting Face	61
Figure 5.1.8.3	UI for Tracking Image	61
Figure 5.1.8.4	UI of after successfully recognized the face	62
Figure 5.1.9.1	View Attendance History	63

LIST OF TABLES

Table Number	Title	Page
Table 2.2.1.1	Advantages and limitations of Biometric Techniques	14
Table 2.2.3.1	Advantage and limitation of algorithm technique	23
Table 2.4.1	Comparison on received Facial Recognition Attendance System	31
Table 2.6.1	Comparison of Attendance System Mobile App Part 1	38
Table 2.6.2	Comparison of Attendance System Mobile App Part 2	39
Table 2.6.3	Comparison of Attendance System Mobile App Part 3	39
Table 4.2.1.1	Specifications of laptop	50
Table 4.2.1.2	Specifications of Android Phone	50
Table 5.2.1.1	Authentication Module	65
Table 5.2.2.1	Change Password Module	67
Table 5.2.3.1	Assign Instructor Module	69
Table 5.2.4.1	Activate Attendance Module	70
Table 5.2.5.1	Modify Attendance Module	71
Table 5.2.6.1	Face Recognition Module	72

LIST OF SYMBOLS

Ψ	Average Face Vector
λ	Eigenvalue
μ	Mean (Eigenface)

LIST OF ABBREVIATIONS

<i>2D</i>	Two Dimensional
<i>CCTV</i>	Closed-circuit Television
<i>SVM</i>	Support Vector Machines
<i>PCA</i>	Principal Component Analysis
<i>LDA</i>	Linear Discriminant Analysis
<i>VQ</i>	Vector Quantization
<i>DTW</i>	Dynamic Time Warping
<i>ANN</i>	Artificial Neural Network
<i>COVID-19</i>	Coronavirus Disease
<i>CNN</i>	Convolutional Neural Network
<i>EBGM</i>	Elastic Bunch Graph Matching
<i>SIFT</i>	Scale Invariant Feature Transform
<i>FLDA</i>	Fisher's Linear Discriminant Analysis
<i>FBG</i>	Face Bunch Graph
<i>MTCNN</i>	Multi-Task Cascaded Convolutional Neural Networks
<i>GUI</i>	Graphic User Interface
<i>XP</i>	Extreme Programming
<i>RAD</i>	Rapid Application Development

CHAPTER 1

Introduction

Attendance is one of the elements that determine the presence of students in the course and ensure that students have followed the learning process. In the traditional way of marking attendance (manual attendance system) was done by asking for the signatures of all class students. Students usually sit in a classroom and the teacher will call out the names of the students individually to mark down student's attendance. Teachers used hard resources such as paper and pen to mark student's attendance. However, this traditional way of marking attendance was inefficient and time-consuming. This is due to the reason that there will be some possibility that those students who do not enter the class will ask their friend who had enter the class to leave their attendance with fake signature. Besides, it was time-consuming that teachers need to spend 5-10 minutes to mark student's attendance before the class start. As a result, this will affect the lesson plan of the course and teachers may have insufficient time to teach all the syllabus. This attendance system finds difficulty during the counting also because teachers must count manually after teachers had mark down all of the student's attendance.

To overcome the problems on above, the facial recognition attendance system had provided an efficient way to address the issue of traditional attendance system. Facial recognition attendance system can work by having a devices or machine that have camera. This is more advanced compared to the traditional way due to the reason that it has a low risk of giving fake attendance since everyone has a unique face. This system also helps to reduce the complexity of counting since the system will count automatically.

Facial Recognition

In this modern era, technology had become a driving force of the world which brings lots of positive advancements. One of the advancement technologies was biometrical authentication. Biometric authentication is a method that can accurately utilizes unique human traits in order to identify a person. Example of biometrical authentication include fingerprints scanning, retina scan of the eye, voice recognition, etc [3]. Facial recognition is also a form of biometric authentication that utilizes the recognition of the

physical characteristics of an individual's face to verify their identity [4]. Facial recognition technology employs an algorithm to identify unique and distinguishable facial features, including but not limited to the distance between the eyes and the shape of the chin. All of these details will then convert into a mathematical formula and compared with other data of faces that stored in the database. By using this technology, facial recognition system was effectively applied in various applications such as attendance system, phone unlocking, security systems, surveillance system, etc. As facial recognition system was security and safety, it has the possibility that can replace the standard password and fingerprint authentication [5].

Facial recognition technology was mostly used in the attendance system due to the reason that every human face was unique and it represent as an individual identity. Thus, the system can record the attendance by comparing the stored images that stored inside the database of a student with the real-time captured image (Margaret Rouse, 2012).

According to [2], the author stated the basic step of facial recognition work as below:

1. Face detection

An image or video is used to capture a picture of the face through a camera. However, it is possible for the face to appear either alone or in a crowded setting. The resulting image will capture the person when they are facing straight ahead or in profile view.

2. Face analysis

After an image of a face has been captured, it is processed using 2D image analysis. One reason for using 2D images in facial recognition technology is that they can easily be compared to public photos in a database. The software then examines the facial geometry of the individual to identify the key landmarks that distinguish their face.

3. Converting the image to data

The face capture process transforms the analog information into a set of digital information which are unique. The information obtained from facial recognition is transformed into a mathematical formula which generates a unique numerical code referred to as a facial signature.

4. Finding a match

The unique numerical code generated from facial features is compared to a database containing other registered faces. A determination was made if the facial signature was matches with an image in a facial recognition database system.

1.1 Problem Statement and Motivation

In the traditional way of marking attendance (manual attendance system) was done by asking for the signatures of all class students. Students usually sit in a classroom and the teacher will call out the names of the students individually to mark down student's attendance. Teachers used hard resources such as paper and pen to mark student's attendance. However, this traditional way of taking attendance records manually brings some disadvantages [1]. The likelihood of human mistake increases when the attendance recordings are performed manually. Furthermore, this article had also mentioned the method of taking and managing the attendance records manually is outdated and inefficient [1]. Hence, the problem statement of this project can be highlighted and evaluate d as below:

1. Time consuming:

The conventional approach of recording attendance using a paper and pen system is known to be time-consuming. By recording the attendance manually, teachers may need to use up 5-10 minutes to called out students name individually or checking student's identification cards respectively. Classes with a large number of students may require more time to complete taking attendance. However, majority of teachers were busy and have insufficient time to check each of the signature. Hence, they would just scan through the list and mark empty line for those students who absent as future reference. In addition, teachers will face difficulty when searching the record of the attendance based on the specific searching (e.g., searching student name in specific date.). As a result, this will not only be distracting the teaching process but at the same time it will also cause interruption for students while sitting for the exams.

CHAPTER 1

2. Possible human errors:

Human error was the most common error in the manual attendance system. There is no doubt that human will make a few mistakes unconsciously, including forget to print attendance sheet, missing of attendance sheet, mistake on counting attendance manually, etc. Moreover, students will also accidentally sign attendance at the wrong place. This problem usually happens when the students sign the attendance sheet randomly and the student will consider as absent. Besides, the attendance sheet can be lost easily due to the human mistake. Consequently, the data in attendance list will be inaccurate due to deception.

3. Data manipulation:

As the attendance was recorded manually, it has the risk that students can easily manipulate the data. One way to cheat attendance system is for a student to help their friend or other students to sign attendance even if they were absent or arrived late. Hence, manual attending system was not reliable because it was unfair to the students who were diligent in class. Student with poor attendance deteriorate student outcomes and received a poor grade as student always skips classes in loop with the curriculum.

4. Waste resource:

As the traditional method to record attendance was by paper-based system (paper and pen). Undoubtedly, it will use a lot of resources such as paper, pen, and pencil. Teacher needs to record the attendance of students everyday thus constantly replenish limited resources is a must to ensure the attendance system process smoothly. However, the expenditure will be high by replenish the resources in the long run.

To further improve the manual attendance system in identification process, a biometric facial recognition technology was proposed and implemented together with the attendance system. With the modern technology, there are many types of biometrical identification system (such as fingerprints, voice recognition, or iris scans). Facial recognition was also one of the biometrical identification systems. Facial recognition has been an important area of study because of its non-intrusive approach

CHAPTER 1

and effectiveness as a primary means of identifying an individual. By implementing a facial recognition attendance system, the likelihood of human errors can be reduced, which will make the system to be more trusted and secured. It also had a near-perfect-accuracy to identify and recognize faces for identity verification.

The main motivation behind this project was the traditional manual attendance system's inefficiency and sluggishness, which prompted us to consider designing a faster and more efficient automated attendance system. This project will choose the most appropriate and suitable algorithms which is Haar Cascade algorithm to identify the facial characteristics by training on lots of positive and negative images for detection. Thus, a facial image of student should be taken in a facial recognition system. The captured image will then compare with the image that stored in the system. Once the image was matched, the attendance of the student will automatically record inside the system.

Other than just identify and verify student, facial recognition technology can also be utilized in criminal investigation by analysing CCTV footage to identify individuals at a crime scene and comparing them against a criminal database to identify potential suspect. Also, it was becoming as feature in daily life where people use face recognition to unlock their phone.

Advantages of attendance system for the biometrical facial recognition:

- Ensures the identity of the student who take attendance.
- Student's data was kept in encrypted and secure.
- Can be done without teacher involvement or physical confirmation.
- No single person can help to sign attendance for student who was absent.
- Improve reliability and speed up the attendance record process.
- Accurate face recognition algorithms that detect changes in facial characteristics.
- Designed intelligently to reduce the errors.

1.2 Research Objectives

The main objective of this project is to develop a facial recognition attendance system that can help the instructor to record and manage the attendance records easier and more effectively. The proposed system is able to avoid time consuming and human error to increase the efficiency and productivity of attendance taking and management. Thus, the objective of this project can be shown as below:

1. To improve the efficiency of taking attendance by solving the time-consuming issues with facial recognition. Students should be able to scan their face to take attendance based on their timetable respectively.
2. To improve the productivity of managing attendance records by avoiding the human error issues by developing an attendance management module. It is important that the attendance records of students are easily and effectively viewable and manageable by the instructor. The instructor does not need to enter the attendance records one by one into the system.

Thus, with the objectives above, the time-consuming issues and human error issues will be solved after the proposed system is implemented.

1.3 Project Scope and Direction

The aim of this project is to address the challenges associated with the traditional attendance system by proposing an innovative facial recognition attendance system that can be implemented in various educational institution. This project will deliver a class-attendance-taking system in android-based application and a web-based application. This proposed system will contain three types of users which are the administrator, student and the instructor. Different roles will have different permissions and will be classified in the following discussion. However, the following assumption will be made before discussing the main scope of this project.

- Authentication module will be built in web-based and Android-based to identify the user.

CHAPTER 1

Firstly, for the web-based version, it allows administrator and instructor to access the system. The following is showing the module that is available on the web-based application only.

1. Class Management Module

This module is to let the administrators create different types of classes such as lecture class and tutorial class. Administrators was also allowed to manage the instructor into their respective class session. Therefore, the scope of this module can be summarized as follows:

- Admins can create and manage different types of classes.
- Admins can manage the instructor into their respective class session.

2. Attendance Management Module

This module allows instructors to manage the attendance of the class and view the attendance records of a class session. The scopes of this module can be concluded as below:

- Instructors can create and manage the attendances of the class and edit the attendance type.
- Instructors can activate the attendance so that student was able to take attendance via facial recognition.
- Instructors can generate the report of the class attendances.
- Instructor can view the attendance records of the students.

3. Personalization Module

This module allows instructors to view and manage their profile. The scopes of this module can be concluded as below:

- Instructors can view their profile.
- Instructor can change their password.

CHAPTER 1

Next, for the android-based application, only students can access this android-based application. The modules that built inside the application should consist of the following modules:

1. Attendance Taking Module

This module allows Students to take attendance.

- Students can take attendance by using the facial recognition method.
- Students was able to view their attendance record.

This project should be considered as a complete system when the following acceptance criteria is fulfilled.

1. Successfully created a class management module that can let administrators create different types of classes which are lecture class and tutorial class and manage the classes while instructors can be added into their respective class session by the administrators.
2. Successfully created an attendance management module that is only allowing the instructors to create and manage the class attendance and the system should allowed instructors to activate the attendance process, allowing student to mark their attendance. Additionally, instructors have the capability to access and download attendance reports for their classes.
3. Successfully created an attendance taking module that is enabling the students to take their attendance by scanning student's faces and the system will be able to verify the validity of the attendance based on the time range of the class attendance.

1.4 Contributions

Through the proposed attendance taking system in this report, instructors and students' reliance on technology will not only grow but also stray further away from the traditional way of taking attendance which requires a lot of time and manpower to perform attendance taking that has a greater chance to cause mistakes and unintended

CHAPTER 1

errors as stated in the problem statement. The proposed system helps regulate records and has an accurate list of students who attend class as well as minimizes instructors' effort in taking attendance. The proposed system offers comfort and humans want comforts. However, machine error is inevitable but compared to the traditional way, the difference between benefits gained and drawbacks is negligible. With the use of the proposed attendance taking system, one may not feel behind as our world gradually moves towards the era of the Internet of Things (IoT) and Artificial Intelligence (AI). Thus, it can be believed that the proposed system will eventually cause the traditional taking attendance methods to become obsolete and replace it. It will also get students and instructors more aware of new technology and improve learning efficiency. In this project, I proposed attendance taking by using facial recognition. The facial recognition approach gives users convenience, saves time, and reduces paper used compared to the traditional method. Student's faces can be captured by a camera within a few seconds while the pen-paper method requires marking attendance one by one and increasing time taken. This automated attendance taking system also supports report export which reduces human errors as mentioned in the problem statement. Users can view their attendance history with just a few clicks.

CHAPTER 2

Literature Reviews

2.1 Introduction

To address the aforementioned issues and ensure authentication in the attendance system, which the attendance system operate in automated, biometric recognition methods, including fingerprint scanning and facial recognition, have been chosen. However, there are lots of biometric system had been developed and implemented previously.

What is Biometric?

Biometrics refers to a mechanized method of analysing and measuring an individual's unique characteristics through statistical analysis. These can include physiological traits like fingerprints and facial or behavioural characteristics like security-authentication puzzle [5]. The aim of this technology was used to identify and access control to systems, devices and data or identifying individuals who are under surveillance [7]

How it works?

Most of the individuals believe that biometrics are safer and better than keys and password which are difficult to keep and memorise. This is due to the reason that biometrics involve unique physical attribute (facial, fingerprint, irises, or veins) and behavioural features (voice, calligraphy, or typing cadence). In generally, one common procedure among biometric systems is the process of Enrolment, Storage and Comparison [8].

In the Enrolment step, when the biometrical system is used for the first time, the system will collect some basic detail of the users such as user's name or an identification number. Next, the system will record or take image of user's unique attributes. In the Storage step, the user's attributes that was recorded by the system will be analysed and convert them into a code language graph rather than storing the entire image or recording. In the Comparison step, the systems compare the attributes provided by the user with the data previously stored in the system when a user encounters the biometric system for the second time. Lastly, the system will conclude the result whether confirm the user's identity or reject it.

2.2 Types of Biometrics

2.2.1 Comparison of existing Biometric Techniques

Face Recognition is a biometrical technique that automatically identifies a person by analysing their facial features captured in an image or video. Facial recognition biometric can act as an incredible system to identify potential threats such as scam artists, criminals or terrorists. However, the function of verifying potential threats was unverified in high-level practice [9]. This technique was mostly used for the verification purpose which the system will analyse dozens of distinguishable features of the facial structure such as mouth, nose, jaw edges, and the distance between eyes. The system will store these characteristics in a database and compare them with the data of users when they interact with the system. There is a different method which are Support Vector Machines (SVM), Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) or Neural Networks that can be used to model facial recognition.

Iris Recognition, also known as iris scanning, is a biometrical method that analyses the iris of the eye within the ring-shaped region that surrounds the pupil of the eye. Since the pattern of a person's iris is distinctive and is well protected by the cornea, it is not easily stolen or duplicated. Hence, iris recognition is known as one of the safest and most accurate biometrical technologies. This system can be performed separately for each eye because the iris pattern is different between the left and right eye. The current iris-based recognition system is user-friendly and cost-effective compared to the early iris-based recognition system which was expensive and required user participation [10]. One of the most effective classifiers for iris recognition is the Daugman's Algorithm which relies on the regular shape with distinctive boundaries that is segmented easily by the algorithm. In more detail, the process of iris recognition typically involves four main stages which are segmentation, normalization, feature extraction and matching.

Fingerprint recognition is a widely recognized biometric technique. This is due to the reason that fingerprint recognition is the biometric solution for most of the authentication systems. Every person has a unique ridges and valleys of each fingerprint, and it does not change together with the growth and age. In a fingerprint ridge, there are three types of basic patterns which are the arch, the loop, and the whorl. An arch is a pattern which is formed by the ridge rising in the centre of the finger. A loop is the most common

pattern in fingerprint where the ridge forms a curve and leaving from the finger which it entered. Lastly, a ridge forms circularly at the central point of a finger is called a whorl. One of the widely used algorithm in fingerprint authentication is minutiae-based algorithm. This algorithm identifies and compares the unique characteristics of each fingerprint image, such as the location and shape of minutiae, to determine a match with another fingerprint image. The number of minutiae pairs between the two fingerprints is used to verify the match. Based on [11], a complete fingerprint contains about 40-100 minutiae which the minutiae points are used to determine the uniqueness of a fingerprint.

Voice recognition is a biometric technique that uses a distinctiveness voice such as frequency, pitch, and tone to identify a person's identity. In case of concern of imposters, voice recognition recognizes a person's unique voiceprint which may influence by the shape and movement of the mouth and jaw. With the rapid development of technology, voice recognition has gained prominence due to the rising of AI virtual assistants, such as Apple's Siri and Amazon Alexa which users is enabled to interact with the technology by just speaking to it. The most famous recognition model that used in voice recognition include Vector Quantization (VQ), Dynamic Time Warping (DTW) and Artificial Neural Network (ANN).

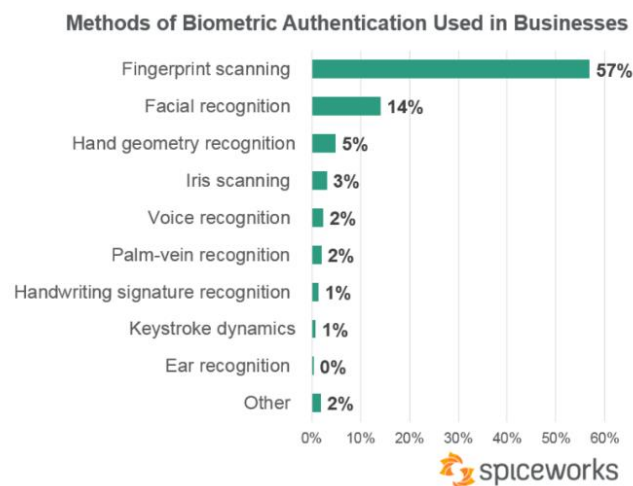


Figure 2.2.1.1: Percentage of Biometric Authentication Used in Business

Source: <https://community.spiceworks.com/security/articles/2952-data-snapshot-biometrics-in-the-workplace-commonplace-but-are-they-secure>

According to the figure 2.2.1.1, the most common biometric authentication used in business was fingerprint scanning which has a percentage of 57%. The second most common biometric authentication that listed in the figure was facial recognition which accounted for about 14% in the business [12].

Although each of this biometric technique is considered as the most effective and safe method that used to verify a person's identity. However, each of them consists of some advantages and limitations as shown in the table 2.2.1.1.

Types of Biometric Technique	Advantages	Limitations
Face Recognition Journal: Smitha, P.S. Hedge, Afshin. Face Recognition based Attendance System, (2020), 9(5), 1190-1192.	<ul style="list-style-type: none"> • Quick and efficient process. • No direct contact between user and the machine. • High acceptance rate by user. • Able to detect from live streaming video of classroom. 	<ul style="list-style-type: none"> • Poor image quality limits the effectiveness of facial recognition. • Cannot be distinguish between twins. • Face can be manipulated with the growth of age and surgery.
Iris Recognition Journal: P.S.Bhagat, S.Y.Chincholikar. Biometric Attendance System using Iris Recognition, (2016). 2(11), 263-266	<ul style="list-style-type: none"> • Quick and high accuracy. • Highly Distinctive of iris and does not change much as people age. • High level of security. • No physical contact between user and machine. 	<ul style="list-style-type: none"> • Cause discomfort when the scanner require user to adopt a certain position. • High cost. • Risk of fake lenses. • Complex processor.

<p>Fingerprint recognition</p> <p>Journal: Akinduyite C.O, Adetunmbi A.O, Olabode O.O & Ibidunmoye E.O. Fingerprint-Based Attendance Management System, (2013), 1(5), 100-105</p>	<ul style="list-style-type: none"> • High acceptance rate by user. • Ease of use. • Low cost. • High stability. • High accuracy. • Distinctive and uniqueness of fingerprint between two fingers. 	<ul style="list-style-type: none"> • Result can be affected by the conditions of the finger. • Fingerprints can be spoofed by accessible technology. • Physical contact between user and machine which cause hygiene problem.
<p>Voice Recognition</p> <p>Journal: J.Shah, V.Salunkhe, J.Saturwar, O.Parab. Voice Input based Attendance System, (2020), 9(1), 1085-1087</p>	<ul style="list-style-type: none"> • Ease of use. • Low training requirement. • No direct contact between user and machine. 	<ul style="list-style-type: none"> • Voice data can be recorded. • Result can be affected by the surrounding environment. • Voice and language change over time. • Lack of accuracy and misinterpretation.

Table 2.2.1.1: Advantages and limitations of Biometric Techniques

2.2.2 Summary on Biometric Techniques

There is no one “perfect” biometric techniques that can fit all requirements. Each of the biometric techniques have their own advantages and disadvantages. Therefore, we can consider some of the factor which are suitable and able to implement to facial recognition attendance system.

Accuracy:

It was true that a biometrical system with a high accuracy result is more reliable so that there will be less possibility of error and data fraud. However, there are a possibility

that the errors may occurred due to some common factors such as poor environment, growth of age, skin integrity, etc. Different type of biometric techniques has different error rates. False reject is when a valid user tries to authenticate to his own account, but the system refuses it while false accept is when a fake or invalid user successfully sign up to that should be refuses by the system. False reject does not necessary indicate a flaw, user is required to try a few times until it was access successfully. However, false accept situation happen when an invalid user trying to sign up a valid user's attendance, then the valid user will always getting false reject. This is due to the reason that the system consider that the valid user had sign up his attendance. According to [16], they state that iris recognition is the most accurate and precise biometric technique for reliable and secure system.

Method	False Reject Rate	False Acceptance Rate
Finger print	3 to 7 in 100 (3-7%)	1 to 10 in 100,000 (.001-.01%)
Face Recognition	10 to 20 in 100 (10-20%)	100 to 1000 in 100,000 (.1-1%)
Voice Recognition	10 to 20 in 100 (10-20%)	2000 to 5000 in 100,000 (2-5%)
Iris	2 to 10 in 100 (2-10%)	>=.001%

Figure 2.2.1.2: FFR and FAR for four example biometric systems

Ease of use:

It was an important factor that a biometrical technology is ease of use for the users. Good biometrical systems automate recognize users without human involvement or physical information. This is because the systems have a powerful algorithm that can find and recognize users automatically. For the first time user who use the biometric system, it was required to input their data and store it in the database. However, it was convenient and ease for the users when they encounter the system again.

Hygiene issue:

CHAPTER 2

In light of the COVID-19 outbreak, the physical contact between the user and machine must be concerned. Contactless biometric such as facial recognition, iris recognition and voice recognition are preferable to use during the pandemic. Using a contactless biometric technology can help to prevent the transmitting of certain pathogens, like COVID-19 that causes diseases. Besides, increase of demand on these technologies in every sector can contribute to improve the infrastructure and technology on contactless biometric.

Among all of the factors discussed above, Facial Recognition is the most suitable biometric system to implement together with the attendance system. Due to new lifestyle of people to adapt in pandemic situation, the contactless nature of facial recognition has proven itself as a valuable assistive technology although the accuracy of fingerprint and iris recognition is much more accurate and precise compared to facial recognition.

2.2.3 Face Recognition

An automated biometric technology capable of verifying an individual's face in images and videos is known as face recognition system. According to Santosh Kumar (2013), face recognition had divided into two main categories namely face verification and face identification, which involve different types of comparison. Face verification and face identification seems to be no distinction between the two, but the function is slightly different between the two.

a) Face verification (or authentication)

Face verification compares one face to another, sometimes can simplify as 1:1 problem. Assuming that the image of a person was stored inside the database. By claiming an identity from an input face, the facial recognition system will compare the captured image of a person's face with the corresponding image stored in the database. The system will then give a decision whether to confirm or reject based on the comparison result.

b) Face identification (or recognition)

Face identification search for a face from the database, sometimes can simplify as 1:N problem. In this phase, the facial recognition system matches the input image against a database of template images to identify the individual's identity.

Face recognition system have been conducted for almost 50 years and now is widely considered as one of the most prominence biometric technique, allowing high recognition rates without being too intrusive. There are many methods of face recognition which had proposed such as Eigenfaces (Turk and Pentland, 1991), Independent Component Analysis (ICA) (Barlett, 1998), and Fisher Discriminate Analysis (Wang et al. 2011) are the classic and well-known holistic approaches. There are also some algorithms like Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Local Feature Analysis, Local Binary Pattern (LBP), Convolutional Neural Network (CNN), Haar Cascade and Scale Invariant Feature Transform (SIFT) are few other statistical and feature-based method that used to solve face recognition problem.

Details of some algorithm that mentioned above:

1. *Eigenfaces*

Eigenfaces is a face recognition that relies on analyzing the appearance-based features of a person's face which capture the variation of face images from the data sets. The systems will then use these face images to encode and decode with machine learning in a holistic (as opposed to a parts-based or feature-based) manner. Due to the simplicity of the algorithm, Eigenface recognition can be implemented easily. However, the accuracy of Eigenface depends on many factors due to its high correlation between training data and recognition data. The recognition rate will be affected under varying facial expression and illumination.

2. *Fisherfaces*

Fisherfaces is a better classifier compared to Eigenfaces. It is a technique similar to Eigenfaces but with an improvement in image classification using Fisher's Linear Discriminant Analysis (FLDA) for reducing dimensionality. By using

FLDA, the purpose of the techniques is to increase the separation between classes by maximizing the ratio of between-class scatter to within-class scatter. Fisherface algorithms is useful when the input images have a large variation in facial expression and illumination. However, it takes more time to process an image and required a larger storage of the face in order to have a better classification.

3. Haar Cascade

Haar Cascade is a machine learning-based object detection technique that used to locate objects on images. Haar Cascade algorithm acquires knowledge comprising positive and negative sample from an extensive dataset. The positive dataset contains an object of interest while the negative dataset encompasses everything except the object that under investigation.

Eigenfaces Algorithm:

According to H.A Fatta, et al (2006), Eigenface algorithm relies on Principal Component Analysis (PCA) and is a facial recognition technique. The algorithm calculates the eigenvalue (scalar value) and the eigenvector (vector squares) of matrix. The following steps outline how to implement the Eigenface algorithm.

- 1) To ensure accuracy during analysis, it is essential that the facial images used for training (I_1, I_2, \dots, I_M) are uniform in size and positioned in the middle of the frame.
- 2) Convert the image I_i to a vector Γ_i for further processing.
- 3) Compute the mean face vector Ψ .

$$\Psi = \sum_{i=1}^M \Gamma_i$$

- 4) Calculate the difference (ϕ) between the training image (Γ_i) and the average (Ψ).

$$\phi = \Gamma_i - \Psi$$

- 5) Compute the covariance matrix (C).

$$C = \frac{1}{M} \sum_{n=1}^M \phi_n \phi_n^T = AA^T \text{ (N}^2 \times \text{N}^2 \text{ matrix)}$$

$$A = [\phi_1 \phi_2 \dots \phi_M] \text{ (N}^2 \times M \text{ matrix)}$$

- 6) Compute the eigenvalue (λ) and eigenvector (v) from the covariant matrix.

$$A^T A v_i = u_i v_i \Rightarrow AA^T A v_i = \mu_i A v_i \Rightarrow$$

$$C A v_i = \mu_i v_i \text{ or } C u_i = \mu_i u_i \text{ where } u_i = A v_i$$

- 7) Once the eigenvector (v) has been compute, the Eigenface (μ) can be calculated.

$$\phi_i - \text{mean} = \sum_{j=1}^K w_j u_j, (w_j = u_j^T \phi_i)$$

The steps outlined above detail how to calculate the Eigenface training set of images. The subsequent process involved facial recognition, where the distance between the input data and the data in the database is calculated and compared. The comparison result uses the Euclidean distance to look for the shortest length. The face recognition stage is performed as below.

- 1) Eigenface is calculated from a new face image (Γ_{new}).

$$\mu_{new} = v(\Gamma_{new} - \Psi)$$

$$\Omega = [\mu_1, \mu_2, \dots, \mu_M]$$

- 2) Compute the distance between the image of the new face and the database images.

$$e_d = \|\phi_{(\text{image of new face})} - \phi_{(\text{image of face in database})}\|$$

- 3) After performing the calculations, the minimum distance should be identified to recognize the face. If this distance is smaller than the threshold, the face will be recognized.

$$e_d < T_d$$

Fisherfaces Algorithm:

Fisherface algorithm is an enhancement of Eigenface algorithm that used both Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). LDA is a

technique of finding the linear subspace which maximize the distance between two classes. Below is the algorithm of Fisherfaces.

- 1) Let X denote a random vector, where the samples are drawn from c different classes.

$$X = \{X_1, X_2, \dots, X_c\}$$

$$X_i = \{X_1, X_2, \dots, X_n\}$$

- 2) We calculate the scatter matrices S_B (maximized matrix spacing) and S_W (minimized distribution matrix) as follows.

$$S_B = \sum_{i=1}^c N_i (\mu_i - \mu) (\mu_i - \mu)^T$$

$$S_W = \sum_{i=1}^c \sum_{X_j \in X_i} (X_j - \mu_i) (X_j - \mu_i)^T$$

where μ denote the mean of the entire dataset

$$\mu = \frac{1}{N} \sum_{i=1}^N X_i$$

and the symbol μ_i refer to the mean of class $i \in \{1, \dots, c\}$.

$$\mu_i = \frac{1}{|X_i|} \sum_{X_j \in X_i} X_j$$

- 3) Fisher's algorithm proceeds to search for a projection W that maximizes the criterion of class separability.

$$W_{opt} = \arg \max_W \frac{|W^T S_B W|}{|W^T S_W W|}$$

- 4) The solution to the optimization problem is obtained by solving the problem of Eigenvalues.

$$S_B v_i = \lambda_i S_W v_i$$

$$S_W^{-1} S_B v_i = \lambda_i v_i$$

- 5) Rewrite the optimization problem as below.

$$W_{pca} = \arg \max_W |W^T S_T W|$$

$$W_{fld} = \arg \max_W \frac{|W^T W_{pca}^T S_B W_{pca} W|}{|W^T W_{pca}^T S_W W_{pca} W|}$$

- 6) The matrix W , which transform a sample into a space with $(c - 1)$ dimensions, can be obtained as follows.

$$W = W_{fld}^T W_{pca}^T$$

Haar Cascade:

Haar Cascade is a classifier that works by using a set of simple rectangular features called Haar-like features. These features are similar to edge, line, and corner detectors but are computed at multiple scales and positions across an image. These features help the classifier differentiate between different objects based on their unique patterns.

This algorithm can be explained in two main keys:

- 1) Calculating Haar Features

A Haar feature is essentially a mathematical operation that conducted on adjacent rectangular areas within a defined detection window. This computation involves the summation of pixel intensities in individual regions, followed by the derivation of disparities between the computed sums. Below are some examples of Haar features:

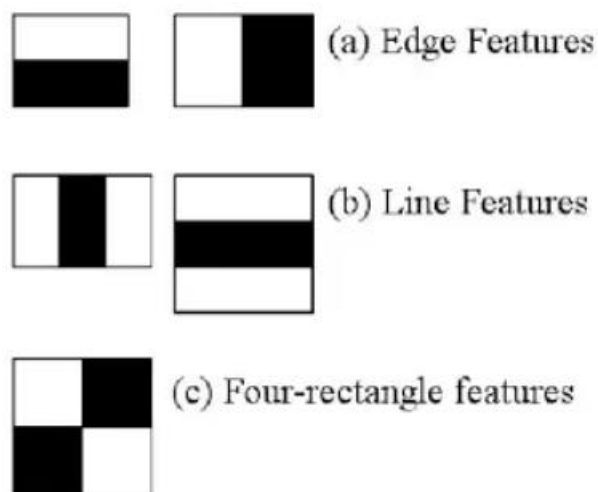


Figure 2.2.3.1 Types of Haar features

Based on the Figure above, there are three types of features which represent different value. Edge features (**two-rectangular feature**) is the difference between the sum of the pixels within two rectangular. Line features (**three-rectangular feature**) is characterized by the sum of pixel intensities within two exterior rectangles, which subtract from the sum obtained within a central rectangle. Four-rectangular feature computes the difference between diagonal pairs of rectangles. (Viola and Jones, 2001)

2) Creating Integral Images

Creating Integral Images helps to boost the calculation of Haar features by creating sub-rectangles and array references for each of the sub-rectangles instead of computing all the pixel. The integral image at location x, y , inclusive:

$$ii(x, y) = \sum_{x' \leq x, y' \leq y} i(x', y'),$$

where $ii(x, y)$ is integral image and $i(x, y)$ is the original image. Using the following pair of recurrences:

$$s(x, y) = s(x, y - 1) + i(x, y) \quad (1)$$

$$ii(x, y) = ii(x - 1, y) + s(x, y) \quad (2)$$

where $s(x, y)$ is the cumulative row sum, $s(x, -1) = 0$, and $ii(-1, y) = 0$

Above are few of the example steps to perform facial recognition algorithm. Different algorithms will use different type of approaches to recognize facial image. To choose the most suitable facial recognition algorithm in attendance system, a table of the advantages and limitations are listed below.

Types of Algorithms	Advantages	Limitations
Eigenfaces Algorithm R. Rosnelly, M. S. Simanjuntak, A. Clinton Sitepu, M. Azhari, S. Kosasi and Husen, "Face Recognition Using	<ul style="list-style-type: none"> • Simple and efficient. • Efficient in processing time and storage. • Does not required knowledge of geometry and reflectance of faces. 	<ul style="list-style-type: none"> • Recognition rate may affect under varying illumination. • Scale-sensitive. • Required a lot of storage to store all the face images.

Eigenface Algorithm on Laptop Camera," 2020, pp. 1-4.	<ul style="list-style-type: none"> • Can identify with variety of different facial expressions. 	
Fisherfaces Algorithm S. Q. Nur Septi, I. N. Yulita and H. Napitupulu, "Face Recognition Using Fisherface and Support Vector Machine Method," 2021, pp. 50-55.	<ul style="list-style-type: none"> • Able to recognize user under varying pose. • Better accuracy. • Less affected by variations in light intensity. 	<ul style="list-style-type: none"> • More complex in locating projection of face space. • Required significant processing time. • Required larger space.
Haar Cascade P. Viola, M.Jones, "Rapid Object Detection using a Boosted Cascade of Simple Features," <i>Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition</i> , 2001, pp. I-I	<ul style="list-style-type: none"> • Low computation time. • Capture face is more accurate. • Faster recognize faces. 	<ul style="list-style-type: none"> • High false-positive detection. • Manual tuning of parameters

Table 2.2.3.1 Advantage and limitation of algorithms technique

2.2.4 Summary on facial recognition algorithm

Based on the evaluation of various facial recognition algorithms, the Haar Cascade algorithm was found to be the most suitable for implementation in the proposed attendance system. The reason that I used Haar Cascade algorithm was that Haar Cascade is computationally efficient, making it ideal for real-time facial recognition applications such as security systems which it was crucial to recognize a face quick and

CHAPTER 2

accurate. Next, Haar Cascade can achieve good accuracy for detecting faces when the faces have consistent orientations such as lighting conditions and scales. Haar Cascade has a good recognition performance which it has lower memory footprint, making it well suited for small-scale facial recognition systems.

2.3 Review on Existing Facial Recognition Attendance System

2.3.1 Deep Learning based facial recognition using Haar cascade technique

In this paper, [18] offer a solution to improve the performance of face recognition by implementing CLAHE for noise reduction, contrast amplification, and illumination equalisation in pre-processing stage. Then authors used HaarCascade classifier to categorize the feature extraction which extracted from the input image. The person will be then recognized as a result of the computer's examination of Haar Cascade result. Below is the block diagram of the proposed method.

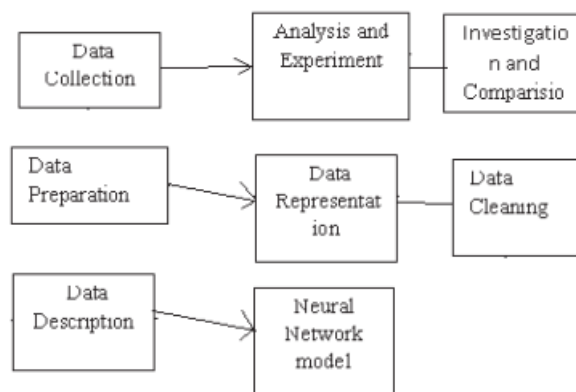


Figure 2.3.1.1 Block diagram of the proposed method

Before understanding the concept of face detection, authors suggested to first understand the working knowledge of Viola-Jones algorithm and the OpenCV's built-in ability to identify a person's face. The proposed solution successfully detected seven people with one false-positive finding. However, there are five people were not detected due to the reason that the picture only partially shows their faces. As a result, this proposed solution shows that the accuracy of the method increased significantly.

2.3.2 Attendance Management System Based on Face Recognition Using Haar-Cascade

In this paper, [19] had proposed a attendance management system that requires people to be at a medium closer distance and was covered by the camera's range. OpenCV-Python will be used in order to get Haar Cascade feature. In this proposed system, there are 5 main steps which are shown below.

- 1) Creation of database and training
- 2) Image Capturing phase
- 3) Image Detection phase
- 4) Image Matching
- 5) Attendance Marking



Figure 2.3.2.1 Phase detection of the image using haar cascade algorithm

Based on the figure above, the Haar Cascade set of rules essentially works with the aid of offering the ROI of the face and was ready to trim out various component of face. The trimmed image will be match with the image that store in the database. If the trimmed image matches the image stored in the database, the attendance will be automatically checked as present.

2.3.3 Face Recognition using Haar Cascade and Local Binary Pattern Histogram in OpenCV

From this journal, [20] work on a facial recognition automated attendance management system using Haar cascade classifier to mark students' attendance. Authors also mentioned that the one-time generation of dataset and face detection from the images that store in the database is more accurate to record attendance.

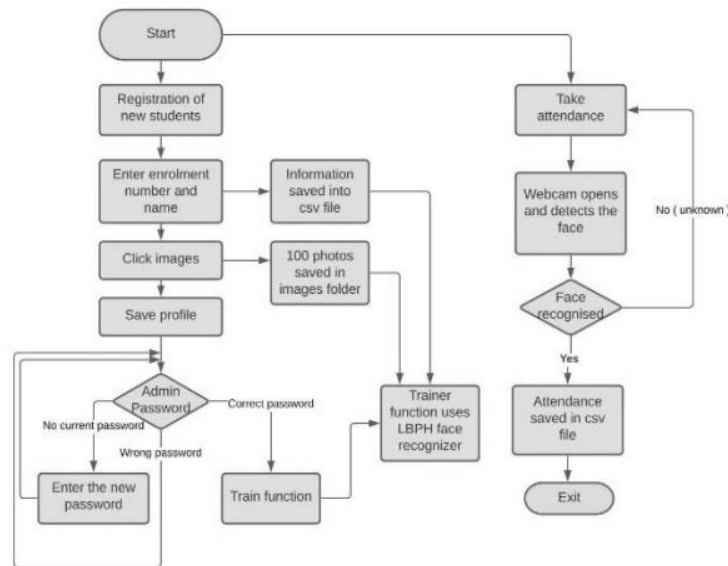


Figure 2.3.3.1 Flow Chart of the Architecture of the Proposed System

The authors had separated the system into two sections which are student/employee database (storing details of student/employee) and attendance database (storing the records of daily attendance). Images will be taken and stored in attendance database and trained by the cascade classifier. Once the images were trained, the student/employee can start to take attendance by comparing and identify their face using a camera. If the faces match to the images that store in the attendance database, the attendance record will be updated.

2.3.4 Real-Time Face Recognition System in Smart Classroom using Haar Cascade and Local Binary Pattern Model

Based on [21], the paper aspires to propose an effective model for the proposed system by using Haar Cascade and Local Binary Pattern to identify and verify students' identity by using facial features. The authors mentioned that this algorithm was implemented due to its robust framework construction and less computation time of object detection which it was suitable to implement in real-time face recognition system.

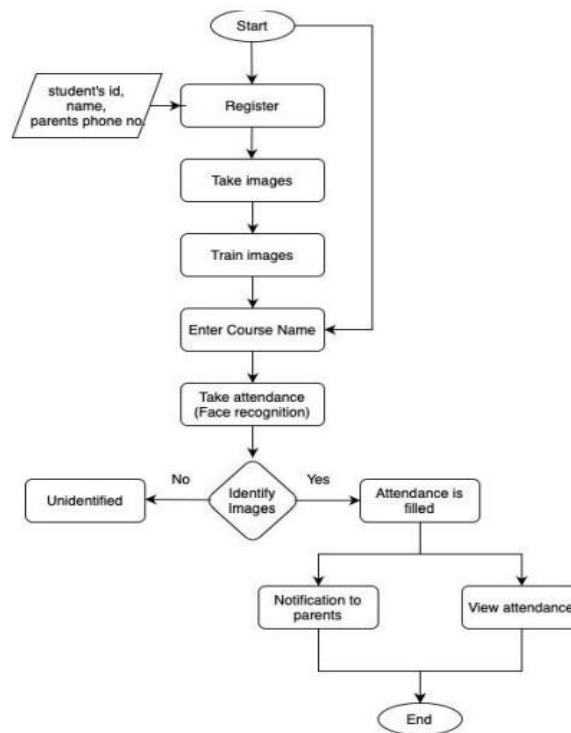


Figure 2.3.4.1 Flowchart of Face recognition of students' class attendance system

As a result, the accuracy of the training model was 99.3% average based on three different timing and conditions. One of the accuracy results provided 98% accuracy while the others provided 100% accuracy due to some condition such as light dimmer condition resulted on false recognition. Also, the authors had tested for the computation time and observed that 74% of time is consumed in capturing image, 22% for pre-processing and 3% for detection using the model. It takes a total time of 7 seconds to complete one cycle of detection and recognition.

2.3.5 An Automated Attendance System Using Face Recognition Technique based on Haar Cascade with LBPH

This paper shows that how the face recognition technology implements to the field of education by developing an efficient automated attendance system that instantly logs a student's presence at specific location. Based on [22], the aim of this attendance system is to use a threshold to identify an unknown persons and save their images while having a low false positive. LBPH and Haar cascade algorithm was utilized in this system for face detection and face recognition.

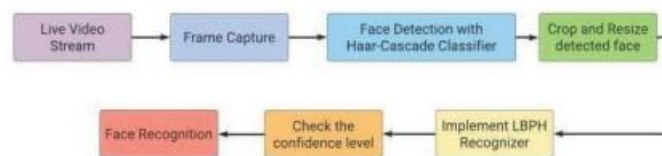


Figure 2.3.5.1 Architecture of the system

Based on the Figure above, there are four main sections can be concluded which are Generation of the dataset, Training image, Face recognition and lastly attendance marking. In this proposed system, authors had set a minimal confidence level which is at least 77% of the face in the video must match the same person's face in training images. As a result, both algorithms work perfectly in face detection and face recognition although the student does not look directly at the camera, the face recognition from all perspectives was still possible. However, this proposed system was significantly affected by the light conditions. Hence, authors decided to create an efficient algorithm for low-light settings in the future.

2.4 Comparison on The Reviewed Facial Recognition Attendance System

To further analysis the reviewed paper, a list of table Table 2.4.1 is listed below:

Paper Title	Technique used	Advantage	Disadvantage
Deep Learning based facial recognition using Haar cascade technique	CLAHE, Haar Cascade, OpenCV	Identification is quite accurate and reliable when there a large number of face characteristics.	False negative and false positive face detection mistakes are two main type that occur in the system.
Attendance Management System Based on Face Recognition Using Haar-Cascade	Facial recognition, Haar Cascade, OpenCV, TLKit	Capable of dealing with numerous faces at once.	May take longer time to recognize all faces.
Face Recognition using Haar Cascade and Local Binary Pattern Histogram in OpenCV	Haar Cascade, Local Binary Pattern Histogram, OpenCV	Robust against monotonic grayscale transformation. Low computation complexity. Recognized both front and side faces.	Produces long histograms, thus slowing down the speed of recognition. Not invariant to rotation.

Real-Time Face Recognition System in Smart Classroom using Haar Cascade and Local Binary Pattern Model	Haar cascade, Local Binary Pattern Model, Python with PyCharm	Less time consuming. Easy to use. High accuracy and less mistakes.	Longer time taken for capturing images.
An Automated Attendance System Using Face Recognition Technique based on Haar Cascade with LBPH	OpenCV, LBPH, Haar Cascade	Face can be detected even if a student not looking properly at the camera, or their head is tilted.	Information must be updated frequently.

Table 2.4.1 Comparison on reviewed Facial Recognition Attendance System

2.5 Review on Attendance System Mobile Applications Currently Using Facial Recognition

2.5.1 FactoTime (Android, iOS)

<https://play.google.com/store/apps/details?id=com.factotime.attendance.app&hl=en&gl=US>

FactoTime is an attendance app which also known as time and attendance tracking app for employee. Employees were able to use this app to capture their attendance with selfie, time, and location. This application was designed to help businesses to manage their employee's time and attendance. It is a software solution that automates the process of tracking and monitoring employee work hours and time of requests. This application also contains database system which used to managed and maintain the records of employee attendance, leave requests, overtime, and other time-related information. (FactoTime, 2022)

Key Features:

- Employees can take attendance using QR code to prevent time theft and buddy punch.
- Punch only from the smartphone registered in the database.
- Can arrange calendar with working days, hours, and weekly off.
- The login feature can be used on various operating systems and devices including Windows, Mac, Linux, Android and iOS.

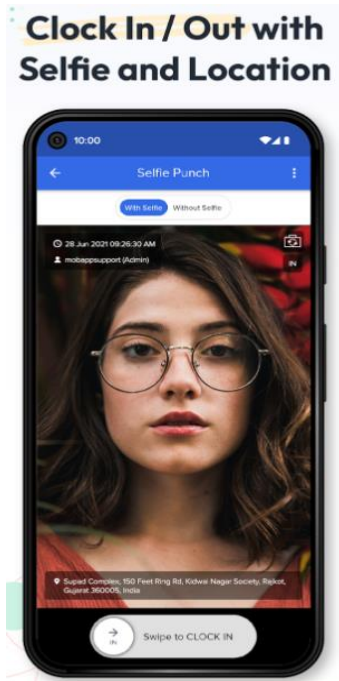


Figure 2.5.1.1: Face Recognition Verify Page

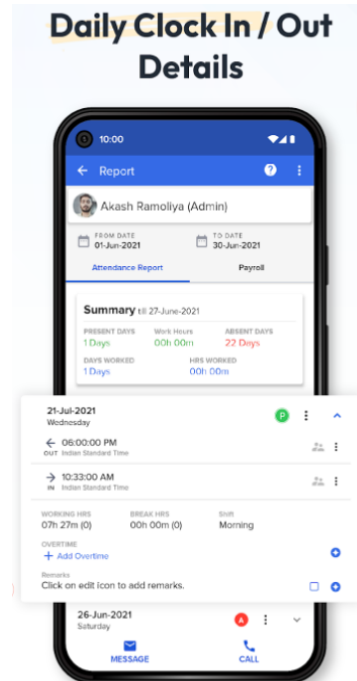


Figure 2.5.1.2: Clock in and Clock Out Page

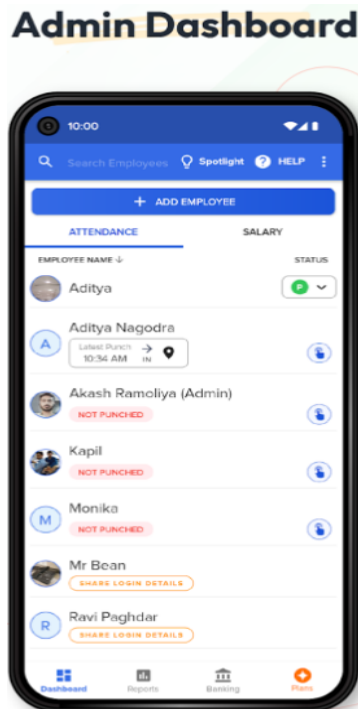


Figure 2.5.1.3 Admin Managing Dashboard

2.5.2 Jibble (Android, iOS)

<https://play.google.com/store/apps/details?id=io.jibble.androidclient&hl=en>

Jibble is a time and attendance tracking application that used cloud technology to provide a secure and accessible platform for businesses to manage their employee time and attendance. It was a unique due to its check-in method which using a selfie to record the attendance of an employee. This application utilizes geo-tagging feature in order to record the specify location where the employee took the selfie without using GPS tracker. (Jibble, 2022)

Key Features:

- Cloud-based time attendance tracking.
- Provides real-time data and advanced reporting and data visualization tools.
- Provides a range of customizable rules such as shift restrictions, lunch breaks and overtime.
- Provides flexible access control options, allowing administrators to control the application.

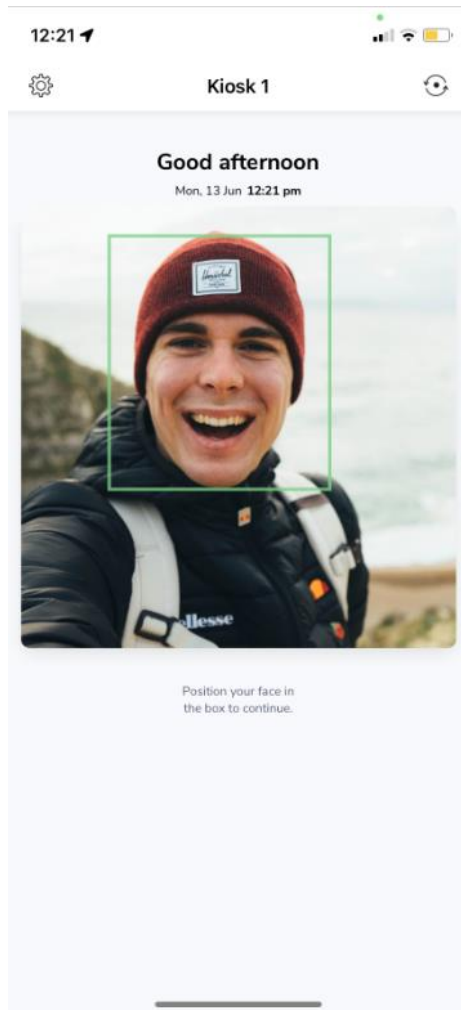


Figure 2.5.2.1 Face Recognition Verify Page

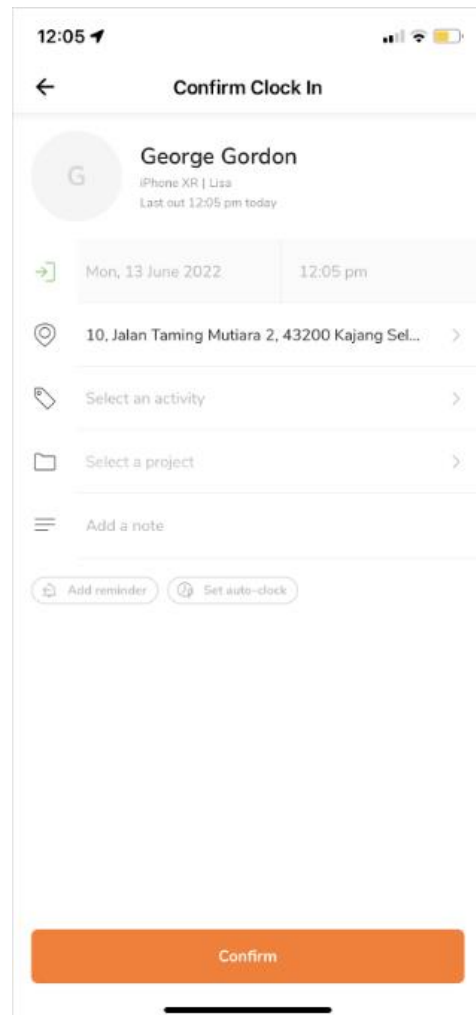


Figure 2.5.2.2 Check-in Page

2.5.3 Face Attendance (Android)

<https://play.google.com/store/apps/details?id=io.gigasource.faceattendance&hl=en>

This face recognition attendance app was designed by Gigasource.io. The app was created to offer an alternative method for registering attendance, moving away from traditional methods. Through this application, institute and organization can manage the attendance of employees or students easily and ensure that the employees or students physically present at the clocking station.

Face Attendance is a cloud-based Facial Recognition for Attendance System which users does not need to concern about the security. One of the most unique features is that the application can detect and recognize the faces of all the users seen in the picture concurrently.

Key Features:

- Extreme fast and precise.
- Utilizes cloud computing technology.
- Capable of detecting more than one face at a time.
- Capable of detecting faces in real-time.
- Operate in both online and offline mode.
- Set a range of check-in, checkout limit.
- Mobile App and Window App
- Comprehensive Report
- Gender, Age and Emotion Recognition



Figure 2.5.3.1 Face Recognition Page

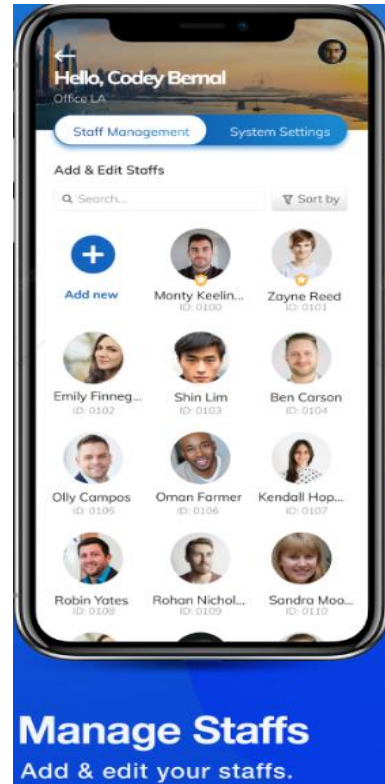


Figure 2.5.3.2 Managing Staff Page

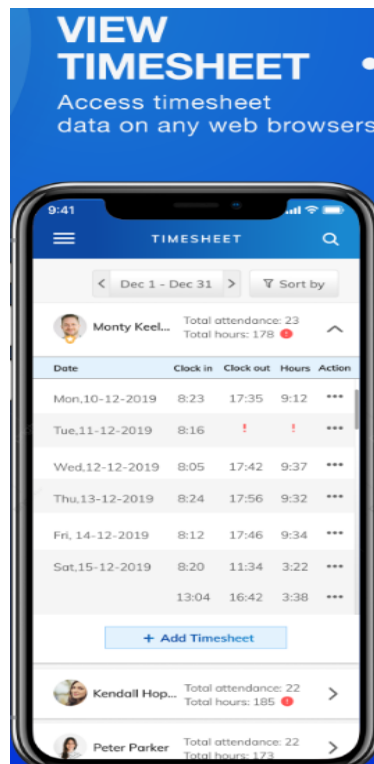


Figure 2.5.3.3 Employee's Timesheet Page

2.6 Comparison on Attendance System Mobile Applications Using Facial Recognition

Based on the three reviewed existing attendance system mobile application using facial recognition, a further evaluation has been made and shown in table 2.6.1 and table 2.6.

Application Name	Rating	Total Download	Platform Available	Price
FactoTime	Google Play: 4.7 Apple App Store: 4.6	100,000+	Android, iOS	Free but In-app purchase for more features.
Jibble	Google Play: 4.2 Apple App Store: 4.2	100,000+	Android, iOS	Free
Face Attendance	Google Play: -	5,000+	Android	Free

Table 2.6.1: Comparison of Attendance System Mobile App Part 1

App Name	Strength	Weakness
FactoTime	<ul style="list-style-type: none"> • Easy for employees to check in and out. • Flexible and able to customize to meet different organization's requirement. • Can accessed through mobile app or web interface. 	<ul style="list-style-type: none"> • Required stable internet connection to function properly. • Limited features such as lack of advanced reporting and data visualization tools. • Only support limited number of languages.
Jibble	<ul style="list-style-type: none"> • Offer a range of advanced features. • Provide detail analytics and reporting features. • Using advanced depth estimation technology to ensure validation of right person 	<ul style="list-style-type: none"> • Required high cost in order to access advanced feature. • Privacy issue as the user's photo is uploaded to their server.

Face Attendance	<ul style="list-style-type: none"> • Secure with the data. • Capability to detect and recognize multiple faces simultaneously. • Able to function properly in online and offline mode. 	<ul style="list-style-type: none"> • Unstable app due to the app was still new. • Lack of advanced feature. The app consists only attendance feature.
------------------------	---	---

Table 2.6.2: Comparison of Attendance System Mobile App Part 2

Criteria	FactoTime	Jibble	Face Attendance
Approach to take attendance	Face, QR Code	Face	Face
Support Offline	No	Yes	No
Software Position	Enterprise Resource Management	Enterprise Resource Management	Attendance Taking Software
Platform Supported	Mobile, Desktop	Mobile, Desktop	Mobile

Table 2.6.3: Comparison of Attendance System Mobile App Part 3

2.7 Conclusion

In a nutshell, the aim of this literature review was to study the field that was relevant to our proposal topic about facial recognition attendance system. This will give us a better view and understanding on our topic. To further understanding more about the topic, there were five existing facial recognition attendance system using eigenface algorithm had been reviewed. Nevertheless, there were three existing attendance system mobile application were discussed and compared.

CHAPTER 3

System Design

3.1 Overview

In this chapter, the user story, use case diagram, description for each use case and activity diagram are drawn and listed to show the design of the system.

3.2 User Story

In the planning phase, the XP user stories will be written, and the planning is expected to be released gradually according to the project timeline. In this project, user stories will be categorized and organized according to the content of the project scope. All future development activities of this project will be carried out to meet the following user stories.

Authentication Module

<p>Title: Sign Up</p>
<p>User Story: As an Instructor, I want to create a new account, So that i can access the features.</p>
<p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Instructor should able to see and input required information. - If Instructor submit the registration form with valid information, it will prompt out a message indicating the account was successfully created.
<p>Title: Sign In</p>
<p>User Story: As an Instructor, I want to sign in to the application using credentials,</p>
<p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Instructor should able to see and input fields for email address and password. - If input incorrect credentials, it will prompt an error message indicating login failed. - If input correct credentials, it will redirected to user dashboard.

Figure 3.2.1 User Stories for Authentication Module

Assign Instructor Module

Title: Assign Instructor
User Story: As an Admin, I want to assign the instructor to the specific class, So that the instructor can manage the attendance of the class.
Acceptance Criteria: <ul style="list-style-type: none"> - Admin should able to see access the assigned class. - Admin should be able to view the members inside the class

Figure 3.2.2 User Stories for Assign Instructor Module

The user stories above are showing the requirements for this assign instructor module, the system should provide the functions to assign the instructor based on the user roles.

Modify Attendance Module

Title: Modify Attendance status
User Story: As an Instructor, I want to modify the attendance status, So that I can manage the student attendance with more flexibility.
Acceptance Criteria: <ul style="list-style-type: none"> - Instuctor should be able to view all the student attendance records of the class. - Insturctor should be able to modify the student attendance status at any time.

Figure 3.2.3 User Stories for Modify Attendance Module

From the figure above, the modify attendance module should be able to provide the function to let the instructor to modify the attendance status. This is due to the reason that sometime the student had facing problem of taking attendance.

Export Attendance Report Module

Title: Export attendance report
User Story: As an Instructor, I want to export attendance records, So that I can manage the student attendance with more convenience.
Acceptance Criteria: <ul style="list-style-type: none">- The report is in csv format.- The report should contain the details such as attendance details, student name, attendance status and date.

Figure 3.2.4 User Stories for Export Attendance Report Module

In this module, instructors are able to export the attendance report into excel file so that instructor can manage the student's attendance more efficiently.

View Profile Module

Title: View Profile
User Story: As an Instructor, I want to view own profile, So that i can manage personal information easily .
Acceptance Criteria: <ul style="list-style-type: none">- Instructor should have a valid user account.- Students should be able to access and view their own profile.

Figure 3.2.5 User Stories for View Profile Module

Based on the figure above, this module allows instructor to review their detailed information, which often include essential information such as name, phone number, email address and faculty.

Change Password Module

Title: Change Password
User Story: As an Instructor, I want to change password, So that i can enhance the security of the account.
Acceptance Criteria: <ul style="list-style-type: none">- Instructor should have a valid user account.- Instructor should be able to enter current password before creating a new one.

Figure 3.2.6 User Stories for Change Password Module

According to the figure above, Instructor was able to update their existing password. This is due to the security reasons and to ensure that instructor can maintain their confidentiality and integrity of their accounts.

Activate Attendance Module

Title: Activate attendance
User Story: As an Instructor, I want to activate the attendance, So that the students can scan the attendance using facial recognition method.
Acceptance Criteria: <ul style="list-style-type: none">- The system is able to allow the student to scan their faces.- The system is able to store their face data into the database.

Figure 3.2.7 User Stories for Activate Attendance Module

According to the figure above, this module should be able to allow the user to activate and scan the attendance via facial recognition method based on the user role.

Face Recognition Module

Title: Face Recognition
User Story: As a Student, I want to scan face recognition, So that I can take the attendance.
Acceptance Criteria: <ul style="list-style-type: none">- The system should have a high accuracy rate in recognizing students' face.- The system should process facial recognition quickly, minimizing wait times for students.

Figure 3.2.8 User Stories for Face Recognition Module

This module is the most important module in this proposed system. Students need to scan their faces in order to take their attendance. Hence, it is important that the system can accurately detect and recognize the student's face in a short time.

View Attendance History Module

Title: View Attendance History
User Story: As a Student, I want to view attendance history, So that I can ensure the attendance of each classes.
Acceptance Criteria: <ul style="list-style-type: none">- The student must be able to log in securely with their unique credentials.- The interface should be intuitive and easy to navigate.

Figure 3.2.9 User Stories for View Attendance History Module

Figure 3.2.9 shows view attendance history module which the students was allowed to access and view their attendance records. It provide students with a convenient way to monitor their attendance in various courses or classes.

3.3 System Overview

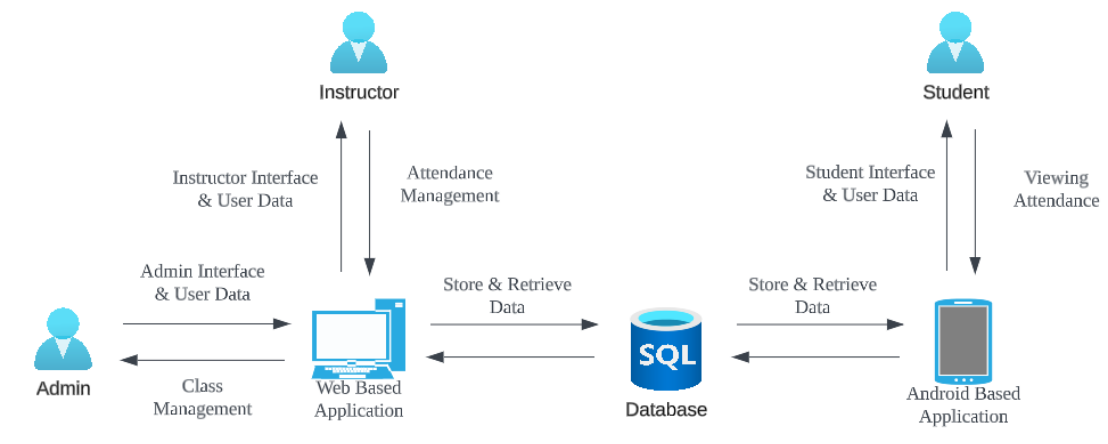


Figure 3.3.1 System Overview of the Proposed System

According to the figure presented, the proposed system's overall structure and functionality can be seen. This figure shows all the components of the system and the interaction of each component. Firstly, the system end user consists of three main actors which are Admin, Instructor and Student. Besides, the system also consists of four main components which are Class Management component, Attendance Management component, Attendance History component and Attendance Taking component. Whether it is a web-based system or an Android-based system, all components work together around a central SQL database and server. Firstly, the Class Management component consists of several sub-component which include the Class Creation component, Student Management component and Instructor Management component. This component is mainly designed for the admin to manage the classroom. The type of class included lecture class and tutorial class; admin can customize the class type according to the situation. In the Student Management component, the admin can add or remove the student from the class. In addition, the admin can also assign the instructor to their respective classes. Secondly, the Attendance Management component also consists of several sub-components which include the attendance component and member record component. This component is mainly designed for the instructor to manage the attendance of each class. The instructor can create the attendance for the class with a specific name and the time period. Besides, the instructor can edit the attendance status of each student at any time. Next, the Attendance History

component allows the student to view their attendance history of each class in the android-based systems.

3.4 System Model

3.4.1 System Top-Down Design

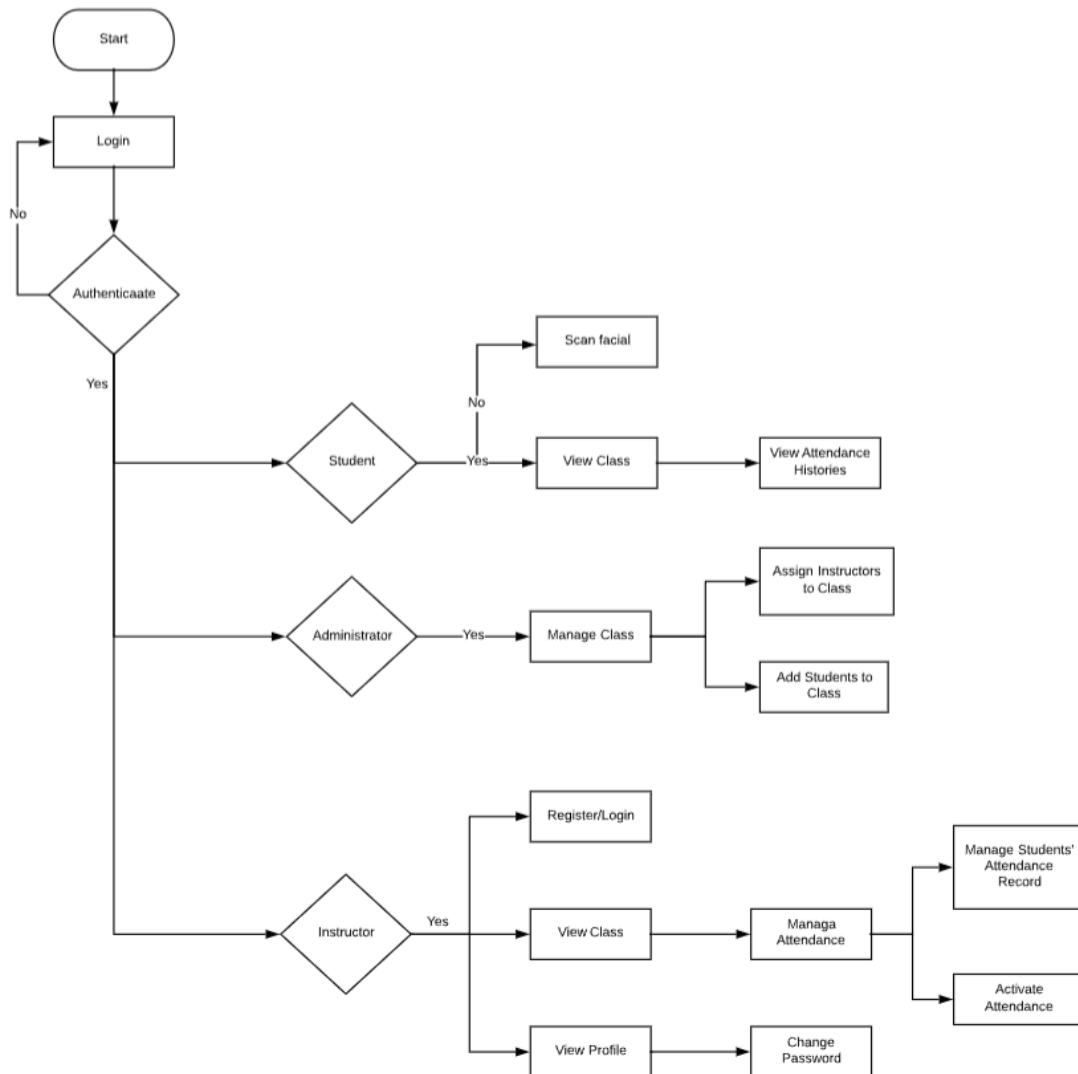


Figure 3.4.1 System Flowchart

According to the figure above, the user of this systems needs to login to the system first in order to authenticate the user identity. Based on the user permission type, a student account was able to view their attendance histories after selecting a class to view. Besides, students’ accounts will have the function to scan their face to take the attendance. If the user who has been verified and granted administrative privileges logs

in, they will have the ability to manage instructors within the system. Administrators can assign the instructors to the respective class and also add the students into the class. If the authenticated user is an instructor, this user will be able to view the classes. In this class, the instructor can create the attendances. In the attendance, the instructor can activate the facial recognition attendance and manage the students' attendance records of this attendance. Instructor was also able to register and login to their account. Not only that, instructor can also view their own profile and change their password if there is a need.

3.4.2 Web-based Features

This project consists of two types of system available; one is web-based and the other is android-based. However, different type of the system will have different functionalities. Therefore, in this section, some use case diagrams will be presented to show the functionality of the system based on the system type.

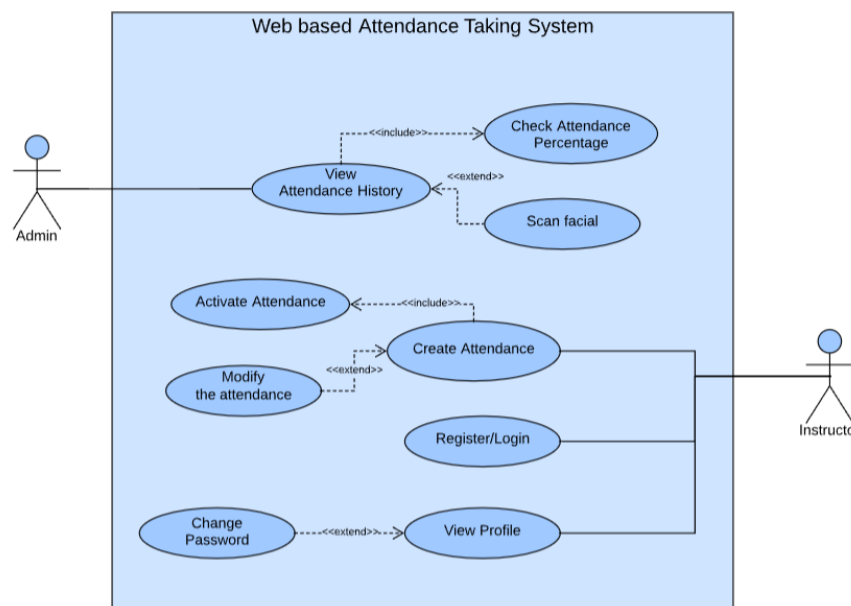


Figure 3.4.2 Features of Web Based Attendance Taking System

From the figure above, there will be two user groups for the web-based system. The first user group will be the admin. Admin will have the power to manage the instructor such as adding student and assign instructor. In addition, the admin will be able to create different types of classes like lecture class and manage the classes and add the instructors and also the students into the class by using an excel file. The administrator just needs to put the student emails into the file as a list, the system will read the emails

and find the students with the emails from the database and add them into the class. On the other hand, the instructor was able to Register or Login to their account in order to enter the attendance management system. The instructor was also able to view their own profile after creating an account and was able to change their password if they need in the future. The instructor can create an attendance and activate the attendance in order to let the students to scan their face and take attendance. In a nutshell, admins can manage the instructors and also the classes and members of class while instructors can only manage the attendance records of the class. Students does not have the access to the web-based system.

3.4.3 Android-based Features

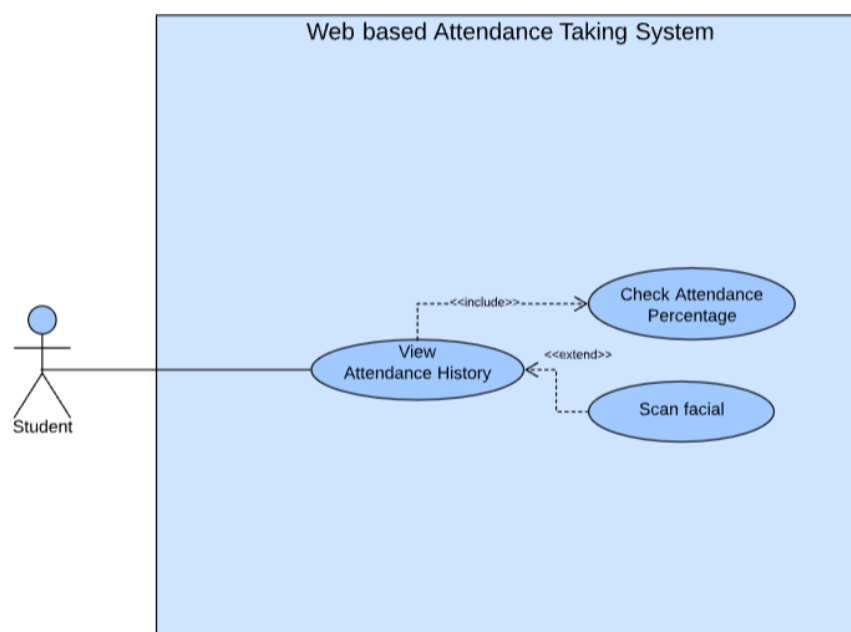


Figure 3.4.3 Features of Android Based Attendance Taking System

The figure above shows the use case of the android-based attendance taking system. There will only one group for the android-based system which is Student. In this diagram, students view the attendance history in their own mobile phone. Students are able to check their attendance percentage based on the classes. Besides, students need to scan their faces using Python with libraries like OpenCV for image processing in order to take the attendance.

CHAPTER 4

Methodology and Tools

4.1 System Methodology

In this project, a methodology Extreme Programming (XP) is used in the proposed system. Extreme Programming is an agile software management strategy which focuses on delivering a high-quality product with fast feedback and continuous testing. The main aim of Extreme Programming is to emphasize on delivering working software quickly and continuously improving the development process. This methodology is useful to improve the attendance system in the future. RAD typically consists of five primary phases: planning, design, coding, testing, and deployment.

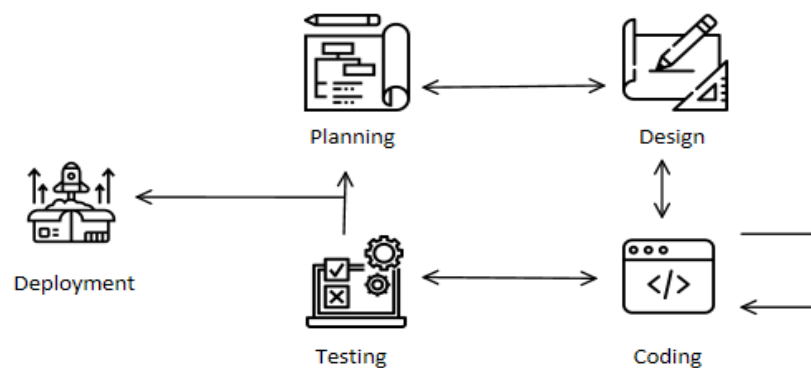


Figure 4.1.1 Development Cycle of XP

According to the figure above, Planning will be conducted to plan the development timeline for the module based on the project scope and direction. Design will be conducted to draw some ideas of how to develop the module. Next, Coding will be conducted to write code for the module. Lastly, Testing will be conducted to find out the integrity and the acceptance of the system. When all the requirements of a module were completed and pass the testing, the developers will continue to the next module and start over the Planning phase again until all the modules were completed then it will proceed to the Deployment. Hence, based on the development cycle, this project will separate the system into few modules based on the project scope which are Class Management Module, Attendance Management Module and Attendance Taking Module.

4.2 System Requirement

4.2.1 Hardware

i. Laptop

The project utilized a personal computer (PC) and an Android mobile device for its hardware components. The PC was used to develop the proposed system and was responsible for all testing activities. The android mobile device is used for the android-based application testing activities. Besides, the mobile device's camera will be used in the application development.

Description	Specifications
Model	Huawei Matebook D-15
Processor	AMD Ryzen 5 3500U with Radeon Vega Mobile Gfx
Operating System	Windows 11
Memory	8GB RAM
Storage	256GB

Table 4.2.1.1 Specifications of laptop

ii. Android phone

Description	Specifications
System Version	Android 10
Memory	8 GB RAM
Processor	Huawei Kirin 980

Table 4.2.1.2 Specifications of Android Phone

4.2.2 Software Involved

Before start to develop the proposed system, there are several software needed to install and downloaded in the laptop. The software that was used to create this system is displayed in the following list.

1. Eclipse



Eclipse is a famous integrated development (IDE) for programming, mainly used for Java development. However, it also supports various programming languages through plugins. Eclipse provides a comprehensive set of tools and features for writing, compiling, debugging and testing Java applications and other software projects.

2. MySQL Workbench 8.0 CE



MySQL Workbench is a graphical tool for database design, development and administration which is primarily used for working with MySQL databases. It is an open-source relational database management system that provides a user-friendly interface for performing database management.

3. Android Studio



CHAPTER 4

Android Studio is an official integrated development environment (IDE) for Android app development. It was created in 2013 by Google. Developing with Android Studio is quicker and easier as it has the drag and drop interface. Android Studio allows developers to write in Java, Kotlin and C++. It is available in operating system such as Windows, Linux, macOS and ChromeOS.

CHAPTER 5

Implementation and Testing

In this section, the system is displayed through screenshots. The screenshots are explained accordingly to prove that the system is implemented, and all the features and functions can achieve the objective of the project. Besides, the functions are testing with unit testing technique to ensure that they are all working well.

5.1 Project Screenshot and Explanation

Project screenshots are shown and explained in this section.

5.1.1 Authentication Module

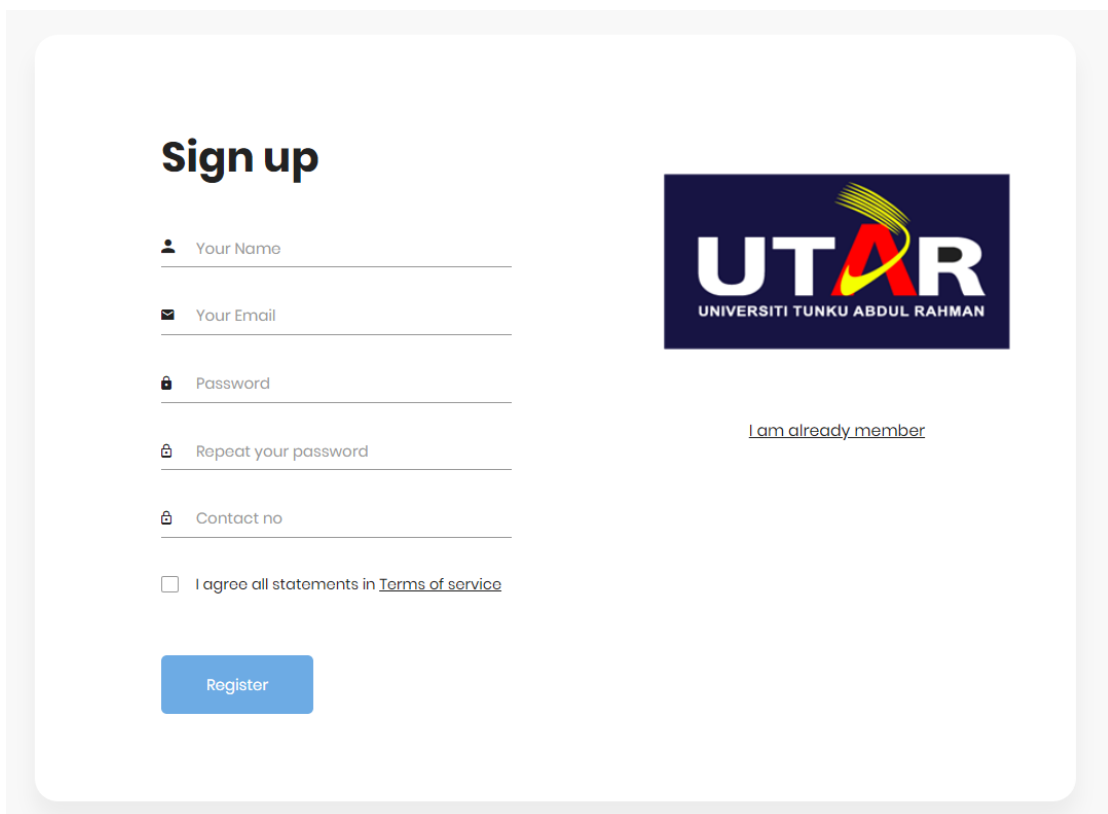
The image shows a registration form titled "Sign up" for UTAR (Universiti Tunku Abdul Rahman). The form includes input fields for "Your Name", "Your Email", "Password", "Repeat your password", and "Contact no". There is a checkbox for "I agree all statements in [Terms of service](#)". A blue "Register" button is at the bottom. To the right of the form is the UTAR logo, which consists of the letters "UTAR" in white on a dark blue background, with a yellow and red graphic element. Below the logo is the text "UNIVERSITI TUNKU ABDUL RAHMAN". A link "[I am already member](#)" is located below the logo.

Figure 5.1.1.1 Register Section

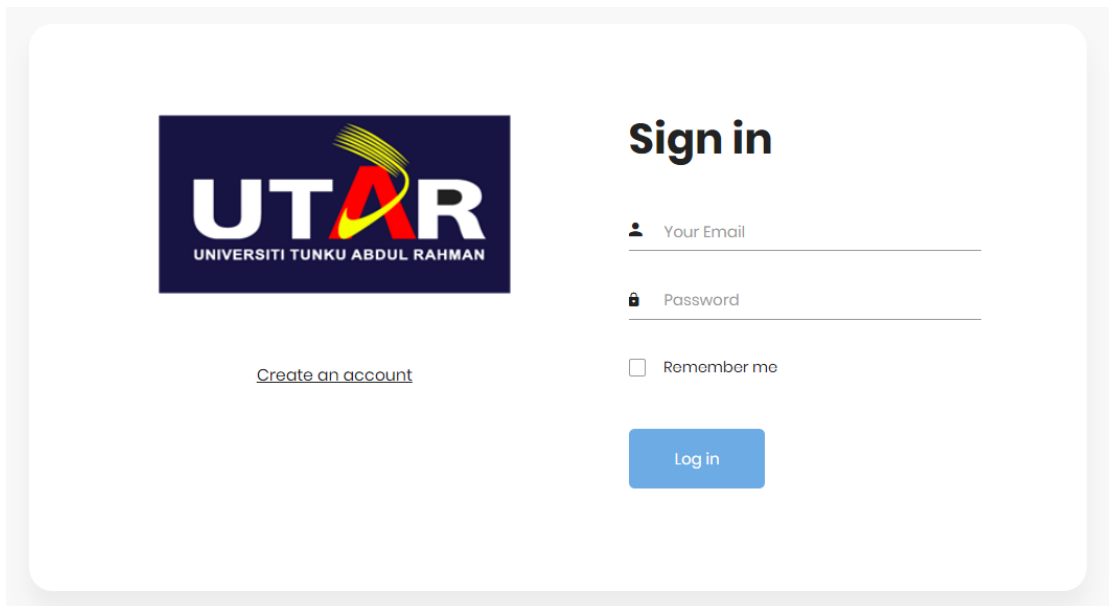


Figure 5.1.1.2 Login Section

Based on the figure 5.1.1.1, a user was able to register a new account if the user was a first-time user. When the user had successfully registered, the data will be store inside the database and the user was able to login to the system using the data that store in the database as shown in Figure 5.1.1.2.

Dashboard

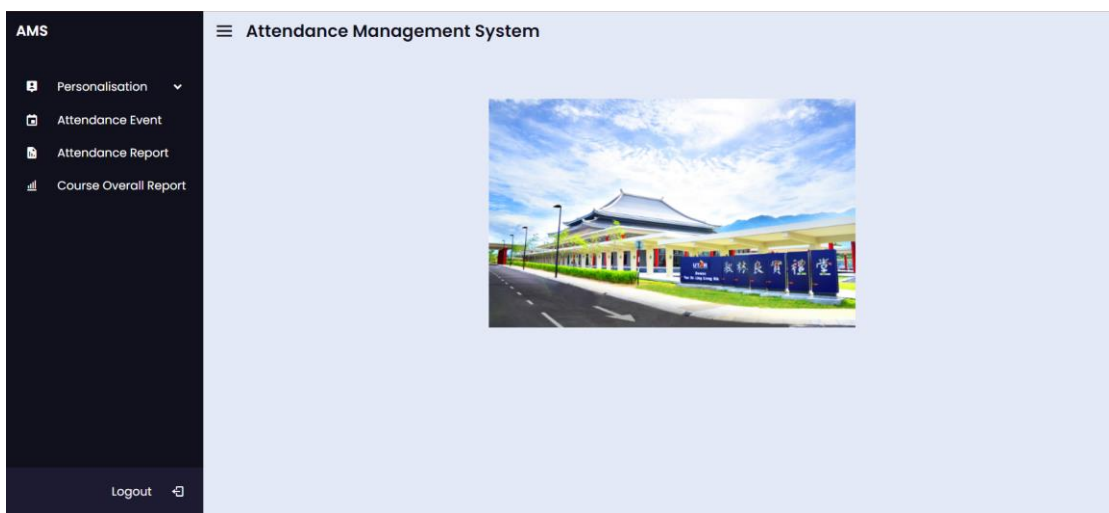


Figure 5.1.1.3 Dashboard of the Attendance Management System

After the user successfully login to their account, the system will redirect the user to the homepage which is the dashboard page. Since it is a web-based system, only admin

CHAPTER 5

and instructor are allowed to access. Admin and instructor are able to choose to and navigate to the page they want. However, users can just use the personalization feature as the rest of the feature are not completed yet. Next, there is a logout button on the bottom of the navigation bar which users are able to logout if they are not used.

5.1.2 View Profile Module



Figure 5.1.2.1 View Profile

From Figure 5.1.2.1, the instructor was able to view their own profile after the user navigate to the personalization feature. In View Profile Module, some personal information such as name, email, mobile number and faculty will be displayed.

5.1.3 Change Password Module

The screenshot shows a web browser window with the URL 'localhost:3600/fyp1/ChangePassword.jsp'. The page has a header with 'Profile' and a navigation bar with 'Back', 'Your Profile(lewtp423@gmail.com)', and 'Change Password'. The main content area is a form with three input fields: 'Enter Old Password', 'Enter New Password', and 'Enter Confirm Password'. At the bottom of the form are two buttons: 'Save' and 'Back'.

Figure 5.1.3.1 Change Password

User was also able to change their password where user need to type their old password and enter the new password they want to change. When the user clicks on the save button, the new password will save into the database.

5.1.4 Assign Instructor Module

The screenshot shows an 'Admin' interface with a navigation bar containing 'Back', 'Assign Instructor', and 'Add Student'. Below the navigation bar is a form with three dropdown menus: 'Subject' (Please select a class), 'Type' (Lecture), and 'Instructor' (Please select an instructor to assign). A green 'Assign Instructor' button is located to the right of the 'Instructor' dropdown. Below the form is a table titled 'Assigned Instructors' with the following data:

SUBJECT CODE	SUBJECT	TYPE	INSTRUCTOR
UCCN2243	Cybersecurity	lecture	Lew Tian Pei
UCCD2044	Object-Oriented Programming Practices	lecture	Ahmad
UCCN1044	Communications and Networking	lecture	Alli
UCCN2243	Cybersecurity	practical	Ahmad

Figure 5.1.4.1 Assign instructor (Admin)

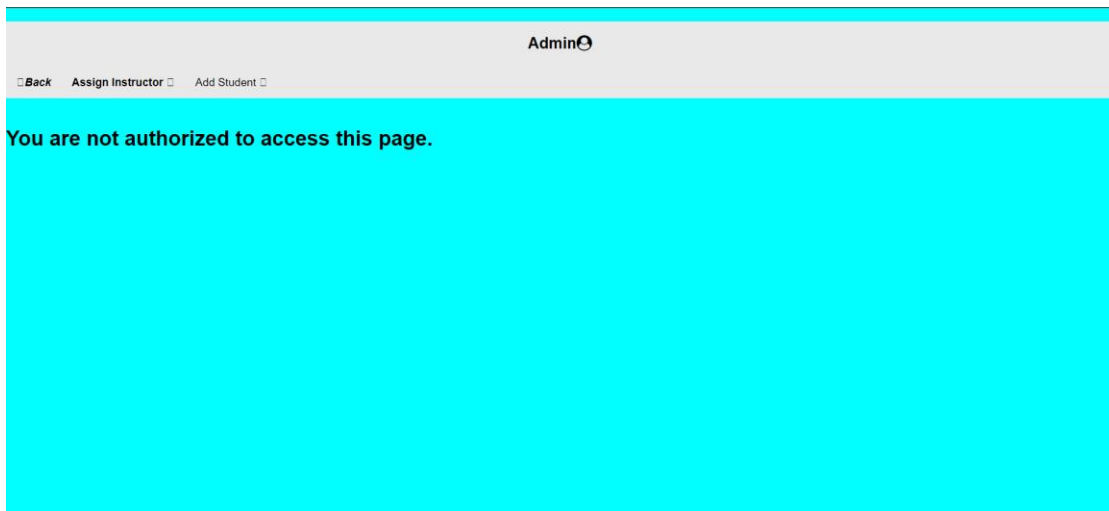


Figure 5.1.4.2 Assign instructor (Instructor)

This figure shows that the admin has the right to assign the instructor to respective classes. The admin can choose the instructor that they want to assign and click on the assign instructor button. However, instructor does not have to access to enter the page. If the instructor enters the assign instructor page, system will prompt out a message: You are not authorized to access this page.

5.1.5 Activate Attendance Module

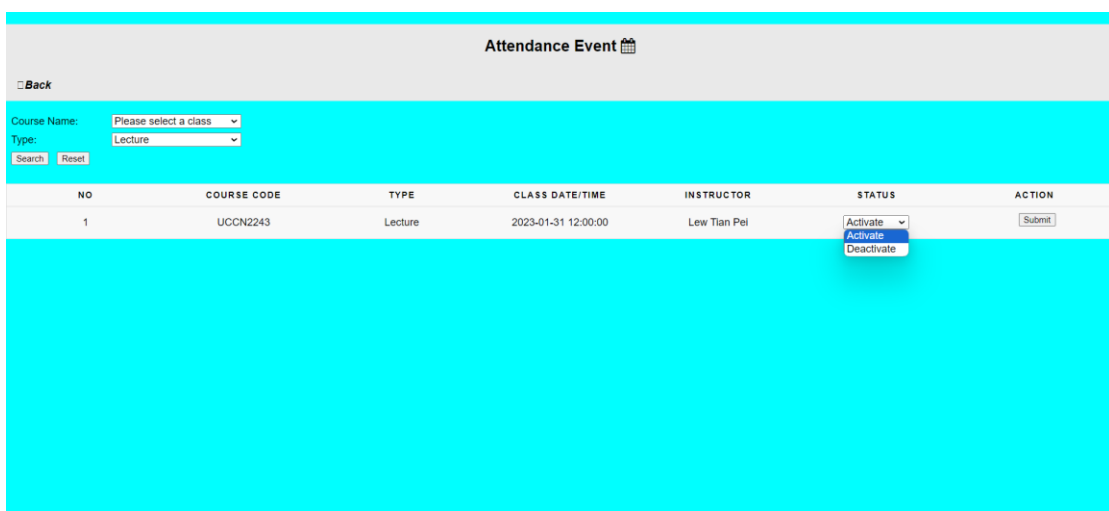


Figure 5.1.5.1 Attendance Event Page

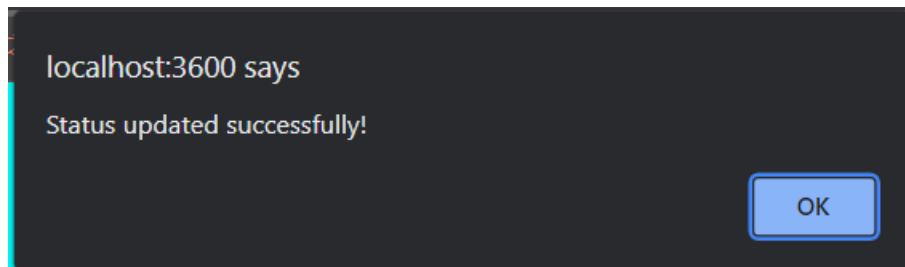


Figure 5.1.5.2 Alert message for successfully modify the status of class

Based on the figure above, the instructor was able to view the class details by selecting the course name and the type of the class. The system will display the course code, type, class date/time, instructor and the status when the instructor had search for a class. Not only that, but instructor can also modify the status of the class whether to activate or deactivate the class. After instructor successfully updated the status of the class, the system will prompt out an alert message showing that the status was updated successfully.

5.1.6 Modify Attendance Module

 A screenshot of a web application's "Attendance Report" page. The page has a light blue header with the title "Attendance Report" and a calendar icon. Below the header is a navigation bar with a "Back" button. The main content area has a light blue background and contains a search form with "Course Name" (set to "UCCD2044Object-Orient") and "Type" (set to "Lecture"). Below the search form is a table with columns: NO, CLASS DATE/TIME, NAME, FACULTY, STATUS, and ACTION. The table contains four rows of data. Below the table is an "Export to Excel" button.

NO	CLASS DATE/TIME	NAME	FACULTY	STATUS	ACTION
1	2023-01-31 15:00:00	Lew Tian Pei	FICT	Attended	Choose status ▾
2	2023-01-31 15:00:00	Alli	FICT	Attended	Choose status ▾
3	2023-01-29 15:00:00	Alli	FICT	Absent	Choose status ▾
4	2023-01-29 15:00:00	Lew Tian Pei	FICT	Attended	Choose status ▾

Figure 5.1.6.1 Attendance Report Page

5.1.7 Export Attendance Report Module

No	Class Date/Time	Name	Faculty	Status
1	2023-01-31 15:00:00	Lew Tian Pei	FICT	Attended
2	2023-01-31 15:00:00	Ali	FICT	Attended
3	2023-01-29 15:00:00	Ali	FICT	Absent
4	2023-01-29 15:00:00	Lew Tian Pei	FICT	Attended

Figure 5.1.7.1 Excel for Attendance Report

Based on Figure 5.1.6.1 and Figure 5.1.7.1, the instructor was able to view the attendance report of each class. The attendance report was able to show whether the student had present or absent the class. Instructor was able to modify the status of the student's attendance if the student had faced a problem on taking the attendance. Besides, instructor was able to export the attendance report into excel file so that instructor can manage the student's attendance more efficiently.

NO	FACULTY	NAME	ATTENDANCE PERCENTAGE
1	FICT	Ali	50%
2	FICT	Lew Tian Pei	100%

Figure 5.1.7.2 Course Overall Report Page

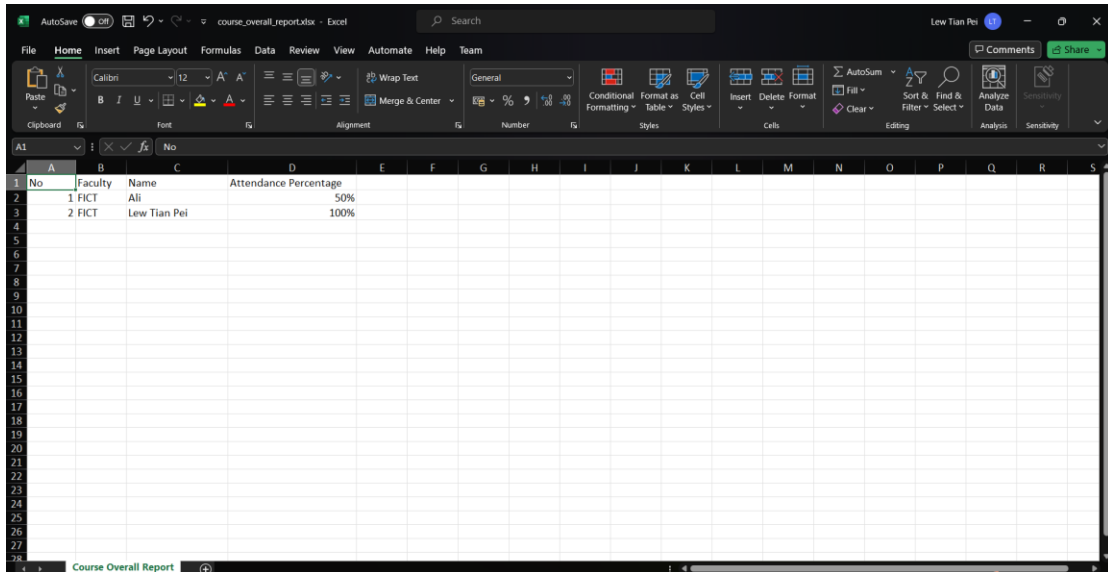


Figure 5.1.7.3 Excel for Course Overall Report Page

Based on Figure 5.1.7.2, the course overall report module is an important module where instructors are able to check the overall attendance percentage. It is important to know the attendance percentage of a student as if the percentage of the attendance is below 80%, the student will be barred from sitting final examination. The instructor was also able to export the course overall report into excel file to have a better efficient management.

5.1.8 Face Recognition Module

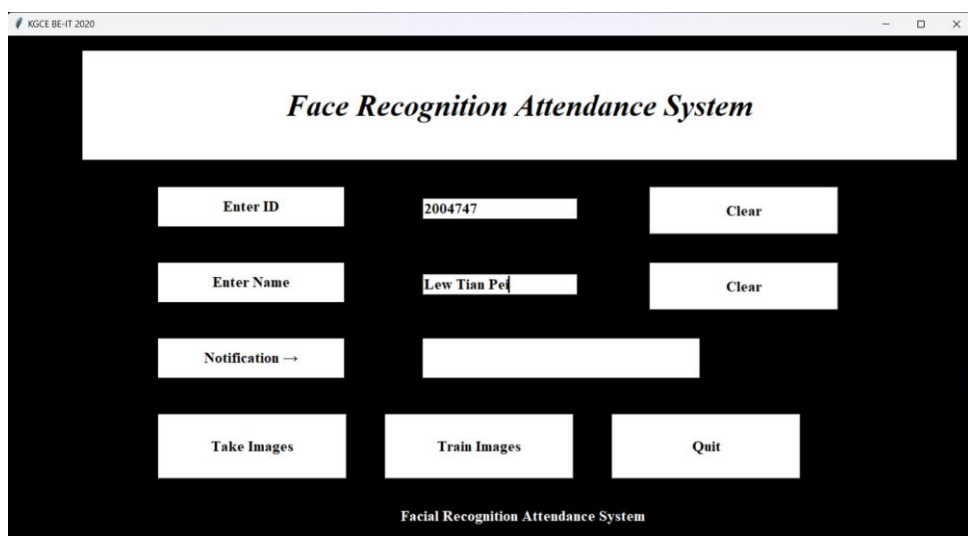


Figure 5.1.8.1 UI for Face Recognition Module

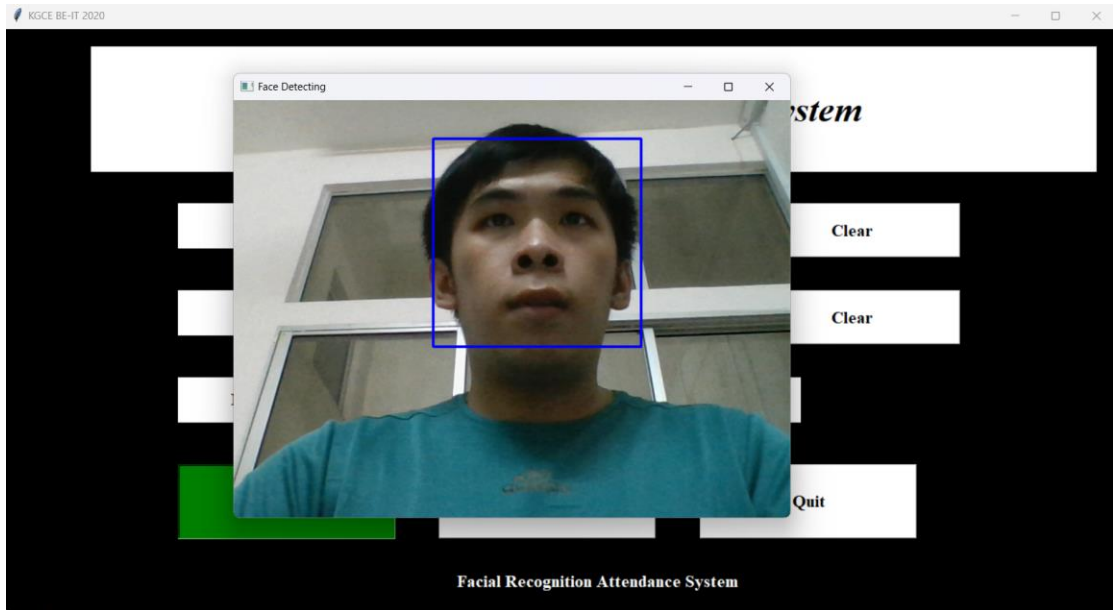


Figure 5.1.8.2 UI for Detecting Face

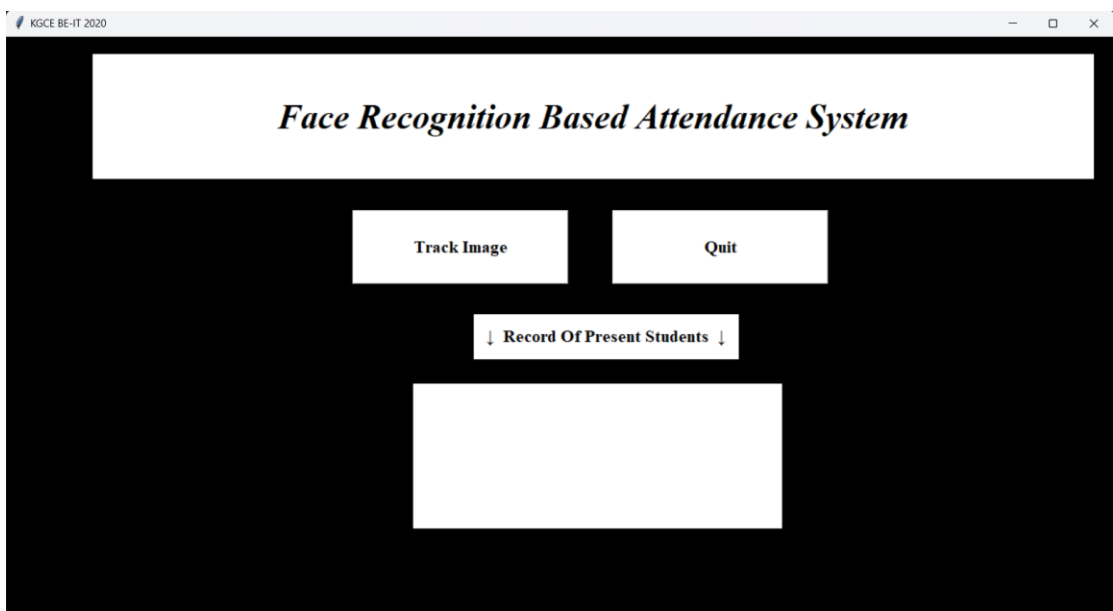


Figure 5.1.8.3 UI for Tracking Image

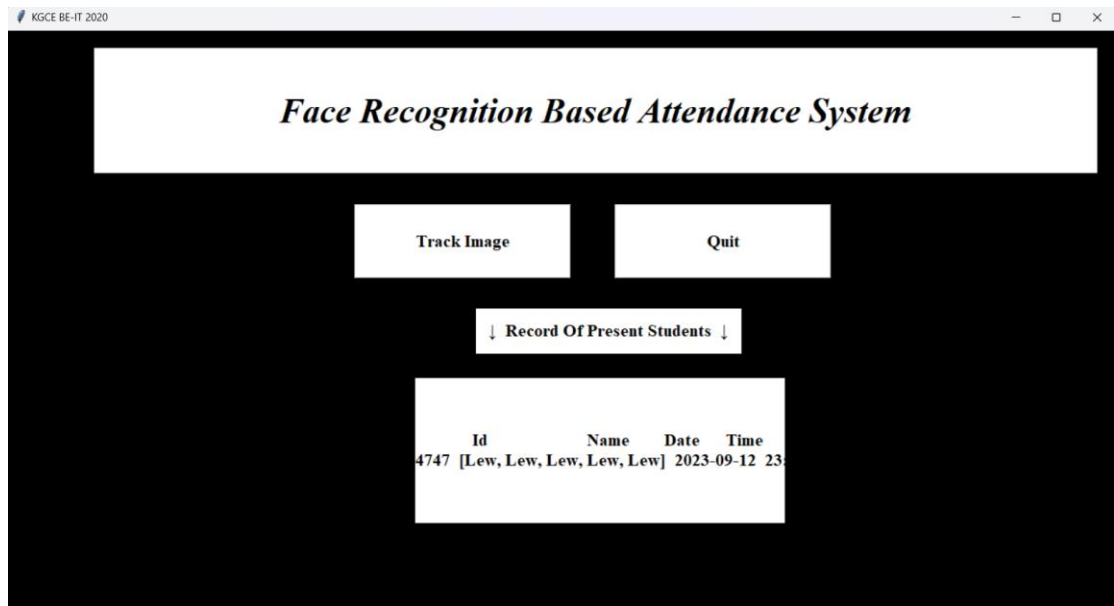


Figure 5.1.8.4 UI of after successfully recognized the face

Based on the Figures above, the face recognition module was done by using python terminal where the Figure 5.1.8.1 shows the user interface of the face recognition module. After the student had insert their details such as name and student ID, student should take the image and after the image was taken, student should press the train image button. By pressing the train image button, the haar cascade module will start to train the image and the training data will be stored in local file. Next, student can start to recognize their face based on Figure 5.1.8.3. Students just need to press on the track image button, and it will start to compare the student face with the training data. If the recognized face and the training image was matched, the attendance will be successfully recorded.

5.1.9 View Attendance History Module

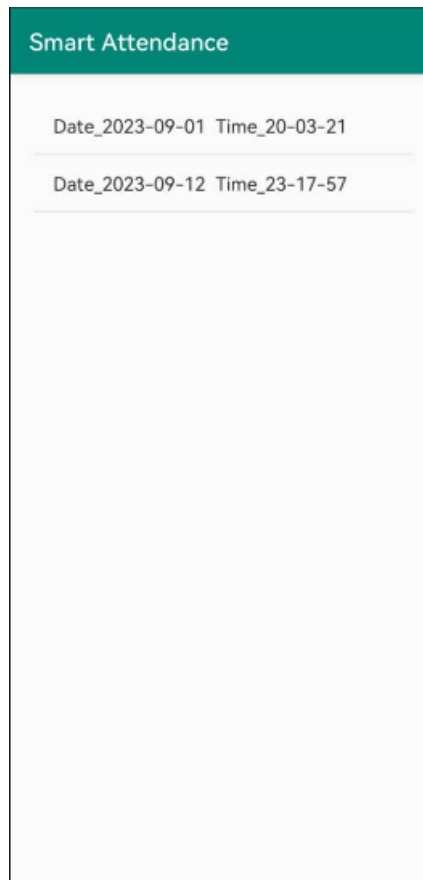


Figure 5.1.9.1 View Attendance History

In this module, students are able to view their attendance history by using their mobile phone. A list of attendance was display and students are able to check whether the attendance record is correct or not. When the student absent, the attendance record will not display out.

5.2 Unit Testing

When a function is completely developed, a unit testing was implemented to check the existence of defects and to fix the defects immediately before the integration of functions. Unit testing was tested by developer as developer was the people who is familiar with the developed system. Besides, a function was simple and easy to be tested before integrated with other functions or modules to become a complex system.

5.2.1 Authentication Module (Register/Login)

Test Case Module: Authentication Module

Test Case Description: To test the user sign-up process.

Test Case #	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1	- Check response when Create Account was clicked. - Check response when valid name, email, password and contact number is entered.	Username: Lew Tian Pei Email: Lewtp423@lutar.my Password: 123 Contact Number: 0105526620	The registration should be successful and directed to the login page.	The registration was successful and directed to the login page.	Pass
2	Check response when name, email, password, and phone number is empty.	Username: Null Email: Null Password: Null	The registration should be failed, and	The registration was failed, and error	Pass

CHAPTER 5

		Contact Number: Null	an error message should be displayed.	message was displayed.	
3	Check response when valid email address and password is entered.	Email: lewtp423@lutar.my Password: 123	Login should be successfully and directed to the main page.	Login was successful and directed to the main page.	Pass
4	Check response when valid email address but invalid password is entered.	Email: lewtp423@lutar.my Password: 321	Login should be failed, and error message should be displayed.	Login was failed and error message should be displayed.	Pass
5	Check response when valid email is entered but password is empty.	Email: lewtp423@lutar.my Password: Null	Login should be failed, and error message should be displayed.	Login was failed and error message should be displayed.	Pass
6	Check response when valid email is entered with no case sensitive.	Email: lewtp423@lutar.my Password: 123	Login should be successfully and directed to the main page.	Login was successful and directed to the main page.	Pass
7	Check response when email is entered with bad format.	Email: lewtp423 Password: 123	Login should be failed, and error message should be displayed.	Login was failed and error message should be displayed.	Pass

Table 5.2.1.1 Authentication Module

5.2.2 Change Password Module

Test Case Module: Change Password Module

Test Case Description: To test the user change password process.

Test Case #	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1	- Check response when Change Password was clicked. - Check response when valid old password, new password and confirm password is entered.	Old Password: 123 New Password: 321 Confirm Password: 321	Password should be updated successfully.	Password was updated successfully.	Pass
2	- Check response when invalid old password, valid new password and confirm password is entered.	Old Password: 321 New Password: testing123 Confirm Password: testing123	Password should be failed to update and error message should be displayed.	Password was failed to update and error message was displayed.	Pass

3	- Check response when valid old password, new password and invalid confirm password is entered.	Old Password: 321 New Password: testing123 Confirm Password: testing321	Password should be failed to update and error message should be displayed.	Password was failed to update and error message was displayed.	Pass
4	- Check response when password is entered with no case sensitive.	Old Password: 321 New Password: testing123 Confirm Password: Testing321	Password should be failed to update and error message should be displayed.	Password was failed to update and error message was displayed.	Pass
5	- Check response when valid old password, but new password and confirm password is empty.	Old Password: 321 New Password: Null Confirm Password: Null	Password should be failed to update and error message should be displayed.	Password was failed to update and error message was displayed.	Pass

Table 5.2.2.1 Change Password Module

5.2.3 Assign Admin Module

Test Case Module: Assign Admin Module

Test Case Description: To test the assign admin process.

Test Case #	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1	- Check response when Assign Instructor was clicked.	Email: admin@1utar.my	User should be successfully entered the page.	User was successfully entered the page.	Pass
2	- Check response when Assign Instructor was clicked.	Email: lewtp423@1utar.my	User should not be able to enter the page.	User was not able to enter the page.	Pass
3	- Check response when valid subject and Instructor.	Subject: Cybersecurity Instructor: Lew Tian Pei	The system should be successfully updated the assigned table.	The system was successfully updated the assigned table.	Pass
4	- Check response when valid subject but Instructor is empty.	Subject: Cybersecurity Instructor: Null	The system should not update the assigned table and error message should be displayed.	The system does not update the assigned table and error message was displayed.	Pass

5	- Check response when valid Instructor but subject was empty	Subject: Null Instructor: Lew Tian Pei	The system should not update the assigned table and error message should be displayed.	The system does not update the assigned table and error message was displayed.	Pass
---	--	---	--	--	------

Table 5.2.3.1 Assign Instructor Module

5.2.4 Activate Attendance Module

Test Case Module: Activate Attendance Module

Test Case Description: To test the activate attendance process.

Test Case #	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1	- Check response when valid course name	Course Name: UCCN2243Cybersecurity	System should successfully display the attendance event of the course.	System was successfully display the attendance event of the course.	Pass

2	- Check response when course name is empty.	Course Name: Null	System should not display the attendance event of the course and an error message was displayed.	System does not display the attendance event of the course and an error message was displayed.	Pass
3	- Check response when status is activated.	Status: Activate	System should successfully update the status of the event.	System successfully updates the status of the event.	Pass
4	- Check response when status is deactivated.	Status: Deactivate	System should successfully update the status of the event.	System should successfully update the status of the event.	Pass

Table 5.2.4.1 Activate Attendance Module

5.2.5 Modify Attendance Module

Test Case Module: Modify Attendance Module

Test Case Description: To test the modify attendance process.

Test Case #	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
-------------	------------------	-----------	-----------------	---------------	-----------

CHAPTER 5

1	- Check response when valid course name	Course Name: UCCN2243Cybersecurity	System should successfully display the attendance event of the course.	System was successfully display the attendance event of the course.	Pass
2	- Check response when course name is empty.	Course Name: Null	System should not display the attendance event of the course and an error message was displayed.	System does not display the attendance event of the course and an error message was displayed.	Pass
3	- Check response when action is Attended.	Action: Attended	System should successfully update the status of the attendance.	System successfully updates the status of the attendance.	Pass
4	- Check response when action is Absent.	Status: Absent	System should successfully update the status of the attendance.	System should successfully update the status of the attendance.	Pass

Table 5.2.5.1 Modify Attendance Module

5.2.6 Face Recognition Module

Test Case Module: Face Recognition Module

Test Case Description: To test the face recognition process.

Test Case #	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1	- Check response when valid face is detected.	Valid face	System should successfully detect the face.	System was successfully detecting the face.	Pass
2	- Check response when invalid face is detected.	Invalid face	System should fail to detect the face and error message was displayed.	System fails to detect the face and error message was displayed.	Pass
3	- Check response when valid training image and valid testing image.	Training image: valid Testing image: valid	System should successfully recognize the face.	System was successfully recognizing the face.	Pass
4	- Check response when valid training image but invalid testing image.	Training image: valid Testing image: invalid	System should fail to recognize the face and error message was displayed.	System fails to recognize the face and error message was displayed.	Pass

Table 5.2.6.1 Face Recognition Module

CHAPTER 6

6.1 Conclusion

In a nutshell, the Facial Recognition Attendance System developed in Eclipse for the web application has proven to be an efficient tool for managing attendance in educational settings. This system seamlessly offers a user-friendly experience for administrators, instructors and students alike.

For administrators and instructors, this proposed system provides a centralized platform for easily monitoring and managing students' attendance records. With just a few clicks, instructors can easily access to the real-time attendance data, tracking student attendance history, and generate reports with excel file which can make the administrative tasks associated with attendance management much more efficiently.

Students benefit from the system's convenience and accessibility. They can scan their faces and record their attendance effortlessly. This approach had significantly reduced some manual process which the students can have more time to study, instructors have more time to teach the students too. Face recognition also enhances the accuracy and security of attendance tracking which the students had no chance of giving fake attendance as students need to record their facial identity in order to get the attendance.

6.2 Future Work

Looking forward, this proposed system can be further improved more and expanded to include few additional features, such as automated notifications for students, detailed analytics for instructors and administrators. Besides, the facial recognition system will also implement into Android Phone so that the students can scan their faces using the mobile application. Overall, this proposed system represents a significant step forward in modernizing attendance management in educational institutions and providing a more efficient and user-friendly experience for all stakeholders.

REFERENCES

- [1] Kiran Bajpai. "Manual vs automated attendance system: Comparison," *SoftwareSuggest Blog*, 2020. [Online]. Available: <https://www.softwaresuggest.com/blog/manual-vs-automated-attendance-system-pros-cons/> (accessed Mar.20, 2023).
- [2] S. Symanovich. "What is facial recognition? How facial recognition works." *us.norton.com*. <https://us.norton.com/internetsecurity-iot-how-facial-recognition-software-works.html> (accessed Jul. 9, 2022).
- [3] A. K. Jain, A. Ross and S. Prabhakar., "An introduction to biometric recognition," in *IEEE Transactions on Circuits and Systems for Video Technology*, Jan. 2004. [Online]. Available: <https://ieeexplore.ieee.org/document/1262027>
- [4] M. A. Dabbah, W. L. Woo and S. S. Dlay, "Secure Authentication for Face Recognition," *2007 IEEE Symposium on Computational Intelligence in Image and Signal Processing*, 2007, pp. 121-126, doi: 10.1109/CIISP.2007.369304.
- [5] J. Hardy, G. Corfield. "Forget your passwords, the era of facial recognition and fingerprints is finally here" *telegraph.co.uk*. <https://www.telegraph.co.uk/technology/2022/05/05/apple-google-microsoft-expand-thumb-face-replace-passwords/> (accessed Aug. 11, 2022)
- [6] A. G. Johansen. "Biometrics and biometric data: What is it and is it secure?" *us.norton.com*. <https://us.norton.com/blog/iot/biometrics-how-do-they-work-are-they-safe> (accessed Jul. 15, 2022).
- [7] A.S.Gillis. "biometrics" *techtarget.com*. <https://www.techtarget.com/searchsecurity/definition/biometrics#:~:text=Biometrics%20is%20the%20measurement%20and,individuals%20who%20are%20under%20surveillance> (accessed Aug. 11, 2022)
- [8] M. Calvello, "What is Biometrics? (+How it Works, Types, & Pros and Cons." *learn.g2.com*. <https://learn.g2.com/biometrics#how-bio-works> (accessed Aug. 11, 2022)
- [9] Versha, Ms and Sarao, Dr, "Comparative Analysis of Various Biometric Techniques," in *Protagonist International Journal of Management and Technology (PIJMT)*, May. 2015. [Online]. Available: https://www.researchgate.net/publication/345003886_Comparative_Analysis_of_Various_Biometric_Techniques
- [10] A. K. Yadav and S. K. Grewal, "Comparative Study of Different Biometric Technologies," in *International Journal of Computer Science and Communication (IJCSC)*, Sep. 2014. [Online]. Available: <http://csjournals.com/IJCSC/PDF5-1/8.%20Arun.pdf>

REFERENCES

- [11] Lin Hong, Yifei Wan and A. Jain, "Fingerprint image enhancement: algorithm and performance evaluation," in *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Aug. 1998. [Online]. Available: <https://ieeexplore.ieee.org/document/709565>
- [12] Spiceworks Inc. "Data Snapshot: Biometrics in the workplace commonplace, but are they secure?" [community.spiceworks.com https://community.spiceworks.com/security/articles/2952-data-snapshot-biometrics-in-the-workplace-commonplace-but-are-they-secure](https://community.spiceworks.com/security/articles/2952-data-snapshot-biometrics-in-the-workplace-commonplace-but-are-they-secure) (accessed Aug. 12, 2022)
- [13] Smitha, P. S. Hegde, Afshin, "Face recognition based attendance management system," in *International Journal of Engineering Research (IJERT)*, May. 2020. [Online]. Available: https://www.researchgate.net/publication/341876647_Face_Recognition_based_Attendance_Management_System
- [14] P. S. Bhagat, S. Y. Chincholikar, "Biometric Attendance System using Iris Recognition," in *International Journal for Innovative Research in Multidisciplinary Field (IJIRMF)*, Nov. 2016. [Online]. Available: <http://www.ijirmf.com/wp-content/uploads/2016/11/201611047.pdf>
- [15] O. C. Akinduyite, A. O. Adetunmbi, O. Ibidunmoye, O. O. Olabode, "Fingerprint-based attendance management system," *Journal of Computer Science and Applications (JCSA)*, vol. 1, no. 5, pp. 100-105, 2013, doi: 10.12691/jcsa-1-5-4.
- [16] S. Kumar and E. Walia, "Analysis of various Biometric Technique," in *International Journal of Computer Science and Information Technologies (IJCSIT)*, Jan. 2011. [Online]. Available: https://www.researchgate.net/publication/267550317_Analysis_of_various_Biometric_Techniques
- [17] L. Wiskott, J-M. Fellous, N. Kruger, C. Malsburg, "Face Recognition by Elastic Bunch Graph Matching," in *Intelligent Biometric Techniques in Fingerprint and Face Recognition*, Jan. 1999. [Online]. Available: https://www.researchgate.net/publication/220182105_Face_recognition_by_elastic_bunch_graph_matching
- [18] A. K. Pandey and R. Mishra, "Deep Learning based facial recognition using Haar cascade technique," *2023 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)*, Greater Noida, India, 2023, pp. 2109-2113, doi: 10.1109/ICACITE57410.2023.10182612.
- [19] A. Yadav, A. Sharma and S. S. Yadav, "Attendance Management System Based on Face Recognition Using Haar-Cascade," *2022 2nd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)*, Greater Noida, India, 2022, pp. 1972-1976, doi: 10.1109/ICACITE53722.2022.9823613.
- [20] A. Sharma, K. Shah and S. Verma, "Face Recognition using Haar Cascade and Local Binary Pattern Histogram in OpenCV," *2021 Sixth International Conference on*

REFERENCES

Image Information Processing (ICIIP), Shimla, India, 2021, pp. 298-303, doi: 10.1109/ICIIP53038.2021.9702579.

[21] R. Mohamed, J. U. Jafni and S. N. M. Rum, "Real-Time Face Recognition System in Smart Classroom using Haar Cascade and Local Binary Pattern Model," *2022 International Conference on Advanced Creative Networks and Intelligent Systems (ICACNIS)*, Bandung, Indonesia, 2022, pp. 1-6, doi: 10.1109/ICACNIS57039.2022.10054833.

[22] K. Chauhan, S. Goyal and G. P. M S, "An Automated Attendance System Using Face Recognition Technique based on Haar Cascade with LBPH," *2023 3rd International Conference on Intelligent Technologies (CONIT)*, Hubli, India, 2023, pp. 1-5, doi: 10.1109/CONIT59222.2023.10205594.

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	Study week no.: 1 & 2
Student Name & ID: Low Tian Pei 20ACB04747	
Supervisor: Ts Phan Khoo Yuen	
Project Title: Facial Recognition Attendance System	

1. WORK DONE

Modify on the UI of Sign Up and Sign In page which had done during FYP 1.

2. WORK TO BE DONE

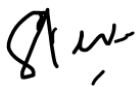
Make improvement on the assign instructor module and develop the modify attendance module.

3. PROBLEMS ENCOUNTERED

No problems encountered.

4. SELF EVALUATION OF THE PROGRESS

- Good practice to start doing fyp during week 1.



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	Study week no.: 3 & 4
Student Name & ID: Low Tian Pei 20ACB04747	
Supervisor: Ts Phan Khoo Yuen	
Project Title: Facial Recognition Attendance System	

1. WORK DONE

Develop Sign up and Sign in page for the website application, assign instructor module and modify attendance module.

2. WORK TO BE DONE

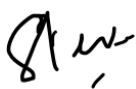
Implement all user data into database.

3. PROBLEMS ENCOUNTERED

No problems encountered.

4. SELF EVALUATION OF THE PROGRESS

40% of the total progress. When exporting attendance report to excel file done, it should be reached 50%



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	Study week no.: 5 & 6
Student Name & ID: Low Tian Pei 20ACB04747	
Supervisor: Ts Phan Khoo Yuen	
Project Title: Facial Recognition Attendance System	

1. WORK DONE

Develop view profile module and change password module.

2. WORK TO BE DONE

Solve problem on the filling data. When the user does not enter any data, the system should prompt out an alert message to notify the user.

3. PROBLEMS ENCOUNTERED

No problems encountered.

4. SELF EVALUATION OF THE PROGRESS

50% of the total progress



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	Study week no.: 7 & 8
Student Name & ID: Low Tian Pei 20ACB04747	
Supervisor: Ts Phan Khoo Yuen	
Project Title: Facial Recognition Attendance System	

1. WORK DONE

Completed developed activate attendance data and export attendance report.

2. WORK TO BE DONE

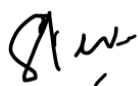
Solve bugs on exporting the attendance report into excel file.

3. PROBLEMS ENCOUNTERED

When exporting the attendance report into excel, it doesn't export the attendance percentage which it is important to identify whether student will be barred from sitting final examination.

4. SELF EVALUATION OF THE PROGRESS

70% of the total progress. Web application should be almost done and start to develop the most important module which is face recognition module.



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT*(Project II)*

Trimester, Year: Trimester 2, Year 3	Study week no.: 9 & 10
Student Name & ID: Low Tian Pei 20ACB04747	
Supervisor: Ts Phan Khoo Yuen	
Project Title: Facial Recognition Attendance System	

1. WORK DONE

Develop sign up/sign in for Android application.

2. WORK TO BE DONE

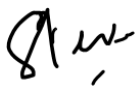
Planning to implement other facial recognition algorithm which is Haar cascade.

3. PROBLEMS ENCOUNTERED

Encountered on implementing algorithm into the source code.

4. SELF EVALUATION OF THE PROGRESS

85% of the development progress. Report writing is currently 70%.



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 2, Year 3	Study week no.: 11 & 12
Student Name & ID: Lew Tian Pei 20ACB04747	
Supervisor: Ts Phan Khoo Yuen	
Project Title: Facial Recognition Attendance System	

1. WORK DONE

All development was done. Unit testing. Report chapter 1, 2, 3, 4, 5 and 6 are written.

2. WORK TO BE DONE

- Submit of report to Turnitin and combine all the chapters into final report.

3. PROBLEMS ENCOUNTERED

- Need to add more feature inside the system.

4. SELF EVALUATION OF THE PROGRESS

- 100% of the report writing. Development progress is currently still 90% which some part can be modify and improved.



Supervisor's signature



Student's signature

POSTER



UTAR
UNIVERSITI TUNKU ABDUL RAHMAN

**FACULTY OF INFORMATION
COMMUNICATION AND TECHNOLOGY**

**FACIAL RECOGNITION
ATTENDANCE SYSTEM**

OBJECTIVE

- 1) Improve efficiency of taking attendance by solving time issues.
- 2) Improve productivity of managing attendance by avoid human errors.

INTRODUCTION




Attendance is an important element to determine the presence of student in the class. However, traditionally way of marking attendance was inefficient. Thus, facial recognition attendance system was developed to address the issue. The final deliverable will enable student to take attendance by scanning their faces.

METHODS



- Using Haar Cascade as the algorithm for facial recognition.
- Using HTML to develop web-based system.
- Using Android Studio to develop android-based system

DISCUSSION

Facial Recognition technology for attendance tracking provides several benefits, including increased accuracy, enhances security and reduced time and resource. These advantages makes it an appealing option for educational institutions, businesses and other organizations looking to improve the systems.

PROJECT DEVELOPER:

Lew Tian Pei

PROJECT SUPERVISOR:

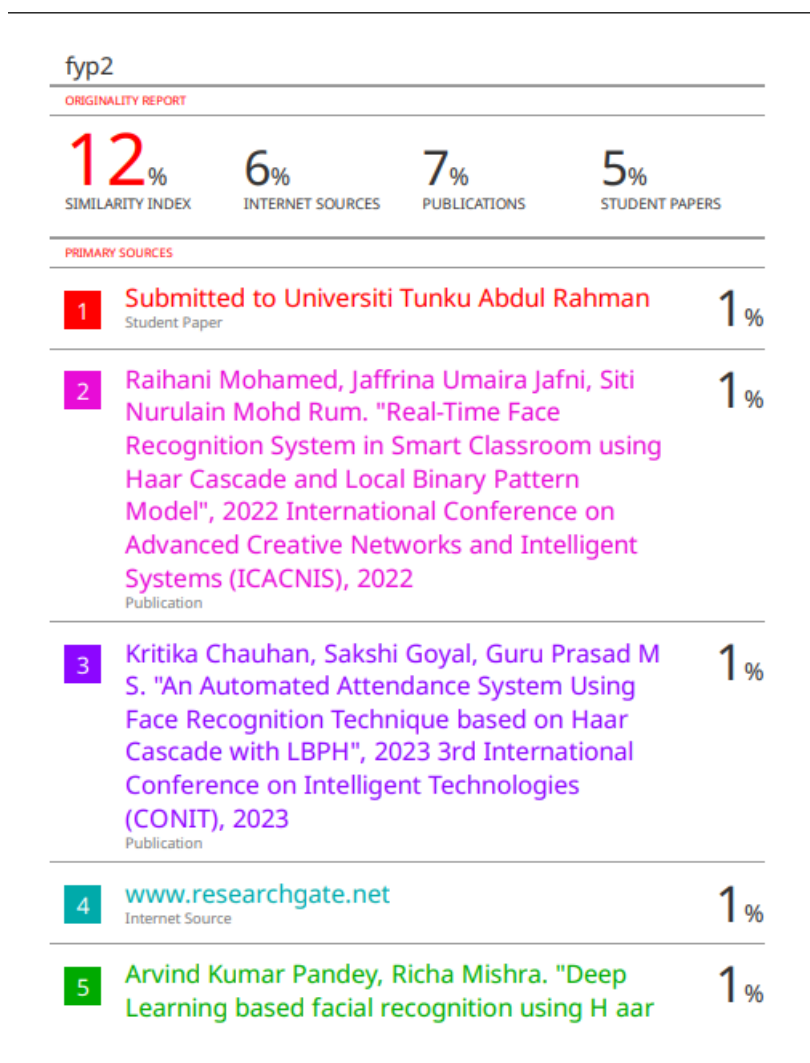
Ts Phan Khoo Yuen

CONCLUSION

Facial recognition attendance system has addressed the problem of manual attendance taking and provided a more efficient way of tracking attendance. Moving forward, I plan to explore ways to improve the accuracy and speed of the systems which has the potential to benefit the educational and business community.

THANK YOU!

PLAGIARISM CHECK RESULT



PLAGIARISM CHECK RESULT

Form Title: Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 14/09/2023	Page No.: 1 of 1



FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	Lew Tian Pei
ID Number(s)	20ACB04747
Programme / Course	BACHELOR OF COMPUTER SCIENCE (HONOURS)
Title of Final Year Project	Facial Recognition Attendance System

Similarity	Supervisor's Comments (Compulsory if parameters of originality exceed the limits approved by UTAR)
Overall similarity index: <u>12</u> % Similarity by source Internet Sources: <u>6</u> % Publications: <u>7</u> % Student Papers: <u>5</u> %	
Number of individual sources listed of more than 3% similarity: <u>0</u>	
Parameters of originality required, and limits approved by UTAR are as Follows: (i) Overall similarity index is 20% and below, and (ii) Matching of individual sources listed must be less than 3% each, and (iii) Matching texts in continuous block must not exceed 8 words <i>Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.</i>	

Note: Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor

Signature of Co-Supervisor

Name: Ts Phan Koo Yuen

Name: _____

Date: 14/9/2023

Date: _____



UNIVERSITI TUNKU ABDUL RAHMAN
FACULTY OF INFORMATION & COMMUNICATION
TECHNOLOGY (KAMPAR CAMPUS)
CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	20ACB04747
Student Name	Lew Tian Pei
Supervisor Name	Ts Phan Koo Yuen

TICK (√)	DOCUMENT ITEMS
	Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
√	Title Page
√	Signed Report Status Declaration Form
√	Signed FYP Thesis Submission Form
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
√	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content
√	Bibliography (or References)
√	All references in bibliography are cited in the thesis, especially in the chapter of literature review
N/A	Appendices (if applicable)
√	Weekly Log
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)
√	I agree 5 marks will be deducted due to incorrect format, declare wrongly the ticked of these items, and/or any dispute happening for these items in this report.

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report.

(Signature of Student)

Date: 14/9/2023