

# **3D Laser Scanning for Digital Preservation and Dissemination of Cultural Heritage**

## **Main scanned objects - Four Temples of Different Religions in Sofia**

Eng. Zlatan Zlatanov, Eng. Milush Blagoev, Irina Nikoevska

Geocad 93 Ltd, 96, Otets Paisii Str., 1303 Sofia, Bulgaria  
office@geocad93.com, misho2@rocketmail.com,  
i.nikoevska@geocad93.com

**Abstract.** The project demonstrates the use of modern technologies for preservation and presentation of the cultural and historical heritage. The idea is a database of cultural and historical heritage sites to be created applying three-dimensional laser scanning technology and a combination of geodetic and photogrammetric methods and shooting techniques.

For the purposes of carrying out this project, we have focused on some heritage sites in the central part of Sofia. We decided to include these particular buildings because of the fact that there is hardly another city in the world where within a radius of 400 m are located four temples of different religions - Jewish, Muslim, Orthodox and Catholic.

In the recent years, preservation of cultural heritage has been increasingly linked to objectives of sustainable development. Today, it has become clear that cultural heritage is also an economic resource that should be used for further economic development (through compulsory preservation of its authentic cultural values). There has been a more active public debate on the role of cultural heritage, regarding the following topics: improving the quality of life through development of cultural tourism, leading to an increase of the employment rate, constantly improving the business climate, etc. Cultural heritage preservation is becoming one of the priority objectives of the urban development policy.

The focus has been shifted to new ways of preservation, mainly combinations of sophisticated technological solutions and their application for the purposes of preservation and dissemination of the cultural heritage.

**Keywords:** Laser Scanning, Cultural Heritage, Surveying Methods

## **1 Introduction**

The development of laser technology and digital photogrammetry in combination with conventional surveying methods allows highly precise and complete information to be obtained about cultural heritage sites. The combination of these methods is an

opportunity providing attractive visualization and simultaneous access to the full historical and geographical information about the objects.

In order to carry out the project, we have chosen as a case study the following heritage sites in the central part of the capital city - the Sofia Synagogue, the Mosque "Banya Bashi", the orthodox cathedral temple "Sveta Nedelya", the Roman Catholic Cathedral St. Joseph (the largest Catholic church in Bulgaria), the building of the Central Sofia Market Hall and the building of the former Sofia Mineral Baths.

Why did we decide to select these buildings? There is hardly another city in the world where within a radius of 400 m are located four temples of different religions – Jewish, Muslim, Orthodox and Catholic. The buildings of the Central Sofia Market Hall and the former Sofia Mineral Baths are architectural masterpieces of last century. The activities to be carried out under the project include:

- Development of an orthophoto map of the terrain.
- Photographic recording of heritage items and creating a photopanoramic virtual tour.
- 3D laser scanning of road and street network.
- Laser scanning of each object.
- Creating data files (3D point cloud).
- Geodetic survey of each object.
- Providing historical information on each facility.

The idea of the project is a model of a hiking tour to be developed and presented, covering a small part of the top iconic locations in Sofia, the historic reference of which provides valuable historical information focusing on the last few centuries.

Specific tasks to ensure the delivery of the project outputs:

1. Dissemination of the information about the sites of cultural patrimony – ensuring attractive promotion and providing detailed information on cultural relics through 3D-visualization.
2. Conservation of valuable immovable cultural heritage and property aiming at:
  - Providing data to experts to carry out full restoration of the sites in case of destruction;
  - Facilitating further decision-making about the conservation and restoration of cultural monuments.
3. Interdisciplinary approach of applying 3D models such as :
  - Developing 3D models of monuments for educational purposes;
  - Implementing 3D models in organizing informative campaigns for tourists;
  - Use of 3D models in historical research.

## 2 Orthophotomap Creation

For the purpose of creating the orthophotomap were used images with a pixel size corresponding to 10 cm. In November 2011 upon request of the municipal mapping company "GIS - Sofia" was conducted an image recording by the company "Geofoto" (GEOF) – Croatia, using UltraCamXP camera on 2,000 m - altitude flight, and the Russian data-processing deployment software PHOTOMOD 5.21.1249. The output obtained was an orthophoto map with resolution of 10 cm and 5 cm in height.



Fig. 1. Orthophoto map of the heritage sites

### **3 Photographic Recording of Objects and Creating a Photopanoramic Tour**

For the photographic recording of the objects was used a NIKON D90 - camera; for the panoramas and photo tours were used Kolor Autopano Giga 2.6 and Kolor Panotour Pro 1.8 software applications.



**Fig. 2.** Photographic recording of objects

### **4 Laser Scanning of Road and Street Network and Individual Objects**

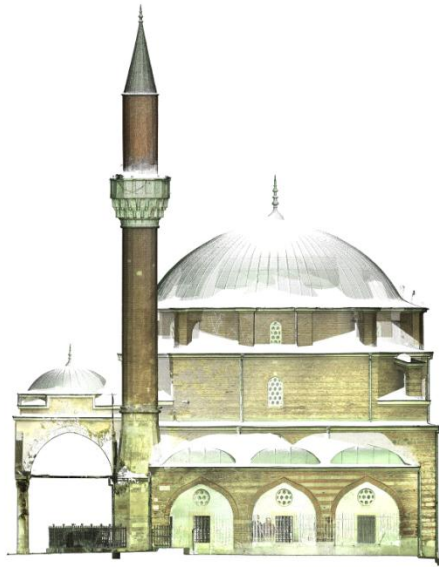
The three-dimensional laser scanning is an electronic-optical technology for remote determination of distances to objects using a focused beam of light without the need for direct access to the research object. With its high accuracy in reflecting the actual objects, laser scanning is one of the few technologies to create 3D digital models of objects with complex geometric shape.



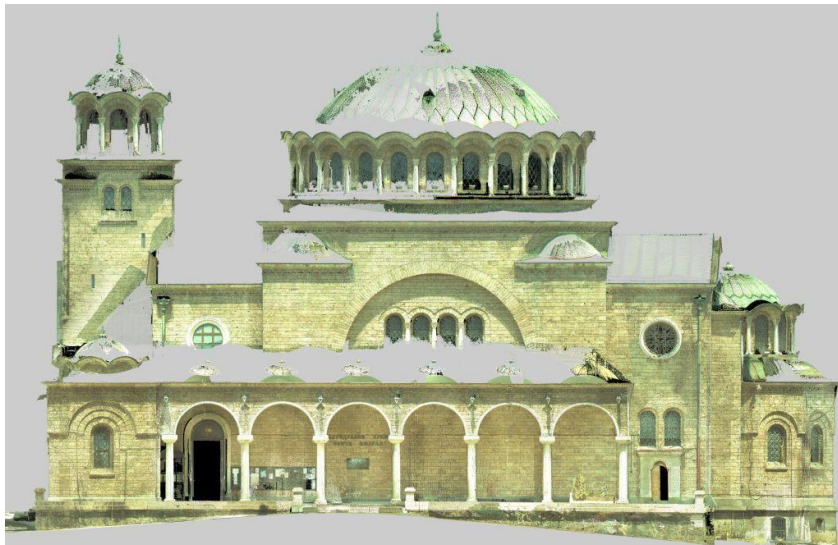
**Fig. 3.** Laser scanning of a street



The laser scanning was conducted, using a Leica ScanStation C10. The processing of results and creation of 3D point cloud was carried out by applying Leica Cyclone 7.1. The scanning resolution was 5 mm (5 cm/100 m). For a single object were scanned about 150 million points.



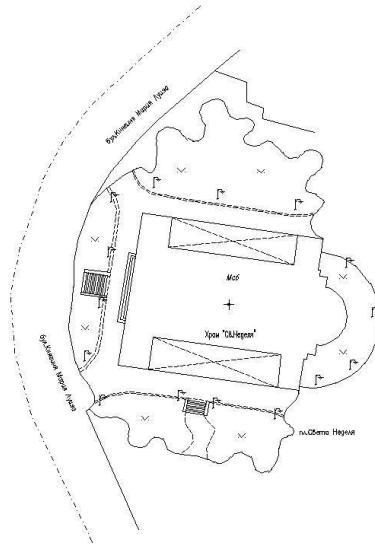
**Fig. 4.** Mosque "Banya Bashi", Sofia



**Fig. 5.** Orthodox cathedral temple "Sveta Nedelya", Sofia, Bulgaria

## 5 Geodesic Image Recording of Sites

For the complex presentation of the objects was also carried out a geodesic image recording of the sites. The recording was carried out, using a SOKKIA total station.



**Fig. 6.** Geodesic image recording

## 6 Conclusion

By September 2012 we will have obtained all the information needed to complete this first stage of the project. The second stage of the current project is to create a website to display the obtained information. Foreign tourists would be able to get familiar with the famous places of interest in the capital. Students will be able to learn about the history and the current state of the objects. A database with information at the time of recording about the objects is organized.

The project allows an entirely new presentation of the rich cultural and historical heritage. The main objectives of the project are:

- The combination of laser scanning and photogrammetric surveying methods to present the most complex picture of the current state of the sites of cultural and historical heritage.
- Laser scanning is used as the most accurate and feasible method of storing data to provide information on sites of cultural and historical heritage to all relevant institutions.
- The close collaboration between historians, archaeologists and engineers-geodesists provides contemporary and accurate picture of the cultural heritage with an easy access to give possibilities for reflecting any further findings.