Optimal textures for 3D real time architectural visualization

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***Abstract*—3D architectural visualization refers to the creation of three-dimensional structures from plans or projects before its actual construction. The motivation of this research is to apply multimedia and virtual reality (VR) technology to create 3D interactive architectural visualization focused on obtaining a realism level the most similar to a commercial one. Our exploration focuses on an examination of the best texturing techniques for creating a 3D model regarding an object in an interior environment using a game engine as a tool.**

Keywords—virtual reality; interactive; visual; realism

I. INTRODUCTION

Architectural visualization is the art of creating three-dimensional images or animations on a computer showing the attributes of a proposed architectural design. 3D renderings play a major role in real estate sale and marketing due to helping make good design related decisions before the actual builds. Architectural renderings are often used in the form of animations in which each scene is created along with landscaping, building (exterior), room (interior), and sometimes includes moving people and vehicles. Walking through and flying by animation can give a better and more dynamic view of the scene than 3D renderings ones. As well as 360 degrees panoramic view (or 360 panorama, virtual panorama, spherical panorama, cubic panorama), the presentation of 360 x 180 panoramic projection of space can also be a supportive strategy since it costs less than animation production. In order to create the media mentioned above, a period of time for the rendering procedure is required and the interaction is limited. However, the aesthetic level is quite high since every component, e.g. texture, lighting, can be fully realized into the high polygon models. In contrast, the media running with the real time rendering concept, e.g. digital game, is outstanding in terms of interaction. Nevertheless, the level of realism is quite low since all components, especially the number of polygons, have to be limited in order to maintain a smooth rendering [1].

According to the concept of minimizing resources for the sake of improving interaction, high polygon count objects and video objects are avoided. This is a main problem when applying real time interaction with the architectural presentation for commercial use, as this application requires a high degree of realism [2]. The main processes of creating 3D objects for a game focused on realism are texturing and lighting; therefore the best technique of each of both areas have to be explored. This paper aims at applying a game engine as a tool for real time photorealistic architectural visualization focused on 3D texture maps.

II. BACKGROUND

Texture in visual arts refers to apparent surfaces that present physical properties such as fur, wood, metal, glass, etc. Texture mapping is a procedure to wrap images around a 3D model by mapping points on an image (called a texture) to vertices on the model. In addition, texture maps (or bit-mapped images) can be used to overcome the limitations of per-vertex surface attributes, a lighting method that calculates on each vertex rather than each face (per-face) [3]. In order to texture 3D models with low geometric features, multi-texturing is the most used technique [4]. Texturing maps include diffuse map; surface's main color, height map; a square gray-scale image whose black pixels represent the lowest height, specular map; a surface's shininess and highlight color, environment map; reflection regarding an environment and normal map (or bump map); lighting detail represents depth.

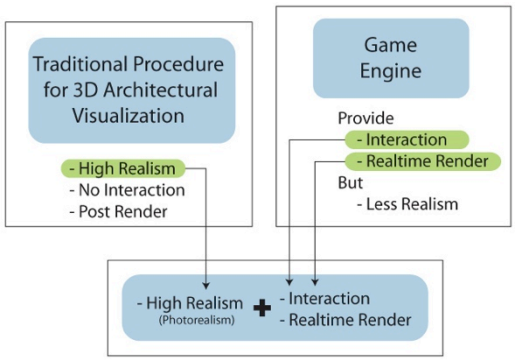


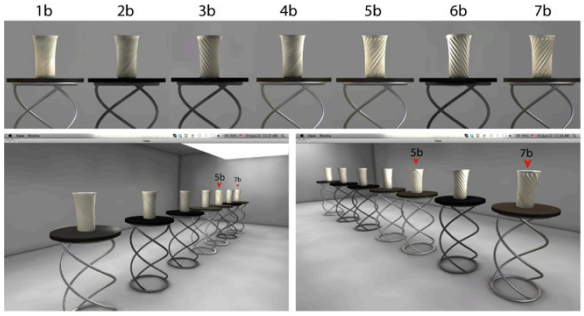
Figure 1: The integration of realism and interaction concepts

With regard to the concept of minimizing the resources for the sake of making smooth of an interaction, high polygon count objects and video objects are avoided. This is a main

problem when applying real time interaction with the architectural presentation for commercial use as this kind of work requires a high degree of realism. The main processes to make 3d objects look real are "texturing" and "lighting" then the best technique of each method have to be explored.

III. Our Study

Three texture maps, specular map (SM), environment map (EM) and normal map (NM), have been preliminary selected regarding to the use with a low polygon object in real time render engine, as the more appropriate to increase realism. The remaining texture maps, not considered here, are diffuse map; different level of texture and height map. They are appropriate with high polygon objects.



Object	SM	EM	NM	Result
1b	✓	-	-	Wrong texture
2b	-	✓	-	Wrong texture, No reflection
3b	-	-	✓	No reflection
4b	✓	✓	-	Wrong texture
5b	✓	-	✓	Correct
6b	-	✓	✓	No reflection
7b	✓	✓	✓	Correct

Figure 2: Texturing comparison result

With these 3 textures we created the 7 different combinations (1b - 7b) and applied them on a cylindrical vase using 3DsMax and Unity3D; see figure 2. We discarded five of the seven combinations as they produce incorrect visualization regarding to the texture pattern and reflection.

Then, we tested the remaining two combinations by running a survey focused on the realism asking laypersons the question: which one (A or B, See Figure 3) looks more real (photorealism) for you?, where
A = 5b = Specular + Normal map and
B = 7b = Specular + Environment map + Normal map

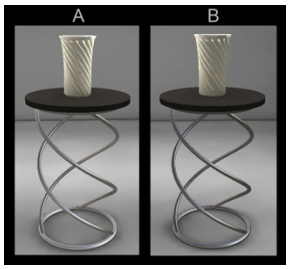


Figure 3: Texturing benchmark

IV. Result

The survey was conducted in a Facebook channel. We got 160 responses, where 56 % preferred B and 32 % preferred A, while 13 % agree that both objects look similar, see Figure 4.

Answer	Amount	Percentage
A looks more reality	51	31.88 %
B looks more reality	89	55.63 %
Both look similar	20	12.50 %

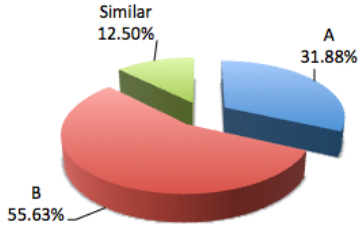


Figure 3: Texturing benchmark

V. Conclusion

We have explored the use of a game engine as a tool for 3D real time interactive architectural visualization, focusing on texturing. A low polygon cylindrical vase, with spiral surface, was modeled and different combination of three textures, specular map, environment map and normal map, were applied. After initially discarding most of the combinations out of incorrect visualization regarding texture pattern and reflection, a survey with laypersons was conducted on the remaining two, asking for their preference (in term of photorealism). 160 respondents replied and most of them stated that the preferred texturing map are the mix of the three textures. In future work, we plan to compare the difference between traditional 3D visualization and real time architectural visualization.

VI. Reference

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