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Facial Recognition Based Attendance System for Santai Esports (FRASE)

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Abstract

Santai Esports in Taman Universiti faces operational hurdles with just two staff members relying on a rotating shift system. Planning to expand, the informal method compromises accuracy and complicates payroll. The proposed solution is a user-friendly Facial Recognition Attendance System, aiming to automate tracking and enhance security. The system, including modules for registration and analytics, targets efficient attendance tracking, reduced workload, and staff accountability. Implemented with the structured Waterfall model, it positions Santai Esports for market growth, addressing inefficiencies and establishing a foundation for robust staff management. As the result, Facial Recognition Based Attendance System for Santai Esports (FRASE) has made significant strides in modernizing attendance management and enhancing security within the establishment.

1. Introduction

A cybercafe is a business where computers are provided for accessing the internet, playing games, or doing other computer-related tasks. Esports (electronic sports) is an organized competitive video gaming. Recently, the skill involved in playing and mastering video games had led to the professionalization of esports [1]. Santai Esports, established in 2023, is a gaming cybercafe located in Taman Universiti. The establishment provides gaming consoles for customers' entertainment and also provides rental services for eSports occasions. However, the establishment finds struggles in its day-to-day operations due to the lack of an organized attendance system. With just two staff members, the current reliance on a rotating shift system becomes problematic as the business plans to hire more staff. This informal approach not only affects attendance accuracy but also makes payroll calculations complicated, prompting the need for a systematic solution. The proposed solution is to implement a Facial Recognition Attendance System (FRASE), designed to be user-friendly and able to accommodate a growing staff. The objectives of the project are to design facial recognition-based attendance system using structured approach, to develop a facial recognition-based attendance system on desktop and web-based application, and to test a system that incorporate attendance data dashboard using user acceptance testing. By utilizing technology such as OpenCV face recognition library, and Firebase for attendance-recording purposes, the system aims to address attendance-recording issues faced by the establishment. Additionally, administrative functionalities are to be implemented as these features will not only address the current inefficiencies but also lay a foundation for a robust staff management system for Santai Esports.

The paper will be structured in the following way: In Section 2, we will thoroughly explore related works that are relevant to the project. In Section 3, we will outline the methodology that we employed in our research. Moving on, Section 4 will provide a detailed examination of the system outcomes. Finally, in Section 5, we will engage in a discussion of the concluding aspects of the project.

2. Related Work

Attendance Management keeps track of employee hours. The system should be able to document the time of the employees work and the time they take off. Additionally, the attendance management can be done by recording employee hours on paper, using spreadsheets, punching time cards, or using online attendance software for the company. Usually, the most common technology used for saving attendance records are by using Microsoft Excel, where it provides the file format to store the records. If there is no management of employee attendance, it can lead to various consequences including financial costs, legal battles, decreased productivity, wasted administration, and uninformed management [2].

In addressing the attendance management issues faced by Santai Esports their current procedure is identified is shown in Appendix A; it begins with the shop owner opening the shop at 2 pm and managing the shop alone until 7 pm, as he waits for the next staff to arrive during the said hour. Once arrives, the shop owner records the arrival time of the said staff in a log book and then leaves the shop. The staff member will manage the shop alone throughout the entire shift. The procedure ends at 3 am when the staff will handle the shop closing all by himself and record the closing time in his log book.

Several existing systems that are related in different aspects to the proposed system are examined. By identifying the components and flaws of existing systems, a new system that incorporates strengths and eliminates weaknesses can be developed. Table 1 shows the comparison between existing systems and proposed system.

Table 1 *Comparison between existing systems and proposed system*

Features/System	SMAP Online	Face Recognition with Real-Time Database	Simple Attendance Management System	FRASE
User Registration	√ Registered by admin	X Preset data inside the system's code	√ Registered by admin	√ Registered by admin
User Authentication	√ User ID and Authenticator Code	√ Facial Recognition	X Admin marks attendance	√ Facial Recognition with anti-spoofing technology
Real-Time Database	√	√	X MySQL	√
Anti-Spoofing Technology	X	X	-	√
Manage User	X	X	√	√
Schedule Management	√	X	√	X
User Attendance Performance Tracking	√	X	√	X
Data Analysis Dashboard	√	X	√ Static Dashboard	√ Dynamic Dashboard
View and Print Report	√	X	√	√

The three existing systems are compared with the proposed systems, highlighting relevant features that contribute to developing a system that fulfills the stakeholders' needs. SMAP online's features in attendance management functionalities such as UTHM iQR and the ability to view and print attendance details align closely with the proposed system. Face Recognition with Real-time Database shines its values in its responsive face scanning for user recognition and the implementation of Firebase. On the other hand, Simple Attendance Management System delivers attendance management capabilities. The proposed system will incorporate the strengths of the three systems in developing a system that will enhance the overall attendance management experience in Santai Esports.

3. Methodology/Framework

3.1 Prototype Model

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The proposed system will be applying the waterfall system development model, as it is a linear model that uses a sequential approach to the project's development. Furthermore, the waterfall model is a strong, reliable method that leads to efficient workflow and productivity, allowing for deliverables to be met with enough attention to detail without any major errors made [3]. It is important to take into account that although the model provides a well-defined process and clear project goals, it is also strict in adaptability to changing needs. Therefore, stakeholders play a crucial role in offering comprehensive analysis and requirements gathering of the project. However, as for this project, Muhammad Firdaus, the owner of Santai Esports gave full cooperation in gathering all the necessary requirements and stated that he has no plans to change it in the future. Table 2 demonstrates the project development activities and their task in each phase.

Table 2 *Software development activities and their task*

Phase	Task	Output
Requirements Gathering	-Proposed the project	- Project proposal and developed Gantt chart
System Design	- Determine the project schedule, activities, and output	- System architecture design, database design document and user interface design
Implementation	- Define system architecture and components	- Source code, database implementation, and executable application
Testing	-Create a detailed database design	Test report
Deployment	-Design user interface and system interactions	Configured system

Functional requirements define what a software product must do: its features and functions, while the non-functional requirements are used to specify various system qualities and attributes such as performance and scalability [4]. Table 3 defines the system functional requirements of FRASE that consist of seven modules and their respective functions.

Table 3 *The functional requirements*

Module	Function
Staff and Visitor Registration	- The system shall require the first-time user to register their details and face before entering the establishment
Attendance-Taking	- The system scan the user's face to record their attendance and store it in the database
Multiple Clock-In Clock-Out Detection Module	- The system shall display a message informing the user that their attendance has already been recorded if they tried to scan multiple times.
Anti-Spoofing	- The system shall be able to only record the user's attendance if their face is authentic, preventing fraudulent inputs
User	- The system shall allow the administrator to view

	visitor and staff lists, and manage user information.

Table 3 *The functional requirements (cont.)*

Module	Function
Attendance-Tracking Analytics	- The system shall provide the administrator insights into the staff's attendance performance, displaying good and bad performance staff, their total work hours, and their estimated salary
Reporting	- The system shall provide automatically generated report.

Non-functional requirements specify performance standards for software, such as speed, security, reliability, and usability. Unlike functional requirements, which detail what the software must do, non-functional requirements dictate how well it performs. They ensure the software meets quality standards and user expectations [5]. For the non-functional requirements, Table 4 shows the aspects that have been considered for the system development.

Table 4 *The non-functional requirements*

Aspect	Description
Security	- The system should be accessed by only authorized users.
Reliability	- The system should never crash or hang.
Performance	- The system should run smoothly with minimal waiting time.
Usability	- The user interfaces of the system should be easy to learn and use by users.
Integrity	- The database should be kept properly and secured by the system from any corruption and non-readable to the user's concern.

3.2 Analysis

This section presents the results obtained from analyzing the system, which are depicted through several visual representations. These include data flow diagrams from context diagram to level 1 diagrams, a Requirements Traceability Matrix, and an entity relationship diagram.

3.2.1 Data Flow Diagram Context Diagram

To gain an understanding of the system's flow of information, data flow diagram helps in presenting a visualization of the data flow. They can be used to analyze an existing system or model a new one [6]. *Figure 1* illustrates the data flow diagram context diagram (DFD CD) of Facial Recognition Based Attendance System for Santai Esports, where the diagram shows the highest level of abstraction of the said system.

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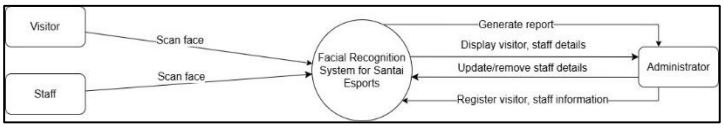

Fig. 1 *Data Flow Diagram Context Diagram (DFD CD) of FRASE*

In the entire context of the proposed system, the staff is simply responsible for providing facial scans for attendance-recording purposes. On the other hand, the administrator is the one who majorly interacts with the other functionalities provided by the system. This includes viewing generated reports and user details, updating or removing staff details, and registering new user information.

3.2.2 Data Flow Diagram Level 0

For a more detailed process involved in the system, the level 0 diagram shows all the major high-level processes of the system and how they are interrelated. The level 0 diagram of the proposed system is as shown in *Fig. 2*.

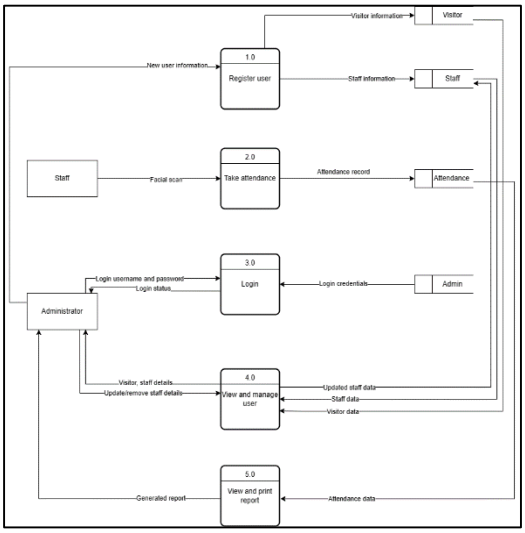

Fig. 2 *Data Flow Diagram Level 0 (DFD 0) of FRASE*

The diagram shows the overall data flow between two entities (staff and administrator), the system process, and the data stores of the system. There are five system processes and four data stores in the system. The five processes include registering users, taking attendance, logging, viewing and managing visitors/staff, and viewing and printing reports. The four data stores are visitor, staff, attendance, and admin.

The register user process is the process where the administrator will be inputting a registration form of visitor or staff details. Next, the said visitor will provide an image of their face, but if the said person is a staff, they have to go through a facial scan to put their record in the system. The take attendance process is the main process, where staff will show their face to the system's camera for facial recognition attendance. The login process requires the administrator to login to the system first, before accessing administration functionalities. The view and manage user process is the process where the administrator can view visitor and staff information and the staff attendance dashboard. The administrator is also able to update or delete the selected staff information. Next, the view and print report process allows the administrator to view the selected timeframe report and print it if needed.

3.2.3 Data Flow Diagram Level 1

Appendix A.1 illustrates the Data Flow Diagram DFD Level 1 (DFD 1) of Register User. In the register user process, the administrator will register the first time user's, selecting either staff registration or visitor registration and filling in personal details and facial scan provided by the staff, while visitors will need to provide a picture of themselves as they do not need to scan their attendance. Then, the completed user information will be manually inspected by the administrator to be validated. Then the process moves on to save the user data by submitting the form. The data will be updated to the NoSQL database in real time. After that, the staff can scan their attendance before entering the establishment, as it is a necessity.

Appendix A.2 illustrates the Data Flow Diagram DFD Level 1 (DFD 1) of Take Attendance. Staff will have to record their attendance before entering the establishment (this only applies to all employees). The staff will scan

their face on the system's camera, and their input facial scan will be converted into encoding. The input encoding will be compared with the encoding stored in the Staff data store to be validated. Once validated, the system will display the attendance status, informing the staff whether their attendance is successful or not. The facial scan is also integrated with an anti-spoofing technology to prevent fraudulent attempts at attendance records. Additionally, the system will update the latest attendance records in the NoSQL database.

Appendix A.3 illustrates the Data Flow Diagram Level 1 (DFD 1) of Login. The process consists of two sub-processes. First, the administrator will input the username and password in the login form. The system will retrieve the login credentials from the Admin data store to compare with the administrator's input to validate. After validation, the validated result will be sent to Process 2.2 for the next system action. Next, the administrator will be redirected to the main page if the login succeeds, the system will display an error message informing the administrator that the login credentials that have been inputted are wrong.

Appendix A.4 illustrates the Data Flow Diagram Level 1 (DFD 1) of View and Manage User. Process 3.1 is the process where the administrator can view user information, which consists of viewing visitor and staff information, and staff attendance dashboard. As for the dashboard, the Excel dashboard will retrieve the staff data from the database and will calculate and generate it in real-time. Additionally, the administrator is also able to update staff details and delete the staff record, if they quit (to ensure that they will not be able to scan attendance again). In process 3.2, the administrator can update or remove existing staff information from the system. Once the administrator has confirmed their actions, the new staff data will be saved to the database.

Appendix A.5 illustrates the Data Flow Diagram Level 1 (DFD 1) of View and Print Report. The process begins at Process 5.1 where the administrator will select a timeframe for the report to be generated. The system will retrieve the attendance data based on the given timeframe. Then, the process moves on to Process 5.2 where the system will generate the report based on the given data. The generated report then will be displayed on the website's interface, where the administrator can view and print the generated report if needed.

3.2.4 Requirement Traceability Matrix

A requirements traceability matrix or RTM is a document that provides accountability to project requirements by mapping out the relationship between requirements and project work [7]. To ensure alignment with business goals and systematic tracking, a RTM is utilized. This matrix assigns unique identifiers, traces the source of each requirement, and monitors its status, providing a structured approach to manage and implement the specified system requirements. Table 5 displays system's RTM.

Table 5 *Requirements Traceability Matrix (RTM)*

Allocated	Descriptions
REQ_100	**Register user**
- REQ_101	- Add new users for first-time users, including visitors and staff
REQ_200	**Take attendance**
- REQ_201	- System display take attendance interface
- REQ_202	- System displays a successful message upon successful clock-in attendance record
- REQ_203	- System displays staff information upon successful message
- REQ_204	- System displays already scanned message for repeated attempts of attendance record
- REQ_205	- System displays a successful message upon successful clock-out attendance record
- REQ_206	- System display error message for already clocked-out attempts
REQ_300	**View and manage user**
- REQ_301	- View visitor information
- REQ_302	- View staff information
- REQ_303	- View selected staff information
- REQ_304	- System display update staff information interface
- REQ_305	- Update existing staff information

Table 5 *Requirements Traceability Matrix (RTM) (cont.)*

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Allocated	Descriptions
REQ_300	- Delete existing staff information
- REQ_306	- System display staff attendance performance
- REQ_307	dashboard
REQ_400	**View and print report**
- REQ_401	- System display selects a timeframe of the report to generate an interface
- REQ_402	- View selected timeframe report
- REQ_403	- Print the displayed report

3.2.5 Entity Relationship Diagram

Figure 3 illustrates the ERD of the Facial Recognition Based Attendance System for Santai Esports. There are four entities, including Staff, Attendance, Admin and Visitor. Each of the entities has its attributes which describe the content characteristic of the entity that holds it. The relationship on the entity shows how an entity associates with another entity.

Staff entity has a relationship with the Attendance entity. The relationship between Staff and Attendance entity signifies that each staff member can have multiple attendance records. The lack of direct relationships for the Admin and Visitor entity indicates that admin and visitor are not directly linked to staff or attendance records in this ERD.

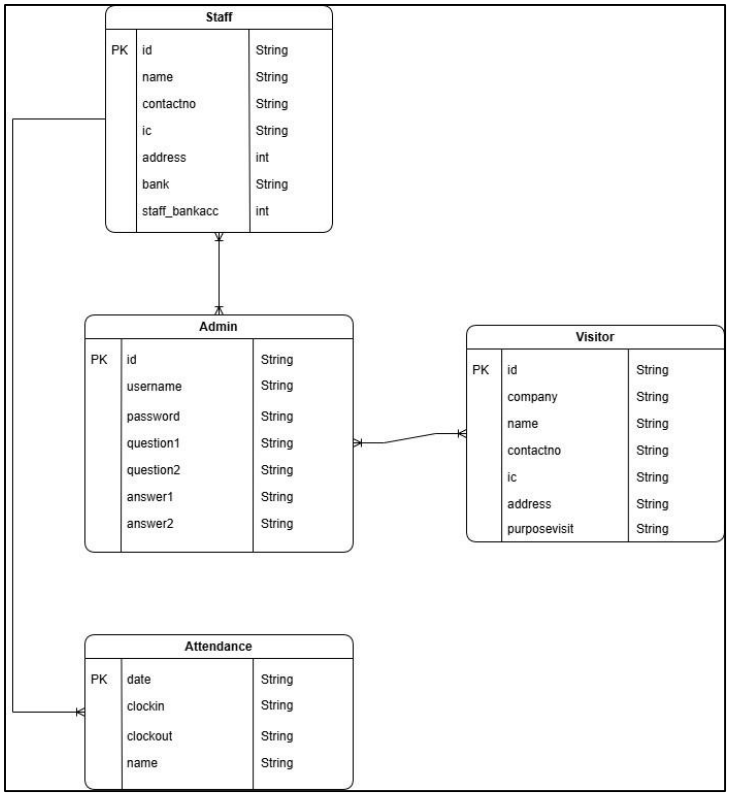

Fig. 3 *Entity Relationship Diagram of Facial Recognition Attendance System for Santai Esports*

Staff entity has a relationship with the FacialEncoding and Attendance entity. The relationship between the Staff entity and FacialEncoding indicates that each staff member has a corresponding facial encoding stored in the system. The relationship between Staff and Attendance entity signifies that each staff member can have multiple attendance records. The lack of direct relationships for the Visitor entity indicates that visitors are not directly linked to staff or attendance records in this ERD.

3.3 Design

The project moves on to the design phase upon the successful requirements analysis. In this phase, both the interface and database were designed to help visualize the system before the project proceeded to system implementation.

3.3.1 Flowchart

A flowchart is a diagram that illustrates the steps, sequences, and decisions of a process or workflow. As a basic form of a process map, it is a powerful tool used across various fields for planning, visualizing, documenting, and improving processes [8]. There are three flowcharts of the modules in the proposed system drawn by using draw.io which are Staff and Visitor Registration, Attendance Taking, and User modules. These flowcharts are presented in Appendix B.1 to Appendix B.3

The proposed system includes a Staff and Visitor Registration module, which is illustrated in Appendix B.1. In this module, the administrator is responsible for user registration. Visitors only need to provide their details to the administrator and take a selfie using the system's webcam. On the other hand, staff members need to provide their details just like visitors, but instead of taking a selfie, they must undergo a facial scan to capture their facial encoding into the system. This is necessary for attendance-taking purposes.

The process of taking attendance at Santai Esports is demonstrated in Appendix B.2. When staff members arrive at the establishment, they must first record their attendance before entering. They need to stand in front of the system's webcam and provide their facial scan for facial recognition to initiate. Within a short period, once the facial scan is completed, the system will identify whether the staff member has already clocked in for the day. If the answer is no, the system will assume that the staff member scanned for clock-in and save the attendance record. However, if the staff member has already clocked in, the system proceeds to check whether they have clocked out. If they have not clocked out, the system will assume that the staff member scanned for the clock-out record and save the attendance record. If the staff member has already clocked in and out for the day and tries to scan their face again, the system will display an error message, informing them that their attendance record for the day has been recorded.

Appendix B.3 displays the process of the User module. Firstly, the administrator will have to log in to the system to access administration functionalities. This module allows the administrator to view the visitor and staff lists. The administrator can view information on the selected user from the list. The administrator is also able to update selected staff information. If a staff member quits, the administrator can delete the staff from the system so that they are not able to take attendance records anymore, to prevent redundant entries.

3.3.2 System interfaces

FRASE was developed for two platforms, Python application for attendance-taking application and web application for administrative functionalities. In developing the system, there are many integrations in making the system work. Integrating Firebase with the Facial Recognition Attendance System for Santai Esports greatly enhances functionality. Firebase's Realtime Database ensures seamless real-time updates for attendance records and staff profiles on both the desktop application (for user registration and staff attendance) and the web application (for system administration). *Fig. 4* shows a Python code segment that updates attendance records in the Realtime Database whenever a staff member scans their attendance.

```
def update_attendance(self, staff_id, staff_info):
    current_datetime = datetime.now().strftime("%Y-%m-%d %H:%M:%S")
    current_date = datetime.now().strftime("%Y-%m-%d")
    current_time = datetime.now().strftime("%H:%M:%S")

    attendanceInfo_date = db.reference('Attendance').child(current_date).get()
    attendanceInfo_id = db.reference(f'Attendance/{current_date}/{staff_id}').get()

    if attendanceInfo_date is None:
        attendanceDate_ref = db.reference('Attendance').child(current_date)
        attendanceDate_ref.update({"firstCreated": current_datetime})

    if attendanceInfo_id is None:
        attendanceId_ref = db.reference(f'Attendance/{current_date}')
        attendanceId_ref.child(staff_id).set({
            "name": staff_info['name'],
            "date": current_date,
            "clockin": current_time
```

Fig. 3 *Code segment of update_attendance*

To make the analytics dashboard, the attendance record in the database must first be moved to spreadsheet Google Sheets. Then, Power BI will retrieve the data from Sheets to create a visual representation of the attendance data. *Fig 4* displays the saved data moved into spreadsheet in Google Sheets.

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NAME	DATE	CLOCKIN	CLOCKOUT	WORK HOU	PAYOUT	EXPECTED	EXCEPTION	DAY	DEDUCTED
SHAHRUL SYAZ	2024-04-01	08:00:00	16:30:00	8.5	45.54	53.6		Mon	8.06
IMAN MUHAIMI	2024-04-01	09:15:00	17:30:00	8.25	44.2	53.6		Mon	9.4
ALIFF SHUKRI	2024-04-01	08:30:00	17:00:00	8.5	45.54	53.6		Mon	8.06
EILMAN HASBU	2024-04-02	08:10:00	16:45:00	8.58	45.96	53.6		Tue	7.64
DANIAL HAQ	2024-04-02	09:00:00	17:10:00	8.17	43.77	53.6		Tue	9.83
DANISH FAUDZ	2024-04-02	08:20:00	16:50:00	8.5	45.54	53.6		Tue	8.06
AMIRUL ZULAZ	2024-04-03	08:30:00	17:00:00	8.5	45.54	53.6		Wed	8.06
AFIQ DANIAL	2024-04-03	09:15:00	17:45:00	8.5	45.54	53.6		Wed	8.06
NAJMI AIMAN	2024-04-03	08:45:00	17:15:00	8.5	45.54	53.6		Wed	8.06
SHAHRUL SYAZ	2024-04-04	08:00:00	16:30:00	8.5	45.54	53.6		Thu	8.06
IMAN MUHAIMI	2024-04-04	09:15:00	17:30:00	8.25	44.2	53.6		Thu	9.4
ZALIFF USRI	2024-04-04	09:00:00	17:30:00	8.5	45.54	53.6		Thu	8.06
ALIFF SHUKRI	2024-04-05	08:30:00	17:00:00	8.5	45.54	53.6		Fri	8.06
EILMAN HASBU	2024-04-05	08:10:00	16:45:00	8.58	45.96	53.6		Fri	7.64
DANIAL HAQ	2024-04-05	09:00:00	17:10:00	8.17	43.77	53.6		Fri	9.83
DANISH FAUDZ	2024-04-06	08:20:00	16:50:00	8.5	45.54	53.6		Sat	8.06
AMIRUL ZULAZ	2024-04-06	08:30:00	17:00:00	8.5	45.54	53.6		Sat	8.06
AFIQ DANIAL	2024-04-06	09:15:00	17:45:00	8.5	45.54	53.6		Sat	8.06

Fig. 4 *Attendance record spreadsheet*

Next, *Fig.5* shows the Power BI dashboard of the attendance record, where it will display custom timeframe to be selected, total employees worked during the timeframe, their payouts, expected payouts and deductions. The dashboard is interactive, where admin can either select custom timeframe or choose specific day on the bar graph.

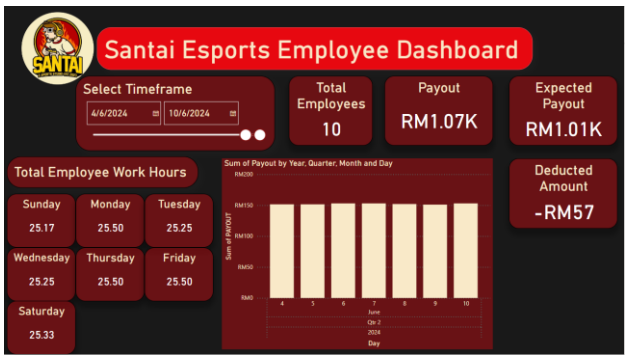

Fig. 5 *Santai Esports Employee Power BI Dashboard*

For attendance-taking process, users will have to run the Python application of the system where they can simply scan their face for attendance. *Fig. 6* displays the user interface of facial attendance-taking application.

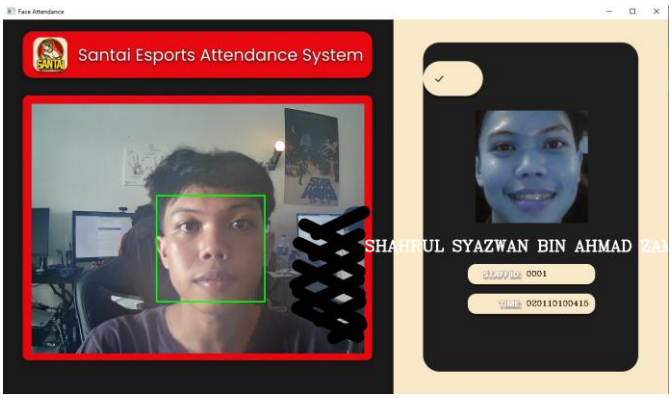

Fig. 6 *User interface of facial attendance-taking application*

From the *Fig. 6*, it can be seen that for every successful scan, the app will display the staff information, including the time of attendance record. Besides that, this module incorporates an auto-crop feature. It automatically crops all face capture images taken during user registration, setting them as the respective user's profile pictures. The implementation result is as seen in *Fig. 6*, where it displays the profile picture of the staff in the staff information interface. The picture is also used in the admin's view and manage user functionalities in the web application. *Fig. 7* demonstrates the code segment that is responsible for the logic.

```python
def detect_faces(image):
    # Create a face detector
    face_detector = dlib.get_frontal_face_detector()
    # Run detector and get bounding boxes of the faces on image
    detected_faces = face_detector(image, 1)
    face_frames = [(x.left(), x.top(), x.right(), x.bottom()) for x in detected_faces]
    return face_frames


2 usages  new *
def crop_and_upload_image():
    # Initialize Firebase storage bucket
    bucket = storage.bucket()

    # Iterate over both Staff and Visitor directories
    for user_type in ["Staff", "Visitor"]:
        image_dir = f"Images/{user_type}"
        output_dir = f"CroppedFaces/{user_type}"

        # Create output directory if it doesn't exist
        os.makedirs(output_dir, exist_ok=True)

        # Iterate over each image in the directory
        for filename in os.listdir(image_dir):...
```

Fig. 7 *Code segment that is responsible for face detection and auto-crop functionalities*

The saved attendance record will be saved into Firebase Realtime Database and the admin will be able to view the attendance dashboard. *Fig. 8* displays the Power BI dashboard embedded onto the web app. Additionally, admin can also view visitors and staff list in the system. If needed, they can update or delete the user record. The interface for the manage user is as shown in *Fig. 9.*

Fig. 8 *User interface of View Dashboard page*

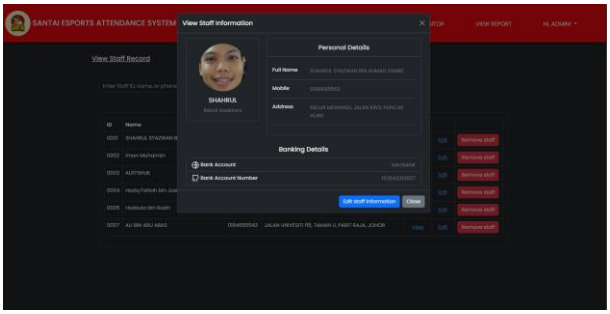

Fig. 9 *User interface of View Staff page*

Fig. 10 displays the code segment that is responsible for displaying the interface as in *Fig. 9.*

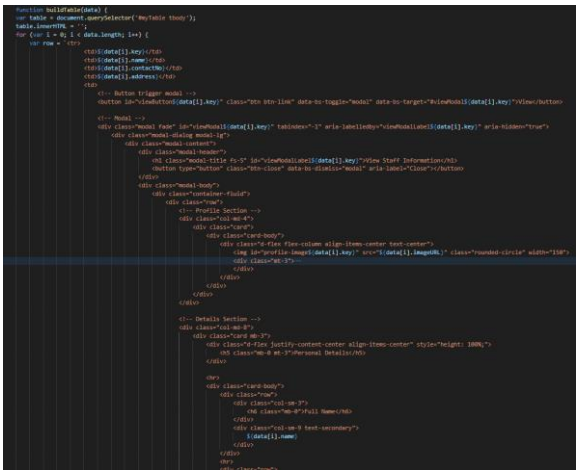

Fig. 10 *Code segment of staff modal popup*

Additionally, admin will also be able to view the attendance record in the table form in View Report page. In this page, Google Sheets has been embedded, displaying the spreadsheet of Santai Esports attendance record. *Fig. 11* illustrates the user interface of View Report page of the system.

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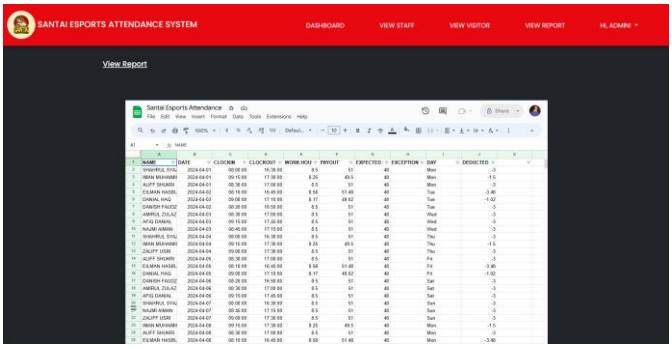

Fig. 11 *User interface of View Report page*

3.3.3 Schema Table

Databases store data based on the schema definition, so understanding it is a key part of designing databases [9]. This section discusses the tables from the database that have been designed for the proposed system. The staff table as shown in Table 6 was used to store all the staff's information. The attributes are id, name, contactno, ic, address, bank, and bankacc. This table has one primary key, id. Additionally, id was used as a primary key to identify the specific staff information.

Table 6 *Staff table*

Attributes	Data Type	Size	Key	Descriptions
id	String	4	PRIMARY KEY	Staff ID
name	String	32	None	Staff full name
bankacc	int	15	None	Staff bank account number
contactno	String	10	None	Staff mobile phone
ic	String	12	None	Staff identification card number
address	String	255	None	Staff mailing address
bank	String	32	None	Staff bank account's name

The visitor table as shown in Table 7 was used for the attendance information. There are 9 attributes which are id, company, name, contactno, ic, address, purposeVisit, imageURL, and datetime. This table has one primary key, id where it is used for admin to manage the visitor information.

Table 7 *Visitor table*

Attributes	Data Type	Size	Key	Descriptions
id	String	4	PRIMARY KEY	Visitor ID
company	String	32	None	Visitor company
name	String	32	None	Visitor full name
contactno	String	10	None	Staff mobile phone
ic	String	12	None	Visitor identification card number
address	String	255	None	Visitor mailing address
purposeVisit	String	255	None	Visitor description of visit (reason, purpose)

Table 7 *Visitor table (cont.)*

Attributes	Data Type	Size	Key	Descriptions
imageURL	String	255	None	Visitor image URL/path of the picture of their face
datetime	String	24	None	Visitor date and time of visit

The attendance table as shown in Table 8 was used for the attendance information. This includes 4 attributes which are date, clockin, clockout and name. This table has one primary key, date. date was used as a primary key to identify the specific attendance record information. name was used as a foreign key to link the staff that is responsible for the specific attendance record.

Table 8 *Attendance table*

Attributes	Data Type	Size	Key	Descriptions
date	String	10	PRIMARY KEY	Attendance ID
clockin	String	8	None	Attendance clock in time
clockout	String	8	None	Attendance clock out time
name	String	32	FOREIGN KEY	Staff name

Admin table is shown in Table 9 was used to store the admin account information. There are 7 attributes which are id, username, password, question1, question2, answer1, and answer 2. This table has one primary key, id which was used to identify the specific administrator account. question1, question2, answer1, and answer2 are used for logging in purposes, where admin can change their passwords via answering their security questions correctly.

Table 9 *Admin table*

Attributes	Data Type	Size	Key	Descriptions
id	int	4	PRIMARY KEY	Admin account ID
username	String	12	None	Admin account username
password	String	60	None	Admin account password
question1	String	255	None	Security Question 1
question2	String	255	None	Security Question 2
answer1	String	255	None	Security Question 1 Answer
answer2	String	255	None	Security Question 2 Answer

4. Result and discussion

4.1 Testing

This section describes and explains the testing of FRASE. In this project, a system testing plan has been conducted, where there are 5 modules that been covered and the total of the test cases involve are 23 test cases in total. *Table 10* shows the test cases involve in the testing phase. There is explanation on the test case and also include the description, expected outcome, actual outcome and the test status either it pass or fail.

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Table 10 *Test cases*

Test Cases	Description	Expected Outcome	Actual Outcome	Status
		TC-01 (Staff & Visitor Registration Module)		
TC-01-01	Registration with Valid Detail	Admin should be able to register user successfully and proceed to take their face capture image	As expected	Passed
TC-01-02	Registration with Invalid Detail	System should display an error message for any of the invalid detail input	As expected	Passed
TC-01-03	Cancel Registration	Admin should be redirected back to "Select User" page	As expected	Passed
TC-01-04	Face Image Capture	Admin should be able to take face image capture of the user and retake, if needed. Then the system will save the image.	As expected	Passed
		TC-02 (Attendance-Taking Module)		
TC-02-01	Scan for attendance	The system should detect staff face and display their attendance information	As expected	Pass
TC-02-02	Record clock-in	The system should record the first facial scan of the day for each staff member as their clock-in time.	As expected	Pass
TC-02-03	Record clock-out	The system should record the next facial scan for the same staff member as their clock-out time, but only if it occurs at least 8 hours after their clock-in time.	As expected	Pass
		TC-03 (Multiple Clock-in Clock-out Detection Module)		
TC-03-01	Record clock-in	The system should only record the clock-in of the staff member once and display "Already Marked" message for already exist clock-in record	As expected	Pass
TC-03-02	Record clock-out	The system should only record the clock-out of the staff member once after atleast 8 hours of their clock-in time and then display "Already Marked" message for already exist clock-out record	As expected	Pass
		TC-04 (User Module)		
TC-04-01	View staff	Admin should be able to view staff record in the web application	As expected	Pass
TC-04-02	View selected staff profile	Admin should be able to view selected staff profile and their details	As expected	Pass
TC-04-03	Update selected staff	Staff information should be successfully updated and the system should display a success message	As expected	Pass
TC-04-04	Remove selected staff	Staff should be successfully removed and the system should display a success mage	Button is not working as intended	Fail

Table 10 *Test cases (cont.)*

Test Cases	Description	Expected Outcome	Actual Outcome	Status
TC-04-05	View visitor	Admin should be able to view visitor record in the web application	As expected	Pass
TC-04-06	View selected visitor profile	Admin should be able to view selected visitor profile and their details	As expected	Pass
TC-04-07	Update selected visitor	User information should be successfully updated and the system should display a success message	As expected	Pass
TC-04-08	Remove selected visitor	Visitor should be successfully removed and the system should display a success mage	Button is not working as intended	Fail
		TC-05 (Attendance-Tracking Analytics Module)		
TC-05-01	View dashboard	The system should display the Power BI dashboard with the correct attendance data	As expected	Pass
TC-05-02	View custom timeframe data	The dashboard should display the correct data with the corresponding timeframe	As expected	Pass
TC-05-03	View specific date data	The dashboard should display the correct data with the corresponding date	As expected	Pass
		TC-06 (Reporting Module)		
TC-06-01	Select Report Type	The system should display the correct selected report type	As expected	Pass
TC-06-02	View Report	The system should display the correct record/data in the report	As expected	Pass
TC-06-03	Download Report	The system should allow the admin to download the selected report	As expected	Pass

Therefore, Table 11 shows the overall result of the test cased that been tested. The table will include all the modules that been covered in the test case which Staff & Visitor Registration, Attendance-Taking, Multiple Clock-in Clock-out Detection, User Module, Attendance-Tracking Analytics, and Reporting.

Table 11 *Overall test case result*

Test Case	Module	Number of test cases	Total passed test cases	Total failed test cases
TC-01	Staff & Visitor Registration	4	4 (100%)	0 (0%)
TC-02	Attendance-Taking	3	3 (100%)	0 (0%)
TC-03	Multiple Clock-In Clock-Out Detection	2	2 (100%)	0 (0%)
TC-04	User Module	8	6 (75%)	2 (25%)
TC-05	Attendance-Tracking Analytics	3	3 (100%)	0 (0%)
TC-06	Reporting	3	3 (100%)	0 (0%)

5. Conclusion

In conclusion, FRASE project has made significant strides in modernizing attendance management and enhancing security within the establishment. By leveraging facial recognition technology and real-time analytics, FRASE offers a comprehensive solution for tracking attendance, managing staff information, and ensuring secure access to the premises.

Despite its advantages, FRASE also faces certain challenges, including its reliance on a stable internet connection, limited depth in dashboard analytics, and restricted access for staff members. However, these shortcomings present opportunities for future improvements and enhancements to the system.

Moving forward, key recommendations for future work include implementing anti-spoofing technology, incorporating local save functionalities, enhancing the Power BI dashboard, and improving the view report page. These recommendations aim to address existing limitations and further optimize the efficiency, security, and usability of FRASE.

Overall, FRASE represents a significant step forward in attendance management technology, offering Santai Esports a modern, user-friendly solution that aligns with the organization's goals of efficiency, security, and data-driven decision-making. Through ongoing development and refinement, FRASE has the potential to continue revolutionizing attendance management practices and setting new standards for operational excellence.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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Appendix A

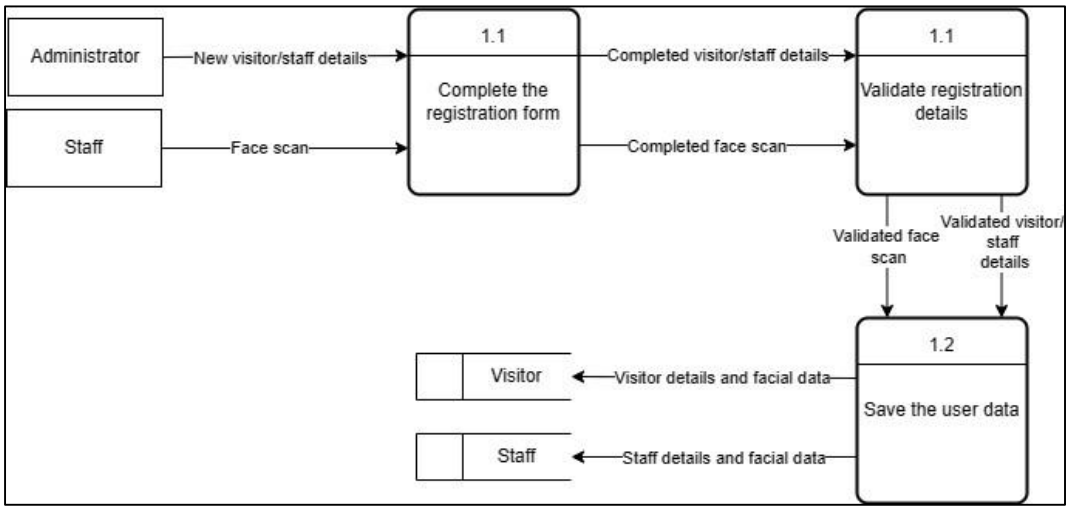

Fig. Appendix A.1 *DFD Level 1 of Register User*

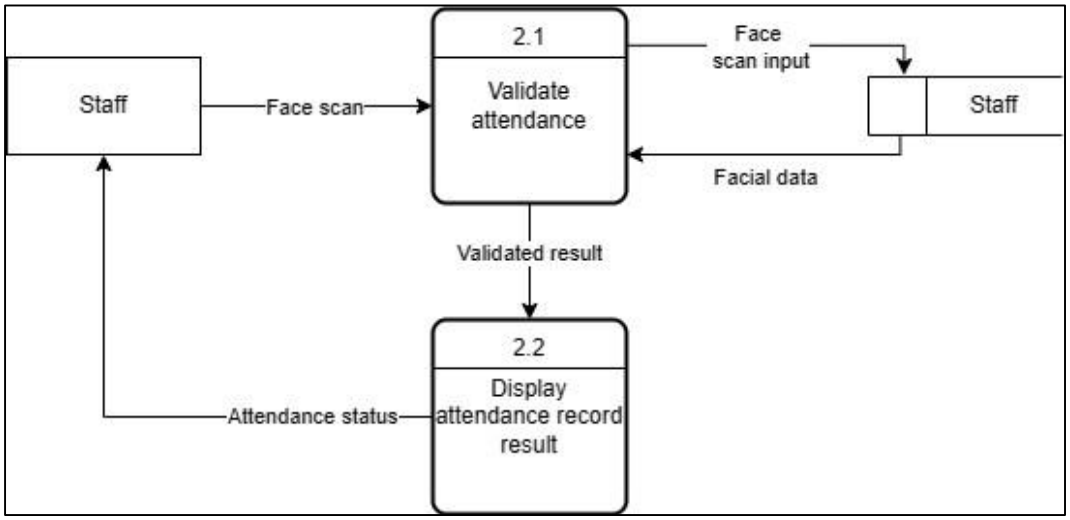

Fig. Appendix A.2 *Level 1 of Take Attendance*

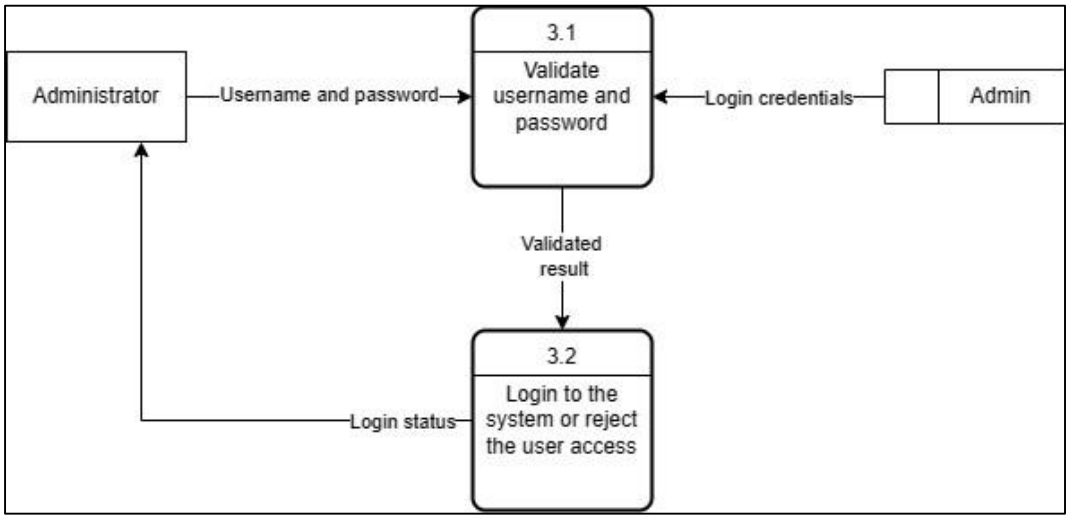

***Fig.* Appendix A.3** *DFD Level 1 of Login*

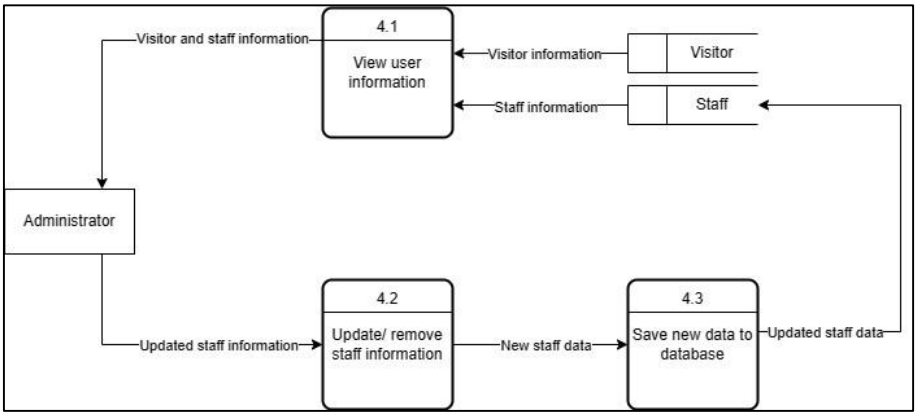

Fig Appendix A.4 *DFD Level 1 of View and Manage User*

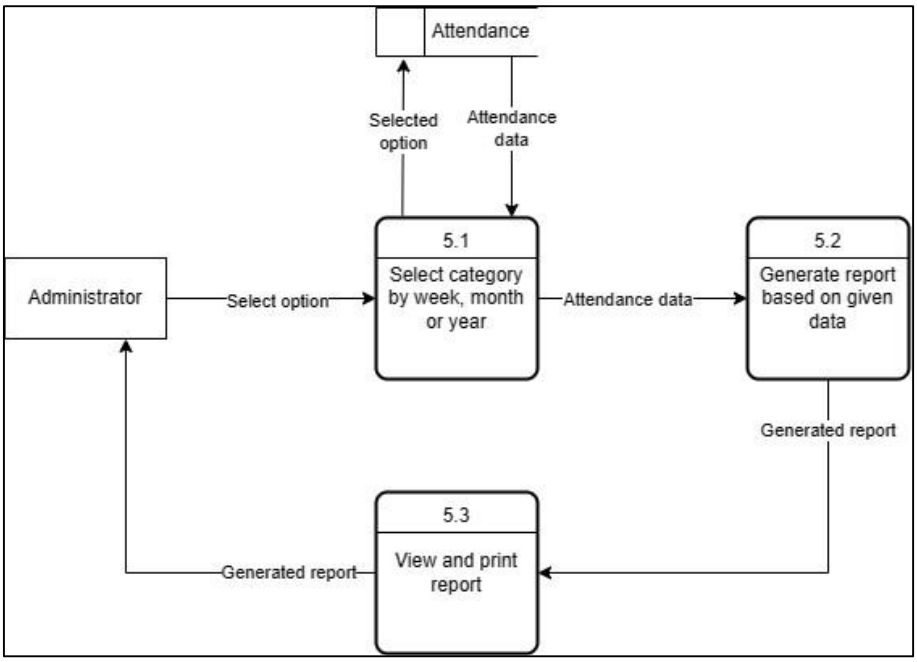

Fig. Appendix A.5 *DFD Level 1 of View and Print Report*

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Appendix B

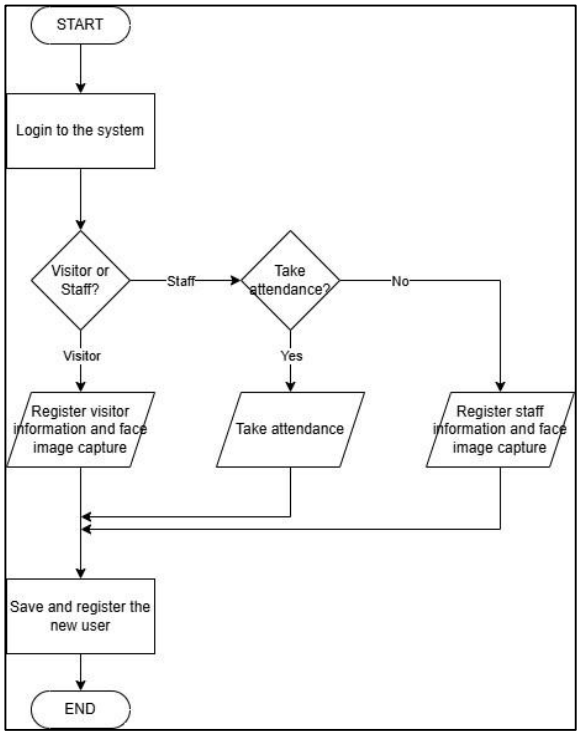

Fig. Appendix B.1 Flowchart of *Staff and Visitor Registration Module*

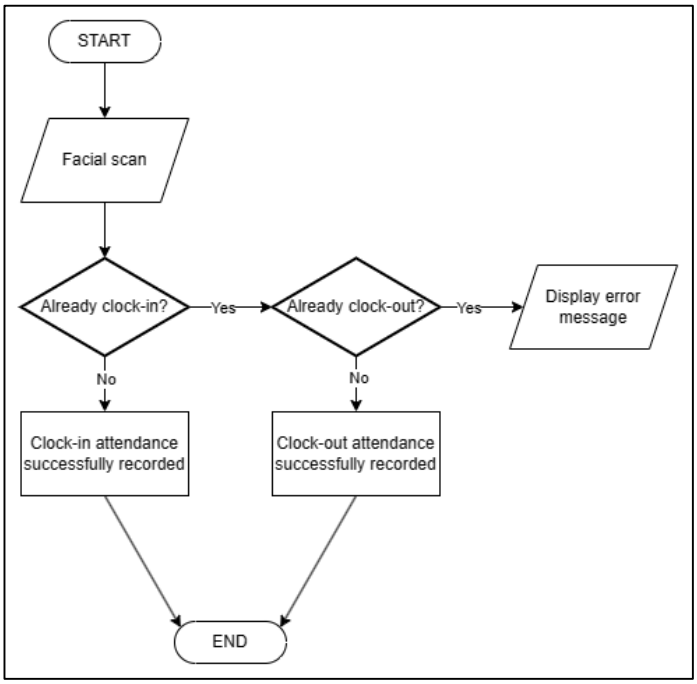

Fig. Appendix B.2 *Flowchart of Attendance Taking Module*

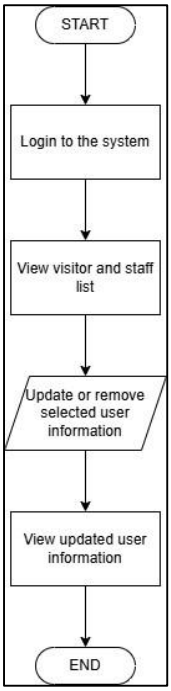

Fig. Appendix B.3 *Flowchart of User Module*