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

Ricardo Langner, Tom Horak, Raimund Dachselt
Visualization Workplaces
Visualizations for mobile devices

- 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 + 2\textsuperscript{nd} 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, Klokmoose, Luger, and Reiterer, 2017]

- **VisTiles**
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”

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
- Application Logic
- Process tracking data

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