

## Pen Interfaces

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## Background

- Current computer interfaces are very good for well-defined input
  - Keyboards for text
  - Mouse as widgets for diagrams
- However this does not fit well with many tasks tasks
  - Creative design from architecture to hci
  - Document review and mark-up eg assignments



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## New possibilities

- Interactive pen interfaces
  - Digital whiteboards
  - Tablet PCs
- Voice interaction

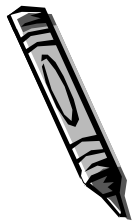


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## Agenda

- Sketching designs
  - Background
  - Conceptual System
  - Prototype
  - Evaluation
  - Discussion and conclusions
- Marking-up and grading student assignments
  - Annotation
  - Marking
  - Workflow
- Recognition
- Pen interfaces



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## Sketch Tool Motivation

- Hand sketching initial designs will result in better designs
- Whereas IDEs encourage students to design using the form designer
- We wanted to provide an integrated, design friendly environment
- And evaluate its effectiveness



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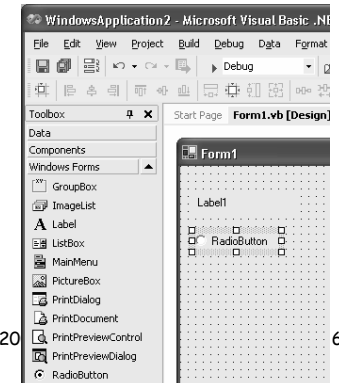
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## Background - Design Process

- Evidence from studies in a variety of domains that widget based designing is harmful to the design process
  - Widget selection precludes ambiguity
  - Aligning, sizing and naming are distractions
  - The formal look of designs implies completeness



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## Background - Programming

### Programming

- The better the plan the better the program
- Scenarios and low-fidelity prototypes help students to understand the problem
- Interface design offers an opportunity to consider functional requirements

### Sketch tools

- Form design - Silk (Landay & Myers, 2001)
- Multimedia design - Demais (Bailey & Konstan, 2003)
- Case tool - Knight (Damm et al. 2000)



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## Background - Sketch tools

- Silk (Landay & Myers, 2001)
  - Form design
- Demais (Bailey & Konstan, 2003)
  - Multimedia design
- Knight (Damm et al. 2000)
  - Case tool



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## Conceptual System

- Direct pen input
- Support group interaction
- Whiteboard paradigm
- Encourage scenario checking
- Integrated into an IDE
- Transformation from sketch to form



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## 2<sup>nd</sup> Prototype

- Editing
- Multiple sketches
- Storyboard
- Run mode
- Shape and character recognition
- Form beautification



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## Functionality

- Sketch space
  - Modal for recognition
    - Draw
    - Write
- Editing
  - Delete gesture
  - No passive pen tracking
  - Select and then edit
  - Draw over
  - Undo
- Storyboard
  - Shows all sketches
  - Navigation links
  - Reorder
  - Delete
- Run Mode
  - Check with scenarios
  - Different ink colour
  - Navigation



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## Recognition

- Shape
  - Is only important for functional gestures and transformation
  - Hidden while sketching
  - Two step
    - Stroke (Rubine's algorithm 1991)
    - Rules
  - Correction
- Word
  - Integrating, then available (2002), character recognition modules difficult
  - Word recognition
    - Characters via Rubine's (1991) algorithm
    - Words matched to vocabulary

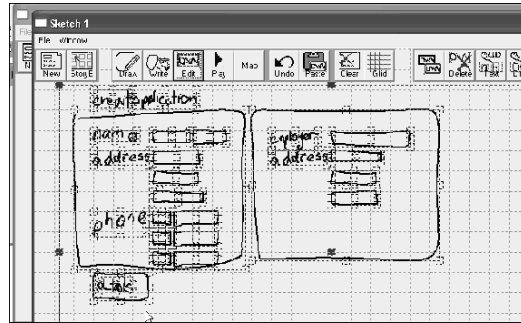


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## Transformation and Beautification

- Align to grid
- Standard sizes either:
  - Fixed
  - Units



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## Evaluation Studies

- Compared Freeform to whiteboard
- Each group completed 2 tasks
- Data
  - Questionnaires
  - Design Evaluation
  - Observations
  - Learning Process Evaluations

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## Findings

- Student questionnaires, significant results
  - Enjoyed Freeform more
  - Increased their motivation to learn programming
  - Like to use it in the future
  - More prepared to complete the problem
  - Checking the scenarios easy

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## Findings

- Design evaluation
  - Freeform designs slightly better
  - This is a positive result!
- Observations
  - Discussion on functional requirements
  - Students made significantly more changes in Freeform
    - Was this because of the interactive nature of the checking?

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## Findings

- Learning experience
  - Quicker learning cycle
    - Explore, evaluate, review
  - Change has less 'cost'
- Students' commented
  - The interactive checking made them 'think computer'
  - 'cool', 'fun'

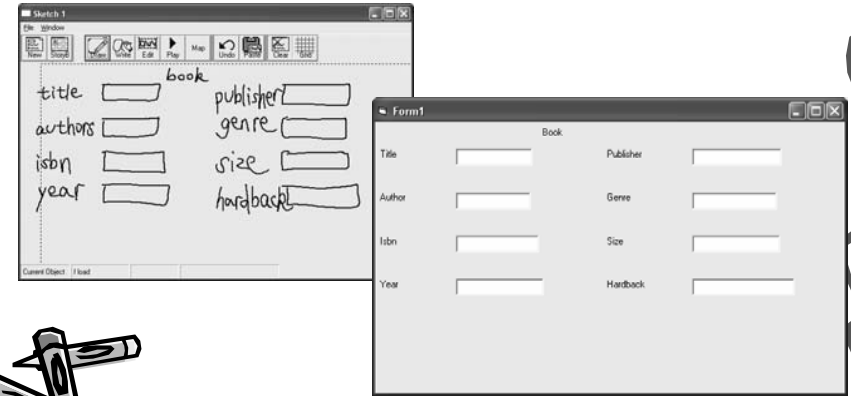


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## Supplementary Study

- Interactive Checking of Sketch vs Formal Design



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## Supplementary Study

- Each group checked two designs
  - One sketch, one VB form
- Counter balanced
- Counted number of changes
  - Sketch 8.6 changes
  - VB Form 6.5 changes



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## Conclusions

- Earlier findings on the advantages of sketching hold true for computer supported sketching
- Computer supported sketching may slightly affect the design process as there are more restrictions than a low-tech equivalent
- But computer supported checking of sketching is probably better as a design environment than either low-tech sketches or formal computer supported diagrams



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## Current work

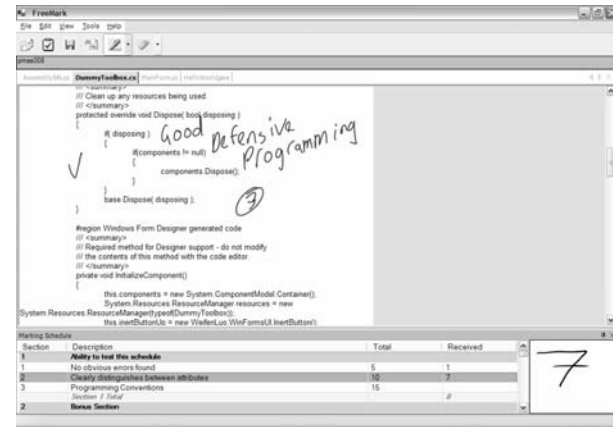
- Prototype 3 windows xp tablet
  - Modeless drawing space?
  - Using tablet character recognition
- Modularising software
  - Configurable drawing space rules
  - Configurable recognition modules
  - Independent sketch >> variety of formal tools
- Two way transformation
- More evaluation
  - Longitudinal study
  - Specific interaction requirements vary with hardware



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## Document Mark-up



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## Motivation

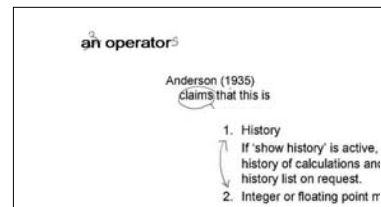
- We have large classes
  - 700 in first year classes, 200 - 300 in 2<sup>nd</sup> 3<sup>rd</sup> year classes
  - Most assignments are electronically submitted, marked and returned
  - This is very efficient, except it is difficult to provide rich feedback



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## Feedback options



In paragraph 2, first sentence you state "Anderson () claims", are you sure this is what Anderson is claiming?

Table 1: Feedback Options



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# Conceptual System

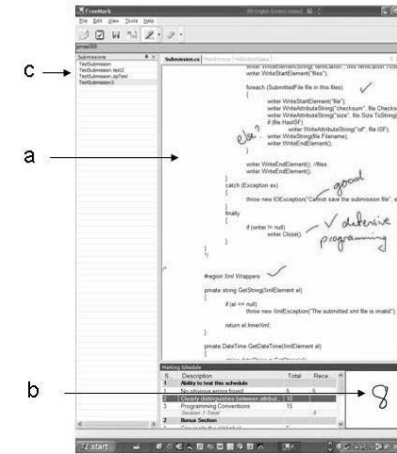
- Annotation and grading
- Workflow support
- Pen only
  - Careful interaction design
  - Recognition of scores



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# Interface



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# Workspace

- Functionality via buttons
- Tab between files

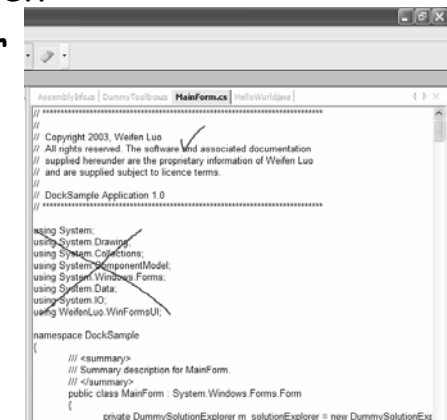


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# Annotation

- Document frozen
- Ink freely over
- Edit ink

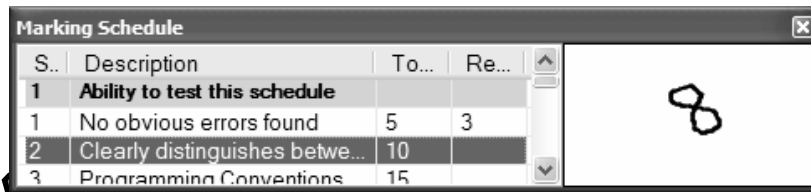


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## Marking

- Marking schedule in docked window
- Mark entered in recognition pane
- Recognitised and insertion into table
- Automatic totalling



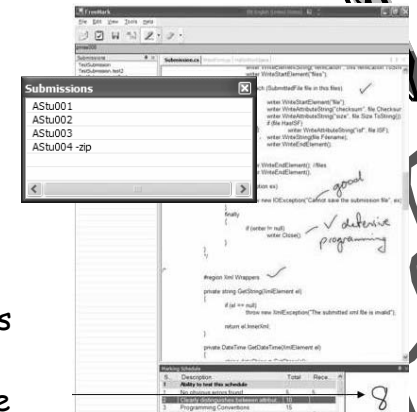
S.	Description	To...	Re...
1	Ability to test this schedule		
1	No obvious errors found	5	3
2	Clearly distinguishes betwe...	10	
3	Programming Conventions	15	

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## Workflow

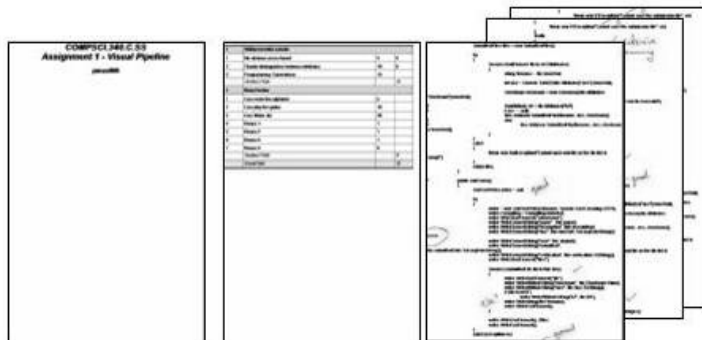
- Program looks for submission files and lists
- Files unzipped and displayed
- After marking
  - Annotated file saved as tiff file and emailed
  - Marks saved as xml file



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## Output file



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## Evaluation

- Usability and workflow underway
- Educational evaluation planned

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## Recognition

- Recognition is difficult
- Windows xp tablet character recognition is good
- However integrating with shape recognition is still difficult
- Combining recognised shapes and words is not challenging
- Modal interfaces unsatisfactory



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## Pen interfaces

- Pen only
- Add a new dimension to the design process
- Support more natural work processes
- Recognition is crucial
- Must accept that it will never be 100% accurate as to get this ambiguity would be stifled



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## Conclusions

- The technology is getting there
  - Particularly with xp tablet
- There is real potential for much richer interaction with pen based software
- Design
  - Design friendly computer interface
  - Interactive sketch prototypes
  - Automatic translation
- Mark-up of documents
  - Assignment marking
  - Document drafts anywhere we currently use word review or paper



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