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Research Article

Final Year Students' Projects Allocation and Management System

Lamido Yahaya[1*], Abubakar Adamu[2] and Sani Ahmad Muhammad[3]
[1]Department of Computer Science, Faculty of Science, Gombe State University, Gombe
[2]Department of Mathematics, Faculty of Science, Gombe State University, Gombe
[3]Department of Computer Science, School of Technology, Kano State Polytechnic, Kano
*Corresponding author: yahayalmd@gsu.edu.ng, doi.org/10.55639/607. 131211

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ABSTRACT

Final year students' project has been one of the requirements for graduation from institutions of higher learning, especially universities, colleges, and polytechnics. The main concern is the complexity associated with managing the task, which increases with respect to the size of problem instance. Although, the use of computer technology has advanced to various fields, manual process of managing students' projects is being practiced almost everywhere. This indicates the inadequacy of the existing technology to address the problem. With the increasing demand for centralized matching systems for students' projects verification and allocation within higher institutions, there is a need for an efficient software package that eliminates or minimises the use of manual process. The use of paper and pen to verify a project title or shelf storage of completed students' project reports, consumes time, and is prone to errors or records loss. In this paper, a web-based platform called Online Final Students' Project Management System (OFSProMS) was developed. The system was implemented for the Department of Mathematics, Gombe State University, in order to handle such complexities. Tools used include PHP, MySQL, JavaScript, HTML and CSS. Observation and interview were used for collecting the data. The waterfall model was adopted as the system design approach. Upon testing with 48 final year project titles, the system was able to verify 45 successfully, which corresponds to an accuracy of 93.75%. Therefore, this system if deployed would go a long way in simplifying the task for project coordinators, supervisors and the students in general.

Corresponding author: Lamido Yahaya, Email: yahayalmd@gsu.edu.ng
Department of Computer Science, Faculty of Science, Gombe State University, Gombe

INTRODUCTION

In today's dynamic world, rapid changes in information and communication technologies (ICT) have become common in every field of human endeavors. The tools and materials that are used in daily commitments are renewed almost daily. In parallel with these changes, ICT applications have inevitably entered into learning and teaching activities. One of the recent advances in the world of information technology is the rapid development of communication which has turned the world into a global village. One can send messages electronically (e-mail), search for information (using the www), buy goods online (e-commerce), withdraw/ transfer money (e-banking), school online (e-learning). This has affected the society positively to a great extent. As a result, computerisation of students' projects verification, allocation and management to avoid duplication should not be exempted in this revolution. However, in universities all over the world, students need to be assigned to projects as part of their degree programmes (Cooper & Manlove, 2018). The final-year project is an academic activity that engages a student in a research work in a certain field of study; which may be graded after successful completion and it carries certain percentage from the student's overall scores in the final semester (Yahaya, Tambuwal, & Sani, 2016). Final year student project management is the process of planning, organizing, and managing resources to bring about the successful completion of a specific project goals and objectives without plagiarism of someone's work. Therefore, a need for verification before a student can precede with his/her research has become necessary. The fundamental objective of final year students' projects management is to avoid duplication, which occurs mainly due to the fact that the number of students increases, which eventually leads to an increase in complexity of managing the task. Regardless of the approach employed, careful consideration needs to be given, to clarify surrounding project objectives, goals, and more importantly the roles and responsibilities of all participants and stakeholders in students' projects allocation and management process.

Usually, a project topic can be chosen at most by one student (for individual project allocation), though in some cases a project is suitable for more than one student to work on simultaneously. To give students something of a choice, there should be as wide range of available project topics as possible (Manlove, 2003). If that is the case, supervisors supply projects from which students make their choices. Typically, a supervisor will offer a range of project topics, but does not necessarily expect that all will be taken up (Manlove & Irving, 2003). Contrarily, in this paper, we designed a web-based system for verification and allocation of project topics to final year students in the Department of Mathematics, Gombe state University, where each student has preferences over the list of project topics that he/she submitted for acceptance, while a supervisor does not have preferences over the students that he/she is willing to supervise. We considered the ways of managing student project titles, verifying to eliminate duplication of project in the department. To reduce the chance of clashing for project topics among different students, they are required to provide an ordered list of finite number of project topics that they are interested in. This list of ordering with priority is known as the preference list (Abraham & Manlove, 2007). The optimal matching between students and project topics is then left to be constructed on their preferences. The goal is to find assignments that are fair and that maximize the collective satisfaction (Chiarandini, Fagerberg, & Gualandi, 2017). It is important to realize that a centralized matching scheme is preferred than that of decentralized because of the property of optimality. A decentralized approach cannot

guarantee such property in general. Also when we have a number of students going for the most popular project titles, then the allocation or Though, research in final year students' projects management has gained much attention from researchers over decades however, in most Nigerian academic institutions, the students' projects management task has been manual. This task is a matching problem that requires optimal assignment of projects to students while taking into consideration the hard constraints. Matching problems, which generally involve the assignment of a set of agents to another set of agents based on preferences, have wide applications in many real-world setting (Manlove & Olaosebikan, 2022). A number of researchers tried to apply these techniques in one way or the other in order to optimally match students with projects. However, Ademola, Adewale, & Ike (2013) developed an online portal for managing final-year undergraduate projects problem where allocation of students to their supervisors is made available online for students to view. They later meet their respective supervisors to discuss on projects. Meeting with their respective supervisors to discuss on projects may convince them to have interest on projects which they did not like before. This is because the supervisor would shed more light on those projects which they lack knowledge or interest. This in fact solves the problem of lacking interest or knowledge on projects. The system does not allocate projects but stores their titles only after when they are done in order to prevent future clashes. Students upload their partially or fully completed projects to the system for supervisors and the project coordinator to view and take all necessary actions. Therefore, it eliminates the problem of projects duplication by students through storing previously done projects in the database. This approach does not consider how projects are allocated to students at all. However, the approach does not clarify whether students carry out an individual or group projects. Therefore, this approach may not prevent two or more students graduating the same year from working on the same project. This means that two or more students can work as a group on the same project. If that is the case, there is no actual allowed number of students in a group, and knowing one another as well as communication gap would be an overhead at the beginning, especially when the number is large. This eventually might lead to substantial delay in their project activities; otherwise some students may not participate actively or fully in the project work.

assignment will be on the basis of first come first serve, which the system automatically generates including date and time of posting.

In another development, Kwanashie, Irving, Manlove, & Sing (2014) proposed a model for students' projects allocation problem based on individual or group projects offered by a supervisor. This model is an improvement over the SPA model by Abraham (2003). In this context, they modelled the SPA as a network flow problem and applied a GREEDY-MAX-SPA algorithm to obtain maximum optimal assignments. In addition, this approach allows for supervisor's minimum and maximum number of students he/she can supervise. Students are allowed to submit a list of projects they find acceptable from the supervisors' lists in a preferential order. However, students have preference over projects topics and supervisors have preference over students as well, and which project is allocated to which student. The major problem here is that supervisors tend to allocate their preferred or ranked projects to those students they prefer to supervise. This however, leads to some students to be assigned projects that are relatively low in their preference lists.

Moreover, Sonali, Shreyash, & Ruchi (2017) developed a web-based application called SPAM (Student Project Analysis and Management). They adopted SSADM (Structural System

Analysis and Design Methods) for the development which follows definite steps to achieve a given task. They used observation, questionnaire and interview methods as fact finding techniques. The system uses MYSQL for conceptual database design and dream-weaver to code the layout in HTML language and CSS, while the functions that are performed by different users were generally achieved using PHP scripting and java script.

Emmenuel & Daniel (2019) developed a cloud-based system for project allocation and supervision intended for tertiary institutions in Nigeria. The system was designed with PHP, Java and HTML programming languages using MySQL server architecture, which could be hosted online. The application is a window based, menu driven and interactive. The idea is based on the ability of the intended users to access the system online. In reality, it is an online platform through which students interact with their supervisors. The system does not verify and allocate project topics automatically; rather everything is done almost manually by the administrator.

Ismaili, Yahiro, & Yokoo (2019) proposed a model (based on two-sided matching problem) called Student-Project-Resource matching-allocation (SPR) for optimal allocation of project topics to students. In this idea, students are matched to projects based on their preferences. In addition, the system incorporates resource allocation mechanism, which determines the resource allocation part, based on some expectations or past data and fixes the capacities of projects.

Although the developed systems mentioned in the literature are limited to allocating project topics to students, and some of them include monitoring project activities as well. They also ensure no two students would be allocated the same project at the same time however, they do not provide facility for checking whether a proposed topic is already done or not. Therefore, this is one of the fundamental issues that were addressed in this paper. In addition, storing previous completed project reports is another important aspect that our proposed model takes into consideration. The proposed OFSProMS model has integrated a functionality that takes care of such aspect in order to save space and ensure faster retrieval when required. These are the major contributions of our paper.

MATERIALS AND METHODS

In this section, we proposed a model called Online Final-Year Students' Projects Management System (OFSProMS) as shown in Figure1. In this architecture, students would be asked to submit their list of project topics in order of preference to the system after which the project coordinator would handle verification and allocation activities. Project supervisors can also log into the system, view students' project choices and which student is allocated which project. They can also view which students are allocated to which supervisor. After successful completion of project works, students are to submit the PDF file copies of the same to the project coordinator who would upload these files to the system for permanent storage.

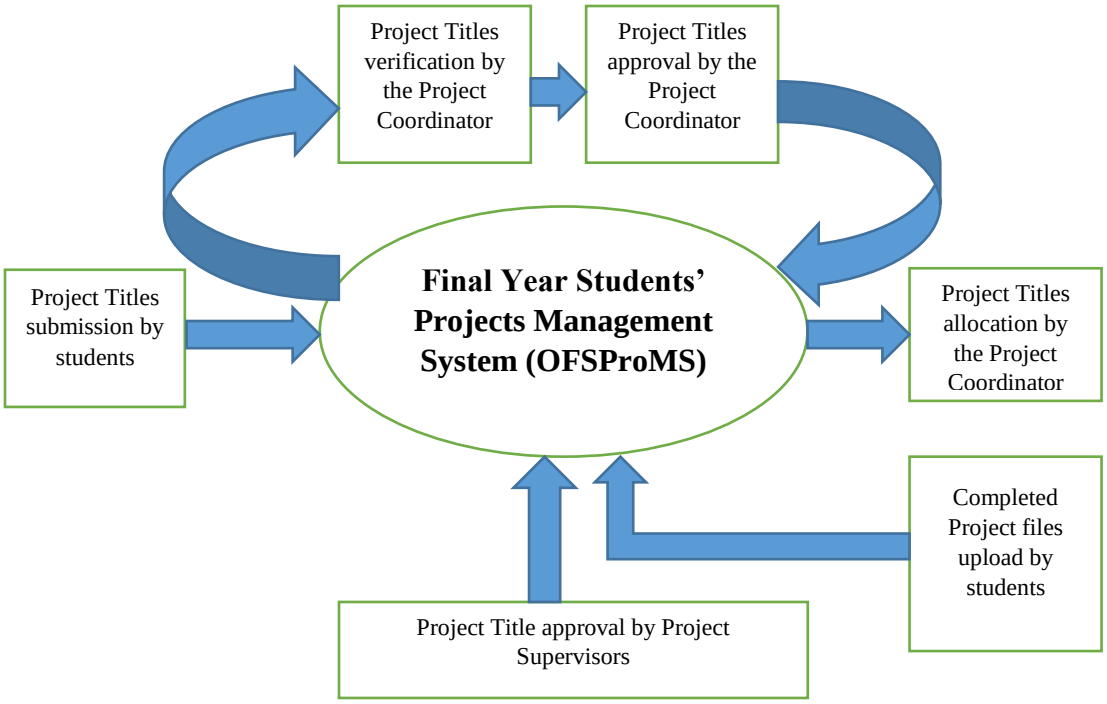

Figure 1: Architecture of the OFSProMS Model

To realize the proposed model, we adopted the waterfall model approach, which is based on well-defined series of sequential stages from requirements analysis to the final stage of maintaining the system. The approach in comparison to others has some fundamental benefits that contributed to its general acceptance in software development life cycle. The waterfall is suitable for this work because it is adaptable and flexible to changes; reducing development time as well as its usefulness when one has to reduce the overall project risks. Waterfall model approach can also ensure that user requirements are completely met and also help the development of project by giving better control of project execution. The software process of waterfall model also promotes communication between project users, by defining essential users and interactions, and by giving a structure to the whole process. As shown in Figure 2, there are five consecutive stages which we followed strictly in order to realize the proposed system.

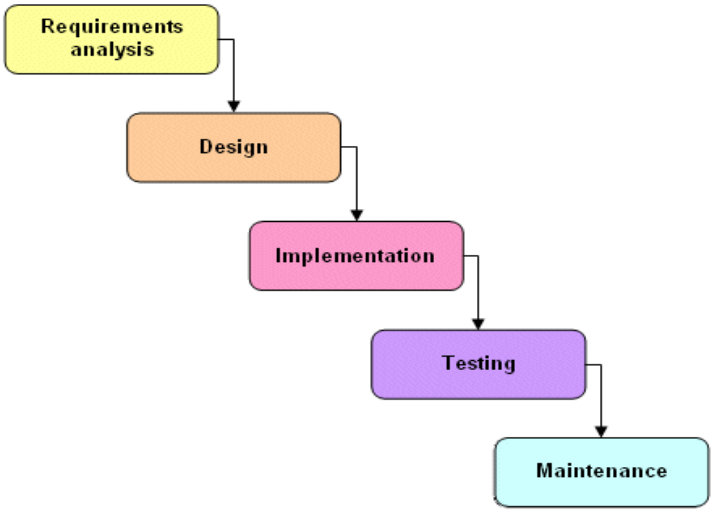

Figure 2: The Waterfall Model
(Source: https://www.technologyuk.net/computing)

Requirements Analysis

At this stage, which is the first, we interacted with the intended users of the system in order to know their requirements. Basically, the intended users are the project coordinator, supervisors, and students. As usual, students would be asked to submit their individual preference lists of project topics (2 to 3) through the system for verification by the project coordinator. They can submit similar project topics but no two would be allocated the same topic. The issue would be resolved by allocating the first student to submit a project topic. Supervisors would log into the system and view the available project topics that match their areas of interest. The allocation would be done by the project coordinator. The students would be allocated to the supervisors irrespective of their research areas in order to avoid imbalance allocation. The proposed system can both be helpful to the students, supervisors and the project coordinators in the department. The system will ease the manual way of carrying out final year students' project verification and allocation, which has been the predominant method within the department. Based on interaction with the intended users, the proposed system has the following features:

i. Project titles verification mechanism to ensure no two students can have the same project topic.
ii. Allocating project topics to students using first come first serve basis to avoid biasness.
iii. A well-organized platform to maintain all the history about the previous project tasks.
iv. In addition, all previous completed project works could be stored in PDF file format.

However, the requirements of the system are basically classified into functional and non-functional. These were briefly explained as follows:

Functional Requirements

In software and systems engineering, a functional requirement defines a function or its component. Functional requirement also refers to the essential functions that the proposed System would need in order to function optimally. The functional requirements of the system are:

Administrator (Project Coordinator): The system administrator or project coordinator performs the following functions on the system:

i. Login into the system;

ii. Verifying project titles;
iii. Uploading or storing completed students' project reports;
iv. Storing recently approved project topics;
v. Allocating project topics to students;
vi. Allocating students to supervisors.

Supervisor: The project supervisors perform the following functions:

i. Login into the system;
ii. View project titles;
iii. View project allocation;
iv. Log out.

Students: Students perform the following functions on the system:

i. Login into the system;
ii. View project allocation;
iii. Log out.

Hardware Requirements

i. A Computer System (Desktop or Laptop) or smart mobile phone;
ii. Processor (1.40GHz and above);
iii. 1GB RAM and above;
iv. Hard disk capacity of 40GB and above;
v. Keyboard;
vi. Mouse or any equivalent component;
vii. Internet access facilities.

Software Requirements

i. Operating System (Window XP version or any latest version) and Android version 5.0 and above for Android devices.
ii. Web browser (e.g. Mozilla Firefox, Google Chrome, etc.).
iii. Text editor.
iv. Web server software, Windows Apache MySQL and PHP (WAMP).

Non- Functional Requirements

Non-functional requirements: are requirements that specify criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions. The non-functional requirement of the proposed system includes: Security, Scalability, Concurrent accessibility, and Usability. Security requirements are important factors in this system as classified data will be stored in the database. User validation will be done during login to ensure that the user is valid and that the user only has access to his or her permission data. General users will only have access through the user interface.

Design

The design stage usually transforms the analysis phase into logical view. For the purpose of this study, flowchart and use case diagrams were used. The two design techniques were used in order to better visualize the various controlled logical steps in using the system. As shown in Figure 3, the logical designs of the proposed system shown represent the functions performed by the project coordinator.

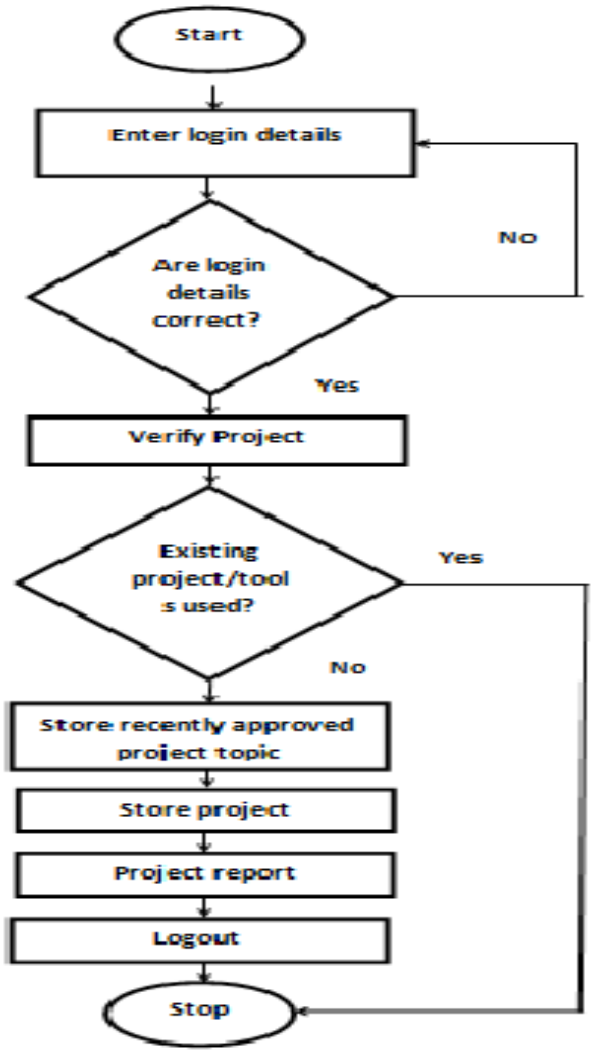

Figure 3: Flowchart of the System

The use case diagram represents user's interaction with the system. It shows the relationship between the users and the different use cases in which they are involved. As shown in Figure 4, the intended users of the system (i.e. Project Coordinator or Admin, Supervisors and Students) and how they interact with the system was depicted.

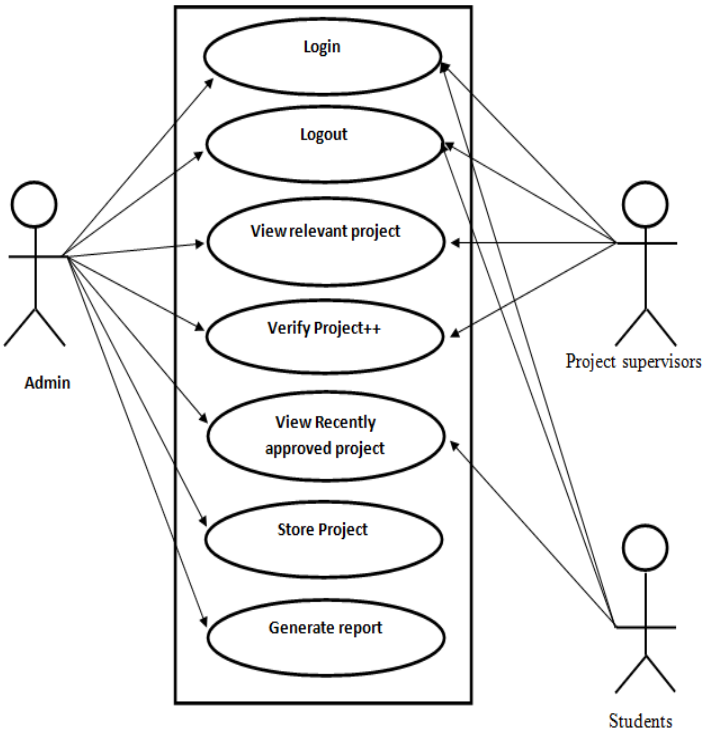

Figure 4: Use Case Diagram of the System

IMPLEMENTATION

This is the coding stage which involves converting the actual design of the system, thereby putting the theoretical design in to practical sense in order to put the new system in to operation such as testing and deployment. Implementation also includes all those activities that take place during the conversion from the old system to the new system. In implementing the system, a number of tools were incorporated. Hypertext preprocessor (PHP), JavaScript and MySQL Database ware used. MySQL is the most popular Open Source Relational database management system that is used for developing web-based software applications. Macromedia Dream-Weaver was used as Integrated Development Environment (IDE) in creating the pages, and we used the cascading style sheet (CSS) to format the layout of web pages. Also WAMP Server was used as a local server for testing the system functionality. Since it's a web-based application, Mozilla Firefox browser was used for the display of test results.

TESTING

System testing is a vital part of any software development. After a system is developed, there is a need to test and verify that the system meets the expectations of its intended users. This refers to system testing. System testing entails the process of executing a program using a test data with the purpose of uncovering and correcting errors in the program. Testing is the process that is carried out to ensure that the system conform to the specification and meets the requirements of the users. System testing means executing software with some data to ensure that the software works correctly. The testing was conducted not only at the end but also during the development of the prototype. Functional and interface testing were carried out for the whole system. Each and every link was checked to make sure that all the links work correctly. Interface testing is carried out to identify that the interface works correctly and faults are not created due to incorrect programming, or poor specification.

Experimentally, we tested the system with 48 formulated project titles for the 2019 graduating students in the Department of Mathematics. The test was carried out by supplying the project titles one after the other to the system. At each step, a search function was invoked to enable the system compare the keywords of the supplied project title with those already stored in the system. The system performed optimally in verifying and allocating the projects to students. 45 project titles were successfully verified. The results of our experiments were presented in the "Result & discussion" section.

Maintenance

This section involves updating and improving the system after it has been put into practical use by the intended department. However, due to some technical limitations, our system has not yet been put into operations in the department. Therefore, nothing has been done with regard to maintenance.

RESULTS AND DISCUSSION

In this section, we presented and discussed the results obtained during testing the proposed system. Various activities were demonstrated using graphical user interfaces (GUIs)-based approach. The application would be accessed using any web browser. For this prototype, Mozilla Firefox browser was used. The interface would be viewed best using 1024 x 768 and 800 x 600 pixels resolution setting. No user would be able to access the major part of the application without logging onto the system using his valid credentials. Here are some major pages of the system which were presented in terms of screenshots.

Home Page

This page will appear immediately when the user starts the application as a welcome page. It consists of the front image of the organization and some important links, which include a link for the departmental project coordinator, project supervisor, and students. The home page is shown in Figure 5 as follows:

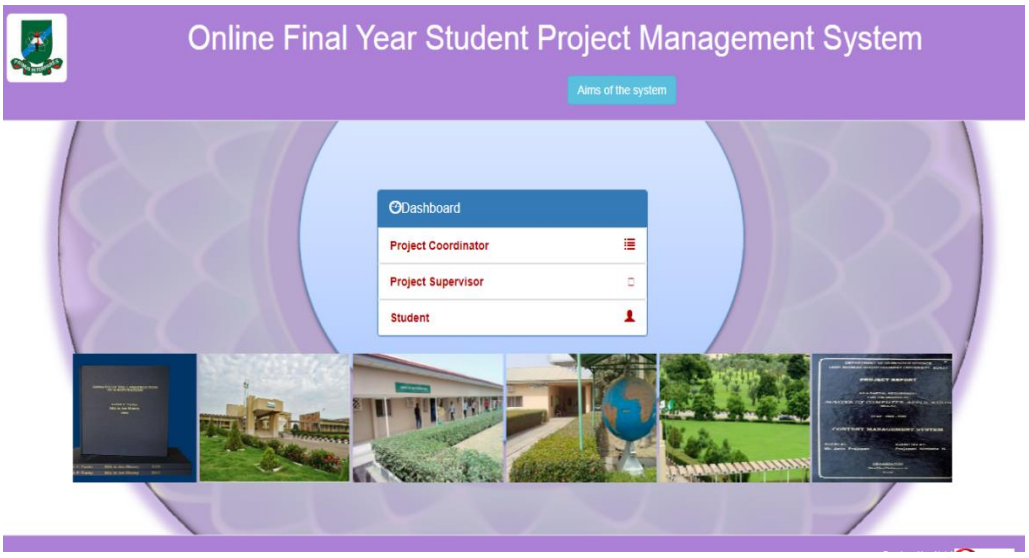

Figure 5: The Home Page

Login Window

The login page prompts for a user to enter his/her username and password to log in into the application. If the username and password are correct then the program will execute and display the required page to the user, otherwise it will display an error message, and wait for

him to try login again. The login page is as shown in Figure 6.

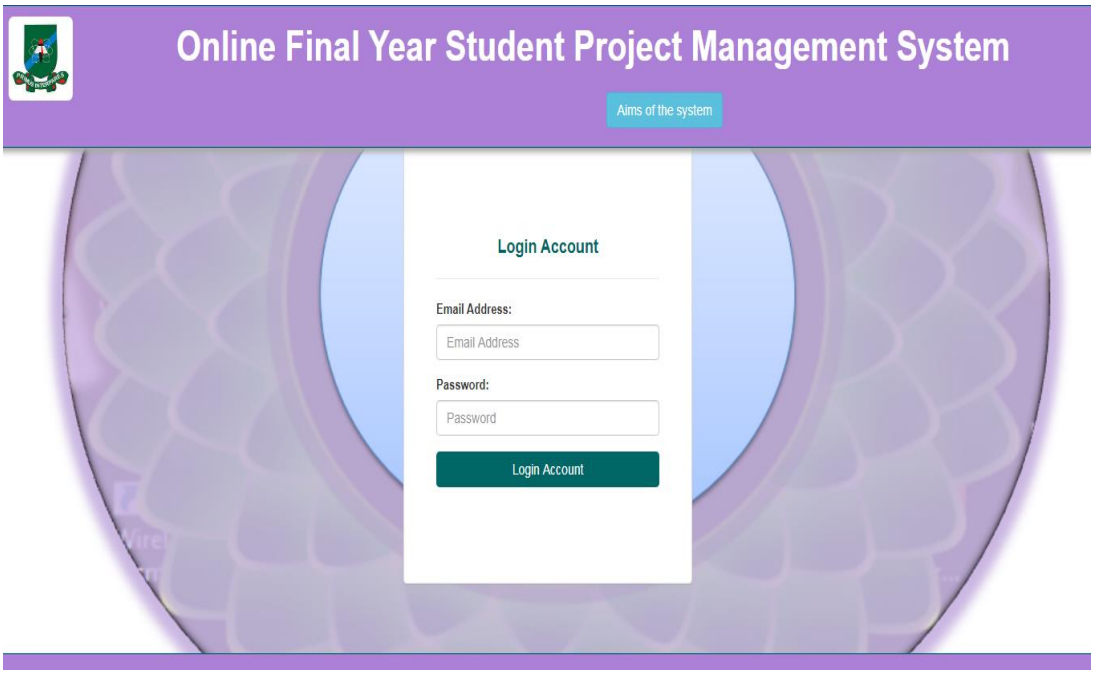

Figure 6: Admin Login Window

Project Coordinator Page

Every user (project coordinator, supervisor or student) has his own customized page upon successful login. This is because the three different users have different privileges as granted on the database. In this section, we displayed the page for the Project coordinator who is also the system administrator. The page was displayed after successful login, and it contains several functional links which enable him to carry out his functions. His functions include registering both supervisors and final year students into the system, approving project topics submitted by students, and so on. As shown in Figure 7, the page was displayed showing the various links for the Project Coordinator.

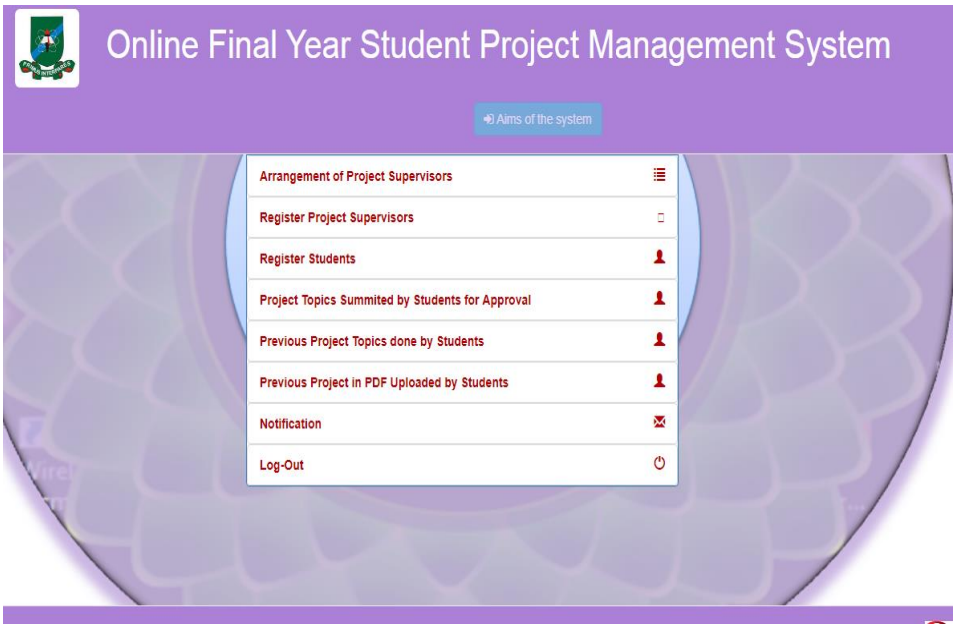

Figure 7: Project Coordinator Page

Search Project

This page allows the project coordinator to search any related works from previous project and he/she can also view project of grandaunts from the department. Project coordinator, supervisor and the students as well can search for the existing or previous projects in order to avoid duplication. This can be shown in Figure 8 as follows:

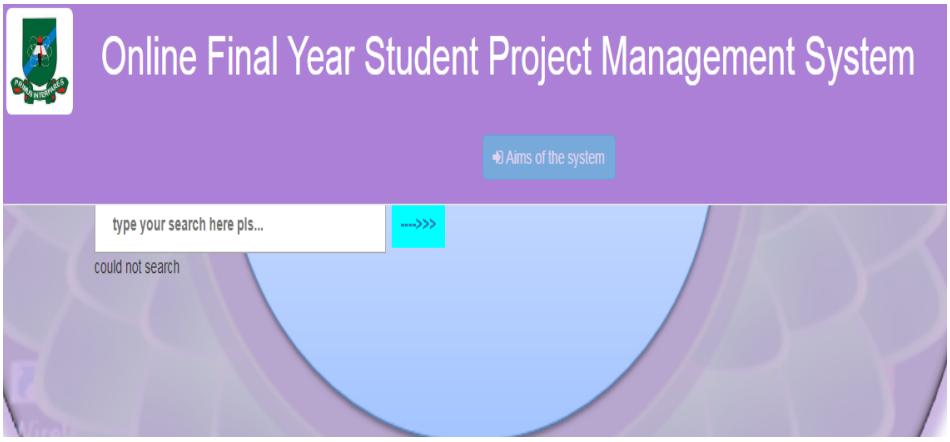

Figure 8: Search Project Window

Project Topics Verification

One of the duties of the Project Coordinator is to verify the similarities between proposed project topics or proposed and previous project topics. This page allows the Project Coordinator to verify project topics submitted by any student undergoing his undergraduate research. The purpose of this is to verify project topics so as not to have students carrying out the same research at the same time. The system works by comparing the similarity between the major keywords of the proposed project topic with an existing one (already stored). When the keywords or the entire project title is typed, a search mechanism is invoked which searches through the existing list of stored projects automatically, and displays the available related titles. The Project Coordinator would decide whether to accept or reject a project topic based on the existence of similarity or not. When a

project topic is successfully verified, it will be stored by the system. When another project topic is submitted, comparison will be done with the previously stored one(s) to prevent duplication. At this stage, 48 project titles were supplied. In this experiment, 45 project titles were verified correctly while 3 were not, because the keywords used were dissimilar but have the same meaning. For example, "An online Learning System" and "A Web-based Leaning Platform" have different keywords but they mean the same thing. The verification page can be shown in Figure 9 as follows:

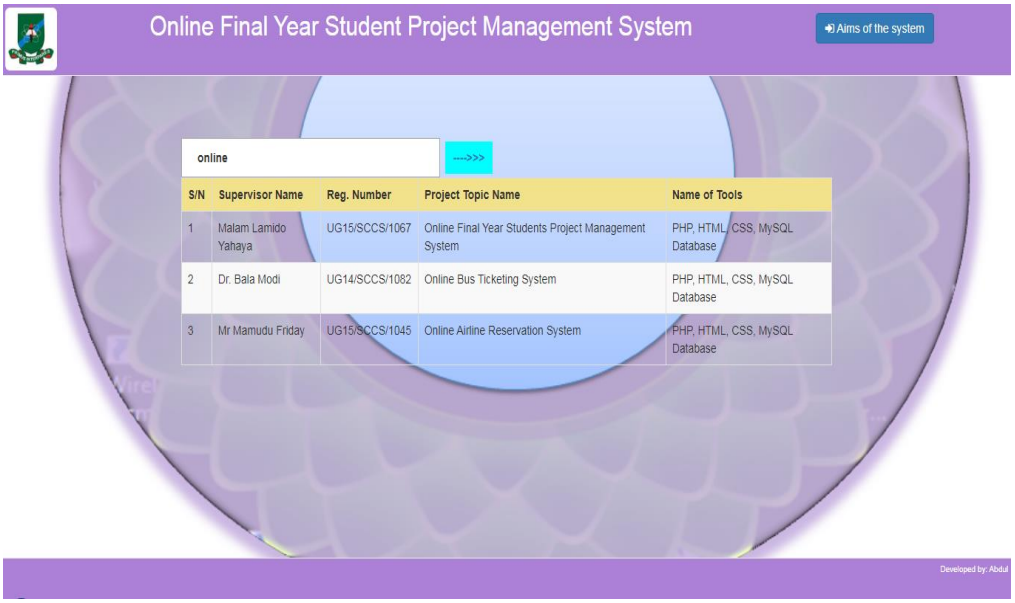

Figure 9: Project Topics Verification

Project Topics Allocation

Upon successful project topics verification, the allocation would be done based on first come first serve basis. A student whose project topic was verified and approved earlier will be allocated first. The allocation process must satisfy the system hard constraints, which specified that no two students can have the same project topic at the same time, and no previous project would be duplicated. The allocation depends on successful verification and supervisor's approval. A project title can be successfully verified but may not be necessarily approved by the supervisor whom was allocated the student that supplied the project topic. In this case, another project topic needs to be supplied by such student. This page allows the project coordinator to allocate project topics after been approved by the project supervisor. The project topics allocation page is shown in Figure 10.

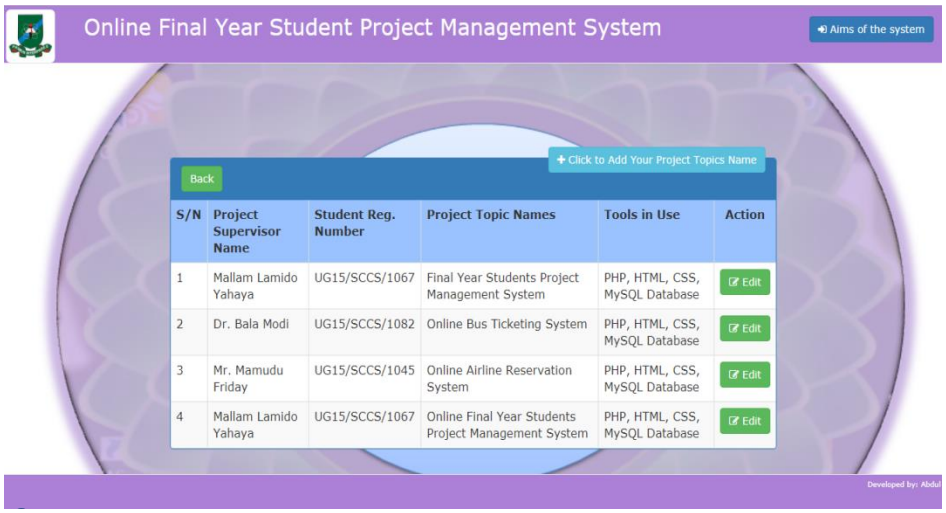

Figure 10: Project Topics Allocation

Project Archives

The system stores all previous project works that were done in the department. This functionality enables the system to store completed project reports in order to avoid their lost due to unforeseen events such as fire outbreak, flood, etc. This page allows the Project Coordinator to upload copies of project reports after been finalized by the department that the project research carried out met the departmental requirements. A student would submit his/her project report in PDF (portable document format) file format to the departmental project coordinator. This page simplifies financial cost of printing hardcopies of the project and at the same time eliminates the manual bulk of project hardcopy storage. Before uploading any project report, there is a need to enter the name of supervisor, student's registration number (owner of the project), project topic title, tools used, and then chose the project PDF file from its location. The project archive page is shown in Figure 11 as follows:

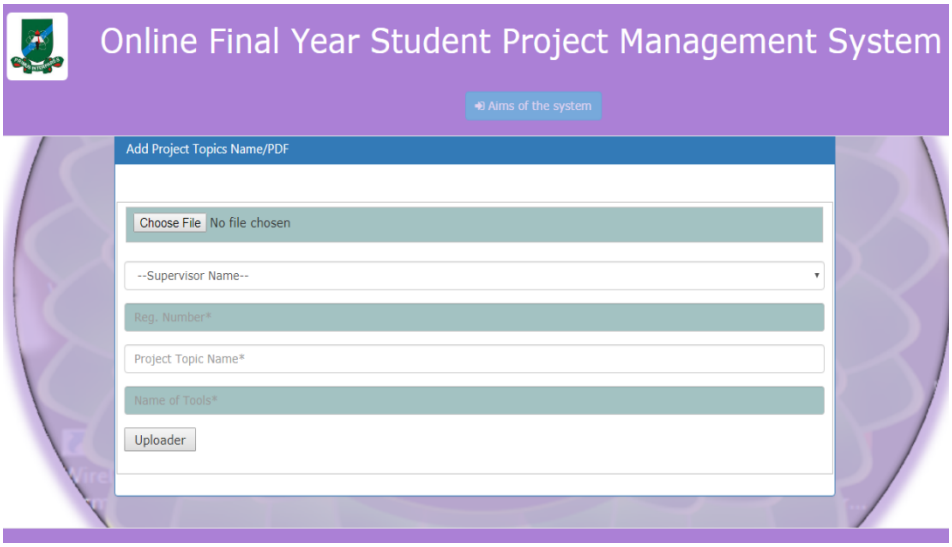

Figure 11: Project Archive

CONCLUSION

Effective management of final year students' project is essential for successful graduation of students and record keeping. Project topics verification and allocation for final year students in tertiary institutions, especially universities is one of the most difficult tasks. The difficulty of such a task increases with the increase in the number of students graduating every year. Having developed a simple prototype which we termed as "Online Final Year Student Project Management System" (OFSProMS), it is subject to modification and improvement in the future as time goes on.

Our simple application provides a good interface which is easy to understand by the intended users, and helps in adapting to its use. The use of this application may reduce the extra time and efforts required to manage and monitor the final year students' projects in institutions of higher learning. Upon testing with 48 formulated project titles, the prototype performed optimally in meeting the requirements of its intended users as well as satisfying the hard constraints. Out of the 48 project titles, 45 were verified and allocated successfully, which corresponds to an accuracy of 93.75%. In addition, the proposed OFSProMS model has integrated a functionality that takes care of storing completed students' project reports in Portable Document Format (PDF), in order to save space and ensure faster retrieval when required. These are the major contributions of our paper.

Today, the complexity of managing final year students' projects has increased due to the fact that the number of graduating students from institutions of higher learning is increasing every year. Avoiding project duplication among students is the most challenging factor to consider. Therefore, to address this issue, the future research on this would be more of Constraint Programming (CP), considering the task as a Constraint Satisfaction Problem (CSP). This would ensure optimal allocation of project topics to students as well as assigning students to their supervisors, taking into account the hard constraints of the system.

CONFLICT OF INTEREST

The authors declared that there is no conflict of interests.

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