Virtual 3D Mapping and Investigation about Remote Sensing Data

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***ABSTRACT** - With the rapid growth of urbanization, conception in the three-dimensional feature is attainment more importance nowadays? 3D modeling and visualization procedures help in decision making process to recognize the third dimensional features in cities. Developers, urban designers, landscape architects and other planning professionals use electronic visualization techniques to encourage the involvement of public in urban planning. Aerial and Satellite images can be used to produce 3D models, but they cannot give a realistic feel due to the deficiency of texture information. The impartial of this study is to build a 3D model along with texture in-formation using presently available software tools and to make it freely accessible for the public. High resolution satellite data are useful for 3D mapping and analysis. In the present study, field photographs and satellite images are used to create 3D database of few iconic buildings in Bangalore city. Satellite images are used to identify the georeferenced foot-print of the buildings or features. The conniving and creation of 3D database is carried out using Sketch up software tools. Texture material is added from the photographs to get a realistic feel of the 3D building. The 3D features are envisioned in Arc scene using Digital Elevation Model (DEM) and orthorectified high resolution Satellite data. Further, techniques have been employed to create a 3D cadaster proto-type for visualization of vertical growth of buildings. Line of sight and shadow analysis was carried out using the 3D model analyst toolbar in Arc scene for understanding the potential of this technology for discovering security cameras.*

***Keywords**— Field photography, Texture, DEM, 3D cadaster, Line of sight analysis, Shadow analysis.*

I. INTRODUCTION

Nowadays Cities are intensifying on the vertical direction due to suburbanization and population pressure and hence, there are a lot of complications in the usage of available space. For example the alternative portion of a building may contain tunnels or subways. A normal 2D map cannot represent these features. 3D models can persuasively represent such complex urban features. 3D cadaster is asubstitute to the existing 2D cadaster in which we can visualize on the virtual atmosphere in a vertical space. 3D cadasterembodies a vertical space divided among individuals, in which eachowner has a specific right to the vertical space owed to him. A 3D parcel is a spatial unit beside which unique and homogeneous rights, accountabilities or restrictions are associated. In urban areas, the 3D cadastral model should not only accommodate 3D RRR (Rights, Responsibilities or Restrictions) and their association with physical objects; the data model should epitomize the spatial extend of 3D RRR's. No country has successfully realized a fully functional and operational 3D cadastral model; a large number of concepts are being attempted.

The Arc scene and Arcglobe atmosphere offers an easy and operative way of storing and analyzing 3D objects. The 3D vector data types which can be stockpiled in Geodatabase are 3D points, 3D lines and 3D polygons. Multipath is used to store volumetric data in ArcGIS. Multipath files generate volumetric data using a gathering of triangles, triangle strips, triangle fans and rings. It can store texture information, images, color transparency and lighting vector information within its geometry. A large no of analysis is possible in the Arc sceneatmosphere like visibility analysis, skyline analysis, 3D routing, security camera coverage, volumetric shadow and glaze and urban heat island analysis. Line of sight analysis is critical input in the fitting of security cameras, checking for possible sniper locations, connection of mobile and radio towers etc. Shadow analysis is the study of how an opaque object's shadow affects the neighboring environment based upon the sun's position, and the time of year.

Large area 3D city reproductions can be created using stereo pairs of aerial snaps or high resolution satellite images. Construction of 3D city model using predictable stereo images of aerial photos or satellite images is cumbersome and is less cost-effective procedure for many applications. For more accurate 3D models either terrestrial or aerial LiDAR can be used to create the 3D model of a large area. The weaknesses of these models are that they do not contain comprehensive designs or texture information. The Sketchup software can be used to develop a 3D model using simple field photographs and satellite images. In the contemporary study Sketchup is used to develop the 3D model to provide realistic view. The better proficiencies of ArcGIS were used in view shed and shadow analysis. Further similar techniques were used in the generation of 3D cadastral model.

II. STUDY AREA

The study area is Bengaluru city located between 12.663°-13.230° latitude and 77.342° - 77.825° longitude. It is the capital of Karnataka state and the IT hub of India. It is one of the fastest growing cities of our country and observed a wonderful growth in the recent past. It holds few of our countries large and iconic buildings. 3D models of some iconic buildings in Bengaluru city like Vidhana Soudha, High Court, UB Towers, Kanteerva Stadium etc, were prepared. A 3D cadaster model of a small area is also developed.

III. METHODOLOGY

Originally field photographs were developed for the iconic buildings. Consequently DEM was generated using Cartosat-1 stereo pair using ordinary photogrammetric technique. Minimal DEM editing was carried out to improve the quality of the DEM. Construction footprints as observed on the high resolution satellite image was digitized to generate the building plan. Later on, each floor plan was fashioned based on the field photographs for imagining. The methodology adopted for the generation of 3D model is given in Figure 1.

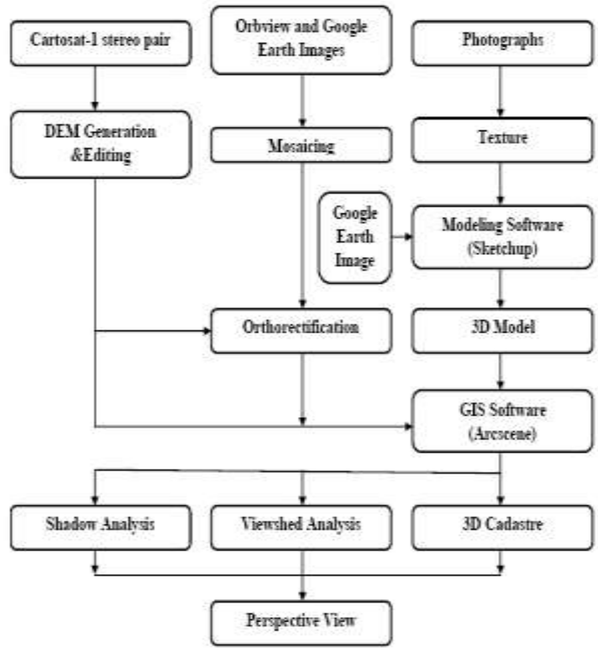

Figure 1. Flow chart of the research methodology

3.1 Field Photography:

High definition photos of the acknowledged buildings were taken from dissimilar angles to represent the realistic view of the construction along with the texture as well as the environments. Photos are taken from all possible angles casing individual faces of the buildings. Photoshop tools were used to edit the photographs to eradicate any obstructions in the view andreplace it with similar texture. The rules for acquiring the photographs were comparable to that of close range photogrammetry as given below.

- Indication of building for identification of the structure
- Numerous photographs covering all faces of the building
- Vertical Photographs while circumventing tilted photographs
- Homogeneous brilliance throughout the photography
- Close-up used for composite structures

3.2 3D Model:

Building model was created using Sketchup ver. 8 software. The orthorectified high firmness satellite images were used to create the 2D framework of the building monitored by generation of full floor plans for the entire vertical structure. The pictures are right imported into a particular face of the building and added as texture. Complex designs and buildings are constructed based on the local knowledge and photographs. The 3D model engendered in Sketchup is exported as Collada file (.dae).

3.3 C. DEM Generations& Editing:

Leica Photogrammetry Suite (LPS) software was used for the group and editing of DEM. Originally, the block file was generated from cartosat-1 stereo pairs and DEM was engendered using Automatic Terrain Extraction (ATE) module of LPS. The DEM was corrected using hard/ soft break lines to bring the contours in line with the terrain and adjusting for any floating/digging points. The DEM was used in the 3D visualization and analysis.

D. Visualization & Analysis:

ArcGIS was used in the 3D visualization and understanding. Collada file was imported as a multipath file in Arc scene and overlaid on the orthorectified satellite image. Minimal modification was carried out to fit the 3D model to the footprint of the building as observed in the satellite data. Satellite image was draped over the DEM to visualize the realistic view of the building and its neighboring areas. A 3D cadaster model for a multistoried building was twisted in Sketchup and then imported to Arcscene. The attribute and other numerical information are added in the Arcscene. Correspondingly, 3D cadaster model was developed in Sketchup itself where the characteristics and other information are added and displayed in Sketchup. The line of sight and shadow conception analyses were carried out using DEM in Arcscene. The target line and opinion point feature was created. The analysis was carriedout to display the visible coverage between the observer point and the target.

IV. RESULTS AND DISCUSSION

The results exposed that the high resolution satellite data could be used as the base data for generation of broad background of the buildings. Based on the footprint, the construction framework along with the outside design was drawn. Based on pitch photography and expectations, each floor plan was designed along the vertical height to deliver three dimensional spaces to the buildings. The original color of the building along with the texture was added using photographs. It was experimental that the virtual and realistic 3D models could be created using Sketchup as shown in Figure 2.

Figure2. Vidhana Soudha Building

3D cadastral model of a construction in Bangalore city is created in Sketchup and represented as shown in Figure 3 to Figure 6. User can query any specific unit or floor in the vertical space. Databases are accessible at three levels: individual housing unit, single floor and building. Figure 4 shows the total building as a single object with its attributes.

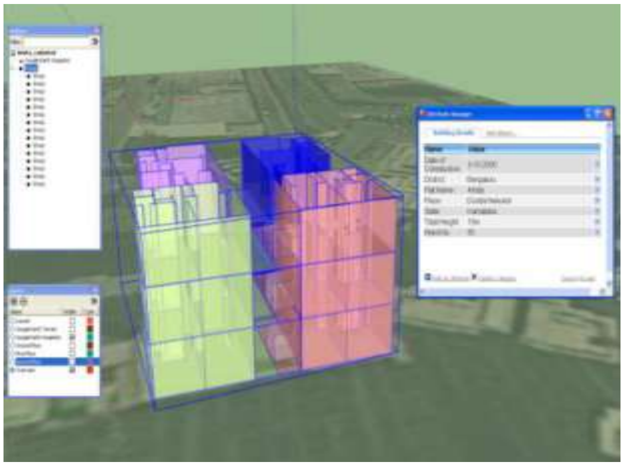

Figure 3. Cadastre model showing whole building as a single unit

Line of Sight Analysis and Shadow Analysis was carried out for nominated areas in Bangalore city. Figure 4 shows the results of line of sight analysis, where the visible areas are epitomized by red lines and the obscured areas are represented by green lines.

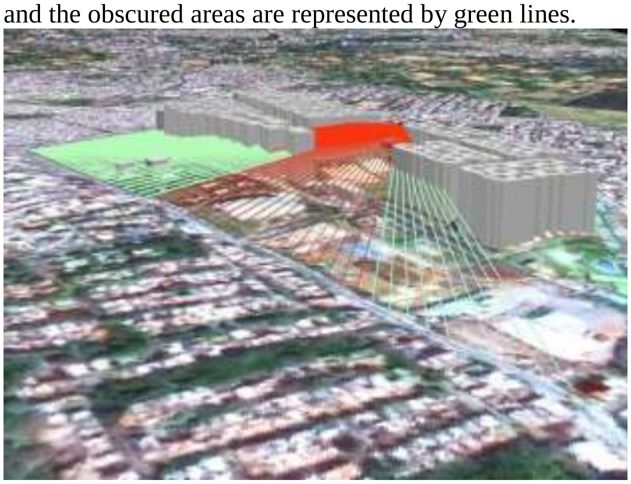

Figure 4. Line of Sight Analysis showing the visible areas and obscured areas

Security camera perceptibility analysis of a building complex was analyzed. Six Cameras are located along the dissimilar places in the study area and a target line was drawn along the boundary as symbolized in Figure 5. Line of sight analysis was carried out to analyze the visibility of these cameras. By correcting the camera location, optimal location for placement of camera and the minimum no of cameras needed were calculated. Figure 6 depicts the visibility of the security cameras.

Figure 5 Observation points and target area for security camera location

Figure 6 Line of Sight analysis showing coverage of security cameras

V. CONCLUSIONS

This study establishes the feasibility of generation of realistic 3D building models and its imagining using high resolution data, photographs and sketchup tools. The convenience of the procedure for development of 3D cadastral was evaluated. The urban 3D models along with DEM permitted line of sight analysis and security camera coverage. 3D information can be very critical input for urban development, disaster management and utility services for local governing bodies.

REFERENCES

[1] E. Tsiliakou, T. Labropoulos and E. Dimopoulou, ―Transforming 2D cadastral data into a dynamic smart 3D

model,‖ ISPRS 8th 3DGeoinfo Conference & WG II/2 Workshop, 27-29 November 2013, Istan-bul, Turkey.

[2] JozefSanecki, Andrzej Klewski, Krzysztof Becz-kowski, Krzysztof Pokonieczny and GrzegorzSte-pien, ―The usage of DEM to create the 3D cadastre,‖ Scientific Journals, 2013, pp. 86-90, ISSN 1733-8670.

[3] Sagar Mali, SachinPanhalkar, C. Pawar and Sandipan Das, ―Generation of 3D city model for urban utility information system using Digital Photogrammetry & GIS technology,‖ Global Journal of Researches in Engineering, ISSN: 2249-4596, 2012.

[4] Shen Ying, Renzhong GUO and Lin LI, ―Application of 3D GIS to 3D cadastre in Urban Environment, 3rd International Workshop on 3D Cadastres: Develop-ments and Practices,‖ 25-26 October 2012, Shenzhen, China.

[5] HrvojeTomic, MiodragRoic and SinisaMasterlicIvic, ―Use of 3D cadastral data for real estate mass valuation in the urban areas, 3rd International Work-shop on 3D Cadastres: Developments and Practices,‖ 25-26 October 2012, Shenzhen, China.

[6] Ali Aien, Mohsen Kalantari, Abbas Rajabifard, Ian Williamson and Rohan Bennett, ―Advanced Prin-ciples of 3D Cadastral Data Modelling,‖ 2nd Interna-tional Workshop on 3D Cadastres, 16-18 November 2011, Delft, The Netherlands.

[7] Tan LiatChoon, Khadijah BintiHussin and Ernest Khoo Hock Oon, ―New Cadastral System Approach for planning sustainability in Malaysia,‖ International Surveying Research Journal, Volume 1, Number 1, pp5-24, 2011.

[8] M. I. Hassan, M. H. Ahmad-Nasruddin, I.A. Yaakop and A. Abdul Rahim, ―An Integrated 3D Cadastre-Malaysia as an Example,‖ ISPRS, Vol.XXXVII. Part B4, Beiging 2008.