Pen Based Computing

Ananda Gunawardena and Victor Adamchik
Department of Computer Science
Carnegie Mellon University
http://www.cs.cmu.edu/~guna
http://www.cs.cmu.edu/~adamchik

15-397 Project Course in Pen-based Computing
What this course is about

• This is a project course specifically focus on pen-based applications
• Your grade will be primarily based on your project
• You should work as part of a team (minimum 2)
• There is a great deal of attention paid to usability of your product
• At the end of the semester, you should have a deployable product that others can use
• We will present project ideas as well as we will solicit ideas from you
Course Content

- The course will focus on 3 aspects on pen-based computing
  - Creating a usable product (HCI)
  - Learning the tool set – Visual Studio 2008 and C#
  - Sketch Recognition – Algorithms, techniques and data structures
- For the most parts, lectures will happen on Tuesdays.
- Thursday is reserved for group meetings and for the groups to meet with Victor and Guna
- We may have some outside speakers to talk about related things
Assessment

- Grading:
  - 3 Programming Assignment – 10%
  - First Prototype – 10%
  - Second Prototype – 20%
  - Final Presentation – 40%
  - Peer Evaluations – 10%
  - Team Evaluation – 10%

- TA’s
  - Some help may be available
Fly Pentop Computer
Microsoft’s Surface Computer

- Introduced in spring 2007
- Computing at another level
- Originally intended for high end restaurants, hotels and other businesses
- Cost - $10,000 per unit
Prehistory – before 2000

- Lots of earlier attempts – mostly failures.
  - DEC, Go, Newton, Pen Windows
- Technology wasn’t ready
- But vertical markets had limited success.
- Needed: better UI, better handwriting recognition (without relying on it).
- Key: Better digitizer (with hover).
An earlier attempt – 1983

- TRS 80 Model 100
- Reporters and students loved it
- Ran for days on AA cells
- Solved most computing needs for its (low aspiration) users.
Another attempt -- 1993

- DEC Lectrice
- 5.5 pounds
- 1.5 hour battery
- Wireless network
- $5K LCD panel
- VxWorks OS, X11 server optimized for reading
Where we started: Internal MS (1999)

- Microsoft proof of concept
  - Transmeta TM5800
  - 256MB DRAM, 20GB HDD
  - 10.4” Slate
- Good points:
  - Proved viability
  - Pushed the Power Efficiency Envelope
    - 5 Hours runtime, 200 Hours standby
  - Provided a development platform to get MS to Tablet PC launch.
- On the Other Hand:
  - It was so slooo0000w
Digitizer Technology

- Wacom’s EMR (Electo-Magnetic Resonance) technology
- The Principles of EMR® Technology
Pen and Touch Sensors
Today’s Market: New Slates

- **Sahara i213**: 12.1”, 1.6GHz Centrino
- **Tatung TTAB**: 10.4”, 1 GHz ULV
- **VersaPro**: 10.4”, 1.1 GHz
- **LE 1600**: Motion Computing
- **LS 800**: Tatung TTAB
- **Fujitsu 5000**: 10.4/12.1, Indoor/Outdoor, 1.1 GHz ULV
Today’s Market: New Convertibles

- **Acer C1xx**
- **Acer C300**
- **Acer C250**
- **Gateway M275**
  - 14.1”, DVD
  - 1.8 GHz Pentium-M
- **Toshiba M200**
  - 12.1” SXGA+
  - 2 GHz Pentium-M
- **Averatec C3500**
  - AMD 2200+
  - 12.1”, DVD
- **Electrovaya**
  - 1.4 GHz Centrino
  - 12.1”, Biometrics
  - Scribbler SC-2200
- **Fujitsu C300**
- **Fujitsu C250**
- **Fujitsu T4000**
- **IBM ThinkPad x41**
- **ViewSonic**
  - 12.1”, 1 GHz
- **SHARP Actius TN10W**
  - 12.1”, 1.1 GHz
- **SHARP**
  - Actius TN10W
  - 12.1”, 1.1 GHz
- **IBM ThinkPad x41**
- **HP tc4200**
Today’s Market: New Hybrids & Ruggeds

Hybrid

HP Compaq TC1100ULV
Celeron or Pentium
10.4”, 1.1 GHz

Ruggedized

Itronix
8.4”, 933 MHz ULV

Walkabout Hammerhead
10.4”, 4.5 lbs
933 MHz P-III M

Xplore iX104
10.4” 1.1 GHz ULV
Concept Design: New hinge
A Concept Tablet for Kids

- Low power
  - (7W)
- 8.4” display
- Tethered pen
- Rugged
Other Form Factors

OQO Model 1

Vulcan FlipStart
• Mobile Market Projections (IDC)

Today’s Market: Forecasts

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra-Mobile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumers, Mobile Professionals</td>
<td>1%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>CY08 Market: 2.5M, CAGR (04-08): 40%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultra-Portable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Professionals, Information Workers</td>
<td>8%</td>
<td>17%</td>
<td>31%</td>
</tr>
<tr>
<td>CY08 Market: 28.4M, CAGR (04-08): 51.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thin &amp; Light</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Workers, Consumers</td>
<td>63%</td>
<td>63%</td>
<td>56%</td>
</tr>
<tr>
<td>CY08 Market: 51M, CAGR (04-08): 22%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Workers, Consumers</td>
<td>30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY08 Market: 8.9M, CAGR (04-08): -11%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Typical Tablet PC use

- Portable, unstable environment, without a keyboard
- Direct interaction,
- Low precision aiming
Microsoft’s ink Recognizer

Jay Pittman
and the entire
Microsoft Handwriting Recognition
Research and Development Team
jpittman@microsoft.com
Beam Search

Ink Segments

TDNN

Output Matrix

Lexicon

Top 10 List

dog 68
clog 57
dug 51
doom 42
divvy 37
ooze 35
cloy 34
doxy 29
client 22
dozy 13

Microsoft Tablet PC 8/26/2008
CMU Projects
Adaptive Book

- A textbook reader platform
- Markup Manager
- Markup Analyzer
- Used in several schools and colleges
Tablet Math Whiz

- A Tablet PC based client
- Server backend
- Ability to analyze the scratch work
- Ability to grade handwritten work
- Ability to provide a view by filtering the scratch work
- Used in several schools
Handwriting Personalization

- A promising project
- Uses machine learning to train a system to recognize individuals handwriting from a set of handwritten work
- Many personal data collected during training and recognition process
  - Speed, orientation, handwriting, pressure etc
- Applications in signature authentication/verification
Remote ink Tutor

- A human computer interaction project
- Goal is to create a network of human tutors supported by ink agents who can provide assistance
- Early stages of development
Flash Cards

- An authoring system for tablet PC based flash cards
- Easy to author and share decks
- Students can study with Tablet Flash cards
- Winner of the “runner-up” award at CMU’s meeting of the mind – Spring 2008
- A result of 15-397 F07 Project
Graph Animator

- A Tablet PC based program for animating graphs
- User draws the graph and provide edge weights
- The algorithm finds the shortest distance between any two nodes
  - Mapquest, google maps
- Many applications
  - Mobile workers
Pen Based Computing Course at CMU

- Offered first time in Fall 07
- Students learn
  - Human Computer Interaction principles for designing mobile and pen-based applications
  - C# and .net platforms
  - Sketch Recognition Algorithms
    - Neural nets
    - Factoids
Conclusion

• Pen Computing
  • Interesting area of research
  • Great for mobile application development

• Interested?
  • Contact: Ananda Guna (guna@cs.cmu.edu)
  • http://www.cs.cmu.edu/~guna
Q & A

- Questions???