Interaction Techniques for Ambiguity Resolution in Recognition-based Interfaces

Jennifer Mankoff
CoC & GVU Center
Georgia Tech

Recognition
- Recognition is becoming ubiquitous
- Recognition is difficult to use
- A range of interface problems result
- OOPS toolkit helps solve them

Definitions
- Mediation
  - dialogue between user and computer
  - used for resolving ambiguity
- Recognizer
  - interprets user input
  - creates ambiguity
- Error
  - mistake from user’s perspective
  - represented with ambiguity

Outline
- Definitions
- Illustration
- Broad Solution: OOPS
- Context Applications
- Discussion
Clicking

Outline
- Definitions
- Illustration
- Broad Solution: OOPS
- Context Applications
- Discussion

OOPS Toolkit (CHI'00)
- Toolkit-level support for handling ambiguity in recognition
  - Library of mediators
  - Architectural support
- 1st version: GUI
- 2nd version: Based on Context Toolkit

Library of mediators
- Based on literature survey
- Generic and re-usable
- Three major classes
  - Repetition
  - Choice
  - Automatic
Library of mediators

- Based on literature survey
- Generic and re-usable
- Three major classes
  - Repetition
  - Choice
  - Automatic

Library of mediators

- Based on literature survey
- Generic and re-usable
- Three major classes
  - Repetition
  - Choice
  - Automatic

Architectural Support

- INDEPENDENT of any specific toolkit
- Separation of mediators, recognizers, context widgets, and application
- Communication by a common internal model (ambiguous hierarchical events)
- Maintains ambiguity indefinitely
Ambiguous Hierarchical Events

Outline
- Definitions
- Illustration
- Broad Solution: OOPS
- Context Applications
- Conclusions

Context Applications
- In/Out Board
- Messaging

In/Out Board
- What's ambiguous?
  - Direction
  - People Forget
In/Out Board: Mediation

- Visual, Audio feedback of guess
- Many choices for how to mediate

In/Out Board: Mediation

- Distributed over space and time
- Implicit -> Explicit input

Messaging/Communication

- How do you reach someone?
  - Many possible devices (Cell phone, email, find them, etc)
  - Many possible situations (meeting, meal, sleep, etc)
  - Many possible locations

Messaging/Communication

- What’s ambiguous?
  - Is it OK to call someone (interrupt)?
  - Where is the person being called?
  - With what device should we try to reach them?
  - Is it OK to give extra info to the caller? What information?
**Messaging: Mediation**

- Give callee choice to answer call
  - Non-speech audio (e.g. ringing phone)
  - Other, less intrusive alternatives?
  - Inform them about caller
- Give caller choice to send call
  - n-best list of ways to reach someone
  - Information about what they’re doing
  - Information about where they are

**Outline**

- Definitions
- Illustration
- Broad Solution: OOPS
- Context Applications
- Conclusions

**Conclusions**

- Resolution of ambiguity through mediation
- General toolkit architecture
- Lots of difficult design work left

**Future Work**

- Testing
- Implicit input
- Arbitrary input devices
- Ambiguity
Acknowledgements
Gregory Abowd
FCE Group

Further Information
http://www.cc.gatech.edu/fce/errata/
jmankoff@cc.gatech.edu

Is subArctic doing the work here?

- No, our minimal requirements are common in today’s toolkits:
  - An event-based toolkit
  - An input-handling module that delivers events to the appropriate places
  - A library of interactors/widgets
  - Access to source code (OOPS is not just a library!)

Recognizer

- Definition:
  - something that interprets user input
  - generally has a domain (of input) and a range (of output)
- Examples:
  - DragonDictate (speech to text)
  - GDT (strokes to gestures)
- Problem areas:
  - Support for correction of errors

Error

- Definition:
  - a mistaken interpretation (from the user’s perspective)
- Examples:
  - substitution
  - rejection
  - insertion
- Problem areas:
  - rejection
Mediation

- Definition:
  - a dialogue between the user and application used to determine the correct interpretation
- Problem areas
  - Occlusion
  - Wrong choices

Examples:

Ambiguity

- Definition
  - A case where there is more than one potentially correct interpretation of the user's input
- Problem areas
  - target ambiguity

Examples

- target ambiguity
- segmentation ambiguity
- recognition ambiguity

Architectural support

OOPS Architecture
Further generalization: OOPS

- Testing
- Implicit input
- Arbitrary input devices

Further generalization: OOPS

- Testing
- Implicit input
- Arbitrary input devices
- Ambiguity
Further generalization

- Testing
- Implicit input
- Arbitrary input devices
- Ambiguity

Further generalization

- Input

Further generalization

- Testing
- Implicit input
- Arbitrary input devices
- Ambiguity

Further Generalization

- Input
  - Cirrin (UIST 98)
  - Locked-In Syndrome (Brain-UI: Current)
  - Cerebral Palsy (Cursor Activity Recognition: Current)
Further Generalization

- Testing
- Implicit input
- Arbitrary input devices
- Ambiguity

- Input
- Output

Further Generalization

- Testing
- Implicit input
- Arbitrary input devices
- Ambiguity

- Input
- Output

- Bringing People and Places together
  (Domisilica; CVE 98)

- Ambient Displays (Ten Inch Pixels; 1999)
Conclusions

- The problem areas are not intractable
- Toolkit-level support allows us to explore them
- OOPS allows us to build general, re-usable solutions

Other thesis results

- Survey of mediation techniques found in existing interfaces to recognition systems
- Two implementations of our architecture