

2D Interaction in a 3D World

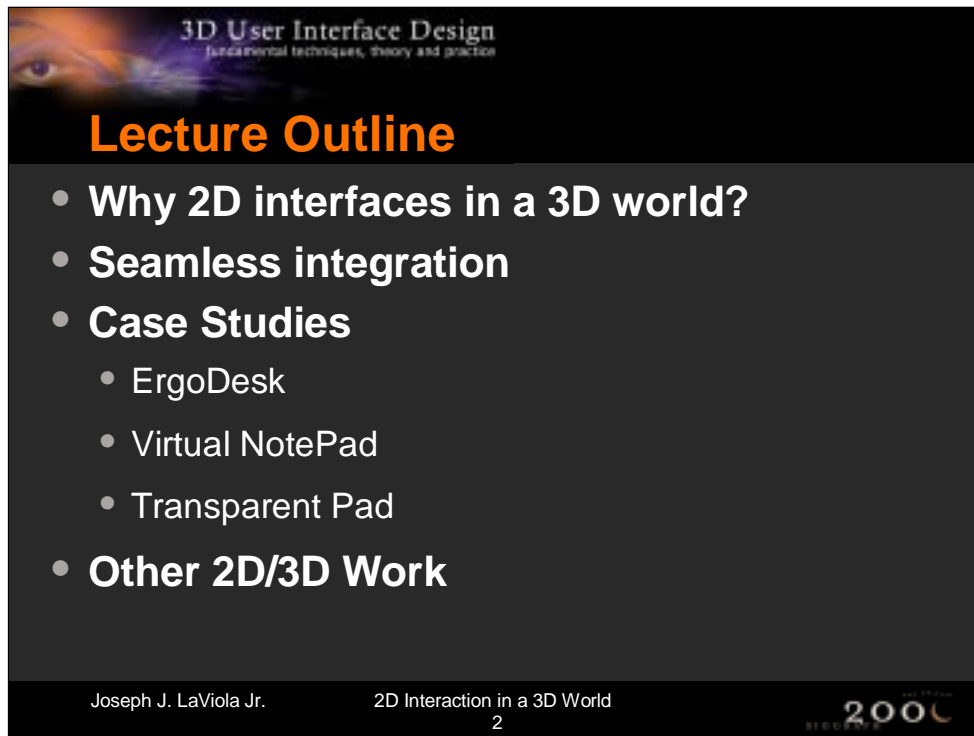
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A presentation slide with a dark background. At the top left, there is a graphic of a human eye. The text '3D User Interface Design' is at the top center, with 'fundamental techniques, theory and practice' below it. The main title 'Lecture Outline' is in large orange font. Below it is a bulleted list of topics. At the bottom, there is a footer with the author's name, the title of the lecture, and a logo for the University of Central Florida (UCF) with the year 2008.

3D User Interface Design
fundamental techniques, theory and practice

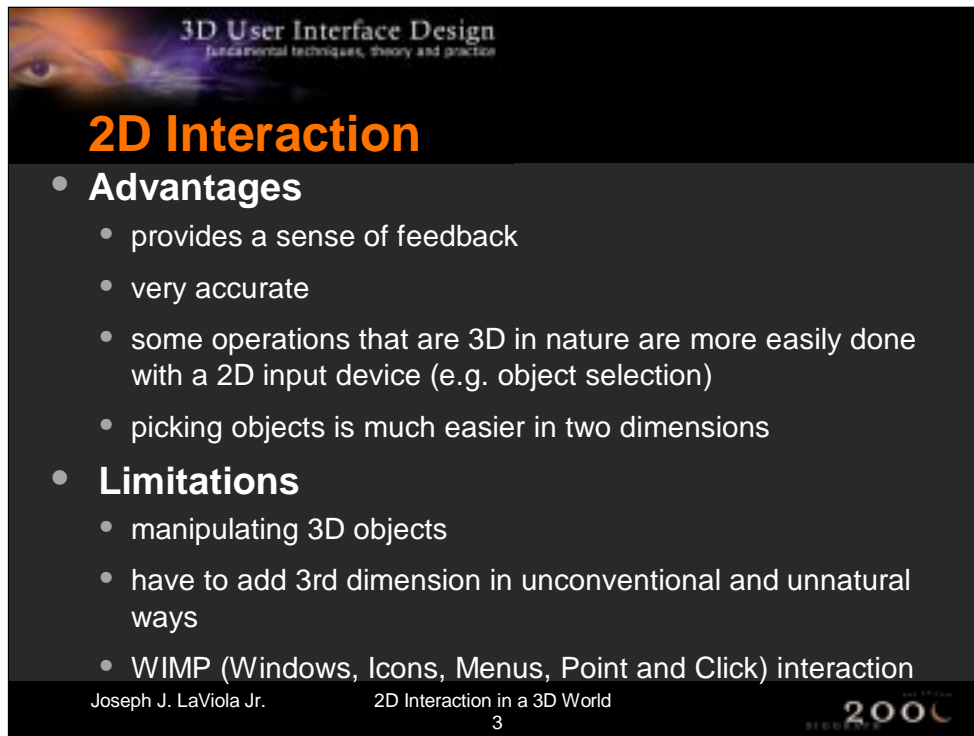
Lecture Outline

- **Why 2D interfaces in a 3D world?**
- **Seamless integration**
- **Case Studies**
 - ErgoDesk
 - Virtual NotePad
 - Transparent Pad
- **Other 2D/3D Work**

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UCF 2008

In this lecture, we will discuss how and when 2D interfaces can be used in 3D applications.

A presentation slide titled "3D User Interface Design" with the subtitle "fundamental techniques, theory and practice". The slide features a dark background with a glowing eye graphic in the top left. The main title "2D Interaction" is in large orange font. Below it, there are two main sections: "Advantages" and "Limitations", each with a list of bullet points. At the bottom, there is a footer with the author's name "Joseph J. LaViola Jr.", the title "2D Interaction in a 3D World", the page number "3", and a "2000" logo.

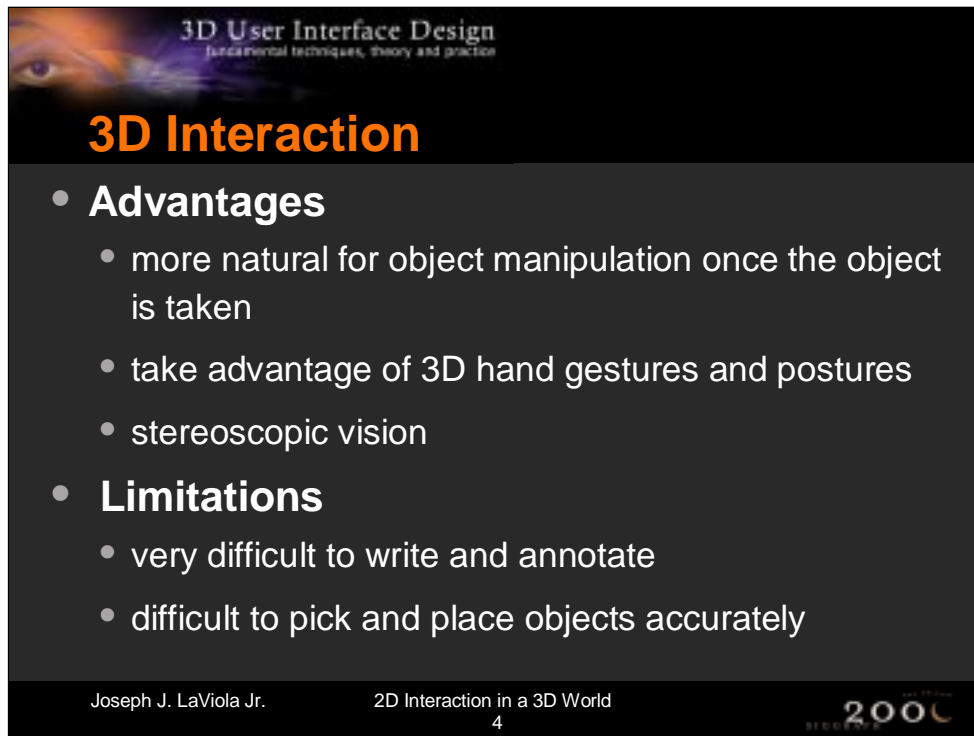
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2D Interaction

- **Advantages**
 - provides a sense of feedback
 - very accurate
 - some operations that are 3D in nature are more easily done with a 2D input device (e.g. object selection)
 - picking objects is much easier in two dimensions
- **Limitations**
 - manipulating 3D objects
 - have to add 3rd dimension in unconventional and unnatural ways
 - WIMP (Windows, Icons, Menus, Point and Click) interaction

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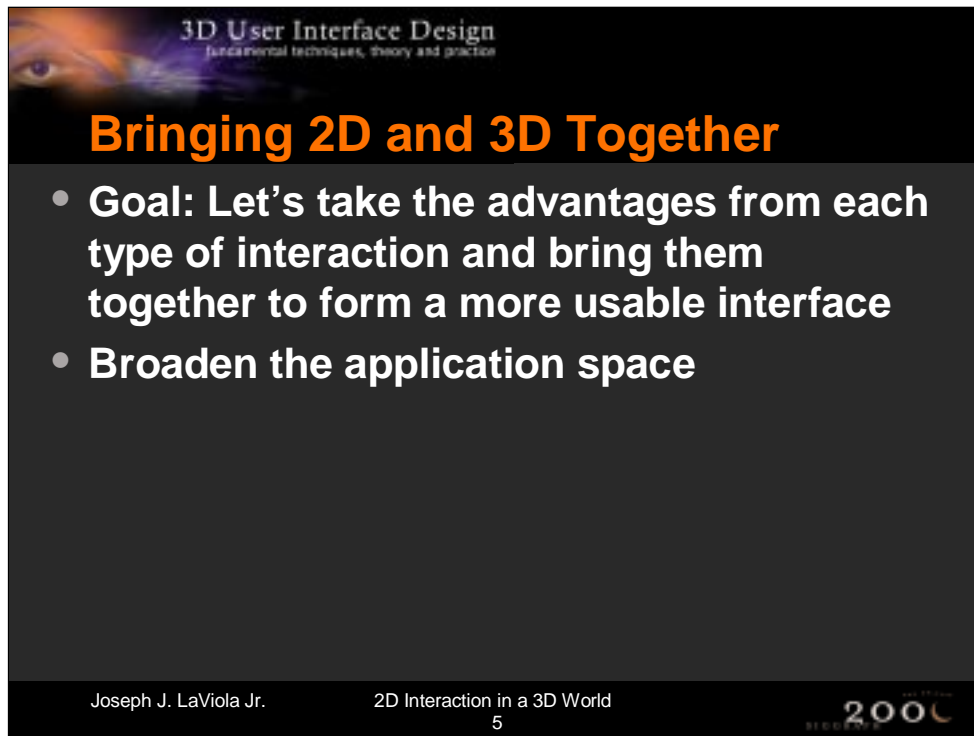
2D interaction techniques have both advantages and disadvantages as shown in the slide.

A presentation slide with a dark background. At the top left, there is a graphic of a human eye. The title '3D User Interface Design' is at the top center, with the subtitle 'fundamental techniques, theory and practice' below it. The main heading '3D Interaction' is in large orange font. Below it are two main sections: 'Advantages' and 'Limitations', each with a list of bullet points. At the bottom, there is a footer with the author's name, the slide title, and a logo for '2000'.

3D Interaction

- **Advantages**
 - more natural for object manipulation once the object is taken
 - take advantage of 3D hand gestures and postures
 - stereoscopic vision
- **Limitations**
 - very difficult to write and annotate
 - difficult to pick and place objects accurately

3D interaction techniques have both advantages and disadvantages as shown in the slide.



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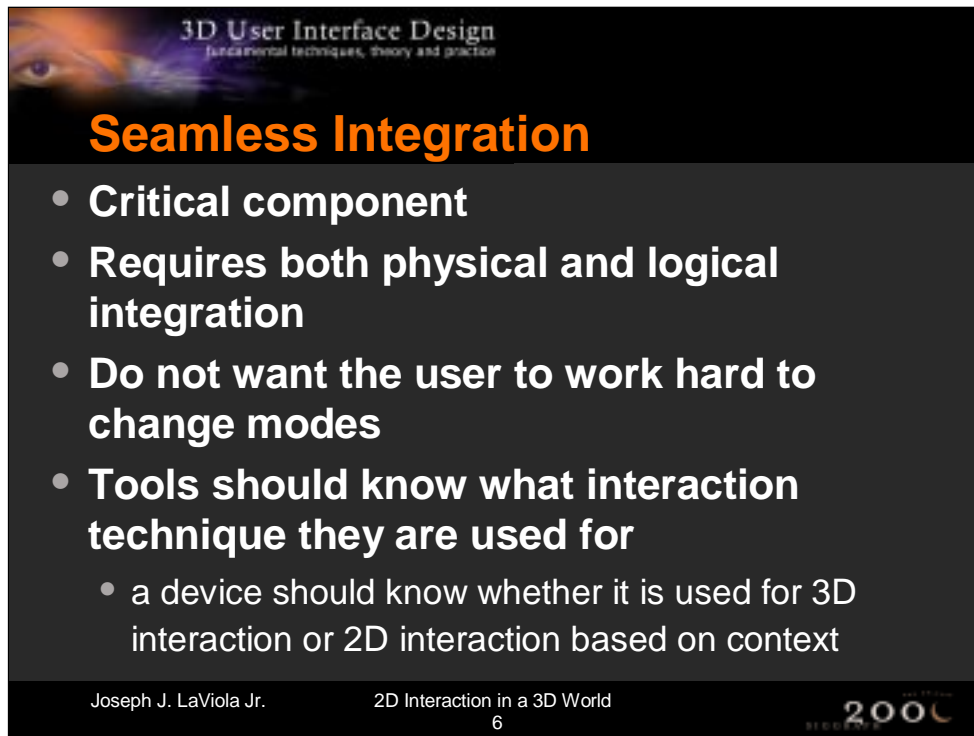
Bringing 2D and 3D Together

- **Goal: Let's take the advantages from each type of interaction and bring them together to form a more usable interface**
- **Broaden the application space**

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By taking advantage of the benefits of both 2D and 3D interaction techniques and metaphors, we can create interfaces for 3D applications that are easier to use and more intuitive for the user. The key research issue is how to combine these two input styles in a seamless manner and to determine whether a particular task is better suited for either 2D or 3D interaction so we can maximize user performance.

A presentation slide with a dark background. At the top left, there is a graphic of a human eye. The title '3D User Interface Design' is in white, with the subtitle 'fundamental techniques, theory and practice' below it. The main heading 'Seamless Integration' is in large orange font. Below it is a bulleted list of four points in white text. At the bottom, there is a footer with the author's name, the course title, and a logo for '200C'.

Seamless Integration

- **Critical component**
- **Requires both physical and logical integration**
- **Do not want the user to work hard to change modes**
- **Tools should know what interaction technique they are used for**
 - a device should know whether it is used for 3D interaction or 2D interaction based on context

The seamless integration of the 2D and 3D interface techniques in a 3D application is a critical design consideration from both a logical and a physical perspective. Physical integration is important because we do not want to make it difficult for the user to switch between 2D and 3D devices. Logical integration is also important because we want the devices used in the application to know whether they are used for either 2D or 3D interaction. This knowledge helps to reduce the user's cognitive load.

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Case Study: ErgoDesk

- 3D modeling application
- 2D interaction on display surface
- Based on Sketch
- Allows users to create, edit, view and manipulate 3D models
- VIDEO



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ErgoDesk is an example of a 2D/3D interface where the user interacts in 2D directly on the display surface. The 2D component of the ErgoDesk application is based on the Sketch conceptual modeling system which uses only a three button stylus (no menus or 2D interface widgets are used). Sketch interprets lines drawn by the user on the image plane of a 3D view as operations and parameters. These operations include primitive creation, primitive manipulation, and camera manipulation. Gestures that create primitives provide enough information to select which primitive to create, its dimensions and its place in 3D. Creating a cube, for example, requires the user to draw 3 gesture lines one for each of the principle axes, each line meeting at a single point. The cube is generated with its length, width, and height corresponding to the three gesture lines and its place in 3D based on the intersection point. Primitives such as cylinders, cones, pyramids, and extrusions can also be instantiated. The primitive manipulation interface allows for automatic object constraint by gesturally drawing a motion constraint over the object before manipulating it. For example, to constrain an object's movement to a given axis, a straight line is drawn indicating what axis to constrain the object to, and when the user moves the object it will only move along that axis. Other gestures constrain objects to move along surfaces, rotate around a given principle axis, or scale and deform to fit a new gesture contour.

References:

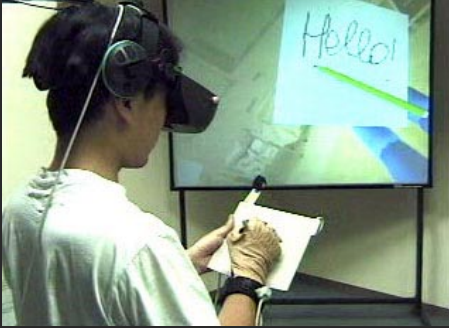
Forsberg, A., LaViola J., and Zeleznik, R. "ErgoDesk: A Framework For Two and Three Dimensional Interaction at the ActiveDesk." In the Proceedings of the Second International Immersive Projection Technology Workshop, Ames, Iowa, May 11-12, 1998.

Zeleznik, R.C., Herndon, K., Hughes, J. (1996) "Sketch: An Interface for Sketching 3D Scenes." Proceedings of SIGGRAPH'96, 163-170.

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Case Study: Virtual Notepad

- Tool for writing in immersive environments
- Allows users to take notes and annotate documents
- VIDEO



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The Virtual Notepad is an example of a 2D/3D interface where users cannot physically see the 2D device since they are wearing an HMD. The 2D device is tracked so a graphical representation of it is present in the virtual environment.

References:

Poupyrev, I., Tomokazu, N., Weghorst, S., "Virtual Notepad: Handwriting in Immersive VR". IEEE VRAIS'98, 126-132, 1998.

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Case Study: Transparent Pad

- **Transparent prop for the Virtual Table**
 - tool and object palette
 - window tools
 - through-the-plane tool
 - volumetric manipulation
- **VIDEO**



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The Transparent Pad is an example of a 2D/3D interface where a transparent prop is used for 2D interaction. The pad is tracked and graphics are projected on the primary display but appear as if they are on the surface and even above the pad.

References:

Schmalstieg, Dieter, L. Miguel Encarnacao, Zsolt Szalavari. "Using Transparent Props For Interaction with The Virtual Table.", In Proceedings of the 1999 ACM Symposium on Interactive 3D Graphics, 147-154, 1999.

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Other 2D/3D Work

- **PDA's in Immersive VEs**
 - Watsen used PalmPilot in a CAVE-like device [IPT99]
 - provides camera, environment, and geometry controls
- **Transparent Props**
 - Coquillart's Virtual Palette and Virtual Control Panel [VR99]
 - used with Responsive Workbench
- **Wacom Tablet in the TAN-Cube**

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This slide shows other work that has been done with 2D/3D interfaces.

References:

Watsen, Kent, Rudy Darken, and Michael Capps. "A Handheld Computer as an Interaction Device to a Virtual Environment." Proceedings of the Immersive Projection Technology Workshop, Stuttgart, Germany, May 1999.

Coquillart, S. and G. Wesche. "The Virtual Palette and the Virtual Remote Control Panel: A Device and Interaction Paradigm for the Responsive Workbench." IEEE VR'99, 213-217, 1999.

Guidelines

- *Seamless integration of 2D and 3D components is essential*
- *Make the tools that the user needs intelligent*
- *Think about how people interact in the real world and apply it to interface design*
- *Many more avenues to explore*
- *Important to find lightweight solutions when using hand-held devices*