DEVELOPMENT OF POWER DISTRIBUTION FACILITIES DATABASE FOR A SECTION OF UWANI USING GEOGRAPHIC INFORMATION SYSTEM (GIS).

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ABSTRACT
One of the greatest challenges faced by the power sector in Nigeria is the dearth of reliable information which has resulted in ineffective management and distribution of power. GIS maps the exact location of an object in space to provide answer to queries using a computer system. This study is aimed at mapping all the facilities of the Enugu Electricity Distribution Company (EEDC) located at Uwani in Enugu. This will help in fast and easier retrieval of information for instantaneous use in the area of planning, monitoring and management of their facilities. The image of the study area was downloaded from Google Earth, added into Arc GIS 10.1 and spatially georeferenced (UTM 32N, WGS 1984). Shapefiles for representing streets major road, electric poles, transformers etc. were created using the Arcatalogue of Arc GIS 10.1. Series of spatial search/query operation was carried out on the electric poles, feeders and transformers to provide answers to the pending questions that will lead to effective management of the facilities. The final output of this work is a complete documentation of the power network of the study area which include the street guide map, the electricity distribution maps and the attribute tables of the facilities of EEDC.

Key words: *Geographic Information System (GIS), Global Positioning System (GPS), ArcGIS 10.1, query, georeferenced,*

INTRODUCTION

The power agency is an integral part of Nigeria economy whose statutory function is to develop and maintain an efficient, co-ordinate and economical system of electricity supply throughout the federation (Olaniyi, 2006). It started as Electricity Corporation of Nigeria (ECN). This agency was eventually merged with the Niger Dams Authority (NDA) to form a single body called National Electric Power Authority (NEPA) by government Decree No.24 of 1972. The name of the agency (NEPA) was later changed to Power Holding Company of Nigeria (PHCN) in 2006. The company was eventually sold to many private companies like Enugu Electricity Distribution Company (EEDC) which manages power supplies in Enugu region of which Uwani is included. Efficient functioning of the generated power cannot be achieved without proper record keeping and monitoring of the transmission and distribution network system. (Igbokwe, J and Emengini, E 2005). Recent study show that some of the major challenges facing PHCN as it concerns distribution of electricity power

are lack of in-depth network mapping, lack of database system, lack of land use information, inadequate distribution networks planning (Igbokwe, J and Emengini, E 2005). Any organization that expects to run an efficient day-to-day operation and to manage and develop its services effectively must know what asset it has, where they are, their condition, how they are performing and how much it costs to provide the service (Pickering et al,1993). Fortunately, the use of GIS has come in handy in tackling/solving these challenges mentioned above. GIS is a valuable tool not only for mapping facilities but also in improved decision making and better infrastructure management. GIS has become a veritable tool for electrical utilities for activities like utility asset management, maintenance planning, outage management and network planning (Parkpoom, 2013). Mapping the electricity network infrastructure will help to quickly locate areas where electrical facilities are malfunctioning, detect free space for new connections or remove the unwanted connection (Bajaj et al, 2016). For the purpose of this research work, GIS was used for the development of database for EEDC facilities located at Uwani in Enugu South L.G.A. Enugu State Nigeria as a sample case study. The end product of this research work can be used for effective planning, monitoring and management of power distribution facilities at Uwani.

STUDY AREA

The study area is Uwani, Enugu South Local Government area, Enugu State Nigeria. Uwani is between latitude 06°25' 18.60"N and 06°25'35.37"N and longitude 7°29'19.4"E and 7°29'42.40"E. It is mainly a residential area with little commercial activities. It is bounded to the North by Ogbete , to the South by Garki, to the West by Achara Layout and to the East by Ogui. Uwani is densely populated therefore resulting in high electricity consumption and a lot of facilities such as transformers, electricity poles.

MATERIALS AND METHODS

The following are the tools and data that were used as objectives to achieve the aim of this work.

Hardware

i. Garmin Hand held GPS
ii. Hard disk drive (HOD) 120GB
iii. A Computer System.

Software

i. ArcGIS 10.1
ii. Microsoft Office Suite

3.1 Data Collection

Satellite Image of the Area:

The satellite image of the area was downloaded from Google Earth. The image which was captured in 2014 is in JPEG Format.

Details of EEDC Power Distribution Facilities in the study area

Information about every transformer; its capacity, names and location in Uwani was provided by EEDC. It was very useful during the course of this project because the data provided were used in building the database of the facilities.

Geometric Data Capture

At every transformer and electric poles, the hand held Global positioning system (GPS) was placed beside them to obtain the x,y coordinates in UTM coordinate system. The coordinates of each pole were obtained street-by-street in relation to the transformer that serviced them.

Validation of the Satellite Image

The validation of the image covering the study area was carried out by obtaining the coordinates of prominent and pronounce features with a hand-held GPS. The features obtained were high tension pole, edges of buildings etc. The coordinates were then compared with the georeferenced image downloaded from Google Earth.

Implementation Strategy

Details on how the Vector Data of the Study Map were produced

The raster image of the study area was added into ArcMap and spatially geo-referenced (UTM ZONE 32 WGS 1984) using coordinates of prominent and pronounced features picked on the ground with hand held GPS. Shape files were created in ArcCatalogue. Care was taken to ensure all the shape files maintained the same coordinate system for the sake of uniformity. All the created shape files were added into ArcMap to optimize digitizing

Vectorization of the Satellite Image

The Satellite image was vectorized in ArcGIS 10.1 to realize streets, major roads buildings, etc in Uwani. The street names were annotated to represent the individual streets as they were on ground.

RESULTS

The following figures below are the research findings.

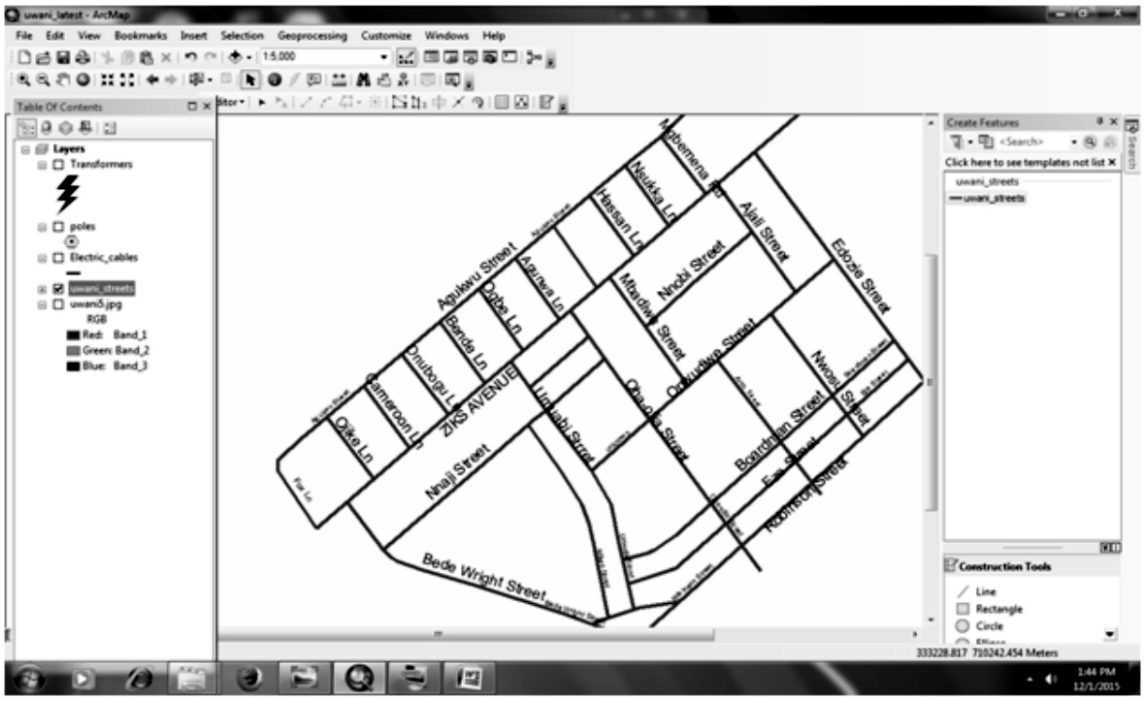


Fig 1. *Street Guide Map of Uwani*

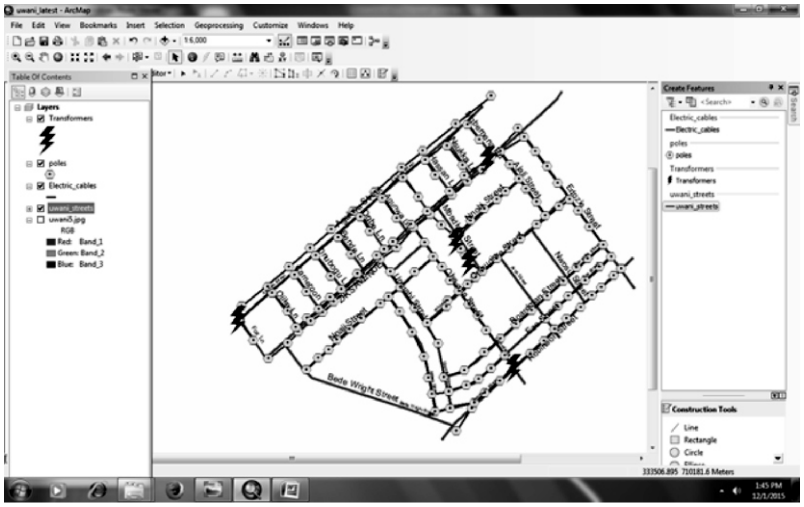


Figure 2. *Electricity Distribution network map and Street Guide Map of Uwani*

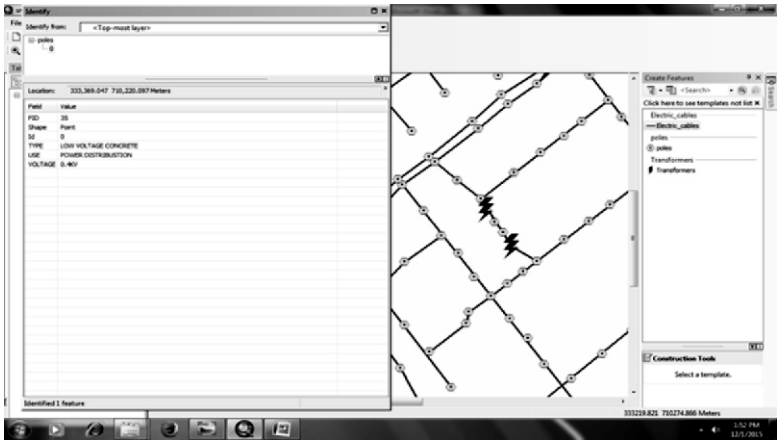


Figure 3. *Query Result of an Electric Pole*

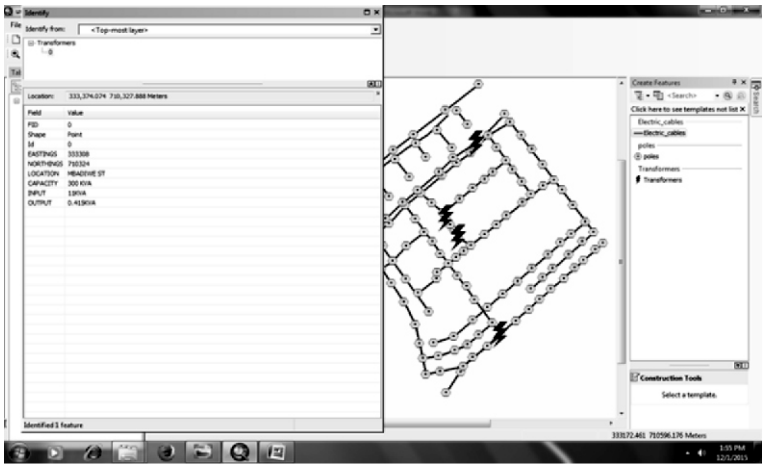
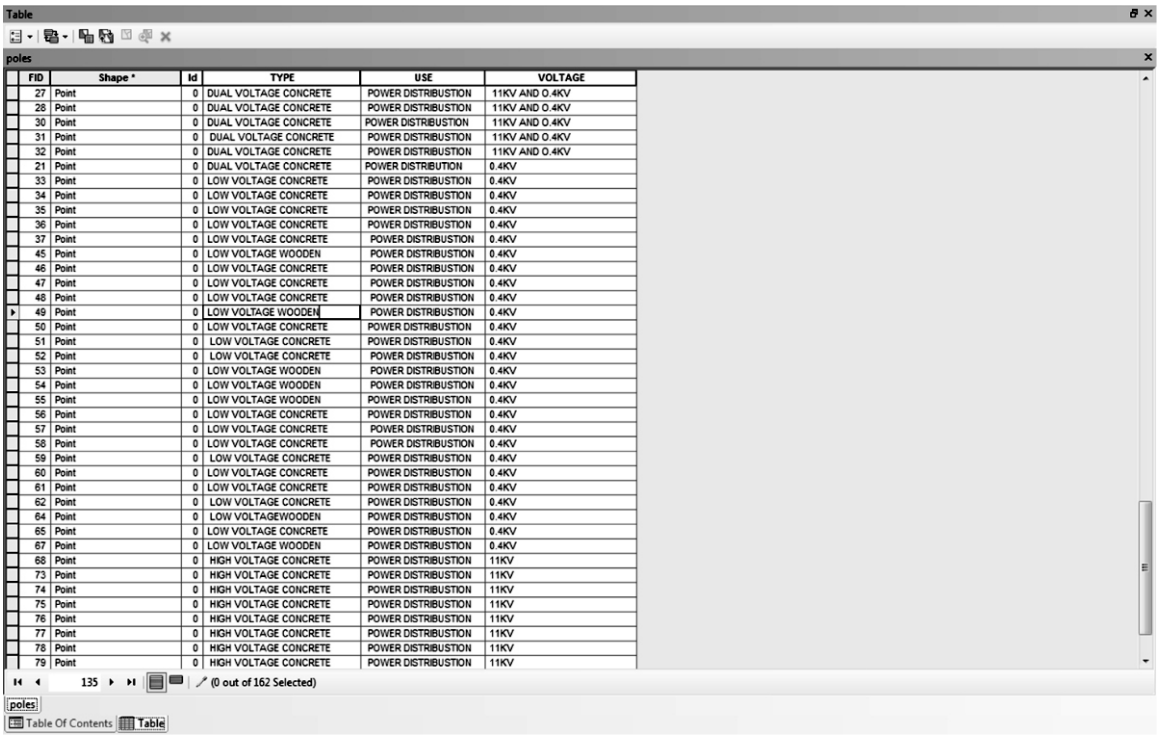


Figure 4. *Query Result of a transformer*



Table

poles

FID	Shape *	Id	TYPE	USE	VOLTAGE
27	Point	0	DUAL VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV AND O.4KV
28	Point	0	DUAL VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV AND O.4KV
30	Point	0	DUAL VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV AND O.4KV
31	Point	0	DUAL VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV AND O.4KV
32	Point	0	DUAL VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV AND O.4KV
21	Point	0	DUAL VOLTAGE CONCRETE	POWER DISTRIBUTION	0.4KV
33	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
34	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
35	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
36	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
37	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
45	Point	0	LOW VOLTAGE WOODEN	POWER DISTRIBUSTION	0.4KV
46	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
47	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
48	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
49	Point	0	LOW VOLTAGE WOODEN	POWER DISTRIBUSTION	0.4KV
50	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
51	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
52	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
53	Point	0	LOW VOLTAGE WOODEN	POWER DISTRIBUSTION	0.4KV
54	Point	0	LOW VOLTAGE WOODEN	POWER DISTRIBUSTION	0.4KV
55	Point	0	LOW VOLTAGE WOODEN	POWER DISTRIBUSTION	0.4KV
56	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
57	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
58	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
59	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
60	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
61	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
62	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
64	Point	0	LOW VOLTAGEWOODEN	POWER DISTRIBUSTION	0.4KV
65	Point	0	LOW VOLTAGE CONCRETE	POWER DISTRIBUSTION	0.4KV
67	Point	0	LOW VOLTAGE WOODEN	POWER DISTRIBUSTION	0.4KV
68	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV
73	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV
74	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV
75	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV
76	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV
77	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV
78	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV
79	Point	0	HIGH VOLTAGE CONCRETE	POWER DISTRIBUSTION	11KV

135 (0 out of 162 Selected)

poles

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Table 1. *Database showing locations of some Electric Poles*

DISCUSSIONS

Figure 1 shows a street guide map of the existing facilities of Enugu Electricity Distribution Company (EEDC) located at Uwani. With this map, the attribute table of the database will be populated with the names of the streets where the various facilities are located for the ease of querying the database. Based on this, EEDC will easily know the spatial information of their facilities which will in turn help them know the sections of the town that lack their facilities. Figure 2 shows the spatial distribution of the Electricity facilities in the study area. This map aids in knowing the coordinates of the facilities on ground and helps for faster location in the event of repair or maintenance. Figure3 and 4 shows the query results of an electric pole and a transformer respectively. The results of the query on the electric pole show a total number of 52 high voltage and low voltage concrete pole, 24 low tension wooden pole, 85 low tension concrete pole and a total of 5 transformers. Table 1 shows a database of the spatial distribution of some electric poles in the study area. This results will be of utmost importance to other Civil Engineers and Urban Planners. This is because, the knowledge of the spatial location of these distribution facilities will help prevent their damages during construction works and routine maintenance.

Analysis of Facilities of EEDC at Uwani in Enugu South L.G.A

i. Total no of dual (High Voltage and Low Voltage) Concrete Pole=52
ii. Total no of low tension wooden

pole =24

iii. Total no of low tension concrete pole =85

iv. Total no of transformer = 5

The results obtained from this research work will assist Enugu Electricity Distribution Company (EEDC) in the following areas;

i. Prioritization of facility maintenance and replacement based on the available information.
ii. Monitoring the status of their facilities
iii. Retrieval of geographic information of their facilities.
iv. Up to date information about the facilities.
v. The research will help engineers in the power distribution sector visualize the spatial distribution of data in maps and decide on which aspect of the distribution network they should focus before visiting the field.

Contribution to Knowledge

The research has provided a tool which will help the power company manage their facilities efficiently. This has in turn contributed to the general knowledge on the capabilities of Geo-information technology. In addition, the research work has also showcased the application of Geographic Information System in the production of Street Guide maps using Uwani in Enugu South L.G.A. as a case study.

CONCLUSION AND RECOMMENDATIONS

The research work clearly demonstrated the capabilities of Geographic Information System in creating a power distribution database which will in turn aid in the effective management of electricity distribution facilities.

With the results and achievements of the research work, EEDC can now easily locate and identify the exact spatial position of their facilities in Uwani using hand-held Geographic Positioning System (GPS) receiver. This will in turn boost their efficiency and enable a timely response in locating faulty facilities for repairs and servicing, thereby improving the general electricity supply to Uwani in Enugu south L.G.A. of Enugu state.

In addition, with the information technology system now available and database management system developed in this research work, EEDC can now make informed decisions on areas in Uwani that require new transformers, high or low tension electric poles, etc. and the overall monitoring and management of their facilities.

Moreover, new facilities that are installed can easily be updated using Geographic Information System.

Finally, the use of Geographic Information System has proved to be efficient and faster in data acquisition, storage, analysis and presentation. It is therefore recommended that staff of the various power distribution companies in Nigeria should be trained on the use of GIS. There is also need for greater awareness to be created at all level of government on the importance of Geographic Information System (GIS).

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