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## **A Secured Automated Workers Screening and Verification System Using Biometric Authentication Technique**

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### **ABSTRACT**

For some decades, government at both federal, state, and local government level have lost huge amounts of money annually expended on the salary wage of ghost workers or those who appropriate and collect such monies. This has been prevalent due to the inability of the government to come up with credible and globally acceptable means of screening, verification and management system for her genuine employees. It is against this background that this research is carried out to design and implement a screening, verification and management system for Taraba State workers. The design methodology adopted for the proposed system was object oriented design (OOD) methodology. Software development tools used were: XAMPP (localhost server), MySQLi, for database while the programming language used were PHP for scripting (i.e connection and communication with the database), HTML5 and CSS for the user interface design, javascript for system dynamic while the IDE used for the coding was notepad++ version 7.5.8. after successful implementation and evaluation of the proposed system it was capable of screening and verifying all registered workers.

### **1. INTRODUCTION**

Over the years inadequate research on computerized screening and verification systems for government workers in Nigeria has continued to create a gap in the literature relating to screening systems that determine the actual number of staff/workers on government payroll at the Federal, State and Local government level. This has led to an unimaginable number of ghost worker's name appearing on the government payroll. The creation of ghost workers is a common fraud that is associated and mostly occurs in the public service setting. Ghost workers are those individuals or persons "who receive salaries from either government or non-governmental agencies without showing up for work or who may not exist, but their salaries are appropriated by someone else" [1]. Lack of proper and accurate record keeping in the public service in developing countries of the world contributes to the emergence of ghost worker names appearing on the government payroll (International Records Management. This is attributed to the government's inability to keep up-to-date records of her employees. This has resulted in the government losing billions of naira in bills for monthly wages of staff leading to the present economic recession facing the country. For instance at the Federal government level, efforts were made to reform and improve the Management of Human Resources and eliminate payroll fraud in the Public Service. The Nigeria Federal government initiated the Integrated Personal and Payroll Information System (IPPIS) aimed at transforming the Nigerian Public Service through identity system (screening and verification system for her workers). The implementation of the project commenced in April, 2007 with Seven (7) Pilot Ministries, Departments and Agencies (MDAs) and later increased to sixteen (16) MDAs in 2009. The then Minister of Finance was quoted to have said in 2011 that the pilot implementation of the IPPIS in the sixteen (16) MDAs saved the nation over N12

Billion between 2007 and 2010. Also, she was quoted to have said in 2015 that, Government had achieved a cumulative savings of about N160 billion through weeding out of 60,000 ghost workers from the payroll as at the end of 2014 [2]. Furthermore, added to the problem is the issue of employees who are due for retirement but often update and extend their years of service to remain on government payroll thereby stretching government purse to pay salary bills which will have been put into capital and developmental projects. This was made possible due to the nature of the existing system of workers screening and verification system. To improve the efficiency of screening and verification system in Nigeria, researchers introduced the use of biometric technology to ascertain the actual identity of individual to determine whether they are who they claim to be. Biometrics refers to the automatic identification of a person based on his or her physiological or behavioural characteristics. It includes fingerprint, iris, facial and retinal among others. Biometrics technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions. Today, biometric is being spotlighted as the authentication method because of the need for reliable security [3]. Fingerprint authentication is one of the most well-known and publicized biometrics technologies. Because of their uniqueness and consistency over time, fingerprints have been in use for identification for over a century, more recently becoming automated due to advancements in computed capabilities [4]. This paper aims to automate the screening and verification system for Taraba State government Workers with a view to create a standard and acceptable means of screening and

verification system to verify and authenticate her employees, a monitoring system to checkmate falsifying and updating of sensitive information by government workers aimed at extending their years of service, prevent replacement of deceased employees without government approval by directors at the MDAs and to check government employees due for retirement.

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## 2.0 Overview of Screening and Verification System on Government Payroll

The common factor contributing to the problem of ghost workers name appearing on government pay roll in developing countries is attributed to poor records management systems in the public services (International Records Management. Most countries particularly the underdeveloped ones lack good personnel information management systems to accurately record and regularly update it staff database [5]. The poor record management systems creates discrepancies between the number of public servants on the government payroll and the actual number of employees recorded on the staff rolls in the various agencies [6]. Several reasons may account for the differences between employee records and those listed on the government payroll. One of such reasons was that the lists of public servants were sometimes kept by multiple agencies that were not updated concurrently [7]. For example, when an employee dies, resigned or vacated posts and those separations were not recorded in the books, there is bound to be differences between official records of employees and the actual numbers appearing on the payroll. Failure by government agencies to regularly update their staff records also create opportunities for separated staff to continue receiving salaries even though they no longer work for the government. Ghost workers increase the wage bill of government workforce above the wage budget which leads to budget overruns in many countries [8]. The problems of ghost workers and the drive for cost effectiveness in the public sectors were the reasons behind the various reforms undertaken by governments to minimize public expenditure relating to compensations. The most common method mostly used to identify ghost workers in the public sector is head count exercises [9]. These headcount exercises were useful tools for verifying the existence of employees in the public services and have assisted many countries to identify and eliminate ghost workers from their payrolls [1]. Also, many countries have used the headcounts as a tool for cleaning their payrolls and therefore did not consider alternative ways to monitor ghost workers apart from conducting the staff censuses [10]. Notwithstanding the benefits, headcounts do not guarantee the total elimination of ghost names from the government payrolls. The major challenge with head count exercises is collusion [11]. Some payroll officials collude with payroll managers to allow ghost workers to participate in head count exercises. This practice defeats the objectives of the headcount exercises when unauthorized employees are allowed to take part in headcount exercises and continue receiving salary. The problem of ghost workers will persist in public institutions so "long as those bad elements inside the civil service who are behind the crime are either shielded or untouched" [12]. It has been observed that collaboration remains another reason why false wage earners will continue to inflate the recurrent expenditure budget of government. [13] observed that internal auditors and the auditing firms assigned to audit the government offices are beneficiaries of the scam. The auditing firm cannot claim to have audited without discovering those who have cooked-up the books. Ukoko also noted that, the auditing processes represent another means of stealing from the government. [14] noted that, there is collaboration within the system that enhances the operation of payroll fraud. In Bayelsa State, until recently, attempts to smash the syndicates behind the scam have yielded very little result [15]. As at July 2009, the biometrics exercise conducted by the state government reveals that the payroll is stuffed with a lot of channels through which the syndicate used in defrauding the government. Precisely, the government announced that top members of the state executive council and civil servants in the state were under security surveillance over their involvement in the fake employment racket and over bloated civil service [16]. According to Okhomina, the surveillance of the top government official over the fraud resulted in continued threat to officers of the bureau in charge of the staff verification and screening exercise in the state with pressure to stop the process. This explains that payroll fraud is identified as a crime of the privileged few and it flourishes because of collaboration, fear and insider syndicates.

### 2.1 Fingerprints

Fingerprint patterns are one of the oldest methods used by humans to distinguish one from another individual with certainty. This means of authenticating and verifying an individual to prove that she/he really is who she/he claims to be is still in use digitally with complex algorithms and cryptography. Our fingers have a Friction Ridge Skin (FRS) which acts as a friction for grips. FRS does not change with time unless it experiences a major permanent wound or scars. The FRS is arranged in a unique way in every individual. The characteristic of FRS are categorized based on its flow as: arch, whorl and loop as shown in the Figure 1.

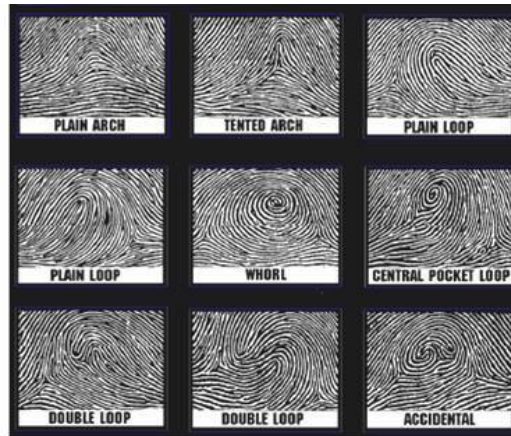


Figure1: Arrangements of FRS (Friction Ridges Skin)

These arrangements of whorls, loops and arches are converted into digital images by using different types of sensors such as optical sensors, ultrasonic sensors and capacitance sensors. Once the templates are obtained, algorithms such as pattern-based algorithms are used to compare and authenticate an individual correctly.

### 3. RESEARCH METHODOLOGY

This research adopts the object oriented analysis and design technology approach to describe the processes used in designing and implementing the screening and verification system. An object-oriented design methodology is defined as the system of principles and procedures applied to object-oriented software development. Different system object diagrams: use-case diagram, sequence diagram and class diagram were adopted for the design and implementation of the proposed system through a unified modeling language (UML).

#### 3.1 Use-Case Diagram

A “use-case” is a narrative that describes the sequence of events an actor can carry out after system implementation.

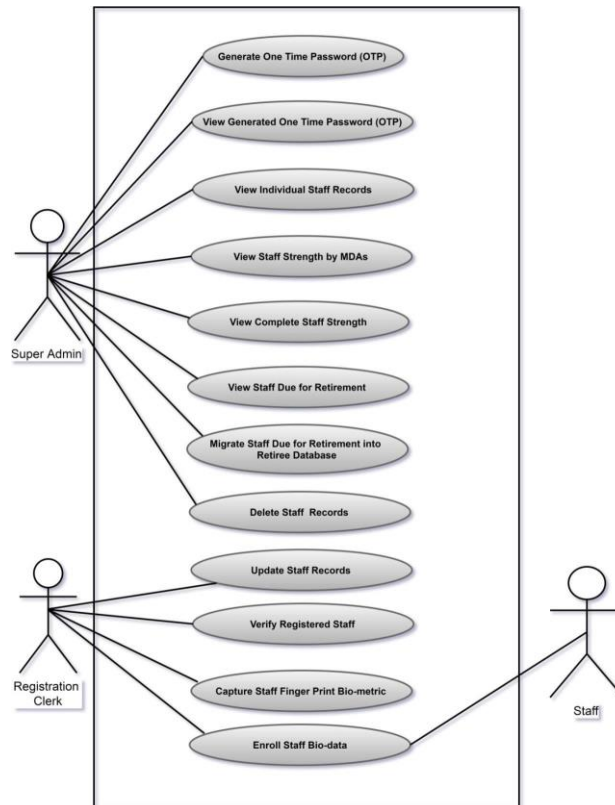


Figure 2: Use Case Diagram of the Proposed System

### 3.2 Class Diagram

A class diagram is a static model of a system. It shows the structure of the software in terms of the constituent classes and how each class is related to other classes. It gives a static view of the system. Figure 3 shows the new system class diagram.

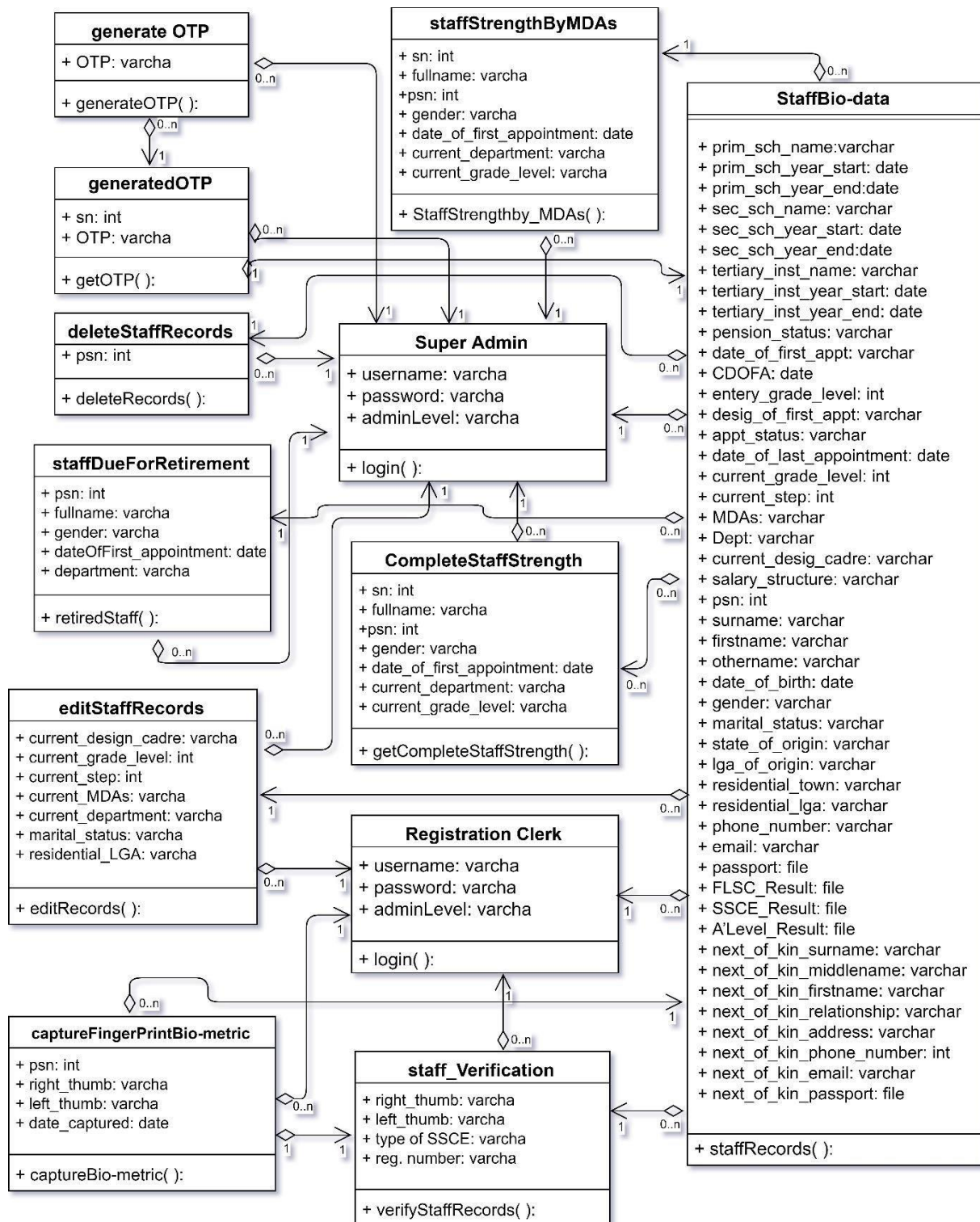


Figure 3: Class Diagram of the Proposed System

### 3.3 Sequence Diagram

Sequence diagrams depict system dynamics by showing the participating objects (classes, components) in the interaction and the sequence of messages exchanged. It's the 2nd most used UML diagram to model a system (behind class diagram). Figure 4 shows the sequence diagram of the various modules/class that made up the system.

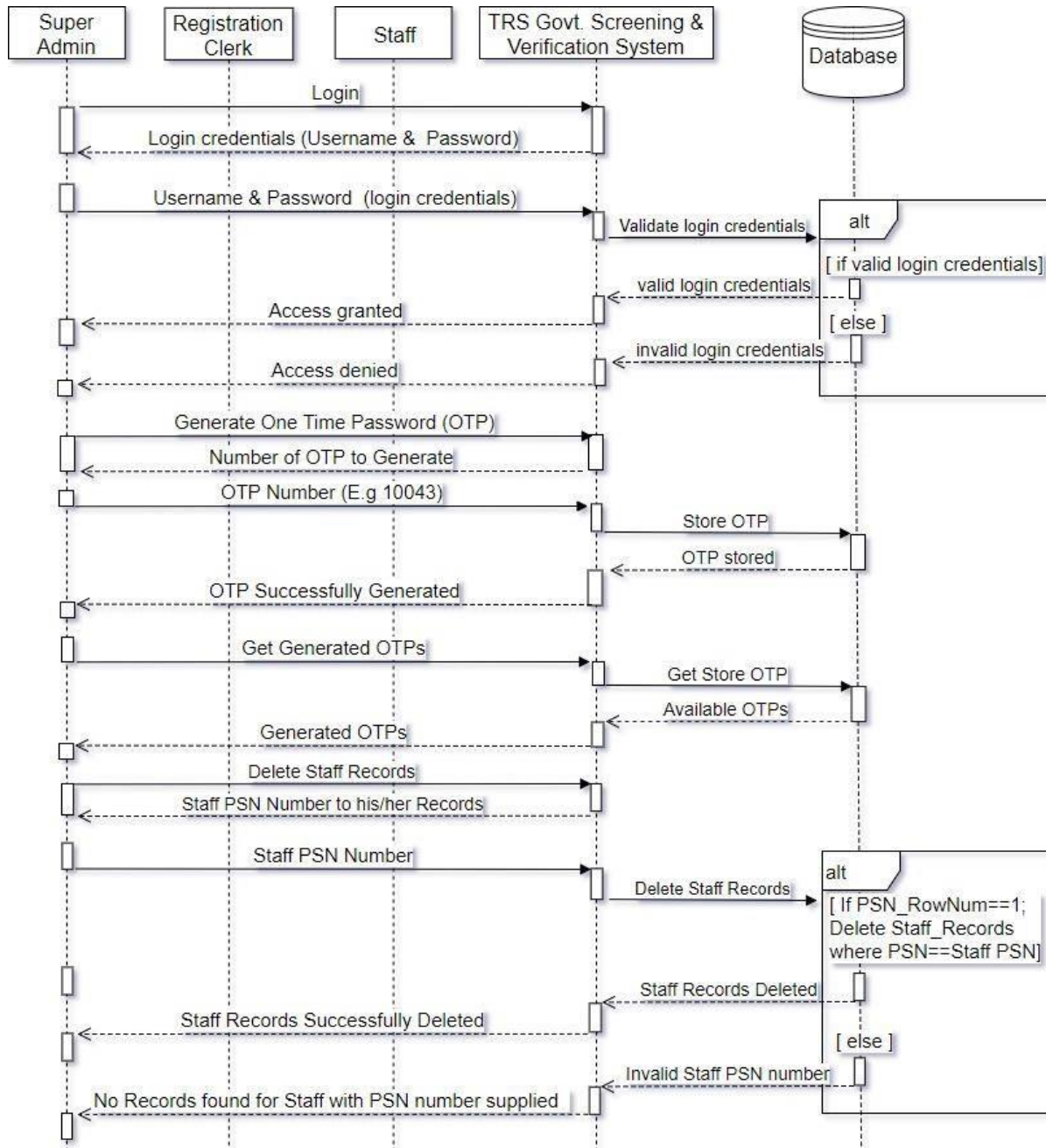


Figure 4: Sequence diagram for super admin to: login, generate OTP, view generated OTP and deletion of staff records

1. **Super Admin Login Module:** Figure 4 shows the Super admin login module. To login into the system, the super admin will send a dispatch message to the system that he/she

wants to login into system by clicking on the Admin button on the index page, the system respond back requiring for super admin login credential (i.e username and password), if the super admin supplied the username and password to the system, the system will then pass same to the database for validation. If the username and password is valid (i.e it exists in database), the database will then return a message to the system that the username and password supplied are valid; the system will then grant access to the super admin functionality/modules; else the database will returned invalid login credentials to the system, the system will denied access to the super admin functionality.

### 3.4 System Architecture

The system architectural design adopted for this system was 3-tier system architecture. 3-tiers system architecture comprises of: presentation tier, business/middle tier and the data tier. The presentation tier contains the graphic user interface (GUI) elements of the system developed using HTML5 and cascading style sheet (CSS). The business tier serves as a mediator between the presentation and the data tier. That is, it receives requests addressed to data tier from the presentation tier and returns a result to the presentation tier depending on the business logic. The middle tier was designed using hypertext pre-processor (PHP) and it runs on the server. While on the other hand, data tier is that part of the system that is responsible for storing and manipulations of data (i.e. the database). Database engine used for developing the system is MYSQLi database. Figure 5 shows the system architecture.

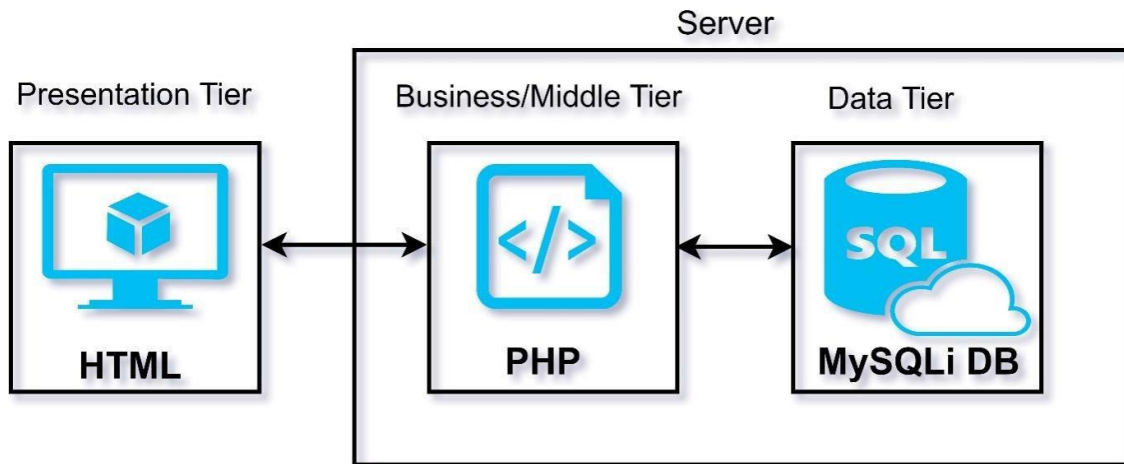


Figure 5: System Architecture

### 3.5 Input and Output Functionalities

**Login module:** The system uses one login page and script for both super admin and registration clerk. The system determines which page to load based on the login parameter supplied.

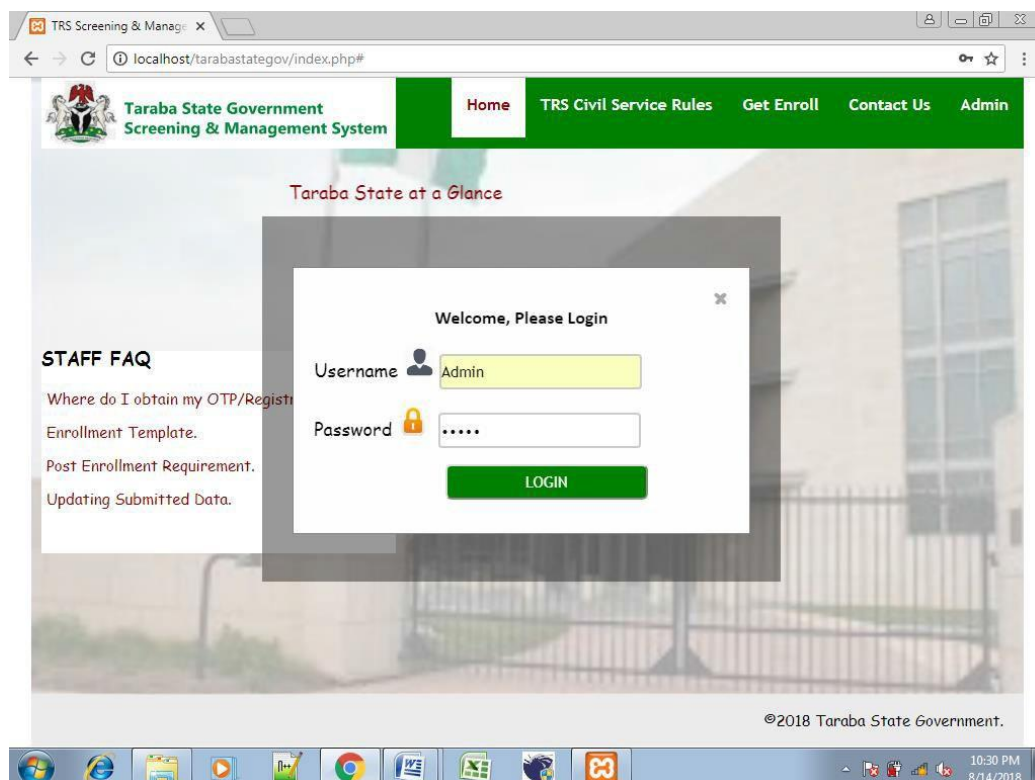


Figure 6: System login page

When the super admin successfully login to the system, a session is created and stored in the database. Hence, the super admin can perform required action(s) such as: generating a One Time Password (OTP), get/view staff strength by MDAs, view complete staff strength, view individual staff strength,

view and staff due for retirement in retiree database, delete staff records among others. For instance, to view complete staff strength, the super admin will click on the view complete staff strength button on the left-hand side of the dashboard; the system will return all staff records found in the database.

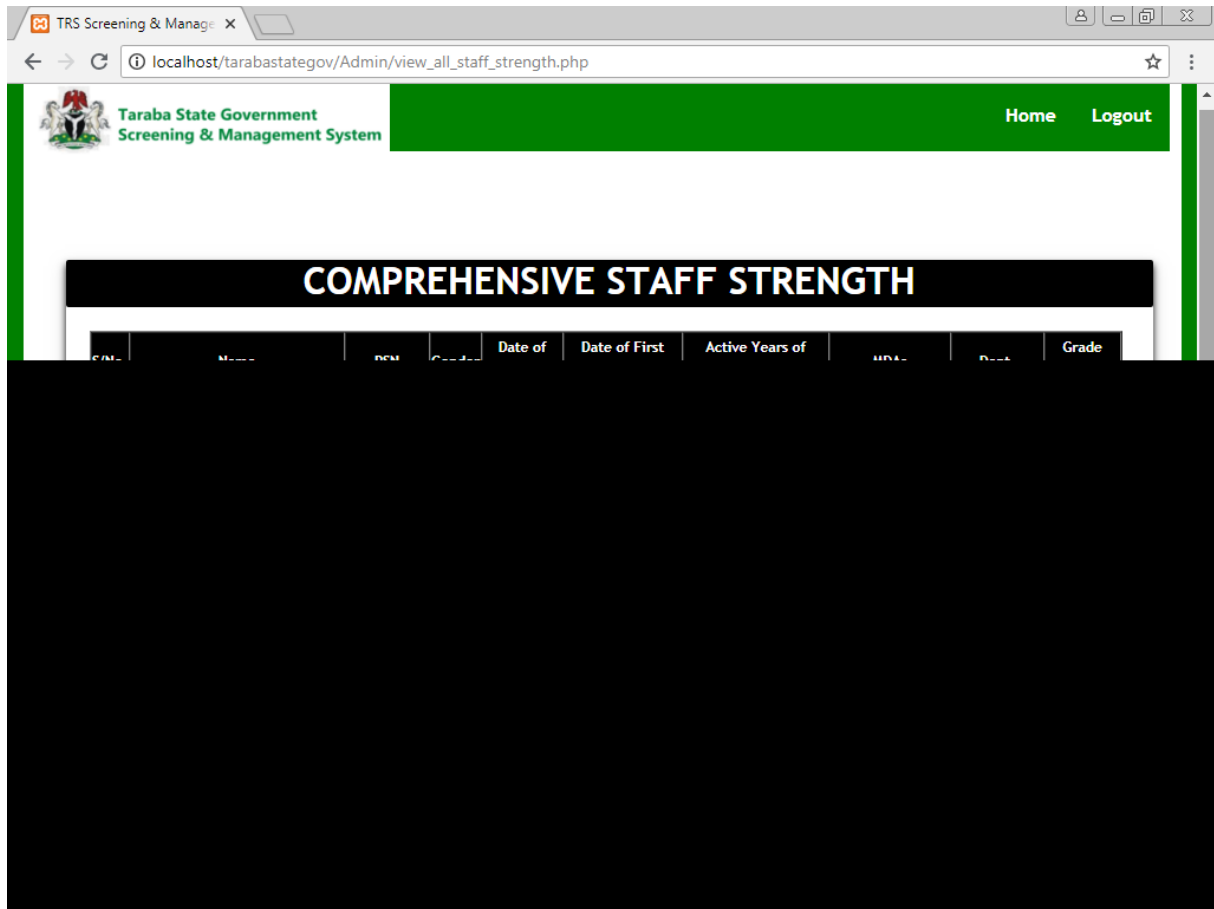


Figure 7: Complete staff strength module

Another important actor in this system is the Registration Clerk Admin whose duties are to enroll new staff, capture staff biometric, verify staff biometric and result. For instance, to capture staff biometric, the registration clerk will click on the enroll staff biometric button, the system will then respond back demanding for staff PSN number to capture his/her biometric. If the staff PSN is found in the database, the biometric capture page will be loaded, else, the system will respond back with the message that “Staff bio-data need to be enrolled before biometric data capture”. If the staff PSN number is valid (i.e found in the database), staff right thumb will be capture and store in the database for future verification and authentication. To verify the stored staff fingerprint biometric, the registration clerk clicks on verify staff on the dashboard and select biometric verification, the page will load, then left and right thumbs of the staff is supplied. If a matched is found in the database, it returns the staff details with image, else it returns a null result if there is no match of the staff fingerprint biometric.

#### 4.0 RESULTS AND DISCUSSION

The proposed screening and verification system was evaluated using the master Test Plan evaluation technique. A Master Test Plan is a single high-level plan for a project or product that combines all other test plans. This test plan was adopted because it allows for easy detection and correction of bugs in the software before it is release to the end-users.

Table 1: A Complete Master Test Plan for all the Subsystems in the Software

Project name: Screening and Management System for Taraba State Government Workers.

Project name: Screening and Management System for Taraba State Government Workers.

Test Case ID	Test title	Test Steps	Test Data	Expected Results	Actual Results
UI_01	Check Super Admin Login with valid Data	<ol style="list-style-type: none"> <li>Go to <a href="http://localhost/tarabastategov/admin.php">localhost/tarabastategov/admin.php</a></li> <li>Enter Username</li> <li>Enter Password</li> <li>Click Login</li> </ol>	Username = Admin Password = admin	User should Login into system	Admin is login to Super Admin index page

**Pre-conditions:** User has valid username and password.

**Pre-conditions:** User is validated with database and successfully login to account. The account session details are logged in database.

UI_02	Check Registration Clerk Login with valid Data	<ol style="list-style-type: none"> <li>Go to <a href="http://localhost/tarabastategov/admin.php">localhost/tarabastategov/admin.php</a></li> <li>Enter Username</li> <li>Enter Password</li> <li>Click Login</li> </ol>	Username = Admin Password = password	User should Login into system	Registration clerk in login into Reg. clerk index page
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**Pre-conditions:** User has valid username and password.

**Pre-conditions:** User is validated with database and successfully login to account. The account session details are logged in database.

UI_03	Check generate OTP by Super Admin with valid Data	<ol style="list-style-type: none"> <li>Login to <a href="http://localhost/tarabastategov/Admin/Admin_index.php">http://localhost/tarabastategov/Admin/Admin_index.php</a></li> <li>Click generate Pins (OTP)</li> <li>Enter number of pins</li> <li>Click generate Pins</li> </ol>	Number of pins = integer	Pins should be generated and stored in the database	OTP are generated and stored in the database.
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UI_04	Check view generate OTP by Super Admin	<ol style="list-style-type: none"> <li>Login to <a href="http://localhost/tarabastategov/Adimn/Admin_index.php">localhost/tarabastategov/Adimn/Admin_index.php</a></li> <li>Click view generate Pins</li> </ol>	Null	Generated Pins should be display	Generated OTPs is display on the screen.
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UI_05	Check view individual staff records with invalid Data	<ol style="list-style-type: none"> <li>Login to <a href="http://localhost/tarabastategov/Adimn/Admin_index.php">localhost/tarabastategov/Adimn/Admin_index.php</a></li> <li>Click view individual staff records</li> <li>Enter staff PSN number</li> <li>Click view records</li> </ol>	Staff PSN number = integer	Staff records should be display	Staff records associated with supplied PSN is displayed.
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UI_0 6	Check view staff strength by MDAs	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastategov/v/Adimn/Admin_index.php">localhost/tarabastategov/v/Adimn/Admin_index.php</a></li> <li>2. Click view staff strength by MDAs</li> <li>3. Select MDAs to view staff string</li> <li>4. Click on view staff strength</li> </ol>	String (ie name of MDAs)	Staff strength by MDAs should be display	Staff strength of the selected MDAs is displayed on the screen. Else no staff is registered for the selected MDAs
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UI_0 7	Check view complete staff strength	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastategov/Adimn/Admin_index.php">localhost/tarabastategov/Adimn/Admin_index.php</a></li> <li>2. Click view complete staff strength</li> </ol>	Complete Staff strength should be display	Complete staff strength is displayed on the screen.	Pass
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UI_0 8	Check view staff due for retirement	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastategov/Adimn/Admin_index.php">localhost/tarabastategov/Adimn/Admin_index.php</a></li> <li>2. Click view staff due for retirement</li> </ol>	Staff due for retirement should be display	If condition for retirement is met, the staff name(s) due for retirement is displayed. Else no staff is due for retirement.
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UI_0 9	Check migrate retired staff into retiree database	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastategov/Adimn/Admin_index.php">localhost/tarabastategov/Adimn/Admin_index.php</a></li> <li>2. Click view staff due for retirement</li> <li>3. Click migrate retired staff to retiree database</li> </ol>	Retired Staff should be migrated to retiree database	The retired staff are moved into retiree database and deleted from the lists of serving staff.	Pass
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UI_1 0	Check delete staff records	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastategov/Adimn/Admin_index.php">localhost/tarabastategov/Adimn/Admin_index.php</a></li> <li>2. Click delete staff records</li> <li>3. Enter staff PSN number to delete his/her records</li> <li>4. Click Ok to confirm deletion action.</li> </ol>	Staff PSN number= integer	Staff records should be deleted	Staff records associated with the supplied PSN number is deleted from the system.	Pass
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UI_1 1	Check enroll new staff bio-data with valid data	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastatego/v/Registration_Clerk/index.php">localhost/tarabastatego/v/Registration_Clerk/index.php</a></li> <li>2. Click Enroll NewStaff</li> <li>3. Enter One Time Password (OTP)</li> <li>4. Click Proceed</li> </ol>	Staff OTP = Vachar	Staff should be enrolled	Enrollment page is load on the system for staff enter all required fields.
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UI_1 2	Check capture staff fingerprint biometric with valid data	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastatego/v/Registration_Clerk/index.php">localhost/tarabastatego/v/Registration_Clerk/index.php</a></li> <li>2. Click Enroll Staff Biometric</li> <li>3. Enter staff PSN number</li> </ol>	Staff PSN = integer	Staff fingerprin t biometric should be able to be capture	Staff fingerprint biometric page will load.
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4. Click Proceed

UI_1 3	Check verify staff fingerprint biometric with valid data	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastatego/v/Registration_Clerk/index.php">localhost/tarabastatego/v/Registration_Clerk/index.php</a></li> <li>2. Click verify Staff fingerprint Biometric</li> <li>3. Enter staff PSN number</li> <li>4. Click Proceed</li> </ol>	Staff PSN = integer	Staff fingerprin t biometric should be able to be verify	Fingerprint biometric verification page will load ready to verify staff.	Pass
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UI_1 4	Check verify staff SSCE results with valid data	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastatego/v/Registration_Clerk/index.php">localhost/tarabastatego/v/Registration_Clerk/index.php</a></li> <li>2. Click verify Staff SSCE results</li> <li>3. Select type of SSCE result</li> <li>4. Click Proceed</li> </ol>	Type of result = varcha	Staff SSCE result should be display	SSCE result verification page will load to verify staff result(s).	Pass
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UI_1 5	Check enroll new staff by the employee with valid data	<ol style="list-style-type: none"> <li>1. Login to <a href="http://localhost/tarabastatego/v/index.php">localhost/tarabastatego/v/index.php</a></li> <li>2. Click Enroll New Staff</li> <li>3. Enter staff One Time Password (OTP)</li> <li>4. Click Proceed</li> </ol>	Staff OTP = Vachar	Staff should be to enrolled his/her bio-data	Enrollment page will load.	Pass
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From table 1, it can be seen that the results of the actual test from the various subsystems satisfied the expected test result of the proposed system in accordance with the software requirement specification (SRS).

## 5.0 SUMMARY AND CONCLUSION

The screening and verification system for Taraba State Workers is a secure database for the management of Taraba state civil servants records including: enrollment of new staff, verification and authentication of registered staff on the system using fingerprint biometric authentication technique, migration of staff due for retirement, viewing of migrated staff due for retirement in the retiree database, viewing individual staff records, updating staff records, viewing staff strength by ministries, department and agencies (MDAs), viewing of complete staff strength as well as updating of staff records respectively. These administrative features of the system aim at restricting some of the irregularities in the public service such as ghost workers, illegal staff replacement, frequent updating of staff sensitive records to allow them remain in active service beyond their retirement age among others. The proposed system was developed using HTML5 and CSS for the Graphic User Interface (GUI), javascript for system dynamic, PHP for communication with the database, MySQLi for database engine, XAMPP server for local host, notepad++ as IDE and browsers for running the application. After successful implementation and testing, the system was able to efficiently screen and verify registered works.

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