Collision Detection in VR

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Outline

Motivation

- Collision detection is one of the critical technique in improving the user experience in VR.
  - Collision between the users and the objects.
- An user should receive feedbacks while the avatar touches the objects or other users.
  - Be blocked, vibration or the vision feedback.

Current Status

- Online 3D games
  - Some MMORPGs don't handle the collisions between users.
  - Others wraps the characters in cubic or sphere bounds, which makes collision detection much easier.
- VR Application
  - An user interacts with objects using the controllers.
  - Real-time human-avatar interaction increases the complexity of multiplayer VR application.

Project Goal

- Evaluate the amount of resources required to perform collision detection between user avatars in a social VR application on cloud server.

Server

- Set up the server.
- Receive sensor data from clients.
- Perform collision detection.
- Monitor the usage of each resource.

Client

- Send data to server: position, orientation and body information.
    - Two or three real users demonstrate the collision effect by keyboard and screen.
    - Lots of artificial users to test the scalibility.
    - Every user has artificial parts with random path, like arms or legs.
- Receive information from server.
    - The information of other users and objects.
    - Collision detection.
- Display

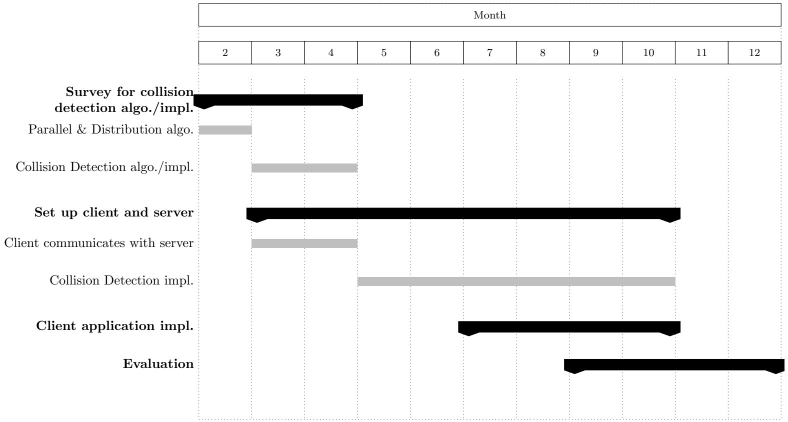
Evaluation

- System scalibility
  - Increase the complexity of bounds on avatars and the number of users in limited resources.
  - Resource management.
- System stability
  - Correctness
  - Time consumed.

Expected Deliverables

- A better collision detection algorithm in parallel and distributed system.
- A resource management system
- A simple application with GUI by Unity 3D.
- Experimental data.
    - eg. resource usage

Gantt Chart


Month
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Survey for collision detection algo./impl.
Parallel & Distribution algo.
Collision Detection algo./impl.
Set up client and server
Client communicates with server
Collision Detection impl.
Client application impl.
Evaluation

Paper

- Perfomance comparison between state-of-the-art point-cloud based collision detection approached on the CPU and GPU
  - from *IFAC-PapersOnline*
- Collision detection between point clouds using an efficient k-d tree implementation
  - from *Advanced Engineering Informatics*
- Real-time KD-Tree construction on graphics hardware
  - from *ACM Advanced Materials Research*
- Self-Customized BSP trees for collision detection
  - from *Computational Geometry*
- Unified GPU voxel collision detection for mobile manipulation planning
  - from *Intelligent Robots and Systems*

Code

- Algorithms in Game Engine Development
- HMD Initialization and Sensor Enumeration Documentation
  - from Oculus.com
- Collision Detection from *jeffThompson on GitHub*
- *JS Game Development - 3D AABB collisions on GitHub*