Personal Augmented Reality for Information Visualization on Large Interactive Displays

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Large Interactive Displays + Personal Augmented Reality → Information Visualization
Large Interactive Displays

- Supports touch and digital pen input
- Can be used by multiple analysts
- Shows big amount of data in high resolution

Issues with perception of data
- Disturbances by other analysts
Spatial immersion and embodied interaction

Personal views for each analyst

Provides additional space to display data

No native support for co-located data analysis

Lacks tactile and precise input modalities
Augmented Displays
[Reipschläger & Dachselt 2019]

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Reipschläger & Dachselt 2019
Augmented Displays

Large Interactive Displays

Mixed and Augmented Reality

Visualization on Large Displays

PARVIS

Information Visualization

Immersive Analytics
Hybrid User Interfaces  
[Feiner & Shamash 1991]

DesignAR  
[Reipschläger & Dachselt 2019]

DualCAD  
[Millette & McGuffin 2016]

SymbiosisSketch  
[Arora et al. 2018]
Augmented Displays

Hybrid User Interfaces [Feiner & Shamash 1991]

DesignAR [Reipschläger & Dachselt 2019]

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SymbiosisSketch [Arora et al. 2018]

[Jakobsen & Hornbæk 2014]

[Langner et al. 2019]

[Prouzeau et al. 2017]

[Isenberg et al. 2012]
Augmented Displays

- Hybrid User Interfaces [Feiner & Shamash 1991]
- DesignAR [Reipschläger & Dachselt 2019]
- DualCAD [Millette & McGuffin 2016]
- SymbiosisSketch [Arora et al. 2018]
- ImAxes [Cordeil et al. 2017]
- AR Graphs [Büschel et al. 2019]
- Hybrid User Interfaces [Jakobsen & Hornbæk 2014]
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[Isenberg et al. 2012]
Design Space for Combining Large Displays and Personal AR

Visualization Techniques

u2vis – Universal Unity Visualization Framework

Prototype Implementation and Use Case
Design Space
Spatial Alignment

Visualization Parts

Personal Views
Spatial Alignment

- top
- right
- in front
- central
- bottom
- left
- behind
Visualization Parts

- View
- Tools
- Selections
- Axes
- Data Marks
- Links
- Annotations
- Legend
- UI Elements
- Grid

Spatial Alignment

Personal Views
Personal Views
Spatial Alignment

Visualization Parts

Personal Views
Visualization Techniques
Perceptual Issues on Large Displays

Managing Density and Complexity
Embedded AR Visualizations
Hinged Visualizations
Curved AR Screen
AR Brushing and Linking
Extended Axis Views
AR Visualization Layers
Personal AR Annotations
Perceptual Issues on Large Displays  
Managing Density and Complexity
Validation: Use Case

Cognitive Walkthrough

Exploration of a IMDB movie data set in multiple coordinated views

Various Tasks

- Identify clusters using *Extended Axis Views*
- Individual annotations in AR
- Comparison of movies using *Embedded Visualizations*
- Guide awareness to connected views using *AR Brushing and Linking* as well as *Hinged Visualizations*
u2vis
u2vis

Universal Unity Visualization Framework
Large Display
independent

Microsoft HoloLens
independent

Dedicated Server
OSC and TCP

synchronizing state and interaction
Discussion
Perception of AR Content and Display

Combining Environments for Data Analysis

Alignment of AR Content in Relation to the Display

Collaboration Between Multiple Analysts

Connecting Multiple Visualizations with AR

Further Potential Utilization of AR
Design Space for Combining Large Displays and Personal AR

Visualization Techniques

u2vis - Universal Unity Visualization Framework
Personal Augmented Reality for Information Visualization on Large Interactive Displays

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Image Sources

Icon
Information Visualization
https://fontawesome.com/