

Computer Graphics Assignment

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Scene Description

The scene created was born off the restriction that we could only use a “box” shape. This same restriction is placed on the popular video game Minecraft; so I rendered a familiar scene from that game.

The scene is a basic home with a window, crafting bench, and on an island surrounded by water. On the island is a chest, for the player to store their items, and a pig, which the player could be keeping as a pet (or as a food source). The scene also contains a tree, which when cut down gives the player wood - the most essential material in the game.

The scene depicts the house made out of wooden planks and cobblestone, the two of the most easily accessible materials, and has some basic windows at the front of the house so the player can see when it is safe to leave their house (as monsters traditionally come out at night).

The scene starts at night; the light is fairly dull and there is a low amount of ambient light. In Minecraft, the ambient light is usually extremely high in the daytime.

Composite Objects:

Composite Object	Component (Textures used)	Shader Used	Surface finishing
Tree	Leaves (1)	Single texture	Leaves - Reflects more light than wood, less than glass or water.
	Wood (1)	Single texture	Wood - A more dull surface, reflects less light than glass but more than stone.
Chest	Top chest (3)	Chest	Wood - A more dull surface, reflects less light than glass but more than stone.
	Bottom chest (4)	Chest	Wood - A more dull surface, reflects less light than glass but

			more than stone.
	Wood block (1)	Single texture	Wood - A more dull surface, reflects less light than glass but more than stone.
Pig	Head (3)	Pig	Pig - The pig is rendered as fairly dull. I would imagine a pig would be fairly unreflective due to mud and all that.
	Body (2)	PigBody	Pig - The pig is rendered as fairly dull.
	Legs x 4 (2)	Pig	Pig - The pig is rendered as fairly dull.
Grass	Grass (2)	Two texture	Grass - Dull, however not as dull as wood.
Water	Water (1)	Single texture	Water - A fairly reflective surface, reflects more light than wood but less than glass.
House	Wood (Front porch) (1)	Slab	Wood - A more dull surface, reflects less light than glass but more than stone.
	Glass x2 (Window) (1)	Single texture	Glass - Extremely shiny, reflects the more light of anything in the scenery.
	Wood x4 (Walls) (1)	Single texture	Wood - A more dull surface, reflects less light than glass but more than stone.
	Stone x2 (Roof) (1)	Slab	Stone - An extremely dull surface that is extremely unreflective

Door	Door (1)	Door	Wood - A more dull surface, reflects less light than glass but more than stone.
Crafting Bench	Crafting Bench (2)	Two texture	Wood - A more dull surface, reflects less light than glass but more than stone.
TOTAL (8 Objects)	26 Unique textures	7 Shaders	7 Surface finishes

Shader Descriptions

- Single Texture
 - Applies the same texture on all 6 sides.
 - Repeats texture by multiplying texture coordinates with scaling factor
- Two Texture
 - Applies the same texture on 5 sides.
 - Applies a different texture on the top side
 - Repeats texture by multiplying texture coordinates with scaling factor
- Slab
 - Applies the same texture on all 6 sides.
 - Scales y axis by 0.5, but does not repeat texture. Only the bottom half of the texture should be shown for the y and z coordinates.
 - Repeat textures where appropriate.
- Door
 - Does not repeat any texture. Scales z coordinate by 1/16.
- Pig
 - Applies the same texture on 3 sides.
 - Applies different texture to front face
 - Applies different texture to side faces.
- PigBody
 - Applies the same texture on 4 sides.
 - Applies different texture to front and back faces
- Chest
 - Applies the same texture on 3 sides.
 - Applies different texture to top face
 - Applies different texture to bottom face
 - Applies different texture to front face

Animations:

- Moving pig
 - The constant animation playing in the scene is the one in which the pig is circling around the tree.
 - The pig:

- I needed to rotate the pig around an arbitrary line (the tree) which was in line with the y axis. To do this, I first needed to translate the line in line with the origin, perform the rotation, then translate the arbitrary line back.
- This simple rotation + translation achieves the effect of the pigs 6 connected components rotating around the tree. However, as it's feet remained static, it looked extremely unbelievable.
- The feet:
 - To make the feet look like they were "walking", I would need the one set of feet to move clockwise in the x direction, and the other set of feet to move in the opposite x direction
 - To achieve this, feet are rendered in pairs. The first set of feet are rotated as followed:
 - $-20 \text{ degrees} * \sin \text{ of the time}$. This will rotate the feet anywhere between -20 and 20 degrees. Any more than this, and the feet will extend into the body and look unbelievable.
 - The other set of feet are rendered by $20 \text{ degrees} * \sin \text{ of the time}$. This means the left set and right set of feet are always travelling in opposite directions, creating a convincing walking affect for the pig
- Chest
 - Activated with the 'R' key
 - Top Chest:
 - In Minecraft, a chest has an opening animation where the top of the chest opens up to a 90 degree angle, and a window opens showing the contents of the chest.
 - I aimed to do something similar, where when a button was pushed, the chest would open ONLY until 90 degrees and display an object inside of the chest.
 - The first thing I did was separate the chest into two objects; the top chest and bottom chest.
 - When the animation started, I would rotate the top chest on the x axis by -90 degrees (rotates the object clockwise).
 - For the rotation to happen over time rather than immediately, I had a variable named chestAnimationFrame. This variable would be divided by 5, and then multiplied by -90 to find the angle in which the chest would be rendered at that frame.
 - This variable increases its value all the way up to 5.0, in which case it stops growing, as $5/5 * -90 = -90$; and we don't want the chest to rotate any further than this
 - The variable starts at 0, so that the chest does not rotate at all at the start, but is set to 0.05 when the R key is pushed, and the variable will increase until 5 only after the key is pushed.
 - Inside Block:

- Inside of the chest, I wanted a block to be rendered. Although this doesn't happen in Minecraft, I wanted a way to show an object was being stored inside of the chest without having to render UI elements.
- I had a 1/5th scale block rendered inside of the chest, constantly spinning on the y axis.
- This was achieved by multiplying the time with the y axis; the rotation will be constant with the time.
- The small block also bounces up and down the chest.
- This is achieved by translating the block between a range of 0 and 1
- To do this, I got the absolute value of the sin value of the time, and then translated the y axis by this value.
- Finally, I only wanted the block to be rendered when the chest was roughly 15-20 degrees open, so I only start rendering the block when chestAnimationFrame is 1.0 or more.
- These two effects together create the animation of a chest opening, and a moving object appearing inside of the chest.