VR Software and Platform

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Outline

• VR engines
  – Open Source
  – License
• Current VR engine in IIG
• VR software
  – VRPN
  – Middleware
• Kinect and Platform
• Open Source Libraries
VR engines

• A system designed for development of VR scenes
• Provide a software framework that the users use to create interactive scenes / Implement game scenarios
• Typical VR engine includes:
  – 2D/3D graphics
  – Physics engine (collision detection)
  – Sound
  – Scripting
  – Animation
  – Networking
  – etc
VR engines

• Open Source VR engine
  – OpenGL
  – Ogre3D
  – Panda3D
  – OpenSceneGraph
  – Godot Engine
  – Etc.
VR engines

• VR engine with license
  – Unity3D
  – Unreal Engine
  – 3Dvia Studio (Virtools 5.1 last version)
  – Cryengine
  – Worldviz
  – Amazon Lumberyard
  – etc
VR engines

• Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Open-Source VR engine</th>
<th>VR engine with license</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUI (visual development)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Latest features availability (e.g. Geometry Shader)</td>
<td>Fast</td>
<td>Slow (Closed)</td>
</tr>
<tr>
<td>VR adaptation (e.g. HMD)</td>
<td>Libraries</td>
<td>Plug-ins (API)</td>
</tr>
<tr>
<td>Development</td>
<td>Time consuming</td>
<td>Time saving</td>
</tr>
<tr>
<td>Resources</td>
<td>Rich</td>
<td>Limited</td>
</tr>
<tr>
<td>Multi platform development</td>
<td>Not limited</td>
<td>Limited</td>
</tr>
<tr>
<td>External device integration</td>
<td>Not easy (via APIs)</td>
<td>Easy (via Plug-ins)</td>
</tr>
</tbody>
</table>
Our VR engine

• YaQ (Previous engine)
  – Real-time crowd simulation and rendering
  – Multiple domains
    • Video game
    • VR
  – Experiment: provide efficient algorithms to generate crowds up to thousands of varied virtual humans in Virtual Environment (VE)
Current VR engine in IIIG

• Unity3D
  – Interface (GUI)
  – Powerful scripting
  – Multiple platforms supported
  – Features (animation, network sound, physics engine, etc...)
  – Support (forum)
  – Resources (asset store, demos, tutorial samples, etc...)
  – Not expensive and free for education/personal use
Current VR engine in IIG

- **Unity3D - GUI**

Current VR engine in IIG

- **Unity3D** – scripting (C#/Javascript/Python[Boo])
  - Javascript:
    ```javascript
    // Move the object to (0, 0, 0)
    transform.position = Vector3(0, 0, 0);

    // Print the x component of the position to the Console
    print(transform.position.x);
    ```
  - **C#**:
    ```csharp
    using UnityEngine;
    using System.Collections;

    public class example : MonoBehaviour {
        void Example() {
            transform.position = new Vector3(0, 0, 0);
            print(transform.position.x);
        }
    }
    ```
- **Demo**
VR software

• VRPN (Virtual-Reality Peripheral Network)
  – Principle: a network-transparent interface between application programs and the set of physical devices (tracker, etc.) used in a virtual-reality (VR) system
  – Support:
    • Tracker (Logitech 3D mouse, PhaseSpace...)
    • Button device (Razer Hydra, Wii Remote...)
    • Haptic device
    • Analog inputs,
    • Etc.
  – Demo with ‘2D Mouse’ case
VR software

• Middleware/GetReal3D in VR
  – Handles interaction devices like 3D trackers
  – Stereoscopic: active and passive/HMD display
  – Clustering (For CAVE)
  – Provide a programming interface to 3D engine
Kinect and Platform

• Drivers/Libraries
  – OpenNI (Open Natural Interaction) by PrimeSense
    • Voice command recognition
    • Hand gestures
    • Body motion tracking
  – Microsoft Kinect SDK
    • User tracking
    • Skeleton representation
Kinect and Platform

• Application programming interface (API)
  – Microsoft SDK : Windows
    • C++/C#
    • Winform application
  – OpenNI : Cross-platform: Mac OS X, Windows, Linux, Android...
    • Body tracking
    • 3D hands tracking
    • 3D face identification
    • 3D reconstruction
    • etc
Kinect and Platform

- Skeleton data (via FAAST*)
  - Skeleton data over VRPN server
    - Tracker0@ip_address
    - Joints are streamed as sensors

*Flexible Action and Articulated Skeleton Toolkit

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>HIP center</td>
</tr>
<tr>
<td>1</td>
<td>Spine</td>
</tr>
<tr>
<td>2</td>
<td>Shoulder center</td>
</tr>
<tr>
<td>3</td>
<td>Head</td>
</tr>
<tr>
<td>4</td>
<td>Shoulder left</td>
</tr>
<tr>
<td>5</td>
<td>Elbow left</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
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</tbody>
</table>
Kinect and Platform

- Videos/Demo
  - Microsoft Official Application Demo
    - Skeleton tracking
    - Voice recognition
    - Interactive Game
  - FAAST (Kinect VRPN server)
    - Gesture recognition
      - Turn left,
      - left arm across,
      - Jump
      - Crouch
      - Etc..
  - Virtual Event
    - Key Press
    - Key hold
    - Etc...

World of Warcraft with Microsoft Kinect using FAAST and OpenNI @MxR Lab
Institute for Creative Technologies and University of Southern California
Open Source libraries

• openFrameworks
  – Libraries for graphics (OpenGL, GLUT...)
  – Audio input, output and analysis (rtAudio, FMOD...)
  – Image saving and loading
  – OpenCV for computer vision
  – 3D model loading
  – Multiple platform (Win, Mac, Linux, iOS and Aridroid)
Open Source libraries

• Cinder
  – Standalone Mac/PC application
  – Screensavers for Mac/PC
  – Internet I/O
  – C++ core
  – Multitouch
  – Communication API (e.g. Arduino)
  – Video:
    • https://vimeo.com/38756750
Open Source libraries

• Video of Kinect and other libraries/APIs
  – Openframeworks (ArtWork)
    • Interactive starry sky
      – https://vimeo.com/36892768
    • Interactive Puppet Prototype
      – https://vimeo.com/16985224
• Questions?