COMS W4172

Introduction

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www.cs.columbia.edu/graphics/courses/csw4172

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Goal

- Learn how to design, develop, and evaluate effective 3D user interfaces
  - Emphasis on Augmented Reality (AR)
What is Augmented Reality?

- Augmenting the real world with computer-generated virtual content (addressing any sense)
  1. Combine real and virtual
     - Much work addresses only visual AR
  2. Interactive in real time
  3. Registered in 3D

Note: The three criteria are part of a definition used by most researchers, first articulated by R. Azuma [Presence, 1997]

- Unlike virtual reality (VR)
  - Supplement rather than replace real world
  - Design virtual world to complement real world

Combining Real and Virtual

- Variations
  - Diminished reality
    - Remove real objects
  - Mediated reality
    - Modify real objects

S. Mann and J. Fung, ISMR 2001

http://civialab.epfl.ch/~lepetit/movies/lepetit_ismr01.mpg
Why Now?

- Commodity devices are finally sufficiently
  - Powerful
  - Small
  - Inexpensive

- Columbia Mobile Augmented Reality System, 1996 –
- Wikitude AR, Layar, Nearest Tube, Aurasma, City Lens..., 2008 –

Why Now?

- Commodity eyewear has started to appear
  - Epson Moverio BT-300
  - Meta 2 dev kit
  - Vuzix Blade
  - Microsoft HoloLens
  - Oculus Rift (opaque VR display)
Why Now?

http://google.com/trends

Approach

- Lectures
- Design, development, and evaluation assignments
  - Unity 2017.3
    - Game development environment
  - PTC Vuforia 7
    - Camera-based 3D position and orientation tracking
  - \( \geq \) Windows 7+ or OS X 10.12+ for development
  - \( \geq \) Android OS 4.4+ or
    - \( \geq \) iOS 9+
    - for deployment
Approach

- Team final projects
  - Interacting with a 16th century “maker’s manual”

The Making and Knowing Project

Intersections of Craft Making and Scientific Knowing

http://www.makingandknowing.org

Approach

- Team final projects
  - Topics and teams proposed by you
**Professor**

- Steve Feiner (feiner@cs.columbia.edu)
  - Director, Computer Graphics and User Interfaces Lab
  - HCI
  - 3D UIs
  - Augmented reality
  - Virtual reality
  - Wearable/mobile computing
  - Hybrid UIs (combining different technologies)
  - Knowledge-based design of graphics/multimedia
  - Games
  - Information visualization
- Office hours: Mon/Wed 1–2pm
  - Schapiro CEPSR 609, 212 939 7083
  - But, most often in Schapiro CEPSR 6LE3, 212 939 7101

**IAs**

- Jen-Shuo Liu (jl5004@columbia.edu)
  - PhD student in Computer Graphics and User Interfaces Lab
  - Office hours: Wed 3:30pm–5:30pm
  - Schapiro CEPSR 6LE3
- Sam Siu (ss4313@columbia.edu)
  - Senior in CS
  - Office hours: Tue 10am–noon
  - Schapiro CEPSR 6LE3
Prereqs

- COMS W4160 (Computer Graphics) or equivalent
  
  or
  
  COMS W4170 (User Interface Design) or equivalent
  
  or
  
  Ask me!

- Math?
  
  ▪ Covered in class

Textbooks


- For this week through 1/23:
  
  LaViola et al. Chaps 1–2
  
  Schmalstieg & Höllerer Chap 1
Grading

- Individual Assignments 60%
  - “Hello interactive 3D world” 10%
  - UI Evaluation 10%
  - Interaction techniques 25%
  - Written 3DUI analysis 15%

- Team project 40%

Lateness Policy

- All assignments due at 1:10pm on scheduled due date
- Four “late days” allowed during semester for which lateness is not penalized
  - None can be used for final project
  - Only one can be used for first assignment
  - Anything turned in past 1:10pm until midnight the next day is one day late
  - Every (partial) day thereafter that an assignment is late (including weekends and holidays) counts as an additional late day
  - Absolutely no late work accepted beyond that accounted for by late days
- If not done on time, turn in whatever you have completed on time to receive partial credit
Academic Honesty Policy

- Department of Computer Science Policies and Procedures Regarding Academic Honesty
  - www.cs.columbia.edu/education/honesty
- All use of GitHub or similar collaborative code dev sites must be done using private repos, open only to appropriate parties
- Videos of your assignments must also be private
- Infractions will be referred to the CUCS Academic Committee and the Deans

Syllabus

- Intro and history
- Design principles (reality, metaphor, magic)
- Case studies
- 3D math
- Development tools
- 3D perception, displays, and devices
- Selection
- Manipulation
- Travel
- Wayfinding
- Control: menus ↔ multimodal
- Symbolic input
- Design issues
  - Two-handed, whole-body, immersion, presence
- Evaluation
- Augmented reality
- Tangible user interfaces
- Future directions
- Guest lectures
Early History

- Flight simulators
  - Mechanical
    - Link Trainer, 1930s
  - Analog video
    - Full-motion cameras “flown” over 3D terrain models/photos
  - Digital
    - NASA space program, 1960s

Sensorama (Mort Heilig, 1962)
- Stereo film
- Audio
- Olfactory
- Haptics

M. Heilig, Designed 1957
www.mortonheilig.com

See an interview and demo:
http://www.youtube.com/watch?v=vSINEBZNCxw
Early History

- Timothy Johnson, Sketchpad III (1963)
  - Built using Ivan Sutherland’s 2D Sketchpad
  - 3D CAD with 2D interaction devices
  - 3D interaction device
  - Tracks 3D position of tip
  - Ultrasonic