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 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-computing
2. C#, Visual Studio, and Windows Presentation Foundation, the StarPad framework
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 24, 2009  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 26, 2009  Talk about final projects
   Papers discussion

Week 2

August 31, 2008  Lecture - Visual Studio, C#, Tablet PC SDK

September 2, 2008  Lecture - Windows Presentation Foundation, StarPad

Readings


Week 3

September 7, 2009  Holiday – No Class

Assignment 1 Out

September 9, 2009  Lecture - Ink Preprocessing & Simple Features
   -- data representation
   -- filtering
   -- transformation invariance
   -- dehooking, cusps, and self intersections
Readings


Week 4

September 14, 2009 Papers discussion

September 16, 2009 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 21, 2009 Papers discussion
September 23, 2009  Lecture - Ink Segmentation
  -- spatial segmentation
  -- temporal segmentation

Readings

Gennari, L., L. Kara, and T. Stahovich. Combining geometry and domain knowledge to interpret

Smithies, Steve, Kevin Novins, and James Arvo. A Handwriting-Based Equation Editor. In

Tevfik Metin Sezgin and Randall Davis. Sketch Interpretation Using Multiscale Models of

Week 6

September 28, 2009  Papers discussion

September 30, 2009  Lecture - Classification Algorithms for Recognizing Digital Ink (Part 1)
  -- Feature Extraction
    **Assignment 2 due**
    **Assignment 3 out**

Week 7

October 5, 2008  Lecture - Classification Algorithms for Recognizing Digital Ink (Part 2)
  -- Classifiers
    - procedural
    - template matching
    - linear classifiers
    - SVMs
    - K-nearest neighbor
    - AdaBoost

Readings

LaViola, J., and Zeleznik, R. "A Practical Approach to Writer-Dependent Symbol Recognition
Using a Writer-Independent Recognizer", IEEE Transactions on Pattern Analysis and

Connell, Scott D. and Anil K. Jain. Template-Based On-Line Character Recognition. Pattern

October 7, 2008  Papers discussion

Week 8

October 12, 2009  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 14, 2009  Papers discussion

Week 9

October 19, 2009  Lecture - Sketch-based Interfaces and Understanding
                -- multi-domain sketch understanding frameworks
Readings


October 21, 2009 Papers discussion

Week 10

October 26, 2009 Lecture - Evaluation Methodologies
   -- user studies
   -- qualitative vs. quantitative
   -- comparative vs. formative.

Assignment 4 due

Readings


October 28, 2009 Papers discussion

Project proposals due
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>Week 11</td>
<td>November 2, 2009</td>
<td>Student paper presentations</td>
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<td><strong>Project proposal decisions made</strong></td>
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<td>November 4, 2009</td>
<td>Student paper presentations</td>
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<td>Week 12</td>
<td>November 9, 2009</td>
<td>Student paper presentations</td>
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<td></td>
<td>November 11, 2009</td>
<td>Project status updates</td>
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<tr>
<td>Week 13</td>
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<td>Student paper presentations</td>
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<td></td>
<td>November 18, 2009</td>
<td>Project status updates</td>
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<tr>
<td>Week 14</td>
<td>November 23, 2009</td>
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<td>Week 16</td>
<td>December 9, 2009</td>
<td>Project Status updates</td>
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<tr>
<td>Week 17</td>
<td>December 14, 2009</td>
<td><strong>DEMO DAY and Final Reports Due!!!!</strong></td>
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**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, and StarPad. 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 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**

   Students will compare two corner finding algorithms Sort, Merge, and Repeat (Wolin et. al, 2009) and IStraw (Xiong et al., 2009) to determine which one is better.

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

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

4. **MiniMathPad**

   Students will implement a small version of MathPad, a system for creating mathematical sketches that combines handwritten mathematics and free form drawing to build conceptual animations.

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>
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<tr>
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<td>Assignment 2</td>
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<td>Paper discussions</td>
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<tr>
<td>Final Project</td>
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The instructor reserves the right to use plus/minus grading in this course.