

# CHAPTER 7: Direct Manipulation and Immersive Environments

*Designing the User Interface:  
Strategies for Effective Human-Computer Interaction*

*Sixth Edition*

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# **Direct Manipulation and Immersive Environments**

## **Topics**

- 1. Introduction**
- 2. What is Direct Manipulation?**
- 3. Some examples of Direct Manipulation**
- 4. 2D and 3D Interfaces**
- 5. Teleoperation and Presence**
- 6. Augmented and Virtual Reality**

# Introduction

- Positive feelings associated with good user interfaces ☺
  - Mastery of the interface
  - Competence in performing tasks
  - Ease in learning the system originally and in assimilating advanced features
  - Confidence in the capacity to retain mastery over time
  - Enjoyment in using the system
  - Eagerness to show the system off to novices
  - Desire to explore more powerful aspects of the system

# Principles of Direct Manipulation

1. Continuous representations of the objects and actions of interest with meaningful visual metaphors.
2. Physical actions or presses of labeled buttons, instead of complex syntax.
3. Rapid, incremental, reversible actions whose effects on the objects of interest are visible immediately.

# Attributes of Direct Manipulation

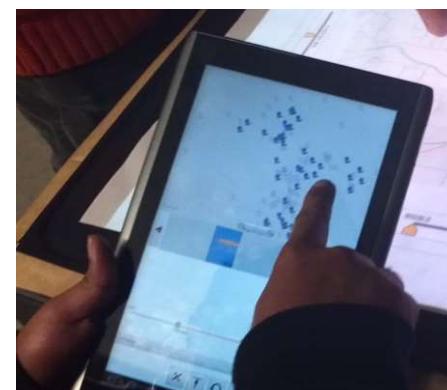
- Novices can learn basic functionality quickly, usually through a demonstration by a more experienced user
- Experts can work rapidly to carry out a wide range of tasks, even defining new functions and features
  - Knowledgeable intermittent users can retain operational concepts
  - Error messages are rarely needed
- Users
  - Immediately see whether their actions are furthering their goals, and, if the actions are counterproductive, they can simply change the direction of their activity
  - Experience less anxiety because the interface is comprehensible and because actions can be reversed easily
  - Gain a sense of confidence and mastery because they are the initiators of action, they feel in control, and they can predict the interface's responses

# Attributes of Direct Manipulation (continued)

- One way of trying to understand and categorize the direct manipulation metaphor is by looking at the translational distance between users and the representation of the metaphor, which will be referred to as *strength*
  - Strength can be perceived along a continuum from weak to immersed
  - This can be further described as the level of indirectness between the user's physical actions and the actions in the virtual space

# Attributes of Direct Manipulation Systems (continued)

- Multi-touch allows new actions to be assigned to various combinations of finger touches
  - The 2-finger actions like zoom in/out are intuitive, but others must be learned and take longer to discover
  - This accounts for why a young child can easily learn to tap, change screens, and touch on a tablet (the intuitive actions), but does not have the skills to re-arrange the icons on the screen (the learned actions)



# Attributes of Direct Manipulation Systems (concluded)

- Examples of Translational Distances
  - Weak – early video game controllers
  - Medium – touch screens, multi-touch
  - Strong – data glove, gesturing, manipulating tangible objects
  - Immersive – virtual reality, oculus rift



<https://www.oculus.com/en-us/press-kit-hardware/>

# Direct Manipulation Systems (example)

- Three users working concurrently on a large tabletop touch device.
  - They can use their hands and fingers to manipulate the objects on the device
  - Note the use of the different hand gestures



# Direct Manipulation Systems (example)

- A tangible user interface for molecular biology, developed in Art Olson's Laboratory at The Scripps Research Institute
  - Utilizes auto-fabricated molecular models tracked with the Augmented Reality Toolkit (from the University of Washington Human Interface Technology Lab)
  - The video camera on the laptop captures the molecule's position and orientation, enabling the molecular modeling software to display information such as the attractive/repulsive forces surrounding the molecule



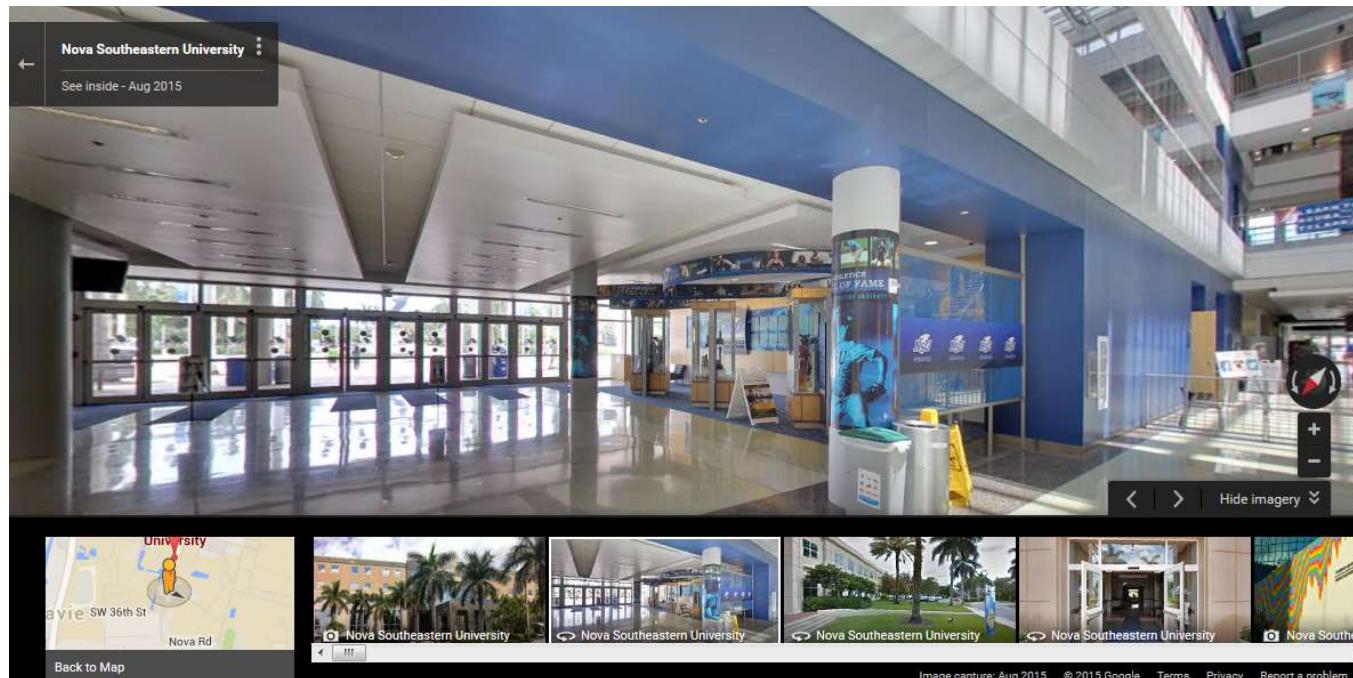
# Discussion of Direct Manipulation

## Problems with direct manipulation

- Spatial or visual representations can be too spread out
- High-level flowcharts and database-schema can become confusing
- Designs may force valuable information off of the screen
- Users must learn the graphical representations
- The visual representation may be misleading
- Typing commands with the keyboard may be faster

# Direct Manipulation Systems (example)

- GPS solutions
  - This is a screenshot from Google StreetView of the inside of the University Center at Nova Southeastern University in Florida
  - On the bottom is a scrollable image of other views on campus. In the left hand corner is a more conventional static map showing the physical street location of the campus
  - Users can move the “person” to a different location on campus and the views will change accordingly



# Direct Manipulation Systems (another example)

- Video games
  - Woman playing World of Warcraft, using both her keyboard and mouse, while hearing sounds of the game via her headset



# Direct Manipulation Systems (another example)

- 3D Printing
  - This shows astronaut (Bruce Wilmore) onboard the International Space Station with the ratchet wrench that was created with Made in Space's 3D printer
  - This device was designed, qualified, tested, and printed in space in less than one week

