3D User Interfaces for Games and Virtual Reality

Lecture #1: Introduction
Spring 2010
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Instructor
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Website will have all required info
www.eecs.ucf.edu/courses/cap6121/spr10
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 2011
  - 3D User Interfaces 2011
  - Foundations of Digital Games 2011
  - SIGGRAPH Sandbox 2011

Required Books

1. "3D User Interfaces: Theory and Practice"
2. "XNA Game Studio: Creator's Guide"
Grading

Assignment 1 (group)  15%
Assignment 2 (group)  15%
Chapter 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 3, 2010
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 (laptops also)
  - 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

- PC with Intel Quad Core processor
- 3GB RAM
- NVIDIA GT8500 GFX Card
- 5.1 Speaker System
- Samsung 50'' 3D DLP HDTV
- Wii Sensor Bar
- TriDef Stereo Emmitter
- Wii controllers
- TriDef Shutter Glasses
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
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 precision
- Lack of constraints
- Fatigue
- Lack of standards
- Layout more complex
- Lack of tools
- Perception
- 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

**Areas Influencing 3D UIs**

- Theoretical and social background
  - Human spatial perception, cognition, and action
  - HCI and UI Design
  - Popular Media

- Technological background
  - Interactive 3D graphics
  - 3D visualization
  - 3D input devices
  - 3D display devices
  - Simulator systems
  - Telepresence systems
  - Virtual reality systems

**3D UIs**

- 2D interaction techniques and interface components
  - Interaction techniques for universal tasks
  - Interaction techniques for complex or composite tasks
  - 3D interaction techniques using 2D displays
  - 3D UI widgets

- 3D UI evaluation
  - Evaluation of devices
  - Evaluation of interaction techniques
  - Evaluation of complete 3D UIs or applications
  - Standardized evaluation approaches
  - Studies of phenomena particular to 3D UIs

- 3D UI design approaches
  - Hybrid interaction techniques
  - Two-handed interaction
  - Multimodal interaction
  - 3D interaction aids
  - 3D UI design strategies

- 3D UI software tools
  - Development tools for 3D applications
  - Specialized development tools for 3D interfaces
  - 3D modeling tools

**Areas impacted by 3D UIs**

- Application areas
  - Simulation and training
  - Education
  - Entertainment
  - Art
  - Visualization
  - Architecture and construction
  - Medicine and psychology
  - Collaboration

- Standards
  - For interactive 3D graphics
  - For other uses

- Reciprocal impacts
  - On graphics
  - On HCI
  - On psychology
Next Class

- Games and 3DUIs
- Readings
  - Bowman - Chapters 1 and 2