International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 9 Sep 2021, pp: 1748-1756 www.ijaem.net ISSN: 2395-5252

Geospatial Technology for Street Guide Mapping of Idah, Kogi State, Nigeria

Apeh Moses Michael
Department of Surveying and Geoinformatics, The Federal Polytechnic, Idah, Kogi State.

Submitted: 15-09-2021 Revised: 25-09-2021 Accepted: 28-09-2021

ABSTRACT
No doubt surveying has been a robust tool for taking accurate measurement on the earth surface. The integration of Geographic Information System technology and surveying has not only speed up geospatial data acquisition but to a larger extent improved productivity, track growth and development over time. The effort made in this research was the introduction of GIS in street guide mapping of Idah, Nigeria. The approach was based on geospatial data base of the road network in GIS environment using Quantum GIS software. The project data was composed of google satellite image map and aerial bing map covering the area and GPS data of some salient locations. The Image map was georeferenced and skeletonized (vectorized) to portray a digital street guide of Idah, Nigeria. The final output is a digital street guide and associated attributes. The work will help visitors and tourists to locate places within the area and to be properly guided.

KEYWORDS: Surveying, Geospatial, GIS, Digital, GPS, Attributes, Data base

I. INTRODUCTION

Due to increasing digital technologies,the world is becoming highly geospatially enabled and there is a need to study trends, patterns and to communicate these phenomena with the evolving special technologies. The main aim of this paper is to focus on how the Geospatial Technology is being implemented in different fields. This paper gives an overview on the applications of geospatial tools in mapping the current status of road networks of the study area. By using some spatial techniques like remote sensing, GIS (Geographical Information Systems) and GPS (Global Positioning Systems), up-to -date situations of what is existing in an environment are recorded and analyzed.

Maps are graphical representation of geographic phenomena as faithfully as possible within the limitation imposed by scale. They are spatial models of the earth surface that have played vital role in the world through aiding decision making and policy formulation processes, aiding tourism and general navigation (Victor et al 2012).

Street guide map focuses on the location of streets especially in an urban area. They are produced to show road information that is current especially to visitors and/or researchers. The last street guide of Idah (if any) was produced using the traditional method of map making that lacks rapid analysis and data display. Also, such map may not display the current status of the area. Idah, which is the traditional home of Igala race has witnessed enormous infrastructural development and changes. These changes need to be reflected and the current status portrayed using GIS technology.

The great strength of GIS is the ability to handle a large multi layered, heterogeneous data base and to answer queries about the existence, location and properties of a wide range of spatial objects in an interactive way (SK Duggal, 2009). Thus, the integration surveying, GIS and Remote sensing has speed up geospatial data acquisition and improved productivity.

Data collected through remote sensing (google image of the area) and other auxiliary data were harnessed and analyzed in GIS environment to produce a street guide of Idah, Kogi state Nigeria. The result of this research work will reveal the impact of collecting, updating, analysis and presently information using GIS technique. The result will assist visitors, researchers and will serve as reference material to students.

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DEFINITIONS OF CONCEPTS

What is Geographic Information System (GIS)?

GIS is a computer-based information system which attempts to capture, store, manipulate, analyze and display spatially referenced and associated attribute data for solving complex research, planning and management problems. It can also be defined as a computerized system that facilitates data entry, storage, manipulation, retrieval, analysis and presentation of spatially referenced data.

A geographic information system helps to better understand the world around us and enables development of spatial intelligence for logical decision making (SK Duggal, 2009).

The use of GIS removes the need of paper maps and associated documents and speeds up the production of information in the form of maps, tables, charts, reports etc by rapidly updating and editing the data in computers.

As seen from fig. 1, the objective of collecting geographic data from different sources and converting them into useful information by means of GIS transcend the boundary of data processing and information management.

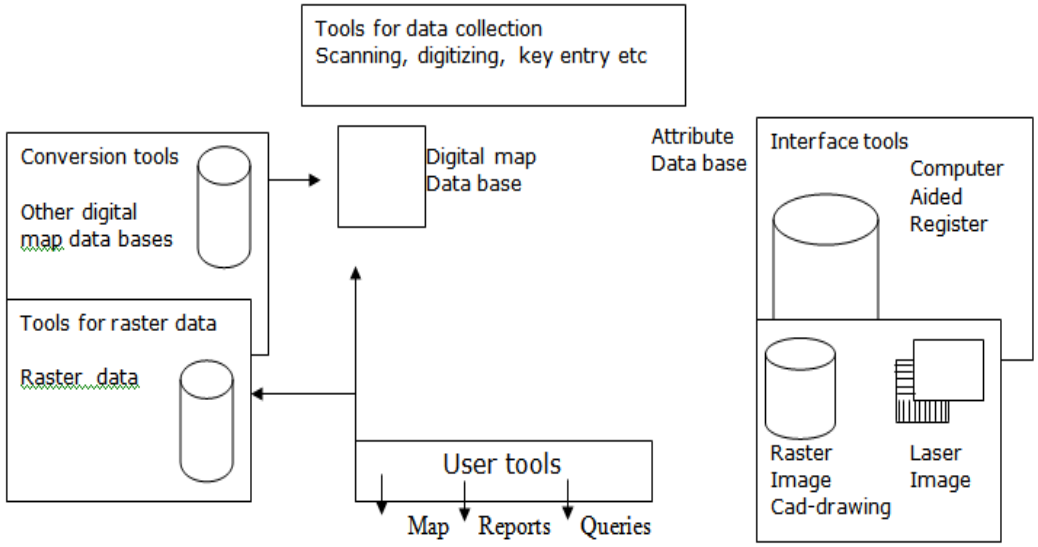

Fig 1: GIS data integration machine

Source: as adopted from prithvish nag and smitasengupta.

What is a street guide?

A street guide is basically a map of a town or city, showing the positions and/or locations and names of all the streets. Street guides are produced to show road information that is current especially to visitors and researchers(I.I Abbas Y.A Adama and J.A Ukoje,2010).

The street guide maps offer a unique view of the development of nation. As you view the change in road of a town or city, you can chart the change in people's transportation and style.

MAPPING IN NIGERIA:

Cartography is an important branch of graphics, since it is an extremely efficient way of manipulating, analyzing, and expressing ideas, forms, and relationships that occur in two and three-dimensioned space. A map lets us see the broader spatial relations that exist over large areas or the details of microscopic particles.Map making in Nigeria is still at the traditional level in some quarters. Though, a lot of ministries and organizations are trying to catch up with the new trend in geospatial technologies but greater percentage are either using the conventional (analog) means or are transiting from the analog to the digital era.

Most states and local government agencies still rely on the traditional maps which to a large extent have numerous disadvantages and above all could only be accessed by limited number of users. Several factors ranging from lack of proper awareness, fear of huge initial capital investment, not been ready to join the geoinformation super-high way

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and lack of trained personnel in geospatial disciplines might be those salient reasons for slow pace in joining the new trend of map making processes in Nigeria.

GEOSPATIAL TECHNOLOGY - VERITABLE TOOLS FOR MAPPING

Geospatial technology broadly includes mapping and surveying, remote sensing, photogrametry, cartography, Global Positioning Systems (GPS) and Geographical Information Systems (GIS). With its unique ability for acquisition, integration and analysis of geographically referenced spatial information, this technology has in recent times been recognized as an effective tool for planning, management and decision making locally and globally.

Collecting and communicating reliable geographic information about things and events requires knowing in a systematic fashion where they occur (Francis Harvey, 2008). With various techniques of recording location, surveying, GPS and digitalization are three generic ways of recording the locations and characteristics of things and events by directly observing them or indirectly measuring the location and possibly their attribute.

Geographic information system (GIS) technology has over the years simplified mapping process. The analogue or the traditional map making process is time consuming, requires more fund and personnel, and lack of database capabilities.

Remote sensing: is defined as the measurement of object's characteristics from a distance using reflected or emitted electromagnetic energy.

Francis Harvey in his book pointed out three advantages of remote sensing over other forms of data collection.

First it makes it much easier to systematically recognize things and events over a large area, second, it makes it easier and less costly to revise most maps. Third, digital remote sensing image can be used by other applications.

Remote sensing stands out among other geospatial technologies due to its bird's eye view or synoptic view so that data covering a large area of earth can be processed to generate map-like product (SK Duggal, 2009).

GIS on the other hand is capable of acquiring spatially indexed data from a variety of sources, changing the data into useful formats, storing the data, retrieving and manipulating the data for analysis and then generate the output required by the user. It is a multidisciplinary science and an indispensable tool to manage land and natural resources, monitor the environment, formulate economic and community-development strategies, enforce law and order, and deliver social services.

According to SK Duggal, the main purposes of GIS are:

a. To support decision-making based on spatial data.
b. To support general research.
c. To collect, manipulate and use spatial data in database management and
d. To produce standardized and customized cartographic production. The synergy of these purposes and flow are portrayed in fig 2.

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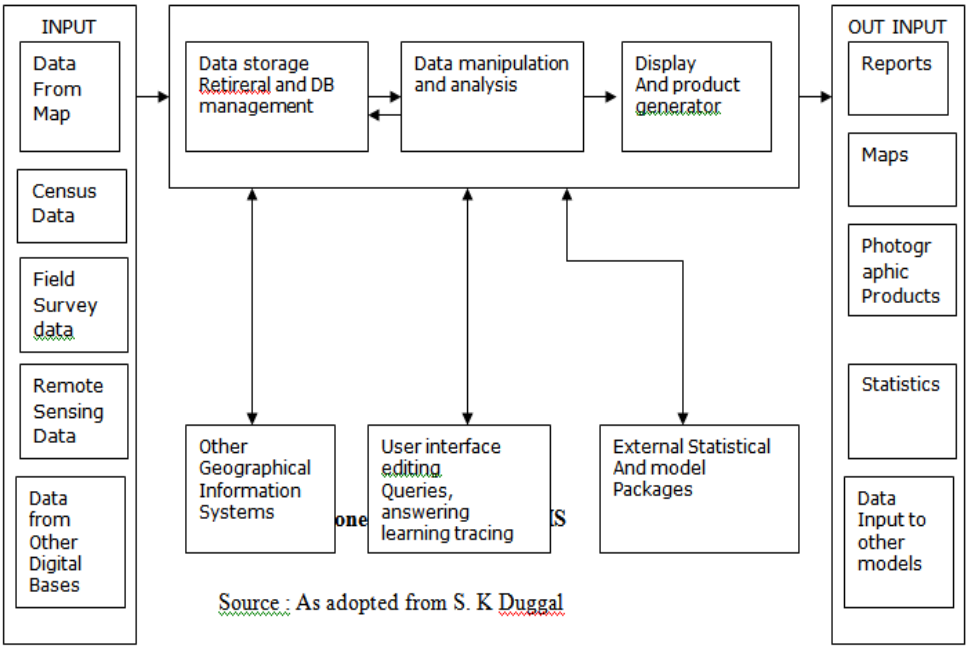

Fig. 2 Component subsystems of GIS

These purposes are further buttress by the fact that GIS answers majorly five generic questions of:

Location: What exist at a particular location? This question seeks to find out for the answer like, location of a particular object or area in terms of latitude/longitude or Easting and Northing.

Condition: Identify where certain condition exists. This tends to answer for all those questions where certain conditions are satisfied.

Trends: what has changed since? This question is applied to a noticeable difference or change incurred within a particular time period.

Pattern: What spatial pattern exists? This is the most logical question answered by GIS-the distribution of spatial features and reasons behind that distribution.

Global Positioning System (GPS) to a large extent, has speed up data collection by obtaining coordinates of any location on the globe in a short period of time. It is a radio-positioning navigation and time transfer system.

It provides accurate information on position, velocity and time of an object or a platform at any moment, anywhere on the globe (Panda, 2005).

The integration of geospatial technologies (Remote Sensing, GPS, GIS etc) has speed up map making processes, improved productivity and produced better and accurate spatial result. These recent advances in remote sensing (and other spatial data handling) not only have given cartographers new tools for creating and updating traditional topographic maps, but have allowed us to map in detail a multitude of new environmental phenomena (Arthur H. Robinson, 2004).

Data collected through remote sensing, supported with GPS data of some salient location with the project area coupled in the anxiliary data and harnessed in GIS environment was the main focus of this research.

Aim and objectives of this work

The aim of this work was to produce a street guide of Idah, Nigeria using GIS technique.

Objectives

- To produce a vector map from an existing satellite image.
- To encourage the use of recent technology in map making amongst policy makers and decision makers.

Methodology

STUDY AREA

Idah is the headquarter of Idah local government area of Kogi State, Nigeria and it is located between longitude $6^0$44’02’’ and $6^0$45’30’’ and latitude 7^0 06’00’’ and 7^0 07’ 30’’.

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It is the traditional home of Igala race with a population of 79,815 as recorded in 2006 population census.It is also covered by an area of 36km^2 and falls within the Plain of Niger Rivers.

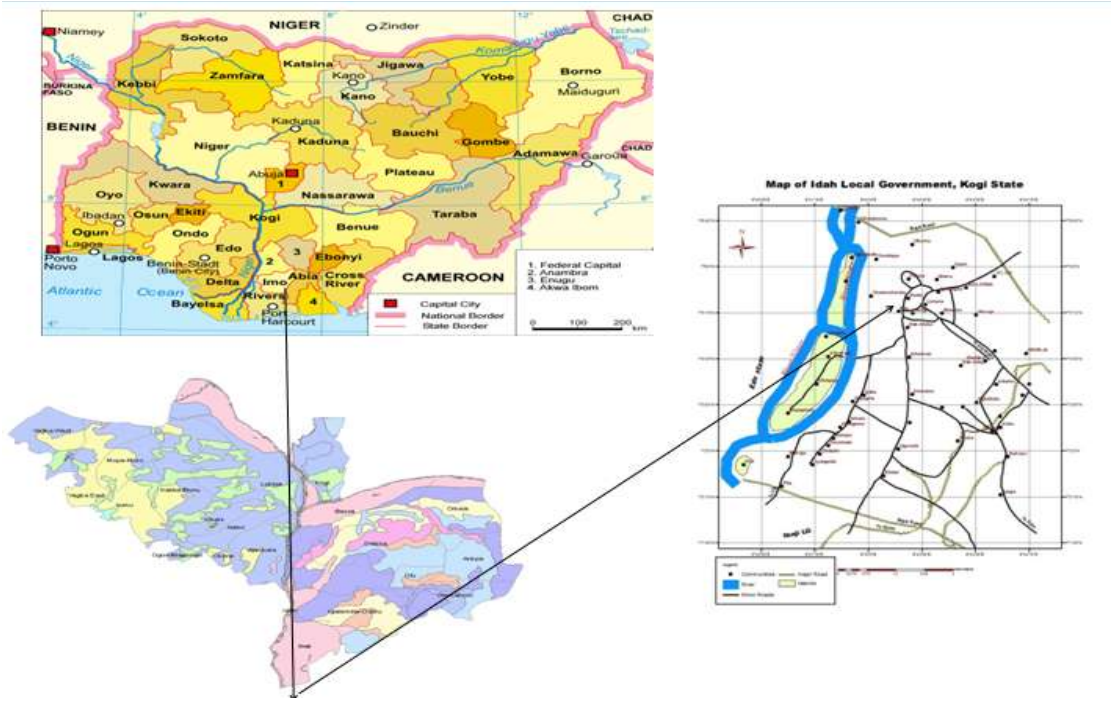

Fig. 3 Map of Nigeria showing the study Area.

Data needs

To carry out this project, the following data were required (needed).

- Google satellite imagery of the study area covering the study area
- Aerial bing map of the study area.
- GPS observation to determine coordinates of some salient point necessary for Geo-referencing.

Social surveys to determine the attribute information of existing spatial elements in the study area.

Sources ofdata acquisition

The data needed to carry out this study emanated from different sources. The map Nigeria showing the study area was obtained from Kogi State Ministry of survey. The google satellite imagery and Aerial bing map was downloaded via the internet. Other non-spatial data were obtained directly by the team in the form of questionnaire. GPS observation is the direct observation of x, y coordinates for verification and georeferencing purposes.

Hardware:

Hand held GARMIN Map GPS 765: For the verification and Ground truthing exercise constituting the primary source of data. This equipment was used for the acquisition of the vector - based data (N, E) for the mapping and ground truthing of some locations depicting the study area. The GPS traverses were executed at specific location identified on the satellite imagery for ground truthing purposes.

Window 8 personal HP LAPTOP with the following configuration was used for data processing :500 Gb HDD,2.30GHz, 2.0 Gb RAM,DVD/DVD writer and a flat screen VDU.

Software:

The basic software for the project is quantum GIS (QGIS). Other software includes Autocad Land Development for digitizing maps of Nigeria and that of Kogi state showing the study area. Microsoft Word 2016 for typing detail, editing and presentation of facts.

Data Integration:Geospatial-data integration is a process that involves collecting data from different sources at different collection modes and unifying them in a unique database to provide a unified environment for processing, modeling, and

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visualization.There are certain considerations to be able to integrate different data sources in a unique database. These include the following: spatial reference of the data, projection of the data, and format of the data (Rifaat Abdalla, 2016).This involves combining data residing in different sources and providing users with a unified view of these data. Data integration appears with increasing frequency as the volume and the need to share existing data explodes.

Georeferencing: When representing real-world features, you need to reference the data describing them to the correct location on the earth's surface. This is called georeferencing. If features are not located precisely or if their shapes are represented incorrectly, using a map or GIS to analyze their spatial relationships yields inaccurate results. Georeferencing is the process of establishing a relationship between the data displayed in your GIS software and its real-world location. This is accomplished by using a coordinate system. The georeferencing of the satellite image was carried out in quantum GIS. A total of eight (8) coordinates were used for the georeferencing.

The procedures for accomplishing the georeferencing are highlighted below.

i. Launch Quantum GIS, go to plugin menu and select georeferencer

ii. On the georeferencer dialog box click on open raster and navigate to where the satellite image (google image) is saved and click open.

iii. Select WGS 84 on the coordinate setting and ok.

iv. Select add point tool and click on the 1st corner of the image, input the X coordinate and Y coordinate of the 1st locationand ok.

v. Pan to the 2nd edge of the image click on the corner and input the X coordinate and Y coordinate and ok.

vi. Repeat the procedure for the 3rd ,4th …… and 8th point.

Go to setting, select transformation setting, click on output raster supply the name and ok.

vii. Click on start georeferencing tool to see a georeferencedgoogle image of Idah. Coordinates used for georeferencing are shown in table 1.

Table 1. Coordinates used for map to ground registration.

S/No.	Northings (Nm)	Eastings(Em)	Location
1	789291.115	252774.112	Sabon Gari
2	788768.715	251362.113	GRA
3	788680.375	251818.027	GRA/Ibrahim,Oruma street
4	788082.953	251362.113	Ibro junction
5	787559.906	250351.668	Beside Attah's palace
6	787550.398	250655.321	Bishop junction
7	787782.855	251119.850	Achadu street

Digitizing

Digitizing is the process of interpreting and converting paper map or image data to vector digital data. The process of digitizing can be done manually or on- screen. On- screen method of digitizing was adopted for this project. This method of geocoding is commonly called "heads-up" digitizing because the attention of the user is focused up on the screen, and not on a digitizing tablet. This technique may be used to trace features from a scanned map or image to create new layers or themes. Quantum GIS has powerful capabilities to digitize raster data. The digitizing was done using Quantum GIS and attribute of streets and roads populated by these steps:

- Load the TIF file (georeferenced image) in QGIS by clicking layer and Add Raster Layer
- Browse to the TIF file and click "open" to load the image into your project.

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- Zoom to the centre part of the image so as to show individual features clearly. Use the zoom-in button on the map navigation toolbar to zoom and pan to the area.

For the classes of roads for instance major roads (express dual carriage road), main roads (tarred road but single lane) and minor roads (untarred road), appropriate layer were created byClicking on layer, select new, in the dialog box, choose "WGS 84" as the coordinate reference system. You can choose any projection system that suits your region and click ok.

Another dialog box will pop-up asking for more information about the new layer. Such information includes: the data type (point, Line and Polygon) line was selected. Other parameters were attribute information line the name of the street or road, the type of road, the width if requires and any other attribute information required about the feature digitized.All the attribute information and "Add to attributes list" was entered.

- The "Digitizing" tool bar by right clicking in the "toolbar" section of QGIS. In the pop up menu, make sure "Digitizing" box is checked
- Each road network (street) was digitized by clicking on "Toogle editing" tool then ssselect line and begin to digitize then fill in the attribute information. The same procedures were repeated for all the road networks the study area.

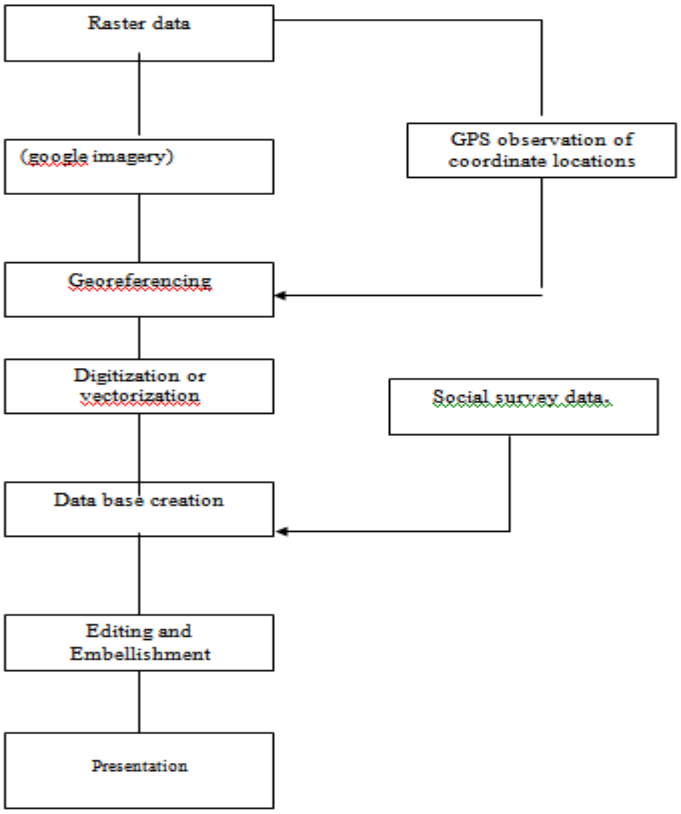

Fig. 4 Cartographic model

II. RESULTS AND DISCUSSION

The study was based on the digitizing of google imagery of Idah and combined with data from GPS, questionnaire etc.

One major road (dual carriage way) was digitized with associated attributes while a total number of forty-six (46) main roads were digitized and a total of fifty-one (61) minor/untarred roads (streets) were digitized

Fig. 5 show the composite map produced in GIS environment. The result obtained from this study satisfied the aim and objectives of the project.

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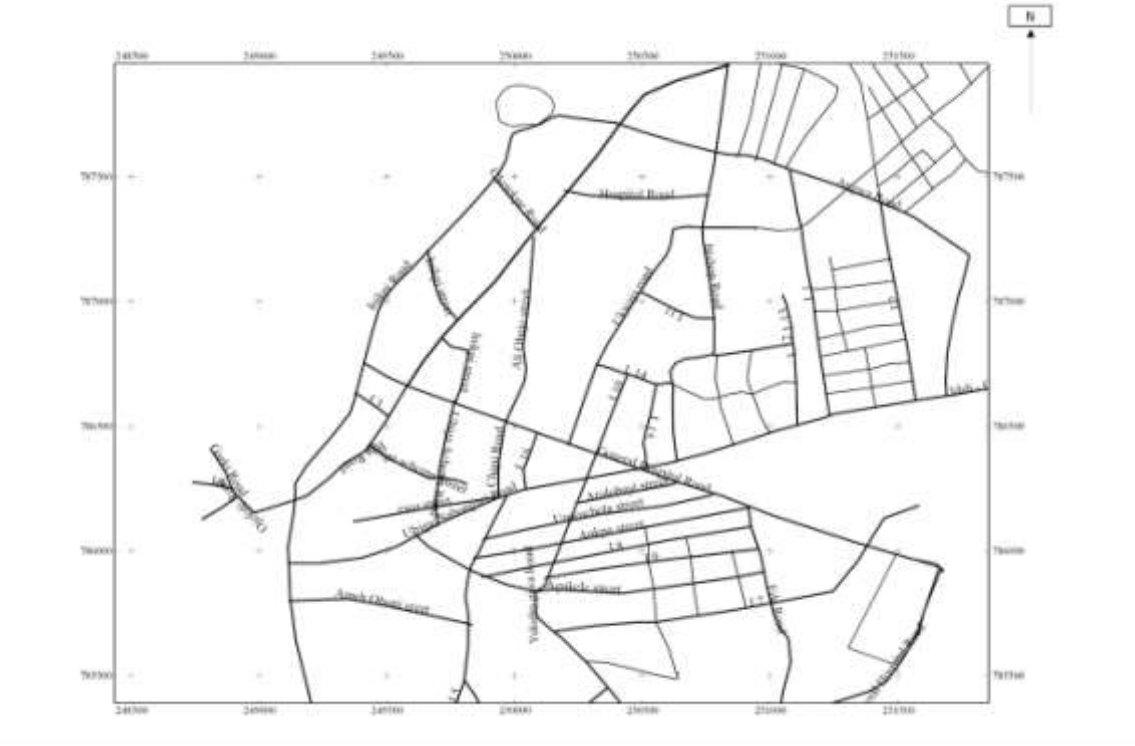

Fig. 5 Street Guide of Idah, Nigeria

A high-quality street guide of Idah was produced using GIS technique. The map and associated database demonstrate the advantages of GIS technique over the analog method.

III. FINDINGS

The study revealed that most of the road's outskirt of the main are losing their linearity as a result of negligence on the path of the settlers along the streets by not maintaining the structure of the road. Other factors include dumping of refuse on the road thereby causing erosion which may eventually alter the structure of the road.

Most roads were without street names which resulted in having an incoherent database of street names The populated database indicated that figures were used in place of street names in some cases. An up- to-date status of roads and database of all streets have not been maintained by the appropriate authority to enhance street useability and accessibility.

IV. CONCLUSION

It is obvious to state form this study that street mapping using GISTechnique is so profound and required less time compared to the traditional map making therefore it can be concluded that: GIS technique is a dynamic approach in mapping street guide as it gives opportunity to harness data from different sources. The street guide will play significant role in transportation. Hospitality, refuse collection and other multi criteria site selection. The digital street map will make map revision easy due to its flexibility of quick up - date and easy integration.

V. RECOMMENDATIONS

Having seen the importance of geographical information system (GIS) in managing both spatial data and its associated attributes, following are recommend.

1.That continuous updating should be carried out from time to time reflect the current status of the area.

2.The street guide should be used as a base for subsequent mapping activity relating to the area.

3.The government should create more awareness in the use of geospatial technology for mapping activity by reflecting the current status of the area and maintaining database of the road networks.

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