SKETCHING HAPTICS

Camille Moussette, 09.11.2010, Chalmers

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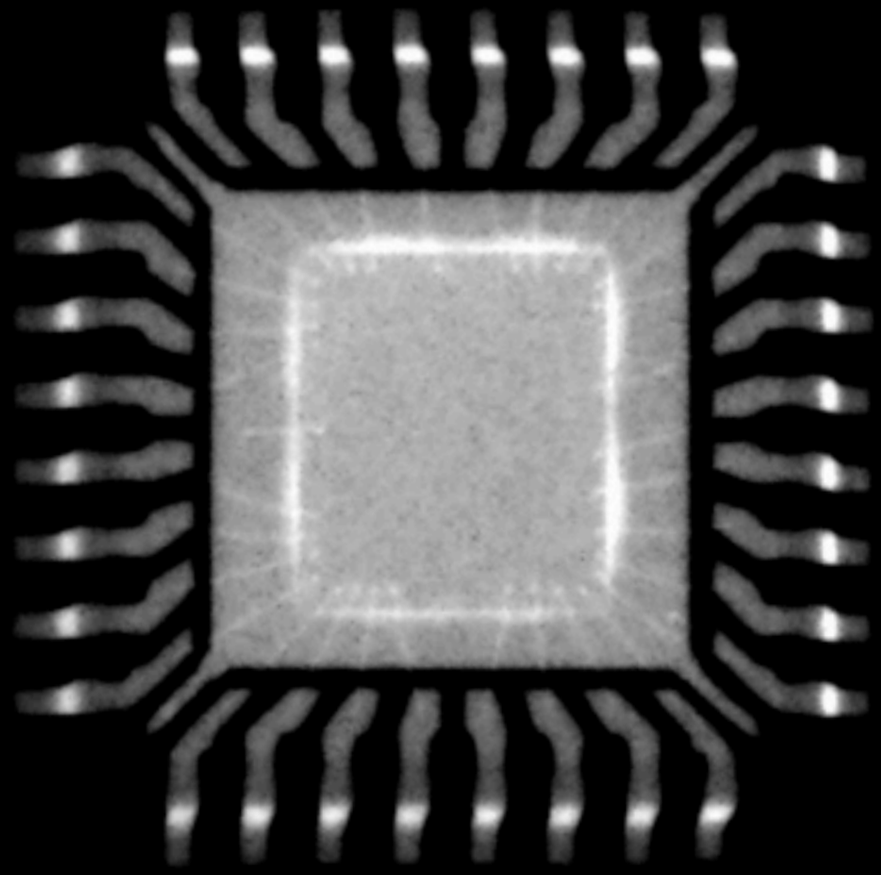


IBM

CAMILLE MOUSSETTE
MONTREAL, CANADA

PHD STUDENT + TEACHER

UMEÅ INSTITUTE OF DESIGN

STARTED PHD IN 2007, ETA 2012

40% TEACHING FOR VARIOUS IXD COURSES

PHD PROJECT

~~TOWARDS MOBILE HAPTIC INTERFACES,~~
~~SKETCHING MULTIMODAL INTERACTION DESIGN~~

NEW TITLE: **SIMPLE HAPTICS, SKETCHING TOOLS FOR HAPTIC INTERACTION DESIGN**

DANIEL FÄLLMAN, DIRECTOR - INTERACTIVE INSTITUTE UMEÅ

BILL BUXTON, PRINCIPAL RESEARCHER - MICROSOFT RESEARCH

OBJECTS OF CONCERN

IS THERE A WAY THE TOUCH SENSE CAN BE USED IN MOBILE INTERACTION DESIGN TO PROVIDE FOR RICHER AND MORE NATURAL-LIKE INTERACTION?

WHAT QUALITIES AND CHARACTERISTICS ARE NEEDED IN MOBILE HAPTIC INTERFACES TO TRANSLATE INTO KINESTHETIC ILLUSIONS THAT ARE TOTALLY BELIEVABLE?

WHAT ARE THE TOOLS, PROCESSES, METHODS AND THEORIES NEEDED FOR INTERACTION DESIGNERS TO GO ABOUT DEVELOPING MEANINGFUL INPUT OR OUTPUT FORMS WITHIN A TECHNICAL DEVICE THAT FEEL NATURAL TO THE USER?

PHASE 1: UNDERSTAND THE PLAYING FIELD

PHASE 2: BUILD, SKETCH, TRY, PLAY, EXPOSE

PHASE 3: PACKAGE THESIS

SIMPLE HAPTICS
SKETCHING TOOLS FOR HAPTIC INTERACTION DESIGN

SKETCHING TOOLS

323.444
465.420
461.103
DELL

NON-VISUAL AND BEYOND THE GUI

COPIC

Adobe

PARALLAX
standard servo
www.parallax.com

SKETCHING IN HARDWARE

VS

EXPERIENCE PROTOTYPING

SKETCHES

VS

PROTOTYPES

SKETCHING IN HARDWARE

OR PROTOTYPING?

Controller

A. Status LCD
Two lines show current state of the input being manipulated

B. Beat Visualization
OFF and 5 levels

C. Visualization Booster
Range from -3 to +3, controlling the diameter of audio generated dots

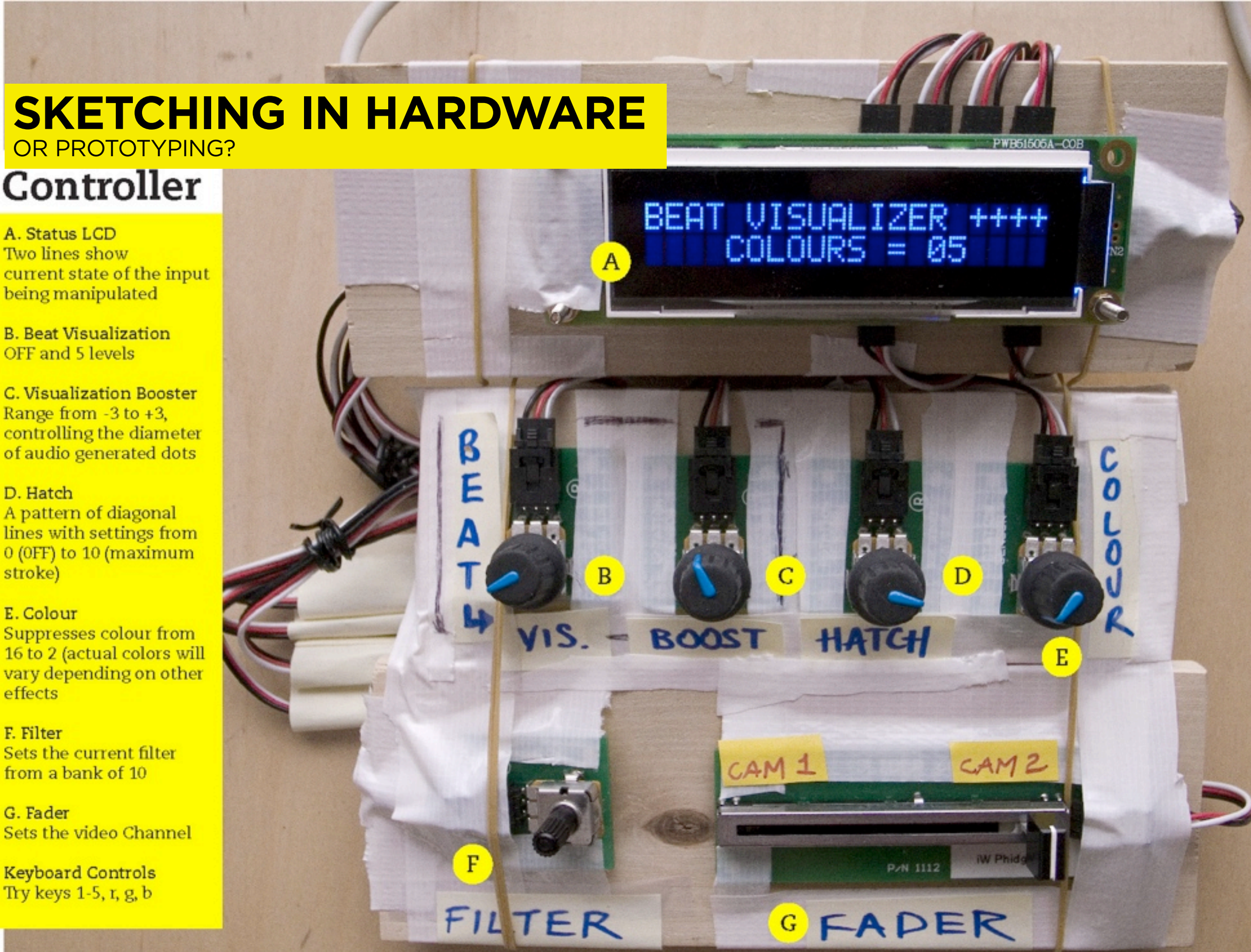
D. Hatch
A pattern of diagonal lines with settings from 0 (OFF) to 10 (maximum stroke)

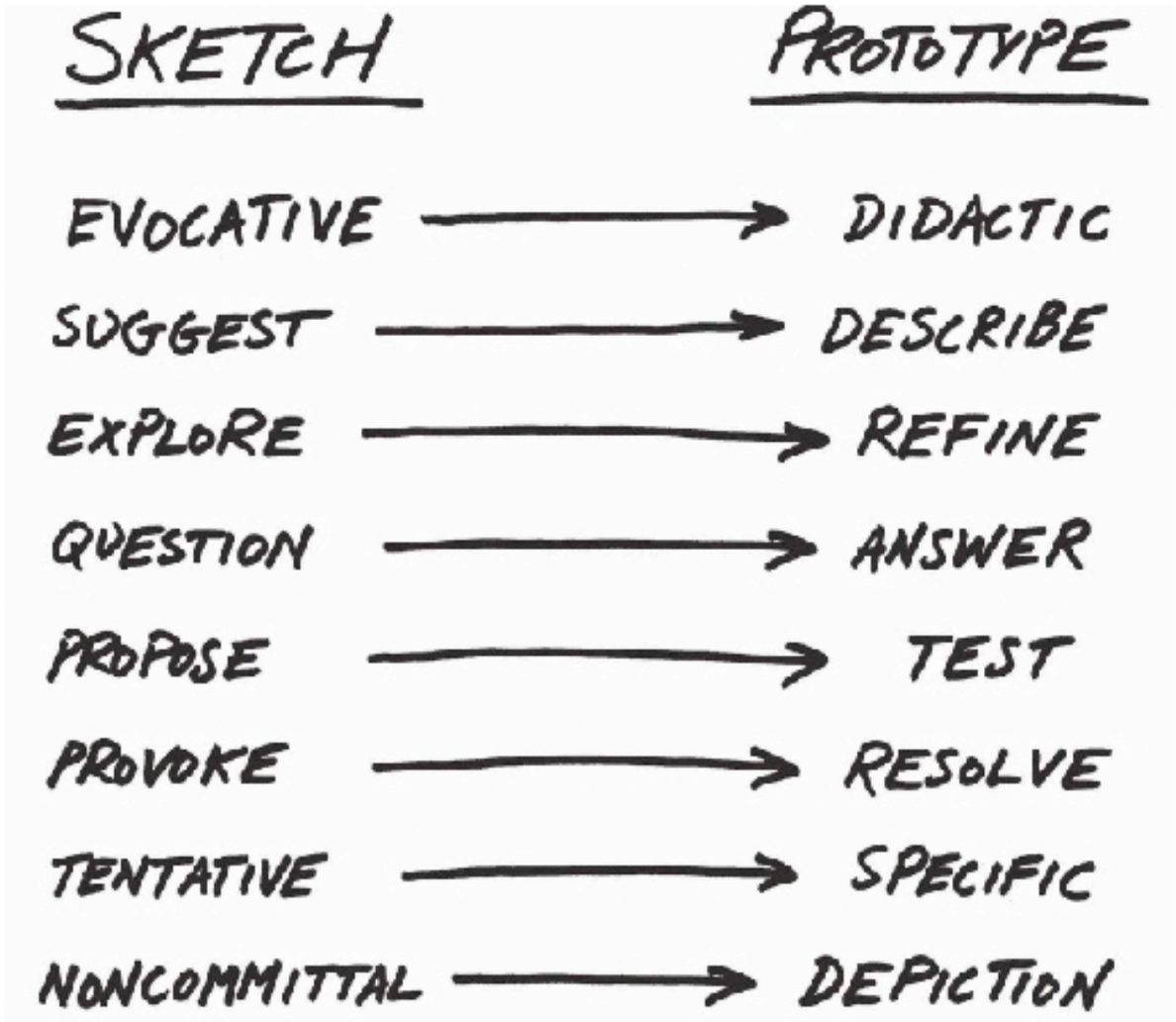
E. Colour
Suppresses colour from 16 to 2 (actual colors will vary depending on other effects

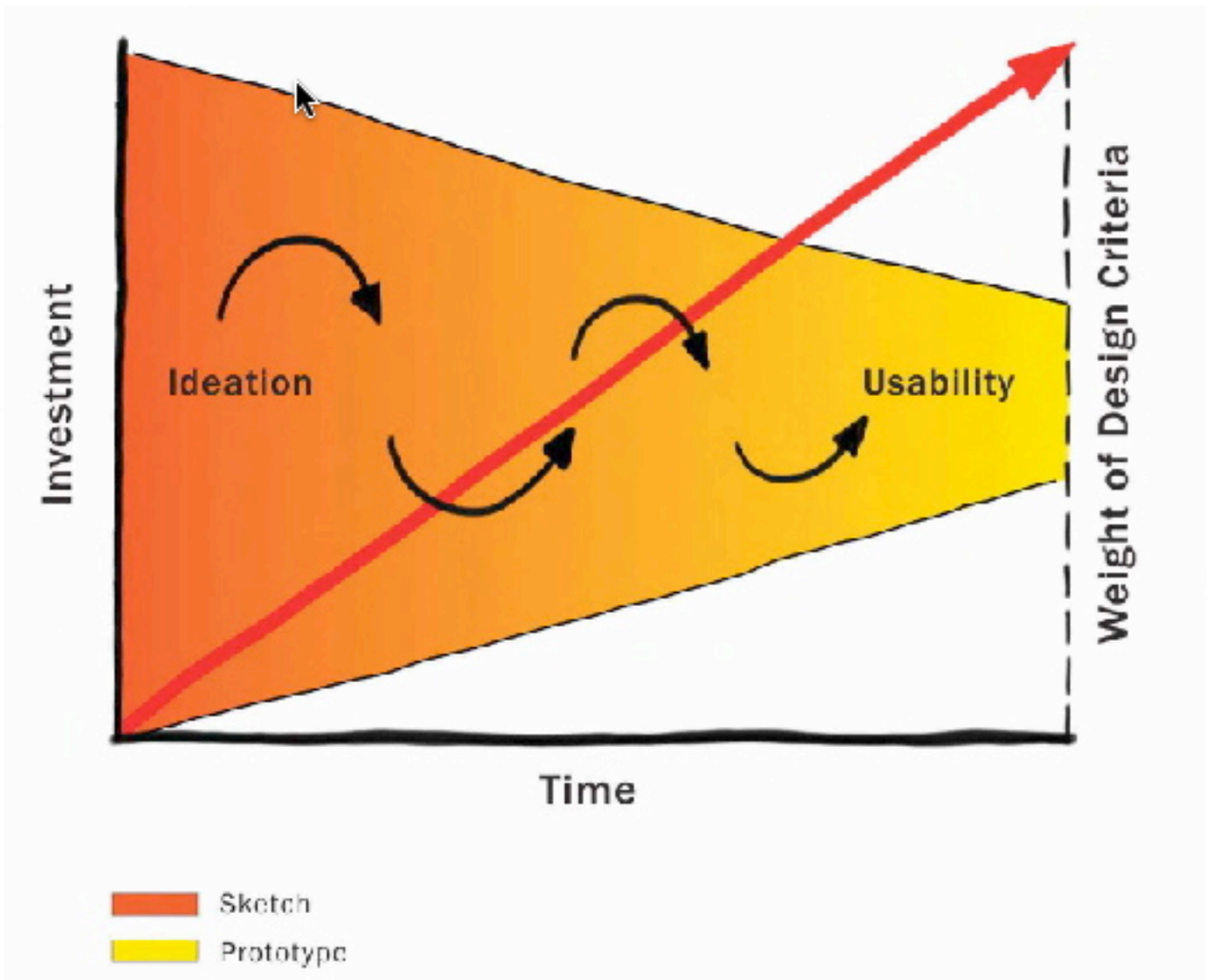
F. Filter
Sets the current filter from a bank of 10

G. Fader
Sets the video Channel

Keyboard Controls
Try keys 1-5, r, g, b




SKETCH
PROTOTYPE
EVOCATIVE → DIDACTIC
SUGGEST → DESCRIBE
EXPLORE → REFINE
QUESTION → ANSWER
PROPOSE → TEST
PROVOKE → RESOLVE
TENTATIVE → SPECIFIC
NONCOMMITTAL → DEPICTION


Ideation
Usability
Investment
Weight of Design Criteria
Time
Sketch
Prototype

Buxton, 2007

Prototypes are...

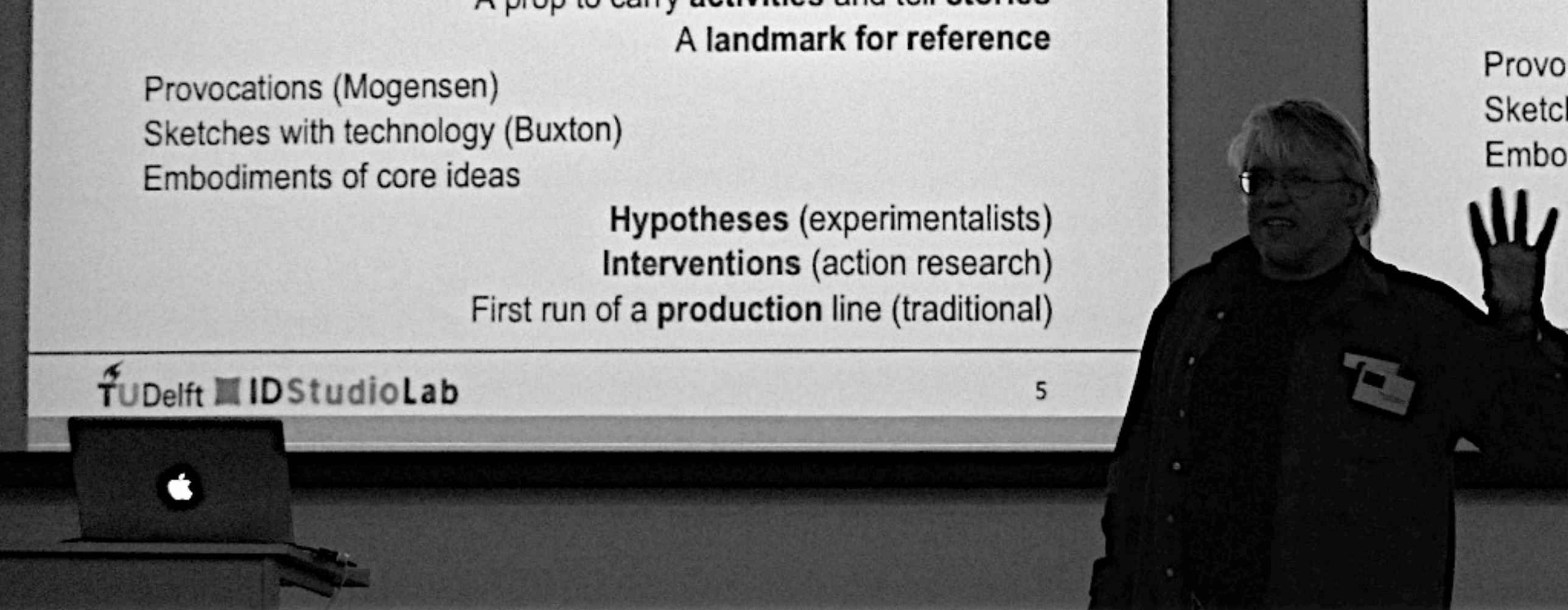
"the things we make to find out things"

How things should be
How things will be
How things can be

Unfinished, open for development
A way to **experience** a **future** situation
A way to connect **abstractions** into experience
A carrier for **discussions**
A prop to carry **activities** and tell **stories**
A **landmark for reference**

Provocations (Mogensen)
Sketches with technology (Buxton)
Embodiments of core ideas

Hypotheses (experimentalists)
Interventions (action research)
First run of a **production** line (traditional)



The Anatomy of Prototypes

Lim, Y.-K., Stolterman, E., and Tenenberg, J. 2008

Prototypes are **filters** that traverse a design space and are **manifestations** of design ideas that concretize and externalize conceptual ideas.

A “good” prototype is very dependent on what you are trying to explore, evaluate, or understand.

The Anatomy of Prototypes

Lim, Y.-K., Stolterman, E., and Tenenberg, J. 2008

The Principles of Prototyping

Fundamental prototyping principle

Prototyping is an activity with the purpose of creating a **manifestation** that, in its simplest form, **filters** the qualities in which designers are interested, without distorting the understanding of the whole.

Economic principle of prototyping

The best prototype is one that, in the **simplest** and the **most efficient way**, makes the possibilities and limitations of a design idea visible and measurable.

Experience **Prototyping**

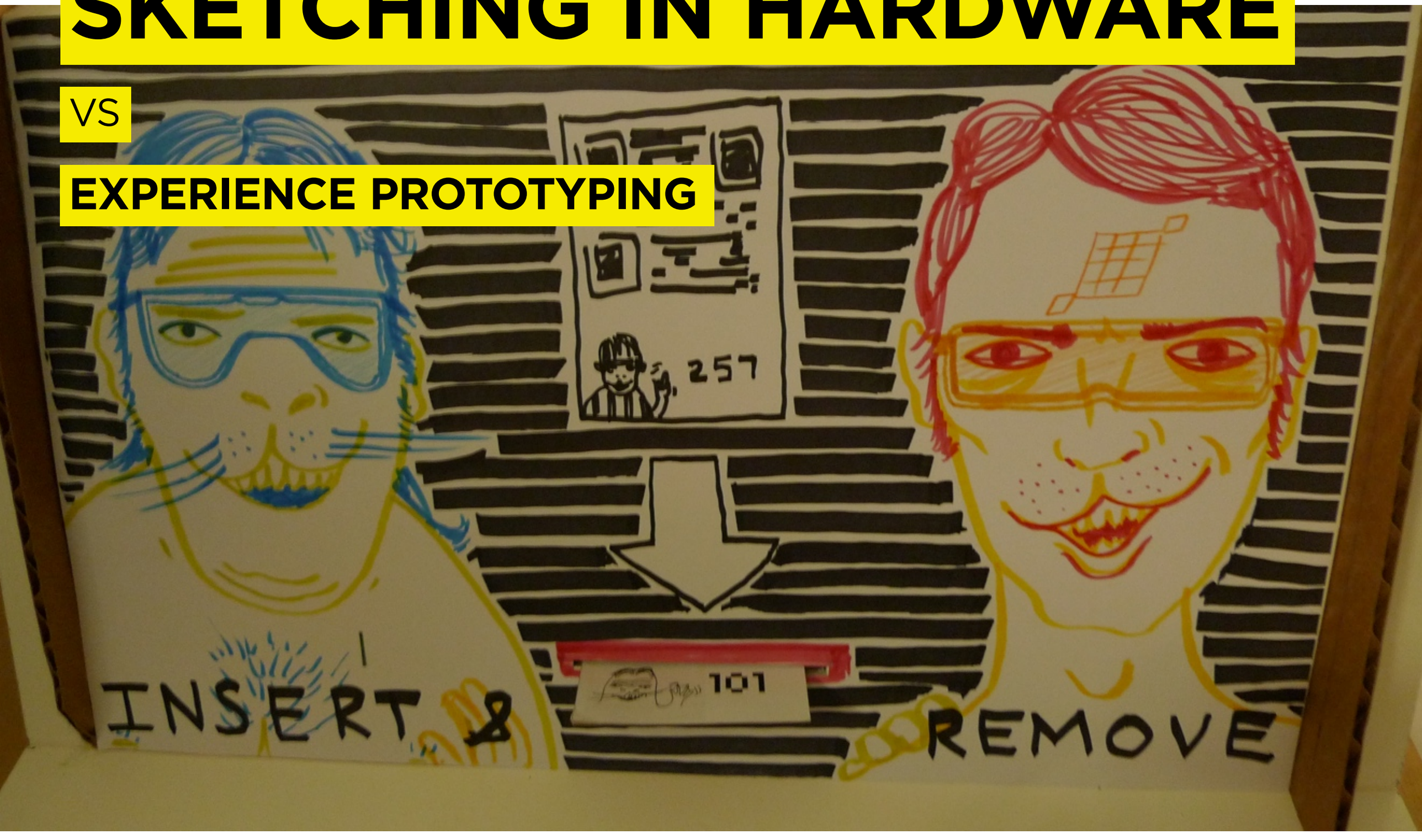
Interaction Design Programme - MA2
Autumn Term 2009
Weeks 41 - 45 (05/10 – 08/11)
Course Responsible: Camille Moussette

Umeå Institute of Design
Umeå University

SKETCHING IN HARDWARE

VS

EXPERIENCE PROTOTYPING



Sketching in Hardware and Building Interaction Design: tools, toolkits and an attitude for Interaction Designers

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Fabricio Dore, IDEO, Munich, Germany, fdore@ideo.com

Abstract

In this paper, we present a *Sketching in Hardware* perspective to Interaction Design (IxD) education and practice. We start our discussion by highlighting the differences between *Prototypes* and *Sketches*, and explaining why we believe the term *Sketching in Hardware* is suitable and appropriate to the IxD practice. We introduce a short history of the term and its origins before relating it to Experience Prototyping activities and other related design processes/methodologies.

Our main discourse consists of observations and a critical analysis of academic activities and professional work suggesting that *Sketching in Hardware* remains quite challenging despite the recent progress in the development of new tools and toolkits. The low barrier to entry and the explosion of tools and toolkits are very welcome, but this democratization can also be misleading. The learning curve is still steep in many ways. The current sketching tools seem to have leapfrogged our design skills and our ability to deal with that avalanche of technical capabilities. Designers regularly loose a critical perspective on their sketching and prototyping activities. We noted that students and designers alike spend a lot of time mastering intricate tools and debugging technical issues when they should be developing, evolving and fine-tuning interesting experiences or sketches informing their design process.

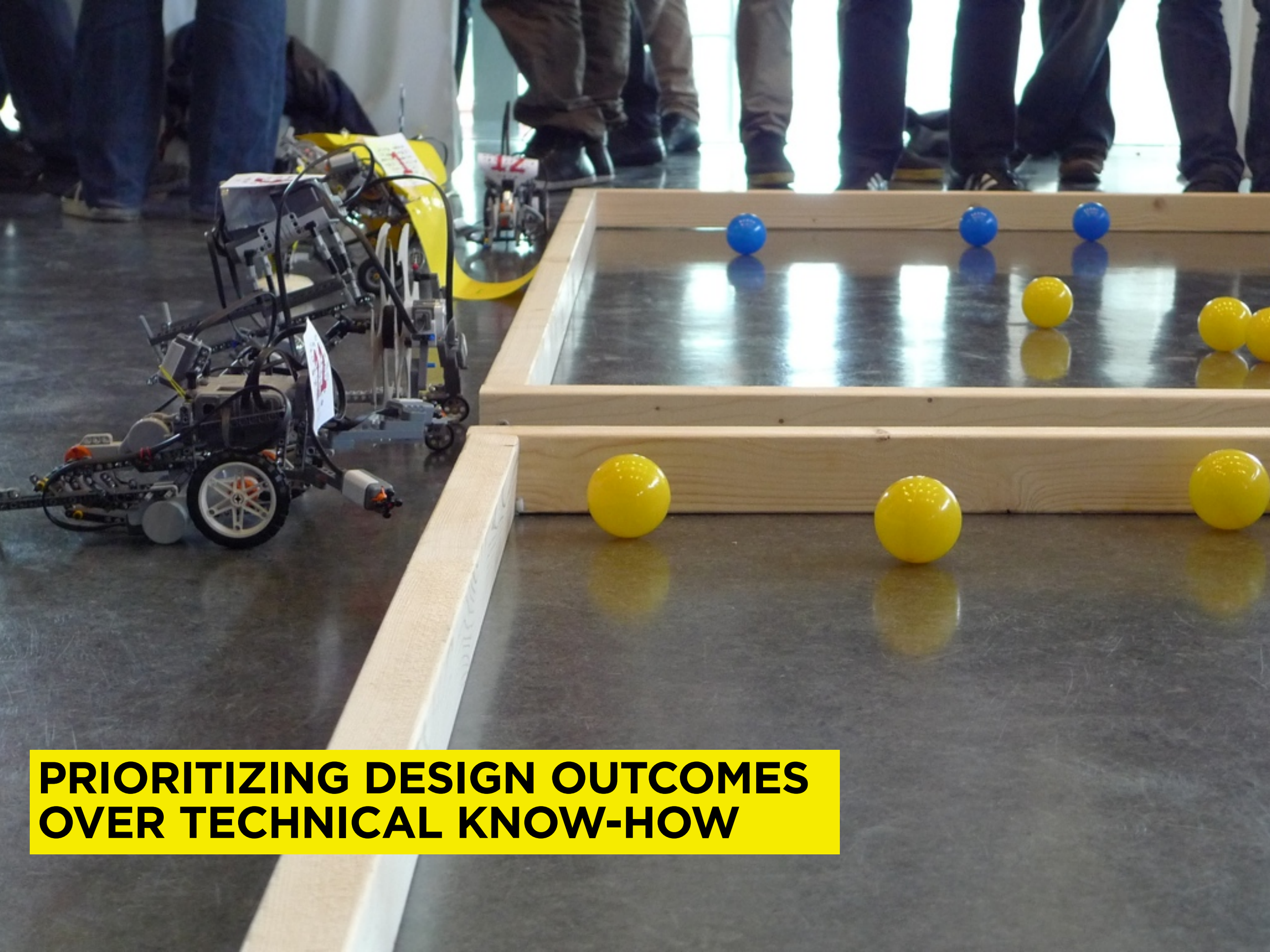
We close our discussion with a review of various toolkits and building blocks currently available to interaction designers for designing new technology and future concepts. We ultimately

MANIFESTING IDEAS

FROM THE SKY DOWN TO EARTH , OR VICE-VERSA

DESIGNING IN THE UNKNOWN

PROBLEM-SOLVING WITH DETOURS



PRIORITIZING DESIGN OUTCOMES OVER TECHNICAL KNOW-HOW

PRIORITIZING DESIGN OUTCOMES OVER TECHNICAL KNOW-HOW

HOW DOES IT INFORM YOUR DESIGN WORK?

TECHNO CENTRIC ↔ HUMAN CENTRIC

SIMPLE HAPTICS
SKETCHING TOOLS FOR HAPTIC INTERACTION DESIGN

HAPTIC INTERACTION DESIGN

Haptic interface

Haptic interface presents synthetic stimulation to proprioception and skin sensation.

Haptic perception

Combination of somatosensory perception on the skin and proprioception, no limited to one organ

First sense to develop in humans and may be the last to fade.

20x faster than vision, we can notice two stimuli just 5 ms apart.

Can sense displacements on our palm as low as 0.2 microns in length.

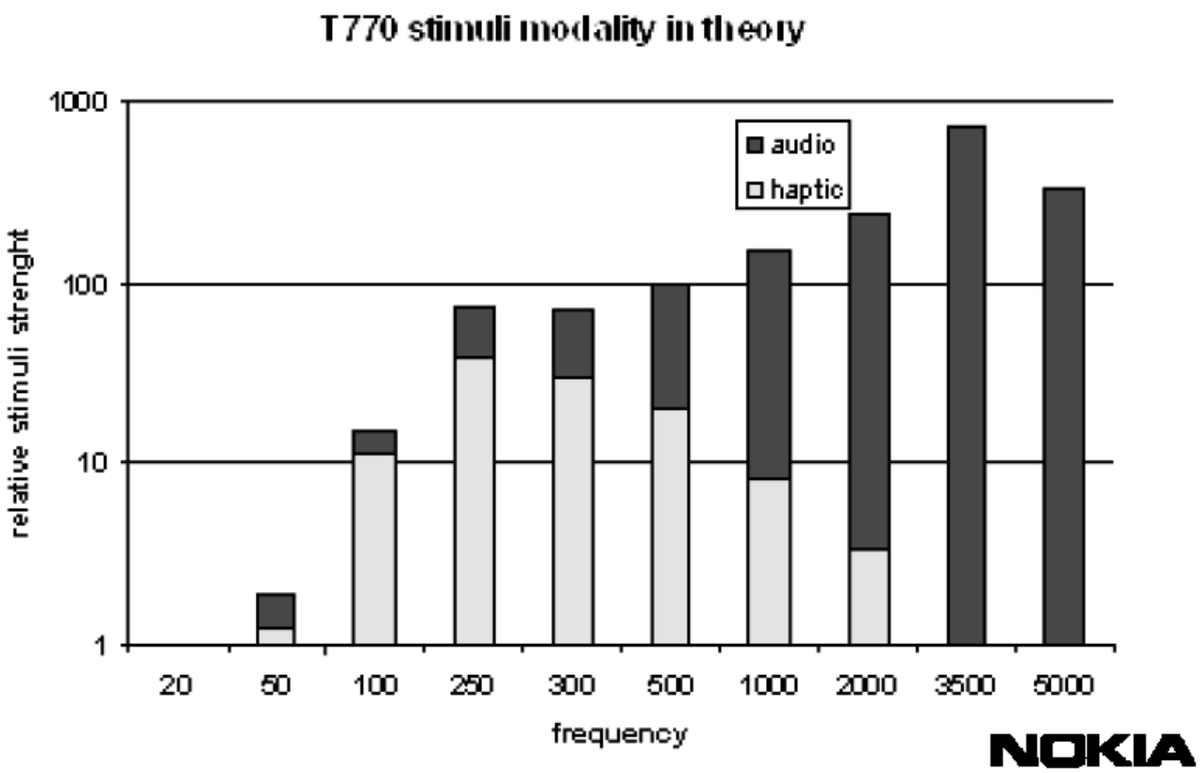
Haptic perception

Active vs passive touch

Haptic interaction is very often **multimodal**

Visual or audio cues can augment haptic perception

No clear boundary between sound and vibration, natural overlap



THE WORLD OF HAPTICS

TYPICAL INTERFACES

THE WORLD OF HAPTICS

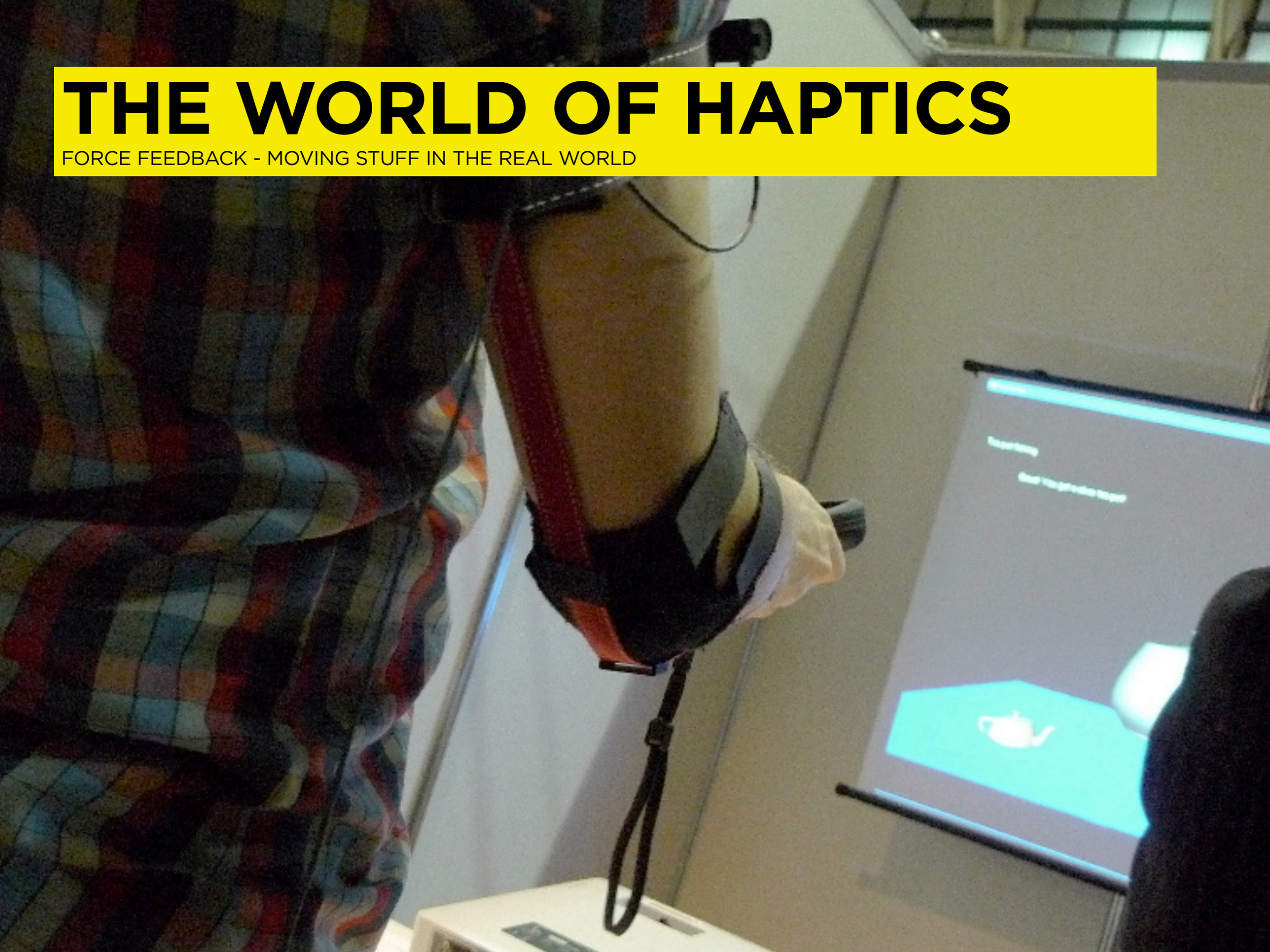
SIMULATION OF DIFFERENT SURFACES

THE WORLD OF HAPTICS

COMPLEX AND TECHNICAL

THE WORLD OF HAPTICS

FORCE FEEDBACK - MOVING STUFF IN THE REAL WORLD

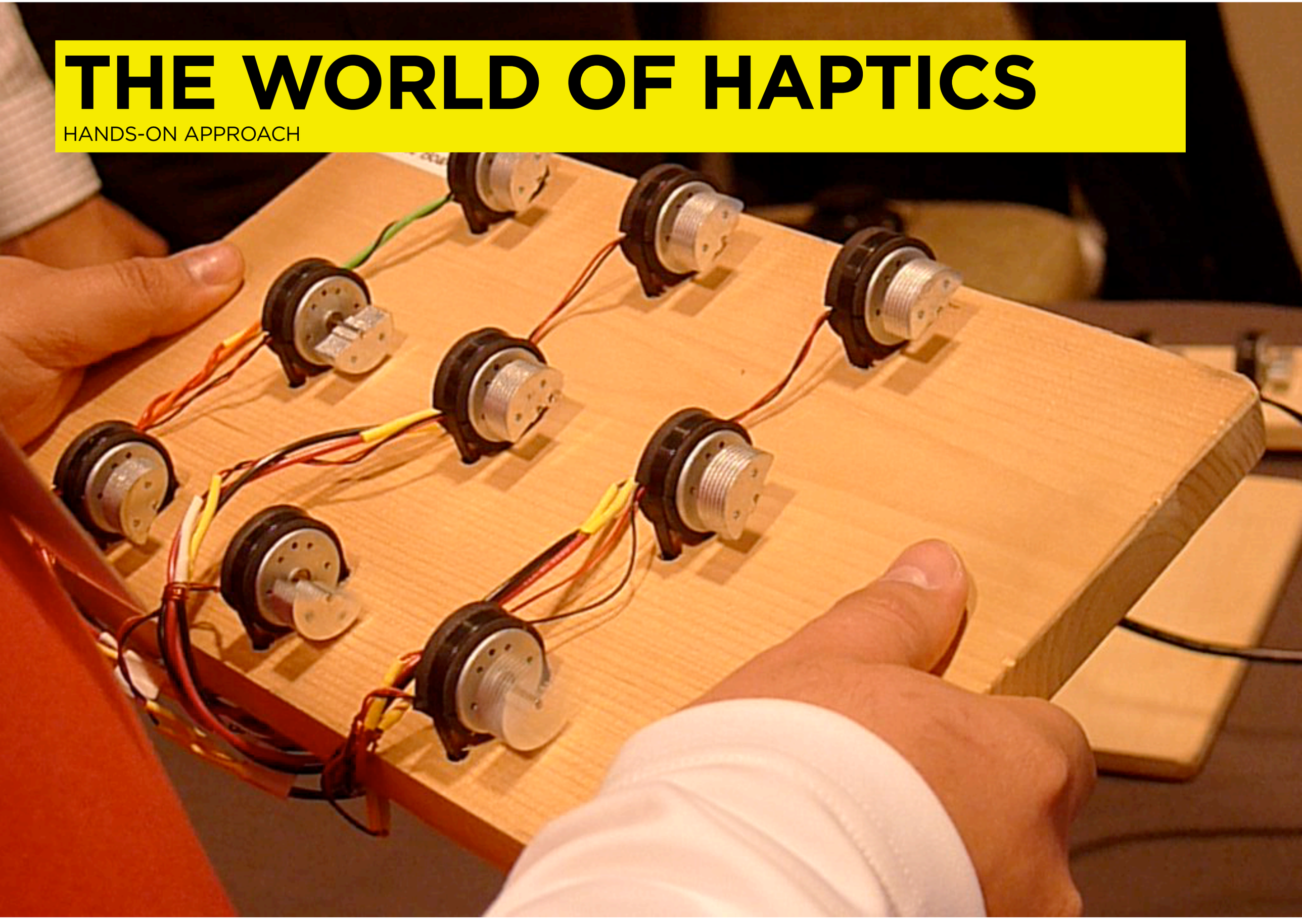


THE WORLD OF HAPTICS

SYNTHESIZING AND FAKING

THE WORLD OF HAPTICS

HANDS-ON APPROACH

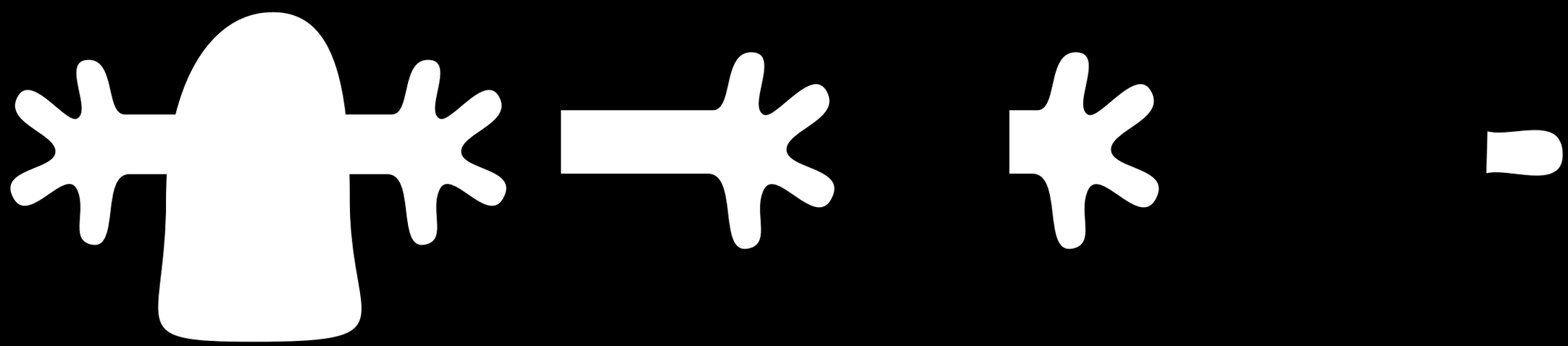


THE WORLD OF HAPTICS

RECREATING THE NATURAL INTERACTIONS

Haptic interface

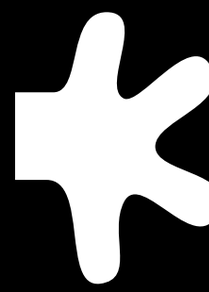
Body	Arm	Hand	Fingertip
1-3 m	20-100 cm	1-20 cm	under 1 cm



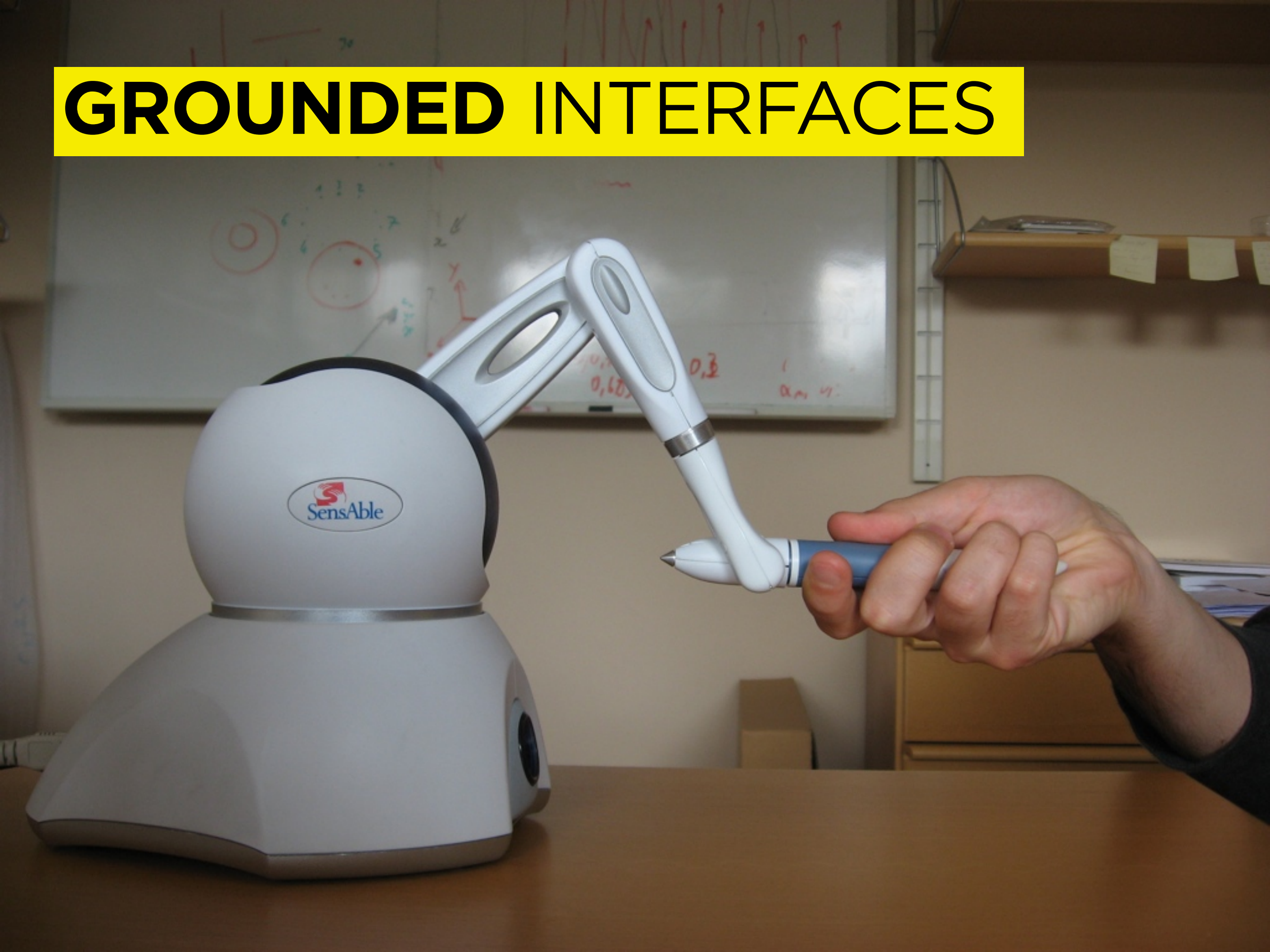
Haptic interface

Hand

1-20 cm



GROUNDED INTERFACES

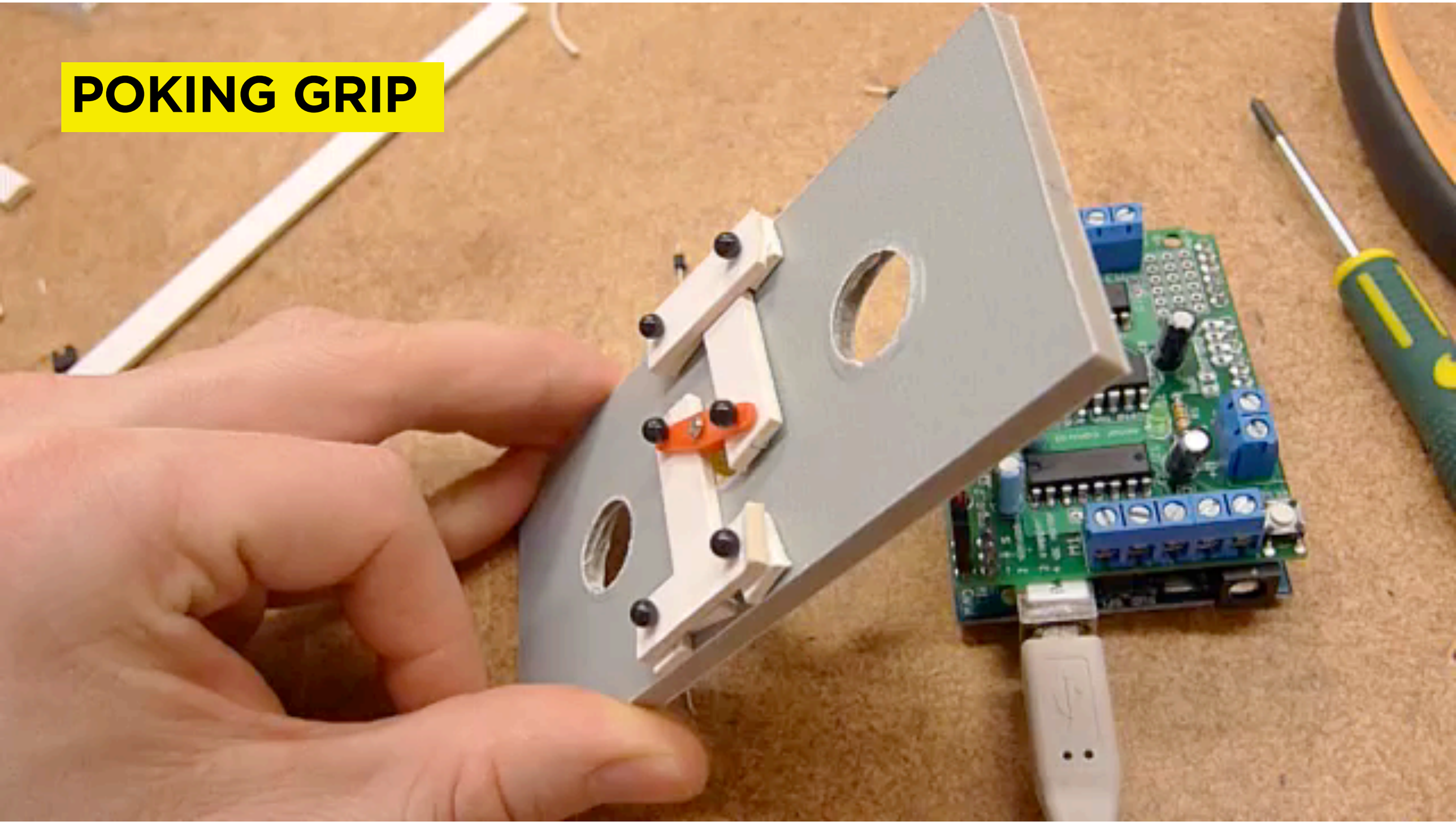


UNGROUNDED INTERFACES

NORDICHI 2008 WORKSHOP:
GUIDELINES FOR HAPTIC LO-FI PROTOTYPING

VIBRO GRIP

POKING GRIP



SKETCHING HAPTICS

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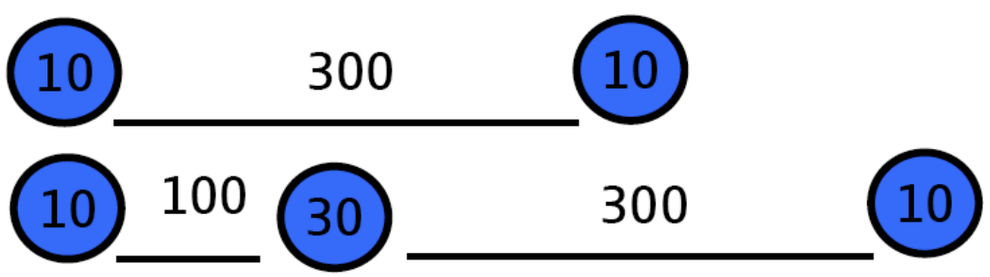
SKETCHING HAPTICS

How do you describe and design haptic I/O?

Lexicon & vocabulary?

Notation system for I/O? Music, sequencer, etc.



Measurement unit for haptic? Audio => dB

Hardware based or perception based?

Does it work across devices, humans, contexts, brands?

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

Related Works: Do It Yourself Haptics

The Art of Nonrealistic Usefulness and Realism Through Shortcuts

Hayward & MacLean, 2007

soft(n): Toward a Somaesthetics of Touch

Schiphorst, 2009

touch-effort	Description
tap	A soft, short, small, touch, rendered with a single finger.
pat	A bigger version of "tap" and a soft version of "slap". Usually rendered with an open hand or palm.
hold	A lingering, soft, big, touch. A hold is encompassing.
touch	"Touch" is a small version of "hold". An indication of comfort. Is rendered with the fingers, hand, or palm.
stroke	A traveling touch, soft but directional, rendered with fingers, hand or palm.
glide	A traveling, meandering, touch. Soft and directionless and rendered with the fingers, hand, or palm.
jab	A hard, short, small, touch. A hard poke by a finger or blunted object. Also known as "poke".
knock	A medium-sized, fist against, rapping hard. it is different than "jab" and "slap" in size only.
slap	An open-handed, hard, short, touch. In our scheme, a large version of "jab" and "knock".
press	This is a long, hard, touch.
rub	This is a moving, hard, touch.
knead	Kneading involves many fingers moving hard and in a slightly wandering fashion.
other touch-efforts not attempted in this system:	
punch	This is like a "knock", but is different in intensity and slightly different in timing.
flick	This is like a "jab", but a slightly different in shape over time. A "flick" wanders slightly more and a "jab" is more stationary.

Table 1: Touch Effort implemented onto Tactile Surface

Weight-Shifting Mobiles

Fabian Hemmert

Haptic design of vehicle interiors at AUDI
Werner Tietz, 2008

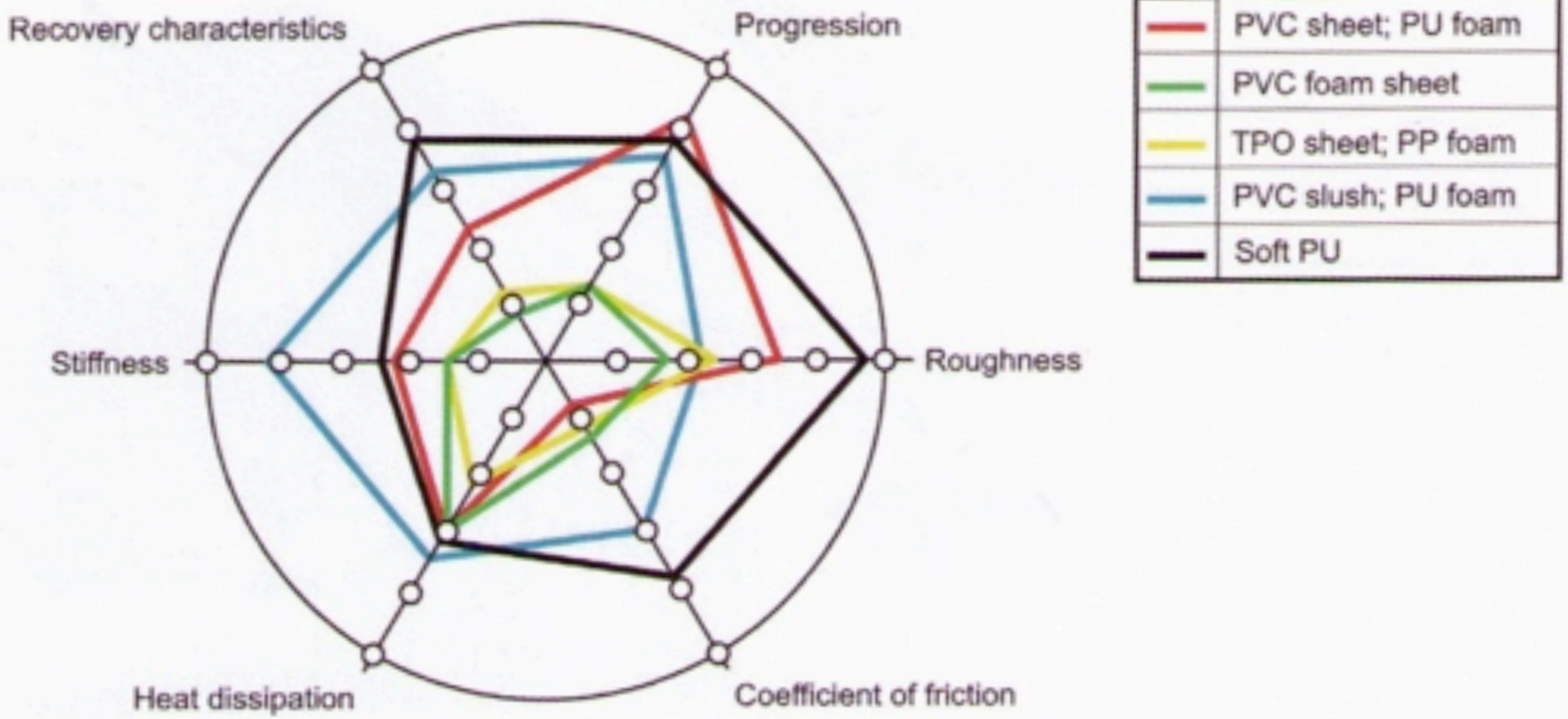


FIGURE 8. ASSESSMENT OF HAPTIC IMPRESSION BY MEASUREMENT

surface and his/her skin. Although it is possible to measure the quantities described above using suitable equipment, considerable deviations are found in the correlation between subjective perception and actual measurements.

The temperature perception reflects whether a surface feels 'warm' or 'cold'. The main factor in

objective, for example, is to achieve unifor in the softness of armrest surfaces, which be achieved by specific alteration of the stiff parameters.

The examples described here serve to an impression of the complexity of the con of 'haptics' for development of vehicle trim

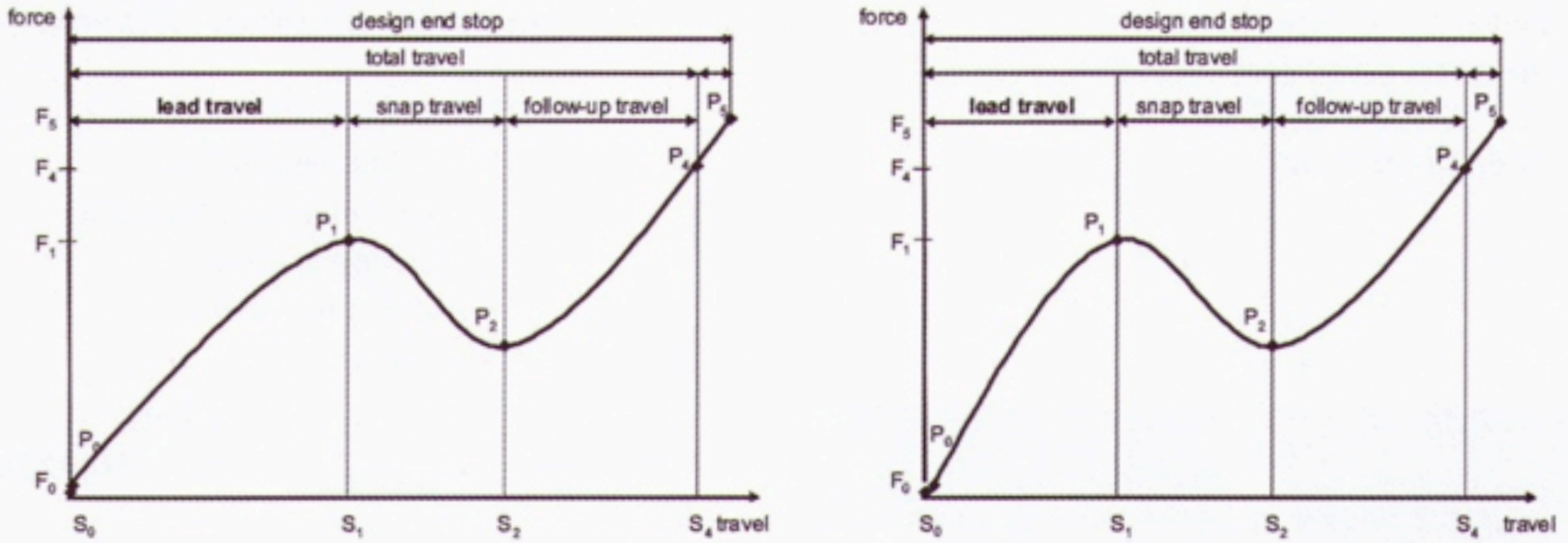


FIGURE 4. FORCE-TRAVEL CHARACTERISTIC: MODIFICATION OF LEAD TRAVEL TWICE

definition of variants the aim is to achieve maximum constancy of influencing factors which are not
swit
forc
contrast, is varied as systematically as possible
in order to clearly attribute differences in subjective assessment (dependent variable) to physical

ed (e.g., three conditions for lead travel x three conditions for snap travel). Figure 4 depicts sys-

variants being
te pair com-
parison, as used in psychophysics, is employed;
that is, each variant is compared to each other
variant with regard to various features. Paired

Haptics research at Daimler AG
Enigk, Foehl & Wagner, 2008

A Brief Taxonomy of Tactile Illusions and Demonstrations That Can Be Done In a Hardware Store

Vincent Hayward, 2008

Sec.	Name	Demonstrability	Stability	Analogs
2.1	Diplesthesia	Household	Not robust	Debatable
2.2	Funneling	Setup	Robust	Debatable
2.2	Cutaneous rabbit	Setup	Robust	Debatable
2.3	Size constancy failure	Household	Robust	Visual
2.4	Blackboard and parchment-skin	Household & setup	Robust	Cross modal
2.5	Weight-size and weigth-X	Household	Robust	Cross modal
2.6	Numerosity of taps from beeps	Setup	Robust	Cross modal
2.6	Numerosity of flashes from taps	Setup	Robust	Cross modal
2.7	Change numbness	Setup	Robust	Auditory and visual
2.8	Temporal ordering	Setup	Robust	Auditory and visual
2.9	Pseudo-haptic effects	Any computer	Moderate	Cross modal
2.10	Comb	Household & hardware	Robust	Tactile specific
2.10	Tactile lens	Specialized device	Robust	Tactile specific
2.10	Fishbone	Household & hardware	Robust	Tactile specific
2.10	Curved plate	Household & hardware	Robust	Tactile specific
2.10	Tactile barber pole	Hardware	Robust	Visual analog
2.11	Müller-Lyer *et alia*	Household & hardware	Moderate	Visual analogs
2.12	Kinaesthetic effects	Household	Robust	Visual analogs
2.12	Force by acceleration asymmetry	Setup	Robust	Tactile specific
2.13	Distal attribution	Household	Robust	Visual and auditory
2.13	Rolling ball	Setup	Robust	Auditory
2.14	Tactile Motion after-effect	Setup	Moderate	Visual and auditory
2.14	Weight after-effect	Household	Robust	Visual and auditory
2.14	Shape after-effect	Household	Robust	Visual
2.15	Texture force fields	Setup	Robust	Haptic specific
2.15	Corner smoothing	Setup	Robust	Haptic specific
2.15	Bump/holes	Hardware	Robust	Haptic specific

Mechanical non-programmable devices
Vincent Hayward, 2008

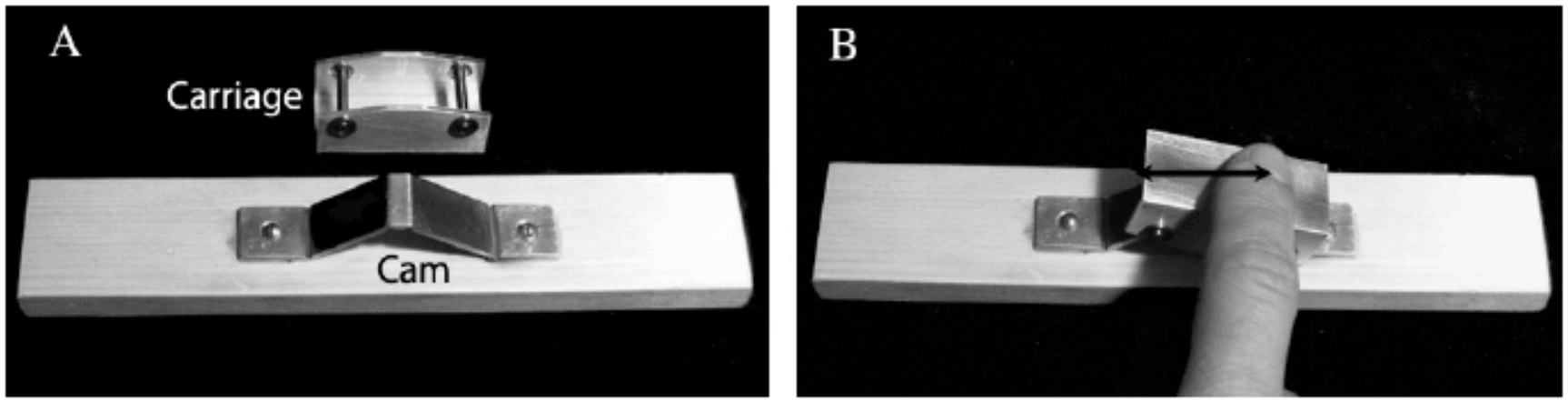


Figure 6: Mechanical delivery of the "curved plate illusion" [22]. (A) The device has a cam made of a bent metal strip which is secured to a wood base and a carriage having two rollers mounted on ball-bearings. Dimensioning is given in appendix. (B) Finger exploring the illusory curvature. For some subjects, the effect is more pronounced when the exploration is fore-aft rather than sideways. In any case it is important that the mechanism has little friction and produces little mechanical noise. These types of disturbances are prone to destroy or weaken the illusion. It is also important to press down lightly.

CHALLENGES AND DIFFICULTIES

Perception of touch: a collection of small and converging cues

Problems verbalizing and communicating sensations

Synthesizing movement and haptic feedback is not trivial, can be highly technical

Often technical problems/issues (i.e stiffness, latency) completely kill the interaction

Formal evaluation and comparison is impossible

Have to build stuff to inform/grasp/evaluate/discuss

QUALITIES AND AESTHETICS OF HAPTIC INTERFACES

Difficult balance between aesthetic and functional qualities

Haptic interfaces generally don’t fit well in our tactile eco-system

Naturalistic interactions are a good fit, but not an absolute rule

Timing, quality/precision, consistency, robustness, others [MacLean]

Tight sensory coupling seems appreciated

BUILD SOMETHING...

BUILD SOMETHING...

Task:

make **3 hardware sketches** that move 1, 5 and 10 mm