# Elasticcon:
Elastic Controllers for Casual Interaction

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A head-worn displays

B

C distant display interaction
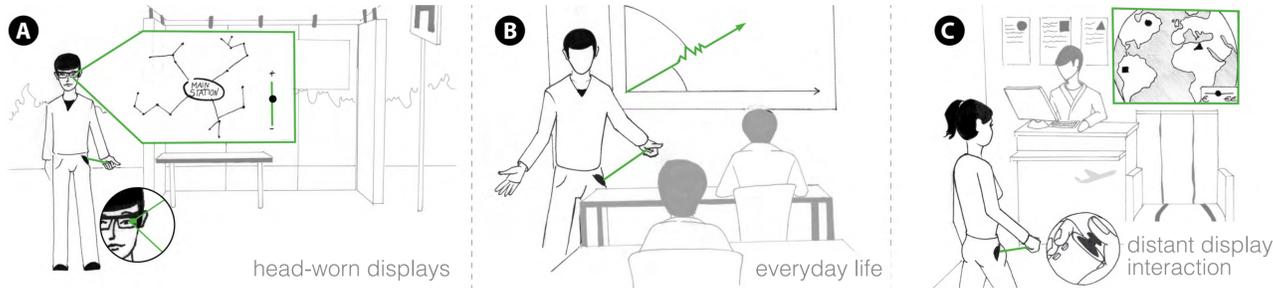
We explore the high potential of elastic controllers for casual interaction in mobile and ubiquitous computing scenarios. While several remote interaction techniques with handheld or body-worn devices have been proposed, the usage of string-based, elastic interaction is still underexplored. Therefore, we first introduce a systematic design space along the axes reference system, interaction dimensions, sensing methods and haptic feedback. Our main contribution is Elasticcon, a versatile, wearable device with a retractable string and a set of exchangeable traction knobs. This elastic controller provides several degrees of freedom and allows rich interaction techniques. As a result of an iterative design process, we also contribute two working prototypes for belt-worn and handheld use. To demonstrate their versatility, we implemented several promising application scenarios. We tested Elasticcon in three user studies investigating selection, manipulation and navigation tasks and found initial evidence for elastic controllers as being comfortable, casual and yet accurate interaction devices.

Interaction Space

❶ Traction
Linear - positioning:
Pulling & Releasing Actions

❷ Deflection
Polar coordinate positioning
Direction Selection
Grid Selection

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

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

z   rx   ry

1D - linear   2D - circular   3D - conical
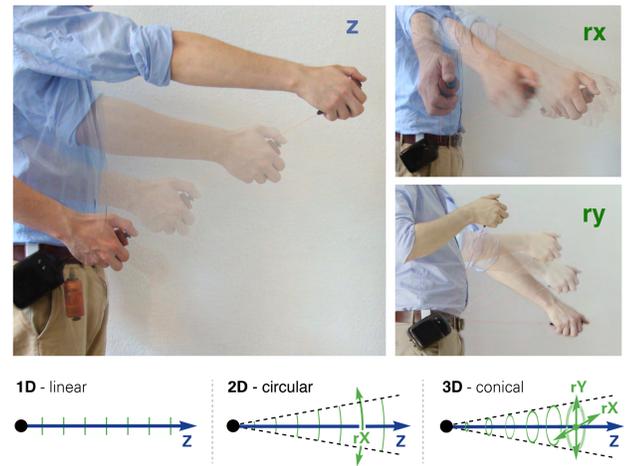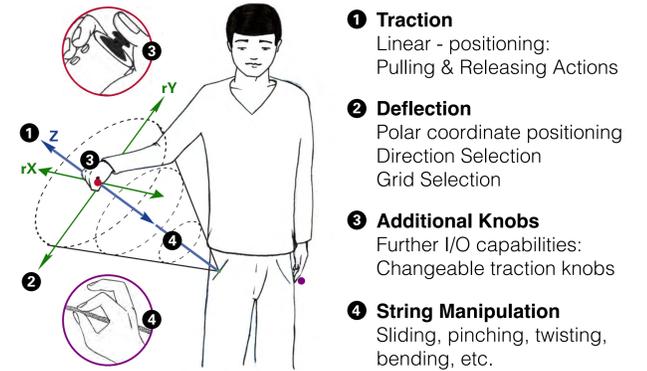
Prototypes

Prototype I
relative rotary encoder & signal cable for knobs

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

Outer Dimensions
11x7x8 cm (LxWxH)

Traction Knobs

Button + Vibro   Two Buttons   Rocker Switch   Pressure Pad

Slide Joystick   Rotary Knob   Three Buttons + Joystick + Vibro
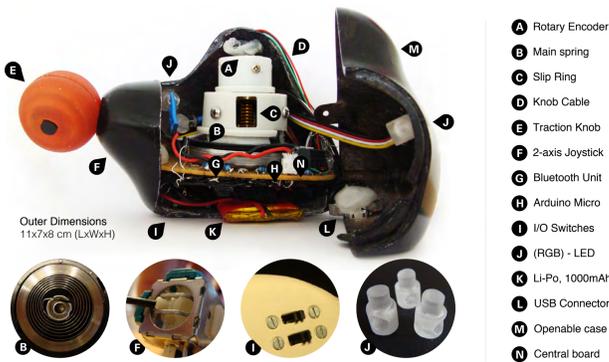
Prototype II
absolute potentiometer & wireless knob

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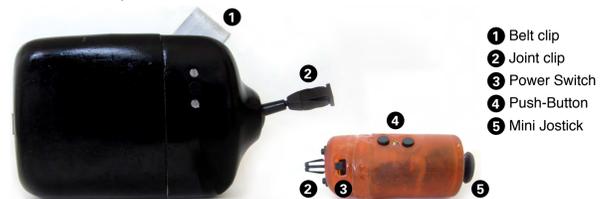
Interaction Principles

Single and Range Selection
adjusting parameters

x   y

x   y
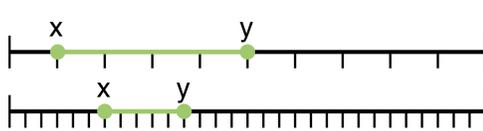
Hierarchical Menus
choosing options or switching states

A Level 1   **B** Level 2   **C** Level 3
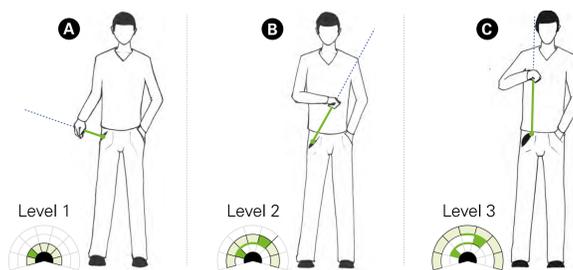
Zoomable Information Spaces
exploring multi-dimensional information spaces

zoom
pulling-based zooming
position-controlled

pan
deflection-based panning

joystick-based panning

rate-controlled
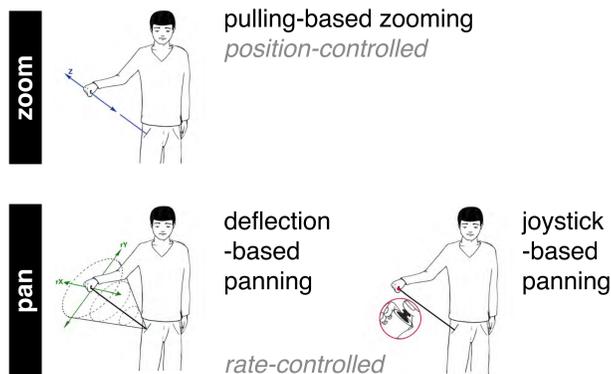
Qualitative Feedback

Study Parts & Tasks

S1 Select the following range between x and y.
x   y
Tasks: 0-10; 0-25; 0-50; 0-100 ticks
Conditions: pulling-based, mouse

S2 Select the highlighted section.
Tasks: 4; 8; 12; 16; 20 circular sectors
Conditions: deflection-based, joystick-based + with / without visual feedback

S3 Match the colored rectangular location target.
Tasks: 8 location targets
Conditions: deflection-based, joystick-based, mouse

### Selected User Comments

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

"I expected an inverted selection, as I was accustomed to control my game console."

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

1. The resistance force is perfect.
2. The pulling actions are easy to perform.
3. The differentiation of deflection-based states are easy for me.
4. The system reacts too slowly.
5. I could imagine a versatile use of the controller.
6. The interaction has been a pleasure for me.
7. I achieve the goal as intended.
8. The use of the controller feels familiar to me
9. I have difficulties in learning the usage of the system

0%   33%   66%   100%

Strongly agree   Agree   Neither agree nor disagree   Strongly disagree   Disagree

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