EXAMINATION MANAGEMENT PORTAL FOR TERTIARY INSTITUTIONS: A CASE STUDY OF FEDERAL UNIVERSITY LAFIA

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Date manuscript Received: 12/07/15 Accepted: 18/12/15 Published: December 2015

ABSTRACT

A study was carried out on the analysis, design and implementation of a Web-based examination management system in Federal University Lafia. A step by step data flow diagram was created as a guide for application developers towards building a more flexible student information system for the university. Using the design, enhanced and intelligent computer software for result computation, integrated with a dedicated database for storing processed results and other relevant records was developed to simplify the University grading system and overcome the short-comings of existing examination packages. An empirical evaluation and comparison of the system with other similar systems shows that it will equally expedite the processing of students' records, semester results and transcripts at various levels and offer a faster, secured management and access to students' results On-line. This system is more efficient and provides substantial benefits for both the University management and students as observed in its implementation.

Keywords: *Examination Management System, Computer Software and Computation.*

INTRODUCTION

Paper examinations still remain the primary means by which student learning in both undergraduate and postgraduate curricula are assessed, as they have unique advantages that may never be replaced in the nearest future. However, paper examinations are laborious to grade, tally, and record. They are also difficult to keep, especially after they are returned to the students. Often, electronic examination is considered a suitable alternative (grading, returning exams, etc). Despite this, more challenges still exist when administering electronic exams, including ensuring that everybody has a secure computer for the examination. Hence, the prevalence of paper examination is expected to continue for quite some time. However, examinations, results and the personal information about students are the key elements of an electronic student information management system. Given the various needs of the different categories of students in a university setting, each student record will need to be processed from time to time in order to meet those needs and the needs of other people outside the university who rely on such records. Some institutions still rely on manual systems for the archiving of students records thereby making its processing and retrieval cumbersome. According to Arekete and Osinowo (2009), student records in other cases are available in semi-electronic or computerized forms which still have the aforementioned inherent difficulties. These electronic formats are unfriendly because they require further cumbersome transformation processes in order to produce the much needed reports. In this current digital era, time is always of essence. There is therefore need to create systems that are seen to be efficient, flexible, reliable and able to produce accurate information as at when required.

Student Information Management Systems (SIMSs) have gone through tremendous changes with respect to technology. According to USDEOPEP (2009), since the early 1990s, the Web has become the technological infrastructure that has enabled the deployment of innovative SIMSs for tertiary institutions. Idogho *et al.*, (2011) reported the creation of an "interactive intranet portal for effective management in tertiary institution". Their work addressed problems that emanate from the processing of student results, payment of fees and management of library resources. They identified services that are relevant to the institution and sought to harmonize them into a single platform. However, their work discussed only two of such services which include result processing and library resource management. Also in Youh (2010), a "client server distributed database for student result processing" was also reported. Their work focused on allowing various academic units to maintain and control their data. They placed emphasis on the benefits of leveraging a distributed architecture as opposed to centralized database architecture. In another related study, Ayodele and Ezugwu (2010) reported the "design and implementation of student's information system for tertiary institutions using neural networks: an open source approach". Just like the previous researches, their work focused on the collection and storage of student records and a prompt processing of results and student transcripts and the end result being the availability of students result online.

This study compared the other similar systems and aims to expedite the processing of students' records, semester results and transcripts as well as offering a faster more secured access to results online.

MATERIALS AND METHODS

The best suitable alternative solution to resolving the stated problem is the creation of an Internet based application. The internet has become a melting pot for the business community, with web application as the key mechanism for success and growth. The choice of adopting web application lies solemnly on some of its important qualities and attributes among which include remote distributive nature (processing occurs at different physical locations), reliability, availability, interoperability and security.

SYSTEM DESIGN METHODOLOGY

Schedule Feasibility

Time evaluation is the most important consideration in the development of project. The time schedule that is required for the development of this project is very important since more development time affects machine time and cost that can cause delay in the development of other systems. A reliable Exam Management System can be developed in the considerable amount of time if scheduled feasibility is properly documented and followed in the cause of the design work. The figures covered in this section are the initial information gathering, which were later projected for a better design model of the proposed system implementation.

System Data Flow Models

The aim of designing a data flow diagram at the early stage of the system planning and implementation is to enable the developer have a wider perspective about the information and functional domain of the overall system functionalities. In the cause of this design process, the data flow diagram is usually

refined to achieve a greater level of detailed information that encompasses the running application to be developed by the software designer. The Web-based Exam Management System data flow diagram is splinted into three levels; ranging from level 0 to level 3 as shown in Figures 1, 2, 3 and 4. The input entities involve Admin (exam officer and MIS staff), Instructors and Students, while the input data objects include: students' profile, course information and examination records. The labelled lines and arrows represent data type hierarchies

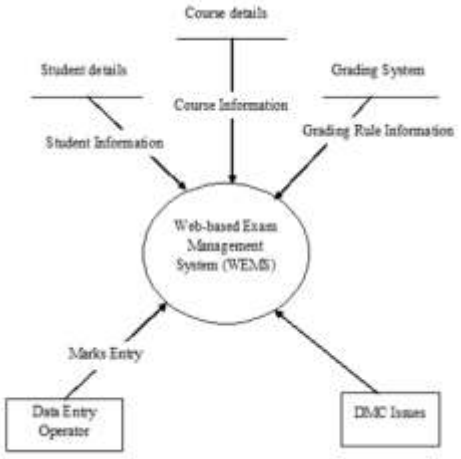


Figure 1: Proposed Exam Management System DFD Level 0

The figure above serves as the core or heart from which we build a fully functional system, with diverse functionalities. Our focus is to develop examination processing engine that will be deployed or migrated across universities, polytechnics and colleges of education. The running of such system should be platform independent and customizable to the taste of end users.

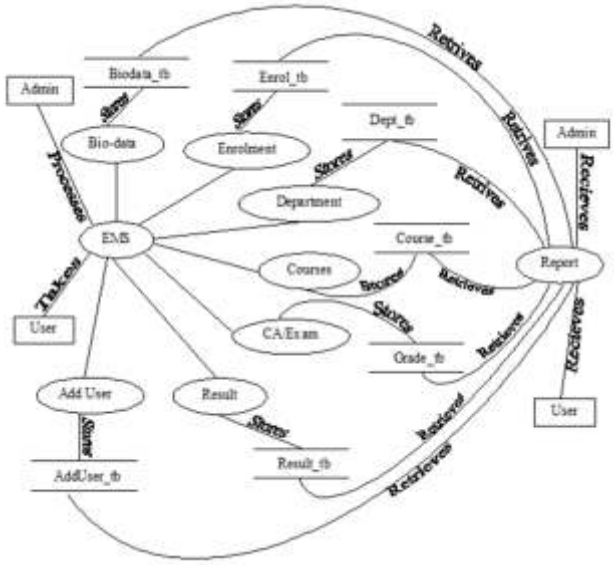


Figure 2: Exam Management System DFD Level 1

The system user comprises both the administrators, instructors and students interface / module, and each of these users will have different degree or level of right of assessments, depending on their respective roles. We will subsequently provide a detailed description of the running system.

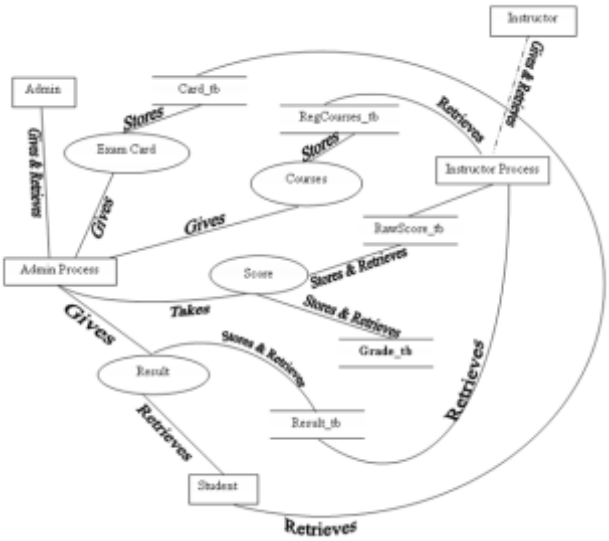


Figure 3: Proposed Exam Management System DFD Level 2

In Figure 3, Examination Card denote a printed or hardcopy identification card containing the list of all courses registered by a student, and on it is also attached the bearer passport photograph. This might differ for some institutions, but WEMS offers a provision for generating examination identification card automatically for individual students.

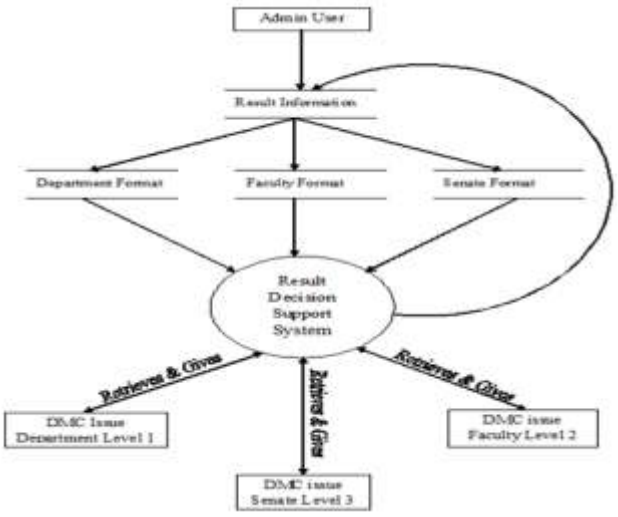


Figure 4: Proposed Examination Management System DFD Level 3

The above entity relationship diagram shows the connection between students, courses and instructors. A connection is established between students, course and instructor because the three are

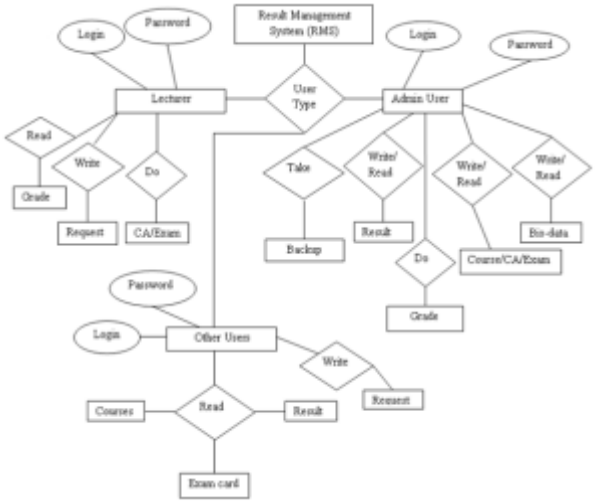


Figure 5: Proposed Examination Management System Entity Relational Diagram

Figure 6: Student, Course and Instructor Entity Relational Diagram

related. This relationship can further be understood by having knowledge of the role of students, courses, and instructors within the context of the proposed system to be implemented. We choose to define a set of object / relationship pairs that defines the relevant relationships. For example, a student registers a course, receives lectures for the course, at the end, he or she takes an examination.

System Design for Project Development

Fig. 7 is a task diagram depicting the work (= tasks) that should be performed to complete the design phase.

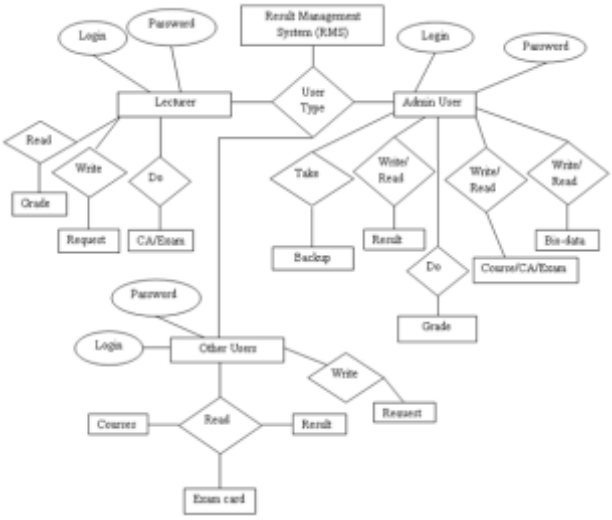


Figure 7: The System Design Task for the Software Project Development Life Cycle

Design of the Application Architecture

Given the data-models, process models and target solution, distribution decisions will need to be made. Figure 8 is a physical data flow diagram (PDFD) that is used to establish physical processes and data stores (databases) across a network of the proposed design

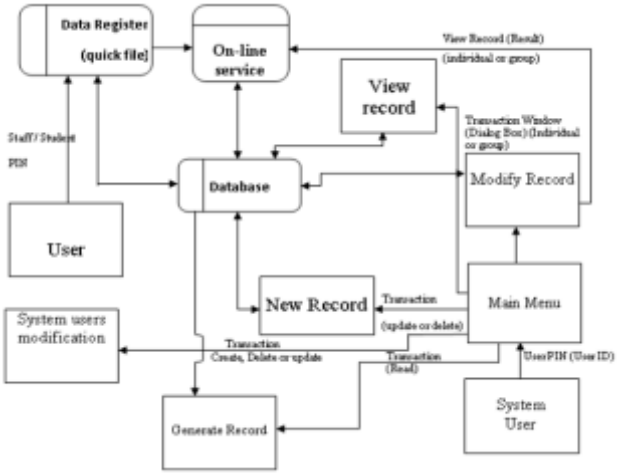
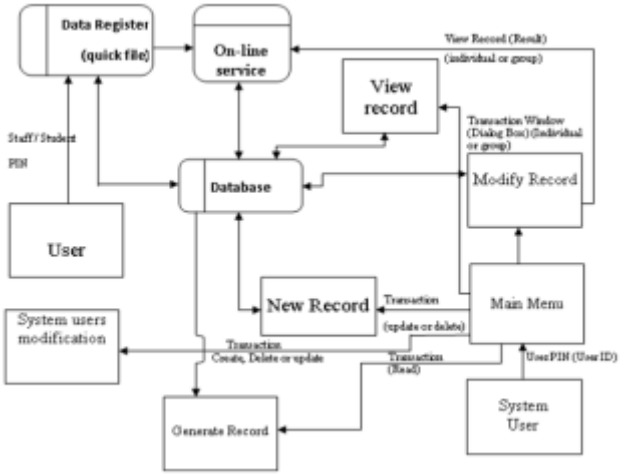


Figure 8: Application Architecture; Physical Data Flow Diagram

Design of the Database(s)

The resulting database schemas shown in Table 1, will serve as container were data are stored as records in tables on the server side database. It consists of a user table (login), Bio-data table, enrolment table, course table, grade table, department table etc. Each table contains a setup information data whose details are provided in the data tables that are shown on the next page:

Table 1: Sample course table from a database.



Data Table

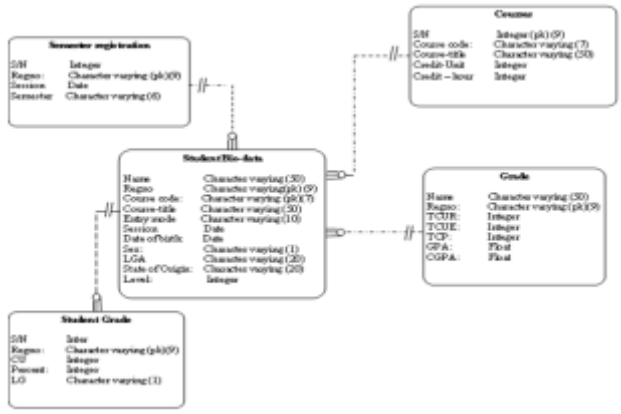


Figure 9: Physical Database Schema

System Design

From the Data Flow Diagram (DFD) depicted earlier on, the next step is the definition of the modules and their relationship to one another in a form called a structured chart, using a data dictionary and other structured tools. The design specifications that get generated at the end of this phase are technical in nature and contain:

i. User interfaces
ii. Databases and data structures
iii. Algorithms and program structures
iv. Equipment and other facilities required
v. Manual procedures that will be part of the implemented system.

Mathematical Model

The most important aspect of the new system is the grading module (mark information management system); the required parameters are basically the semester registration, course registration, assignment, and examination raw scores. The course credit unit registered is denoted by CC. The semester is broken into two; first and second semester and likewise those courses taken at the respective periods for first semester are usually denoted by odd number course codes, (MATH101, COSC201, STAT305, etc) while those for second semester are given even number course codes (MATH104, COSC206, STAT304, etc.) respectively. A student is expected to register for a minimum of 48 credit unit in 100 levels. Thus, the total number of credit unit expected at the end of the first year is given by:

$$\sum_{i=1}^{N} CC_i \leq 24 \quad (1)$$

For first semester cumulative

$$\sum_{i=1}^{N} CC_i \leq 24 \quad (2)$$

Second semester cumulative

$$\sum_{i=1}^{N} CC_i + \sum_{j=1}^{N} CC_j \leq 48 \quad (3)$$

Where i, j = 1, 2, 3, …, N and N represents the total number of courses registered by a student per semester.

The credit unit point and grade point average are then computed based on the above perimeter as follows:

$$TCP = \sum_{i}^{N} CG_i \times CC_i \quad (4)$$

$$GPA = \frac{\sum_{i=1}^{N} CG_i \times CC_i}{\sum_{i=1}^{N} CC_i} \quad (5)$$

Where CC_i the course's credits, N is the total number of courses; CG_i is the course grade point of the course credit system evaluation policy.

The mathematical models which yield equations (4) and (5) will be used in the mark information management module, to compute grades. Subsequently, the processed marks information will be made available for transcript processing and semester result generation.

RESULTS AND DISCUSSION

The technological approach for the development of the new system is based on WAMP Server (Apache, MySQL, and PHP) open source solution Adewale (2006). The web server has what seems to be a simple straightforward job. It sits there over a network, running on top of the client's machine listening to requests that somebody on the web might make, and it responds to those requests and serves out the appropriate web pages. In reality, it is a bit more complicated than that, and because of the web that runs twenty four hours a day, seven days a week, the stability of the web server is a major issue. PHP and MySQL are popular pair for building dynamic web applications. PHP is the most widely supported and used web scripting language, and an excellent tool for

building web database applications (Williams and Lane, 2004). MySQL is a client / server database that consists of a multithreaded SQL server that supports different back ends, several different client programs and libraries, administrative tools, and a wide range of programming interfaces Connolly & Begg (2002). It can hold up to 60,000 database tables with approximately 5 billion records).

The new system is built around a three-tier architecture model, fourth-tier could also be considered as a suitable alternative,depending on the availability of hardware / preference (see figure 10). At the base of the application is the database tier, consisting of the relational database management system that manages the data that users create, query and delete. This database tier is implemented using MySQL database server. Built on top of the database tier is the middle tier, which contains most of the application logics that have been developed using PHP as the scripting engine. This middleware works closely with the web server to interpret the request made from the World Wide Web, process this requests, interact with other programs on the server to fulfil the request, and then indicate to the web server exactly what to serve to the client browser. At the user end is the client tier, usually, a browser software (Internet Explorer, Mozilla Firefox, Opera or Safari) that interact with the application.

Figure 10:Three-tier architecture model

System Requirements

Table 2: System Requirements

HardwareRequirements		
Processor	*R*	*DiskSpace*
PentiumIII, PentiumIVorHigher	512MborHigher	250
SoftwareReq		
OperatingSystem	*Da*	
Win-2007, Win-XP, Linuxoranyother higherversion	MyS	
ServerRequi		
Server Platform	*Br*	
Apache WAMP Server	Internet Explorer, Firefox	
WAP Server	I	
NetworkReq		
Connectivity with University Campus		

System Description

We describein brief some keyroles being performed by the administrative officer, system users and students.

Admin: This module enables the administrator to carry out some administrative task such as addition of new students, enrolments, record modification, computation of result, system update and some basic system maintenance. There can be more than one administrator at a time, whose basic function is to manage the system.

Users: This component of the system carries out the interface or modules for all the users that access the system which includesinstructors, student affairs and students. They can always access the system with a common web browser via the internet or local area network connectivity. Each user hasan own interface which isalways active on the client side of the system. Their respective role is further explained:

i. Instructors interface: This is an interface where all the instructors can manage their own courses and exams. The instructors are assigned the tasks of grading students and submitting their continuous assessments and exams raw scores to the administrative officer in charge of result processing to handle. This module also provides the instructors with the opportunity of knowing the total number of students that registered for their courses.
ii. Student interface: With this interface the students can perform three operations. First, they can use it to print their examination cards online, and second, preview or print out their semester results.Lastly, they can use the interface to report complaints regarding detected faults to the administrative officer in charge of processing.

Creating Student Profile: The bio-data of students are usually to be created during the first semester registration or at the beginning of the course and are not needed to be re-entered again for the rest of the semester a student has. The bio-data captures the basic students' information as required by the school authority which is needed for generating reports and other particulars that are required by other bodies who are involved within the academic cycles. As long as a student is already registered in the university portal, the system automatically imports some of the necessary profile needs such as a student's registration number, department etc, since some of these information are not given at the departmental level.

Student Enrolment: The students' enrolment is a repetitive process for every semester. The user is required to enrol students based on their registration

status in the university on-line portal, which might include full time / part time, admission category, and exam details. Most importantly, it is at this level of functionality that the user selects the courses registered by the students.

The enrolment steps might include the following, depending on department choice:

i. Session for which students are to be enrolled
ii. Faculty / Department from which the course is taken
iii. Course status (i.e. core, elective or cognate)
iv. Exam date
v. Courses under which students are to be enrolled
vi. Semester
vii. Admission category
viii. Registration number

The examination management system flowchart shown in Figure 11 describes the activities diagram that takes place in the WEMS System. The various interactive scenarios that take place upon successful system login are also presented in chapter five of this in the form of screen shots.

a. The system first checks the user name and password of the system user.If they are not valid, the login interface is re-presented again with a specific login error messages. If the username and password of the user are correct, then the interface presented to the user is based on the user type and access right. The admin user will have a different user interface presented to him as regards what other users will have. When an instructor logon with instructors credential, a different interface is presented and this looks different from that of a student.

b.Student Registration: Figure 14 presents an interactive user friendly form to the admin officer in charge of students' registration in every semester to enter the necessary students' data into the system database.

c.Course Registration: Students are expected to carry out their registration process online. They can login into the system using their registration numbers and a pin code given to them by the departmental examination officer as pass mark. After a successful login, they can select the appropriate course for that particular semester. There are rooms for course registration preview, but modifications of courses registered are not allowed not until after the course registration weeks are over.

d.Generate Exam Card: The system will automatically generate examination cards for students, based on their registration status. The examinationidentification card will be systematically dispatched to the web portal and made available for student to download in the cause of their examination time table release.

e.Recording ofExam/CA: It is usually the work of the lecturers to make available their CA / Exam raw score by submitting it into the exam database via the mark-sheet interface meant for that purpose.The processed scores are later retrieved by the exam / admin officer who is in charge of result processing.

f.Process Result: Result processing is performed automatically by the system based on the set conditions inbuilt in the examination package.The system processes result by means of computing the overall grade obtained by students for every course heor she hasregistered and sat for during the semester. Also among the computed result options include GPA and CGPA. Once the processing is done, it is auto sent to the result database and stored for future report generation.

g.Generate Result: Results are generated inform of reports by querying, and this is often based on request. Students can only access their individual's result online via the university web portal in the form of semester result with their registration numbers, of which they can print out their results for documentation.

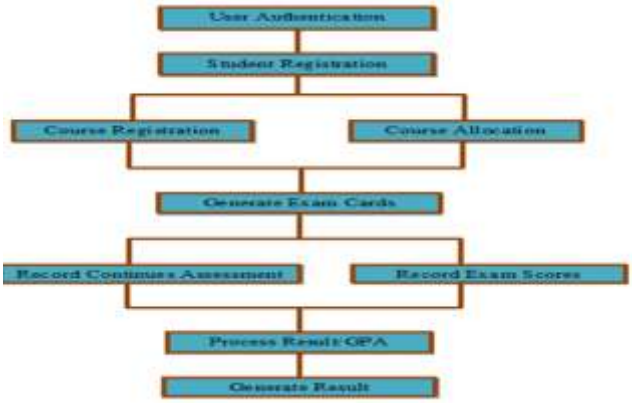


Figure 11: Examination Engine Activity Diagram

Figure 12: Online Registration Activity Diagram

The system process assumes that every student should have performed the initial central registration and such registration being validated by MIS as required by the school authority. The departments enrol the students based on retrieved information from MIS central database. Figure 12 does not fall into the range of activities executed by WEMS, but rather it is shown to clarify the initial requirements among various stages that are involved in the process tasks.

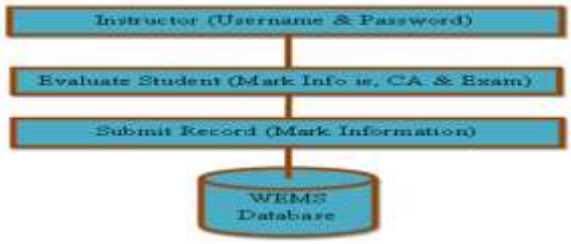


Figure 13: Result Entry Activity Diagram

This activity diagram presented in Figure 13 depicts a module that enables the Instructor to enter students' mark information into WEMS database. The record that is submitted by the instructor will serve as data input which is required by the administrative officer for further processing of the students' final results.

Figure 14: Departmental Course Report Activity Diagram

The departmental administrative officer can use the interface presented in Fig. 4.5 to produce lists of all students that registered for a particular course from within and outside the department.

Figure 15: Online Result Checking activity diagram

This presents an activity diagram for students to check their results via online interface that is provided for such purposes. The system first requires the user to provide his / her registration number and password for authentication, after which accessis granted or denied. For every successful login, the student sends quires (i.e., session, semester and year via a dropdown combo box). The system displays the students' page with the following information, students' personal data, and all courses and grades information that are obtained by the students for that session.

CONCLUSION

This model has presented a multitier academic management software models for managing students' academic records' in tertiary institutions. The implementation of the proposed system in Federal University Lafia was a success and this could be attributed to the initial models presented for the Web-based Examination System Package. The various detailed data flow and entity relationship diagrams assisted in the development of a mathematical model for WEMS result computation engine which has been implemented on a four-tier architectural model for a Web-based dynamic application,designed using the WAMP technology (Web server, Apache, MySQL and PHP),an open source solution. Because of the sensitive nature of the system, a role-based model access mechanism has been built into the new system to further boost security of the system. The Web-based Exam software serves a dual purposes;It serves as a stand alone student registration software and at the same time dedicated for remote computing / processing of students results from different departments of the university. It also has the features that will enable the user to enter data from any remote location, thereby facilitating the enrolment process for students academic records. WEMS, when integrated into the university portal,will present end users with aninterface whereby students can automatically generate and print out their examination cards, check results and also print transcripts remotely.

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