MODELLING BUILDINGS USING STATIC 3D GEOGRAPHIC INFORMATION SYSTEMS (GIS)-CASE STUDY OF RIVERS STATE COLLEGE OF ARTS AND SCIENCE (RIVCAS) CAMPUS, PORT HARCOURT - NIGERIA.

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Abstract

3-Dimensional (3D) model of earth’s man-made features is very important for built environment and facilities management professionals. The virtual reality modelling language (VRML) technology enables virtual 3D models of static geo-location building. 3D models data are used for planning, visualization, and space analyses. Open sources data (e.g. Google Earth and other web map services) increase the needs for 3D model. The campus is a small space to experiment this work. In this work, a static three-dimensional model Geographic Information Systems (GIS) of building and terrain of Rivers State College of Arts and Science (virtual 3D campus) will be modelled. This study aim to create Static 3-Dimensional (3D) Campus model using extruded building footprint method (building heights) and it will exported in geometry-VRML; freely available open source Google Earth imagery was used to digitize 2D building footprint in GIS shapefile using Harvard world map. In addition, one meter contour of study area converted into triangulated irregular network (TIN), and further to raster format, and save in VRML file format. ArcScene was used for processing and visualizing model and terrain results. The 3D models of the campus will be integrated in land information systems. Multimedia - the model animation will be export as Video Clip and use as campus 3D tour on the institution website. This paper will outline the introduction, methods, Results, Conclusion, and outlook.

Keywords: 3D building models, Virtual Campus, Static 3D GIS, and open source data.

INTRODUCTION

According to Singh et al., 2013, techniques based image are useful for 3D building Modelling. In third world country like Nigeria, 3D images in street view are not available in Google earth and other web map services. Alternatively, the traditional building surveys can be used to determine elevation of building. To the planners 3D visualisation and modelling is important and topic for researchers of Geoscience and others (Markus et al., 2008), Markus et al., 2008 further states that 3D city models using GIS as a tool that has evolved for urban decision processes and information system particularly in planning, simulation, and navigation. GIS helps in modelling of the earth’s features and other man-made urban features, in a three dimension and is refer to as 3D city models (El Garouani et al., 2013).

Singh et al., 2013 defined a Campus as “a land of College, Institute or University, on which the buildings are situated”.

According to Torrens 2014, general group modelling of city in three dimensions, and are based on their operational purposes, and these can be categorise into four main types:

1. Three dimensional computer aided design models
2. Geo-database three dimensional cities models in Static mode
3. Modelling of spatial three dimensional Navigable cities, and
4. Simulation of 3-Dimensional model of urban environment.

Torrens 2014, further states that modelling in 3-Dimension is useful in querying city environment in a spatial database, also spatial processing on the Web, in addition visualization modelling output, and further accessed to simulation operational models.

The buildings approach use the plan dimension polygon as building footprints (in GIS shape file), to their appropriate elevation (building design heights), and extrude footprints to their appropriate height (building apex), in static format based on VRML polygon or geometry. For terrain, the approach is to create Triangulated Irregular Network file, and convert to image (raster format) as terrain model.

This work aim to create Static 3D GIS model of a Campus using extruded building footprint method and save as geometry (VRML); the Harvard Google Earth imagery base map is use to digitize 2D building footprint and for visualizing 3D building model results in ArcScene. In addition, the campus terrain is model using one meter contour of study area.

STUDY AREA AND TOOLS

RIVCAS campus lies Latitude 04°50’ North and Longitude 06°59’ east situated at Rumuola, in obio/akpor Port Harcourt, Rivers province, Nigeria. According to the school website, the Nigerian Government established school as Rivers State School of Basic Studies in 1977, and by the1991 Law, the institution was upgraded to a College stature. The Technical Nation Board accredited RIVCAS Programmes same as other Polytechnic institution within Nigeria.

Tools: ArcScene is one of the three components of ArcGIS 3D Analyst. ArcScene application is made of the SxDocument. The sxdocument contains scene and the library of 3D Analyst has SceneGraph, which records events and data occurrence in scene. This process allows spatial data to be view in the third dimensions. 2D Features are transforming to 3D by using elevation information from the geometry of feature.
METHODOLOGY
Firstly, select the location of campus from Google Earth. Next, Google earth imagery output is projected to user EPSG (UTM ZONE 32N) using the number (code). Freely available open source Google Earth imagery base map was used to digitize 2D building footprint on the Harvard world map platform and the GIS shapefile output format was downloaded and exported to Arc Scene. In addition, one meter contour of study area converted to TIN format, further converted to raster as topographic model, and then exported it as VRML geometry. Arc Scene was used for processing and visualizing model and terrain results. Overall method is as shown in fig(3).

RESULTS AND DISCUSSION
A static 3-Dimensional geodatabase model of building and terrain of RIVCAS campus (virtual 3D campus) was created.
Rendering of the street and road not achieved. In this work, other features such as trees and vehicles not modelled. Modelling is not very easy for these elements using static approach. The models shown in figure 4 to 7 above are spatial queries and visualization in a geo-database. Model are not navigable and cannot be query in real-time; however, the query can done be on building in static three dimensions as displayed in figure 4 to 7. The 3D static campus models can be view as building information systems. The model animation can be export as Video Clip and use as campus 3D tour on the institution website. The terrain model also shows the campus landscape. The school management can used the model for space planning and analysis.

CONCLUSION AND OUTLOOK

To the surveyors, this work have provided a technique for modelling heights beyond 2.5-Dimension(x, y, z), and 3D [x, y, z, and features (building), heights] using the GIS tools is now an option of expanding professional boundaries.

3D modelling of any campus is very important for school management for space availability, situation, and structural characteristics that lies within the campus. This paper has also provided an effective approach using exist built environment for 3D modelling of user community to virtualise 3D Campus or cities static format. The 3D models may be display on website of RIVCAS, to attract the visitors for simulation, analysis, visualization, and animation. Future work will contain solutions for modelling of spatial three dimensional Navigable cities and 3D urban simulation model.

References