IMGD 3xxx - HCI for Real, Virtual, and Teleoperated Environments: Physical Input

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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
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

- 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

- 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"
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 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 8 from *Programming Interactivity*
- Interface Hall of Shame
  - [http://tinyurl.com/4lasef](http://tinyurl.com/4lasef)