Elasticcon:
Elastic Controllers for Casual Interaction

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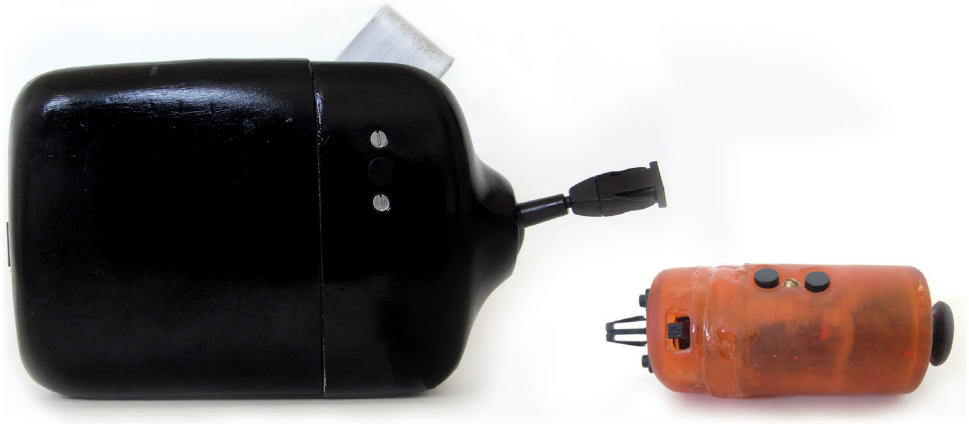

MobileHCI 2015
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Copenhagen, Denmark

TECHNISCHE UNIVERSITÄT DRESDEN
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Elasticcon in a Nutshell

Elasticcon in a Nutshell: Head-worn Displays and Glasses

Elasticcon in a Nutshell: Presentations

Elasticcon in a Nutshell: Remote Interaction

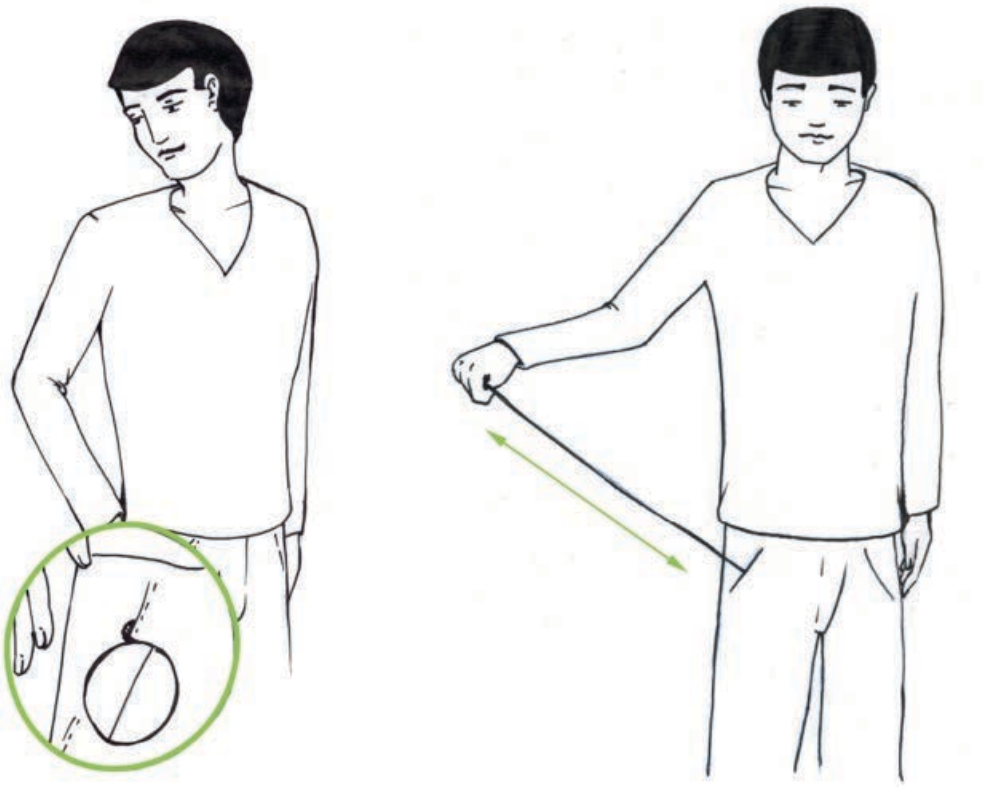
Motivation

Our Solution

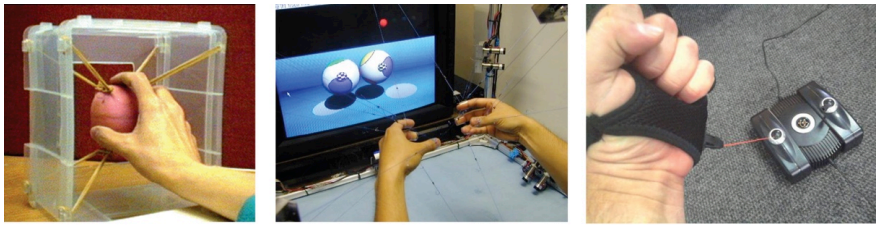
- body-attached
- haptic feedback
- multiple DoFs for flexible mappings

- unobtrusive
- simple interactions
- close to body

Idea: Physical Elastic Interaction

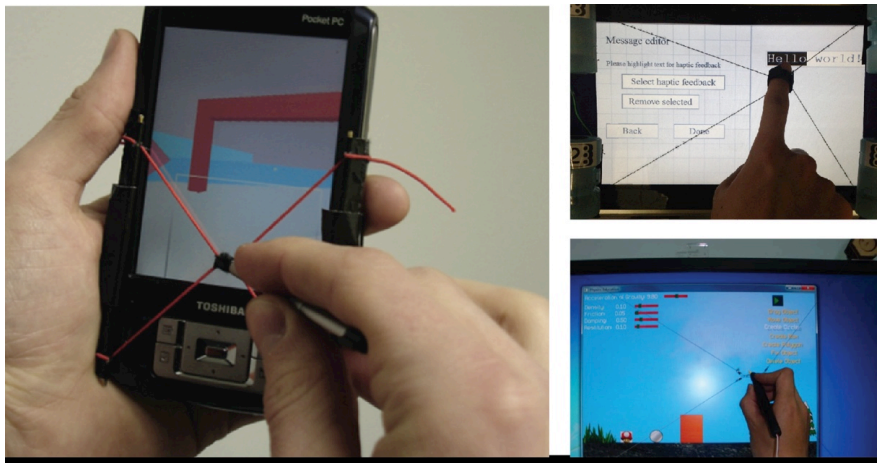


Related Work: String-based Interaction



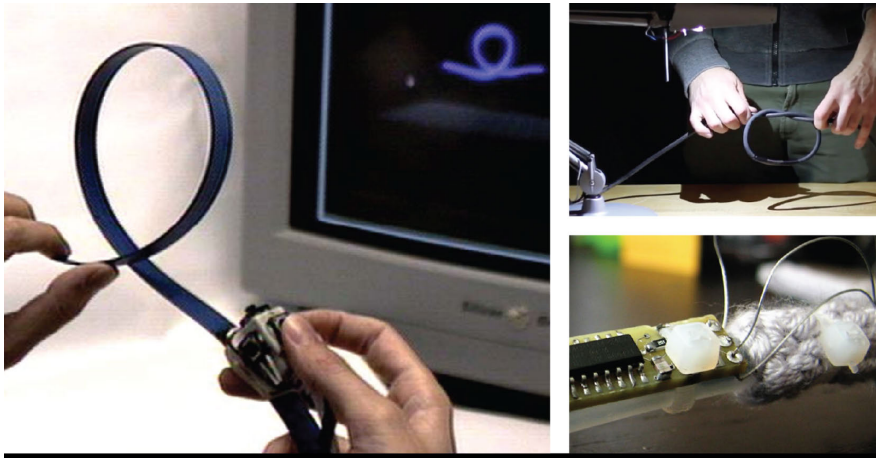
Ground-based

[Zhai ’95] [Kohno+ ’01] [Myers ’00] [Yao+ ’11] [Non. ’13]



Surface-attached

[Hachet & Kulik ’08] [Tamura+ ’13] [Lin+ ’11]



Manipulable Cords and Tapes

[Balakrishnan+ ’99] [Schoessler+ ’14] [Schwarz+ ’10]

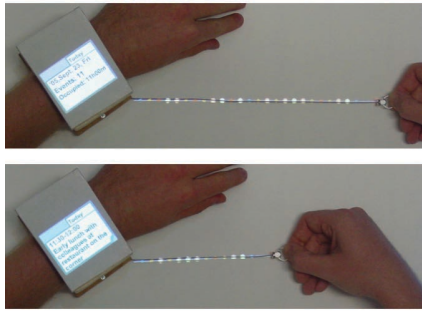
Body-centric

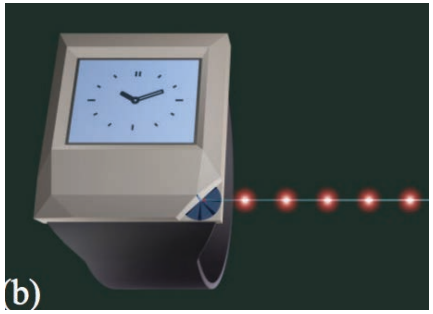
[Pohl+ ’13] [Blaskó+ ’06] [Koch & Witt ’08]

Related Work: Body-centric

Blaskó et al., 2006

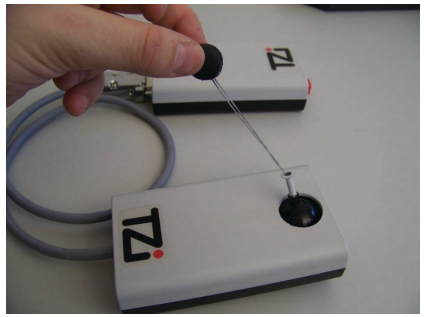
- wrist-worn watch
- display elements at string
- projected & optically tracked

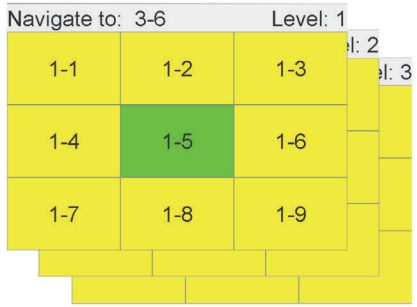




Koch & Witt, 2008

- chest-worn
- cone-shaped interaction space
- 3 x 3 x 3 grid selection

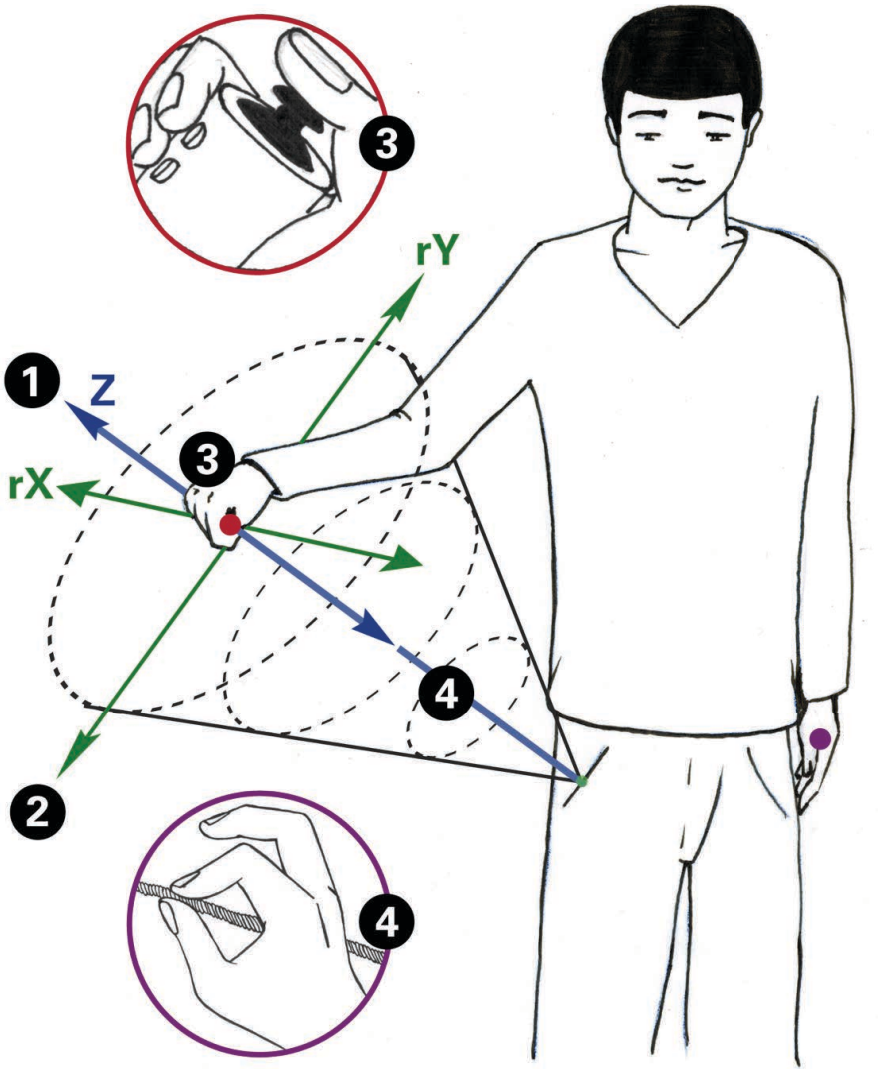




Pohl et al., 2013

- belt-worn badge
- indoor navigation & name badge

Interaction Space



1 Traction
Linear - positioning:
Pulling & Releasing Actions

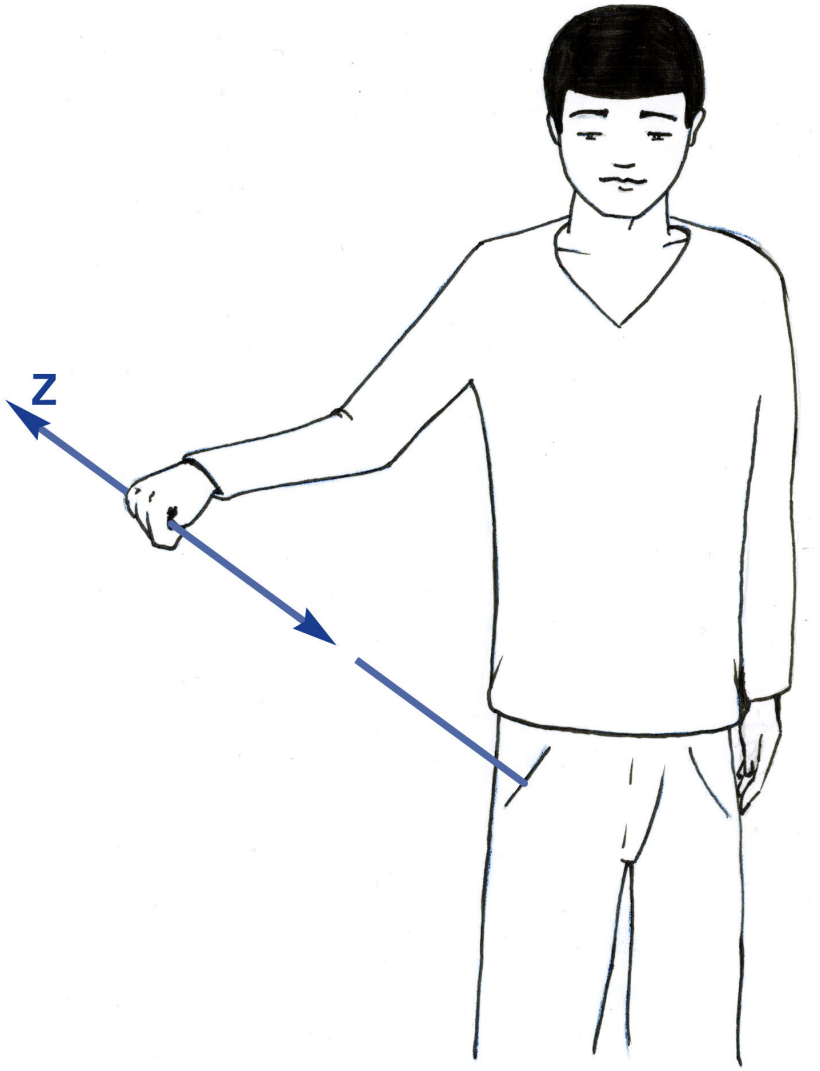
2 Deflection
Polar coordinate positioning:
Direction Selection
Grid Selection

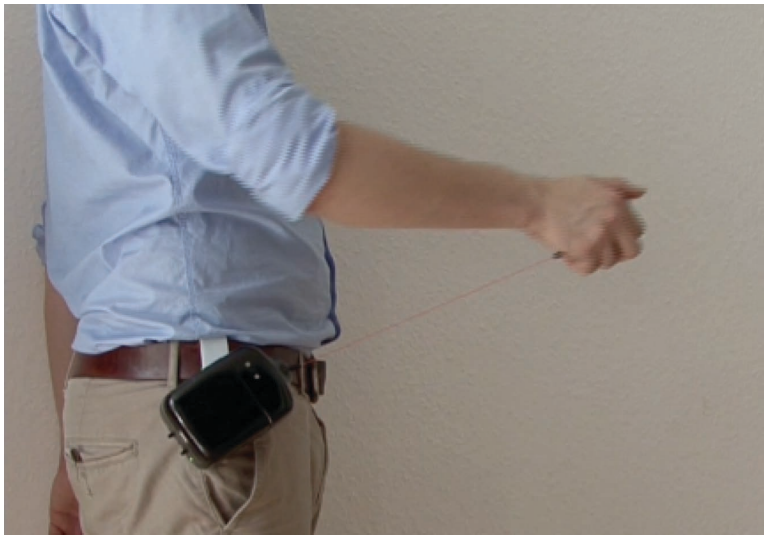
3 Additional Knobs
Further I/O capabilities:
Changeable traction knobs

4 String Manipulation
Sliding, pinching, twisting, bending, etc.

Interaction Space

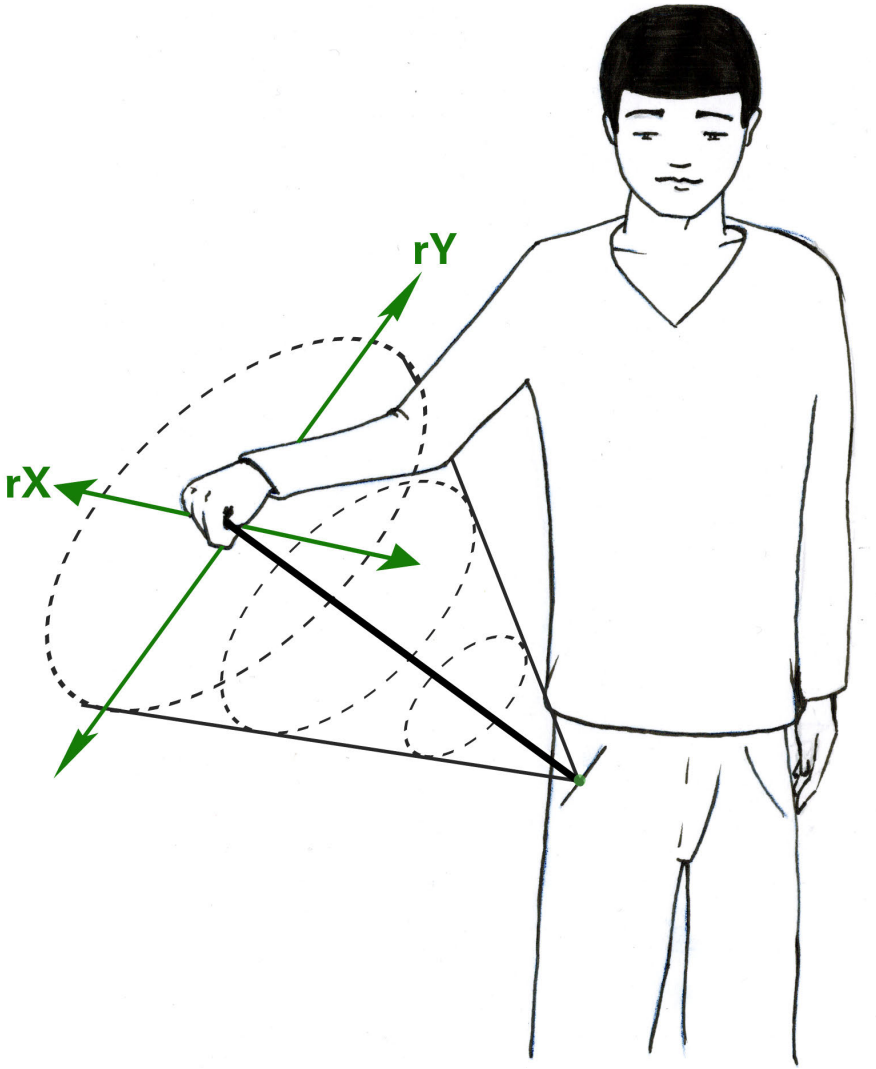
1 **Traction** 2 Deflection 3 Additional Knobs 4 String Manipulation

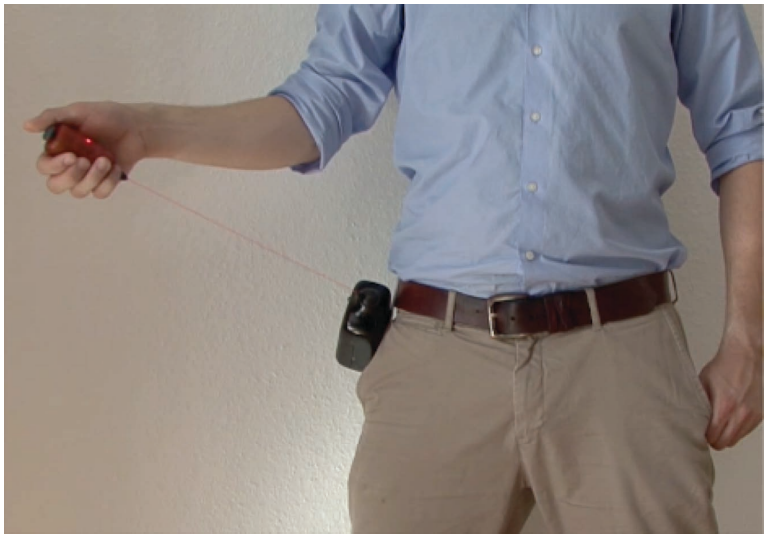




Interaction Space

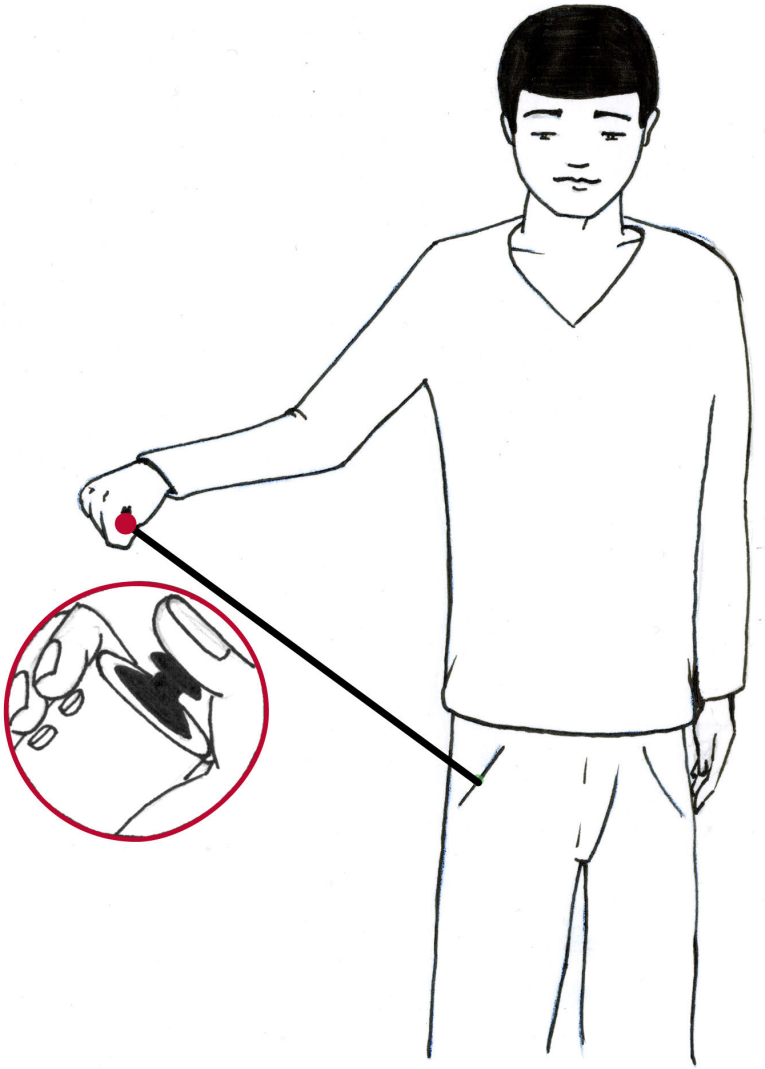
1 Traction **2 Deflection** 3 Additional Knobs 4 String Manipulation





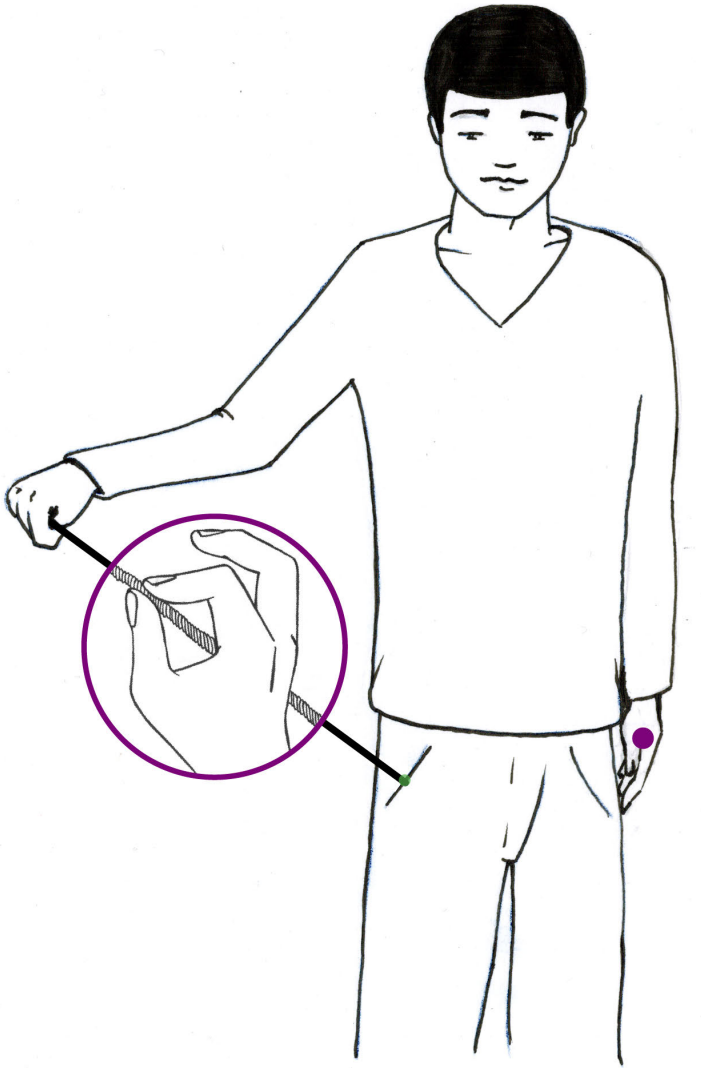
Interaction Space: Additional Knobs

1 Traction 2 Deflection **3 Additional Knobs** 4 String Manipulation

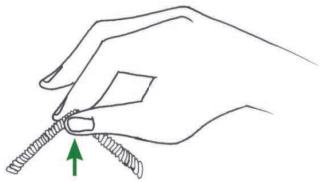


Interaction Space: String Manipulation

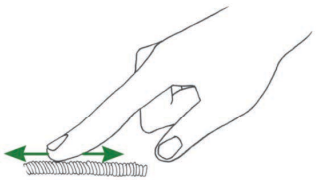
1 Traction 2 Deflection 3 Additional Knobs **4 String Manipulation**



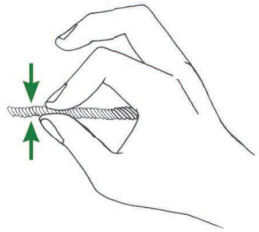
pulling



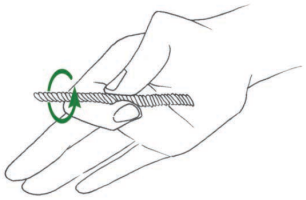
bending



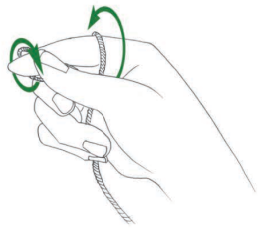
sliding



pinching

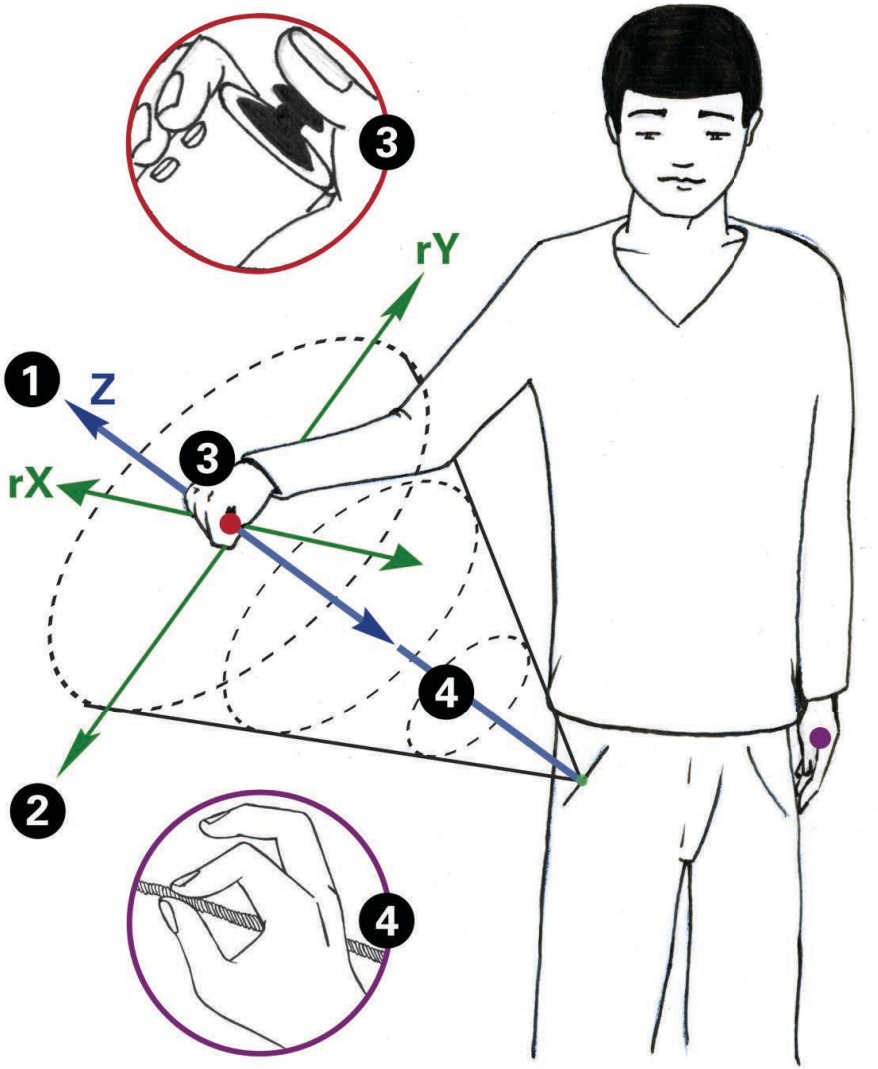


twisting



gesture-based manipulations

Interaction Space: Input Dimensions



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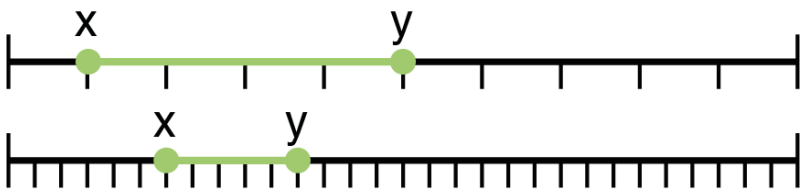
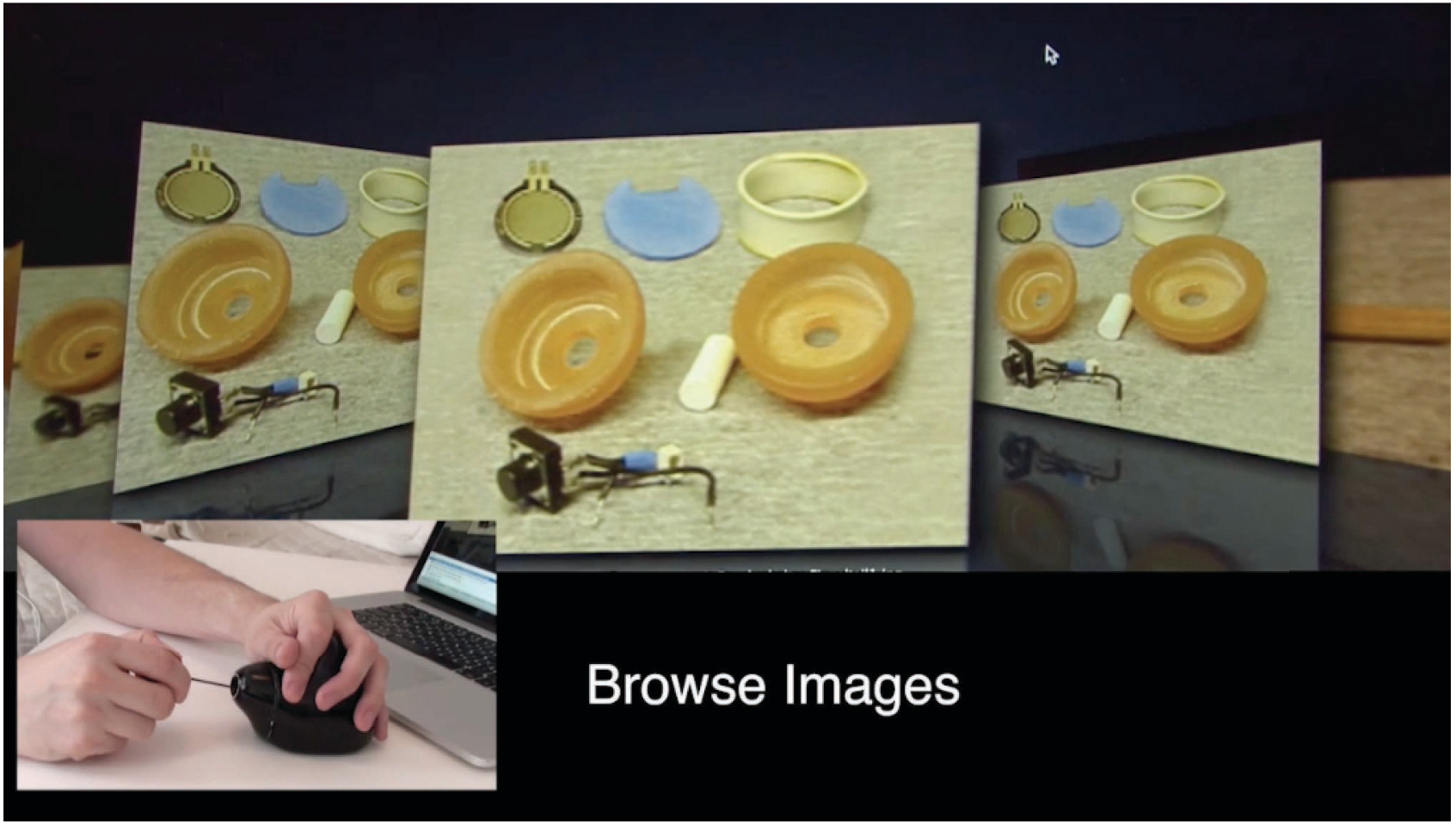
Basic Interaction Tasks

Single and Range Selection

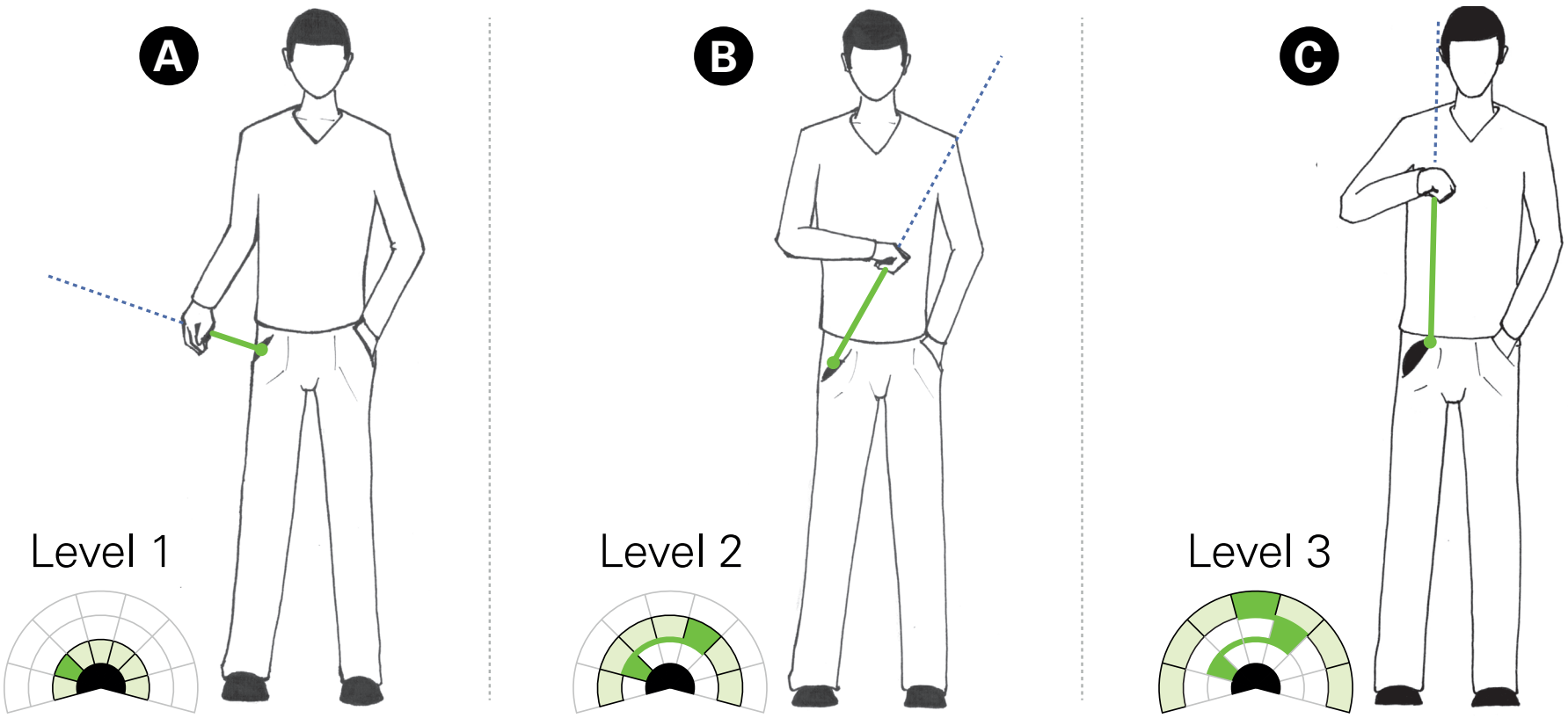
for adjusting parameters





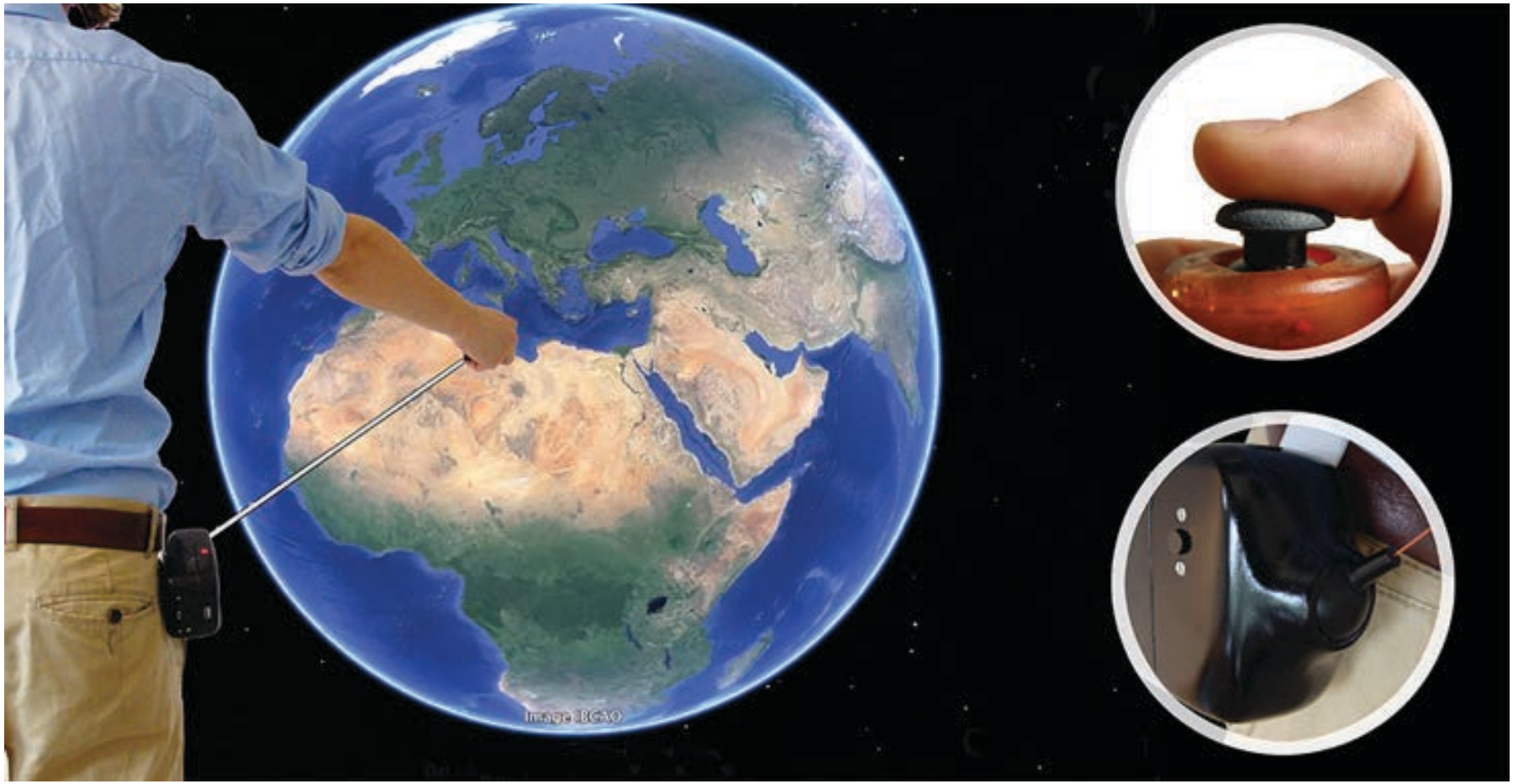
Selection in Hierarchical Menus

for choosing options, functions or switching states



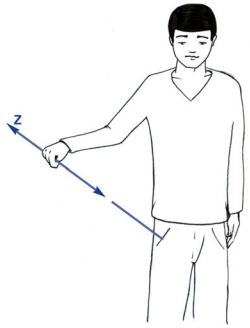
Zooming & Panning in Zoomable Information Spaces

for exploring multi-dimensional information spaces



Basic Interaction Tasks: Zoomable Information Spaces

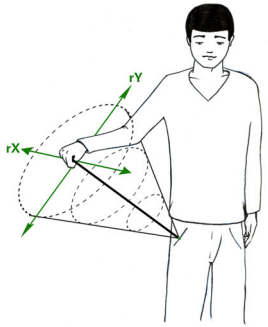
ZOOM



pulling-based zooming

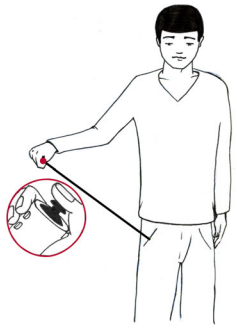
traction as a position-controlled and continuous zoom function

PAN



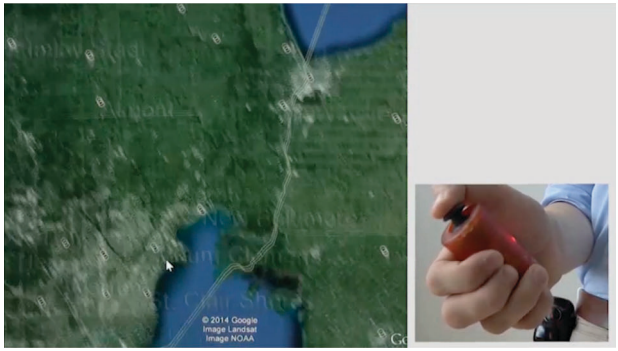
deflection-based panning

maps the deflection of the pulled string to a specific direction (rate-control).



joystick-based panning

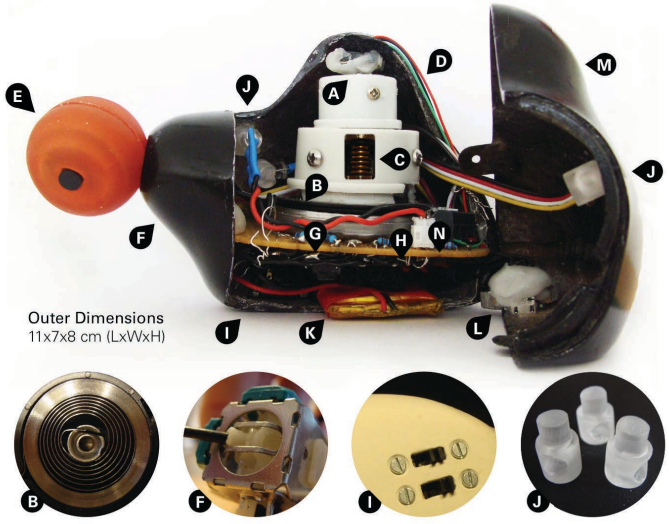
maps the deflection of the thumb joystick to a specific direction (rate-control).



Realization

Prototype I

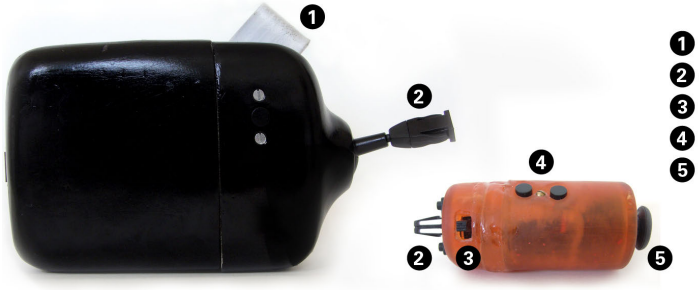
- cable used for knob signals
- rotary encoder



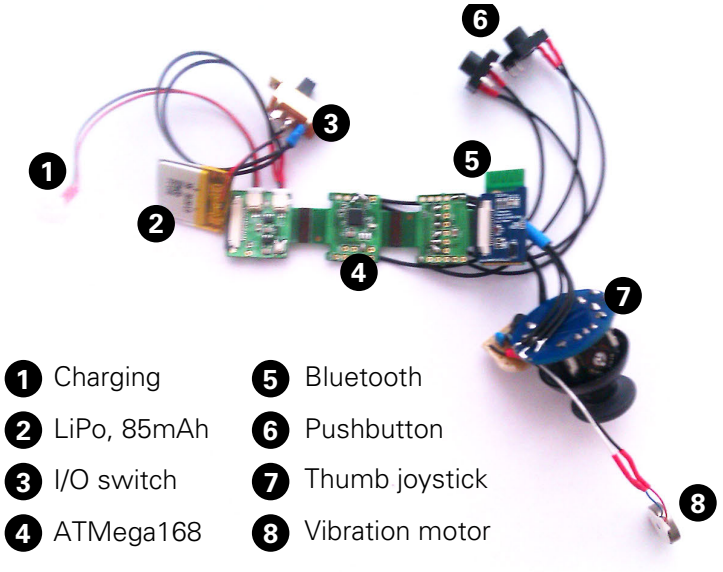
- A Rotary Encoder
- B Main spring
- C Slip Ring
- D Knob Cable
- E Traction Knob
- F 2-axis Joystick
- G Bluetooth Unit
- H Arduino Micro
- I I/O Switches
- J (RGB) - LED
- K Li-Po, 1000mAh
- L USB Connector
- M Openable case
- N Central board

Prototype II

- autonomous knob (wireless)
- absolute potentiometer



1. Belt clip
2. Joint clip
3. Power Switch
4. Push-Button
5. Mini Jostick

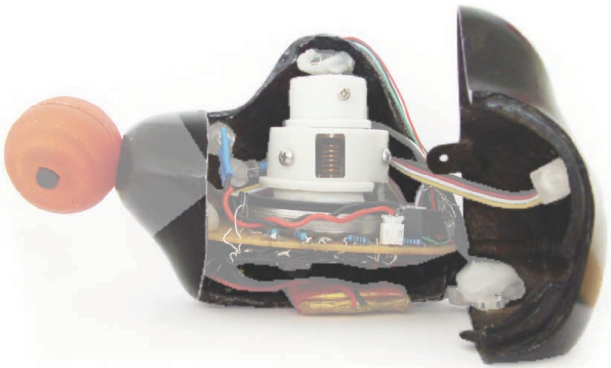


1. Charging
2. LiPo, 85mAh
3. I/O switch
4. ATMega168
5. Bluetooth
6. Pushbutton
7. Thumb joystick
8. Vibration motor

Realization: Additional Material

Abstract | Construction Details | Publications

http://imld.de/elasticcon



Components

To obtain more information of a component please select a entry in the list.

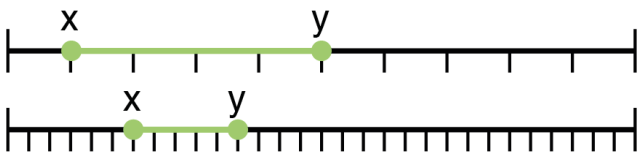
- Rotary Encoder
- Main spring
- Slip Ring
- Knob Cable
- Traction Knob
- 2-axis Joystick
- Bluetooth Unit
- Arduino Micro
- I/O Switches
- (RGB) – LED
- LiPoly, 1000mAh
- USB Connector
- **Openable case**
- Central board

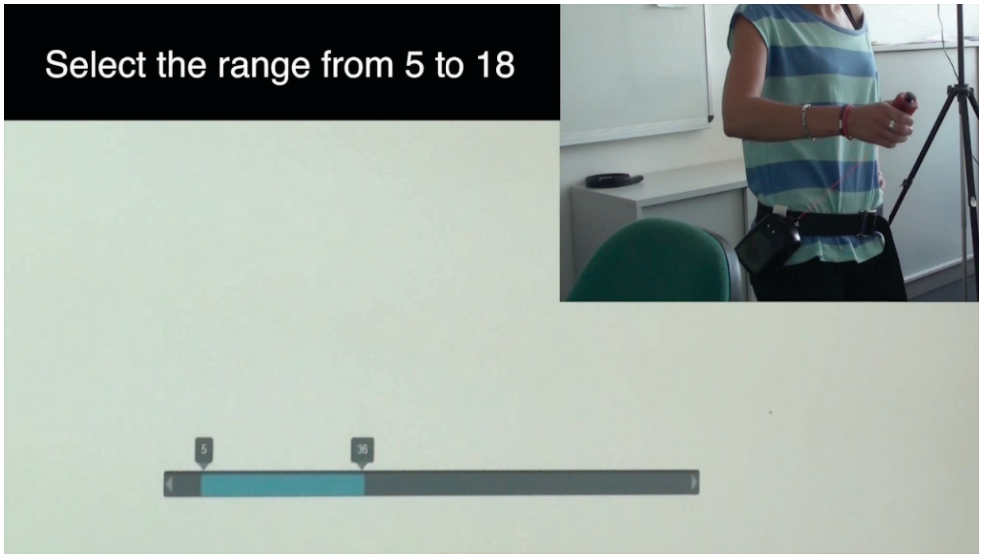
Openable case

Starting from the sketch, we carved and shaped a polystyrene block to an appropriate form that met all of our requirements. To achieve a smooth and robust surface, we reinforced the polystyrene model with some layers of plaster and sand the surface area with grit paper. Based on the result of these iterative form-finding process with polystyrene and plaster, we created a negative mould based on the final sanded and waxed model. The negative mould serves as the starting point for the final case building with fibre-reinforced polymer. In order to regain the smoothness of the surface, the hardened FRP-form is plastered and sanded again and compounded to a electrical component optimized final form, which have a side door and a strengthened thumb-joystick mounting position and several additional mounting holes for the micro usb connector, LEDs and switches. All parts were fit into the casing and disassembled again after all fine adjustments. As a last step

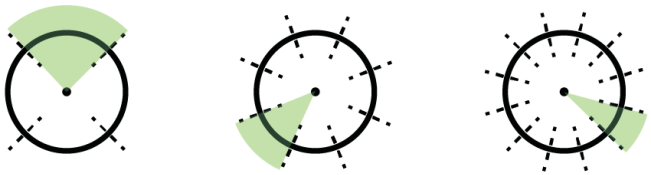
Qualitative Studies: Single & Range, Radial Selection

Single and Range Selection



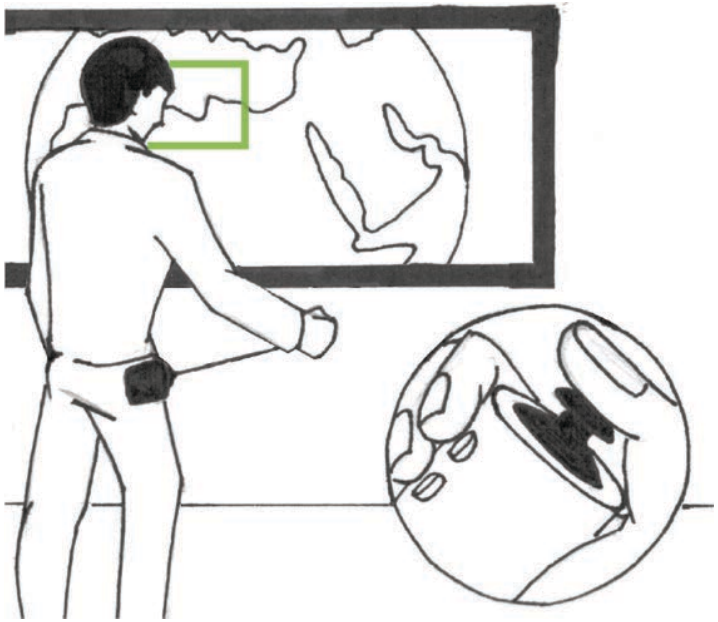


Radial Selection



4x 8x 16x

Qualitative Studies: Zoomable Information Spaces



Results

- Users preferred combination of traction (Zoom) and joystick knob (Pan)

> *"The joystick control is more precise for me, since I can immediately stop by releasing my thumb."*

- Problem of slipping out of position during trigger actions
- Some people preferred inverted control scheme for y-axis
- Overall people really liked the novel elastic controller

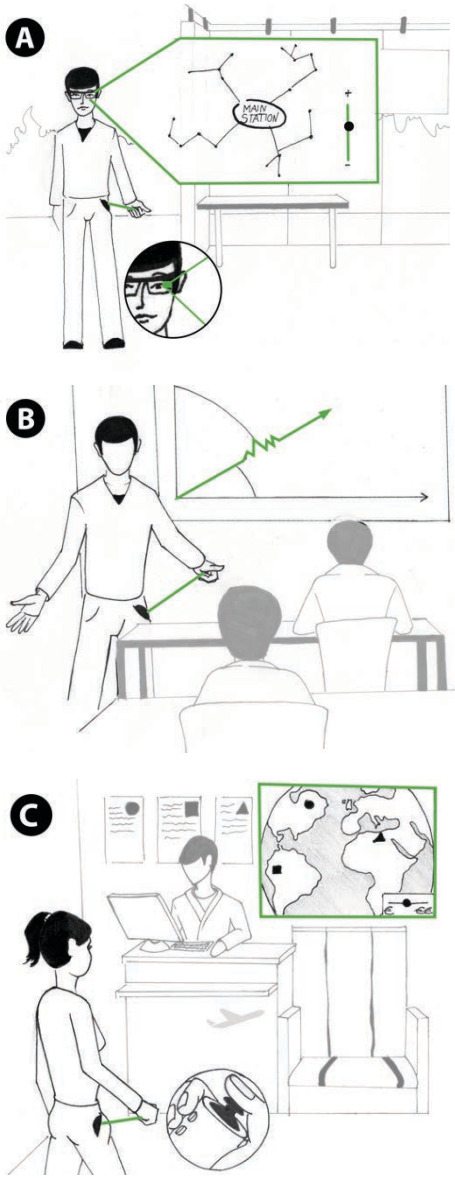
> *"I was really surprised and pleased how natural and accurate it felt to select data by pulling a string"*

Summary

- Elasticcon:
  an Elastic Controller for Casual Interaction
- Several Degrees of Freedom:
  traction, deflection and exchangeable knobs
- potential for several mobile interaction tasks

Future Work

- Further technical improvements
  and miniaturization
- Investigate combination of
  further knob modalities
- Use it for real-world applications





Questions?

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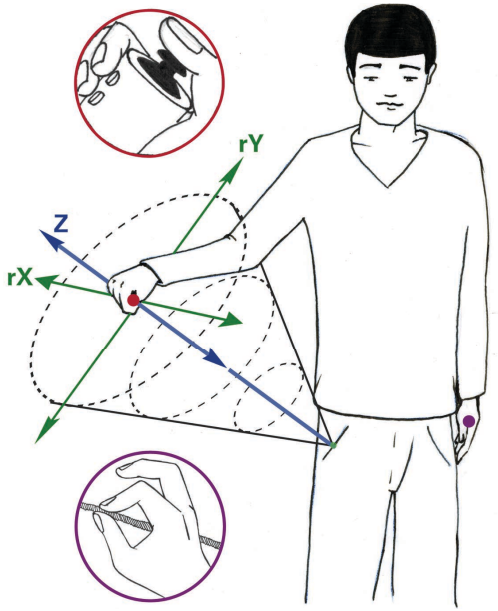

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Interactive Media Lab Dresden
http://imld.de/elasticcon

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