

# Stackables: Combining Tangibles for Faceted Browsing

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TECHNISCHE  
UNIVERSITÄT  
DRESDEN

IMLD

informatics mathematics  
*Inria*

The Aviz logo, which includes a stylized black eye icon above the word "Aviz" in a bold, sans-serif font. The "A" is blue and the rest of the letters are black.

# Motivation

- Decision making
  - Buying computer equipment, choosing books for a library...
  - Need to balance rich set of options
  - Collaborative process in small groups
  - People with varying priorities and skills involved



# Motivation

- Faceted Browsing & Search
  - Looking at data from different conceptual dimensions
    - Technical attributes, author, price, ratings, book genre ...
  - Incremental refinement by restricting facet values
- Challenges of faceted information seeking UIs
  - Decision makers start with private exploration and selection
  - Need to communicate facets to collaborators
  - Fluidly share, transfer, and manipulate them
  - Work in closely/loosely coupled way
- individual + collaborative information seeking UIs needed
- Idea: explore tangible interaction



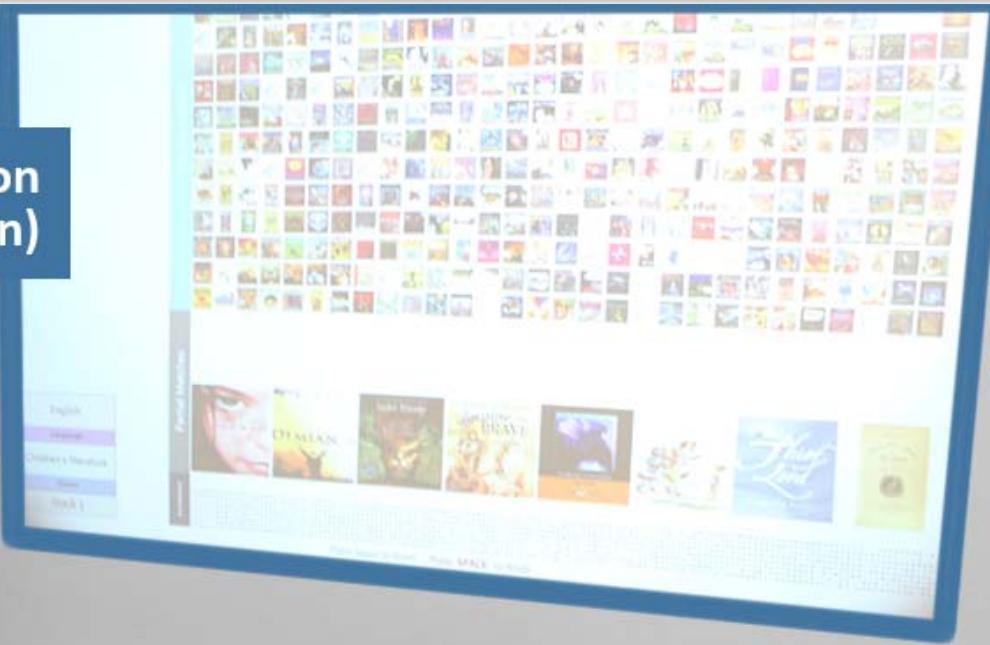
# STACKABLES

- Make facets & values graspable
- Physical Widgets with controls for faceted browsing
- Stacking metaphor: build query
- Can be manipulated, shared, transferred
- By individuals and groups
- Used for negotiating results



# Our Proposed Solution: Stackables

Result presentation  
(e.g., display, screen)



Workplace  
(e.g., office desk)



# Our Proposed Solution: Stackables

The image shows a screenshot from a video game. At the top, there is a horizontal scroll bar with numerous small book icons. Below it is a shelf containing several books, including "DEMIAN" by Herman Hesse and "Tigratine BRAVE" by Constance Kukla. In the foreground, three stackable devices are on the floor. The device on the left is labeled "Individual facet tokens". The middle device is labeled "Combined facet tokens (on ground plate)" and has two screens: one showing "English" under "Language" and another showing "Children's literature" under "Genre". The device on the right is labeled "Available Facets" and lists various categories like "Book", "Author", "Title", "Genre", "Language", "Year", "Publisher", and "Series".

Press Space to finish   Press SPACE to finish

Individual facet tokens

Combined facet tokens  
(on ground plate)

Available Facets

- Book
- Author
- Title
- Genre
- Language
- Year
- Publisher
- Series

# Our Proposed Solution: Stackables



# Related Work: Web-based Faceted Browsing

## Features

- Clear
  - Zoom Lens**
  - Image Stabilization (11)
  - High Sensitivity (7)
  - LCD Display (7)
  - Optical Zoom (7)
  - Photography (6)
  - Standard Zoom (6)
- [› See more...](#)

## Brand

- Nikon (3)
  - Canon (9)
  - Sony (5)
  - Olympus (3)
  - Fuji (3)
  - Kodak (2)
  - Opteka (1)
- [› See more...](#)

## Megapixels

- 5.9 MP & Under (2)
- 6 to 7.9 MP (2)
- 8 to 9.9 MP (2)
- 10 to 11.9 MP (11)
- 12 to 13.9 MP (6)
- 14 to 15 MP (3)
- 16 to 17 MP (1)

## Price

Any Price  
 to  **GO**

## Optical Zoom

- 3x to 3.9x (13)
- 4x to 5.9x (1)
- 6x to 9.9x (1)
- 13x & Up (4)

## Condition

- New (24)
- Used (22)
- Refurbished (10)

### Nikon D3000 10.2MP Digital SLR Camera with 18-55mm f/3.5-5.6G AF-S DX VR Nikkor Zoom Lens

Buy new: \$549.95 **\$489.95**

18 new from \$486.96

42 used from \$325.99

In Stock

(284)

[See newer model of this item](#)



### Canon Digital Rebel XSi 12.2 MP Digital SLR Camera with EF-S 18-55mm f/3.5-5.6 IS Lens - Black

Buy new: \$716.00

12 new from \$679.00

54 used from \$373.50

Only 10 left in stock - order soon.

(779)

[See newer model of this item](#)

### Sony A390 Digital SLR Camera - Black

Buy new: \$449.00

6 new

7 used from \$394.98

In Stock

(22)



### Canon Digital Rebel XTi 10.1MP Digital SLR Camera with EF-S 18-55mm f/3.5-5.6 Lens (Black)

2 new from \$749.00

39 used from \$300.00

(878)

[See newer model of this item](#)



### Olympus E-P2 12.3 MP Micro Four Thirds Interchangeable Lens Digital Camera with 14-42mm f/3.5-5.6 Zuiko Digital Zoom Lens (Electronic View Finder not included)

Buy new: \$1,099.99 **\$459.95**

7 new from \$459.95

6 used from \$405.00

Get it by **Thursday, May 24** if you order in the next **7 hours** and choose one-day shipping.

Only 1 left in stock - order soon.

(10)

Eligible for FREE Super Saver Shipping.



### Canon Digital Rebel XT 8MP Digital SLR Camera with EF-S 18-55mm f3.5-5.6 Lens (Black)

2 new from \$420.00

21 used from \$297.99

(545)

[See newer model of this item](#)



### Canon Digital Rebel XT 8MP Digital SLR Camera with EF-S 18-55mm f3.5-5.6 Lens (Silver)

6 new from \$749.00

35 used from \$260.00

(545)

### Nikon D60 10.2MP Digital SLR Camera with 18-55mm f/3.5-5.6G AF-S DX VR Nikkor Zoom Lens

Buy new: \$1,049.99

6 new from \$919.00

39 used from \$325.00

### Sony Alpha A230L 10.2 MP Digital SLR Camera with Super SteadyShot INSIDE Image Stabilization and 18-55mm Lens

6 used from \$290.00

(34)

# Related Work: Web-based Faceted Browsing

Search

Change Selections

[WOMEN](#) [MEN](#) [JUNIORS](#) [KIDS](#) [BRANDS](#) [SALE](#) [SPECIALTY SHOPS](#) [GIFTS FOR DAD](#)

Home / Men / Shoes / Athletic / Hiking

**Shoes**

**Athletic**

All Athletic

**Running**

All Running

Lightweight/Minimal

Motion Control

Neutral

Stability

Trail

**Training**

All Training

**Hiking/Walking**

All Hiking/Walking

**Hiking**

Walking

**Sport**

All Sports

Basketball

Tennis

Golf

**Featured Brands**

Nike

New Balance

Merrell

## HIKING

NARROW BY:

Size & Width: 7, 7.5, 8 | Color: | Price: \$100-\$150 | Brand: Keen Footwear, The North Face, Timberland | Store Availability: | CLEAR ALL X

SORT BY: FEATURED | NEWEST | PRICE | SALE | CUSTOMER RATING

3 ITEMS PAGE 1

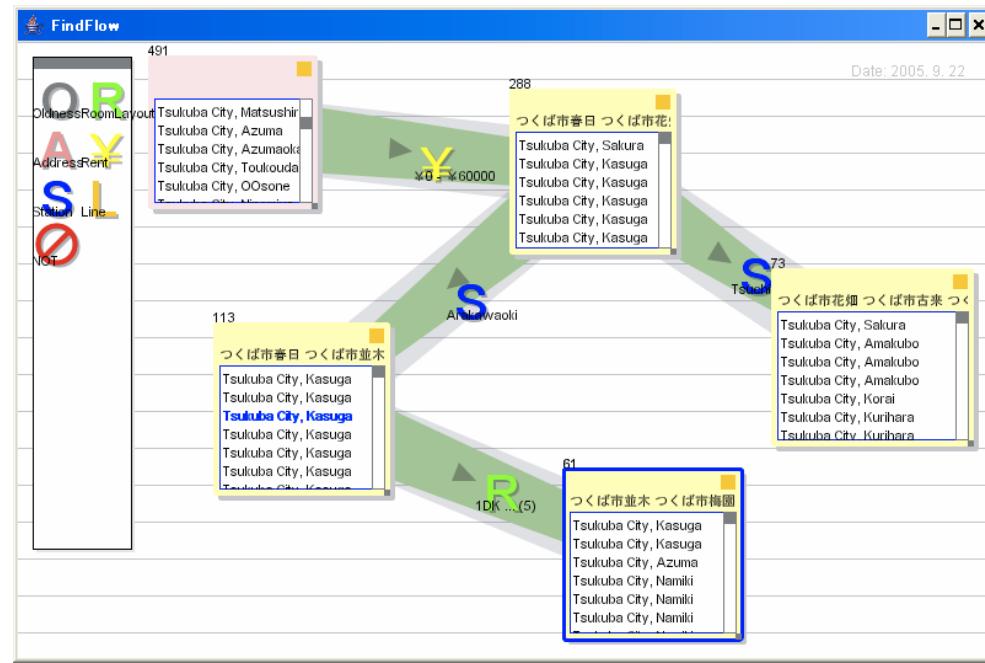
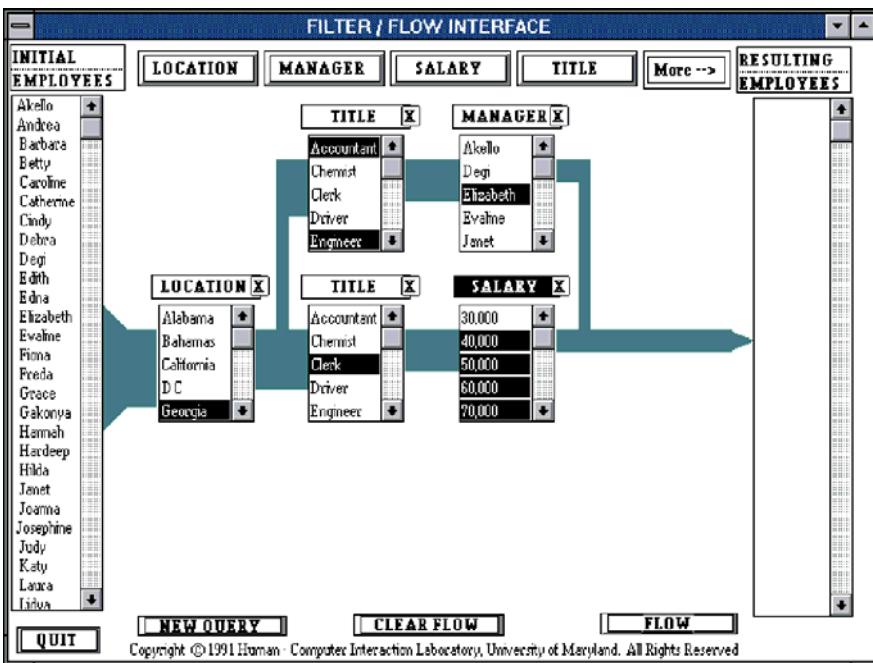
Keen 'Voyageur Mid' Hiking Boot (Men)  
EUR 99.71

The North Face 'Hedgehog GTX XCR III' Hiking Shoe (Men)  
EUR 99.75  
★★★★★

NEW MARKDOWN  
Timberland 'Chocorua' Trail Boot  
Was: EUR 108.06  
Now: EUR 89.69 15% OFF  
★★★★★

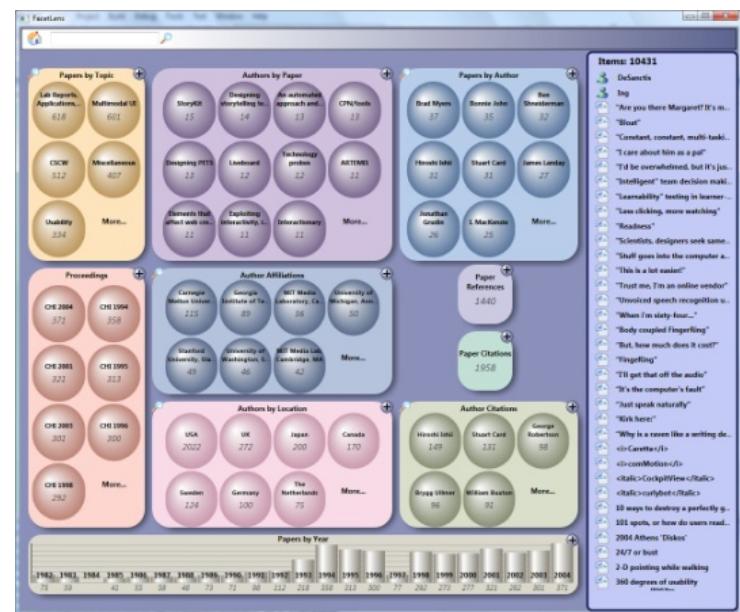
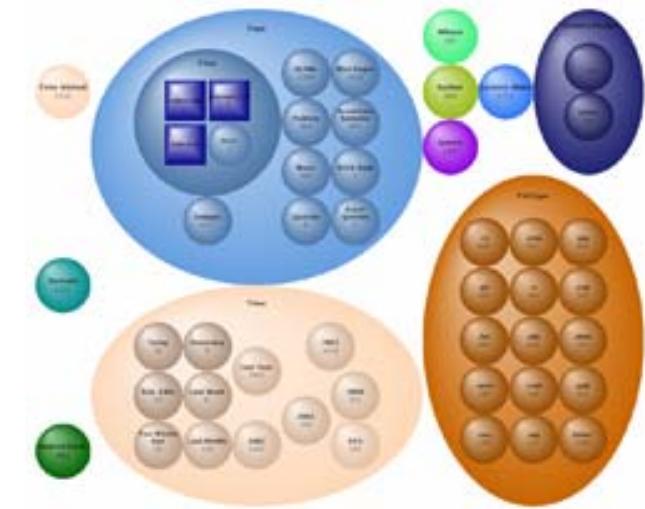
# Related Work: GUIs for Faceted Browsing & Search

- 20 years of research in interactive query refinement
  - Filter/Flow [Young & Shneiderman 93] facets as water filters
  - ...
- FindFlow [Hansaki et al. 06]



# Related Work: GUIs for Faceted Browsing & Search

- Zoomable UIs
  - FacetMap [Smith et al. 2006] →
  - FacetLens [Lee et al. 09] ↘
  - TimeSlice [Zhao et al. 12]
  - FacetZoom ↓  
[Dachselt, Frisch & Weiland 08]



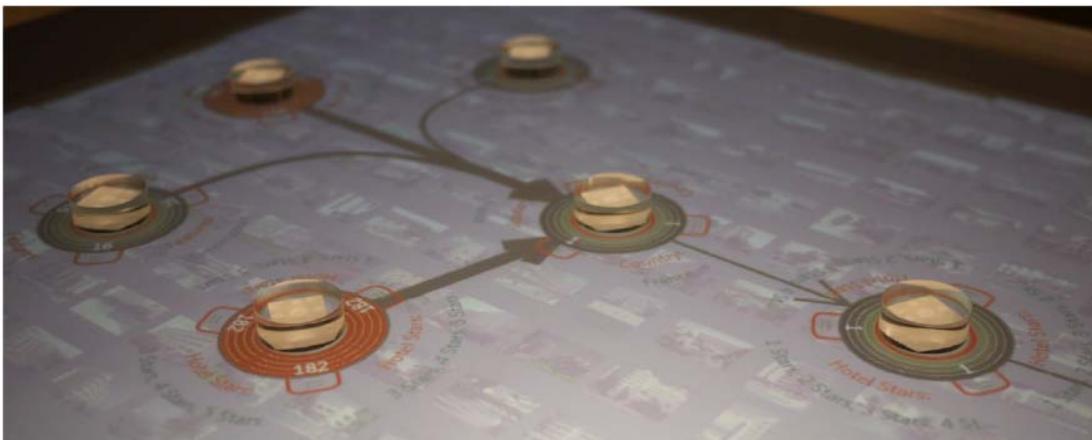
# Related Work: Tangibles for Information Seeking

- Navigational Blocks [Camarata et al. 02]
  - Early tangible faceted browsing interface
- Tangible Query Interfaces ↴  
[Ullmer, Ishii & Jacob 03]
  - Physical widgets for attribute control
- Venice Unfolding
  - Tangible UI for faceted geo-spatial data  
[Nagel & Heidmann 11]



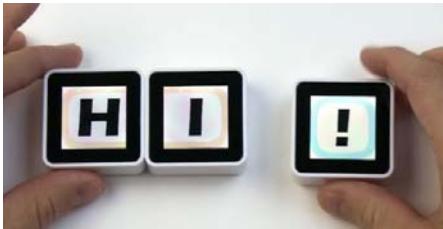
# Related Work: Tangibles for Information Seeking

- Cartouche [Ullmer et al. 10] →
  - A generalization of tangible menus
- FacetStream [Jetter et al. 11] ↓
  - Collaborative usage of tangibles

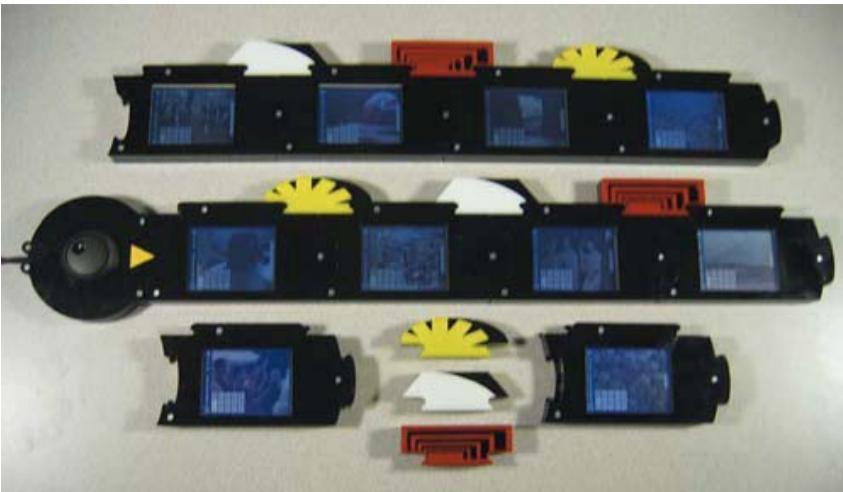


# Related Work: Combing and Stacking Tangibles

- Horizontal combination
  - Siftables [Merrill, Kalanithi & Maes 07]
  - Sifteo Cubes ([www.sifteo.com](http://www.sifteo.com))

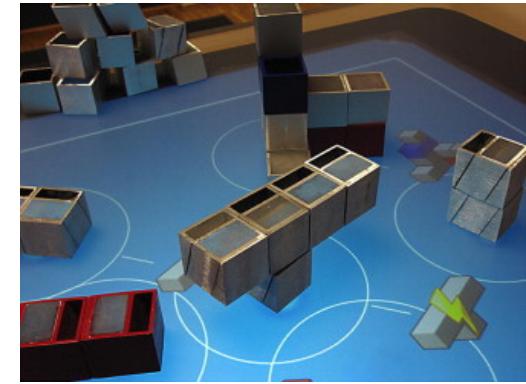
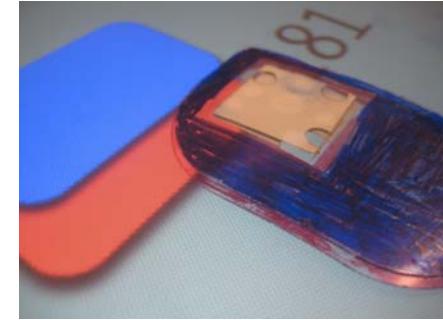
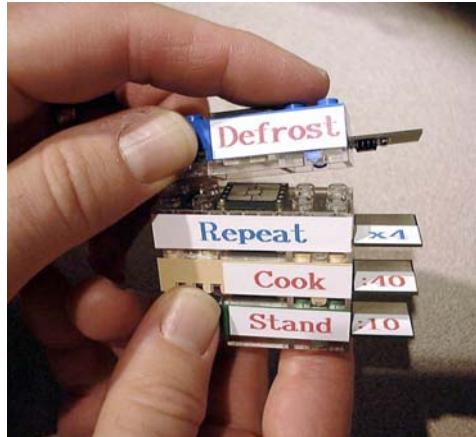
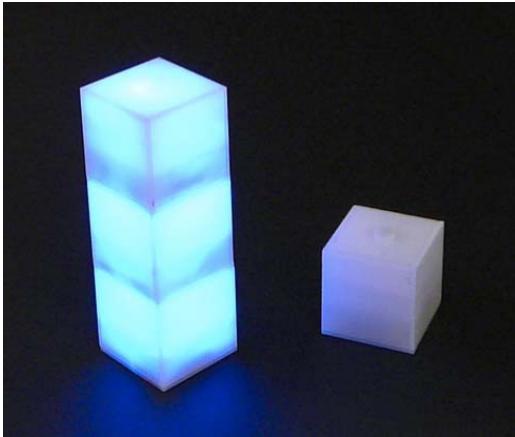


- Video Editing [Zigelbaum et al. 07]



# Related Work: Combing and Stacking Tangibles

- Vertical combination
  - Stacks on the Surface → [Bartindale & C. Harrison 09]
  - Lumino [Baudisch, Becker & Rudeck 10] ↴
  - CapStones and ZebraWidgets ↴ [Chan et al. 12]
  - Tangible Programming Bricks ↴ [McNerney 2000]
  - TimeBlocks [Hayashi et al. 12]  
↓



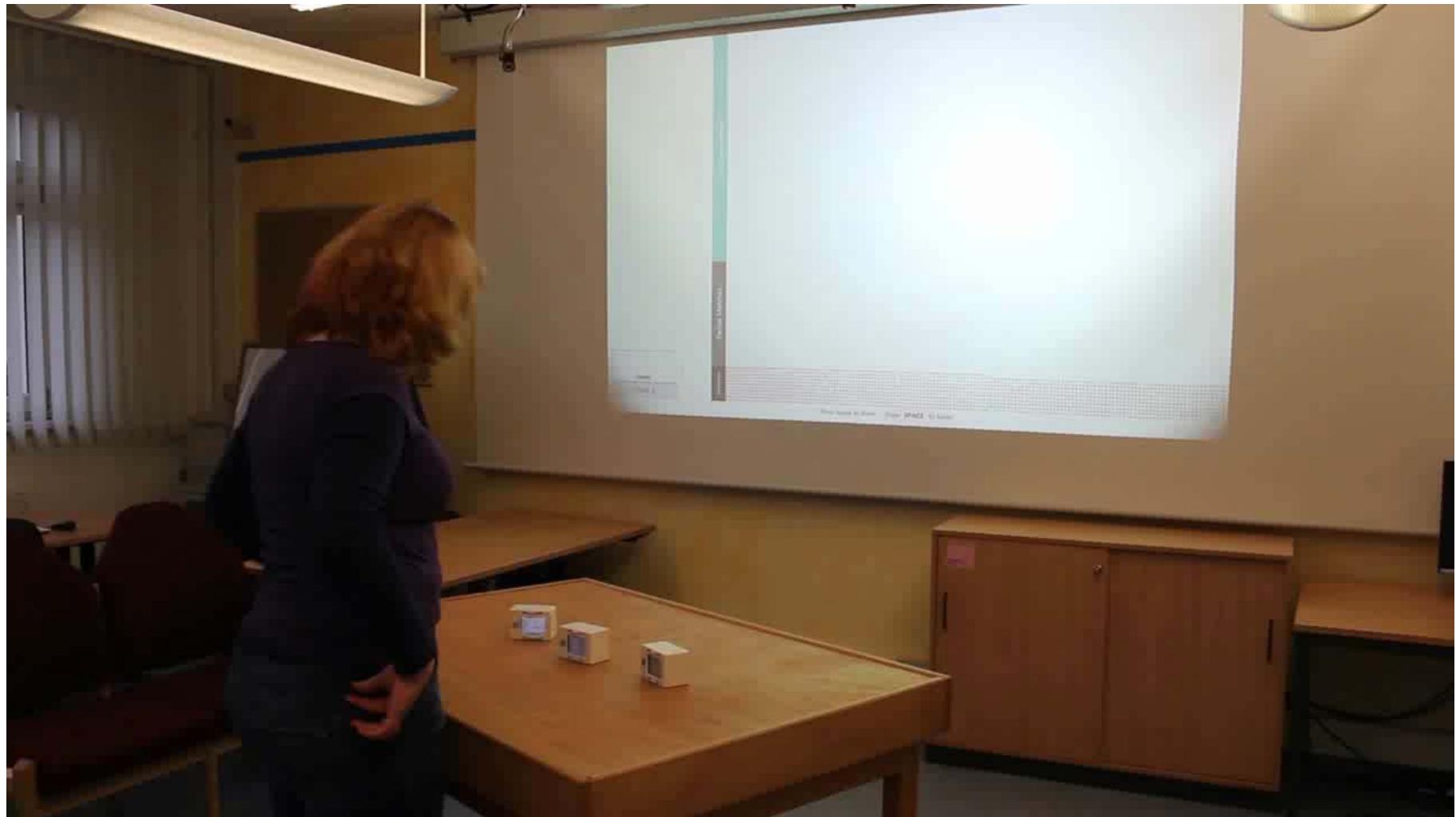
# Stackables: Design & Interaction

## ■ Stackable Facet Tokens

- Main building blocks are stacked to form queries
- Similar abstract box shape for all facets (numerical + categorical)
- Facet type can be re-assigned, values adjusted at any time
- Arbitrary number of facets and facet values
- Color display + 2 input wheels + touch button



# Facet Selection



# Interface Design: Categorical Facets

Genre	
Children's literature	Comic science fiction
Chivalric romance	Conspiracy
Comedy	Crime fiction
Comic fantasy	Cyberpunk
Comic novel	Dark fantasy

A    C    G    M    P    S    Z

Author	
Disch, Thomas	Dokey, Cameron
Divakaruni, Chitra	Donaldson, Stephen
Dixon, Larry	Douglas, Drake
Doctorow, Cory	Douglas, Lloyd C.
Doctorow, E. L.	Douglass, Sara

A    C    F    K    N    S    Y

Awards	
	Andre Norton ...
Academy Honor...	Anisfield-Wolf ...
Alex Awards	Anthony Award...
Ambassador Book...	Anthony Award...
American Book...	Anthony Award...

A    B    G    J    N    P    Y

Language	
	French
American English	German
Bokmal	Hebrew
Chinese	Italian
English	Japanese

A    F    J    Y

# Interface Design: Numerical Facets



# Interface Design: Idle Mode



Year

1931 - 1939



1931 - 1939



Year

## Genre

Absurdist fiction	Anthology
Adventure	Apocalyptic an...
Adventure novel	Autobiographic...
Albino bias	Autobiography
Alternate history	Bangsian fantasy



Adventure

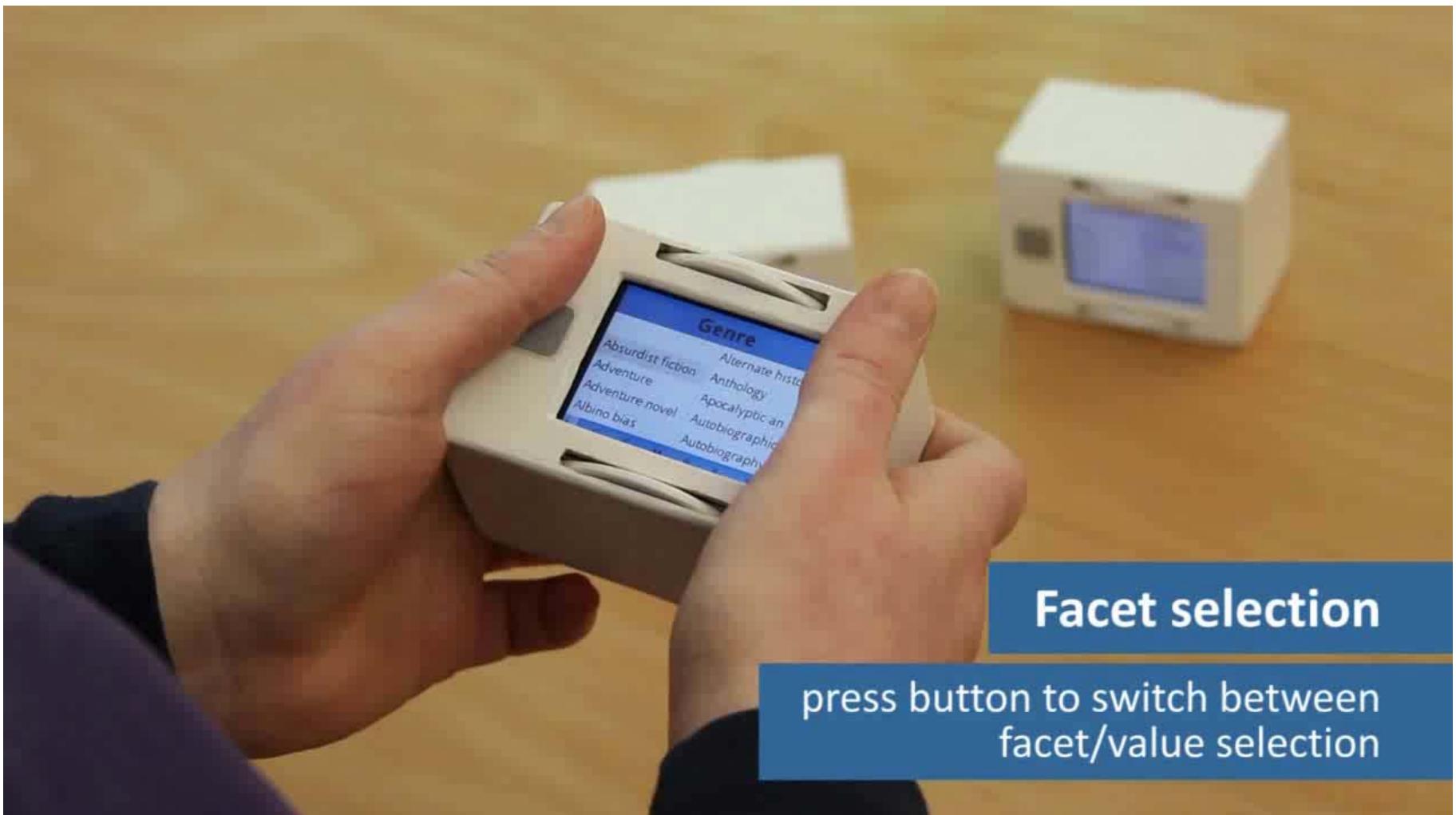
A C G M P S Z

Genre

# Adjusting Facet Values – Single and Range Selection



# Single Facet Value Selection: with Upper Wheel



# Single Facet Value Selection: with Lower Wheel

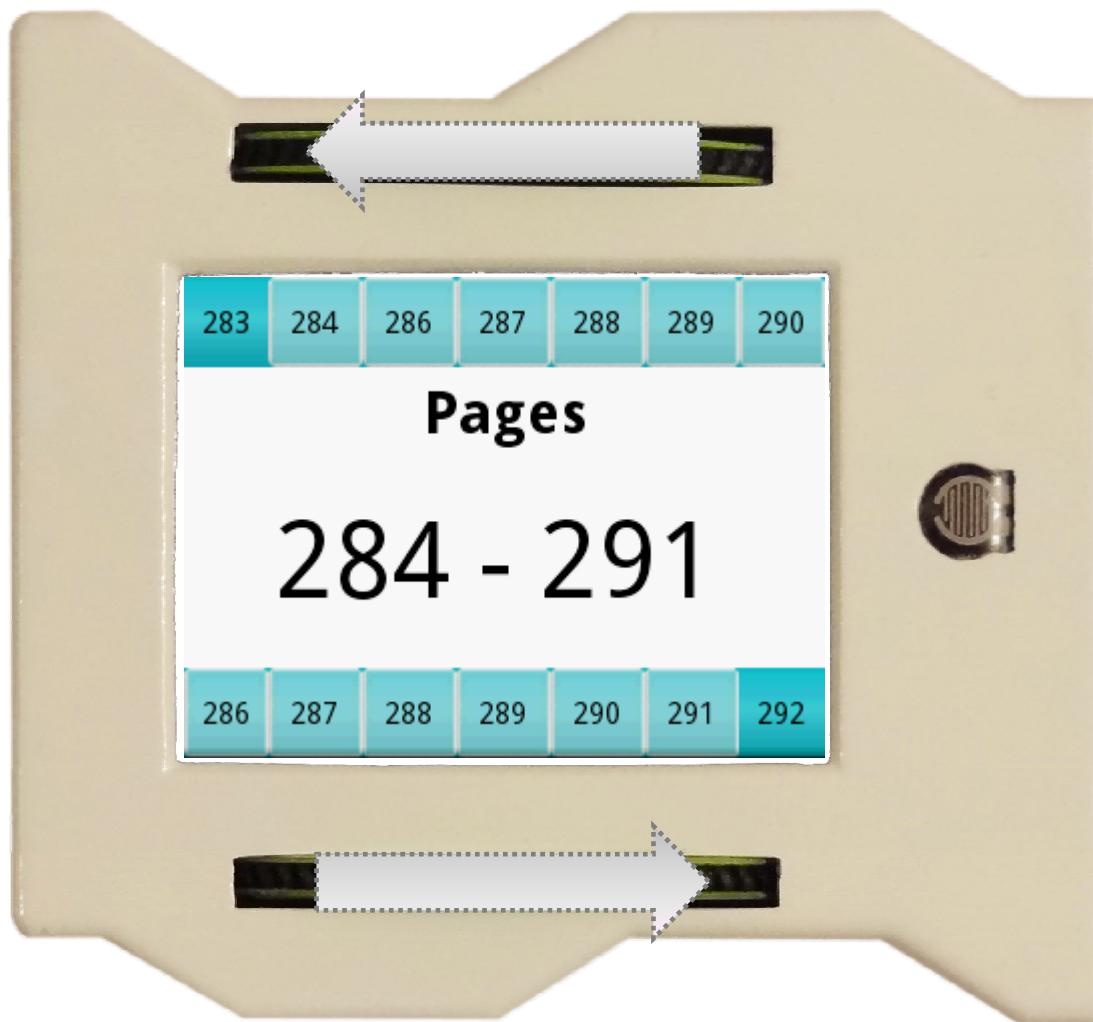


# Value Range Selection: Categorical Values



activate range selection by  
twisting wheels apart

# Value Range Selection: Numerical Values



# Value Range Selection: Numerical Values



# Issuing a Query: Stacking facets (AND)



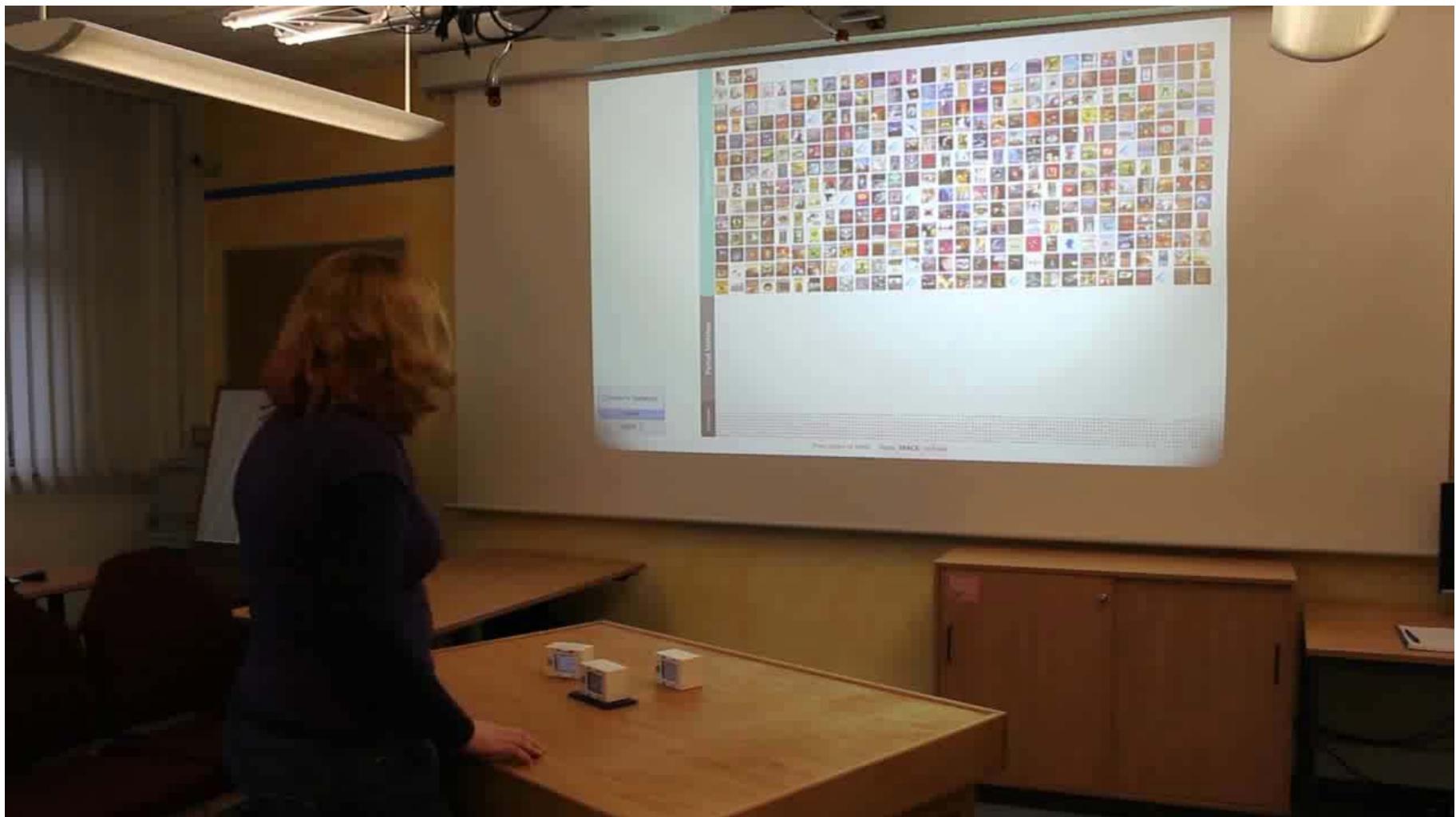
# Dynamic Change of Facet Value Availability



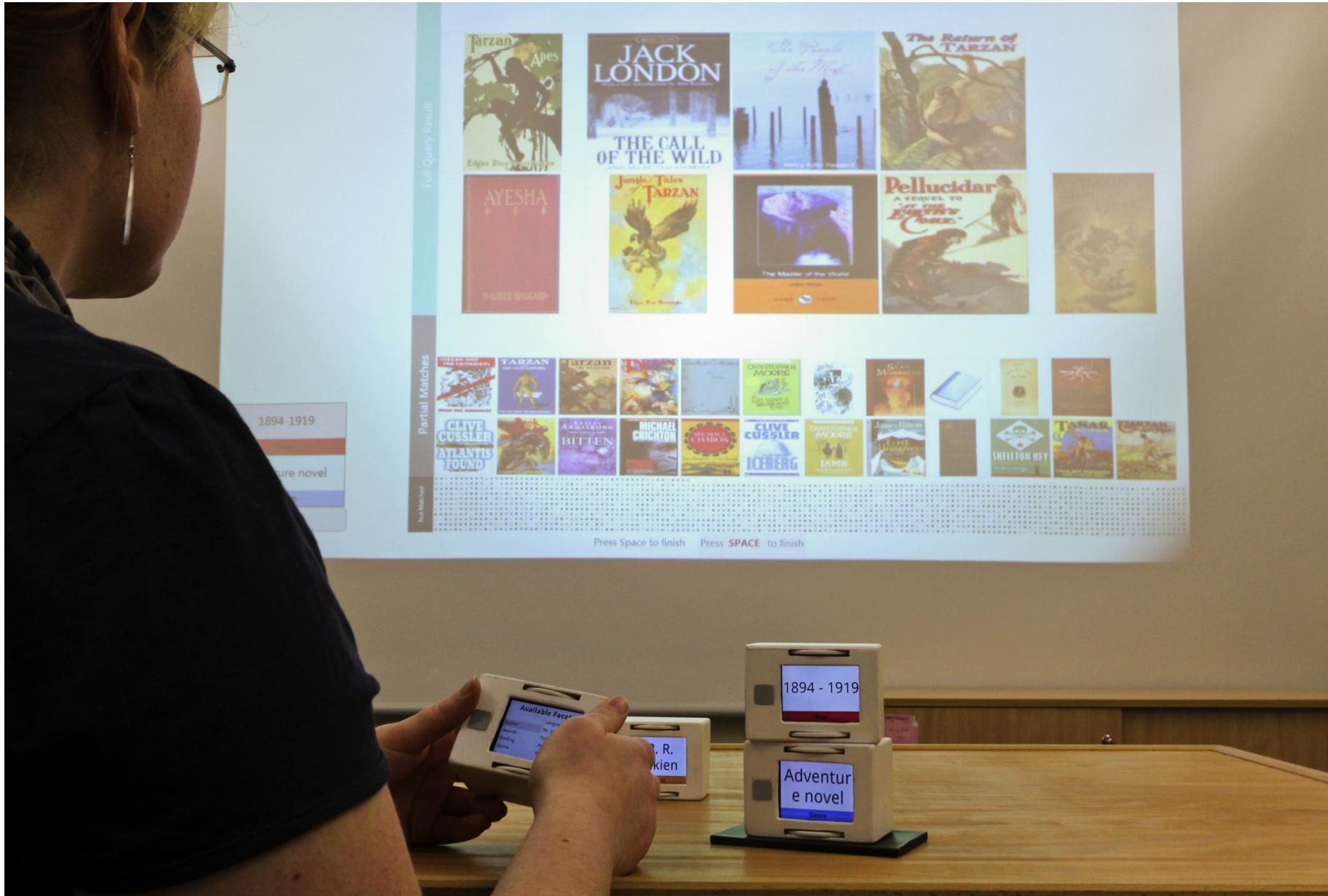
# Issuing a Query: Stacking facets (Negation)



# Issuing a Query: Stacking facets



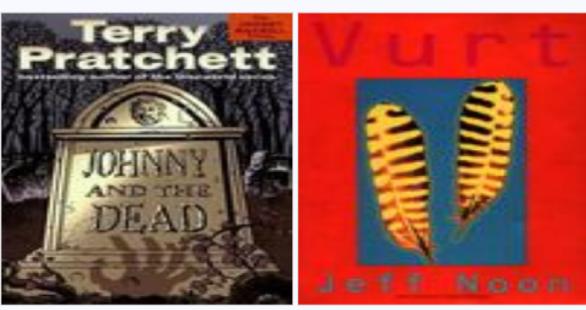
# Result Visualization on a Distant Display



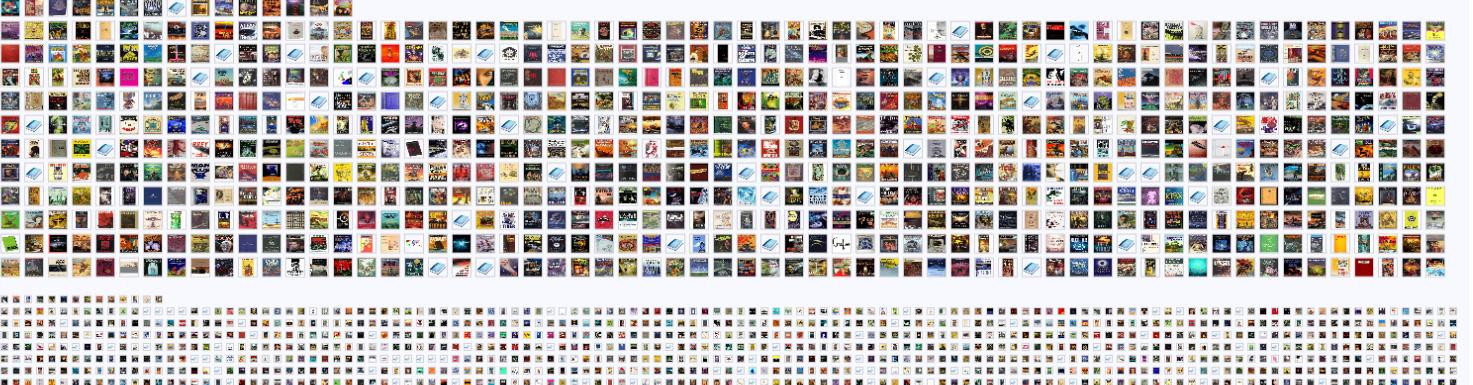
# The Visualization Application

1993
Year
England
Subject
Science fiction
Genre
Stack 1

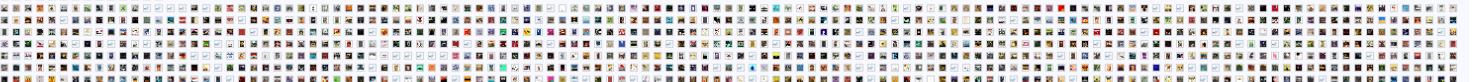
Full Query Result



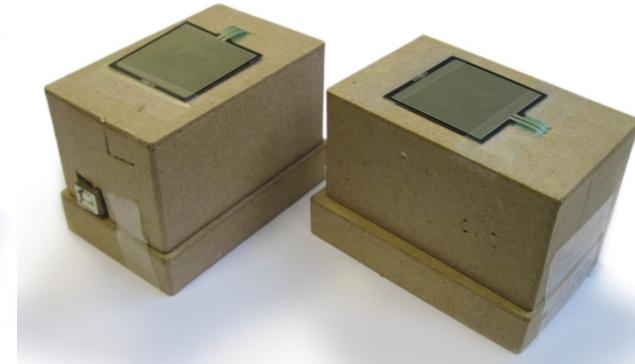
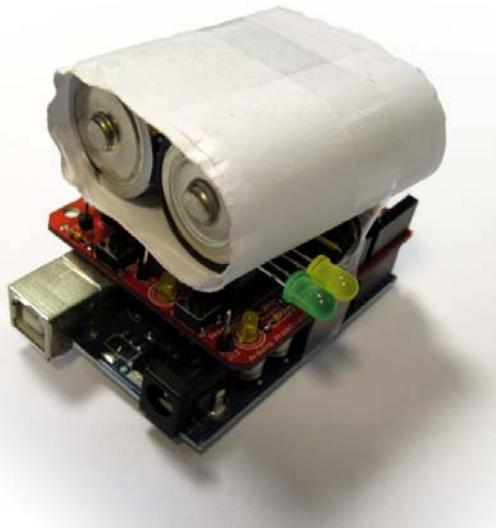
Partial Matches



Not Matched



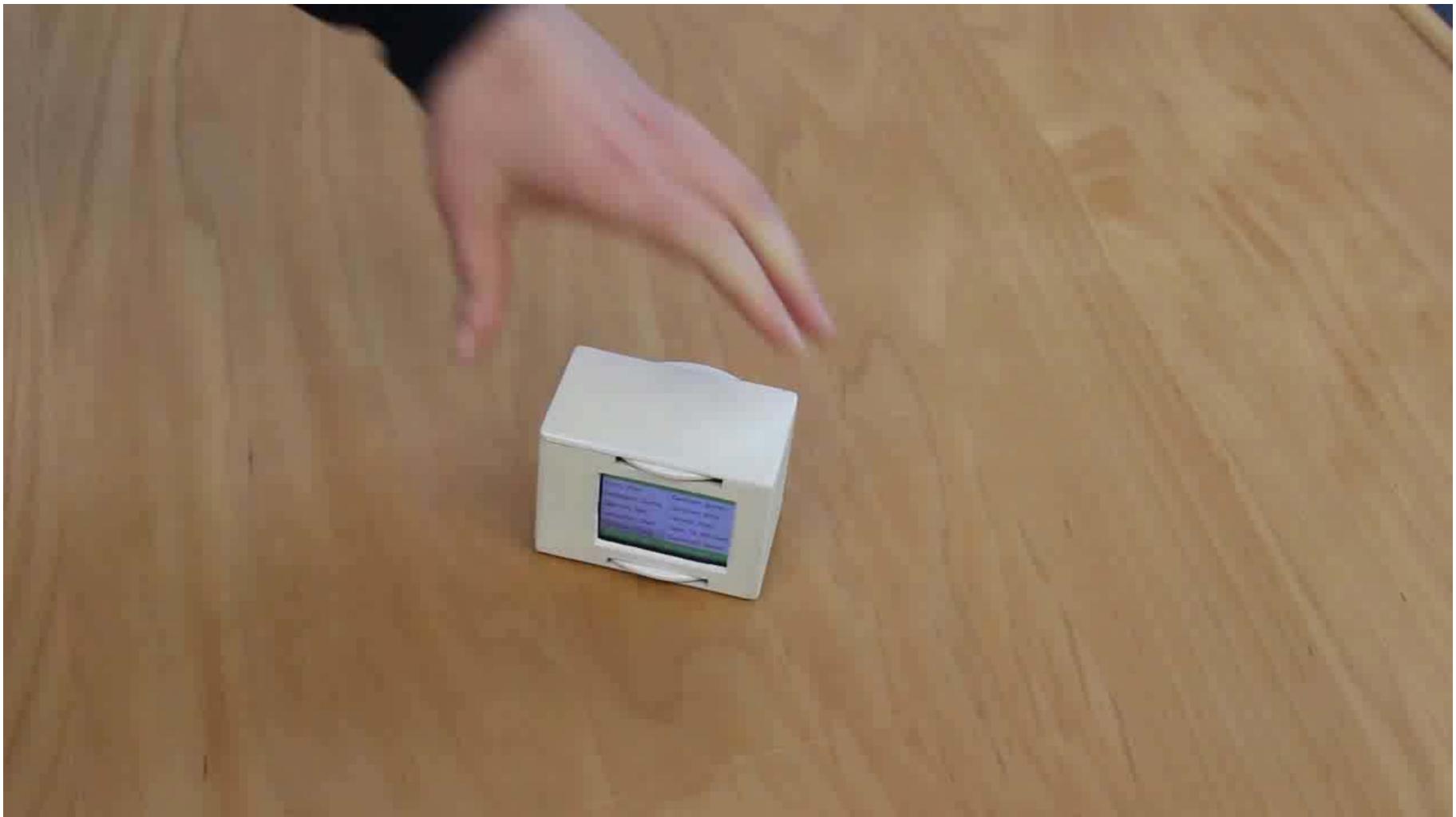
# Iterative Design Process & Technical Realization



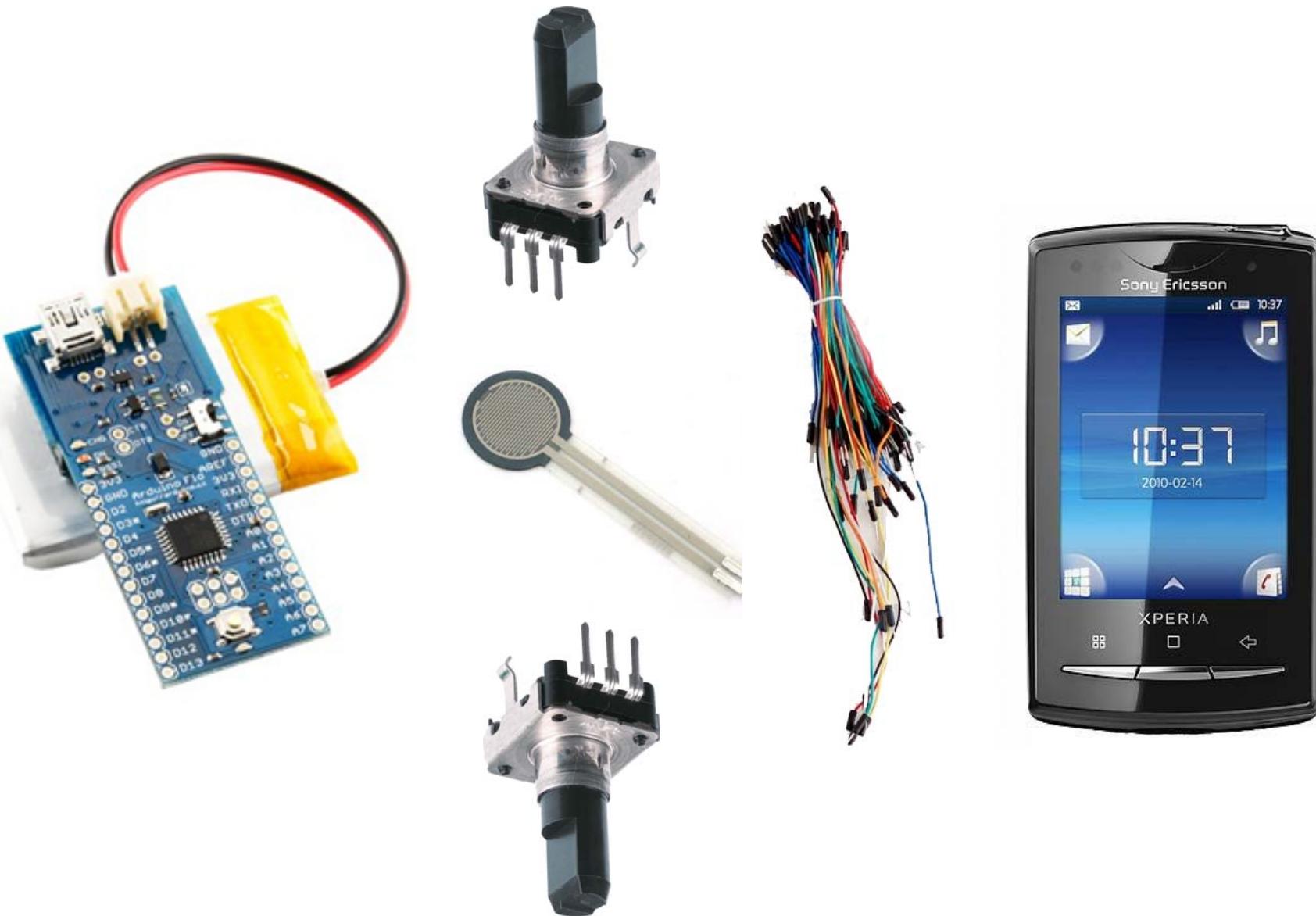
Usability study → paper



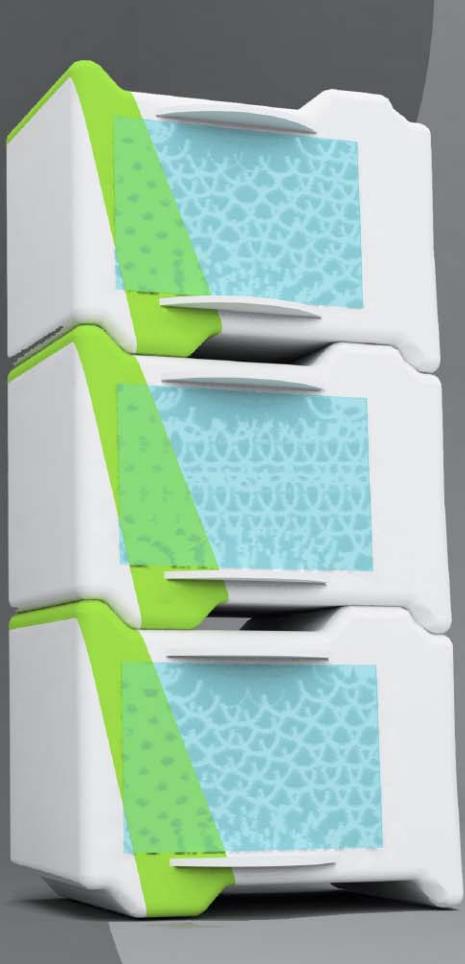
# Penultimate Design



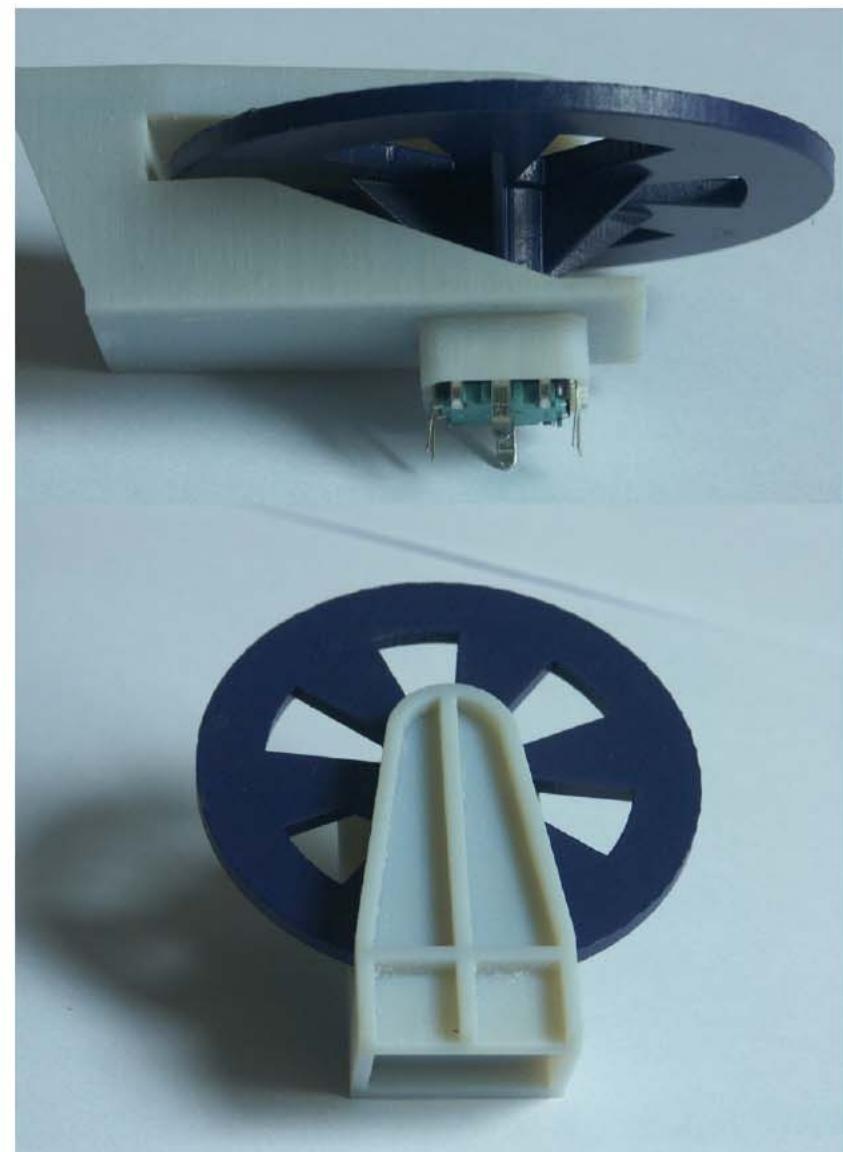
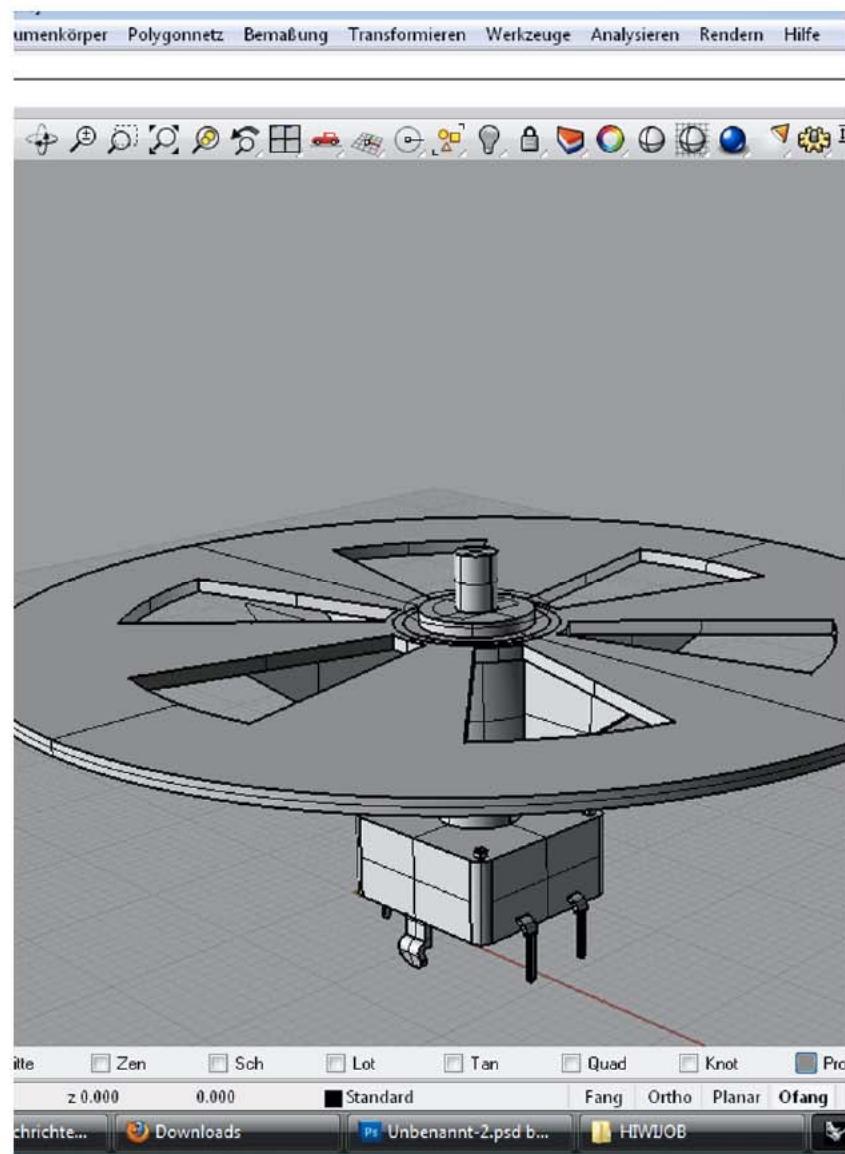
# Electronics Inside



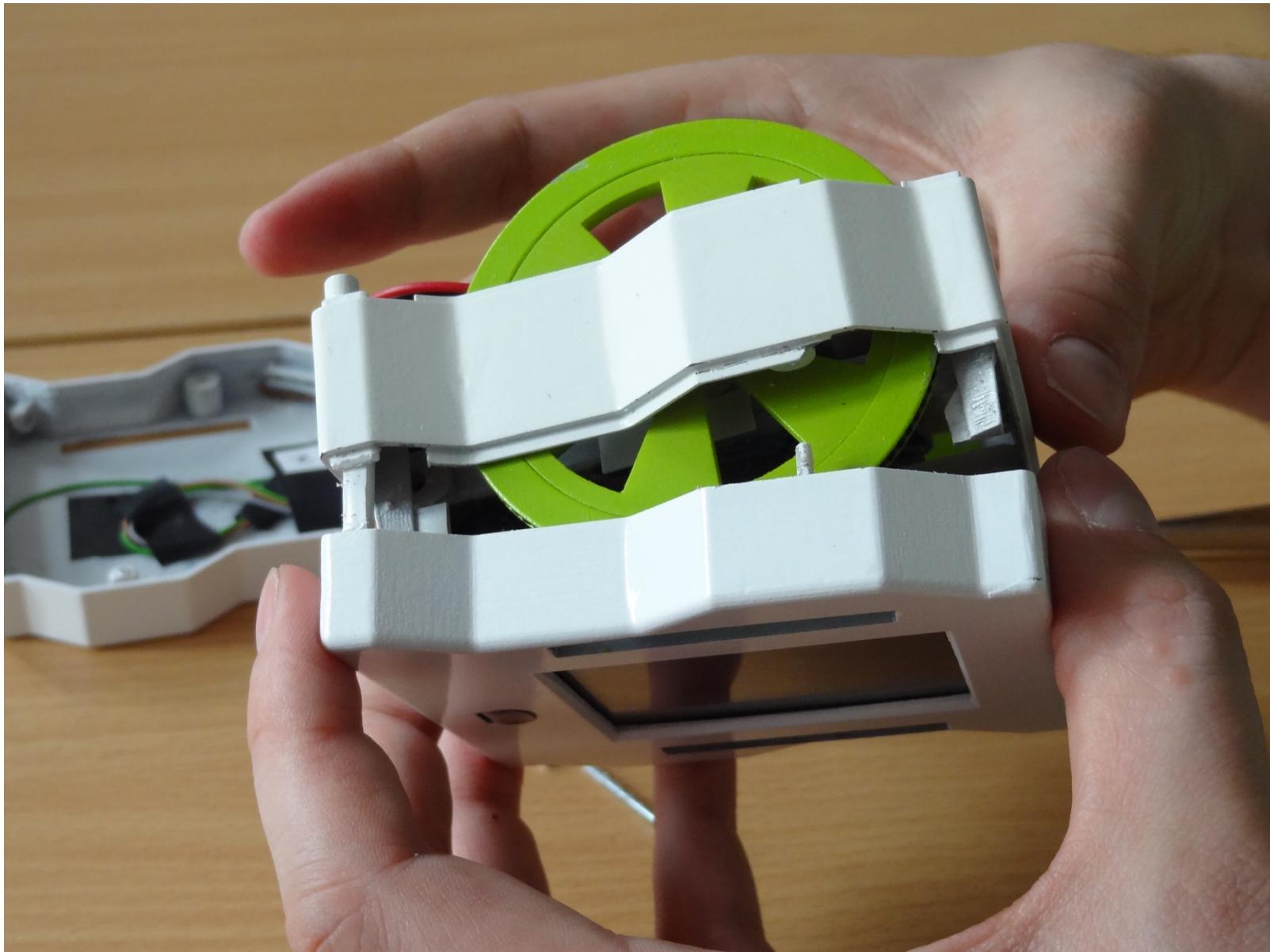
# Developing the Improved Design

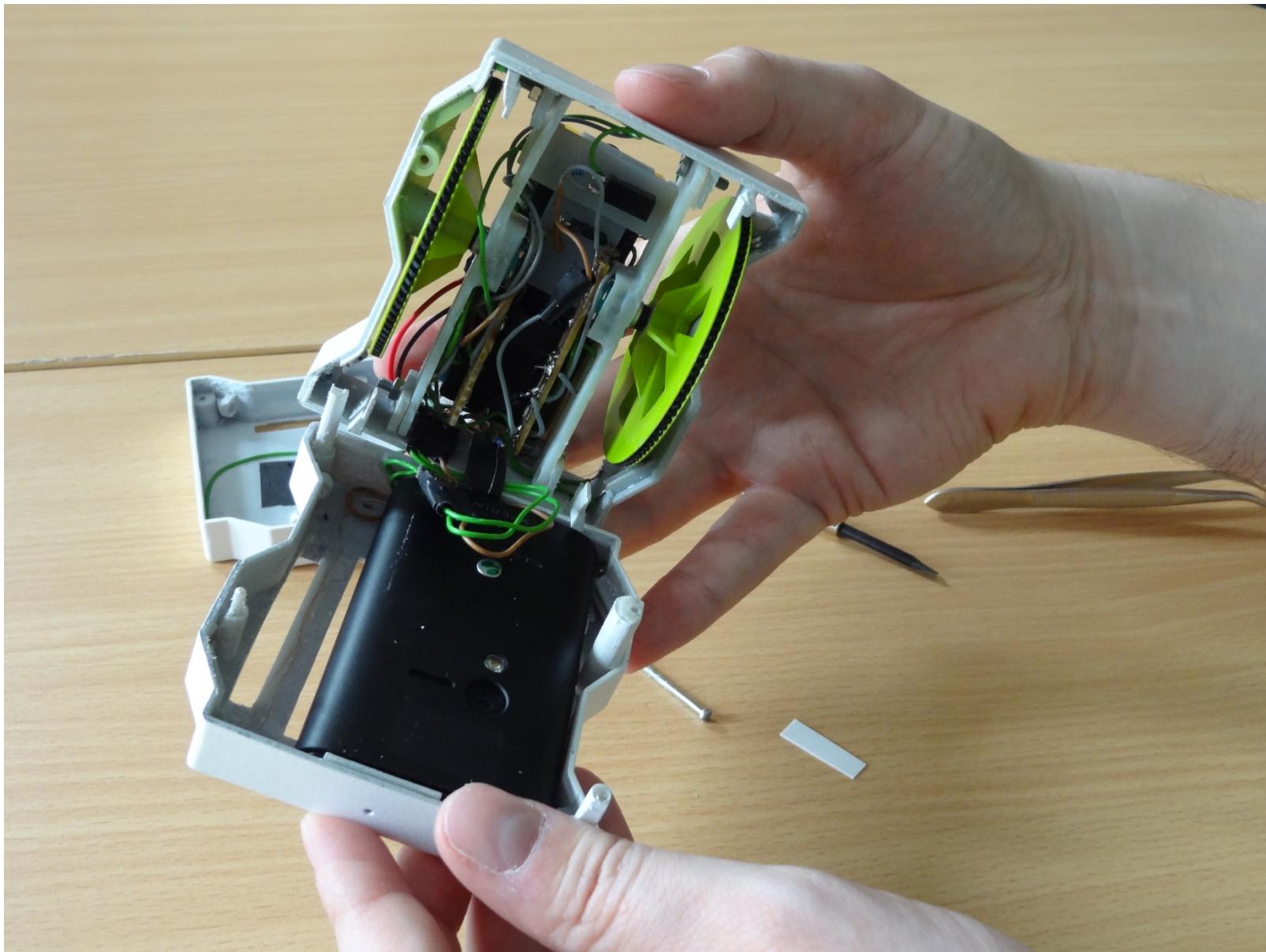


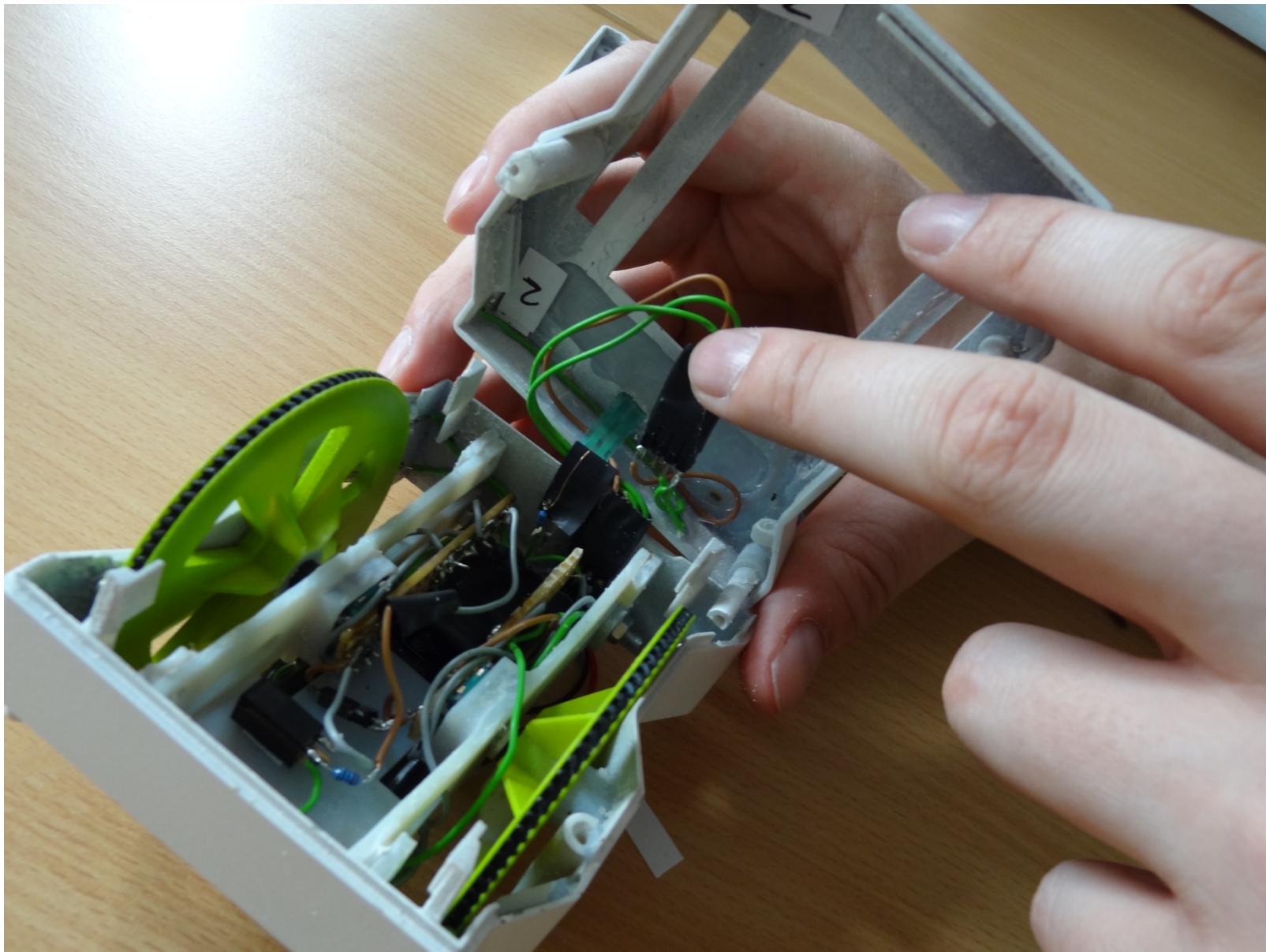
# Developing the Improved Design



# Stackables: Latest Version







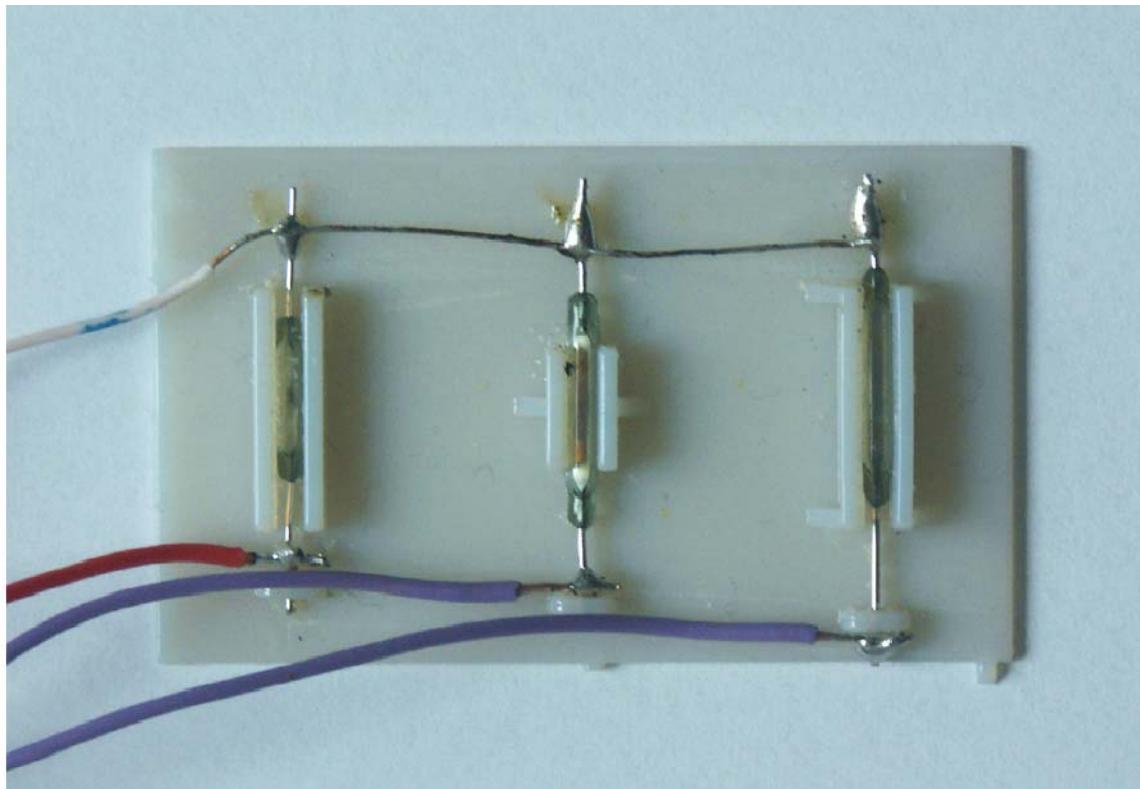




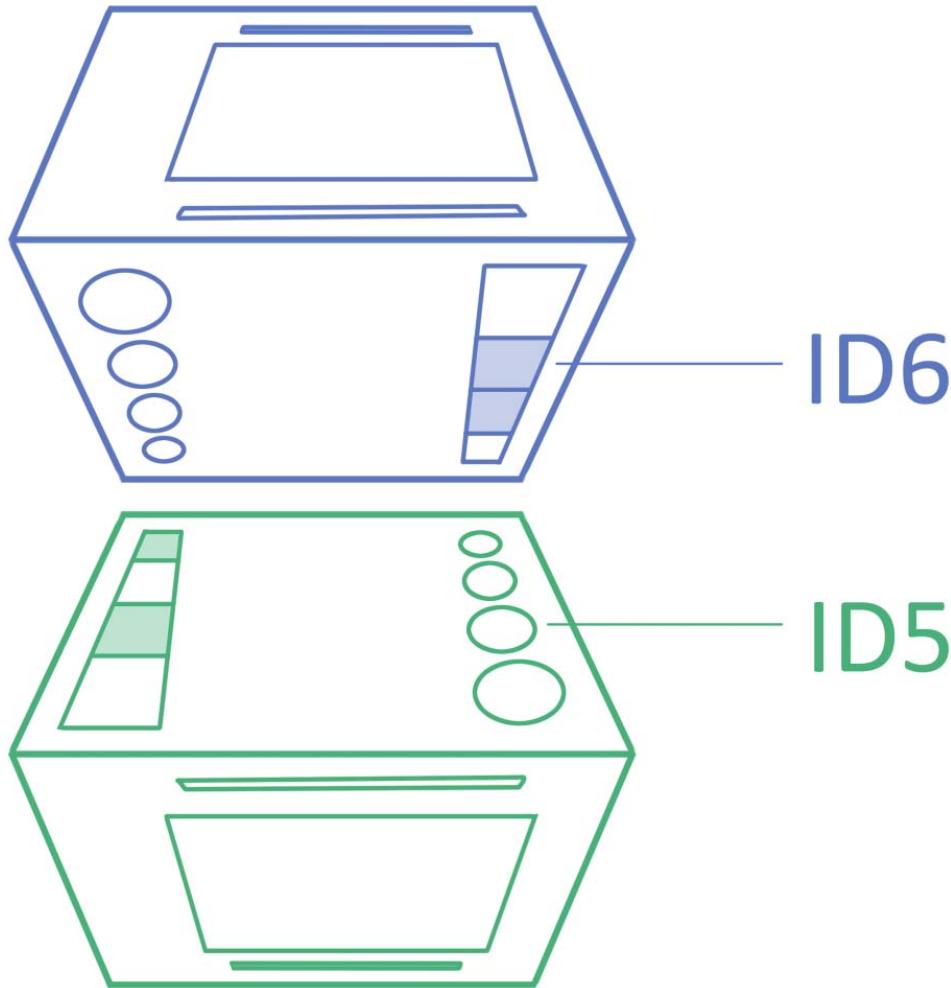
# Stacking Recognition: Reed Switches & Magnets



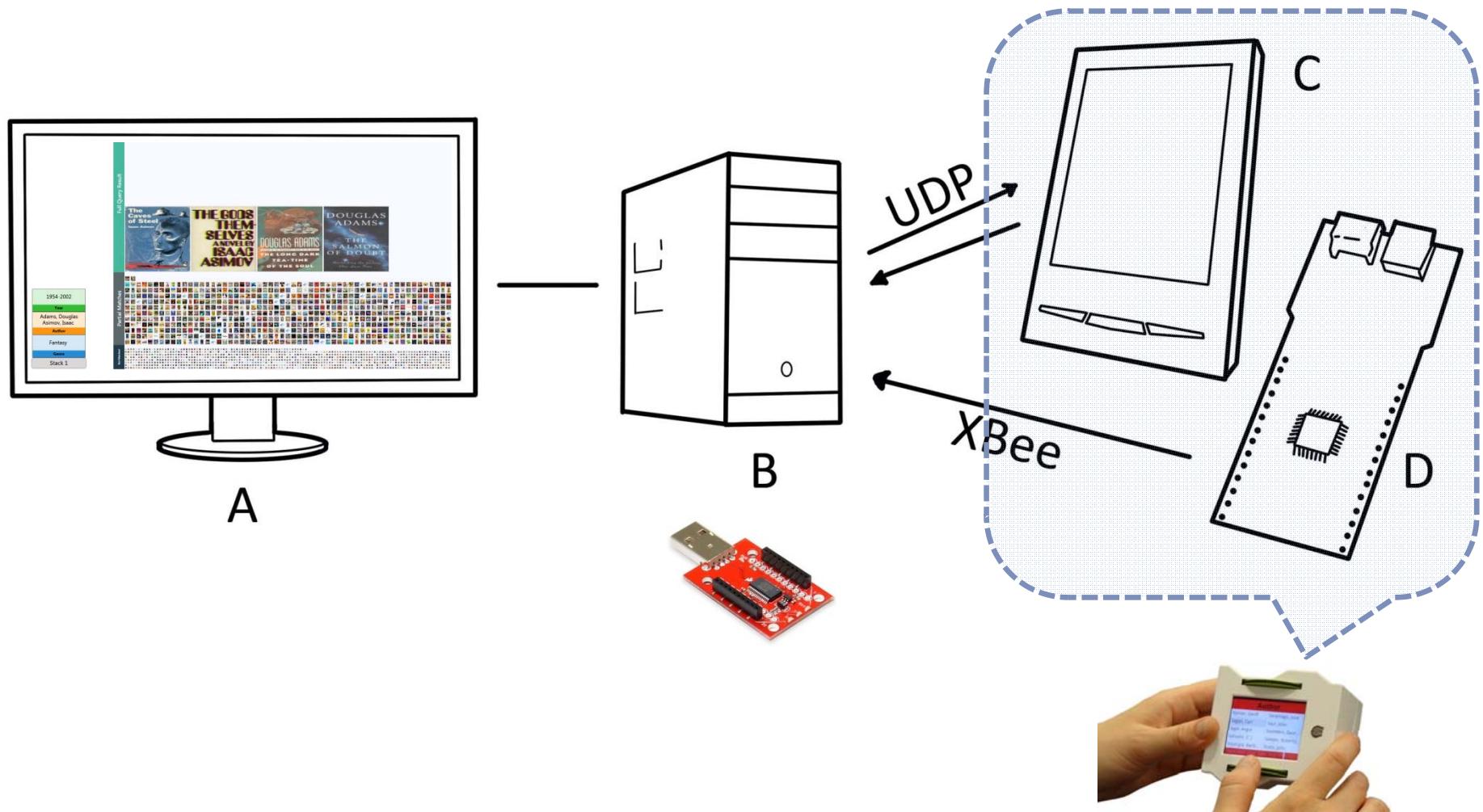
# Stacking Recognition: Reed Switches & Magnets



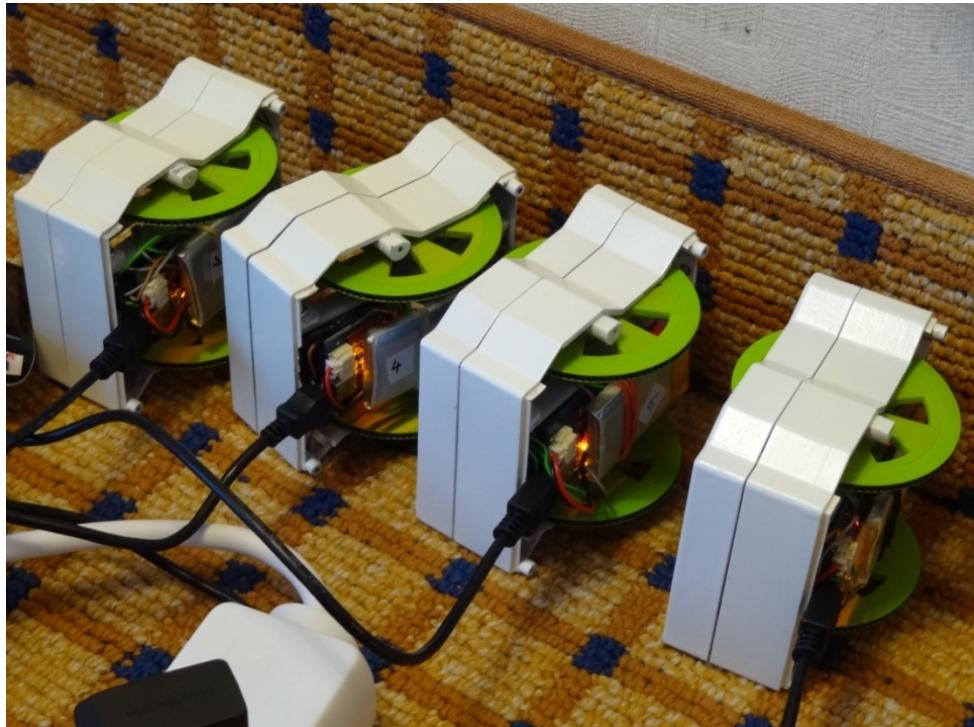
# Stacking Recognition: 4 Switches + 4 Magnets / each Side



# Communication



# Some power is also needed...

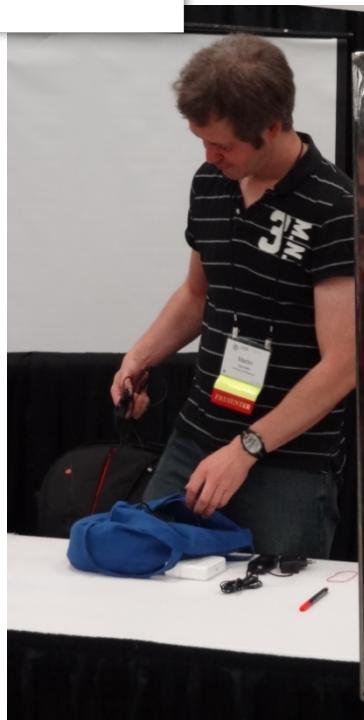




Stackables @



as Interactivity

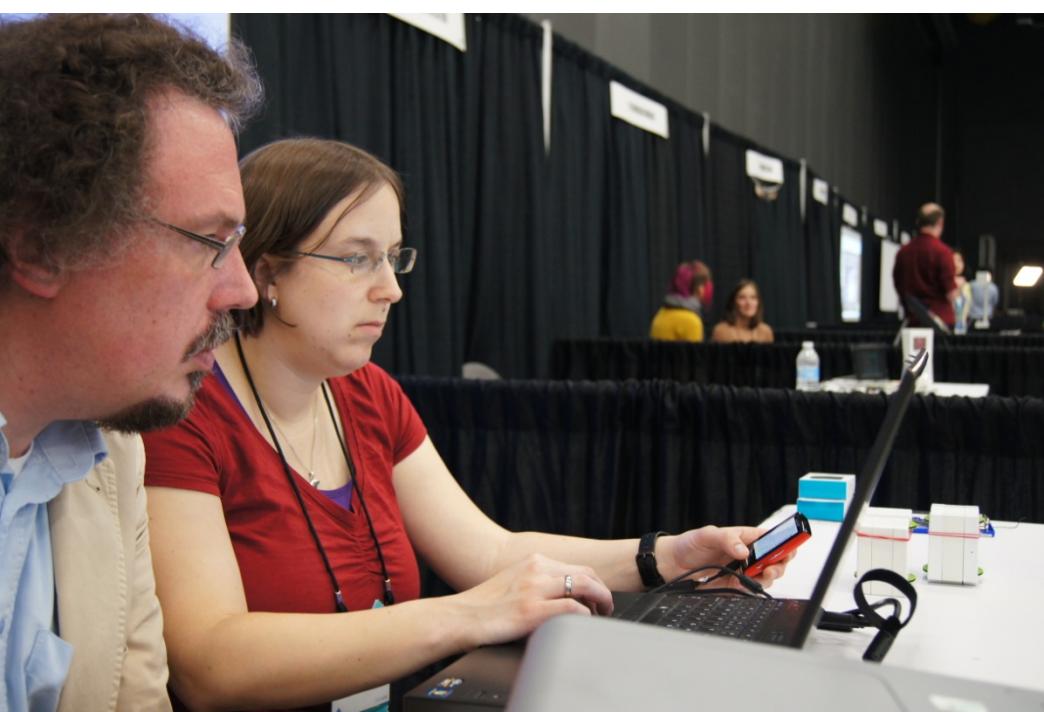


Stackables: Faceted Browsing with Stacked Tangibles

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Jean-Daniel Fekete, INRIA  
Raimund Dachsel, University of Magdeburg

Use the Stackable building blocks to query a set of 1500 books. Interact with the wheels to select facets and their values and stack the blocks to form queries. Collaborate with your peers!

# Interactivity @



## STACKABLES

- Tangible solution for faceted information seeking
  - Tangibles for representing & adjusting arbitrary facets & values
  - Can be manipulated, shared, transferred
- Visualize queries in a physical form by vertical stacking
  - Physical manifestation of result of information seeking process
  - Minimized footprint, several towers for multiple queries
- Individual and parallel interactions in a co-located setting
  - Negotiation of results
- Technical solution with potential for generalization

# Conclusion

- Limitations
  - Size still too large, stack sizes limited
  - Display angle, focus switch
  - Technically complex
- Future Work
  - Further look into collaboration issues
  - Tackling the visualization challenges
  - Generalization for other types of applications (e.g. games)

## ■ Acknowledgements

- Stefanie Klum (Diploma Thesis),  
Petra Isenberg, Ricardo Langner,  
Jean-Daniel Fekete, Raimund Dachselt
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project grant ANR-11-JS02-003



# STACKABLES.

## THANK YOU!

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