VisTiles

Coordinating and Combining Co-located Mobile Devices for Visual Data Exploration

Ricardo Langner, Tom Horak, Raimund Dachselt

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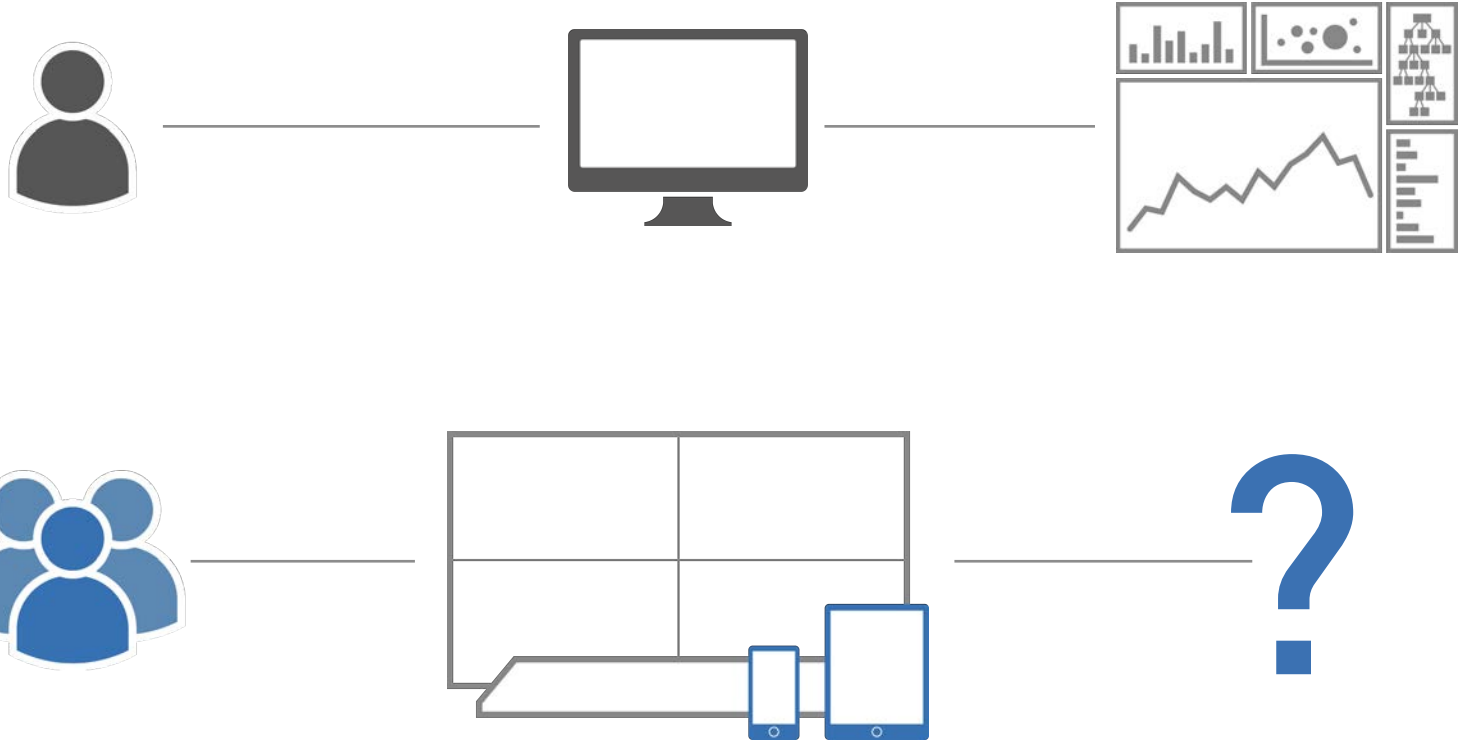
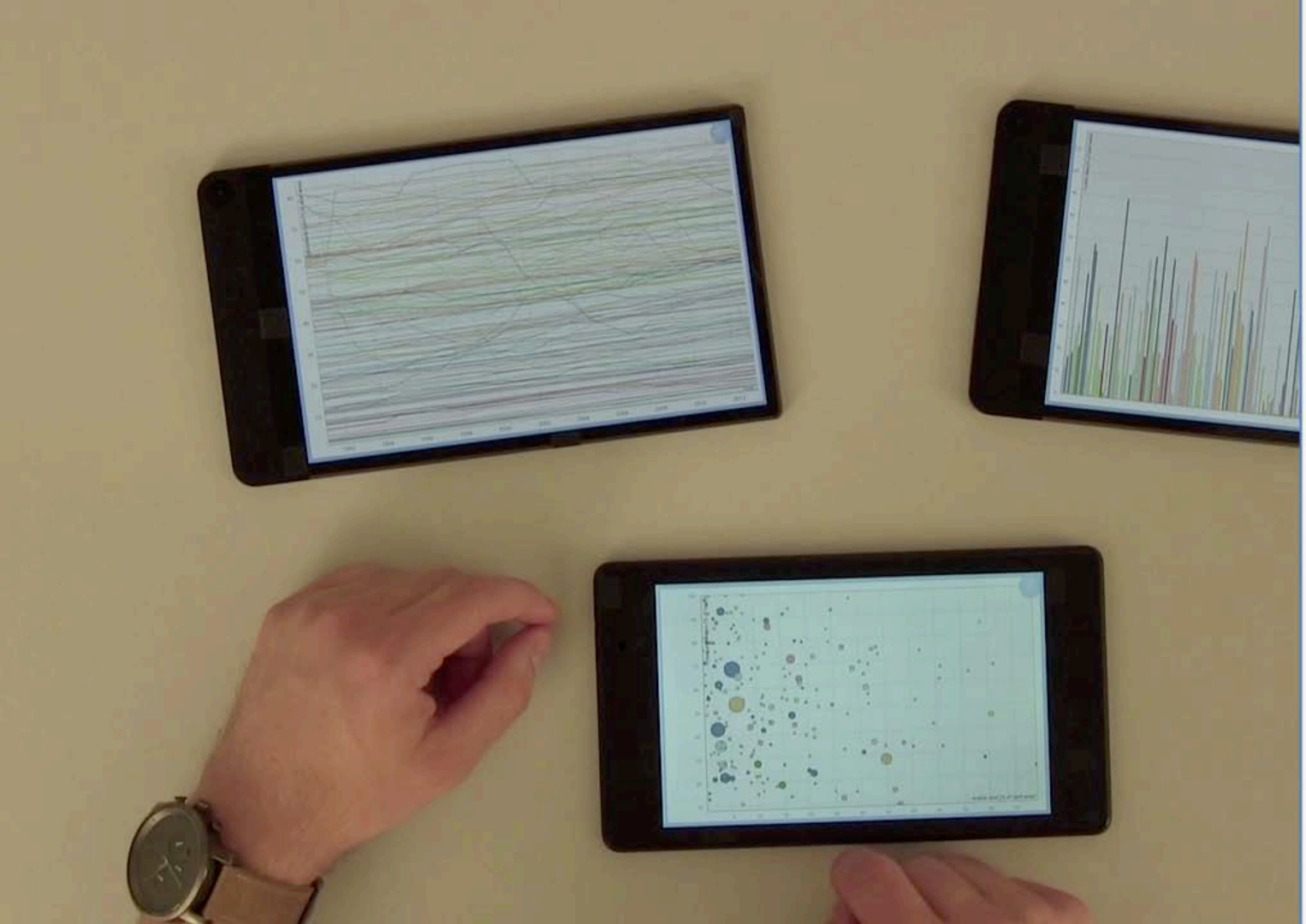
TECHNISCHE UNIVERSITÄT DRESDEN

INTERACTIVE MEDIA LAB DRESDEN

Visualization Workplaces





VisTiles

Visualizations for mobile devices

Supports, e.g.,

- Linked Brushing
- Overview & Detail
- Alignment
- Rearrangement
- UI Offloading
- Extended View Synchronization

Why Mobile Devices?

⊕ Everyday devices

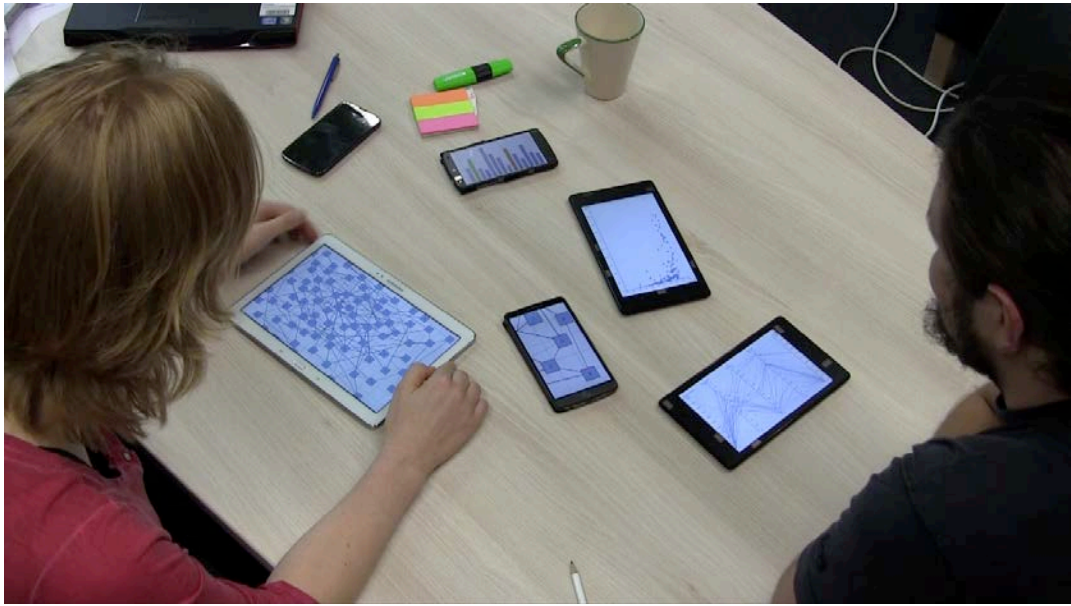
⊕ Availability

⊕ Advanced

⊕ Quantity

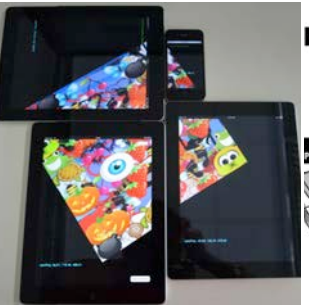
⊖ Display size

- Combination of multiple devices
- Support basic collaboration
- Ad-hoc and spontaneous use
- Make use of spatial capabilities, physical arrangement



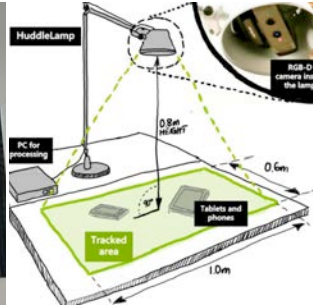
HCI Research on Mobile Devices

Device Localization



Dynamic Tiling Display

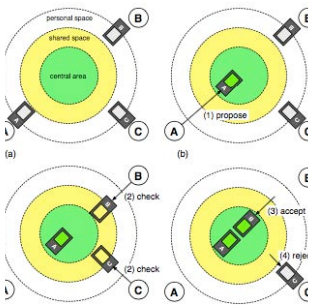
[Li and Kobbelt, 2012]



HuddleLamp

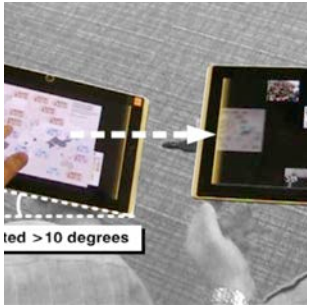
[Rädle, Jetter, Marquardt, Reiterer, and Rogers, 2014]

Interactions Techniques



Proximity Regions Around Mobile Devices

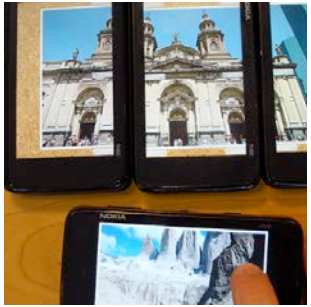
[Kray, Rohs, Hook, and Kratz, 2008]



Cross-Device Interaction

[Marquardt, Hinckley, and Greenberg, 2012]

Use Cases



Pass-Them-Around

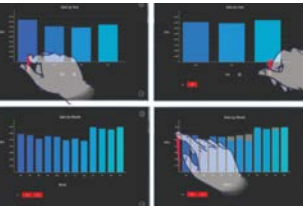
[Lucero, Holopainen, and Jokela, 2011]

Dynamic Duo

[Piazza, Fjeld, Ramos, Yantac, and Zhao, 2013]

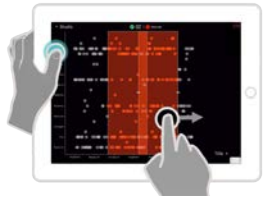
Mobile Devices for InfoVis

Single Mobile Device



TouchViz

[Drucker, Fisher, Sadana, Herron, and schraefel, 2013]



Expanding Selection

[Sadana and Stasko, 2016]

MCV for Tablets

[Sadana and Stasko, 2016]

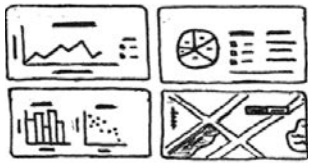
Mobile + 2nd Display

Tangible Views

[Spindler, Tominski, Schumann, and Dachselt, 2010]

GraSp

[Kister, Klamka, Tominski, and Dachselt, 2017]



Display Ecologies

[Chung, Sarang, North, and Chen, 2015]

Multiple Mobiles

Thaddeus

[Wozniak, Lischke, Schmidt, Zhao, Fjeld, 2014]

Is Two Enough?

[Plank, Jetter, Rädle, Klokmose, Luger, and Reiterer, 2017]

VisTiles

VisTiles

Visualization **Tiles**

=

Visualizations that are distributed and synchronized across multiple mobile devices

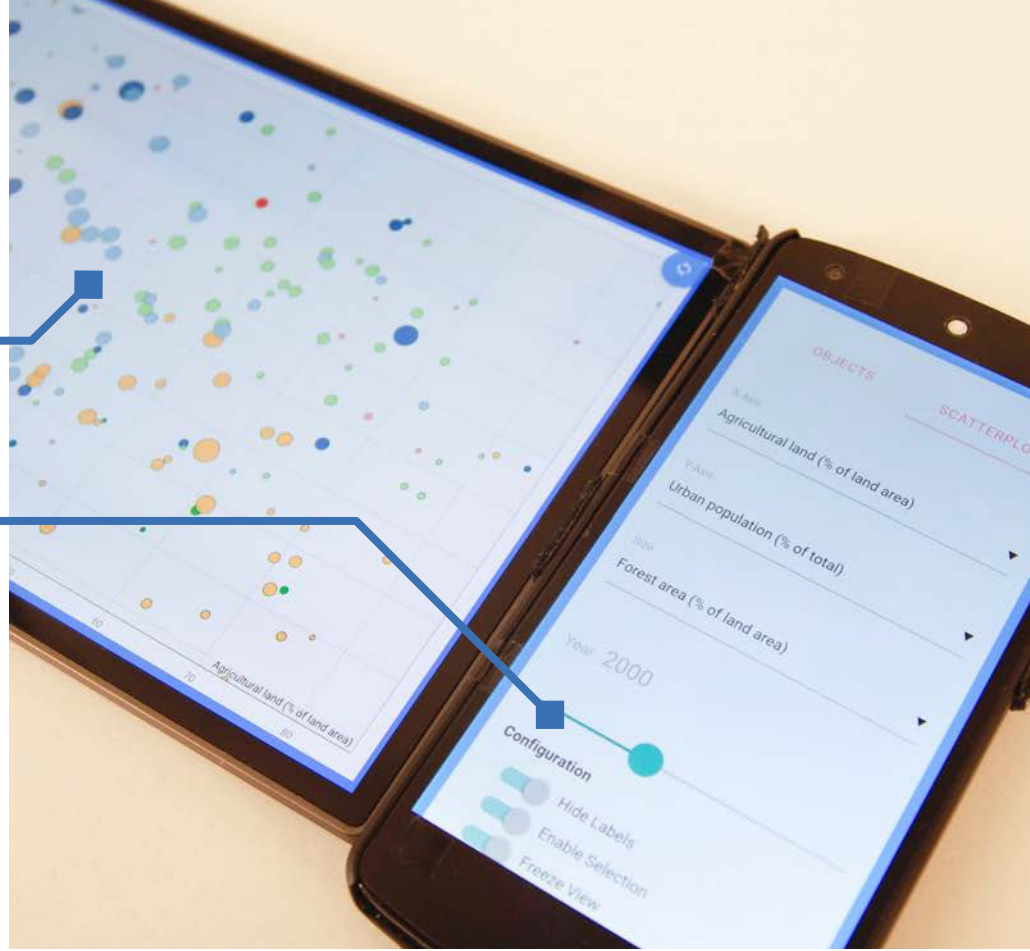
What Is a **Tile**?

- Two general types:

  Data tile — Visualizes data using a specific visual representation

  Control tile — Display further elements of the UI

- Single visualization per device



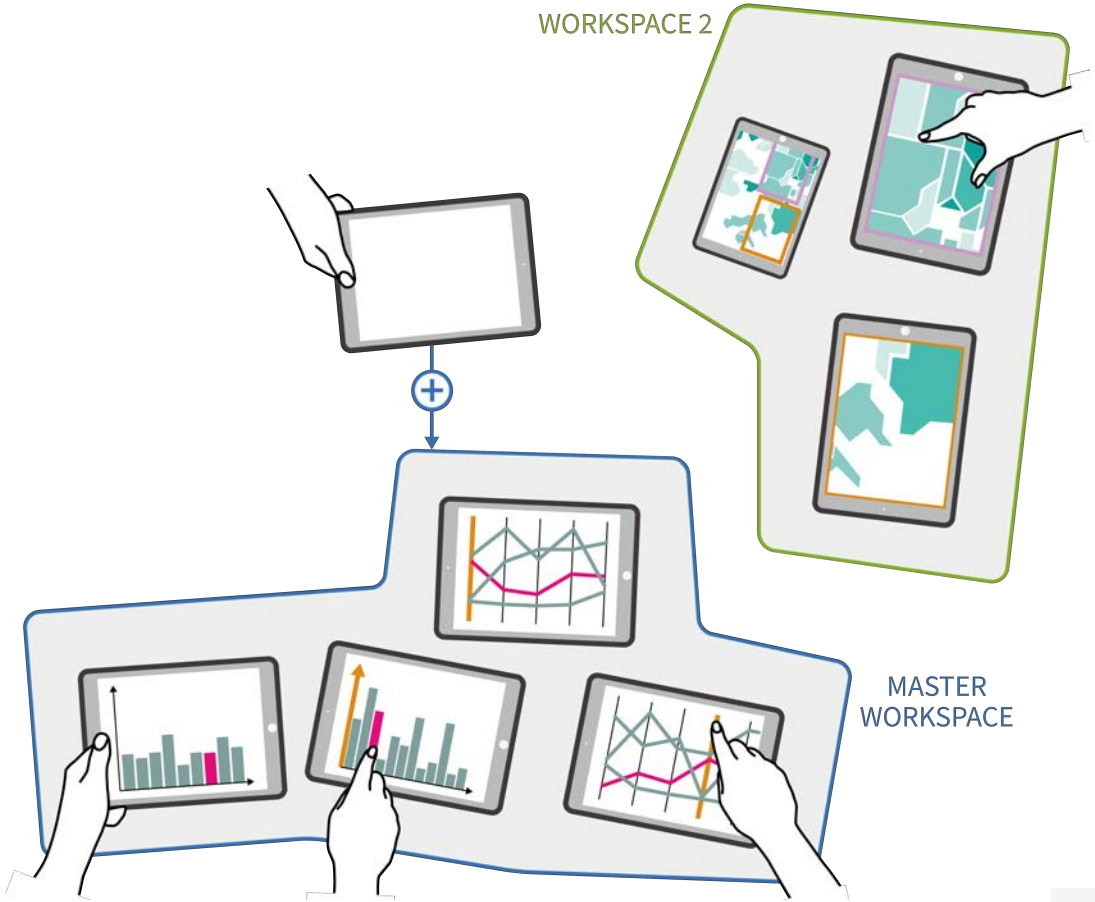
View Distribution

Basic approach: assign views to tiles manually

Physical Workspace

- Grouping mechanism
  - Easy way to control coordinations
  - Good for basic collaboration and parallel work

- User-defined arrangement
  - Adapt to different situations
  - Address concepts of "intelligent use of space" and "space to think"



Physical Workspace

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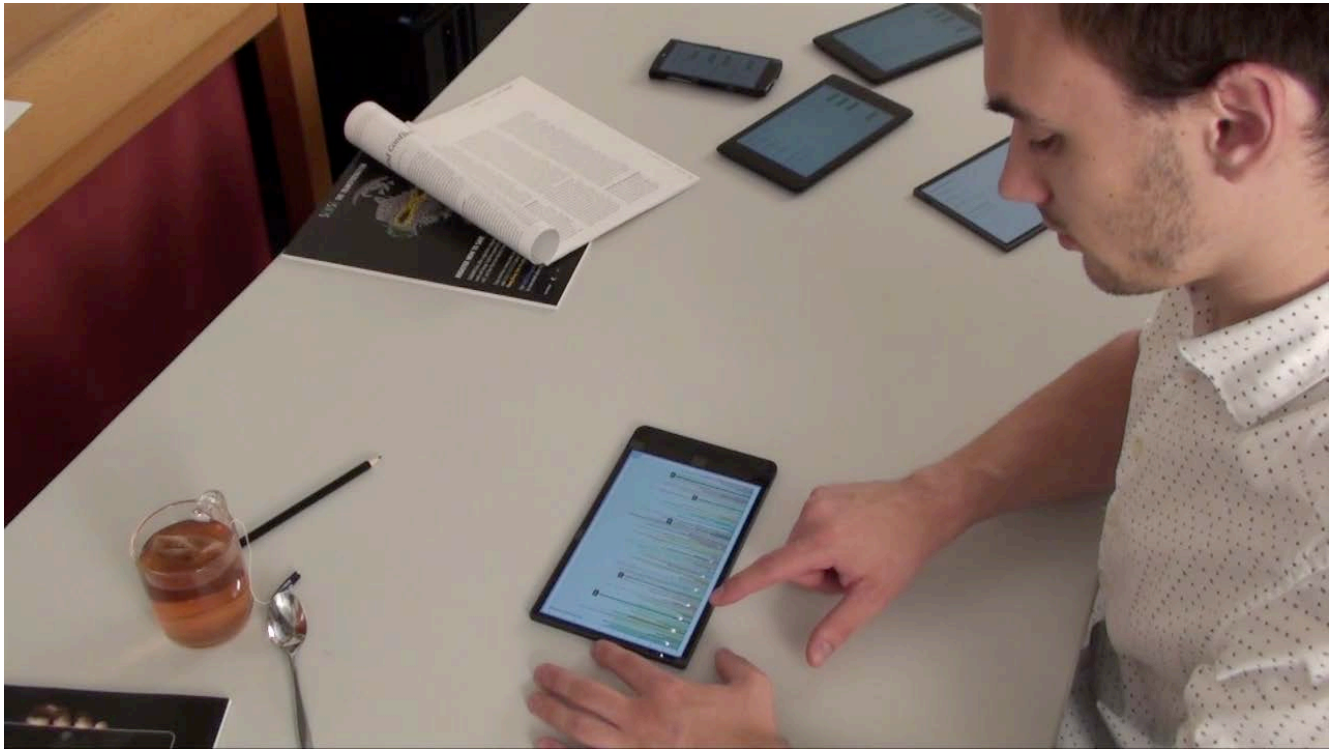
“ How we manage the spatial arrangement of items around us, is not an afterthought; it is an integral part of the way we think, plan and behave ”

“ Whether we are aware of it or not, we are constantly organizing and re-organizing our workplace to enhance performance ”

— David Kirsh, 1995: The intelligent use of space.

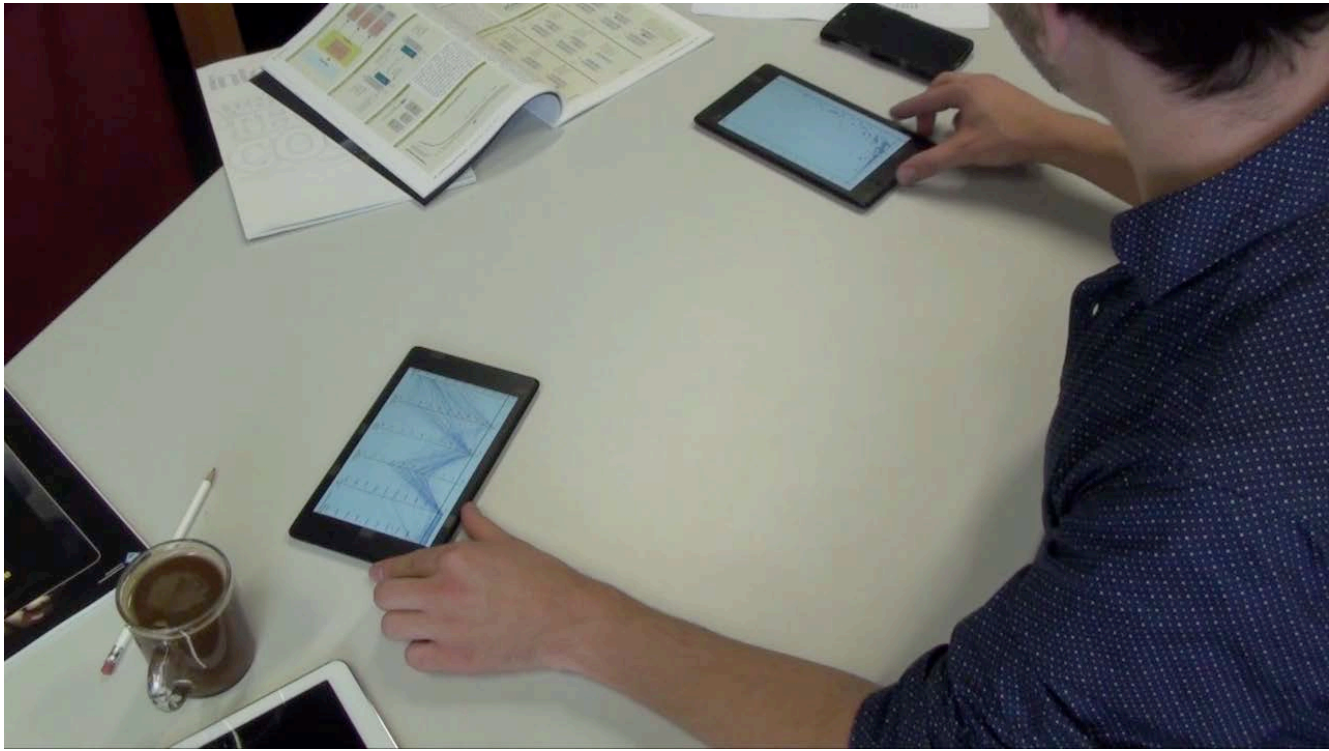
Use of Device Combinations

Display Extension
Expand a visualization
across tiles



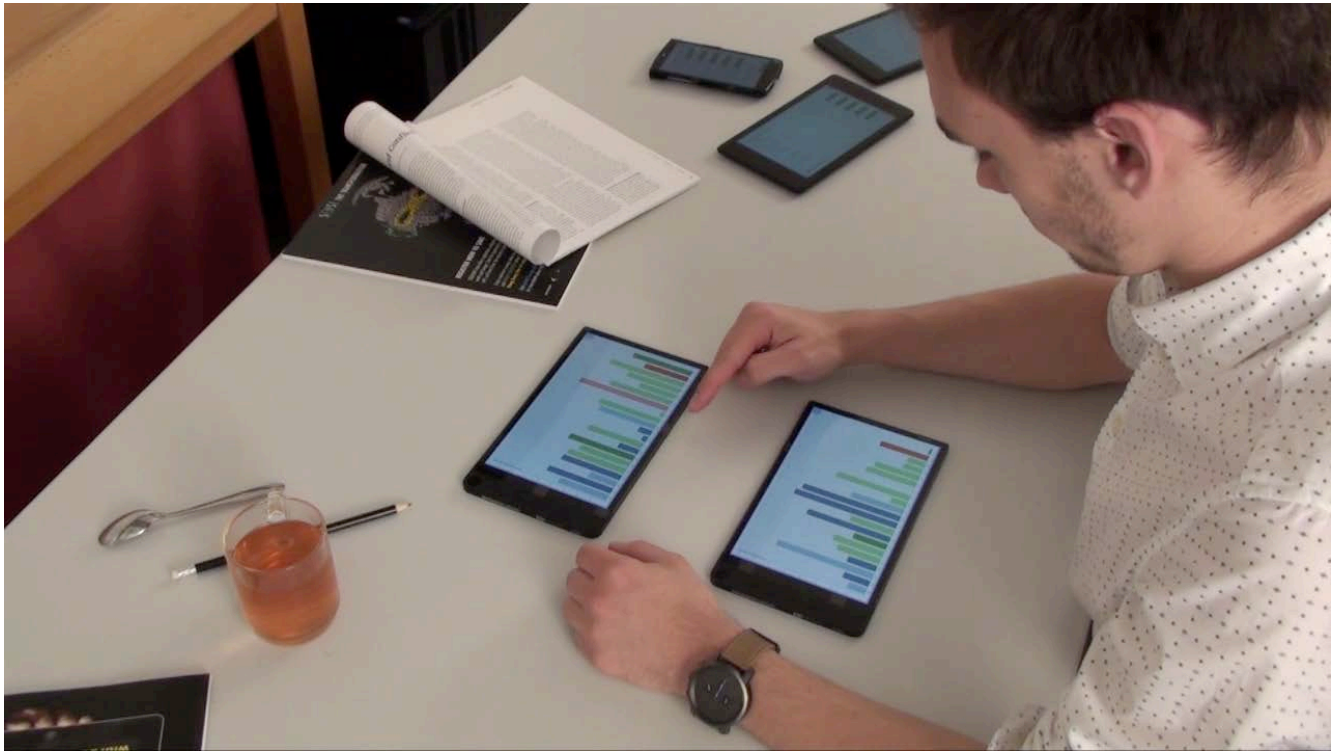
Use of Device Combinations

Alignment of Visualizations



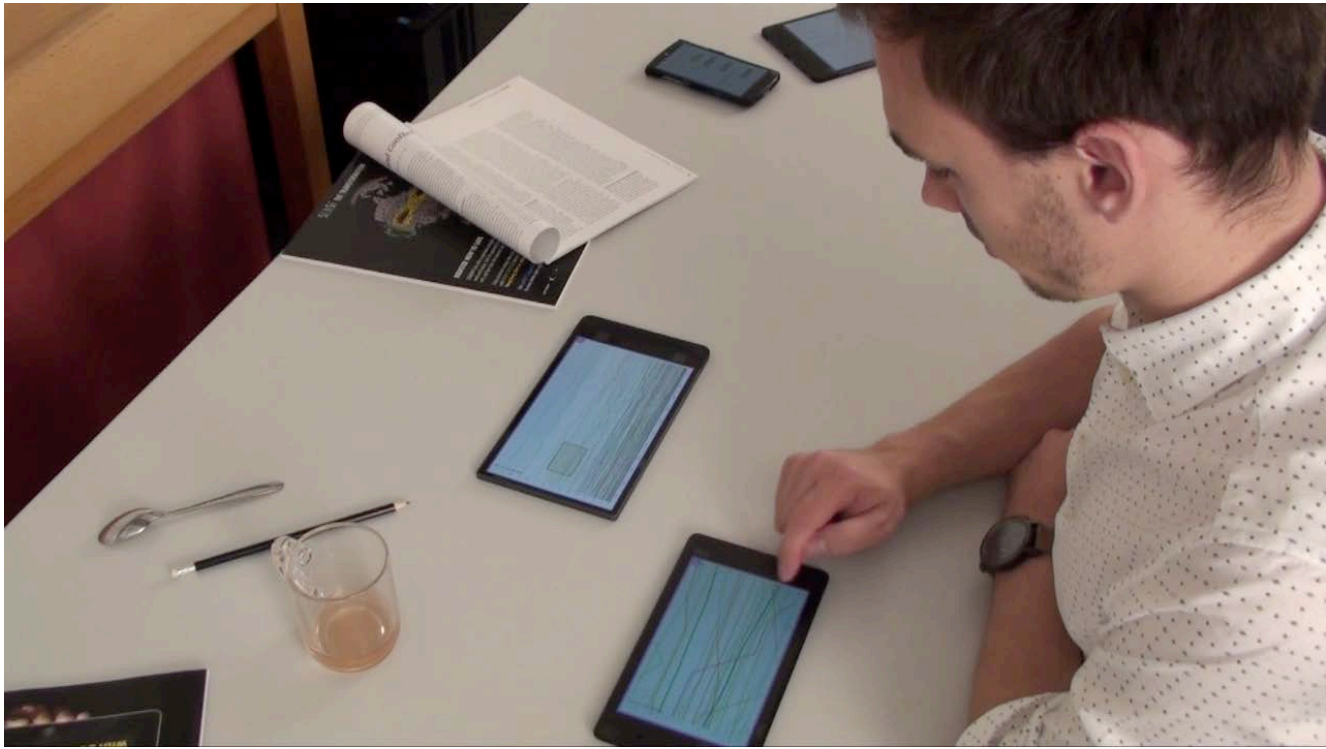
Use of Device Combinations

Rearrangement of Data Items



Use of Device Combinations

Overview & Detail
Tiles of the workspace indicate the position and size of viewports



Use of Device Combinations

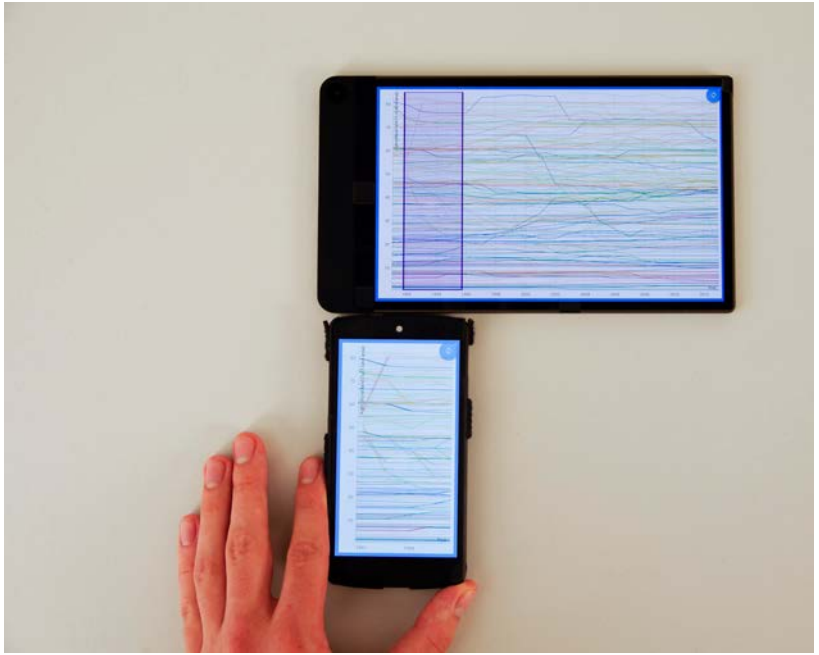
Dynamic Offloading of UI Components

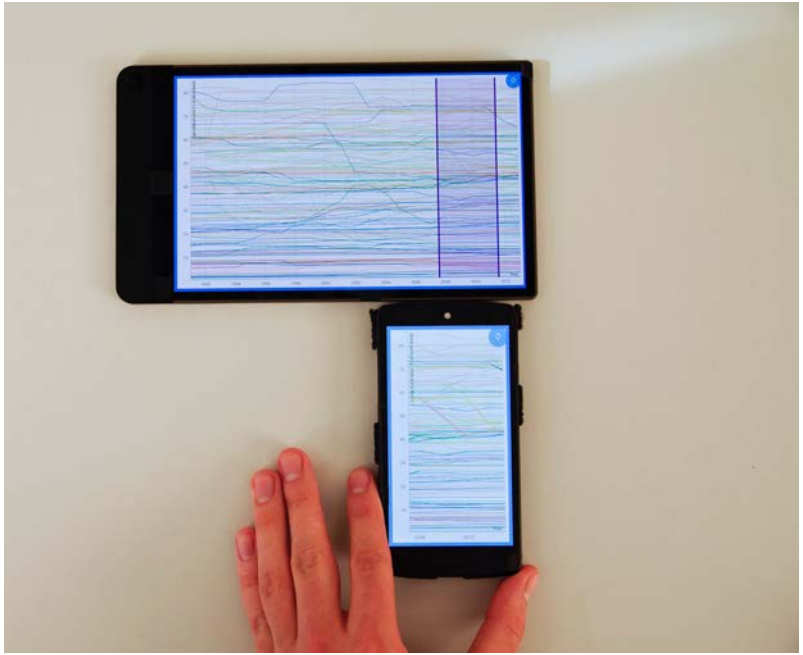
Use of Device Combinations

Filter-by-viewport
Zooming and panning one of the views filters *offscreen* data items

Use of Device Combinations

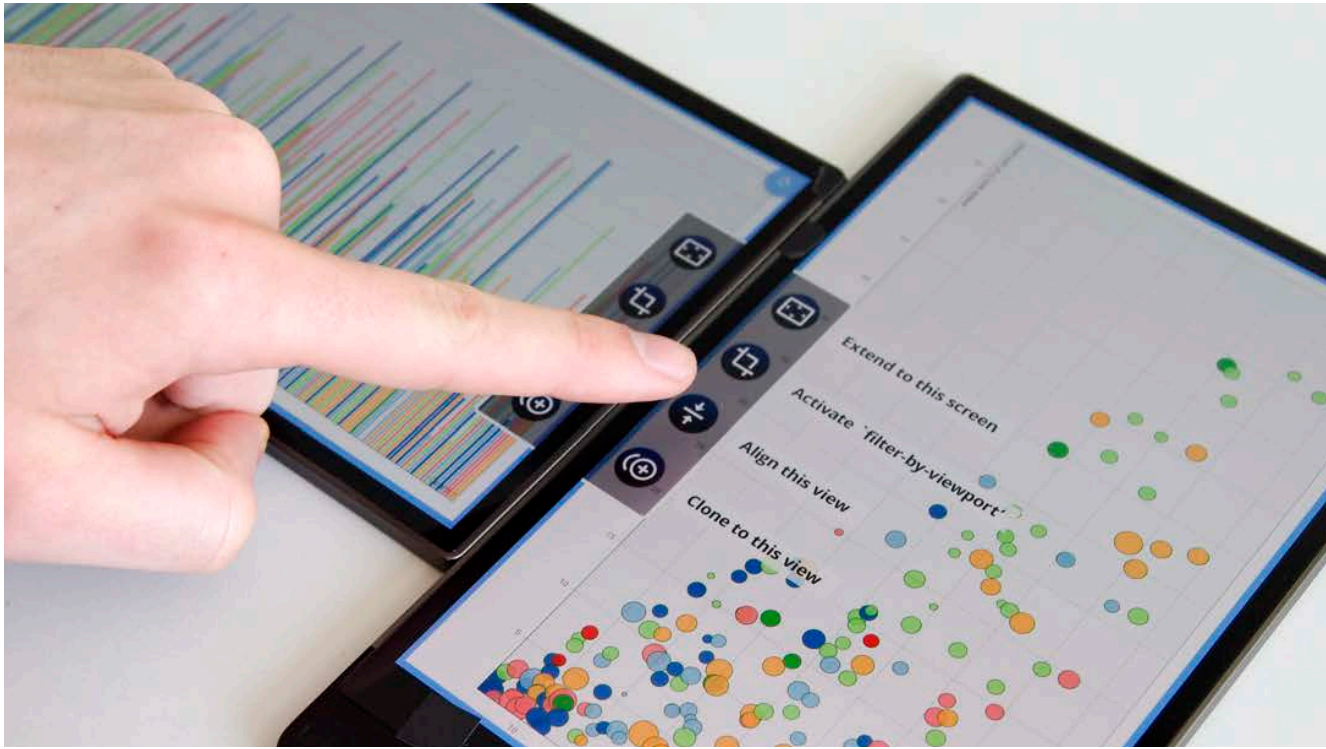
- Spatial movement: adjust visualization parameters continuously





Manage Adaptations and Combinations

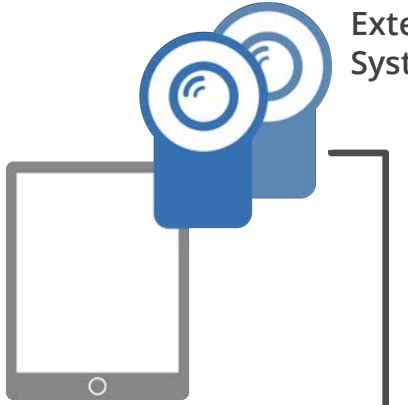
- Several options
- Sidebar shows available options: *“application suggests, users confirm”*



Prototype Implementation

Mobile Devices

- Show D3-based visualization
- Forward input events to server



External Tracking System

Server

- Application Logic
- Process tracking data

Source code freely available at Github: https://github.com/imldresden/vistiles

Outlook and Open Research Questions

How do people arrange devices and make use of the space?

How many devices are needed or can be handled?

Does it help to use a physical display for each visualization?

Conclusion

- VisTiles allows to interact with visualizations that are distributed and synchronized across multiple mobile devices
- New class of InfoVis interfaces based on mobile devices
- Mobile devices offer great potential for many visualization applications

Thank you.

VisTiles

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Project Website
https://imld.de/vistiles

Github
https://github.com/imldresden/vistiles