



# Virtual Reality as Innovative Approach to the Interior Designing

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## Abstract

We can observe significant potential of information and communication technologies (ICT) in interior designing field, by development of software and hardware virtual reality tools. Using ICT tools offer realistic perception of proposal in its initial idea (the study). A group of real-time visualization, supported by hardware tools like Oculus Rift HTC Vive, provides free walkthrough and movement in virtual interior with the possibility of virtual designing. By improving of ICT software tools for designing in virtual reality we can achieve still more realistic virtual environment. The contribution presented proposal of an innovative approach of interior designing in virtual reality, using the latest software and hardware ICT virtual reality technologies.

**Keywords:** virtual reality, real-time visualizations, dynamic visualizations

## 1 Introduction

Digital designing of building is essential to avoid unnecessary construction and design misunderstanding. Virtual Reality (VR), like modern ICT tool, breaks traditional design environment by providing interactive imagery creation. Dynamic real-time visualization (DRTV), being a type of VR tool, act as a new approach to interior design practices. This provides new ideas and perspectives in the application of VR tools for interior design. Using game engine technology in the 3D design field has overall shorter virtual construction process [1]. The difference between using an average 3D design software and a gaming software as a 3D design software is the ability for interactive virtual environment. Users are allowed to experience a dynamic and interactive virtual interior environment by using 3D gaming engine as the development software for DRTV. Users can then explore the interior design by walking through the room layout. Using a gaming development software acts as a dynamic design process and solution due to the freedom and limitless options that such software can offer to the field of interior design. Also, it provides new opportunities for comparisons with other design solutions [2].

There are 3 types of animation representation techniques [1 & 3] when the 3D house models are intended to be presented animatedly. One of it is conventional animation where users are

spectator in the visualization. There is no interactivity at all between users and the virtual world. The other type is interactive visualization using authoring software where this type of technique is still static, but interaction can be done using methods such as point-click. This technique is only in 2D animation [4]. Last but not least, the third technique is interactive visualization using game engine as development software. The 3D designs that navigates user can become dynamic, providing engagement and collaboration between users and the 3D world created [5]. Although CAD tools can create 3D visuals, non-interactive 3D model will be hard for interior design to fully express what they intend to display in their work. Interactive virtual walkthrough gives user an experience of being in the virtual environment and explore the interiors freely. Besides that, it will help interior designers to see their work from the perspective of a user when him enter the room [1].

## 2 Dynamic real time visualizations of interiors based on game engine

Technology of game engine is primarily used in developing computer games for game consoles (PC, Playstation, Xbox, etc.). With the ability to easily create virtual environments and interact with a virtual environment, this technology has found wide application in the industry of architecture and designing [6 & 7]. Through the "game engine" it is possible to create realistic interactive environment of interiors, where observer can freely move around and designing interactively in virtual reality (move furniture and furnishings, edit the material and color solutions of interior surfaces) [6]. The process of developing dynamic real time visualization (DRTV) for the architectural designing of the interiors is presented by IPO model of DRTV (Fig. 1).

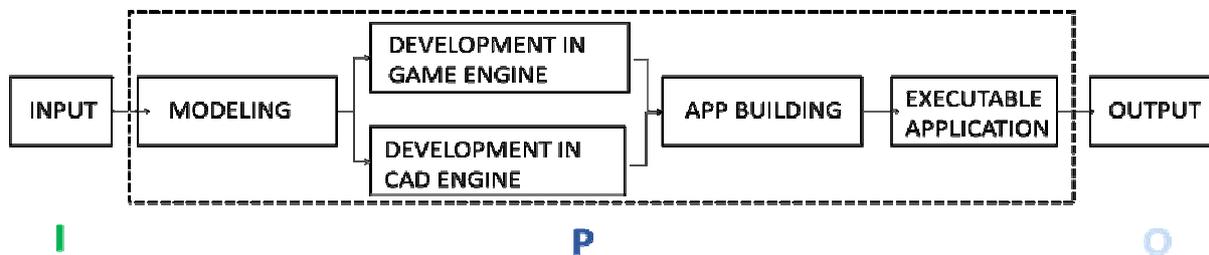


Figure 1: DRTV IPO model

Input forms at first from user requirements for output information. This requirements are through devices for control DRTV, which also form part of the input, transmitted to the Process. Process is characterized by the entire development process of DRTV application implementation. The process starts by modeling 3D objects and 3D environment. Subsequently are processes of application development in development engine. Two development engines are used. First game engine and second CAD engine, in which application is builded (executable standalone application). Output information flows from Output (Oculus Rift, HTC Vive,..) to user.

Creating of 3D models (modelling) is necessary for processing of DRTV and also for virtual interior designing. We can divide it to two main groups:

- 3D interior environment - 3D model of interior space, which is obtained from 2D or 3D building design

- 3D interior objects - individual 3D objects of furnishings
- 3D models (Fig. 2, 3) are generally processed in 3D CAAD software (eg. 3D Studio Max, Maya, Sketchup, etc.)

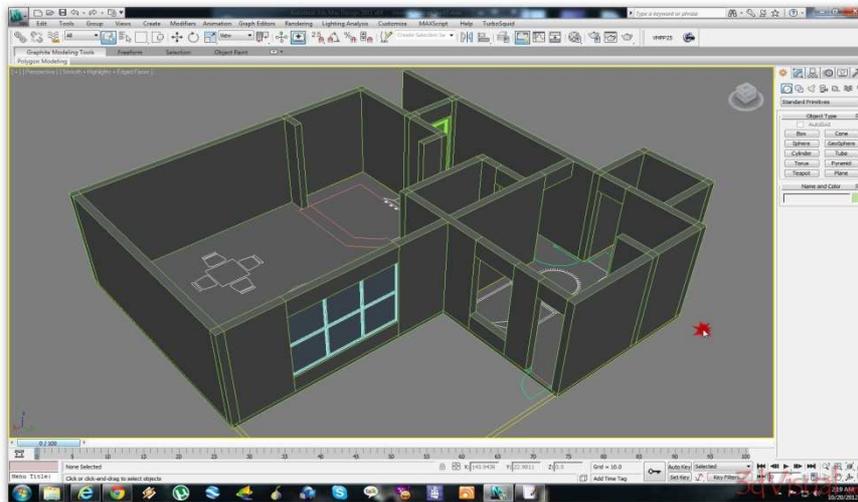


Figure 2: Preparation 3D model of virtual interior environment in CAAD software

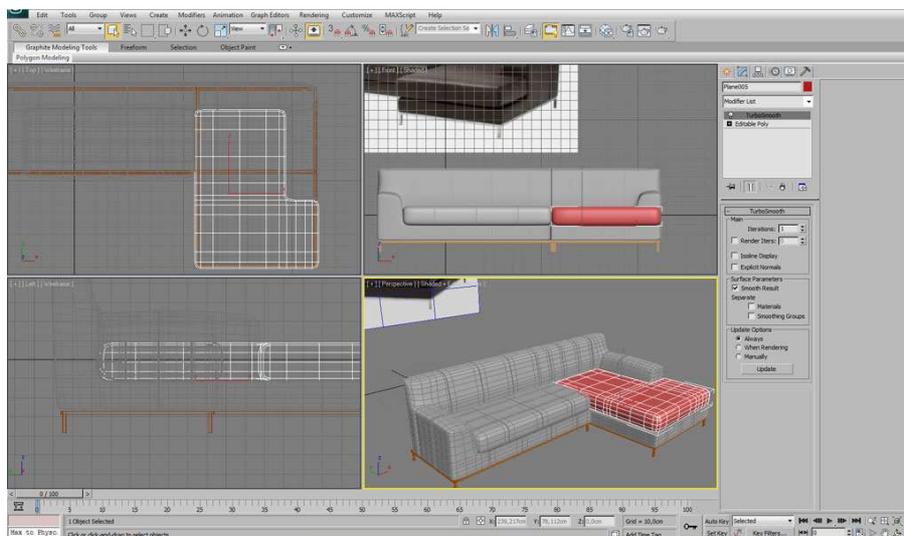


Figure 3: Preparation 3D model of virtual furniture environment CAAD software

Subsequently, the models are imported into the development game engine environment (CryEngine, Unreal Engine, Unity 3D) which define the surface character of individual objects, lighting conditions (indoors and outdoors) and not least the interaction between them (Fig. 4). The next step is scripting interactions and behavior between users, virtual environment and objects through commands entered by keyboard, mouse or other input devices such as Leap Motion (sensor device that supports hand and finger motions as commands input).

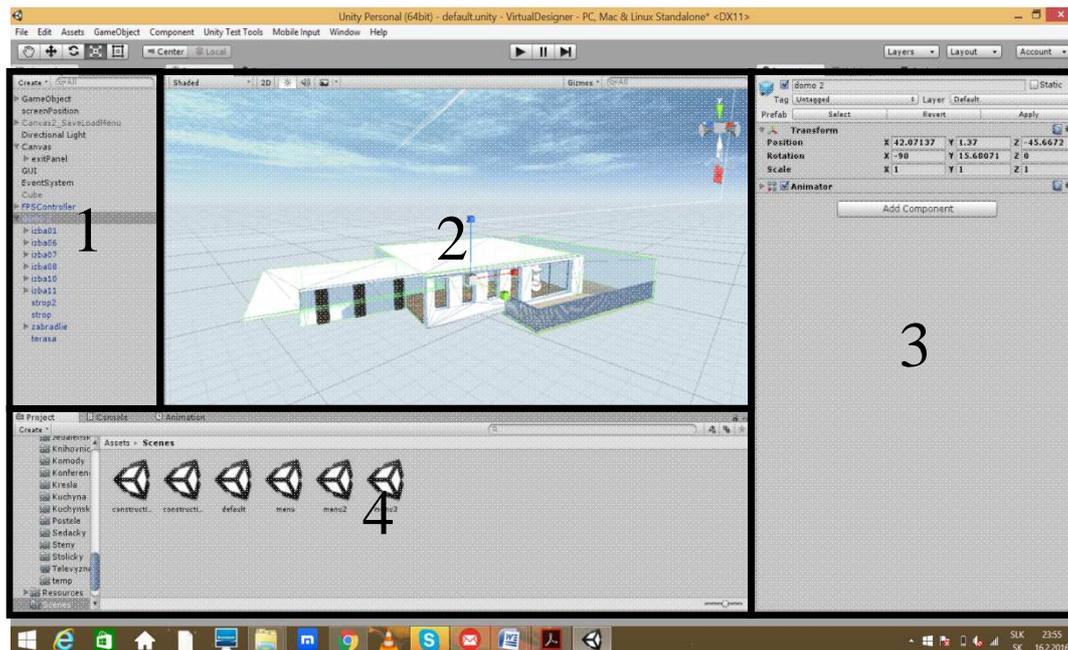


Figure 4: Screen of developing engine Unity 3D

(1-Scene object hierarchy, 2-Scene designer, 3-Solution view 4-Assets view)

After app building processing in game engine we get executable application for using through output devices. The most of DRTV developed by game engine environment, now widely used in practice, allows the user only to walk free in the interior design without possibility to affect the design (Fig.1 - phase Run & walkthrough). DRTV environment for interior designing should offer a wider range of control for the purpose of control of the design at the real time. For this purpose it is necessary to use two main groups of devices for displaying and controlling VR (Fig. 5).

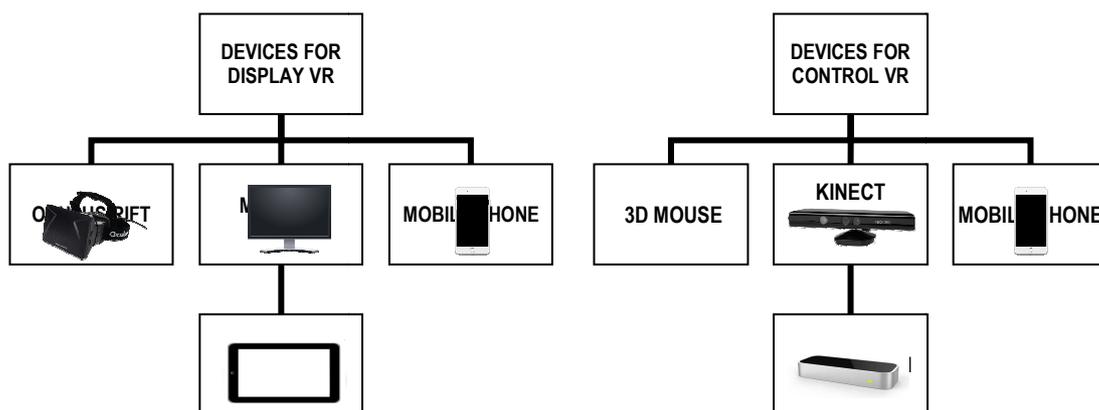


Figure 5: Devices for displaying and controlling VR

At the phase of designing the interiors the investors are interested also about costs. Professional design software environment should also have a link to the budgeting. DRTV enables upgrade costs of interior solution throughout the design process. Cost information may relate to the selected equipment, as well as costs of surface finishing of the interior. Faculty of Civil Engineering - Technical University in Košice within the start-up of the project (vizualizacky.sk) has been developing DRTV of the construction projects. Presented a case study demonstrates the potential of using VR for interior design in DRTV.

### 3 Case study of interior designing in VR

The subject of the study was designing the interior of 4-room apartment with total area of 169 square meters within the development project of residential building Saffron garden in the center of Kosice (Fig. 6). 3D interior environment and 3D interior objects are created in 3D Studio Max. These models were imported into Unity 3D, which were set their graphic characteristics and interactions between them.



Figure 6: From 2D Floor plan to DRTV of case study project

To control and display interactions in case study were tested equipment for VR control - keyboard, mouse, Kinect, Leap Motion, tablet, mobile phone, and for VR display - Oculus Rift VR Technology (Fig. 7).

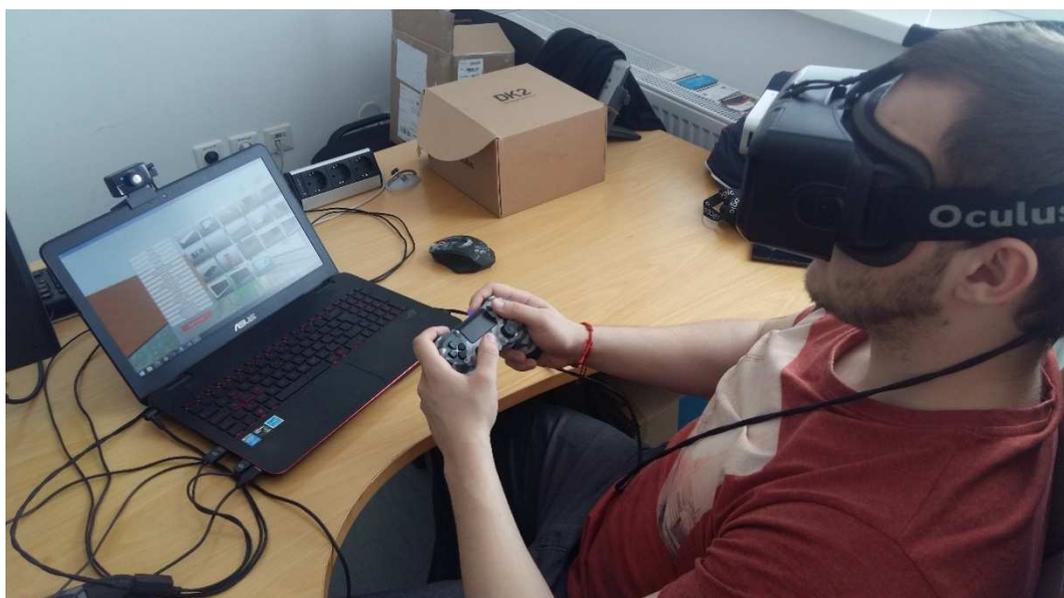


Figure 7: Devices for control and display of case study DRTV

DRTV uses two main groups of commands:

- commands for manipulation with objects (delete, import, rotation, place),
- commands for change the object's surface character (texture, reflection, shine ...)

Process of designing begins by place 3D interior objects to the 3D interior environment. 3D interior objects are divided into three basic groups: furniture, electrical equipment and decoration. By manipulating with these objects we have the opportunity to design interior (Fig. 8) and see the graphical output in real time from a first person (FPS) perspective. By commands to change the object's surfaces characters we can modify the colors and a material of floors, walls, ceilings surfaces and also of 3D interior objects.



Figure 8: Selection of 3D interior objects from database and manipulating with it

Presented DRTV tool allows creating a detailed budget of interior design (Fig. 9). The budget is divided into two main parts. In the first part are costed all imported interior objects. Sources of information include costs from different suppliers. In the second part of the budget are costed surface finishes of floors, walls and ceilings. As a cost basis, for budgeting this part are

used price lists of construction works. On the other hand, budget of surface finishes without costs can serve as a document for price offer. By furnishing all rooms of apartment in a residential building, customer gets an overview of the total cost associated with the purchase of an apartment as well as with furnishing. This allows planning the distribution of cost flow for a longer time, in case when the customer after the purchase of the apartment does not have the necessary funds for its furnishing. He can therefore decide which parts of the interior furnishings have a higher priority or customize standard of equipment to its financial envelope. Price of apartment mentioned by developer is 315 000 EUR including VAT. Price of interior furnishings, calculated by DRTV is 30 740 EUR including VAT which constitutes 9,76% of the purchase price.



Figure 9: DRTV linked to the budget

## 4 Conclusion

The case study presented specific tool of VR technology for interior designing. DRTV developing in game engine supported by modern tools to display and control VR allows in interior design:

- intuitive process of design in DRTV,
- see design in real-time without re-rendering visualization,
- adapt the dimensions of furniture to dimensions of room,
- cost control in real time...

Benefits of DRTV is also a realistic view of the interior from the first person which makes easier perception of space, its size, daylight conditions, and the overall impression for users with less imagination. Also communication between designers and investors through DRTV gaining a

whole new dimension and is incomparably effective than communication based on 2D drawings or static visualization.

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