3D User Interfaces for Games and Virtual Reality

Lecture #1: Introduction
Spring 2016
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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/spr16
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 2017
  - 3D User Interfaces 2017
  - CHI PLAY 2016
  - SUI 2016
  - UIST 2016
  - SIGGRAPH Asia 2016

Required Books

- 3D User Interfaces: Theory and Practice
- Unity 5.x Cookbook
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 2, 2016
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)
  - 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 Kinect
- VR Headset
Tools - Even More Hardware

Spring 2016
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

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
  - Simulation systems
  - Ubiquitous computing
  - Virtual reality systems

3D UIs
- 2D interaction techniques and interface components
  - Interaction techniques for universal tasks
  - Interaction techniques for complex computer tasks
  - 3D interaction techniques using 3D devices
  - 3D UI widgets

3D UI evaluation
- Evaluation of devices
- Evaluation of interaction techniques
- Evaluation of complete 3D UIs or applications
- Generalized evaluation approaches
- Studies of phenomenon pertinent to 3D UIs

3D UI design approaches
- Hybrid interaction techniques
- Two-hand 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 psychiatry
  - Collaboration
- Standards
  - For interactive 3D graphics
  - For UI description
- Reciprocal impacts
  - On graphics
  - On HCI
  - On psychology
Next Class

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