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Spatiotemporal Dynamics Digital Mapping of Land Use, Obakekere Campus Federal University of Technology, Akure, Nigeria

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ABSTRACT

The quest for the production of digital map that could replace the existing analogue base map of Obakekere campus area of the Federal University of Technology, Akure; considering the rapid rate of developments has led to the dire need for this project. However, the review of available related literature has not taken into consideration, the digital mapping of Obakekere Campus area of the Federal University of Technology, Akure, Nigeria. The aim of the study is to produce a digital map with database for monitoring the present and the features land use activities in the study area. Ground survey approach was used in carrying out spatial data acquisition, the geometric data was acquired using South DGPS for control extension and coordination around the study area and Stonex R2+ Total Station was used for perimeter boundary traverse and detail survey of the area of study and the attribute data was acquired through social surveys. Data quality check was carried out to ensure data quality reliability, the data pre-processing involved data download, retrieval, sorting, editing, and storage respectively. The processing stage involved data plotting while Surfer 11.0 was used for Spot heights and Contours. The database was created with ArcGIS 10.3 that give room for dynamic changes over time. However in the future, spatiotemporal database which include spatiotemporal objects that supports corresponding query functionalities may be included.

Key words: Analogue, Mapping, Database, Digital, Coordinates

INTRODUCTION

Surveying is the process of determining the relative position of natural and manmade features on or under the earth's surface, the presentation of this information either graphically in the form of plans or numerically in the form of tables, and the setting out of measurements on the earth's surface [1]. It usually involves measurement, calculations, the production of plans, and the determination of specific locations. Surveying is important in many related tasks in agronomy, archeology, astronomy, forestry, geography, geology, geophysics, landscape architecture, meteorology, paleontology, and seismology, but particularly in military and civil engineering [2]. The authors further see surveying and mapping as the bedrock of all physical and socio-economic development of all nations. Therefore the importance of this sector cannot be over-emphasized. As a matter of fact, no sustainable development can take place effectively and efficiently without an inventory of human and land resources in their proper spatial context**.**

Mapping is the creation of maps, a graphic symbolic representation of the significant features of a part of the surface of the earth. Mapping surveys are made to determine the locations of *natural* and *cultural* features on the Earth's surface and to define the configuration (*relief*) of that surface [2].

Once located, these features can be represented on maps. Natural features normally shown on maps include vegetation, rivers, lakes, oceans, etc. Cultural (*artificial*) features are the products of people and include roads, railroads, buildings, bridges, canals, boundary lines, etc. The relief of the Earth includes its hills, valleys, plains, and other surface irregularities. Lines and symbols are used to depict features shown on maps. Names and legends are added to identify the different objects [2].

A map is the representation of any real-world object or location on a two-dimensional surface (a paper, a computer monitor etc.) [3]. Maps are indispensable for all land-based developments and activities such as road, dam and bridge construction, mineral prospecting, location of industries, boundary demarcation, flood and erosion control, urban and

regional planning, census mapping and enumeration, property delineation, tourism and recreation, development of cities, rail-lines, harbours and airports. Digital mapping (also called digital cartography) is the process by which a collection of data is compiled and formatted into virtual image [3]. The primary function of this technology is to produce maps that give accurate representations of a particular area, detailing major road arteries and other points of interest. The technology also allows the calculation of distances from one place to another [4]. A digital map is concerned with the automated methods of producing all kinds of maps, generally at medium to large scale. It is a mapping method that involves the use of digital electronics and information technology tools. Digital mapping is a complete process of producing digital map from the process of reconnaissance to computation and plotting using digital tools [3]. Digital mapping is advantageous as it can be made faster, cheaper and more accurately, fast to reproduce, better map analysis and revision etc.

Overview of Study Area

The study area is Obakekere Area of The Federal University of Technology, Akure, Ondo State, Nigeria. It is situated along the latitude 7º 15’ 0” N to 7º 18’ 22.32” N and longitude 5º 09’ 12”E to 5º 14’ 10” E. It is located within Akure South local government area of Ondo State. The total area of Obakekere Campus area of the Federal University of Technology, Akure is 166.778 hectares.

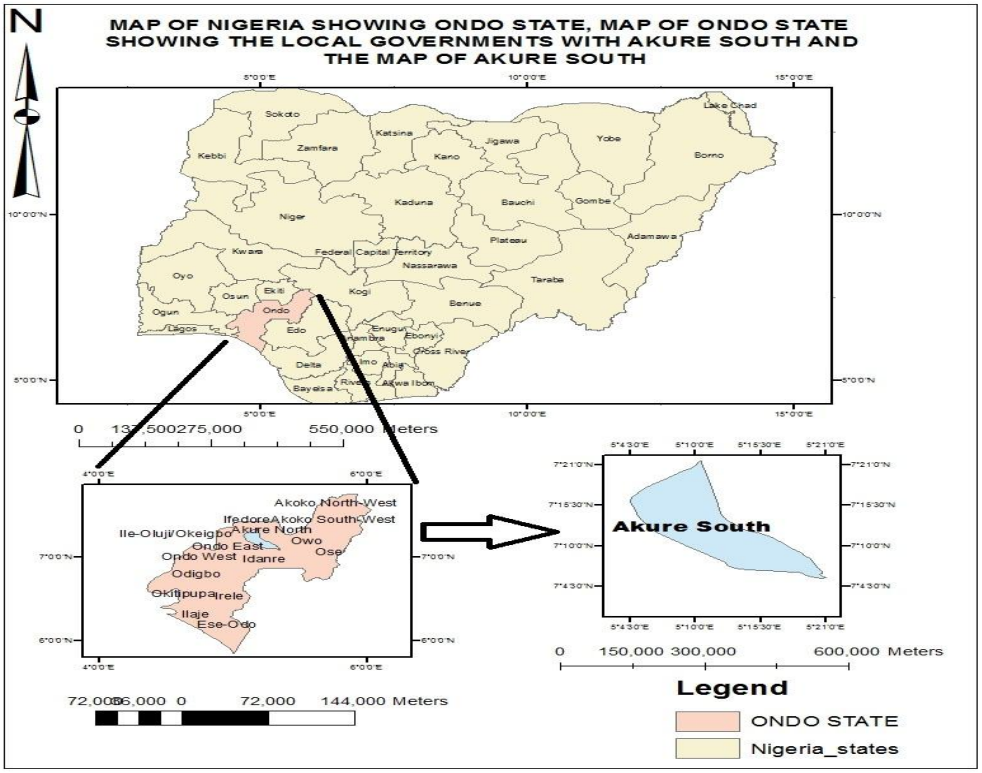

Fig. 1 Map of Nigeria showing Ondo state and Akure south local government

Fig. 2 Google Earth Image of Obakekere campus FUTA 2016

MATERIAL AND METHODS

For the production of digital maps, series of methods and principles were applied and carried out on the field. More so, earlier schedule of scope of work was adopted to ease the task. The data used involved the attribute and geometric data. Attribute data information contains information that can be linked to the spatial data or geometric data. It is referred to as the project fact about the objects within the area in question. The information obtained from the ministry is the coordinates of government control pillar used to coordinate the study area and Google earth map used to get necessary information about the geographic features on the project site e.g. information about buildings or roads condition, names and function of building, type of electric poles, etc. and guidance and to know where updating is needed. These data formed the attribute part of the features necessary for database creation. Geometric data acquisition is the locational data (X, Y, Z coordinate) acquisition from the site.

RESULTS AND DISCUSSION

Results

From the table 1 below shows the Northings, the Eastings and the height as obtained from the field observation using Total Station. Each row shows the coordinates for each point.

Table -1 Perimeter Survey Data Extract

Point	Northing	Easting	Height
BP1	806577.813	737423.030	365.521
BP2	806581.610	737295.097	363.428
BP3	806582.960	737227.964	367.350
BP4	806563.574	737229.856	365.475
BP5	806536.628	737080.120	371.898
BP6	806579.680	737074.401	369.616
BP7	806586.716	736941.618	367.847
BP8	806591.300	736876.328	365.213
BP9	806600.517	736753.273	368.728
BP10	806608.735	736667.130	370.236

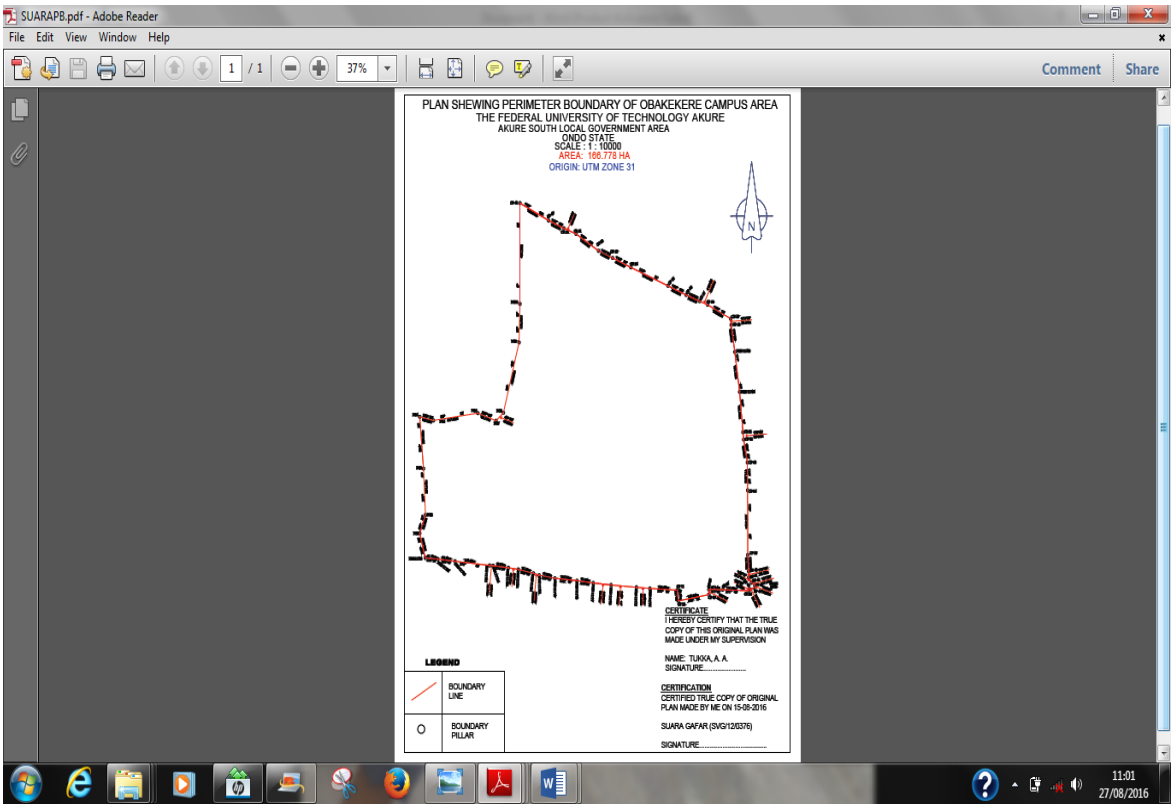

Fig. 3 Plan showing Perimeter Survey of the study area

Road Network Data Extract

The extract of road network data is presented in table 2 as obtained from the field observation using. Each row shows the coordinates for each point.

Table -2 Extracted data for road networks

Point ID	Northings	Eastings	Height
RD1	806639.526	737418.547	359.309
RD2	806716.094	737407.125	359.794
RD3	806733.33	737407.884	360.02
RD4	806790.653	737407.474	360.385
RD5	806796.951	737407.459	360.493

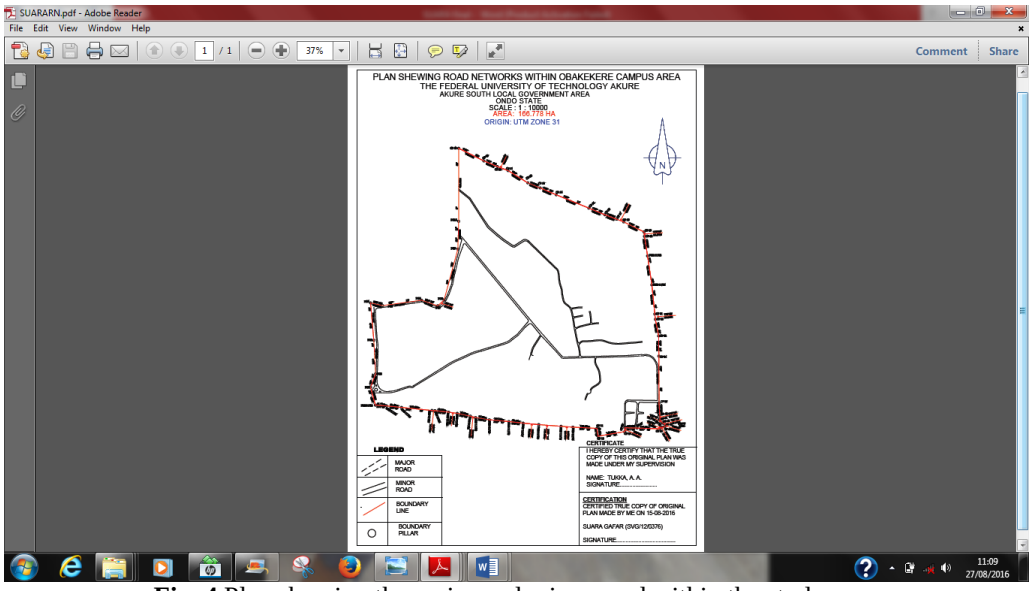

Fig. 4 Plan showing the major and minor road within the study area

Presentation of Contour results

From table 3 Column shows the extracted coordinates for each point.

Table -3 Extract of contour data

Northings	Eastings	Height
807917.376	736547	377.3028
807882.068	736545.35	376.7566
807903.478	736563.09	376.5743
807861.551	736565.39	375.8964
807844.769	736581.46	374.8682
807823.531	736539.45	376.8753
807813.893	736527.56	376.9945
807816.683	736512.58	377.0912

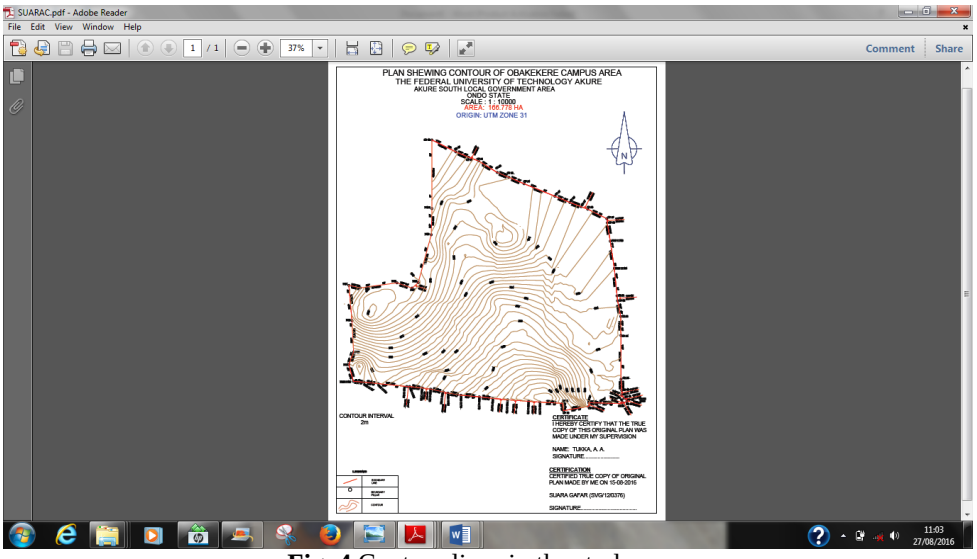

Fig. 4 Contour lines in the study area

Presentation of data for all features and details Results

The table 4, below exacted coordinates as obtained from the field observation. Each row shows the coordinates for each point.

Table -4 Sample of extracted data for all features and details

Point	Northing	Easting	Height
EP1	806877.3653	737403.7844	361.2892
EP2	806832.1158	737404.0625	360.8451
EP3	806789.3521	737418.5094	360.4920
HCP1	806782.5742	737402.8798	360.5922
FHC1	806802.0043	737401.1388	360.7455
FHC2	806842.1604	737400.8736	361.0982
CFS1	806779.8007	737401.5091	360.5248

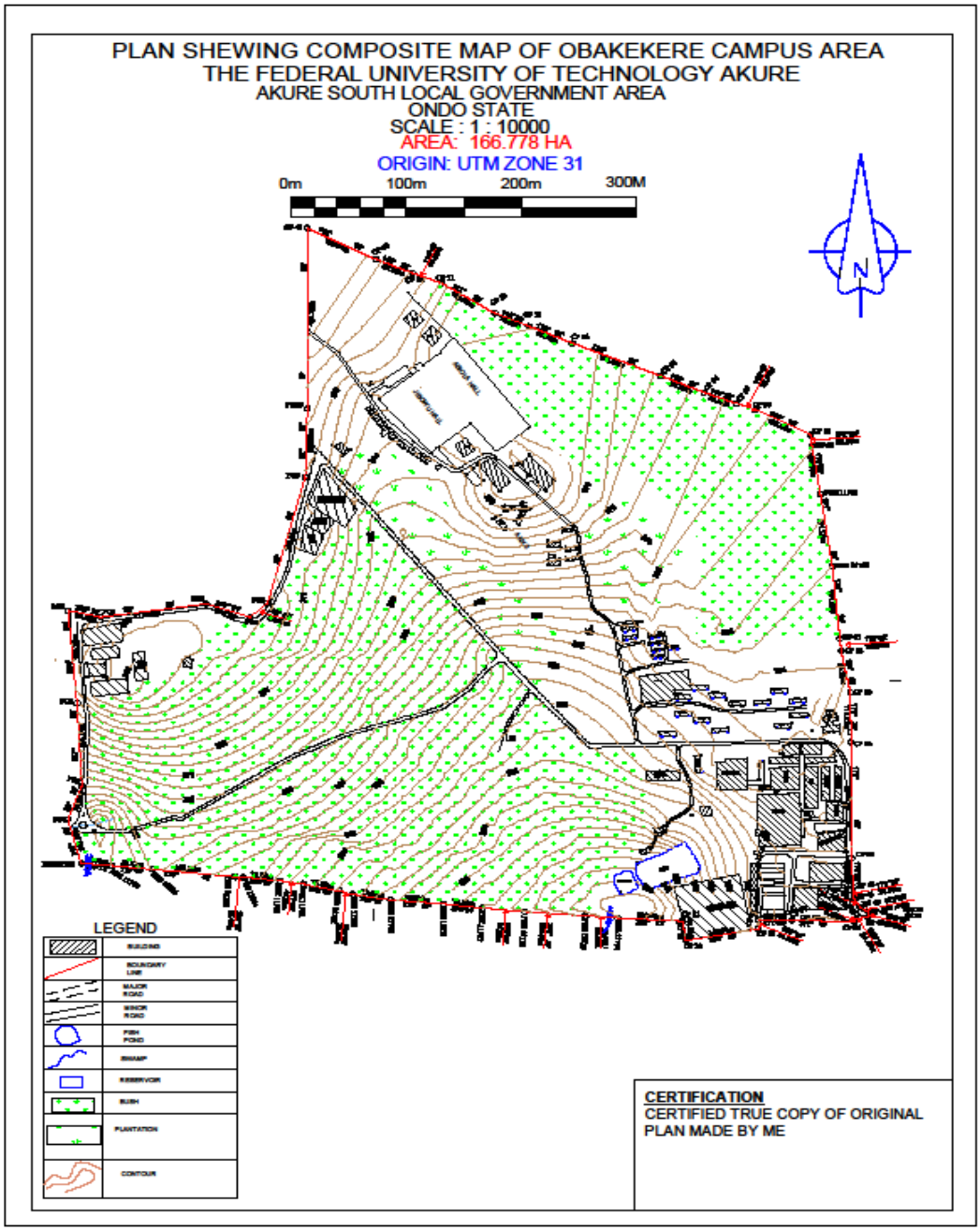

Fig. 5 A Composite Map of the study area

Discussions

The spot heights can be classified according to their values as high, mid and low. The points with the higher contour show that no water logging can take place there. While the points with moderate contour can contain little water and the points with low contour value needs to be filled as some of it are ditches. More so, the channels for some of the water bodies along the area of study should be cleared of debris for free flow of water to avoid stagnancy of water and its effects such as unhealthy odour and breeding grounds for mosquitoes. The digital mapping of Obakekere campus area of the University was segmented using names and Codes such as Buildings (BDG) Staff quarters (SQR), Road (RD), FUTA Fence (FFC), Water tank (WT), Electric poles (EP), FUTA Health Centre (FHC), Mosque (MSQ). Queries for all existing communicational features such as offices, lecture room, laboratory, staff quarters and hostel. The result were analysed by performing queries on the designed database for all features in the area study using ArcGIS software.

Spatial Query

Queries were designed for the purpose of retrieving information from the database. The queries performed in this project gave answers to certain generic questions asked from the database. This was made possible as a result of the implicit link of both the spatial and attributes data. The queries were based on the products from the analysis carried out on the database. During the creation of the attribute table, the query is done. After the query for Ohaneze road within the study area in the database, the road was highlighted as shown in the figure above both on the map and in the attribute table which gives full information concerning the road such as shape, length, name, condition, width, start point and end point of the road.

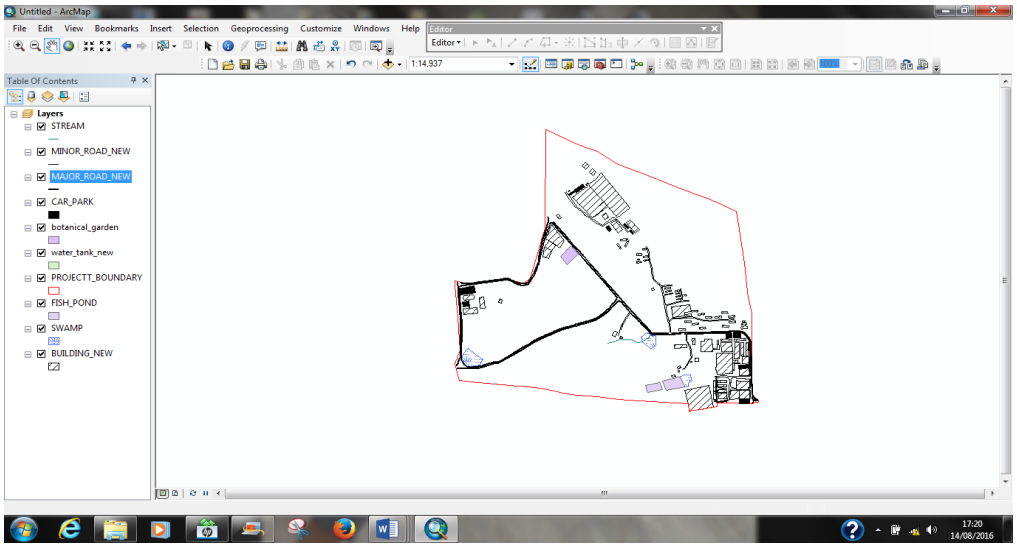

Fig. 6 Study area before querying

Single Criteria Query

A single criteria is carried out where one condition is used to design query. This condition is used to retrieve the information from the database. This was performed using the single query syntax: NAME = “OHANEZE_ROAD”).

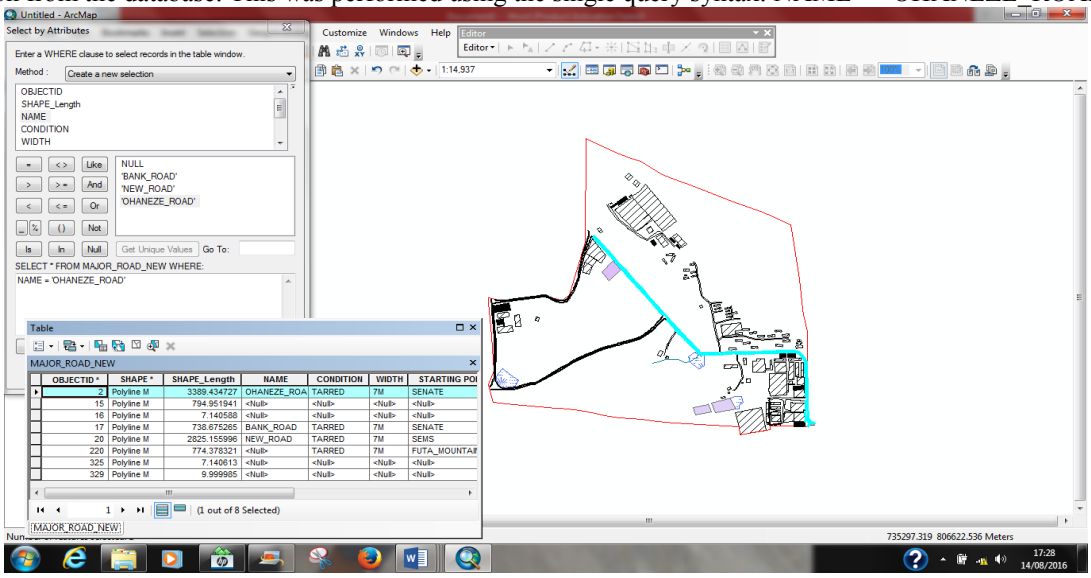

Fig. 7 Result of query for Ohaneze Road in the study area

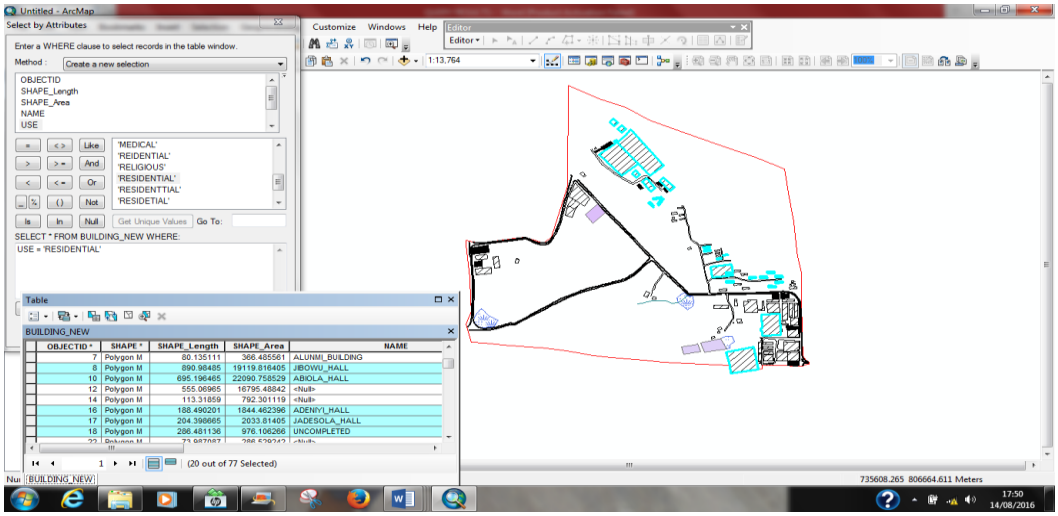

Fig. 8 Result of query for all residential buildings within the study area

After query was performed for all Residential buildings within the study area, the buildings were highlighted and this shows the properties of all the queried road such as capacity, area and names of each buildings.

Multiple Criteria

This is a situation where two or more conditions are used to design a query. The conditions determine the information that may be requested by the user from the database. The double query was performed using the double query Syntax: NAME = "MAALU ROAD AND ZOO ROAD".

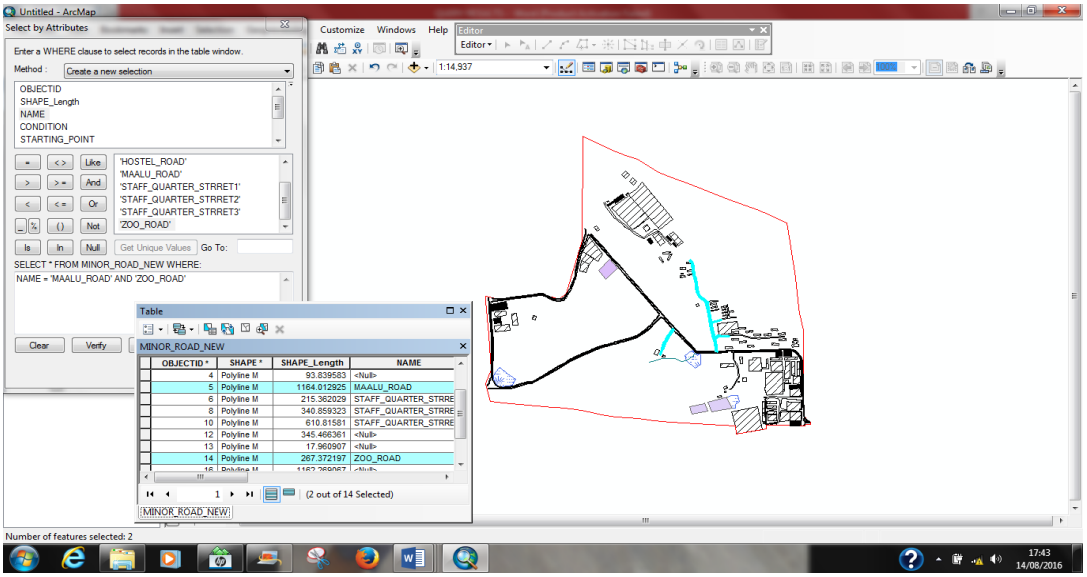

Fig. 9 Query of minor roads leading to FUTA Zoological Garden

After the query was performed for minor road leading to FUTA zoological garden, they were highlighted as shown in figures 7, 8 and 9 and the query also give an insight on the properties of the minor roads such as length and distance to place of interests, name and condition.

CONCLUSION

This study has attempted to produce the spatiotemporal dynamics digital map with database for Obakekere campus area of the Federal University of Technology, Akure, Nigeria.

Specifically, the geometric data was acquired using Total Station and its accessories, while the secondary data was acquired through social survey for database design creation. The data quality test was carried out before processing so as to validate its correctness and reliability. The quality of the data acquired are reliable based on the procedure used in accessing the control station stability that was used as a reference to connect the project.

Conclusively, the perimeter survey, spot height, contour map and the digital map of the study area were successfully presented using AutoCAD and Surfer 11.0. The database was created using ArcGIS 10.3. Therefore, it can be inferred that the digital map and detail survey from the study could be adopted for a typical infrastructure representation and development with query within the University. The digital map and detail survey in this work proved to be an alternative

to the existing analogue base map of Obakekere campus area of the University with new developments of feature and detailed update inclusive. It is hereby, recommended for adoption and as a replacement of the existing base map of the University.

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