Games and 3D User Interfaces: Past, Present, and Future

Lecture #2: Games and 3DUI*
Spring 2010
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*Special thanks to Ivan Poupyrev

3DUI and Video Games – Why?

- Video games
  - multi-billion dollar industry: $10.5 billion in 2005 in US
  - major driving force in home entertainment: average gamer today is 33 years old
  - advanced 3D graphics in HOME rather then universities or movies studios
- Driving force in technological innovation
  - graphics algorithms and hardware, sound, AI, etc.
  - technological transfer to healthcare, biomedical research defence, education (example: Folding@Home)
- Recent innovations in 3D user interfaces
  - graphics is not enough anymore
  - complex spatial, 3D user interfaces are coming to home (example: Nintendo Wii)
- Why 3D user interfaces for games?
  - natural motion and gestures
  - reduce complexity
  - more immersive and engaging
- Research in 3D UI for games is exciting
  - will transfer 3DUI to other practical applications, e.g. education and medicine

3DUI and Video Games – What?

- Goal of 3DUI in games
  - desiging input devices and interaction techniques to effectively control highly dynamic 3D computer generated contentent
  - three are basic approaches
- Mapping 2D input to interact with 3D world
  - keyboard and mouse, joysticks, game controllers
  - traditional form of gaming user interfaces: e.g. Flight Simulator, Second life, Halo 3
- Simulating real world tools or using physicial props
  - simulation: steering wheels, light guns, musical instruments
  - physical props: dance pads
- True spatial tracking of user gestures
  - camera, e.g. Sony Eyetoy
  - acceleration/infrared tracking: Wii controllers

Lecture Outline

- Historical Perspectives
  - early consoles
  - arcades
  - early 3D/VR game interfaces
- 3DUI in the home today
  - new generation of game UI
- The Future of UI in games
  - AR/VR/mobile games
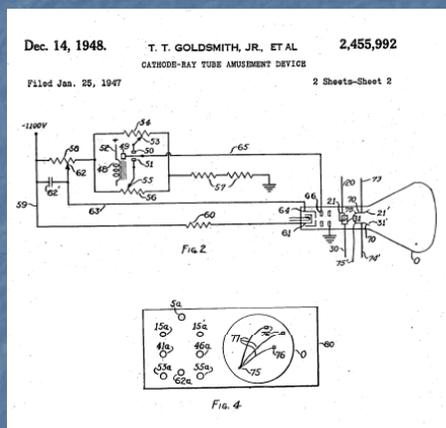 - working towards the future
- Conclusions

Historical Notes on Game UIs

Early Video Games

- 1947: Cathode-ray tube amusement device
  - probably the earliest proposal for electronic gaming device
  - not known if it was implemented
- Proposed interface
  - knobs and buttons

Early Video Games

- **Tennis for two:** Second ever video game:
  - 1958 by William Higinbotham @ Brookhaven National Laboratory
  - display: oscilloscope, Input: dial and a button
  - first ever computer game was invented by Douglas, A. at Cambridge in 1952
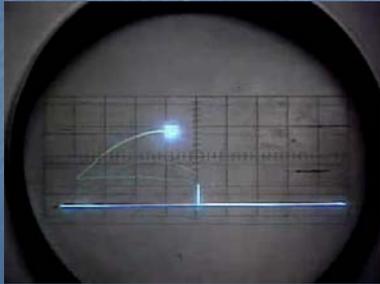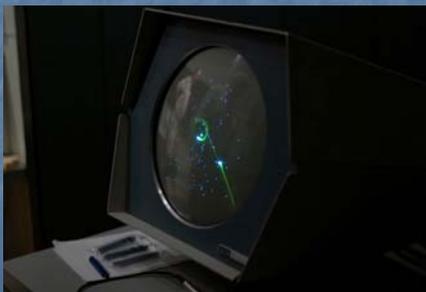

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Early Video Games

- **Spacewar!** first (?) computer game:
  - 1961 by Russell, S., Graetz, M. and Wiitanen, W. at MIT used DEC PDP-1
  - interface: mostly buttons, but also joysticks and light pen

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Early video games

- 1971: "Computer Space" is a first ever arcade game
  - Spacewar! clone created by Nolan Bushnell
  - interface is mostly buttons
  - has not become very popular since
    its rules were too complex

COMPUTER SPACE

NA-2010

Early Video Games

- 1972: Magnavox "Odyssey" is a first ever home game console
  - invented by Ralph Baer
  - could play Ping-Pong game
  - collaborative: two people
  - first game controllers: button and dials: 1D
  - battery operated
- 1975: Atari creates Pong for home and arcades
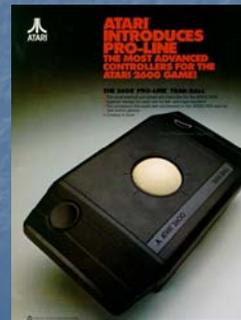 - game industry is born

Early Video Games

- 1977: Atari 2600 console
  - cartridge based system, i.e. allows to change software
  - 2D controllers: Joystick as well as peripherals devices, i.e. trackball
  - introduce quality sound hardware: still popular today

Early Video Games

- 1978: Magnavox Odyssey^2
  - includes full-sized keyboard
  - used for educational software and programming
  - first home electronics device with speech synthesis

Modern Consoles

- 1983: Nintendo Famicon
  - modern controller layout: controls for both hands, directional buttons
  - increasingly complex controllers and interfaces: games are still 2D, but interaction is becoming more complex and rich.
- 1994: Nintendo 64
  - first "true" 3D console
  - adds joystick to controller, game pad gets more controls

Modern Consoles

- 1996: Sony dual-shock controller
  - adds second joystick and shoulder buttons
  - standard controller for PS, PS2, PS3

- Some observations
  - gradually increasing complexity of game interfaces to allow more expression in games;
  - difficult to master
  - focuses more and more on "hard-core" gamers;
    casual gamers often find games difficult
  - similar situation was in early arcades games

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Arcade Games

- Arcade games:
- "Easy to learn, but difficult to master"
    - has to be learned <u>immediately</u>
    - can not have complex interfaces
    - specialized interfaces for particular games
    - many innovative and original interfaces
    - often based on simulation activities
        - shooting, driving, snowboarding, fishing, sliding etc.
    - many innovative and original interfaces has been developed: 3D, haptic response, realistic.

www.afterpicture.com

Arcade Games

- Video Arcades began in the mid 1970s
- (2D games only)
    - Pong
    - Breakout
    - Space Invaders
- First game with 3D graphics – Battlezone (1980)
    - vector graphics
    - very simple interaction
        - move and rotate on 2D plane
        - used two joysticks

Arcade Games – UI Innovation

BeachHead   Football Power   Aliens Extermination

Arcade Games – UI Innovation

Manx TT   Dance Dance Revolution

Virtual Reality Arcade Games

- **Arcades were first to introduce Virtual Reality and 3DUI in games**
  - head/body tracking
  - stereoscopic vision
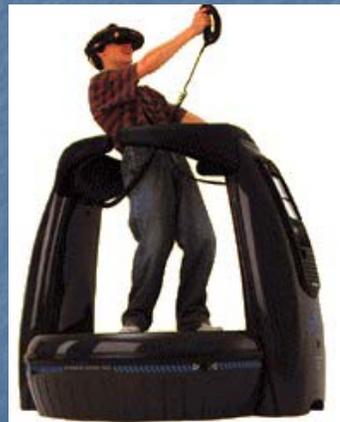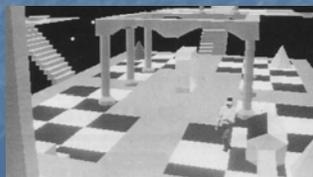 - immersive displays
  - 3D spatial interaction

Virtual Reality Arcade Games

- **Dactyl Nightmare: one of the first VR games**
  - part of several other VR games: Legend Quest, Hero, Grid Busters
  - 1-4 players
  - basic shoot-em-up game
- **Developed by W Industries/Virtuality in early 1990s**
  - system sold as the 1000CS
  - used Amiga 3000 computer
  - HMD with tracked 3D joystick

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Virtual Reality Arcade Games

- VR entertainment centers
  - multi-user combat simulation in BattleTech universe
  - fighting robots
  - first opened in 1990
  - provided an immersive experience
  - very little in the way of 3D user interface
- Can still play in Houston, Texas
  - MechCorps (www.mechcorps.com)

Virtual Reality Arcade Games

- DisneyQuest: Indoor interactive theme park (opened in 1998)
- Several VR games
  - Pirates of the Caribbean: Battle for Buccaneer's Gold
    - uses motion platform, shoot cannons, navigate with steering wheel
    - surround screen display, users wear stereo glasses
  - Virtual Jungle Cruise
    - users sit in raft, steer and paddle
  - Aladdin's Magic Carpet Ride
    - users wear HMD, sit on motorcycle-like device to steer

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3D and VR on Game Consoles

- Several attempts to introduce 3D/VR
- for game consoles
  - Nintendo U Force
  - Mattel Power glove
  - Sega 3D glasses
  - Nintendo Virtual Boy
  - Not successful
    - low quality, did not work well
    - not really necessary since games were simple enough
    - considered to be a gimmick

3D and VR on Game Consoles

- 1986: Sega Master System
  - 3D glasses
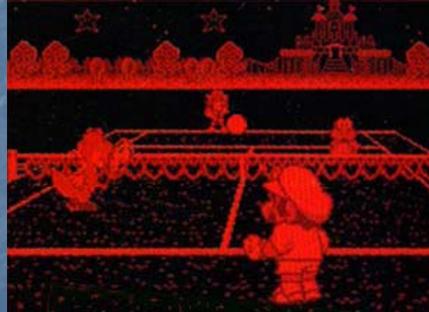 - used active LCD shutters
  - few games were supported

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3D and VR on Game Consoles

- 1995: Nintendo Virtual Boy
  - Virtual reality goggles, monochrome, stereo

Some Conclusions From History

- Games complexity increases
  - 1970: Pong
  - 1980: Donkey Kong
  - 2000: Halo
  - interaction complexity increases
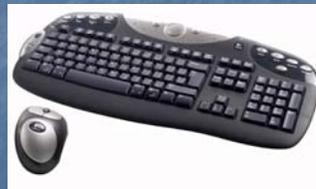
Some Conclusions From History

- The complexity of controllers increased
  - use same interface components as in 60s
    - Buttons
    - Joysticks
    - Keyboard / mouse
  - combined together / increased number
  - more difficult to learn and master
  - less accessible to casual user
- 3D spatial controllers / 3DUI
  - very successful in arcades
  - failed in home devices
  - inaccurate/low quality

3DUI in the Home Today

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3DUI in the Home Today

- Revival and rapid growth of 3D spatial interfaces for games today
  - cheaper and higher quality of sensors
  - fast game hardware can perform complex tracking/recognition
  - need for simpler and more intuitive interaction with games
  - games has become mainstream culture, more casual not only hard-core gamers
- The first 3D UIs in people hands
  - often based on previous research results and ideas
  - simplified for price

3DUI in the Home Today

- 2003: Sony PS2 Eye Toy
  - video camera interface for PS2
  - casual/party games
  - significant success in Europe/US
  - based on several decades of research on visual tracking in robotics and computer vision
  - developed by Richard Marks

3DUI in the Home Today

- Nintendo Wii
  - latest game console from Nintendo
- Key innovation – Wiimote controller
  - provides 3D UI in the home
- Makes games accessible to casual users
  - Great competitive edge over Xbox 360 / PS3

3DUI in the Home Today

- Wiimote features
  - uses Bluetooth for communication
  - senses acceleration along 3 axes
  - optical sensor for pointing (uses sensor bar)
  - provides audio and rumble feedback
  - standard buttons and trigger
  - uses 2 AA batteries
- Supports two handed interaction
  - can use 2 Wiimotes simultaneously
- Easily expandable

3DUI in the Home Today

Nunchuk   Steering Wheel   Zapper

Wii Helm   Boxing Gloves   Sports Pack   Fishing Reel

3DUI in the Home Today

- PS3 AR Game / Eye of Judgement
  - first 3D AR games on the market
  - 3D interaction and manipulation of 3D graphics images possible
  - based on Cybercode: technology for tracking 2D square markers
  - invented in 1990s at Sony CSL

3DUI in the Home Today

- DLP – digital light projection
  - developed by Texas Instruments
- 3D DLP HDTV
  - high resolution 1920x1080
  - high definition 1080p
  - no special graphics card needed
  - runs at 120Hz (60 Hz each eye)
  - requires shutter glasses
  - 3D stereoscopic content sent to TV v
    DVI or HDMI port
  - available on Mitsubishi TVs
- Play games in 3D
  - DVDs as well
- 3D LCD TV on the way this year

3DUI in the Home Today

- Some observations/conclusions
  - renaissance of 3D / spatial user interfaces in gaming
  - for the first time very successful with public
  - attracts casual gamers
  - allows for easier introduction of new 3D user interfaces in the future
  - still very simplistic when compared with 3DUI developed in research labs
  - great possibilities for the future growth!

3DUI in the Home – On the Horizon

TrueMotion from Sixense

GameTrak Freedom from PDP

Microsoft Project Natal

Future of Game UI

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Future of 3DUI in Gaming

- **What are the technologies that will influence future game 3DUIs?**
    1. Transfer the body of VR research into games
    2. Development of complex Augmented Reality games
    3. Outdoor games with complex 3DUI
    4. Mobile 3D games
- **Some examples follow**

Toshiba Bubble Helmet (360 degree view)

Future of Gaming: VR

- **Port of Quake II to the CAVE**
    - developed by Paul Rajlich (NCSA)
    - fully immersive experience
    - uses 6DOF wand as gun proxy
    - head tracking allows for peering around walls
    - players can physically jump and duck
- **Quake III Area ported to CAVE as well**

Future of Gaming: VR

- SwordPlay: explore what 3D UIs are appropriate in gaming
  - developed as part of course in "Innovating Game developement" (Brown U. 2006)
  - user has sword and shield/bow and arrow
  - uses Mine's Over-the-Shoulder deletion technique to invoke bow and arrow
  - user can draw spells in 3D with sword

http://www.cs.brown.edu/courses/cs196-2/groups/swordplay/

Future of Gaming: AR

- AquaGuantlet
  - developed at Mixed Reality Systems Laboratory, Japan (Tamura et al. 2001)
  - collaborative AR environment
  - players wear see-through HMDs
  - shoot creatures superimposed into real scene
  - guns have vibration feedback

www.jello.net

Future of Gaming: AR

- Markerless AR technology
  - tracking natural features (SLAM techniques)
  - no visual markers: works in any unprepared environment
  - future of AR gaming

Future of Gaming: Outdoor Games

- AR Quake where monsters are superimposed into real world (i.e., Quake in the physical world)
  - developed by Thomas, Piekarski et al. in 2000 (South Australia)
  - can walk around in both indoor and outdoor environments
  - equipment is somewhat cumbersome
    - getting smaller and cheaper

Future of Gaming: Mobile Games

- **Today mobile gaming platforms**
  - PSP and Nintendo DS
  - interaction is still 2D
- **Future mobile platform**
  - true spatial interaction
  - location-based interaction
  - AR tracking and interaction

Moving Towards the Future of 3DUI and Games

- **Body of knowledge on 3D user interfaces**
  - interaction technique
  - interaction metaphors and styles
  - input devices
  - usability studies
- **Want to transfer to the video game domain**
  - reduce interaction complexity
  - provide more realistic experiences
  - exercise!!!

Conclusions

- 3D UI for games is important and interesting research area
- Its real and possible to create new user interface culture
- Transfer to other areas of everyday human activity
- You can start developing 3D game user interfaces yourself

Next Class

- The Wiimote and You
- XNA Bootcamp begins
- Readings
  - start reading XNA Game Studio Creator's Guide (Cawood and McGee)