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Development of a Web-Based Street Guide Map of Malali, Kaduna State - Nigeria

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ABSTRACT

Mapping has substantially improved because of Remote Sensing (RS) data and Geographic Information System (GIS) technologies. These have been employed in the study of the attributes of natural and manmade Earth features, in the monitoring of natural and physical occurrences, and in the development of street guide maps. Satellite imagery collected from SAS planet was utilized in this study to create a Web-based Street Guide Map of Malali, Kaduna North Local Government Area (LGA) of Kaduna State. The research methodology used was an integrated and conceptual strategy that included digital image processing and cartographic procedures. The digitized features' spatial data were collected using a handheld GPS receiver. QGIS software was used to process the collected data. During the procedure, a web-based street guide map was constructed, which depicted numerous important features in the study area, such as roads and their names, as well as facilities such as schools, hotels, and hospitals. The end result is designed to improve the visitor experience and make it easier to access important attractions in the neighborhood, which is sometimes hampered by the lack of and often inaccurate, outdated street maps, among others.

1. INTRODUCTION

The advent of digital technology and the internet has led to the question being asked of how maps can be visualized beyond the traditional paper map (Fasote et al., 2016). GIS-derived maps make great use of digital technology in the process of their creation, and their great potential to get new perspectives on the world using highly advanced techniques can only be exploited because of the most recent advances in digital technology (Nnam et al., 2012). Therefore, the question remains whether digital technology beyond its analytical power may also be able to provide new means of cartographic practice to show maps in the digital world (Benjamin, 2016).

Over the years, maps have evolved to be the most efficient way of representing and depicting spatial phenomenon as they appear on the earth surface (Endalew et al., 2019). The Street guide maps over time, have proved to be very effective in guiding people or commuters in a particular environment (region) where they have never been before (Fasote et al., 2016; Neema et al., 2004; Nnam et al., 2012). This goes to show that there exists a cordial relationship between maps and finding locations or directions (Garba et al, 2018).

Maps are spatial models of the earth's surface or is a mathematically determine presentation of a portion of the earth surface systematically plotted to scale upon a plane surface (Endalew et al., 2019; Nnam et al., 2012). It plays a vital role in

the world through aiding decision making and policy formulation processes aiding tourism and general navigation (Nnam et al., 2012).

A street guide map is a graphic portrayal of a town or city, showing the positions and names of all the streets; major/minor highways and roads, railroads, tracks and other points of interest and the general road network (Chiang et al., 2014; Jorda et al., 2021). It is a form of map that details roads and transport links. Street maps are used for locating houses and streets; car navigation; planning of transportation, trips and driving directions; and for planning of movement and provision of facilities, goods and services (Udoh & Igbokwe, 2014).

Street guides are not only important for aiding navigation within the city, but are also useful in planning enumeration areas by demographers, and are equally useful to tourists, salesmen, firemen, security personnel, tax collectors, postal services etc. and also serve as base for land use classification mapping and town planning (Abbas et al., 2010; Kolawole et al., 2016). There is need therefore to produce street guides from data that can portray reality as faithfully as possible, so that the rapid nature of changes is accommodated in the guides (Abbas et al., 2010).

Geographic Information System (GIS) is a computer-based tool that analyzes stores, manipulate and visualize geographic information on map. It is also a system for management, analysis and display of geographic knowledge,

which is represented using a series of information set such as maps and globes, geographic data set, processing workflow model, data models and metadata (ESRI, 2012).

Rapid infrastructural development and advancement of Malali area is making people (mainly visitors) and those that haven't visited the area for a long period of time find it difficult to locate places and to easily navigate within the area. There is the need for an updated street guide map accessible to all categories of users as it will aid in location and navigation.

The importance of web-based street guide map made many researchers around the world, Africa and Nigeria carried out researches in this regard. From around the world, Neema et al. (2004) carried out this type of research in Bangladesh, Jorda et al. (2021) in Philippines, Medina et al. (2015) in Brazil, among others. In Africa, Endalew et al. (2019) carried out similar research in Ethiopia. In Nigeria also, Fasote et al. (2016) in Ijoro, Ekiti State, Nnam et al. (2012) in Enugu South, Enugu State, Abbas et al. (2010) in Kaduna Metropolis, Kaduna State, Kolawole et al. (2016) in Ife Metropolis, Osun State, Udoh & Igbokwe (2014) in Uyo, AkwaIbom State, this is to mention but a few.

The present study aims at providing a web-based street guide map of Malali, Kaduna State to aid location and navigation for all categories of users any time of the day and also free of cost.

2. METHODOLOGY

Surveying at an initial stage deal with visitation of area to be worked on (in this case the study area) to study it and plan for the task ahead. This will help in the selection of appropriate survey equipment to be use, the type of survey procedure to be adopted, the accuracy level needed for the work, manpower/labor, where to begin and end the survey. In the present study, this is not different. Both primary (spatial and attributes of features using a handheld GPS (Global Positioning System)) receiver and secondary (satellite imagery from SAS Planet) forms of data were collected for the study.

The ArcGIS software was used in the digitizing, annotation and editing of these two datasets. These three processes led to the production of the desktop-based map. Finally, the QGIS software was used to produce the web-based map.

2.1 Datasets and Sources

The following are the datasets used in the present study, type, source, description and the reason for its usage.

Table 1: Datasets and Sources

S/No	Data Name	Data Type	Date	Source	Description	Purpose
1	Attribute data of features	Primary	2020	Field	Names of some prominent features in the study area	For annotation
2	Spatial data of features	Primary	2020	Field	E, N GNSS Data	For mapping
3	Satellite image	Secondary	2020	SAS Planet software	Satellite image of the study area	For digitizing

2.2 Software Used

The following are the software used in the present study, and their usages.

Table 2: Software Used

S/No	Software	Usage
1	ArcMap 10.4.1 software	Uploading data, processing and map production.
2	QGIS software	Web-based map production.
3	SAS planet software	Used for downloading the image of the study area

2.3 Web-based map production

This is the preparation of the map to enable it to be accessed on the web. To achieve this, the shapefiles of the various features digitized on the ArcGIS software were uploaded to the QGIS software and all the necessary editing and symbolization of the features was done to make the map good looking and user friendly.

A plugin named QGIS2WED was installed on the QGIS software which has the function of converting the different map layers into a web application. The web-based street guide map was obtained using the "Openlayers" which was chosen among the other option given by the system leaving the Leaflet and Mapbox.

Finally, the obtained result is an interactive web App/document folder which contains all the web map data, the CSS document that designed the interface of the web application, the java script document and the HTML document that covers all the other elements which can be used to access the street guide map online.

2.4 Study Area

Malali is located in Kaduna north LGA and is found between latitude 10° 23' 30" N and 10° 38' 00" N and longitudes 7° 21' 30" E and 7° 30' 30"E. It has an area of approximately 7 km² and a population of 357,694 at the 2006 census and it is bordered by Ungwan Gado, Kwaru, Ungwan Rimi and a water body. Fig 1 is inset map of the study area.

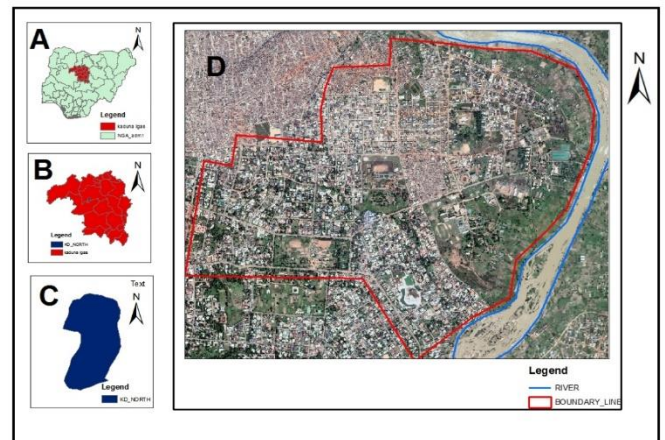


Figure 1: Locational maps (A) Nigeria (B) Kaduna state (C) Kaduna North L.G.A (D) Malali area

3. RESULTS AND DISCUSSION

The final result of the present study is the creation of web-based street guide map of Malali area of Kaduna North local government area, Kaduna state. This was done by creating various shapefiles and digitization of the satellite imagery of the study area using ArcGIS software. Various layers of features digitized in producing the web-based street guide map includes major and minor roads, some other prominent features like schools, health centers, hotels, eateries, religion centers and other features are outlined using various figures.

Figures I, II, III, IV, and V in the appendices section of this paper presents all these shapefiles (Major and Minor roads, Schools and Health Centers, Religion Structures, and Uncategorized Layers respectively). Four (4) major roads and 136 minor roads, 32 schools and 16 health centers, 13 mosques and four (4) churches, seven (7) hotels and 13 eateries, and 11 prominent features that are uncategorized.

The final desktop-based map produced and all the features that were digitized are selected to give clear details about the map content as well as all the basic and necessary elements that a good and complete map should contain, these elements include the north arrow, the title, the scale bar, the legend, the grid lines and so on (see Fig. 2).

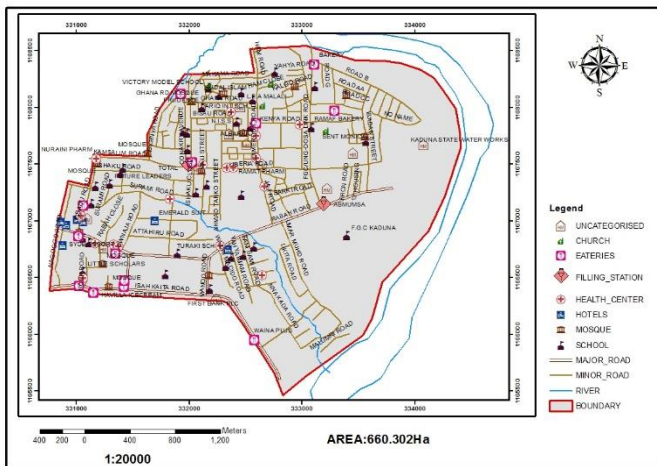


Figure 2: The street guide map of Malali area

3.1 Web-Based Map

The web-based map produced contain all the digitized features within the study area. This can be accessed via the link; (<https://emyaaqub.github.io/Muhammad/>). This is user friendly in the manner that it has some features that enable the users to know their own location when navigating within the study area, the users can zoom in and out to see features clearly, they can search for several feature when online and can locally search the name of minor roads even when offline, the user can measure distance by using measuring tool of the web map. The web-based map also contain legend which the user can use to identify several features on the map, the users can decide what feature they want to see on the map i.e., by unchecking the mark

sign that is attached to every feature on the legend. Fig. 4.2 is the interface of the web-based map.

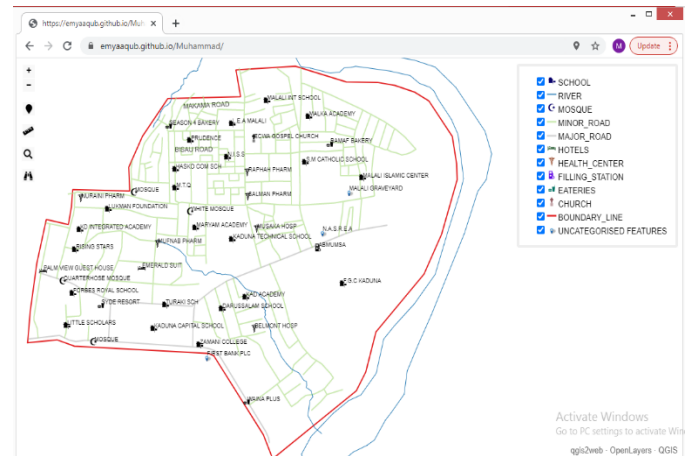


Figure 3: The interface of the web-based map

4. CONCLUSION

This research was set out to develop a web-based street guide map of Malali, Kaduna north local government area, Kaduna state.

It provides a detailed and up to date web-based street guide map of the study area which contains the spatial and attribute data of some major roads, minor roads, public structures such as schools and market places, hospitals, business-oriented structures like banks, hotels, eateries, recreational centers etc. which will help visitors and all category of users for easy locating places and for navigation.

This will serve as a visual representation of the Malali area and can therefore be regarded to guide and give direction to people especially when they are visiting the area for the first time.

It will however proper to conclude that Geographic Information System (GIS) and satellite imagery provide a reliable base map for street mapping, particularly when satellite imagery of high resolution is used.

5. RECOMMENDATIONS

From the result of the study, it is recommended that:

- i. The government and other stakeholders should provide a signboard or any other means of identifying the names of the street especially in the developing part of the study area which will make it easy for people to locate places and to navigate within the study area.
- ii. A provision should be made for updating of the street guide map of the area as new constructions of residential buildings and other business centers are always made in the study area.
- iii. There should be public enlightenment by the governments, traditional rulers and other dignitaries in

the society on the issue relating to land, its use and administration as many citizens have little or no knowledge about it which makes any survey work around their vicinity to be very difficult due to lack of cooperation from their own parts. This makes the life of those undertaking the works in danger as some of the illiterate people may attack them thinking that they want to hijack their property from them most especially at this very period where most of demolitions are in progress in Kaduna state.

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APPENDICES

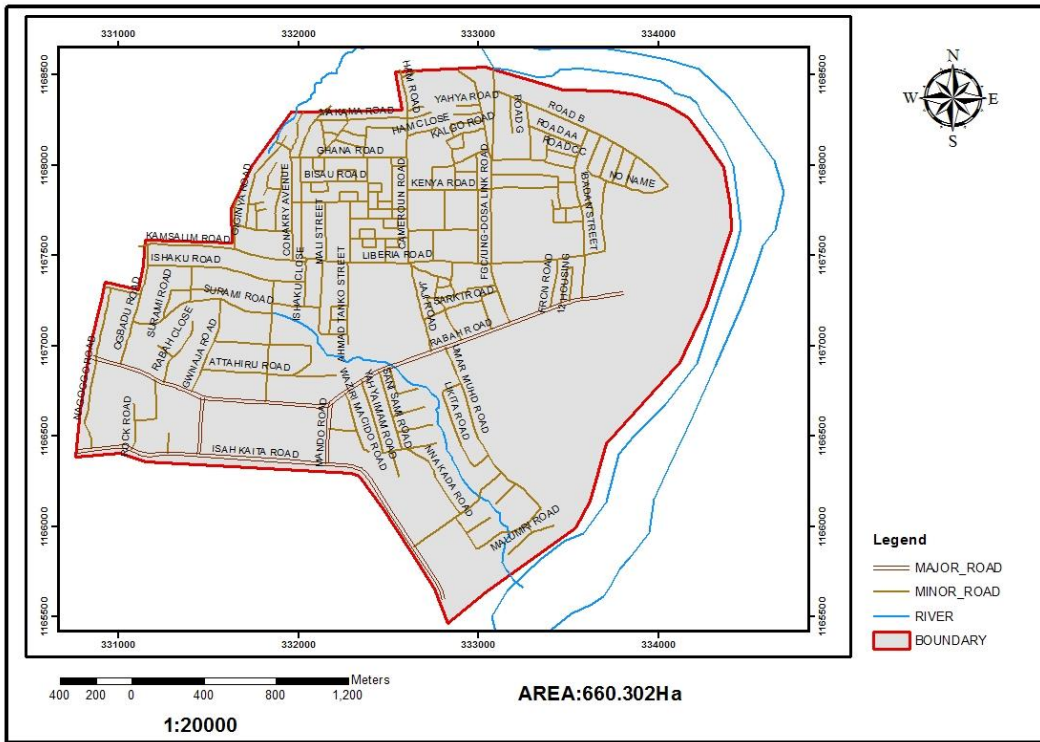


Figure 4: Major and Minor Roads

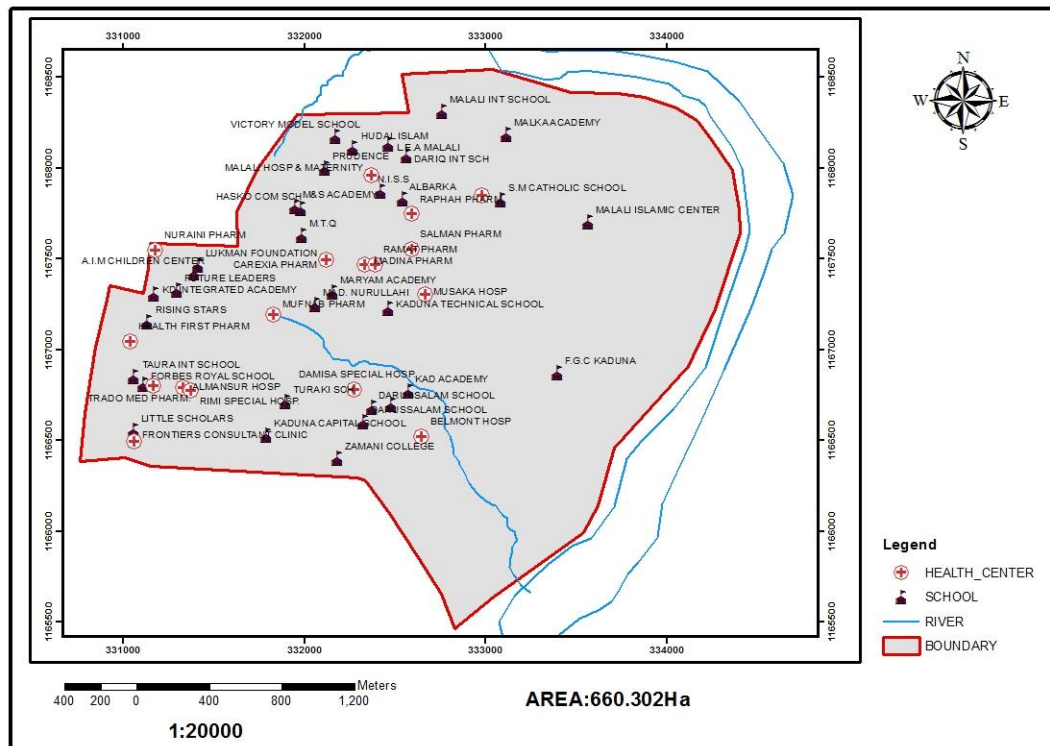


Figure 5: Schools and Health Centers

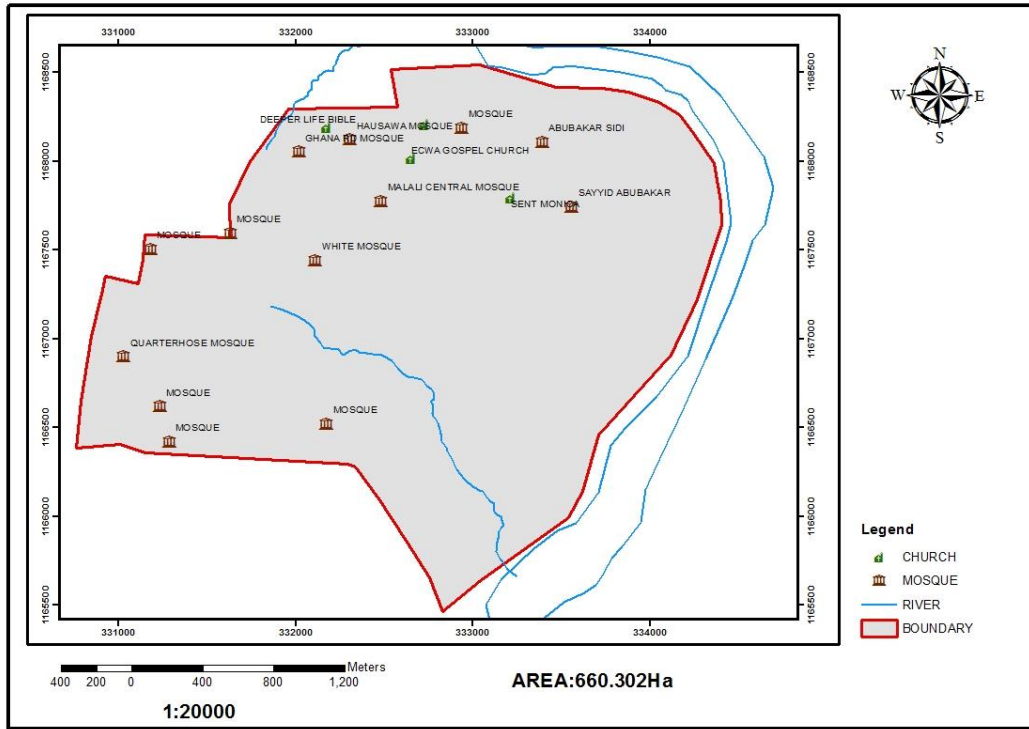


Figure 6: Religion Structures

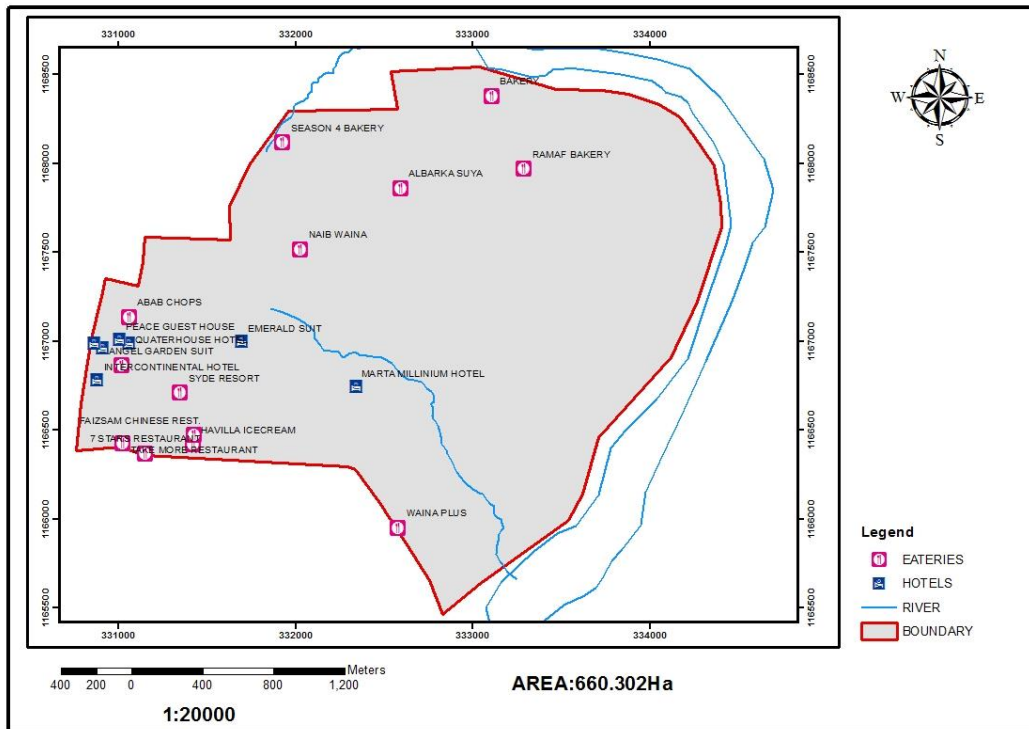


Figure 7: Hotels and Eateries