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Integrated Subscriber Identification Module Registration

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Abstract- It is an undisputed fact that majority of the world's population are connected by mobile network or mobile communication, and Nigeria is also part of the fast technological development the world has achieved, in the aspect of mobile communication. Unfortunately, the challenges such as; service quality and hidden crimes that are committed using mobile phones is a current national problem that demands serious attention. In a typical Nigerian large city setting, Subscribers' Identification Module (SIM) registration centers apart from being situated at the mobile network specific registration centers are also very far apart. However, when a subscriber has multiple SIM cards of different networks, he/she have to register each of them individually by visiting respective SIM registration points; that leads to data duplication, time consuming and more financial cost. The before mentioned problems, motivated to the development of an integrated SIM registration system which can: register and verify both mobile subscribers and registering agents, update subscriber profile with new number instead of re-registering the same subscriber in the case of additional SIM.

Keywords-*Mobile Network, Registration Agent, Subscriber Verification, SIM, Telecommunication*

I. INTRODUCTION

Information and Communication Systems has become important for firms, organizations and companies to survive or thrive in a technology centered environment [1]. The amount of inputs required for information system equipment in telecom-based organizations is large, therefore, there is need to employ or use a sophisticated system that will give the best services needed to handle organizational and customers' demands. Looking at the level of technology, ref [2] predicted that technology advancement, particularly in the area of information and communication keeps growing every day, therefore there is need for technological improvement to manage this growth.

The coming of mobile communication systems has changed the way information is sent or received [3]. The development has brought about clues, ideas and innovations in the discipline of telecommunication and a good portion of people of the world are connected with mobile phone as of 2008 [4].

Nigeria is also part of this fast development the world has achieved in the aspect of mobile communication [5]. The country is also currently facing security challenges. Challenges such as service quality and hidden crimes are committed using mobile phones, as a result of Subscribers' Identification Module (SIM) cards that were given to mobile network subscribers without the proper requirement for registration, to help the identification of subscribers. As these problems persist, there was an attempt by Nigerian Communications Commission (NCC) to enforce subscriber registration [6]. The effort turned out unsuccessful as desired, because emphases was not on the documentation of telephone lines that are in use against the name and full identity of those who purchase them for use. Consequently, security issues came up as a result of the negligence [7]. Therefore there is need to review the existing SIM registration system and make available a general platform that is cost effective for subscriber registration begins as registration of identity information to activate a mobile SIM card, is fast becoming universal in Africa [8].

The current SIM registration system of mobile network service providers in Nigeria is engulf with a lot of challenges that includes the following:

- The current SIM registration cannot verify the registration status of subscriber at all available outlets, which causes multiple registration and duplication of data at the backend system (database). This duplication causes redundancy in the database making some data occupy space with no use.
- Delayed registration and time wastage is another problem faced by the current system as it uses end to end retransmission to ensure that data arrives correctly at the database.
- Registering agents are not registered and verified before registering a subscriber, which could lead to fraudulent acts by agents in form of data misuse (e.g. using your information to register multiple SIMs for sale), trailing, kidnapping and so on.
- There is also a problem of data duplication for people having the SIM cards of different networks at different registration points. Identity theft could easily happen when some people with malicious intent gain access to target subscriber details.

The aim of this research is to provide a unified SIM registration system where any subscriber of any network can register, verify their registration status through a primary mobile phone number. This would help to avoid re-registration,

duplication, redundancy, reduces database traffic, prevent the actions of unregistered agents and also the service providers can easily detect on whose account a problem occurs and also allow the network subscribers to register their SIM cards (any network) in any outlet in case of additional SIM.

This paper is organized as follows: This section of introduction provides a brief background to the concepts of SIM registration, the challenges and the needs to register SIM cards. This is followed by an extensive literature review on relevant approaches, tools and techniques for the development of the proposed intelligent integrated SIM registration system for mobile companies. The third section of this paper present the materials and methods adopted in order to successfully develop the proposed system and the fourth section discusses in details the design artefacts for the proposed system.

II. SIM REGISTRATION CONCEPT

A. General Concept

SIM registration system is an information system. It captures a mobile network subscriber's details for identification purposes. [1] Said that information system have become an important aspect for survival of organizations, firms and industries in a fast growing technology environment. Due to this fast growth, the resources and equipment required for information system tend to increase to a higher volume; therefore it needs to employ a robust and well protected system that can deliver good and reliable services needed to maintain subscribers and service providers (organizations) demands.

The current SIM registration system of mobile network service providers in Nigeria cannot verify the registration status of their subscribers at any available registration outlets of the available networks. Delayed registration and time wastage is another problem faced by the current system as it uses end to end retransmission to ensure that data arrives correctly to the database. Most of the registering agents are not registered and verified before registering a subscriber which could lead to fraudulent acts by agents in form of data misuse (e.g. using subscribers information to register multiple SIMs for sale), trailing, kidnapping and so on. There is also a problem of data duplication for people having the SIM cards of different networks at different registration points. Identity theft could easily happen when some people with malicious intensions gain access to target subscriber details.

Indeed, our home country Nigeria is included in this widespread development the world has recorded, in the aspect of mobile communication as Nigeria struggles to become a technology driven economy [5]. The United States embassy in 2011 during its economic section presentation on the fact sheet of Nigeria's telecommunication sector, as the most viable and fastest growing industry of [8], Nigerian economy, providing jobs of all nature. The telecommunication services which started in Nigeria in the year 1986 through a connection between London and Lagos stayed under developed until deregulation took place in 2001 [9]. The author [9] also noted that this deregulation exercise caused lesser restriction in the sector which leads to the complete inauguration of GSM services in the country. Still with these changes there are still some big problems (challenges) like service quality and hidden crimes, vices and other atrocities committed by the use of mobile phones [10]. The believe of many people is that blames are to the government, reasons being that government after inauguration of the GSM services in 2001 as mentioned earlier did not provide a rule for proper registration requirement to help identification of the subscribers before they are given the Subscriber Identification Module (SIM) cards.

The NCC in 2001 made an attempt as a regulatory body to enforce subscriber registration [11]. Much result was not realized from this effort as emphasis was not on the record (documentation) of telephone lines and contacts that are in use against the name and full identity of subscribers who buy them for use. Therefore there was a threat to security due to this inaccuracy. [12] Said that the need for subscriber registration has increased recently, therefore it has to then impose compulsory subscriber registration for both new and existing subscribers in order to check these crimes and improve service delivery to the subscribers. SIM registration is now growing fast in Africa due to its good effect of reducing subscriber anonymity and communication surveillance. It checks security [13].

B. Challenges of GSM Companies and SIM Registration

No one can dispute the fact that Nigerians are happy with the advent of GSM technology, but the service providers are not finding it easy rendering their services. The long time challenges still persist today in the GSM industry; enabling laws and regulations limitation; epileptic power supply, customer education are the common and persistent problems [14]:

1. *Unstable and Inadequate Power Supply*: Power supply in Nigeria today is not enough to meet the demands of the GSM sector. To maintain operations, the various GSM companies or operators have to run their base stations, substations and transmission stations [15] using generators. The cost of fueling and maintenance is so high which leads to high charges on services provided to individuals. SIM registration centers are also substations that are run using generators. According to Business World, MTN, GLO and AIRTEL spend not less than 24.2 billion Naira in fueling and maintenance of generator sets.
2. *Transmission Infrastructure Issues*: This a big problem facing the GSM operators. MTN *y'hello* edition in 2007, stated that MTN had to construct first phase of the *y'hello* Bahn transmission support which created the biggest 4:1 support in Nigeria to solve the problem of unreliable land transmission and database congestion.
3. *Expensive Import Duty Cost and Clearance Process*: Almost 100% of GSM equipment and registration tools are imported into Nigeria [16]. This process is usually disturbed by difficult clearance which sometimes hinders network release and registration (creation of more outlets).
4. *Destruction (vandalism) of GSM Equipment*: Frequent destruction of GSM equipment have been recorded across the nation [17] ranging from theft to destruction of fuel

(diesel), Air Conditioners, Automatic Voltage Regulator, generators, and so on by criminals. Of course replacing these equipment tends to be hard [18].

5. *High Tax Rate*: High taxes, levies and other charges are seriously affecting the GSM industry [19]. Recently, the association of licensed telecommunication operators of Nigeria (ALTON) is in court with Lagos state government over the imposition of 500,000 naira charge for per base in the state [18].

III. Review of Related Work

[2] Made an assertion looking at the level of technology advancement, especially in the field of information and communication increase daily; it therefore ought to be utilized properly. International Telecommunication Union statistics shows an estimated value of 6.8 billion mobile phone subscription all over the world as of February 2013 and this represents 96% of the world population [5].

According to [20], Africa may continue to have identification problems if a proper documentation is not put in place. Organizations rendering services to customers need to have information about their respective customers, which will help their plan, both present and future. Keeping customer records as seen in their work help to improve communication between service providers and their customers.

A statement by [21] pointed out that Africa shall soon turn to a mobile centric society, therefore identification devices like SIM (either soft or hard) needs to be given proper attention, as to control of purchase and documentation [22]. This paper also pointed that the sales of unregistered or preregistered SIM cards need to be terminated with immediate effect, reason being that crimes are committed using anonymous and untraceable SIM card lines.

According to [23], one good advantage of SIM registration as a communication surveillance is that the registration needs the active participation (physical or in person) involvement (participation) of the subscriber in the registration process. This paper examines different patterns of registration and then made a conclusion that the physical pattern is better as active participation is required.

[1] Pointed out that the government and some organizations (for example the East African Communication Organization) had believes that a compulsory SIM registration scheme on subscribers will decrease the use of mobile phone in committing crimes. The paper also showed that tracking of subscribers by their identity and address and location has helped many security agencies in Africa.

[24] Said that the Kenyan government sanctioned mobile network operators for unregistered SIM cards on their networks. This was because of the hire crime (especially wiretapping) rate recorded was very high, which a great percentage were committed on mobile phones. Kidnapping which was the order of the day then was done most of the times on mobile phones.

[25] Stated that mobile network service network providers could also use registration details to advertise (market) new services or products to their subscribers (customers). They also pointed out that having adequate information or details of customers (subscribers) helps to manage and plan resource utilization by mobile network service operators. It also helps to plan market competition strategy.

The NCC stated that SIM registration is a condition (prerequisite) for number portability. The Tanzanian Communications Regulatory Authority also emphasized that SIM registration is to the advantage of subscribers especially in services like electronic money transfer and other financial transactions [26]. The paper emphasized that when a subscriber registers as due, he/she will get adequate service information, promo, adverts and other value added services and be free from line deactivation.

According to [22], the executive secretary of EACO pointed out that our mobile phones and telephones have become part of our identity. In 2013, the Republic of Benin recorded a high rate of crime by means of wiretapping [27]. Also in South Africa, a branch of MTN was accused of allowing (permitting) the president of republic of Benin to wiretap his opponents (political) directly from his home or office [28]. From the scenarios above, SIM registry information would help identify the communication terminals for the wiretapping [29].

Zimbabwe uses SIM registration to clamp down on political speeches [30]. MTN Nigeria CTO also suggested in his advocacy saying that SIM registration data should be linked up with banking, driving license data and health. The paper pointed out that with the details of every phone call made on each network, Zimbabwe was able to track the people behind malicious political speeches. Indeed that is a significance of having details of subscribers.

[31] Shows that SIM registration also depicts a kind of communication monitor and surveillance which reduces anonymity of subscribers. The Ugandan ICT ministry made a statement that the only individual who is frightened by SIM registration, normally is a criminal minded person [32]. Indeed an innocent citizen will have no reason not get his/her SIM registered.

[33] Talks about Foundational Identity Systems for the new global development agenda have become richer by the inculcation of SIM registration data together with the existing components [34]. The global agenda is an initiative for capturing of peoples information by regions. Having adequate information from the integrated SIM registration system will go a long way in feeding the database of the global system.

According to [35], a lot of positive changes are expected in the integration of enterprise (business) information structure (flows) which leads to easier and faster access to operational data. It shows that data could be access to different registries of the nation, for verification. So having adequate information in the SIM registration system will also help check the authenticity of information supplied to other registries by subscribers.

According to [36], Bangladesh as a country has suffered a great criminality rate due to unregistered and untraceable SIM lines used to perpetrate crimes. It also shows that a lot of mobile SIM vendors were arrested and prosecuted for selling millions of preregistered SIM cards to people. These acts lead to the imposing of mandatory SIM registration in Bangladesh and all mobile network operators there were ordered by the government to de activate all unregistered active lines.

[37] Emphasizes on the negative effects of finger print capture during SIM registration which has reduced the registration coverage. This is seen in the paper as it points out that most rural dwellers whose occupation is mostly hard labor find it difficult to get their finger prints captured. This is because of fainted prints due to their kind of occupation and they constitute a large portion of the population.

[38] talks about the SIM registration situation in Nigeria, SIM cards were sold mostly by street vendors without any form of user identification data collected until the recent direction by the Federal Government of Nigeria to the effect that all mobile telecoms operators selling new Subscriber Identification Module (SIM) cards must obtain the data of prospective subscribers and that all previously obtained SIM cards must be registered without delay. This is no doubt a good policy aimed at keeping accurate data on all mobile phone users in the country. This policy will also help in reducing the incidents of technology related crimes.

According to [39], Subscriber Registration is the documentation of the telephone lines that are in use against the names and full identity of those who have purchased them for use. Our own emphasis is on getting a perfect record of all things that happen in the network including the identity of all users of all facilities. We need this type of information to manage today, and to plan for the future.

[40] In their article shows that in a variety of government and private domains biometric recognition are being promoted as a technology that can help identify terrorists, provide better control of access to physical facilities and financial accounts, and increase the efficiency of access to services and their utilization. Bio- metric recognition has been applied to SIM registration, patient tracking in medical informatics, and the personalization of social services, among other things. In spite of substantial effort, however, there remain unresolved questions about the effectiveness and management of systems for biometric recognition, as well as the appropriateness and societal impact of their use.

The difficulties some African countries are facing due to their inability to meet up or cope with the advancement in information and communication technology [41] which is largely due to lack of adequate information for proper planning. There is also an increased rate of kidnapping and other related crimes without being tracked because the phone calls made during these acts cannot be monitored as the SIM lines are not registered.

According to [42], the SIM (Subscriber Identity Module) is security element used in the authentication of the subscriber before granting him/her access to the mobile network. The ingenuity of the SIM lies on the fact that it is a separate tamper resistant module which can be installed or removed from the mobile phone or when not duly registered. However, with the advances in wireless and storage technologies there is proposal to replace the current SIM by the so-called soft SIM, which consists of a tamper resistant module soldered on the mobile phone and a software SIM downloadable over-the-air. This means that a subscriber has to register before downloading.

According to [43], stated that pre-paid SIM card registration is mandated in a number of countries and requires consumers to provide proof of identification in order to activate and use a mobile SIM card. A number of governments adopt this policy as part of efforts to help mitigate security concerns and to address criminal activities like kidnapping. However, in places where the SIM registration exercise is working effectively by considering local market circumstances, like the ability of mobile operators to verify customers' identity documents, SIM registration can enable many consumers to access value added mobile and digital services that would otherwise be unavailable to them as unregistered subscribers.

[43] Emphasizes that the effectiveness of SIM registration solutions also depends on the availability and pervasiveness of national identity schemes. There are also economic and social considerations; if registration requirements are too stringent and do not reflect the national circumstances there is a real risk of excluding large sections of the community, often the most vulnerable or geographically the most remote. Whilst the direct impact to operator revenues can affect investment and the corresponding reduction in tax revenues is not ideal for governments, the impact on individual citizens can be very significant.

According to [44], the revolution of information and communication technology (ICT) has brought assurance to many people especially low income earners that they can feed themselves or families, provide shelter for selves and have a secured future. The Global Service for Mobile communication (GSM) serves as a tool for economic, political and social interactions among people of all profession, classes and status. The GSM usage has also helped to bridge the communication gap between urban and rural dwellers as was witnessed in the Niger Delta area of Nigeria. SIM registration has also created jobs for people who serve as registration agents.

[45] Attempts to explore the process of change and to examine in more depth the nature of the changes in management control of the mobile network service providers and telecommunication sector as a whole by the adoption of the new information technologies within small and medium enterprises. In particular, recognizing that management control change is a continuous organizational process (rather than an outcome), the trajectory of which is shaped by an incessant interplay of several influence, this research intends to explore the way in which the implementation of a new integrated information system contributes to this process. A good example of the integration of information system could be the merging of mobile network services.

IV. MATERIAL AND METHODS

Both primary and secondary data collection methods were used for the development of the proposed integrated SIM registration system. The Primary data collection methods used were interview and observation while the secondary data collection methods used were journals, books, articles, conference proceedings. These methods were used to obtain quality and reliable data for this research. The system development methodology adopted for the project is the extreme programming. The system was implemented using the following tools: Django framework, Django Python, Django html, Pycharm, Virtualenv, due to it is flexibility. MYSQL DBMS is used as the backend.

A. High Level Model

The high level model for the integrated SIM registration system, consisting of the major components as shown in fig. 1.

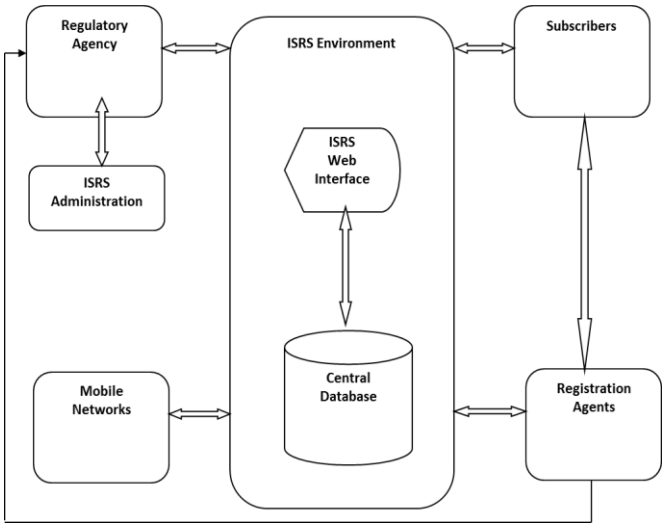

Figure 1. High Level Model of the Integrated SIM Registration System

The high level model (Fig.1) shows the interaction between the components of the system, a subscriber is registered by a registration agent while the subscriber is registered by the admin. The mobile network operators have access to the system and view their subscribers. All the data is passed to the central database.

B. Data Flow Diagram

Data flow diagram of the system showing the various interactions in the system is shown in figure 2.

The data flow diagram (Fig. 2) shows the interactions between the various components of the system with the database. It show that every detail fed in as input must be passed to the database either for verification or storage, for example, an agent supplies login details, which is then passed to the database for verification against the one stored in the database. This is how the data flow continues throughout the system.

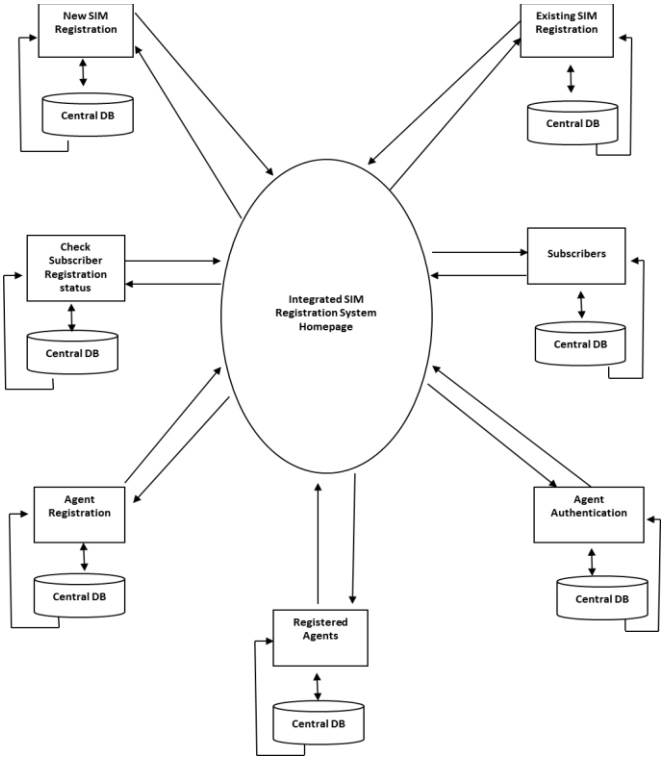

Figure 2. Data Flow Diagram

V. SYSTEM ARCHITECTURE AND DESIGN ARTIFACTS

The design phase of the Integrated SIM Registration System describes and decides how the system works/operates, just as the basic purpose of a design phase is to decide how to build the system. The design will also determine the overall system architecture, which will consist of physical components, hardware, software, people and communication among the components, which will satisfy the basic requirements.

The design also leads to the development of the basic architecture design that describes the hardware, software and network infrastructure that will be used. The proposed system will add to and change the system that already exists. The interface design specifies how the user will move through the system. It also specify the database specifications which defines the data that will be stored and where they will be stored.

The architectural design (Fig. 3) of the Integrated SIM Registration System depicts the communication among stakeholders of the system (regulatory body, subscribers, mobile networks and registration agents) where the subscribers have double edge arrow connection showing communication exchange with the registration agents, the agents interact with the system to carry out the registration or verification functions, the regulatory body registers the registration agents through the administration interface. The double edge connection arrow between two stakeholders shows the to and from communication path.

The design artifacts for the proposed system were produced in UML diagram descriptions. While Fig. 4 illustrate the use case description for the system, showing three categories of use case and each use case represents the operation a user can perform using the system.

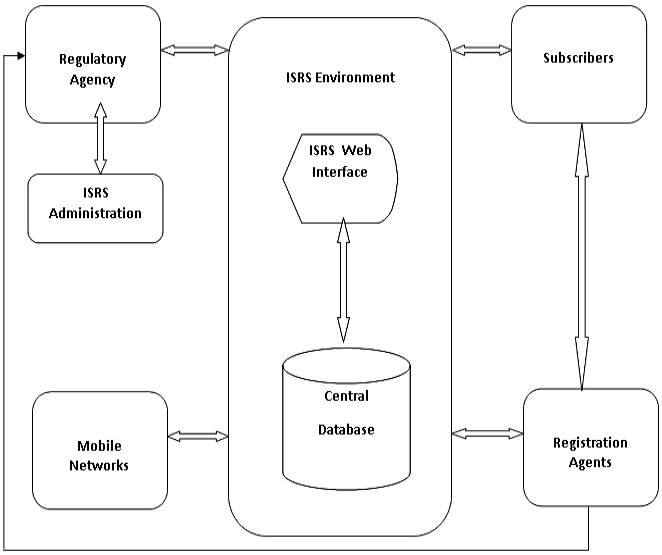

Figure 3. Architectural Design of the Integrated SIM Registration System

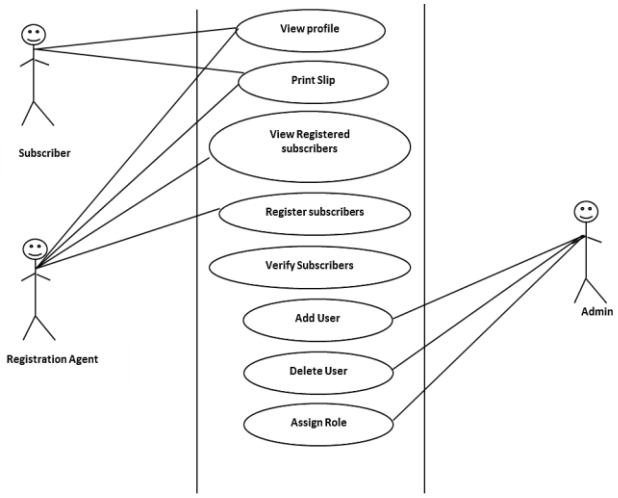

Figure 4. Use Case Diagram of the Integrated SIM Registration System

VI. USER INTERFACE DESIGN AND SPECIFICATION

As the new system is focused on creating an Integrated SIM Registration System, effort was made to develop interesting interface that will suite the objective of the system. The proposed system is user friendly that ensure the satisfaction of the target audience. In addition, the proposed system requires minimal system specification and it can be accessed from any mobile devices.

Fig. 6, 7 and 8 is showing some screen short of log in page, profile page and subscriber registration and verification of the proposed system respectively. Also, fig. 9 shows admin page with a complete and full control of all the clients.

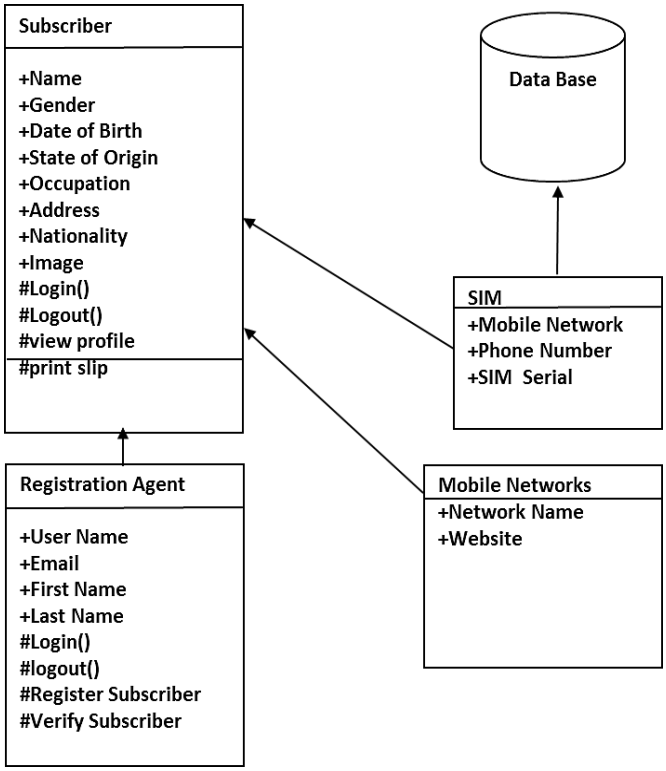

Figure 5. Class Hierarchy of the Integrated SIM Registration System

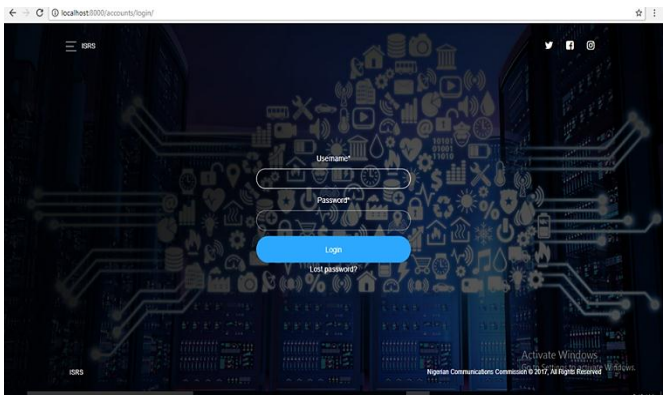

Figure 6. Login Page of the Integrated SIM Registration System

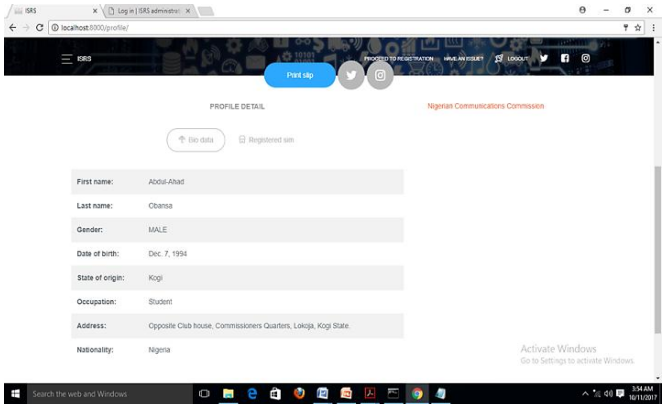

Figure 7. Profile Page of the Integrated SIM Registration System

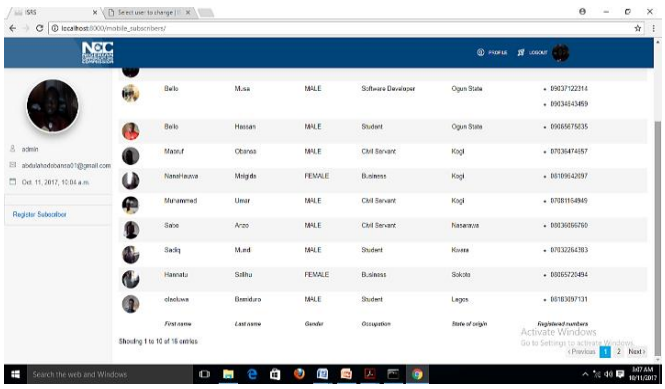

Figure 8. Subscriber Registration and Verification Page of the Integrated SIM Registration System

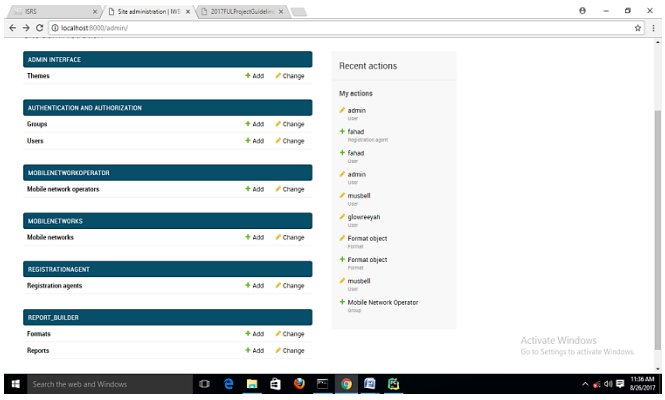

Figure 9. Admin Page

VII. System Performance Evaluation

Testing was carried out on the system to determine its performance and response using a workload. Load testing which is the basic test type was carried out using multiple subscribers with multiple SIMs of different networks. Soak testing was also carried out and the system endured and sustained the continuous expected load. Both dynamic and static tests were also carried out where the system demonstrated the result of running tests. Test values used were five subscribers of each network (MTN, GLO, AIRTEL, and ETISALAT). Basic test parameters used were usability, accessibility and feedback. The test result is shown in table 1.

TABLE I. System Test

	Usability	Accessibility	Feedback
Integrated SIM Registration System	High	Moderate	Good

1. Unit test was carried out throughout the development process of the system to test specific sections of the program code.
2. System test was also carried out to test the requirement satisfaction, where the navigation from login to carrying out different activities to logout after use were are all functioning well and satisfactory.
3. Usability and accessibility test were also carried out and the user interface turned out quite accessible and easy to use or interact with.

For performance evaluation, the current SIM registration system is compared to the Integrated SIM Registration System. The metrics used are response time, throughput and page view load time. Response time gives the time it takes for a user to use the application and complete a transaction. The throughput shows whether a system can or cannot handle an increasing number of concurrent users. And the page view load time is the number of page views and how long it takes them to load as shown in Table 2.

TABLE II. System Performance

Performance Measurement	System Performance Evaluation		
	Response Time	Throughput	Page View Load Time
Current SIM Registration System	Moderate	High	Low
Integrated SIM Registration System	High	High	Moderate

VIII. Conclusion

This research paper is of significant important to the mobile communication unit of the telecommunication industries in improving the SIM registration system and processes. This was achieved through the implementation of the proposed system which has all subscribers of all networks being registered at any registration outlet, agents registered and verified and subscribers verified. A subscriber also can have access to his/her profile (where they can print the registration slip). This integrated information system for SIM registration is a very substantial and valuable piece of software which will be of great and priceless value to the mobile communication industry.

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