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A web based mobile archival system using waterfall model approach

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Abstract
This research introduces a mobile archival system employing a web-based waterfall model approach, aimed at securely storing digital documents within a mobile environment. The proposed system operates on a web-based waterfall model, allowing users to authenticate, securely store, and retrieve records while ensuring data safety on their devices. This research outlines the design and implementation of the mobile archival system, detailing its components, architecture, and features. It also presents the outcomes of test cases conducted to assess the system's performance and security. Additionally, potential applications of the system are discussed along with suggestions for future enhancements. Test results demonstrate the system's effective performance and its ability to securely store digital records. Notably, the system eliminates manual data entry and simplifies secure record retrieval from any location. Moreover, it guarantees data safety and privacy, rendering it suitable for diverse mobile and web-based applications. In conclusion, the mobile archival system proposed in this paper presents a promising solution for securely storing digital records in a mobile setting. It offers secure authentication, storage, and retrieval functionalities while ensuring data safety and privacy. The proposed system provides a user-friendly interface, making it easy to store and retrieve digital records from anywhere with a few clicks.

Keywords: Waterfall model, Archival System, Mobile Application, 3-tiel Client Architecture, Academic Research report.

1. Introduction

A mobile archival system is a storage system that allows for the automated storage, retrieval, and organization of various types of archives. It can be used for law archives, historical manuscripts (Wang, 2018), and electronic archives (Al-Maadeed et al., 2018). The system typically includes mobile containers or storage chambers that can be moved and connected together (Shehu & Gabasa, 2019). It may also have features such as automated retrieval systems, bin handling vehicles, and information storage units (Ma & Fang 2015). The mobile archival system offers advantages such as convenience in storing and accessing archives, automated generation of archive information, and reduced time for manual search. It can also provide services for borrowing and returning books at stop points, saving time for readers and reducing the labor intensity of library workers. Overall, a mobile archival system based on mobile Internet technology facilitates the management, storage, and access of archives in a convenient and efficient manner.

A mobile archival system utilizing a web-based waterfall model approach has been developed in various studies. The Waterfall method, a systematic and sequential model, has been used to design web-based information systems (Ariadi et al., 2022). This approach aims to transform manual processes into computerized systems, making them faster, more efficient, and eliminating the need for physical archiving locations (Mulyanto, 2022). Additionally, the use of a web-based system reduces errors and allows for easy access to information by the public (Chandra et al., 2022). Another study applied the Waterfall model to develop a mobile web-based system for public complaint management, improving the efficiency and effectiveness of public services (Wijaya et al., 2022). These studies demonstrate the effectiveness of the Waterfall model in developing web-based systems for various purposes, including archival systems and public service management.

A web-based waterfall approach is mentioned in multiple papers. Asrin proposes implementing a web-based school information system using the structured development process of the waterfall model (Fauzan, 2023). Irfan and Lutfiyani also use the waterfall methodology to create an online and web-based attendance system (Muhammad & Anisatul, 2023). Wahyuni follows the Waterfall concept to develop a dynamic web-based information system for cash management at the Cirebon City Youth and Sports Service (Fitria, 2023.). Budiarti, Fathin, and Sulistiyani utilize the waterfall method to create an information system for recording student achievements at Al Qur'an Education Park (Rizki et al., 2022). Rohman uses the waterfall method to design and implement a web-based information system for a neighborhood (RT) in Langensari Barat (Abdul, 2023). These papers demonstrate the use of the waterfall approach in developing web-based systems for various purposes.

The Waterfall model has been used in various studies to develop web-based systems for different purposes, including archival systems and public service management. This systematic and sequential approach aims to transform manual processes into computerized systems, making them faster, more efficient, and eliminating the need for physical archiving locations (Deshmukh et al., 2023). The use of a web-based system reduces errors and allows for easy access to information by the public (Calvin et al., 2023). For example, a study applied the Waterfall model to develop a mobile web-based system for public complaint management, improving the efficiency and effectiveness of public services (Bahriah et al., 2022). These studies demonstrate the effectiveness of the Waterfall model in developing web-based systems for various purposes, including archival systems and public service management (Miskiewicz, 2022).
This research addresses the need for efficient data management in the digital age through mobile archival system development. Despite promising applications of the Waterfall Model in web-based environments, key research gaps exist. These include the need for understanding the integration of mobile technology in the model, prioritizing user experience in each phase, adapting the model to varying scales of data, addressing security and privacy concerns, and accommodating emerging technologies. Closing these gaps is crucial for developing a robust Mobile Archival System aligned with dynamic technological and user requirements. This research seeks to address problems associated with manual archive systems for academic research reports by transitioning to an electronic database.
The objectives of this research are to:

i. develops a model for E-Archival system.
ii. develop an online data warehouse for academic research report for better reference.
iii. design a web-based platform for quick and easy way to load the online Database.
iv. develop a mobile application based on the developed model, which will serve as the platform to access the Database.

2.0 Material and methods

The proposed Web-Based Mobile Archival System utilizes the Waterfall Model methodology for structured development, emphasizing documentation, sequential stages, testing and offers a novel solution to archival management and access, combining innovative technology (Pargaonkar, 2023). It integrates web and mobile platforms, enhancing accessibility across devices (Costa et al., 2017). Its user-centric design prioritizes appealing user interface and satisfaction (Katuu, 2015), while scalability ensures long-term relevance (Bornholt et al., 2016). Leveraging web and mobile technologies promotes accessibility and collaboration (Bass, 2013), revolutionizing archival practices.

This selection of the research covers the methodology, design, and implementation stages, focusing on the development of a web-based electronic Database system for Academic research. It provides an overview of the development tools and technologies utilized and delves into their specific applications in creating the system. These approaches synergized to successfully accomplish this research's objectives, enabling thorough research, strategic technology adoption, and the creation of a resilient content management system within a web-based framework.

2.1 Development Tools and Technologies Used

The selection of development tools and technologies was driven by the system's specific requirements. The project, a web-based e-database system for academic research, adopts a 3-tier client-server architecture for web applications. This design choice is reflected in the illustration below (Figure 1), showcasing the structured 3-tier client-server architecture. Figure 1 below illustrates a 3-tier client-server architecture design.

2.1.1 A 3-tier architecture

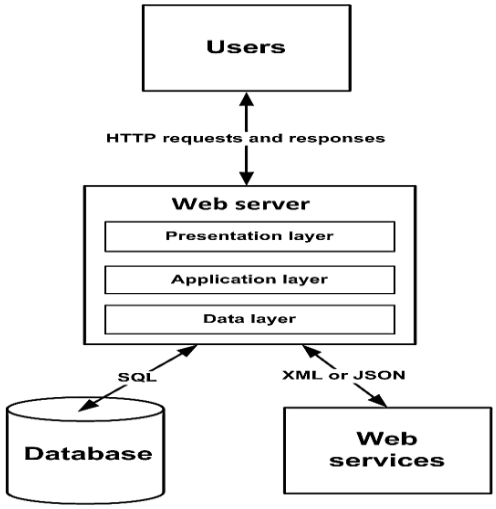


Figure 1: A 3-tier client-server Architecture (Source: https://quora.com)

A 3-tier architecture is a client-server architecture in which the user interface, data processing logic, information and data storage and access are deployed and maintained as separate modules, usually on separate platforms. The 3-tier architecture divides a system into distinct layers: Presentation, Application, and Data Access, each managing specific functionalities independently. For this project, various tools were employed at each layer:

2.1.1.1 Presentation Layer

This topmost layer communicates with others and presents results to users. Any operating system (Linux, UNIX, Mac OS, Windows) can serve as a client machine, accessing the web-based application via browsers like IE, Mozilla Firefox, Google Chrome, Safari. Additionally, mobile devices with WAP-enabled browsers can access the application.

2.1.1.2 Application Layer:

Responsible for application functionality and logic, encompassing the User Interface (UI), Business Rules, and Database Access components. Web service technology facilitated data access to MySQL Database using PHP for server-side programming. PHP was used extensively for all data access code, while HTML crafted the web pages and forms. Cascaded Style Sheet (CSS) styled the user interfaces (web pages and HTML forms).

2.1.1.3 Data Access Layer (Database Layer):

Comprised of Database Servers, this layer manages data storage and retrieval independently. Separating data from application servers or presentation layers ensures scalability and performance. MySQL 5.5.24 was employed as the system's database in this project. The phpMyAdmin feature in WAMPServer 5.1.73 provided a graphical user interface for managing the MySQL database, enhancing accessibility and management.

This meticulous allocation of tools within each layer facilitated the distinct functionalities of the 3-tier architecture, ensuring efficient communication, logical processing, and streamlined data management in the development of the web-based e-database system for academic research. The development tools used are listed below and illustrated in the basic architecture of the system.

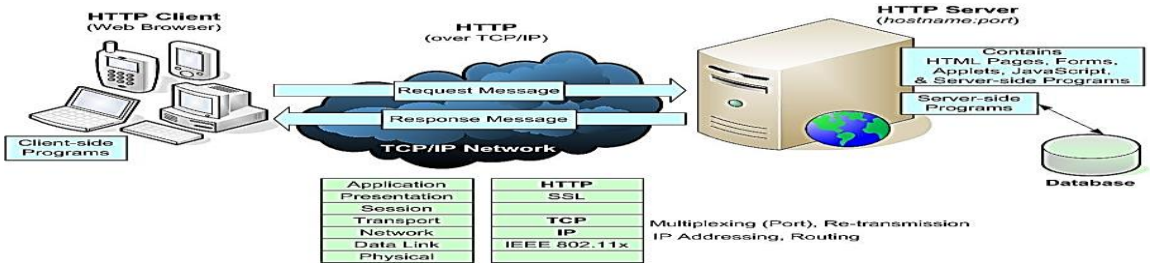


Figure 2: Architecture of the system (Source: Google Image, Architecture of a client-server Application, 2016)

The development and implementation of this web application cater to an electronic database system designed for academic research within the University environment. Its core aim is to automate the conventional method of archiving research reports by creating an online database for easy storage and retrieval. The system accommodates four main user types: students, supervisors, guests, and administrators. System analysis involves dissecting a system into its constituent parts to study how effectively these components function and interact to achieve their intended purpose. It's a methodical approach aimed at identifying goals and devising efficient procedures to achieve them. Synthesis and analysis complement each other, where each synthesis builds on prior analysis, and vice versa, ensuring accuracy in results.

On the other hand, systems design encompasses defining the architecture, modules, interfaces, and data of a system to meet specific requirements. It's akin to applying systems theory to product development, overlapping with disciplines like systems analysis, architecture, and engineering. The waterfall model stands as a classical software engineering model renowned for its widespread use in government projects and major companies. Emphasizing early-stage planning, this model helps detect design flaws beforehand and excels in projects emphasizing stringent quality control. The pure waterfall lifecycle comprises non-overlapping stages, starting with system and software requirements establishment and progressing through architectural design, detailed design, coding, testing, and maintenance. It serves as a foundation for numerous other lifecycle models, showcasing a structured and sequential approach to project development. This detailed process ensures a methodical and well-structured development of the web-based electronic database system for academic research, emphasizing planning, analysis, and systematic progression through various development stages.

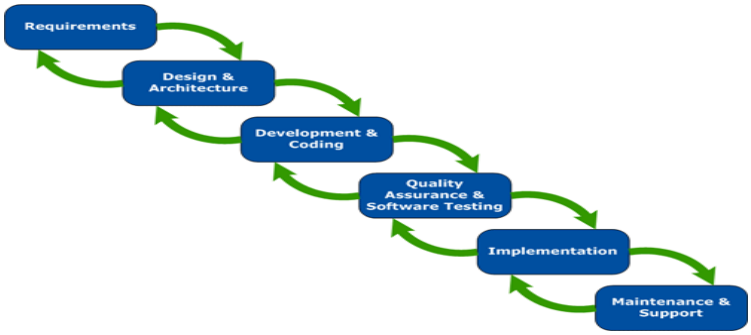


Fig 3: The waterfall model (Source: https://google.com)

2.1.2 Use case modeling

Use cases are widely used systems analysis modeling tools for identifying and expressing the functional requirements of a system. Each use case is a business scenario or event for which the system must provide a defined response. Use cases evolved from object-oriented analysis. In a use case model, dialogs are used to describe the relationship between the user and the system. The users make an action, and the system make an appropriate reaction.

2.1.2.1 System actors:

(i) Administrator
(ii) Supervisor (lecturers)
(iii) Students
(iv) Guest

(i) ADMINISTRATOR

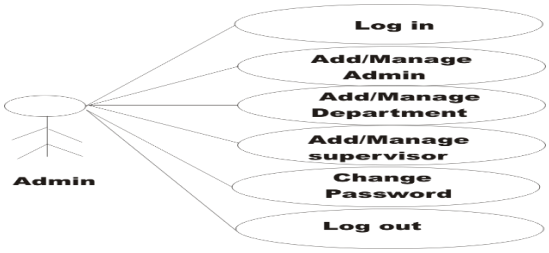


Figure 4: Use case diagram for administrator.

From the administrative end, the system consists of following functional features:
Administrator's Login – The administrator must login to the system using his/her username and password to have access to the administrator's personal page where operations relating to the administrator can be performed. If the administrator supplies the wrong answer, the system gives the alerts and asks him/her to try again. If the correct answer is supplied, the system gives congratulatory message and proceeds to the administrative dashboard.
Administrator's Personal Page –It shows the details of currently logged administrator. It has a personal menu with links through which operations relating to the administrator can be carried out. These include; Register new admin, register new supervisor, remove supervisor.
Register new admin: Through this feature, the administrator can register new user as an admin which would be granted an admin privileged. The system prompts the admin to enter the following information for the new user: Full name, Email, Phone number and default password.
Upon clicking OK, the system registers the new account and gives a success message.
Register new Supervisor: This feature allows the administrator to register a new user with supervisor privileged. If the admin chooses to register a supervisor, the system required that the following field should be filled about the new supervisor; Status (e.g Mr/Mrs/Dr/Prof), Full name, Department, Field of Study, Email, Phone number, Default password.
View Registered Supervisor: this features help the administrator to view the entire registered supervisor, the system will bring in tabular form the detail of the entire supervisor registered with the system.
Remove Supervisor: Admin can remove a supervisor by alighting the supervisor name on the supervisor table and click remove. The system will ask the user to confirm the action. Upon clicking yes, the supervisor name is totally removed from the system.
Administrator's Logout –By clicking this link, the system resets all administrators session to default or null value.

(ii) STUDENT

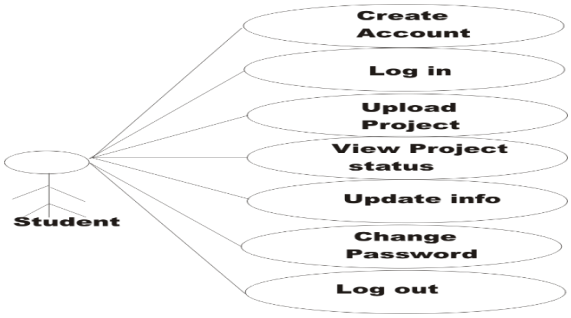


Figure 5: Use case diagram for Student.

From the student's end, the system consists of following functional features:
Student Login: When the Student start the system, log-in page is appeared where he/she is asked to login by selecting the appropriate user category and supply the username (email) and password. If the student supplies the wrong answer, the system gives alerts and asks to try again. If the user supplied the correct answer, the system congratulates the user and proceeds to the student dashboard which list the operation which can be perform by the student. These include; Upload project, update personal information, view my project, edit project information, delete project, logout.
Create Account: If the student is a new user, create account will be initially choosing instead of login. The student will be expected to supply the following information; Full name, Matric Number, Category (Undergraduate, postgraduate Diploma, M.Sc degree, P.hd degree), Department, email, phone number, password, confirm password. Upon clicking create account, the system registers the student, congratulate user for the successful account creation and proceed to the log in page.

Upload Project: After the student login, one of the operations that can be performed is to upload a project into the e-database. If the student chooses to upload project, the system bring on a form which contain the following information about the project to be uploaded; Project title, project abstract, Date uploaded (system date), project year, Author (Name of the student), project category (as graduate project, postgraduate diploma project, M.sc dissertation, PhD Thesis and academic journals), Supervisor (the system bring the registered supervisors in the chosen department if any) and the project file is attached (pdf format). After the student provide the information correctly and click OK, the

system give a success message for the uploaded project. And also a message that tells a student to contact his supervisor for approval. *"Your project is successfully uploaded. Please contact your supervisor for approval "*
Update info: This functionality gives the student to update his/her information on the system. If the user chooses to update info, the student information is fetched from the student table of the database and made available on the form which is ready to be changed and resubmit. Upon student click on update, the information is updated in the database.
My Project: If the student chooses my project, all the uploaded project is appeared on the table with some attribute. The operation that can be performed on the project include to edit information about it and to delete it. If the project is alighted and edit button is selected, all the information about the project is made available on the form which is ready to be change and resubmitted. The resubmitted project is automatically removed from the public if it has been approved before and appears on the selected supervisor for re approval. If the project is alighted and the delete button is selected, the system prompts for confirmation of the action and then deleted if confirm yes. The deleted project is automatically removed from the online database and also from the public.

Students' Logout –By clicking this link, the system resets all administrator's session to default or null value. The student is automatically logged out of the student page and the system back to login page.

(iii) SUPERVISOR

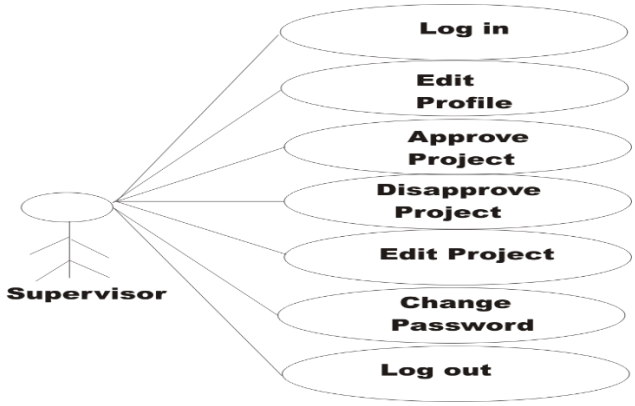


Figure 3.6: Use case diagram for Supervisor

Supervisors' Login: The Supervisor login by selecting the appropriate user category and supply the username (email) and password. If the wrong answer is supplied, the system gives alerts and asks to try again. If the correct answer is supplied, the system congratulates the user and precedes to the supervisor dashboard which list the operation which can be performed by the supervisor.
Approve Project: In supervisor dash board, the list of the entire uploaded project by the student under the user supervision that is appeared on the table with option to approve or disapprove in front. Once the project is approved, it indicated approve on the dashboard of the supervisor. The approved topic is automatically appeared to the general user of the system (Guest) to view on the web and on the mobile application.
View all approved Project: this feature gives the supervisor the privilege to view all the approved projects by him/her so far.
Update Info: this gives the supervisor an opportunity to update his information. This fetched the registered detail about the user from the database into a form ready to be edited and resubmit.
Change password: The user can also choose change password option. If the change password option is choosing, the user is provided with the form comprises of the following field to be filled; Old password, New password, Confirm new password. The system gives an alert for successful change of the password.
Supervisors' Logout: When this link is clicked, the system resets all supervisor session to default or null value.
From the guest/general user end, the web based electronic database system does not require the user to login. It provides a privilege for the user to view all the available approved projects in the online database. It works the same way with the mobile application.

2.1.2.2 Description of the mobile App

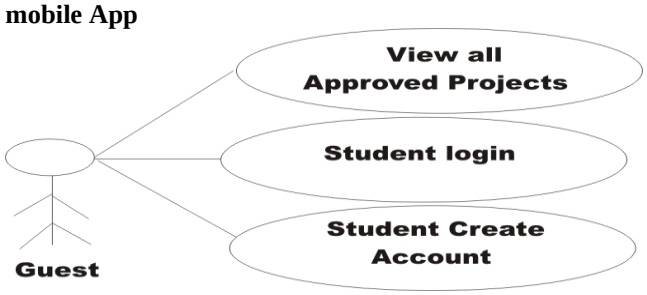


Figure 7: Use case diagram for Mobile app users.

The Guest (general user) operates on the mobile platform of the system. Upon launching the system, the user is provided with the entire approved project from various supervisors fetched from the online database. The fetched projects appeared with the following attribute; Project title, Project abstract, Date uploaded, Project year, Project category (graduate project, postgraduate diploma project, M.sc dissertation, PhD Thesis and academic journals), Department and Supervisor. The Mobile app user is provided with an option to download the project file if available. The guest is given an opportunity to sort/search/refine the listed project based on the following criteria; Project department, Project by particular supervisor, Project category, Project year and Project title. The option to create account is available for the student user who is bonafide student of UNILORIN and eligible to use the system for uploading project. Also, log in platform exist on the mobile app for the student that has already registered with the system to perform appropriate action.

2.1.3 Process Flow Diagram of the System

A Flow Diagram is a type of diagram that represents an algorithm, workflow or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows. This diagrammatic representation illustrates a solution model to a given problem. Flow Diagram is used in analyzing, designing, documenting or managing a process or program in various fields. Like other types of diagrams, they help visualize what is going on and thereby help understand a process, and perhaps also find flaws, bottlenecks, and other less-obvious features within it. The flow diagrams in figure 5, 6 and 7 describe the flow of processes that can be carried out by the supervisor, students and the administrator on the system respectively.

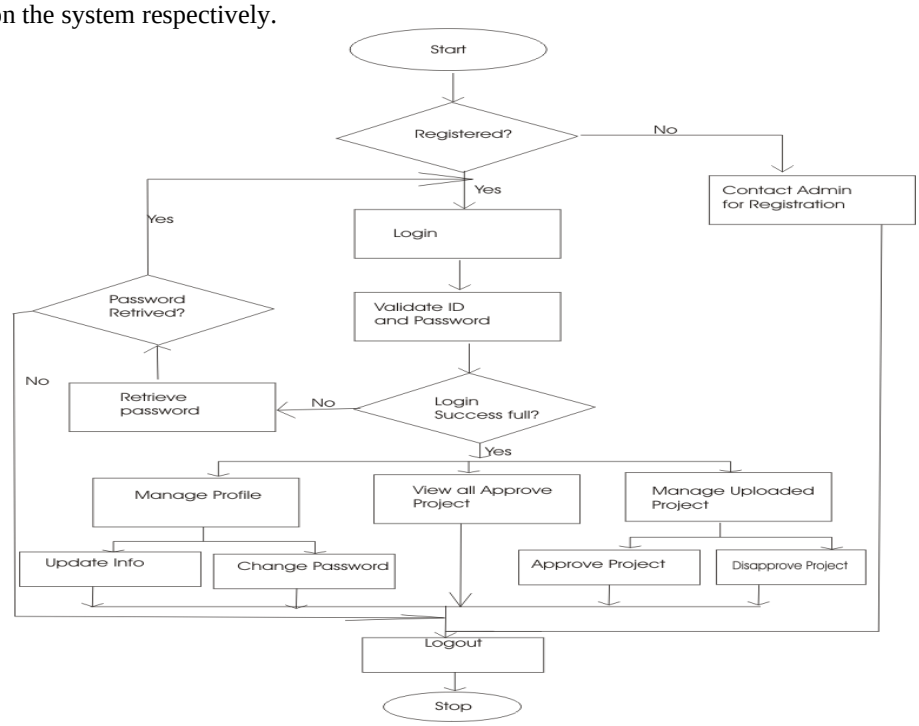


Fig 8: Supervisor Process Flow Diagram.

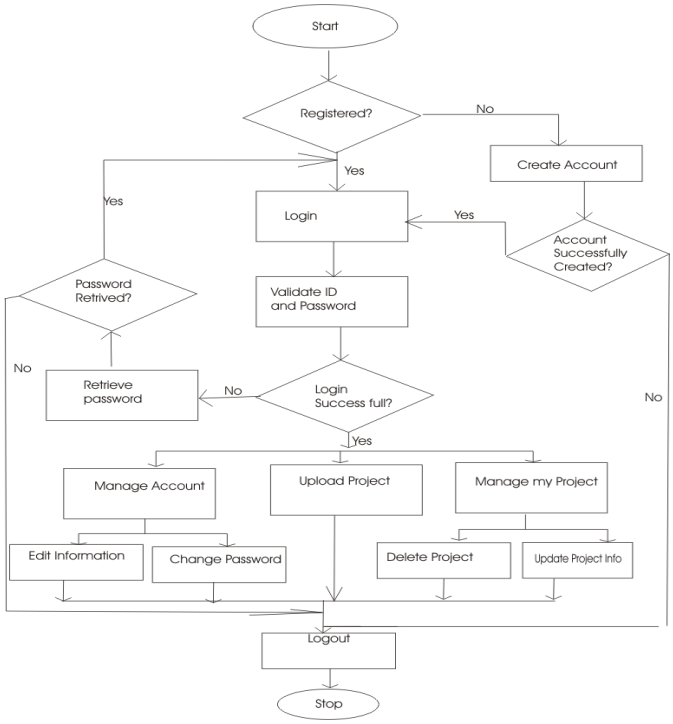


Fig 9: Student Process Flow Diagram.

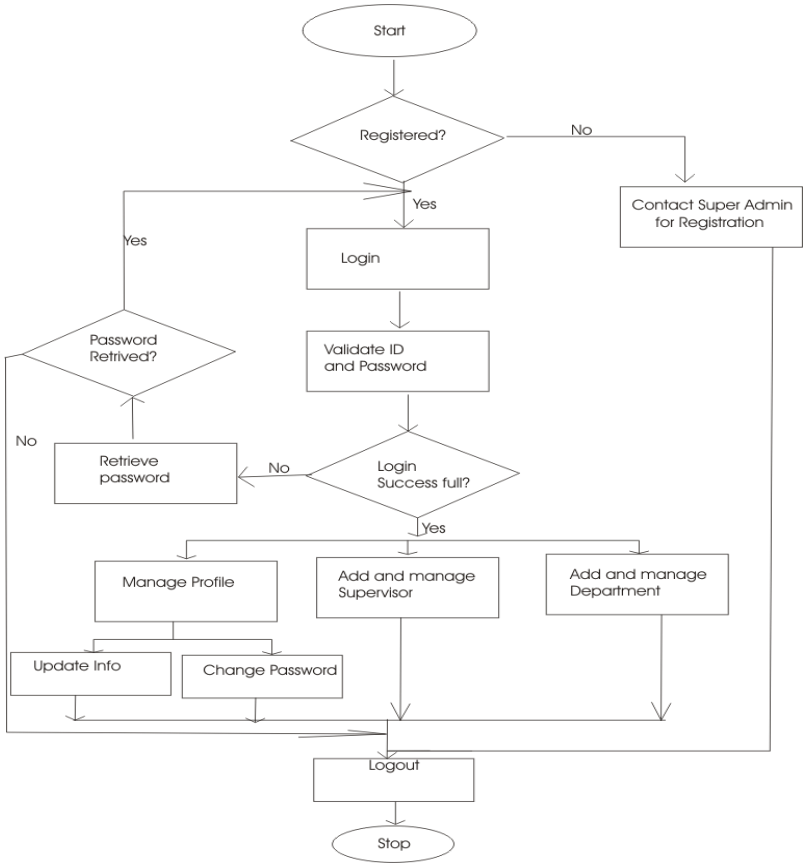


Fig 10: Admin Process Flow Diagram.

2.1.4 Activity Diagrams of the System

The activity diagrams illustrate the workflow of stepwise activities or events that can occur within the system. Figure 8, 9 and 10 below illustrate the activities in stepwise order that can be carried out by the student, Supervisor and the admin respectively.

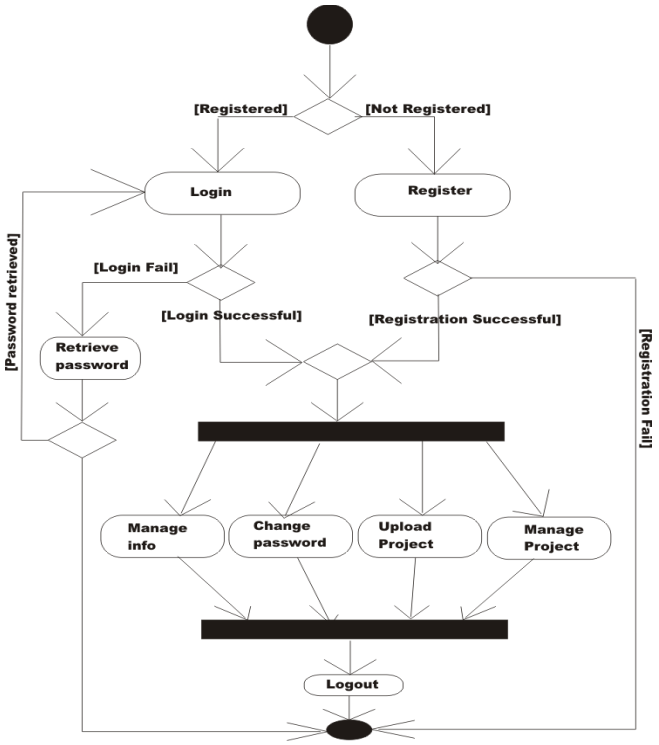


Fig 11: Student Activity Diagram

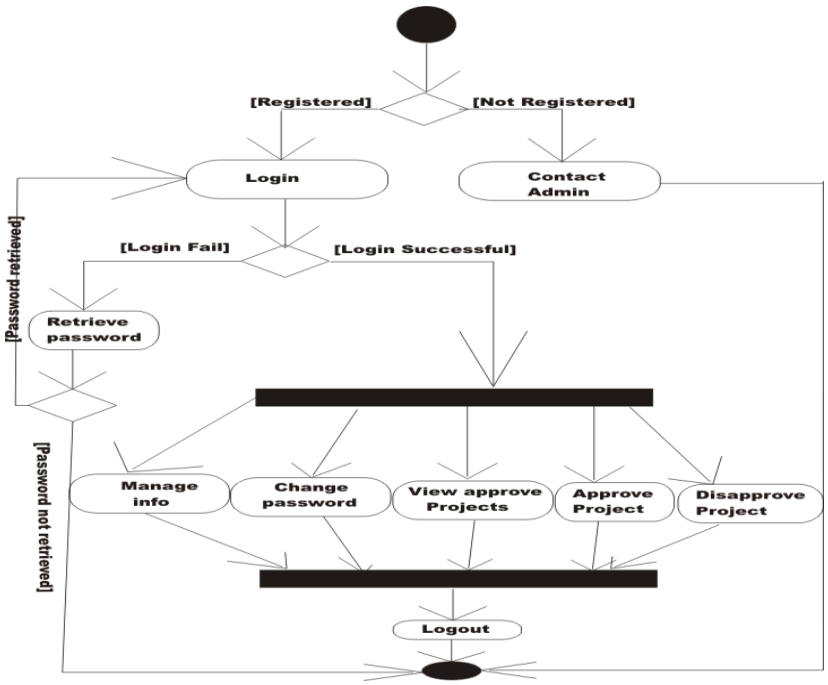


Fig 12: Supervisor Activity Diagram.

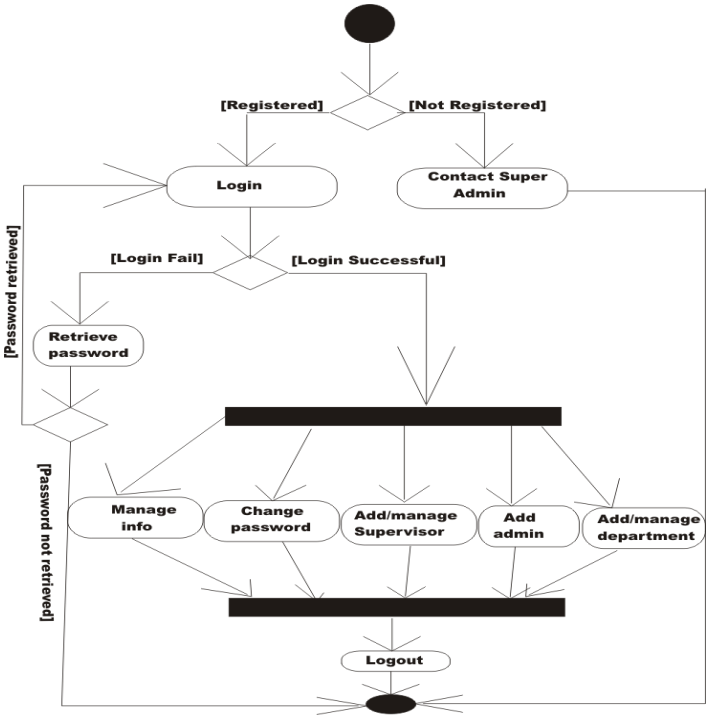


Fig 13: admin Activity Diagram.

2.2 Database Design

The system consists of a database, upf with five tables. The basic structures of the tables in the systems database are illustrated in the following subsection.

Structure of Database Tables

i. Table admin has 4 fields, with field id as the primary key

Table 1: Table admin in database upf

S/N	Field	Type	Attributes	Null	Default	Extra
1.	id	int(11)		No	NONE	AUT_INCR
2.	name	varchar(100)		No	NONE	
3.	email	varchar(200)		No	NONE	
4.	password	varchar(200)		No	NONE	

ii. Table department has 4 fields, with field id as the primary key

Table 2: Table department in database upf

S/N	Field	Type	Attributes	Null	Default	Extra
1.	id	int(11)		No	NONE	AUT_INCR
2.	name	varchar(300)		No	NONE	
3.	faculty	varchar(300)		No	NONE	
4.	status	tinyint(4)		No	NONE	

iii. Table project has 10 fields, with field id as the primary key

Table 3: Table project in database upf

S/N	Field	Type	Attributes	Null	Default	Extra
1.	id	int(11)		No	NONE	AUT_INCR
2.	title	varchar(300)		No	NONE	
3.	abstract	text		No	NONE	
4.	author	varchar(300)		No	NONE	
5.	category	varchar(300)		No	NONE	
6.	department	varchar(300)		No	NONE	
7.	supervisor	varchar(300)		No	NONE	
8.	year	varchar(10)		No	NONE	
9.	project_file	varchar(300)		No	NONE	
10.	date_uploaded	varchar(20)		No	NONE	
11.	status	tinyint(4)		No	NONE	

iv. Table student consist of seven fields, with field id as the primary key

Table 4: Table student in database upf

S/N	Field	Type	Attributes	Null	Default	Extra
1.	id	int(11)		No	NONE	AUT_INCR
2.	name	varchar(300)		No	NONE	
3.	matric_number	varchar(20)		No	NONE	
4.	department	varchar(300)		No	NONE	
5.	email	varchar(200)		No	NONE	
6.	phone	varchar(100)		No	NONE	
7.	password	varchar(200)		No	NONE	

v. Table supervisor has four fields, with field id as the primary key

Table 5: Table supervisor in database upf

S/N	Field	Type	Attributes	Null	Default	Extra
1.	id	varchar(200)		No	NONE	
2.	name	varchar(400)		No	NONE	
3.	password	varchar(800)		No	NONE	
4.	department	varchar(800)		No	NONE	

3.0 Results and discussions

This study used performance evaluation metrics include response time, throughput, scalability, and uptime/downtime. Security evaluation metrics encompass authentication mechanisms, data encryption, access control, and vulnerability assessment. Positive performance and security metrics signify enhanced user experience, data integrity, confidentiality, and long-term sustainability.

This section shows details of the outcomes of the system's implementation. It focuses on illustrating the interface of both the web-based and mobile-based electronic Database system for Academic research. Various screenshots obtained during the system testing using Mozilla Firefox are included.
Figure 14 displays the student registration form situated on the registration page. Students are required to input all necessary information on the registration form and subsequently click the signup button to finalize the registration process. Notably, each email address can only be registered once within the system.

Upon successful registration, the system displays a success message (as depicted in Figure 15) and redirects the user to the login page. Students use the provided email and password during registration for subsequent logins. However, if the email supplied during registration already exists within the system, an error message is displayed (Figure 17), notifying the student that the email is already registered. This ensures clarity during the registration process and prevents duplications within the system.

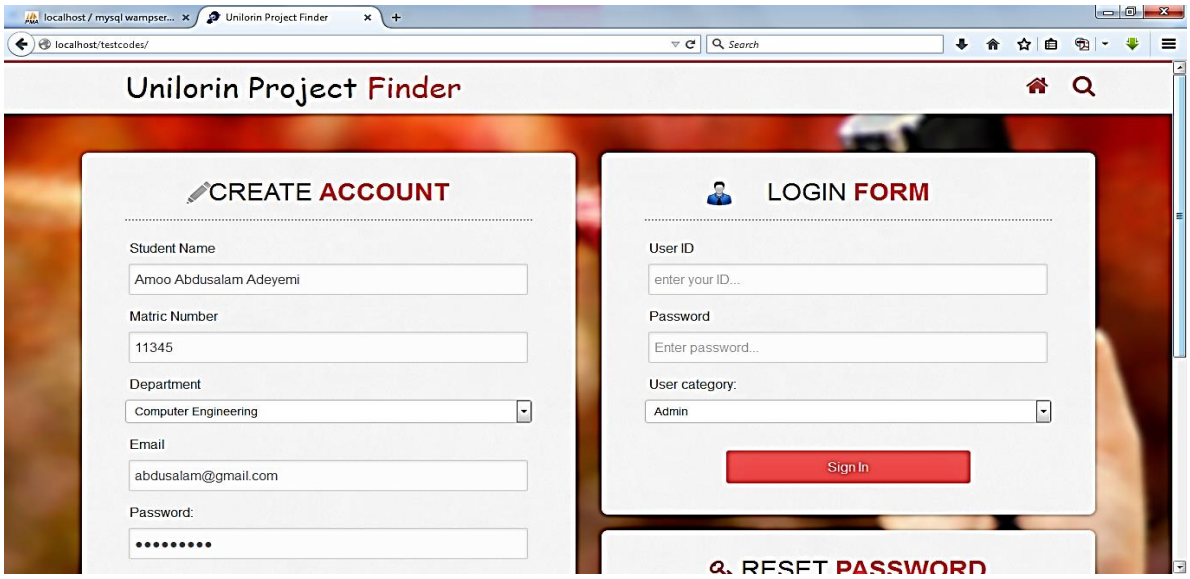


Figure 14: Students Registration Page (Registration Form)

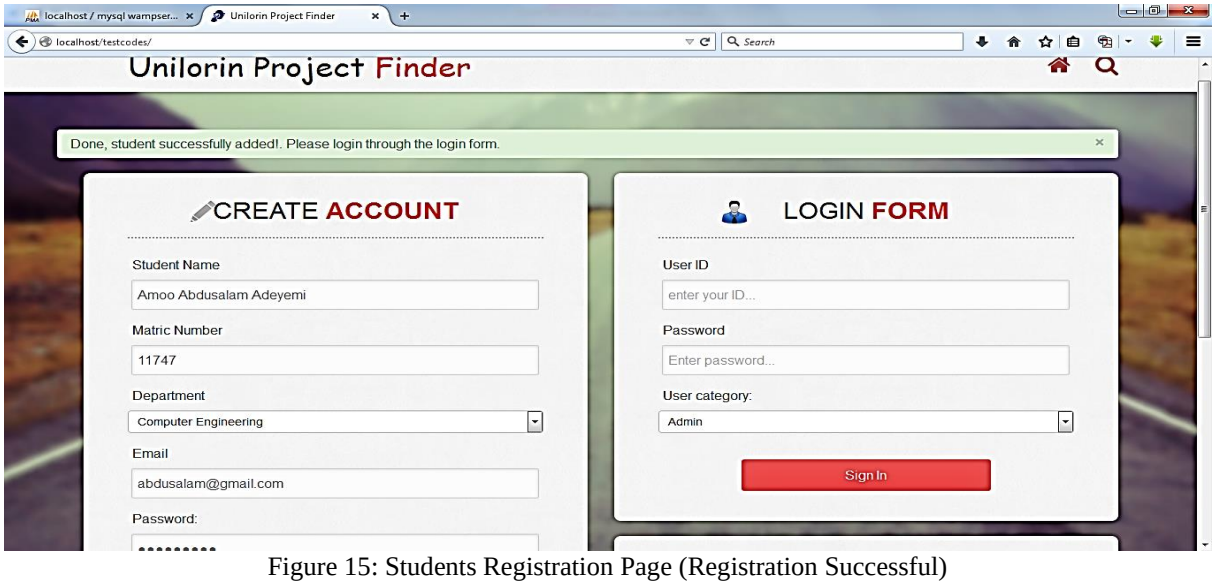


Figure 15: Students Registration Page (Registration Successful)

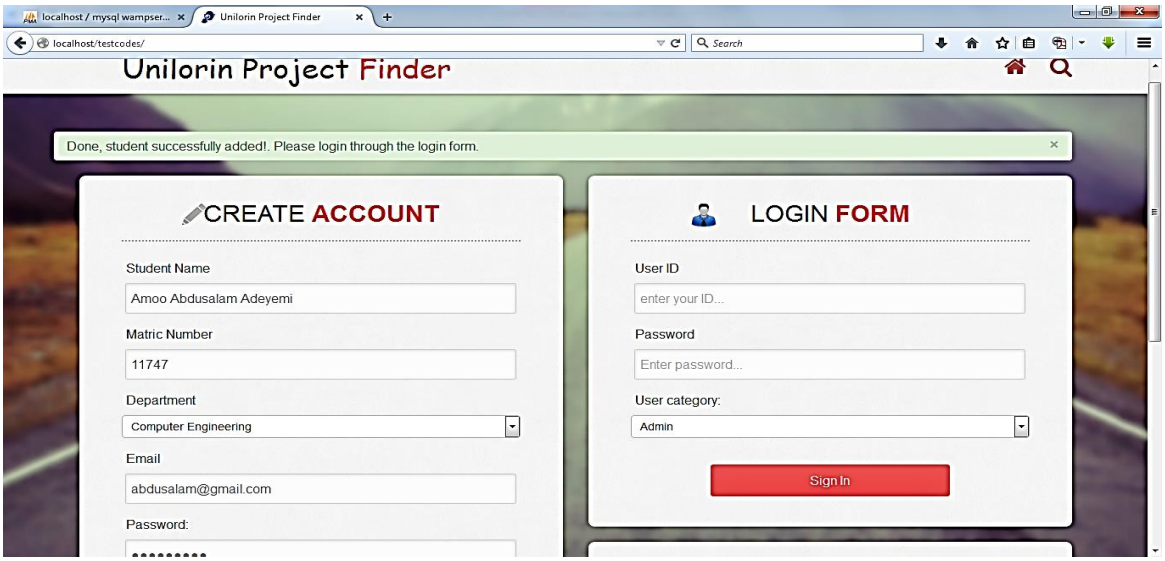


Figure 16: Students Registration Page (E-mail already registered message)

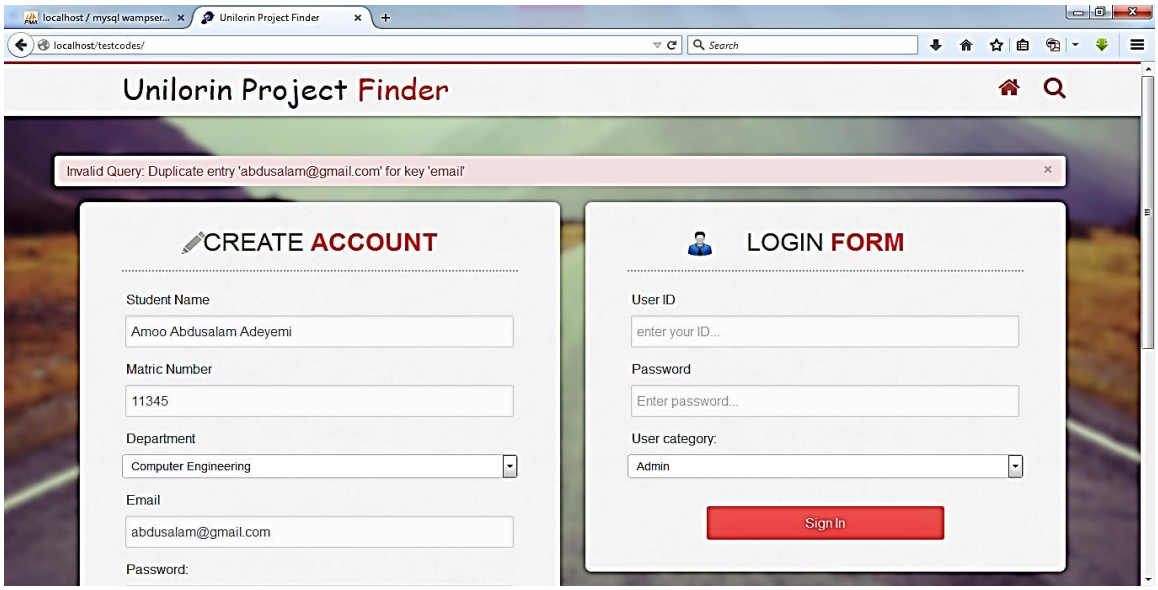


Figure 17: Students Login Page (Login Failed)

Figure 18 showcases the student's personal home page, accessible upon successful login. This page exhibits essential information about the currently logged-in student, including their full name, registration number, department, email address, and phone number. Upon successful login, students encounter an upload project form, also depicted in Figure 18. This form enables students to upload their projects into the system seamlessly. To complete the upload process, students are required to furnish all necessary information on the upload project form and subsequently click the "upload project" button. This setup streamlines the user experience by providing a personalized home page for each student and a straightforward upload mechanism for their projects within the system.

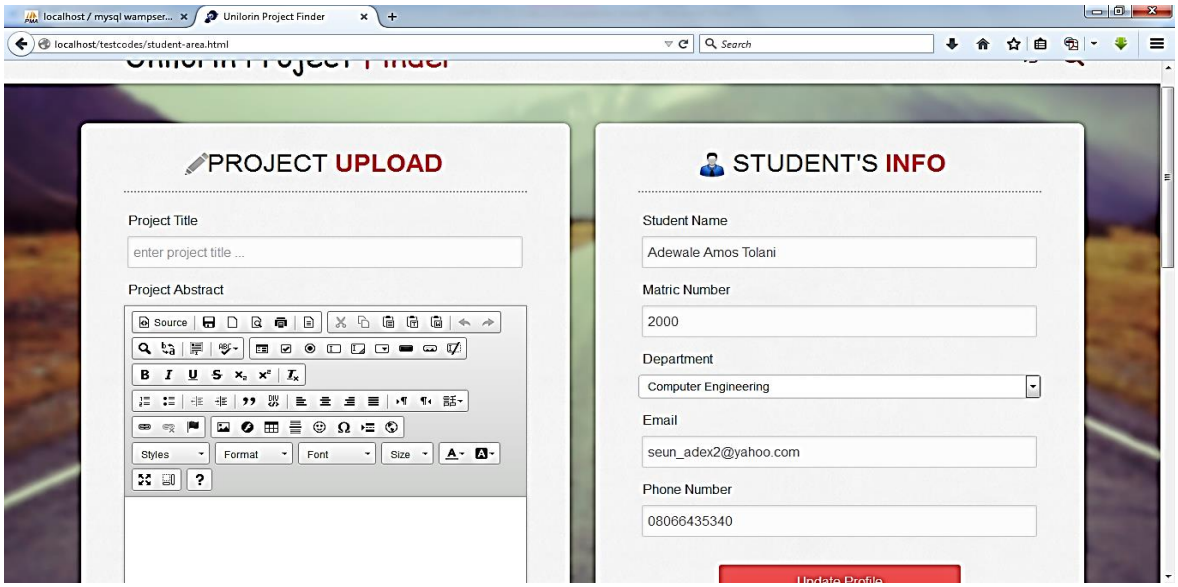


Figure 18: Student's info Page and upload project form.

Figure 19 illustrates the change password page, allowing users to modify their passwords if they suspect a compromise. This feature enables users to enhance their account security by updating their passwords.

To initiate a password change, the user inputs their old password alongside the desired new password. However, if the old password entered does not match the current password on record, the system displays an error message. Subsequently, the password remains unchanged, ensuring security measures are upheld and preventing unauthorized password modifications.

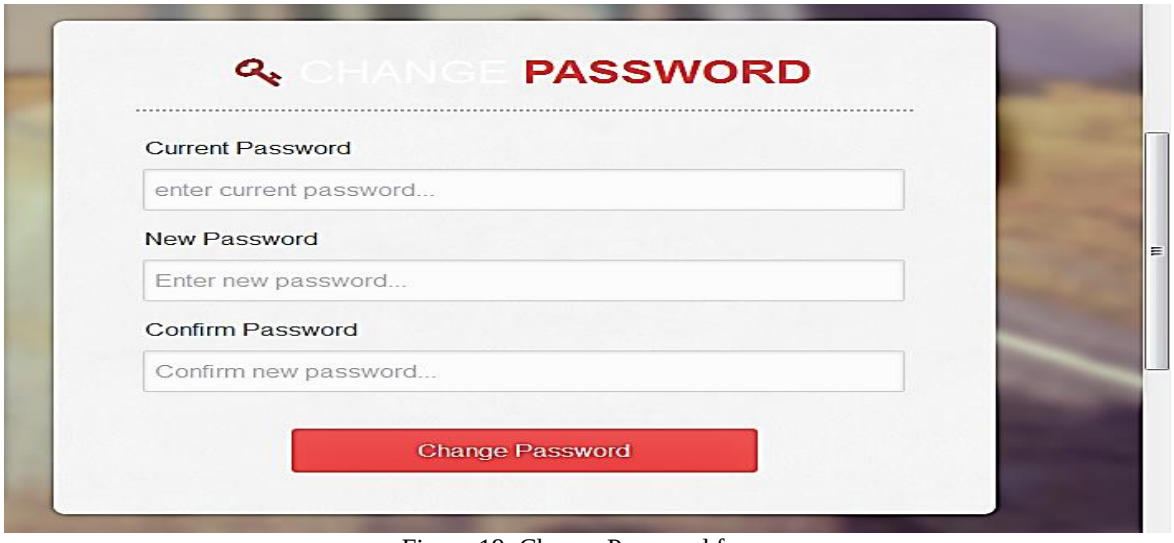


Figure 19: Change Password form.

Displayed in Figure 20 is the student's projects table, offering comprehensive details about the projects uploaded by the currently logged-in student. This table provides an overview of each project's status, indicating whether it has been approved by the designated supervisor or not.

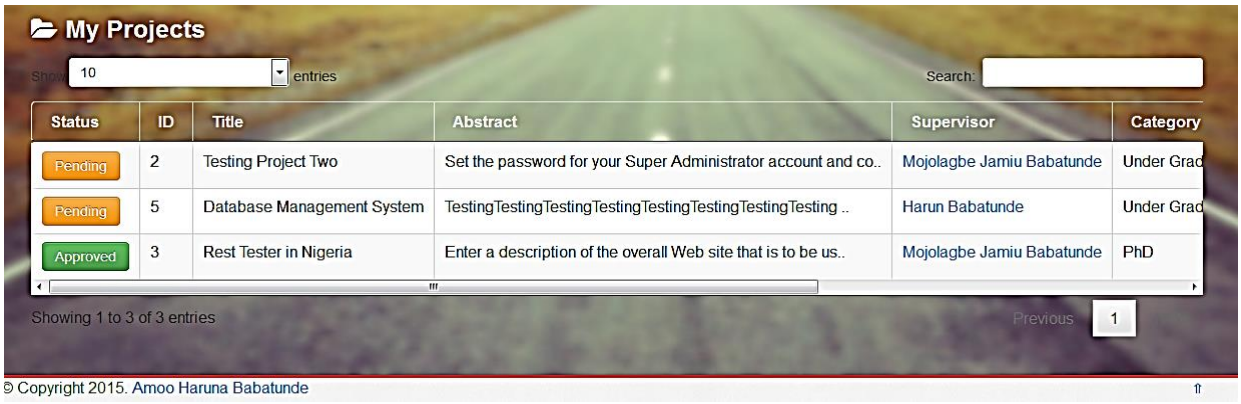


Figure 20: Student Project Table.

The Supervisor projects table is shown in the figure 21. It displays detailed information about the uploaded projects of all students under the currently logged in supervisor. It also shows all the operation that can be performed on the selected project (i.e. to approve, disapprove edit or delete a particular project).

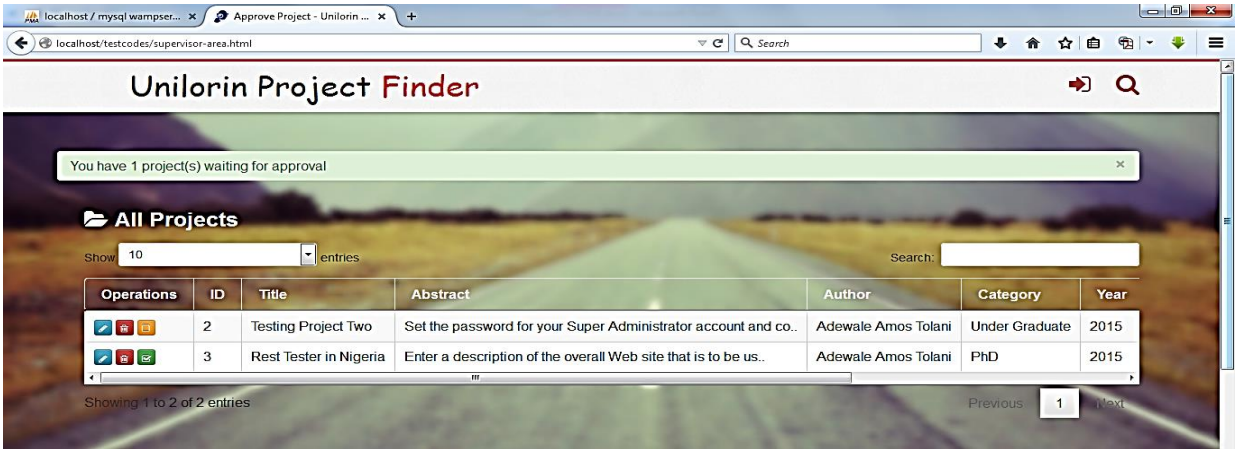


Figure 21: Supervisor Project Table.

Password Retrieval Page

A user can retrieve his/her password if the password is forgotten. The screenshot of the password retrieval page is shown below in figure 22. The user must complete the fields to complete the password retrieval process. The user ID and the user category must be selected. After entering the information and clicking the "Reset Password" button, the system will send a new password to the registered email address. If the user ID supplied and the user category selected does not match, the system displays an error message notifying the user as the case may be.



Figure 22: Reset Password form

Administrator's Dash board and Operations

Administrator's Personal Page –It shows the details of currently logged administrator. It has a personal menu with links through which operations relating to the administrator can be carried out. These include; Register new admin, register new supervisor, remove supervisor, edit supervisor, add new department, remove department or edit department detail.

The figure 23 shows a form which admin can use to register new supervisor and the table shows the already registered supervisor with the system. Also figure 24 shows add department form and the already registered department with the system.

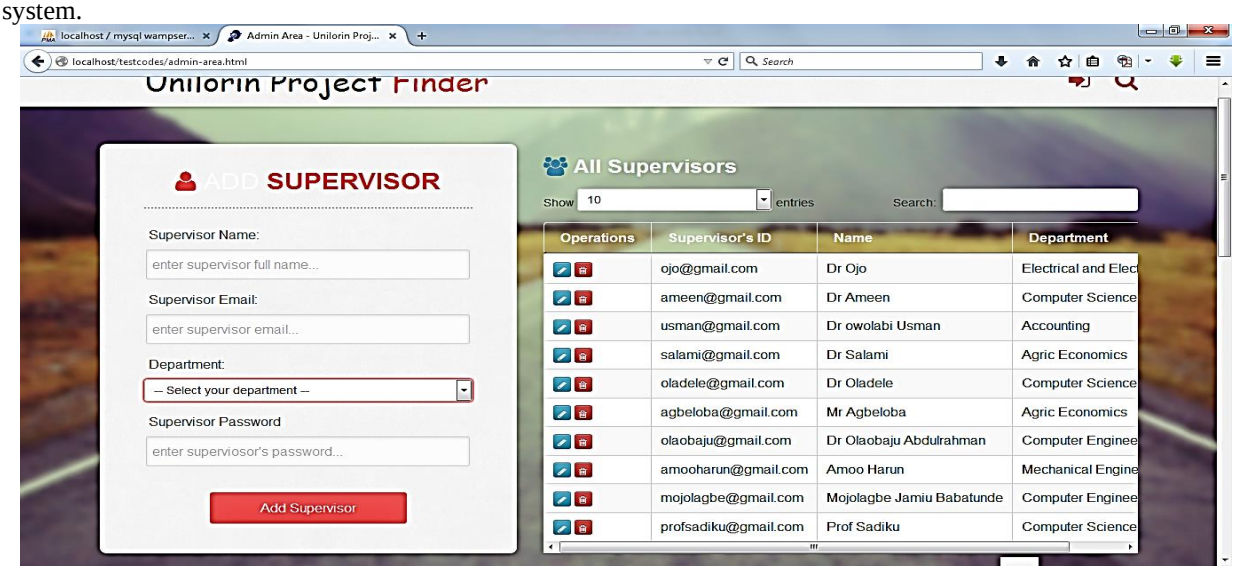


Fig 23: Add supervisor form and registered supervisor table.

The Guest (general user) operates on the mobile platform of the system. Upon launching the system, the user is provided with the entire approved project from various supervisors fetched from the online database. The fetched projects appeared with the following attribute; Project title, Project abstract, Date uploaded, Project year, Project category (graduate project, postgraduate diploma project, M.sc dissertation, PhD Thesis and academic journals), Department and Supervisor.

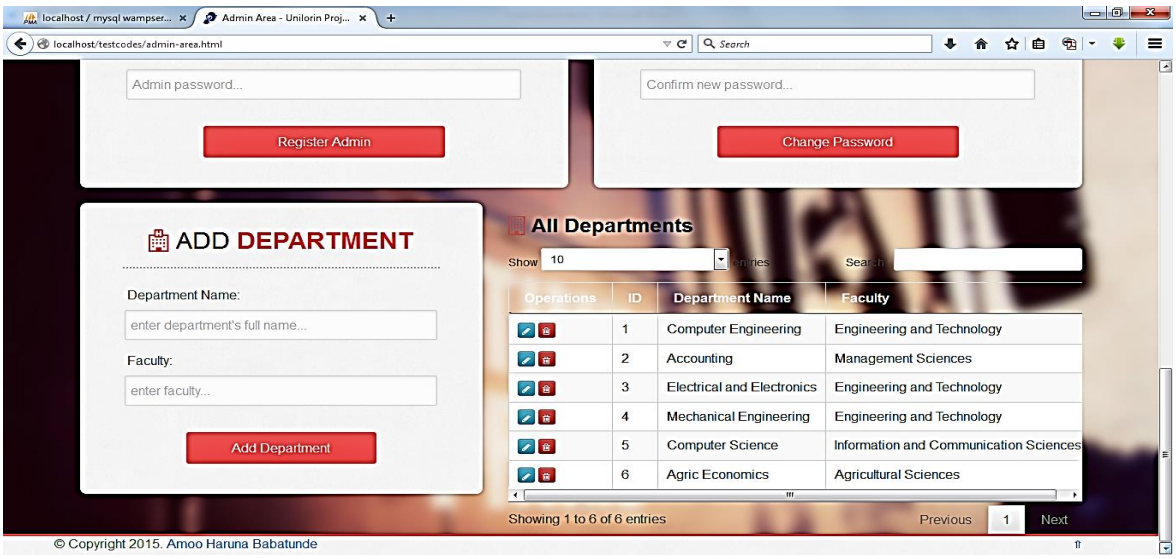


Fig 24: Add Department form and registered department table.

3.2 Description of Mobile Application

The Guest (general user) operates on the mobile platform of the system. Upon launching the system, the user is provided with the entire approved project from various supervisors fetched from the online database. The fetched projects appeared with the following attribute; Project title, Project abstract, Date uploaded, Project year, Project category (graduate project, postgraduate diploma project, M.sc dissertation, PhD Thesis and academic journals), Department and Supervisor. Fig 4.12 shows the home page of the application as it appeared upon the lunching. On the page is the more detail button which the user can click to view more detail about the software.

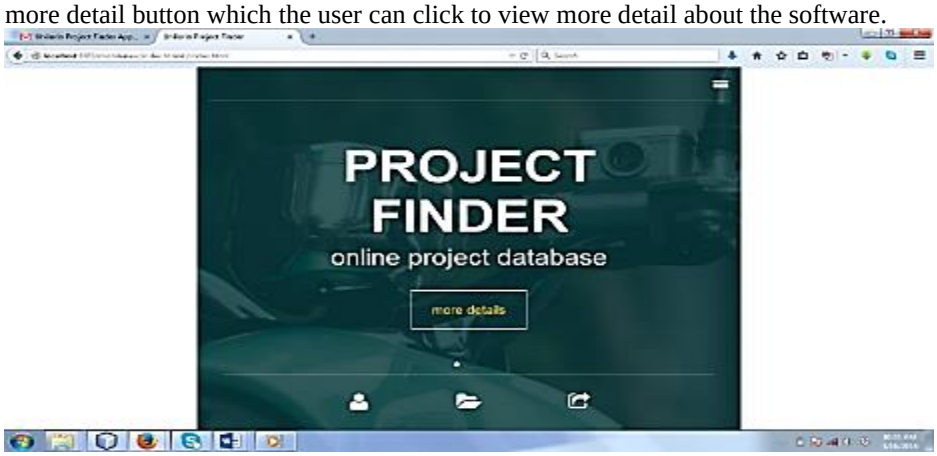


Fig 25: Mobile application home page.

Mobile Application About app page.

The about us page introduces the application and what it does. It explain the functionality of the system, its limitation and scope. It also contained the name of developer of the system.

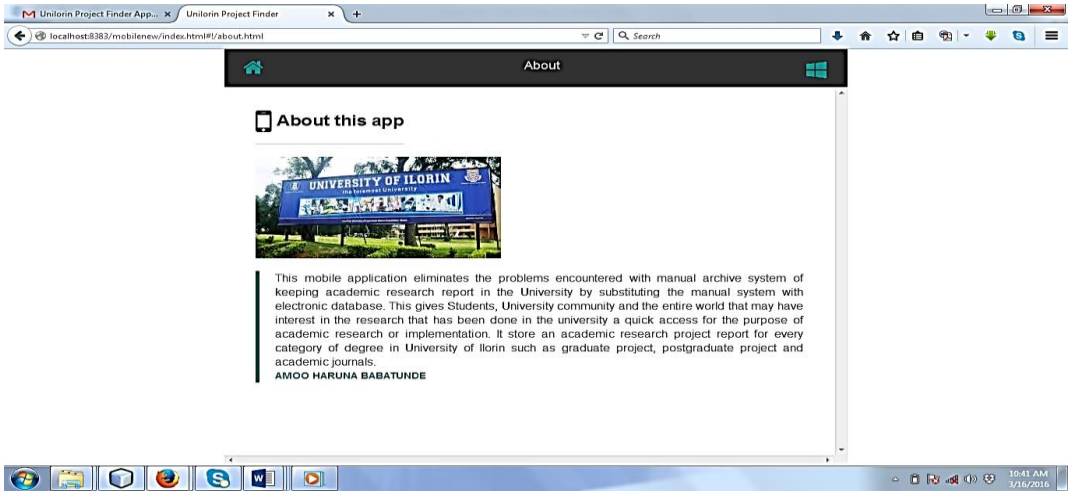


Fig 26: About App Page.

Mobile App Operation Dash board.

The mobile application is designed primarily to access the online database without constrain. That is a user can use the system to download the project from the database without necessarily login in to the application. A web application user such as students and supervisors can also login using the mobile App to perform all the operation dedicated to them. This include creating account by student and supervisor, uploading project by students, approve project by supervisor, and edit or download project by the Student or the Supervisor.

The fig below shows the screenshot of the operation dash board of the mobile App.

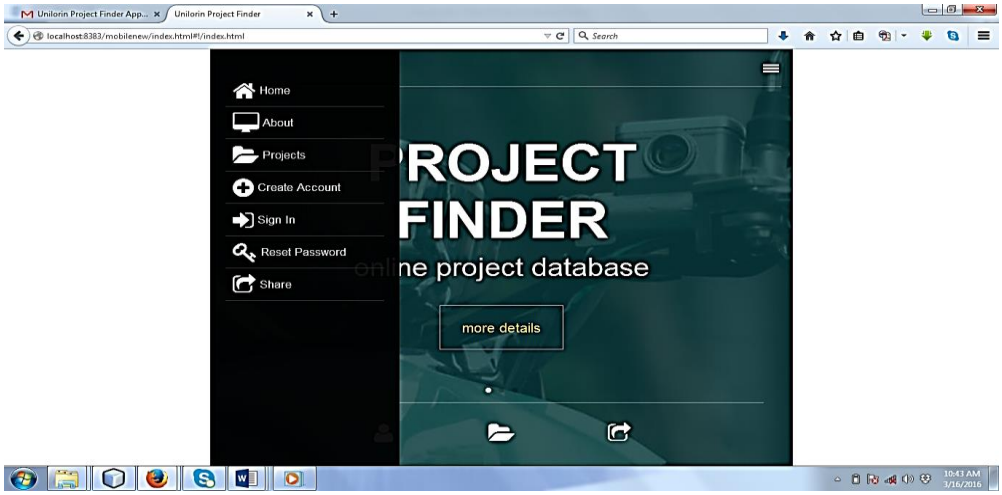


Fig 27: Mobile App operation Dash board.

4.0. Conclusion

The implementation of an electronic database for academic research presents several evident benefits. Chief among these is the enhanced accessibility to research reports within higher learning institutions, leading to a reduction in operational costs and time. Research by Castilla et al, (2023) have emphasized the implementation and adoption of mobile solutions for archival purposes to cater to the evolving needs of researchers and academic institutions. They argue that such systems can enhance accessibility, usability, and efficiency in managing research data. By automating processes involved in retrieving academic write-ups like research reports, academic journals, and theses, the system streamlines operations and eliminates the need for manual archiving at the University of Ilorin. Research by Khan et al, (2024) have provided insights into the Waterfall Model's structured approach to project management, emphasizing its sequential phases of development, including requirements analysis, design, implementation, testing, deployment, and maintenance. Furthermore, it fosters improved communication between lecturers (Supervisors) and students. The time saved from system implementation can be redirected towards developmental tasks, while cost reductions can be allocated to other essential areas.

The system was successfully developed as planned, utilizing JQuery Mobile for front-end mobile app development, MYSQL database technology for the backend, and PHP as the server-side scripting language bridging the gap between the database and the system's front-end. Research by Niederst, (2018) emphasis the configuration and efficient interpretation of requests between the application and the database. Employing HTML 5, CSS, and PHP within a 3-tier client-server architecture, the web-based platform offers an effective solution. It has eliminated challenges associated with manual archiving of project reports, significantly enhancing accessibility through an electronic database. The system's integration of project approval processes provides substantial academic benefits by enabling students to electronically submit projects for supervisor approval without geographical constraints. Also, the integration of this research offers a structured framework for systematic planning and execution. This approach ensures that each phase of development is completed before proceeding to the next, thereby potentially reducing risks and enhancing the quality of the final product (Suharno & Imraan, 2024).

Research by Watanabe et al, (2024) also explored the practical implementation of Mobile Archival Systems using the Waterfall Model. The study shows the development of a Mobile Archival System for a university library using the Waterfall Model. Their findings highlighted the benefits of adopting a systematic approach in meeting project objectives, ensuring stakeholder satisfaction, and delivering a reliable archival solution. In conclusion, the integration of the Waterfall Model into the development of Mobile Archival Systems provides a structured framework for project management, potentially enhancing efficiency, reliability, and stakeholder satisfaction (Shelar et al, 2023). However, further research is warranted to investigate its effectiveness across different contexts and its implications for the usability and accessibility of archival systems (Acuna et al, 2024).

5.0 Recommendation

For future enhancements, implementing an electronic database system for academic research could involve integrating multiple learning institutions, especially universities, into a unified research repository. This comprehensive

integration would establish a vast electronic database, thereby increasing the accessibility of research reports and promoting transparency within academic institutions.

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