Lecture7 Input Metrics

1. Measure Input Devices

- **Question**
  - how much does the design of a particular input device affect the feel of a virtual object controlled with it?
  - to what degree is game feel defined by the input device itself?
  - to what degree is the possibility space of a virtual object defined by the physical object used to control it?
- **Answer**
  - measure the input space represented by a particular input device
  - compare the input space of one input device to another in a meaningful way
  - examine how the feel of a particular game is affected by the physical construction of the input used to control it
- **Three Levels Examine**
  - micro level: examining each individual input that makes up the input device
  - macro level: examining the possibility space of the input device as a whole, its layout and construction and the types of actions it implies
  - tactile level: examining how the construction of the input device affects of input virtual feel of game objects controlled with it

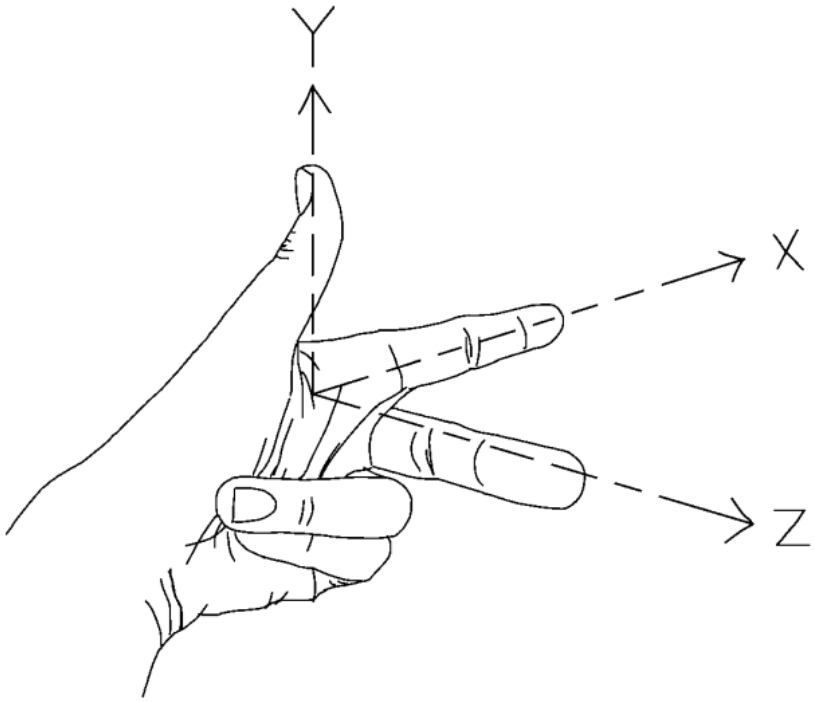
2. Micro Level: Individual Inputs

Classification

Type	A	B
discrete vs. continuous	send individual, momentary signals (keyboard key, mouse button, controller button)	send signals continuously (joystick, mouse, steering wheel)
linear vs. rotation	measures movement linearly (mouse)	measures rotation (steering wheel)
position vs. force	measures changes in position (mouse)	measures how much force is being applied against spring resistance (joystick)

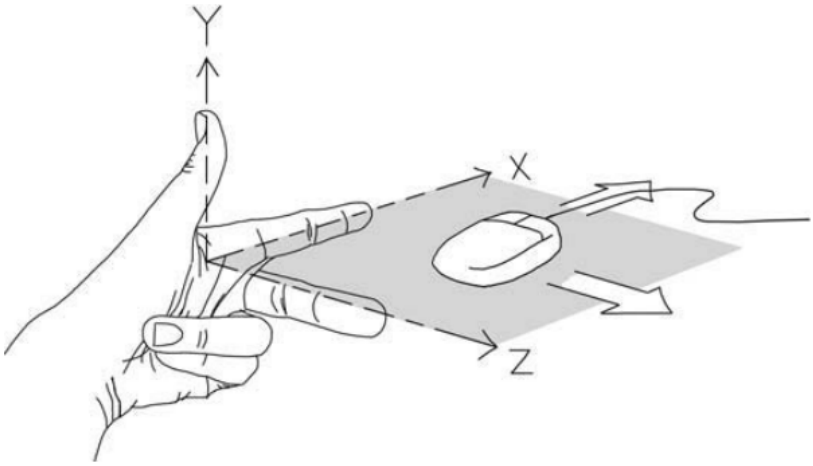
Type	A	B
direct vs. indirect Input	control the input device and see effects on the other device (mouse, keyboard key)	control the input device and see effects on the same device (touch screen)
dimension	linear movement in 1d (trigger button)	linear movement in 2d (mouse)
boundaries	round casing enclosing (thumbstick)	no physical boundaries on it's motion (mouse)
sensitivity (how many different states can the input exist in)	low sensitivity On & Off (button)	high sensitivity (mouse)

Visualize properties for a particular input device

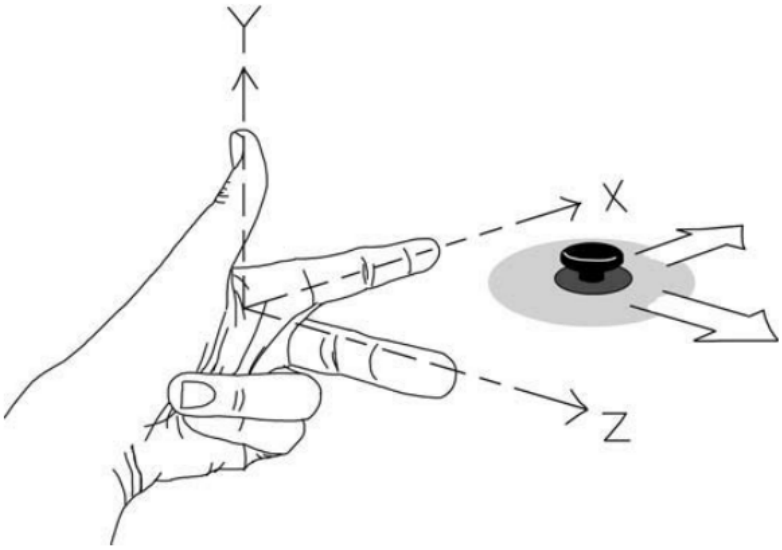


- hold out your hand, this is useful in comparing movement of an input device to movement of the object being controlled

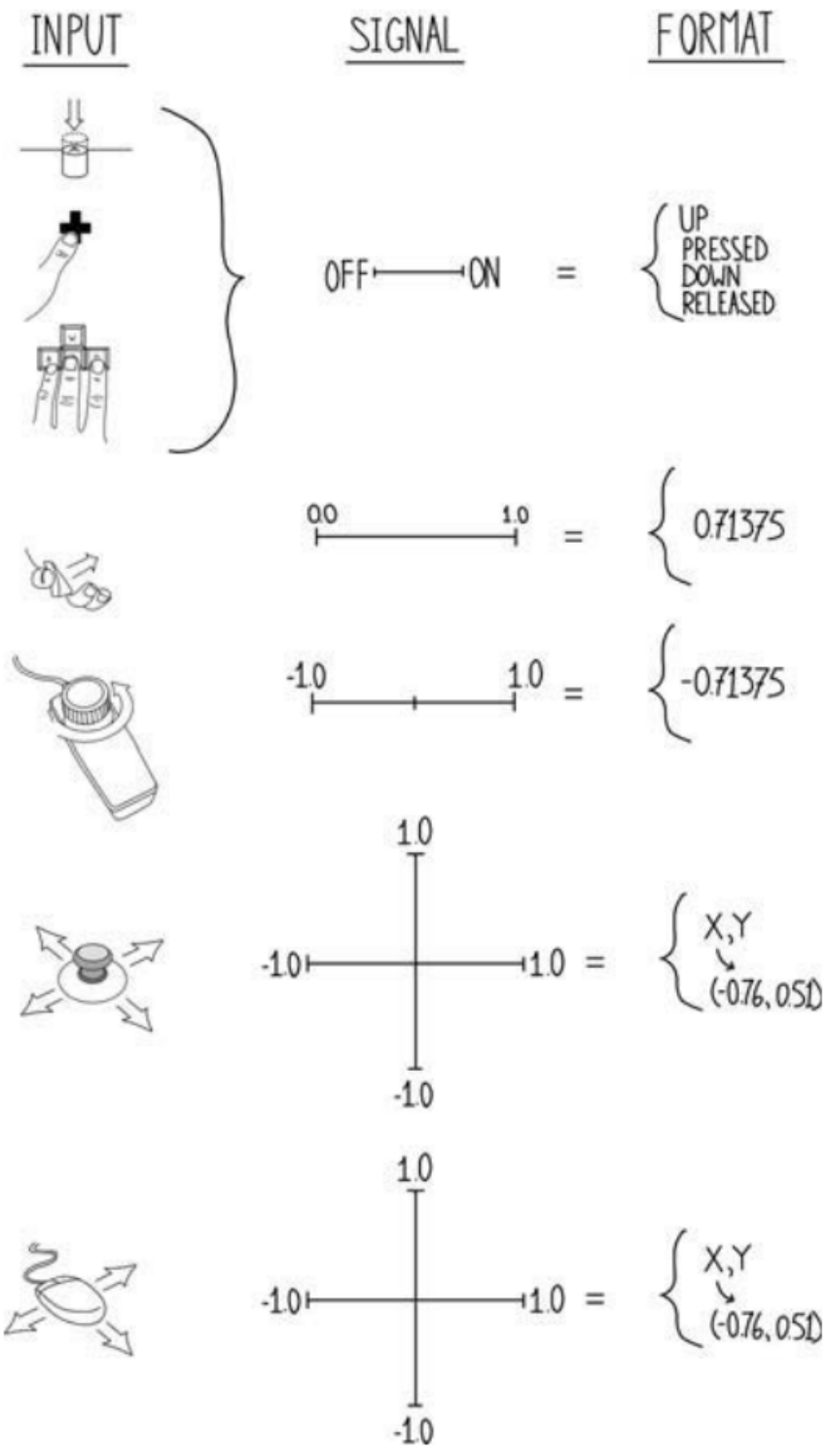
Mouse



Thumbstick



Signal Sent by Various Devices

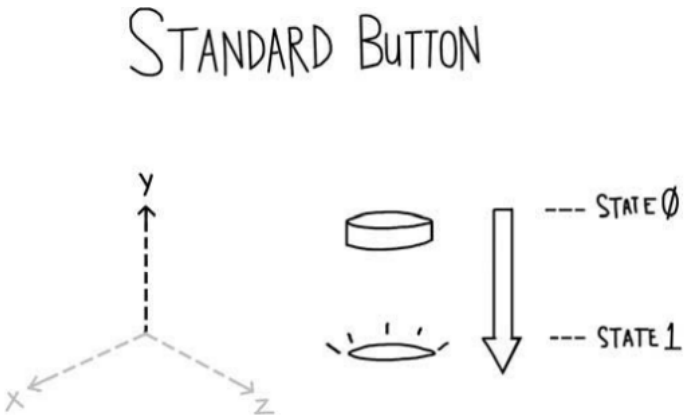


Input Measurement Examples

	Standard Button	Trigger Button	Paddle	Thumbstick	Mouse
Type of Motion	The button moves in only one axis, the vertical or Y-axis.	Linear. The button moves along one axis linearly.	Rotation. The paddle's motion is rotational around one axis.	Linear. The thumbstick moves linearly along the X- and Z-axes.	Linear. The mouse moves linearly along the X- and Z-axes.
Dimensions of Motion		The button moves in only one axis, the forward or X-axis.	Y-axis rotation only.	The thumbstick moves in the X and Z dimensions.	The button moves in the X and Z dimensions.
Direct or Indirect Input		Indirect; you press the trigger in your hand and something changes in the game. You don't directly touch the screen with the trigger.	Indirect; you don't directly touch the screen with the trigger.	Indirect input.	Indirect input.
Boundaries on Motion	Two hard boundaries, fully pressed or fully released.	Two hard boundaries, fully pressed or fully released.	Two hard boundaries, full left rotation or full right rotation.	One boundary, typically round (but can also be square or grooved, which changes the feel of using the joystick).	Four soft boundaries.
Sensitivity	The button has only two states, on or off. There are no states between the hard on/off boundaries.	Four to five possible states between on and off.	Hundreds of possible states between the two extremes of rotation.	Thousands of possible states between up/down, left/right movement, and all the positions in between fully released and pressed against the housing.	Millions.

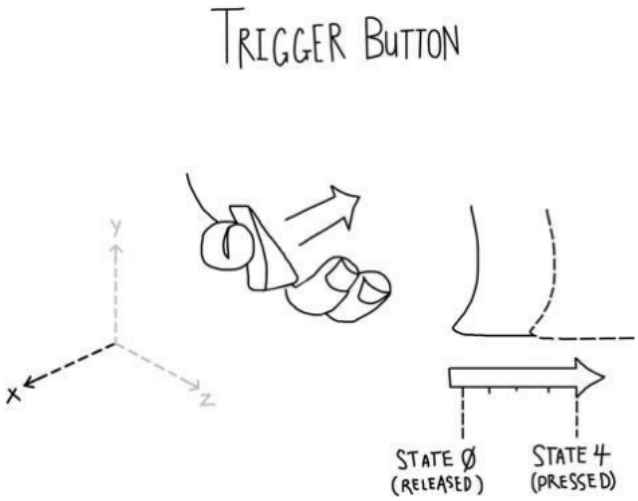
Type of Sensitivity		Force. The button is sensitive to how far its spring-loaded mechanism has been displaced from its normal position.	Force (torque in this case). The paddle knows how far it's rotated to the left or right of center by spring resistance.	Force. The thumbstick is sensitive to how far its spring-loaded mechanism has been displaced from its normal position.	Position. The mouse is sensitive to changes in position; when it's dragged left, right, up or down, this changes the signals it sends.
Signals	Binary; "up," "pressed," "down" or "released."	Float value between 0.00 and 1.00.	Float value between −1.00 and 1.00.	Two float values, each between −1.00 and 1.00. One for the left/ right axis, one for the up/down axis.	Float value between −1.00 and 1.00

Standard Button / Keyboard Key / Mouse Button / Shoulder Button



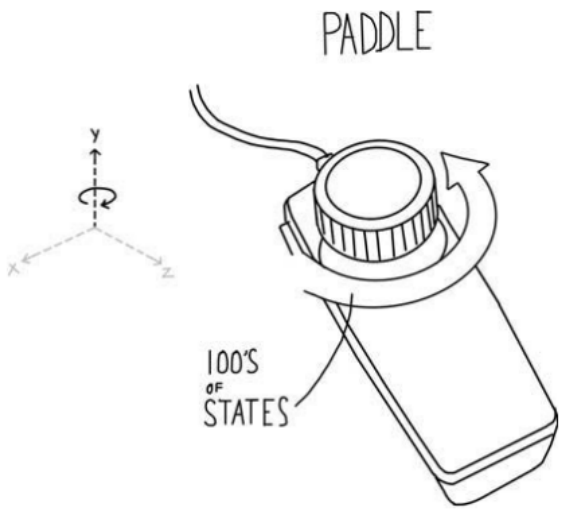
- two-state button: ON and OFF
- The signals are **binary**; the button is either on or off at any given time

Trigger Button



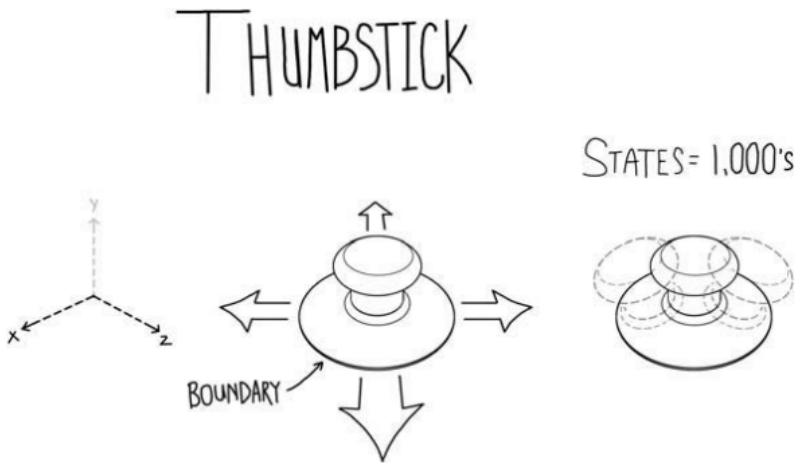
- trigger buttons are unlike standard buttons because they recognize many states between their boundaries
- between the fully pressed and fully released states, there is a zone of sensitivity inside which it's possible to have many different positions of the trigger
- a trigger button typically returns a **float value,** a number **between 0.00 and 1.00**

Paddle



- one-axis rotation
- there was one spinner input on the front of the controller
- through a combination of factors, this input type fell out of vogue, but it was quite a sensitive input, with hundreds of possible states between fully left rotation and fully right
- a paddle controller returns a **float** value, in a **range from -1.00 to 1.00**

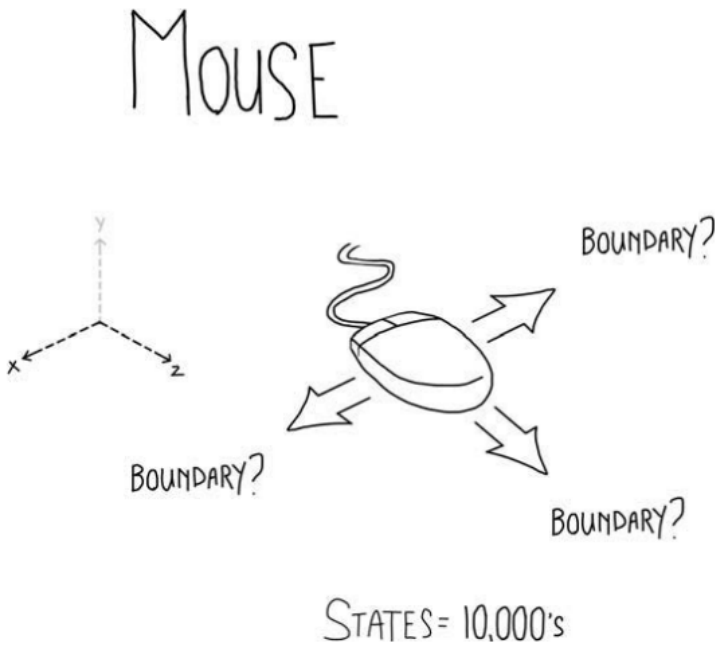
Thumbstick



- a typical thumbstick is movable in two axes simultaneously, left-right and up-down
- when using a thumbstick to control something in a game, there is no notion of discrete states, but a fluid, smooth sense of highly accurate positioning

- the thumbstick returns **two** constantly changing **float** values at the same time, one for each axis of motion
    - left to right: -1.00 to 1.00
    - up to down: -1.00 to 1.00

Mouse



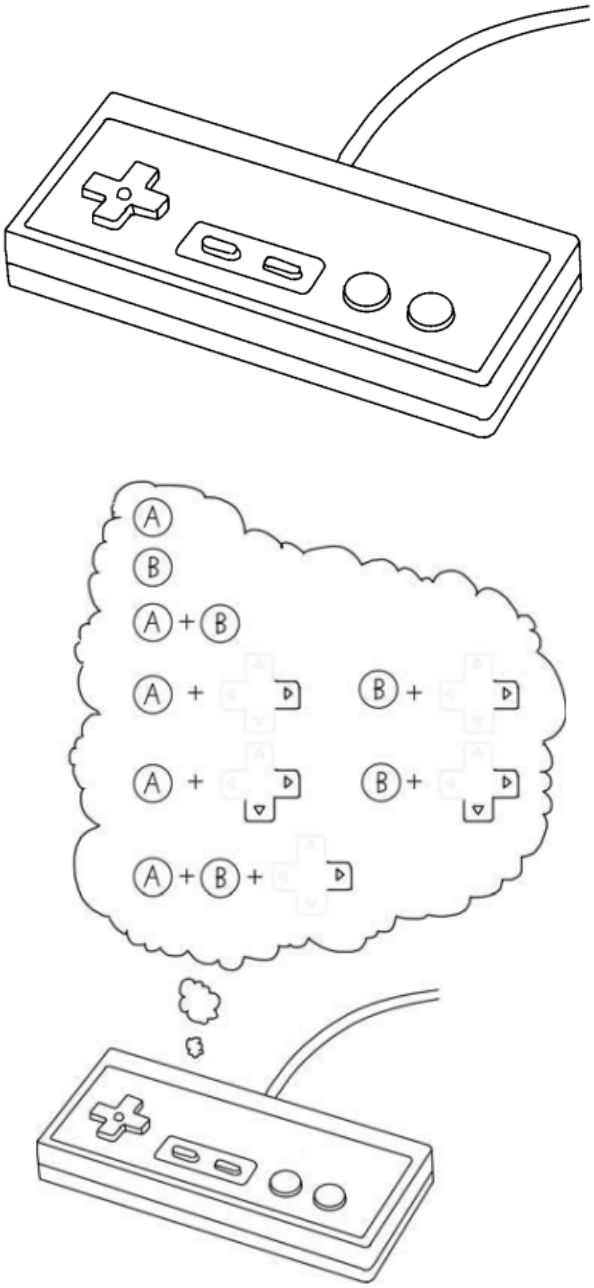
- enables movement in two axes
- there are no in-built boundaries for mouse
- the potential for different states is even higher than with a thumbstick
- a user can't be expected to accurately hit targets smaller than a certain size (checkbox on a dialog), but the sensitivity is there
- the mouse returns two separate float values

3. Macro Level: The Input Device as a Whole

Considering Level

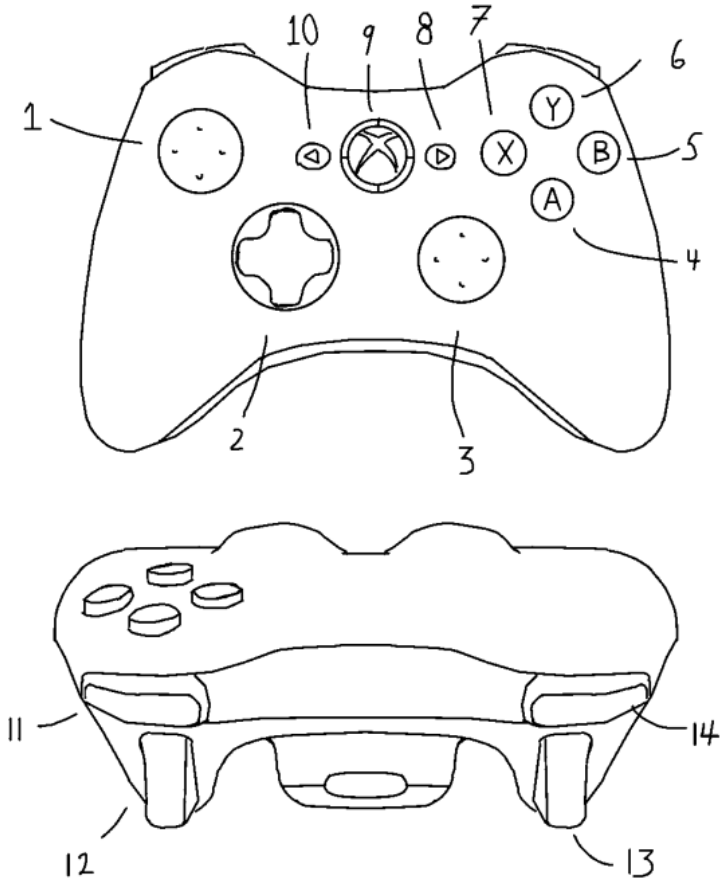
- Micro
    - how much sensitivity does each input have?
- Macro
    - how do the layout and design of the controller reduce and/or increase sensitivity?

NES controller



- this is very low-sensitivity input device
- the sensitivity is reduced by the mutually exclusive D-pad buttons and increased by the combined possibilities of the buttons, laid out as they are for use with both thumbs
- it suffices to know that NES controller is much less sensitive than a computer mouse

Xbox 360 controller



- 15 separate inputs
  - 1: Left thumbstick
  - 2: Directional pad
  - 3: Right thumbstick
  - 4, 5, 6, 7: X-, Y-, A- and B-buttons (standard buttons)
  - 8, 9, 10: some flimsy, seldom-used buttons for select, start, wireless resync and other miscellany
  - 11, 14: Right and left "shoulder" buttons
  - 12, 13: Right and left “ trigger ”buttons

4. Tactile Level: The Importance of Physical Design

- It’s also useful to understand how the input feels physically
- Games played with a good feeling controller feel better

Weight

- A heavier, more solid-feeling controller is perceived as being of higher quality
- For a game’s feel, this can go a long way toward making actions feel weighty, powerful or satisfying

- In general input devices seem to trend toward being too light, flimsy and cheap-feeling. This significantly affects the feel of control of a virtual object

Materials

- The material used to construct the device has an impact on the way the user feels about the controller and, therefore, the game

Button Quality

- the feel of the spring resistance: tight or loose, quick-responding or sluggish
- the actual mechanical differences in the sticks/buttons tension and mechanical ‘travel’ distance

5. Summary

Categorize input devices

- individual inputs
    - how many different inputs there are on the device
- the input space of the device as a whole
    - the ways in which they can be combined (hard metrics)
- tactile feeling
    - the feel of each input (the resistance to movement, springiness, etc.)
    - feel of input device as a whole (heavy and solid versus light and flimsy, physical properties of the materials)