CS 174A Project Report

Team Slytherin
Link : https://github.com/intro-graphics/team-project-team-slytherin

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1. Description

Game: 3D Snake

The game is an alternate version of the ***Snake*** video game that originated in the 1970s, but with a 3D field of view and additional features such as obstacles and items.

The player controls a snake that moves around in an enclosed space, eating food while avoiding the obstacles. Each time the snake consumes food, its length grows longer.

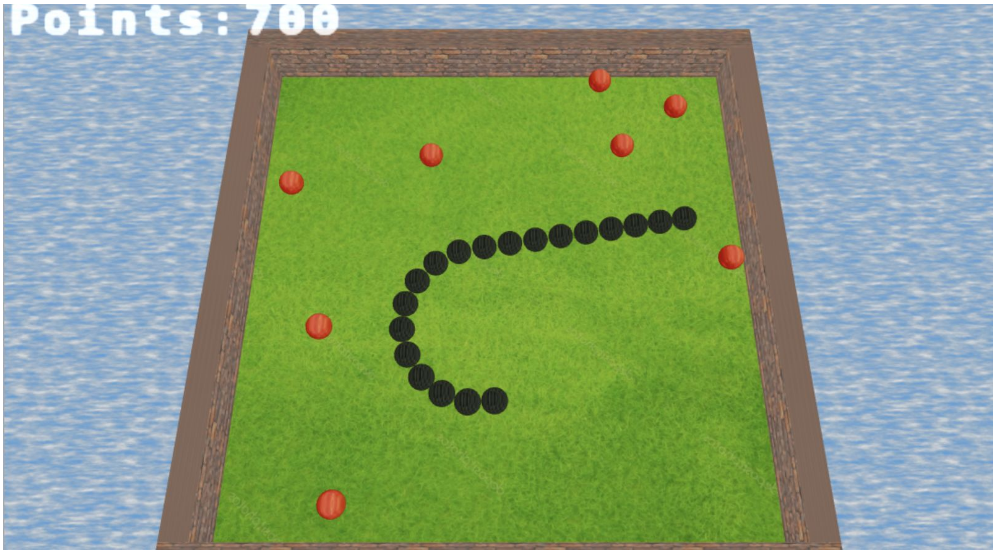
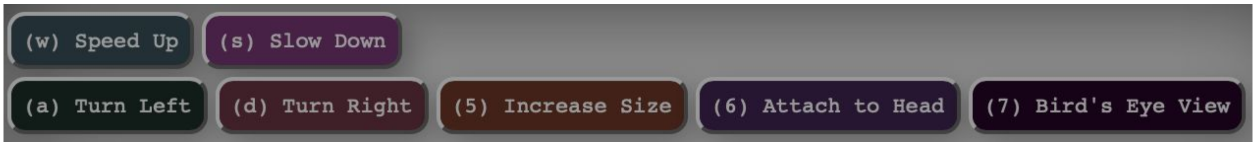


Figure 1. 3D Snake game

1.1 Controls

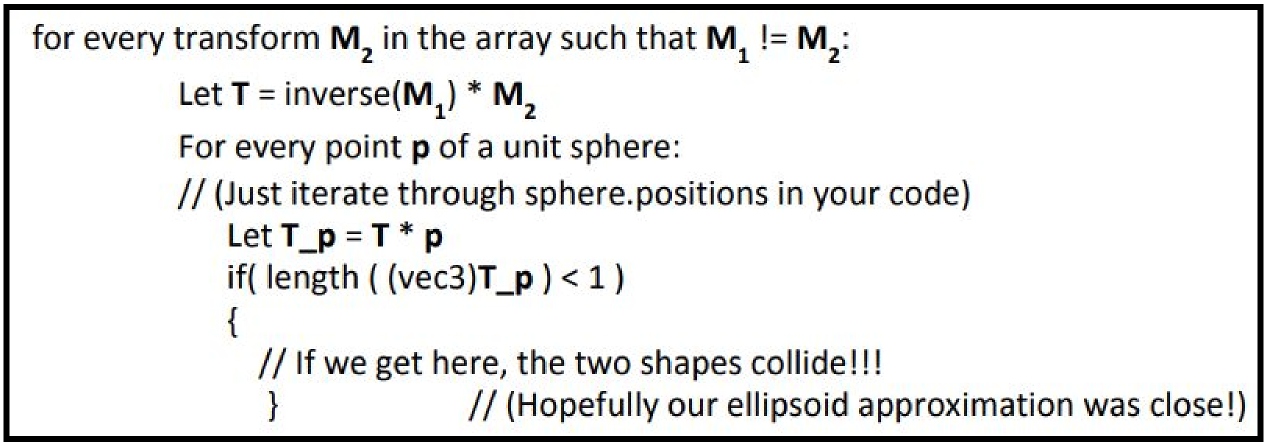


1.2 Game rules

- The obstacle, food, and items are placed randomly in the map
- The player earns points when taking apples (100 points)
- The higher the score, the faster the snake moves
- When the snake is colliding to the wall, the snake dies and the game is over
- When the snake’s head is colliding with its body, the snake will lose some parts of its body and lose points.
- When the snake takes items, it would get the following effects:
    1. Speed up
    2. Longer snake’s body
    3. Extra life

2.1 Features - Collision Detection

The snake will be able to experience collisions with 3 types of objects: Walls, objects (items), and the snake body. Collisions with walls or obstacles result in the loss of a life, with the special case of the snake colliding with itself, upon which the snake length will reduce to length between the head and the collision point. Collisions can be detected by approximating objects’ shape with collision ellipsoids. Each object in the game has their own model transforms, by using the model transforms on a unit sphere we can generate such collision ellipsoids and by comparing each model transforms we can detect whether there is a collision or not. The implementation is similar to the one provided on the slides on week 6, with the only difference being that we only need to check collisions with the head of the snake and when we place a new object in the map, since they are the only events that can cause a collision. However, in order for the approximation to be accurate, each object’s vertices must be centered around the origin and roughly unit length in all directions.



```
for every transform $M_2$ in the array such that $M_1$ != $M_2$:
        Let T = inverse($M_1$) * $M_2$
        For every point p of a unit sphere:
        // (Just iterate through sphere.positions in your code)
            Let T_p = T * p
            if( length ( (vec3)T_p ) < 1 )
            {
              // If we get here, the two shapes collide!!!
              }            // (Hopefully our ellipsoid approximation was close!)
```

Figure 2.1. Collision detection implementation

3, What we have done in the demo

3.1 Structure

Class : “Team_Slytherin_Project”

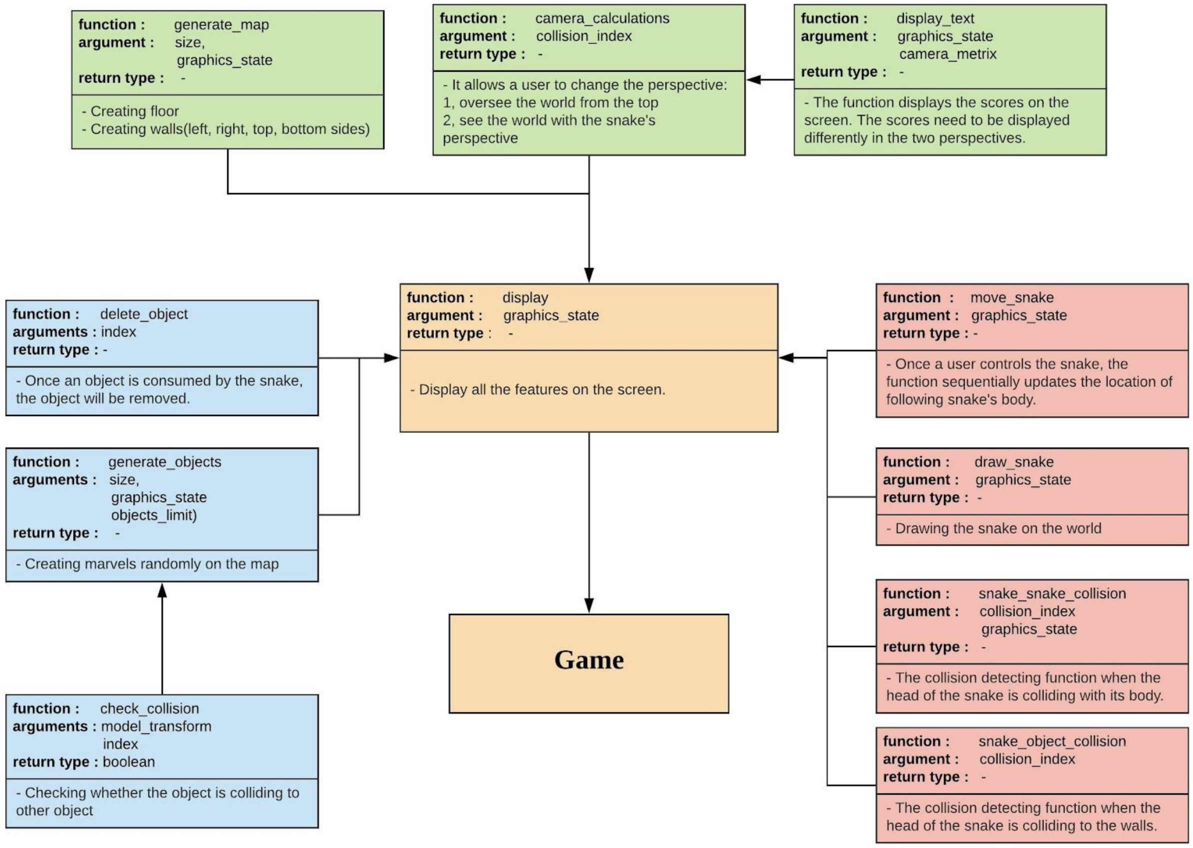

function : generate_map
argument : size, graphics_state
return type : -
- Creating floor
- Creating walls(left, right, top, bottom sides)
function : camera_calculations
argument : collision_index
return type : -
- It allows a user to change the perspective:
1, oversee the world from the top
2, see the world with the snake's perspective
function : display_text
argument : graphics_state camera_metrix
return type : -
- The function displays the scores on the screen. The scores need to be displayed differently in the two perspectives.
function : delete_object
arguments : index
return type : -
- Once an object is consumed by the snake, the object will be removed.
function : display
argument : graphics_state
return type : -
- Display all the features on the screen.
function : move_snake
argument : graphics_state
return type : -
- Once a user controls the snake, the function sequentially updates the location of following snake's body.
function : generate_objects
arguments : size, graphics_state objects_limit)
return type : -
- Creating marvels randomly on the map
function : draw_snake
argument : graphics_state
return type : -
- Drawing the snake on the world
Game
function : snake_snake_collision
argument : collision_index graphics_state
return type : -
- The collision detecting function when the head of the snake is colliding with its body.
function : check_collision
arguments : model_transform index
return type : boolean
- Checking whether the object is colliding to other object
function : snake_object_collision
argument : collision_index
return type : -
- The collision detecting function when the head of the snake is colliding to the walls.

Figure 3.1. Structure of the game

Orange box: it is the main function to draw all objects in the screen.

Blue box: the functions related to creating or removing objects(items) on the map.

Red box: The functions related to the snake’s control, movement, and collision update.

Green box : the functions related to the background and perspective.

3.2 Features

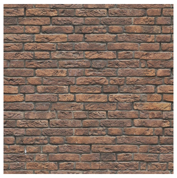
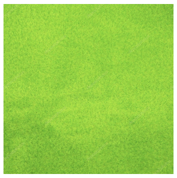
Basic object:

We created the background (world) and the snake objects. The world is the multiple combination of cubes and the board; the snake is the series of multiple marbles.

Behaviors:

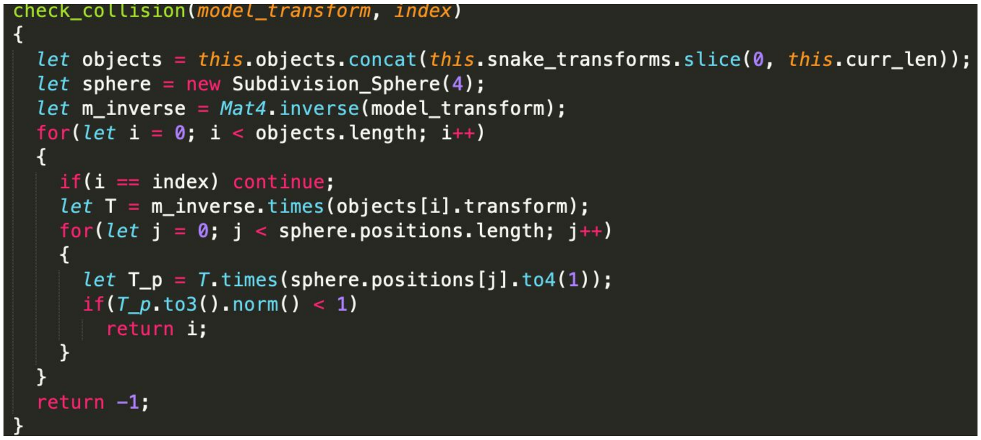
The snake is moving straight as a default behavior and can go left or right. When changing the direction, it turns around as a circular shape. The body of the snake is following the head of the snake and each location of each marble is updated to the location of the front marbles. The items are created in the world randomly and it is consumable by the snake. If it is consumed, a new item will be created in the random location and it always keeps the constant number of items in the map. When the snake is colliding into the wall, the snake is considered as dead and the game is over.

Texture:

1	**Wall**		4	**Apple**	
2	**Sky**		5	**Snake**	
3	**Ground**				

Collision:

Based on the return value from the function(check_collision), it detects whether the collision between objects exists or not; the collision detection algorithm has been used. As a big picture, the collision can be categorized into the three: snake with wall, snake with object, snake with snake. All objects are saved into an array with the order (Wall, Apple, Snake body) and the type of the objects can be specified by calling (object.type). It allows not only detecting the object collision but also it helps recognizing which objects are colliding with each other.



```
check_collision(model_transform, index)
{
  let objects = this.objects.concat(this.snake_transforms.slice(0, this.curr_len));
  let sphere = new Subdivision_Sphere(4);
  let m_inverse = Mat4.inverse(model_transform);
  for(let i = 0; i < objects.length; i++)
  {
    if(i == index) continue;
    let T = m_inverse.times(objects[i].transform);
    for(let j = 0; j < sphere.positions.length; j++)
    {
      let T_p = T.times(sphere.positions[j].to4(1));
      if(T_p.to3().norm() < 1)
        return i;
    }
  }
  return -1;
}
```

Figure 3.2. Collision Detection implementation

Controls:

Speed up(‘w’) - the snake is moving faster

Slow down(‘s’) - the snake is moving slower

Left(‘a’) - the snake moves its direction left side as a circular motion

Right(‘d’) - the snake moves its direction right side as a circular motion

Increase size(‘5’) - for one hit, the snake gains one marble on its tail.

Attach to Head(‘6’) - the user can change the perspective of the playing scene to snake perspective. With the perspective change, the score will be displayed differently; right above the snake head.

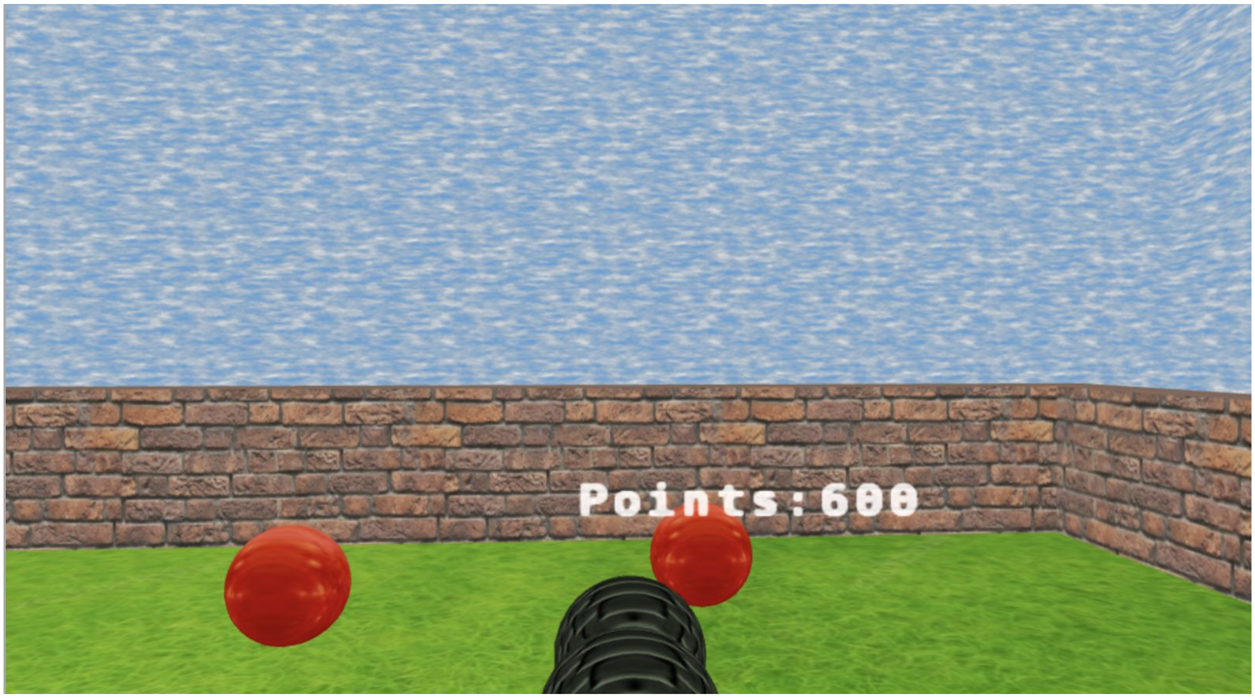


Figure 3.3. Attach to Head (perspective 1)

Bird’s Eye View(‘7’) - it is a default perspective and it allows a user to see all the world and a snake from above. With the perspective change, the score will be displayed differently; located to the left above of the game screen.

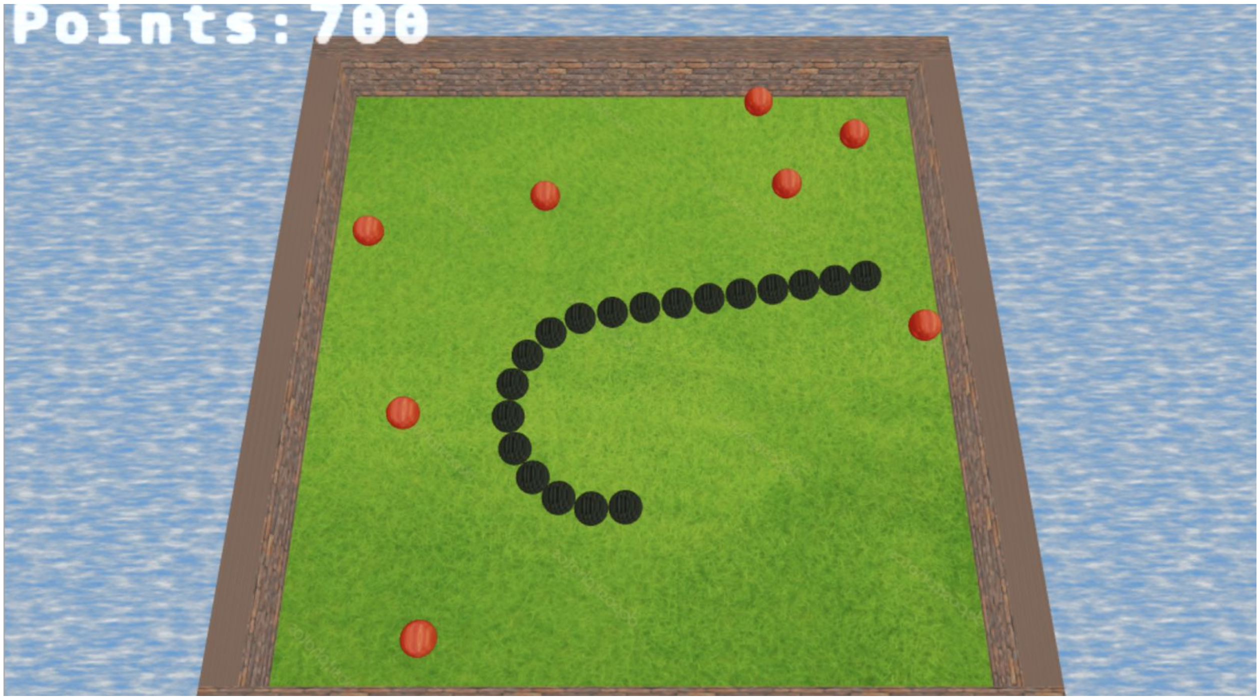


Figure 3.4 Bird’s Eye View (perspective 2)

4, Interesting things

1, screen shaking - When the snake is colliding with its body, the game screen is shaking left and right for one second.

2, rat object - due to heavy workload, the function is not completed and commented out.

[completed one] The rat runs away from the snake. When the euclidean distance is within 20, the rat is reacting to it and if not, it does not react.

[incompleted one] When the rat is moving away from the snake, the rat can encounter the apple objects and its behavior(direction) is complicated and it took a lot of time to make it. For this reason, we decided to comment it out.

5, Contribution

Commits:

Format : https://github.com/intro-graphics/team-project-team-slytherin/commit/[number]

Wilson

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Minu Jung

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Gawun Kim

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