SketchUML

A Tablet PC-based e-Learning Tool for UML Syntax using a Minimalistic Interface

Bastian Tenbergen*, Colleen Grieshaber, Lisa Lazzaro, Rick Buck

{ tenberge | lazzaro | buck } @ oswego.edu
colleen_grieshaber @ yahoo.com

* presenting and corresponding author

Human-Computer Interaction Laboratory
Interactive Learning Technology Laboratory
Oswego State University, NY, USA

Project Websites:
http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Outline

- Traditional Interfaces
- Minimalistic Interfaces
- Naturalistic Interfaces
- Tablet PC-based Education
- SketchUML
- Usability Study
- Results
- Discussion

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Traditional Interfaces

- Computers play an important role in education
  - Computer-aided design helps in understanding development processes
    - Also eases instruction of certain (mostly computer science and graphic design related) topics
- Mostly traditional screen-and-mouse interfaces
  - Packed screens

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
```java
package edu.oswego.hci.hci530.betrecommender;

import java.io.File;

public class Engine { // implements MLPs {
    private Layer input;
    private Layer hidden;
    private Layer output;
    private Vector features;

    public Engine(String file) throws FileNotFoundException {
        features = new Vector();
        int maxValue = 0;
        // load & parse file
        Scanner sr = new Scanner(new File(file)).useDelimiter("\n");
        while (sr.hasNextLine()) {
            // now parse each column in row
            String row = sr.nextLine();
            StringTokenizer st = new StringTokenizer(row);
            int[] featureVector = new int[st.countTokens()];
```
Traditional Interfaces

- **Problem:**
  Many applications to aid in development/design processes like
  - IDEs (Eclipse, Netbeans, #Develop, ...)
  - Design Tools (Illustrator, Flash, Photoshop, ...)
  - CGI Applications (AutoCAD, Inventor, ...)
  have no support for learners!
  - No “Beginner Mode”
  - No Wizards
  - No feedback when a design concept is wrong
  - No context-sensitive assistance
    (with few exceptions)

- **High Learning Curve!**

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Minimalistic Interfaces

- Minimalistic Interfaces can do a better job
  - No confusion on “what means what”
  - Clear outline of elements
  - Easy-to-understand symbols

- Allow for
  - Learning by doing
  - Undoing the previous step
  - Incremental learning process

- But, potentially still some problems...

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Minimalistic Interfaces

- Potential Problems:
  - Learning curve still high
    (although not as high as with fully-featured applications)
  - Wrong concepts might be learned
  - No context-sensitive help

- Most significant:
  - Lack of features in most applications with minimalistic interfaces!

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Naturalistic Interfaces

- Non-Naturalistic Interfaces
  - Don't introduce mapping between action and reaction
    - on/off switch for a pump, furnace, etc
    - Eject button on your VCR

- Naturalistic Interfaces
  - Allow for direct or indirect mapping of action and reaction

- Inferred Naturalism vs Direct Naturalism

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Naturalistic Interfaces

- Inferred Naturalism
  Indirect mapping of action and reaction
  - Arrow Keys
  - Mouse
  - Joystick

Map an action on the interface to some corresponding re-action on the display:
  - Right arrow means right
  - Mouse up means up
  - Joystick down-right means down-right

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Naturalistic Interfaces

- Direct Naturalism
  Direct mapping of action and reaction
  Mostly used in Direct Manipulation Paradigms
  - Virtual Reality Glove
  - Nintendo Wii Controller
  - Touch Screens
  - PDA Stylus
  - Tablet PC Pen

Map an action on the interface to identical action on the display

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Tablet PC-based Education

- Pen/Stylus is a direct naturalistic interface
  - Only when used to draw ink in ink-enabled applications

- Allows for a multitude in educational advances for:
  - Faculty
    Can interact with screen content more directly to show complex interaction of concepts
    - For instance: TabCon (Concurrency Teaching Utility for Tablet PCs)

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Tablet PC-based Education

- Allows for a multitude in educational advances for:
  - Students
    - Can **explore** the program without having to figure out the controls first
    - **Collaborative learning** allows feedback from peers and instructors
    - **Mobility** allows to learn anywhere (as opposed to tablet-peripheries)

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
SketchUML

- Goal:
  Combine the advantages of
  - Minimalistic Interfaces
  - Naturalistic Interfaces
  - Tablet PCs
  to provide a good learning experience when learning complex design tasks.

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
**SketchUML**

- Designed to facilitate learning the UML syntax
- Allows to draw ink on blank canvas
- Program converts it into valid UML
  - Only if gesture corresponds to UML component

- Context Sensitive help
- Allows for self-guided learning
  - Without complex algorithms to supervise learning
  - Can easily be ported to other design concepts

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
SketchUML

- A short demonstration...

- You can also check out our demo video:
  http://www.youtube.com/watch?v=clF6_S-xJq

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Usability Study

• Purpose:
  – Investigate the performance and potential pitfalls of applications that employ minimalistic and naturalistic interfaces
  – Investigate the ability of naturalistic interfaces to mimic non-digital interfaces
  – Find out how computer-aided design principles can be exploited to facilitate learning when employed in these interfaces

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Usability Study

- **Participants:**
  - 11 students of Northeastern US college
  - Enrolled in software engineering class
  - Mediocre knowledge of UML

- **Apparatus:**
  - 6 HP Compaq TC4200 Tablet PCs
  - 1.7GHz CPU
  - 512mb Memory
  - SketchUML pre-release version

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Usability Study

● Procedure:
  - 1. pre-test demographic questionnaire
  - 2. introduction to SketchUML on projector
  - 3. separated participants into two groups
  - 4. handed out task description depending on participants group
    • Two different tasks
    • Tasks designed to incorporate every feature of SketchUML at least once
    • Tasks were text only – students had to invent diagram given the task description!
  - 5. Post-test questionnaire on perceived experience

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Usability Study

- Experiment was not timed
- Participants were free to start over as often as necessary
- When finished, diagrams were stored using SketchUML's built-in export function

- Performance was recorded by conducting a task performance analysis
  - Measure number of erroneous steps made in the final diagram against an ideal solution.

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Results

First condition – Group 1
(participants asked to create a diagram)

- Overall of 9 mistakes in 6 participants
- 21 steps to complete the task (minimum)
- Only 1 mistake in symbol manipulation
- Majority of 8 mistakes when manipulating labels with handwriting!!

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Results

Second condition – Group 2
(participants asked to critique diagram)

- 16 mistakes by 6 participants
  (3.2 mistakes/participant)
- 7 steps minimally to complete the task
- Majority of mistakes made during label and connector manipulation

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Results

Post-Test Questionnaire

- Students reported high satisfaction with product interaction
- Frustration only occurred when handwriting was recognized incorrectly
- Context-sensitive gesture recognition was perceived as easy to understand and learn

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Discussion

- Gesture recognition did not cause problems!
  - Minimalistic naturalistic interfaces can rely on this mode of interaction
- Context-sensitive functionality increased learning experience

- Poor handwriting recognition performance caused frustration and inhibited learning
  - That's Microsoft's Problem... not ours ;-)

http://moxie.cs.oswego.edu/~tenberge/SketchUML
http://sketchuml.tenbergen.org
Discussion

- Minimalistic Interfaces do not inhibit functionality and learning!
- Naturalistic Interfaces can increase learning experience
  - In complex design concepts
  - Help to focus on design task rather than the interface
  - Collaborative learning can enhance this effect
  - Unobtrusive!
Acknowledgements

- This project is made possible by the generous support of
  - Dr. Gary Klatsky
  - Dr. Douglas Lea (both at SUNY Oswego)
  - Dr. Lin Qiu (formerly at SUNY Oswego)
  - The Research Foundation of SUNY

- And through the generous funding of the

Hewlett-Packard Development Company, L.P., HP Technology for Teaching Grant Number U06TFH0037C.
SketchUML Project Site

Be sure to check out:

http://moxie.cs.oswego.edu/~tenberge/SketchUML

http://sketchuml.tenbergen.org

Demo Video:

http://www.youtube.com/watch?v=clF6_S-xJqs