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UTMSPACE Research Grant Management System

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***Abstract*—The "UTMSPACE Research Grant Management System" is a web application designed to improve the efficiency and accessibility of managing grants for both administrators and applicants. The current manual process, involving paper forms and departmental submissions, leads to delays, tracking difficulties, and increased administrative workload due to human errors and misfiling. The new online platform addresses these issues by enabling seamless submission and management of applications, budget matters, and other grant-related information. The system aims to streamline the application process, enhance user-friendliness, and replace traditional methods. It will be developed using HTML, CSS, PHP, MySQL, and JavaScript, following an Agile methodology to ensure continuous collaboration between developers and stakeholders. The ultimate goal is to enhance the management of research grants, promoting efficiency, accessibility, and user satisfaction, and contributing to the advancement of research endeavors. By transitioning to this digital system, we anticipate a significant reduction in processing times, with the potential to decrease the time spent on application processing by 50-70%. Additionally, the system is expected to reduce human errors by 60-80%, leading to more accurate and reliable grant management. These improvements will not only enhance the overall user experience but also contribute to more effective and streamlined research grant administration.**

***Keywords*—UTMSPACE Research Grant Management System, Web Application Development, Software Engineering**

I. INTRODUCTION

A. Problem Background

The current system of the project is working by manual. The application form was filled in by the project leader and needed to be sent out to the department. Since all the processes are manual, the users did not know the application status was as soon as possible. It takes time to let the project leader know the progress. Other than that, the impact of the current system is that the staff's tasks become more difficult to handle.

The main reason for the system project is to make sure users can apply for the application online. Developing this website system will be beneficial to the staff and the users. For instance, the staff's tasks will become easier to handle for all the researchers and the users will be able to access the system anytime and anywhere. There will be a lot of improvements that this project will produce to the benefit of the system.

UTMSPACE Research Grant Management System was made for the convenience of the admin to know the details for all the application easily and for the users to apply the application online. The benefit for the "Bahagian Pengurusan Penyelidikan dan Sumber Pembelajaran" (BPSP) from implementing this system is that they will be able to improve and standardize their system performance. The main goals of developing this system are to ensure that high-quality systems are delivered and to maximize the system's productivity. The purpose and goals of introducing this system are to increase operational efficiency and ensure that the system runs smoothly in the long run. We will look forward to increasing the accuracy of data that is used by the admin and the applicant. The system also will be created and designed according to our plans and will be updated in the future.

B. Project Objectives

The objectives of the project are:

- To identify the user requirements will be analyzed based on what users want for the application.
- To develop and design a web application system for UTMSPACE Research Grant Management System based on the requirement.
- To evaluate and test the application using user acceptance testing.To investigate the requirements needed in developing a new platform of E-Counselling Management System in UTM.

II. COMPARISON OF THE EXISTING SYSTEM

A. Current System Analysis & Comparison

Table I below shows the comparison to these three websites, UTMSPACE Research Grant Management System will have the same features such as user and admin login description. Features such as a view history application will be incorporated in the system. Users can view all their applications and admin gets to view and monitor the user's application. Besides that, the generate letter also will be included where the system will generate the approval letter to the user after user's application has been approved. Furthermore, the status also will be included for user and admin to get to know their status of the application, budget, and declaration while the menu- driven interface will also be incorporated based on the user requirement

TABLE I. COMPARISON OF THE EXISTING SYSTEMS

Features	***Malaysian Greater Research Network System (MYGRANTs)***	***UITM Portal for Research and Innovation Management (PRIME) System***	***UniKL Grant Management System (UGMS)***	***UTMSPACE Research Grant Management System (Proposed System)***
User Registration	Yes	No	Yes	Yes
Choose Grant Application Type	Yes	Yes	No	Yes
Choose Wages Application Type	No	No	No	Yes
Activity Application	No	No	No	Yes
Progress Report	No	No	No	Yes
Completion Application	No	No	No	Yes
Payment Application	No	No	No	Yes
Claim Application	No	No	No	Yes
Choose Wages Application Type	No	No	No	Yes
Budget	Yes	Yes	No	Yes
Application Status	Yes	Yes	Yes	Yes
Declaration Status	Yes	Yes	Yes	Yes
View History Application	Yes	Yes	Yes	Yes
Edit and Add Application	No	Yes	Yes	Yes

III. PROJECT METHODOLOGY

A. Methodology Choice & Justification

Agile methodology is the chosen system development methodology for this project. It has been broadly used in today's system development for its reliability and based on reviews instead of processes. Besides acquiring system requirements with the stakeholders where enhancement of the project easily accessible based on their feedback and criticism, agile is also a process of managing a project that involves regular collaboration and working in iterations (Asana, 2024).

The Table II below shows the phases of Agile Methodology in this project.

TABLE II. PHASES OF AGILE METHODOLOGY

Phases	**Activity**
Planning	The initial phase of Agile is to enable a comprehensive understanding of project objective that is aligned with stakeholder expectations. To achieve this, the project will work closely with stakeholders to recognize and prioritize essential software features and requirements. An interview session was conducted with Mrs. Nor Azliana Binti Ramali, the senior executive for Division of Digital Technology, at UTMSPACE office in Taman Universiti to identify problems on the current system that had been explained in introduction. The requirements given by the stakeholder such as user requirement, workflow, role, and manual form are compiled into an excel file for easy reference and can assist in the development process of this system as attached in Appendix B. Furthermore, In Appendix C is the formalized Letter of Intent (LOI) as an agreement to the project collaboration with the stakeholder. As a whole, the objective of this phase is to ensure that the project is on the right track and understand the stakeholder's needs and preferences.
Design	To build a system that meets current user requirements, information collected during the previous phase will be used and specifically designed to meet user requirements in the development of this system include system architecture, interface design, and database design. Enterprise and Figma are the two software tools used to design system architecture and interface design. While Enterprise Architect is used to design use case diagram, activity diagram etc. Figma is used for designing the interface design. This allows stakeholders to visualize the user interface design and provide feedback. To get an overview of the architecture and interaction between entities involved in the UTMSPACE Research Grant Management System, the requirements gathered in the previous phase of the UTMSPACE Research Grant Management System and more technical information is provided in Appendix E's Software Design Description (SDD) and Appendix F's Software Testing Description (STD).
Development	In the development phase, the product program code is developed in line with the design document specifications while actual code is written, and the application is constructed in line with the design documents and defined requirements. When it is developed, HTML, PHP, MySQL, JavaScript, and CSS are the programming languages and Visual Studio Code and MySQL Workbench are the tools used for writing the code and managing database that will be utilized in the Research Grant Management System. The selected programming language is used to build dynamic and interactive web pages. The development phase will start

Phases	Activity
	to build slowly based on the requirements given by stakeholder. It will undergo many changes while developing the system.
Testing	This phase is designed to guarantee that all user criteria and objectives are met. In this testing phase, in order to identify logic flaws and ensure that the needed user output is effectively produced, it is necessary for a collaboration between system developers and users to assess the efficiency of the prototype that has been generated. To guarantee that no errors occur when output is generated, the prototype built, known as the UTMSPACE Research Grant Management System will be tested with various inputs. For the programming code to be corrected, any sort of faults will need to be documented. Data collected during the testing phase, such as output changes, database modifications, and design changes, will be used to establish the prototype's capability. Additionally, this phase uses black-box testing and user acceptance testing (UAT) methodologies. In the absence of programming code, the external testers use black-box testing to evaluate the system's output. For example, to see how the system reacts to test orders, testers will examine each system function by entering accurate or erroneous inputs. The primary goal of user acceptance testing is to ensure the system meets user requirements and functions as intended in real-world scenarios. UAT relies on the tester's desire to assess the overall efficacy and user-friendliness of the system from an end-user perspective.
Deployment	In the development phase, the product program code is developed in line with the design document specifications while actual code is written, and the application is constructed in line with the design documents and defined requirements. When it is developed, HTML, PHP, MySQL, JavaScript, and CSS are the programming languages and Visual Studio Code and MySQL Workbench are the tools used for writing the code and managing database that will be utilized in the Research Grant Management System. The selected programming language is used to build dynamic and interactive web pages. The development phase will start to build slowly based on the requirements given by stakeholder. It will undergo many changes while developing the system.
Review	The Agile methodology facilitates incremental enhancements and adjustments by means of continuous application review and evaluation, culminating in the production of a superior and user focused UTMSPACE Research Grant Management System. To make sure the application runs well and complies with requirements, performance, security, and compatibility tests are also conducted during the review process. In order to find any possible problems or faults, this step entails carrying out extensive testing and quality assurance procedures. To assure the application satisfies the required functionality and usability, it is tested against the specified requirements. Future iterations and upgrades of the programme will consider the feedback and ideas provided by users.

B. Technology and Tools Used

For the documentation, Enterprise Architecture (EA), and Figma are used for UML modelling and user interfaced design. For development, Visual Studio Code is used as code editor, and XAMPP as the database management tool.

IV. REQUIREMENT ANALYSIS AND DESIGN

A. Requirement Analysis

1) Functional Requirements

Functional requirements show the common tasks that the users will conduct in a system. Table III shows the functional requirements extracted during the requirement elicitation process

TABLE III. FUNCTIONAL REQUIREMENTS

Functional Requirements	Description
Register	Allow user to register an account before using the system to apply grant.
Login	Allow user, admin HOD BPSP, admin BPSP, admin deputy chairman, admin manager, admin assistant manager and admin executive logging into the system to use the function for each user.
Choose Grant Application Type	Allow user to select a grant application type and fill in the required information through an online system based on the chosen type.
Choose Wages Application Type	Allow user to select a wages application type and fill in the required information through an online system based on the chosen type.
Payment Application	Allow user to fill in the required information through an online system.
Activity Application	Allow user to fill in the activity details through an online system.
Preliminary Application	Allow user to fill in the required information through an online system.
Claim Application	Allow user to fill in the claim details through an online system..
Progress Report Application	Allow user to fill in their progress report through an online system.
Completion Application	Allow user to fill in the complete project details through an online system.
Manage Application Status	Allow admin HOD BPSP to manage all user's application.
Manage Budget Status	Allow admin HOD BPSP to manage all user's budget application status.
Review Budget	Allow admin HOD BPSP to manage all user's budget application details.
Add Budget	Allow user to apply for budget and fill in the budget details.
Manage Declaration Status	Allow admin manager, admin executive and admin deputy chairman to declare all user's application.
View form	It will display all the details that user applied in a form. It also allow user to print the form for hardcopy.
View History Application	It will display all the list of applications that user applied. Allow user to view all their applications in history application. While for admin, they can view all the user's application information.
Manage Application Details	Allow user to edit, add or delete their application details such as group member, research projects,

Functional Requirements	Description
	academic publication, resources, and budget.
View Application Details	Allow user to view all their application details based on selected on the list from history application.
View Letter	Allow user to view approval letter after their applications have been approved by admin.

The requirements are converted into use case diagram as Fig. 1 below.

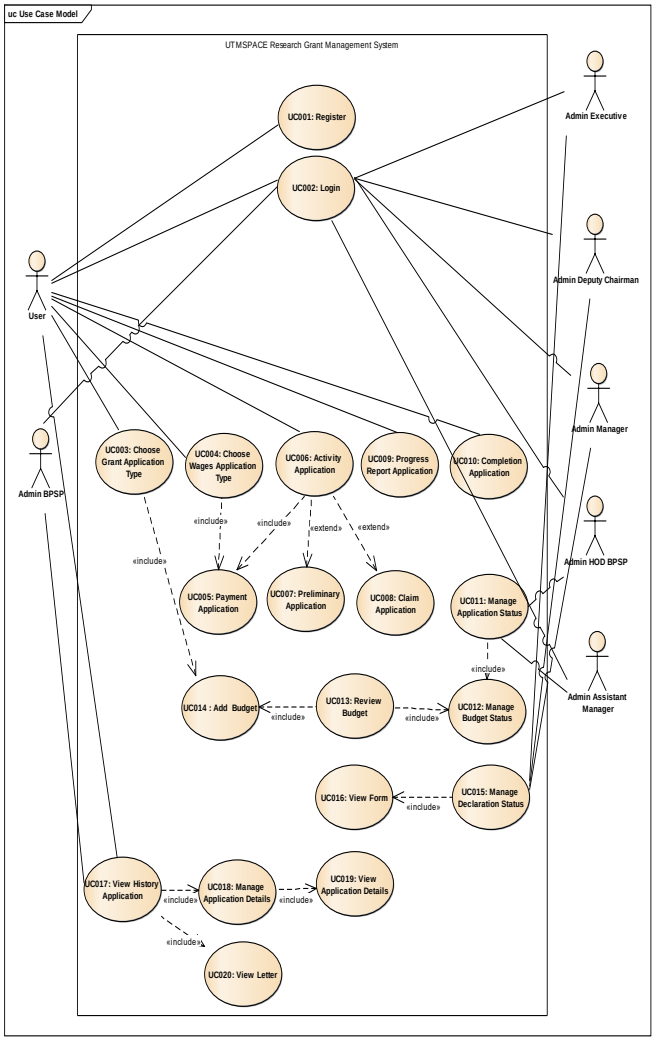


Fig. 1. Use Case Diagram of UTMSPACE Research Grant Management System

Each of the use cases are described further in detail using use case specification, activity diagram and sequence diagram.

2) Non-Functional Requirements

The non-functional requirements of this system are described as Table IV below:

TABLE IV. NON-FUNCTIONAL REQUIREMENTS

Non-Functional Requirements	Details
Usability	The system can be opened by more than one user.
Reliability	The system should execute as expected without returning any issues. When launched, the system shall stay running unless there is an intentional shutdown of the application of the platform

B. System Design

The UTMSPACE Research Grant Management System utilizes a client-server architecture with two main components: the client and the server. The client, which can be a specialized app or web browser, interacts with users, handles form completion, request submissions, result presentation, and manages user authentication and authorization. The server handles data processing, storage, and application logic. It processes user requests, performs necessary operations, and communicates with the database to retrieve or store data before responding to the client. This design ensures efficient and secure management of user interactions and data processing.

Fig. 2 and Fig. 3 below shows package and class diagram of this system.

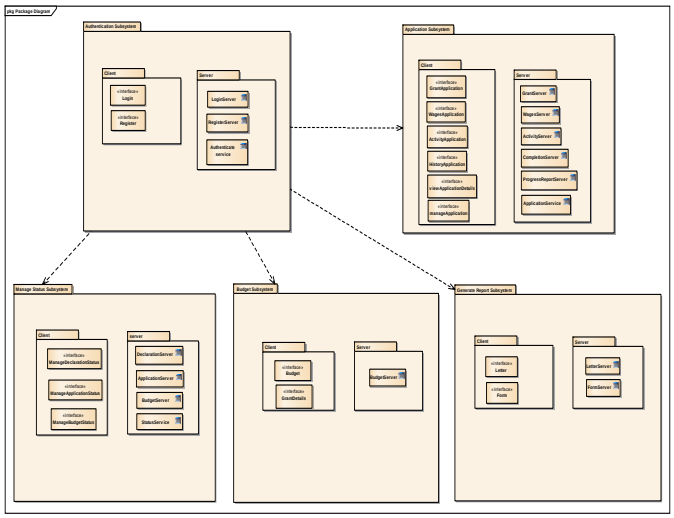


Fig. 2. Package Diagram of UTMSPACE Research Grant Management System

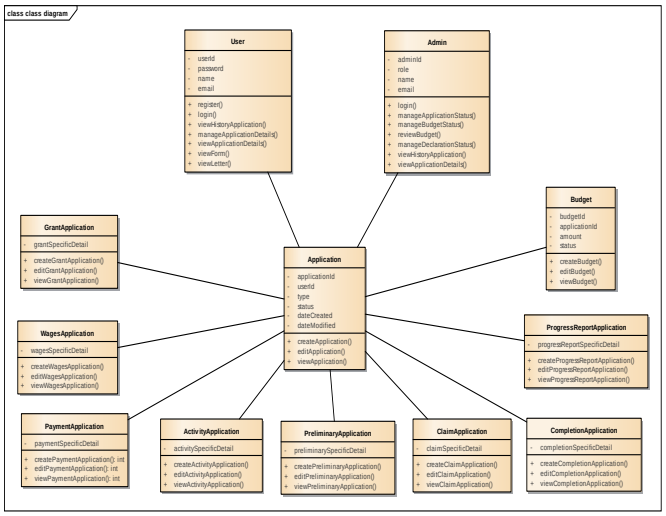


Fig. 3. Class Diagram of UTMSPACE Research Grant Management System

C. Database Design

Fig. 4 below shows the database design represented in Entity Relationship Diagam (ERD).

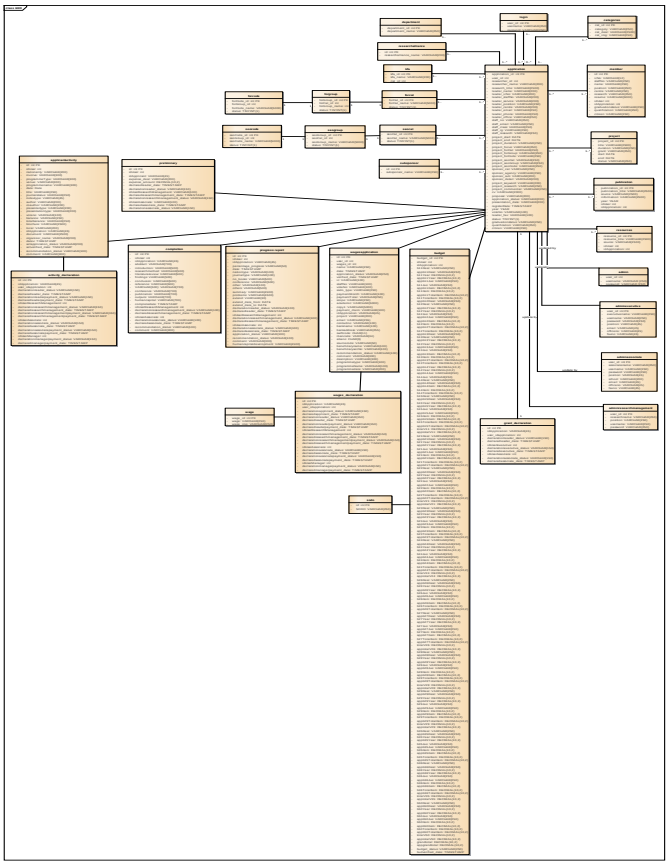


Fig. 4. Entity Relationship Diagram of UTMSPACE Research Grant Management System

D. User Interface Design

The user interface design is important as it communicate directly with the users. Fig. 5 and 6 below shows some of the user interface design for UTMSPACE Research Grant Management System.

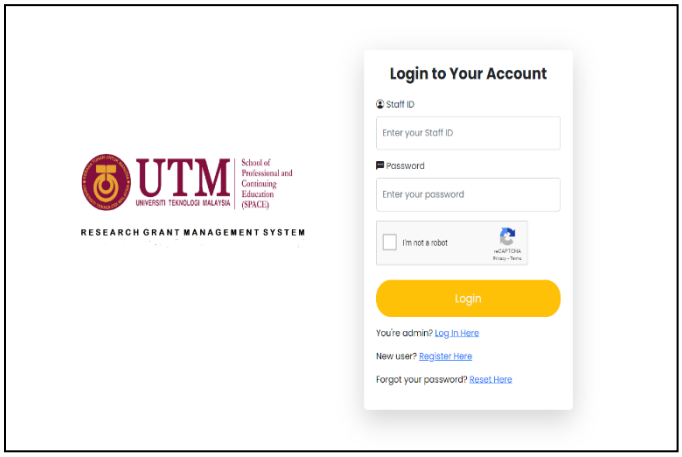


Fig. 5. Login Page for User

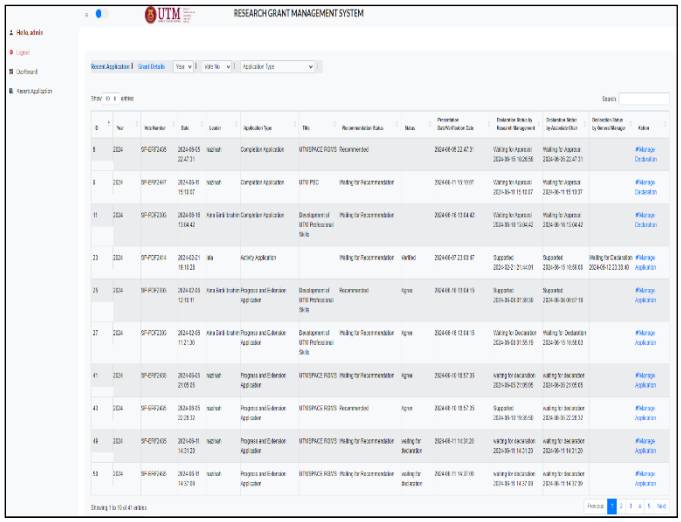


Fig. 6. Home page for admin

V. RESULT, TESTING AND DISCUSSION

A. System Implementation

Visual Studio Code and MySQL Workbench are key tools in developing the UTMSPACE Research Grant Management System, supporting its client-server architecture. Visual Studio Code is used for front-end development, enabling developers to write, organize, and debug client-side code in PHP, HTML, CSS, and JavaScript. It runs on the user's device, such as a computer, smartphone, or tablet, and interacts with the server to retrieve and manipulate data. MySQL Workbench is a server-side tool for managing the MySQL database, facilitating effective data storage, retrieval, and management. Together,

these tools enable developers to build both the client-side and server-side of the application efficiently. The Fig. 7 and 8 below show some of the coding of the system and database.

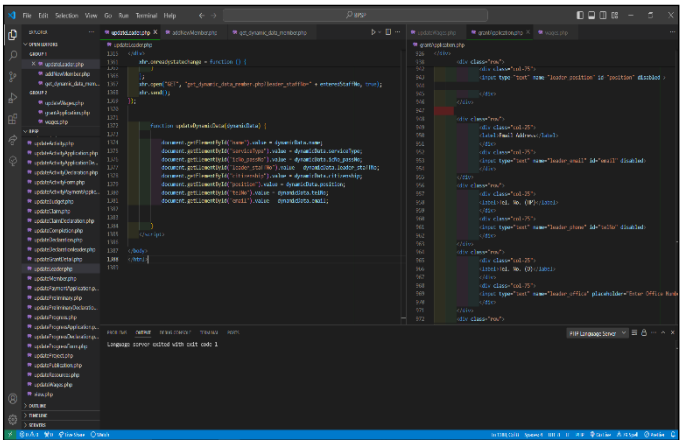


Fig. 7. Visual Studio Code

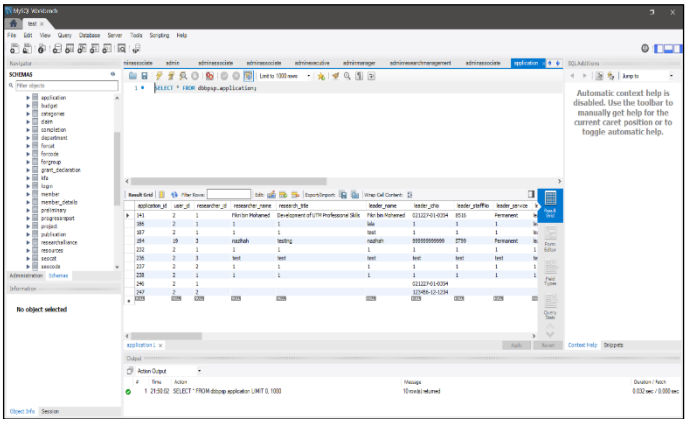


Fig. 1. MySQL Workbench

B. Testing

In this project, two kind of testing are used, which are black box testing and user acceptance testing.

1) Black Box Testing

Fig. 9 below shows that black box testing for use case choose wages application type. The prerequisites are stated such that the condition must be fulfilled before performing the test. Then, the test was carried out by using the test data.The testing focused on ensuring that the system could handle all possible input variations and perform the necessary functions without errors. This will led to the refinement of the validation logic and optimization of the application's responsiveness and to ensure a smoother user experience.

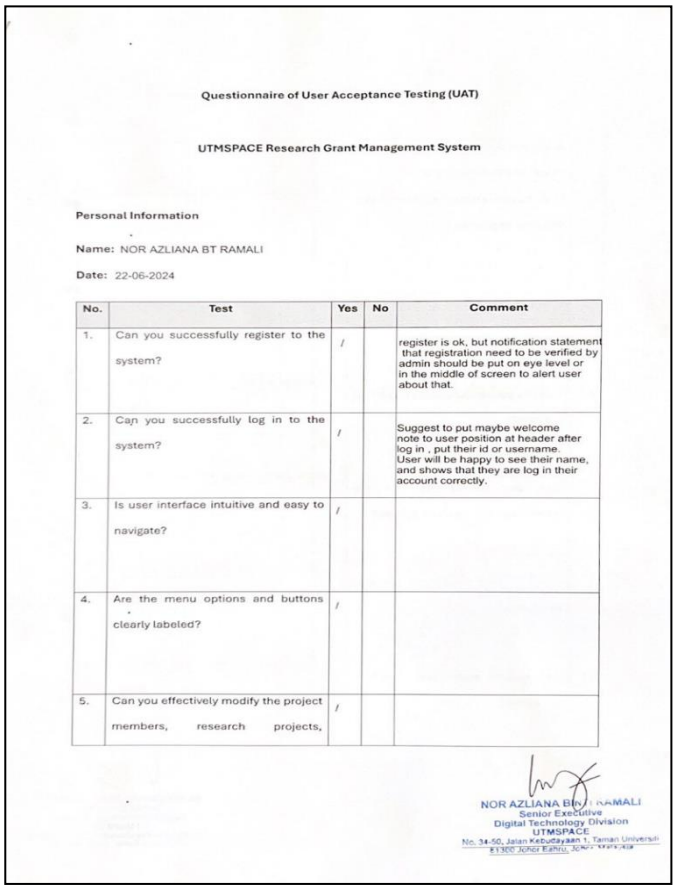
Test Case ID	TC004_01_03	**Date**	23/6/2024
Test Case	Test add wages with no active grant vote number.		
Tester Name	Nazihah Binti Surati	**Version**	1.0
Pre-conditions	1. User is login to the system.		
Test Data	Vote No: SP-ERF2447 Name: nazihah surati Email: nazihah@gmail.com Contact Number: 01110544224 Staff No.: ST1919 Identity Card/Passport No.: 123456-12-4444 Academic Qualification: Please attach file in PDF: degreecert.pdf SODO Code: B11000 Payment RM (Monthly): 100 Total of Payment (RM): 1200 Scope of Work: testing Project Title: UTM PSC Bank Particulars: Bank Name: mbb Bank Address: Taman Eko Botanik Swift Code: MBBEMYKL Source Code: 12345 IBAN Code: MY991234567890 ABA No: 123456789 Beneficiary Name: nazihah surati Beneficiary Account No: 151614098787		

Steps:	**Expected Result**	**Actual Result**	**Pass/Fail**
1. Select vote number to apply wages	Display the selected vote number	The system displays the data based on the selected vote number	Pass
2. Fill out the required information.	Enter the information	Data can be entered	Pass
3.Enter "submit" button	System should display the successful message	The system display "Your application has been processed!"	Pass

Fig. 2. TC004_01_03: Choose Wages Application Type

2) User Acceptance Tesing

User Acceptance Testing (UAT) is carried out to test the UTMSPACE Research Grant Management System. User Acceptance Testing (UAT) is the ultimate testing phase before a system is incorporated into production, and it involves actual users running the system under normal conditions. This testing method is especially efficient in identifying most problems or defects because consumers provide valuable feedback based on their real-world experiences. Fig. 10 below shows the UAT results and comments, which revealed areas needing improvement, such as interface navigation and form field clarity. Based on these insights, adjustments were made to simplify navigation, improve user guidance, and enhance the overall user experience, ensuring that the system met user expectations effectively.



Questionnaire of User Acceptance Testing (UAT)

UTMSPACE Research Grant Management System

Personal Information

Name: NOR AZLIANA BT RAMALI

Date: 22-06-2024

No.	Test	Yes	No	Comment
1.	Can you successfully register to the system?	/		register is ok, but notification statement that registration need to be verified by admin should be put on eye level or in the middle of screen to alert user about that.
2.	Can you successfully log in to the system?	/		Suggest to put maybe welcome note to user position at header after log in , put their id or username. User will be happy to see their name, and shows that they are log in their account correctly.
3.	Is user interface intuitive and easy to navigate?	/		
4.	Are the menu options and buttons clearly labeled?	/		
5.	Can you effectively modify the project members, research projects,	/		

NOR AZLIANA BINTI RAMALI
Senior Executive
Digital Technology Division
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Fig. 3. User Acceptance Testing

VI. Conclusion

A. Achievement of Project Objectives

The objectives that are defined in the planning phase of the project have been achieved. For the first objective, which is to analyze the problems from the stakeholder related to UTMSPACE Research Grant Management System. An interview session was conducted with Mrs. Nor Azliana Binti Ramali, the senior executive for Division of Digital Technology, at UTMSPACE office in Taman Universiti to identify problems on the current system that had been explained in introduction. The requirements given by the stakeholder such as user requirement, workflow, role, and manual form are compiled into an excel file for easy reference and can assist in the development process of this system as attached in Appendix B. Furthermore, In Appendix C is the formalized Letter of Intent (LOI) as an agreement to the project collaboration with the stakeholder.

The next objective that has been achieved is to design the UTMSPACE Research Grant Management System, which includes user interface, test case design and architecture model. After that, the implementation of the system was started after all the requirements and design were completed. The testing is carried out such as UAT and black box testing.

In conclusion, all the objectives that defined in project objectives had been achieved which are to analyze the problem, to develop and design a web application system for UTMSPACE Research Grant Management System and finally to evaluate and test the application using user acceptance testing.

B. Suggestions for Future Improvement

There are several suggestions that can be implemented to improve the system. Among them are:

(a) Real time updates and notifications for administrators and leaders receive real time updates and notifications about their application status.

(b) A guideline to teach the user and admins on how to use the system.

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Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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