MAP MASHUP APPLICATION AND FACILITATED VOLUNTEERED WEB-BASED INFORMATION SYSTEM FOR BUSINESS DIRECTORY IN AKWA IBOM STATE

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ABSTRACT

The paper presents a third party Google Maps mashup application and a web-based volunteered information system that are interfaced and used to capture, process and map user-generated spatial and non-spatial business directory information in Akwa-Ibom state. Also, point precision geocoding tools are provided by the system to enable users to generate point precision spatial data about their business establishments. The user-generated information in the system is moderated by a facilitator. The system enables the host or facilitator organisation to use software as service architecture to render the web-based business directory listing and mapping services for the users. In this wise, users must register on the system before they can upload their user generated contents into the system. The system facilitator moderates the contents uploaded and provides necessary feedbacks to the registered users either on request or as the system administration policies demand. The system is expected to bring innovative solution to the paper-based offline business directory that is currently used in Akwa Ibom state. It will also enhance global web presence and accessibility for the teeming business entities in Akwa Ibom state.

Keywords: Business Directory, Facilitated Information System, Volunteered Information System, Geographic Information system, GPS, Geocoding, Point Precision Geocoding, Map Mashup.

INTRODUCTION

According to ESRI, (1996), Geographic Information Systems (GIS) is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display many forms of geographically referenced information, Sreekanth, et al., (2013); Yun, (2011); Session, (2007); Ma and Bartholic, (2003); Nathanail and Symonds, (2001); Isaak and Hubert, (1997); Foote and Lynch, (1996). The technological advancement and development of web based-GIS and the availability of geospatial applications on the Internet has fuelled the integration of online maps on web information systems for several applications and uses. Some of these applications include resource management, resource configuration, urban planning and management, environmental management, geosciences, crime management, business management, etc. This paper presents a map mashup application and facilitated volunteered web-based information system for business directory in Akwa Ibom State. This system is an Enterprise Information System (EIS) developed for capturing compiling, storing, using, and distributing spatial and non-spatial business information so as to enhance global visibility and accessibility of business entities, Serova, (2010); ESRI, (2006).

The system uses Google Map mashup and web-based database system to capture process and map user-generated spatial and non-spatial information about business establishments in Akwa Ibom state, Qian and Xianglong, (2010); Miller, (2006). A mashup is a web application that uses content from more than one source to create a single new service displayed in a single graphical interface. For example, one can combine the addresses and photographs of a business premises with a Google map to create a map mashup, Cruz-Cunha and Varajao, (2011); Bidgoli, (2010); Jennex, (2010). Specifically, in this Google Map mashup, an online business directory form is provided to enable users to supply the required spatial and non-spatial information about their business establishments. The information is stored in the online database. A facilitator after moderating the information makes it visible and accessible to the users of the system. Importantly, precision geocoding tools are provided by the system to enable users who do not have GPS-enabled mobile phones and devices to provide point precision spatial data about their business establishments. The geospatial information and other relevant business information are provided by the interested businesses organisation during business information upload. As such, higher precision and accurate Geotags are achieved.

The system used a three tier architecture for the online web applications. It also used software as service architecture whereby the users do not need to have a copy of the software but rather, the users register on the online applications, after which they can upload their business information, modify the contents and request for updates from the system moderator. In addition, the user generated contents are hosted online by the system and can be accessed by the user based on their user privileges.

LITERATURE REVIEW
Web Application and Online Business Directory

Generally, web applications are defined as software, which can be accessed via a web browser over a network such as Internet or an Intranet, Elsayed Ali, Ahmed and Abdullah, (2012). In addition, Web-based applications is any software application that depends on the Web system (Web server, network, HTTP, browser) for its correct execution and uses a website as its interface, Turan, (2009).Technically, Web applications query the content server and dynamically generate web documents to serve to the client/people surfing the website, Cheah, (2012); Patel, (2012). The documents are generated in a standard format to allow support by all browsers (e.g., HTML or XHTML). The web browser is key - it interprets and runs all scripts etc. while displaying the requested pages and content, Cheah, (2012); Patel, (2012).

A business directory is a list of businesses categorized based on location, activity, size or type of business. The details provided in a business directory vary from business to business. They may include the business name, addresses, telephone numbers, location, type of service or products the business provides, number of employees, the service region and any professional associations. Some directories include a section for user reviews, comments, and feedbacks. A web-based automation of business directory is known as online business directory. Online business directory enable users to search for a particular business using keywords, Monberg, Mariani and Staab, (2003).

Web Based Spatial Information Delivery System and Volunteered Geographic Information (vgi) System

Spatial information can be delivered on the web using any of these two methods - Web Mapping Services (WMS) and Web Feature Services (WFS). According to Graham (2008), "WMS is a method that allows visual display of spatial data without necessarily providing access to the features that comprise those data." Web Man Service, (2009) opined that " WMS is a standard protocol for serving georeferenced map images over the Internet that are generated by a map server using data from a GIS database." The underlying data can be queried, but no manipulation of the data can be done Graham, (2008).The requirements for displaying WMS output are low and the client may or may not be web based, Beaujardiere, (2004). The WFS provides an interface allowing request for geographical data across the web using platform independent calls. WFS serve actual data to the client application, usually in a format such as geography markup language (GML), Vretanos, (2005). GML is an Open Geospatial Consortium (OGC) standardised extensible markup language (XML) based data storage and transfer format that can be read by many different types of software, Portele, (2007). Provided the GML is consumed by a richly featured application, it can be queried, edited and visualised by the user Graham, (2008).

Volunteered Geographic Information (VGI) is spatial data that has been contributed for free by volunteers Haklay, (2010); Coleman, Georgiadou and Labonte, (2009). Goodchild, (2007) and Sui, (2008) have defined 'volunteered geographic information (VGI)' as digital spatial data that are produced not by individuals and institutions formally charged as data producers, but rather, are created by citizens who use the tools available to them to gather and disseminate their observations and geographic knowledge Elwood, (2008).

Google Map Mashups Application

Google maps is a free web mapping service application and technology provided by Google to allow users pan, zoom, and drag without the page being reloaded. Google maps powers many map-based services, such as the Google Maps website, Google Ride Finder, Google Transit. Also, it is possible to integrate Google maps with third party websites for specific service by the aid of Google Application Programming Interface (API), Jin-Tsong, (2008). The API is an online libraries and functions used in creating map mashups. In this wise, map mashup application is any application that obtains data from different sources and integrates that data and outputs they on a common output like the Google map, Cruz-Cunhaand Varajao, (2011); Bidgoli, (2010); Jennex, (2010). For instance, a business directory map mashups application can work as follows; user generated business directory information (address , coordinates, etc) are obtained from a third party business directory website and these data are presented on a Google map with the help of other information obtained from Google map server. The Google Maps API is a free beta service for web applications that are free to consumer, GTS, (2009); Jin-Tsong, (2008); Bildirici, (2010).

Challenges of The Existing Online Business Directory System For Akwa Ibom State

Although there are some forms of online business directory system in existence, the most popular is the business location mapping system provided by Google through its 'Map My Business' service. The service enables the business owners to upload their business names, contact information and location coordinates onto Google map and the information will be mapped after some weeks after the information has been moderated by Google map service

facilitators. The drawbacks of the system include long time it takes before the user generated information is uploaded. Secondly, the data is hosted by Google and hence, the user or third party service provider will have no control on the data. It also takes much time to update such information. The mapping system also uses street- or city-wide precision. In that case, different locations on the same streets or city may be collapsed onto one or few coordinates. When third party map service providers want to provide business directory mapping as service, they will need a system that will enable them to host and manage the user generated contents and will merely use the Google map as the base map for visualising the contents. Equally, the system should provide point precision mapping tools and other user friendly user interfaces that are not available on Google map.

Specifically, for Akwa Ibom state business directory mapping system, there is need for a system that will enable the government agency of an accredited agent of the government to collate, host and moderate the business directory information for the business entities in Akwa Ibom state. It is also required that such facility must provide additional services and functionalities such as map-based visualisation of content, point precision geocoding tools, batch geocoding tools, map-based direction searching tool , among others. Such facility is not yet available in the state.

METHODOLOGY

Incremental Software Development Life Cycle (ISDLC) of Figure 1was adopted in the development of the map mashup application and facilitated volunteered web-based information system. The methodology starts with the preliminary software requirement engineering through which the major modules of the system were identified and then decomposed into their lower level sub-modules. Subsequently, an iterative approach was used to iteratively design, code, test and integrate the individual module and their sub-modules until the complete software system is obtained. The activities that are involved in the ISDLC method include the following:

1) Preliminary Software requirement engineering
2) Functional decomposition of the system through stepwise refinement approach
3) Planning (selection of the module or sub-module for the current iteration)
4) Detail requirement elicitation, requirement analysis and specification for the current module or sub-module.
5) Design of the current module (or sub-module)
6) System implementation and unit testing
7) Integration and integration testing
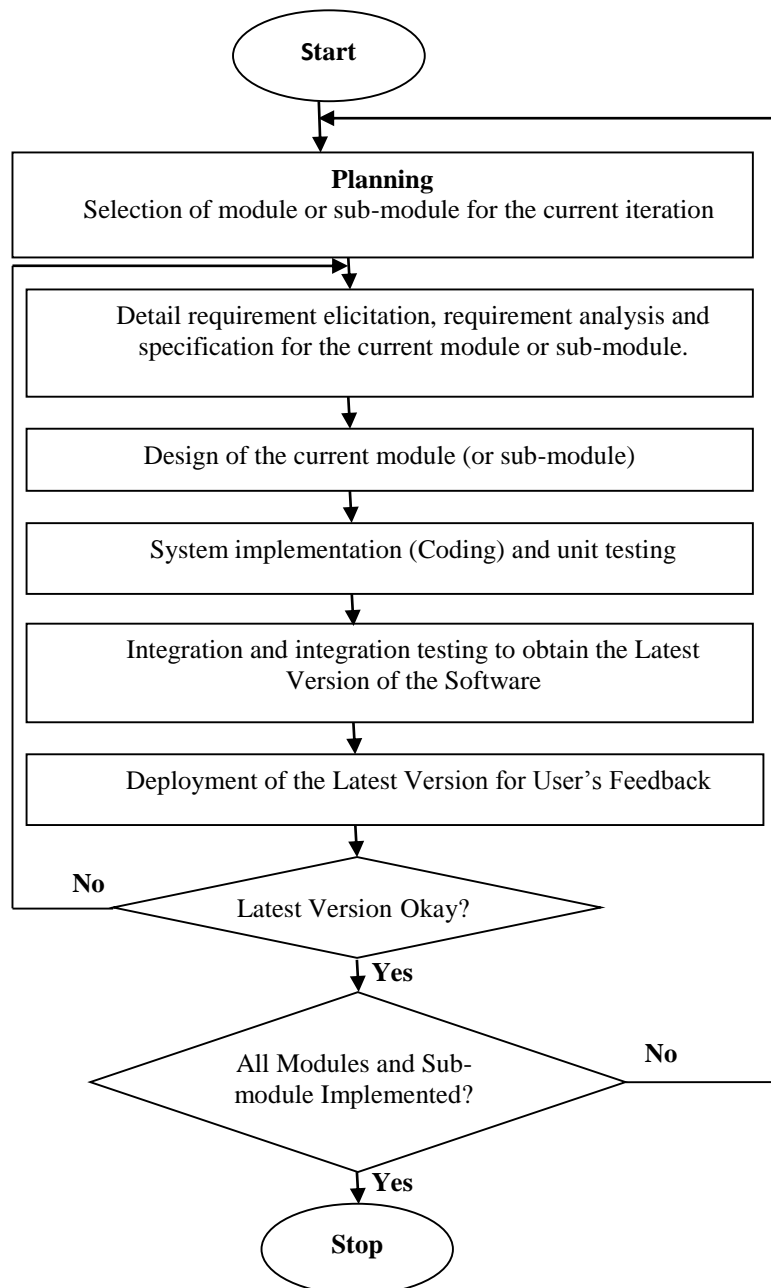8) Repeat step 3 to 7 until all the modules and their sub-modules are implemented, integrated and tested.
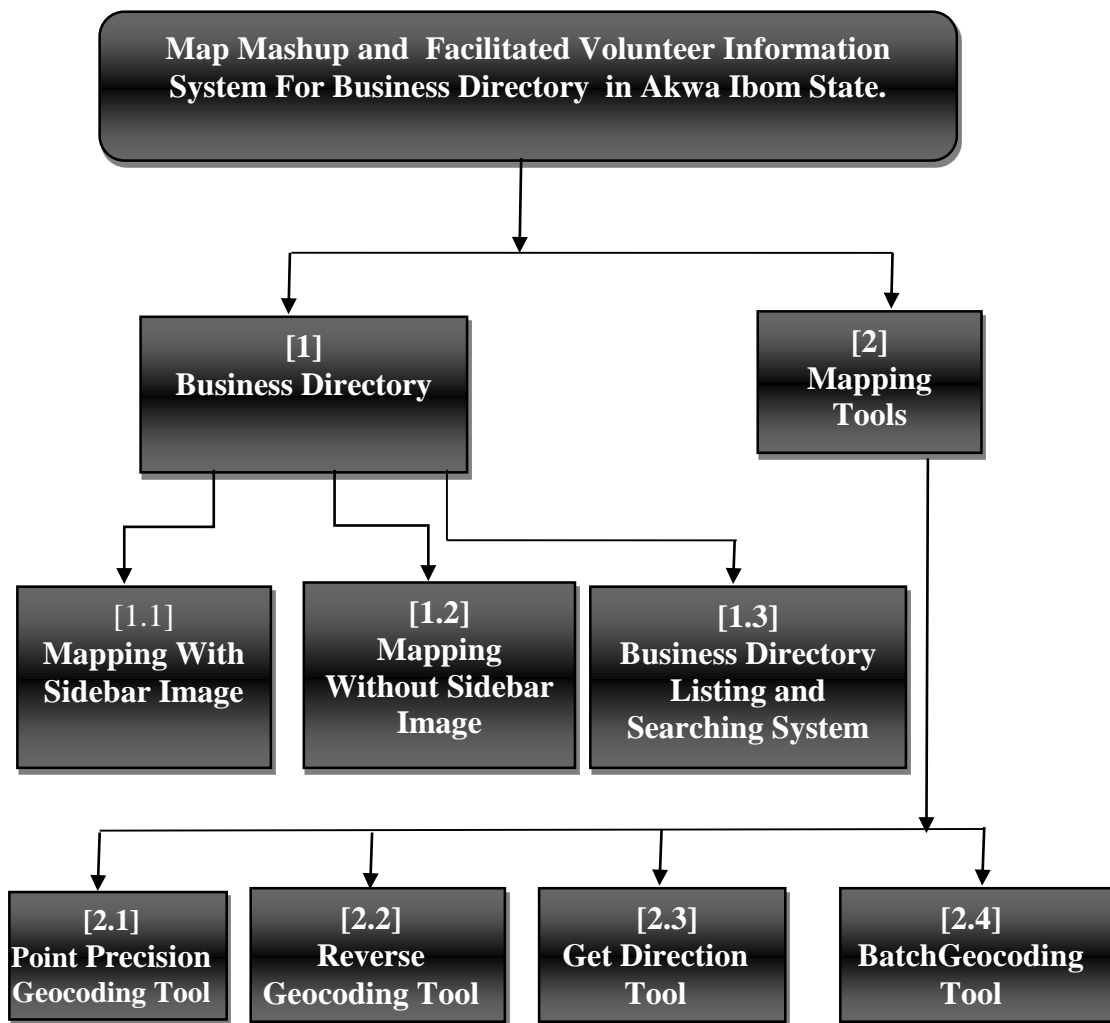
Figure 1, Incremental Software Development Life Cycle (ISDLC) methodology.

Functional Decomposition Of The Business Directory Mapping System

The functionalities of the Business Directory Mapping System (Figure 3.2), is divided into two major modules, namely;

1) Business Directory
2) The Mapping Tools

The business directory module has the user generated business directory information capturing interfaces and the business directory listing and searching tools. It also has the third-party mapping application that enables the business directory information to be visualised on Google base map.

Figure 2 Functional Decomposition of the Business Directory Mapping System

According to the functional decomposition of the business directory mapping system, there are two formats for visualising the information on map, namely, map with sidebar images and map without sidebar images. In each of the tow map visualisation format, the information to be viewed on the map is obtained from the business directory listing and searching system. The business directory listing and searching system is interfaced to the Google map server though a Comma Separated Version (CSV) file, as shown in Figure 3.
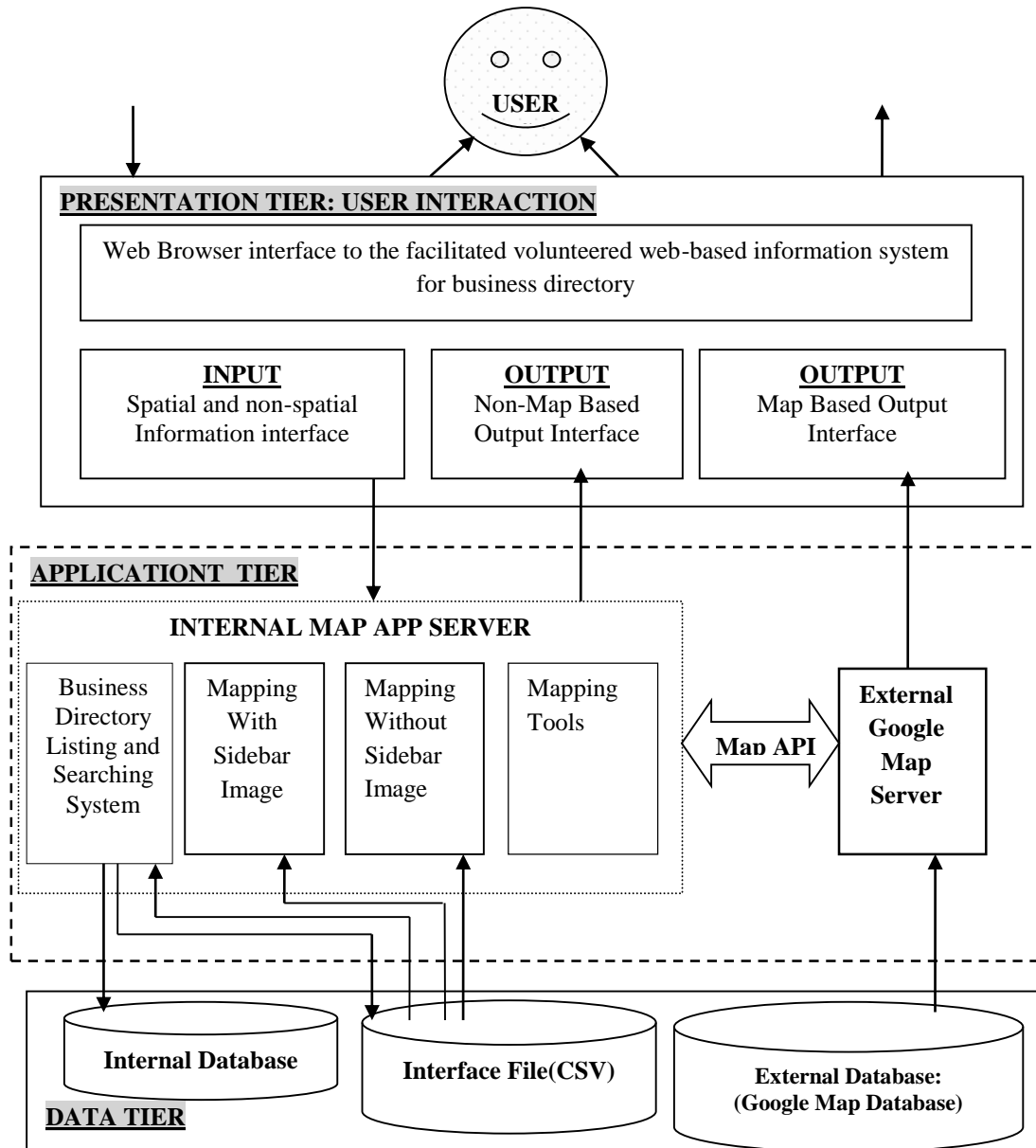
Figure 3, The Detailed Three-Tier System Architecture for the Business Directory.

Information Architecture and Flowchart For Selected Modules In The Business Directory

Due to space constraint, information architecture and flowchart for some selected modules in the software will be presented in this section. The information architecture diagram is used to present the layout of the user interface for the given module or sub-module. Specifically, the information architecture is presented using wireframe diagrams. Furthermore, flowcharts are used to present the detailed process of capturing and transforming the user inputs to output in each of the selected modules. The information architecture for Add New Record Module is given in Figure 4 and the flowcharts for Add New Record Module are given in Figure 5.
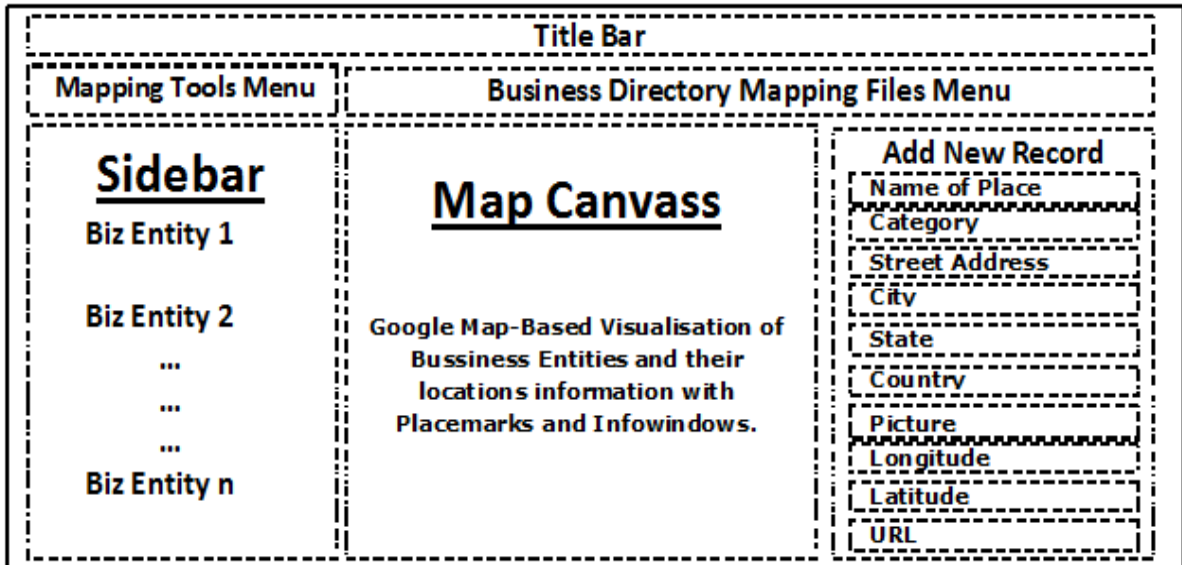
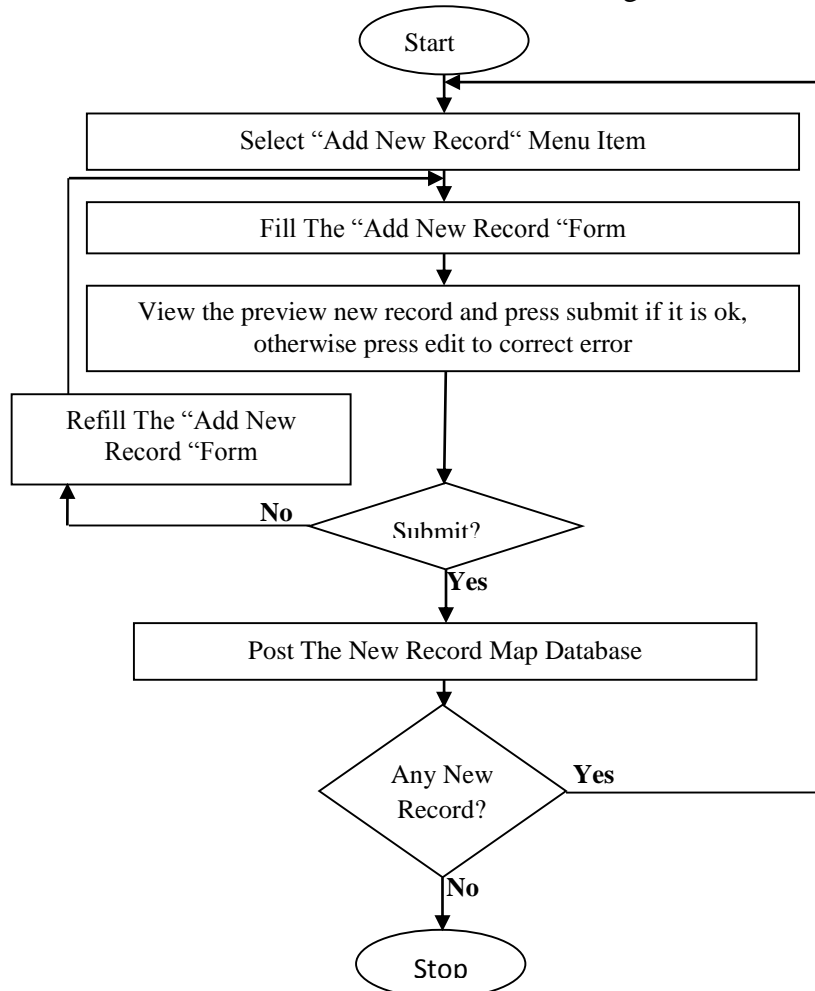Figure 4, The Information Architecture: The Wireframe Diagram For Add New Record.

Figure 5,   The flowcharts for Add New Record Module

The information architecture for Search Module is given in Figure 6 and the flowchart for Search Module is given in Figure 7.
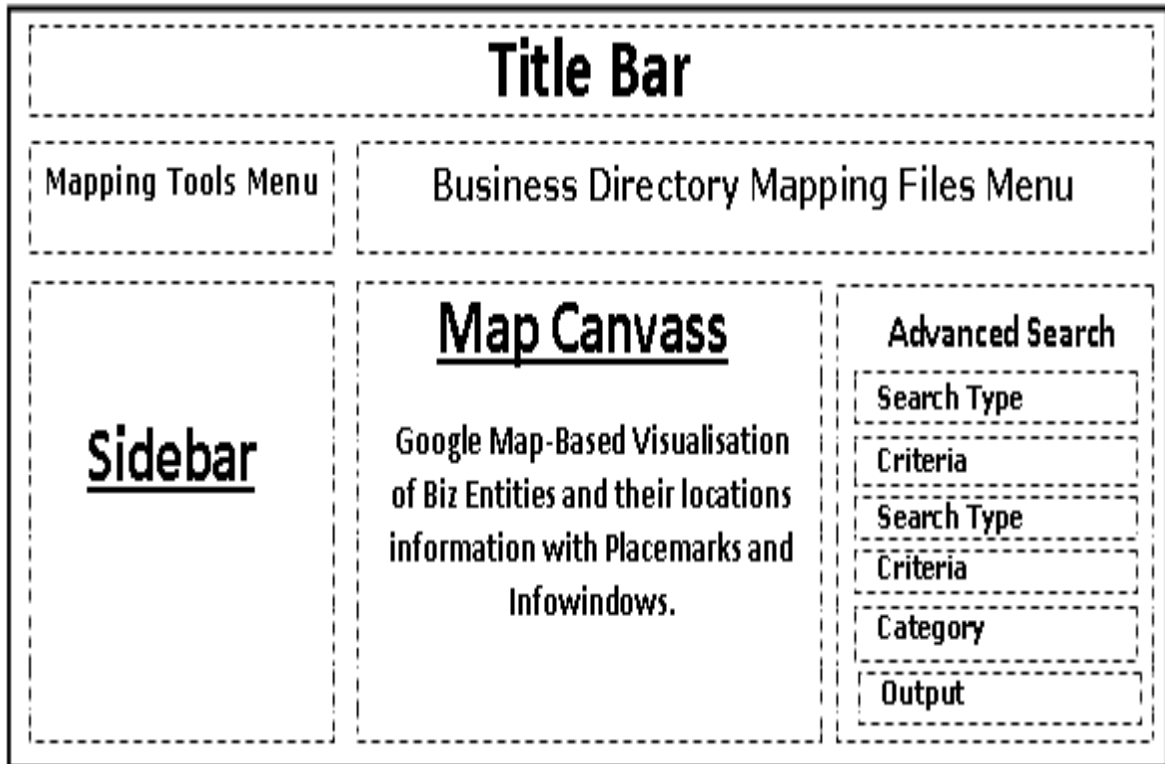
Figure 6, The Information Architecture: The Wireframe Diagram For Search Module.
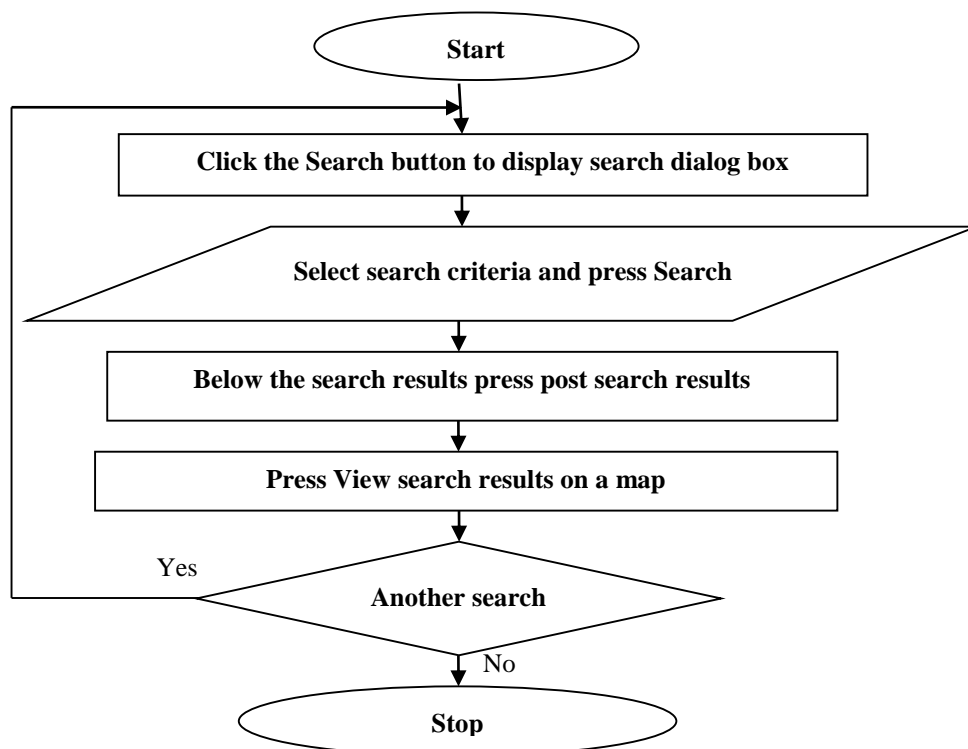

Figure 7, The Flowchart for Search Module

The information architecture for Get Direction Module is given in Figure 8 and the flowchart for Get Direction Module is given in Figure 9.
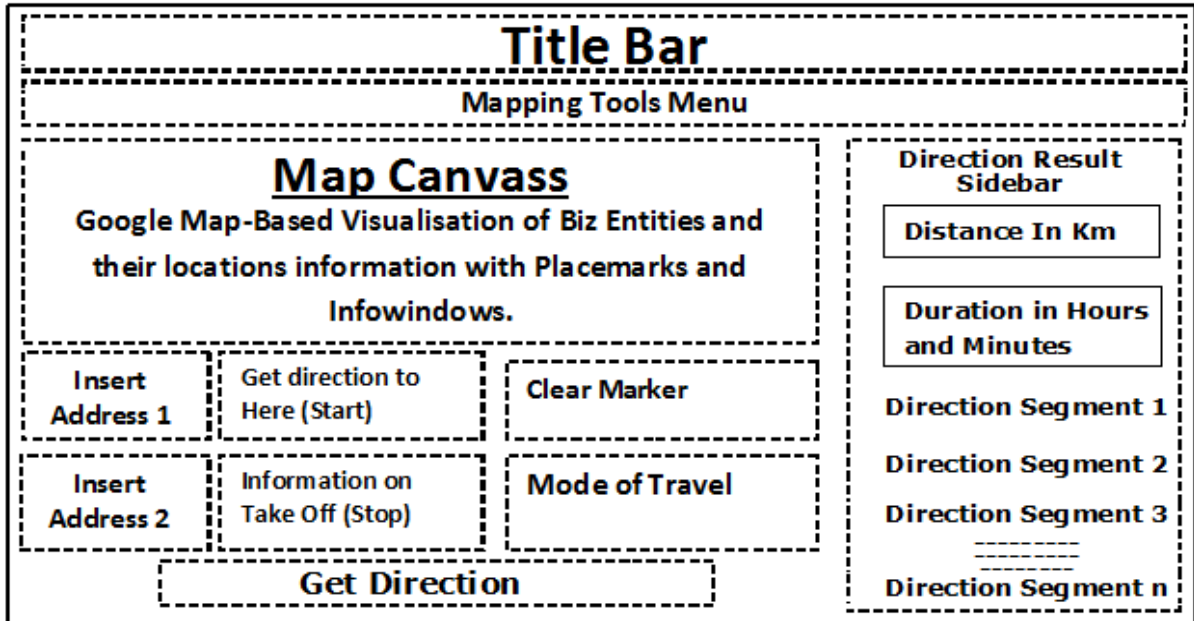
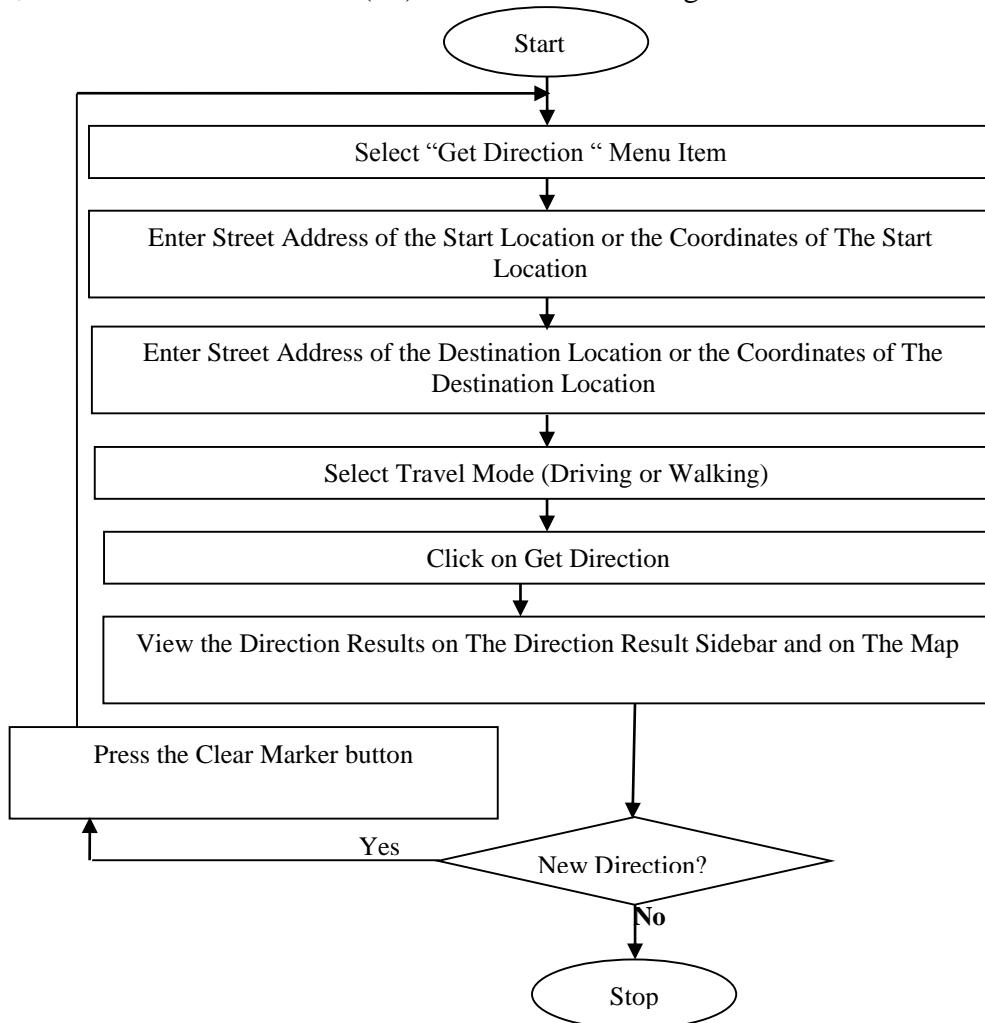Figure 8, Information Architecture (IA): The Wireframe Diagram for Get Direction Module.

Figure 9: The Flowchart For Get Direction module

The information architecture for Map Display With Sidebar Image is given in Figure 10 and the information architecture for Map Display Without Sidebar Image is given in Figure 11.
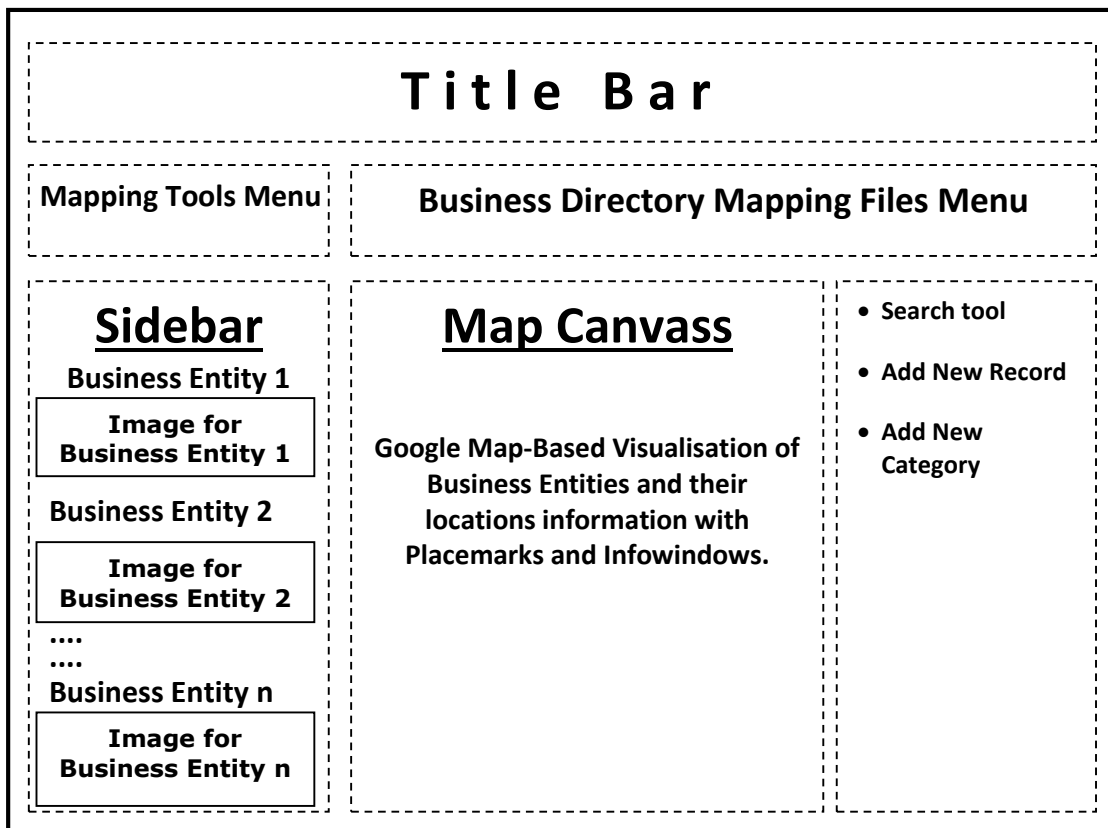
T i t l e B a r

Mapping Tools Menu

Business Directory Mapping Files Menu

Sidebar

Business Entity 1

| Image for Business Entity 1 |

Business Entity 2

| Image for Business Entity 2 |

....
....
Business Entity n

| Image for Business Entity n |

Map Canvass

Google Map-Based Visualisation of Business Entities and their locations information with Placemarks and Infowindows.

- **Search tool**
- **Add New Record**
- **Add New Category**

Figure 10, The Information Architecture: The Wireframe Diagram For Map Display With Sidebar Image

T i t l e B a r

Mapping Tools Menu

Business Directory Mapping Files Menu

Sidebar

Business Entity 1

Business Entity 2
...
...
...
Business Entity n

Map Canvass

Google Map-Based Visualisation of Business Entities and their locations information with Placemarks and Infowindows.

- **Search tool**
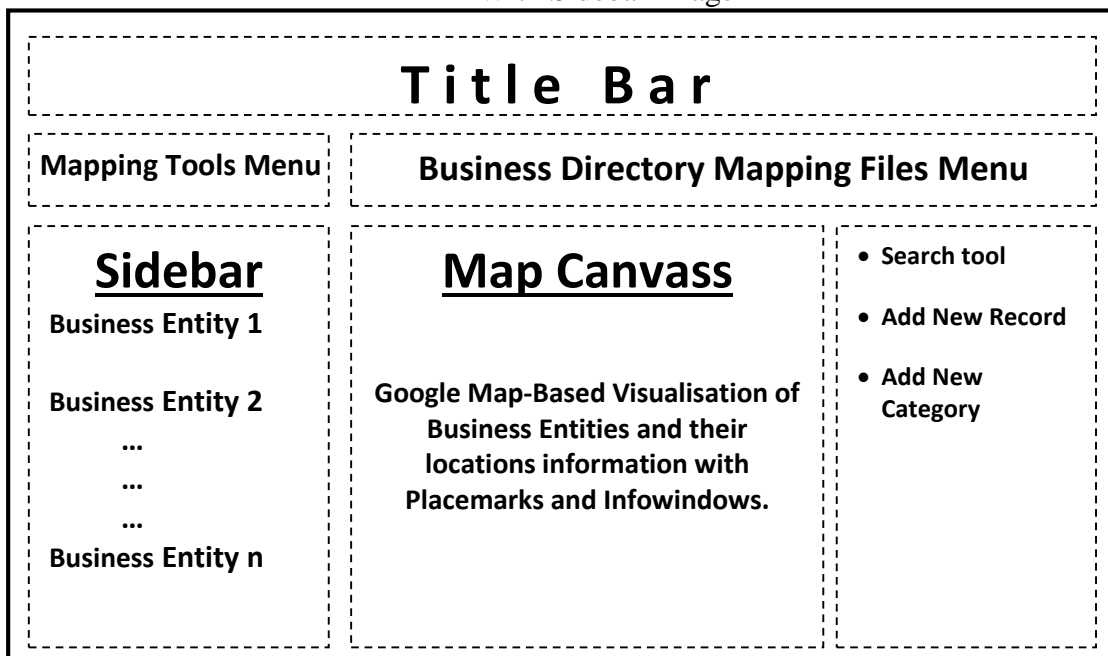- **Add New Record**
- **Add New Category**

Figure 11, The Information Architecture: The Wireframe Diagram For Map Display Without Sidebar Image

RESULTS AND DISCUSSIONS

This section presents the screenshots of some features available in the map mashup application and facilitated volunteered web-based information system for Akwa Ibom state. Figure 12 is the screenshot of the Directory Map Display with Sidebar Image and Figure 13 is the screenshot

of the Directory Map Display Without Sidebar Image. The Map Display With Sidebar Image (Figure 12) enables users to view the entities listed in the map directory on a map in such a way that the pictures associated with each of the business entities are displayed on the sidebar along with the name of the business entity. The Map Display Without Sidebar Image (Figure 13) enables users to view the entities listed in the map directory on a map in such a way that the pictures associated with each of the business entities are not displayed on the sidebar along with the name of the business entity. This approach allows more items to be visible simultaneously on the sidebar.

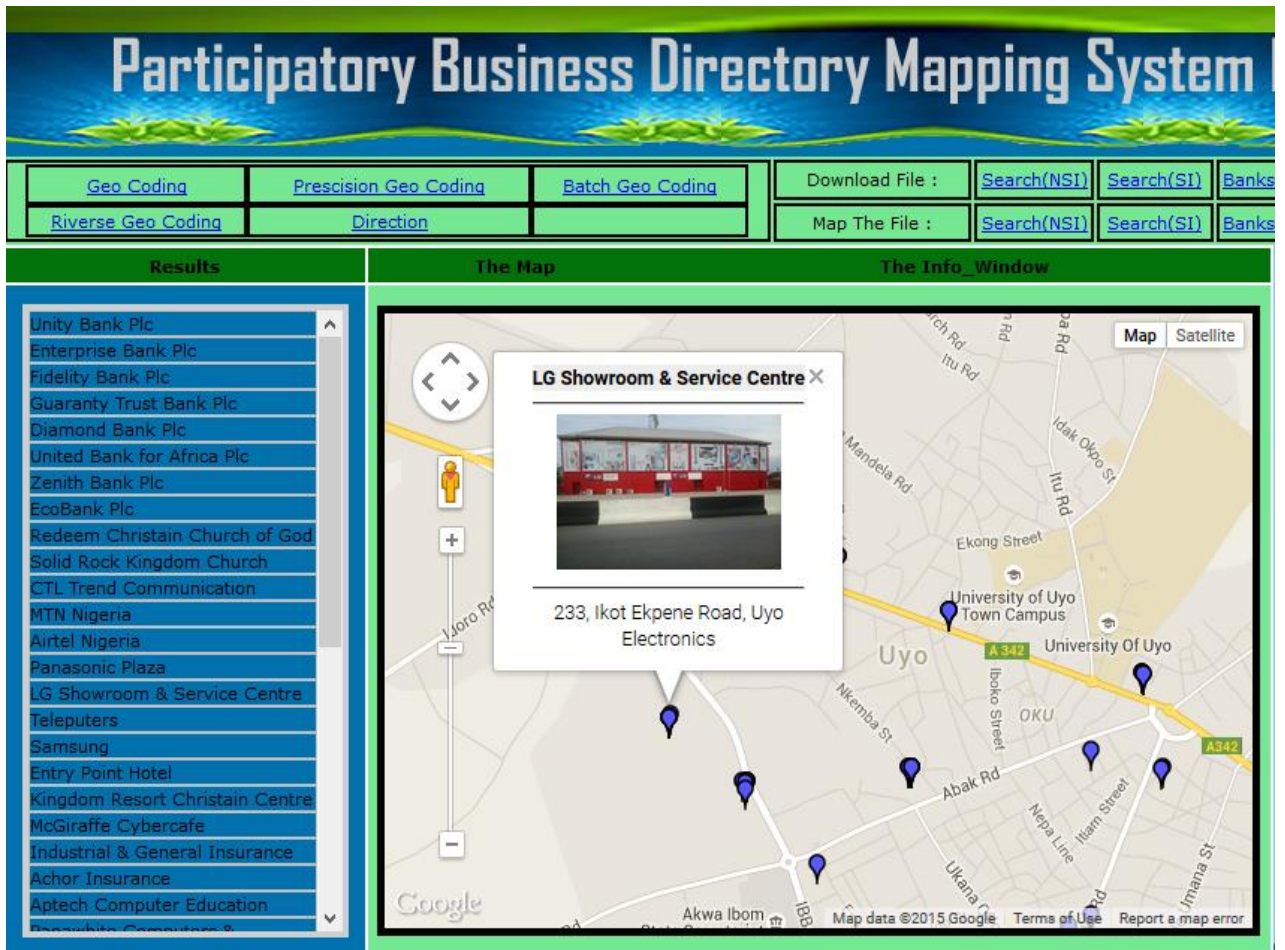Figure 12: Screenshot of The Directory Map Display With Sidebar Image

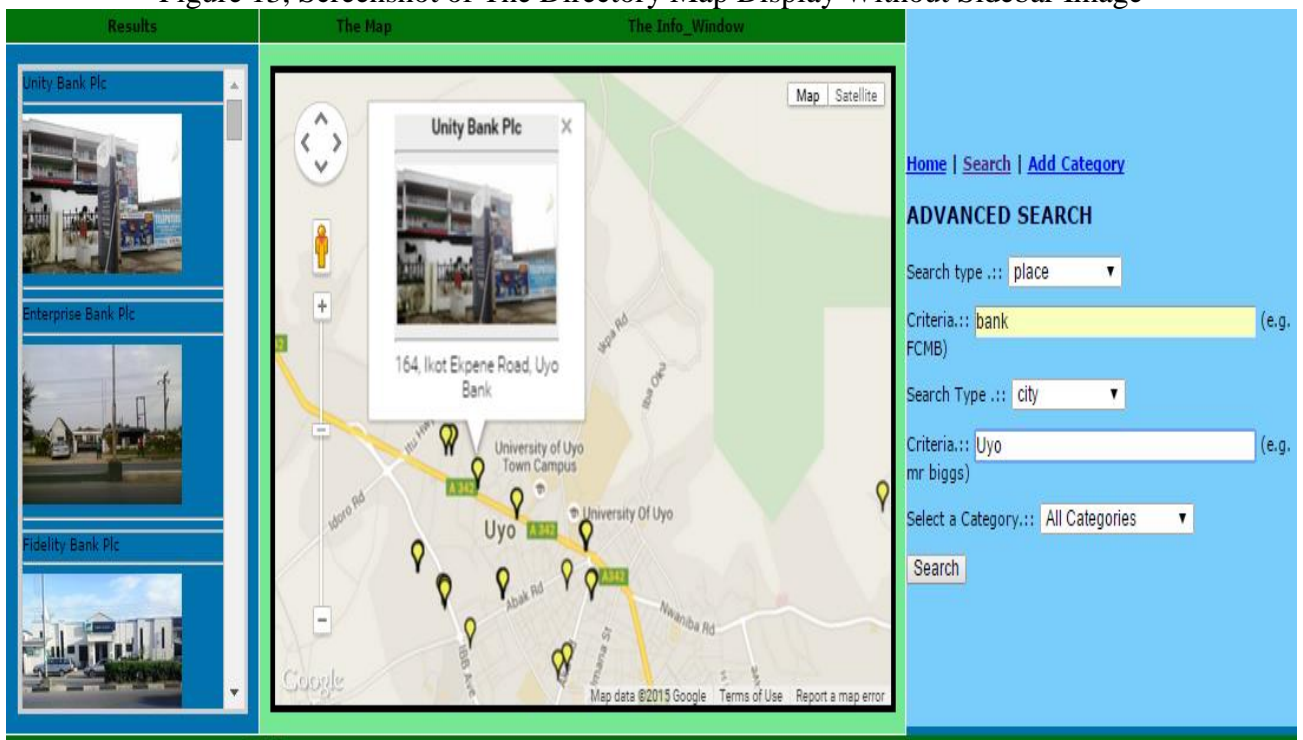Figure 13, Screenshot of The Directory Map Display Without Sidebar Image

Figure 14, Screenshot of The Search Directory Module

The screenshot of the Search Directory Module is given in Figure 14. The search module enables users to search for any specific business entity or a category of business entity. For

instance, the user can search for all the banks in the city of Uyo in Akwa Ibom state or the search can be for a specific bank in Uyo. The search result gives a list of all the items found. The search result is also contained in a search result file which can be viewed on the map.

The screenshot of the Add New Records Module is given in Figure 15. The Add New Record Module enables users to upload the information about their business entities. The information includes among other things; the business name, address, pictures, longitude, latitude, state, city, etc.
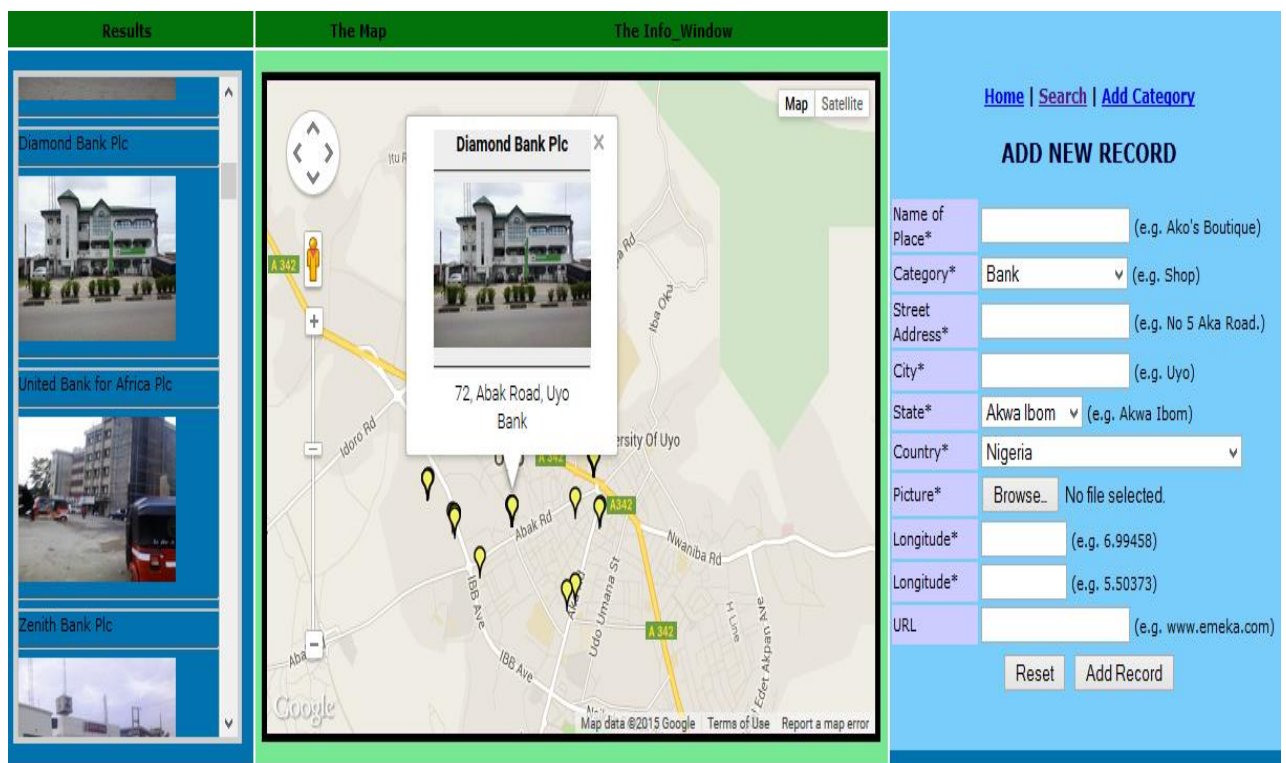

Figure 15, Screenshot of The Add New Records Module

The Screenshot of The Get Direction Module is given in Figure 16. The Get Direction Module enables users to get map direction from where the user is to any of the business entities contained in the business directory. The application has a downloadable CSV file containing all the business entities and their coordinates (longitude and latitude). So, the user can obtain the location information for the business entities and hence use such information for the map direction search.
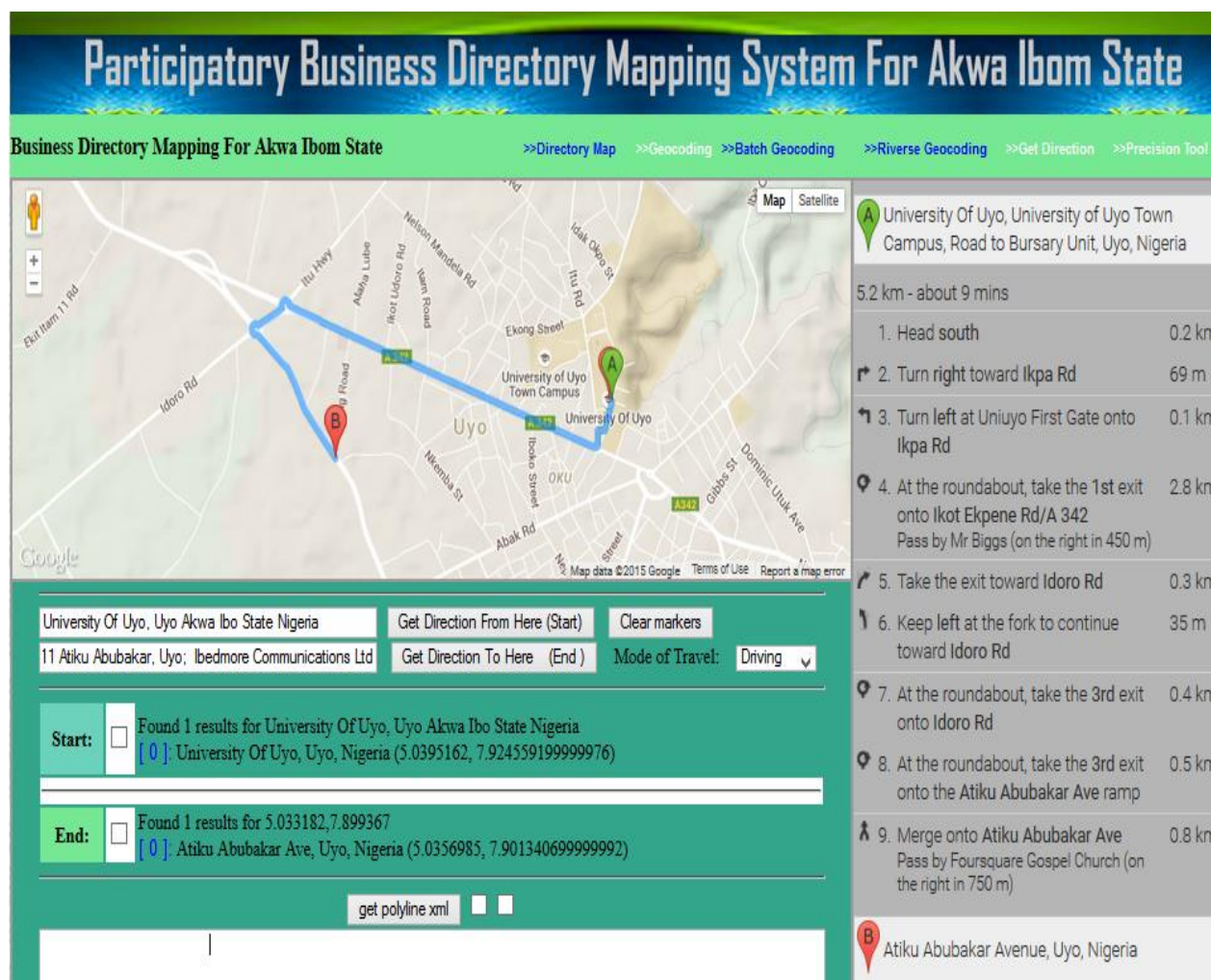
Figure 16, Screenshot of The Get Direction Module

The screenshot for the precision mapping module is given in Figure 17. With the point precision tool the users can obtain the exact coordinates for their business premises. The precision tool uses a draggable marker that allows the users to drag the marker to the exact location on the map where their business entity is located. The tool returns the longitude and latitude of the draggable marker along with the city and the street name, where they are available.

CONCLUSION

In this paper, a third party Google map mashup application and online spatial and non-spatial information system were developed to capture, store, manage, publish and map user generated business directory information for Akwa Ibom state in Nigeria. The third party mapping application was developed based on Google map's Application Program Interface (API) version 3 to enable the business directory to be visualised on Google maps. Some mapping tools were also developed to facilitate the collection and processing of the spatial (geographic) information about the business entities in the business directory. In all, the spatial and non-spatial information system and the third-party Google map mashup application developed in this paper enabled the collection and mapping of business entities in Akwa Ibom state on Google maps. Search tools are also provided in the system for locating specific business entity or group of related business entities. Such search results are mapped on the Goole map with

sidebar images and without sidebar images. Infowindows are also associated with each business entity on the map to provide detailed information on demand for any given business entity shown on the map.

RECOMMENDATIONS FOR FURTHER WORKS

In this paper, the mapping is based on Google map only. There are other free web-based map service providers which can be used for this purpose. In this case, additional studies are required to study the API for each of those free web-based map service providers and hence develop the mapping system that will render the business directory map on those other web-based maps. Furthermore, given that the system is open for members of the public to upload their spatial and non-spatial information about their business entities, it may require users' registration for effective management and verification of user-generated contents. Such facility is not yet built into the business directory mapping system presented in this research. Further work is therefore required to implement such functionality.

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