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The Development of a Student Mentoring System (SMS) Using the Model-View-Controller Architecture Framework

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Abstract

The Student Mentoring System (SMS) is an innovative online platform designed to facilitate virtual communication between mentors and mentees during mentoring sessions. This system is significant in its capacity to enhance students' academic performance, especially when mentoring is initiated early in their educational journey. It emphasizes the critical role that mentor-mentee relationships play in providing advisory support and monitoring academic progress. This study focuses on the development of SMS using the Model-View-Controller (MVC) Classic Architecture Framework. The system enables mentors to analyze and record mentee information in the database system. Key functionalities, such as displaying mentee performance metrics and tracking academic status, are integrated into the platform to streamline these processes. By leveraging the MVC framework, the SMS ensures a clear separation of concerns, facilitating efficient data management and user interface operations. This architecture enhances the scalability and flexibility of the system and simplifies updating and maintaining the application. The modular design of the MVC framework allows additional features and adaptations, addressing the evolving needs of educational institutions. SMS significantly reduces the effort required by mentors to monitor and track mentee performance and academic status. It alleviates common challenges associated with managing large volumes of mentee data and analyzing individual progress. As a result, mentors can focus more on providing personalized guidance and support, ultimately fostering stronger mentor-mentee relationships and improving overall academic outcomes. This research highlights the technical and practical benefits for future innovations aimed at enhancing the mentoring experience and promoting student success.

Keywords: Mentoring, Student Mentoring System (SMS), Model-View Controller (MVC) Framework, Educational Support System

Introduction

Mentoring is a common approach for transmitting knowledge and ideas from an established expert in society to an inexperienced member of the same industry. With the development of new technology comes the concept of online mentoring, also known as E-Mentoring, which has long been recognized by the education sector as a highly beneficial tool. E-Mentoring transfers information and abilities from mentor to mentee by a technological medium. It focuses on the relationship between mentors and mentees (Smith, A., & Roberts, L. 2021; Nawi et al., 2018).

E-mentoring was introduced as a platform to support mentoring programs in higher education as a strategy to improve academic performance and career development needed by modern learners (Williams, S. L., & Kim, J. 2011; Owen et al., 2018; Lee et al., 2011; Neureiter et al., 2017). The e-mentoring was developed to facilitate counselling support through asynchronous and synchronous communication method between mentors and mentees (Headlam-Wells et al., 2006; Ang, L. W. 2016; Lee et al., 2011). Mentees can make an appointment online with mentors and schedule a meeting based on the available time and they also can have online session for both parties (Lee et al., 2011; Neureiter et al., 2017).

Background of study

Since the mentors are using traditional ways of storing mentees' data, it would be difficult for the mentors to manage the data of mentees as there are many mentees that need to be handled by every mentor. Mentors face challenges in quickly identifying mentees with academic or personal issues, as they rely on manually stored mentee information. When mentees complete their studies, their details must be removed to avoid confusion with new mentees' data. Furthermore, the current system limits mentors' access to academic performance information to prevent potential misuse of sensitive data.

Based on the situation, The SMS was designed at UNITAR to provide the facilities to facilitate mentoring program to solve the following problems:

- *Difficulty in organizing data:*
  At UNITAR International University, mentors are responsible for many mentees from different sections and subjects. With each mentor potentially handling over 100 students, it becomes challenging to manage and organize all the mentees' information effectively.
- *Difficulty in tracking performance and academics:*
  Mentors often use Excel files to record and track their mentees' academic performance. With many mentees, it becomes time-consuming to analyze each student's progress, especially when identifying those who do not meet the university's standards. This manual process makes it harder to monitor academic performance efficiently.
- *Difficulty in communicating and scheduling meetings:*

The mentor-mentee sessions are held only once a week, on Wednesday afternoons, and last for two hours. This limited time makes it difficult for mentors to fully engage with mentees and schedule enough activities. Communication between mentors and mentees is also restricted due to the short duration of the program. The Student Mentoring System (SMS) enables mentors to efficiently track mentees' progress while offering a visual overview of their academic performance for better insight and evaluation. The system allows mentors to upload their schedules, enabling mentees to select appropriate meeting times. It also speeds up the process of updating and analysing mentees' data, saving valuable time.

This research focuses on developing an e-mentoring system using the MVC Architecture framework that supports:

- The ability to manage mentee data through data manipulation functions. The process can significantly reduce the amount of time spent organizing the mentees' data.
- Visual representations of mentee data such as line graphs using appropriate charting tools. Therefore, based on data visualization figures, the mentors can view the mentees' academic performance.
- The mentor uploads the available timetable. By uploading this timetable, the mentee can view the availability for meeting's schedule.
- Displaying mentee results in terms of Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA). If a mentee's results do not meet the minimum requirements, a notification alert will prompt the mentor to reach out to the mentee for guidance in addressing the issues.

Literature Review

Mentoring

According to Eby (2011), mentoring is an interpersonal relationship where individuals with more experience provide guidance to those with less experience. This connection can occur in various settings, and the terms coach, mentor, and tutor are often used interchangeably (Parsloe & Wray, 2000). Mentoring has been implemented across different fields, including nursing and business, with the primary goal of enhancing both personal and professional growth. In business settings, the mentorship process focuses on advancing the mentee's career while aligning with the organization's strategic objectives (Fajana & Gbajumo-Sheriff, 2011). Similarly, in nursing, mentoring helps students transition smoothly into professional roles by familiarizing them with the culture and work environment (Beecroft, 2006). Effective mentoring also plays a crucial role in worker retention, as research shows that nurses are more likely to resign if they fail to integrate into the professional culture within their first year (Beecroft, 2006). For mentorship programs to succeed, mentors should receive appropriate training, and regular meeting times should be established. This approach mirrors strategies used in business models (Beecroft, 2006; Fajana & Gbajumo-Sheriff, 2011).

Types of Architectures

There are four different types of architecture that can be used to develop the system, such as MVC Architecture Framework, PCMEF Architecture Framework, XWA Architecture Framework, and e-Informatyka Portal Architecture. This research utilizes the MVC architecture framework to develop an e-mentoring system (SMS)

MVC Architectural Framework

Model-View-Controller (MVC) Architecture is an architectural technique that breaks the application into three modules, which are model, view and controller. The Model does include all the required data, and it's related to the logic. The View presents the user data or handles user interaction or user interfaces (UI). The Controller is an interface which connects the components of Model and View (Supaartagorn, 2011). There is some research work that applies the MVC architecture for developing various web application systems such as for distance education systems (Supaartagorn, C., 2011; Caixian Chen & huijian Han., 2008).

The MVC architecture is effective method for the development of SMS application. It is because all three components can be connected to the system. The View component does provide a presentation of data in a visual form such as charts, diagrams, and tables. This component allows the mentor and mentee to view the data which have been sent by the Controller. The admin can act as a Controller who handles the user interaction. For example, the admin wants to add mentors and mentees, edit the mentees' performance and so on. As for the Model, it will represent the data that is being transferred from the Controller to the View. The Model can be related to the database system which stores the data and transfers it when the data is obtained. The Object-oriented programming languages including SmallTalk, Java, Php can be used to develop user interface of the system (Supaartagorn, C., 2011; Burbeck, S., 1992).

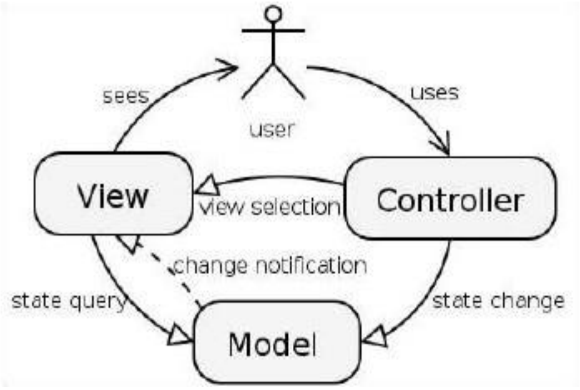


Figure 2.1: MVC architecture framework

Figure 2.1 demonstrates how the view collects the model state (state query) whenever it is informed of a change. On the other hand, the model is not tied with the presentation technology, so the view can be reimplemented or even replaced without requiring model implementation modifications. The primary function of the Controller is to respond to user inputs (such as mouse clicks) and map them to model operations (state change) or view changes (view selection). The controller, in conjunction with the view, is responsible for the appearance and behavior of the application.

Methodology

The selected methodology that is used for the implementation of the system is the waterfall model as it is simple to organize due to its sequential nature.

System Process Requirements

Context Diagram

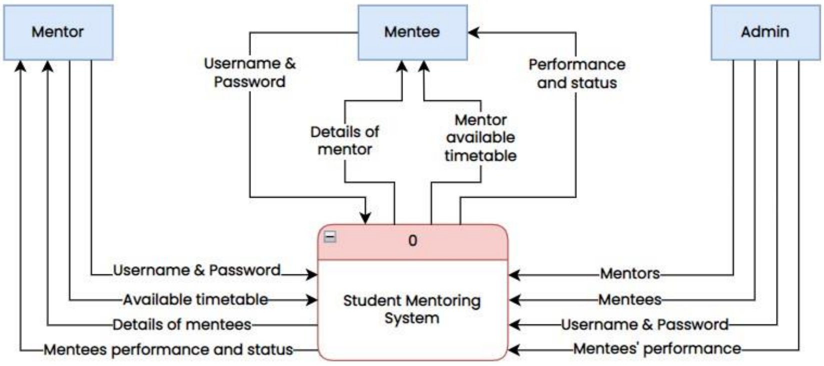


Figure 3.1: SMS Context Diagram

Figure 3.1 the mentor, mentee and admin are the external entity, while the student mentoring system is referred to as the system process and the line that connects from an external entity to the system process will be the flow line. The mentor does provide two inputs which are username and password and available timetable while for the outputs, the mentor does receive the details of mentees and mentees' performance and status. As for the mentees, the mentee does only provide a single input which is a username and password while for the outputs, the mentee does receive the performance and status, the details of mentor, and the mentor's available timetable. The admin does only provide inputs which are username and password, mentors, mentees, and mentees' performance.

Logic Requirement

Decision Tree Diagram

i. Admin Decision Tree Diagram

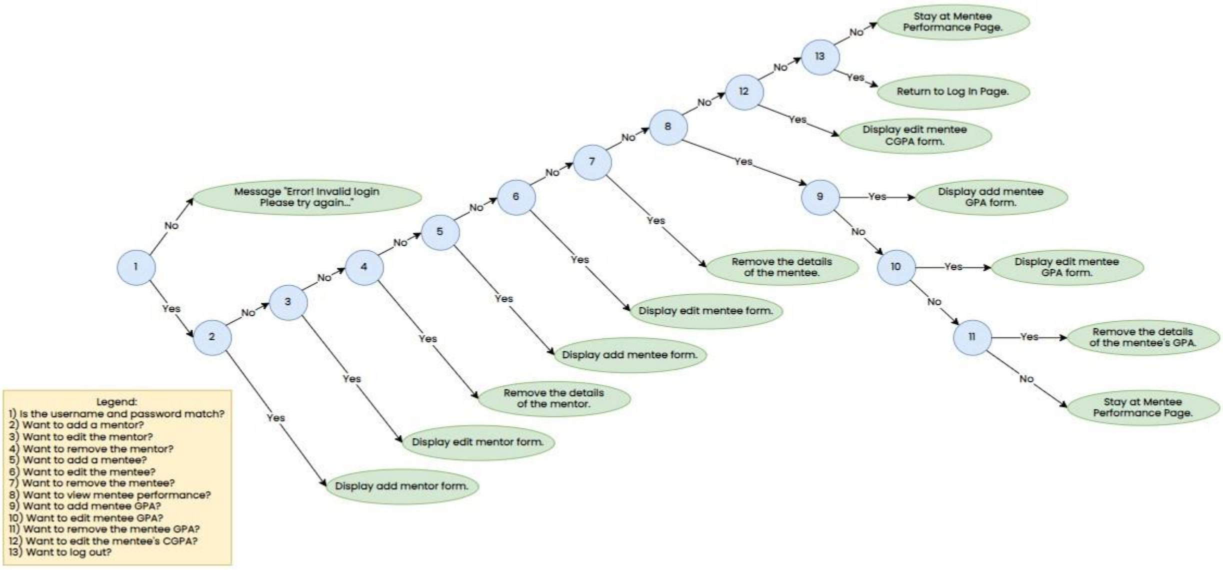

Message "Error! Invalid login Please try again..."
No
Yes
1
2
3
4
5
6
7
8
9
10
11
12
13
Display add mentor form.
Display edit mentor form.
Remove the details of the mentor.
Display add mentee form.
Display edit mentee form.
Remove the details of the mentee.
Display add mentee GPA form.
Display edit mentee GPA form.
Remove the details of the mentee's GPA.
Stay at Mentee Performance Page.
Display edit mentee CGPA form.
Return to Log In Page.
Stay at Mentee Performance Page.
Legend:
1) Is the username and password match?
2) Want to add a mentor?
3) Want to edit the mentor?
4) Want to remove the mentor?
5) Want to add a mentee?
6) Want to edit the mentee?
7) Want to remove the mentee?
8) Want to view mentee performance?
9) Want to add mentee GPA?
10) Want to edit mentee GPA?
11) Want to remove the mentee GPA?
12) Want to edit the mentee's CGPA?
13) Want to log out?

Figure 3.2: Admin Decision Tree Diagram

Figure 3.2 shows the decision tree of the admin side which consists of thirteen conditions. The first condition is the admin username and password match. If the username and password are matched, then it will proceed to the second condition or else it will appear error message

"Error! Invalid login Please try again…". The second condition is the admin wants to add a mentor. If yes, then it will display add mentor form, else it will proceed to the third condition. The third condition is that the admin wants to edit the mentor. If yes, then it will display the edit mentor form, else it will proceed to the fourth condition. The fourth condition is that the admin wants to remove the mentor. If yes, then it will remove the details of the mentor, else it will proceed to the fifth condition. The fifth condition is the admin wants to add a mentee. If yes, then it will display the add mentee form, else it will proceed to the sixth condition. The sixth condition is the admin wants to edit the mentee. If yes, then it will display the edit mentee form, else it will proceed to the seventh condition. The seventh condition is the admin wants to remove the mentee. If yes, then it will remove the details of the mentee, else it will proceed to the eighth condition. The eighth condition is the admin wants to view mentee performance. If yes, then it will proceed to the ninth condition, else it will proceed to the twelfth condition. The ninth condition is the admin wants to add mentee GPA. If yes, then it will display add mentee GPA form, else it will proceed to the tenth condition. The tenth condition is that the admin wants to edit the mentee GPA. If use, then it will display edit mentee GPA form, else it will proceed to the eleventh condition. The eleventh condition is the admin wants to remove the mentee GPA. If yes, then it will remove the details of the mentee's GPA, else it will stay at the mentee performance page. The twelfth condition is the admin wants to edit the mentee's CGPA. If yes, then it will display edit mentee CGPA form, else it will proceed to the thirteenth condition. The thirteenth condition is the admin wants to log out. If yes, then the admin will return to the login page, or else the admin will stay at the mentee performance page.

ii. Mentor Decision Tree

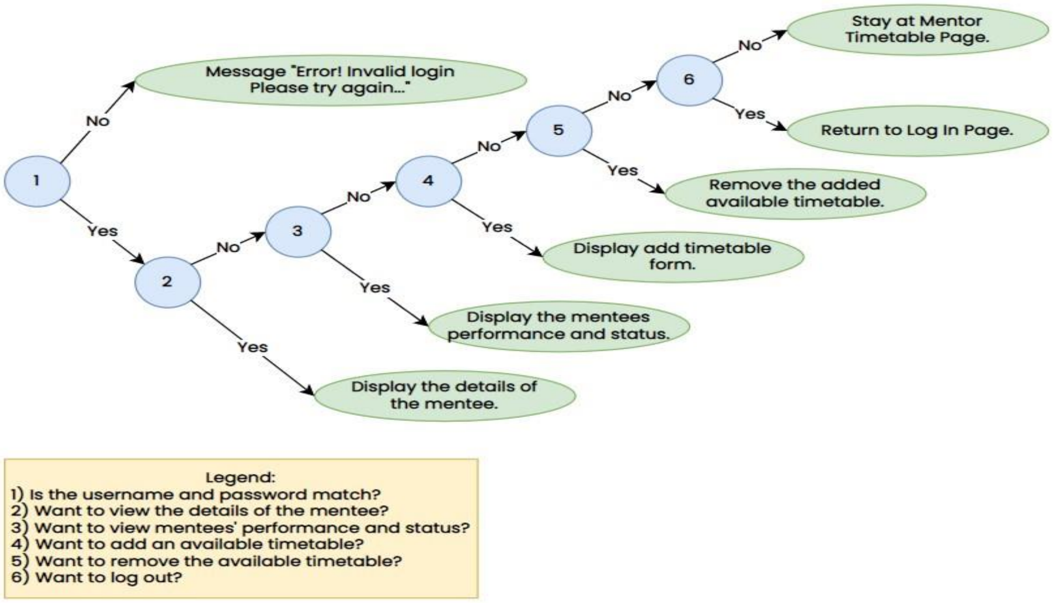

Stay at Mentor Timetable Page.
No
6
Message "Error! Invalid login Please try again…"
Yes
No
Return to Log In Page.
5
No
Yes
1
4
Remove the added available timetable.
No
Yes
3
Yes
No
Display add timetable form.
2
Yes
Display the mentees performance and status.
Yes
Display the details of the mentee.
Legend:
1) Is the username and password match?
2) Want to view the details of the mentee?
3) Want to view mentees' performance and status?
4) Want to add an available timetable?
5) Want to remove the available timetable?
6) Want to log out?

Figure 3.3: Mentor Decision Tree

Figure 3.3 shows the decision tree of the mentor side which consists of six conditions. The first condition is the mentor username and password match. If the username and password are matched, then it will proceed to the second condition or else it will appear error message "Error! Invalid login Please try again…". The second condition is the mentor wants to view the details of the mentee. If yes, then it will display the details of the mentee, else it will proceed to the third condition. The third condition is the mentor wants to view mentees' performance and status. If yes, then it will display the mentees' performance in a line graph and its status, else it will proceed to the fourth condition. The fourth condition is the mentor wants to add an available timetable. If yes, then it will display add timetable form, else it will proceed to the fifth condition. The fifth condition is the mentor wants to remove the available timetable. If yes, then it will remove the added available timetable, else it will proceed to the sixth condition. The sixth condition is the mentor wants to log out. If yes, then the mentor will be returned to the login page, or else the mentor will stay on the timetable page.

iii. Mentee Decision Tree

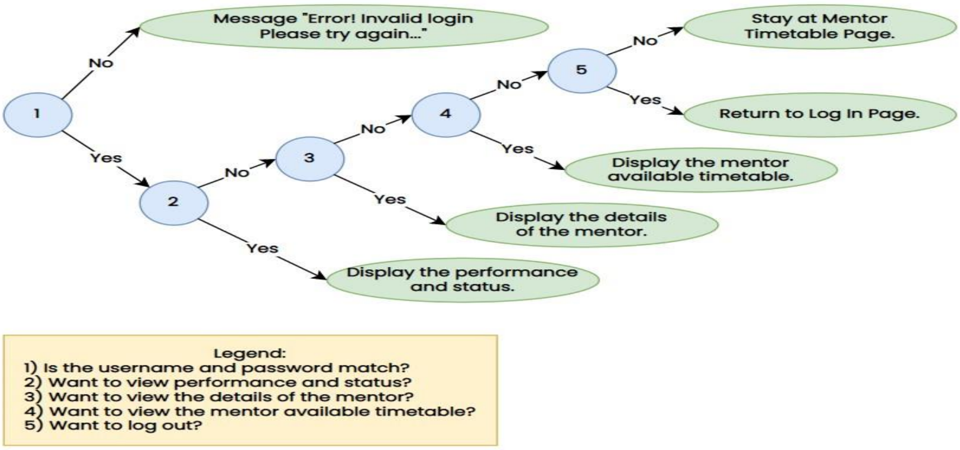

Message "Error! Invalid login Please try again..."
No
1
Yes
2
No
Yes
3
No
Yes
4
No
Yes
5
No
Yes
Stay at Mentor Timetable Page.
Return to Log In Page.
Display the mentor available timetable.
Display the details of the mentor.
Display the performance and status.
Legend:
1) Is the username and password match?
2) Want to view performance and status?
3) Want to view the details of the mentor?
4) Want to view the mentor available timetable?
5) Want to log out?

Figure 3.4: Mentee Decision Tree

Figure 3.4 shows the decision tree of the mentee side which consists of five conditions. The first condition is the mentee username and password match. If the username and password are matched, then it will proceed to the second condition or else it will appear error message "Error! Invalid login Please try again…". The second condition is the mentee wants to view performance and status. If yes, then it will display the mentee performance and status, else it will proceed to the third condition. The third condition is the mentee wants to view the details of mentor. If yes, then it will display the details of mentor, else it will proceed to the fourth condition. The fourth condition is the mentee wants to view the mentor available timetable. If yes, then it will display the mentor available timetable, else it will proceed to the fifth condition. The fifth condition is the mentee wants to log out. If yes, then the mentee will be returned to the login page, or else the mentee will stay on the mentor timetable page.

System Data Requirements

Entity Relationship Diagram (ERD)

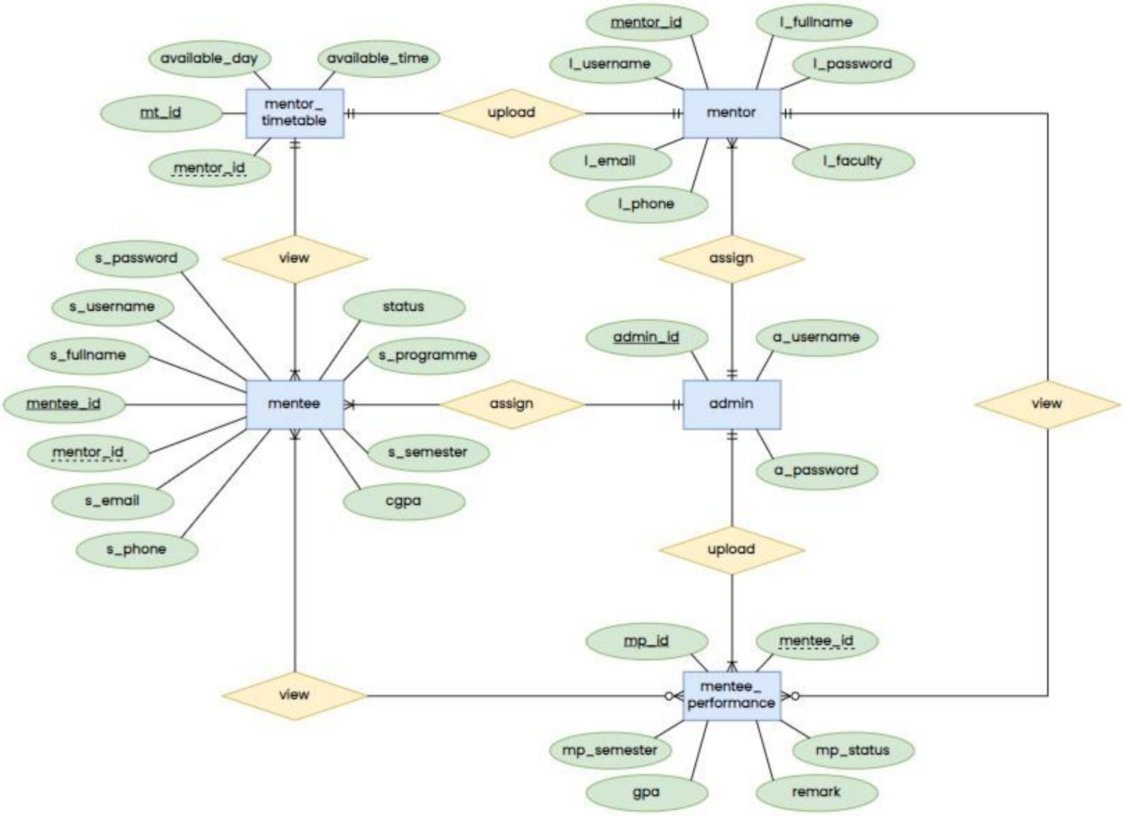
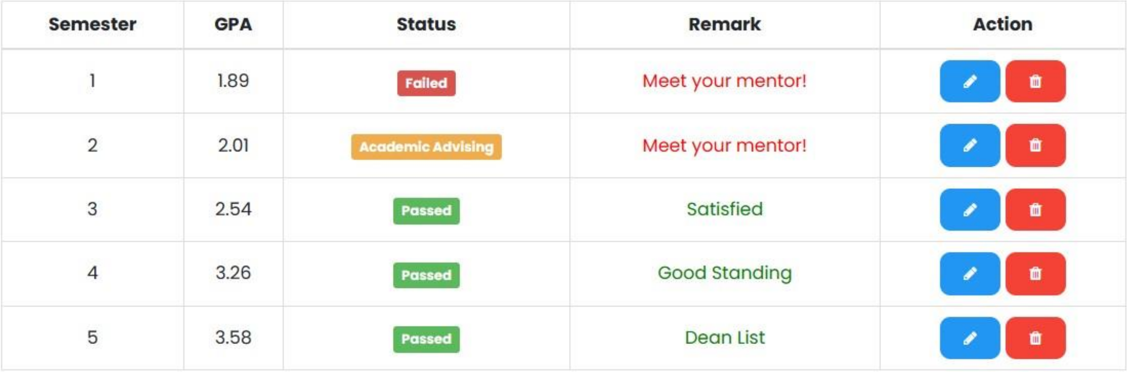


Figure 3.5: Entity Relationship Diagram (ERD)

Figure 3.5 shows the diagram of Entity Relationship Diagram (ERD) which illustrates the concept or process of the database flow that is used in the system. There are three components of ERD which are entity, relationship, and attributes. According to Figure 3.5, there are five entities which are admin, mentor, mentee, mentee performance, and mentor timetable.

System Design and Result

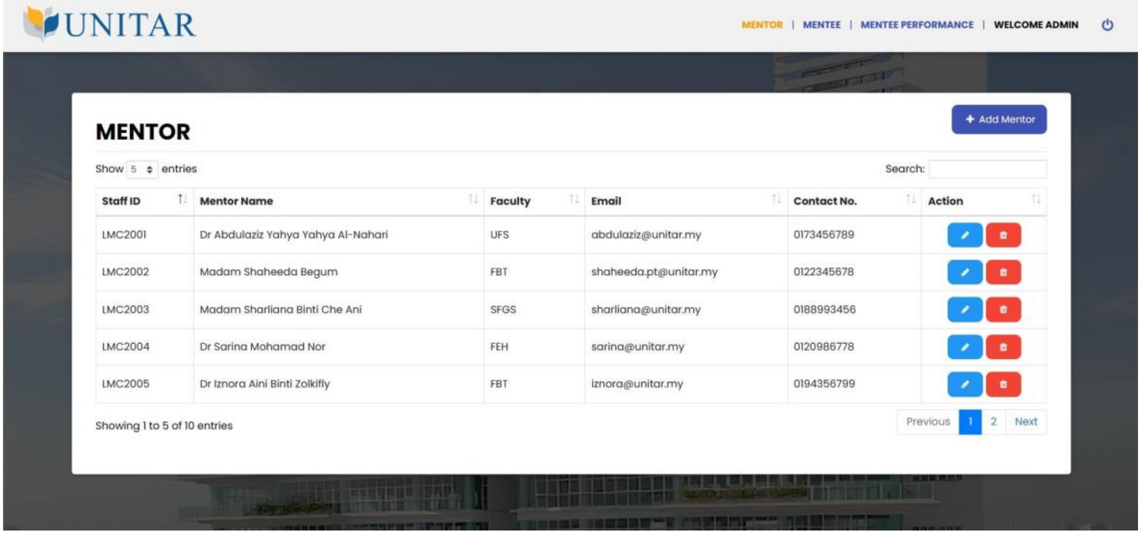
Reports Design



Semester	GPA	Status	Remark	Action
1	1.89	Failed	Meet your mentor!	✎ 🗑
2	2.01	Academic Advising	Meet your mentor!	✎ 🗑
3	2.54	Passed	Satisfied	✎ 🗑
4	3.26	Passed	Good Standing	✎ 🗑
5	3.58	Passed	Dean List	✎ 🗑

Figure 4.1: Mentee Performance Report

Figure 4.1 displays the mentee report status, which the admin use to evaluate the mentee's performance. The report is provided in a tabular format, making it easier for the admin to review each aspect of the mentee's performance.



MENTOR

Show 5 entries

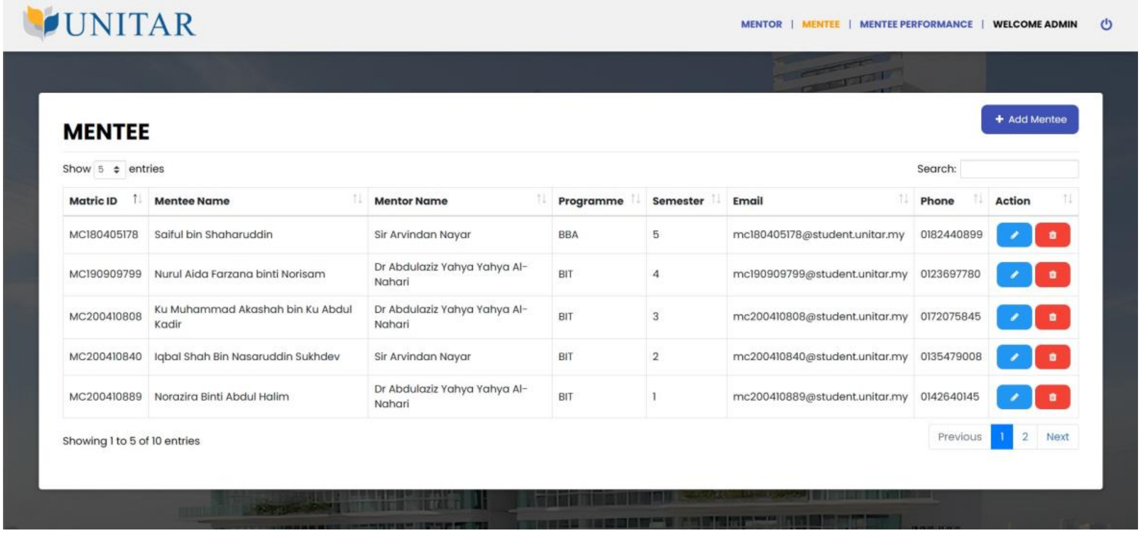
Search:

Staff ID	Mentor Name	Faculty	Email	Contact No.	Action
LMC2001	Dr Abdulaziz Yahya Yahya Al-Nahari	UFS	abdulaziz@unitar.my	0173456789	✎ 🗑
LMC2002	Madam Shaheeda Begum	FBT	shaheeda.pt@unitar.my	0122345678	✎ 🗑
LMC2003	Madam Sharliana Binti Che Ani	SFGS	sharliana@unitar.my	0188993456	✎ 🗑
LMC2004	Dr Sarina Mohamad Nor	FEH	sarina@unitar.my	0120986778	✎ 🗑
LMC2005	Dr Iznora Aini Binti Zolkifly	FBT	iznora@unitar.my	0194356799	✎ 🗑

Showing 1 to 5 of 10 entries

Figure 4.2: Admin’s Mentor Page

Figure 4.2 shows the admin’s mentor page which allows the admin to add, edit, and remove mentor. The admin can view the data once the data is inserted. The admin also will be given the ability to select number of entries, search for specific data, and sort data into an ascending or descending order.



MENTEE

Show 5 entries

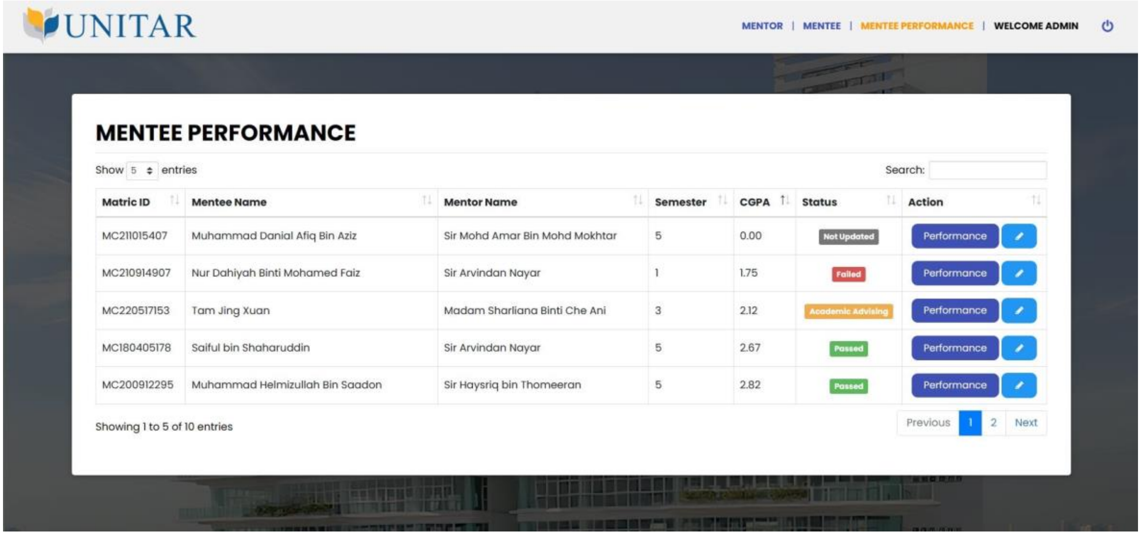
Search:

Matric ID	Mentee Name	Mentor Name	Programme	Semester	Email	Phone	Action
MC180405178	Saiful bin Shaharuddin	Sir Arvindan Nayar	BBA	5	mc180405178@student.unitar.my	0182440899	✎ 🗑
MC190909799	Nurul Aida Farzana binti Norisam	Dr Abdulaziz Yahya Yahya Al-Nahari	BIT	4	mc190909799@student.unitar.my	0123697780	✎ 🗑
MC200410808	Ku Muhammad Akashah bin Ku Abdul Kadir	Dr Abdulaziz Yahya Yahya Al-Nahari	BIT	3	mc200410808@student.unitar.my	0172075845	✎ 🗑
MC200410840	Iqbal Shah Bin Nasaruddin Sukhdev	Sir Arvindan Nayar	BIT	2	mc200410840@student.unitar.my	0135479008	✎ 🗑
MC200410889	Norazira Binti Abdul Halim	Dr Abdulaziz Yahya Yahya Al-Nahari	BIT	1	mc200410889@student.unitar.my	0142640145	✎ 🗑

Showing 1 to 5 of 10 entries

Figure 4.3: Admin’s Mentee Page

Figure 4.3 shows the admin’s mentee page which has the same display and features as the admin’s mentor page. The only difference is this page allows the admin to assign a mentee to the mentor.



MENTEE PERFORMANCE

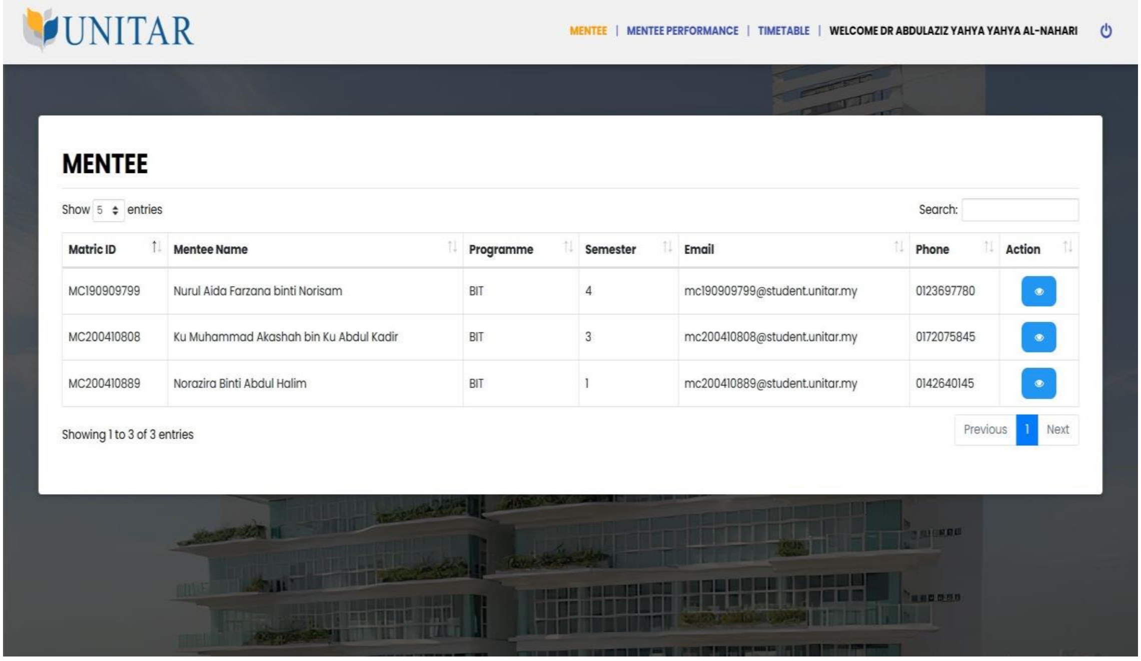
Show 5 entries Search:

Matric ID	Mentee Name	Mentor Name	Semester	CGPA	Status	Action
MC211015407	Muhammad Danial Afiq Bin Aziz	Sir Mohd Amar Bin Mohd Mokhtar	5	0.00	Not Updated	Performance ✎
MC210914907	Nur Dahiyah Binti Mohamed Faiz	Sir Arvindan Nayar	1	1.75	Failed	Performance ✎
MC220517153	Tam Jing Xuan	Madam Sharliana Binti Che Ani	3	2.12	Academic Advising	Performance ✎
MC180405178	Saiful bin Shaharuddin	Sir Arvindan Nayar	5	2.67	Passed	Performance ✎
MC200912295	Muhammad Helmizullah Bin Saadon	Sir Haysriq bin Thomeeran	5	2.82	Passed	Performance ✎

Showing 1 to 5 of 10 entries

Figure 4.4: Admin’s Mentee Performance Page

Figure 4.4 shows the admin’s mentee performance page which allows the admin to edit and view mentee performance for the current semester. The admin also can add, update, and view the individual mentee performance in a graph visualization.


UNITAR
MENTEE | MENTEE PERFORMANCE | TIMETABLE | WELCOME DR ABDULAZIZ YAHYA YAHYA AL-NAHARI

MENTEE

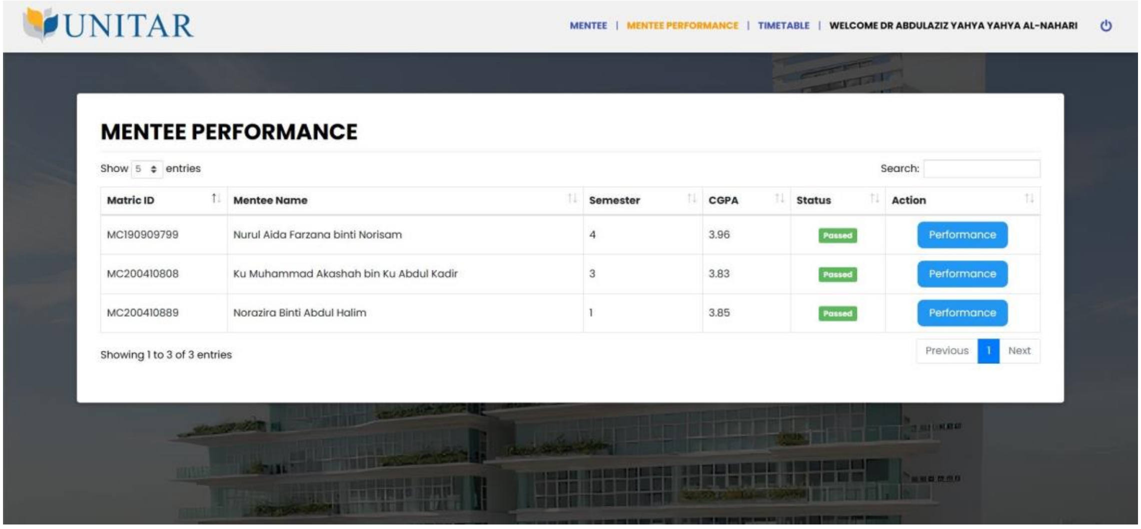
Show 5 entries Search:

Matric ID	Mentee Name	Programme	Semester	Email	Phone	Action
MC190909799	Nurul Aida Farzana binti Norisam	BIT	4	mc190909799@student.unitar.my	0123697780	👁
MC200410808	Ku Muhammad Akashah bin Ku Abdul Kadir	BIT	3	mc200410808@student.unitar.my	0172075845	👁
MC200410889	Norazira Binti Abdul Halim	BIT	1	mc200410889@student.unitar.my	0142640145	👁

Showing 1 to 3 of 3 entries

Figure 4.5: Mentor’s List of Mentees Detail Page

Figure 4.5 shows the view of the mentor’s list of mentees' details that displays all the information related to the mentee such as mentee ID, mentee full name, program, semester, email and phone number. The mentor is also able to view the mentee’s username and password.


UNITAR
MENTEE | MENTEE PERFORMANCE | TIMETABLE | WELCOME DR ABDULAZIZ YAHYA YAHYA AL-NAHARI

MENTEE PERFORMANCE

Show 5 entries Search:

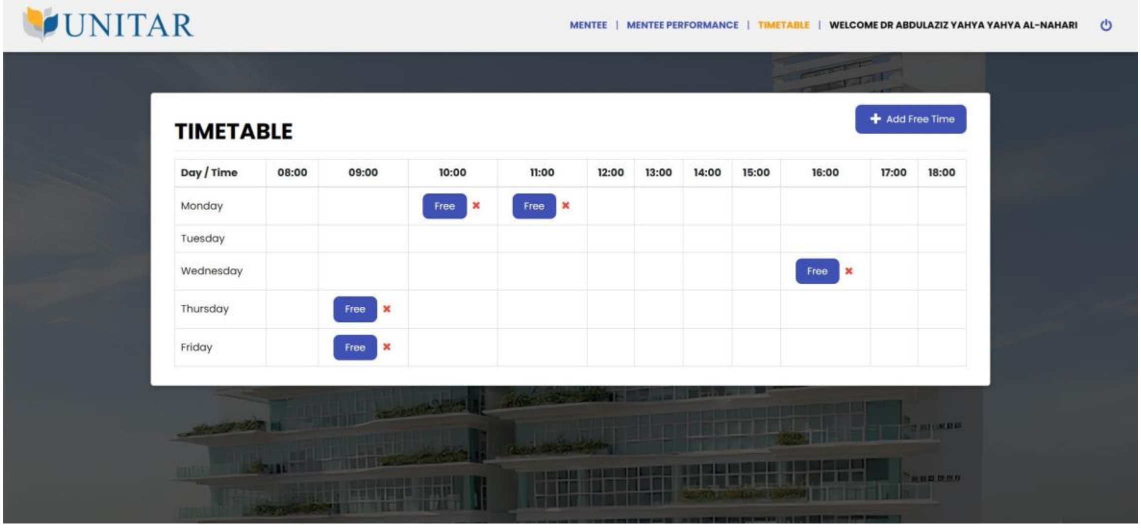
Matric ID	Mentee Name	Semester	CGPA	Status	Action
MC190909799	Nurul Aida Farzana binti Norisam	4	3.96	Passed	Performance
MC200410808	Ku Muhammad Akashah bin Ku Abdul Kadir	3	3.83	Passed	Performance
MC200410889	Norazira Binti Abdul Halim	1	3.85	Passed	Performance

Showing 1 to 3 of 3 entries

Previous 1 Next

Figure 4.6: Mentor’s Mentee Performance Page

Figure 4.6 shows the mentor’s mentee performance that displays the list mentee performance under the mentor. The mentor also has a similar function as the admin which can view the individual mentee performance in a graph visualization, but the mentor does not have the feature to edit.

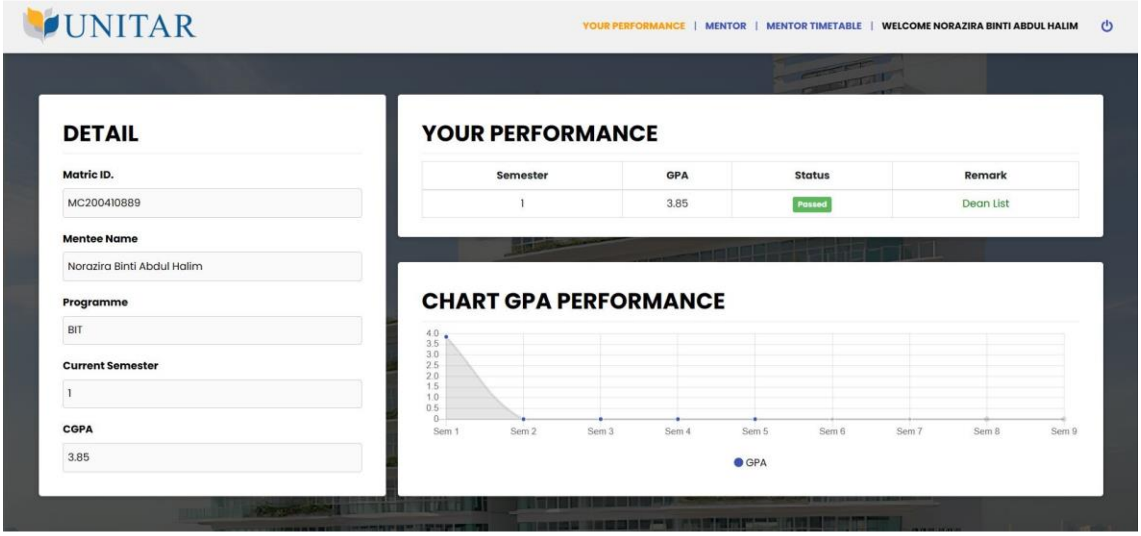

UNITAR
MENTEE | MENTEE PERFORMANCE | TIMETABLE | WELCOME DR ABDULAZIZ YAHYA YAHYA AL-NAHARI
+ Add Free Time

TIMETABLE

Day / Time	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
Monday			Free ✖	Free ✖							
Tuesday											
Wednesday									Free ✖		
Thursday		Free ✖									
Friday		Free ✖									

Figure 4.7: Mentor’s Timetable Page

Figure 4.7 shows the mentor’s timetable which allows the mentor to add and remove the timetable according to the availability of the mentor. A box with “Free” text will be appear once the mentor adds the free time based on the day and time that have set. The Mentee can view and reschedule the meeting.



DETAIL

Matric ID.: MC200410889

Mentee Name: Norazira Binti Abdul Halim

Programme: BIT

Current Semester: 1

CGPA: 3.85

YOUR PERFORMANCE

Semester	GPA	Status	Remark
1	3.85	Passed	Dean List

Figure 4.8: Mentee’s Performance Page

Figure 4.8 shows the mentee’s performance which will only show its own performance. The mentee has an overview performance for every semester. A line graph also will display which shows academic progress for each semester.

Front Page of the system

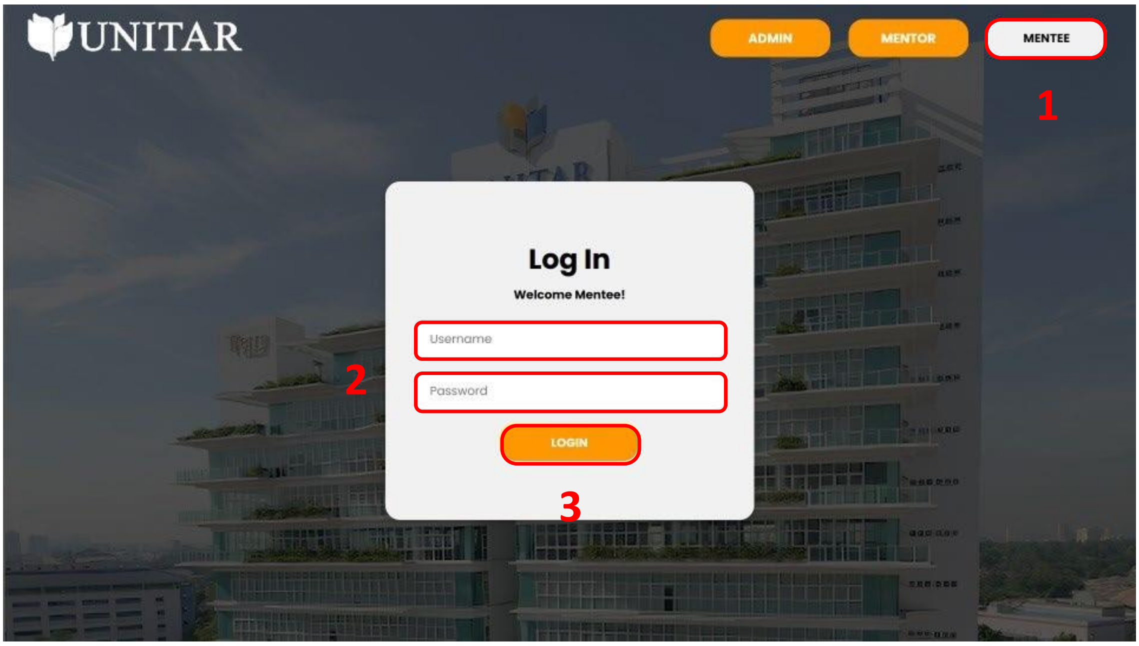


Figure 4.9: Mentee Login Page

Figure 4.9 displays the system's main page, featuring three buttons for the admin, mentor, and mentee. When the mentee button is clicked, it opens the login page, allowing the mentee to proceed to their page view.

Conclusion

This research presents the development of a Student Mentoring System (SMS) leveraging the Model-View-Controller (MVC) architecture framework, marking a substantial advancement in educational support systems. The primary contributions include:

- Enhanced Communication: The system facilitated robust real-time communication between students and mentors, promoting stronger relationships and timely guidance.
- Efficient Data Management: The MVC framework's separation of concerns ensured efficient data management and easier updates and maintenance.
- User-Friendly Interface: A well-defined view layer contributed to a user-friendly interface, improving the user experience for both students and mentors.
- Improved Monitoring and Reporting: The system offered better tracking of student progress and mentor activities, enhancing monitoring and reporting capabilities.

Future Research Enhancement

Expanding the system to mobile platforms to increase accessibility and convenience.

Currently, the SMS system is only accessible through a website and is limited to PC or laptop devices due to the database being connected to the XAMPP application. However, to provide greater accessibility and convenience, the system can be enhanced by developing a mobile application that allows users to access the system from anywhere and anytime using smartphones. This future enhancement will provide a significant improvement in the user experience, making the SMS system more accessible and user-friendly.

Add a booking feature

The system allows mentors to accept or decline the request. This will enhance the functionality of the system, enabling users to easily schedule appointments and manage their time effectively.

Integrating machine learning algorithms

Future research could focus on integrating advanced features such as machine learning algorithms for predictive analytics, which could provide even more personalized and proactive mentoring.

SMS development using the MVC Architecture framework is a significant contribution to modern education, setting a precedent for future educational technology innovations aimed at fostering academic success.

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