The Fisheye View Metaphor

The fisheye view is a metaphor coming from the fisheye lens used in photography. Such a wide angle lens distorts an image in the way that things in the central area appear enlarged, while things aside appear small. The idea behind the fisheye is enlarging the focus and keeping the context.

The Fisheye View Metaphor

In many contexts, humans often represent their own "neighborhood" in great detail, yet only major landmarks further away.

*(George W. Furnas - CHI 1986)*

The fisheye metaphor is more than a distortion of an image to display. It can be applied to many fields – networks, hierarchical structures. All you need is a metric/context/distance function, that means something that tells whether another object is far or near.

The Fisheye View Theory

*(George W. Furnas - CHI 1986)*

Degree of interest (DOI) function:

\[ \text{DOI}(a|.=b) = \text{API}(a) - D(a,b) \]

\( \text{DOI}(a|.=b) \): DOI of a, given the current focus is b.
\( \text{API}(a) \): static global a priori importance measure.
\( D(a,b) \): distance between a and b.

Fisheye Views

Principles, Applications and Programming

Heiko Drewes
The Fisheye View Theory

Example for DOI function applied on a tree structure.

This ideas are from 20 years ago. At that time computational graphics power was very limited. Take this as inspiration for your ideas now.

Figure 1. Distances, A Priori Importance and the Fisheye DOI for a rooted tree.

(Y. K. Leung, M. D. Apperley 1994)

A unified theory of distortion techniques

- "...stretchable rubber sheet mounted on a rigid frame"
- Stretching = Magnification
- Stretching one part must equal shrinkage in other areas

Multi focal projections

Fisheye Views Applications

- Semantic fisheyes
- 1-dimensional fisheyes
- 2-dimensional fisheyes
- Fisheyes for precise input
1-dimensional Fisheye

- Time axis
  - historical calendar
  - story line
- Menus

2-dimensional Fisheye

- Typically surfaces
  - geographical/topological data i.e. maps
  - desktop

Fisheye views controlled with the mouse avoid the scrolling interactions but also speeds up the mouse velocity. (Think about a fisheye view for Google Earth)

1-dimensional Fisheye

Example: Fisheye Menu

Benjamin B. Bederson.
Fisheye Menus. UIST'00


2-dimensional Fisheye

Document Lens

(G.G. Robertson, J.D.Mackinlay
UIST 1993)

1-dimensional Fisheye

Fisheye Table

2-dimensional Fisheye

FiCell Project

http://iihm.imag.fr/vernier/
2-dimensional Fisheye

Fisheyes applied to networks

Manojit Sarkar and Marc H. Brown 1992

Fisheye for input

Paper/Video from Mitsubishi


http://www.merl.com/people/forlines/videos/MERL_ZoomAndPick_highRes.mov

3-dimensional Fisheye

Marcelo Cohen, Ken Brodlie,
Focus and Context for Volume Visualization,

Fisheye for input

Paper/Video from Mitsubishi


http://www.merl.com/people/forlines/videos/MERL_ZoomAndPick_highRes.mov

How to program

Fisheyes for bitmaps

1-dimensional Fisheye

Normal scaling: Display an object of size A on a window of width B

The magnifier function is the first derivative of the transfer function

The transfer function is the integral of the magnifier function

The magnifier function is

The transfer function is

1-dimensional Fisheye

Normal scaling: Display an object of size A on a window of width B

The magnifier function is the first derivative of the transfer function

The transfer function is the integral of the magnifier function

The magnifier function is

The transfer function is
1-dimensional Fisheye

The problem with the magnifier:

(G.G.Robertson, J.D.Mackinlay
UIST 1993)

The problem with the magnifier:
Parts of the origin will not appear at the destination.
In the picture below the Central Station is visible, but not Marienplatz.

Transfer function \( T(X) \)

Magnifier function \( M(X) \)

\[
T(X) = \frac{(1 + d) \cdot X}{(d \cdot X + 1)^2}
\]

\[
M(X) = \frac{(d + 1)}{(d \cdot X + 1)^2}
\]

1-dimensional Fisheye

To have transfer function independent of window sizes and resolutions it is common to work with normalized coordinates, i.e. working with intervals from -1 to 1.

Transfer functions from Y.K.Leung and M.D.Apperley

2-dimensional Fisheye

Applying transfer functions for x- and y-coordinates independently does not give a nice result.
2-dimensional Fisheye

The transfer function for $X$ should depend on $Y$. For $Y=0$ in normalized coordinates the transfer function for $x$ should be the 1-dimensional fisheye transfer function $T(x)$. For $Y=1$ it should be the undistorted transfer function $T_u(x)$, normally $T_u(x) = x$.

This can be achieved by a weighting function $W(Y)$ with values from 0 to 1. ("function morphing")

$$T(x, Y) = (1-W(Y)) \cdot T(x) + W(Y) \cdot T_u(x); \quad W(0) = 0; \quad W(1) = 1;$$

Examples:

- $W(Y) = Y$
- $W(Y) = Y^2$

What is the difference?

2-dimensional Fisheye

Continuous transfer function using Cartesian coordinates

This is one part of the exercise

Using polar coordinates

Because a fish-eye should not twist the picture, the transfer function does not depend on the angular coordinate. So the transfer function for the 1-dim. case can be used for the radial coordinate.

$$T(r, \phi) = (T_{\text{1dim}}(r), \phi)$$
2-dimensional Fisheye

Continuous transfer function using polar coordinates

This is the other part of the exercise

Chapter 3: Mobile HCI

Table of Content

- Input & Output Devices
- Input & Output Techniques
- Guidelines
- System Architectures for Mobile UIs
- Example: Applications for Mobile Phones

Hints for Programming

- For bitmaps iterate over the pixel of the destination bitmap using the inverse transfer function \((X,Y) = T^{-1}(x, y)\)
  - No pixels are left out
  - The number of pixel are less
  - The multiplication of integers and floats may have unexpected results!
  - Use well chosen names for variables

Dynabook Vision

- Handheld
- Wireless connectivity
- Multimedia capabilities
- Support for programming

Mobile Computing / mobile UIs

1972 Xerox Dynabook

- Alan Kay's group at Xerox PARC
- First description of "mobile computing" with a focus on the UI?
- A portable interactive personal computer, as accessible as a book
- A computer for children (learning aid)
- Big problem: software that facilitates dynamic interactions between the computer and its user

http://www.honco.net/os/kay.html

The Dynabook Revisited - A Conversation with Alan Kay
Mobile User Interfaces

“Beyond the laptop…”

Devices are used while the user is mobile
- Handhelds & PDAs
- Phones
- Wearable Computer
- Tablet Computers
- Car Infotainment system

Input to Mobile Devices

What to input?
- Commands
- Text
- Drawings/sketches
- Images
- Audio
- Movies

Apple Newton
Commercial Handheld Computer

Recognition Architecture
- Recognizes handwriting—printed, cursive, or a mixture of the two—with the assistance of a 93,000-word, built-in word list
- Lets you add up to 1,000 words
- Includes four pop-up keyboards: typewriter, numeric, phone, and time/date
- Recognizes graphics and symmetrical objects

- 320 by 240 pixels Display
- Sold from 1993

Input to Mobile Devices

How to input?
- Keyboards
  - Full-size
  - Miniature
  - Chord-keyboard
  - On-screen
- Stylus
  - Point and click
  - Handwriting recognition
- hard buttons / wheels
  - Scroll wheels
  - Joypad-style navigation
- Capture
  - Camera
  - Microphone
- Future devices
  - Tilt scrolling
  - Virtual workspaces

Itsy
Pocket Computer

Research platform
- Gesture and speech interaction
- tilt-to-scroll and Rock ‘n’ Scroll to include the use of gestures to issue commands.

http://research.compaq.com/wl/projects/itsy/itsy.html

Input Technologies for Mobile Devices

- Soft Keyboards
- Screen Keyboards
Input Technologies for Mobile Devices

- Keyboards

Virtual Keyboards

Projection Keyboards


Yoyo Input Device designed for artic environments

- Smart Clothing for the Arctic Environment by J. Rantanen et al. in proceedings of the int. Symposium on Wearable Computing 2000 (ISWC2000)

Input Technologies for Mobile Devices

- Virtual Keyboards
- Projection Keyboards

Chord Keyboard
- One-handed Keyboards
- Example Twiddler
  - Combines keyboard and Mouse
  - keypad designed for “chord” keying
  - This means you press one or more keys at a time. Each key combination generates a unique character or command.
  - 12 finger keys and 6 thumb keys, the twiddler can emulate the 101 keys on the standard keyboard

Example Twiddler

• Combines keyboard and Mouse
• keypad designed for “chord” keying
• This means you press one or more keys at a time. Each key combination generates a unique character or command.
• 12 finger keys and 6 thumb keys, the twiddler can emulate the 101 keys on the standard keyboard