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## Creating Realistic Images in a 3D Scene Using Illuminations and Renderings to Create an Animation

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**Abstract:** Creating realistic images, whether used or not for prints or video images, it depends on illuminating and rendering a scene. The representation of lights, shadows and textures is realized with the help of software and hardware. A 3D animated scene is a set of different objects which were defined geometrically in three-dimension space, together with viewing and lighting parameters. This article briefly presents the way that all this given effects apply to a scene. This is not a modelling scene made pixel by pixel, this is rather a presentation of a pipeline and workflow, just like an artist works to create a building or an object for a next-gen game.

**Keywords:** Scene 3D, illumination, rendering, shadows, realistic image

### 1. INTRODUCTION

A 3D animated scene is a set of different objects which were defined geometrically in three-dimension space, together with viewing and lighting parameters. Different possibilities for representing a 3D scene have been explored in the literature. This paper presents briefly how the lights and the shadows applied the renderings of a scene and the big influence that they have in a 3D scene.

### 2. RELATED WORK

The 3D Character Animation and Special Effects award is focused on the creation of original CGI (Computer-Generated Imagery) characters and stories, while at the same time building upon the traditional animation principles of timing, movement and expression.

Volume graphics [1] involves the synthesis, manipulation, and rendering of volumetric objects, which are stored as an array of voxels. Interactive sculpting tools for clay-like [2], [3] and solid [4] models represent the material by voxel data and define tools that can add/remove material, as well as perform a smoothing operation. Some sculpting metaphors utilize alias-free volume sampling [5] or uniformly sampled scalar fields [6] as the volume representation.

These efforts are extended in [7] to achieve interactive editing speeds using resolution adaptive volume sculpting and also in [8] to create a real-time sculpting system using subdivision solids. Some volume sculpting applications use haptic feedback to give the user a sense of shaping a virtual material [9].

Sketch-based modelling tools allow the user to sketch the salient features of a 3D primitive and the system produces the corresponding 3D model in the scene. Numerous sketch-based modelling techniques have been developed for meshes [10], [11], [12], [13], [14], [15], parametric surfaces [16], procedural surfaces [17], volumetric models [18] and implicit surfaces [19], [20], [21], [51], [22], [23], [24]. Their main advantage over voxel-based models is their ability to provide a high-level surface paradigm based on a low-level volumetric representation [25].

### 3. ILLUMINATIONS AND RENDERINGS

Illumination and shading are two complementary aspects in graphics that add realism to rendered scenes.

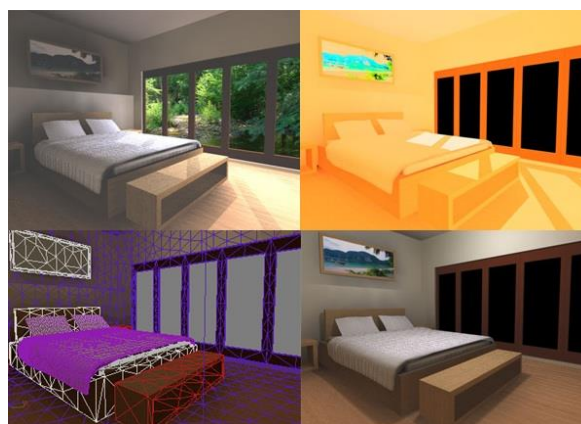


Fig. 1. Using different kind of light and texture in a scene

Illumination refers to use of lights in virtual world while shading refers to effects that lights have on 3D objects in the scene. Many kinds of illumination models and shading models are available

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in 3D graphics. In computer-aided graphic, rendering is a command which abstract description of a 3D animated scene is converted into an image.

Rendering has property to illuminate objects and project them in the two-dimension space of image, and thus the color intensity of each pixel can be calculated to achieve the visual effect of the resulted image.

Real-time applications or interactive ones require high demands on their processing power. Rendering highlights the way in which images are presented once it was finished modeling, animation, illumination and scene texture achievement.

For high quality images or complex scenes, rendering involves millions of operations with integer and real numbers for each scene, requiring higher computing power [26].



Fig. 2. Light distribution [26]

To achieve a realistic three-dimensional scene shadows and lights are essential. Lights are important to the emotional state of the stage play. A scene can be enhanced by a corresponding intensity of light but the abundance of light can damage the scene. Light can be used to focus a viewer's attention on a particular object within a scene.



Fig. 3. Mental Ray Rendering [26]

Rendering of light, shadows and texture is achieved with software renderer. Scene becomes more realistic when activating the raytracing, with the disadvantage that rendering will have a significantly greater amount of time.

#### 4. ALGORITHM

Graphics problems require intense mathematical calculations and enforce the laws of physics to create a realistic 3D scene. So, in computer-aided graphics, illumination and rendering are techniques that one scene created by means of a modeling tool can come to life. Rendering equation describes how the light intensity moves and influences the scene [26].

In realistic depiction of a scene, the main challenge will remain the solution of the rendering equation specific to a scene. An approach for solving the equation is based on the finite element method [27].

Two distinguishing characteristics for 3D animated scenes are: rendering linearity – composed only from multiplications and additions and homogeneity of spatial rendering – the same in all positions regardless of orientations. These two characteristics of rendering equation give the possibility to equation factorization and re-arrange in a very vast way.

#### 5. CREATING THE SCENE

Therefore, we have chosen as source of inspiration for this model the Ancient Rome Cities, adding a few European influences, resulting in a mix of elements that confer personality to the building and surrounding items. Although the intention was of a photorealistic project, in order to make the scene more spectacular, some details – proportions, colors, positions, volumes, etc – had been slightly exaggerated. Depending on the scene type and on the action speed (the animation itself), the viewer has more or less time to “admire” the actual scene and its details.



Fig. 4. The Ancient Rome Cities

Therefore, it's best to know from the beginning how much detail to add in geometry and textures. Tables should be placed as close as possible to their first reference. In the process of creating the shapes in different versions, the computer allows the tridimensional visualization of the shapes and also the functional, technological, esthetical, etc.

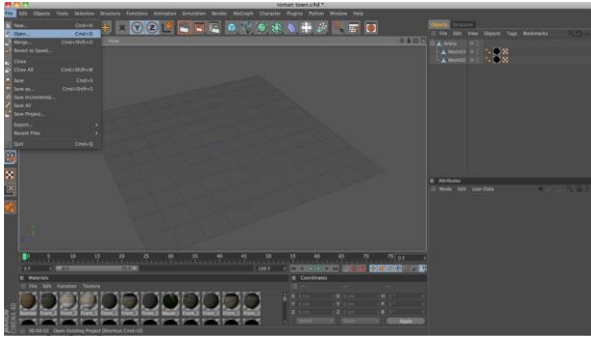


Fig. 5. Open New Scene

Moreover, through its close to the reality and fast visualizations and its structural control, the computer could move the projection level from geometrical conceptualization (a theoretical plan) to item projection (a practical plan). Open New Scene Application from the Cinema 4D software allows the 3D projection.

First part is about the items to be included in the scene, careful to choose items from the same style and era, in order to obtain a good integration. A first step for the scene creation is to download 3D building models from Google Earth Maps.

After that, we use copy/paste to open it in the new created scene. The software Cinema 4D is used to create virtual animation by using its own editing and item modeling commands or importing it from other compatible graphic media (AutoCAD, Inventor, etc.).

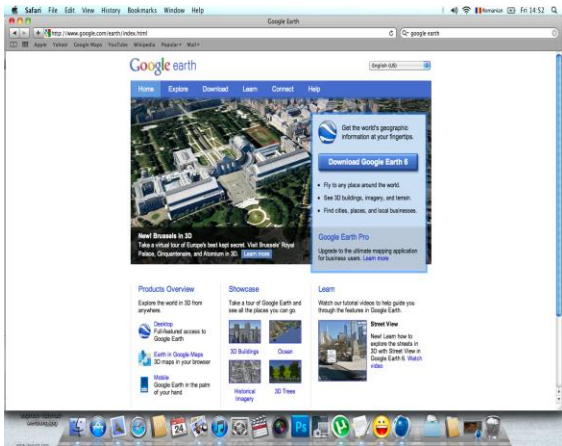


Fig. 6. Google Earth Maps

For a photorealistic building, we have to select carefully the textures, with a good pixilation, without blur and artifacts. When searching for a texture, it doesn't have to be the exact color from the concept art, because the color it's the easiest to change, but we must make sure to have the same material and very interesting details.

Even though the textures must be photorealistic, from project to project we should slightly exaggerate them, in order to confer as much personality and character to the building or item as possible.

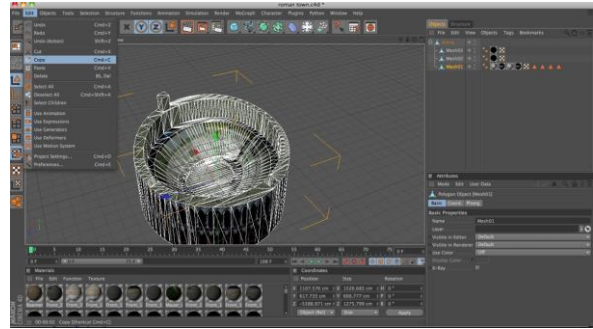


Fig. 7. Load scene with 3D models

We should see the building as a character that has to integrate to the scene itself, through its chromatics, style, era, design, etc. We must not change too much of the initial image, for not to destroy the basics like colors and details, therefore obtaining a monochrome and flat texture. On the contrary, due to the technical limitations, the texture should stand for the lack of geometry and add as much as detail as possible.



Fig. 8. Position of the building in the scene

Still, we should be careful in adding the detail – this is not to be an illogical blend of colors and spots. In order to make it easier to reading and to avoid an obvious tile, the details and the elements should be very distinctive, very well placed on the texture.

The more the outline and the colors of certain details are defined, the more the items are easier for the viewer to notice and read, and the texture and the building will appear more interesting. The texture role as *specular* is showing how much a material reflects the light. Therefore, some materials like wood, bricks, rock are less reflecting the light, and some others like glass, plate or most of the metals are reflecting it more.

In such cases, in order to adjust properly every detail, the creation of textures requires a continuous testing in viewport. For the final model to reflect exactly the colors from the concept art, a final adjustment of intensity and color is required after the creation of the three textures, because when adding normal map and specular map, the diffuse texture is darkening a lot. Just like the normal map texture, a *specular* texture, not being a simple gray version, requires to analyze carefully the color texture and the materials contained.

Depending on the *engine*, those could be colored, but also black-and-white. In the image above we could see a part from the final specular texture. The lowest values are those of bricks, mortar and wood. In certain situations, even those ones could have higher values, such as painted or oiled wood and wet or refined bricks.



Fig. 9. Elements in the scene

A scene is a collection of items, light sources and at least a camera to describe a visualization point of the environment. The items are defined by their geometrical parameters – scalar values or tridimensional coordinates – and by material properties.

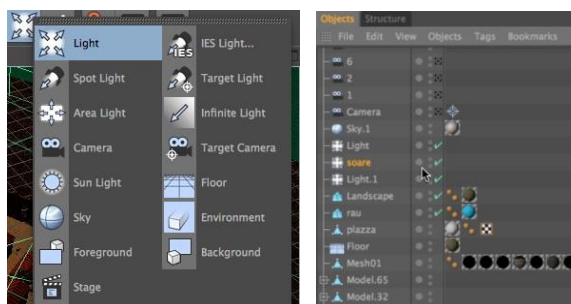


Fig. 10. Source of the lights

The light sources could be defined by position and intensity or color, but they also could have others parameters like direction, light cone or other geometrical shapes.

To generate an image from a scene, the scene data base must be researched. First, we should handle the changes occurred during modeling.

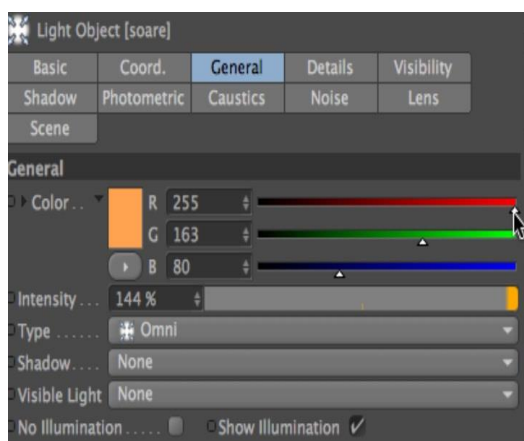


Fig. 11. Setting the light in the scene

That includes translation, scaling and rotation to transfer every item from the model space (local) to the universal space. The latter, represented by the coordinated universal system, is the common coordinated space where we make illumination math and take other steps of the generating algorithm.

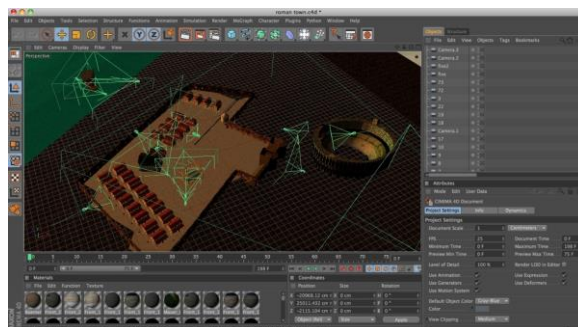


Fig. 12. Position of the light source

Using the position of the camera, a first optimization can be made. The items placed backwards could be easily ignored for the next steps of the algorithm, except when the algorithm is able to take their influence into account for the final image (for example, a mirror could reflect the light back into the scene).



Fig. 13. Source of the light in the scene

The next step is an attempt to simulate the light effect that illuminates the scene, being perceived by the observer. The ways we implement this step represent a major influence for the quality of the image and for the quantity of time required.

Next steps are using camera parameters to generate the image of the illuminated scene on the screen space. The visual change becomes perspective change, mapping a 3D point on a parallel plan to the screen.



Fig. 14. Keyframe

In order to create the animation, we set the key frames – indicating where to place an item or an attribute at a certain time – and the program makes the intermediary drawings.

The animation is easy to customize: we could change the time or the distance that key frames cover, we could adjust their speed by changing the animation curve that binds them.

In the animation software, the *camera* is designed to select the best shooting spot, with the correction of the viewpoint; the focal length; the animation points and the parameters. The selection of the viewpoint could be made from *Perspective*, but here we don't have the possibility to make corrections and to perform conveniently such actions.



Fig. 15. Designing a camera

Therefore, we create a camera from Create/Camera. There are two types of camera: *Free* and *Target*. The distinction between them is that the Target camera could be adjusted from the point where the camera is placed, and this point also establishes its direction. The Free Camera adjusts as an independent item.

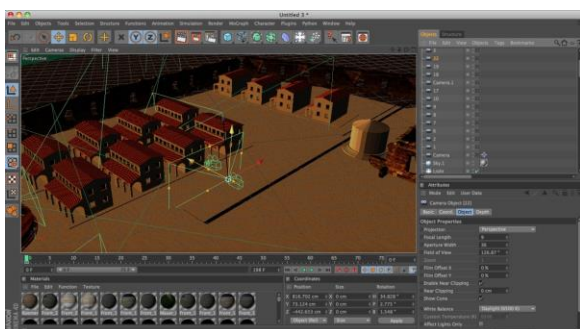


Fig. 16. Creating the cameras in the scene

In Cinema 4D, the cameras and the regular items could be moved and rotated when needed and with requested tools. To see how scene's items look like from camera viewpoint, click on a sight name and select Views/Camera from the menu.

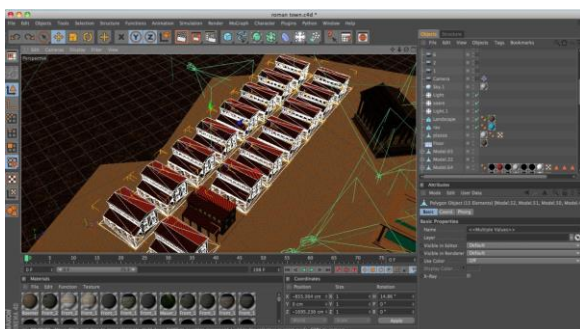


Fig. 17. Apasements of the camera on the buildings

There is also an option to specially adjust the Camera window, from the panel with the visualization windows. To change the camera parameters, use

Modify/ Parameters from the panel. Videos and animations are two similar media that despite minor differences are melting in one. They are based on the same technology: to play similar frames at a high rate, in order to create the movement illusion. For a more realistic touch, video and animation are usually associated with sound.

The timeframe in multimedia is 25-30 fps. Therefore, the difference between video and animation is small: the videos are reality happenings recorded on digital camera, while animation is created with special software (Maya, 3D MAX, Cinema 4D, etc.) or the result of manual work using pencil and paper (older animation).

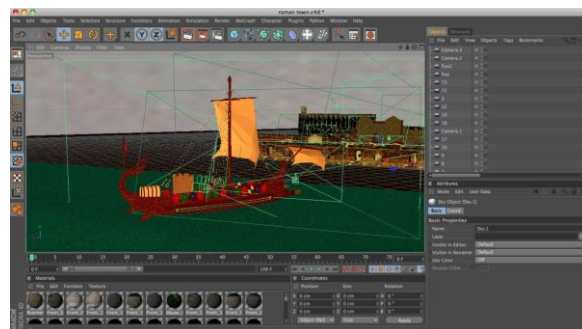


Fig. 18. The camera Parameters

Some of the scenes from the new movies are the result of the computer processed images recorded from real world. Computer and multimedia users usually prefer movies and animations as media for the information transmission because they are stimulating simultaneously the sight and the hearing, as they are very easy to perceive.

## 6. CONCLUSIONS

In designing a scene, the graphics is a very important communication tool for the experts involved in the creation of that scene. The graphic representation is the connection between imagination, reason and objective reality.

The engineers are using engineering graphics (manual/ computerized) as a mean for expressing and transmitting the information. Besides talking and writing, it's unconceivable to express a technical idea without the aid of drafting.

Light rays are distributed from the light source; when light rays hit an object, they give rise to other beams projected from the object, in turn producing another effect of light and reflected colors. Existes a type of rendering who has the ability to turn every object into a type of light. This paper presents briefly how they apply these renderings of a scene.

There are many reviews saying that 3D animation will have a much bigger impact that already has had. 3D animation scenes shooting have to offer a larger array of options for camera shooting.

3D graphics is much more complex, working with textures, volumes, light sketches; everything is computer generated and gets the help of a brilliant

mind – the one of the 3D editor. 3D software is spectacular, but you need time and assays to accommodate it.

Because of the progress in hardware and software, the 3D scenes illumination and dynamic generation is easier to integrate into more complex scenes.

Probably the viewer won't even notice that some of the landscapes are computer generated by the 3D graphics editor. It is known that characters artificially created are featured more naturally and new software generations sustain and prove this statement.

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