CS 174 Final Project Report

Team Member

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Description

We get the idea of Balance Ball from the cell phone game balance ball. Most cellphones have this game to show off the ability of the built-in gyro. We tried to simulate the physical behavior of the ball on the ice surface. Since the real physics is very complex, we simplified some of our parameters and tried our best to simulate a more realistic-looking scene.

How to play the game

The game will start with a random angle of tilt so the board is not balanced The purpose of this game is to make the ball stay on the ice surface as long as possible. The score is based on the time you survived. Use 'w', 'a', 's', 'd' to control the tilt of the floor, press 'x' to restart a new game.

Advanced Features and Implementation

Collision detection
Detect the contact between ball and floor, a function will detect if the ball is on the floor. A supporting force on the ball when it collides with the floor. When the ball was dropped from the middle of the air, it will record its position and compare it with the boundary of the board. When it collides we will know if it should bounce or just roll on the floor depend on the vertical velocity of the ball.

Physics-based simulation
-Gravitational acceleration
Simulate gravity so the ball can free fall, roll, slide, and rebound. We imply a constant acceleration vertically on the ball. When the ball does not collide with the floor, it is always in a free-fall motion since it's in the middle of the air. When it detects the ball collides with the floor, the floor should have a vertical upward supporting force. We reflect the force as acceleration on the ball by using a series of trig functions. This acceleration will be used to update the velocity of the next frame.

-Rolling
Simulate a ball's motion on a surface with minimum friction. Since our board is an ice surface, the ball barely has any friction. We simulate the rolling by combining two parts, sliding and rotating. When the ball collides with the board, it should only be rolling towards the relative velocity with respect to the board. And when we rotate the board, the ball should be moved as well. The rotation direction should be the same as the relative velocity so we make the rolling axis the cross product of velocity and normal vector of the board upwards. The rotational speed is based on the angular velocity.

-Elastic collision
Simulate elastic collision so the ball will bounce on the ice surface. Whenever the ball collides with the floor when it's in free fall, it will bounce. We don't have an elastic coefficient but we simulated it by giving it an opposite velocity with some energy loss.

Individual Contribution

Mingchao Lian: rolling, texture, display of ball
Xiangyu Wan: collision detection, elastic collision, gravitational acceleration
James Yang: light, shader
Zijian Zhao: tilting control of the board, Html interface, modeling (discontinued)
https://github.com/intro-graphics/team-project-team-wdnmd/graphs/contributors