Focus+Context

CPSC533C

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Paper selected

1. ## Focus+Context Taken Literally

   Kosara, R., Miksch, S., and Hauser, H. "Focus+Context Taken Literally," IEEE Computer Graphics and Application. Jan/Feb 2002, p. 22-29.

2. ## Continuous Zooming

   The Continuous Zoom: A Constrained Fisheye Technique for Viewing and Navigating Large Information Spaces L. Bartram, A. Ho, J. Dill and F. Henigman, UIST '95, pp. 207-216

- ## DateLens

  DateLens: A Fisheye Calendar Interface for PDAs Benjamin B. Bederson, Clamage, A., Czerwinski, M. P., & Robertson, G. G. ACM Transactions on Computer-Human Interaction (TOCHI), March 2004, 11(1), pp 59-89.

Focus+Context Taken Literally

Focus+context method that <u>blurs objects based on their relevance</u> (rather than distance) to direct the user's attention.

2002

1 An example of depth of field in photography.

Focus + Context

1. Spatial methods

- **A visualization is distorted** to allow more space for the currently more important objects, and less for the context.

- Examples are fish-eye view, hyperbolic trees, the document lens, stretchable rubber sheets, and other distortion-oriented methods.

2. Dimensional methods

- **Users can move a focus over** a visualization to display different data about the same objects.

- Examples are magic lenses, tool glasses, etc.

3. Cue methods

- Objects that meet certain criteria **are stressed by assigning visual cues** to them so that they are more prominent to the viewer without hiding the context.

- Examples: use color saturation and brightness. A method used in a system that lets up to 26 layers of geographical information be displayed at the same time.

Focus + Context

1. Spatial methods

They don't allow control of the degree of interest (DOI) that's completely independent of the layout of the object..

2. Dimensional methods

They don't display more objects, but they allow <u>more or different data dimensions</u> of the already displayed ones.

3. Cue methods

Users can move the focus between layers by changing their blur level and transparency.

Why Semantic Depth of Field?

1. When all other cues are already used.

2. To reinforce another cue or provide additional information.

3. Blur is intuitive; untrained users quickly understand what's pointed out.

4. Blur works independently of color.
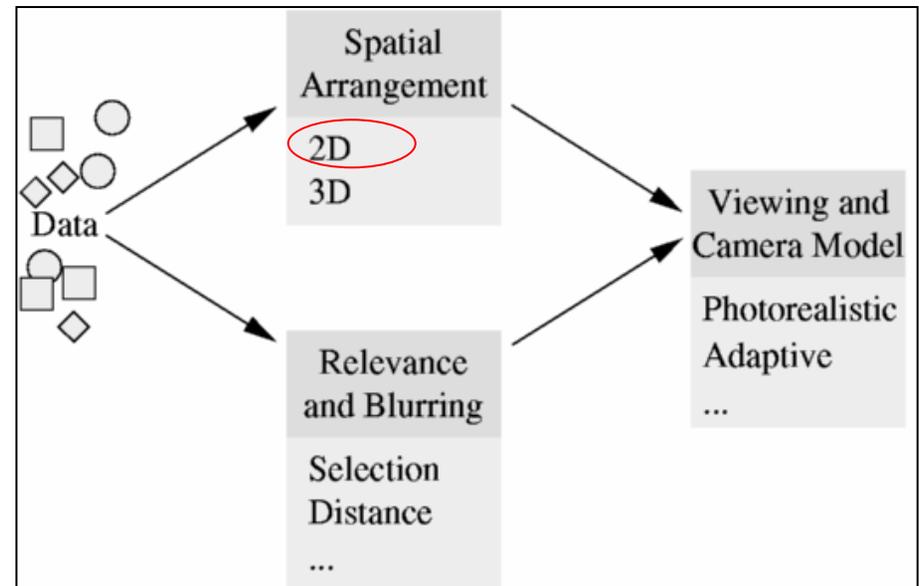
5. SDOF in preattentive.

Semantic Depth of Field

Depth of Field (DOF)

- Blurring the less relevant parts of the display while sharply display the relevant information.

Semantic Depth of Field (SDOF)

-- A focus+context method that blurs objects based on their relevance (rather than distance) to direct the user's attention.

The building blocks of SDOF (Kosara et al, 2001)

Our relevance function resembles the degree of interest (DOI) function. But relevance is completely independent of layout (quite contrast to fisheye views)

Semantic Depth of Field

1. Relevance and blur
2. Properties
3. Applicability
4. Parameterization
5. Interaction

1. Relevance and Blur --
The main parts of rendering an SDOF image

Each object or data point is assigned a relevance value *r*.

• The relevance value *r* range from 0 (means completely irrelevant) and 1 (means maximally relevant).

• The relevance values are translated by the blur function into a blur value *b*.

• The blur function is determined by the threshold *t*, the step height *h*, and the maximum blur diameter *bmax*.

• The gradient *g* is calculated by the application (software).
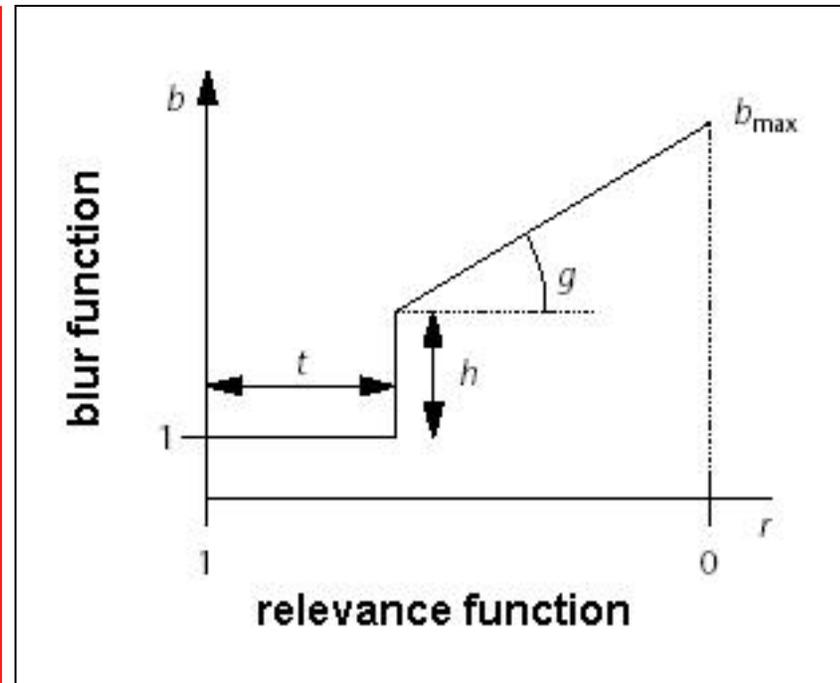
(see Parameterization)

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2. Properties of SDOF

- SDOF is intuitive, like our field of view.
- SDOF is Independent of color.
- SDOF distorts irrelevant objects rather than relevant ones.
- Blurring removes the high spatial frequencies and reduces the contrast.
- Small details getting lost. (to the context objects, not a relevant problem)

3. Applicability of SDOF

- SDOF suits for some applications than others.

- SDOF suits applications where objects should be pointed out that are of sufficient size so that they don't have to be magnified to be shown to the user. (SDOF doesn't work well with pixel-based visualizations.)

- SDOF can be used where other visual cues have already been used and additional ones are needed.

- SDOF can be used as an intuitive cue when color, saturation, and other cues are not .

- SDOF depend on the appearance of blur on the viewing angle, it is required to have the knowledge about the output device and ways for users to interact with the application.

4. Parameterization

- A means for user to adjust the parameters of the display or at least use good default values.

- Users can adjust the values h and the maximum blur diameter b_{max} In the blur function. (limits of the usable blur)

- Users can change the threshold t as often as necessary to show different amount of objects in focus while examining data.

5. Interaction

- A means to adjust the parameters of the display or at least use good default values.

- Users can adjust the values h and the maximum blur diameter b_{max} In the blur function.

SDOF Applications
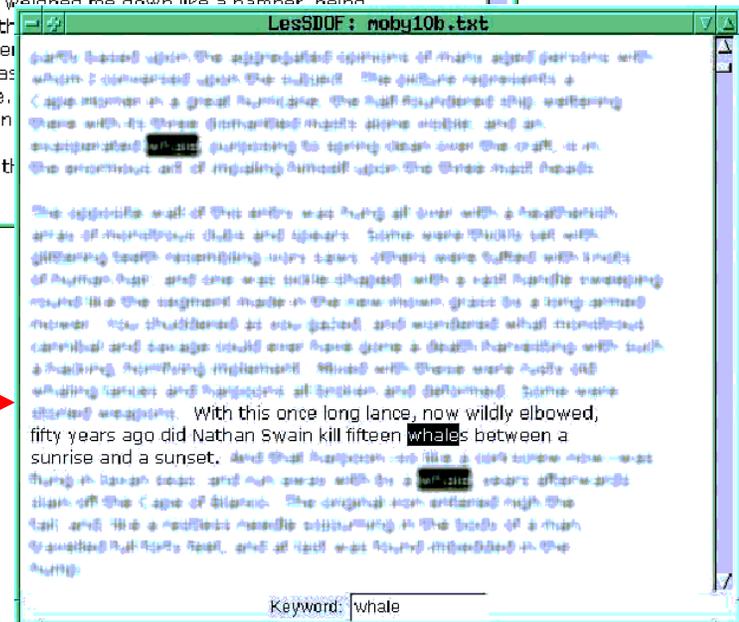
1. LesSDOF
2. sfsv
3. sscater
4. sMapViewer

1. LesDOF: *Text display and keyword search*

Scrolling in LesSDOF.
Three lines on the top are
context from the last page,
and therefore blurred, but
still readable.
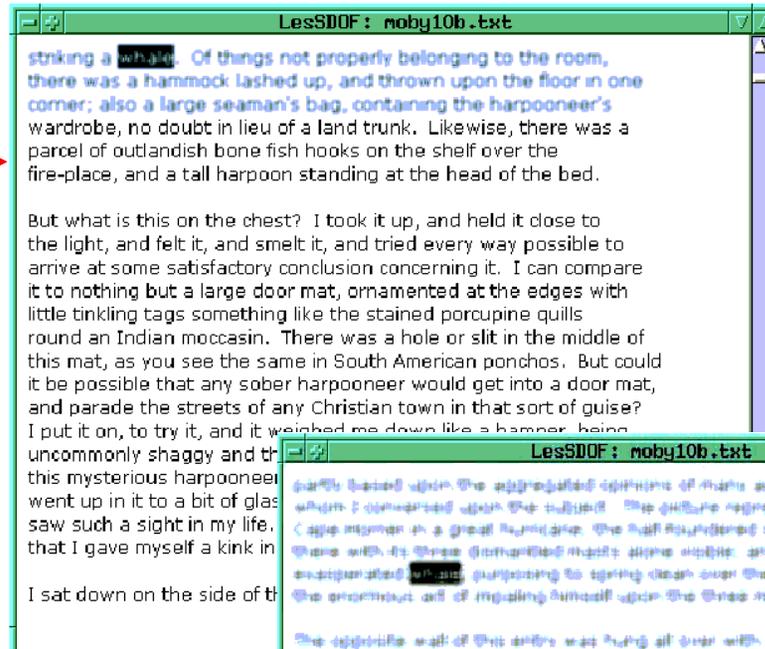
Finding a keyword in LesSDOF. Three
hits appear on this page, with the focus
currently on the middle one.

1. LesDOF: *Text display and keyword search*

SDOF aspects.

• The application only uses a binary relevance classification.

•Blur and other cues reinforce each other.

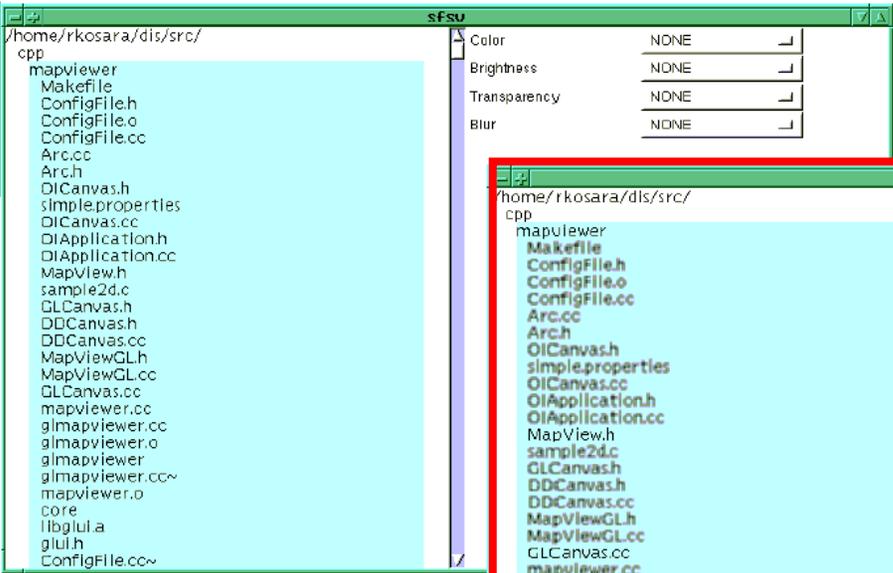•This example doesn't use any color and still effective in guiding the viewer's attention.
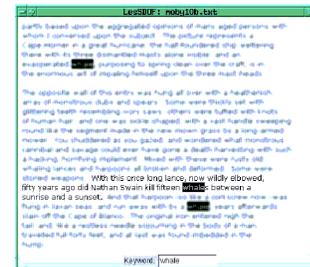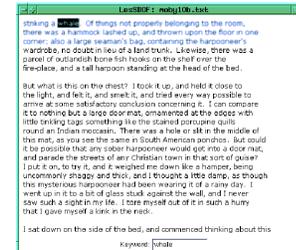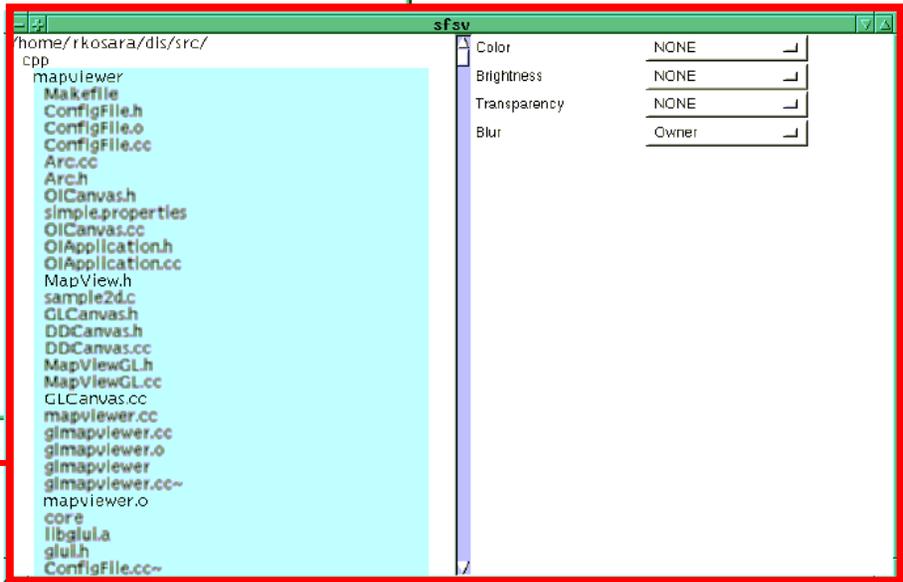

Interaction.

• Users can't influence either the relevance or the blur function.

• Minimum perceivable blur, when paging through a text.
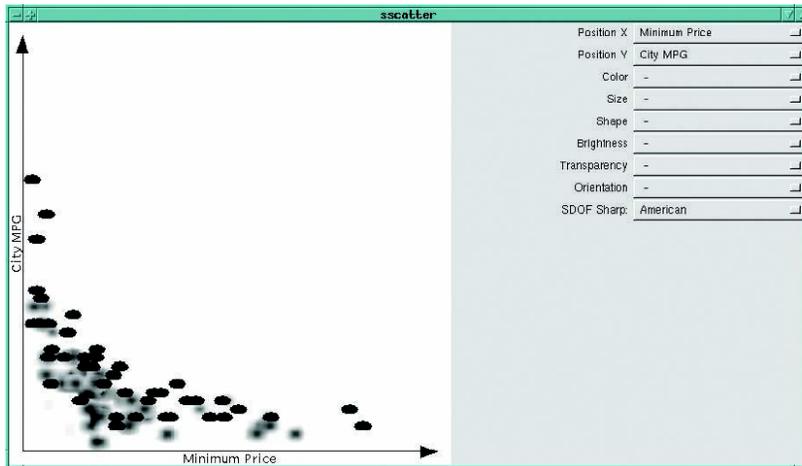
2. Sfsv: File System Viewer

A file system viewer with all files in focus.

A file system viewer with one focusing on the files of one user

2. Sfsv: File System Viewer

SDOF aspects and Interaction:

• SDOF can be used as an orthogonal cue and reinforcement, depending on the user's needs.

• The combination of cues allow to find file in their context.

• It is poor to quickly look for different information in a directory or directory structure without loosing the context.

3. sscatter: Scatter plots

7 A scatter plot of car data showing that more expensive cars have a lower miles per gallon (MPG) number and that American and other cars are available over the full price and MPG range.
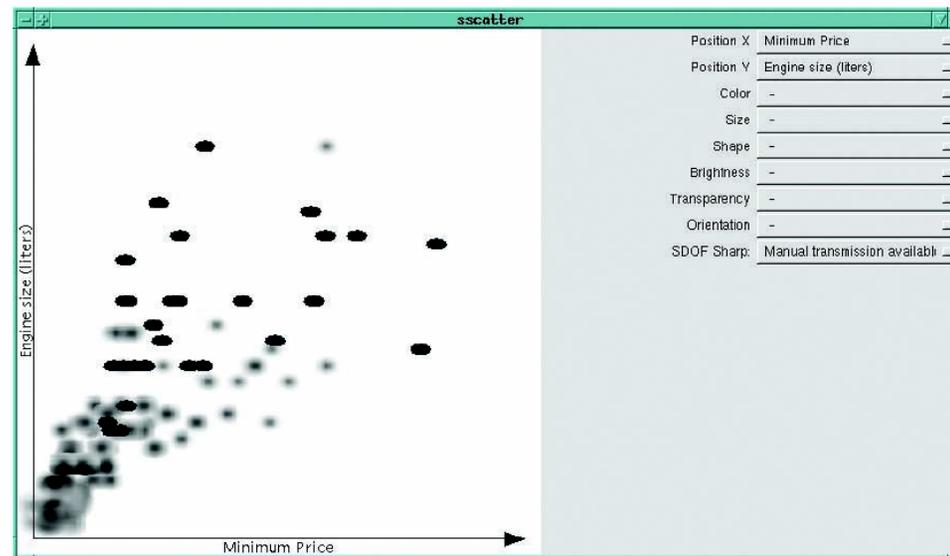
8 A scatter plot of car data showing that more expensive cars have larger engines and that the availability of manual transmission is generally a feature of more expensive cars.
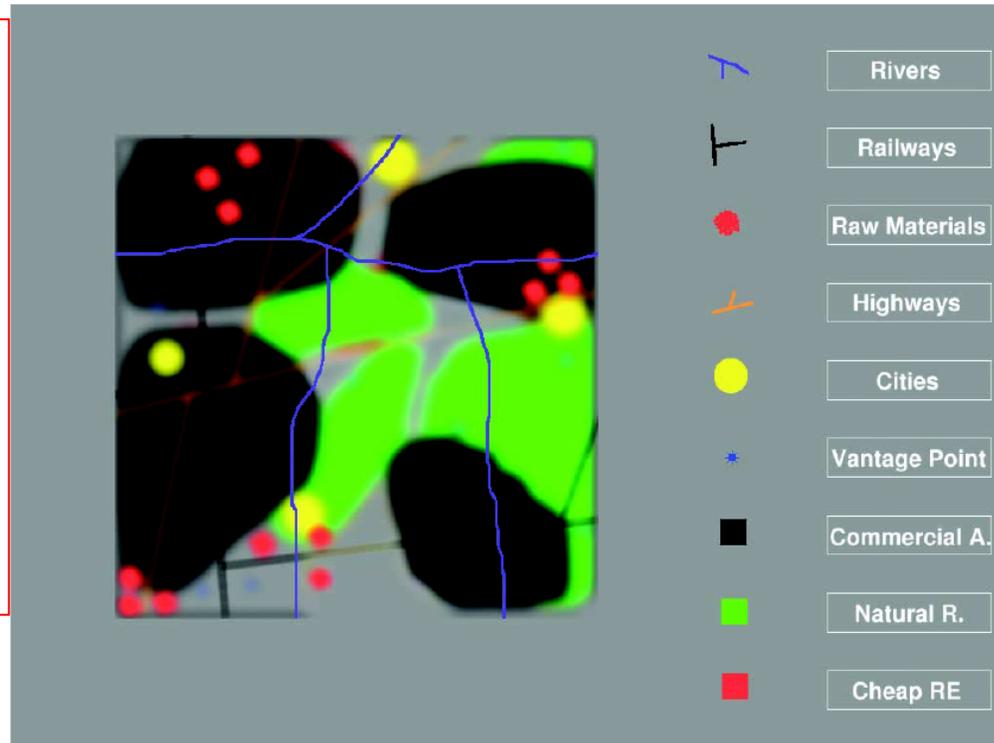
3. sscatter: Scatter plots

SDOF aspects and Interaction:

• Users are free to choose data dimensions for SDOF display, several relevance measures can apply:

—Binary (such as availability of manual transmission)

—Discrete (such as number of cylinders)

—Continuous (such as price, engine size,…)

• Scatter plots are useful to get overview for data and test hypothesis.

• But scatter plots are only useful for two data dimensions.

• A large number of easily distinguishable cues are therefore needed.

4. sMap Viewer

- Users stack layers of geographical information on top of each other.

- The topmost layer is displayed sharply, while all other layers are increasingly blurred.

- It creates a sense of depth.

Rivers
Railways
Raw Materials
Highways
Cities
Vantage Point
Commercial A.
Natural R.
Cheap RE

SDOF aspects:
The possibility of defining a continuous relevance function.
Interaction:
Users can select the layer to be put on top of the stack.

Implementation

- Modern graphics hardware support blurred image quickly and usable in interactive applications. (texture mapping, e.g. in computer games)

- They draw an image several times at slightly different positions and having the graphics hardware sum up the color information at every step.

- Blurring sums up the information around a pixel for every pixel in the image.

- Calculate auxiliary sums and then sum up in a second step.

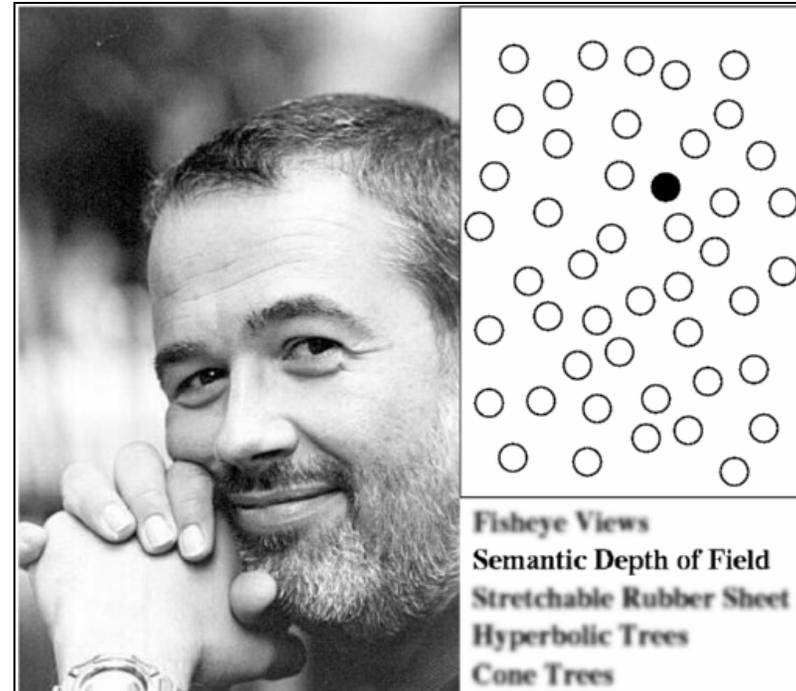Table 1. Performance figures for the applications shown in this article.

Program	Size (Pixels)	Percentage Blurred	Frame Rate	Figure
LesSDOF	500 × 400	12	167	4
LesSDOF	500 × 400	92	143	5
sfsv	380 × 480	25.5	31	6
sscatter	600 × 600	37.2	23	7
sscatter	600 × 600	46.5	19	8

User Study: Preattentive Processing

16 subjects were able to detect and locate objects (up to 63 distractors) for only 200 ms (with more than 90% accuracies), they were able to estimate the no. of sharp objects.

Example:

1. A portrait (left) - the blurred objects surrounding the face are hardly noticeable;

2. The object different to all others is immediately perceived (top right);

3. text is another example (bottom right).

Fisheye Views
Semantic Depth of Field
Stretchable Rubber Sheet
Hyperbolic Trees
Cone Trees

Giller, V. et al., **Experimental Evaluation of Semantic Depth of Field, a Preattentive Method for Focus+Context Visualization**, tech. report TR-VRVis-2001-021, VRVis Research Center, Austria, 2001, http://www.vrvis.at/.

Conclusion & Future Work

- **Pros:**
  - SDOF is preattentive.
  - SDOF is useful for discriminating a small number of classes. (3 or 4 – subject to further tests)
  - No difference in search time between blur and color.
- **Cons:**
  - Can't use SDOF as a fully fledged visualization dimension
    - Tiring to tell the difference in blur between blurred objects
    - Not able to tell that difference in any meaningful way.
- Future Work
  - How well SDOF works together with Focus+Context techniques.
  - How SDOF can be applied to areas such as volume and flow visualization and user interface.

Critique

- A well structured and well-written overview article.

- Reference to previous work on SDOF and user study; provides the website link for further studies.

- Gives definition, applications, implementation, user study, and conclusion and future work.

- Lack of technical details on implementation part.

Continuous Zoom

In large real time systems such as power generation/distribution, telecommunications and process control.

(1995)

The Goal

- A better way in navigating and viewing large information spaces
  - Supports multiple focus points;
  - Enhances continuity through smooth transitions between views, and
  - Maintains location constraints to reduce the user's sense of spatial disorientation.
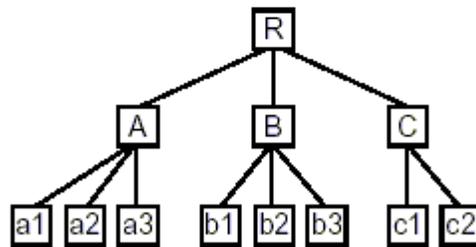
Continuous Zoom

- Uses both filtering and distortion, and Graphical Fisheye to create detail-in-context views.

- Creates a graphic interpretation of Furnas's filtering method using compression as well as removal.

- Deals with a large network depicted as a collection of non-overlapping rectangles connected by links. When the user make a rectangle grow , the other rectangles in the network shrink.

- using a fisheye algorithm that takes into account the network proximity.
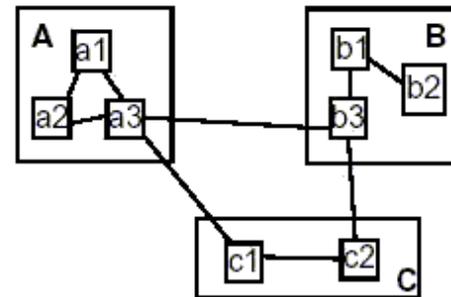
The Continuous Zoom Approach
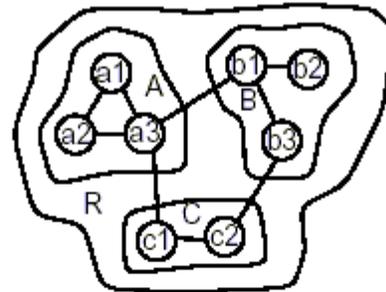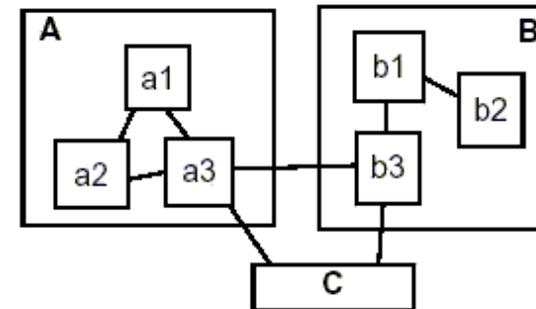

a) a small network with hierarchy indicated

b) the display hierarchy of the network

Figure 1. Network and display hierarchy

a) continuous zoom display with all clusters open

b) after closing cluster C

Figure 2. Network of Figure 1 with cluster C closed.

The Continuous Zoom Approach

• The entire hierarchy is visible at all times (though some times "summarized" by closed clusters)

• The detailed portions always appear in context.

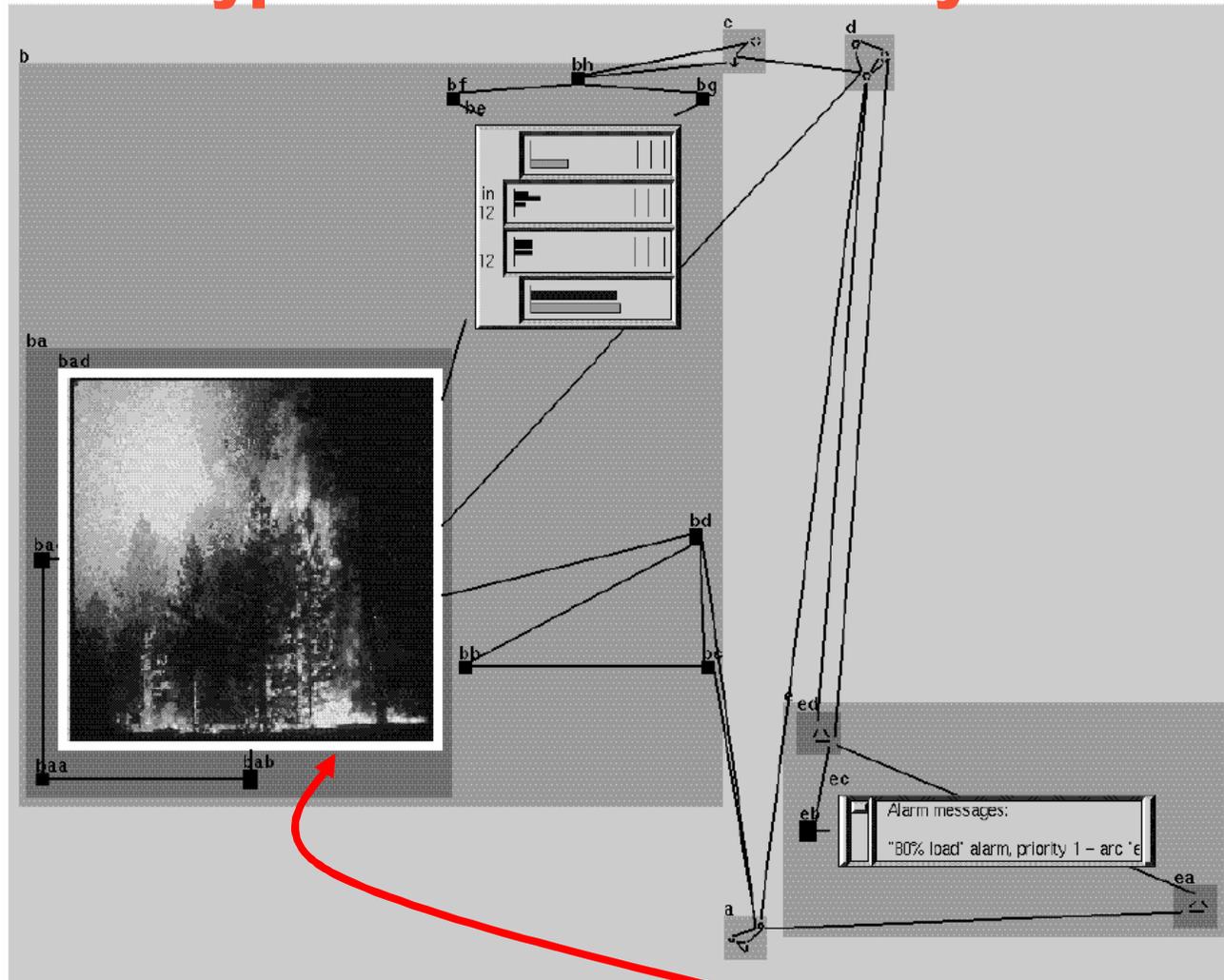•Multiple areas can be zoomed simultaneously (more than one focal point)

a) continuous zoom display with all clusters open

b) after closing cluster C

Figure 2. Network of Figure 1 with cluster C closed.
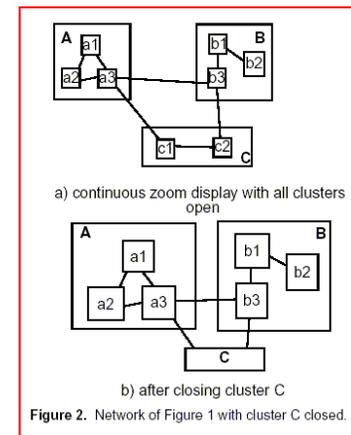
Continuous Zoom in A
Protoype network control system
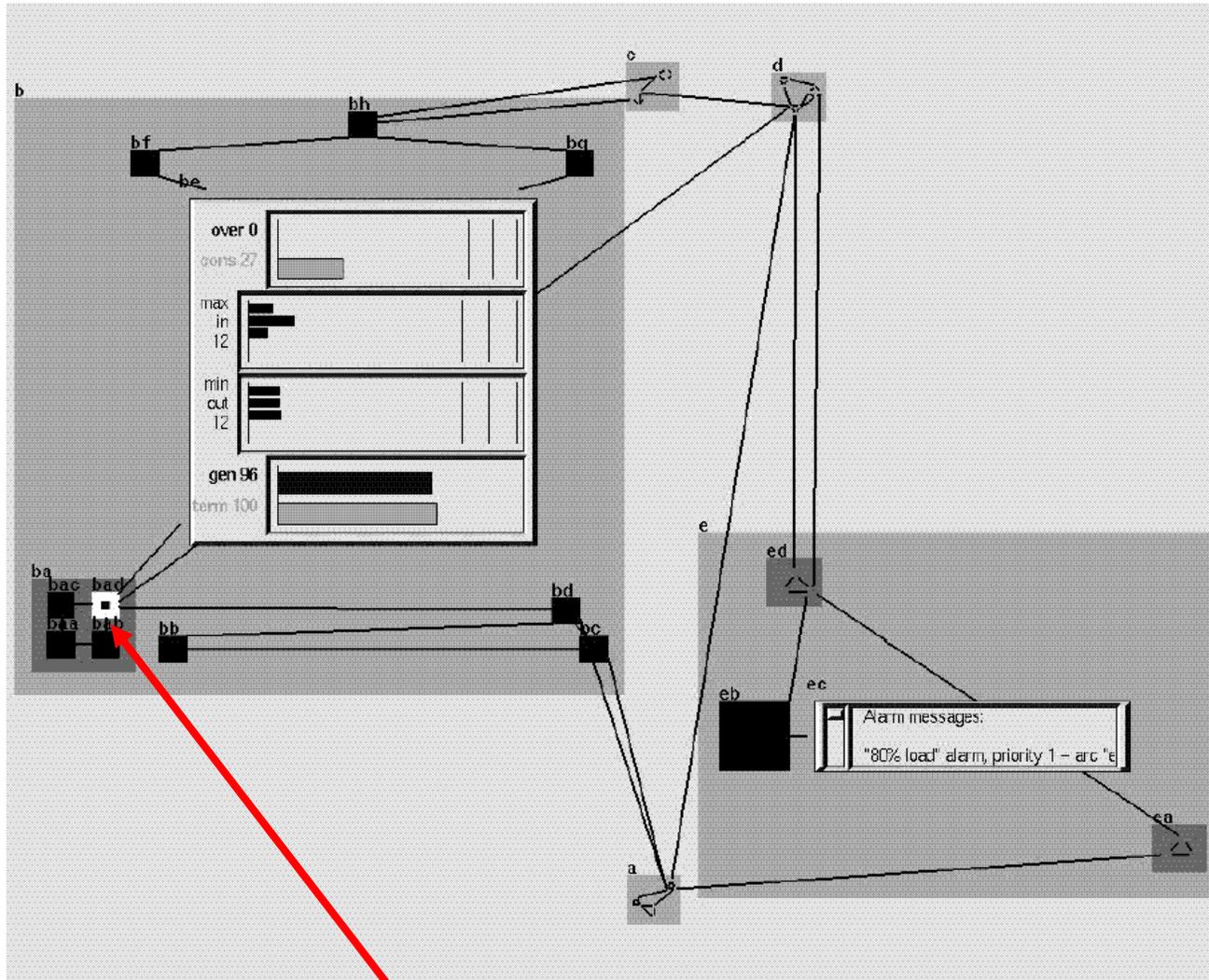
Screen with node "in alarm" bordered in white.

Screen after user has selected node in alarm.

The Continuous Zoom Approach

Mechanism

- – The node size shows a DOI that each node maintains.

- –The arcs (links) of the network are always draw on top of the nodes

- – Holding the mouse button to increase or decrease the size of the node until the button is released.

- – DOIs are dynamically calculated based on a node's a priori importance, its current sate and its proximity to interesting nodes.

- –The neighbors of interesting nodes get more space than nodes farther away.

The Continuous Zoom Algorithm

- The initial layout of the network (normal geometry)

  – The initial layout is constant.

  –The display is controlled by changing scale factors.

  – A "budgeting" process to distribute space among the nodes of a network.

- Subsequent DOI-based size adjustments (A set of scale factors)

  – A scale factor for each node controls the node's size.

  – A scale factor is first computed for every interval.

  – Whenever a node size changes the new representation is automatically given the largest size possible based on its min size requirement, on its DOI and on available space.

- The two are combined to produce the zoomed geometry.

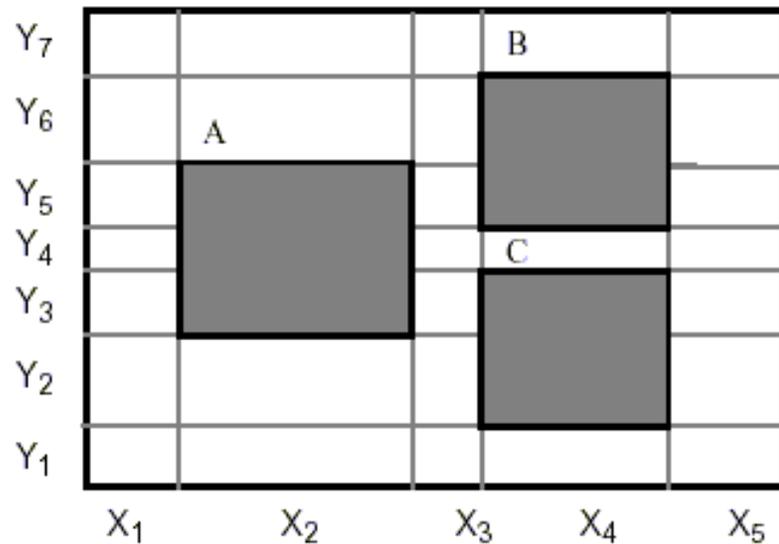- The algorithm works independently in the X and Y axes.
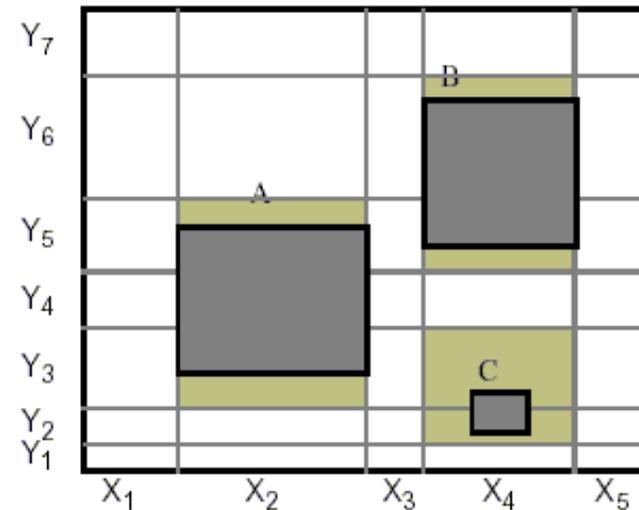
Figure 4. Sample three node network, initial size

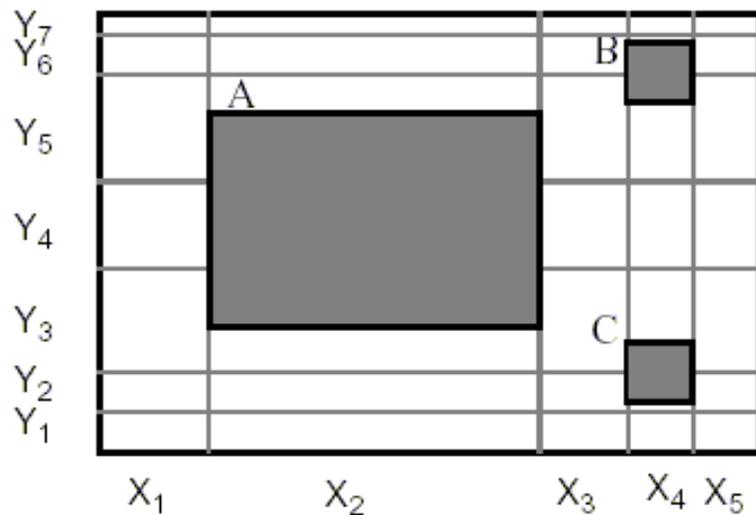**Figure 6.** Node C scaled down from Figure 4 (zoom holes are shaded).

Figure 5. Node A increases at the expense of nodes B and C.

1. The node size changes, but stay within their intervals; however, node projections may overlap;

2. The interval size shifts, but they never overlap;

3. After computing, the nodes are repositioned;

4. After reposition, a nodes' center stays at the same relative position in its interval.

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Propagation

- Combine global A hybrid continuous zoom

- The global algorithm is applied to the subtree rooted above the node being scaled.

- Sizing based on DOI
  - Stop as soon as any node become too small.
  - Augmenting the basic algorithm with a two-stage calculation.

Discussion

- The animation does suffer from certain discontinuities in motion.

- The free space allocation to nodes based on their DOIs can let let some space go to waste.

- The scalability of this technique has not yet fully explored by the authors.

- How hierarchical structures may be used to represent links and how the algorithms may be extended to support space allocation and navigation issues in the link space as well as in the node space need further studies.

- Full filtering is not supported in the continuous zoom.

Critique

- Research questions are clearly defined.
- Detailed descriptions on approaches, algorithm, and discussion.
- The dynamically calculation was a pioneer approach due to the computer technology then.
- No user study.
- No quantifiable evidences provided to explain test results. (about 5 steps seem to be sufficient)
- Illustrations do not demonstrate its application a large information space.
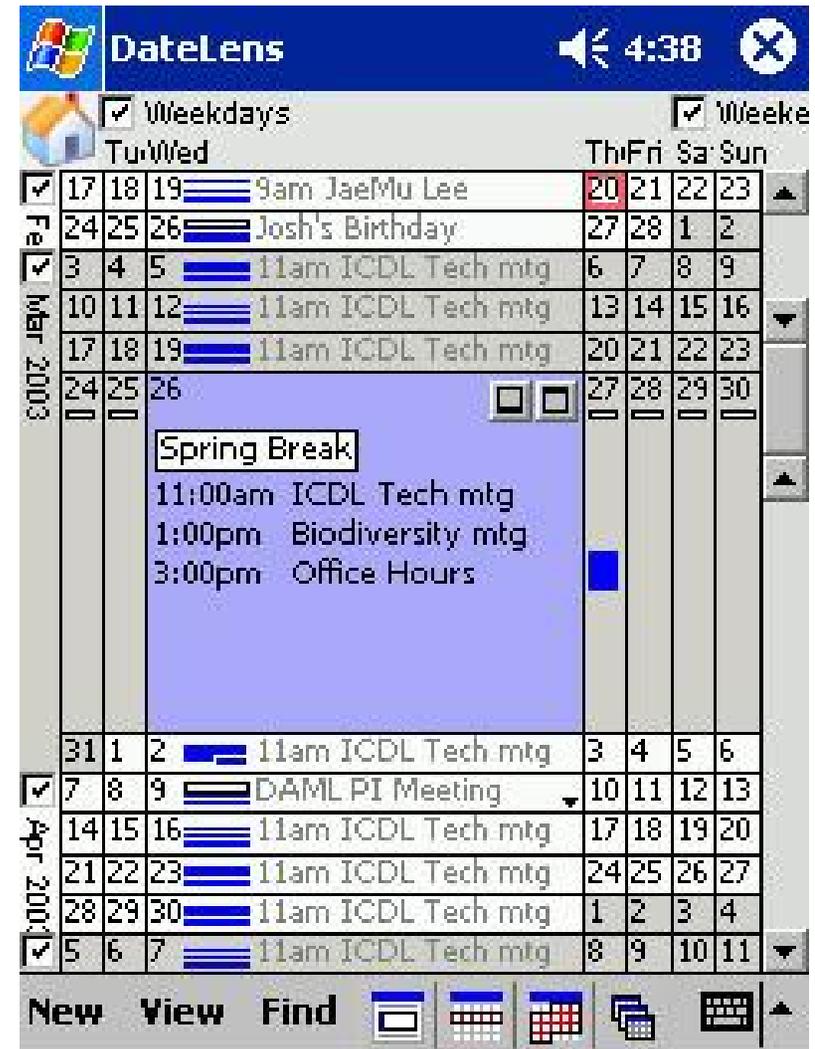- No qualitative data too. (in the opinion of our users)
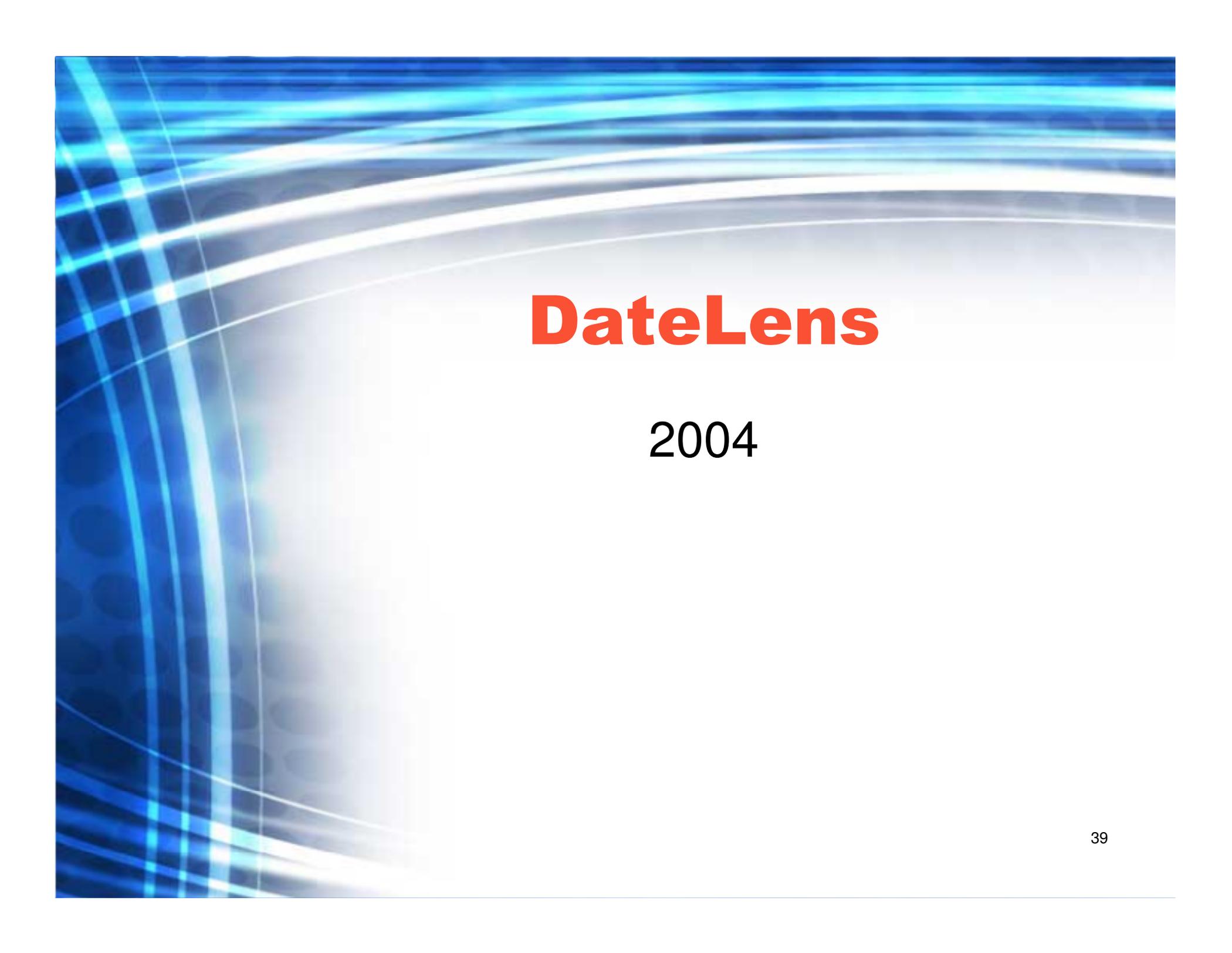
DateLens

2004

DateLens

- A conventional calendar information

- Fisheye distortion technique

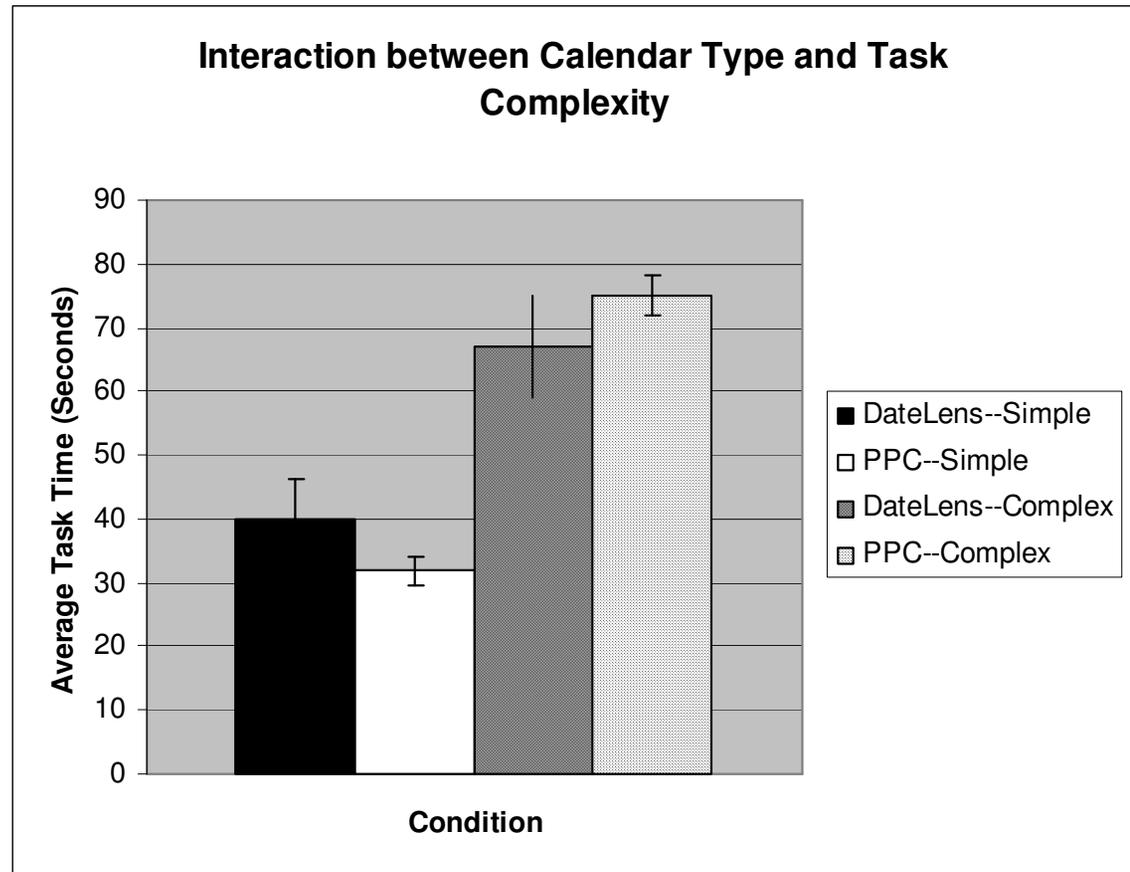- Zooming interaction

DateLens Functions

- A conventional calendar employs Fisheye distortion and along with Zooming interface

- Tasks including scheduling, navigate and counting, and searching
  - Picking a good weekend to camping
  - Counting the number of Mondays in November
  - Finding start and end dates of a trip

- Support from PDA and up to Desktop
  - The ability to switch between devices

DateLens User Studies

- Two user studies at Microsoft Research
  - First with non-PDA users
  - Second with MSR PDA-using employees
- Similar timing results
- Overall quite enthusiastic

Bederson, 2004

Interaction between Calendar Type and Task Complexity

Legend:
- DateLens--Simple
- PPC--Simple
- DateLens--Complex
- PPC--Complex

Y-axis: Average Task Time (Seconds)
X-axis: Condition

Future Work

- Improve usability issues
- Fulfill User requested functions
  - Such as faster data entry
- Tease apart the individual influences of integrated search and the flexible, fisheye visualization to complex tasks
- Apply DateLens interface to smaller devices (such as cell phones) and larger ones (such as tiled displays)

Conclusions

- Does zooming work?

- Is animation helpful?

- Are toolkits beneficial?

- => Clearly yes (sometimes)

  - Good small representations needed

  - Animation to help maintain object constancy best

  - Understanding of domain and users crucial

- Like all interfaces, good visualizations remain hard

DateLens

- [Video](http://www.cs.umd.edu/hcil/datelens/datelens-video-web-server.wmv)

- Demo http://www.windsorinterfaces.com/datelens-demo.html

- Commercialized at www.datelens.com

Critique

- This paper gives an overall review of researches of a design (now it is a commercialized product).

- Comprehensive, well-structured, well-written, and well-illustrated.

- Contains both quantitative and qualitative studies.

- Detailed reports on user studies.

- No technical details.

- Two user studies, but limited to the design team because of privacy concern.