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Architectural Framework for Development of Generic Application for Candidates Admission Eligibility Clearance for Tertiary Institutions in Nigeria.

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ABSTRACT

Nigerian government is faced with the problem of reconciling access to education with quality in the face of the explosive population of school age children and youths, against the backdrop of inadequate educational facilities and infrastructure. The nation's tertiary institutions can hardly accommodate up to 30% of the population of prospective candidates into tertiary institutions in Nigeria. This puts high pressure on the admission process. Thus manual methods of credentials evaluation to determine eligible candidates in the various courses of study, becomes cumbersome and error prone. More often than not, evaluation and selection processes are compromised as a result of personal interest, subjectivity in judgment, fatigue or graft. Consequently, some candidates are enrolled into courses where the fall short of entry requirements. Following established principles for software architecture designs, this study seeks to present a suitable architecture that can be used to design data structures and program components that are required to build a computer-based system for determining the eligibility of candidates seeking admission into tertiary institutions in Nigeria. It presents the structure and properties of the components that constitute the system, and the interrelationships that occur among all the architectural components of the system. This framework presents standards and procedures which systems developers can adopt to develop generic application for credentials evaluation and eligibility clearance for prospective candidates into Nigerian tertiary institutions.

Keywords: Candidates' eligibility, credentials screening, prospective students, admissions, tertiary education.

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1. INTRODUCTION

Over the past few decades, there has been unprecedented upsurge in the population of school age children and youths in Nigeria. Presently, Nigeria is ranked as the sixth most populous nation in the world after China, India, USA, Indonesia and Brazil NPC (2014). Bello (2017) asserts that the population of Nigeria is currently put at 182 million with more than half its people under 30 years of age. This puts a severe strain on a nation with its slowing economy and declining revenue to provide enough schools and health facilities. Against this backdrop of explosive population, Adegbesan (2010) asserts that it is well known that the problem Nigerian government has is in reconciling access with quality in the provision of education. There are no enough schools to accommodate the teaming population of children and youths.

The Joint Admissions and Matriculation Board (JAMB) application and admissions statistics, JAMB (2015) shows that of the 1,428b,470 applications to tertiary institutions in Nigeria, only 415,500 candidates representing 29.09% were admitted.

This accounts for the pressure on the admission process since the competition is high. One herculean task facing admission officers and heads of department is the labor involved in manually scrutinizing the school certificate results presented by prospective candidates to ascertain their eligibility status. Most of the available online educational portals function to aggregate lists of applicants by courses of study and by departments but leave the screening of applicants' credentials to the admission officers, committees or heads of department. Consequently, the admission processes are error-prone as a result of fatigue due to high volumes of paper work, subjectivity in judgment and sometimes graft. To facilitate the work of screening credentials of prospective candidates, there is need to evolve computer-based routines for eligibility clearance of the applicants that will track candidates with deficiencies in entry qualification, and bar ineligible candidates from accepting admissions even if their names appear on admission lists. This will ensure speed and adherence to standards in the admissions processing system. Service providers and systems developers will find this architectural framework handy for developing new systems or upgrading existing academic information processing systems in Nigerian institutions.

1.1 Admission Policy to Tertiary Schools in Nigeria

The policy adopted by the Nigerian Universities and other tertiary institutions is based on the Ashby Commission report of 1959 Okoroma (2008). Following this report the Federal Government of Nigeria (FGN) established the National University Commission in 1962 which became a statutory body in 1974, as an advisory agency. In 1976, the Joint Admissions and Matriculation Board (JAMB) was established for the conduct of entrance examinations for tertiary institutions in Nigeria, backed by legal instrument promulgated in 1978 by the Federal Military Government, it became Federal Executive decree in 1982. JAMB was intended to regulate and monitor admissions into tertiary institutions through its various admissions policies Adetunji et al (2016).

It is noted that the policy to conduct meaningful selection procedures has been replaced by political interests and affiliations since the introduction of the quota system favoring some regions or states over others Agboola & Ofoegbu (2010). Also students are denied admission on the basis of the implementation of policies that consider carrying capacity, state of origin, the quota system and catchment area Okebukola (2006). Other factors that have contributed to the pressure on admission processes in Nigeria include, the 60:40 ratio for science: liberal arts disciplines for universities and 70:30 ratio for non-universities like polytechnics and colleges of education Imhanlahimi & Maduewesi (2006). NUC, IN 2004 noted that due to the increasing number of applicants seeking university education yearly, the carrying capacity could only cater for 17% to 20% of applicants. Another factor bedeviling access to tertiary education is the policy of government aimed at creating equal representation.

This set guidelines for admission into tertiary schools based on 45% merit, 35% catchment/locality, and 20% for educationally less developed states. This policy led to the rejection of many brilliant candidates and the admission of weak ones because of their place of origin or the connection they have with influential people Igbape (2014). This situation is further instantiated by the 2015 JAMB admission statistics which puts the percentage of candidates accommodated by the nation's tertiary institutions at 29.09%.Consequently, candidates scramble for admission as a scarce but essential commodity in Nigeria. This puts pressure on the admission process leading to sharp practices.

1.2 System Architecture

In computer-based systems development, architectural design represents the structure of data and program components that are required to build a computer-based system Pressman (2005). It considers the architectural style that the system will take. The structure and properties of the components that constitute the system and the interrelationships that occur among all architectural components of the system. Clearly, software architecture must model the structure of a system and the manner in which data and procedural components collaborate with one another Eckerson (1995).

Just as it will make no sense to attempt to build a house without a blueprint, software architecture provides;

i. The big picture and ensures that the software engineers and other stakeholders got it right.
ii. An enabling environment for communication between all parties interested in the development of the computer-based system.
iii. A highlight of early design decisions that will have a profound impact on all software engineering work that follows.
iv. Relatively small, intellectually graspable model of how the system is structured and how its components work together.

3. MODELING APPROACH

The A number of real life problems were encountered in the admission process for higher institutions in Nigeria. Derived from the researchers' work experience, interest and observations, innovative concepts and research idea that showed potential to improve actual human and organizational capabilities were formulated.

Two key issues were established;

i. Every course of study at the tertiary level of education in Nigeria has specific departmental entry requirements. However, every prospective student is required to sit for the national common entrance examination conducted by JAMB. During this process, some candidates with deficiencies in their respective departmental entry requirements, enroll for the Joint Admissions and Matriculation Examination (JAME), more often than not, such candidates could score above the cut-off marks for such courses.
ii. The manual procedures for processing applications and determining candidates who are eligible have become cumbersome and error prone due to the explosive population of prospective candidates.

To establish the existence of the problems, investigations were carried out through interviews and follow-up of admissions processes in some selected institutions in Nigeria. We also relied on secondary sources, through extensive review of available related literature, periodicals, technical materials, forms, operating documents, various policies of regulatory agencies and government publications. Key concepts were identified and research objectives and suitable solution formulated to resolve the eligibility clearance impasse for prospective candidates seeking admission into tertiary institutions in Nigeria.

4. PROPOSED ARCHITECTURAL FRAMEWORK

Various educational portals are available and in use by most institutions in Nigeria. They have proved quite useful for aggregating applications and enrolment data as well as students' academic records processing. They also perform bursary clearance routines to determine whether students have met financial requirements for enrolment into the institutions. The main thrust of this work is to develop a model and architectural framework for a system that can perform entry qualifications evaluation following Software Engineering best practice principle. After a careful study of the admission processing procedures in the Nigerian education system, a design model is built which consists of the following phases; (i) identification of attributes, (ii) content design, (iii) conceptual design, (iv) user interface design, (v) architectural design, (vi) conclusion.

A. Identification of Attributes

Table 1: Classification of Attributes

Identification information	User_id, Reg. Number, Surname, Othernames, Department, Course, Verification Phone Number, System Staus.
Course of Study Information.	tment, Course Name.
Eligibility Clearance Information	Subject Code1 … Subject Code8, Subject1 … Subject8, Letter Grade1 … Letter Grade8, Numeric Grade1 … Numeric Grade8 Value1, … Value8, Total Core Value, Total Value, Assessment Remark.
Entry Qualification Subjects Information.	Subject Code1, Subject Name, Exam Type, Exam Year, Exam Number, Number of Sittings

B. Conceptual Design

The objective of the entire concept is to determine whether a candidate satisfies specific departmental entry requirements for the proposed course of study. For this study, we have used eight subjects as the maximum list of subjects for each course of study and four subjects as core subjects inclusive of the mandatory English and Mathematics. The general entry requirements are five credit passes at one sitting or six credit passes at two sittings both of which must include English Language and Mathematics. These requirements are divided into two categories; (i) Core subjects (mandatory subjects, (ii) Other relevant subjects. For every course of study, the mandatory subjects are English, Mathematics and two other core subjects. Then any other one or two subjects (but relevant to the course domain) can be selected from a list of four optional subjects and added to the list of core subjects. Thus a candidate has a list of eight subjects provided, out of which he/she can select five or six subjects as the case may be. This is shown in Fig. 1.

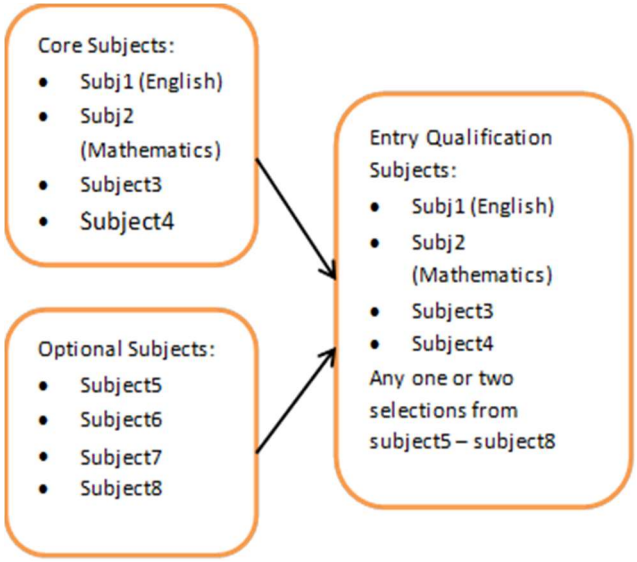


Fig. 1. Entry Requirements Subjects

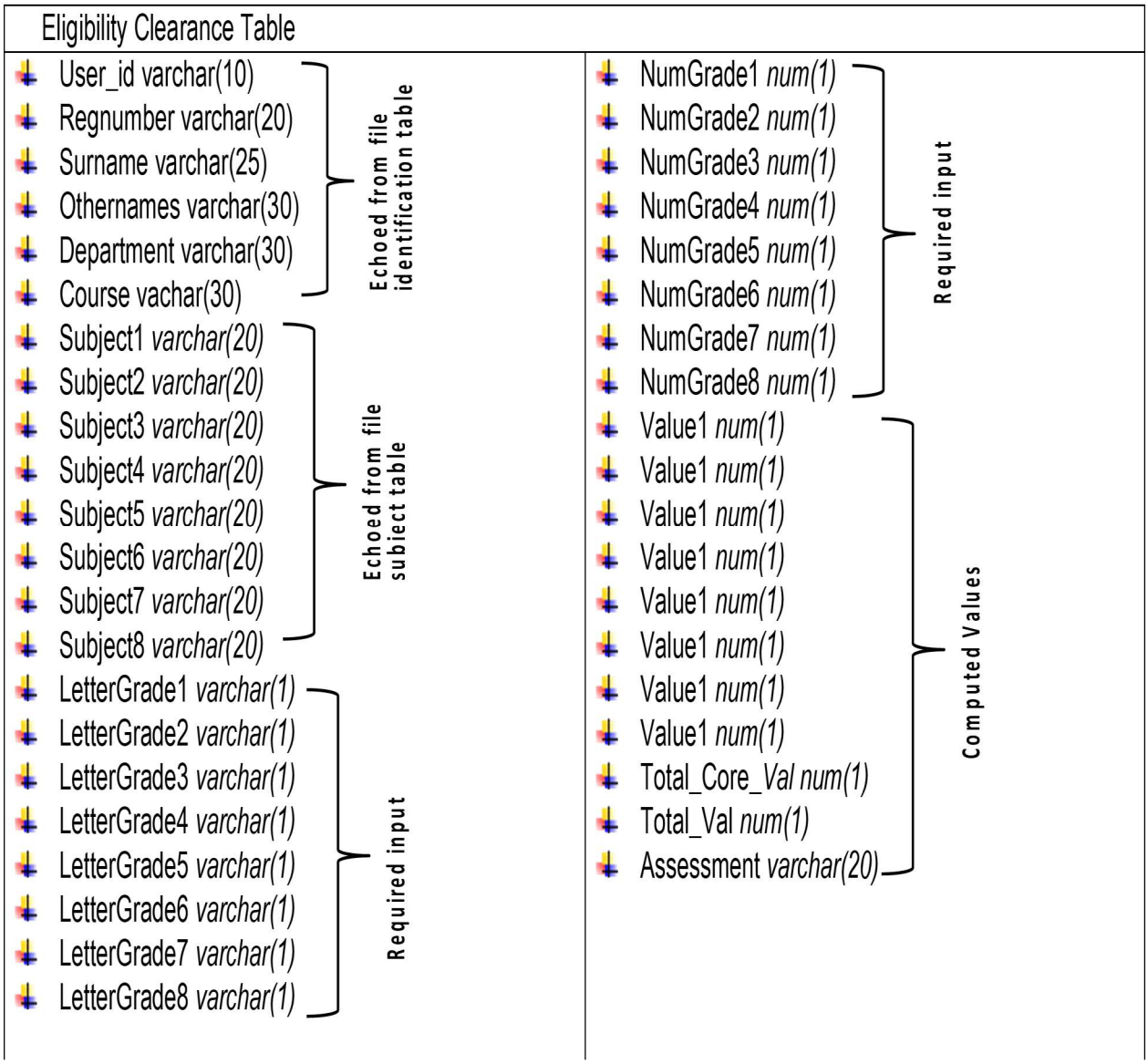
The administrator prepares and populates the entry qualification subject table with the list of eight subjects relevant to each department. The table structure for the entry qualification subjects information is shown in Table II.

Table 2. Schema for Subjects and Identification Tables

Subjects Table	Identification Table
⊕ User_id *int(10)*	⊕ User_id *int(10)*
⊕ DeptCodeV*archar(15)*	⊕ RegNumber *varchar(20)*
⊕ CourseCodeV*archar(15)*	⊕ Surname *varchar(25)*
⊕ Subject1 *varchar(20)*	⊕ Othernames *varchar(30*
⊕ Subject2 *varchar(20)*	⊕ Dept_Code *varchar(15)*
⊕ Subject3 *varchar(20)*	⊕ CourseCode *varchar(15)*
⊕ Subject4 *varchar(20)*	⊕ PhoneNumb *archar(15)*
⊕ Subject5 *varchar(20)*	⊕ Status *varchar(15)*
⊕ Subject6 *varchar(20)*	⊕ Username *varchar(25)*
⊕ Subject7 *varchar(20)*	⊕ Password *varchar(25)*
⊕ Subject8 *varchar(20)*	

Based on the course of study selected during application process, the relevant subjects for the selected course will be echoed into the eligibility clearance table and presented to the candidate for input of grades.

Table 3. Schema for Eligibility Clearance table



C. E valuation of Grades

The assessment criteria adopted here is to assign a numeric value 1, to any subject with numeric grade between 1 and 6, and a value of 0 otherwise. Thereafter, the sum of the values will be used as criteria for determining the number of subjects with credit passes. A credit pass is a numeric grade between 1 and 6. We have used eight subjects for this study, thus n=8. This may vary as application demands in other environments.

If $NumGrade_n \leq 6$, $Value_n = 1$
Else, $Value_n = 0$; n=1,8
Endif()

$Total\_Core\_Value = Sum(Value_n)$; n=1,4
$Total\_Value = Sum(Value_n)$; n=1,8

D. Conditions for Eligibility

A candidate is considered eligible for admission if he/she obtains five credits in one sitting or six credits in two sittings. Both of which must include English language and mathematics and any other relevant subjects to the desired course of study, which must include two core subjects. This presents two cases:

Case1, NumSittings=1
If Total_Core_Value=4 .AND. Total_Value≥5
Assessment = "Eligible"
Else,
Assessment = "Not Eligible"
Endif()

Case2, NumSittings=2
If Total_Core_Value=4 .AND. Total_Value≥6
Assessment = "Eligible"
Else,
Assessment = "Not Eligible"
Endif()

E. User Interface Design

User interface design creates an effective medium of communication between the human (user) and the computer machine. If software is difficult to use, or it forces the user into mistakes or if it frustrates user's effort to accomplish goals, no one will like it, regardless of the computational power it exhibits or the functionality it offers. The interface has to be right because it molds the user's perception of the software Eckerson (1995).

In this application environment, we consider various elements for designing user interface, such as; page layouts, direct data manipulation, navigation, forms and input. To achieve the user interface design aspect of this work, various elements for designing user interface have been considered. These include (i) table layout, (ii) widgets (text views, check boxes, menu, date and time pickers), (iii) containers (scroll views, list views).

User authentication screen layout

This screen input is used to determine whether the user is legitimate (Administrator or Student user).

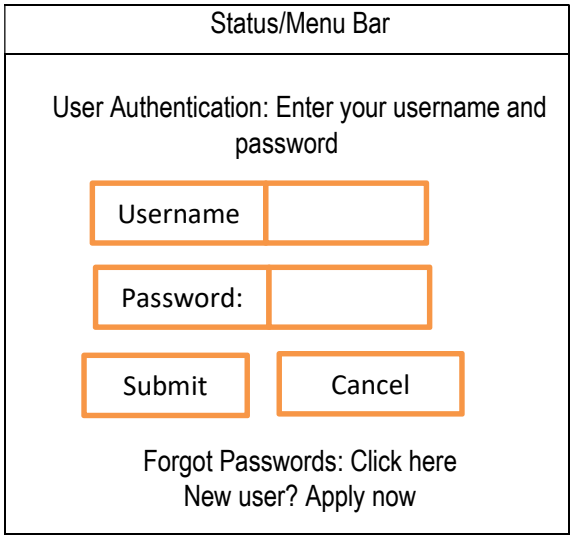


Fig. 2. User Authentication Screen Layout

Results Input Screen Layout

On successful login, a candidate is presented with results input screen for eight subjects relevant to the chosen course of study, inclusive of the mandatory English language and mathematics with other two core subjects. The candidate is required to input letter grade, numeric grade and examination registration number for each subject. Examination type (e.g WAEC, NECO, etc.) and year of examination are selected from a drop down list.

Subject	Letter Grade	Num. Grade	Exam. Type	Year	Reg. Number
English			∇	∇	
Mathematics			∇	∇	
Subject3			∇	∇	
Subject4			∇	∇	
Subject5			∇	∇	
Subject6			∇	∇	
Subject7			∇	∇	
Subject8			∇	∇	

Fig. 3. Results Input Screen Layout

F. Architecture design

The sequence of content presentation in this project domain is predefined and generally linear. The sequence of interactions is predictable as illustrated in Fig. 4.

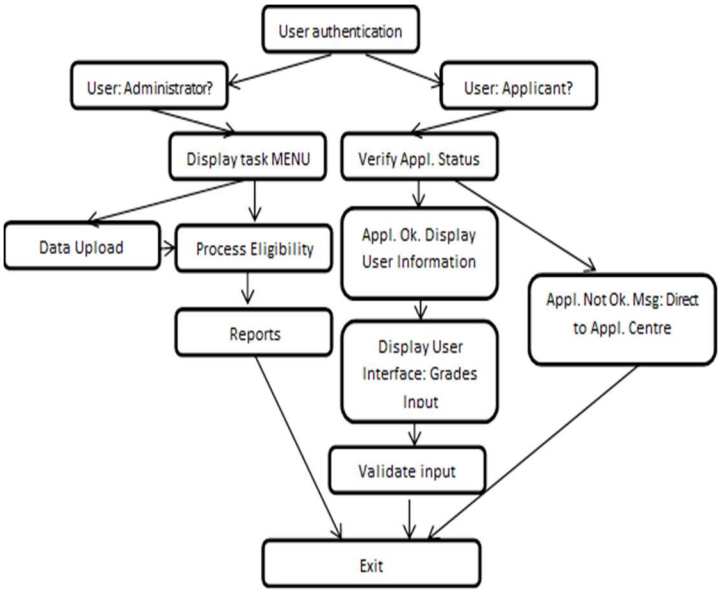


Fig. 4. Data Flow Architecture

In this section we present the architectural framework for the implementation of the conceptualized system. The prototype used to simulate the system was achieved through interfaces created to enable access to database system. The architectural framework as presented in fig. 4 is based on the three tier architecture concept Eckerson (1995), [14].

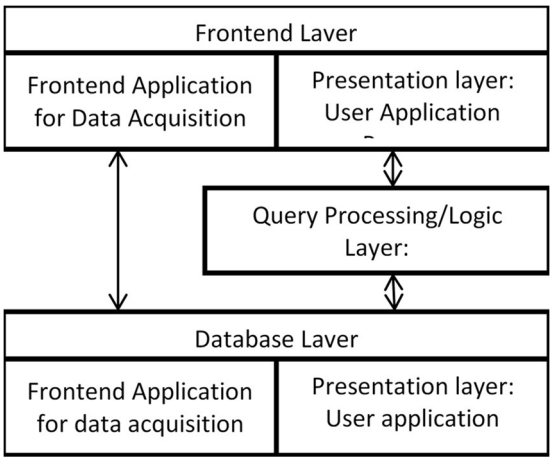


Fig. 5. System Architecture

Developers can create applications for the frontend users, and the logic/query processing layer using technologies provided by the .NET development environment and the .NET framework Software Development Kit (SDK). PostgreSQL also provides development library for .NET programmers Blum (1985). MySQL database engine and PHP Scripts can also be used to implement the system.

5. CONCLUSION

This work addressed credentials screening issues arising from real life scenario in the Nigerian admissions processes into tertiary institutions. Peculiarities in the system are as a result of the high population of prospective candidates against the backdrop of inadequate education facilities and schools. The manual procedure for credentials screening has proved tedious and error prone. This work has presented an architectural framework for the development of a computer-based system for assessing the entry qualification of candidates seeking admission into Nigerian higher institutions. It is hoped that developers and institutions will find this framework useful in developing applications or upgrading existing educational portals.

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