

# Development of a Web-based Population Monitoring Information System

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## ABSTRACT

*Nigeria being the most populous country in Africa has been using the manual method in population count. This has its attendant problem of being tedious, time consuming, monotonous as well as repetitive. The need to improve our manual census activities to an online based method was conceived. Hence, the objective of this research is to create a web-based population monitoring information system (web-based-PMIS) that provides inputs and outputs information support to admin/users in order to update their demographic information. In this project, the object oriented analysis and design methodology (OOADM) was adopted. The high level model of the proposed system was also designed and displayed in a format easily understandable to the user. There were two modules in all, each taking care of specific function like: user module and admin module. User module manages individual registration based on user option, search, and complaints while admin module add users and report generation such as updating and deleting report. Consequently, the parallel change over methodology was adopted to enable the comparison of the results of the two systems before implementation. For easy allocation, PHP, Ajax, JQuery and MYSQL were used for this development, which makes this application easily accessible from any part of the world, furthermore, the end result is an electronic identity that is encrypted which makes it very secured. This project is useful in any agency whose primary job is to enumerate human beings of any age bracket and obtain suitable demographic information as well as empower countries to make informed decisions for effective policy, planning and management of their economy.*

**Keywords:** Information system; web-based; image; information technology, census

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## 1. INTRODUCTION

Most governments rely on the information contained in census statistics for decision-making, and thus aids for administration and planning of the different departments in the government. This popular saying is true: 'Just like we cannot survive without roads and bridges, the country does not function well without updated census to distribute funds to areas that most need them to support community decisions and their own future.' Every country needs an accurate and accepted census data to plan for virtually everything. As a result, this work is geared at designing a web-based system that give information about birth rate, death rate, married, unmarried, employed, unemployed, children, youth, adults, aged etc. in other word, about the population monitoring information system.

In [1], Soesanti described information system as a combination of information technology and human activities that use information technology to support the activities, operations, management and decision-making of an organization. We developed a web-based monitoring information system to ensure that population information can be accessed and updated globally. Web-based technology is one that utilizes the information and communication technology applications. Therefore, the application of web technology for information systems used for population census is very important, because the information systems can help improve decision-making, planning as well as productivity and competitiveness at large.

The increasing complexity of modern life means a greater need to plan housing, schools, roads, transportation, and a vast range of social and economic requirement for nation. For this to be achieved, there must be a detailed count of the population and thus the role of NPC or any other organization given such mandate. The installation of computer and software in these organizations or bodies that manage census information will assist not only in fast-recording information but also in solving certain problems, which cannot be easily resolved manually. The human resource of any enterprises is considered to be their most valuable assets, if they are properly harnessed and are well motivated to perform their assigned tasks in such a manner as to enhance the enterprises goals and objectives. Hence, people related information such as the size of the population, age structure, educational attainment, labor force and socio-economic characteristics need to be captured and integrated in a

centralized database which will be helpful to the government and the individual. This prompted the authors to develop such a software for this purpose.

In Nigeria, the National Population Commission (NPC) was established using the Decree No. 23 of 1989 and is saddled with the responsibility to manage all related census tasks, such as to reach and monitor national population polity and set up national population information bank. Census issues have caused a lot of dispute in the past, for instance in the 1962 report on census conducted in Nigeria, there was disagreement in the authenticity of the census figures computed [2], likewise the same controversy surrounded the report of 2006 census [3], which one of the author of this paper was involved. With this fact, population census in Nigeria has been considered and termed inaccurate and unreliable [4]. The controversy is surrounded in some difficulties [5] such as deliberate and ill-minded attempts to inflate population figures, in other to favor one geopolitical zone or the other. These cannot represent a nation's image as far as human population is concerned. To sum this up, Tom [6] pointed out that population census has remained the most sensitive and most controversial issue in the politics and administration of the Nigerian state.

The absence of virtually any reliable current demographic data has not prevented national and international bodies from generating estimates and projections of population and population growth in Nigeria. Unfortunately, Nigeria still relies on foreign statistics population information data bank for most of their population estimation. This project aims at developing an Online Integrated Information System for Demography in Nigeria, which is user- friendlier and widely accessible to users, taking advantage of new technologies to better meet the purpose. In this project, it was suggested that every effort be made to reduce the number of inaccuracy and manual method in the area of demographic data collections.

Monitoring, by definition, means: systematic observing, detecting or measuring operations of a system and to detect changes or alteration of any form [7]. However, monitoring implies not only to observe a process, rather if there are any deviations from the expected course, it can be interrupted in order to achieve a regular operation. During monitoring, the detection of changes over a certain period of time using technical tools can be flagged. The registration and recording of data repeatedly at regular intervals is

critical and essential. Thus, comparable conclusions can be obtained from the data.

The rest of this paper is organized as follows. Section 2 discusses related works. The methodology used in the work is described in Section 3. Experimental results are shown in Section 4 and the conclusions are drawn in Section 5.

## 2. LITERATURE REVIEW

Population census is a complete process of collection, reception, assessment, analysis, publication and distribution of demographic, economic and social data, which relate, at a given moment in time, to all the residents of a country or of a well-defined partial geographic area; as reflected in the Population and Housing Censuses Handbook of the UN, 1992[8].

Some approaches have been applied toward solving demographic data issues relating to census. A computational and statistical approach was applied by [9] in which they tried to leverage any possible errors associated with census data, furthermore, to fine tune the census figure, a demographic approach was employed to obtain a more statistically sound and viable estimate. Bamgbose [10] was of the view that in order to reduce the population census problems, population census figures should not be used for allocation of governmental benefits as is practiced by the Nigerian state. Meanwhile, the census problem will always remain a reoccurring decimal unless ethnic domination and mutual suspicion among the various ethnic groups in the country are tackled squarely. [11] on their part insisted that a biometric system of data collected and a centralized database is the key in solving the Nigerian census problem. Therefore, they proposed a biometrics approach to population census and national identification in Nigeria, which will rather help in planning and development. This view confirms the work of [12] who reiterated that population, in terms of its size and composition, has far-reaching implications for change, development and the quality of life in a society.

For studies on information system, interested readers may see the following works: Reimer [13], Kellar [14], Meyer, et al. [15] and Freihat [16]. In [17] the researchers designed and implemented a secured census information management system by equipping it with computational science and biometrics. They employed C#.NET as the programming language, Microsoft Visual Studio was used as an integrated environment, Microsoft SQL Server (2005) served as a

relational database management application etc. From the results they obtained, they can make informed decisions for an effective policy for the economy. In our case, we employed PHP, Ajax, JQuery and MYSQL for our development, which makes this application easily accessible from any part of the world.

[18] Presented a new way to set up a distributed manufacturing control system by using web technologies such as responsive web design (RWD) and embedded systems. In other word, they developed a web based monitoring system for a distributed production. To reduce cost sharply, they effectively employed the cloud infrastructure which makes real time monitoring possible. The authors discussed the advantages and weaknesses of web-based software solutions and show a methodical approach for the use in a modern production system. In [19], Nugraha developed information systems based on client-server that was capable of providing the administrative services to the citizens in the rural areas (Bagolo Village) more quickly and accurately. By using the client-server as the basis, this enables the data to be stored centrally on the server, which reduces data duplication and data loss.

In [21], information system was discussed but not in relationship with population census rather in connection with people's health. The aim was to develop a health information system geared at improving and enhancing the delivery of quality, data availability as well as administrative effectiveness of people's health. The developed system was tested over various network topologies which revealed that the time taken to move a packet and received acknowledgement for standalone, LAN, WAN and Intranet was 3ms, 4ms, 8ms and 10ms respectively. These short periods of time demonstrated a faster and efficient delivery of health activities. Sasmito et al. [22] did a research on the two methods of collecting population data in Indonesia. Based on their results it was observed that the process of developing a population administration web application using the Scrum framework only took 30 days. This was faster and preferable when it was compared to the population profile web owned by the Tegal city government and was developed using the waterfall method and it took up to one year to complete the web platform. The use of the Scrum framework was faster because all Scrum teams were involved in the process of completion. Consequently, the population administration web application was highly recommended to be applied to

the Population and Civil Registry Office and the Central Bureau Statistics throughout Indonesia.

### 3. METHODOLOGY

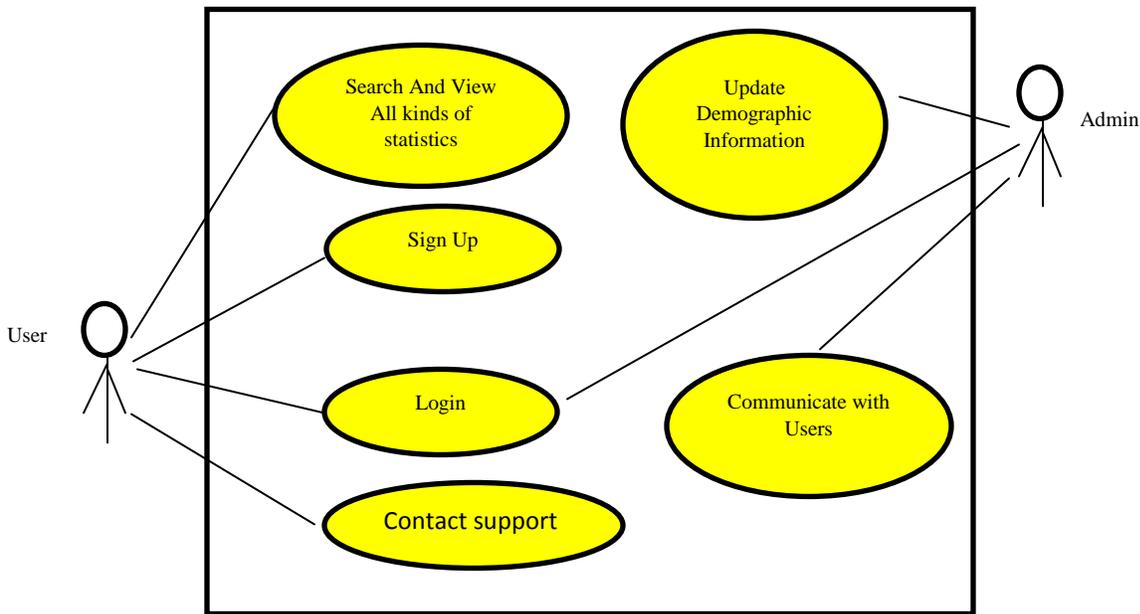
Design and development of web-based population monitoring information systems (web-based PMIS) is described as follows. The methodology adopted in this work is object oriented analysis and design methodology (OOADM), which is the principal industrial proven methodology for developing high quality object oriented system. In addition, OOADM has appeared as a response to solve the development of complex application programs. The reason for chosen OOADM is because it will help in studying the existing system into a useful application, easier maintenance since objects may be understood as stand-alone entities and objects are potentially reusable component. OOADM involves three aspects:

- i. Object oriented analysis which deals with the design requirement and the overall architecture of a system and is focused on describing what the system should do in terms of key object in the problem domain.

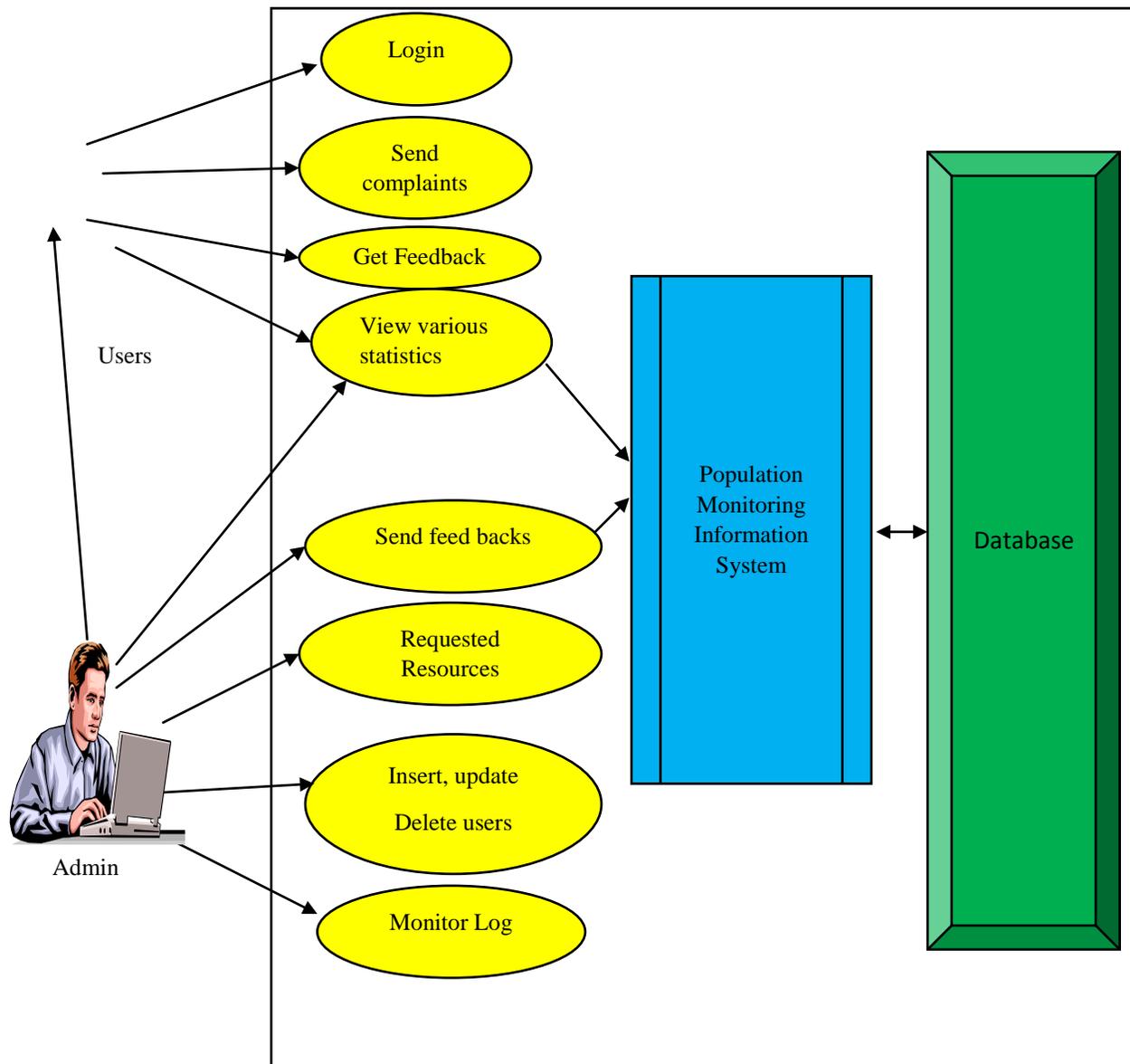
- ii. Object oriented design which transforms system architecture into programming constructs such as interface, classes, and method descriptions.
- iii. Object oriented programming which implements these programming constructs. The fundamental idea behind an object oriented language is object decomposition, breaking, combining the data and functions that operate on that data into a simple unit, the object are discussed and built by modeling real world instance.

#### 3.1 Use Case Diagram

Figure 1 is a *use case diagram*, it is a description of the systems behavior from a user’s viewpoint and it is a valuable aid during analysis. Developing *use case diagram* helps us to understand requirements and use cases can drive an entire development process, from inception through to delivery.



(a)



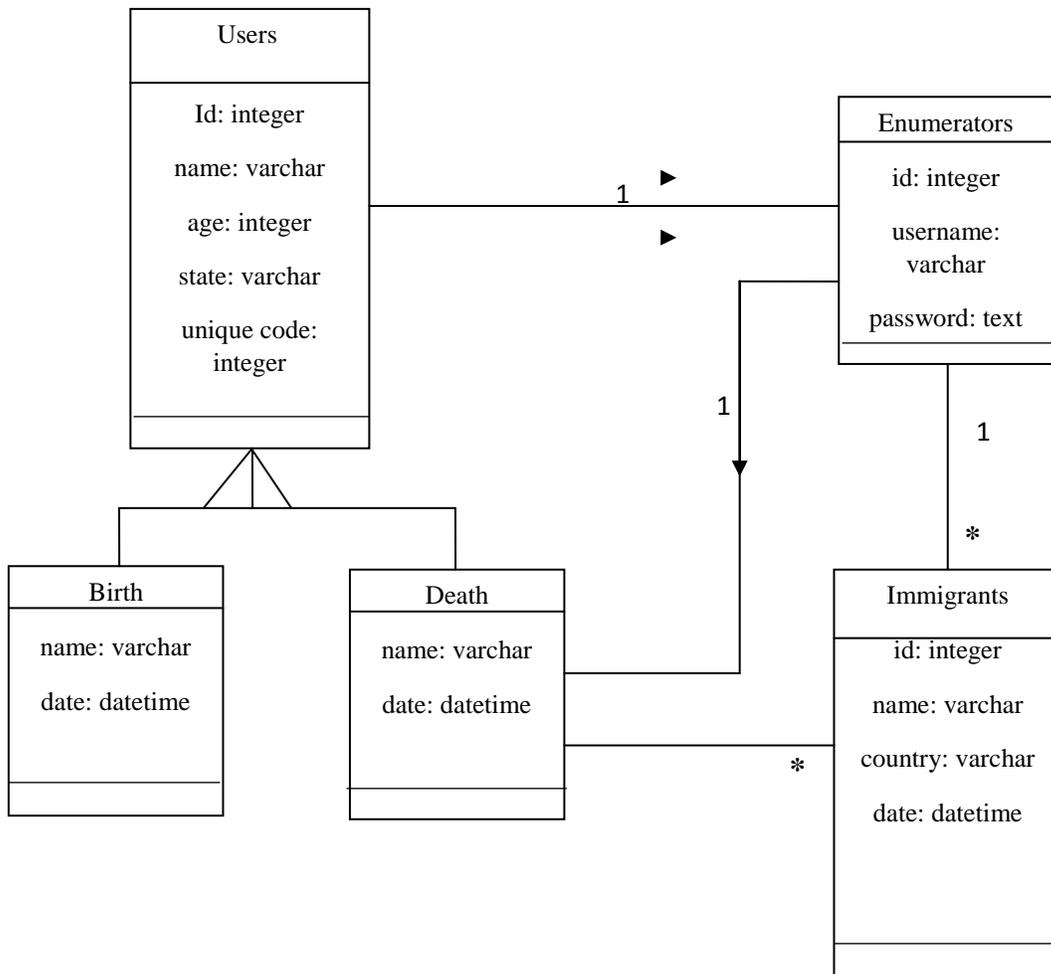
(b)

**Figure 1:** Use case diagrams: (a) Interaction between the User and the Admin (b) Interaction between the User, the Admin and the System

**3.2 Class Diagram of Web-Based PMIS**

This class diagram of Web-Based PMIS represents the classes which are denoted as boxes within the system,

that is, the way information go and this system has also its own class diagram as follows (see Figure 2).



**Figure 2:** Class Diagram of Web-Based PMIS

3.3 Collaboration Diagram Web-based PMIS

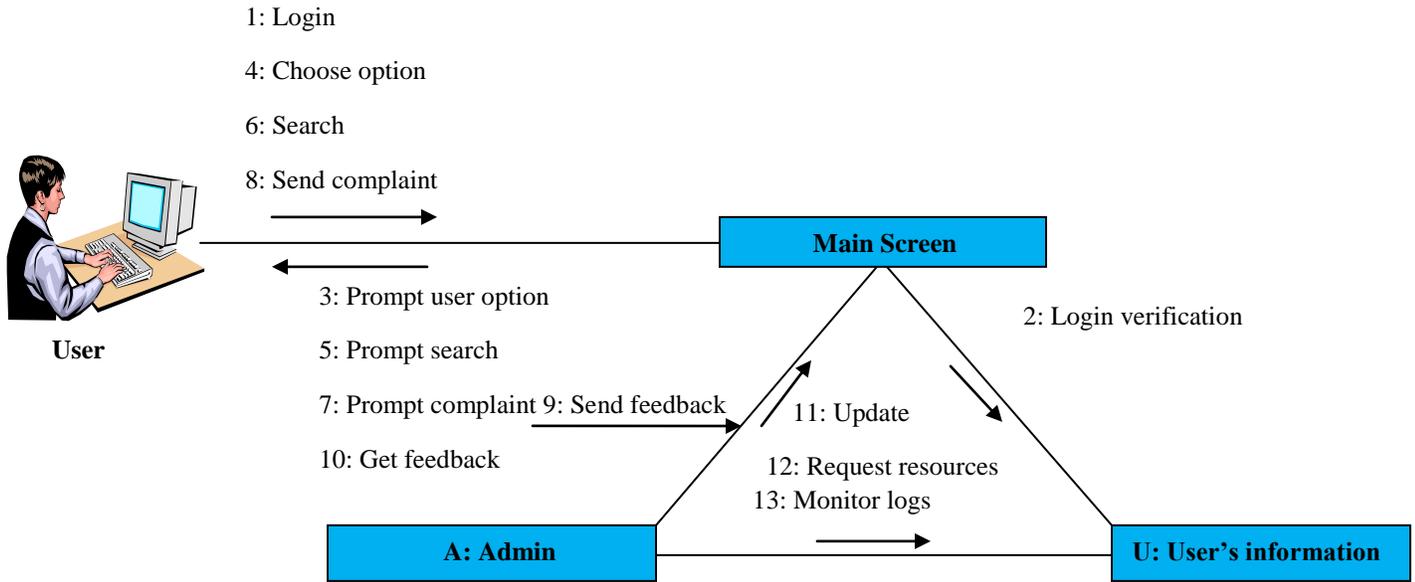


Figure 3: Collaboration Diagram of the Web-based PMIS

Figure 3 represents a collaboration diagram of the web-based PMIS. This diagram represents the objects in the system and their associations and it is used to show how objects interact to perform the behavior of the above use case in Figure 1, or part of the use case. They are composed of three elements such as: objects, associations and messages. Note: the object diagram, program chart, structure chart and user population collection form of the proposed system were deliberately left out because of space.

3.4 High Level Decomposition of the Web-based PMIS

The high level decomposition shows a quick glimpse of how the users of the system navigate through the various possible channels and gets validated by the system before they get access to modify their information with their unique code (see Figure 4 and Figure 5).

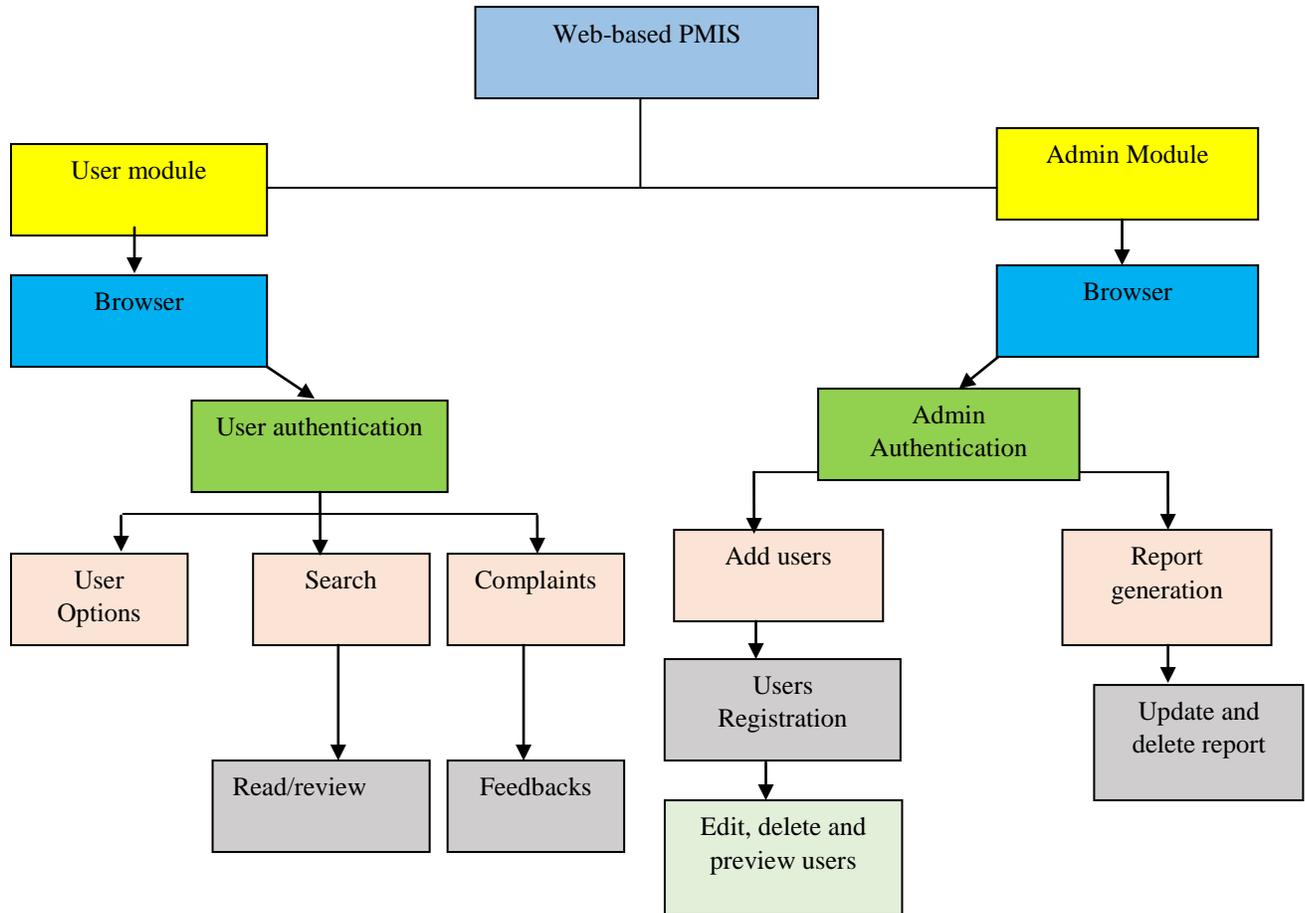
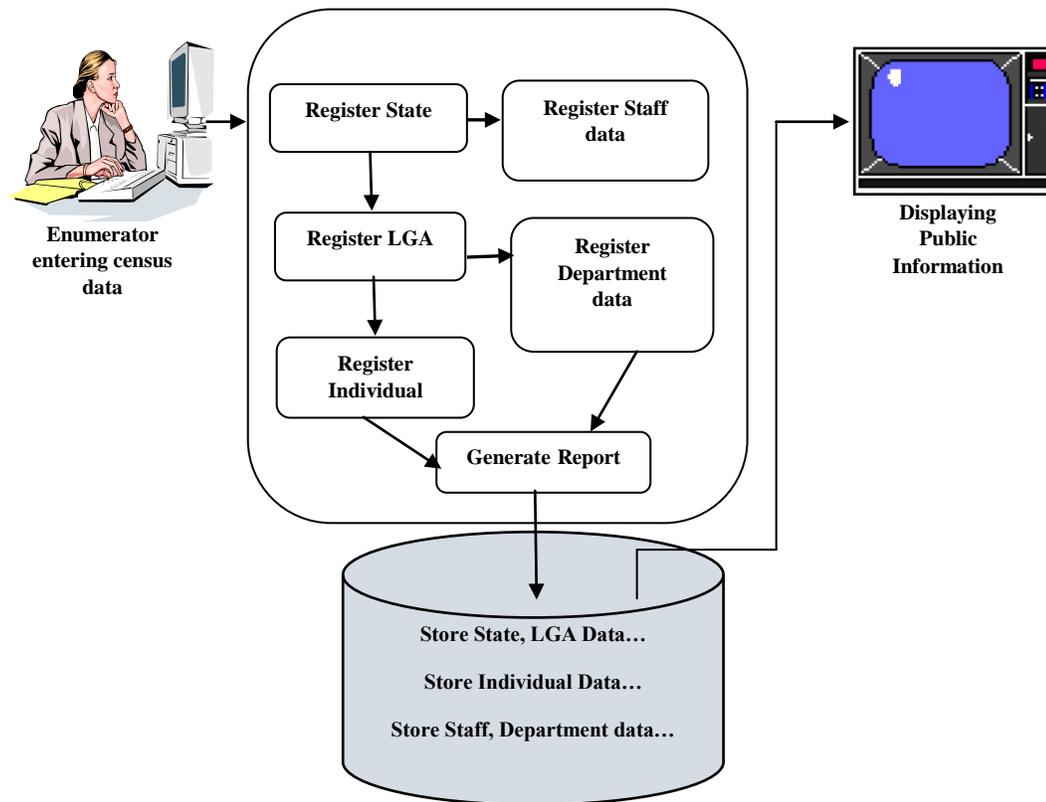


Figure 4: High Level Decomposition of the Web-based PMIS

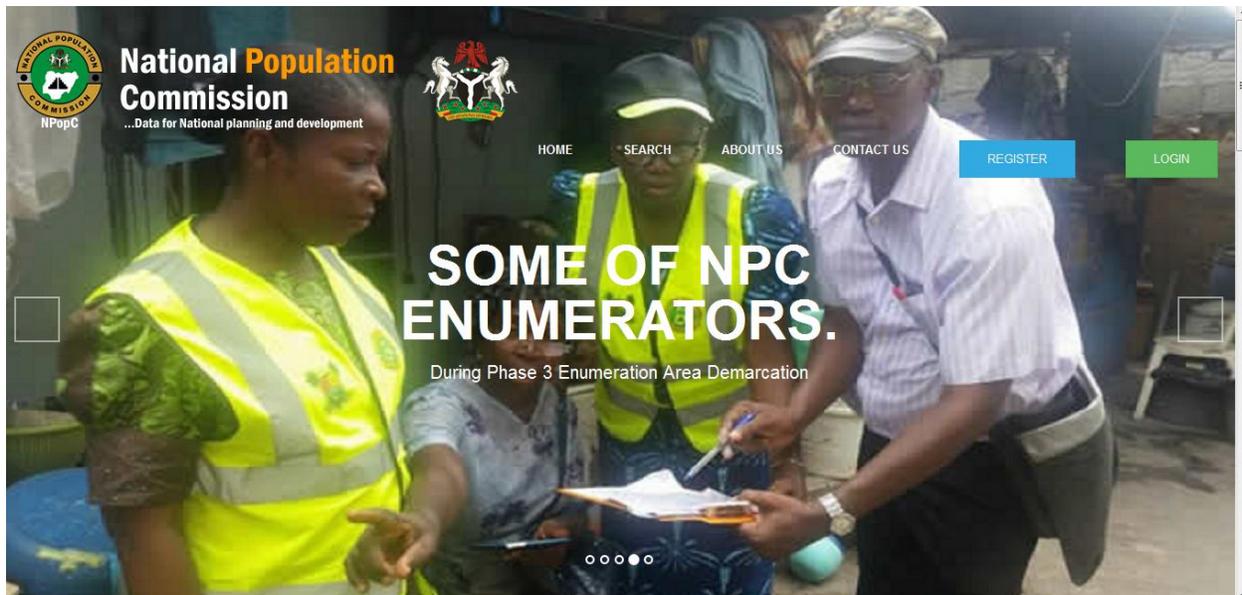


**Figure 5:** The Data Flow Diagram of the Web-based PMIS

### 3.5 The Enumerator

The Enumerator conduct interview from house-to-house interviewing respondents based on the questionnaire given and checks that the respondents properly fill all questionnaires during the survey (see *Figure 6*). He also establishes a necessary report with the households head and members which will assist him to enumerate successfully all the households within the area. Furthermore, he checks the boundary and map of the enumeration area and ensures that the boundaries coincide with the adjoining enumeration

that no area is left in between the enumeration areas and no adjoining enumeration areas overlap. The data collected at the local level by the enumerators under the supervision of the supervisors goes through the controllers. Prior to all these, the enumerators would have received adequate training for the job by NPC. The enumerators will receive training in the following subjects: remote areas, fully and partially occupied buildings in the area, compact geographical units with identifiable boundaries and/or man-made features, numbering the buildings and households in the buildings etc.

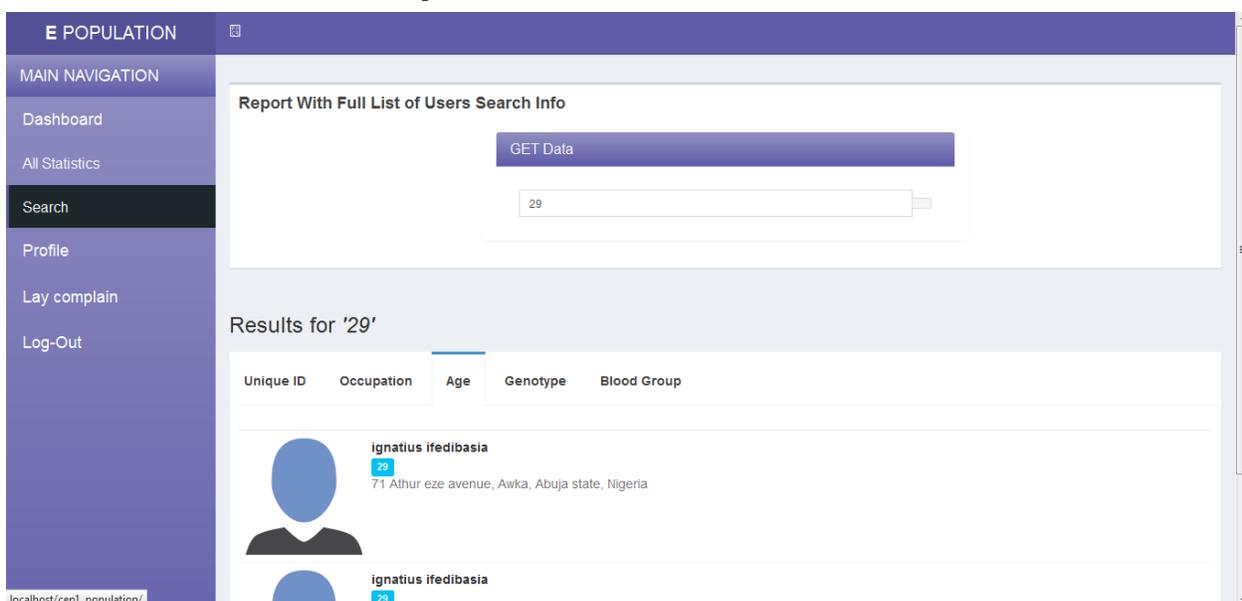


**Figure 6:** Screen Shot Enumerators in the Field (Source: National Population Commission [20])

#### 4. RESULTS AND DISCUSSION

The web-based PMIS system was successfully tested according to the test plan which defined the desired results. After successful testing, the following results were obtained vis-à-vis the expected results.

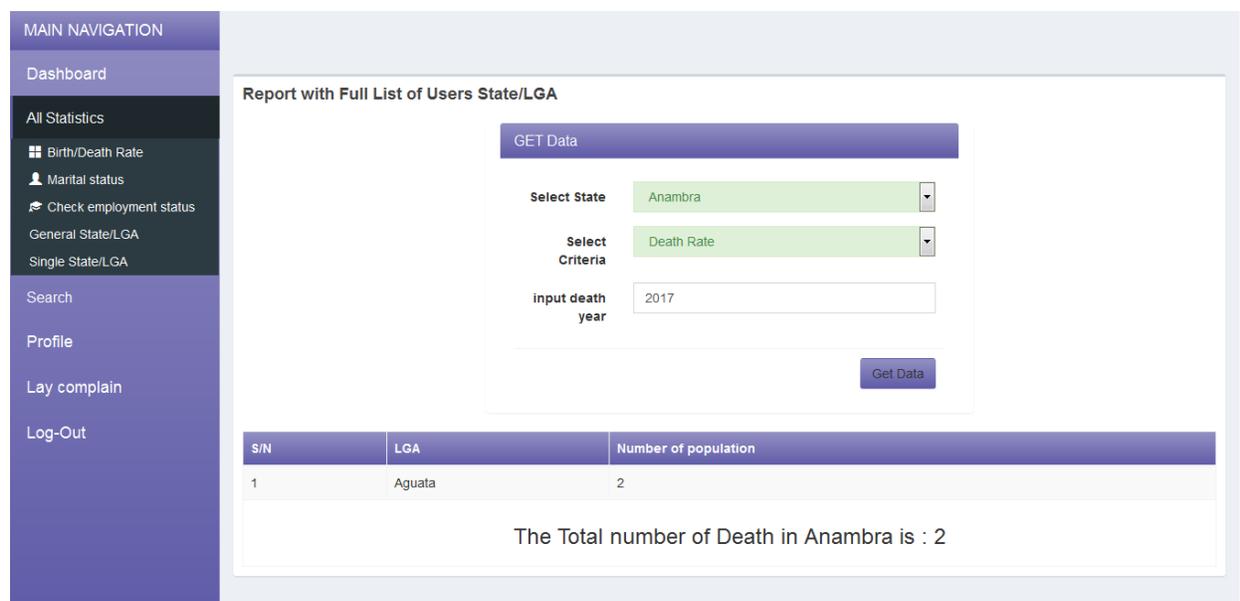
Furthermore, the results obtained from the test cases executed suggest that the modules involved in these tests interface functioned properly with each other (see *Figures 7 -10*).



**Figure 7:** Screen Shot of Report with Full List of Users Search Information

Figure 7 is the result of searching through our system to search for a particular candidate among the 29 candidates that have been recorded or stored in the system. As can be seen from the output, the candidate’s unique ID, occupation, age, genotype as well as blood group are being displayed. The genotype and blood group will definitely help medical

practitioners and the ministry of health in carrying out analysis concerning the entire population.



**Figure 8:** Screen shot of Report with Full List of Users State/LGA

In Figure 8, the result of searching through the system to ascertain the total number of death within a particular year (in this case 2017) in a specific state (e.g. Anambra State) has been shown. For birth rate

result see Figure 10, were the result was demonstrated. Meanwhile, Figure 9 reports a full list of the total number of male population in each state and their total in Nigeria.

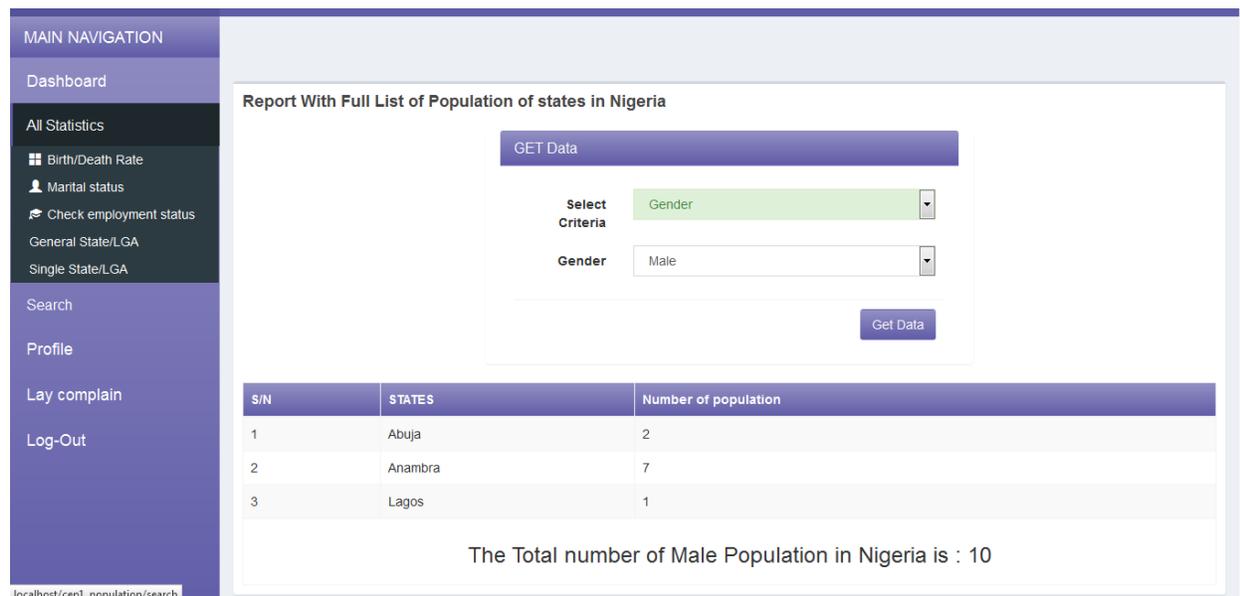


Figure 9: Screen Shot of Report with Full List of Population of States in Nigeria

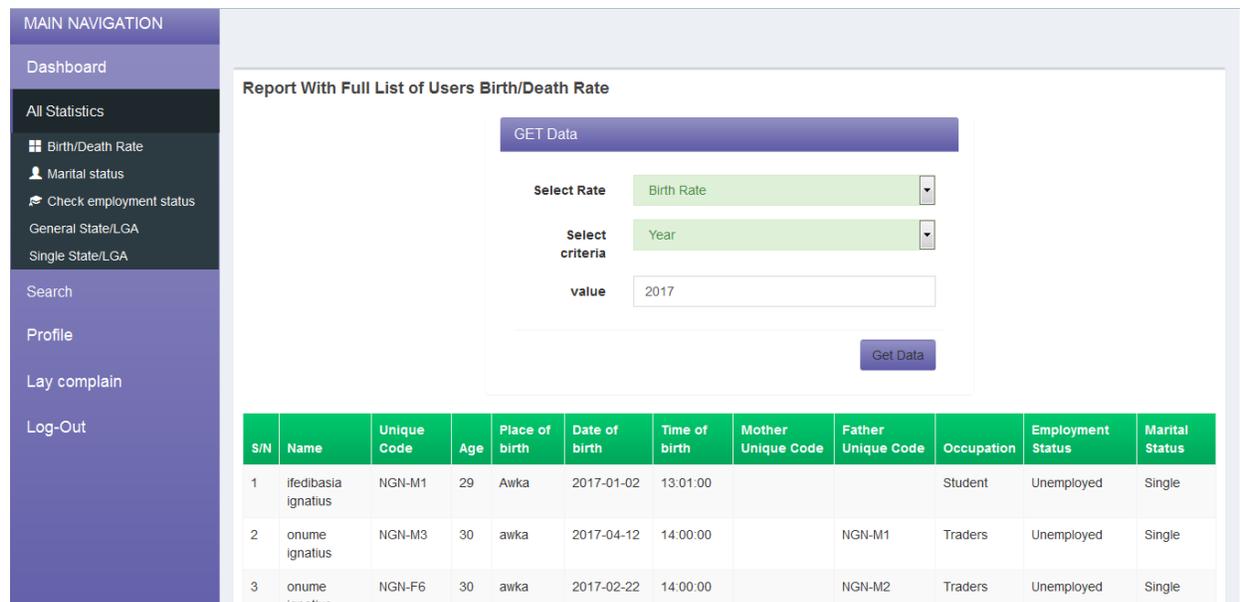


Figure 10: Screen Shot of Report with Full List of Users Birth/Death Rate

## 5. CONCLUSION AND FUTURE WORKS

It is our belief that with the adoption of this web-based PMIS system any agency whose primary job is to monitor and enumerate human beings of any age bracket and obtain suitable demographic information will find it helpful. This system could process data and produce accurate and reliable results when given correct data as well as bridging the gap of transporting data with vehicle through the use of computer network. Furthermore, the web-based PMIS system will empower countries to make informed decisions for effective policy, planning and management of their economy and population. The use of web-based PMIS system in census operations will solve problems encountered in the manual system as it focuses on the collection of information and report generation, the system will increase the processing speed and improved storage facilities and easy retrieval. For future work, researchers should look at using multiple layers authentication controls that will detect fraudulent activities in the system as well as embed basic population calculations and projections analytical tools.

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