best practices for teaching haptics:

INTERACTION DESIGN

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what does "interaction design" mean?

some familiar things that it's ***not:***

- psychophysical experimentation
  innate human capabilities, reflexes, musculoskeletal wiring
- application design
  I've made a neat gizmo that should be good for X
- human-centered design
  but they are close cousins

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useful definitions?

wikipedia on "interaction design":

"… has an interest in form but its main focus is on **behaviour** …

… it is **synthesis and imagining things as they might be**, more so than on how things are…

… satisfying the **needs and desires** of the people who **will use** the product …"

Often, those people aren't ready to imagine their needs or desires yet themselves. Interaction designers may have to do a lot of this themselves.

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behavior, and context

what will people want/need/naturally tend to do, given a particular goal(s), conditions, social environment, state of mind and body… ?

how does/could it relate to what they do now?

how can the system's design – shape, handles, apparent function – *influence* this?

Affordance:

the set of possible actions allowed by the form of an object and given a set of effector capabilities.

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some interaction-design ways of thinking about **Touch as a Tool**

Being able to control how something feels is a **DESIGN TOOL**.

You must understand the strengths (and weaknesses) of your tool, e.g.:

touch relative to other sensory modalities

haptic technology relative to graphic/audio display

contexts of use, or of constraint which impacts some modalities more than others.

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some key features of Touch that can be exploited in tool-like ways

special qualities: bidirectionality, social loading, gesture, richness, privacy and proximity

information available: assessment, verification, monitoring, mental model bulding, social judgments

forms: tools and textures; language; mediating models

active touch advantages: reconfigurability, dealing with complexity

mainlining our biology: comfort, aesthetics, affect, social communication

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challenges for haptic interaction design

displaying interaction potential: one handle / many functions best when tasks use same rules

continuous / discrete manual control: many tasks require both; transitions are interesting

embedding haptic interfaces: can be customized to a specific task context (okay when cheap & simple). But what if it's a multipurpose handle? runs on batteries?

tight sensory coupling for perceived control: millisecond-level latency. Most communication protocols today aren't designed for it. (hence MS-DOS nostalgia)

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getting back to teaching it…

interaction design is a **way of thinking** that does **not always come naturally** to scientists.

iterative *never-never-never accept your first ideas*

sketchy *junkyard prototyping wins over careful planning*

exploratory *won't know if it's interesting til you try it*

imaginative *as in: wackiness should be encouraged*

it's the journey *stuff you learn along the way*

At some point, we refine and perfect. But not at first.

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my haptics course

used to be: the tripod of

engineering device design, control, rendering
+ human haptics perception, motor control, attention…
+ human centered application design pick a human need, study it, fix it

= nice, carefully specified design + solid experiment

→ lots of neat projects over last 12 years.
many became good papers.

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but…

times have changed

tools are different *mostly, a lot better.*
tho sometimes I miss MS DOS

do I care more that they understand a PID, can render a wall and design an experiment…

or that they can grasp the *opportunity* of this sense, and the technology that speaks to it,

and truly imagine change?
Physically **imagine it?**

what would that look like, anyway?

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thus

this year, an Experiment

we're half-way through

coincides w/ running this conference
so, a little half-baked.

students have been very patient

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haptic sketching

credit for many of these ideas to collaborator
Camille Mousette: http://www.guchmu.com
Interaction designer, doing PhD on teaching this stuff
Umeå Institute of Design, Sweden

he's around here somewhere

has partnered in revising my grad course this year –
a work in progress

view the mid-term results at UBC Open House!

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new course is structured as:

- instructor-presented material haven't completely abandoned the "tripod" but there's a lot less room for it
- set of "sketching" labs in first half
- team project dominates second half

sharing / learning from others paramount:

- regular full-class design reviews
- students blog labs and projects
  build as a team, but tell your own story about it
- pass/fail marking for intro components

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key design metric

In my group, we have tried to rigorously evaluate **delight** in an interaction.

It's hard to capture.

But that's what we're really after here.

Have you come up with something that delights you and others?

How can you tell?

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The Sketching Labs

1 week each – kickoff with an "open lab"

initial stage is more about interaction than haptics

1. make something move. No-Tech puppeteering – no electronics or Arduino, just wire, duct tape and popsicle sticks. Get familiar with the tools and materials.
2. basic actuation: introduce Arduino in context of making a motor turn. Make it move
3. communicate something using a sensor-motor control loop.
4. controlled actuation using PID.

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lab 1:

make 3 hardware sketches that move **1, 10 and 100 mm.**

no electronics.

human actuation.

be inspired by

- the "junk" box(es) in the lab
- the class Meccano set
- your desk, kitchen, ??
- your nephew's toy bin
- wandering the aisles of the local hardware store (the dollar store is good too)…

aim to spend **3 hours** on prototyping work.
I think the reality was a bit more. But I didn't make them.

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lab 2

do lab 1, but replace human-powered actuation with an Arduino-controlled motor

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what is Arduino?

http://www.arduino.cc/en/Guide/Introduction

Open source physical computing platform
i.e. embedded processor that's very easy to program, and is easily integrated with sensing and actuation systems.
For: EASILY developing physically interactive objects.

Philosophy here: HAPTIC SKETCHING
try things out quickly and move on
more fun, less pain

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lab 3

pick 3 words see list of examples

program a motor's response
to at least two sensor inputs and connect that motor action to a physical display of your construction.

communication should be "**ambient**"
i.e. operate in user's attentional background.

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some ways to move

grow, explode, shrink, scale, rotate, pulse, flick, rest, disappear, clutch, release, hold, capture, pin, prompt, confirm, repeat, stable, glide, slide, stop, hit, kick, cancel, ease in/out, ramp, augment, increase, decrease, agitate, shake, twist, transform, bounce, cycle, follow, guide, grab, screw, implode, circulate, constrain, channel, force, lead, invite, smooth, hard, harsh, solid, soft, compliant, bounce, spring, break, stop, collide, permute, accelerate, react

Courtesy Camille Mousette - 2011

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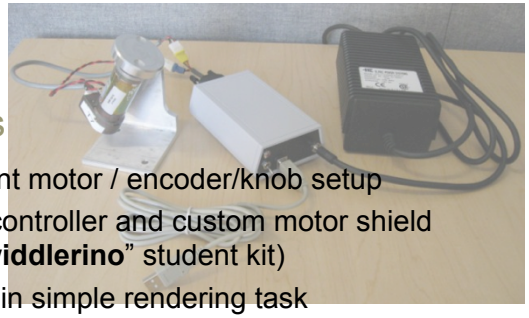
lab 4 Segue to haptics



take a decent motor / encoder/knob setup

w/ arduino controller and custom motor shield (SPIN's "**Twiddlerino**" student kit)

→ control it in simple rendering task

similar to past approaches:

- understand principles of closed-loop control
- basic rendering – wall, etc

still deciding if this is best setup for haptic control for non-engineers.

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lab 1: make something move, puppetry (florin)

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lab 2: move, actuated (john)

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lab 3: express a word (chaos, Jeremy)

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the "new" 543 project
a good one will have these traits:

- **must start with** an interesting objective: e.g. explore
  - vision or question about a compelling experience
  - real problem to be solved
- imaginative and appropriate prototyping
- iteration: different approaches and/or increasing refinement
- progress or insights relating to stated objective
  or towards an even more interesting problem found on the way
- resourcefulness in face of adversity
- good documentation – multimedia. As-you-go + summative, reflective at key decision points.

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how can you tell if you've made progress without rigorous evaluation?

evaluation is crucial throughout HCI design cycle… but it doesn't always stimulate creativity.

at these "expansive" stages, progress indicators can be:

1. Your process (probably indirect) has led to **clearly different, new-to-you ideas /insights** – "*I hadn't thought of doing it that way*"
2. You experience **a personal *"aha, that's it"* moment** after a struggle. For now, you are your own judge, and if it makes you happy, that's a good sign.
3. You have **added something notable** to inspirations and ideas you've freely taken /combined from the world.
4. **Informal feedback from others** successfully informs iterations that increase "progress types" listed above. Show your ideas, ask, and listen.

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project specifics

- work in team 3-4 members → 4-5 teams in a 20-p class.
  teams can be loose or tight organizational units, w/ common goal
- state & motivate your guiding project objective (proposal)
- **three iterations**, with start and end dates (see calendar)
  As you approach each, **set an objective for that iteration**. What do you want to try/learn next?
- **expand design space** (explore different approaches)
  or, **evolve/refine one approach** (each takes concept further, more detail, functionality, etc). Or both.
- can break iterations up – e.g. individuals or pairs try objective independently. Or, divide job up /take different pieces. Do collaborate!
- each iteration will conclude with a demo
  and open **DESIGN REVIEW – 20 minutes/team ideal**

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project assessment

- document each iteration on individual blog
  marked pass/fail, with informal feedback from instructor and class
- final team-prepared formal report
  marked on conventional 100-point scale
- public final presentation and demo
  during exam period

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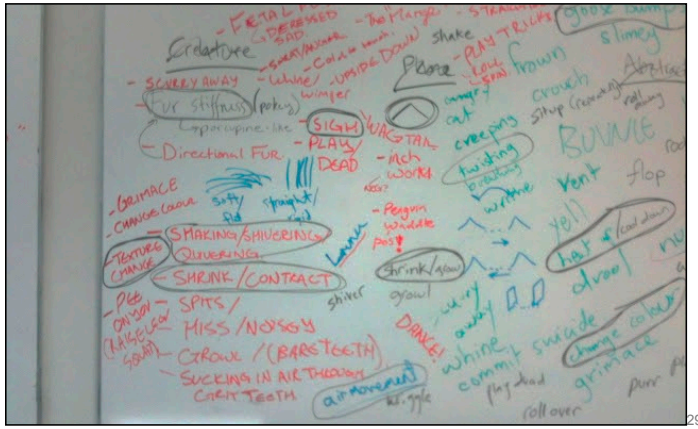
project iteration 1:
one team set out to portray negative affect



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negative affect: hackles

source

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tai chi magic: using user's internal forces for a "heavy haptics" exergame -- kinect, FSR and flex sensors

some challenges in teaching this course (in a comp sci dept)

prototyping skills vary

infrastructure: need access to things like laserjet printers, simple modelmaking tools (easier in Mech, hard for us)

and staff to teach people who don't know how to use it, and make it feel safe for them.

other skills vary too. I strive for a mixed class (CS, Mech, ECE, arts, psych). Students teach one another. Basic electronics and arduino-level programming can be mastered in a project context.

assessment. Pass/fail stimulates adventure, playfulness and sharing (and scales well for instructor). But at some point, our system requires a mark (or does it?)

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in closing…

goal is to help students explore **synergy** between *interaction design* and *haptic design*

both are often new concepts; lots to absorb
- fab & controls skill development; way of thinking (Camille's interaction design students' challenge is the coding)

new tools and platforms give promise of bringing novices up the "skills" curve much faster

tradeoff between depth in haptic rendering & tactile display concepts, and iterative practice on interaction design

→ next iteration of course ???

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