Background

Gesture sensing video game technologies such as the Nintendo Wii and Xbox Kinect have provided a new area of experimentation for both computer music composers and gamers alike. In some applications of the live composition of computer music, musicians use Wii-motes to create sounds in predetermined ways. Likewise in the gaming community, video games such as Wii-Music allow users to use their Wii-motes to create sounds with on-screen instruments. Yet, users have not been able to create music by designing their own musical environments in 3D space.

Objective

A user will be able to create meta-instruments in 3D space which can produce sounds statically and be provoked by the user through his or her interaction. The user will be able to manipulate meta-instruments to explore a wide variety of timbres. Users may then create music by playing or performing in their 3D Sound Space. The final deliverable will maximize utility for the student, musician, and composer.

System Design

The Microsoft Kinect generates a 3D depth map using infrared structured light. This data is passed into the OpenNi framework where skeletal tracking algorithms generate positional information for nearly 15 joints. Simple OpenNi relays the information to Processing, where visual rendering, audio parameterization, and state machine maintenance is performed. From Processing, OSC messages are sent to SuperCollider, which provides real-time audio synthesis based on synthesizer definitions.

Results

- **3D** The Microsoft Kinect produces a 640x480 depth map which is rendered by Processing. A user may calibrate the OpenNi skeletal tracking system and begin visualizing their skeleton manipulating 3D meta-instruments in digitally rendered 3D space.
- **Interactive** Sphere objects perform FM synthesis based on their location. WAV objects play audio files while rate and pitch modulating values are parameterized based upon location. A sphere object is also activated in Run mode by one-to-one provokation with the hands.
- **Customizable** Sphere and WAV objects produce sounds during movement in space as well as through interaction with the user’s hands while in stats.
- **Multi-user** Student: Principles of FM synthesis as well as pitch and rate modulation can be studied. Musician: Wide timbral variance is achieved with FM Synthesis as well as the ability to play and filter WAV recordings. Composer: Classical audio synthesis techniques are performed in newly interactive ways.

Components

- **Microsoft Kinect**: A XBox gaming platform device which uses infrared light to generate a 3D depth map (among RGB and microphone data)
- **OpenNi**: Provides skeletal tracking middleware and Kinect drivers
- **Simple OpenNi**: Uses OSC to relay joint position data to Processing
- **Processing**: A Java-based programming platform focused on computer graphics. Project use includes visual rendering, audio parameterization, and state machine maintenance
- **SuperCollider**: A programming environment and language which defines and runs audio synthesizers
- **OpenSoundControl (OSC)**: A standard communication protocol used in digital media

Meta-Instruments and Parameterization

- **Sphere**
  - carrier freq multiplier
  - modulation index
  - z: modulation
- **WAV**
  - carrier freq multiplier
  - modulation index
  - rate modulation

Future Work

- Use of extended audio filtering techniques
- Use of parallel and series FM synthesis
- Use of 3D digital display technologies
- Multi-disciplinary educational potential
- Viewing the solar system
- Interacting with molecules to create chemical bonds

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Open Source Software:

- OpenNi, Processing, SuperCollider, Simple OpenNi