IMGD 3100 – Novel Interfaces for Interactive Environments:
Physical Input

Robert W. Lindeman

Associate Professor

Interactive Media & Game Development

Human Interaction in Virtual Environments (HIVE) Lab

Department of Computer Science

Worcester Polytechnic Institute

gogo@wpi.edu

Overview

- Manipulating Physical controls is different from manipulating virtual controls
  - "Handling" them is different
  - Brain activity is different
  - Uses may be different

- We need to design to best suit the application, user, and environment
  - Tap into previous experience
  - Support adequate expressiveness
  - Automate what we can
  - Provide multi-modal redundancy

Physical vs. Virtual Controls

- In the past, physical controls were more common

- Now, virtual controls are as common

- Examples?

- Many virtual tools mimicked physical tools

- However, since physical manipulation requires touching, virtual versions are often flawed

In-Class Exercise

☐ http://tinyurl.com/oq2fft9

    ☐ (or Google: "Interface Hall of Shame")

☐ Click on "Selecting the wrong control"

The Brain/Hand Connection

- Every interface has to be learned
  - Could be a short learning time though

- Over time, some people master an interface to the point where they don't really think about it anymore (muscle memory)
  - Guitar/piano players
  - Remembering phone numbers

- Goal of Interaction Design
  - To allow users to perform actions instinctively and without the need to consider each action but to instead consider its larger consequence.

- Make it so your users can develop (good) habits

A Button is Much More than Just a Button

WPI

- □ An electrical object
  - ■ Pushing it closes the circuit, alerting the Arduino

- □ An interactive object
  - ■ More common than knobs today, because many things we control are digital
    - □ Thermostat, mp3 players, phones
  - ■ Buttons are quick too

- □ A state in program code
  - ■ We address the button using the state of a pin

A Knob is Much More than Just a Knob

WPI

- Buttons are digital (ON/OFF)

- Analog gives us more expressiveness

- Knob as Interactive Object
  - Represents a range of values
  - Less precise than a button
  - Some knobs change the values in fixed increments

- Implemented as a potentiometer for us
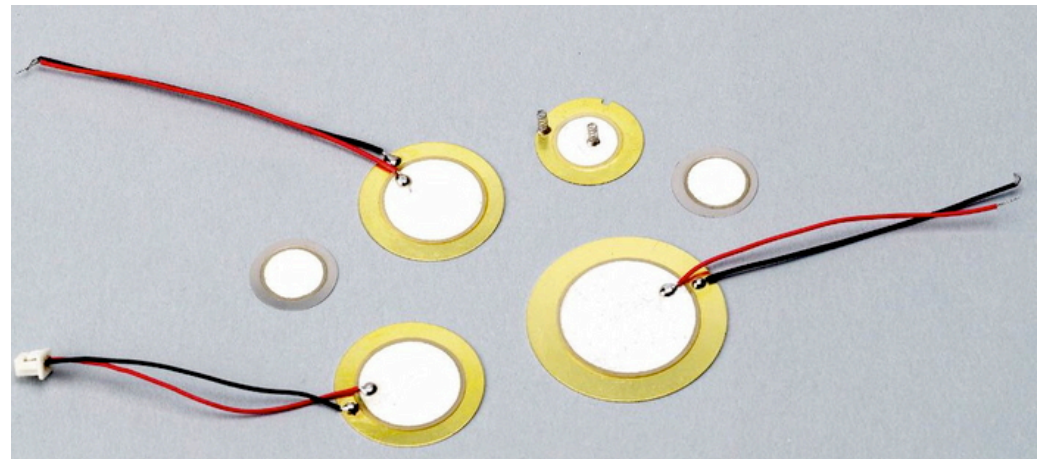 - Could be "soft potentiometers"
  - http://www.spectrasymbol.com/typo3/site/en/softpotsplash/softpot.html
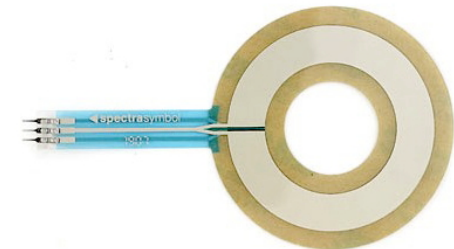
Lights

- ☐ Tell us the state of something
  - ■ Charging state of a battery
  - ■ Progress of an activity
  - ■ State of a larger device

Touch and Vibration

☐ Piezoelectric sensors (or just *piezos*)

☐ Use for sensing

- Pressure
- Acceleration
- Strain
- Force

☐ Crystals generate an electric potential in response to stress

- More current is returned when bent

Detecting Motion

- Easy and fun
  - Use when someone approaches your installation
  - Proximity on phones

- Passive Infrared (PIR) sensor
  - Senses rapid changes in the presence of IR energy
  - Caused by people coming into the scene
  - 9 or 10 micrometer wavelength

Reading User Distance

- ☐ Two main technologies
  - ◼ Ultrasonic (range finders)
    - ☐ How long it takes a wave to return
    - ☐ Magnitude is proportional to distance
  - ◼ Infrared
    - ☐ Two parts: emitter and receiver
    - ☐ Angle of beam returning is measured to estimate distance
    - ☐ Used in digital cameras

Detecting Forces and Tilt

- Accelerometers
  - When you push on the gas pedal, you sink back into your seat
  - Measure the change in angle between a pendulum and gravity

- Two-axis, three-axis accelerometers
- They are noisy, so averaging is a good idea

Binary Numbers

- ☐ Decimal vs. Hexadecimal vs. Binary

Further Reading

- Chapter 7 from ***Programming Interactivity***

- Interface Hall of Shame
    - http://tinyurl.com/oq2fft9