Wooden Toy | Breakdown

Complex Scene

Name : Jonathan Sugijono

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Houdini Version: 18.0.499

Important Statistics:

Image Resolution : 1280 x 720

Render Time : 6 mins/ frame

Number of lights in scene: 2

Sampling:

Noise Value : 0.01

Pixel Samples : 4 - 4

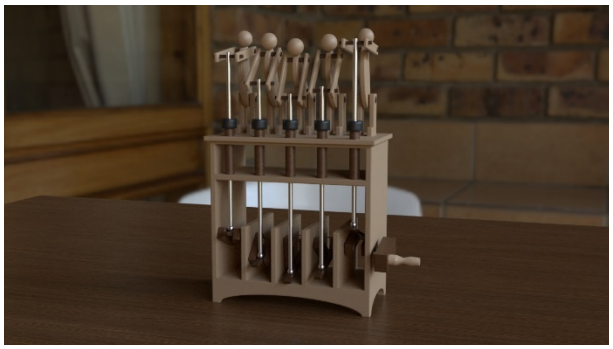
Min/ Max Rays: 5 - 13

Diffuse Quality: 2

Project Description:

Reference image:

Final Result:



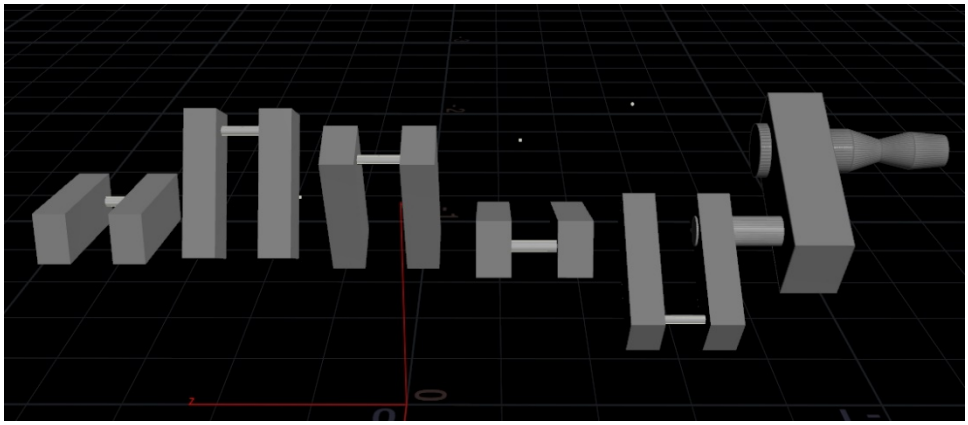
https://www.youtube.com/watch?v=uz8TV7gkeT0

In this project, I created a wooden automata toy using procedural animation. I really like it because it has a very simplistic design. One handle controls the whole movement and rotation of this automata. I want to keep the minimalist element in this project, so I decided to render it without any additional geometry and keep it simple.

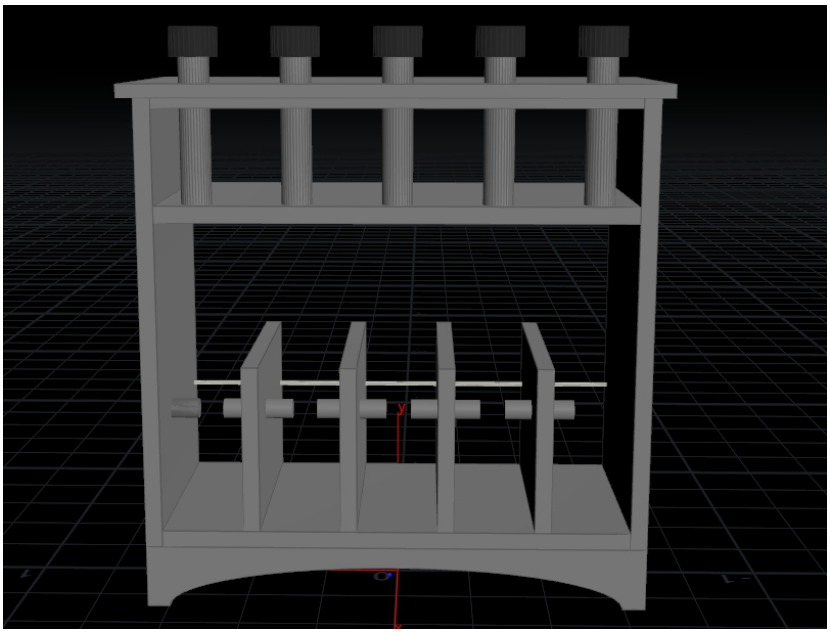
Technical Guide:

Process:

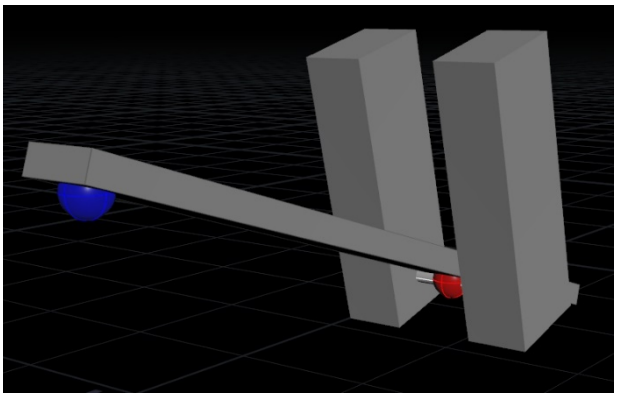
My first step was modeling the handle and the middle parts that were being controlled by the handle. I use box node and tube node for the basic geometry.



Then, I rotate them based using simple expression which is $F * 10. For the structure, I use box to create the outer frame and the middle sections. I also use tube for the top part that where the pillars were placed.



After that, I created an expression that rotates the plank based on the rotation of the middle parts. I used wrangle node to create this expression. The red and the blue sphere are only for reference for the points.



Jump Back *Alt+LeftArrow*

Attribute Wrangle pointwrangle1

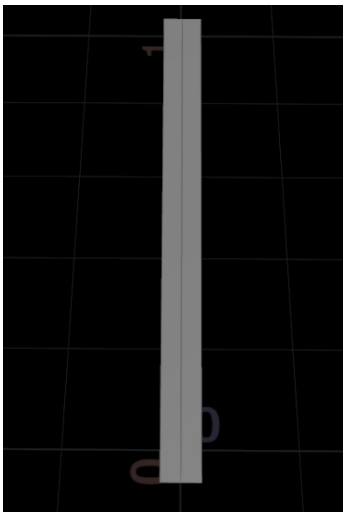
VEXpression

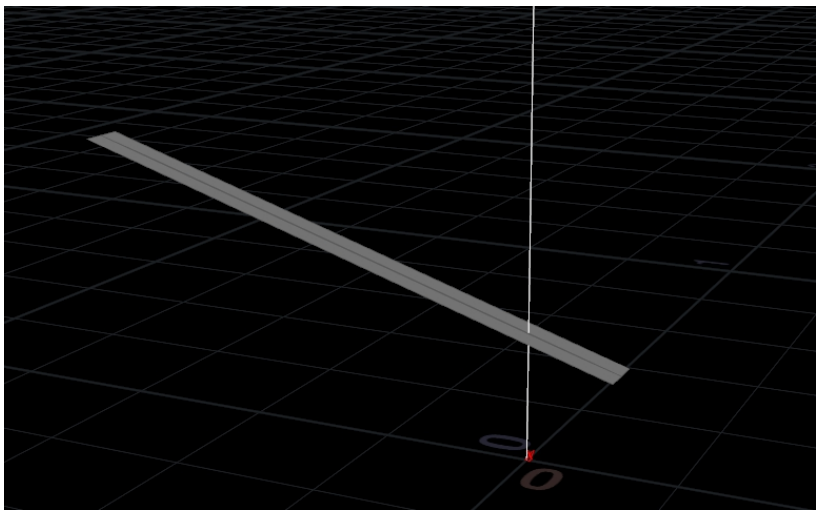
```
v@ptred = point(@OpInput1,"P",1);
v@ptblue = point(@OpInput2,"P",8);
v@ptblue.x += ch("../transformToPlace/tx");
v@ptblue.y += ch("../transformToPlace/ty");
v@ptblue.z += ch("../transformToPlace/tz");

vector line = normalize(v@ptred-v@ptblue);
@angle = -degrees(acos(dot(line,{-1,0,0})));

if (v@ptred.y < v@ptblue.y)
    @angle *= -1;
```

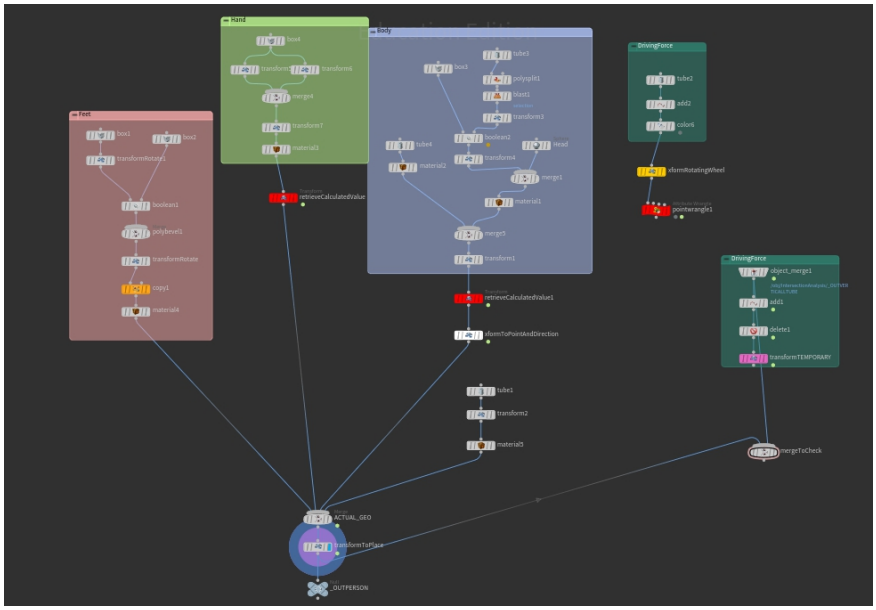
For the vertical movement, I use intersection analysis node to figure out where the intersection between the plank and the pole is. First, I deleted all the faces from the plank except for the one that first intersect with the pole and divide it in the middle vertically. Then, I used the intersection analysis to find the point of the intersection.





I used the point to set the placement in the y-axis for the pole. So, it would move at the same time with the plank's movement. After this process, I continue to make the two-point constraint for the mannequin on top of the wooden toy.

Below is the screenshot node for the mannequin:



I use the movement of the pole as the driving force and use a VEX expression to setup the two-point constraint.

VEXpression

```
float R = ch("../PurpleTube_R/height");
float r = ch("../GreenTube_r/height");
float x1 = ch("../retrieveCalculatedValue/tx");
float y1 = ch("../retrieveCalculatedValue/ty");
vector Pt0 = point(@OpInput1,"P",40);
float x0 = Pt0.x;
float y0 = Pt0.y;
float D = sqrt(pow(x1-x0,2) + pow(y1-y0,2));
float d = (R*R - r*r + D*D)/(2.0*D);

// compute for the purple leg
// Remember that hscript uses degrees, but vex uses radians
float angleE = degrees(acos(d/R));
float angleT = degrees(acos( (x1-x0) / D ));
f@angleRotPurple = angleT - angleE;

// compute for the green leg
float angleG = degrees(acos((D-d)/r));
float angleS = 180 - angleT;

f@angleRotGreen = -(angleS - angleG);
```

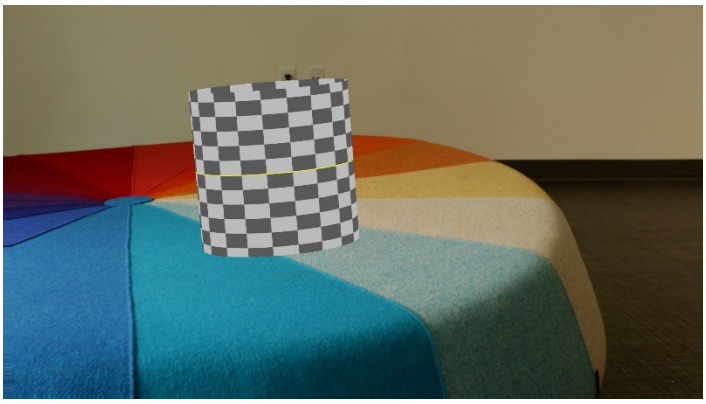
http://www.deborahfowler.com/MathForVSFX/DotProduct.html

Finally, I combined all the geometries using object merge and copied it 5 times and time shift it 5 frames per piece.

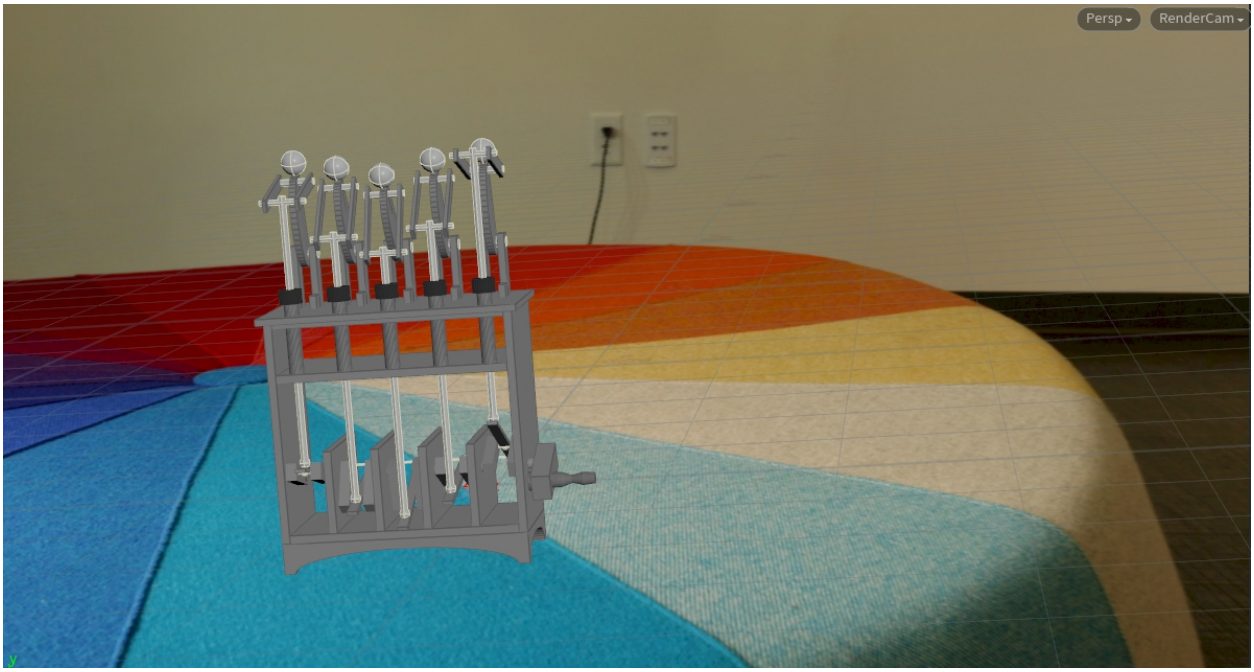
Beyond the requirements:

I did some camera tracking which is not required for this project. I used great image sequences that was taken by Kiersten Yahn.

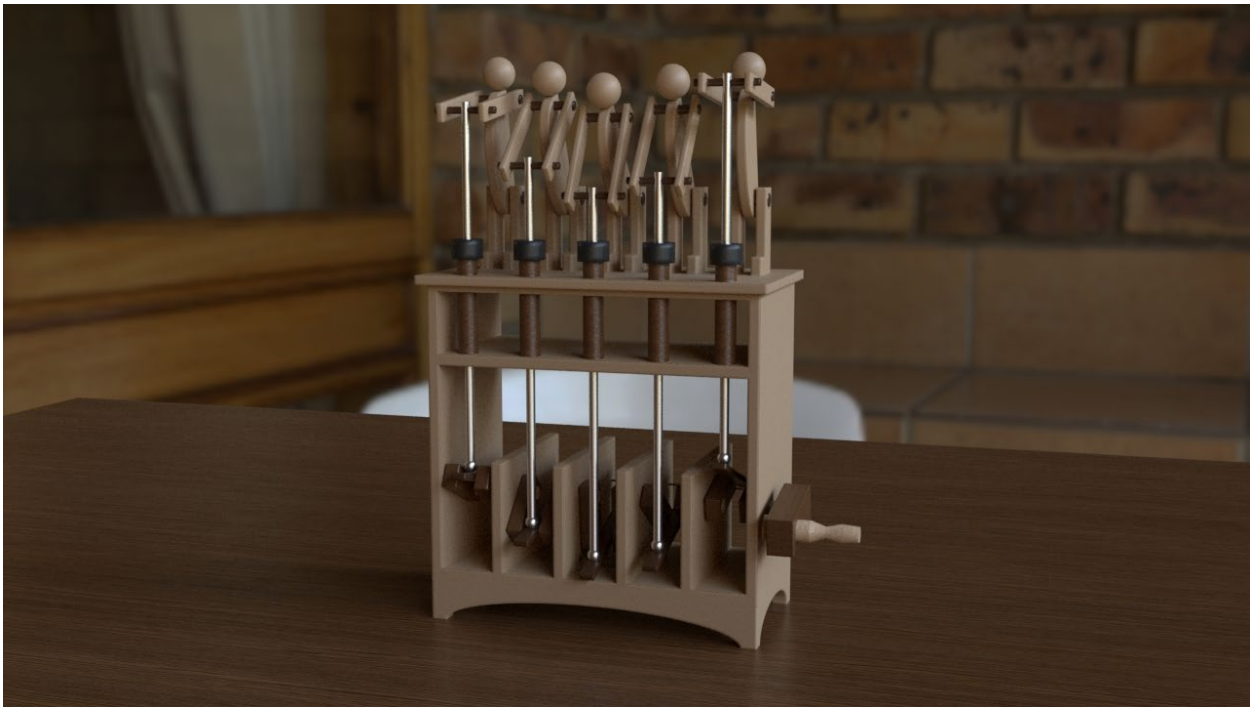
Here is the reference frame and the screenshot of the tracked images.



I already tried to integrate the automata into the image sequence and rendered it out, but I figure that it looks odd because it does not have any context. It looks like someone just put it there for no reason.



So, I decided to use a wooden table and use backyard environment which fits well with the wooden automata.



Problem and Solutions:

My main problem is to get the plank rotation and the two-point constraint working properly, which is a big issue to continue doing this project. In the future, I have to carefully write the expression and check multiple times whether I mistype something in the code.

Reference link:

https://www.youtube.com/watch?v=uz8TV7gkeT0 – Automata Sampling, uploaded by Cecilia Schiller

http://www.deborahfowler.com/MathForVSFX/DotProduct.html - Two-point constraint, Deborah Fowler