



Classifying 3D Input Devices

by

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Motivation

- ❑ The mouse and keyboard are good for general desktop UI tasks
 - Text entry, selection, drag and drop, scrolling, rubber banding, ...
 - Fixed computing environment
 - 2D mouse for 2D windows
- ❑ How can we design effective techniques for 3D?
 - Use a 2D device?
 - Use multiple *n*-D devices?
 - Use new devices?
 - Use 2D interface widgets?
 - Need new interaction techniques!

Motivation (cont.)

- ❑ Gaming and Virtual Reality
 - Tight coupling between *action* and *reaction*
 - Need for precision
- ❑ VR can give *real*/first-person experiences, not just views
 - Head-mounted Display
 - ❑ In order to look behind you, turn your head!
 - Selecting/manipulating an object
 - ❑ Reach your hand out and grab it!
 - Travel
 - ❑ Just walk (well, not quite):!
- ❑ Doing things that have no physical analog is more problematic

Common Input Devices



Mouse



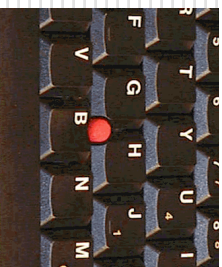
Keyboard



Joystick



TrackBall



TrackPoint



TouchPad



Tablet



MightyMouse

Game Controllers



Atari 2600
(1977)



Intellivision
(1980)



PlayStation2
(2000)

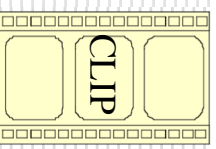


Xbox 360
(2005)



Revolution
(2006?)

Source: <http://www.axess.com/twilight/console/>



Classification Schemes

- ❑ Relative vs. Absolute movement
- ❑ Integrated vs. Separable degrees of freedom
- ❑ Digital vs. Analog devices
- ❑ Isometric vs. Isotonic devices
- ❑ Rate control vs. Position control
- ❑ Special-purpose vs. General-purpose devices
- ❑ Direct vs. Indirect manipulation

More on Classifications

- ❑ Relative vs. Absolute movement
 - Mouse vs. Tablet
- ❑ Integrated vs. Separable degrees of freedom
 - Mouse has integrated X, Y control
 - Etch-a-sketch has separate X, Y control
 - ❑ Motions that are easy with one are hard with the other
- ❑ Analog devices allow more sensitivity
 - For example, analog game controllers

Isometric vs. Isotonic Input Devices (Zhai)



Devices (Zhai)

- No motion vs. No resistance
- Actually a continuum of elasticity
 - TrackPoint (mostly isometric) vs. mouse (mostly isotonic)
 - Many devices are re-centering (e.g., joysticks)

Rate Control vs.



Position Control (Zhai)

- ❑ Mouse is normally used for position control
- ❑ Mouse scroll-wheel
 - Position control
 - Click-drag for rate controlled scrolling
- ❑ Trackballs typically use position control
- ❑ Joysticks: Control position (cross-hair), or Control velocity (aircraft)
- ❑ Rate control eliminates need for clutching/ratcheting
- ❑ **Isotonic-rate control and isometric-position control tend to produce poor performance** (Zhai)

Special-Purpose vs. General-WPI

Purpose Input Devices (Buxton)

- ❑ Game controllers are designed to support many types of games
 - Game developer decides on mapping
 - No "standard" mappings -> each game different
- ❑ Some special-purpose devices exist
 - Light guns
 - Steering wheels
 - RPG keyboard/joystick
 - Drum kits, dance pads, bongos, etc.

Direct vs. Indirect Manipulation

- Direct
 - Clutch and drag an icon with mouse or stylus
 - Touch screens, PDAs use direct manipulation
 - Works well for things that have a physical analog
- Indirect
 - Use some widget to indirectly change something
- Problems with direct manipulation
 - Some things do not have a physical analog
 - Precision may be lacking
 - Selection/de-selection may be messy

3D Input Devices



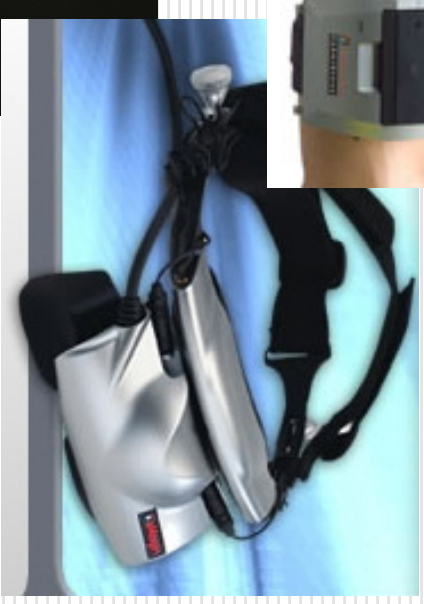
SpaceBall



SpaceMouse



CyberGlove II



HMD with
3-DOF tracker



Tracked Paddle for 2D Interaction



PHANTOM Omni
Haptic Device

Other Options

- ❑ Some alternatives
 - Speech
 - Gestures: pointing to fly
 - Device actions (e.g., buttons, joysticks)
 - Head/gaze directed
- ❑ Hybrid
 - Speech and gesture (e.g., "Put that, there.")

Mapping Devices to Actions

- For each (user, task, environment)
 - For the four basic VR tasks
 - For each device DOF
 - Choose a mapping to an action

- We also need to easily switch between actions!

Placing Devices in Context

□ Table?

Device	Rel/Abs	Int/Sep	Dig/Ana	Isom/Isot	Rate/Pos	Spec/Gen	Dir/Ind
Mouse	Relative	Integrated	Digital	Isotonic	Position	General	Both
Glove	Absolute	Integrated		Isotonic			
...							
...							
...							

Verification and Comparison

- ❑ Framework for user studies
- ❑ Interesting to fill in the empty spaces
 - Isotonic position control for rotation?
 - Other novel combinations?
- ❑ Very active field right now
 - ACM CHI, IEEE VR, 1st 3DUI Symposium
ACM SIGGRAPH



More Info

- Shumin Zhai at IBM Almaden
- Bill Buxton at U. of Toronto (Alias | Wavefront)