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The First International Students Scientific Conference
"MULTIDISCIPLINARY APPROACH TO CONTEMPORARY RESEARCH"

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PREFACE

The Proceedings includes the selected Papers and Abstracts presented at The First International Student Scientific Conference "Multidisciplinary Approach to Contemporary Research". The Conference was held on 25-26th November 2017. at Central Institute for Conservation, Belgrade, Serbia, Terazije 26. It was organized by Central Institute for Conservation, Belgrade and Scientific Association for the Development and Promotion of New Technologies, Belgrade.

The aim and main idea of the Conference was to present science and scientific way of thinking and working closer to the students, as they will be able, in the future, when they are employed, to connect science and industry. For this reason, the right to participate had only undergraduate and master students, who, with help and monitoring by their teachers and/or colleagues, wrote and prepared papers and presentations.

The aim of this Conference was, also, to provide a Forum for students and researchers from various countries to exchange their ideas and achieved results.
The Conference brought together the participants from Universities, Innovation Centres and Institutes from different countries: Croatia, Romania, Bosnia and Herzegovina, Macedonia, France, Russia, Montenegro, Spain, Republic Srpska, Slovenia and others.

The aim of the conference was, also, to connect different/various fields of science, because we can find many common points between different research areas, and by doing that, to open possibilities of developing new technologies or improving the old ones. Therefore, the Conference covers various topics from the following fields: mechanical science, transport and traffic engineering, material science, metallurgy, electrical engineering and other engineering areas, but all other sciences as well, including for example medical science, which uses different techniques of experimental examination and testing.
Although, the Conference had multidisciplinary character, the participants had very active discussion after the presentations and we hope that it will provoke the further cooperation between them with a new point of view.

The paper presentation was by oral and poster, due to limited time of Conference duration and traffic conditions of participants. The all papers are reviewed. Considering that this was the Students Conference and the age and experience of the first authors, the reviewers *had neglected* language and textual mistakes which were not provoked the ambiguity of the papers.

We would like to thank all authors who have contributed to this Proceedings and also to the Scientific Committee, Organizing Committee, reviewers, speakers, chairpersons, and all the conference participants for their support for a successful scientific meeting.

Editors

CONTENT

CENTRAL INSTITUTE FOR CONSERVATION, BELGRADE
SCIENTIFIC ASSOCIATION FOR THE DEVELOPMENT
AND PROMOTION OF NEW TECHNOLOGIES

CONTEMPORARY SOLUTIONS FOR 3D VISUALISATION OF A CULTURAL HERITAGE MONUMENT

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Abstract *Recent advances in information technology (IT) solutions opened new possibilities concerning graphic visualization and presentation of existing architectural objects. Cultural heritage objects have the specific importance in presentation of historical, cultural and architectural values characteristic for one town, country, people or geographic area. Simulation of 3D architectural space is important for both the professionals and common observers. The necessary part for professionals is objects' technical documentation prior to the intention to reconstruct, renew or to analyze. 3D model of architectural structure plays the most important role in such tasks.*

The paper presents the role of contemporary techniques joined in two presentation tasks (case studies) - Cvijeta Zuzorić Art Pavilion's entrance portal and the window on the Technical Faculty building in Belgrade. Several successive contemporary technological solutions are employed in these tasks: terrestrial laser scanning and cell phone application - for measurement, 3D modeling software – for documentation and finally augment reality (AR) application - for visualization. The intention was to explore and fit on possibilities for visualization, regarding 3D models, and not only its use in the work of architects and other professions, but also in presentation for common observers. 3D models of the two cultural heritage objects are generated in modeling software surrounding and implemented into real architectural environment by AR application.

***Key words**: visualization, measurement techniques, 3D model of cultural heritage object, augmented reality application*

1. INTRODUCTION

Wide palette of cultural heritage monuments – architectural objects exists in Serbian territory, starting from roman archeological sites, medieval monasteries, up to monumental buildings in classicistic architectural style [1,2]. Contemporary standards in architectural visualization of cultural heritage objects demand complete 3D reconstruction of a monument or a site, and accurate 3D models, generated in adequate computer software surrounding [3]. Procedure which enables such result in various engineering professions is called "reconstructive engineering", or "modeling" and it is inverse process regarding its design, where a professional obtains an objects' 3D graphic representation along with its dimensions. Besides valuable technical documentation as a modeling deliverable, further visualization goals are multiple. The final product – an image, 3D model itself, or animation (after measurements, modeling and materialization) could be of various interests in education (cultural, historical, or

professional), informative space (various multimedia archives, libraries, virtual museums, etc.) and advertizing.

The first phase of 3D reconstruction, real dimensions – measurement data is needed, that is prior to 2D drawing or 3D modeling. Object's spatial surrounding could be included. In the *classical* approach technical documentation contained 2D drawings (floor plans, sections and facades), while the graphic presentation was limited to axonometric or perspective 2D drawings (with colors and shading-by means of hatching). *Contemporary* methods, aided by new IT achievements, imply 3D model generating in adequate graphic software environment. There are two essentially different procedures for 3D model generation. The first one is 3D modeling in computer graphic software surroundings by modeling tools, where a creator uses technical documentation (objects dimensions) and starts modeling from the scratch. The other procedure is image based and it starts with photogrammetric or laser-scanning surveying which result with row data – a point cloud model [1,2]. Such model needs further data processing, for obtaining final one – mesh model with materialization. In the next stage of presentation, technique varies due to data outcome: 3D model images, 3D animations of a model, or 3D printed replicas. Augmented reality as a new visual technology enables 3D computer model implementation in some other spatial surroundings besides the real one. Commercial purposes are limitless and offer multi-media presentations, suitable for galleries, museums or visitor centers.

1.1 Two creative tasks

Two impressive architectural buildings – cultural heritage objects are of great importance as cultural and educational centers in Belgrade: Technical faculty building (three joined technical engineering faculties: Electrical engineering, Civil engineering and Architecture) – Fig. 1 and Cvijeta Zuzorić art pavilion – Fig.2. The two architectural elements of these two important buildings were chosen for creative visualization tasks regarding 3D model creation.

Figure 1: Part of the facade of Technical faculty, University of Belgrade, in Belgrade

Figure 2: The main entrance of Cvijeta Zuzorić art pavilion in Belgrade

Technical faculty building is monumental architectural structure, designed by architects Nikola Nestorović and Branko Tanazević, in architectural style of academism with classicistic elements and plenty of decorative elements [5]. Its large windows play the important role in design scheme of the four main facades. Exceptional beauty in proportions and decorative elements make these windows worth of attention. More than 90 years old, windows need revitalization and creation of prototype model for the purposes of possible substitution with new ones.

Cvijeta Zuzorić art pavilion has been built in the same period of time (the third decade of 20th century) and its designer - architect Branislav Kojić was influenced by modern European style *Ar deco*, where classical elements of the building (massive ionic columns and highlighted horizontal cornices) have a new role [6]. Its monumental entrance with classical ionic columns was challenging for both geometric and dimensional analyses in the 3D modeling process and later visualization.

3. METHODS AND RESULTS

The paper presents all the phases prior to visualization of the window on Technical faculty and main entrance elements of Cvijeta Zuzorić art pavilion. In both cases, there was no sufficient technical documentation required for the option of 3D solid modeling (from the scratch).

3. 1 3D model of Technical Faculty window

In order to generate solid 3D model of the window in Auto CAD modeling software accurate dimensions are needed. C*lassical* measurement methods i.e. manual measurements of details – window cross section profiles, are provided *in citu*. The measurement data of the window are recorded by terrestrial laser scanner Leica Scan Station P20. Point cloud model of the window is generated in Leica Cyclon computer software. Several point cloud models were obtained from various scanner positions (Fig.3).

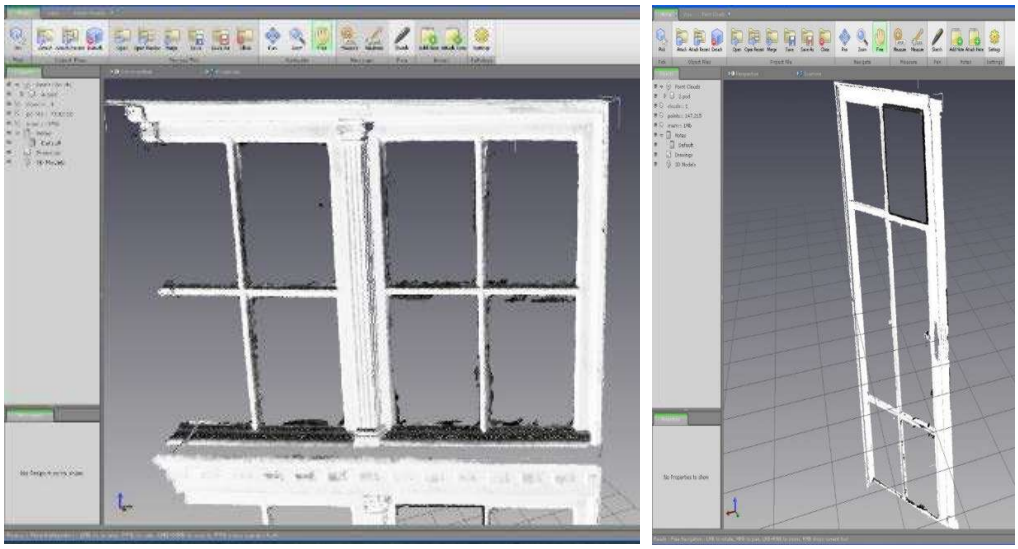

Figure 3: Point cloud models of the window of Technical Faculty building

The performances of the scanner enable high level of accuracy, but point-to-point distances taken directly from point cloud data (by measuring tools in appropriate point cloud viewer) are not convenient for obtaining of small dimensions (less than 1cm).

Parallel modeling process is performed in Auto CAD software, where each element of the structure was separated in its own layer, for the purposes of the final prototyping (Fig.4). Final model comparing (point cloud and solid model) shown approximate value of 1cm difference.

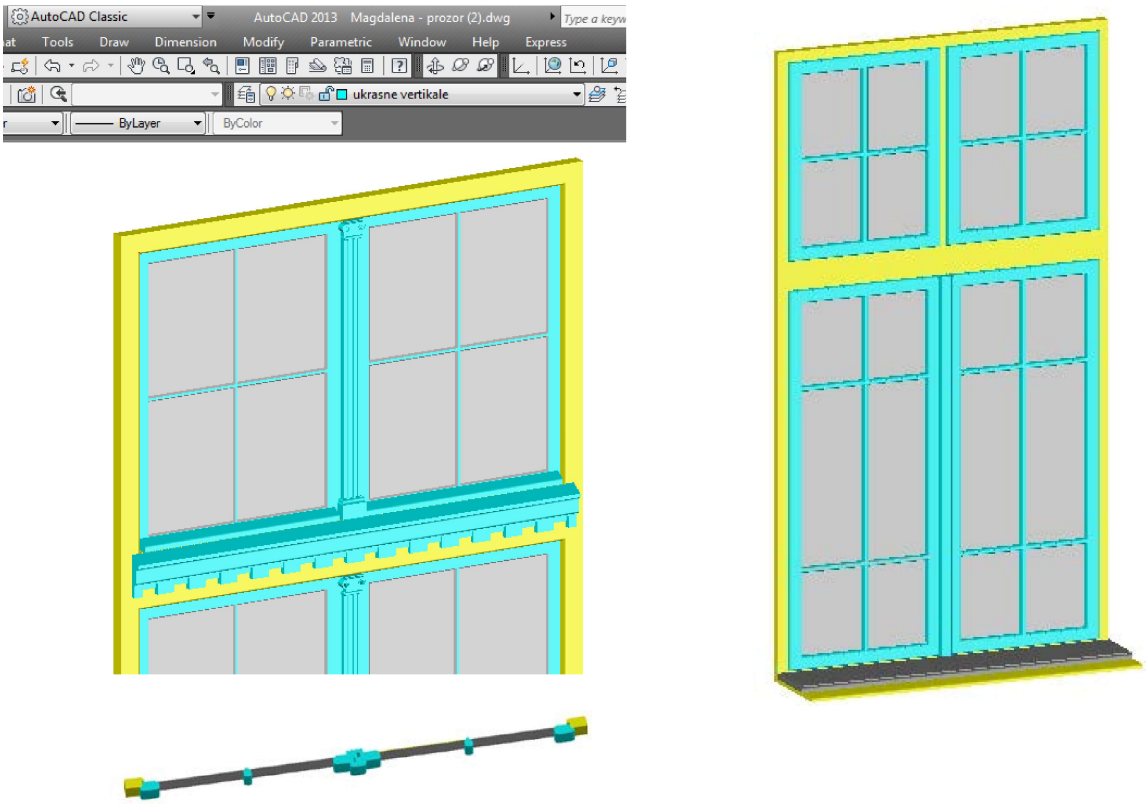

Figure 4: 3D solid model of the window: details of decoration - exterior side (left); cross section of the window (bottom); model view – interior side (right)

3. 2 3D model of the entrance platform of Cvijeta Zuzorić Art Pavilion

The second task had a different concept, regarding the measurement data acquisition. The dimensions of the architectural elements of the pavilion's entrance were provided partly from the existing documentation, while the rest (mostly dimensions in vertical plan) are obtained by inverse perspective drawing procedure, based on pavilions' photo image (Fig.5). Modeling procedure was obtained in AutoCAD software based on set of available dimensions (Fig. 6). 3D modeling of decorative details of the entrance columns (capital and the base) rely on complex geometry and proportions described by Vitruvius in his famous "Ten books of Architecture".

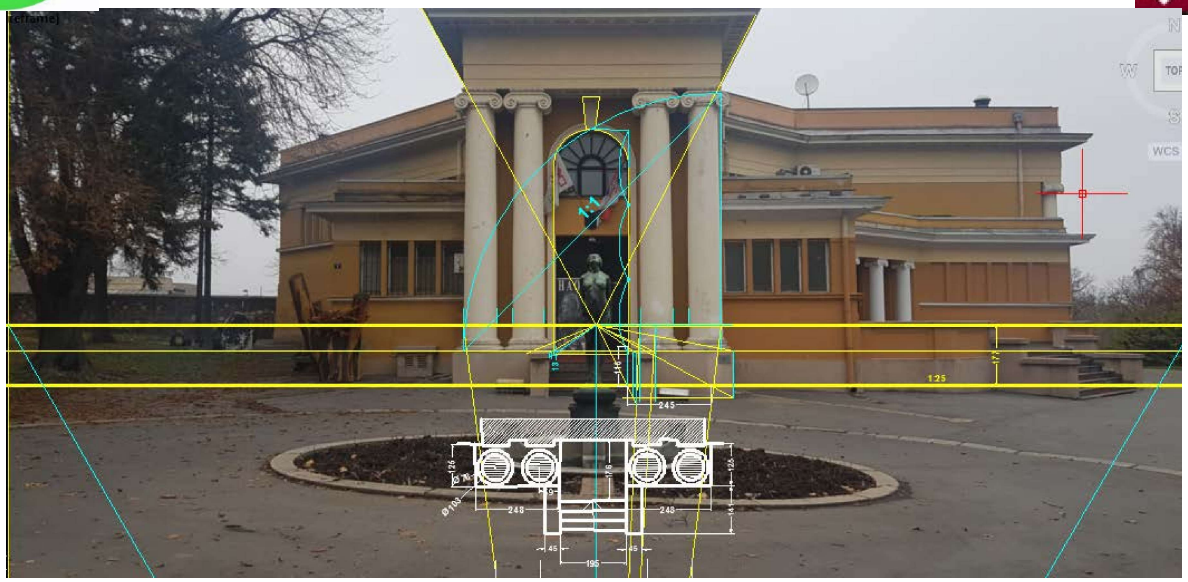

Figure 5: Inverse perspective drawing procedure (perspective with one vanishing point)

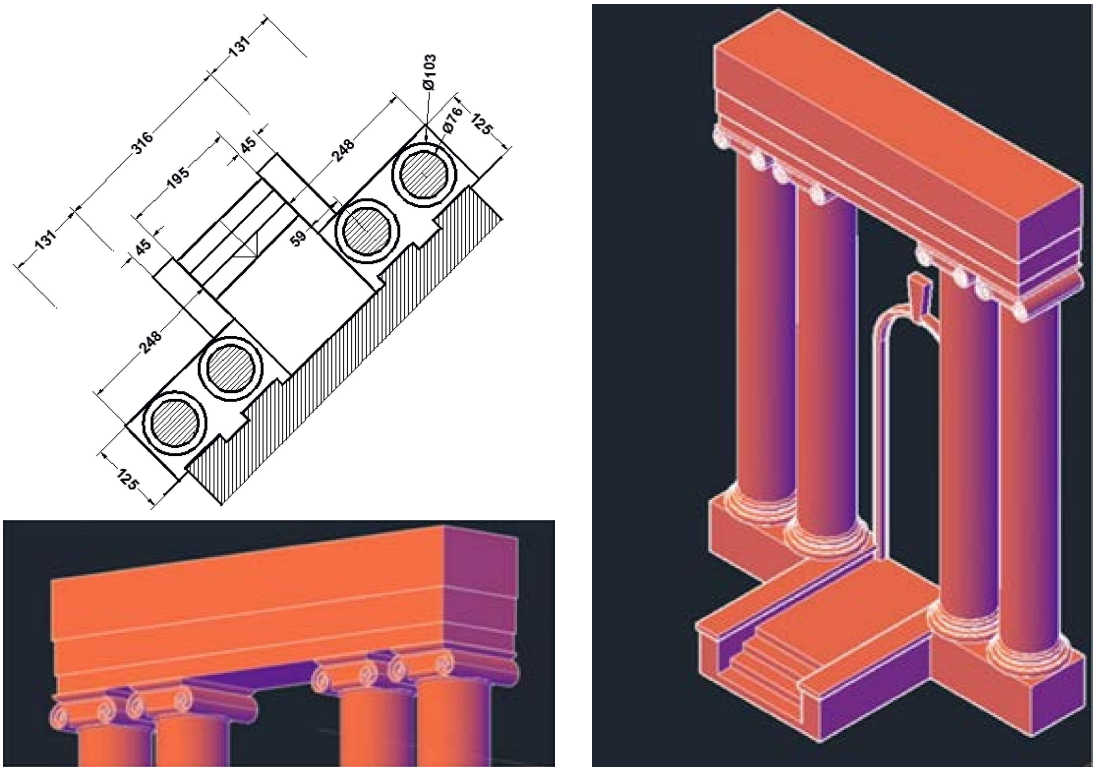

Figure 6: Drawing of the entrance plan concept with annotations; 3D model of the structure

3.3 AR Application

Contemporary streamline in media presentations is going towards AR contents, friendly oriented to the youngest population, which use mobile phone or tablet devices based on

Android or IOS technology. The interaction of a user and some "live" content is happening on the smart-phones' screen. Finger movements enable manipulation with the content. Such applications became usable in several areas: advertising, marketing and sales, project presentations and education. In this paper, both 3D models of the window and entrance platform (previously created in Auto CAD software) were inserted into *Augment* – AR application [8]. In order to activate the application, user has to log in to the Augments' website, add the model in model storage, then scan QR code and start interaction with 3D content through mobile phone camera. Further model implementation into "real" environment depends on the users' imagery (Fig.8).

Figure 8: 3D models' implementation into realistic environment

4. DISCUSSION AND CONCLUSION

The results of visualization of two architectural elements of cultural heritage monuments shown the complexity of processes and knowledge required for its realization. The privilege of being a member of the team in task realization have: architects, geodetic engineers and designers. Beside professional knowledge, working experience, curiosity and courage in testing of new applications and technologies (such as AR), constant learning is the most important prerequisite for being professional and concurrent in these tasks. However, multidisciplinary approach and cooperation of various professionals is necessary if the final goal is results' quality. High standard of measurements rely on very expensive equipment (devices such as laser scanners, photo cameras, or drones aided by adequate software) which enable accurate 3D models, and hence objects dimensioning and documenting.. The benefits of its usage are obvious, regarding both time efficiency and accuracy. The tendency in technological solutions is that expensive devices/processes have the adequate alternatives for common customers. In such manner, contemporary applications for mobile phones and tablets

exist, regarding measurements and visualization processes. They are not reliable in precision, but offer some practical and often amusing solutions.

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