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Mitigating the Challenges of Building Maintenance Using the Integration of GPS, GIS and Remote Sensing: A Case Study of Federal Polytechnic, Idah, Kogi State

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Abstract— *This study focused on the integration of GPS, Remote sensing and Multimedia GIS. This integration provided very powerful approach for monitoring infrastructures allowing for enhanced geographic information. The integration of these technologies led to the generation of a hyper map. Through this integration, a research gap was filled in the area of lack of compatible database system for multimedia systems. The database so developed is called Normal Relational – Hypermedia database system. This System is an offshoot of the University of Nigeria Relational - Hypermedia database System. The database is capable of storing, retrieving as well as query the database nonlinearly using hyperlinks.*

Keywords— *GPS, Remote Sensing, Hyper map, Multimedia GIS, Database, Relational – Hypermedia.*

I. INTRODUCTION

Maintenance issues is a threat to the wellbeing of both public and personal building infrastructures in Nigeria and this ultimately results in depreciation in the value and use as well as in the aesthetics of such buildings. Besides, defects of varied degrees are brought about. According to the 1984 version of BSI, the act of attempting to keep a building in its original state or return it to the its original state such that it would maximally perform the duties or usage required of it is referred to as maintenance. This in essence is a combination of deliberate technical and intelligent processes and procedures (BS1 1984). The older edition of it had it that maintenance of building has to do with the work carried out in order that a building may be kept in an acceptable state so as to be able to perform its intended functions or to keep it in any state that may be acceptable in any given time (BSI 1974).

The act of making sure that things threatening the wellness of the buildings are removed or not allowed to develop at all through proactive and conscious endeavours is referred to as retention. On the other hand, restoration is the removal of minor defects from building. To make buildings continually performing, it's worthwhile to note that some elements of embellishment or improvement are required to be effected periodically, taking into consideration the required standard of comfort and available amenities. The ability to manage multimedia GIS when integrated with GPS and remote sensing is a very effective technology by which the environment can be represented through its very successful visualization capabilities. This is because it generates a visual model through the use of photos and videos which never tell lies.

Also, image models have a lot of benefits over graphical ones. Among such benefits is its ability to be generated using either specialized camera or normal digital ones. When produced using ordinary camera, they are quite cheap and affordable while still being effective. For the photographic competent of the multimedia, they are normally shown in 2D and can be assembled from a series of photos and they adequately mimic the environment (Cohen, 2000). Multimedia application permits generation of cheap but scientific modeling of reality that could support some form of measurements. These images form rich reservoir of information about real world and spatial entities and are indispensable component of the database (chapman and Deacon 1998).

Mosaicking photographs and video chips are cheaper and faster than solving complex mathematical equations for solving some problem.

Terrestrial photogrammetry is currently a preferred method when designers and planners aim to monitor and map bridges, pipelines, transport networks etc. where the axis of the camera takes care of the area surface to be covered (linkedin.com 2016).

Multimedia GIS is applicable on the internet as it is very amenable to it. It is also a suitable documentation method for informatics. A new sphere is being added to georeferencing of informatics to generate an information platform with more effectiveness (Alkay and Altan, 2003). This is called hyper-mapping which according to Guney (2004) is a map with multimedia data formats and used in a multimedia geo-representation. Such a model is used for designing and implementing hyper map database management system, as well as for modeling hyper map application is GIS. Multimedia in essence is the representation of various media components like photo, audio, video, text, animation on the computer system such that they are displayed in harmony. Multimedia GIS is the fusion of GIS with multimedia (Unel *et al.*, 2006).

The combination of multimedia data with map gives rise to more colourful illustration and technical issues giving rise to educational effects. That is because as they are shown in different formats, they permit a high degree of visualization which makes them easily remembered by viewers.

Advantages of MMGIS

1. They have the ability to render services to but skilled and unskilled users
2. Multimedia representation affords the users comfort as well as ease of analysis. The users thus easily understands the rendered data sets better
3. The users tend to be retentive of the information displayed than when rendered traditionally owing to various formats of rendering same information
4. It permits display of data in digital format and speeds updating of same at the minimum expenses

5 Data acquisition procedures are improved as well as the accuracy, management and display (Soomro *et al.,* 1999).

II. Literature Review

The ability to sustain huge public investment has posed major challenges to developing countries where the developments of infrastructures are yet at the minimal level (Ojara, 2013). This is due to the fact that successive administrations tend to focus on provision of infrastructure like road, railway, generation and distribution of electricity, etc. This is on not so in developed economies where the focus is on how to maintain the existing ones. In order to create the atmosphere of sustainability, the culture of maintenance must be bought and cultivated. This will reduce the level of dilapidation witnessed in public infrastructures as indentified by Ojara (2013).

BS 3811 (1974) defines maintenance as the integration of procedures through initiation, organization and implementation towards retaining an infrastructure in a state in which it can maximally perform the functions required of it. Kunya (2012) identified defects in housing infrastructure to include wall surface peeling, high rate of substructure dampness, failure of floor slab, leaking roof and beam sagging among others. He stressed that the culture of maintenance must include timely diagnosis of threats and taking adequate steps to prevent deterioration. The absence of timely information of such defects is the bane of most public infrastructures and it has led to the rot and delay witnessed in them.

Ipingbemi (2010) noted that defects in housing infrastructure are caused by the use of sub- standard materials like cement, chippings etc. lack of proper management, non-availability of checkup of the infrastructure and failure to engage skilled Geoinformatics experts to generate the monitoring data.

Ipingbemi (2010) further noted that attention of government was more on developing new properties without paying attention to maintaining the existing ones and its sustainability. With the down turn in economy of the Nation, attention is now being paid to maintenance of the existing stock of infrastructures. Maintenance of buildings becomes more difficult as the age of the facility increases coupled with the quality of materials used originally and maintenance routine (Adenuga 1999). Siyanbola *et al.,* (2013) noted that building maintenance did not receive adequate attention from designers, contractors and users. The essence of maintenance is to keep buildings as initially envisaged functionally, structurally and aesthetically so that they remain in such lofty state and keep their economic value for a long period of time (Ipingbemi 2010). Users of such facilities do not use them wisely as they hardly follow the guidelines contained in users' manuals where they exist (Siyanbola *et al.,* 2013). Majority of developers try as much as possible to keep maintenance cost to the barest minimum to maximize profit and undermine the long time effects of this action on the property. Sometimes designers are unmindful of the expected life span and ease of maintenance of materials used in construction (Adejimi, 2005).

Kunya (2012) was of the view that short comings or defects can be averted by using qualified artisans, careful use of facilities by occupiers, using correct construction materials, regular monitoring of structures using surveying and Geoinformatics approach and prompt utilization of the information so acquired.

Aim and Objectives

The aim of this study was to show the effects of urine on walls and general deterioration of public building using Geoinformatics techniques.

The objectives included the following:

(a) Collection of spatial data using total station.
(b) Collection of digital photographs.
(c) Collection of videos.
(d) Creation of a robust database system to store, manage, analyse and display the data

III. Materials and Methods

Study Area

Federal Polytechnic Idah was formerly called Idah College of technology and it is owned by the Federal Government of Nigeria and was established in 1977 in Idah, Kogi State (Obahopo, 2014 and Abah, 2015). The National Board for Technical Education approved it for running both National and Higher National Diplomas (ND and HND). It has as its aim the training of competitive manpower for development and the motto is Technology for Self Reliance.

Methodology

The imagery was downloaded from Google Earth PRO in 2016. This was georeferenced using GPS coordinated points and had a residual error of 0.06m using ten (10) points. It was further rectified and projected.

The image was exported into ArcGIS 10.1 software and a geodatabase was created as Road Network Mapping. Under this, other feature classes' namely major roads, dualised untarred road, dual carriage way, untarred road, foot paths, frame work and prominent buildings were created.

The on screen digitizing method was adopted for each feature class and coordinates of points were generated as the cursor was used in tracing over the features.

Lastly cartographic embellishment such as using of appropriate symbols, insertion of scale, north direction etc. was done.

The total station traversing was adopted in obtaining the spatial coordinates of the buildings under study while a digital camera was used for collecting both photographs and videos. The database was created using the normal procedure and stored in the C Drive of the system. This was overlain on the map of the campus produced by same Authors as a feature class and named as Infrastructure Information management System and given red colour as shown. Text and photo / images were converted to video clips using Cyber link Photo Director 5. Video clips obtained by the Digital camera were downloaded with the aid of ULEAD video studio into the HP Core i7 personal computer. Hot linking of photographs and video was done in ArcMAP. The system design is presented below:

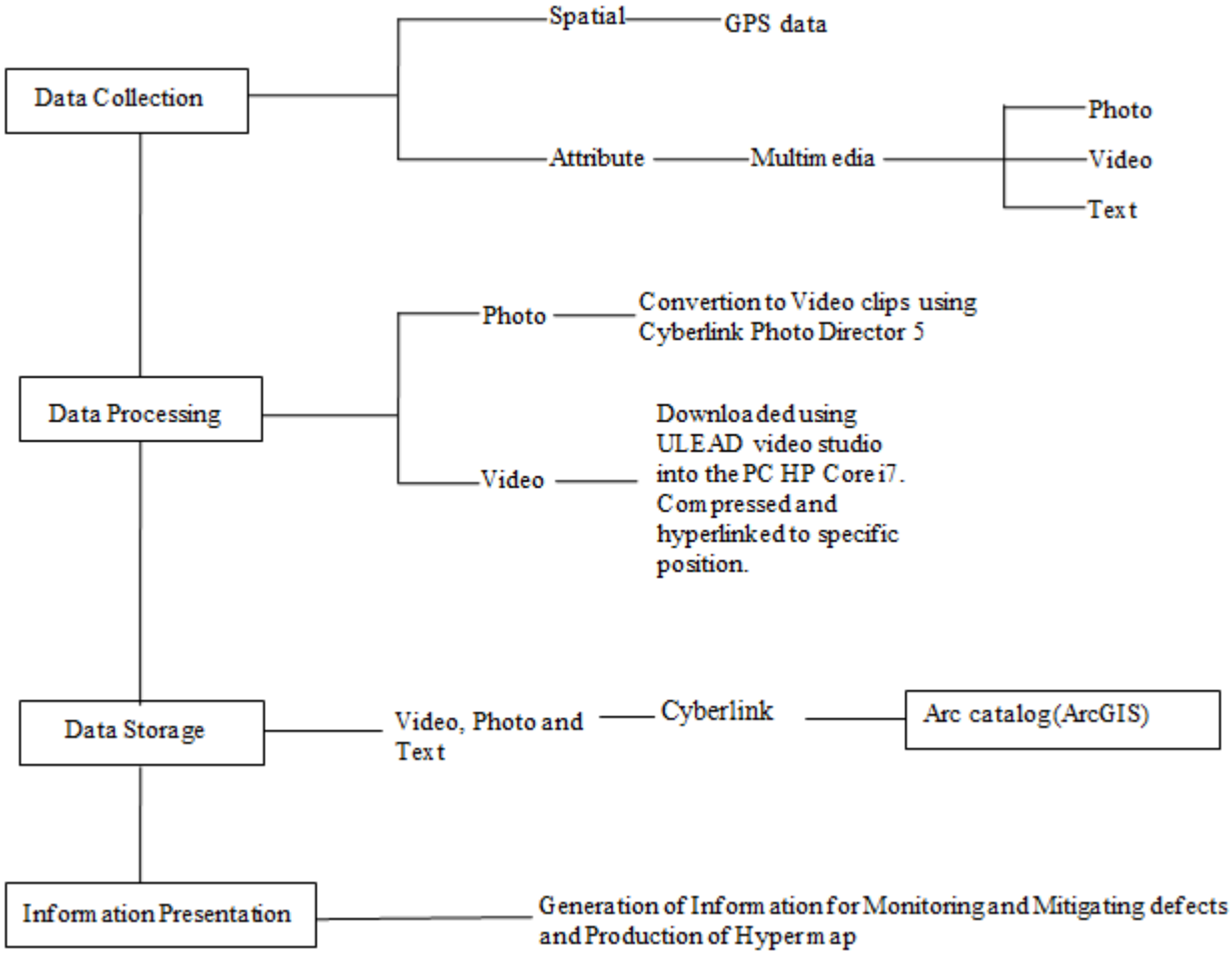

Fig. 1. System Design

Source: Author

IV. Results and Discussion

The hyper database (Normal Relational – Hypermedia) is robust and gives qualitative and quantitative information about the covered infrastructures through queries. This research work is an offshoot of a Doctoral research work by the same Author which has helped to bridge a research gap by this development of a database system for handling a specie of multimedia data set. To exploit the database, the identify tool of the ArcGIS is employed. This is taken to any position of interest on the map coloured red and clicked for a pop up showing the elements (attributes) of the database in a tabular format.

Any chosen attribute is comprehensively displayed. Using identify tool to show Dean's Office S E S.

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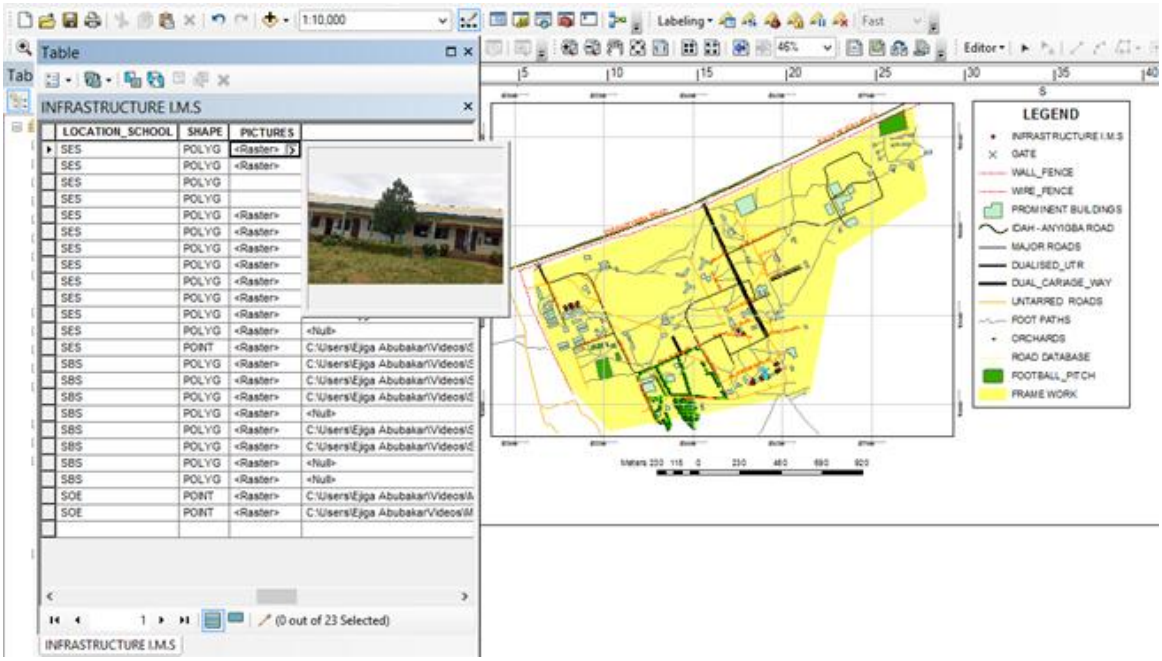
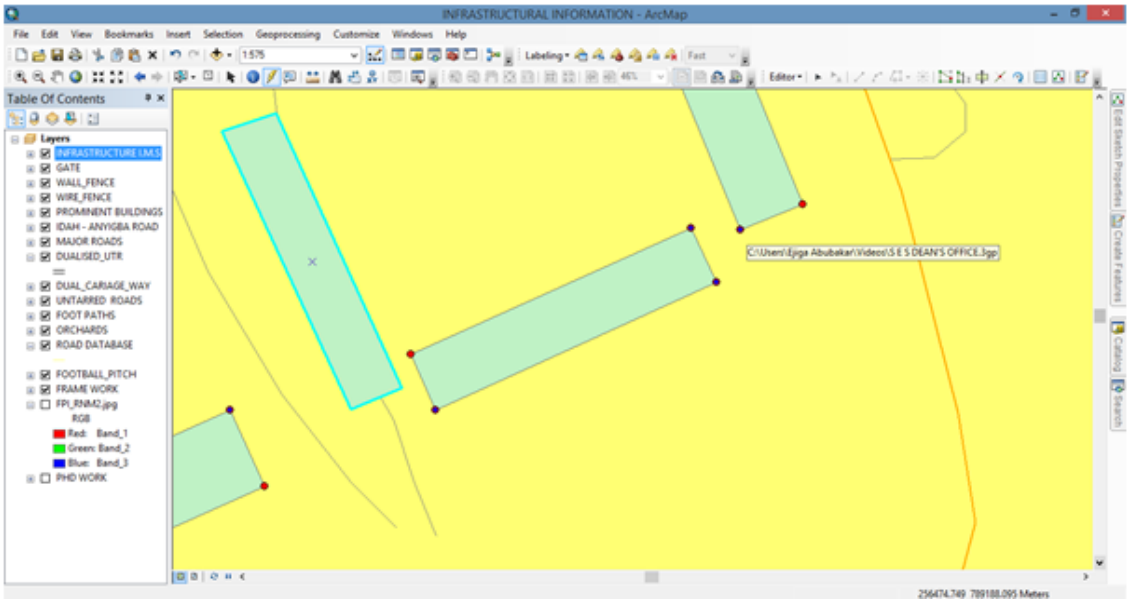
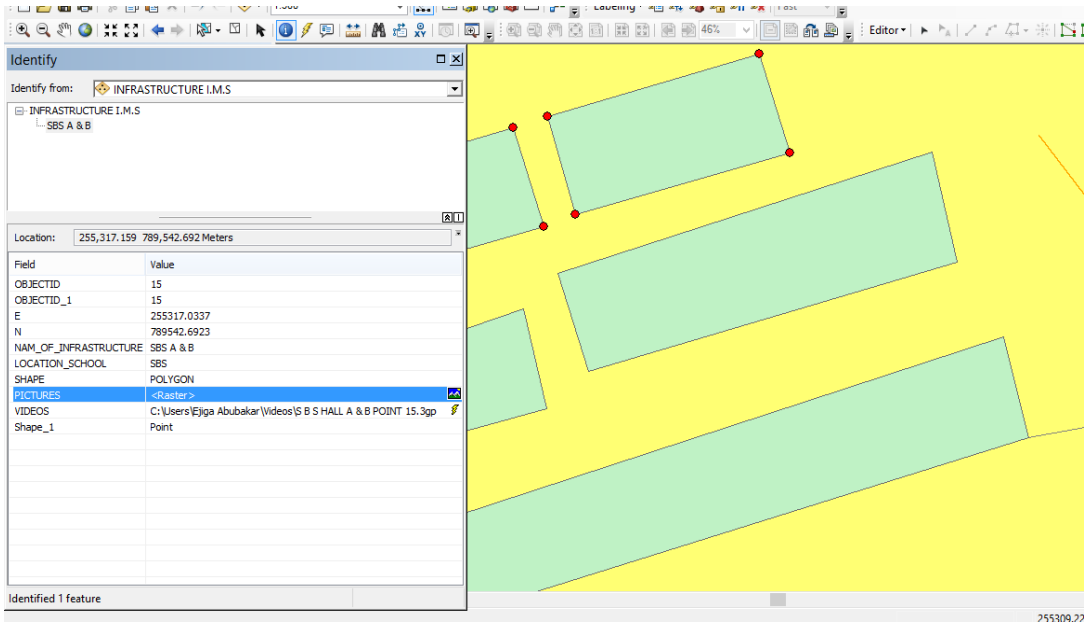
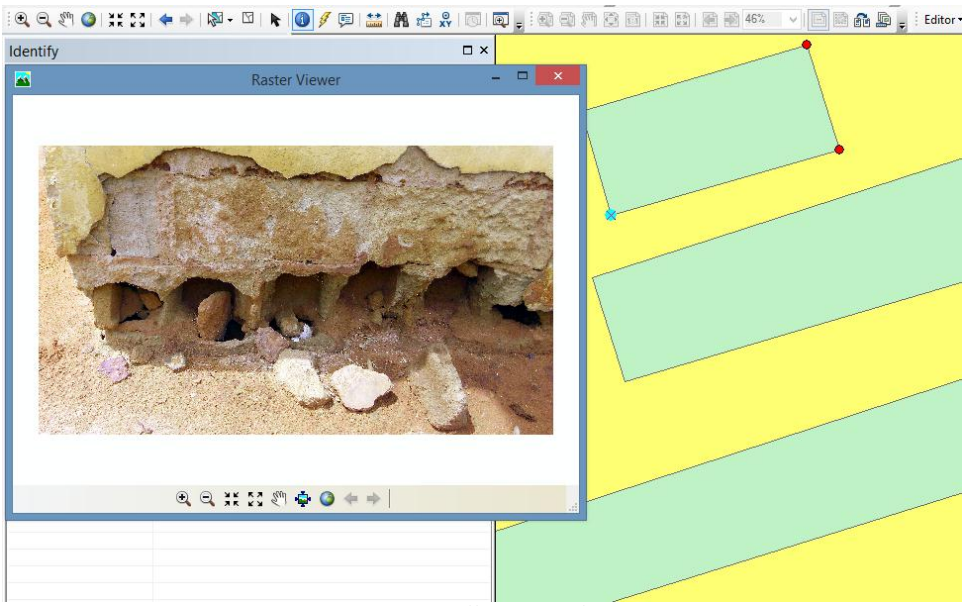




Video Showing the Affected Part of the Deans Office S.E.S



Video showing affected part of Lecture Hall 1, 2 3 & library S E S



Photograph showing affected part of SBS C & D

V. CONCLUSION

The state of the Infrastructure can be ascertained quickly and rightly. This when properly applied can provoke aggressive monitoring and management of infrastructures especially with the on going change mantra so that abandonement and waste in public sector can be curbed. This will make the society to function properly and progressively. The 'change begins with you' campaign of the present administration should be adhered to by all and sundry so that indesciminate urine on walls could be stopped except in designated places. The notion that government property belongs to none and so can be abused should be discouraged and instead seen as a public asset that should be properly managed for the betterment of the country. By so doing, the scarce resouurces at the disposal of the government instead of being used to refurbish exiting dilapidated infrastructures can be used in doing other economically viable ventuures to move the nation and its people forward.

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