GENERATION OF 3D CITY MODELS FROM TERRESTRIAL LASER SCANNING AND AERIAL PHOTOGRAPHY: A CASE STUDY

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Abstract:

Using 3D city modeling is increasingly prevalent in different areas such as urban planning and redevelopment, facility management, logistics, security, telecommunication, disaster management etc. Main objective is to get the look of the buildings as simple and close to reality on the web or PC. Cultural, natural, historical and touristic heritage is one of the most important connections from the past to the future for any nation. The importance of these objects should be more than other buildings. In this study, Sille Aya-i Eleni Church, Karatay Madrasa, The Inceminare Madrasa, Alaaddin View Terrace, Horozlu Inn are scanned by 3D Ilris terrestrial laser scanning. Cloud points are registered by Polywork software. Local coordinates of each object are transformed into global coordinate system. 3D modeling of objects is realized by Polywork software using cloud point. Orthophotos of Konya are used as ground plans. These data are integrated and virtual model of historical places is obtained.

1. INTRODUCTION

Use of 3D city models is to increase rapidly in different fields. Virtual 3D city models compose particularly an important concept in 3D geoinformation systems. They can be used in urban planning, defining of traffic routes, disaster management etc. They require different geodata such as terrain models, ground plans, buildings models, vegetations models and cadastral data. Terrain models can be obtained by airborne laser scanning data and ground plans can be captured by aerial photography and remote sensing images in a short period of time. Buildings models can be achieved by terrestrial laser scanning and photography-based methods (especially close-range photogrammetry). 3D GIS concept has revealed requirement to present the more realistic of world in virtual area. Different source data should be integrated for this purpose. 3D measurement and questioning can be done on the 3D city models as if you measured part of land on the reality world. For this purpose, measurement accuracy must be performed in the especially development plan or architecture activities.

In this study, Sille Aya-i Eleni Church, Karatay Madrasa, The Inceminare Madrasa, Alaaddin View Terrace, Horozlu Inn are scanned by 3D Ilris terrestrial laser scanning. Orthophotos of Konya are used as ground plans. These data are integrated and virtual model of historical places is obtained.

2. MATERIAL AND METHOD

In the this study, The Sille Aya-i Eleni Church, The Karatay Madrasa, The Inceminare Madrasa, The Aladdin View Terrace, The Horozlu Inn in the Konya are measured.

The Sille is a special place, which has a significant centre for early Christianity period and has a special meaning for Anatolia civilization where different cultures were living in peace.

The Karatay Madrasa is located in the northern part of the Aladdin Hill. It was constructed by Emir Jelaleddin Karatay during Sultan Izzettin Keykavus II period in 1251.

The İnceminera Madrasa is located on the west direction of the Aladdin Hill. It was constructed by the Vizier Sahip Ata Fahrettin Ali during the Seljuk Sultan Izzettin Keykavus II for providing the "Hadith" education in 1264 [1].

The Aladdin View Terrace is located on the Aladdin Hill. It was constructed by Seljuk Sultan Kılıçarslan II as part of palace. It was restored by Aladdin Keykubat and was named as Aladdin View Terrace.

The Horozluhan Caravansary was built in Seljuk period on historical silk roads. It is located 15 km away from centre of the Konya city. It was built from masonry stone. Its facade door at the east side includes fine masonry stone. Its dimensions are 29.88 meters and 28.18 meters.

All objects are scanned by ILRIS 3D terrestrial laser scanning (Figure1).

Figure: 1 ILRIS 3D Terrestrial Laser Scanning

Optech's ILRIS-3D Intelligent Laser Ranging and Imaging System is a complete, fully portable, laser-based imaging and digitizing system for the commercial survey, engineering, mining and industrial markets [2].

Features:

- High resolution and high accuracy
- Highest dynamic range available on the market: from 3 m to beyond 1 km
- Class 1 laser rating: completely eye safe
- On-board 6-megapixel digital camera and large-format LCD viewfinder

Table.1 Some technical properties of ILRIS-3D Terrestrial Laser Scanner

Dynamic scanning range	3 m - 1,500 m to an 80% target 3 m - 800 m to an 20% target 3 m - 350 m to an 4% target
Data sampling rate (actual measurement rate)	2,500 points per second
Beam divergence	0.00974°
Minimum spot step (X and Y axis)	0.00115°
Raw range accuracy	7 mm @ 100 m
Raw positional accuracy	8 mm @ 100 m
Laser wavelength	1,500 nm
Laser class (IEC 600825-1)	Class 1
Digital camera	Integrated digital camera (CMOS sensor) optional external camera
Scanner field of view	-20° through 90° (V) x 360° (H)
	-90° through 20° (V) x 360° (H)
Scanner field of view	40° x 40°

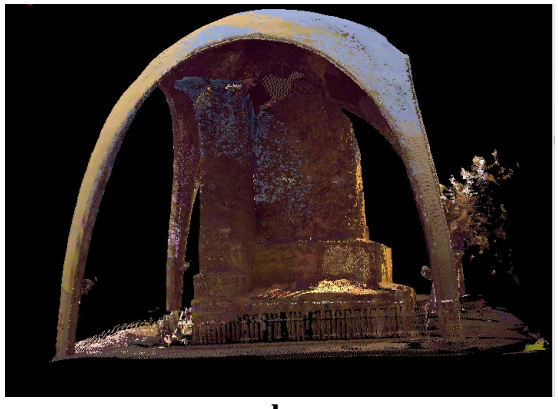
In this study, Polyworks point cloud software has been used to process of point clouds data. Polyworks is a comprehensive software package that quickly generates high-precision polygonal models and NURBS surfaces from 3D digitizer and image data [3].

For this study, Orthophotos of the Konya city has used. These Orthophotos are produced in 2007 all around Konya city centre in 1/2000 scale. Orthophotos are provides high resolution view of city centre, building settlements and urban places. Orthophotos are imported into ArcGIS software as an infrastructure image to show point clouds on it. ArcGIS software has a worldwide user and developer body. It has powerful tools for Geographical Information systems, spatial analysts, data management and raster tools to visualisate analyse and produce 3D digital elevation models. With 3D viewing software of ArcGIS, named ArcScene, Orthophotos and point clouds are visualisate together.

3. RESULTS

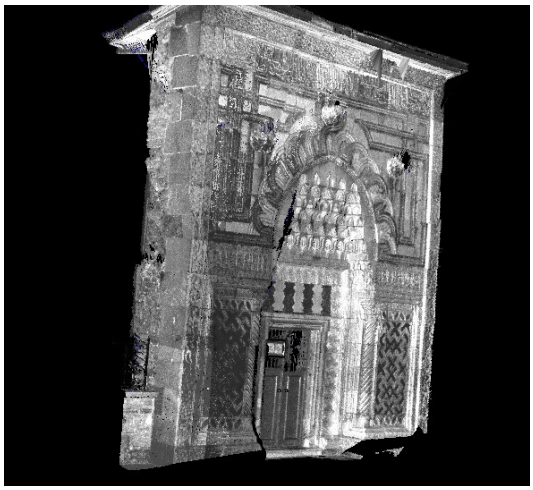
The all objects scans were performed with different point spaces from different away. The scans were performed as partially overlapping with the previous scan (Fig.2). They are georeferenced with global coordinate system.

a



b

c



d

e

Figure: 2 a) Sille Aya-i Eleni Church b) Aladdin View Terrace c) Inceminare Madrasa d) Karatay Madrasa e) Horozlu Inn

First step of the application is constitute a Geodatabase to store Orthophotos and point clouds for effective using raster tools and import point clouds quickly into map window. With using ArcCatalog tools, Orthophotos and point clouds are imported into Geodatabase and coordinate systems are set to global coordinate system. Because of there are over than one million points for an object which had measured with laser scanning, geodatabase storage is getting higher. This situation causes large datasets and slower display power. For this reason unnecessary attribute data of points (as like symbol type, symbol color, and point name) which attributes comes from during importing and exporting processes between softwares. By eliminating unused attribute data, geodatabases are covering lower disk spaces. This will reflect to the project as speed, quality and faster visualization.

The other process of the application is combining Orthophotos and point clouds in map window. In ArcScene software, by adding layers to the map window and by defining altitude, seem angle and rotation parameters, point clouds are seemed on Orthophotos separately. With symbology settings, best visualization of the point clouds gathered.

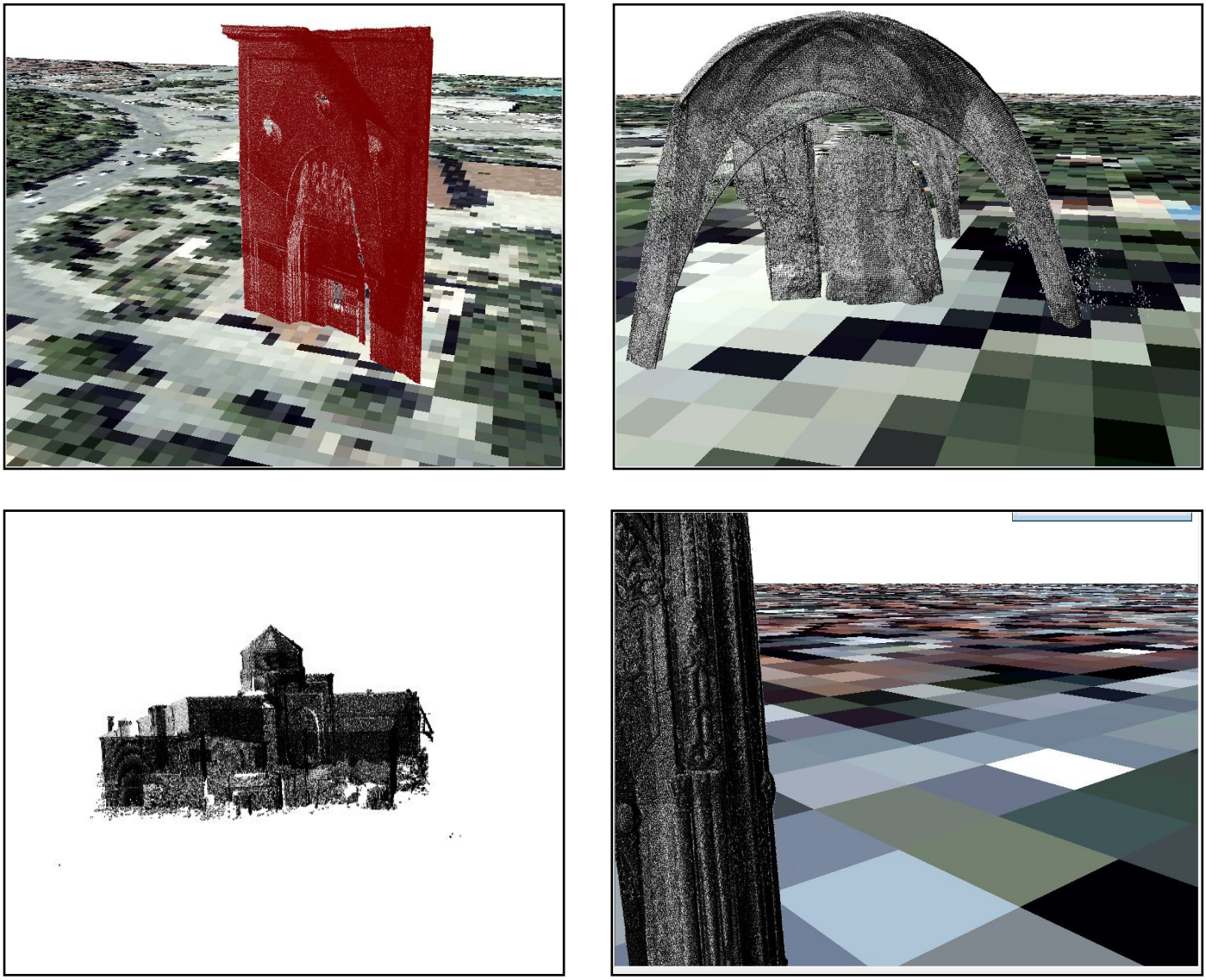


Figure 3: Point clouds on orthophoto

4. CONCLUSION AND FUTURE WORK

As a result, with this study it has shown that, point clouds can be use in processes of constituting 3D city models with integrating together with Orthophotos. But the usage easiness of the project is depends on hardware of the computer. For example, one 3D building has 4 faces which had gathered by terrestrial photogrammetry technique, and it has carrying so little hard disk space. But point clouds mean that for one 3D building over than one million points with its attribute values. So it is hard to visualisate point clouds as normal. Because of the aim of this project is put forward high detailed 3D models for study area, there is no process about decreasing point number and decreasing detail level. The study only aimed to show ability of point clouds can be shown as the others in 3D city models.

Also ArcGIS software performance has showed that ArcScene software extensions can be used for constituting 3D city model processes.

5. REFERENCES

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