WEB-BASED MAP MASHUP APPLICATION FOR PARTICIPATORY WIRELESS NETWORK SIGNAL STRENGTH MAPPING AND CUSTOMER SUPPORT SERVICES

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ABSTRACT

In this paper, a web-based Google map mashup application that will enhance customer support services and addresses the challenges of post-deployment site survey for wireless networks service providers is presented. Incremental Software Development Methodology (ISDM) is used in the development of the software system. The system allows the wireless network clients to use GPS tool and network discovery tool such as NetSurveyor to capture and upload their current location coordinates along with the signal strength of the wireless networks at their current location. Furthermore, the system enables network service providers to use Google map to visualize the location of their network access points, the location of their clients and the signal strength at their clients' locations. The system has provision for clients to interact with the service providers to facilitate prompt response to the clients' challenges. The wireless network service providers can use this information in troubleshooting and in providing or planning for maintenance and support services to their clients. The system was developed using PHP and Java scripting languages, HTML, MYSQL database management system and then hosted locally using apache WAMP server. Sample data are collected from wireless networks and their clients in Owerri municipal in Imo state.

Keywords: Site Survey, Web Application, Map Mashup Application, Incremental Software Development Methodology, Wireless Network, geolocation.

INTRODUCTION

Nowadays, there is growing adoption of numerous kinds of wireless network devices and systems across the globe. With the ubiquitous wireless device usage, people expect glitch-free performance in wireless network service delivery and the ability to maintain constant connectivity while operating or moving within the network coverage area. Accordingly, in order to get the best performance out of wireless networks, network service providers endeavour to ensure that the network Access Points (AP) are in the most optimal locations and that the effect of other radio frequency (RF) sources which can cause interference are kept to a minimum. This is achieved through site surveys of the wireless network. For a small network in a limited area, only manufacturer's information on the coverage range is sufficient to deploy the APs. For a larger network, a more accurate pr-deployment site survey is required to ensure sufficient coverage and network functionality.

Basically, a site survey helps define the contours of wireless network coverage in a particular facility. It helps to discover regions where mulitpath distortion can occur, areas where RF interference is high and find solutions to eliminate such issues. A site survey that determines the RF coverage area in a facility also enables the network service providers to choose the number of wireless devices that a network needs to meet the required quality of service to the clients.

In any case, after the deployment of wireless networks, there is need for periodic site survey. Such post-deployment site survey is necessary because no environment is perfect or static and even the best wireless network pre-deployment plans require post-deployment adjustments and validations. Notably, post-deployment site survey can account for changes in the wireless network environment which may significantly affect the network coverage or the quality of service in some areas within the previously established network coverage area. Such periodic post-deployment site survey is rarely done given that it can be quite expensive and time consuming for the Network Service Provider (NSP). Alternatively, this problem can be solved by the use of participatory platform that enables the wireless network users to periodically provide the network performance data at their locations to the network service providers. Accordingly, this paper presents a participatory platform that can enable the network users to capture and report on the performance of the wireless network at the user's current location.

Further to the user volunteered network performance parameters module, the system incorporates other customer support functionalities that will leverage the customer participation to improve on the service delivery to the customers. Presently, the participatory platform enables users to use network survey tool (such as NetSurveyor) to collect and display information concerning the wireless access points it detects, enabling users to verify the network configuration and the signal strength at the client's location [1]. Among other parameters, Netsuveyor can capture the signal strength, Service Set Identifier (SSID) and network access point identification number for each wireless network it detects, along with the channel used by the Access Point (AP) servicing that network. On the other hand, the wireless network user (or client) can use the GPS device, or the GPS facility on mobile phone or the online geolocation service to capture the coordinates of the client's current location. The software presented in this paper is web-based map mashup application that will enable the network clients to upload the network information at the clients' locations to the service providers. Furthermore, the system enables the network service providers to visualise the network's signal strength distribution on a Google map. The system also enables the service providers to see other wireless networks which can cause interference at the client's location. The log of such user-generated network data can be used to determine the time, the duration and the rate of occurrence of certain network problems. In all, such system is very useful for wireless network maintenance and user support.

The system is developed using PHP as the server-side scripting language, Java script as the client-side scripting language, HTML, MYSQL database management system and then hosted locally using apache WAMP server. Sample data are collected from wireless networks and their clients in Owerri municipal in Imo state. NetSurveyor software was used for capturing the wireless network signal strength. Also, geolocation facility was enabled in the client's laptop used for the site survey; hence, the geolocation service provided the coordinates of the current location of the client's laptop.

REVIEW OF RELEVANT LITERATURE

Wireless Networks and WIFI Site Surveys

A wireless network is a network that uses radio waves rather than wires to communicate between nodes. There are two main types of wireless networking; peer-to-peer or ad-hoc and infrastructure wireless network. An ad-hoc or peer-to-peer wireless network consists of a number of computers each equipped with a wireless networking interface card. Each computer can communicate directly with all of the other wireless enabled computers. They

can share files and printers this way, but may not be able to access wired LAN resources, unless one of the computers acts as a bridge to the wired LAN using special software. An infrastructure wireless network consists of an access point or a base station. In this type of network, the access point acts like a hub, providing connectivity for the wireless computers. It can connect or bridge the Wireless Local Area Network (WLAN) to a wired LAN, allowing wireless computer access to LAN resources, such as file servers or existing internet connectivity [2].

Essentially, wireless local-area networks which are also referred to as WLANs or Wi-Fi is a flexible data communication system that can be implemented as an extension or as an alternative to a wired LAN [3, 4]. Wireless networks are reliable, but when interfered with, its coverage range can be considerably reduced and significant fluctuation in the RSS (Received Signal Strength) can also be experienced. In practice Wi-Fi site survey is usually conducted so as to design networks that can operate optimally within its coverage range. Wi-Fi site survey is a method to survey Wi-Fi signal strength route by route within its coverage area [5, 6]. It also involves measuring network performance at various locations and finding coverage and performance issues. Among others, NetSurveyor is an free WiFi scanners or 802.11 network discovery tool that can be used, during WiFi site survey, to gather information about nearby wireless access points in real time and displays it in useful ways [1]. *NetSurveyor* reports the Service Set Identifier (SSID) for each wireless network it detects, along with the channel used by the access point (AP) servicing that network.

NetSurveyor has been used in many WiFi studies and site surveys. [7] used NetSurveyor to collect WiFi signal strength (IEEE 802.11g) as a reference for location estimation. The recording of the signal strength was done manually using paper records and Microsoft Excel [7, 8]. [5] used NetSurveyor software in conducting a measurement-based Log-distance propagation model for effective planning of outdoor WLAN in the 2.4 GHz Band [5].

Customer Support for Wireless Networks

Basically, customer support is a range of customer services to assist customers in making cost effective and correct use of a product. It includes assistance in planning, installation, training, trouble shooting, maintenance, upgrading, and disposal of a product [9]. Excellent customer service means acknowledging a customer's question in a timely manner. When customers have problems with their products, excellent customer service means solving these issues and problems promptly, or at least executing a reasonable plan of action. Most common ways of giving customer support is through a phone, e-mail, consultancy, tool or a web service. Nowadays, web-based customer support service is very popular as it can be used at all times and it’s available everywhere.

Particularly, for wireless network service providers, there is need for an improved customer support system that will allow each client to capture and upload network performance parameter that can be used by the service provider to provide prompt remote troubleshooting of the network and better quality of services to their clients. This requires the integration of wireless network monitoring and site surveying tools with the conventional online customer support system. In addition, in order to facility map-based visualisation of network coverage and location of the network clients map mashup application is required to interface with the online customer support system. Presently, such integrated services customer support system for wireless networks is rare. As such, in this paper, the issues concerning the development of such system are raised and some of the basic functionalities of such system are implemented.

METHODOLOGY

Modified Waterfall Model (MWfM) of Figure 1 is used in the development of the web-based map mashup and customer support application. The MWfM methodology incorporates literature review and preliminary requirement engineering that are essential for identifying the possible functionalities that will be built into the software and to decompose the software into various functional units. After the functional decomposition, an iterative section that comprises of detailed requirement engineering, design, coding and testing is used to develop the software one modele at a time until all the identified functional units are developed, tested and integrated into the overall software.

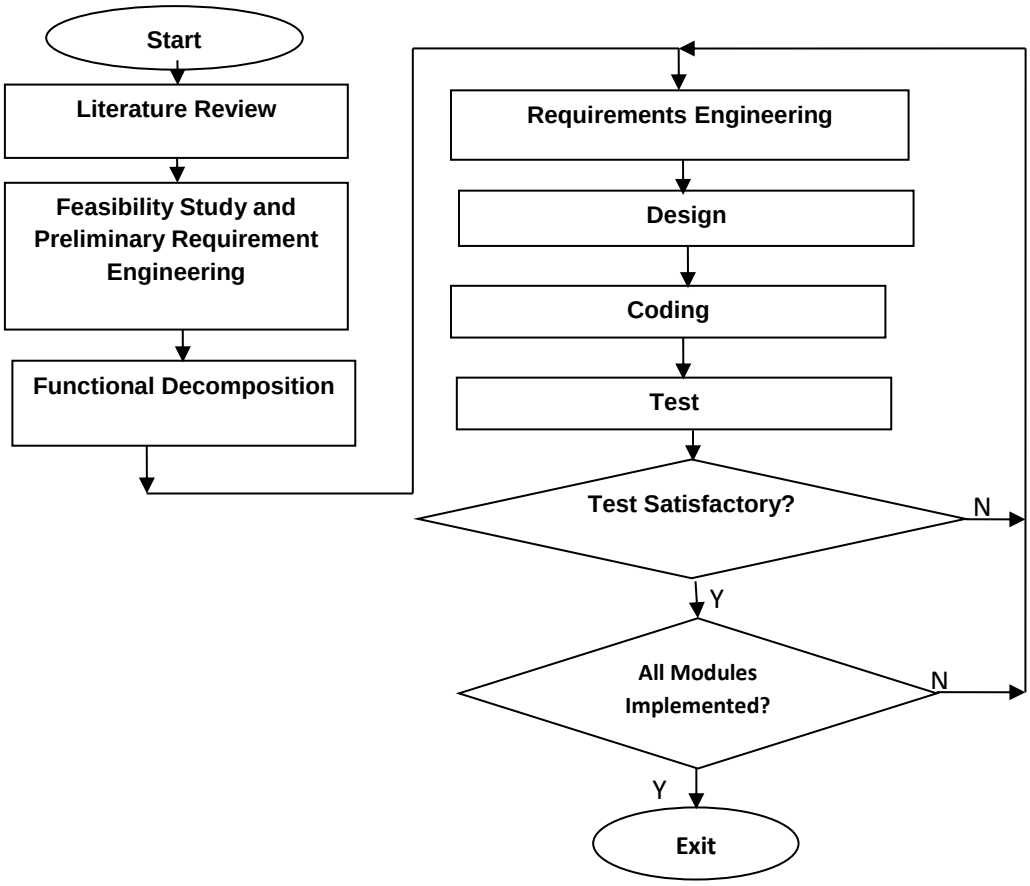

Figure 1: A Modified Waterfall Model.

During the detailed requirement engineering stage, Figure 2, brainstorming, interviews, ethnographic survey, focus group discussion and low fidelity prototyping, were used to gather the necessary user and system requirements. The requirements are then analyzed and triangulated to ensure that the requirement specifications are consistent with the user's needs and system specifications. The design of the system is based on the three-tier architectural design philosophy.

As part of the system administration policy, (in figure 3), every new user must register and every registered user must login before permission will be given to the user to access the system. The user's access capabilities are determined by 'user privileges' that are set by the system administrator.

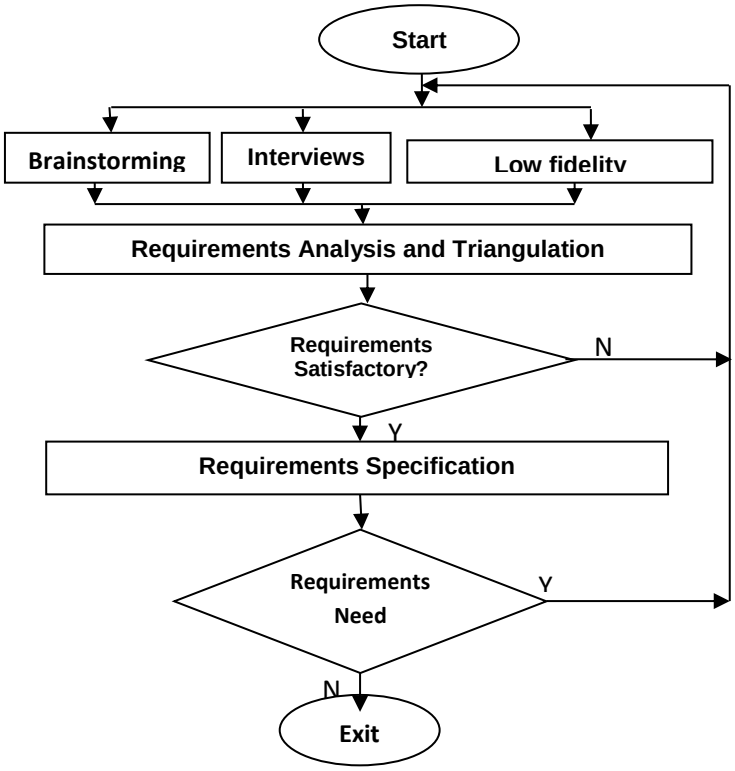

Figure 2: Flow Chart for the Detailed Requirements Engineering.

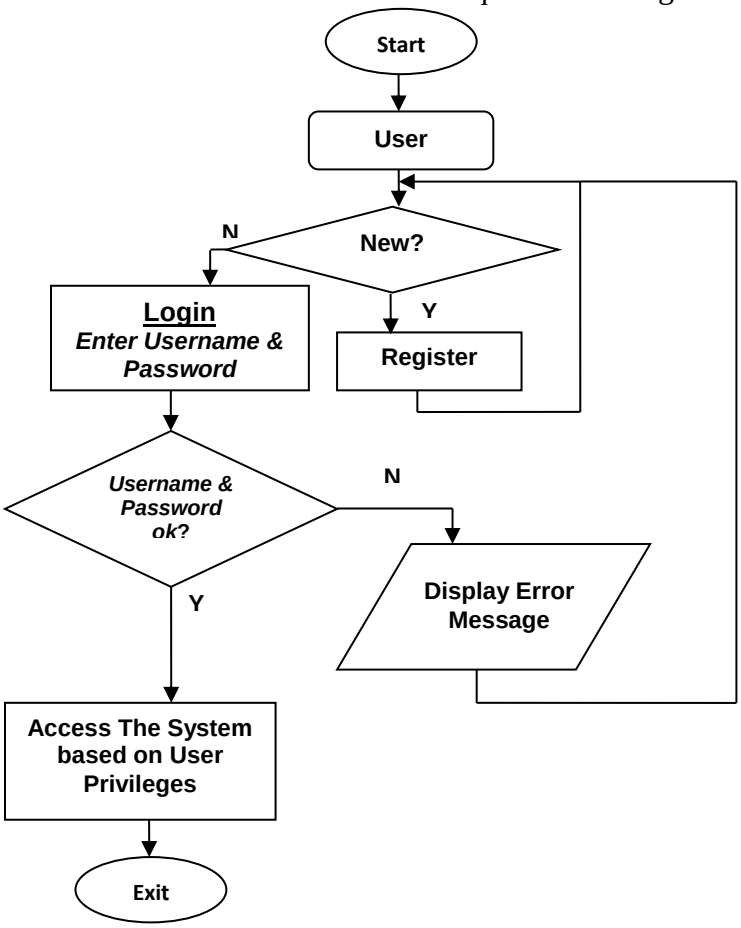

Figure 3: Flowchart For The System Policy On User Login and Access.

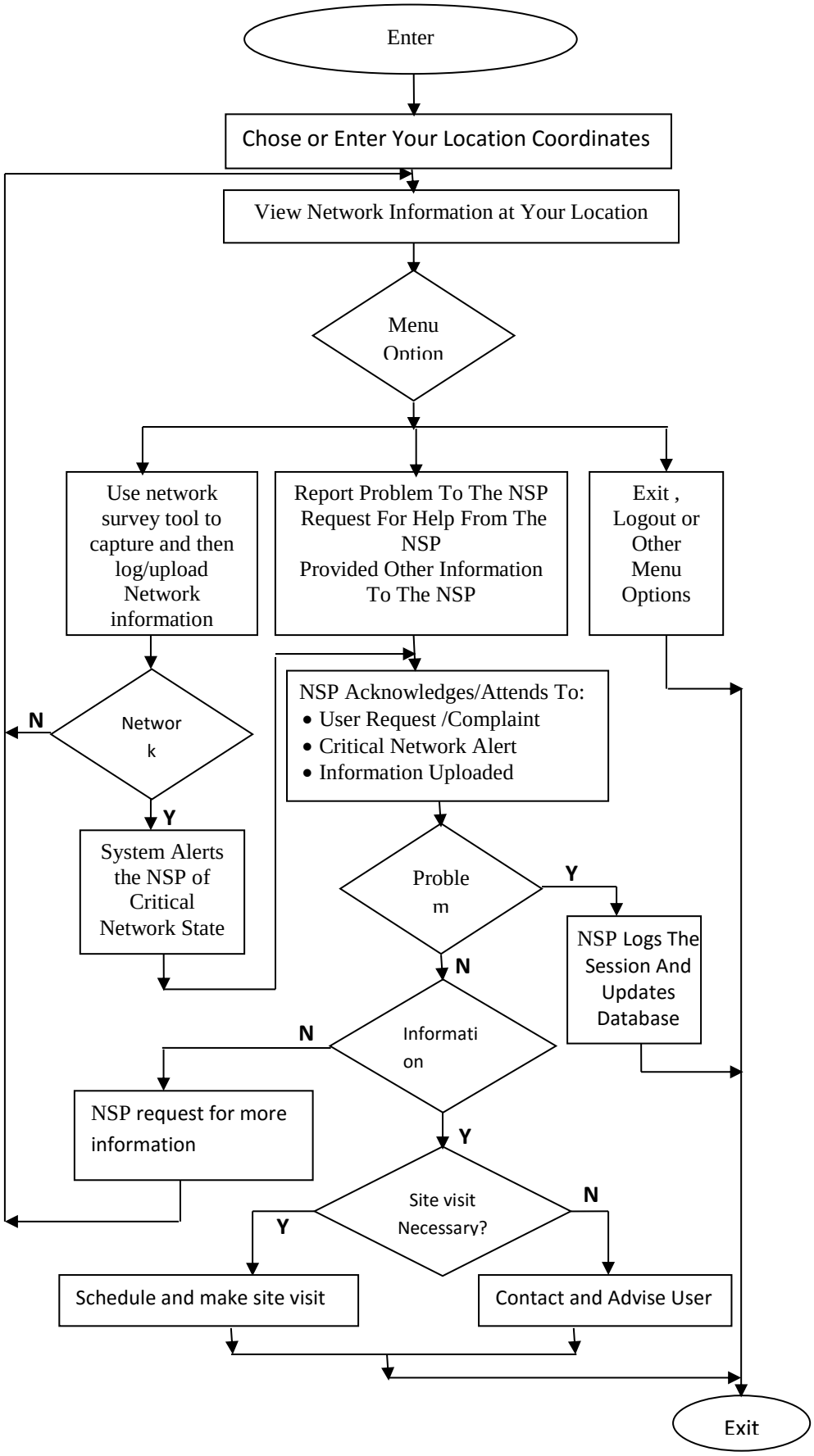

Figure 4: Policy For Client Volunteered Information And Client Support.

Figure 4 shows the flowchart for the policy on client volunteered information and client support. The policy is used to manage how the system capture, store, and respond to client volunteered information, requests and complaints. Some tools are needed at the clients end for data collection, as shown in Fig 5. Specifically, network performance data need to be captured with WiFi Scanners or Network Discovery software. Consequently, the clients will have the free NetSurveyor software installed in their system. They can also download the NetSurveyor from the download link provided in the system. Mobile users need to update their location coordinates each time their location changes whereas fixed point clients do not need such updates. In this regard, the clients can use any GPS tool or web-based geolocation service can be enabled in their system to allow them to capture the coordinates of their current location.

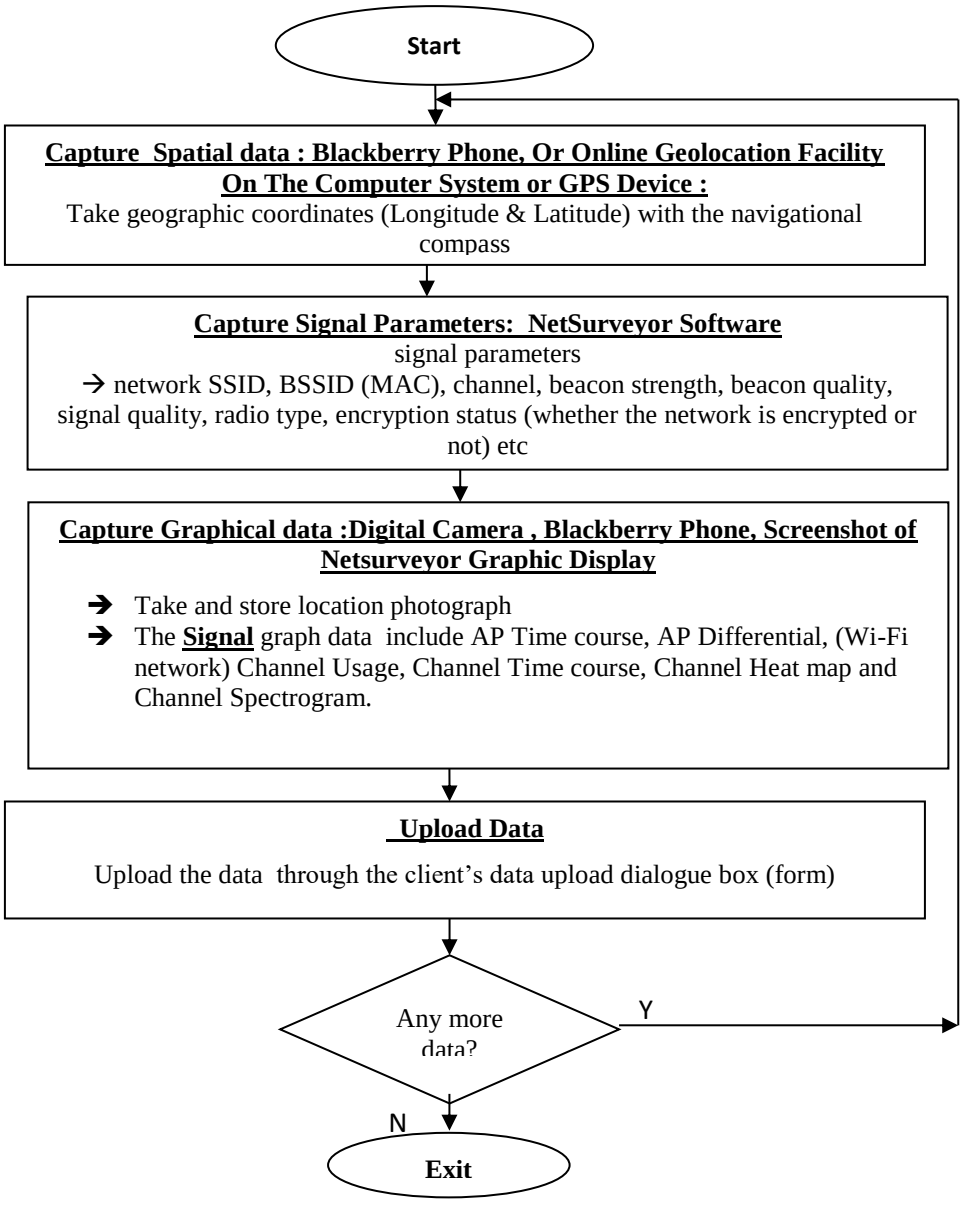

Fig 5: Data Collection Process for the System.

RESULTS AND DISCUSSION

The system is locally hosted in a laptop with internet access. Sample data are collected for a number of locations and wireless networks in Owerri municipal in Imo state, Nigeria.

Screenshots of the results and some notable services or functionalities afforded by the system are presented in this section. Figure 6 is the registration page and form for new users. Figure 7 shows the Login page for registered users.

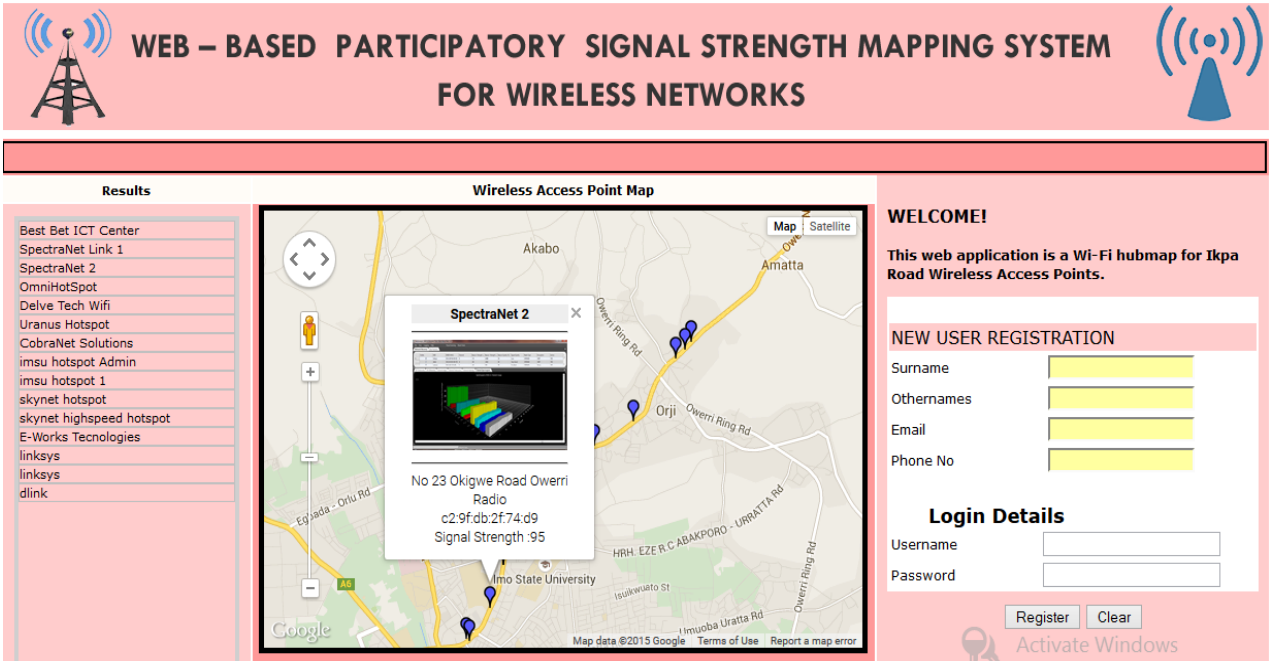

Figure 6: Screenshot of the Registration Page and Form for new users.

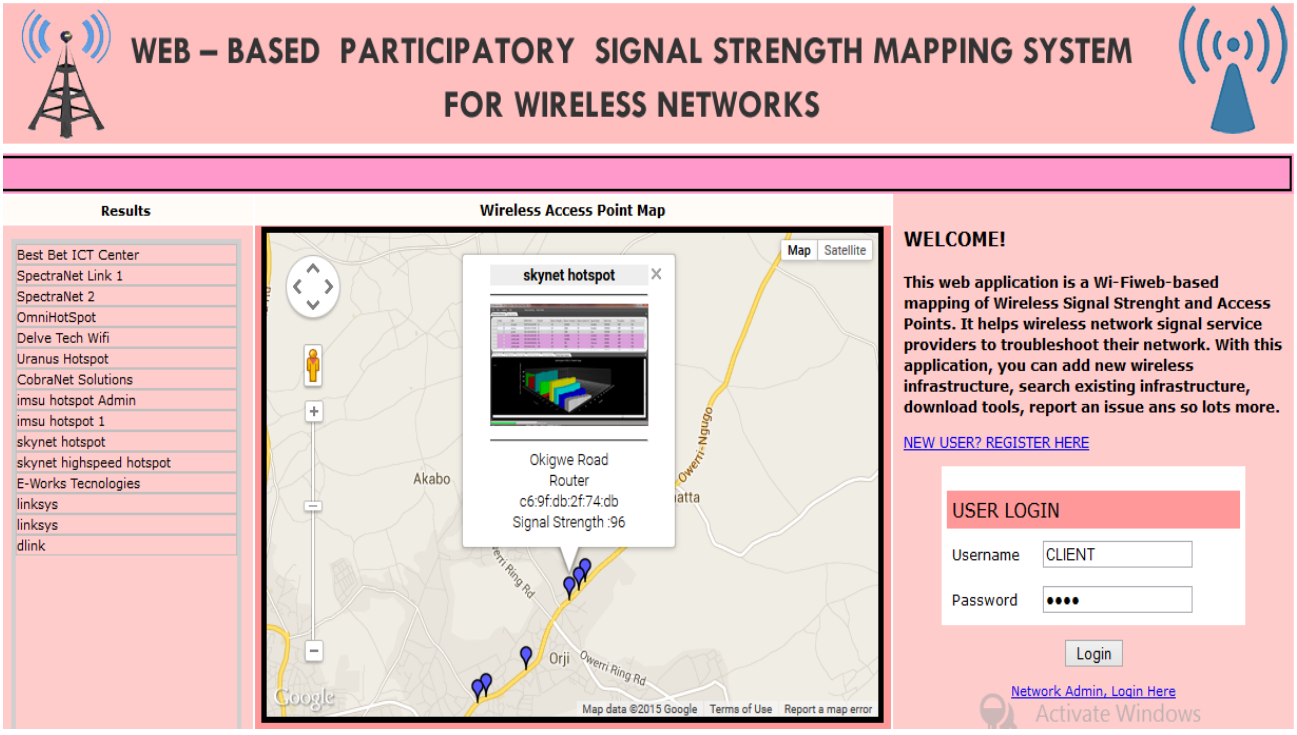

Figure 7: Screenshot of Login Page and Form for Registration Users.

On successful login, clients will have access to the Clients' Homepage shown in Figure 8. The client can use the ADD NEW WIRELESS INFRASTRUCTURE link to access the page or form for uploading client-generated data/information as shown in Figure 9.

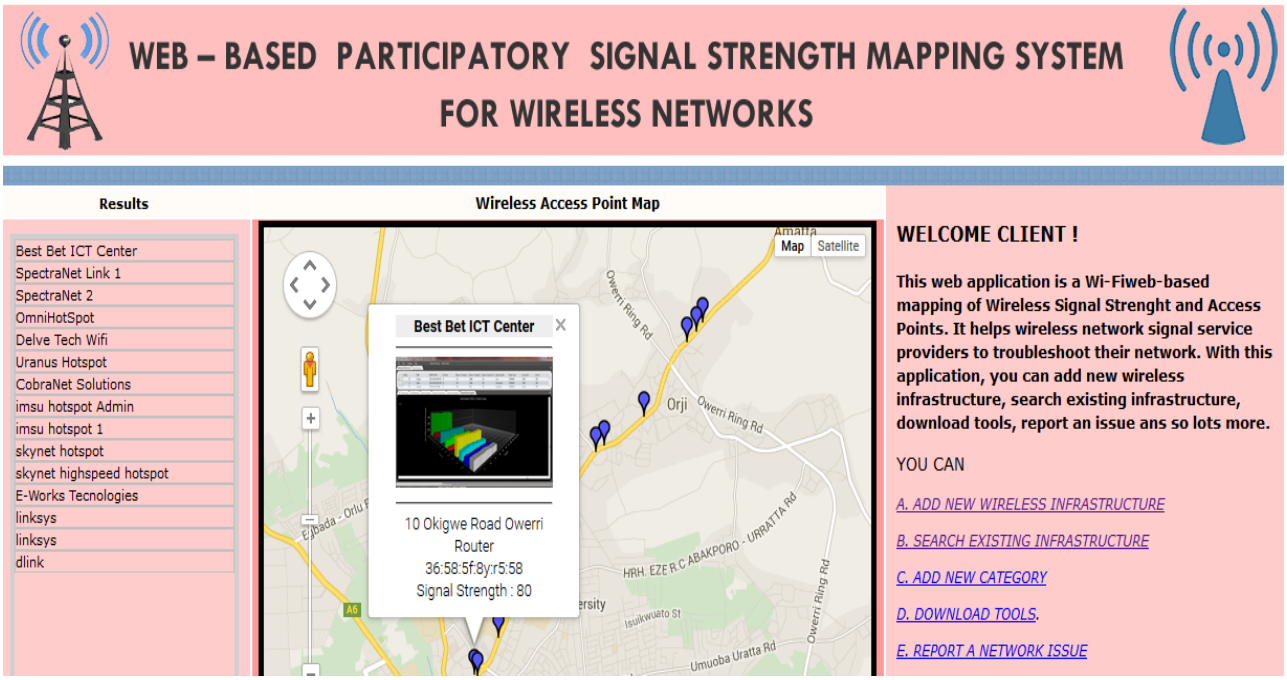

Figure 8: Screenshot for Client's Home Page

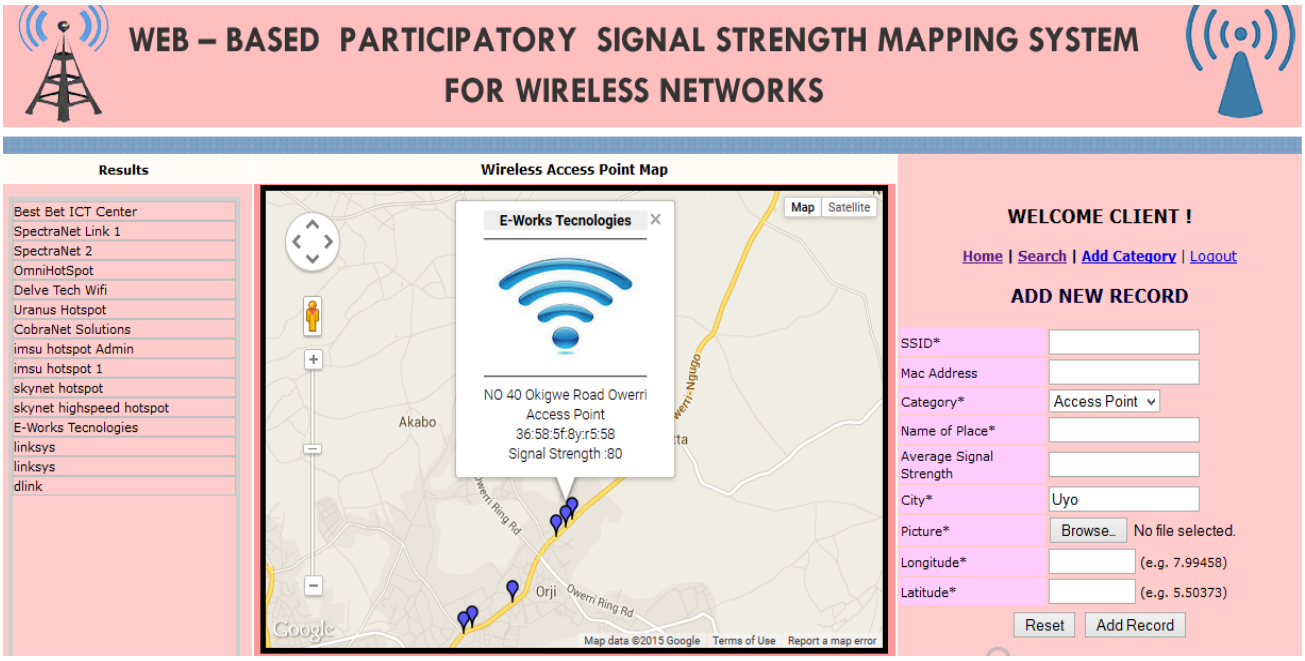

Figure 9: Screenshot for Uploading Client-Generated Network and Client's Location Data

The ADD NEW WIRELESS INFRASTRUCTURE link enables the client to upload network parameter, signal strength values, pictures, screenshots of graphic displays from the NetSurveyor software and other information about various WiFi networks the client detected on his/her system. In addition, the client can send additional information such as complaints, requests, comments, etc to the network service provider by clicking on the REPORT A NETWORK ISSUE link which will open the form in Figure 10. As shown in Figure 11, the system administrator, (possibly, the network service provider) can view the list of all the client-generated information (complaints / requests /comments) . By clicking on "View" link beside any of the client's generated information in Figure 11 the detailed of that particular client's generated information will be displayed, as shown in Figure 12.

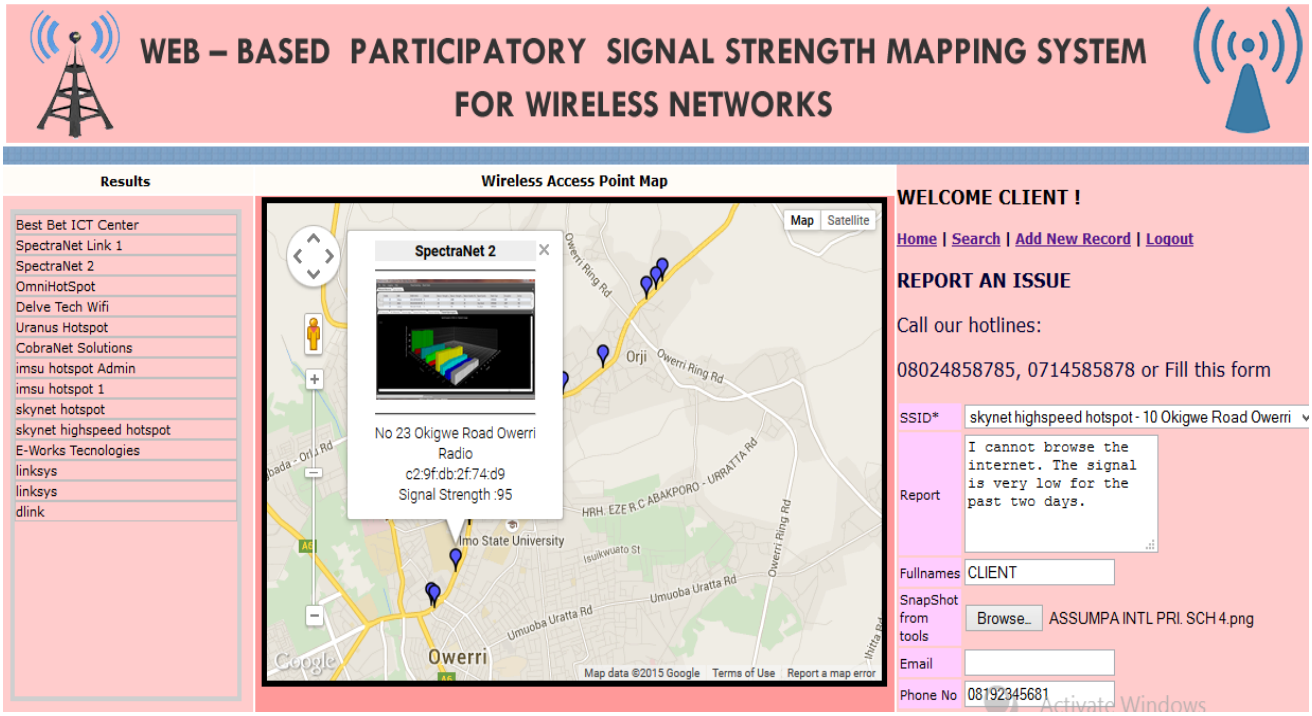

Figure 10: Screenshot for Client-Generated Information (Complaints / Requests /Comments)

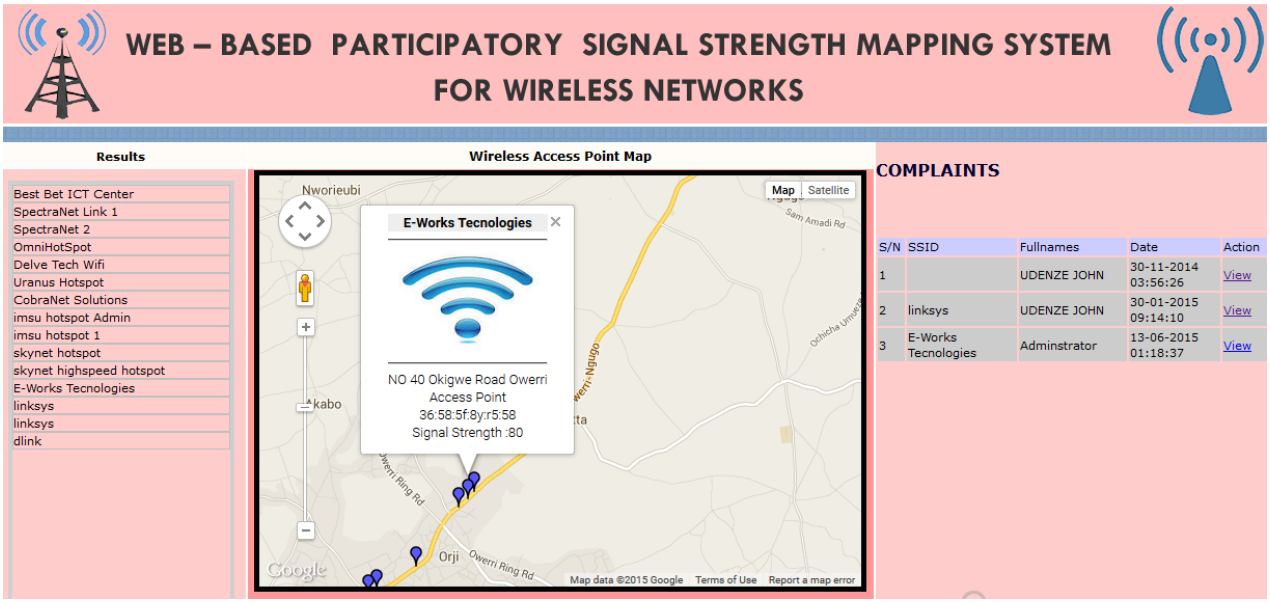

Figure 11: Screenshot for Admin Page: List Of Client-Generated Information (Complaints / Requests /Comments)

Figure 13 is the screenshot for Search Module. The user can search for specific network service provider, access point or other network device identified by the NetSurveyor software or uploaded by the clients or by the system administrator. Figure 14 shows the screenshot for Search Module based on signal strength. The user can search for records based on a lower and upper signal strength values.

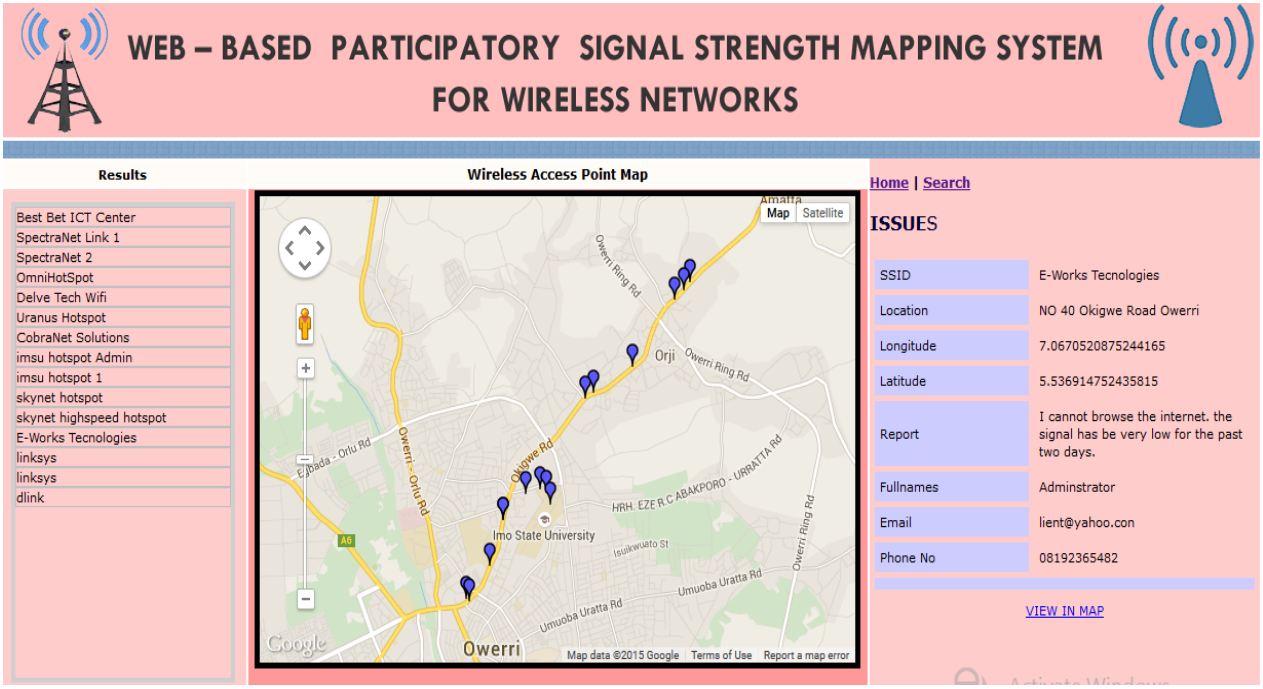

Figure 12: Screenshot for Admin Page : Detail Of One Client-Generated Information (Complaint / Request /Comment)

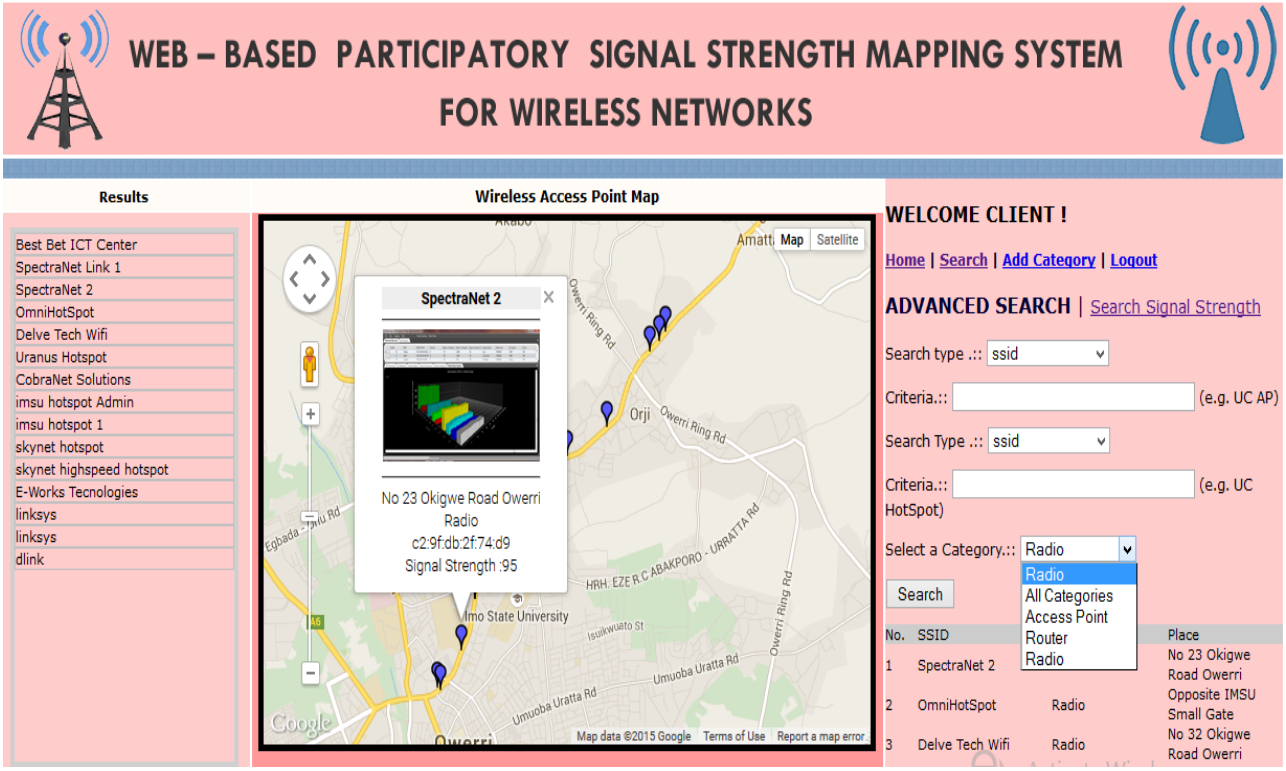

Figure 13: Screenshot for Search Module: Search Network Service Provider or Network Device

Figure 15 shows the link for downloading the Netsurveyor software and other software tools the system intends to provide to the users. In Figure 16, shows the list Network Service Providers (NSP) that are registered on the system. In all, the system architecture is such that the software can serve large number of wireless network service providers and their clients. Each NPS has its admin login and the clients also have their client login privileges. The functionalities accessible to each user depend on the user category and associated privileges.

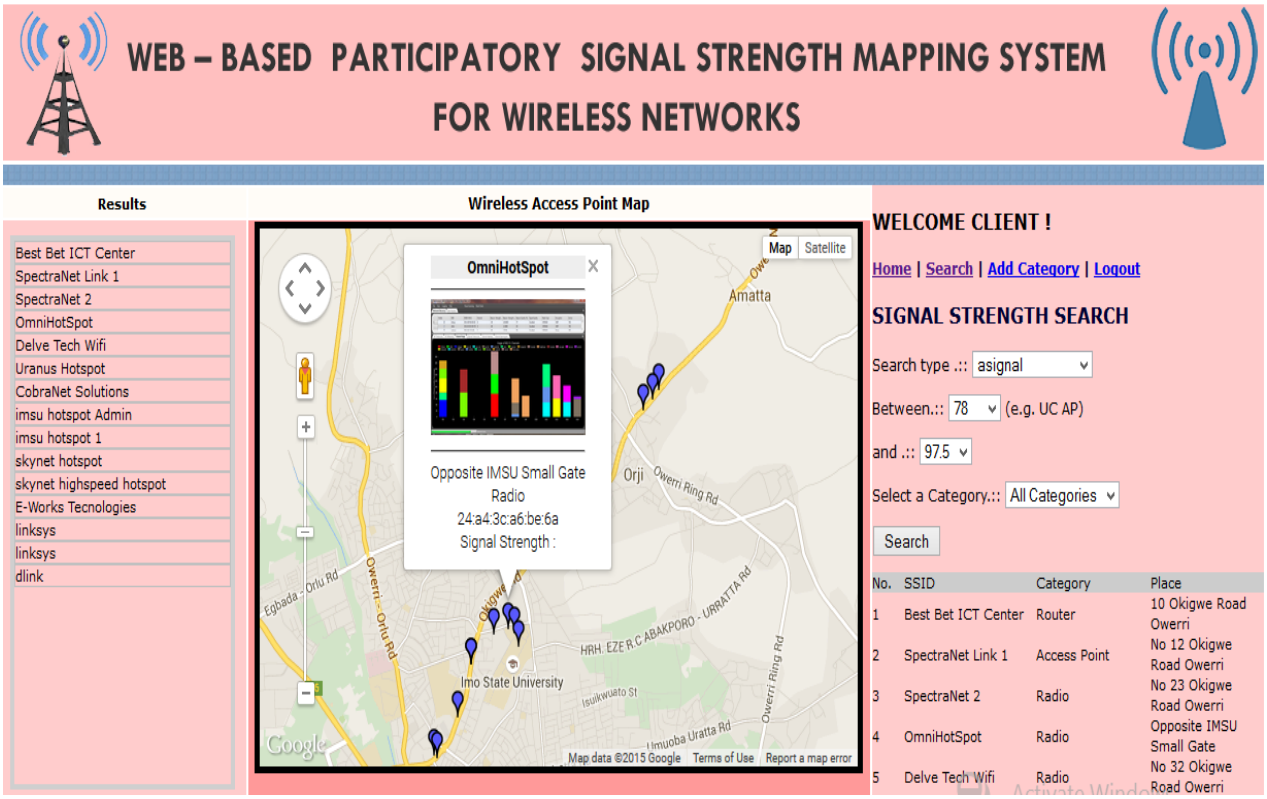

Figure 14: Screenshot for Search Module: Search Based On Signal Strength

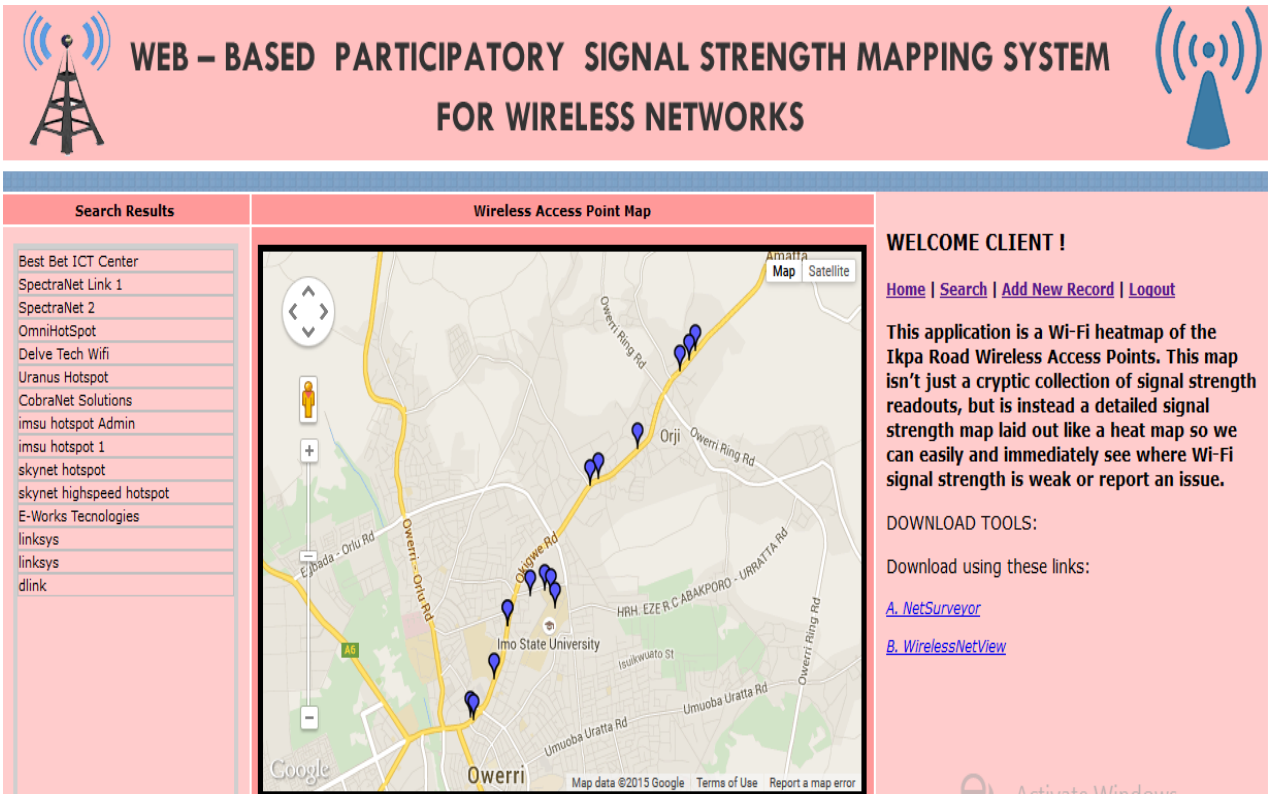

Figure 15: Screenshot for Download Network Site Survey Tools

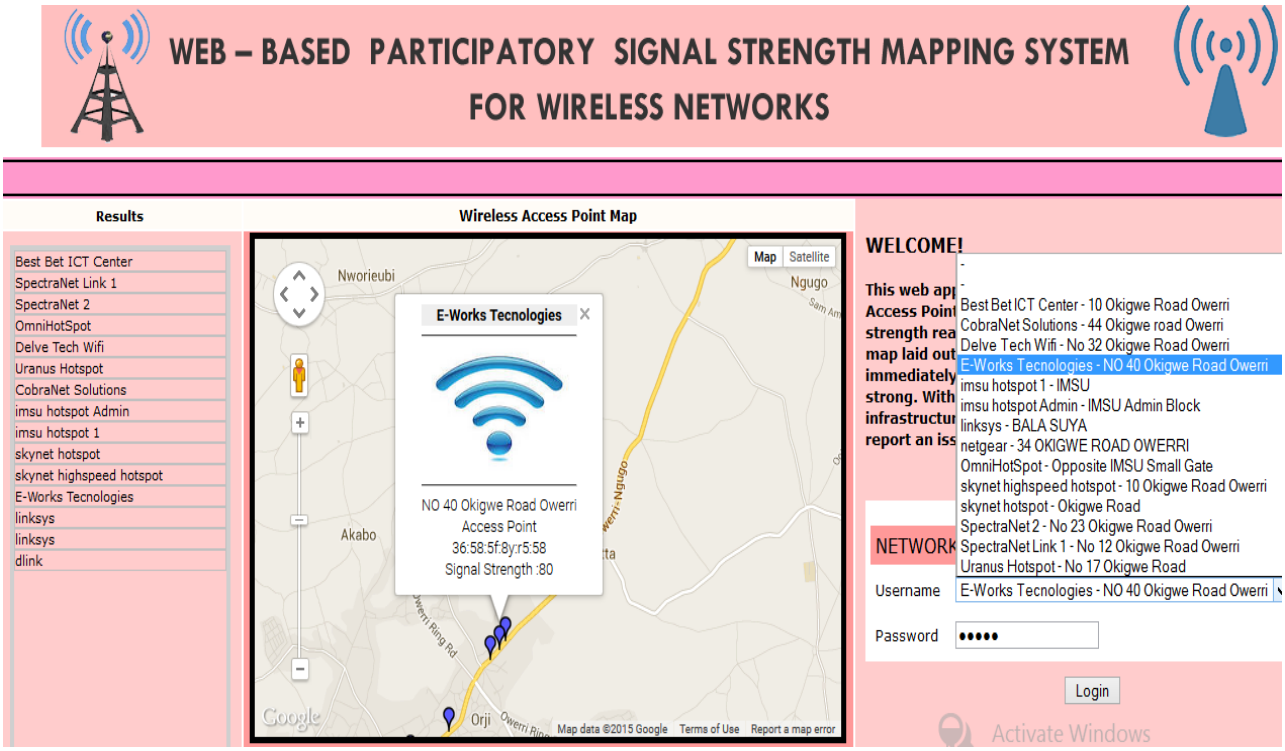

Figure 16: Screenshot Showing Admin Login For Network Service Providers

CONCLUSION

In this paper, a web-based Google map mashup and client support application is developed for wireless network service providers to capture, store and manage their clients' generated information and complaints. Based on the contents supplied by their clients, system makes it possible to visualize on a Google map the clients' locations, the network signal strength at client's locations, client's network challenges and the network coverage. Furthermore, as a client support system, it can facilitate prompt and timely troubleshooting of several network issues by the wireless network service providers. The system was developed using PHP and Java scripting languages, HTML, MYSQL database management system and then hosted locally using apache WAMP server. Sample data are collected from wireless networks and their clients in Owerri municipal in Imo state.

RECOMMENDATION

The present application is a web-based version. Further work is needed to incorporate a mobile application version. Also, the mapping system is based on the two dimensional Google map. Further work is required to develop the three dimensional Google earth version that will enable the mapping system to distinguish location on different floor of a multi-storey buildings. Above all, the system requires the client to read and upload the signal strength and other network parameters manually. Further work is needed to automatically capture such information.

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