

Application of Remote Sensing and Multimedia Geographic Information System (GIS) in the Administration of Socio-Economic Activities in Nnewi Urban Area of Anambra State, Nigeria

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Abstract: The growth of world population has been a source of attention to Local authorities, which have limited resources to properly manage its assets and quality of services it delivers to the population. All such activities of the local authorities depend on spatial information. Nnewi Urban area of Anambra State is faced with a myriad of problems as a result of ineffective management of this spatial information thus leading to loss of enormous revenues by the urban authority. The available maps are static in inform and limited in its application hence, any addition/alteration regarding present/proposed land use or road network is very difficult to represent on plan. No new information can be extracted from printed maps likes area, location and no of units like educational institutions, major, health facilities, length of major roads, major settlements, financial institutions, major hotels and major motor and bike parks. All these leads to wrong estimation of expected avenue. Geographic Information System (GIS) and Remote sensing technologies are such leading/emerging tools, which can perform very active roles in the management of assets by local authorities, hence, the study: Application of remote sensing and multimedia GIS in the Administration of socio-Economic Activities in Nnewi Urban Area of Anambra State. The objectives of this study involved acquisition, digitally processing and integrating satellite image (Ikonos) over the study area and generating thematic data sets there from, creation of a multimedia GIS database for the study area and demonstrating through various analysis the potentials of the multimedia GIS in various socio-economic activities. The methodology adopted for this research involved acquisition of primary and secondary database of the study area, data processing and analysis using various software such as ARCGIS 9.0 for handling multiple table and relating them to each other as well as query manipulation using appropriate commands, U lead video studio version. 4.0 for video editing, Microsoft windows media player for playing video clips and G7 Towin software for processing GPS data. The result of database queries were presented inform of digital map (thematic maps), database tables, animated graphics and still pictures and subsequently discussed. It is recommended that urban authorities should develop GIS unit, embark on extensive retraining of existing staff on modern trend in spatial data acquisition amongst others.

Key words: Multimedia GIS, local Government Administration, spatial data, urban planning, project implementation

INTRODUCTION

In Nigeria (since 1963), an urban center is one with a population of 20,000 inhabitants or more (Kayode, 1997). Urbanization therefore, is an indication of radical physical, economic and social transformation that the society is passing through as a result of development (UN, 1970). Administration of socio-economic activities in any urban area will involve pooling together the human and material resources available to the urban development authorities. Many urban development and planning authorities do not have vital record or accurate data or enough finance to

implement their programmes and polices hence they rely heavily on federal and state allocation for salary payment, project implementation.

Geographic Information System (GIS) and Remote sensing technologies can perform an active role in management of assets by urban authorities (Igbokwe, 2005). These assets if properly managed will enable the exploration of potential revenue source to expand the existing ones with the aim of generating more revenue to the augment statutory allocation. This research x-rays a study carried out to achieve the aforementioned goals.

Study area: Nnewi urban area of Anambra State was the chosen area for the study. It is located between latitudes 5°59' 41.64"N and 6°03' 28.44"N and longitudes 6°03' 28.44"E and 6°52' 41.64"E. It lies within the tropical rainforest zone of West Africa. It is enclosed within Nnewi North Local Government Area. The major communities that make up Nnewi urban includes: Uruagu, Umudim, Otolo and Nnewichi.

Specifically, the boundaries of the study area were defined by the extent of coverage of the available high resolution satellite imagery. The average relative humidity is 80%. The mean daily temperature is 30°C, while the mean annual rainfall is 200 cm. The inhabitants are Ibos who are widely recognized for their industry and resourcefulness with skilled manpower in business, commerce and other professions.

The population of Nnewi North LGA as at the national population census conducted in Nigeria in 1991 stood at 121,065. This is made up of 61,617 males and

59,448 females (National Population Commission, Awka). This further confirms Nnewi urban status since the United Nation defines a city as a settlement of 20,000 or more in population (Albert, 1994). Figure 1a shows the location of study area, Fig. 1b indicates the map of study area with major towns.

The study area witnesses 2 distinctive climatic changes in a year, the dry season and rainy season. The city records highest rainfall around September. The rain occurs as violent downpour accompanied with thunderstorm and heavy flooding.

This area is characterized by presence of many tree species of the rainforest interspersed by tall grasses but most of these have given way to pockets of infrastructural development. Vegetation therefore, consists mostly of wooded shrub lands and pockets of forests. The basic crops within the study area are grown as subsistence or market garden corps. Thus, the farmland is mostly the outfield. A fallow system is practiced within the study

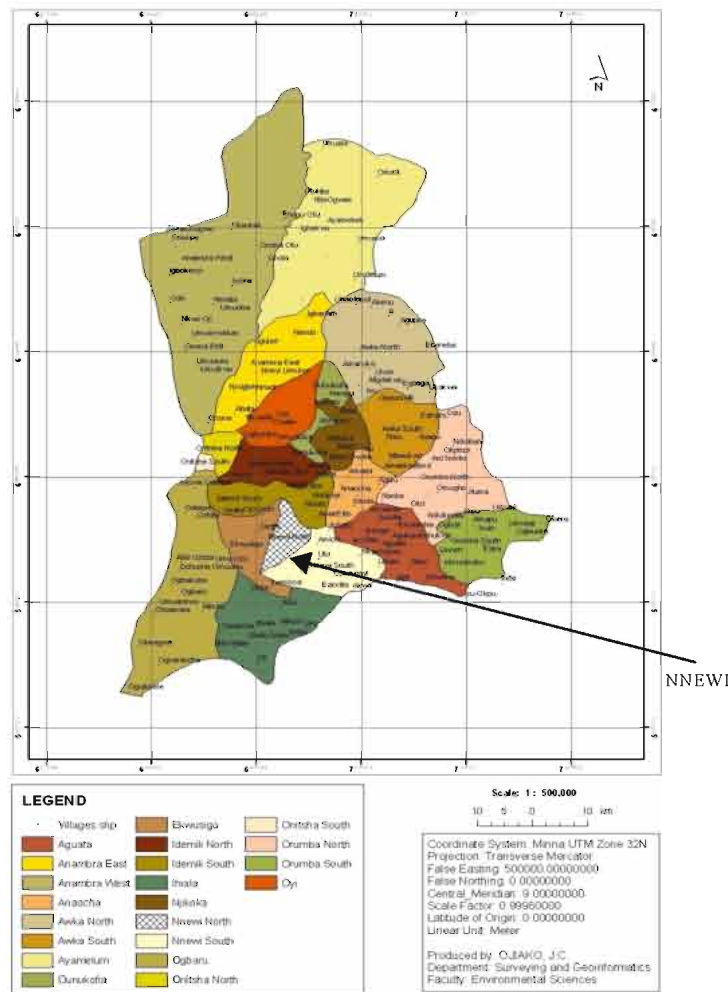


Fig. 1a: Map of Anambra state showing Nnewi urban area

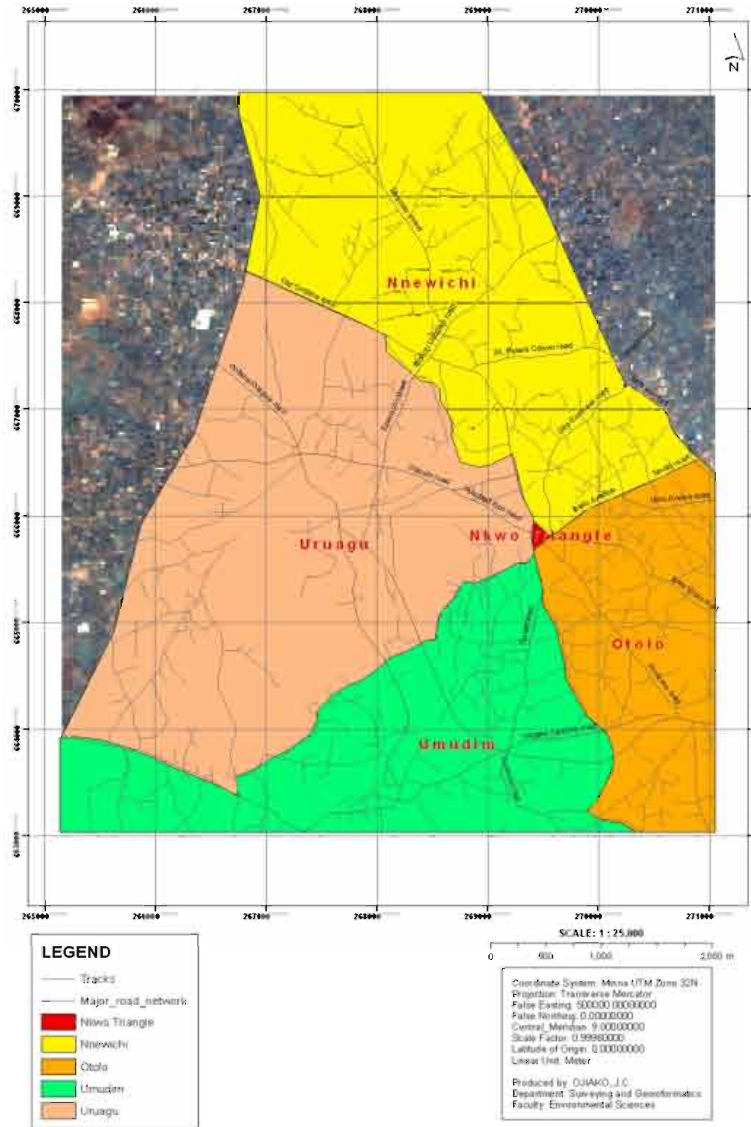


Fig. 1b: Map of the study area showing 4 major communities

area and major crops are yam, maize, cassava, cocoyam, vegetables and fruits. Other crop trees include palm trees, cashew, mango, rubber, oranges and pear. The agricultural practices in the area depend on the annual rainfall.

MATERIALS AND METHODS

The techniques adopted for various stages of the study are:

Planning stage: For a proper and effective optimization, planning is very important. In this phase of the project, the hardware and software selection was done.

Hardware requirement: These include the following: AO Scanner (for scanning maps), Pentium IV 2000 MHZ processor computer, Digital camera (Canon power shot A420), 1 No. handheld Global positioning system (Garmin gps map 76 sec).

Software requirement: The following software were used: ArcGIS 9.0 version, U lead video studio version 4.0, Microsoft window media player, G7 Toinw software.

Fieldwork/primary data acquisition: The primary datasets obtained through field visits were:

- Positions of sites of interest using GPS (Garmin GPS map 76 sec) where possible e.g., markets, financial institutions, health institutions schools, etc. The acquired GPS points were downloaded using G7 Towin software and later exported to Excel in the CVS format and saved as a text file for importation to Arcmap environment. The saved text file was later displayed in ArcMap environment after specifying the projection parameters. This was then overlaid on the digitized satellite image (Ikonos) to enhance proper identification and confirmation of such positions
- Attribute data includes non-spatial descriptive information on such sites of interests including published/unpublished records kept by statutory bodies and organizations
- Direct video coverage of sites using canon power shot A420 digital camera

Acquisition of secondary dataset: The secondary dataset needed were obtained mainly from digitization (using ArcGIS 9.0 software) of available map data and satellite imagery such as:

- Nnewi Urban map showing road network, towns and locations of sites of interests
- Satellite imagery (Ikonos) covering parts of Nnewi Urban

It should be noted that the satellite image on WGS 84 projection datum was converted to Mina Datum before being digitized in ArcMap environment (Fig. 2).

GIS database creation: The design of the database and its implementation were guided by the relationships between the data to be stored in the database. The database design process was concerned with expressing these relationships followed by implementation and setting up a new structure for these relationships within the chosen database software. A data model is generally to be made up of 3 components (Kroenke, 1998). A set of data structures, a set of data operations, a set of inherent integrity rules. The data modeling stage in this study comprised of 4 different level i.e., reality, conceptual design, logical design and physical design phases. The reality stage is the mental abstraction of the reality for any application. In this project, the objects (entity types) in consideration were Banks, motor and Bike parks, Hospitals, Industries, Hotels, major roads, major settlements, schools, communities/villages, Tracks/other roads. After this conceptual design phase was done, we had to decide how the view of reality would be represented in a simplified form.

Multimedia GIS database creation: This approach involved integrating multimedia in GIS (Schneider, 1999). The attachment of pictorial representation within the GIS

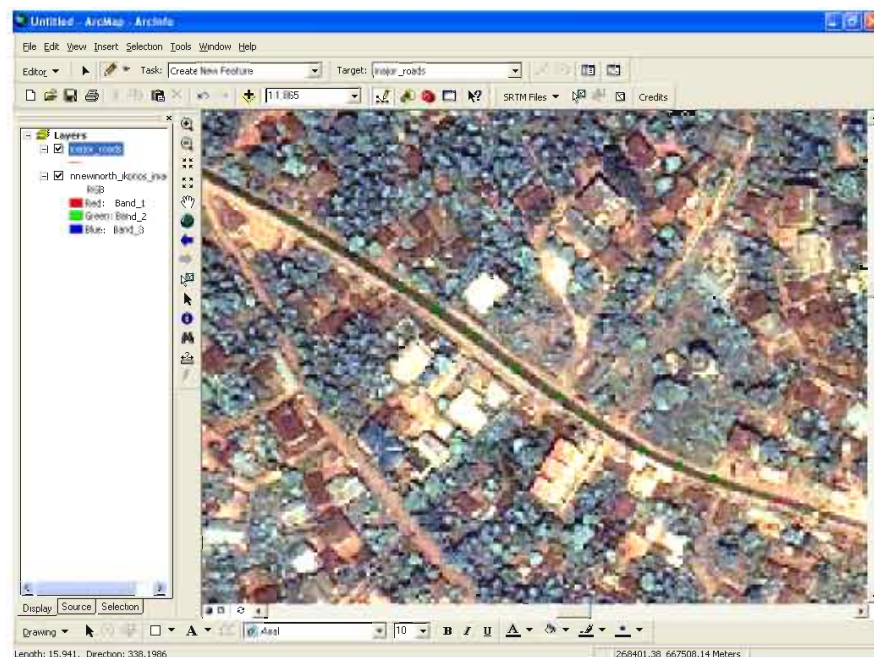


Fig. 2: Satellite image (Ikonos) of study area being digitized in Arcmap

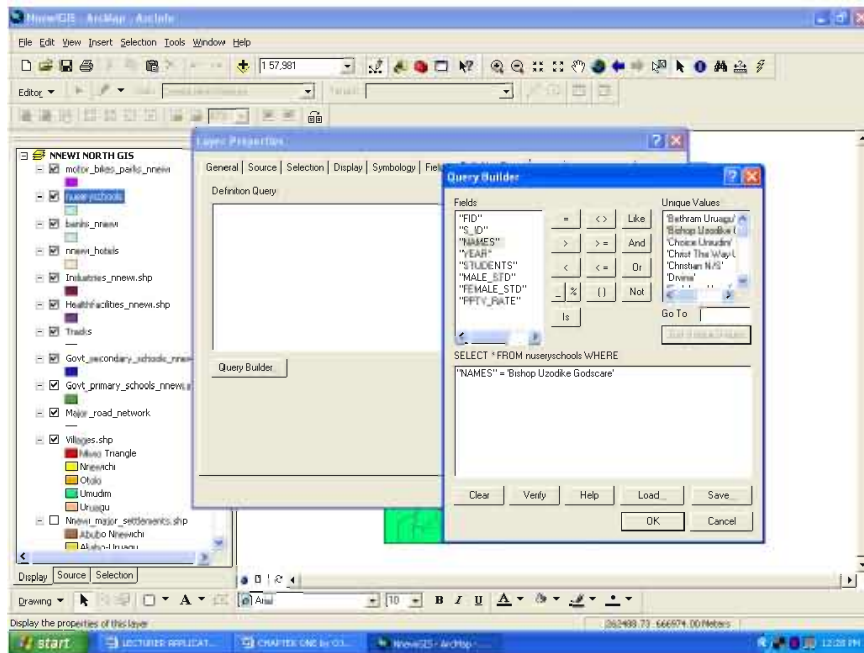


Fig. 3: A representation of query builder module of ArcGIS

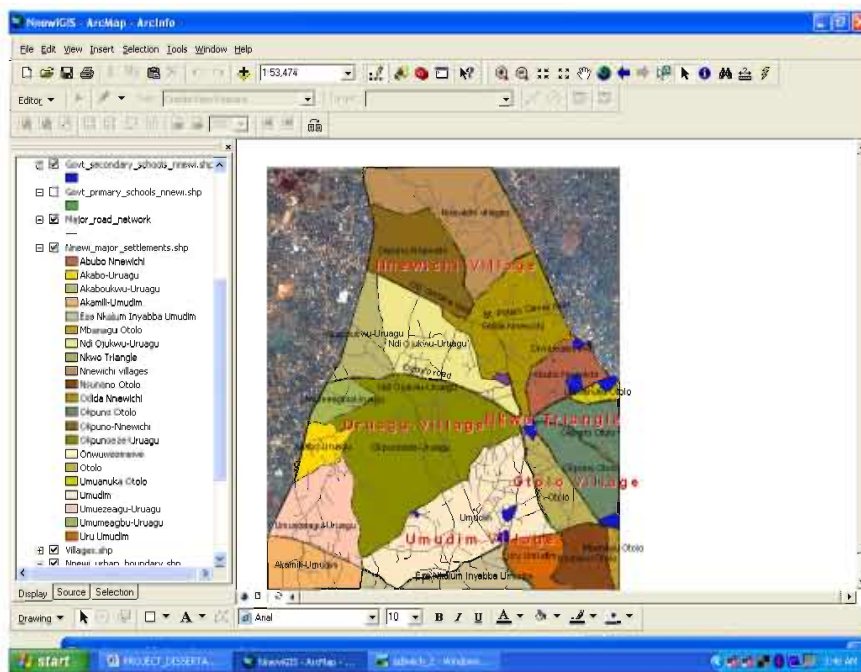


Fig. 4: Satellite image (Ikonos) of the study area with thematic datasets generated from it

was done using the hyperlink facility of Arc map. Pictures of various sites of interest were taken using a digital camera (Cannon power shot A420), edited using U lead video studio software and hyper linked in the GIS.

Development of analysis: This comprises of query implementation after GIS had been created. From the vital information inputted in the database tables attached to each object, the user can ask

questions in form of query or by the use of query builder module of ArcGIS. With the query builder module, expressions representing question to be asked in the database were used (Fig. 3).

RESULTS AND DISCUSSION

Results of database queries were presented in form digital maps and attribute tables. These include (Fig. 4-8 for samples of results obtained).

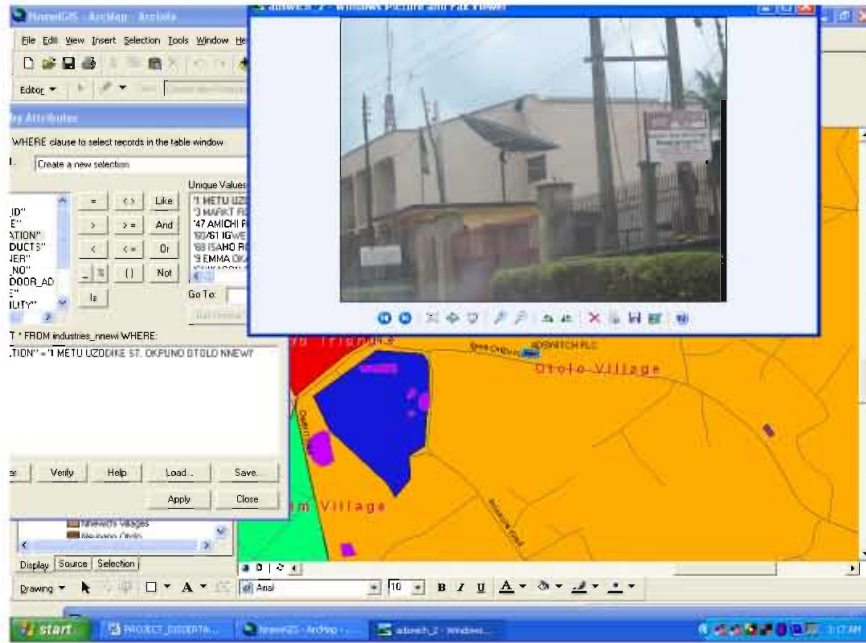


Fig. 5: A multimedia query of the study area

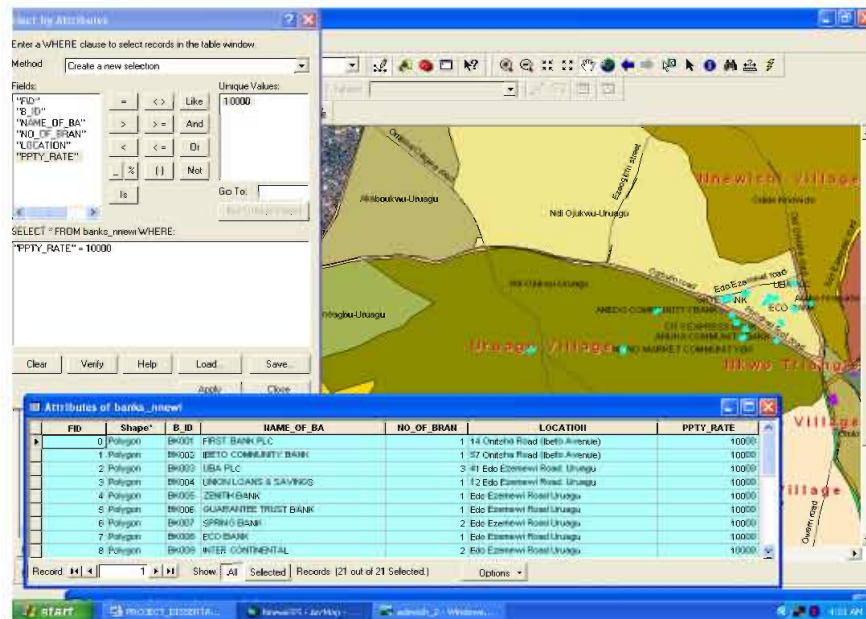


Fig. 6: Demonstration of multimedia GIS in socio-economic activities

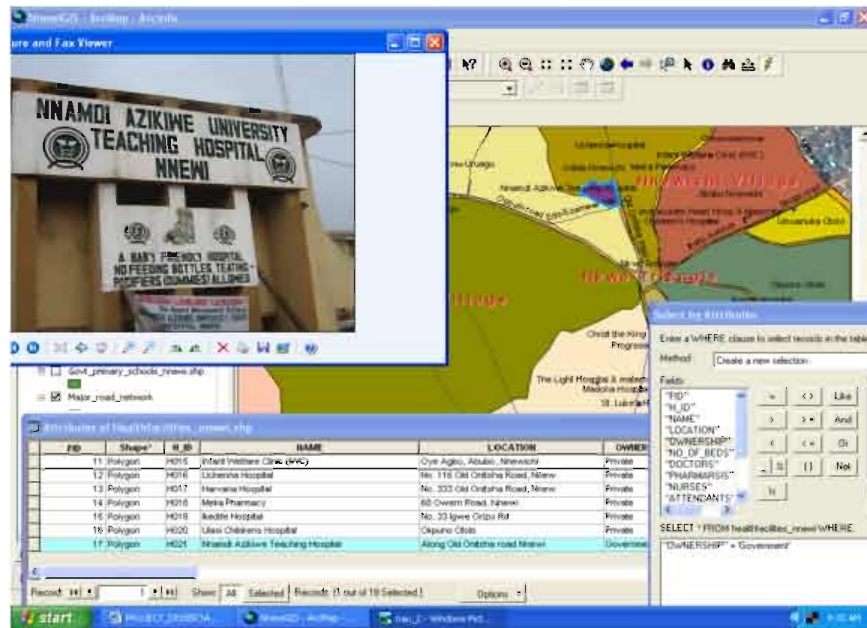


Fig. 7: Image hyperlink of Government owned hospital within the study area

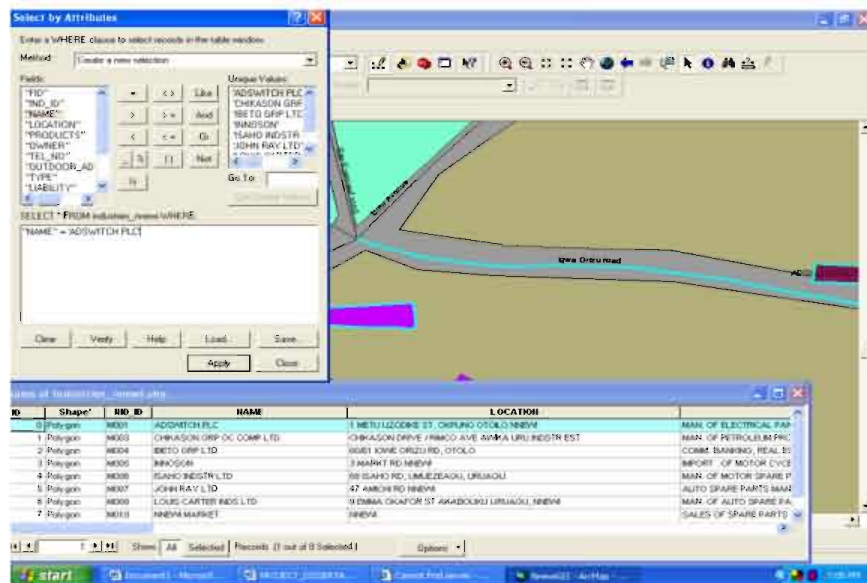


Fig. 8: Route analysis query of industrial facilities database within the study area

- Satellite image (Ikonos) of the study area with thematic datasets generated from it
- A multimedia query of the study area
- Demonstration of multimedia GIS in socio-economic activities
- Image hyperlink of govt. owned hospital
- Route analysis query

The Fig. 4 shows the satellite image of the study area with major road network and settlement as well as other thematic datasets generated from it. Different colours are used to distinguish between settlements.

This result Fig. 5 shows the location of an industry (ADS witch PLC) in the digital map as well as the multimedia view.

Figure 6 shows the query command to determine the banks that pays property rate ten thousand naira (N10,000.00) within the study area. The result shows a total of 21 banks.

Figure 7 shows a query command to determine which health facilities are owned by the federal Government. The result shows 1 out of 18 hospitals as well as the image hyperlink.

Figure 8 shows a query command to determine the best route to an industry (ADS witch PLC). The result shows the route (Igwe Orizu road) on he digital map.

CONCLUSION AND RECOMMENDATIONS

On completion of this study and based on experience gathered, the application of remote sensing and multimedia GIS will enhance the administration of socio-economic activities in Nnewi Urban Area and in other urban Areas of Nigeria in general. It will also be a veritable tool for attracting indigenous and foreign investors to contribute to the economic development of both Nnewi and Nigeria at large, it is recommended that the local authority should as a matter of urgency embark on the following measures in order to ensure efficient administration of socio-economic activities.

- Develop a GIS unit in each local government area or urban development board to be manned by a GIS expert
- Involve survey department of the local government or urban development board in the developmental project in order to ensure efficient data acquisition
- Public awareness on the need to freely give required information on data to the relevant authority by organizing seminars and workshops on issues relating to geographic information

- Extensive training of local Government and urban Authority staff on modern trend in spatial data acquisition and management
- A policy development strategies (integrating remote sensing and GIS technology) should be embarked upon by concerned bodies to alert mismanagement of human and material resources

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