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-, touch-, and gesturally-based user interfaces. In addition to 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- and Sketch-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 and Multi-touch based Interfaces
9. Evaluation Methodologies
Syllabus

Week 1

August 20, 2012  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 22, 2012  Talk about final projects
                Papers discussion

Week 2

August 27, 2012  Lecture - Visual Studio, C#, Tablet PC SDK
August 29, 2012  Lecture - Windows Presentation Foundation

Readings


Week 3

September 3, 2012  Holiday – No Class
Assignment 1 Out

September 5, 2012  Lecture - Ink Preprocessing & Simple Features
                -- data representation
                -- filtering
                -- transformation invariance
                -- dehooking, cusps, and self intersections
Readings


Week 4

September 10, 2012 Papers discussion

September 12, 2012 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 17, 2012  Papers discussion

September 19, 2012  Lecture - Ink Segmentation
  -- spatial segmentation
  -- temporal segmentation

Readings


Peterson, E., Stahovich, T., Doi, E., and Alvarado, C. Grouping Strokes into Shapes in Hand-Drawn Diagrams Proc. of the 24th AAAI Conference on Artificial Intelligence (AAAI-10), 2010, pp. 974-979


Week 6

September 24, 2012  Papers discussion

September 26, 2012  Lecture - Classification Algorithms for Recognizing Digital Ink (Part 1)
  -- Feature Extraction

Assignment 2 due
Assignment 3 out

Week 7

October 1, 2012  Lecture - Classification Algorithms for Recognizing Digital Ink (Part 2)
  -- Classifiers
    - procedural
    - template matching
    - linear classifiers
  - SVMs
  - K-nearest neighbor
  - AdaBoost
Readings


October 3, 2012 Papers discussion

Week 8

October 8, 2012 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 10, 2012 Papers discussion

Week 9

October 15, 2012 Lecture - Sketch-based Interfaces and Understanding
-- multi-domain sketch understanding frameworks

Readings


October 17, 2012 Papers discussion

Week 10

October 22, 2012 Lecture - Evaluation Methodologies
-- user studies
-- qualitative vs. quantitative
-- summative vs. formative

Assignment 4 due

Readings


October 24, 2011 Papers discussion
**Project proposals due**

**Week 11**

October 29, 2012 Student paper presentations
**Project proposal decisions made**

October 31, 2012 Student paper presentations

**Week 12**

November 5, 2012 Student paper presentations

November 7, 2012 Project status updates

**Week 13**

November 12, 2012 Student paper presentations

November 14, 2012 Project status updates

**Week 14**

November 19, 2012 Student paper presentations

November 21, 2012 No class

**Week 15**

November 26, 2012 Student paper presentations

November 28, 2012 Project Status updates

**Week 16**

December 10, 2012 **DEMO DAY!!!**
**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 25 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 replicate Windows Journal to get them acclimated to Visual Studio, C#, Windows Presentation Foundation, and pen and multi-touch input. This application will also be a test bed for the other assignments in the course.

2. **2D SKETCH**

Students will develop a 2D shape recognition program to create and manipulate circles, rectangles, squares, and triangles. Students will explore how to best combine pen and multi-touch input for the various operations needed. The focus of the assignment will be on heuristic gesture recognition.

3. **Math Symbol Recognizer (Research Contest)**

Students will implement Anthony and Wobbock’s $N$ symbol recognizer and try to improve its accuracy.

4. **Pen Calculator**

Using the math symbol recognizer created in assignment 3, students develop a pen-based calculator that will recognize and evaluate mathematical expressions. Students will use both pen and multi-touch input for different parts of this assignment.

5. **Final Project**

Students will do a final project of their choice that explores a particular concept in pen-, sketch-, or multi-touch-based user interfaces. They must first write a short proposal and get it approved by the professor.
**Tentative Grading Scheme:**

<table>
<thead>
<tr>
<th>Component</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>
<td>10%</td>
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<tr>
<td>Assignment 3</td>
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<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.