3D User Interfaces for Games and Virtual Reality

Lecture #1: Introduction

Spring 2017

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Instructor

Professor – **Joseph J. LaViola Jr.**

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Office Hours – Tues. 4:00pm – 5:30pm

Wed. 6:00pm – 7:00pm

Office is Harris 321

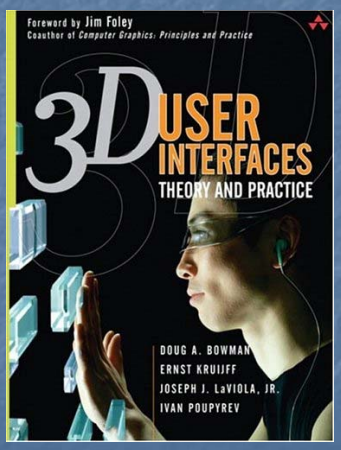
Website will have all required info

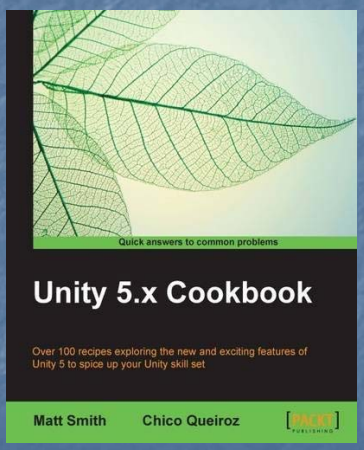
www.eecs.ucf.edu/courses/cap6121/spr17

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

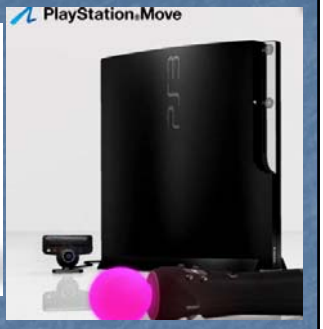
Novint Falcon

Tobii Eye X

IZ3D Monitor

Thalmic Labs Myo

Tools – Even More Hardware



Tools – Even More Hardware

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

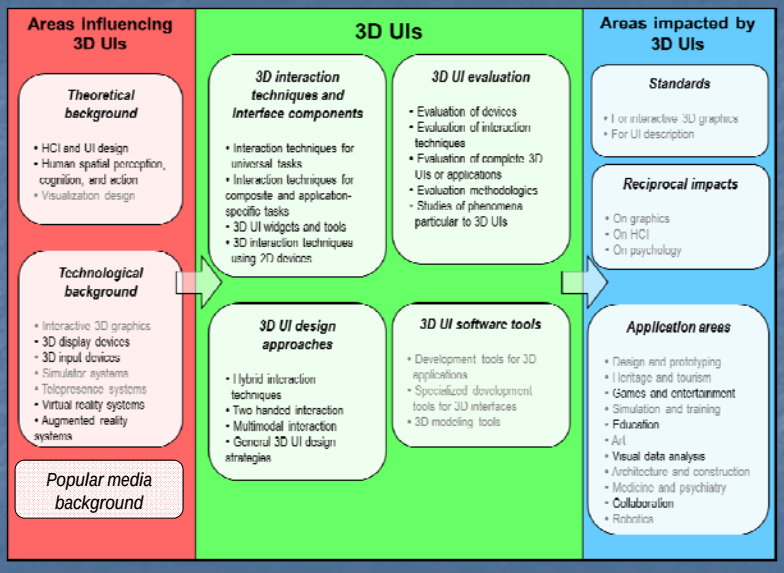
3D UI Design Philosophies

- 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

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