

1. Project description

With the arrival of 2024, the year of the Dragon, the final project of PACSSR-301005 involved the modelling and rendering of a Chinese Dragon.

The 3D modelling process was completed procedurally on OpenSCAD. First, there was a rough sketch of the elements/body-parts that were going to make up the Dragon – body, head, horns, claws, tail. Then, group members tasked with Modelling translated the sketch into a 3D model, utilising OpenSCAD functions such as: Syntax e.g. “module”(); 2D elements e.g. “circle ()”; 3D elements e.g. “cylinder()”; Transformation functions e.g. “translate([])”, “rotate([])”; Boolean operations e.g. “union()”

After modelling the Dragon, our group went ahead to render it. Our team used three.js to texture the model and add lighting and shadows to the dragon.

2. Approach

2.1. Modelling Part 1 (Dragon’s body)

Version 1 of the Dragons body consisted of hundreds of cubes, generated with a for-loop. The cube stacked with each other, forming a “straight line” (Fig. 1).

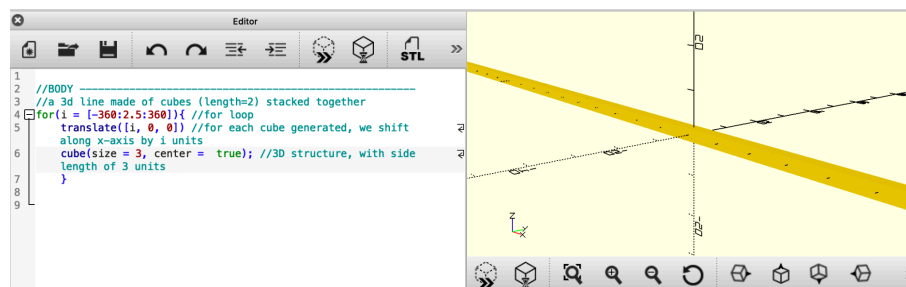


Fig. 1

To get the curvature of the Dragon’s body, trigonometric functions were introduced. Value of i dictated the x-axial position of the cube; $f1(i)$ dictated the y-axial position of the cube; $f2(i)$ dictated the z-axial position of the cube (Fig. 2). The position of each cube on the y-axis and z-axis were in irregular oscillatory motion, giving rise to the loops of the Dragon’s body.

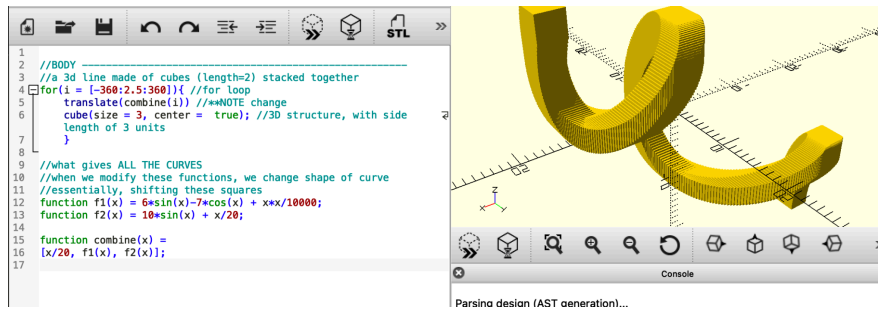


Fig. 2

However, the first version of the dragon's body was abandoned, as advised by the Assistant Professor. It would take a great amount of time and effort to render such a body, as each of the 200+ cubes would have to be rendered separately.

This led to the second version of the dragon body, where circular extrusions of a 2D circle (translated formed C-shaped rods (Fig 3). Four c-shaped rods, each with different extrusion angles, rotation along the z-axis formed the dragon's body (Fig 4). Each C-shaped rod was rotated along the y-axis by a different degree.

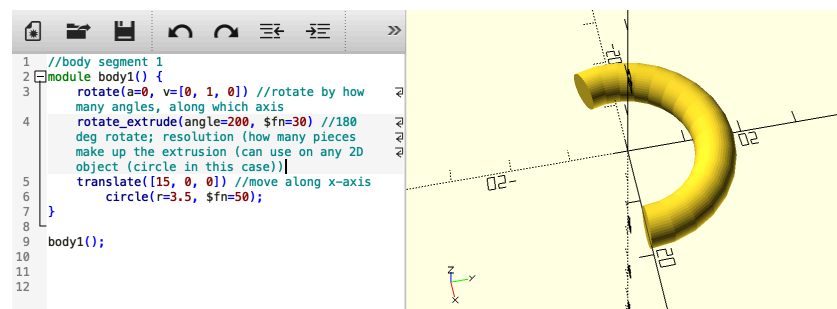


Fig. 3

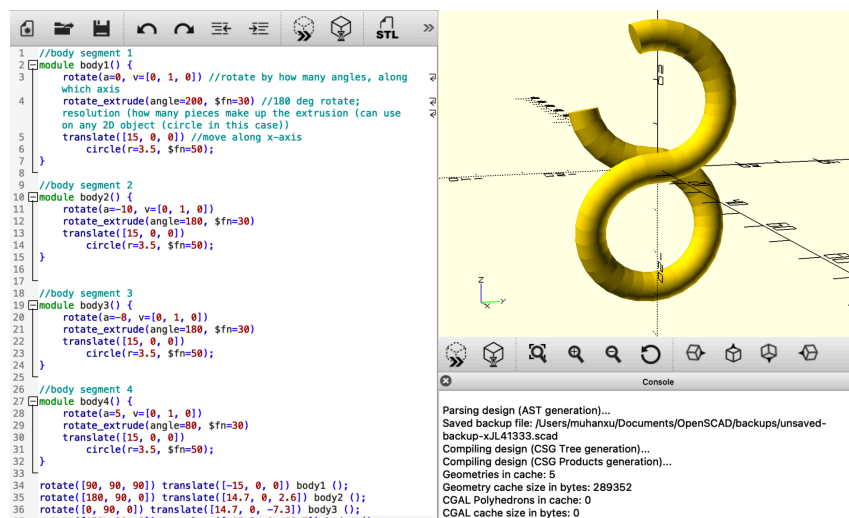


Fig. 4

2.2. Modelling Part 2 (Dragon's head, horns, tail)

The dragon's head is composed of a sphere with a radius of 5, a cylinder with a height of 10, and another sphere with a radius of 3 connected using union(). (Fig 5)

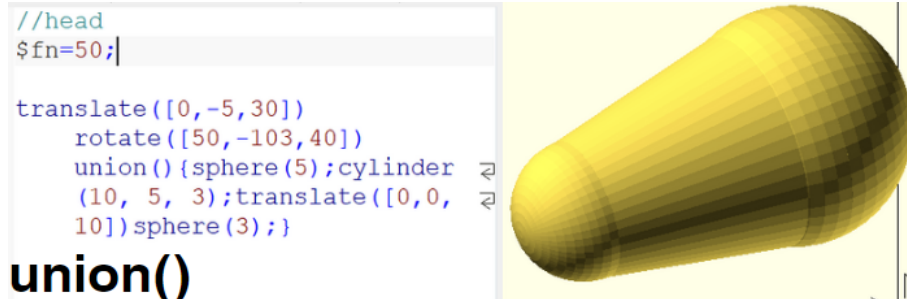


Fig. 5

To create the dragon's eyes, horns, and claws, use translate() to join cylinders, triangles, and spheres of various sizes and shapes into the appropriate places. Also, use rotate() to rotate them to the correct position to make them more vivid. In addition, in order to make the two corners of the dragon curve more naturally, a for loop and power operation were used to create a cylinder. (Fig 6, Fig 7, Fig 8, Fig 9).

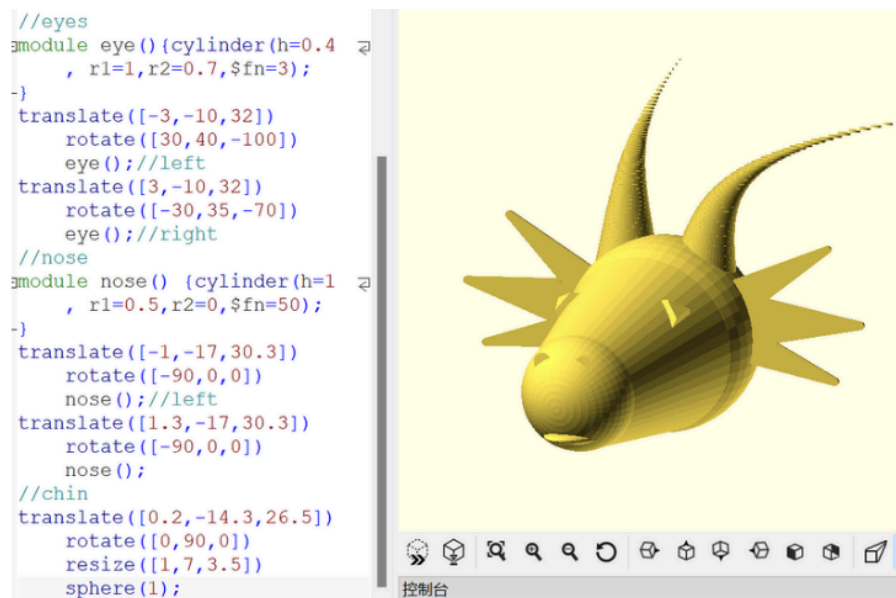


Fig. 6

```
for (i = [0:0.1:h]){
    translate([0,pow(2, i)*0.01,i])
    cylinder(0.1, (h-i)*0.2, (h-i)*0.2);
}
```

Fig. 7

```

module claw() {
  cylinder(h=8, r1=2, r2=
1.5, $fn=30);
  translate ([0, 0, 8])
  sphere(r=1.6, $fn=40);
  translate([-0.4, 0, 8])
  rotate([55, 0, 90])
  cylinder (h=7, r1=1.3, r2
=1, $fn=30);
  translate ([6, 0, 12.5])
  sphere(r=1.3, $fn=40);
  translate([6, 0.4, 12.5
]) rotate([48, 0, 130])
  cylinder (h=2.5, r1=0.8,
r2=0, $fn=20);
  translate([6, 0.2, 12.5])
  rotate([48, 0, 110])
  cylinder (h=2.5, r1=0.8,
r2=0, $fn=20);
  translate([6, 0, 12.5])
  rotate([48, 0, 90])
  cylinder (h=2.5, r1=0.8,
r2=0, $fn=20);
  translate([6, -0.2, 12.5
]) rotate([48, 0, 70])
  cylinder (h=2.5, r1=0.8,
r2=0, $fn=20);
  translate([6, -0.4, 12.5
]) rotate([48, 0, 50])
  cylinder (h=2.5, r1=0.8,
r2=0, $fn=20);}

translate([-2.35, 13, 12])
  rotate([70, -71, -40])
  claw(); //front-right
translate([2.35, 13, 12])
  rotate([130, -90, 15])
  claw(); //front-left

```

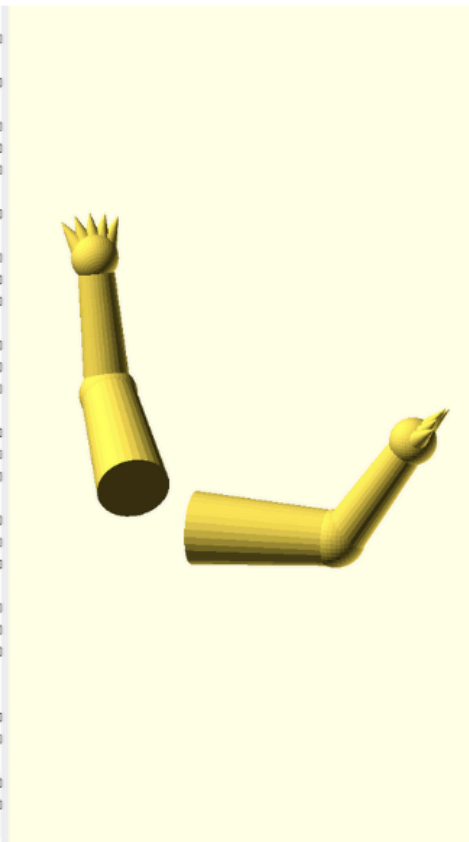


Fig. 8

```

//tail
translate([-11.55,-17.3,26.31
]) rotate([-10.5, 175.5, 0
]) cylinder(h=14, r1=0.5,
r2=3.5);

```

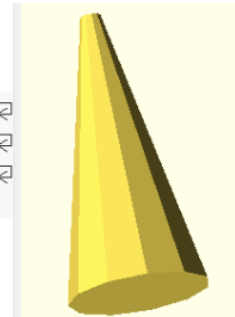


Fig. 9

2.3. Rendering/Shading

First import the model into three.js. There was a problem here at the beginning, because the dragon model is a whole, and there is no way to distinguish the various parts of the dragon for mapping. So later, I imported the stl files of different bodies of the model one by one, and finally successfully textured and rendered them.

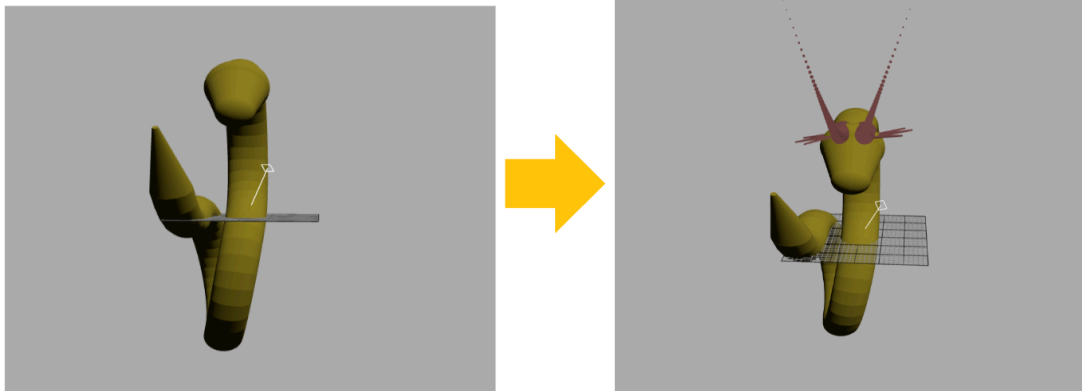


Fig. 10

First import the dragon head and body, and add a yellow texture to them. Then, we imported the dragon horn, and here we gave it a red texture.

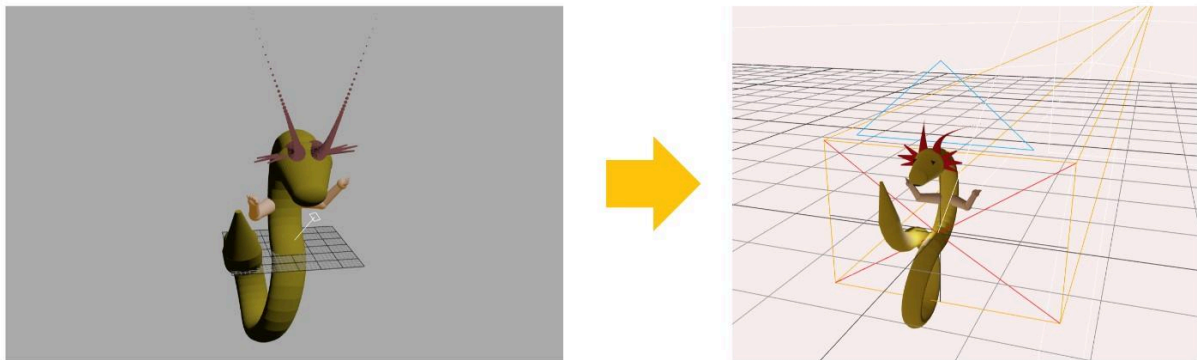


Fig. 11

Then import the dragon's claws and dragon's eyes. Finally we added lighting and shadows to make the dragon look more realistic.

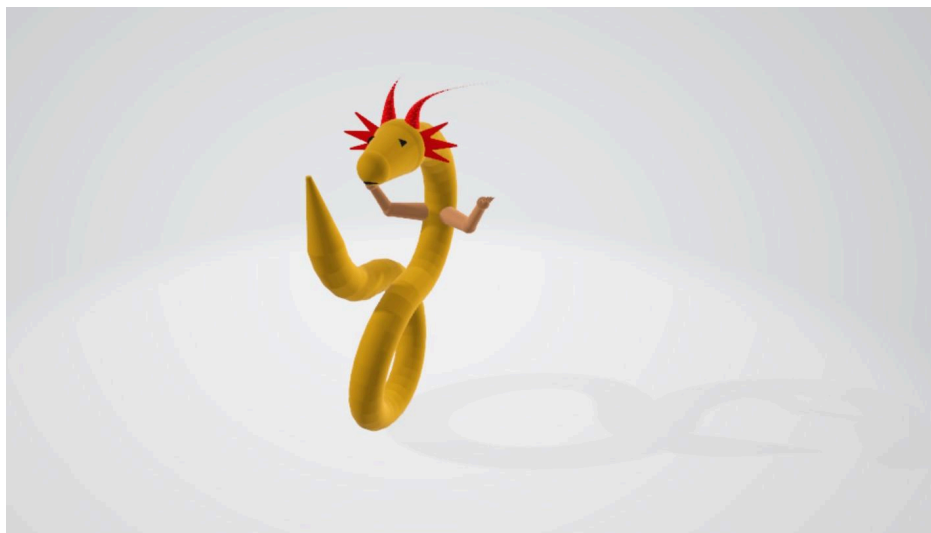
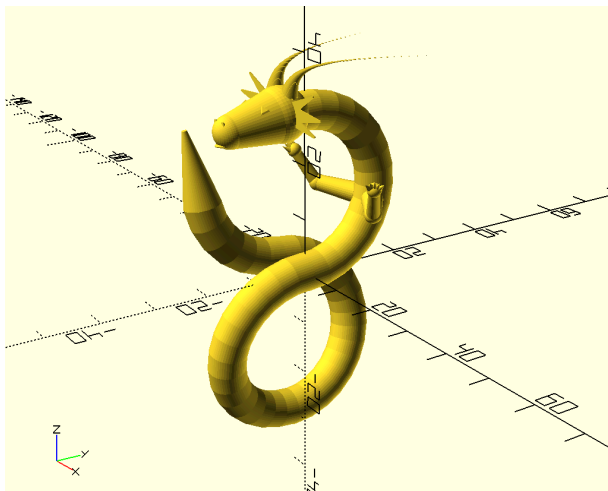
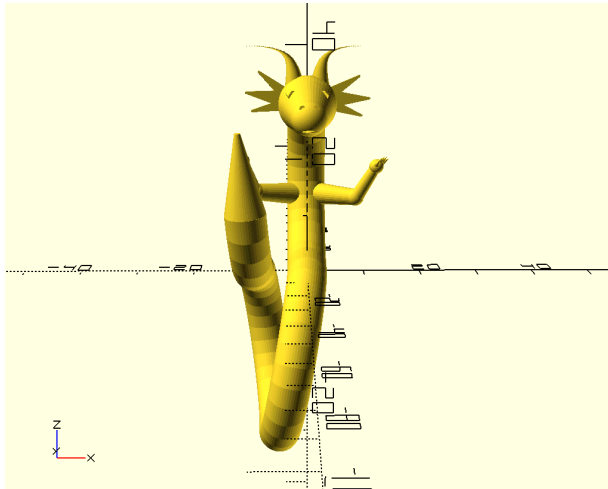
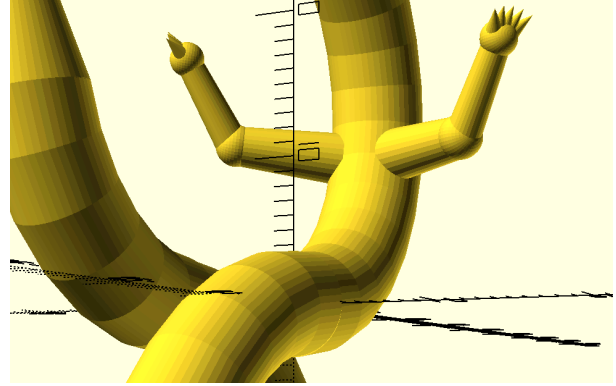
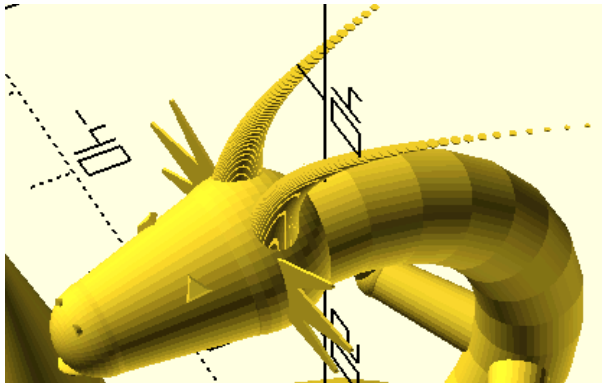


Fig. 12

3. Results

(Before Rendering)





(After Rendering)

