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The Development of UTHM Course Recommender System For SPM Graduates

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Abstract: UTHM Course Recommender System for SPM Graduates (UCRS) is a web-based system that help students find suitable diploma courses in University Tun Hussein Onn Malaysia (UTHM) based on their SPM results and personality test since most of SPM Graduates are not clear with their future, less knowledge on choosing right courses and no appropriate system to validate their choices. This UCRS will be design, developed and be tested to produce a good system to be use by SPM Graduates and being monitored by an admin which is UTHM staff. Next, theory and technique being applied in UCRS system are Rule-Based Technique to determine courses based on SPM Result and J. Holland Theory used to determine personality type of students to find suitable courses for them. By using Iterative model as the method to conduct this system, five phases need to be done thoroughly which is, planning and requirement, analysis and design, implementation, testing and evaluation. Besides that, PHP language as the programming language and Visual Studio Code is the programming tool with MySQL as the database to build up UCRS system. As a result, a system will be able to give suggestions to SPM Graduates about their chosen courses and can determine their courses by SPM Result or personality Test.

Keywords: Recommended System, Courses, Personality Test, Decision Support System, Iterative Model, Object-Oriented Approach

1. Introduction

Education institutions in Malaysia nowadays have become one of the most important sectors. As we know the Malaysian education system started with preschool education, primary education, secondary education and then tertiary education and surely most of the children in Malaysia register to enter preschool at 5 years old. Besides that, there are also some examinations and evaluations for qualification that need to be taken by the students in order to measure their performance in school for example '*Ujian Penilaian Sekolah Rendah*' (UPSR), '*Peperiksaan Tingkatan 3*' (PT3) and also '*Sijil Pelajaran Malaysia*' (SPM). These examinations will ensure our position in the upcoming year and will measure our performance at school.

As we already know, students nowadays have a very hard time choosing the right courses in the university especially for SPM candidates who have no knowledge or experience about choosing the suitable courses for themselves. So, this UTHM Course Recommender System for SPM Graduates (UCRS) will help the students to choose the right courses for their diploma in UTHM such as Diploma in Civil Engineering, Diploma in Mechanical Engineering, Diploma in Electrical Engineering, Diploma in Information Technology, Diploma in Animation Technology, Diploma in Applied Science, Diploma in Chemical Engineering Technology [1].

The main objective of this system are to design Uthm Course Recommender System for SPM Graduates using rule-based technique, To develop Uthm Course Recommender System for SPM Graduates with additional methods to determine the course which is by personality test and to test the develop system. Scope for this project are authentication, insert and edit SPM Qualification, Answer personality test, view personality type, view and view recommended courses.

The expected result of UCRS are it will help students to make decisions by providing recommendations and appropriate course options. By inserting their SPM's result in the system, the system will generate the suitable course for the students based on the requirements and conditions of that course. This personality test is based on Holland's theory where the majority of people in our culture belong to one of six personality types which is Realistic, Investigative, Artistic, Social, Enterprising, and Conventional[2]. So, the personality test will generate a personality type of the student then the personality type itself will align with the course offered to the students that answered the personality test. Furthermore, this system also provides access for students to search more details about the courses for diploma level in UTHM. So, this system will help SPM graduates to know and learn more about courses offered in UTHM and also give them opportunity to make a choice and label themselves in the right place before applying for the courses. The report organization for this paper is continued in Section 2 where any related work that being used along the development of UCRS system is explained such as method use in UCRS system. Next in Section 3, methodology used in UCRS system will be described in detailed along with explanation about development activities and analysis and design used in the system. Then, Section 4 will described more about result and discussion about UCRS system where results of testing and findings will be explained in detailed. Lastly is Section 5 where conclusions are made and advantages, disadvantages and recommendations will be stated and also acknowledgment will be included in this section.

2. Related Work

In this new era development of technology, many new ways to find solutions already being created by the mankind. Either we can find it online or we created it, many references we can refer to do it. Same goes to this recommender system, people nowadays tend to find a very easy path to solve their problems. Furthermore, recommender system will help their user to make a choice and help to make a decision.

2.1 Decision Support System

As we knew decision support system (DSS) is a computerized program that aids in the making of decisions, judgments, and courses of action in a company or organization. A data science system sifts through and analyses large amounts of data, generating complete data that can be utilized to solve problems and make decisions[3]. There are three main components of DSS Framework which are Model Management System, User Interface and Knowledge Base. Besides that, Communication Driven, Model-Driven, Knowledge-Driven, Document-Driven and Data Driven are the types of DSS [4]. In addition, DSS also got their own characteristics such as Support for decisions that are interconnected or sequential, Intelligence, design, decision, and implementation are all supported, variety of decision-making procedures and styles are supported, DSSs learn and adapt throughout time. Lastly, DSS surely give benefits in many ways as example, time savings since decision making time become decrease and enhance effectiveness because decision making become more precise and have a great quality [5]

Rule-based systems require a set of facts or a data source, as well as a set of rules for altering that data, to function. Because they tend to follow the line of 'IF X happens THEN do Y,' these rules are commonly referred to as 'If statements.' The majority of the created systems employ rule-based techniques to recommend courses since rule-based may mimic the decision-making abilities of human experts while also increasing functionality and reliability [6]. rule-based technique is being applied in UCRS to determine suitable courses for SPM Graduates. It works when students inserted their SPM results then the system will pair it with the suitable courses based on the minimum requirements of the course.

J Holland Theory consists of some holland code and the holland code will be useful in determining people's personalities. Besides that, the holland code are classified to six different groups which is Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E) and Conventional (C) [7]. UCRS will applied this theory accordingly with the personality test so that students can determine their courses based on their personality itself.

2.2 Comparison of Existing System

Based on Table 1 it can be seen that, all of the system are occupied with authentication module which is registration and login but there are a little bit different in EduAdvisor since the registration form only needed if the users want to speak to an advisor. Next is results form where only the proposed system and AfterSchool.my system required to fill up the results form before proceeding to the next step in order to generate the suitable courses same goes to subject module and recommended course module. Next is courses module where all the system has the module except for Course Advisor. Lastly are personality test module where only UCRS system occupied with personality test in order to generate the best and accurate courses for students.

Table 1 System's Comparison

System	AfterSchool.my System	EduAdvisor System	Course Advisor	UCRS System
Registration & Login	✓	✓	✓	✓
Result Form	✓			✓
Subject	✓			✓
Courses	✓	✓		✓
Recommended Course	✓			✓
Personality Test				✓

3. Methodology

The iterative model is a type of software development life cycle (SDLC) that concentrates on a simple, initial implementation that keeps increasing in complexity and features until the final system is complete. When describing the iterative technique, the idea of incremental development, which represents the incremental changes made during the design and implementation of each new iteration, will be utilized openly and interchangeably [8]. The iterative model consists of five iterative phases which is Planning and Requirements, Analysis and Design, Implementation, Testing and Evaluation.

As shown in Table 2 below, all the activity to conduct this project were already planned and a Gantt chart will track all the activities. All the collected data were produce by analysis of functional requirement. As the output, an object-oriented approach will be use and produce use case diagram, sequence diagram, activity diagram, class diagram and flowchart of the system.

Table 2: Development phase and work activities

Phase	Task	Output
Planning and Requirements	<ol style="list-style-type: none"> Determine title, problem statement, objective and scope of the system. Choose suitable methodology for project Create a timeline for project Determine suitable software and hardware to be use 	<ol style="list-style-type: none"> Produce project proposal. Produce Gantt Chart.
Analysis and Design	<ol style="list-style-type: none"> Collecting and gathering information regarding the project Designing user's interface Determine suitable work plan for the system. 	<ol style="list-style-type: none"> Identified user need for the system. Use Case Diagram and Sequence Diagram. Interface design. System flowchart and architecture.
Implementation	<ol style="list-style-type: none"> Start writing the coding for the system. Produce functional system 	<ol style="list-style-type: none"> Functional outcome system (UCRS system)
Testing	<ol style="list-style-type: none"> Test the UCRS system by using Alpha testing. 	<ol style="list-style-type: none"> Feedback and suggestion from the testing. Test Cases
Evaluation	<ol style="list-style-type: none"> Examine the UCRS system for improvements and future needs 	<ol style="list-style-type: none"> Report

3.1 Planning and requirement

The planning phase is a starter for developing a proper and functional system. Information gathering about the system, identifying system requirements, and analyzing the user's requirements are all activities that need to be done in this phase. In this phase, the title, objective of the project, problem statement, scope and project significant will be created. In addition, an interview will be done in this phase to collect some information from teachers regarding SPM such as minimum requirement to pass in SPM.

3.2 Analysis and Design

Analysis is a process where the formation of the system can be started by collecting information related to the system to be developed and selecting the appropriate tools to use. As example, the manual implementation of searching course seems to be hard and taking time, so these things need to take in consideration and improvement need to be implement in UCRS system. Next, the data collected such as regarding SPM and Personality Test should be analyzed more carefully to facilitate the next process which is design phase. Analysis surely will help to get clear idea about development of UCRS system. Design is a phase where the architectural design and model process must be built based on the analysis that has been done. The design of the database and user interface must meet the criteria and characteristics that already being set. Database will store information about UCRS, system properly,[9] while user interface is a center of interaction and communication between humans and computers in this UCRS system [10]. This project will use object-oriented approach where use-case diagram, sequence diagram, class diagram and activity diagram are produced in this section.

3.2.1 Use Case Diagram

Use Case Diagram can be used to have a list of system requirements, set the context in which a system should be seen and give users a bird's-eye view of a system [11]. Figure 1 illustrates the application use case model, shown the user-to-application interactions.

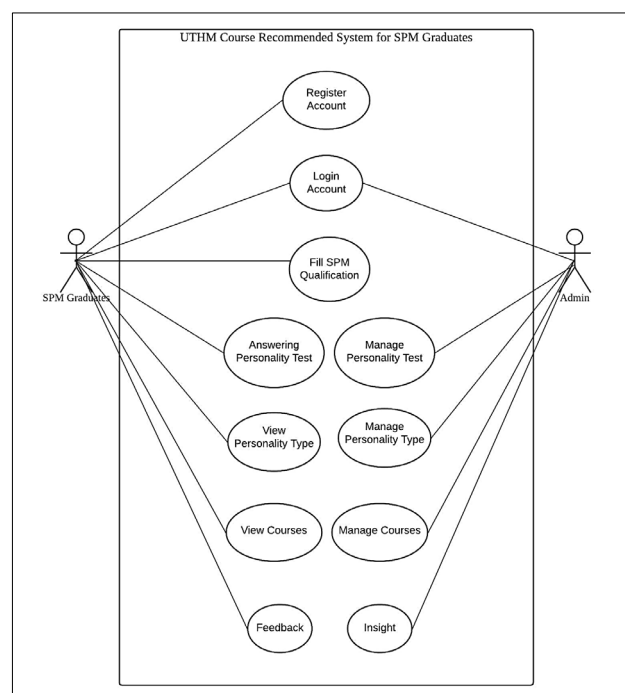


Figure 1: Use Case Diagram

3.2.2 Sequence Diagram

A sequence diagrams show a single use case's scenario or series of events. The sequence diagram's message flow is determined by the narrative of the specific use case and be shown in the Figure 2 below.

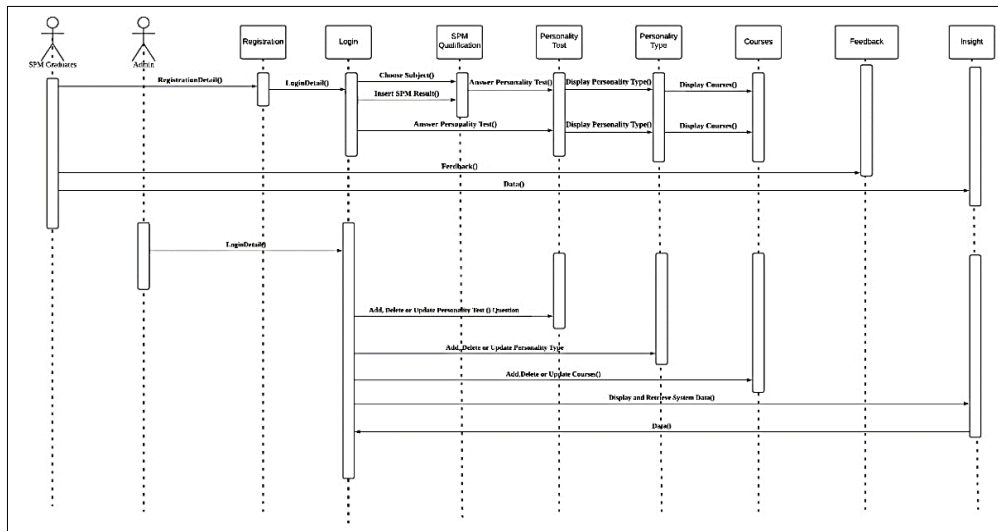


Figure 2: Sequence Diagram

3.2.3 Activity Diagram

An activity diagram illustrates business and software operations as a series of actions made by people, software components, and computers. These diagrams are used to document the implementation of system processes as well as to define business processes and use cases. As shown in Figure 3 (a) is the activity diagram for user and figure 3 (b) is the activity diagram for admin.

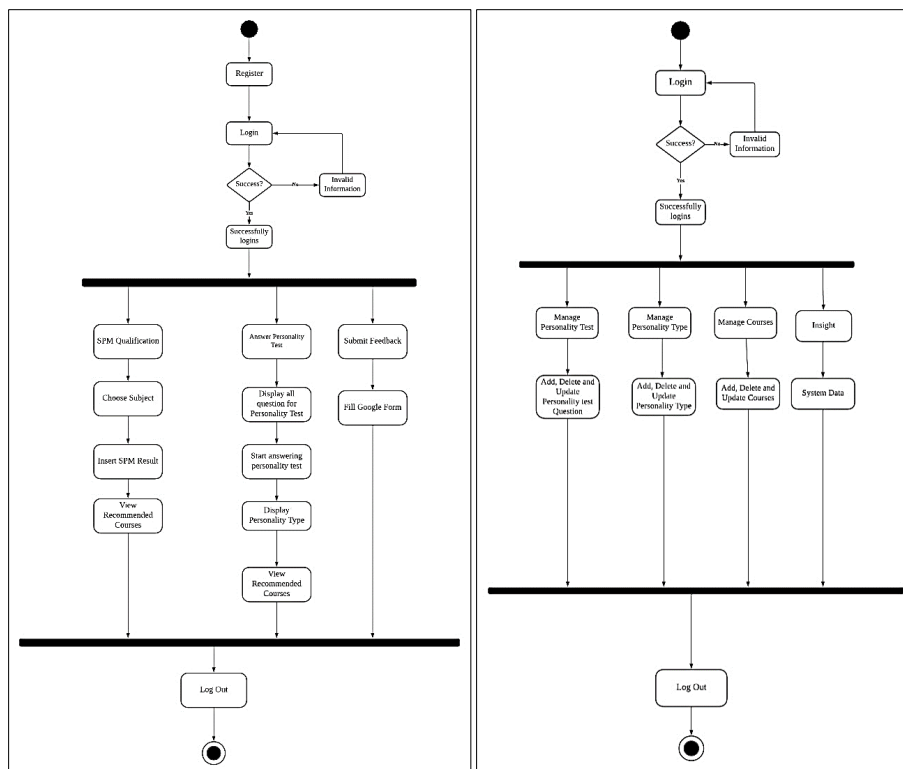


Figure 3(a): Activity Diagram for User Figure 3(b): Activity Diagram for Admin

3.2.4 Class Diagram

In object-oriented modelling, class diagrams are the most basic component. They're used to display the various objects in a system, as well as their attributes, operations, and interconnections. Figure 4 shows the class diagram for UCRS system.

3.2.4.1 Database Design

Database design refers to a set of procedures that make it easier to plan, create, implement, and maintain enterprise data management systems. A good database design will be more easy to manage and may increases data consistency, and saves money on disc storage space.

- I. SpmGraduates (UserId, Name, Email, Phone, Gender, Password, Date, Time)
- II. Admin (AdminId, AdminName, Password)
- III. SpmQualification (Id, SubjectName, Grade)
- IV. PersonalityTest (Id, QuestionName)
- V. PersonalityType (Id, TypeCode, TypeName)
- VI. Courses (Id, CourseName)

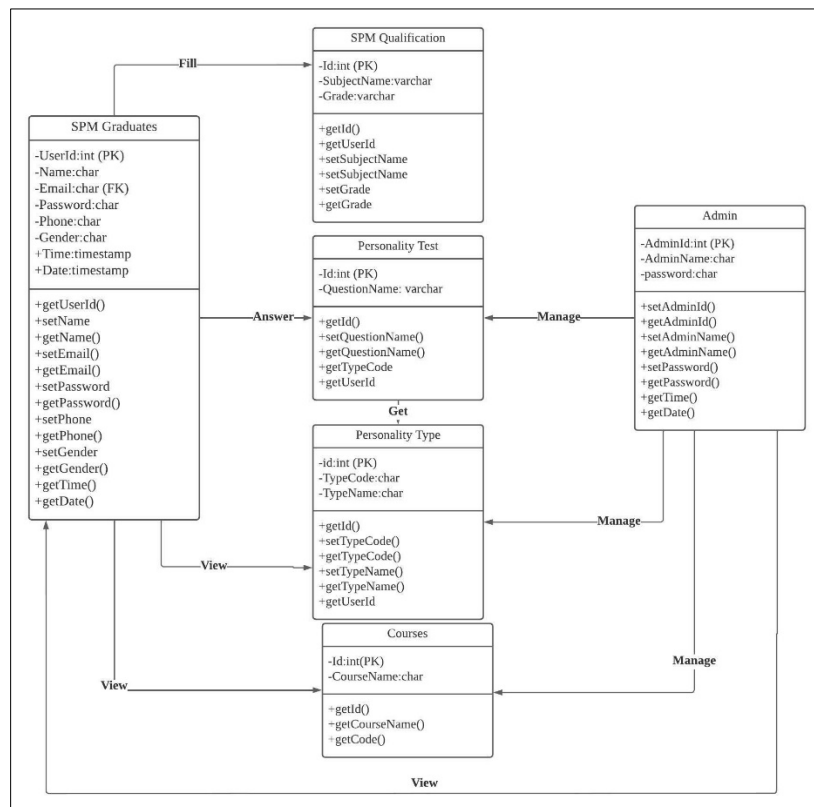


Figure 4: Class Diagram

3.2.5 Interface Design

The visual layout of the elements that a user might interact with in a website or technical product is referred to as user interface design, or UI design.

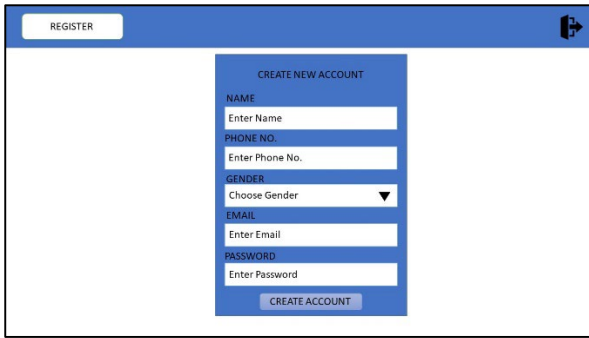


Figure 5(a): Interface Design for User's Registration

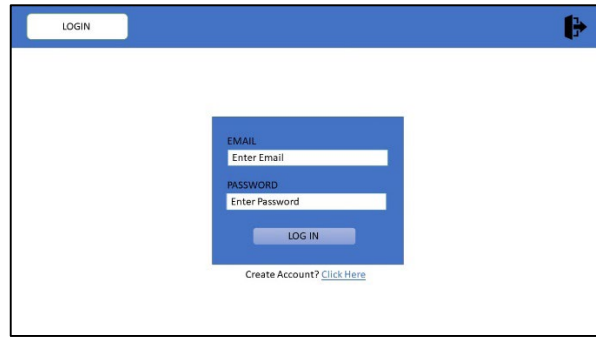


Figure 5(b): Interface Design for Login



Figure 6: Interface Design for SPM Qualification

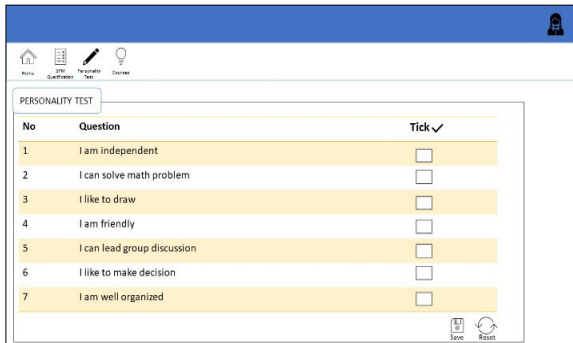


Figure 7(a): Personality Test Interface for User

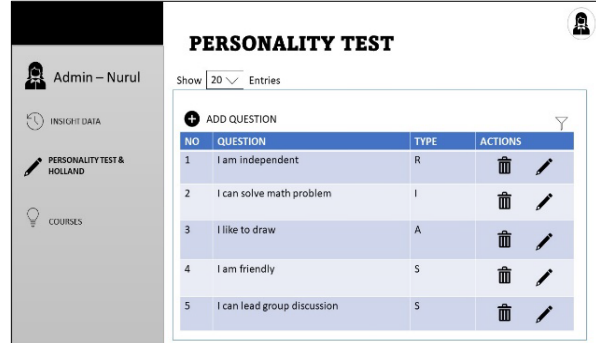


Figure 7(b): Personality Test Interface for Admin



Figure 8: Personality Type Interface Design

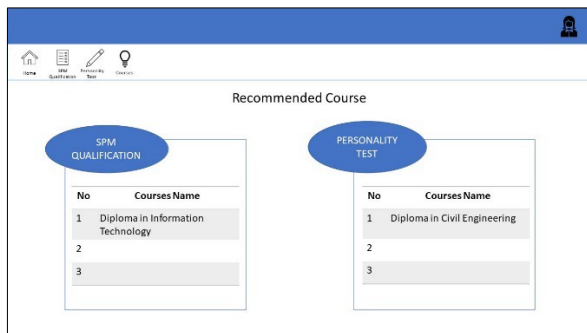


Figure 9(a): Courses Interface Design for User

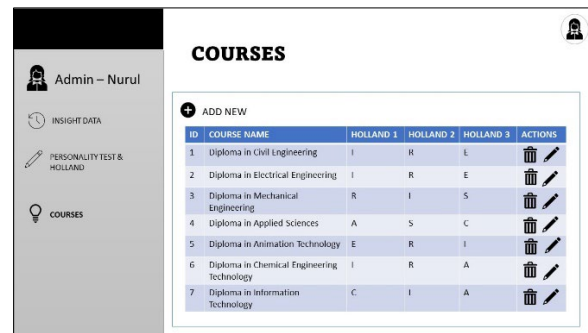


Figure 9(b): Courses Interface Design for Admin

3.3 Implementation

To develop the UCRS system, Php is the language used along the development of each module. Visual Studio Code be the code editor and mySql as the database type along with phpMyAdmin as the client for the database. The Laragon as server applications that works to develop this system.

Table 3: Software Requirements

No.	Type	Software
1.	Operating System	Microsoft Windows 10
2.	Programming Tool for coding purpose	Visual Studio Code
3.	Server Application	Laragon
4.	Database	PhpMyAdmin
5.	Programming Language	Hypertext Pre-Processor

3.3.1 Database Connection

MySQL as the database and phpMyAdmin as the client for the database and can directly be the editor. Laragon will be the environment to run the UCRS and database. Figure 10 below shows the coding segment of database connection for UCRS system.

```

'connections' => [
    'sqlite' => [
        'driver' => 'sqlite',
        'database' => env('DB_DATABASE', database_path('database.sqlite')),
        'prefix' => '',
    ],
    'mysql' => [
        'driver' => 'mysql',
        'host' => env('DB_HOST', '127.0.0.1'),
        'port' => env('DB_PORT', '3306'),
        'database' => env('DB_DATABASE', 'forge'),
        'username' => env('DB_USERNAME', 'forge'),
        'password' => env('DB_PASSWORD', ''),
        'unix_socket' => env('DB_SOCKET', ''),
        'charset' => 'utf8mb4',
        'collation' => 'utf8mb4_unicode_ci',
        'prefix' => '',
        'strict' => true,
        'engine' => 'InnoDB',
    ],
],
    
```

Figure 10: Code Segment for MySQL Database Connection

3.3.2 Registration Page

Figure 11 (Appendix A) shows the register interfaces for new users. To start use the system, the users should sign up and create an account before proceeding to login into the system. User's data will be

stored in the database and user can easily login after that since they successfully sign up an account. Different with admin since admin's data was already store in the database, so, admin can directly login by inserting their registered details.

3.3.3 Login Page

Figure 12 (Appendix A) shows the login interface for user and administrator. They need to insert their registered email address and password to login to the system. Error messages will be displayed if the credential of the email or password does not match to the records in the database. If users are forgetting their password, users can directly click to forgot password button to reset new password.

3.3.4 Dashboard page

Figure 13 (Appendix A) shows the dashboard page for the users. After they successfully login to the system, they will directly go to dashboard page where the step on how to use the system are shown. Any new progress on the system will be shown on the dashboard.

3.3.5 SPM Qualification Page

This module asked the users to insert the SPM form that containing the Subjects they took during SPM and the grades of each subject. The users to insert the real SPM's result to generate the suitable courses for them. The users also can renew the SPM Qualifications and save the progress. Figure 14 (Appendix A) shows the SPM qualification page for the user.

3.3.6 Personality Test Page

This module will let the users to answer personality test that will help the users determine their courses. The personality test page will display two types of tests. So, the users can choose either quick or advance type of test since they are containing the same questions but different method of answering. For admin, they can manage all personality test questions by edit the question and the personality type involve which is the holland code. Figure 15 (Appendix A) shows the personality test page (a) for user and (b) for admin.

3.3.7 Personality Type Page

This module will display personality type of users based on J. Holland Theory that consists of six holland code which is Realistic, Investigative, Artistic, Social, Enterprising and Conventional. This personality type was generated based on the personality test that users answered. The percentage of personality type that suit with the users will also be display. Only top three personality type will be display along with the description of each personality type. Figure 16 (Appendix A) shows the personality type page.

3.3.8 Courses Page

This module will recommend the best courses that users can take based on personality test or SPM. The courses were generated after user fill up the SPM qualification or answering personality test. Admin can manage the courses by edit the courses available for diploma level in UTHM along with the related personality type for each course. Figure 17 (Appendix A) shows the courses page (a) for user and (b) for admin.

3.3.9 Insight Page

This module is for admin. It will display data about the system such as number of users of the system, total subject in the system and also total courses available. It will be easy for admin to notice any new activities happening in the system. Figure 18 (Appendix A) shows the insight page.

3.3.10 Feedback Page

This module will allow user to submit their feedback. The user will be directed to google form page where the feedback can be made there. The users are required to insert their email address and answering

questions given and lastly write their comments about the system for future improvements. Figure 19 (Appendix A) shows the feedback page.

3.4 Testing

After succeeding to deploy the system, alpha testing and beta testing has been conducted. It is one of the important steps before launching the final product of the website to the users since any maintenance or improvement still can be made here.

4. Result and Discussion

In this testing phase, UCRS system is tested and documented using the functional system testing and testing to support users. Tests should be done to determine whether the application contains any error and meet the needs of project requirements. The results of functional testing for the application are shown in section 4.1 while results for user acceptance test will be displayed in section 4.2

4.1 Alpha Testing

The alpha testing can be described as the testing on functionals and features of the application. This testing will determine that the system functions properly according to the expectations. The test elements based on many test cases of each module already integrate with the test plans.

As shown in table 4, the test case for registration module will allow new users to register an account before login to the system. Table 5 illustrate the login test case for login module where user and admin can insert their email and password to login. Move to Table 6 where test case for SPM Qualification will be test and user can choose number of subjects, the subjects and grades. Table 7 shows the test case for Personality Test and user can answer personality test questions while admin can manage the personality test questions. After that, table 8 shows the test case for personality type where user can view their personality type after answering personality test. Test case for the Courses is shown in Table 9 where users can view their recommended courses based on SPM and Personality Test while admin can manage the courses available in UTHM. Table 10 shows the test case for insight that is used by admin to monitor the system's data. Lastly is test case feedback are shown in Table 11 where user can submit their feedback there.

Table 4: Test Cases for Registration Module

No	Test Cases	Expected Output	Actual Output
1.	Sign Up for new user	Sign Up successfully and can log in	As expected
2.	Incomplete Phone Number (<11 digits)	An error message is displayed to enter a valid phone number	As expected
3.	Wrong Password Format	An error message is displayed to enter valid password	As expected
4.	Blank Space	Error message displayed	As expected
5.	Successfully Registered an Account	A 'Successfully Registered' message will be display and user will be redirected to login page	As expected

Table 5: Test Cases for Login Module

No	Test Cases	Expected Output	Actual Output
1.	Log in using email and password	Successfully log in	As expected
2.	Forgot Password	Redirect to new reset password page	As expected
3.	Invalid email and Password for Log In	Error message displayed	As expected

Table 6: Test Cases for SPM Qualification Module

No	Test Cases	Expected Output	Actual Output
1.	Choose Number of Subject	Multiple Choices of number will be displayed	As expected
2.	Choose Subject	Display all subjects for SPM level and choose the subject	As expected
3.	Save the progress	All the data will be saved for future used	As expected
4.	Re-Save	The users can rechoose again all the number of subjects until the subject	As expected

Table 7: Test Cases for Personality Test

No	Test Cases	Expected Output	Actual Output
1.	Choose Between two types of tests whether simple or advanced	Directed to desired page	As expected
2.	Answering all the questions	Successfully answer and submit	As expected
3.	Manage the questions and holland code involve	Can edit the questions and the holland code	As expected

Table 8: Test Cases for Personality Type

No	Test Cases	Expected Output	Actual Output
1.	Display Personality Type after answering Personality Test	Personality Type of the users are display accordingly	As expected

Table 9: Test Cases for Courses

No	Test Cases	Expected Output	Actual Output
1.	View Courses based on SPM Qualification.	Redirect to page that display the courses based on SPM Qualification	As expected
2.	View Courses based on Personality Test.	Redirect to page that display the courses based on Personality Test	As expected
3.	Manage Courses for diploma in UTHM	Able to edit the courses and holland code involve	As expected

Table 10: Test Cases for Insight

No	Test Cases	Expected Output	Actual Output
1.	View System's Data	Display number of users, number of subjects and number of courses.	As expected

Table 11: Test Cases for Feedback

No	Test Cases	Expected Output	Actual Output
1.	Write Feedback	Redirect to Google Form Page.	As expected
2.	Submit Feedback	Thankyou message will be displayed and user will redirect to Homepage	As expected

4.2 Beta Testing

Beta testing will test the beta version of UTHM Course Recommender System for SPM Graduates. It will be evaluated by SPM Graduates via google form. Total of 4 respondents are collected and they tested on this laptop. Figure 20 shows the result for evaluation of system features while Figure 21 shows the results for evaluation of interface.

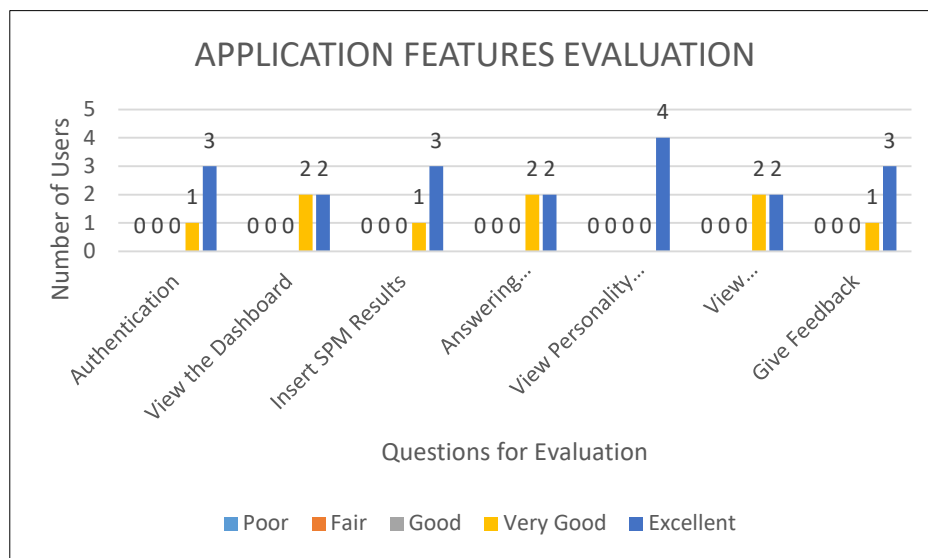


Figure 20: Result for System Features Evaluation

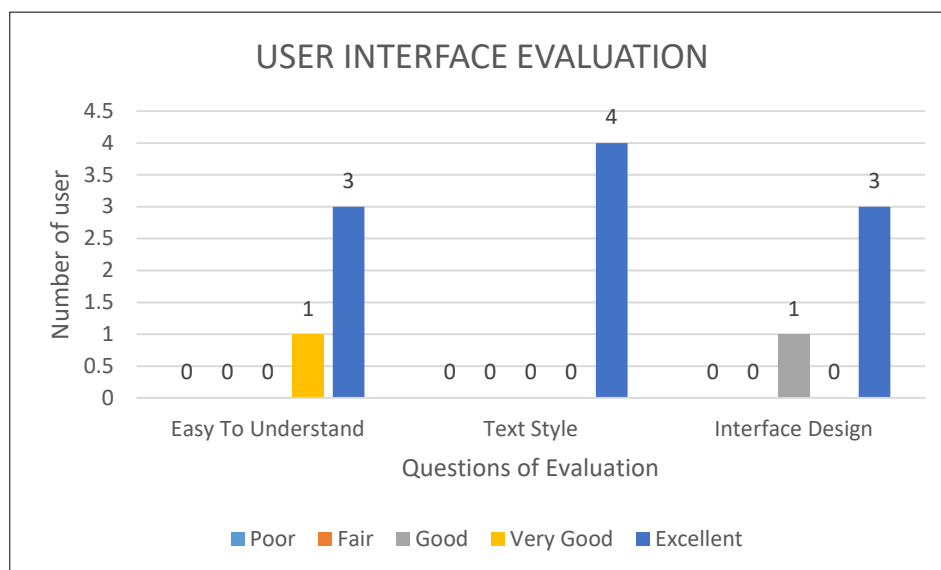


Figure 21: Result for User Interface Evaluation

5. Conclusion

In conclusion, UTHM Course Recommender System for SPM Graduates has successfully developed. Few advantages, limitations and future improvements of the system were identified.

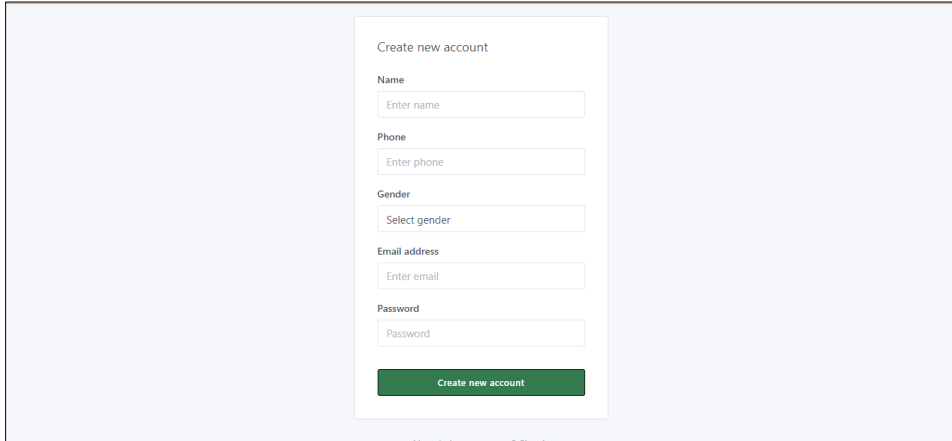
The advantages of the system are users can easily get more information about diploma in UTHM. Besides that, personality test in an add-value for user to determine their courses and lastly students can choose the best courses for them. The limitation of the system is surely the internet connection where user need to have access to internet to using the system. Besides that, the recommendations of the course could be more than one.

For future improvements, few suggestions will be done in order to make an improvement to the system such as system can also be used offline. Next, the system should only focus to recommend one course only and lastly, the system should do notification functions where user can get to know new update about the system.

Acknowledgement

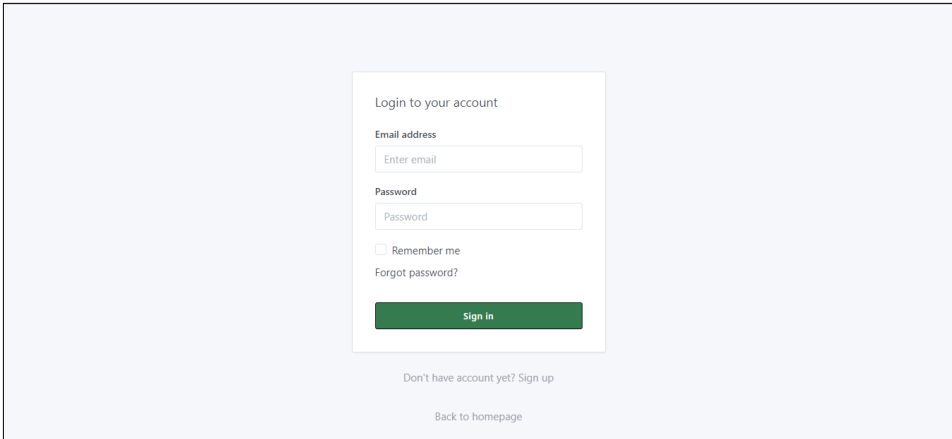
I would like to use this opportunity to the Almighty God who is always guide me and give me a desired to work on the right track of life. Without his willingness, this study might not be a reality. Secondly, a bunch of thanks I would like to give to both of my parents for their spiritual, encouragement and time to lend me their thoughts and spirit to me along this journey. Without them, especially their prayers, I would not be able complete this project successfully. Thirdly, I would like to express my thanks to my lovely supervisor, Dr. Nurezayana Binti Zainal for her support and guidance helping me in this journey of study since most of the time she would give me advice and help me to correct me if I am wrong. Comments and guidance from her meant a lot to me to finish up this project, Lastly, I am grateful to have such a nice group of friends that always help each other to completing this study together. For all I mentioned above, they help me so much along my journey of study.

Appendix A



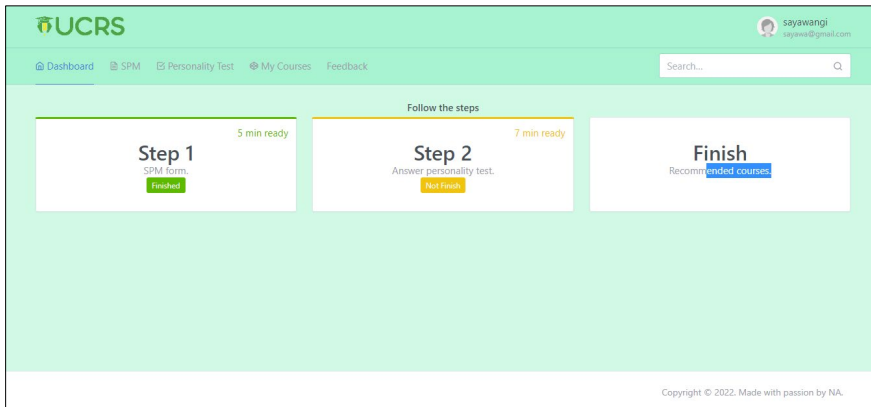
The screenshot shows a registration form titled "Create new account". It contains the following fields: "Name" (text input), "Phone" (text input), "Gender" (dropdown menu), "Email address" (text input), and "Password" (text input). A green "Create new account" button is located at the bottom of the form. Below the form, there is a link that says "Already have account? Sign in".

Figure 11: Registration Page



The screenshot shows a login form titled "Login to your account". It contains the following fields: "Email address" (text input) and "Password" (text input). Below the password field, there is a checkbox for "Remember me" and a link for "Forgot password?". A green "Sign in" button is located at the bottom of the form. Below the form, there is a link that says "Don't have account yet? Sign up" and a link that says "Back to homepage".

Figure 12: Login Page



The screenshot shows a dashboard page for "UCRS". The header includes the UCRS logo, a user profile for "sayawangi" with email "sayawa@gmail.com", and a search bar. The main content area is titled "Follow the steps" and contains three cards: "Step 1" (SPM form, 5 min ready, Finished), "Step 2" (Answer personality test, 7 min ready, Not Finish), and "Finish" (Recommended courses). The footer contains the text "Copyright © 2022. Made with passion by NA."

Figure 13: Dashboard Page

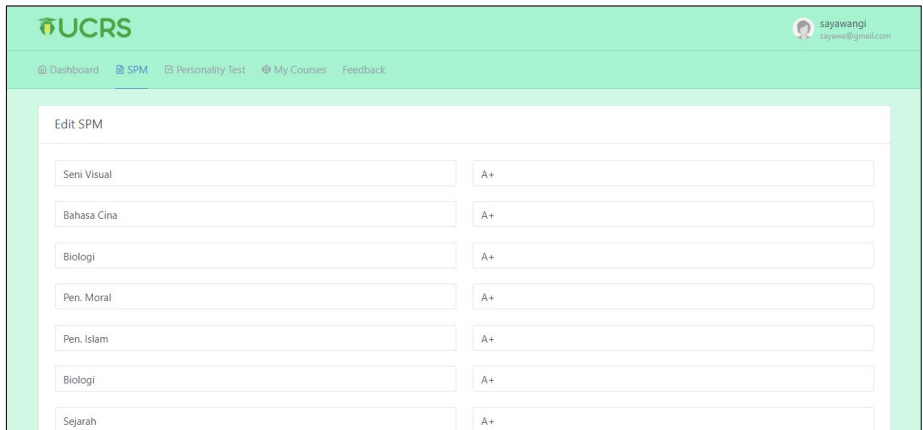


Figure 14: SPM Qualification Page

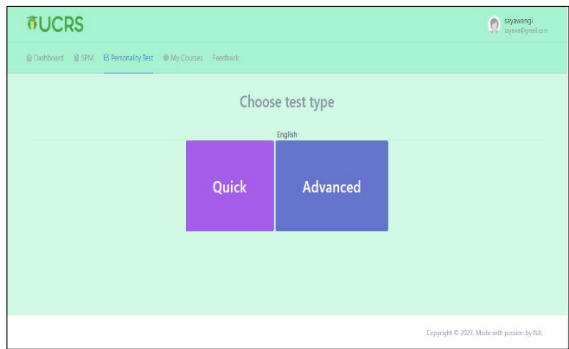


Figure 15(a): Personality Test Page for User

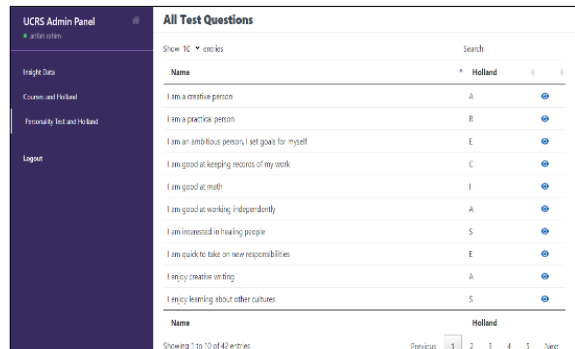


Figure 15(b): Personality Test Page for Admin

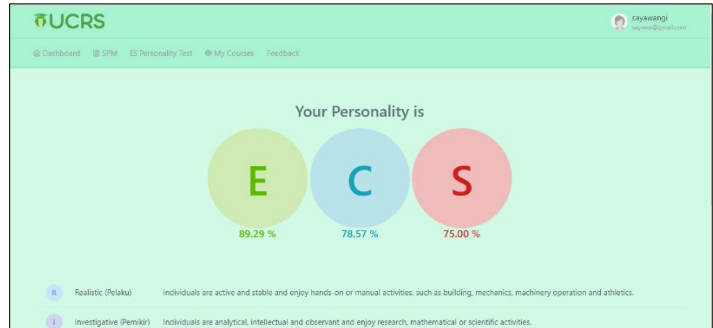


Figure 16: Personality Type Page

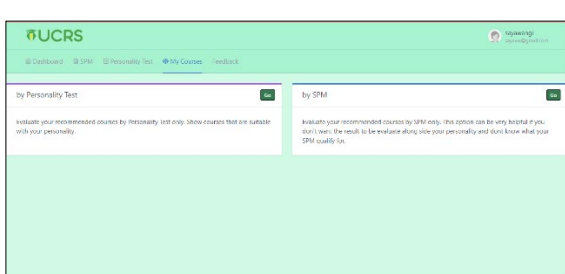


Figure 17(a): Courses Page for User

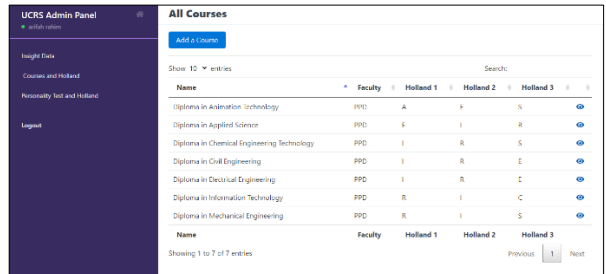


Figure 17(b): Courses Page for Admin

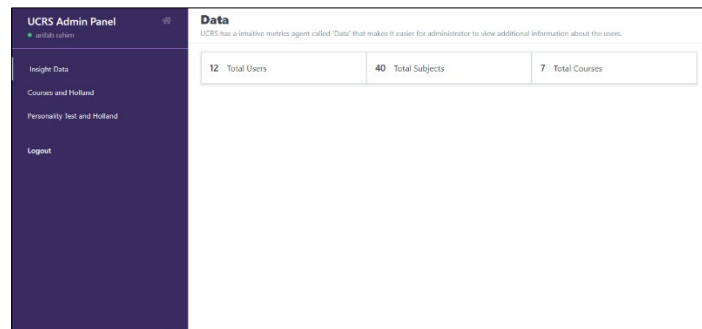


Figure 18: Insight Page

Figure 19: Feedback Page

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