

Computer Graphic Modelling and Rendering: Assignment

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Summary

The aim of this assignment is to redevelop four images into computer graphics model. The students develop the scenes using software called 3Ds max 5. During the development of the assignment the student will appreciate the technical implementation involved. Using the tools in 3Ds max, the student will learn how to model the geometry accurately so that it matches to the image. In addition, through the right use of lighting and applying the right rendering algorithm the student can develop several effects as portrayed in the photograph. The challenge of this assignment is to simulate the images as realistically and closely as possible to the photograph given. This document includes the report of the four final image renderings explaining how they were effectively completed.

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Introduction

The aim of this assignment is to simulate four photographs into 3D computer graphics models. The students are provided with the software called 3Ds Max 5. The following reports contain the details of the technical implementation involved to develop the rendering of the scene.

Image 1: “stairs”

The photograph of the staircase (Figure 1.1) is a very detailed scene to simulate into a 3D computer graphics model. It was relatively challenging to model the geometry by eye. The main characteristic that required a lot of time to develop is the lighting. The photograph was taken with a flash. Certain objects are illuminated and generate shadows different to other objects.



Figure 1.1 – Original Photograph of “stairs”

Modelling

The modelling process of this scene was fairly complex as there were several features and details to consider. The basic geometry was measured and developed onto 3Ds Max by eye. The measurements are not precisely the same as they are in real life. This applies to the other three images of this assignment. The 3-dimensions (X, Y and Z) were used to displace the objects at the appropriate place. The align tool was used many times in order to avoid misplacement and the inappropriate effect that it can give. Based on the perspective of the photograph, there are 15 stairs visible. Each stair contains several details that can be divided into four parts: the main step box, the longer top box, the red strip (plane) and the metal piece (box) in front the top box. As this was modelled other details were then added (Figure 1.2).

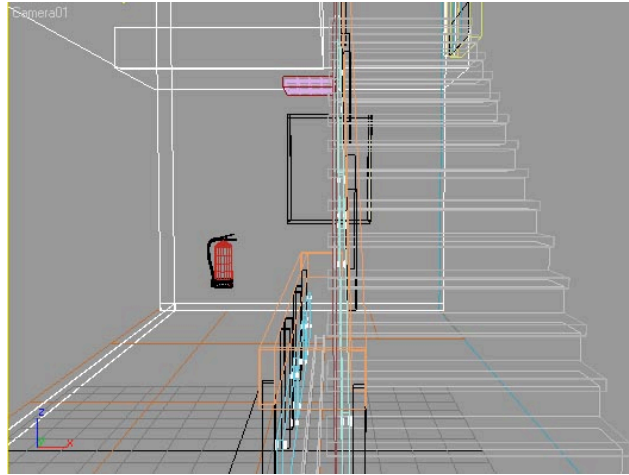


Figure 1.2 – Detailed model of the scene (wire)

Most of these objects are also represented by boxes. The wooden rails are not sharp edged therefore it had to be modelled using chamfer boxes to simulate the round edges as shown in the photograph (Figure 1.3).



Figure 1.3 – Chamfer boxes were used to model the wooden rails

The first floor is represented by a plane and the bolts that hold the glass fixtures are modelled using cylinders. The fire extinguisher and the light bulb are the only objects that were built by a group of various object types. They include cylinders, boxes and a sphere. They had to be modelled at a large scale in order to model its features accurately. Once the object was completely modelled, it was grouped together and scaled down in relation to the scene. Each object was examined and displaced to a position so that they are similar to the photograph (Figure 1.4).



Figure 1.4 – Detailed model of the scene (render)

Visual Angle

As we examine the photograph, we see that the camera captured the image from the bottom of the staircase. The viewer sees the upward succession of the stairs and the long extension of the wooden rails. The viewer is able to notice that there are glass fixtures by the rails. The camera was added during the modelling process in order to model the geometry accurately (Figure 1.5). The visual angle of the camera was adjusted and fixed so that it matches the angle represented in the photograph.

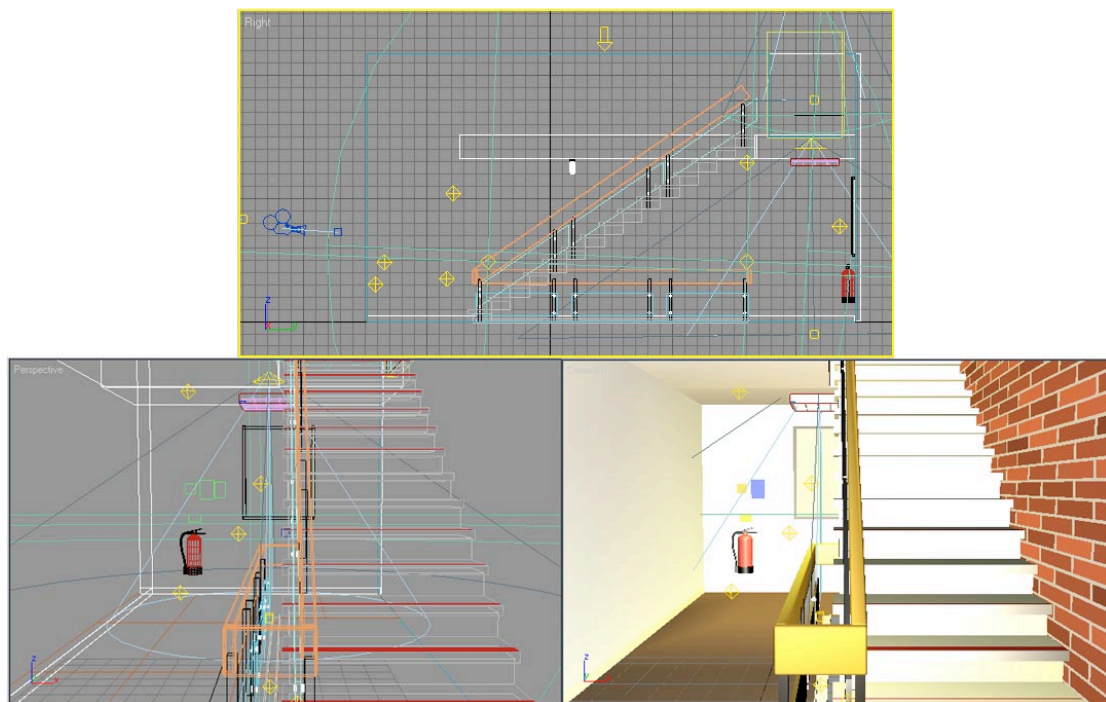


Figure 1.5 – Camera angle was set similar to the photograph

Rendering Algorithm (Materials)

Most of the materials affected the rendering of the image as they include various types of rendering algorithms (Figure 1.6). This includes raytracing that applies the shininess that some of the object provides. Raytracing involves rendering the scene one pixel at a time until all pixels are accounted for. This increased the calculation time of rendering the scene. Additional material such as glass and texture mapping was added. Texture mapping was added to the poster, stickers and the fire alarm (Figure 1.7). These maps were made from the photographs I made with a digital camera. These were added to give a realistic feel to the scene that is similar to the photograph.



Figure 1.6 – The materials generated for the stairs scene



Figure 1.7 – Texture mapping was applied to various objects

Lighting

The lighting required a lot of time in order to simulate them as closely as it is presented in the photograph. When we examine the photograph, we see that there is a light being emitted from the chandelier. The same effect is apparent on the second floor. This was implemented using target spotlight source as it produces the distinct lighting shape the chandelier provides. The atmospheric lighting was developed using two omni lights and a free spotlight. The flash caused certain objects to illuminate and

generate shadows differently to others. Three features were mainly influenced by the flash:

- The stairs
- The wooden rails
- The chandelier

This involved placing various omni lights in the scene. The trick was excluding certain object from the lighting so that it only affected certain objects. This technique was used to generate the shadow of the rails to the stairs, the chandelier to the back of the wall and the fire extinguisher to the back wall. The technique was also used to simulate specular effect that is generated by the metal pieces of the stairs (Figure 1.8).

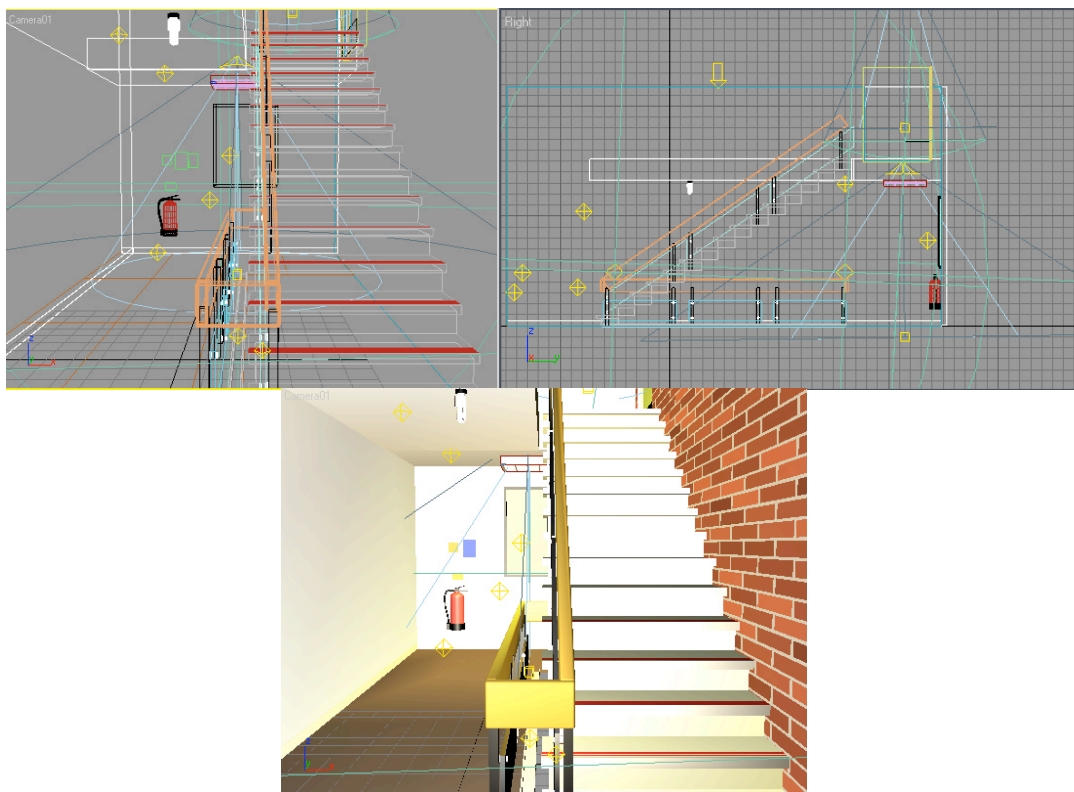


Figure 1.8 – Lighting involved in the stairs scene

Although the scene was not simple, I managed to succeed in modelling it to a 3D computer graphics model as realistically as possible.



The Final Rendering of the “stairs” scene.

Image 2: “corridor”

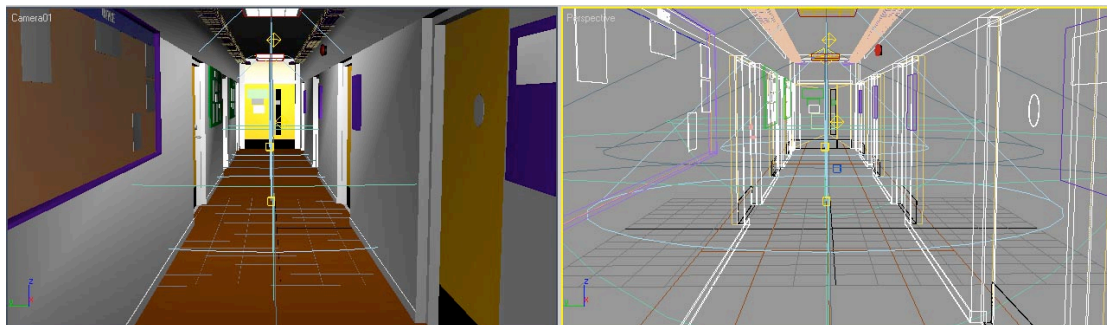
The corridor is another photograph that involves a lot complex representation of lighting (Figure 2.1). The geometry of the corridor is simple to model however it takes time to match them perfectly to the photograph by eye.



Figure 2.1 – Original Photograph of “corridor”

Modelling

There are several features to consider about the geometry of this image. We realise that the corridor is long and it presents several doors. There are three doors on the left wall, four doors on the right wall, and one central door that is faced to the viewer. The three last doors of each wall are parallel to each other. The first door on the right wall faces a notice board. Most of the objects in the scene were modelled using boxes. Details such as the boards, laminated paper, and labels were also created using boxes. Certain details such as bent paper were added by extruding a rectangle spline and applying a bend modifier to it. The door handle and the fire alarm are represented by cylinders and spheres. The shape of the fire bell was developed by applying a non-uniform scale to a sphere. Although the geometry is generally simple to model, it still required a lot of time to develop the scene by eye (Figure 2.2).



**Figure 2.2 – Detailed model of the “corridor” scene
(smooth + highlights / wire)**

The doors are spaced out evenly on each wall. This feature was straightforward to model as parts of the wall was modelled first, grouped together and cloned. This technique saves time and conforms the even spacing of the scene. This technique was also used to develop the cages that hold the wires. It still did involve a lot of time but it is more efficient compare to cloning each instance one by one. The align tool was used to place the objects accurately next to each other as to avoid any displacement errors that may be created from moving them using the mouse.

Visual Angle

Throughout the modelling process a camera was planted in the scene in order to fit the visual similarity (Figure 2.3). The camera was placed while adjusting the walls of the camera. I concentrated on following the perspective of the walls where each door becomes less visible towards the end of the corridor. This angle was generally easy to follow.

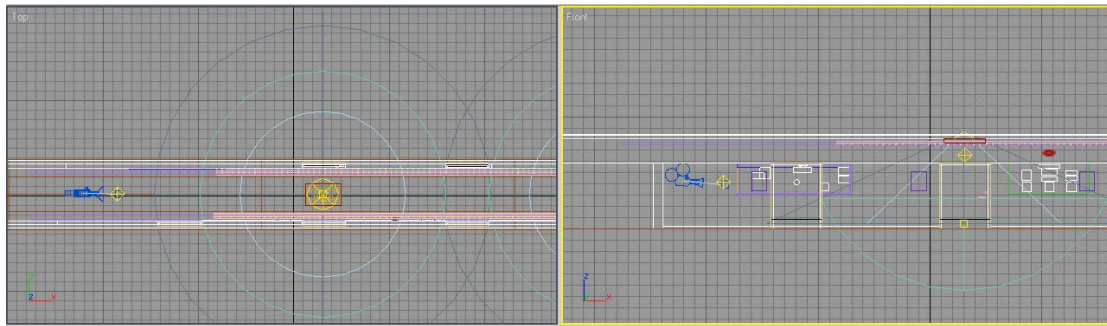


Figure 2.3 – Camera angle was adjusted to match the photograph

Rendering Algorithm (Materials)

The appropriate material need to be generated and applied to the right objects (Figure 2.4). This was very important to develop before implementing the light as some of the objects absorb or reflect light differently. Practically every object in this scene has a material applied to it. Raytracing is involved to simulate the shiny effect which is apparent from the doors, laminated paper, metal pieces in front of the door and central parts of the chandelier. These were essential in order to simulate the effect they give as shown in the photograph. Raytracing involves rendering the scene one pixel at a time until all pixels are accounted for. This increased the calculation time of rendering the scene. A glass material was added to the windows of the door in the centre of the room. An object is placed behind it to shows that the object is see-through.



Figure 2.4 – The materials generated for the corridor scene

Lighting

Unlike the previous image, this scene was not taken with a flash. However, there is some detail of lighting involved (Figure 2.5). The room is relatively dark. We clearly observed that the light is emitted from the chandelier. As a result certain parts of the rooms are illuminated in a distinct circular shape. The intensity of light is relatively higher than the rest of the room. A target spotlight was used to imitate this effect. An omni light was placed in the middle of the room with an intensity that would simulate the atmospheric lighting represented in the photograph. It had to be stretched using, the scale function in order for the lighting to extend across the whole corridor model. Some areas of the ceiling are affected by the lighting of the chandelier as well so additional omni lights were placed in order to simulate this effect.

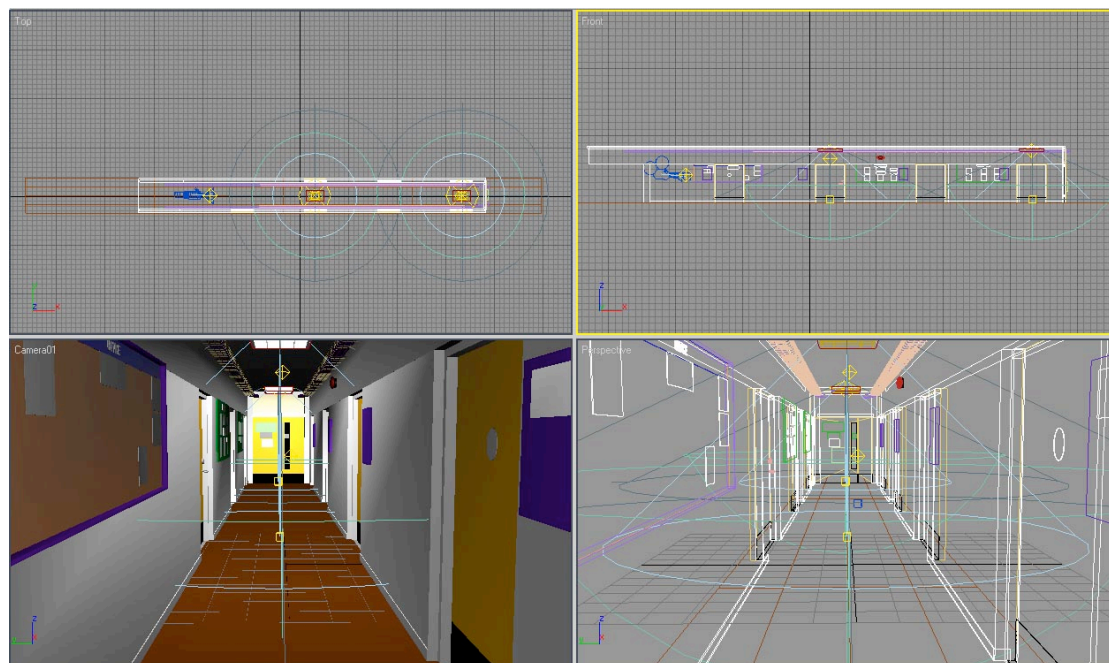


Figure 2.5 – Lighting involved in the corridor scene

This image was very interesting to model as it was quite hard to match to the exact geometry by eye. Modelling the basic form of the scene was relatively simple. However it is harder to implement the important details. Most of the development time was devoted to the lighting as it was relatively hard to fit certain lights that accurately simulate the features of the photograph. The image has been successfully

rendered and the majority features of the final rendering matches to those in the original photograph.



The Final Rendering of the “corridor” scene.

Image 3: “table”

The third image involves a photograph showing a table placed in front of a white board. On top of the table, there is three of the most important standard primitive object types involved in 3D Graphics: the cube, pyramid and sphere (Figure 3.1). This photograph was taken with a flash. It is noticeable as the flash is being bounced off from the white board. The main feature to consider is the lighting and the material.

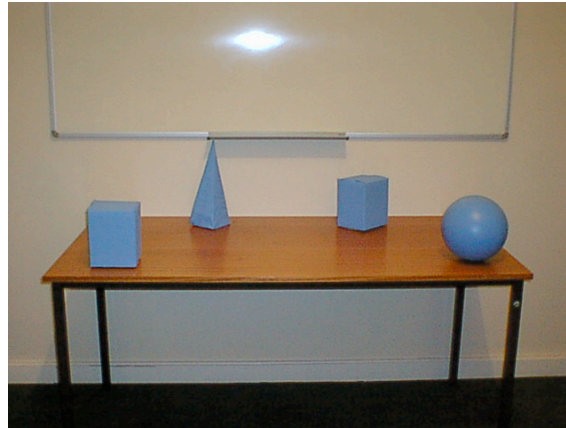
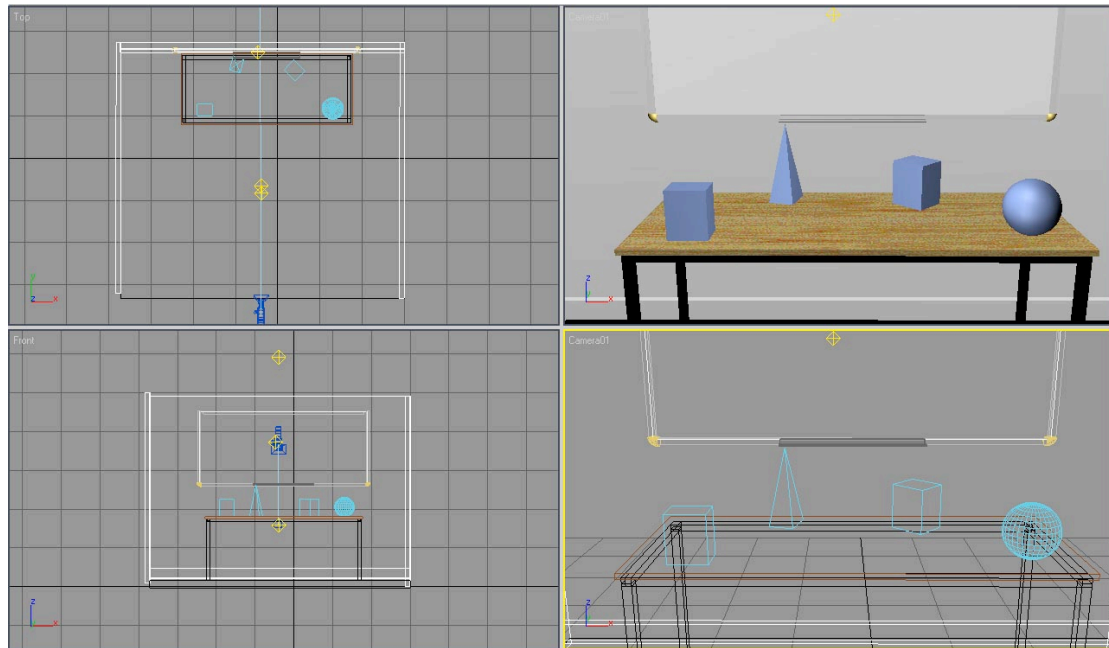


Figure 3.1 – Original Photograph of “table”

Modelling

The majority of the objects were modelled using boxes (Figure 3.2). In order to build the model with accuracy, the align tool was used in order to avoid any misplacement of objects which is common as a result of placing the object using the mouse. This was very helpful when it came to placing the shapes on the table as it is difficult to judge if they are exactly on the table using the mouse. The corners of the white board are represented by the Torus object type. The shape was cut using the Boolean function to imitate the joint between the metal pieces. Although the scene is simple to model, it is quite easy to overlook the certain details. There is a ledge that extrudes from the back wall. In addition, there is a chalk holder on white board. Both of these objects were modelled using boxes. From the perspective of the photo it is quite hard to distinguish the physical shape of the chalk holder. It was modelled using imagination and the help of the shape created by the shadows.



**Figure 3.2 – Detailed model of the “table” scene
(different perspectives)**

Visual Angle

The visual angle that is shown in the photograph is not complicated. The camera is placed so that it is looking straight at the table and the white board (Figure 3.3). It is looking slightly down at an angle so that shows some area of table’s surface. It was practically easy to place and adjust the camera to an angle that matches the photograph.

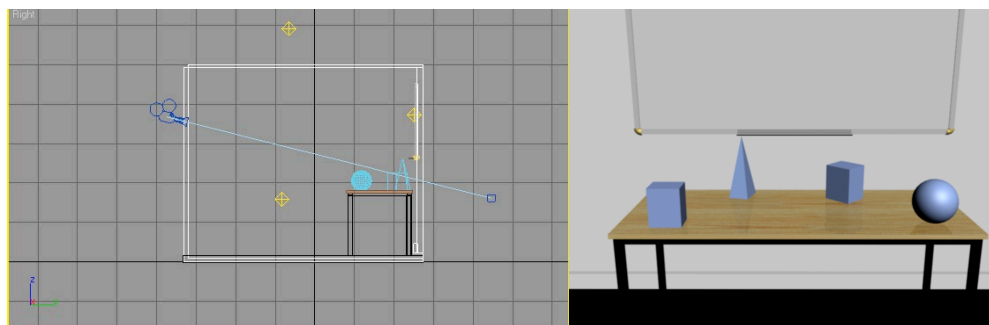


Figure 3.3 – Camera angle matches to the angle to the photograph

Rendering Algorithm (Materials)

The table object is one feature that is particularly noticeable as the wooden surface reflects the objects that are on top of it. A wood texture that was found in the internet was used as a map and a reflection was applied to the material in order to simulate the effect as shown in the photograph. Raytracing has been applied to the white board and the chalk holder in order to develop the shiny effect. Raytracing involves rendering the scene one pixel at a time until all pixels are accounted for. This increased the calculation time of rendering the scene. The shapes presented on the table absorb light at a certain level therefore they also had to be supplied with a material (Figure 3.4).



Figure 3.4 – The materials generated for the table scene

Lighting

The lighting involved in this scene is not very complex. The atmospheric lighting was developed using two omni lights which are placed in the middle of the room (Figure 3.5). One is placed at the top of the room to illuminate the objects as it is represented in the photograph. The second omni light was placed near the level of the table in order to supply some lighting that is diffused near the bottom of the room. Using only one omni light at the top of the room did not supply enough lighting to the scene as it causes the lower part of the room to be darker. We clearly observed that the image contains shadows. These shadows are generated from the omni light that is placed at the top of the room. This light source is placed at a position so it generated the shadows to a form that is similar to the photograph. The detail where lighting affects an object intensely is the flash that is bounced off the board. The solution to this effect was implemented by placing an omni light near the front of the board so that it look like a beam of light being bounced off the board. This light source was deformed into its shape by using the scale function.

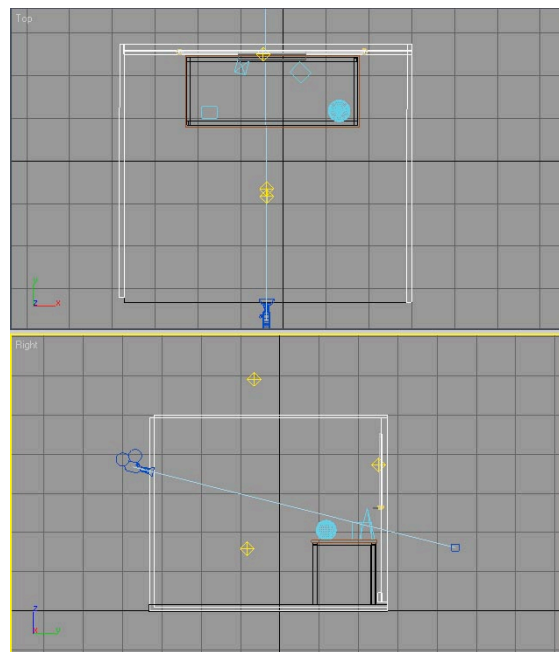
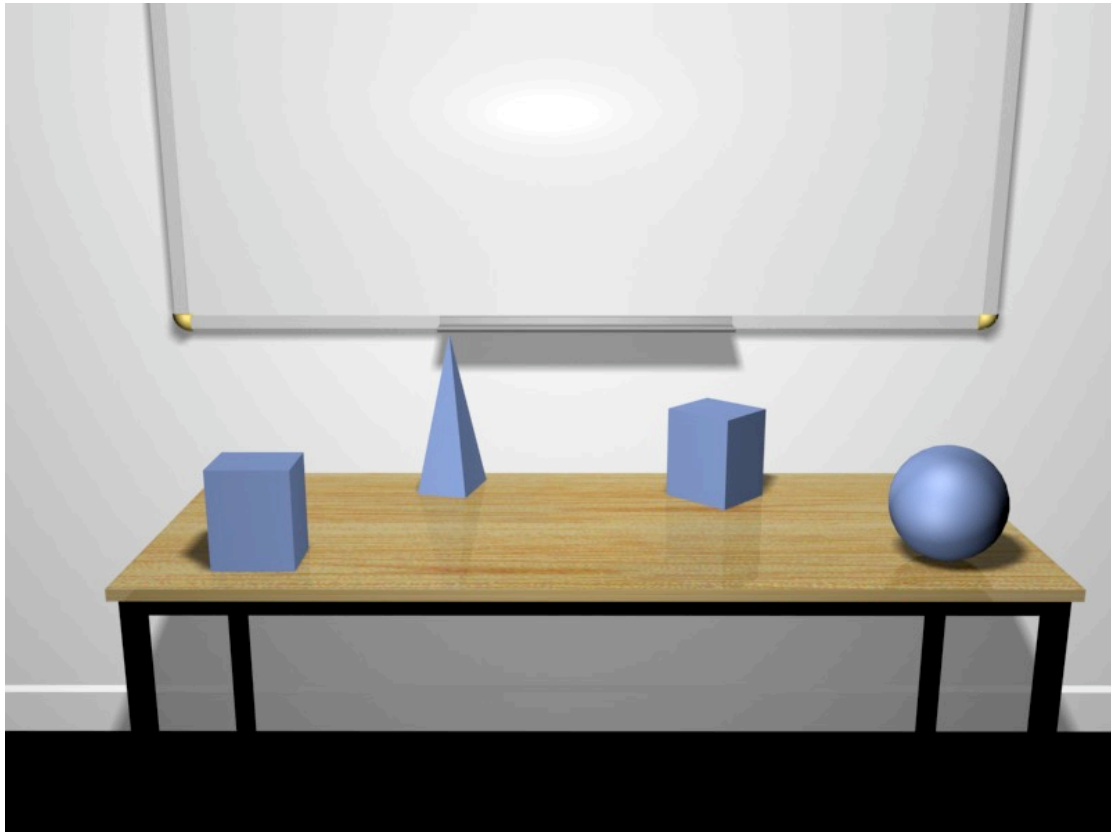


Figure 3.5 – Lighting involved in the table scene

This scene did not take very long compared to the last two images. Not much detail much was needed to be modelled. However, many effects such the flash, shadows and reflection were effectively implemented. The final rendering of this scene was very successful.



The Final Rendering of the “table” scene.

Image 4: “bottle”

This image is not particularly simple to simulate. It involves a bottle in front of a coffee cup (Figure 4.1). The bottle contains a low level of water in it. It seems that the photograph was taken with a lighting that causes the bottle to reflect some of it and produce a caustic effect on the background wall.



Figure 4.1 – Original Photograph of “bottle”

Modelling

The bottle could not be effectively be represented by any object type supplied in 3Ds Max. It was modelled by examining the outer line of the bottle, drawing it using a line spline, and creating the 3-dimensional shape by applying the lathe modifier to it (Figure 4.2). The water inside the bottle is actually a clone of the bottle itself. It was scaled to a smaller size and cut off using the Boolean function. The labels of the bottle had to be created from scratch using splines. The big label was created by extruding an arc spline that would fit on the circumference of the middle part of the bottle. The additional round part of the label is originally another instance of an extruding arc. It was modelled to round shape by editing the mesh. The same technique was used to develop the label at the top part of the bottle. It is originally an eclipse. I was able to fit the label to the bottle by applying the bend modifier to it. The bottle cap was made using various shapes provided in the software. It is basically a group of different size cylinders and toruses. The coiled effect is represented by a spring. The coffee cup was relatively easier to model. The cover is also represented by a stack of cylinders and toruses. The Boolean function was used to imitate the distinctive shape and the sipping hole. The cup and the cover around it are represented by cones.



Figure 4.2 – Bottle modelled using the lathe modifier

Visual Angle

The placement of each object was not very difficult to simulate therefore it was relatively easy to match the scene similar to the photograph. The bottle is the central view of the image and the coffee cup is placed behind the bottle. The viewer can also observe the background wall as the lighting and caustic effect can be distinguished.

Rendering Algorithm (Materials)

The materials are the major effect that forms this scene (Figure 4.3). The glass and water was created by applying 100 opacity with a falloff map and some refraction with a raytrace map. Raytracing involves rendering the scene one pixel at a time until all pixels are accounted for. This increased the calculation time of rendering the scene. The material used to simulate the coffee cup was developed by observing the effects of the lighting to the scene. Material was applied to the different parts of the coffee cup. An image of the cup's logo was mapped onto the cup to give a realistic feel. The image was taken by a digital photograph which I took. No maps could be applied to the label as there was no source to effectively find them.

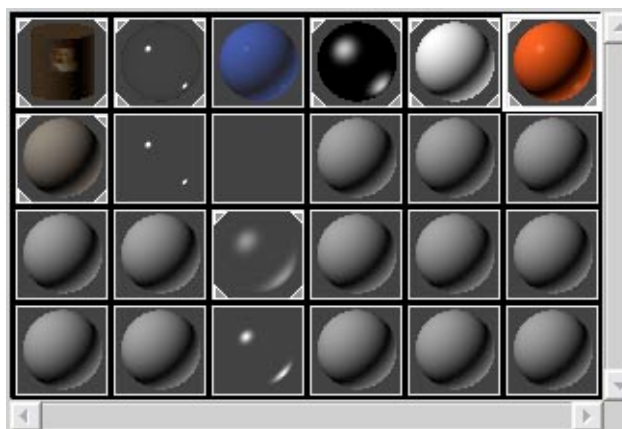


Figure 4.3a – The materials generated for the bottle scene

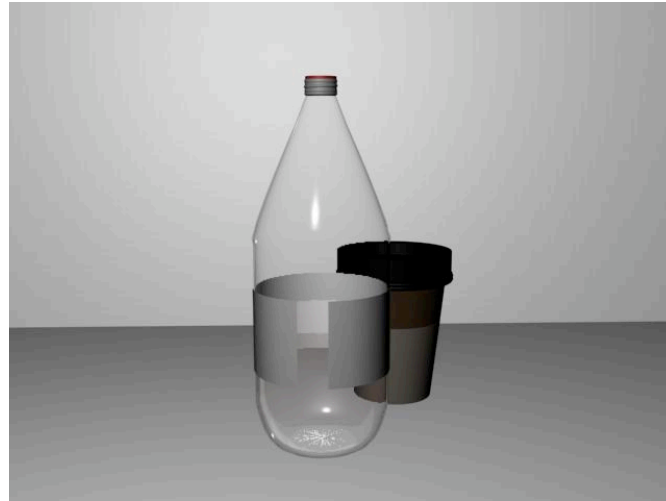


Figure 4.3b – The materials applied to the objects

Lighting

By observing the photograph we realise that the light source is targeted towards the object. Two light sources were used. One to illuminate the whole scene and another one that concentrates on illuminating the coffee cup so that the hole can be seen. It was very important to develop the right lighting for that the hole of the coffee cup cover as it is visible in the original photo (Figure 4.4).

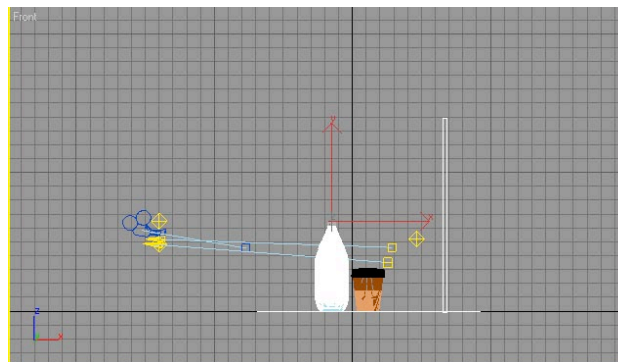


Figure 4.4 – Omni lights and target spotlights were used to simulate the lighting of the scene.

The caustic effect was particularly difficult as there was no easy solution to implement that effect. Projection maps were used. One target camera was used to develop the lower caustic effect, which was mapped using the stucco map. It had to be scaled and rotated appropriately to create the right effect. Another target camera was used to create the top caustic effect, with a projection map which I created in Adobe Photoshop (Figure 4.5). It also had to be modified in order to provide the right effect.



Figure 4.5 – The projection map of the upper caustic effect

Although it did require a lot of time and fines to model this scene, I was able to simulate the image into a 3D computer graphics model effectively.



The Final Rendering of the “bottle” scene.