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FLY-THROUGH ANIMATION AT THE FACULTY OF TECHNICAL SCIENCES IN NOVI SAD*

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Abstract. *This article describes application of Fly-Through animation, especially in architecture. It shows application of this animation technique on Computer Graphics – Animation in Engineering studies and on Architecture and Urban Planning studies at the Faculty of Technical Sciences in Novi Sad. Three historically significant buildings have been modeled and animated: Gymnasium Jovan Jovanovic Zmaj, Department of Architecture and Urban Planning and a City Hall in Novi Sad. Development process of these models and animations is described in details, step by step.*

Key words: *computer graphics, animation, architecture.*

1. FLY-THROUGH ANIMATION

Animation is used as a presentation technique in architecture and urbanism. When it comes to presentation, it can be an important link between architectural idea and implementation (construction of facility). Architects have always tried to explain their ideas to the public, especially to investors, because facilities cannot be built without investors support.

The modes of project presentation have changed through history, from drawings and impressive models to multimedia object renders in electronic form. The aim of all forms of presentation is to provide as much information about the project. This information should be readable not only for expert architects, but for wider public, which are not from this profession. Quality of presentation is very high if the basic idea of the project can be understood by everyone, regardless of expertise and level of education. Also, it should not be ignored that the goal of presentation is to impress a client.

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Fly-Through animations often shows cars, nature or people, in addition to architectural objects (Nikolić and Obradović, 2010.).

The most common way to represent models in architecture and urbanism is done through digital technology. There is a wide range of software for 3D modeling: Autodesk 3ds Max, AutoCAD, ArchiCAD, Solid Works, Sketchup, Autodesk Maya, Blender, LightWave 3D, Autodesk Softimage, CATIA, etc. The goal of all these software is to model 3D objects with ease and to render them with high level of details as real objects, which will be understandable to observers. Today it is possible to represent models in photorealistic-looking level and possibilities of digital 3D model rendering are getting higher in time. One of the most popular software is Autodesk 3ds Max. It is the most used software in the world studios for final project presentations. This software was among the first software which comes with packages for modeling, rendering and animation tools (http://area.autodesk.com/maxturns20/history, 2011). This synergy of tools enables a new architectural media – animation.

1.2. Application of Animation in Architecture

Animation quickly becomes a mainstream in project presentation in the greatest studios for architectural projects, such as Herzog & de Meuron, OMA, MVRDV, etc. The world's leading architects uses animation as new form of project rendering, such as Zaha Hadid, Eric Owen Moss, Santiago Calatrava, etc.

The famous architectural theorist, professor Greg Lynn, one of promoters of animation as presentation form in architecture, says:

"Architecture is too static and does not use enough the possibilities of the animation – movement, growth and change... - to formulate its own spaces." (Rottenbury, Bevan, Long, 2004). He believes that architecture should use more various presentation media and not only to integrate them in final presentation but in development process also. There are more and more animations which show conceptual idea and make an influence on design and development.

In standard presentation type (project drawings, object renderings on the paper), according to Kinoto Miyakoda, designer tends to show only images of existing state and images of modified state after project realization. This presentation type does not provide information about idea development and object concepts, but they would occupy too much space if they are on the same paper with the project. Animation can provide a solution for it. Integrating 3D models into a multimedia presentation, the audience can experience 3D space using walk-through or fly-through animation. This can be done in 3D modeling software. By connecting multiple image sequences, viewer gets a sense of movement through the space. This provide more information than a single image, viewer can understand the space much better (Miyakoda, 2005).

Animation not only illustrates some ideas, it can show interaction between people and designed environment also. By using a sound in animations, viewer can have even a better experience.

Architect does not need only to realistically render their designs; they need to explain object's functions, structure and purpose of certain rooms or facilities. For example, the project of the train station in Liège (Belgium) shows how designed station will be working (Devetaković, 2008). Herzog & de Meuron Studio is well known by photorealistic renders, especially for very popular competition for Gazprom Tower in Saint Petersburg, Russia

(http://archpaper.com/news/articles.asp?id=4128, 2011). Animation can be also used to describe the existing building, such as for example a Therme Walls, designed by architect Peter Zumthor, 2010., Pritzker Award winner. There is a large number of animations which shows concept and building interior (http://www.polygraphyworld.info/play/vrF5D_SByFQ/Animation_for_Peter_Zumthor_-_Therme_Vals%252C1996.html, 2011).

Animation can be used to show reconstruction of buildings which were destroyed or there is a little substantive information about them. For example, MiraLab Studio in Geneva made animation of life in Pompeii (http://www.youtube.com/watch?v=hVMzp0QjCJ4&feature=related, 2011). Based on this example, it can be concluded that animation in architecture can be used for four purposes:

1. animation of moving building parts and constructions,
2. animation of concept development,
3. animation of architecture history, and
4. animation of final design, usually a fly-through animation (scene flyover).

Fly-through (or Flyby) and walk-through is the most common form of animation of architectural works. It is also and the simplest form of animation with only a camera animated (Parent, 2002).

It is necessary to define the path that viewer will follow, and to define information which will help viewer's orientation. The path is interpolated among key frames which will be shown to a viewer. There are different ways how to aim viewer's attention to important building's elements. For example, center of interest can be constantly presented in every frame while viewer follows the path (point of view is direction vector between the position of the viewer and the center of interest). This is useful when viewer "fly" over certain area or building, or inside interior. The path can also be constructed to follow series of buildings in the area. In this case, animator usually keeps the center of view on one building for couple of frames, before it moves to the next building. Center of view can be even pointed to some particular object, for example: following an arrow in animation.

During fly-through animation setting, it's necessary to properly set observer tilt. It can greatly affect how the audience will experience architectural space. One option is to interpolate direction of view and then set to head-up orientation and apply observer tilt to all. This means to set camera to eye position (this is usually 170-180cm in architecture projects) and to head angle (head right, head looking up or head looking down). All settings depend on the way how project designer wants to show the project to the audience or investors.

2. FLY-THROUGH ANIMATION IN NOVI SAD

2.1. Gymnasium Jovan Jovanovic Zmaj

This is large Serbian Orthodox gymnasium, established on Saint Sava's day, 1810. It was established in Novi Sad, a city which gain a Free City Status in the Austrian Empire, 1748. Novi Sad was the most important Serbian economic and cultural center in the region. This gymnasium has a great significance for Serbs in Soutern Hungary, it was a gardian of Serbian language, national spirit, culture and art. Gymnasium is divided into blocks: A, B, C and D. Each block has a ground floor, first floor and attic. The interior has many plaster decorations, which are placed from main entrance up to the Great Hall.

Great Hall is exceptional masterpiece that is full preserved, as the most of the building. Wood and marble is the most dominant materials.

After examining the existing projects, it was found that cross-section projects are missing, because of many renovations. These cross-sections are crucial for the determination of measures and heights of individual segments of the building. Because these difficulties, collecting of information was done in several stages:

- analysis and determination of measures based on existing construction projects,
- additional measurements on the site,
- taking interior photographs,
- analysis of collected information and additional measurements if necessary.

It should be noted that all measurements and photographs are collected only for those segments of the building which are required for this project, in this case the centre of the gymnasium.

The second stage of the project was modelling and mapping 3D model of gymnasium Jovan Jovanovic Zmaj. This was done in segments (Divljanović and Obradović, 2009). Central gymnasium segment (walls, floor and ceiling) were done first, and finished segments (windows, doors, benches) were imported after it. The term "finished segments" means 3D models with applied materials. These operations were done in following order:

- map preparation and required materials definition,
- modelling of central gymnasium segment and mapping,
- modelling and mapping of individual segments of the building, and
- import 3D models into central segment and positioning.

Fig. 1. Entrance of Gymnasium Jovan Jovanovic Zmaj

Fig. 2. Basic floor

This is the most important part of the project, which largely affect the quality of final results. The last and not the least important part was brightness adjustment of 3D models, rendering and receiving pictures and movies in the proper format. Operations are conducted in the following order:

- setting lights,
- setting camera (path, moving timings, key frames, etc.),
- final rendering, and
- additional post-processing of images and movies (if necessary).

Fig. 3. Stairs

Fig. 4. Stairs and second floor

For all operations it is necessary to define available resources and their purpose. This means hardware and software components.

2.2. Faculty of Technical Sciences

In this part, a computational model of fourth floor of Faculty of technical science is presented (Rauš and Obradović, 2010). This work represents all elements of architecture visualization, based on original project documentation which exists on Faculty of Technical Sciences, and also all details and elements which exist inside this object, like desks, chairs, banks etc. After finishing computer modelling, for realistic representing, it was needed to add appropriate textures and maps to created elements, set illumination, than to do rendering and to make pictures of characteristic scenes. Those pictures, if needed, may be treated in software prepared for that. At the end, it was needed to set camera on path constraint and to make short animated movie where will be shown characteristic elements and parts of Department for architecture and urban planning.

Fig. 5. Hallway base

Modeling basic visible surfaces means creating walls, floors, ceilings and stairs. Segments which are used in this project are easy to model and maps separated from main scene, and then import them in main scene as separated files. This workflow requires more hardware resources, but it is proven as a simpler solution.

Modeling should be started with segments that are repeated. In this case, there are a lot of segments that repeats because the classrooms are equipped on almost identical way. Doors, windows, chairs, tables, blackboards are modeled first, and then all other segments (Obradović at all, 2009).

2.2.1. Mapping

Mapping is done after modeling basics and all individual elements. The ceiling is different in hallway and classrooms, because one part of ceiling in the classrooms is covered with wood. There are some differences between walls in different classrooms, and in the hallway also. The same material were used, but with different maps. The stairways were defined with two materials, one the same as for walls in the hallway and the other with marble texture. The spiral stairs were done with only one material (wood).

Fig. 6. 3D models of tables and chairs (rendered images)

2.2.2. Lighting

The last part of the project was lighting adjustments for scene, rendering and saving images of complete floor and saving the movie in proper format. It is necessary to use light sources in the scene to get realistic 3D objects renders. Light source is any object which emits the light energy. Number of light sources increases brightness of the scene, a large number of various light sources create the image of natural light. To make an object visible and to create realistic render it is necessary to set a light's type properly and set positions of light sources, then adjust intensity of lights, directions and light diffusions. Before setting the lighting it is necessary to decide which kind of lightning type will be dominant in the scene. For this scene we choose artificial light.

2.2.3. Camera Settings

Camera settings define how audience will see the scene. Camera movements are done by making a path which camera will follow and then connecting a camera to this path. A lot of control points are placed on this path, to gain better control over camera and get more quality results. In this project it was used target camera, to ensure proper movement of the camera it is necessary to place camera target to path and set camera view during animation. This is more complex technique than working with free camera but it gives much better control. Figure 6 shows the path with camera attached to it.

Fig. 7. Camera tracking the path

Lens size is set to 24 mm. This lens gives the best ratio of distortion and viewed space. In this stage of workflow, it is necessary to define additional parameters for animation. Speed and animation length are very important parameters. It is well known that animation length is defined with number of frames, and speed with number of frames per second. It is necessary to adjust these parameters well because it may come to noncontinuous camera movement, even to camera stopping.

2.2.4. Final Rendering

Rendering is a process of creating images based on graphical models. It represents very complex area which is under intensive research today. Rendering tools, in addition to model geometry calculate also lighting, shadows, colors, textures, transparency as well as some advanced features of some software packages.

Rendering process turns four space dimensions into two, if we take X, Y, Z as three dimensions and a time as fourth, while we have 2 dimensions as output (V,W coordinates), which are bitmap coordinates. This process requires computer with high hardware performances, strong CPU and greater amount of RAM.

Before final renderings were done, at first some test renderings were done on lower resolution. On this way computer faster runs calculations and creates renders. Rendering output is JPEG, a bitmap format image. Image as output format, instead video format, is used as safety measure if rendering process crashes, especially for long rendering times. If video is chosen for output format, after rendering process crash whole rendering process must be redone from the beginning. If image is used as output format, after rendering process crash, process can be continued where it was stopped. At the end, image sequence can be connected in animation.

After rendering, it is needed to control image sequence. If some image is different from the sequence, or it has some irregularities it can be edited in some image editing software, like Adobe Photoshop.

There are many rendering tools, one of these tools is 3D Studio Max, which enable animation, rendering and game elements development. In the case of final rendering at resolution 800 × 600 px, with lightning, it was needed 30–120 min, depending on the scene. Reason for slow rendering is great amount of details in the scene.

2.2.5. Creating of Animation

Fig. 8. View on floor at Faculty of Technical Sciences

Fig. 9. Spiral stairs

According to one definition, animation is images in "motion". Using timeline, images replace one with another. Every image stays on the screen some amount of time. Animators have to decide how much each image will be held and these produce specific effects. Images have a small differences and that is the way how they join in peaceful and steady movement.

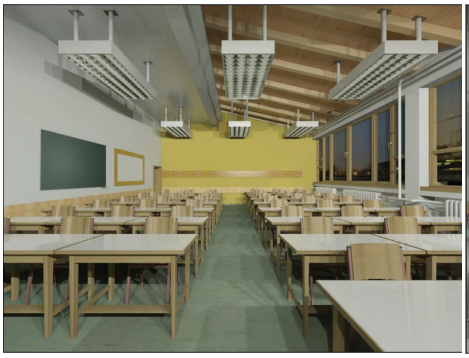

Fig. 10. Classroom

Fig. 11. End of the corridor

The impression of motion pictures is based on physical properties of the human eye. If viewer sees sequence of images in short time interval, previous picture join with the next one and, in the case of movies, we have an illusion of continuous movement. Under reproduction at 24 pictures per second viewer sees smooth illusion of movement.

2.3. City Hall in Novi Sad

For further promotion of important buildings in Novi Sad, it was picked a building older the one century (Poznanović and Obradović, 2010). This model is representative neo-Renaissance palace with a tower, it is a City Hall.

Fig. 12. Novi Sad City Hall entrance

Fig. 13. Arcade

Construction of City Hall was started in 1893 on the place of "Ferenciane" ruins, based on the project by Georg (Djerdj) Molnar. It was finished in 1895. There are domes over all four corner of the palace. Tall tower with a balcony dominate the building, in which was placed the bell "Matilda" in 1907 (melted in the war) which was alarm fires in the city. Building's front has strong columns and arcades on the ground floor. Facade has beautiful allegorical sculptures of Greek goddesses. Inside Great Hall on the first floor, painter Pavle Ruzicka was painted marks of craft and trade.

2.3.1. Project Development

Development of this kind of project requires work in several stages:

The first stage was collecting of information about target object and we can divide this stage to:

- analysis and determination of measures based on existing construction projects,
- additional measurements by hand of whole interior,
- taking interior photographs,
- analysis of collected information and additional measurements if necessary.

Fig. 14. Conference Hall

Fig. 15. Piano

The second stage was the modelling and mapping the stage:

- modelling of basic supporting segments of the City Hall,
- modelling of individual segments of interior,
- connecting and placing,
- photo editing for map development (using Adobe Photoshop), and
- using maps for segments of interior.

The third stage was lightning of the scene, placing the lights on the right positions and light settings. The forth stage was camera placing and setting. The fifth stage was rendering and all operation which are performed as preparation and finishing ending results. The sixth stage includes animation development from rendered image sequences.

3. CONCLUSION

Animation, as a form of architectural project presentation, is becoming more popular in the world. It is a great tool for telling a story about single object and impreses the viewer. This means that its function is narrative.

Animation goal is to describe a concept, to show function of space and possible interaction between users and designed space. It recently became one of the favorite forms of multimedia presentation of projects in architecture and urbanism, therefore there is a great potential for development and research in this field.

Animation has potential, according to some architects, to become even a part of designing methods, to became a part of creative thinking process during development, not only a form of finished project presentation. This is the future of animation in architecture and urbanism, according to experts.

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PRIMENA FLY-THROUGH ANIMACIJE NA FAKULTETU TEHNIČKIH NAUKA U NOVOM SADU

Branislav Popkonstantinović, Ivica Nikolić, Ana Perišić, Igor Kekeljević

U ovom radu je dat pregled korišćenja Fly Through animacije, posebno u arhitekturi. Specijalno je prikazana primena ove animacije na studijama Računarske grafike-Animacija u inženjerstvu i na studijama Arhitekture i urbanizma, na Fakultetu tehničkih nauka u Novom Sadu. Prikazana su tri istorijski značajna objekta: Gimnazija Jovan Jovanović Zmaj, Departman za Arhitekturu i urbanizam, kao i gradska kuća u Novom Sadu, na čijim modelima su urađene animacije. Postupak izrade ovih animacija je detaljno opisan, redom, kako su objekti i animacije napravljeni.

Key words: *kompjuterska grafika, animacija, arhitektura.*