Beyond-the-Desktop Interactive Visualizations

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Steffen Wenz
LFE Medieninformatik
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Ludwig
Maximilians-
Universität
München

Introduction

Criteria

Screen Size	Input	Data Type	Task	Technique

- Criteria should…
  - …reflect device the visualization was designed for (screen size, input)
  - …reflect the type of visualization (data type)
  - …reflect how visualization is adapted to device specifics (task, technique)

- → How are common visualizations adapted to different devices?

Criteria

Screen Size	Input	Data Type	Task	Technique

- Main limiting factor of mobile devices!
- Screen size associated with typical devices & usage behaviors

Small	(Mobile phone, PDA)
Medium	(Laptop, desktop computer)
Large	(Tabletop, surface computer)

- → Which screen size & usage behavior was an application designed for?

Criteria

- Input devices = Combinations of sensors
- Linear/rotary axes
- Continuous/discrete (also buttons)
- Example: Mouse – 2 continuous linear sensors (mouse position), 1 discrete sensor (mouse wheel), 3 discrete/binary sensors (buttons)

Stylus	2D (+ 1D strength?)
Multi-touch	2*2D (two fingers)
Tilt-sensor	3D
…	

- → Can an application in principle be ported to another device with compatible methods of input?

Source: S. Card, J. Mackinlay, and G. Robertson: “A morphological analysis of the design space of input devices.”

Criteria

- Characterizes data that is visualized
- Also indicates typical tasks

- → Are visualizations compatible with other kinds of data?

1D	Text
2D	Images
3D	Architectural models
Temporal	Timeline with events
Multi-dimensional	Database records
Tree	Hierarchies
Network	Computer networks

Source: B. Shneiderman: “The eyes have it: a task by data type taxonomy for information visualizations.”

Criteria

Screen Size	Input	Data Type	Task	Technique

- Tasks supported by application to help user achieve his goal (i.e. find a piece of information)
- Based on Shneiderman's information seeking mantra: "Overview first, zoom and filter, then details-on-demand"
- → What tasks can applications offer on certain device types?

Overview
Zoom
Filter
Details-on-demand
Relate
History
Extract

Source: B. Shneiderman: "The eyes have it: a task by data type taxonomy for information visualizations."

Criteria

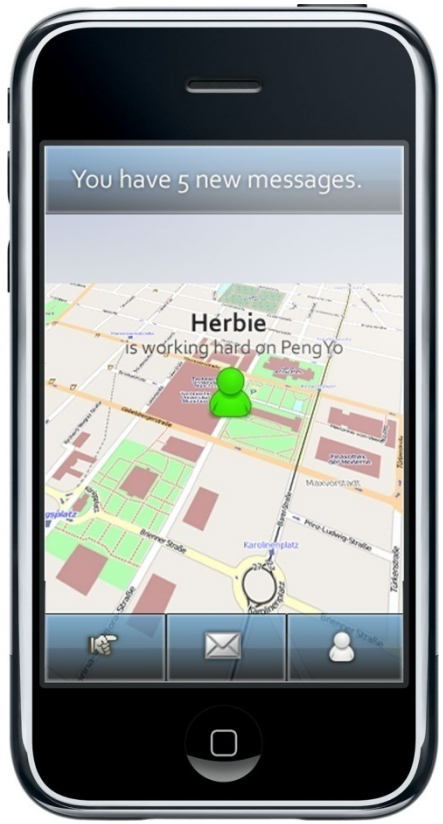
- "Clutter reduction techniques" - techniques employed by application to use screen space efficiently
- Three categories: Appearance, spatial distortion, temporal
- → How does a visualization deal with device limitations?

Sampling
Filtering
Change point size
Change opacity
Clustering
Point/line displacement
Topological distortion
Space-filling
Pixel-plotting
Dimensional reordering
Animation

Source: G. Ellis and A. Dix: "A Taxonomy of Clutter Reduction for Information Visualisation"

Example: PengYo

- Social interaction tool for iPhone
- Map visualization
- Panning/zooming via multi-touch interface
- Map as plane in three-dimensional space
- Viewing angle controlled by tilting

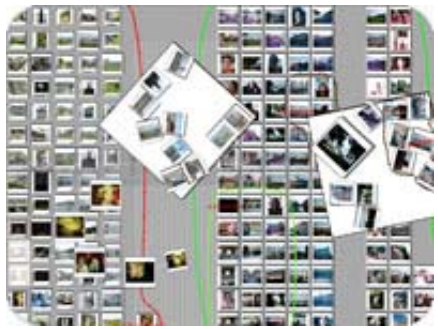


Screen Size	Input	Data Type	Tasks	Techniques
Small	Multi-touch (2*2D), tilt (3D)	Map (2D), overlay (2D)	Overview, zoom	Change point size, topological distortion

Source: M. Gross, H. Mangesius, D. Filonik, A. Hackel, and M. Bilandzic: “Pengyo: A mobile application to support phatic communication in the hybrid space”

Example: Flux

- Photo collection visualization for tabletop computers
- Photos manipulated directly using two fingers/pens, simulate physical properties
- Photos can be clustered in workspaces

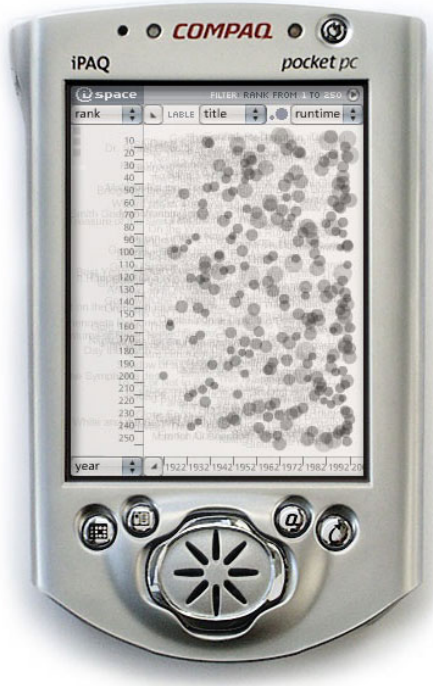


Screen Size	Input	Data Type	Tasks	Techniques
Large	Multi-touch (2*2D)	Photo collection (1D temporal, 1D quality, 1D similarity)	Overview, zoom, filter, relate	Filtering, change point size, clustering, point/line displacement, animation

Source: D. Baur, O. Hilliges, and A. Butz: “Flux: Enhancing Photo Organization through Interaction and Automation.”

Example: Mobile Liquid 2D Scatter Space

- Scatterplot visualization for PDAs (stylus)
- “Liquid browsing” – Neighboring items move aside when an item is selected → no overlap
- Details on demand when item is tapped



Screen Size	Input	Data Type	Tasks	Techniques
Small	Stylus (2D) + strength (1D)	Multi-dimensional (3D visualized at the same time)	Overview, filter, details-on-demand, relate	Filtering, change point size, change opacity, point/line displacement, non-uniform topological distortion, dimensional reordering, animation

Source: C. Waldeck, D. Balfanz, C. Center, and G. ZGDV. “Mobile liquid 2D scatter space (ML2DSS)”

Observations

- Nine visualizations examined altogether
- All require at least 2-dimensional input: Data items are directly manipulated in screen space
- Common tasks: Overview, zoom, animate
  - Map visualizations only support overview & zoom
  - Photo collections offer more tasks, such as filter & relate
  - Scatterplots support details-on-demand

- On average, visualizations on medium/large screens…
  - …supported **more tasks**
  - …employed **fewer clutter reduction techniques**

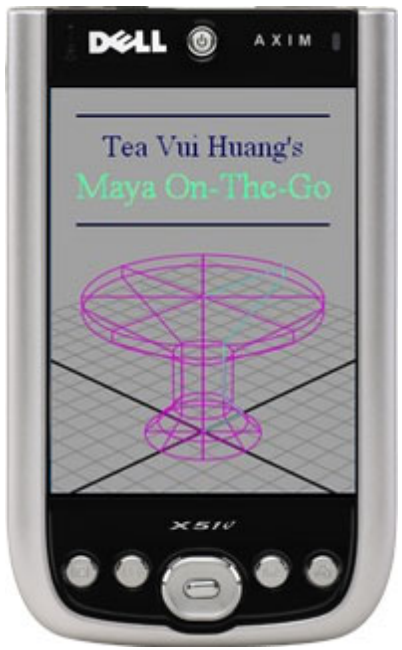
	Small	Medium/large
Tasks	2,7	4,0
Techniques	4,3	3,7

Discussion

- Photo collections
  - On desktop computers: Interface largely based on file browsers
  - On other devices: Forced to develop different interfaces due to *limitations*
  - New concepts actually more suitable for photo collections!
- Map visualizations
  - On desktop computers: Pan & zoom with mouse as always
  - On other devices: New interface concepts due to new input *possibilities* (multi-touch, tilt sensors etc.)
  - Already started to influence desktop computers: Multi-touch in MacBooks, Windows 7
- Scatterplots
  - On desktop computers: Mostly used for scientific/business visualizations
  - Potential for mobile applications, because screen space is used very efficiently

Conclusion

- Criteria led to some interesting insights
- Data type criterion not always clear: Photo collections?
- Tasks & clutter reduction techniques matter of interpretation



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