3D User Interfaces for Games and Virtual Reality

Lecture #1: Introduction

Spring 2009

Joseph J. LaViola Jr.

Instructor

Professor – **Joseph J. LaViola Jr.**

Email – jjl@cs.ucf.edu

Office Hours – Tues. 4:30pm – 6:30pm

                 Wed. 5:45pm – 6:45pm

Office is Harris 321

Website will have all required info

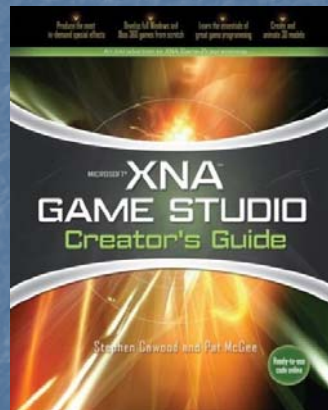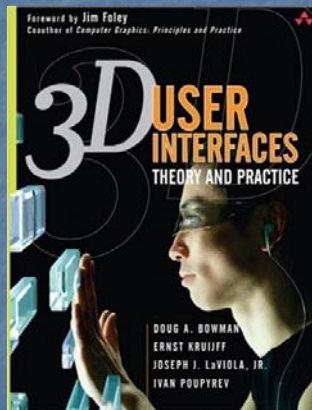www.eecs.ucf.edu/courses/cap6938/spr2009

Class Goals

- Provide in-depth introduction to spatial 3D user interfaces
- Focus on 3D games
- Speaking and presentation skills
- Start of master's projects and PhD dissertations
- Possible publications
  - Virtual Reality 2010
  - 3D User Interfaces 2010
  - Foundations of Digital Games 2010
  - SIGGRAPH Sandbox 2010

Required Books

Grading

Assignment 1 (group)   15%
Assignment 2 (group)   15%
GameUI Paper (individual)   15%
Paper presentation (individual)   5%
Final Project (group)   50%

Final Projects

- 2-3 person teams
- Must have research component
  - related to games
  - innovative 3D UI
- Everyone must write and get approved a project proposal
- Final Project write up required
- DEMO DAY!!!! – May 4, 2009

Class Structure (see syllabus for details)

- Lectures
  - Fundamentals of 3D user interfaces
    - hardware
    - common interaction tasks
    - user evaluation
- Student paper presentation
  - 20 minute presentation
- Final project update sessions
- Work done in ISUE Lab – Harris 208
  - key access required

Course Topics

- XNA Development
- 3D Hardware
  - perception
  - input and output devices
- Common 3D Interaction Tasks
  - travel (e.g., navigation and wayfinding)
  - selection and manipulation
  - system control
- 3D UI Design
- 3D UI Evaluation
- 3D UI and Augmented/Mixed Reality

Collaboration and Late Policy

- Collaboration encouraged
  - do your own work on assignments
  - cheating = BAD!!!
- All assignments must be handed in on time
  - Assignments – by 11:59pm on due date

Tools – Hardware

Wii Sensor Bar

PC with Intel Quad Core processor

3GB RAM

NVIDIA GT8500 GFX Card

Samsung 50" 3D DLP HDTV

TriDef Stereo Emmitter

5.1 Speaker System

Wii controllers

TriDef Shutter Glasses

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Tools – More Hardware

Natural Point Track IR

Wii Balance Board

Novint Falcon

3rd Space Gaming Vest

IZ3D Monitor

Tools – Software

- Visual Studio 2008, C#
- Microsoft XNA 3.0
  - basis of development environment
  - audio support, vector/matrix tools
  - physics engine (external component)
    - Bullet (3D)
  - our version: modified to handle 3D DLP stereo
- **Custom built XNA components**
  - Scenegraph
  - Wii controller API
  - head tracking (TrackIR from Natural Point)
  - content loader
- **Google SketchUp Pro**
  - nice model database

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What are 3D UIs?

- 3D interaction: Human-computer interaction in which the user's tasks are carried out in a 3D spatial context
  - 3D input devices
  - 2D input devices with direct mappings to 3D

- 3D user interface (3D UI): A UI that involves 3D interaction

- 3D interaction technique: A method (hardware and software) allowing a user to accomplish a task in a 3D UI

Why 3D Interfaces?

- 3D applications should be useful
  - immersion
  - natural skills
  - immediacy of visualization
- But, applications in common use have low complexity of interaction
- More complex applications have serious usability problems
- Technology alone is not the solution!

What makes 3D interaction difficult?

- Spatial input
- Lack of constraints
- Lack of standards
- Lack of tools

- Lack of precision
- Fatigue
- Layout more complex
- Perception

Interaction Goals

- Performance
  - efficiency
  - accuracy
  - productivity
- Usability
  - ease of use
  - ease of learning
  - user comfort
- Usefulness
  - interaction helps meet system goals
  - interface relatively transparent so users can focus on tasks

Universal 3D Interaction Tasks

- Navigation
  - travel: motor component
  - wayfinding: cognitive component
- Selection/Picking
- Manipulation
  - specification of object position & orientation
  - specification of scale, shape, other attributes
- System Control
  - changing the system state or interaction mode
  - may be composed of other tasks
- Symbolic Input

3D UI Design Philosophies

- Artistic approach: Base design decisions on
  - intuition about users, tasks, and environments
  - heuristics, metaphors, common Sense
  - aesthetics
  - adaptation/inversion of existing interfaces
- Scientific approach: Base design decisions on
  - formal characterization of users, tasks, and environments
  - quantitative evaluation results
  - performance requirements
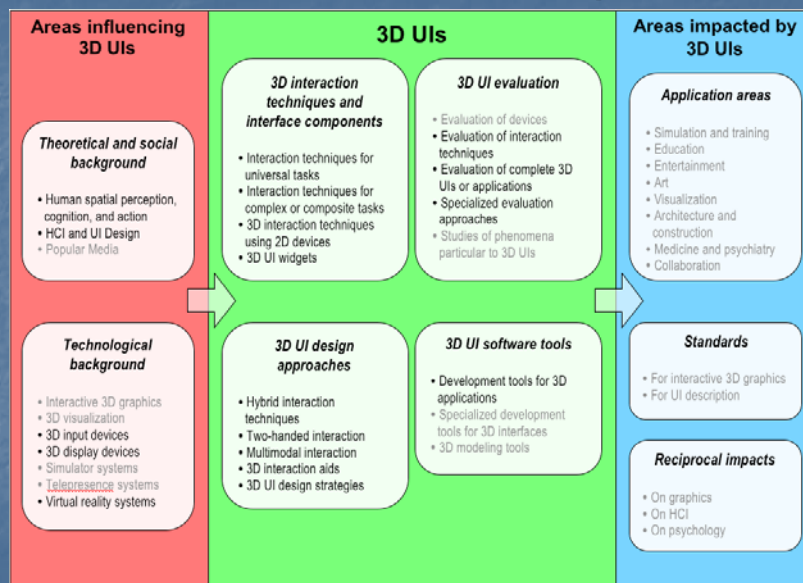 - examples: taxonomies, formal experimentation

Applications

- Architecture / CAD
- Education
- Manufacturing
- Medicine
- Simulation / Training
- Entertainment – *Games!!!*
- Design / Prototyping
- Information / Scientific Visualization
- Collaboration / Communication

3D UI RoadMap

Next Class

- Games and 3DUIs

- Readings
  - Bowman – Chapters 1 and 2
  - Bowman, D., Chen, J., Wingrave, C., Lucas, J., Ray, A., Polys, N., Li, Q., Haciahmetoglu, Y., Kim, J., Kim, S., Boehringer, R., and Ni, T. "New Directions in 3D User Interfaces", *International Journal of Virtual Reality*, vol. 5, no. 2, 2006, pp. 3-14.
  - LaViola, J. "Bringing VR and Spatial 3D Interaction to the Masses through Video Games", *IEEE Computer Graphics and Applications*, 28(5):10-15, September/October 2008.
  - Doug A. Bowman, Sabine Coquillart, Bernd Froehlich, Michitaka Hirose, Yoshifumi Kitamura, Kiyoshi Kiyokawa, Wolfgang Stuerzlinger, "3D User Interfaces: New Directions and Perspectives," *IEEE Computer Graphics and Applications*, vol. 28, no. 6, pp. 20-36, Nov/Dec, 2008

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