Course Objective and Topics

Topic in Pen-Based User Interfaces is a course designed to give students a thorough understanding of the latest techniques, algorithms, and evaluation methodologies used in designing and developing pen-, sketch-, and gesturally-based user interfaces. In addition reading and presenting research papers, students will write several programs to reinforce concepts discussed in class and will produce a final project of their choice.

General Topics include:

1. Introduction and History of Pen-computing
2. C#, Visual Studio, and Windows Presentation Foundation
3. Ink Preprocessing
4. Gestural User Interfaces
5. Ink Segmentation
6. Classification Algorithms for Recognizing Ink
7. 2D Parsing
8. Sketch-based Interfaces
9. Evaluation Methodologies
Syllabus

Week 1

August 25, 2008 Lecture - Introduction to Pen-based UIs
-- go over course mechanics
-- discuss the history pen computing
-- present some challenges with pen computing
-- present various applications

Readings


August 27, 2008 Talk about final projects
Papers discussion

Week 2

September 1, 2008 Holiday – No Class

September 3, 2008 Lecture - Visual Studio, C#

Readings


Week 3

September 8, 2008 Lecture - Tablet PC SDK, Windows Presentation Foundation
Assignment 1 Out

September 10, 2008 Lecture - Ink Preprocessing & Simple Features
-- data representation
-- filtering
-- transformation invariance
-- dehooking, cusps, and self intersections
Readings


Week 4

September 15, 2008   Papers discussion

September 17, 2008   Lecture - Gestural User Interfaces
   -- in computer graphics/modeling
   -- gesture structure - 1 or multi-stroke
   -- gesture invocation - buttons & button placement
   -- gesture learning - existing notations, tutorial, embedding in GUIs
   visual (pre & post) feedback
   -- FSAs
   -- punctuated gestures

   **Assignment 1 due**

   **Assignment 2 out**

Readings


Week 5

September 22, 2008  Papers discussion

September 24, 2008  Lecture - Ink Segmentation
  -- spatial segmentation
  -- temporal segmentation

Readings


Week 6

September 29, 2008  Papers discussion

Assignment 2 due
Assignment 3 out

October 1, 2008  Lecture - Classification Algorithms for Recognizing Digital Ink (Part 1)
  -- Feature Extraction

Week 7

October 6, 2008  Lecture - Classification Algorithms for Recognizing Digital Ink (Part 2)
  -- Classifiers
  - procedural
  - template matching
  - linear classifiers
  - SVMs
  - K-nearest neighbor
  - AdaBoost

Readings


October 8, 2008 Papers discussion

Week 8

October 13, 2008 Lecture - Parsing Ink
-- parsing mathematics
-- multi-stage
-- parsing drawings
-- parsing diagrams
- 2D grammars
- graph rewriting
- procedurally coded syntax rules
- stochastic grammars

Assignment 3 due
Assignment 4 out

Readings


October 15, 2008 Papers discussion
Week 9

October 20, 2008  Lecture - Sketch-based Interfaces and Understanding
-- multi-domain sketch understanding frameworks

Readings


October 22, 2008  Papers discussion
  Assignment 4 due

Week 10

October 27, 2008  Lecture - Evaluation Methodologies
  -- user studies
  -- qualitative vs. quantitative
  -- comparative vs. formative.

  Project proposals due

Readings


Li, Y., Hinckley, K., Guan, Z., Landay, J. A. Experimental Analysis of Mode Switching Techniques in Pen-based User Interfaces. CHI 2005, 461-470.


October 29, 2008  Papers discussion
  Project proposal decisions made
Week 11
November 3, 2008  Student paper presentations
November 5, 2008  Student paper presentations

Week 12
November 10, 2008  Student paper presentations
November 12, 2008  Project status updates

Week 13
November 17, 2008  Student paper presentations
November 19, 2008  Project status updates

Week 14
November 24, 2008  Student paper presentations
November 26, 2008  No class

Week 15
December 1, 2008  Student paper presentations
December 3, 2008  Project Status updates

Week 16
December 8, 2008  **DEMO DAY and Final Reports Due!!!!**

**Collaboration Policy**

Students must do their own work but are encouraged to collaborate with others in the form of discussion of concepts and implementation details pertaining to Visual Studio, C#, and Windows Presentation Foundation. For final projects, teams of up to two students are encouraged.

**Assignments**

**Paper Presentations** – Students will have to present 1-2 papers of their choice, outside of the assigned readings and give a 20 minute presentation on it.
Guided Discussion – During the paper discussion sections, students will lead the discussion on a particular paper that was assigned in class.

Programming Assignments

1. Intro

Students will create a simple 2D/3D drawing application to get them acclimated to Visual Studio, C#, and Windows Presentation Foundation. This application will also be a test bed for the other assignments in the course.

2. Corner Finder (Research Contest)

Students will implement Wolin and Hammond’s state of the art corner finding algorithm and will try to improve its performance.

3. Math Symbol Recognizer (Research Contest)

Students will implement Wobock et al.’s $1 symbol recognizer and try to improve its performance.

4. Pen Calculator

Using their results from assignment 3, students will develop a simple pen-based calculator by developing a 2D mathematical expression parsing engine using a simple 2D grammar.

5. Final Project

Students will do a final project of their choice that explores a particular concept in pen-based user interfaces. They must first write a short proposal and get it approved by the professor. Students will also have to prepare a final report on their projects.

Tentative Grading Scheme:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>10%</td>
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<tr>
<td>Assignment 2</td>
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<td>Assignment 3</td>
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<tr>
<td>Assignment 4</td>
<td>10%</td>
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<tr>
<td>Paper discussions</td>
<td>5%</td>
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<tr>
<td>Paper presentations</td>
<td>5%</td>
</tr>
<tr>
<td>Final Project</td>
<td>50%</td>
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</tbody>
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The instructor reserves the right to use plus/minus grading in this course.