



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

by

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# Overview

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- 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

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- ❑ 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

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- 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

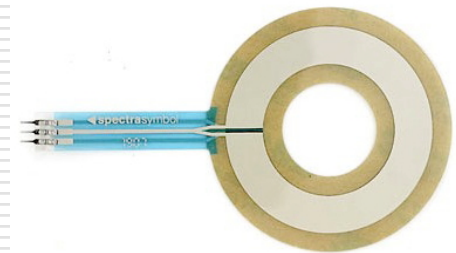
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- An electrical object
  - Pushing it closes the circuit, alerting the Arduino
  
- An interactive object
  - More common than knobs today, because many things we control are digital
    - Thermostat, mp3 players, phones
  - Buttons are quick too
  
- A state in program code
  - We address the button using the state of a pin

# A Knob is Much More than just a Knob

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- 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/softpot/splash/softpot.html>



# Lights

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

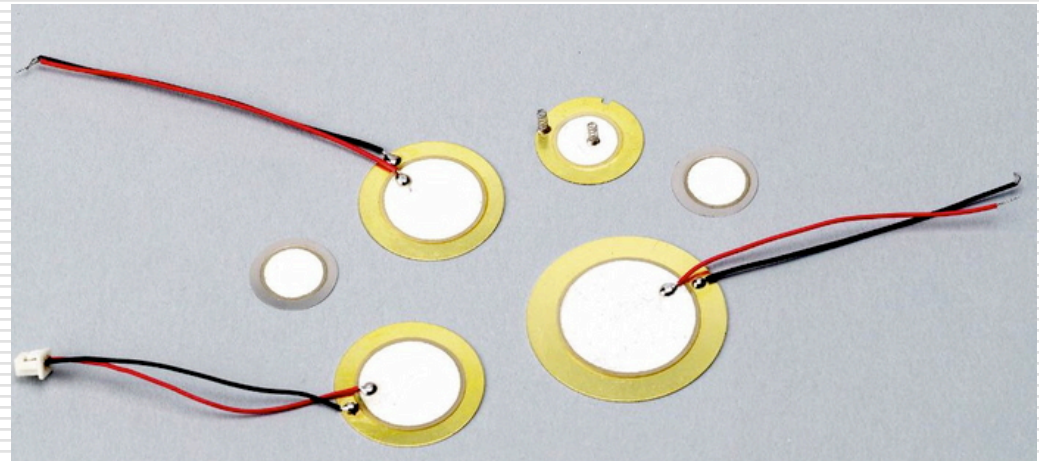
# Touch and Vibration

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□ 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

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- 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

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- 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

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## □ 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

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□ Decimal vs. Hexadecimal vs. Binary

## Further Reading

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- Chapter 8 from ***Programming Interactivity***
- Interface Hall of Shame
  - <http://tinyurl.com/4lasef>