Applied Information Technology And Computer Science Vol. 2 No. 2 (2021) 1111-1129
© Universiti Tun Hussein Onn Malaysia Publisher's Office

AITCS

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/aitcs
e-ISSN :2773-5141

The Development of a Supervision System for FSKTM Undergraduate Students

Chong Er Juan, Norfaradilla Wahid*

Faculty of Computer Science and Information Technology,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor, MALAYSIA

DOI: https://doi.org/10.30880/aitcs.2021.02.02.069
Received 31 July 2021; Accepted 12 November 2021; Available online 30 November 2021

Abstract: FSKTM Supervision System is a web-based system and it is developed especially for Faculty of Computer Science and Information Technology (FSKTM) year 3 students. This project is proposed to assist year 3 students when they are starting and doing their final year project. Students will be more easily and systematically to do appointments to approach their potential lecturer to discuss their final year project and get the notification for the notice announced. The coordinator can easily gather all the year 3 students and upload important information without anyone left out. This project is developed based on the Prototyping method where improvement is done from time to time. The development tools that used to build supervision system are Brackets, Notepad and XAMPP. Additionally, phpMyAdmin is used for the system database. Based on the testing by test plan, it is shown that the actual output is the same as the expected output. For the user acceptance testing, most of the respondents felt strongly satisfied and satisfied with the system.

Keywords: supervision system, appointment, prototyping method

1. Introduction

Before embarking on the final year project, each student in Faculty of Computer Science and Information Technology (FSKTM) has to find themselves a lecturer who guides them throughout the project development. To get a supervisor, students have to ask their potential supervisors first about their availability for supervision as each lecturer have a limit to receive the student. An appointment with the potential supervisors has to be made to discuss the project ideas. The situation is students might not know which lecturer has already reached the limit of receiving students. Students still do appointments with the lecturer and wait for the approval of the appointment from the lecturer. Another situation is the appointment message or email might be not received by the lecturer. This situation is due to technical problems or too many emails to read and work to be done cause to miss read the appointment. In addition, there are some students who really do not have an idea or inspiration about what title should they do for their final year project. Lack of a proper platform to disseminate the information leads to excellent ideas from lecturers has been left out. Student who confused about what should be done in the final year project will still be struggling for thinking of a suitable title to do in their final year project.

*Corresponding author: faradila@uthm.edu.my
2021 UTHM Publisher. All rights reserved.

Before student starting their final year project, students have to enter a Facebook group in which the coordinator will update all the information into the group for students to get to know about the flow of the final year project. Some students might not in the group so that some information will not reachable and sometimes the notification of the post in the group might even delay pop out.

In this project, a system for making an appointment and view notices has been proposed to solve the problem faced by students, lecturers, and coordinator during the final year project. Student will have a platform for checking the availability of the lecturer and do the appointment. While the lecturers can easily manage all the appointments more systematically. Planning, organizing, allocating, applying, and controlling time effectively so that all identified activities, projects, and procedures are executed at the right time as referring to time management [1]. Even though students were provided with a medium to report their final year project log activities in [2], but it is only limited to that particular function and does not offer any communication medium before the project is even started.

The objective for this project has included to analyze and design a FSKTM Supervision System for students in FSKTM. The second objective for this project is to develop a web-based supervision system based on the structural approach method. While the third is to test and evaluate the system to make sure the system is useable and following all the requirements stated.

The rest of the paper will be organized as follows. Section 2 will describe the related work which is the research on the current non-computerized supervision system, proposed system, and the comparison of the characteristic between three existing systems and the proposed system. In Section 3 we will explain the methodology used to develop the proposed system and system development activities of this project. Section 4 will describe the system analysis and design which includes structural diagrams such as context diagram and Entity Relationship Diagram. In Section 5, the implementation and testing of this project system will be discussed in detail. Finally, Section 6 will discuss the conclusion and future works of the project.

2. Related Work

2.1 Current non-computerized supervision system

Before entering the third year of study, students have to prepare at least one idea to be discussed with the lecturer. After the idea has been prepared, students need to approach their potential lecturer which they will do an appointment for discussion with the lecturer by using communication applications such as email or WhatsApp and some of them also do appointments face to face in the lecture class. Students have to check and study the lecturer's timetable for doing appointments when the lecturer's no class time. After discussion, the lecturer will give opinions and decide whether to accept the student as a supervisee. If the lecturer already exceeds the limit of students, students have to find another lecturer who can still accept them. Figure 1 shows the flow before the supervision system is proposed.

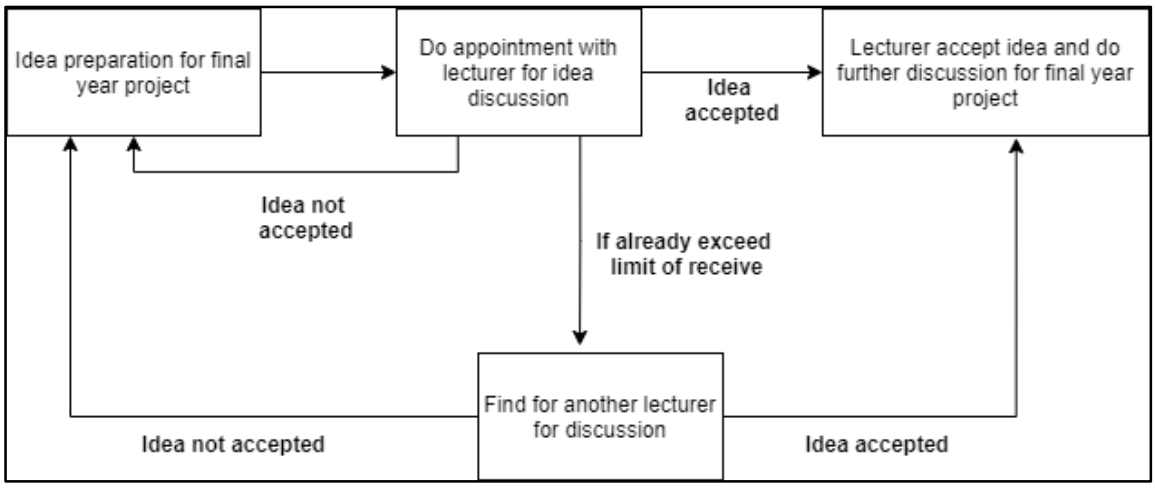

Figure 1: Process flow to approach lecturer for project supervision system

2.2 A Study on Similar Systems

Three similar systems have been selected for comparisons. The systems are Gleneagles Hospital Web-based System [3], Precious Medical Centre System [4] and Online Appointment System (OLAS) for HIO [5]. Table 1 shows the comparison between the characteristic of the existing system and the proposed system.

Table 1: Comparison between similar systems with the proposed system

System Characteristic	Gleneagles Hospital	Precious Medical Centre System	Online Appointment System (OLAS)	Proposed System
Appointment calendar	/	/	x	/
Time section chosen for appointment	x	/	x	/
Update profile	x	x	/	/
Notice information board	/	/	/	/
Change system language	/	/	x	x
Reminder	/	/	/	/
Login and register	x	x	/	/
Check availability for appointment	x	x	x	/
List of professional	/	/	/	/
Comment on notice	x	x	x	/

As compared to the three existing systems, the only characteristic that the proposed system does not have is the change system language function. Change language function is not in the proposed system is because the target user of the proposed system is familiar with English which are student and

lecturer in FSKTM. The characteristics such as notice information board, a reminder for the user and a list of professionals are owned by three existing systems and the proposed system.

3. Methodology

In this project, the methodology model used to develop the proposed system is by using the Prototype model. By following this model, a prototype is developed, tested, and reworked until getting satisfaction from the customer. A prototype is considered as a base of the final system built. Firstly, a prototype is built and send to the user for initial evaluation. The feedback and suggestion of the evaluation get are then used to modify the prototype and iterated until the user is satisfied with the prototype. The final system is then built based on the final prototype which is accepted by the user. In the prototyping model, there are four main phases which are the planning phase, analysis phase, design phase and implementation phase.

3.1 Prototyping Model

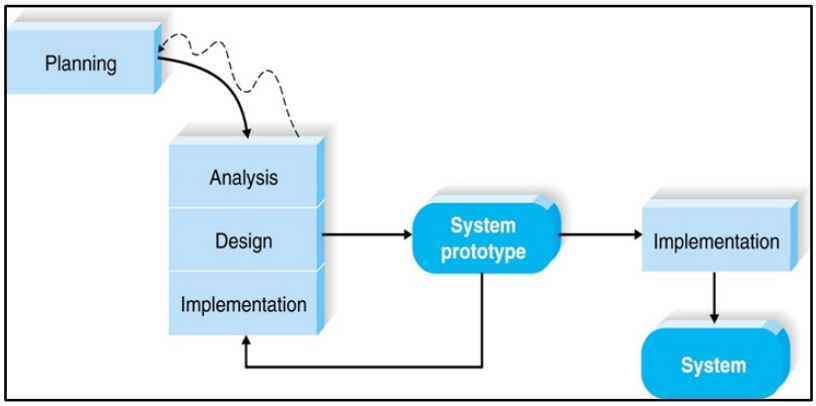

Figure 2: Prototyping Model [6]

Figure 2 shows the prototyping model. In the planning phase, finding about the problem when a student doing the final year project such as an appointment with a lecturer has been studied. An idea about the proposed system which is FSKTM Supervision System is prepared and transformed into a proposal. Project activities are also designed into a Gantt Chart (see Appendix A). Also, the problem statements are defined, objective and project scope are determined for developing the FSKTM Supervision System. Research and studies on related topics about the system have been done to find out more about the proposed system.

In the analysis phase, three existing systems which is related to the proposed system had been studied. The comparison of the characteristics among the three existing systems and the proposed system had been analysed. An interview with the coordinator, Dr. Rahayu A Hamid through Google Meet has been conducted to get know about the existing e-PSM system. Requirement analysis has been done as a survey using Google Form had been shared to FSKTM year 3 students to get the data about suggestions and requirements for the proposed system. The functional and non-functional requirements are identified to make sure that the system is functioning well to achieve the project's objective. The software and hardware requirement are described. Flowcharts are illustrated to show how the system will work and flow. The Data Flow Diagram (DFD) is drawn to map the processes in the system. Data flow diagrams (DFD) are illustrated the movement of data between external entities and the processes and data stores within a system [7].

In the design phase, the database of the system and the prototype user interface of the system is designed. The entity Relationship Diagram (ERD) is created to develop the database system. An entity-relationship diagram (ERD) is a drawing showing the information that is created, stored, and used by a system [8]. Wireframe of design for the system user interface is built using draw.io. Digital wireframes

allow for high fidelity providing interactivity of design to test features [9]. The wireframe is produced to provide a basic preliminary idea for the design and arrangement for the implementation phase of the development system.

In the implementation phase, software used to develop the proposed system and implement the coding are PhpMyAdmin database, Bracket, Notepad and XAMPP server. The programming language used to implement the system is Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), PHP and JavaScript. The prototype system is then tested to make sure the objective of the project has been achieved. Improvement and modification need to be done to fix the bug and error to make sure the system will reach the system requirements.

3.2 System Development Workflow

Table 2 shows the summary of system development activities. Each activity in each phase has been listed with the output of the activities done in each phase.

Table 2: Summary of system development activities

Phases	Activities	Output
Planning	- Proposed idea and title for the final year project - Do appointment with lecturer for supervision - Prepare proposal - Prepare project work plan with Gantt Chart - Determine problem statement, objective, project scope - Do research and study about the related topic to the proposed system	- Project proposal - Project work plan - Gantt Chart
Analysis	- Study of existing system - Comparison among three existing system and the proposed system - Do interview and survey - Analyse the result of interview and survey - Define hardware and software requirement - Illustrate flowchart, context diagram and Data Flow Diagram	- Functional and non-functional requirement - Hardware and software requirement - Literature review - Google Form survey result - Flowchart, context diagram and Data Flow Diagram
Design	- Design process system, database system, and interfaces of the proposed system - Create wireframe for user interface - Illustrate Entity Relationship Diagram (ERD)	- Wireframe - Interface Design - Database Design - Entity Relationship Diagram (ERD)
Implementation	- Code implementation - Testing - User evaluation	- User evaluation result - Test plan result - Final complete system

4. System analysis and design

System Analysis is the phase of determining users' requirements for an application to be developed or modified. Analysis of the requirements involves all the tasks performed to identify the needs of various stakeholders. Analysis of requirements therefore means analysing, documenting, validating and managing the requirements of software or system. In this section, system analysis and design will be discussed. However, due to the limitation of the paper, only a context diagram will be shown here for system analysis; while for system design, a user interface design for the homepage will be shown. Flowchart for student and the system Entity Relationship Diagram can be seen in Appendix B of this paper.

4.1. System analysis

A context diagram is drawn to define and represent the entire system. A context diagram is a data flow diagram about an overview of an organizational system that shows the system boundaries, external entities that interact with the system and the major information flows between the entities and the system [10]. Figure 3 shows the context diagram of the FSKTM Supervision System. There are three entities in the context diagram which are student, lecturer and coordinator.

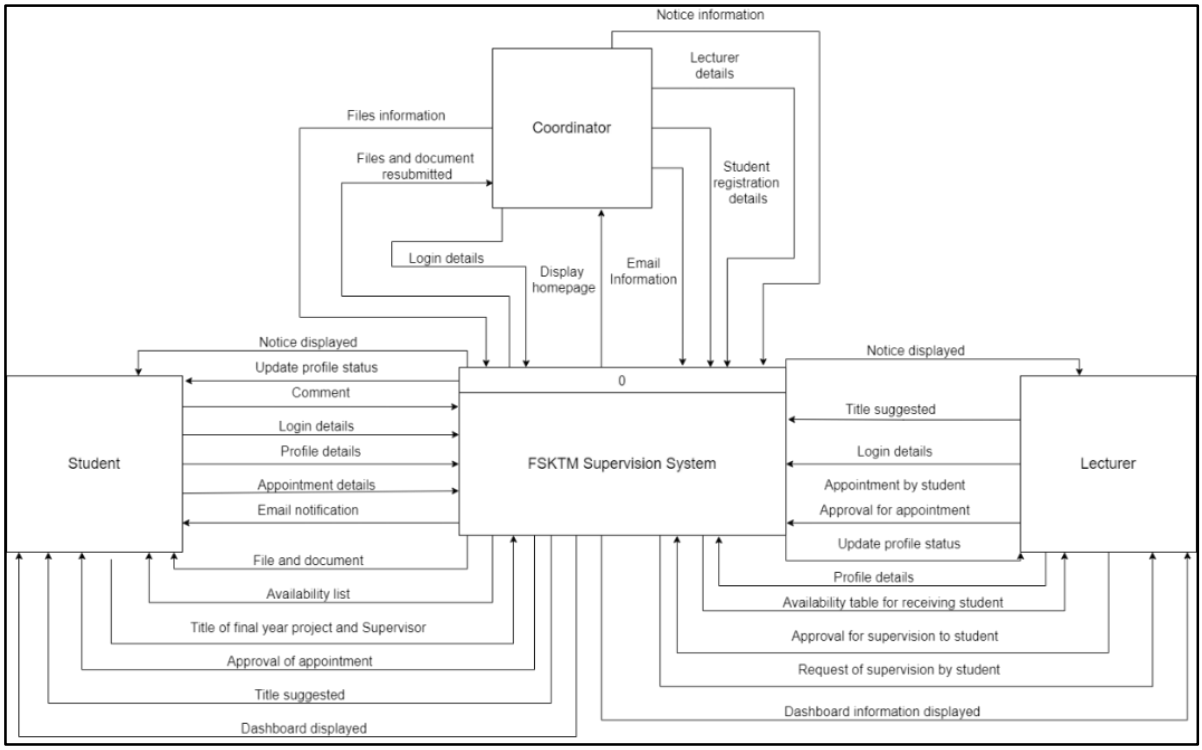

Figure 3: Context diagram of the proposed system

4.2 System design

System design can be shown by constructing a wireframe for the system. A wireframe is a diagram that shows how content and features on a page is designed. Figure 4 shows one of the user interfaces that have been designed for the system. It is the user interface design for the dashboard of the student interface. Profile details such as name, course and matric number will be displayed out and there are two buttons in this section which are the update profile button and update profile picture button that allows students to link to the update profile interface to input title for final year project and supervisor's name. The input of the supervisor's name will be transfer as a request to the lecturer's interface. If the lecturer has accepted the request, the details of the supervisor will be displayed in the second section of the dashboard.

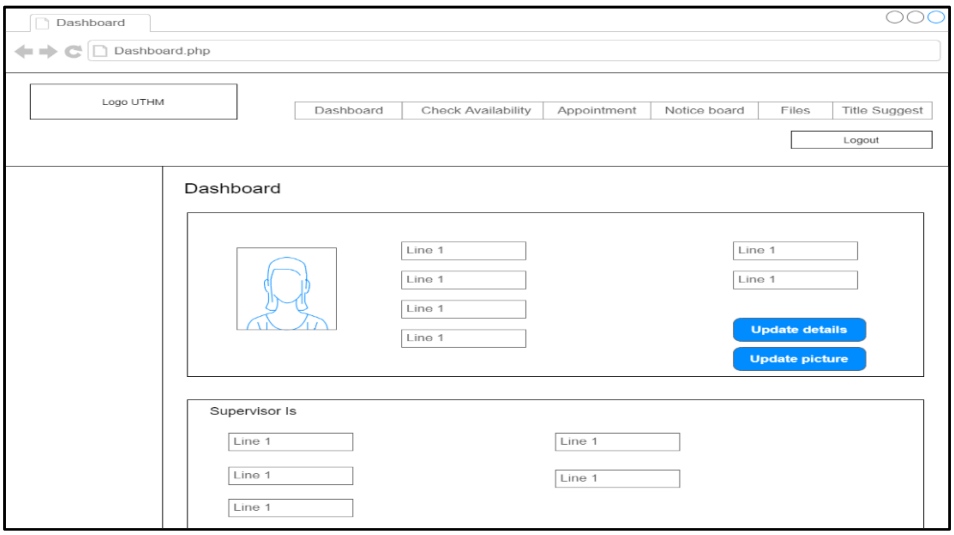

Figure 4: User interface design for the dashboard of student interface

5. System implementation and testing

In this section, system implementation will be shown with the real user interfaces and the code segment of the system will be stated. The system testing which includes the test plan and user acceptance testing will be discussed. Supervision system for FSKTM is developed by using scripting languages for example, PHP, JavaScript, HTML and CSS. While MySQL is chosen as the database.

5.1 System implementation

System implementation in this section is shown by displaying the interface of the system and code segment of the system. Figure 5 shows the login interface for the lecturer and coordinator whereas Figure 6 shows the code segment for the login function. Lecturer or coordinator has to input their staff ID and password as well as select the radio button which their role is login as lecturer or coordinator to login to this system.

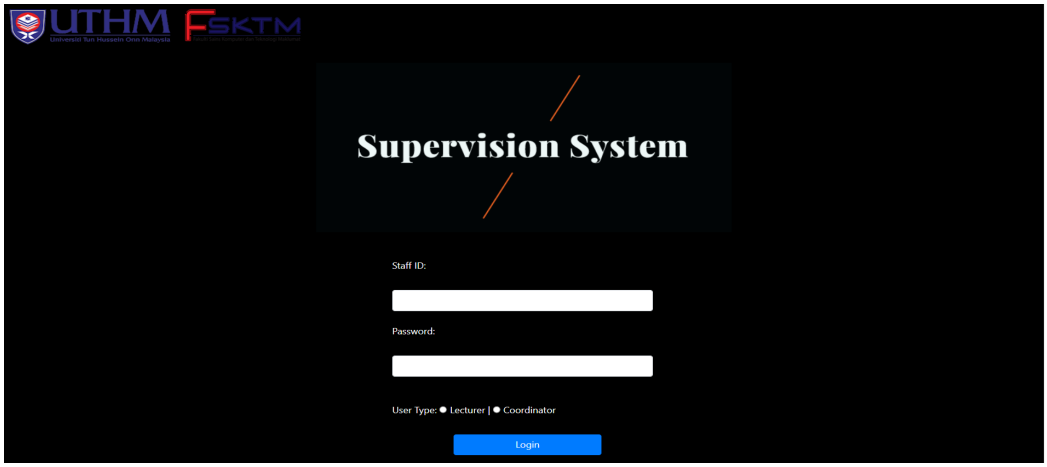

Figure 5: Login interface for coordinator and lecturer

```php
<?php
    require('db.php');
    session_start();
// If form submitted, insert values into the database.
if (isset($_POST['login'])){
$staff_ID = $_POST['staff_ID'];
$lect_password = $_POST['lect_password'];
$role = $_POST['role'];
$sql = "SELECT * FROM lecturer WHERE staff_ID=?
and lect_password=? and role=? ";
$stmt=$con->prepare($sql);
$stmt->bind_param("sss",$staff_ID,$lect_password,$role);
$stmt->execute();
    $result = $stmt->get_result();
    $row = $result->fetch_assoc();

    session_regenerate_id();
    $_SESSION['staff_ID'] = $row['staff_ID'];
     $_SESSION['role'] = $row['role'];
     $_SESSION['id']=$row['user_id'];
    session_write_close();

if($result->num_rows==1 && $_SESSION['role']=="lecturer"){
header("Location: dashboardlect.php");
}
    else if($result->num_rows==1 && $_SESSION['role']=="coordinator"&& $_SESSION['id']=$row['user_id']){
header("Location: home.php");
}
        else{
    echo "<div class='form'>
<h3>Staff ID/password is incorrect.</h3>
<br/>Click here to <a href='loginlect.php'>Login</a></div>";
}
}else{
?>
```

Figure 6: Code segment for login process for lecturer and coordinator

Figure 7 shows the student interface for the update profile function. Student is able to change their phone number and password in this interface. Student will have to input their final year project title and supervisor's name once confirmed. When student picks the name of the supervisor, a request for supervision will be sent to the lecturer to be approved.

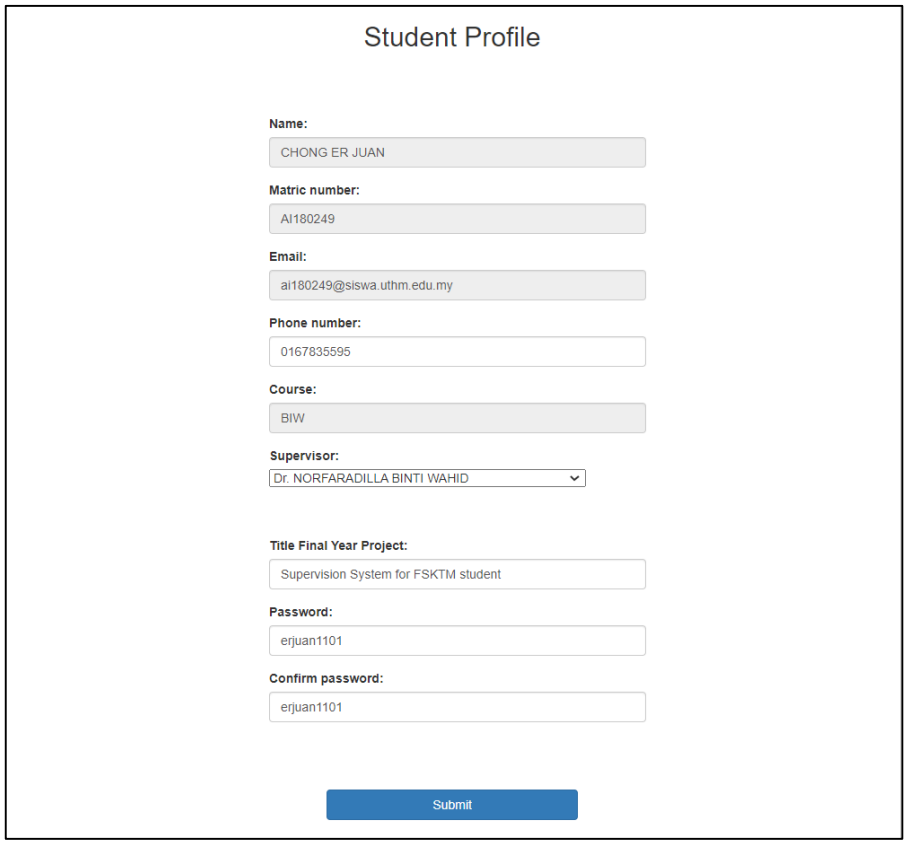

Figure 7: Interface for update profile function

Figure 8 shows the approval for supervision function in the dashboard of the lecturer's interface. As mentioned above, when student inputs the name of the lecturer, a request will be listed in the

lecturer's dashboard and the form shows in figure 8 is the approval form for approve or reject the request for supervision.

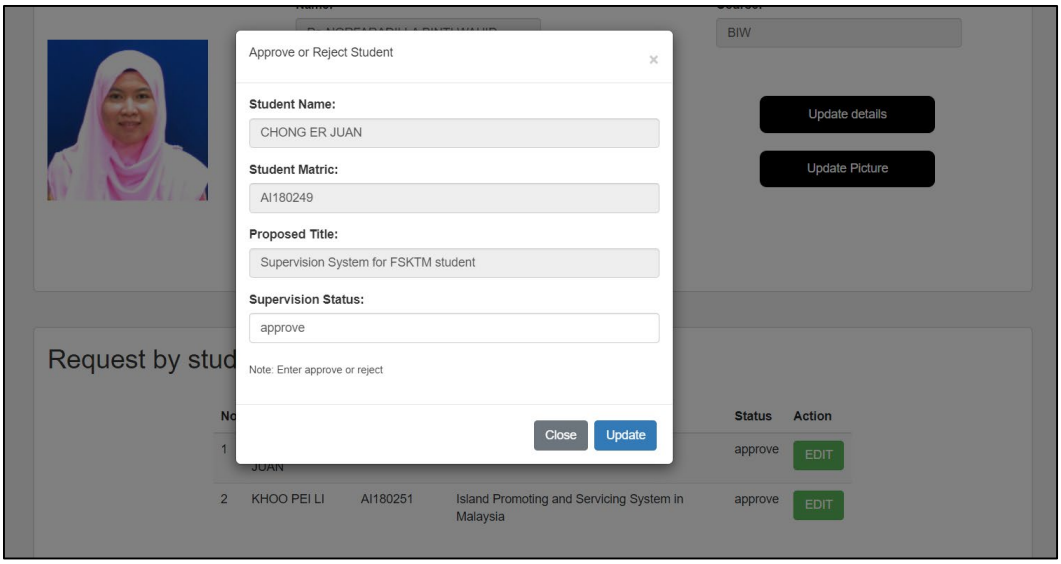

Figure 8: Approval for supervision function interface

Figure 9 shows the coordinator interface for the registration student by batch function while Figure 10 shows the code segment for the registration student by batch. In this interface, coordinator just needs to upload the excel file with the student's details and can register for many students once an upload and there is no need to submit the registration form one by one for one student per registration.

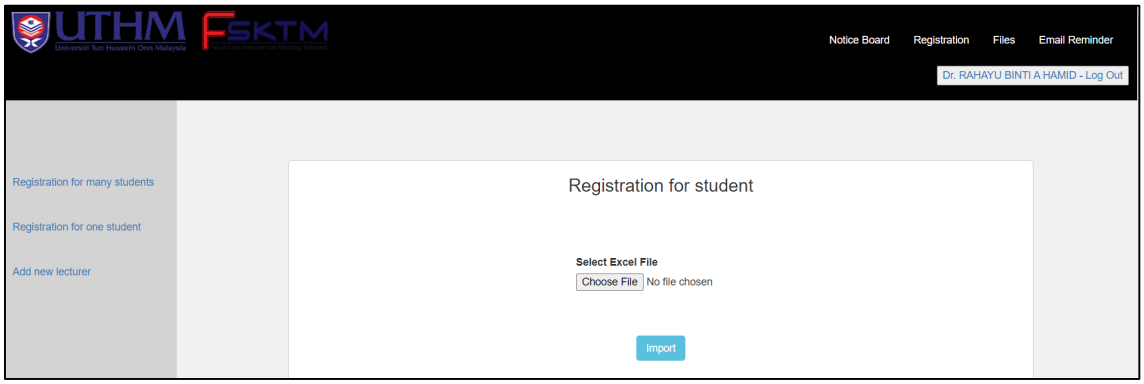

Figure 9: Interface for registration student by batch

```php
if(isset($_POST["import"]))
{
 $extension = end(explode(".", $_FILES["excel"]["name"]));
  $allowed_extension = array("xls", "xlsx", "csv");
  if(in_array($extension, $allowed_extension))
  {
   $file = $_FILES["excel"]["tmp_name"];
   include("Excel/Classes/PHPExcel/IOFactory.php");
   $objPHPExcel = PHPExcel_IOFactory::load($file);

   $output .= "<label class='text-success'>Data Inserted</label><br /><table class='table table-bordered'>";
   foreach ($objPHPExcel->getWorksheetIterator() as $worksheet)
   {
    $highestRow = $worksheet->getHighestRow();
    for($row=2; $row<=$highestRow; $row++)
    {
     $output .= "<tr>";
     $matric = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(0, $row)->getValue());
     $name = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(1, $row)->getValue());
     $email = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(2, $row)->getValue());
          $phonenum = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(3, $row)->getValue());
          $course = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(4, $row)->getValue());
        $year = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(5, $row)->getValue());
          $password = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(6, $row)->getValue());
          $confirm_password = mysqli_real_escape_string($con, $worksheet->getCellByColumnAndRow(7, $row)->getValue());
    $query = "INSERT INTO studentregister(stud_matric,stud_name,stud_email,stud_phonenum,stud_course,stud_year,stud_password,studconfirm_password)
    VALUES ('".$matric."', '".$name."', '".$email."', '".$phonenum."', '".$course."', '".$year."', '".$password."', '".$confirm_password."')";
     mysqli_query($con, $query);
  $output .= '<td>'.$matric.'</td>';
     $output .= '<td>'.$name.'</td>';
     $output .= '<td>'.$email.'</td>';
     $output .= '<td>'.$phonenum.'</td>';
     $output .= '<td>'.$course.'</td>';
      $output .= '<td>'.$year.'</td>';
     $output .= '<td>'.$password.'</td>';
     $output .= '<td>'.$confirm_password.'</td>';
     $output .= '</tr>';
    }
   }
   $output .= '</table>';

  }
```

Figure 10: Code segment for registration student by batch

Figure 11 shows the interface for registration for one student. Besides registration by batch, this registration form can be used to register for one student once a new student is added or a student which missed out can be registered in this interface.

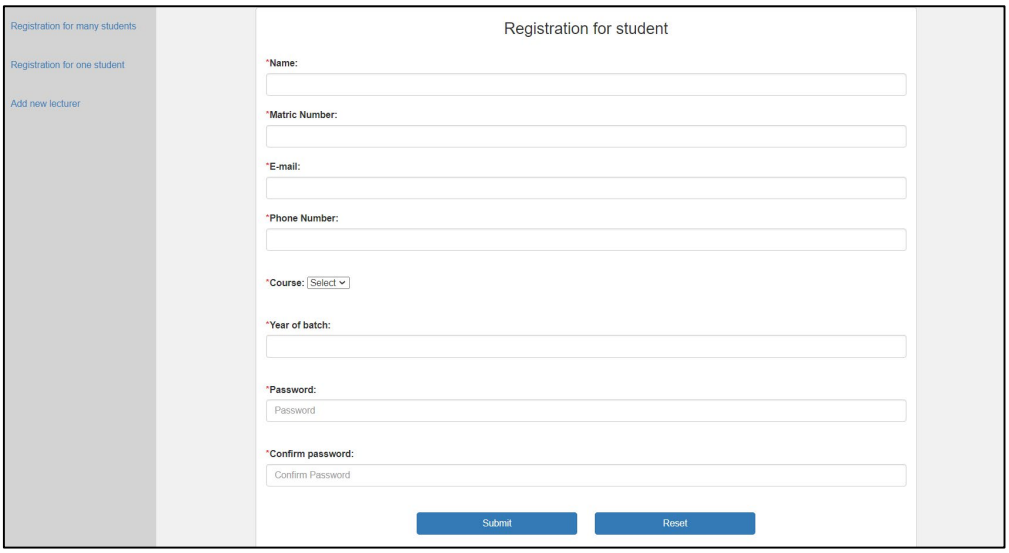

Figure 11: Interface for registration for one student

Figure 12 shows the student interface for the appointment function. Student needs to input the appointment details such as appointment date, time and reason to make an appointment.

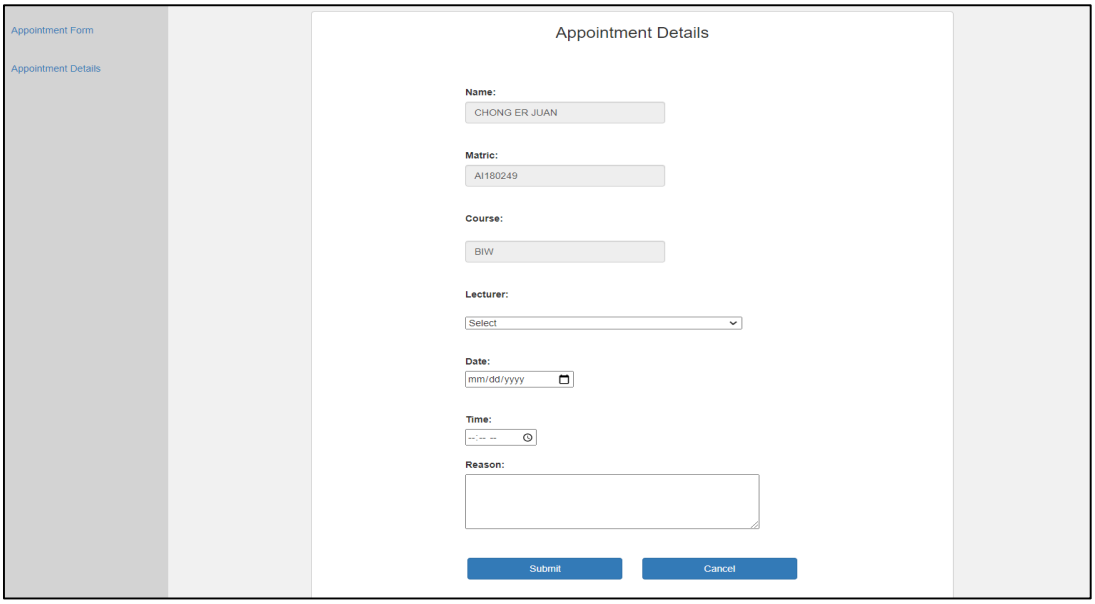

Figure 12: Student interface for appointment function

Figure 13 shows the interface for the lecturer to check the appointments from students. After the student had done the appointment, the appointment will be list on a table with the appointment details. Lecturer can click the action button to do approval for the appointment.

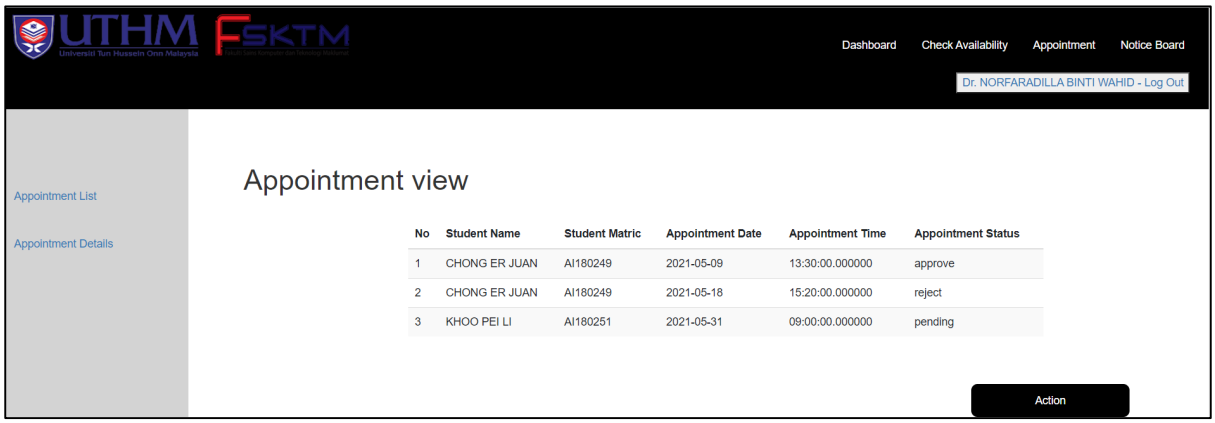

Figure 13: Table list of appointment by student

Figure 14 shows the interface for check availability for the student. Student needs to choose their course for viewing the list of the lecturer. Student can click the book appointment button to link to the appointment interface.

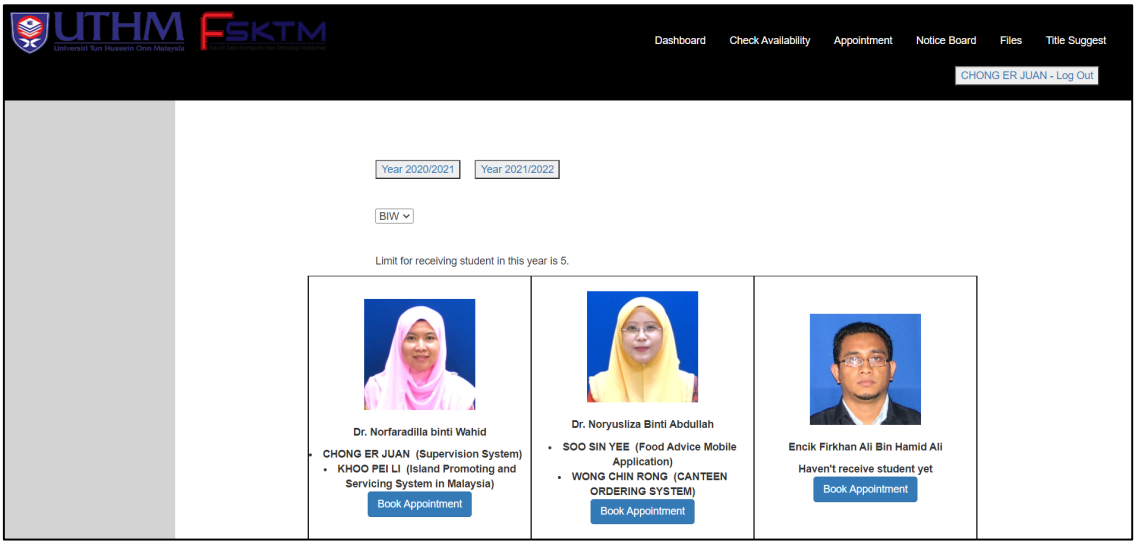

Figure 14: Interface of check availability function for student

Figure 15 shows the interface for the notice board function for coordinator to upload notice. Coordinator will have to input the notice and choose the notice that belongs to which category and then post it.

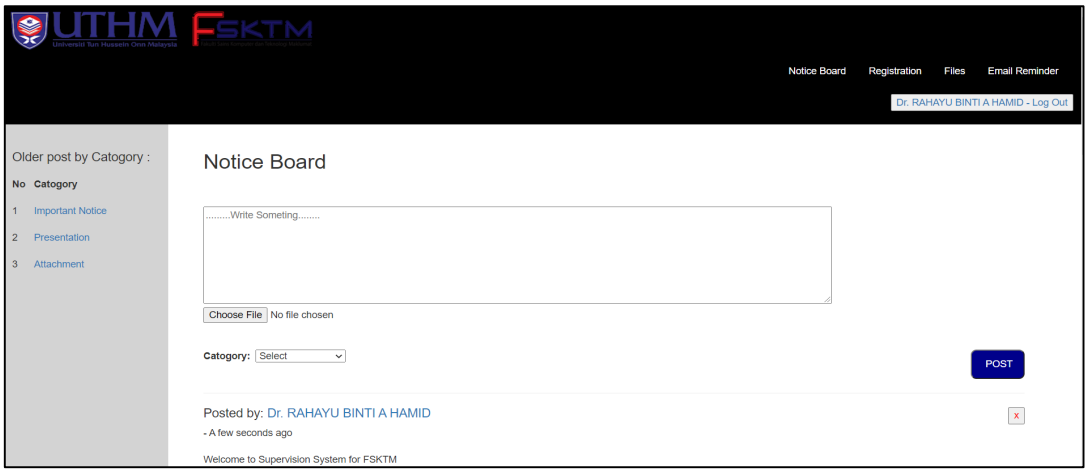

Figure 15: Interface for notice board function

5.2 System testing

In system testing, functional testing and user acceptance testing are carried out. System testing for FSKTM Supervision System is conducted to ensure the system performs properly and smoothly as well as prevent major bugs and errors when the system is being used. The system is tested to make sure the expectation and objectives of the system developed have been achieved accordingly.

5.2.1 Functional testing

A test plan is a document that outlines the sections and actions of system testing. Test plan is used to underdoing testing for the system developed to check if the system is satisfying and getting its design considerations and requirements. Because of the limitation of this paper, only two test plans tables will be shown and discuss. Table 3 and Table 4 shows the test plans conducted for the functionality of login and appointment in FSKTM Supervision System.

Table 3: Test plan results for Login function

No	Test Cases	Expected Output	Actual Output
1	Enter invalid matric number and password.	Display error message and matric number /password incorrect.	Display error message and matric number /password incorrect.
2	Press login button without input matric number or password.	Display alert message to fill in that particular field.	Display alert message to fill in that particular field.
3	Enter valid and correct matric number and password.	Login successfully and redirect to dashboard.	Login successfully and redirect to dashboard.
4	Enter invalid staff ID and password.	Display error message and staff ID /password incorrect.	Display error message and staff ID /password incorrect.
5	Press login button without input staff ID, password or role.	Display alert message to fill in that particular field.	Display alert message to fill in that particular field.
6	Enter valid and correct staff ID, password and role.	Login successfully and redirect to dashboard.	Login successfully and redirect to dashboard.

Table 4: Test plan results for Appointment function

No	Test Cases	Expected Output	Actual Output
1	Submit the appointment form without fill in all the details needed in the form.	Display alert message please fill out this field.	Display alert message please fill out this field.
2	Submit the appointment form completely with valid input.	Display message appointment successfully.	Display message appointment successfully.
3	Check appointment status	Display the status of each of the appointment made including the appointment note given by lecturer.	Display the status of each of the appointment made including the appointment note given by lecturer.
4	Display appointment by student	Appointment details by student and the status of the appointment are displayed.	Appointment details by student and the status of the appointment are displayed.
5	Manage appointment by student	Able to change the status of the appointment from pending to approve or reject and add the appointment note whether why reject and approve.	Able to change the status of the appointment from pending to approve or reject and add the appointment note whether why reject and approve.

Table 4: (cont.)

No	Test Cases	Expected Output	Actual Output
6	Display appointment by student	Appointment details by student and the status of the appointment are displayed.	Appointment details by student and the status of the appointment are displayed.

Test plan result of login function and appointment function has been stated as above. From the test plan result, it can be concluded that the actual output of the function is same as the expected output. For example, when user enter invalid staff ID and password, error message will be displayed by the system.

5.2.2 User Acceptance Testing

User Acceptance Testing (UAT) is a sort of system testing in which the end user evaluates and validates the software system developed. The user acceptance test is the last phase of testing in the development of a system. User acceptance tests can ensure that the system's expectation has passed and met from the perspective of the end user [11]. Figure 16 shows the user acceptance result for the system interface. There are 16 respondents (89%) who strongly satisfied whereas 2 (11%) of them satisfied with the interface design. 14 out of 18 respondents (78%) felt strongly satisfied with the text in the interface and the remaining 4 (22%) are satisfied. From the result, there are 13 students (72%) as respondents strongly satisfied and 5 students (28%) satisfied with the easiness of the system to be understood. Both 9 respondents (50%) felt strongly satisfied and satisfied with the easiness of the system to be navigated. 12 out of 18 respondents (67%) vote for strongly satisfied and 6 respondents (33%) vote for satisfied with the appropriate use of the navigation to the function.

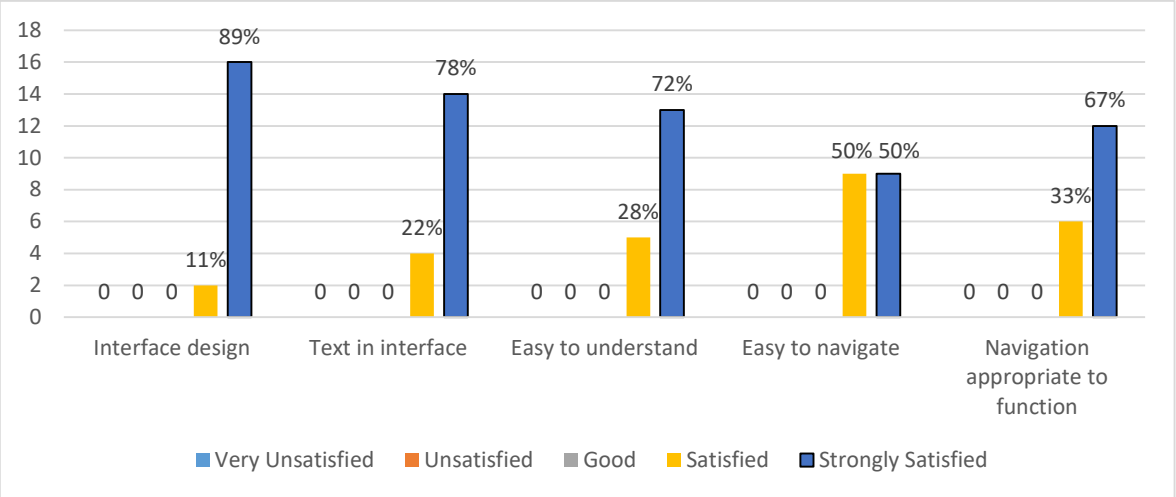

Figure 16: User acceptance testing result for system interface

Based on the result derived from the graph, the user acceptance evaluation by the user is considered good and above for the system interface of the FSKTM Supervision System. Most of the respondents are strongly satisfied and satisfied with the system. The respondents vote for 4 or 5 for the system interface which can be conclude that users have a good experience after using this system. The interface design of the system is liked by 89% of the respondents who vote for 5. The text used in the interface gets vote for 5 from 78% of the respondents which can be concluded as the text used is clear and understandable by the respondents.

5. Conclusion

The significance of doing this project is to help students save their time when they are looking for their supervisor for the final year project. Students can check the availability of lecturers who still accepting students and do appointments more easily with their preferred lecturer, time will be saved. Appointment miss-reading or not received by the lecturer is being solved. Also, it is easier for lecturers to arrange a time for appointment and it becomes much more systematic. Before this, the coordinator needs to accept the students join group requests on the Facebook page and some might be left out or some students not even request to join the group. The developed system also has successfully ensured all students will get the notice and important files or forms that needed to fill in. The system also lets students alert about the important week like the title defence week or for any submission week. It is shown that all the requirements of the system have been successfully fulfilled. Although the system is developed successfully, there are also some limitations. For example, in the notice board function, there is a selection for view by category but students and lecturers have to scroll down to view the older post. For the form and file that resubmitted by the student, the coordinator has to download one by one and there is no button for download for all of the files resubmitted.

Acknowledgement

The authors would like to thank the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia for its support and encouragement throughout the process of conducting this study.

Appendix

	Task name	Start date	End date
		23/08/2020	**10/03/2021**
1	**Planning**	**23/08/2020**	**11/09/2020**
1.1	Get idea for final year project	23/08/2020	01/09/2020
1.2	Appointment for supervision with lecturer	02/09/2020	05/09/2020
1.3	Discuss final year project's idea with lecturer	06/09/2020	11/09/2020
2	**Analysis**	**12/09/2020**	**05/10/2020**
2.1	Project Proposal Preparation	12/09/2020	18/09/2020
2.2	Requirement gathering	19/09/2020	03/10/2020
2.3	Study existing system	24/09/2020	29/09/2020
2.4	Comparison between existing system and proposed system	30/09/2020	05/10/2020
3	**Design**	**06/10/2020**	**01/12/2020**
3.1	Interface design	06/10/2020	03/11/2020
3.2	Database design	03/11/2020	01/12/2020
4	**Implementation**	**01/12/2020**	**07/02/2021**
4.1	System modules development	01/12/2020	15/01/2021
4.2	Intergrate system	16/01/2021	30/01/2021
4.3	Connect database	31/01/2021	07/02/2021
5	**Testing**	**08/02/2021**	**10/03/2021**
5.1	System testing	08/02/2021	15/02/2021
5.2	Fix bugs and errors	16/02/2021	02/03/2021
5.3	Identify limitation	03/03/2021	10/03/2021

Figure 17: Gantt Chart

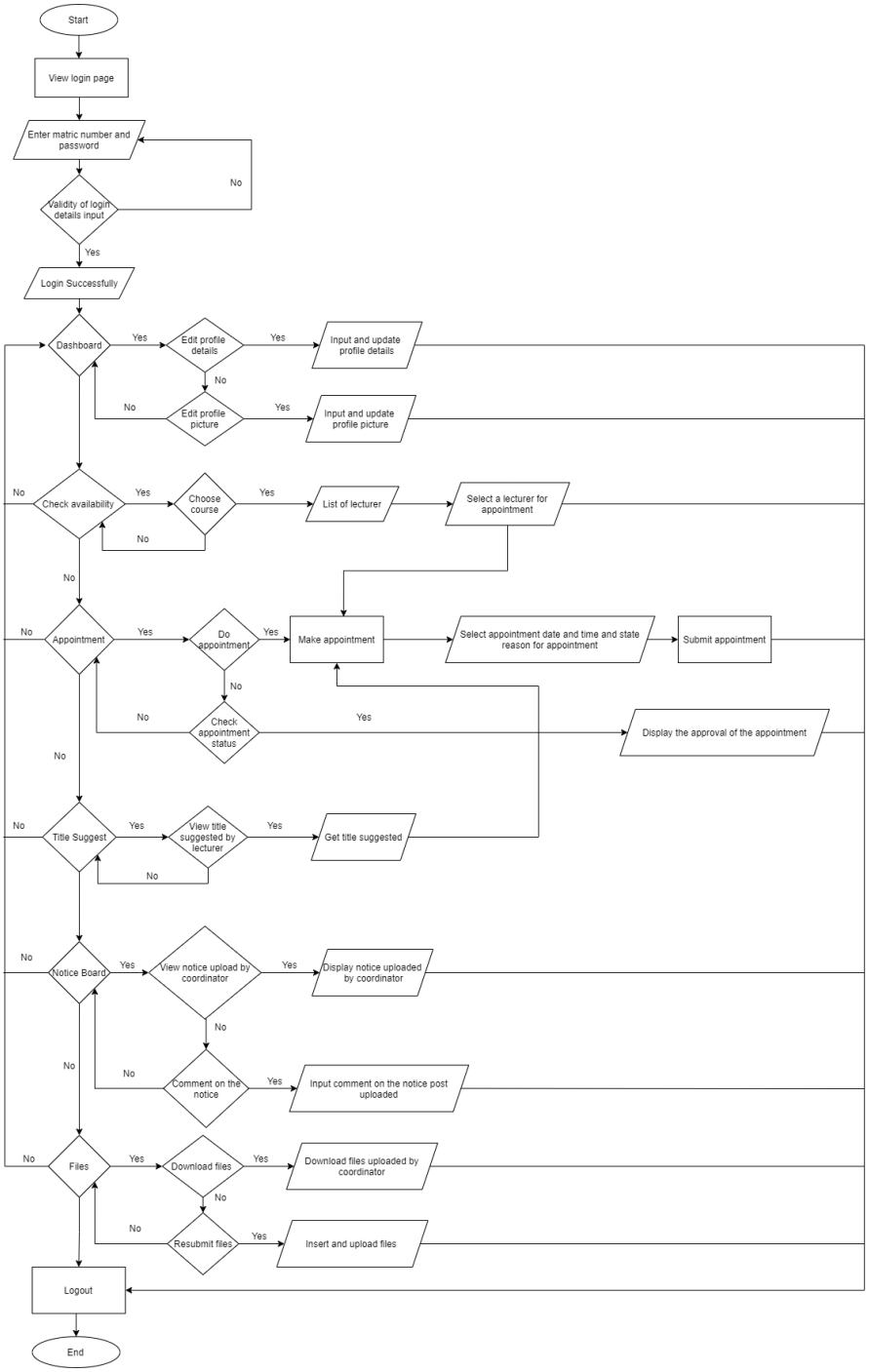

Figure 18: Flowchart for student

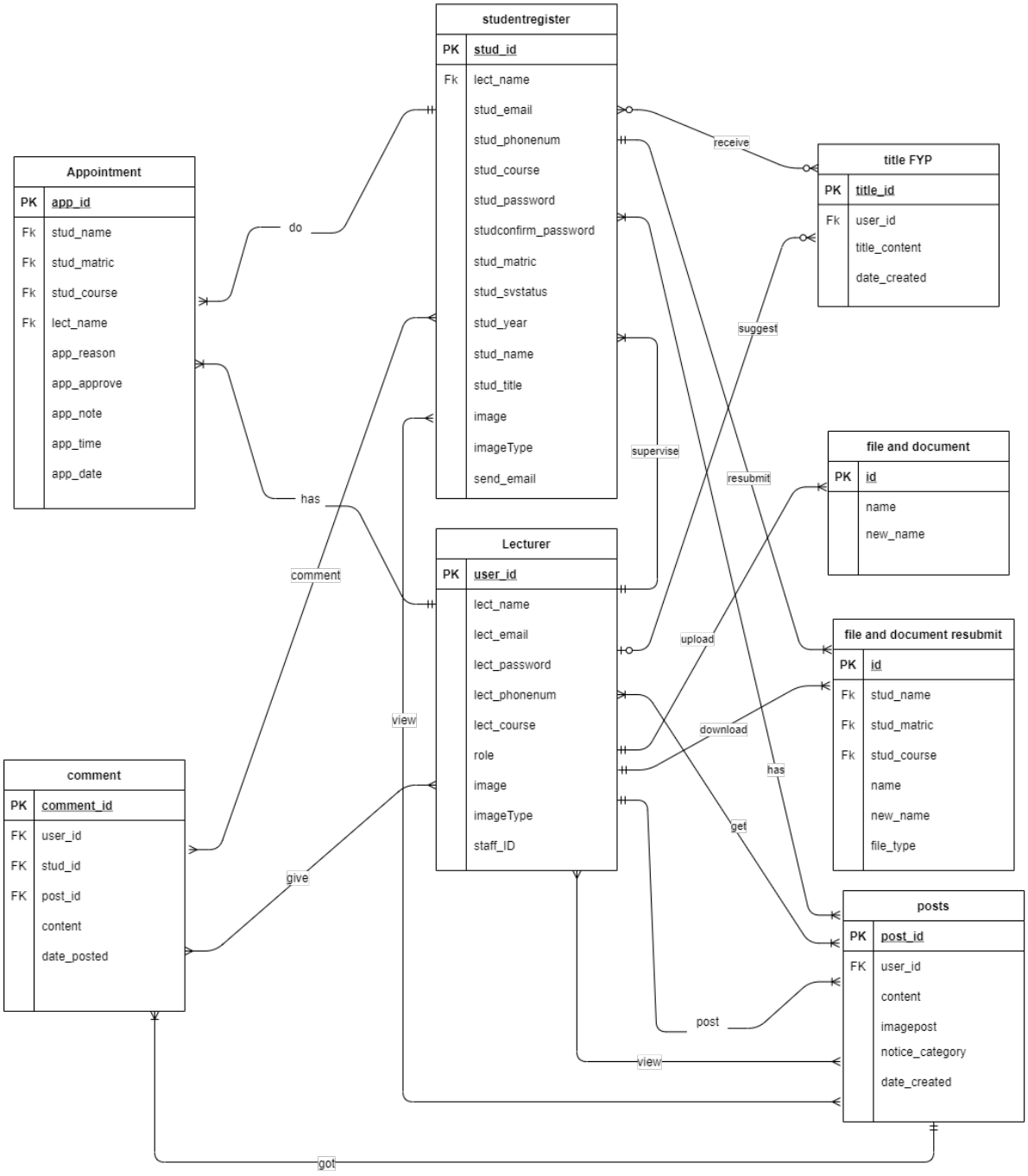

Figure 19: Entity Relationship Diagram for the system

References

[1] M. T. Amron and N. S. M. Salleh, "User Requirement and Design of Appointment System with Email Alert Notification." J. Appl. Environ. Biol. Sci, vol. 7, no. 11, pp. 88-92, 2017.

[2] "Smaponline," UTHM. [Online]. Available: https://smap.uthm.edu.my/reg/epsm. [Accessed July 6, 2021].

[3] "Gleneagles hospital MALAYSIA," Gleneagles. [Online]. Available: https://www.gleneagles.com.my/#. [Accessed June 13, 2021].

[4] "Medical centre at paragon: Precious Medical," Precious. [Online]. Available: https://www.preciousmed.com/. [Accessed June 13, 2021].

[5] "Harvard international office," Make An Appointment | Harvard International Office. [Online]. Available: https://hio.harvard.edu/make-appointment. [Accessed June 13, 2021].

[6] K. E. Kendall, Kendall, J. E. Kendall, Systems analysis and design, New Jersey: Pearson Prentice Hall Upper Saddle River, 2011.

[7] Ibrahim, Rosziati, "Formalization of the data flow diagram rules for consistency check," arXiv preprint arXiv:1011.0278, 2010.

[8] Tilley, Scott, and Harry J. Rosenblatt., Systems analysis and design, Cengage Learning, 2016.

[9] S. Sutipitakwong and P. Jamsri, "Pros and Cons of Tangible and Digital Wireframes," 2020 IEEE Frontiers in Education Conference (FIE), pp. 1-5, 2020.

[10] Hoffer, A. Jeffrey, Modern systems analysis and design, 6/e, Pearson Education India, 2012.

[11] L.Antonelli, G.Camilleri, J. Grigera, M. Hozikian, C. Sauvage, and P. Zaraté, "A modelling approach to generating user acceptance tests," 4th International Conference on Decision Support Systems Technologies (ICDSST 2018), vol. 313. Springer, 2018.