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Web – Based Academic Information System for Nigerian Universities

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Abstract - *A common challenge faced by universities is effective management of large amounts of data that are encountered in day-to-day operations. Access to these data requires various privileges and restrictions to cater for the various user categories. Traditional paper-based approach to managing these data, as practiced in many Nigerian universities, is costly, error-prone and ineffective. Existing solutions to this problem, where they exist, are ad hoc or not comprehensive. In this thesis, we developed a web-based information (WeBAIS) capable of managing large bodies of data effectively for Nigerian universities. Evaluation feedback of WeBAIS received from the two pilot universities where it was deployed showed that WeBAIS met its design objectives. We believe WeBAIS will receive further favorable assessment as further research is conducted to polish its other modules.*

Key Words: Information System, Design Science, PHP, MySQL, University, Web – Based application, educational institutes.

1. INTRODUCTION

A major challenge faced by university academics is the effective management of large amounts and various types of data that are encountered in day-to-day operation, ranging from personal data to varied types of documents. The data have various access privileges and restrictions and will be input by a variety of sources, ranging from individuals themselves (e.g., a current student or applicant submits a resume), to a member of the faculty to a member of the departmental administration (e.g., Head of Department who manages the affairs of the Department), to automatic uploading of transcripts or test scores for an applicant. Automatically generated statistics regarding this information will be used by many different stakeholders, both inside and outside the department. Traditional paper-based operation is not only costly but also ineffective.

We designed and implemented a Web-Based Academic Information System (WeBAIS), to effectively manage school information. The design of the overall system follows the guidelines from the Design Science for Information System [1] and benefits from the study in Computer-Supported Co-operative Work (CSCW) (Grundin, Computer Supported Cooperative Work History and Focus, 2005). To increase the usability of our system, we followed Computer-Human Interaction (The Apache Software, 2007) and Iterative Design guidelines [2].

1.1 Research Motivation and Goals

The greatest challenge of today's information system design is to provide users with the required functionality needed for the organization which, in many cases, happens not to be possible or requires huge resources including money, time and highly skilled personnel. Information systems of many Nigerian Universities suffer from some of the following challenges:

a. Ineffective management of the large amounts and different types of data
b. Inability to cater for different user categories with various access privileges and restrictions
c. Lack of related components that need to be integrated together such as registration and academics.
d. Lack of robust, portable and extensible components that support efficient data management.

The objective of the research in this thesis is to develop a robust information system with a single integrated data store that overcomes these limitations and more.

1.2 Methodology

The following are the proposed steps needed for the realization of this research work.

a. Literature review to determine best practice in modern information system design
b. Develop the architecture of the proposed WeBAIS system
c. Implement the WeBAIS system
d. Deploy WeBAIS in pilot universities
e. Collect feedback from WeBAIS users
f. Analyze user-feedback against WeBAIS objective

2. RELATED WORK

Academic institution is an educational institution dedicated to education and research, which grants academic degrees [3]. Teaching and research remain the primary activities in higher institutions, but there are other important activities as well, like managing of students' data at the different levels of higher education (undergraduate,

postgraduate, and doctorate levels); tracking of students' progress at each level; as well as other administrative and managerial activities [3]. The creation and management of accurate, up-to-date information regarding students' academic career is critically important in the university as well as colleges. Student information system deals with all kind of student details, academic related reports, college details, course details, curriculum, batch details, placement details and other resource related details too [4].

Obasi, et al in [3] developed a web-based student academic records information system which implements a wide range of students' functionality. Limitations of this work include: only students use the system; no roles for administrators and staff, no candidate application module, no admission processing, no SET module on the system and it does not use any of the IS moled.

Youh in [5] presented a distributed system for student result processing. Their system emphasizes advantages of distributed system and allows each department to maintain its database. Limitations of this system include lack of roles for students & staff, lack of application, admission, registration and SET modules. Their system is also difficult to manage, maintain and upgrade.

Obiniyi & Absalomin [6]: addressed the problems arising from result processing on the intranet, which focuses on speeding up collection of students' academic data to expedite processing of results and transcripts at various levels. It also allows online access of results for students. Limitation of this system include only two services (result processing and library resources management) were supported, no candidate application module, no course management, staff records, course allocation and roles for administrators and staff have not been implemented.

From the much documented in the Staff User manual, this system does not provide the kind of management information that would be expected for management activities.

The approach adopted for result update is a major concern. These concerns include:

a. Possibility of the inbuilt formula in Microsoft Excel file used to collate results broken.

b. Not much difference from the earlier approach used by the University, except for the fact that the results collated using Microsoft Excel is eventually stored in a database.

c. Amount of time taken to manually search through the Excel file to update a score.

d. Unnecessary duplication of data as a result of versioning. This leads to wastage of storage.

From the above literatures, in summary, we observed and derived the simple architecture for the related information system on the figure 2.1 below:

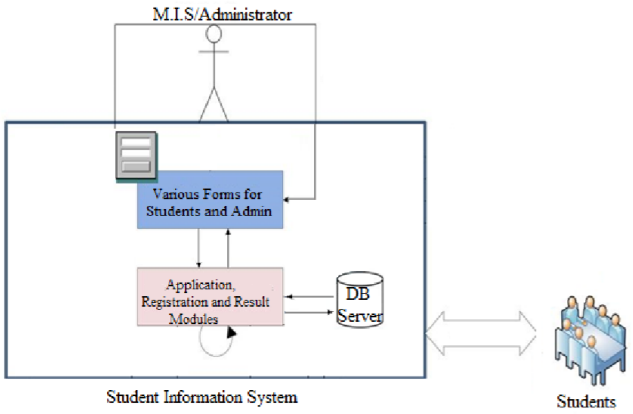

Fig. 2.1: Student Information System Architecture

2.1 Modern IS Design

A growing amount of interdisciplinary work explores the number of goals: answering how the activities of complex systems can be coordinated [7]. Some work focused on coordination in parallel and distributed computer systems while others on coordination in human systems [7]. However, the common theme is that the targeted complex systems usually include both people and computers; our project shares the same characteristic. In modern IS design, some inter disciplinary areas enlighten on how to design IS that is robust, reliable and cost – effective. Below are some of these inter-disciplinary fields and recent findings about them which will help us in laying down the theory background of our work. In most of the papers reviewed above they described in detail how they designed and implemented there IS, none of them discovered and used the latest discovery of IS by either by selecting Design Science or Behavioral Science [8].

2.2 Information System

According to Hevner in [5], Information Systems (IS) are "implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization" [5]. Two paradigms that characterize much of the research in the IS discipline are behavioral science and design science. The behavioral science paradigm seeks to develop and verify theories that explain or predict human or organizational behavior. The design science paradigm seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts [5].

2.3 Database Design

Our work involves massive data management which requires a sophisticated database design. Database design is defined as: "the logical and physical structure of one or more databases to accommodate the information needs of the users in an organization for a defined set of applications" [9]. A Database Management System (DBMS) is computer software designed for the purpose of managing databases. Typical examples of DBMSs include Oracle, Microsoft SQL Server, and MySQL. Step 3 involves making choices of DBMS.

In logical design step (Step 4), the ER diagram is converted into tables in the database. Physical database design (Step 5) consists of executing tables in an actual DBMS software file. Database system implementation (Step 6) consists of entering data and maintaining the DBMS.

3. DESIGN OF WeBAIS

Different components of WeBAIS share common functionality in different ways. Some components are very similar to each other. For example, WeBAIS-graduate and WeBAIS-undergraduate are parallel components that share significant functionality. Some common functionality is required in all components. For example, all components need functionality to upload and manage documents. Some similar functionality is used in all applications, but they differ from each other slightly. For example, all online applications involve some kind of review process, although they may not be exactly the same. In the following, we provide an overview of the requirements and functionality for each component.

Figure 3.1 shows the functional diagram of the WeBAIS system whose main components we briefly describe next.

• WeBAIS-applicant – a component used to manage information and procedures related to students' applications and admission Status.

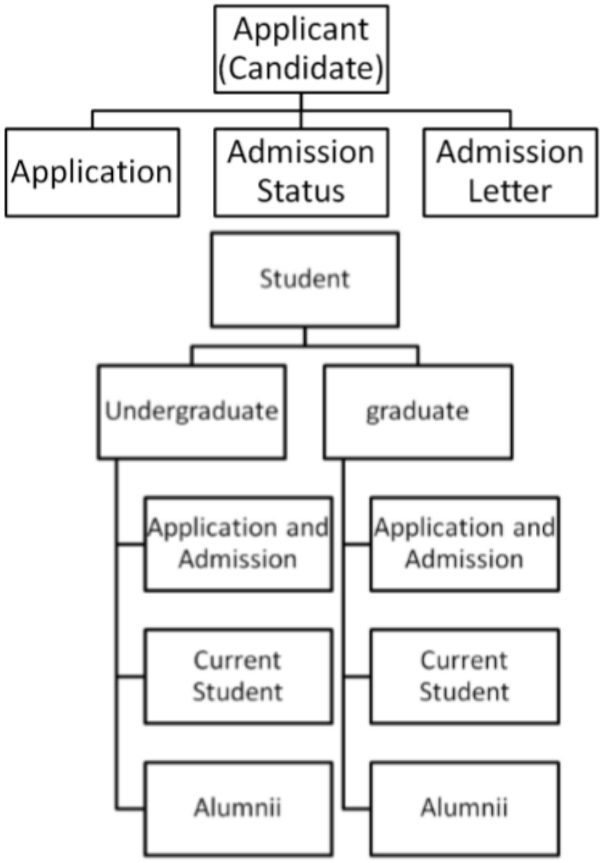

Fig. 3.1: Functional Diagram of WeBAIS

a. WeBAIS-Student – a component used to manage information related to Students (both new and returning).

In this work, we also provide a detailed case study of the Student Evaluation of Teaching (SET), which is a tool to monitor staff teaching performance response by the students. The SET interacts with all WeBAIS components: students who apply for admission (WeBAIS-applicant) will pay application fee as well as processing fee. Also, students who secure admission (WeBAIS-student) will continue with course registration from entry point to graduation level where all the information for the student will be available for various accesses according to their respective privileges.

a. WeBAIS-undergraduate – much of the planned functionality for this component is already in production use. It includes undergraduate admissions (on-line submission of application materials by applicants, on-line review by the department, and on-line decision by the admission committee); current undergraduate student information management (degree progress monitor, dismissal/withdrawal process, application, assignment, enrollment history); and former undergraduate student information management (listing of degree, graduate year).

b.WeBAIS-graduate – much of the planned functionality for this component is in progress. It includes graduate admissions (on-line submission of application materials by applicants and references, on-line review by the department/faculty, and on-line decision by the admission committee); current graduate student information management (degree progress monitor, application, review and assignment, enrollment history); and former graduate student information management (listing of degree, graduate year).

c. WeBAIS-faculty – on-line submission of application materials by applicants and references, online review by the faculty, some support for the interviewing process.

d. WeBAIS-department – Research Experience for Undergraduate (REU) program (on-line submission of application materials by applicants and references and review by the faculty) and academic programs administration (semester course planning and scheduling support, instructor assignments and attendance, etc.)

3.2 WeBAIS-graduate and WeBAIS-undergraduate

WeBAIS-graduate and WeBAIS-undergraduate are parallel components that share a large amount of functionality. In this section, we first introduce the common functionality for both components and then discuss the component-specific functionality. Academic program information is essential for an academic department. Providing tools for students, faculty, and staff to easily access/manage the various types of academic information is important. WeBAIS-graduate and WeBAIS-undergraduate provide tracking for academic information throughout students' stay in the program. For example, students' basic information, tests scores and various types of degree program related information. Data are mainly and maintained by the level coordinators, but

students are allowed to input and/or edit certain data. Most data are available (accessible) to student and all data are available to all faculty members. In this application, we plan to support the following functionality for current students:
a. Student basic information: Name, contact information, gender, citizenship, ethnicity, Nigerian residency, photo, etc.
b. Degree progress monitor: Provides information about milestones (degree plan, prelim exam, final exam, etc.), enrollment, academic performance (GPA and CGPA).
c. Registrations & Payments Records, history, selection, and evaluation (RPR) d. Email support: Listserv management and other mailer tools e. Statistics and report generation (admission, graduation, enrollment).
Maintaining contact information and tracking the accomplishments of former students are important aspects of an academic department. We plan to support the following functionality for alumni:

a. List of alumni to be used to generate list on public web pages and statistics accessible on internal web pages.
b. Tracking of alumni (where they went and how they are doing) to build a network of former students to assist current students and for university purposes.
c. Alumni events, newsletters, and other services to be provided for the university's alumni.

3.3 System Design

Design is very important in interactive systems and needs to be evaluated at each stage of development. We followed the Iterative Design approach [10] which states that once a component has been partially or completely implemented, we can receive feedback from users. Based on that feedback we can find out problems in the design of the interface or problems in the functionality of the system, and re-evaluate alternatives. Our design has to take into account the various types of data and users in different applications.

We split our design into the system architecture, application architecture, data flow diagram (DFD), the web interface, the database, and the code. For DFD we applied DFD Standard using IS framework [11], for the design of the web interface, we applied User Centered Design [12]. Working closely with the final users allowed us to know their specific needs. For the design of the database, we used the Entity-Relationship (ER) [13] model for the data modeling. The object-oriented programming paradigm was used to design and implement the code. This paradigm will ease maintainability. Also, object-oriented programming offers a natural way of defining functions and data in terms of a class hierarchy.

4. CONCLUSION

We presented a University Web – Based Academic Information System called WeBAIS. It was developed following Information Science design paradigm, Software Engineering techniques, and Computer-Human Interaction guidelines. It is a robust, large-scale information system for Nigerian Universities, well-designed object- oriented application. We also used Student Evaluation of Teaching (SET), which is a tool to monitor and for the purpose of improving teaching performance by the teaching staff. This feature has not been implemented by any university digital system in Nigeria. The Application has been deployed and in use at two universities and attested by users to meet its design objectives, largely. It has also been deployed currently to Kano State Polytechnic for Application, Admission and Registration exercise (after some adjustments). Many more Collages, Institutions are about to deploy the system including Universities. WeBAIS has made a big impact on the University daily operation. It improves the efficiency of many operations. The difference in processing time is significant. There are many things we can do now with WeBAIS that we could not do before. In WeBAIS, we designed and implemented a set of web utility classes which are general and self-contained. They greatly increase the re-usability and maintainability of our codes. The web utility classes can be used by other web applications. We plan to make them open source in the future. Although WeBAIS is a customized information system for the University Academics (of Kano University of Science and Technology, Wudil) as a case study, it can be easily configured to be used by other Universities, Mono &Polytechnics, Colleges and other Institutions.

Lastly, WeBAIS achieved it is designed objective as observed. User responses show that WeBAIS made significant impact to university daily operation.

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