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**Intro to Virtual Reality CS5407**

**Project Title: DESTRUCTION OF BUILDING**

**Project Description Submitted for Approval:**

**Abstract:**

1.where I will be constructing a building and there will be a security office at entrance.  
2. People will be entering the building and having a lawn with grass and pathway for entrance and tables in lawn.  
3. I will try to create hill and on top of it a stone when it falls on building making destruction of building.   
4. The building entrance will be in a lawn with grass  
5. I will include a pathway for the entrance of the building with a main door.  
6. I will try to make it more natural by creating people entering the main door and will try to add as many things as possible.

**References:**

* **In-Class Experiments/Lectures: Class- (table)**
* [https://www.sidefx.com/docs/houdini/nodes/sop/switch.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.sidefx.com%2Fdocs%2Fhoudini%2Fnodes%2Fsop%2Fswitch.html&data=05%7C01%7Cskbg8%40mst.edu%7Ce47b784b705f4c63d3fc08dbf3796cd4%7Ce3fefdbef7e9401ba51a355e01b05a89%7C0%7C0%7C638371475060521027%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=SCnY2RM1beVcU7uLch%2Bmsszf5I05gYcSk3aJ3uPuOBM%3D&reserved=0)
* <https://www.youtube.com/watch?v=tQfoBAJpnDo&t=84s>
* <https://www.youtube.com/watch?v=EOVNfkFs1CM> -Building construction
* <https://www.youtube.com/watch?v=-q13eJOztyg>
* [https://www.sidefx.com/docs/houdini/nodes/dop/gravity.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.sidefx.com%2Fdocs%2Fhoudini%2Fnodes%2Fdop%2Fgravity.html&data=05%7C01%7Cskbg8%40mst.edu%7Ce47b784b705f4c63d3fc08dbf3796cd4%7Ce3fefdbef7e9401ba51a355e01b05a89%7C0%7C0%7C638371475060521027%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=2bxmcQrPR9hyO2wloUKHgPs5n3KyKtbT%2FPgh5wCWaTQ%3D&reserved=0)

**Introduction:**

The project I have chosen is “Destruction of building”, this includes a building and its surroundings that has a mountain on top of it a rock, lawn, tables & chairs for people, trees, a pathway, security office and the main concept is when a rock rolls and hit the building it collapses.

**Geometry:**

* Land
* Lawn
* Trees
* Mountain
* Building
* Pathway
* Security office
* Tables
* Chairs
* Rock
* People run
* People walk

**A group of icons on a black background

Description automatically generated**

**Step-by-step Description:**

**1. Land:**

* To create the land, I have created a grid node and in parameter pane adjusted the size as 100.Then after created a color node to look the base color as sand or mud color so selected color parameter it to be as red color in parameter pane and then connected it to a transform node adjusted its uniform scale to 5.82 and translated it along y- direction about 20 and rotated it 90 degrees along y-direction.

A screenshot of a computer

Description automatically generated A screenshot of a computer

Description automatically generated

A red square on graph paper

Description automatically generated

**2.Trees:**

* I have created a curve node and drew a branch like shape in scene view and simultaneously created a box node with a uniform scale of 0.2 and center to be as 0.9.
* Now, connected a resample node to the curve node and decreased the maximum segment length to 0.36 to make it appear more curved. Now, connected both box node and resample node to Poly extrude node, select the group from which you want your curve to come out to form as a branch i.e., ‘4’ in the parameter pane adjusted the values of distance, inset, division as per need and from dropdown selected the spine shape option to curve from second input.
* Now connected color node to the Poly extrude node to give it a green color followed by revolve node where in this parameter pane adjusted the origin to 1, 0, 0 to make it revolve in x-axis and divisions as ‘10’ for no. of branches.

A graph on a graph

Description automatically generated A green snake on a grid

Description automatically generated

A green octopus on a grid

Description automatically generated

* For the trunk I created a tube node with primitive type as polygon and applied endcaps to it and adjusted the values of tube center,radius scale and height according to needs. changed its position according to the branches that I had created earlier. Connect the tube node to color node and select a color that suits trunk of a tree as brown.
* Then created a Merge node for both color node of tube node and revolve node of box node (trunk, branches) and connect a transform node to give it scope to be placed anywhere required and adjusted the translate parameter values along x,y,z -direction.

.A palm tree with a green leaf

Description automatically generated A screenshot of a computer

Description automatically generated

* After creating a single tree, for creating copies of the trees and placing them in one corner of the base land to look more attractive. I have used a copy node and connected it to the output of transform node and in parameter pane changed the total no.of copies to be 7 and then created another transform node for positioning of the trees by adjusting the translate parameter along x,y,z direction.

A screenshot of a computer

Description automatically generated A row of trees with green leaves

Description automatically generated

**3.Lawn:**

* In order to create lawn I have used line nodes, 5 line nodes and merged them together using a merge node, I have set the direction of each line node in a different direction in order for them to look like a grass and adjusted their length accordingly.
* Then created the transform node and connected the output of merge node to this node and adjusted the parameter values of translate, rotation and uniform scale and then to add grass color created color node selected green as color and then created a grid node adjusted it’s size and changed values of rows& columns to be as 250 and center along y-direction to 21 and then created copytopointsnode and connected the output of grid node to second input of this node and output of color node to first input of this node in order to create the copies of the grass to look like a lawn.

A grid with green lines

Description automatically generatedA close-up of a grid

Description automatically generated

A screenshot of a video

Description automatically generated A green square on a grid

Description automatically generated

A screenshot of a computer

Description automatically generated

**4.Mountains:**

* To create mountains, I used circle node and changed its orientation to ZX Plane, radius to (5,5), center as (-3.8,1.5, -10) and then connected a polyextrude node connected output of circle node to input of this node chosen divided into be individual elements, extrusion mode to point normal, adjusted distance, inset values accordingly to look like mountain.
* Then connected transform node connected output of polyextrude node to input of this node and then adjusted translation along x as -8, z as 6, rotation along y as -90 and z as 180, uniform scale to be as 1.98.
* Connected a color node to show it as a mountain selected color as brown.
* Then to make multiple mountains connected copy node and selected total number to 4 copies and translated it along z-direction to -4.5 and connected transform node adjusted translation along y to 5, z to 11 and uniform scale to be as 7.

A close-up of a cone

Description automatically generated

* Then to make it look more natural like cracks uneven surface on top I connected a mountain node and increased the amplitude to 6.4. and connected it to a transform node to place it in a required position adjusted the parameter values of translation to (15,38,-70) and rotated it along y- axis about 90 degrees.

A screenshot of a computer

Description automatically generated A screenshot of a computer

Description automatically generated

A brown cone shaped object on a grid

Description automatically generated

**5. Tables:**

* In order to create the tables in the lawn, table which has ‘top’ and ‘legs’, therefore, to create the top I have used the ‘grid node’ and set its size to (1,2).
* Then created a transform node and connected the output of grid node to input of this node to scale the position adjusted the translate, scale values accordingly in parameter pane.
* Now I have connected output of transform node to input of polyextrude node and adjust the distance parameter to extend the top.
* Now to create legs I have used the tube node, set it’s radius scale to ‘0.192’, height to ‘1.8’, center as (-0.1,-0.83) and then I had connected the tube node to the polyextrude node to look like table legs, so adjusted the distance to be ‘-0.389’.
* Now to create the copies of legs I have used the ‘copy to points’ node, the polyextrude node of the tube node is connected to the first input and the grid node (top) is connected to the second input of the copy to points node.

A 3d model of several cylindrical objects

Description automatically generated

* To create a design on top of the table I have used another grid node with the same parameters as that of the top and connected it to the polyextrude node for applying the design, to do that I have set the ‘divide into’ option to individual elements and the inset to ‘0.247’.
* Then I merged it by connecting the output of the copytopoints, grid (tabletop), polyextrude node of both the grid nodes to the merge node then a table is created in scene view.Then I have connected it to color node and selected a color to add it to table. I have used the transform node to place it in position accordingly by translating to (21.3,-4, -2.7) .
* A 3d model of a table

  Description automatically generated
* To create Multiple tables I have used copy and transform node and selected total number of copies to be as 2 and translated it along x-axis about -43 then multiple tables have been created as shown in below image.

A screenshot of a computer

Description automatically generated A grid paper with a grid on it

Description automatically generated with medium confidence

* Then created other two tables by following previous steps in addition changed the transform values accordingly as per needs. Hence four tables have created in scene view as shown in below image.

A screenshot of a computer

Description automatically generated

**A table on a grid

Description automatically generated with medium confidence**

**6. Chairs:**

* To create the chairs, I have used ‘two grid nodes’, one for the seat and one for the back-support.
* Both grid nodes are set to same parameters i.e., their size is set to (2, 2) and the (rows, columns) to (2,2) and center along y direction to -1.
* Both these grid nodes are connected to two polyextrude nodes, their distance is set to ‘0.168’.
* Now to create their legs I have used ‘four tube nodes’ by keeping same radius scale, height and adjusted the center parameter for four legs accordingly. And enabled the end caps.
* Then I used merge node by connecting the output grid and tube nodes using the merge node. Now I have adjusted the position by creating a transform node by adjusting the translate, scale and rotation values accordingly.

A screenshot of a computer

Description automatically generatedA purple chair with legs

Description automatically generated

* Then I have connected it to a copy and transform node in order to create multiple chairs .

A screenshot of a computer

Description automatically generated

A purple chairs on a white surface

Description automatically generated

* Similarly, by following similar steps I have created total of 8 chairs by just changing the translation, rotation parameter values in transform node .
* Then connected merge node to show all the chairs created and these chairs are placed near the tables using the transform node by scaling the position values.

**A group of chairs on a grid

Description automatically generated**

**7. Pathway:**

* Then created the pathway to walk inside the building and lawn, so used grid node and set the size of the grid to (7.5, 280), and set it’s (rows, columns) to (2, 2), center to be (70,20.5,5.1) and rotation along y-direction to be 90.
* Then I connected it to the transform node to adjust its position accordingly to enter building by translating to (65, 1.7, -8.2)
* Then connected it to a color node to change its color suitable to a pathway, I have set it to black color.

A screenshot of a computer

Description automatically generated A close-up of a grid

Description automatically generated

**8. Security Office:**

* I have created a security office at entrance, where I used a box node and set its size to (4, 7, 3), center to be (2.5, -4.5,-24) and connected it to the color node by selecting pink color.
* Now I have created the entrance of the building by using the grid node, by setting its size to (1.5, 2.6) and then placed it on the building by adjusting center as (2.5, -6.6, -25.6), rotated it along y-direction to 180. Then I connected a color node set color as blue.
* Then created a text node and added text as Security Office and placed it on top of the building adjusted its origin, rotation, font size accordingly.
* Then I used merge node to merge grid, box and text nodes and then connected a transform node to scale the position I have adjusted the values of translate to (293,55.5, -121), rotated it along y direction 180 degrees and set it uniform scale to be 4.42.

A screenshot of a computer

Description automatically generated A pink sign with black text

Description automatically generated

**9.Rock:**

* To create a rock shape, I have used a sphere node and adjusted its radius as (5,5,5) and frequency to be as 50.
* Then connected it to a mountain node to create some noise pattern and decreased the element size to 0.6.
* Then connected it to a transform node and adjusted translation about (-7,85,85), uniform scale to 2.19 and then after for the rock to roll and hit the building I have connected it to another transform node adjusted translation along y to be $F/2\*-1, z to ch("ty”) \*1.5 .Connected it to another transform node and adjusted it’s uniform scale value to 1.42.

A grey ball on a grid

Description automatically generated A screenshot of a computer

Description automatically generated

A close-up of a ball

Description automatically generated A screenshot of a computer

Description automatically generated

* Rock to hit ground: -
* Here when the sphere hits the building it directly goes into the plane, so to control and to make the sphere fall on the ground I have followed the similar steps of creating rock but in addition I just used switch node by connecting the output of color node of rock and transform node of other rock that touches ground ,by taking frame number as reference and adjusted select input parameter to be as 130-$F to control the falling of sphere on the ground as we can see in the scene view.

A screenshot of a computer

Description automatically generated

A video game of a bowling alley

Description automatically generated

**10.Building:**

* To create building I have used a grid node by changing its size to (1,1) and rows & columns to 4.
* Connected it to a polyextrude node name it as wall 1 and in order to increase the height of building adjusted the distance parameter value to 2 and to show no.of floors of building I have adjusted the divisions parameter to 4 and disabled output front and inorder to create windows I have connected it to another polyextrude node selected divide into as ‘individual elements’ and adjusted the inset value to 0.06 and enabled frontgroup and then connected it to another polyextrude node selected group parameter to extrudefront and adjusted distance value as -0.04,inset to be 0.029, enabled front group then when we turn on blue flag we can view that windows have been created on the walls.

A screenshot of a computer

Description automatically generated A white rectangular object with a black top

Description automatically generated

* Now to create top of the wall for building I have connected another polyextrude node (name it as wall 2) to grid node and kept distance, divisions values to be same as previous polyextrude node in addition I have just disabled the outputside.

A screenshot of a computer

Description automatically generated A square tile on a floor

Description automatically generated

* Now by using merge node I have connected output of wall 1 and wall 2.
* Now to color the windows I have used color node and selected the group to extruded front and color to be blue.
* Then to place it in required position have connected it to transform node and in parameter pane translated it to (-9,20, -3) adjusted its uniform scale to 15.

A screenshot of a computer

Description automatically generated A white cube with blue windows

Description automatically generated

**Building Collapse: -**

* (Repeat the previous steps until creation of building)
* Create rbdmaterial fracture and Connect output of merge node to input of first pin of rbdmaterialfracture and in parameter pane of rbdmaterialfracture node, enable the Fracture per piece and in chipping tab enable chipping and increase chipping ratio to 0.8 and in constraints tab adjust search radius to 1.6, disable use tags, primary strength value to 400, and chipping glue strength to 100 and strength variance to be 0.42.
* Then create rbdbulletsolver node and connect first pin of rbdmaterial fracture output to firstpin of rbdbulletsolver input and then connect second pin of rbdmaterial fracture output to secondpin of rbdbulletsolver input and in parameter pane of rbdbulletsolver node, adjust the start frame value to 103, in collision tab ground Collision changed grouptype to Ground Plane, and in constraints tab select constraint name to be glue then enable &increase angle threshold to 20,force to 2,time scale ,impact, torque thresholds to 1.
* Create a group connect output of thirdpin rbdmaterialfracture node to group node and in parameter pane of select group type to points and enable keep in boundary regions adjust size is (2.28295, 1.85269, 4.35065) and center value is (0.398907, 0.998789, 2.21394).
* Connected it to a pointvelocity node and in parameter pane select group to group1,enable calculate speed and frame sample 2.79 and in curl noise tab enable add curl noise change scale value to 2.17,pulse duration to 3.93 and in from object tab enable add object motion change scale value to 2.02 and in conical noise tab enable conical noise adjust scale to 20,core angle to 102.1,direction along y to 0.5,global seed to 1.99 and connect it to input of third pin of rbdbulletsolver.
* Create transform node and Connect output of firstpin of rbdbulletsolver to transform node and in parameter pane adjust translate parameter it to (-11,20, -3) and uniform scale to 10.
* Now inorder to collapse building when it rocks falls on it, I have used switch node and Connected output of transform of building and building\_collapse to switch node and in parameter pane of switch pane to $F-103 then we can view building collapse at that frame number.

A screenshot of a computer

Description automatically generated A screenshot of a computer

Description automatically generated

A screenshot of a computer program

Description automatically generated A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

A broken object with blue and white objects

Description automatically generated with medium confidence

**11.People\_walk:**

To create a person walking I have used mocap biped1 node and in parameter pane translate it along x direction about (15+$F/5),y direction to 20,z direction to -152 and rotated it along y direction to 90 and scale to (14,14,14),select animation type to walk, adjust speed to 0.38 and cycle frame offset to -23.

A screenshot of a video editing program

Description automatically generated A cartoon of a person

Description automatically generated

**12.People\_Run:**

To create a person running I have used mocap biped3 node and in parameter pane translate it along x direction about (61+$F/5),y direction to 21,z direction to -3 and rotated it along y direction to 90 and scale to (14,14,14),uniform scale to 11, in animation tab select animation type to runs and in material tab adjust texture to 10.

**A screenshot of a video editing program

Description automatically generated A person standing on a skateboard

Description automatically generated**

**FINAL PROJECT LOOKS LIKE:**

Before building collapse:

A video game graphics of a mountain and palm trees

Description automatically generated

After Building collapse when rock hits it:

A green grass field with trees and a pyramid

Description automatically generated