3D User Interfaces for Games and Virtual Reality

Lecture #1: Introduction
Spring 2017
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Instructor
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Office Hours - Tues. 4:00pm – 5:30pm
Wed. 6:00pm – 7:00pm
Office is Harris 321

Website will have all required info
www.eecs.ucf.edu/courses/cap6121/spr17
Class Goals

- Provide in-depth introduction to spatial 3D user interfaces
- Focus on 3D games and other apps
- Speaking and presentation skills
- Start of master's projects and PhD dissertations
- Possible publications
  - Virtual Reality 2018
  - 3D User Interfaces 2018
  - CHI PLAY 2017
  - SUI 2017
  - UIST 2017
  - SIGGRAPH Asia 2017

Required Books
Grading

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

Final Projects

■ 2-3 person teams
■ Must have research component
  ■ Does not have to be related to games
  ■ innovative 3D UI
■ Everyone must write and get approved a project proposal
■ DEMO DAY!!!! – May 1, 2017
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
  - ISUE Lab – Harris 208 (laptops also)
  - VR Lab – Barbara Ying Center, Room 119
  - code access required

Course Topics

- Unity 3D
- 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
Tools – More Hardware

- NVIDIA 3D Vision Kit
- Wii Balance Board
- Novint Falcon
- Tobii Eye X
- IZ3D Monitor
- Thalmic Labs Myo

Tools – Even More Hardware

- PlayStation Move
- Wii U
- Xbox 360
- PlayStation 3
- Honda Asimo
- Leap Motion

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Tools - Even More Hardware
Interactive Visualization Wall

Tools - Software

- Visual Studio 2015, C#
- Unity 3D
  - game engine
  - audio support, graphics support
  - physics engine
  - development UI
  - Scripting in C#, Javascript
  - Supports 3D stereo
- Microsoft Research Kinect 2 SDK
- Sony Move.Me
- Razer Hydra API
- Leap Motion API
- Custom Client/Server code
- 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 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
- Robotics

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3D UI RoadMap

**areas influencing 3D UIs**

- Theoretical background
  - HCI and UI design
  - Human spatial perception, cognition, and action
  - Visualization design

- Technological background
  - Interaction, 3D graphics
  - 2D display devices
  - 3D input devices
  - Simulation systems
  - Telepresence systems
  - Virtual reality systems

- Popular media background

**3D UIs**

- 3D interaction techniques and interface components
  - Interaction techniques for manual tasks
  - Interaction techniques for computer and application-specific tasks
  - 3D UI widgets and tools
  - 3D interaction techniques using haptic devices

- 3D UI evaluation
  - Evaluation of devices
  - Evaluation of interaction techniques
  - Evaluation of novel 3D UI software approaches
  - Evaluation of novel 3D UI software approaches

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

**areas impacted by 3D UIs**

- Standards
  - GUI
  - 3D UI description

- Reciprocal impacts
  - OR graphics
  - OR design

- Application areas
  - Design and prototyping
  - 3D design and engineering
  - Virtual reality and simulation
  - Interaction and navigation
  - Simulation
  - HCl
  - Virtual reality analysis
  - Architecture and construction
  - Movies and graphics
  - Evaluation
  - Evaluation
Next Class

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