Today’s lecture

- Goals of Today’s Lecture:
  - What is a User Interface (UI)?
  - What is the difference between 3D graphics and 2D graphics?
  - History of Video Games and Interfaces
  - Different types of Output:
    - 2D vs 3D vs Virtual Reality vs Augmented Reality
  - What is a 3D UI?
What is a User Interface?

- Where the interaction between humans and machines occurs.
  - User interface refers to the parts of a computer and its software that you (the user) see, hear, touch, or talk to.
  - Input – allowing the users to manipulate a system.
  - Output – allowing the system to indicate the effects of the input.

- For example, if I use a mouse to point and click, or I speak instructions to the computer those are input. And the output is what I see displayed on the screen or what I hear coming out of the speakers.
User Interfaces
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User Interfaces
2D vs 3D
2D vs 3D Graphics

3D Graphics
- Use a 3-dimensional representation of geometric data, that is rendered as a 2D image to the screen.
  - Same as how a movie is rendered as a 2D image is a recording of a 3D world.
  - 3D graphics often use 3D models which is the geometrical representation of any 3-dimensional object.

2D Graphics
- Displaying digital images to the screen.
  - As an array of pixels.
Why Video Games?

- Why do you want to learn about video games?

  Video Games
  - Multi-billion dollar industry: $18.5 billion in 2010 in US alone.
  - Major driving force in home entertainment.

- Driving force in technological innovation
  - Graphics algorithms, hardware, sound, AI, etc. can be applied to other fields.
  - Technological transfer to healthcare, biomedical research, defense, and education.
Does anyone know when the first video game was invented?

1947: Cathode-ray tube amusement device.
- Earliest proposal for an electronic gaming device.
- The interface consisted of knobs and buttons.
- Based on WWII radar displays, players use knobs to adjust the trajectory of light beams (missiles) in an attempt to hit targets.
- Nobody knows if it was actually implemented, but the idea was patented.
Early Video Games

- **Tennis for two: Original video game:**
  - 1958
  - Display: oscilloscope – graph that shows a change in voltages.
  - Input: dial and a button
  - [http://www.youtube.com/watch?v=6PG2mdU_i8k&feature=youtube_gdata_player](http://www.youtube.com/watch?v=6PG2mdU_i8k&feature=youtube_gdata_player)
Early Video Games

- **Spacewar! First computer game:**
  - 1961: by Russel, Graetz, and Wiitanen at MIT.
  - Interface: mostly buttons, but also joysticks and light pen.
  - 2 armed spaceships attempt to shoot one another while maneuvering in the gravity well of a star.
Early Video Games

- 1972: Magnavox “Odyssey” is a first ever home game console.
  - Could play Ping-Pong with 2 people.
  - Buttons and dials, 1D.
- 1975: Atari creates Pong for home and arcades.
  - Game industry is born.

http://www.youtube.com/watch?v=H2Elsnr_cv4&feature=related
Early Video Games

- 1977: Atari 2600 console
  - Cartridge based system, so you could change games.
  - 2D controllers – joystick and a trackball.
  - Introduce quality sound hardware, which is still popular today.
Early Video Games

- 1978: Magnavox Odyssey2
  - Includes full-sized keyboard.
  - Used for educational software and programming.
  - First home electronics device with speech synthesis.
Modern Consoles

- **1983: Nintendo Famicom**
  - Modern controller layout: controls for both hands, directional buttons.
  - Increasingly complex controllers and interfaces: games are still 2D, but interaction is 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.

**Observations**

- Increased complexity of game interface allows for more expression in games.
- Difficult to master
- Focuses more and more on “hard-core” games, since casual gamers often find games more difficult.
Arcade Games

- “Easy to learn, but difficult to master”
  - Has to be learned immediately.
  - Interface can’t be too complex.
- Began in the mid 1970’s
- Specialized interfaces
  - Often based on simulation activities:
    - Shooting, driving, snowboarding.
  - Many innovative and original interfaces...
Arcade Games – UI Innovation
Arcade Games UI Innovation

Manx TT

Dance Dance Revolution
Virtual Reality Arcade Games

- Arcades were first to introduce VR and 3DUI in games (1990’s)
  - Head/body tracking
  - Stereoscopic vision
  - Immersive displays
  - 3D spatial interaction

- In a virtual reality environment, a user experiences **immersion**, or the feeling of being inside and a part of that world.
  - The user is able to **interact** with his/her environment in meaningful ways.
  - The combination of a sense of immersion and interactivity is called **telepresence**.

- An effective VR experience causes you to become unaware of your real surroundings and focus on your existence inside the virtual environment.
Virtual Reality Arcade Games

- Disney Quest: Indoor interactive theme park (opened 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 Head Mounted Display (HMD), sit on motorcycle-like device to steer.
3D and VR on Game Consoles

Several attempts to introduce 3D/VR for game consoles.

1986: Sega Master System
- 3D glasses, LCD shutters, few games.

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

Not successful
- Low quality, didn’t work well.
- Not necessary since games were so simple.
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 the 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.
3D User Interfaces - Today
3DUI – What?

- Goal of 3DUI in games
  - Designing input devices and interaction techniques to effectively control highly dynamic 3D content.

- 3 basic approaches:
  - **Mapping 2D input to interact with 3D world**
    - Keyboard and mouse, joysticks, game controllers.
    - Ex. Flight Simulator, Second Life, Halo 3
  - **Simulating real world tools or using physical props**
    - Simulation: steering wheels, light guns, musical instruments.
    - Physical props: dance pads.
  - **True spatial tracking of user gestures**
    - Camera, ex. Sony Eyetoy, Microsoft Kinect.
    - Acceleration/infrared tracking: Wii controllers.
3DUI in the Home Today

- 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.
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.
3DUI in the Home Today

- **Nintendo Wii - 2006**
  - 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

Nunchuk

Steering Wheel

Zapper

Wii Helm

Boxing Gloves

Sports Pack

Fishing Reel
Spatial UIs in the Home Today

- Microsoft Kinect - 2010
  - RGB camera
  - Depth Sensor
  - Microphone
Nintendo 3ds with Augmented Reality

- [http://www.youtube.com/watch?v=NicuHL0r5ak](http://www.youtube.com/watch?v=NicuHL0r5ak)
- Released 2011
53 years from the first video game in 1958 to 2011.


2006 – 2011, 5 years of development in spatial tracking of user gestures.
3DUI in the Home Today

Conclusions:
- New wave in video games with 3D / spatial user interfaces.
- Attracts casual gamers
User Interfaces in Video Games

- **Types of User Interfaces**
  - Keyboard and mouse – control a Graphical User Interface (GUI).
  - Console controller (XBOX, PlayStation)
  - Nintendo Wii – wiimote, balance board.
  - Arcade games, specialized UIs, Dance Dance Revolution.
  - Microsoft Kinect – webcam using gestures or spoken commands.