

# VISTILES

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

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# 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

🖯 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, Marguardt, Reiterer, and Rogers, 2014]

### Interactions Techniques



Proximity

Regions

Devices

2008]

[Kray, Rohs,

**Cross-Device** Interaction Around Mobile [Marguardt,

### Hinckley, and Greenberg, 2012] Hook, and Kratz,

### Pass-Them-Around

[Lucero, Holopainen, and Jokela, 2011]

### Dynamic Duo

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

Use Cases



# 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]





#### Tangible Views

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

GraSp

Mobile + 2<sup>nd</sup> Display

[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]

### VisT

## VisTiles



# VISTILES \_\_\_\_\_

Visualizations that are distributed and synchronized across multiple mobile devices

# What Is a <u>Tile</u>?

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

- Grouping mechanism
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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.

**Display Extension** Expand a visualization across tiles



Alignment of Visualizations



Rearrangement of Data Items



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



Dynamic Offloading of UI Components



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



Spatial movement: adjust visualization parameters continuously



# Manage Adaptations and Combinations

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



# Prototype Implementation



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

# **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



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# VISTILES

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> <u>Project Website</u> https://imld.de/vistiles

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<u>Github</u> https://github.com/imldresden/vistiles

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