Interactive Graphics - Homework 2

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1 Create a hierarchical model of a kangaroo

The hierarchical model is a technique with which we can visualize different components of the same object as nodes and leafs of a connected tree and draw them doing a transversal visit of each node. To built a Kangaroo, based on the starter humanoid hierarchical figure, i added the neck, the tail, the pouch and the left and right haunch branches in this way:

1. I give to each component a unique Index
2. I define the height and the width of the component
3. I add the corresponding "case" in the switch in the initNodes() function, with its corresponding parent, sibling and children.
4. I add the corresponding draw function for each component

Then I modify the Theta values to give to the figure the posture of a kangaroo and for the light brown color i modify the color vector in the fragment shader: (0.6, 0.4, 0.3, 1.0).

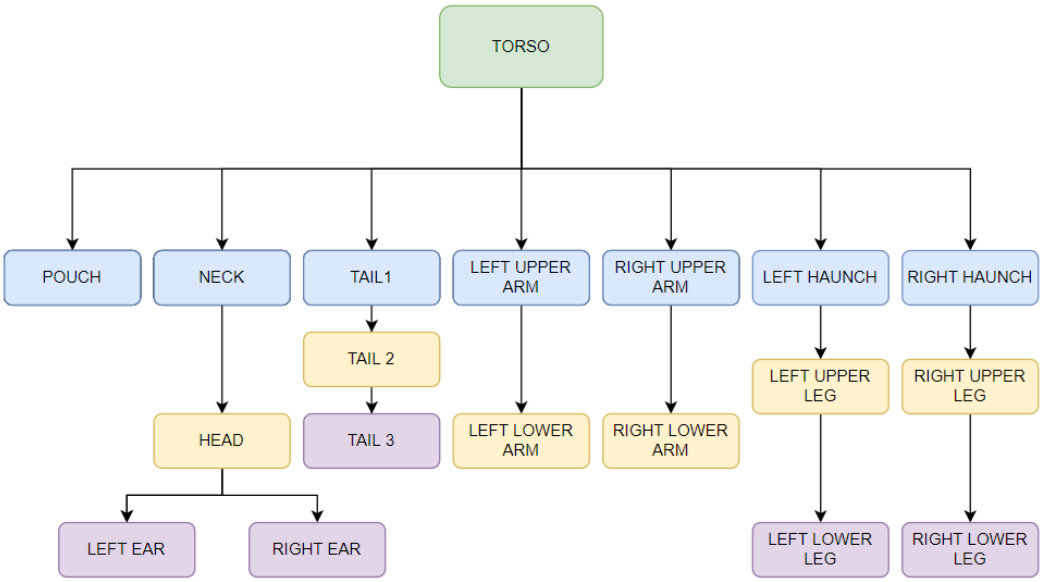

Figure 1:

2 Add a surface that corresponds to a grass field. Add to it a texture to give the appearance of a grass field.

A surface is essentially another cube, but separated from the kangaroo figure. So I define index, width and height for the grass cube and I create a new hierarchical schema, separated from the Kangaroo one and a new Transversal function. I decided to use a color texture on it, so i take the color texture in the book for the "textureCube4" and i modify manually each components to have a green background and brown stripes.

Figure 2: kangaroo

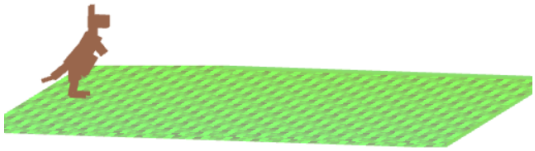

Figure 3: kangaroo with grass

3 Generate a color texture to be attached to the front face of the head and a bump texture to be applied to the sides of the body.

1. **Front Face**
   Similary to the grass field I define a new Texture function, and I define a new variable "Choose Texture" with which I can change the texture in each component of the model. Considering that in the head function the cube faces are drawn in this order: Botton-dx-back-front-top-sx I use the Face Texture only in the fifth drawArrays , and for the other faces i left the inizial ligth brown color.

2. **Bump Texture**
   For the Bump Texture I used the "BumpMap" example in the book. I define all the paramiters for the Texture such as the normals and the data and I define also light paramiters such as the light positions, ambient light and diffuse light. I attached them on the back of the body of the Kangaroo in the same way of the front face texture and I used it also on the ears, lower legs , lower arms , tails and for the pounch.

4 Modify the surface so that there is a small hill, a low one.

To create a small hill, I added a child to the grass component an I used the "hat" example in the book in order to have a rounded hill in the middle of the grass field.

Figure 4: hat/hill

5 Kangaroo Animation

5.1 The Movements

The Animation of the Kangaroo is composed by 3 types of movement:

1. **The Circular Motion**

   This kind of movement allows the kangaroo to rotate around the hill. In order to realize it I used the sine and cosine properties of the x-Position and z-Position of the body of the kangaroo respecting the following formula:

   x = cos(Signal * Velocity)*distance;

   z = sin(Signal * Velocity)*distance;

2. **The Sinusoidal Motion**

   To simulate the kangaroo jump I used the sine function of the y-Position of the kangaroo body. In this way the sinusoidal function together with the circular motion create an impression of dynamic leap.

3. **The Movement of the Upper and Lower Legs**

   The two previous motions are not enough to make the animation dynamic, so I decided to change the angle of the upper and lower legs, contained in the "theta" array, during the course of the animation to simulate the joints in the pre-jump, during-jump, post-jump situation.

5.2 The life cycle of animation

When the button "start animation" is pressed the varable "kAnimation" is set to TRUE and the animation start. The entire animation is managed especially through the "signal" parameter. This parameter allowed me to define the start and the end of a single tour of the kangaroo around the hill. In particular the revolution ends when signal is equal to 62.63, when this value has been reached, all the angles and the position is reset and the button of the animation is switched to FALSE. This means that when the kangaroo has finish one complete ride around the hill , He stops and is ready to start another round.

6 Allow the user to move the camera before and during the animation.

To allow the user to move the camera I introduced 3 values: Radius (the distance from the origin), theta and phi (angles that allows you to change the camera view) and I implement the lookAt function. To manage these values I add Buttons.