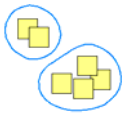
Interactive Techniques



Introduction

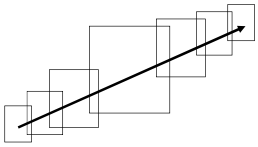
主にデスクトップコンピュータにおけるGUI操作を改良する手法について紹介する。

- Scroll
- Pointing
- Visualization
- Pen computing
- Voice input

Scroll Interface

UIST 00

Speed Dependent Automatic Zooming for Browsing Large Documents



Takeo Igarashi (Univ of Tokyo)
Ken Hinckley (Microsoft Research)

Problem

Navigation of a large document is difficult.

Scrolling Interfaces

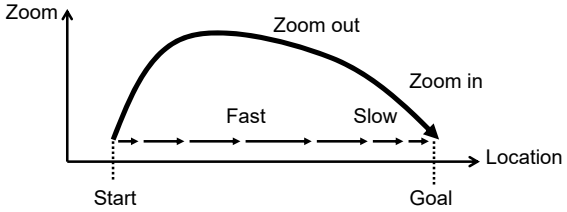
Zooming Interfaces

autozoom

Solution

Speed dependent Automatic Zooming

Fast ⇒ Zoom out
Slow ⇒ Zoom in



Demo

autozoom

3. Implementation Issues

Basic Algorithm

$$scale \bullet speed = constant \quad \text{(Eq.1)}$$

This ensures that the perceptual scrolling speed remains constant.

Refining the Implementation

Straightforward implementation of the equation causes problems.

1) Sudden zoom-out at the beginning.

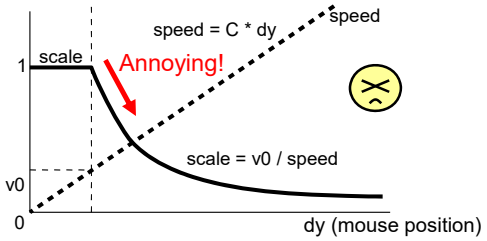
2) Abrupt swelling at turning.

1) Sudden zoom-out at the beginning

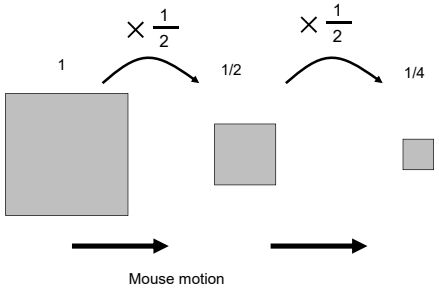
Naïve implementation:

Speed is proportional to mouse movement

Scale is then calculated based on eq. 1.

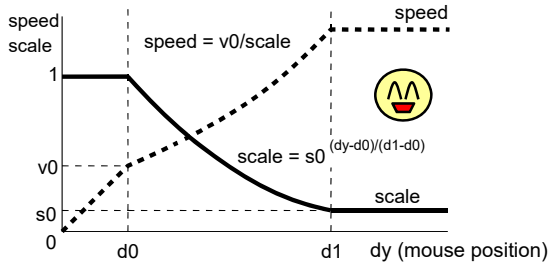


Zooming should be exponential!



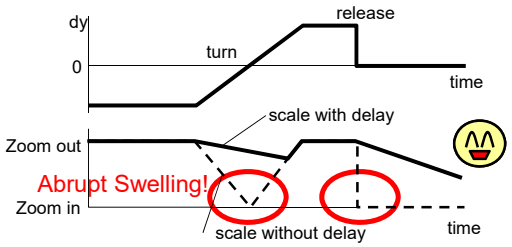
Revised implementation:

Scale is exponential to mouse movement
Speed is then calculated based on eq.1.



2) Abrupt swelling at turning

Solution: delayed scale change (dumping)



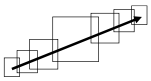
Summary

Problem:

Browsing large document combining scrolling and zooming.

Solution:

Automatically zoom in and out depending on scrolling speed.

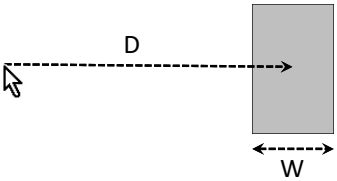


Pointing

Fitts's law

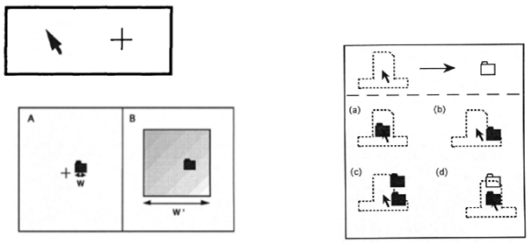
A model of target acquisition:

$$T = a + b\,log_2\left(1 + \frac{D}{W}\right)$$



The Area Cursor

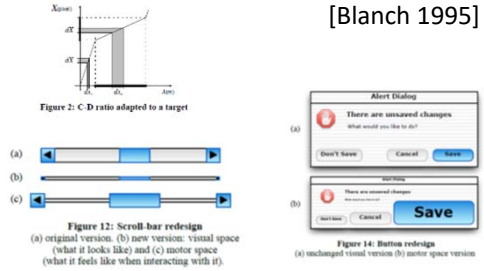
[Kabbash 1995]



The cursor expands in void area.

Semantic Pointing

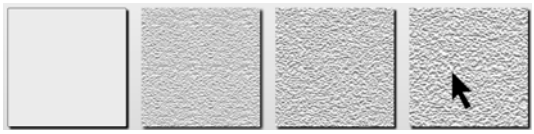
[Blanch 1995]



Adaptively adjust Control/Display ratio.

Visual Haptics

[Watanabe 2002]

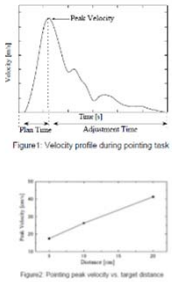


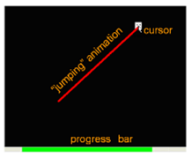
Creative cursor behaviors.

demo

Predictive Pointing

[Asano 2005]



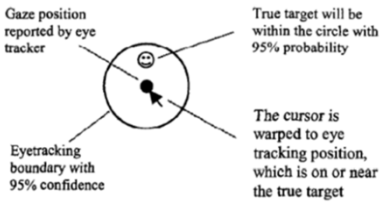


Predict target position based on peak velocity.

movie

Cascaded Pointing

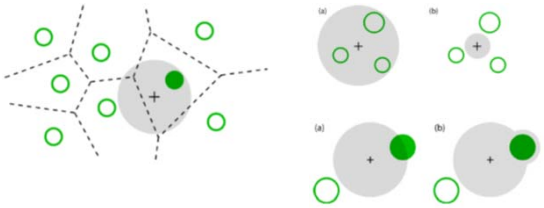
[Zhai 1999]



Cursor jumps to eye gaze.

The Bubble Cursor

[Grossman 2005]



The cursor expands in void area.

movie

CHI 2008

Ninja Cursors:

Using Multiple Cursors to Assist Target Acquisition on Large Screens

Masatomo Kobayashi
Takeo Igarashi

Problem

It is difficult to point to a distant object.

Introducing “ninja cursors”

Video

ninja_cursors.mov

26

Basic idea of “ninja cursors”

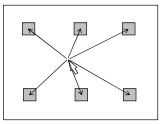
Cover the screen with multiple, synchronously moving cursors.

→ The user can use the nearest cursor.

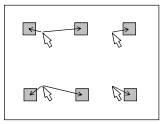
Reducing the distance

Average distance from the nearest cursor:

$$D \rightarrow \frac{D}{\sqrt{n}}$$ (***n*** : # of cursors)

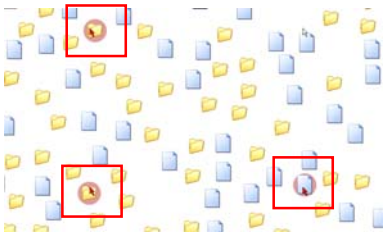


n = 1



n = 4

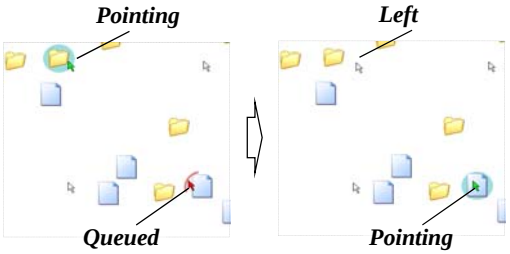
Ambiguity problem



What happens if multiple cursors point to multiple targets simultaneously?

Resolving ambiguity

Only one cursor can point to a target;
others are blocked and in the waiting queue.



Visual feedbacks

Normal

Pointing

Blocked

Visual feedbacks

Long waiting

Short waiting

Pointing

Summary

Problem:

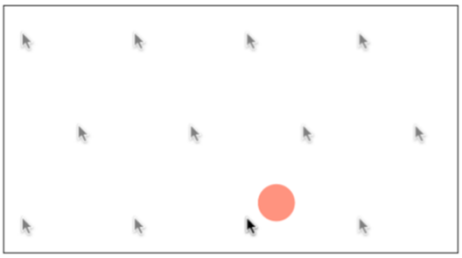
Pointing a distant target on a very large display.

Solution:

Show multiple cursors and use the nearest one.

Rake Cursor

[Blanch 2009]



Cursor disambiguation using gaze.

Visualization

UIST 2008

Bubble Clusters

An Interface for Manipulating Spatial Aggregation of Graphical Objects

Nayuko Watanabe, Motoi Washida, Takeo Igarashi
(The University of Tokyo)

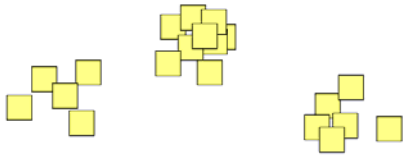
Introduction

Introduction

Spatial aggregation supports loose clustering of information

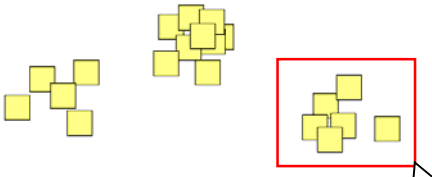
Problem (1)

Visual cluster ≠ Semantic cluster



Problem (1)

Visual cluster ≠ Semantic cluster



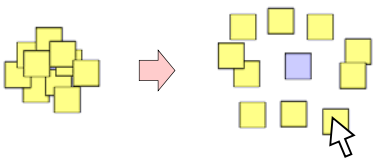
Explicit, manual grouping is required

Problem (2)

Target can be hidden in a dense cluster

Problem (2)

Target can be hidden in a dense cluster

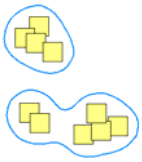


The user needs to uncover it manually

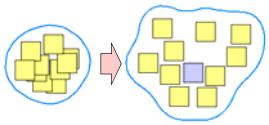
bubble

Bubble Clusters

Bubble Clusters



Automatic Grouping



Automatic Spreading

Demonstration

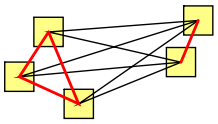
bubble ink

Implementation

Clustering

Simple pair-wise distance thresholding.

```
for ( all objects o_i )
    c(o_i) = {o_i};
for ( all object pairs o_i, o_j )
    if ( distance(o_i, o_j) < threthshold[o_i, o_j]) )
        merge( c(o_i), c(o_j) );
```

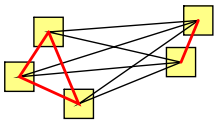


47

Clustering

Simple pair-wise distance thresholding.

```
for ( all objects o_i )
    c(o_i) = {o_i};
for ( all object pairs o_i, o_j )
    if ( distance(o_i, o_j) < threthshold[o_i, o_j]) )
        merge( c(o_i), c(o_j) );
```

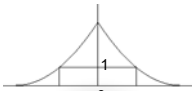


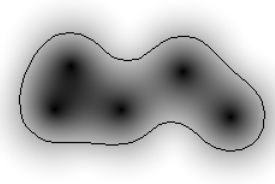
small value if $c(o_i) \neq c(o_j)$
large value if $c(o_i) = c(o_j)$
in previous step

Hysteresis Effect

Bubble Visualization

2D Implicit Surface



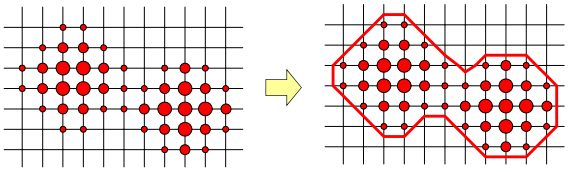


Potential field around each element.
Trace the iso-surface of the field.

opengl

Isosurface Extraction

Process each cluster independently.



Evaluate potential field at grid points

Extract isosurface by Marching Cubes

[Lorensen 87]

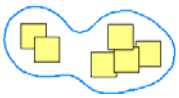
Summary

Problem:

Management of spatially organized icons on a desktop.

Solution:

Automatically cluster nearby icons as a bubble.

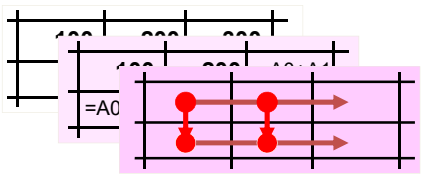


Visual Languages 98

Fluid Visualization of Spreadsheet Structures

Takeo Igarashi (Univ. of Tokyo)
Jock Mackinlay (Xerox PARC),
Bay-Wei Chang (Xerox PARC),
Polle Zellweger (Xerox PARC)

A spreadsheet has an underlying *dataflow graph* in addition to the surface numerical view.

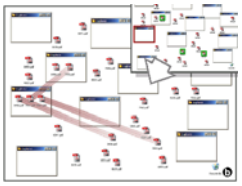


We visualize these structures using animation and interaction techniques.

..¥..¥..¥archive¥www¥~takeo¥video¥fluid.mpg

Phosphor: Explaining Transitions in the user Interface Using Afterglow Effects

[Baudisch 2006]



- 残像効果でX ggrを支援
- アニメーション効果との比較実験など

movie

halo

[Baudisch 2003]

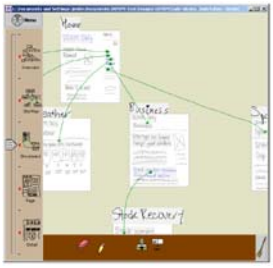
- 画面の外にあるものを円周で表示

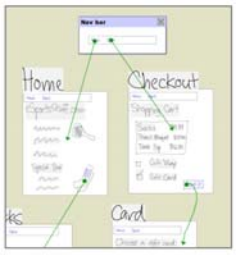
movie

Pen Computing

Denim

[Berkley, Lin 2003]

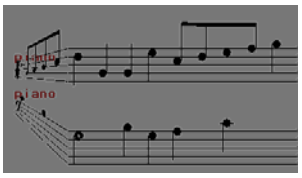


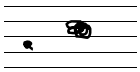


- Web site design
- 手書きのページをブラウジングできる。

E:¥movies¥sketch¥denim_talk.rm

Music Notepad (Brown Univ.)



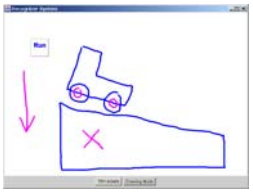


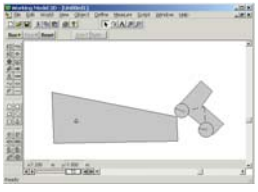
- Music score editing based on gestures

E:¥movies¥sketch¥musicnotepad.mpg

ASSIST

(MIT Media Lab.)





絵を描くと、物理シミュレーションが走る。

E:¥movies¥sketch¥assist.wmv

Appeared at CHI'99

Flatland: New Dimensions in Office Whiteboards

Elizabeth D. Mynatt, Takeo Igarashi
(Georgia Tech.) (Univ. of Tokyo)

W. Keith Edwards, Anthony LaMarca
(Xerox PARC) (Xerox PARC)

Research Goal

Designing computationally augmented office whiteboard

Observation

Office whiteboards are used for informal, pre-production activities.

Examples:

- Note-taking over a phone.
- Organizing to do list.
- Sketching paper outlines.
- Discussing with office mates.

Design Goal

Design a computational system that complements current desktop computers.

Goal-oriented
Tedious, complicated
Formal, typed

Pre-productive
Light, simple, easy
Informal

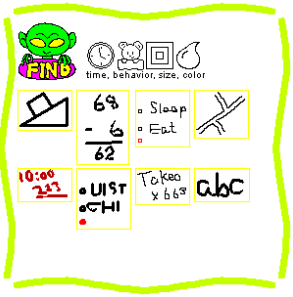
Features

1. Managing Space
2. Behaviors on Surface
3. History Management

Demo!

flatland

Context-based search



User Input

Primary input – ink strokes.

Always inking!

Secondary input – control strokes.

Erasing, Dragging,

Splitting,

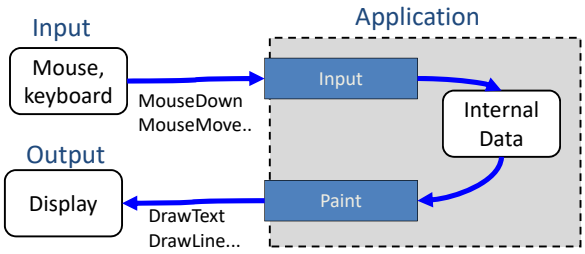
Pie & marking menu

Flatland architecture

A pen version of GUI-based window system.

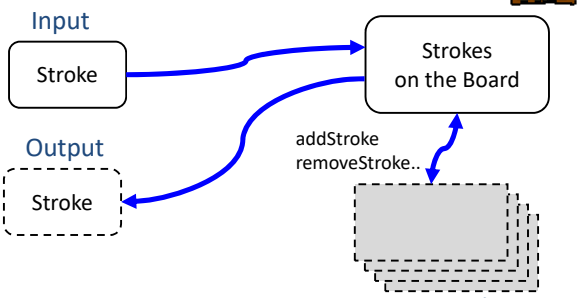
Standard GUI	Flatland
Mouse	Pen
Widgets and pixels	Strokes
Windows	Segments
Applications	Behaviors

Standard GUI applications



An application encapsulates the data.

Behaviors in Flatland



Behavior works as an attached service.

Code example

```
PlainDrawingBehavior

   void addInputStroke(Stroke stroke){
      segment.addPaintedStroke(stroke);
   }
```

Code example

```
MapBehavior

void addInputStroke(Stroke stroke){
   ....
   segment.addPaintedStroke(left_stroke);
   segment.addPaintedStroke(right_stroke);
}
```

Summary

Problem:

Multiple informal tasks on a electronic whiteboard.

Solution:

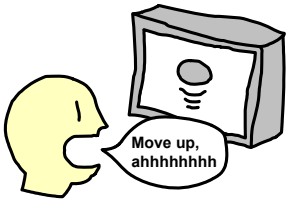
A window system for digital ink.

Voice Input

UIST 01

Voice as Sound: Using Non-verbal Voice Input for Interactive Control

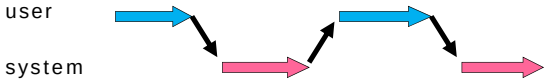
Takeo Igarashi
John F. Hughes
(Brown University)



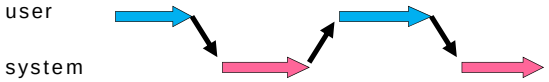
Two Aspects of Voice

- Verbal information
  - → Speech recognition
- Non-verbal information
  (pitch, volume, speed, etc)
  - → Voice as Sound techniques

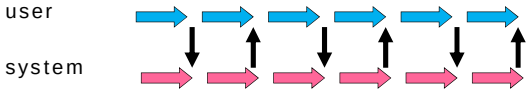
Interaction turn-around is long in voice recognition.



Interaction turn-around is long in voice recognition.



Voice as Sound achieves more immediate control.



Video

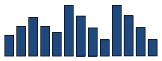
voice

Implementation

- Signal Processing (FFT) – C++
- Application Control – Java

On/off ... total volume > threshold
(ignore low frequency part)
Pitch ... detect change in frequency

Pitch Detection



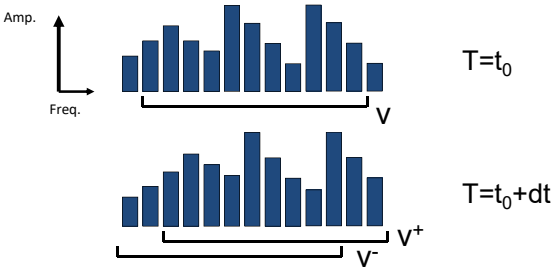
Naïve approach: identify absolute pitch

⇒ Ambiguous, noisy, unstable

Our approach: up or down at each frame

⇒ Reliable and stable

Pitch ... comparing spectrum

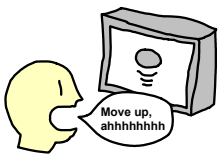


$v \cdot v^- > v \cdot v^+$ … pitch gets lower
$v \cdot v^- < v \cdot v^+$ … pitch gets higher

Summary

Problem:
Continuous control using voice.

Solution:
Use non-verbal aspect of voice.



非言語情報を利用した
音声インタフェースの例

(音声補完シリーズ)

音声補完

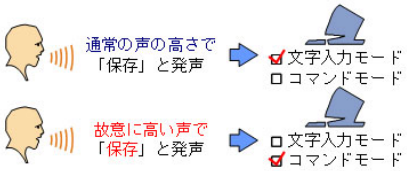
［後藤 2000］

言いよどむと助けてくれる。

D:.MPG

音声シフト

［後藤 2001］

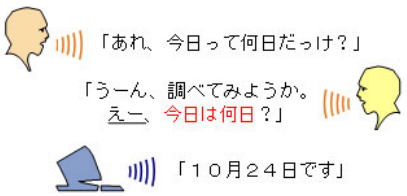


声の高さでモードを切り替える。

D:.mpg

音声スポッタ

［後藤 2004］



言い淀んだ後に高い声で
発声した箇所だけ音声認識する

D.mpg

Summary

主にデスクトップコンピュータにおけるGUI操作を改良する手法について紹介した。

- Scroll
- Pointing
- Visualization
- Pen computing
- Voice input