

# Computer Graphics: OpenGL Assignment Report

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# Project Theme

To fulfill the “Recreation” themed requirement for this assignment, I decided to create a scene from a neighborhood park. The scene depicts many objects commonly found at a park including, a basketball court, swing set, barbeque, water fountains, bins, and an undercover area with a table and benches.

## Objects Created

At the time of designing the scene, I was unaware of the use of cube mapping to apply cube-based images. Therefore, I was required to create additional thin objects to cover sides of a main object that had a repeated image. For example, the face of the man was repeated on all six sides of the cube. So, I covered each of these sides, except for the face, with a separate object each with an individual image. The following subsections will provide examples for further clarity regarding how I managed this issue.

### Basketball Ring

The base pole was created with simple translations and scaling transformations. The backboard, however, was slightly more complicated due to the aforementioned issue of lack of cube mapping. Separate objects were created to cover each of the repeated images of the main backboard object. Precise translation and scaling were required for each of these objects to appear as a single backboard object.

In total, the completed basketball ring object consisted of thirteen different sub-objects.

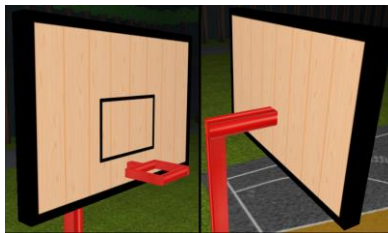


Figure 1: Basketball Ring (left: front of backboard, right: back of backboard)

### Surfacing/Textures

As the surface of the base pole and ring is supposed to be metal with a moderate shine, I have added the light-colored high specular texture as shown in Figure 2. A simple black texture, same as the black border around the backboard image, was used for the four coverings along the top, bottom, left and right of the backboard edges.

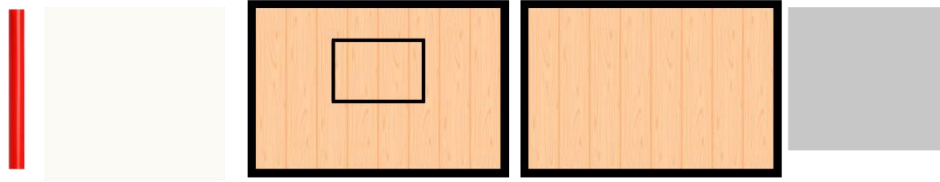


Figure 2: Left to right: base pole, high spec. texture, front backboard, back backboard, mild spec. texture

## Man

The man I created is quite similar to the Minecraft characters, due to it being based off of box transformations. The transformations involved to create the man were primarily translation and scaling. However, for the two sets of upper and lower arm boxes, rotation transformations were used to give the arms a more natural position in relation to the animation of bouncing the ball. Once again, individual boxes were utilised to show separate images for each side of the head.

In total, the completed man object consisted of seventeen different sub-objects.



Figure 3: Man bouncing basketball

## Surfacing/Textures

A jeans texture was used for the man's legs and a blue camouflage pattern was used for the shirt. A separate texture was used for the back of the shirt to include the text "CG 4 Lyfe" as shown in Figure 4. As no part of the man should have any kind of shine, I utilised a black image for no speculation.



Figure 4: Textures used for man

## Swing Set

So that the swing set wasn't facing an awkward direction, the entire structure was rotated on a 45° angle against the y-axis. Several of the individual components were also rotated to give it a more realistic appearance.

In total, the completed swing set object consisted of thirteen different sub-objects.



Figure 5: Swing set

## Surfacing/Textures

A wooden log-like texture was used for the frame of the swing set. The seat and rope textures are from an actual swing set. A non-specular texture was used for everything except for the seat, which has a mild specular texture.

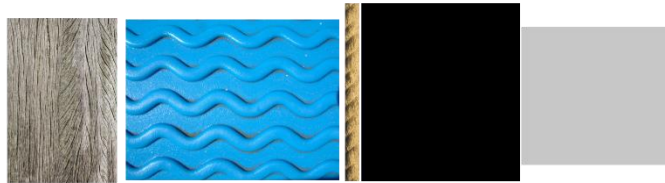


Figure 6: Textures used for the swing set

## Gazebo

Basic translation and scaling transformations were used to construct the frame of the Gazebo. Rotation transformations were done on the roof components to give it a slight  $5^\circ$  angle tilt, as present in many real-life park gazebos.

In total, the completed gazebo object consisted of thirteen different sub-objects.

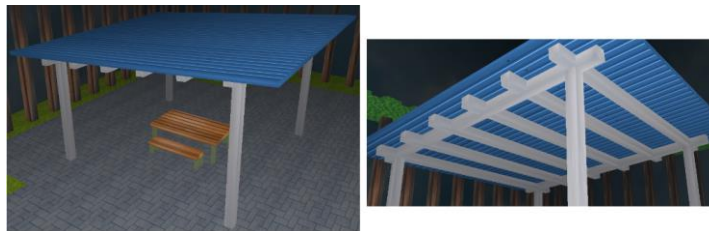


Figure 7: Gazebo

## Surfacing/Textures

An aluminum texture was used to replicate a metal frame and a blue Colorbond texture was used for the roof. A high specular texture was used for the aluminum frame, to give it a realistic shine, whereas the roof had a mild specular texture for a duller shine.

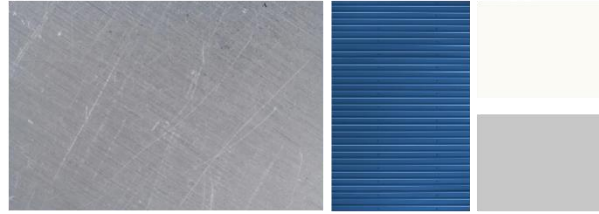


Figure 8: Textures used for the Gazebo

## Table & Benches

The table and two benches are actually identical objects, with the table just being on a larger scale to the benches. Basic translation and scaling transformations were used to create these objects.

In total, the completed set of table and benches consisted of fifteen different sub-objects.



Figure 9: Table and two benches

## Surfacing/Textures

The texture used for the table and bench tops is of wooden slats. The legs of the table and benches is of a painted green metal texture. The tops of both structures have a non-specular texture, whereas the legs have a mild specular texture to produce a slight shine, as it is supposed to replicate a metal texture.



Figure 10: Textures used for the Table and Benches set

## Barbeque

The base of the barbeque is a simple rectangle cube, with a benchtop-like object on top. However, the hot plate and grill, each with their own separate borders, required precise translations and scaling to achieve the final effect. The panel also required these transformations to be placed in the desired location.

In total, the completed barbeque object consisted of thirteen different sub-objects.



Figure 11: Barbeque

## Surfacing/Textures

A paving texture was used for the base of the barbeque, along with a dark metal texture for the bench top. An image of a grill was used for the texture for the grill, and a Teflon texture was used for the hot plate. I took a photo of the front panel of a barbeque at my local park and used that as the texture for the front panel object. All three specular textures (non-specular, mild, high) were used for a variety of shininess effects on the relevant objects of the barbeque.



Figure 12: Textures used for the Barbeque

## Bins

The set of bins (general waste and recycling) were created to replicate a main compartment for storing rubbish, on top of a metal plate and pole cemented into the ground. The transformations required to achieve this were through translations and scaling. I decided to introduce additional complexity by making the bin hollow, rather than a solid single object.

In total, a single completed bin object consists of nine different sub-objects.



Figure 13: General Waste and Recycling bins

## Surfacing/Textures

The texture used for the main bin container structure is of a wood panel. A black painted metal texture is used for the pole and plate that each bin is mounted on top of. Relevant signage was used to designate the purpose of each bin. Only the metal sections of the object received a mild specular texture.



Figure 14: Textures used for the set of bins

## Water Fountain

The two water fountains created are more basic than the previously mentioned objects, however it still resembles what an actual water fountain would look like. Translation, scaling and rotation transformations were used to create the final object.

In total, the completed water fountain object consists of seven different sub-objects.



Figure 15: Water fountain

## Surfacing/Textures

I used a pebble aggregate texture for the main structure of the water fountain. An aluminum texture was used for the drinking tap fixtures. These fixtures also have a high specular texture for a more prominent shine, whereas the base structure has no shine.

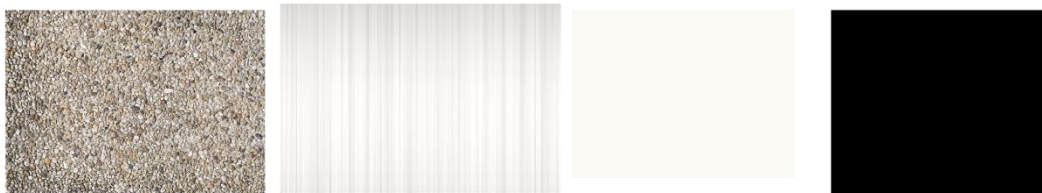


Figure 16: Textures used for the water fountains

## Animations

The centerpiece of the scene is the basketball court. This was the main inspiration I derived from the theme of “recreation”, as I personally enjoy playing basketball as a hobby. Therefore, I wanted this incorporated into the animations in some way.



## 1<sup>st</sup> Animation

The first animation that is played upon the rendering of the scene is of the man bouncing a basketball and of a bird hovering up and down over a dog.

### Bouncing the ball

To have the man simulate the action of bouncing the ball, I used a rotation over time with GLFW's time function. Through the use of this along with other translation, scaling and rotation transformations, both the left and right arms of the man appear to move up and down as if to bounce the basketball.

The animation of the ball is executed in a similar manner, utilising the GLFW's time function with the rotation transformation. I had the ball pass through the ground slightly, to give the effect of the ball being compressed against the ground as it is bounced. I felt that this slight feature added to the overall animation of the man bouncing a basketball.

### Flying bird

The bird hovering up and down above the white dog is achieved much the same as how the bouncing ball was executed. This part of the animation, was primarily included as a precursor to the second animation.

## 2<sup>nd</sup> Animation

The second animation, that is played upon pressing the "R" button, is of the dog looking up and chasing the bird a short distance then stopping and jumping up and down, as the bird circles above. Due to this distraction, the man loses his concentration and fumbles the basketball and it rolls away from him.

### Dog chasing the bird

This required a rotation of the dog's head to point upwards as it looks up at the bird above as it chances and tries to catch it. The distance at which both the dog and the bird travel is based on a variable that is incremented through the render loop until it equals a set distance, at which point the final looping animation is played with the dog jumping up and down as the bird circles above.

The circling bird animation is achieved using two calculations of sin and cos over time against the x-axis and z-axis.

### Man fumbling the basketball

This part of the animation was significantly more complicated, due to the man's head turning as the ball rolls away from him. This required that each of the six objects placed on all sides of the man's head box needed to be rotated and translated precisely. The man's arms and hands also required two rotation transformations to simulate them following the path of the ball as it rolls

away. Additionally, to illustrate the man's dismay, his once happy face is changed to a shocked face upon activation of the second animation.

## Additional Features

To add to the ambience of the scene I included a variety of flooring textures. This included grass, paving, basketball court and a soft play floor for the swing set.

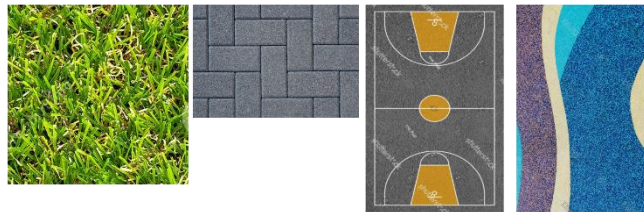


Figure 17: Textures used as ground cover

The dog and bird objects are extremely simple, and require a fair amount of imagination. They were primarily created to be used for animation purposes. The basketball is also just a simple cube.

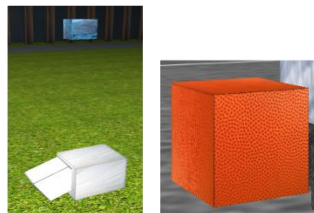


Figure 18: Dog, with fur texture. Bird with feather texture. Basketball with basketball texture

I used a large tree line surrounding the boundaries of the scene to serve as a barrier for the camera movement. Each tree consists of four different sub-objects.



Figure 19: Tree line to serve as a barrier for the scene

Finally, I placed the entire scene within a large skybox which depicts a cloudy blue sky.