Mobile Text Entry

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Engelbart's NLS Demo

- Invented the mouse

- What was in the other hand?
... a Chording Keyboard
Mobile Text Entry Today

- ~ 2 billion mobile phone users
  - 500 million phones sold / year

- 1 trillion text messages per year
Overview

- Different Methods
- Research Issues
- Mobile Keyboards
  - Twiddler
  - Mini-QWERTY
  - Blind Typing
- Outstanding Issues
Entry Methods

- Keyboards
  - Phone keypad, mini-QWERTY, Half-QWERTY, Twiddler, others?
- Stylus
  - Ink based
    - Handwriting recognition
    - Graffiti & unistroke
  - Soft keyboards
  - Hybrid techniques - Shark
What Makes a Method Good?

- Text entry rate (wpm)
- Error rate

- Other factors
  - Learning rate
  - Ergonomics
Optimization

● Movement
  – Fitts' law
  – Keypresses

● Dictionary aids
  – Prediction / disambiguation (T9)
  – Issues
    • Out of dictionary
    • Attention
Evaluation

• Methods
  – Analytic
  – Empirical

• MacKenzie & Soukoreff
  – Text copy task
  – Standard procedure
  – Phrase set
  – Total error metric
Mobile Keyboards

• Typing on a mobile phone is slow!!

• How many hours spent entering SMS?
  – 2 trillion words @ ~10 WPM
  – ~≈ 3.3 billion hours
## Current Phone Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>WPM</th>
<th>Experience</th>
<th>Keyboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>LetterWise</td>
<td>21.0</td>
<td>550min</td>
<td>desktop keypad</td>
</tr>
<tr>
<td>T9</td>
<td>20.36</td>
<td>expert</td>
<td>Nokia 3210</td>
</tr>
<tr>
<td>Multi-tap</td>
<td>15.5</td>
<td>550min</td>
<td>desktop keypad</td>
</tr>
<tr>
<td>TiltText</td>
<td>13.57</td>
<td>165min</td>
<td>Motorola i95cl</td>
</tr>
<tr>
<td>Multi-tap</td>
<td>11.04</td>
<td>165min</td>
<td>Motorola i95cl</td>
</tr>
<tr>
<td>T9</td>
<td>9.09</td>
<td>novice</td>
<td>Nokia 3210</td>
</tr>
<tr>
<td>Multi-tap</td>
<td>7.98</td>
<td>novice</td>
<td>Nokia 3210</td>
</tr>
<tr>
<td>Multi-tap</td>
<td>7.93</td>
<td>expert</td>
<td>Nokia 3210</td>
</tr>
<tr>
<td>Multi-tap</td>
<td>7.2</td>
<td>n/a</td>
<td>desktop keypad</td>
</tr>
</tbody>
</table>
Twiddler and Mini-QWERTY

- Two different mobile text entry devices
Twiddler

- Mobile, one-handed
- 3 x 4 grid of buttons
- Chording
Evaluation of Twiddler Learning

- Novice Twiddler users
- Longitudinal evaluation
  - Within subject
  - Twiddler vs Multi-tap
  - 20 minute typing sessions
- 10 participants for 20 sessions
- 5 participants for 25 hours
Average Learning Rates

400 minutes

- 26.2 wpm

25 hours

- 45.2 wpm
Twiddler Typing Rates

• Novice users can learn to type quickly on the Twiddler
  – 45.2 wpm

• What about other mobile keyboards?
  – Mini-QWERTY
Mini-QWERTY Keyboards

- Miniature version of full desktop keyboard
- Found on PDAs and some mobile phones
Evaluation of Mini-QWERTY Learning

- Novice mini-QWERTY users
- 20 minute typing sessions
- 14 participants for 400 min.
- Two mini-QWERTY Keyboards
  - Targus & Dell
Mini-QWERTY Rates

Session 1
- Targus 34.3 wpm
- Dell 29.3 wpm

Session 20 (400 min)
- Targus 58.7 wpm
- Dell 59.3 wpm
Twiddler and Mini-QWERTY

- Both keyboards offer fast expert rates
- Performance under more realistic conditions?
Blind Typing: Typing with Limited Visual Feedback

- Mobile and wearable users
  - Divide attention between environment and computer
  - Limited attention devoted to computer
- Example: taking notes in conversation
  - Visual attention directed towards conversational partner
  - Only glance at text entered
- Nokia SMS
Twiddler Blind Typing Conditions

- Normal: Show characters as typed
- Dots: Only show “.” as characters typed
- Blind: Show no visual feedback

the bus was very crowded
the bus wa_

<table>
<thead>
<tr>
<th>WPM</th>
<th>avg</th>
<th>last</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.22</td>
<td>29.61</td>
<td></td>
</tr>
</tbody>
</table>

| ACC  | 98.9% | 100.0% |
Twiddler Blind Typing Results

- Limited feedback did not hinder users
- If statistical difference, better performance

<table>
<thead>
<tr>
<th>Participant</th>
<th>Normal</th>
<th>Dots</th>
<th>Blind</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51.8</td>
<td>51.7</td>
<td>53.7</td>
</tr>
<tr>
<td>2</td>
<td>37.6</td>
<td>37.5</td>
<td>37.5</td>
</tr>
<tr>
<td>3</td>
<td>64.2</td>
<td>67.2</td>
<td>67.7</td>
</tr>
<tr>
<td>4</td>
<td>36.2</td>
<td>36.0</td>
<td>36.6</td>
</tr>
<tr>
<td>5</td>
<td>41.8</td>
<td>43.1</td>
<td>41.7</td>
</tr>
</tbody>
</table>
## Twiddler Blind Typing Results

<table>
<thead>
<tr>
<th>Participant</th>
<th>Normal</th>
<th>Dots</th>
<th>Blind</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>94.4</td>
<td><strong>95.2</strong></td>
<td>95.0</td>
</tr>
<tr>
<td>2</td>
<td>94.4</td>
<td>95.0</td>
<td><strong>95.4</strong></td>
</tr>
<tr>
<td>3</td>
<td>93.0</td>
<td><strong>94.3</strong></td>
<td><strong>94.1</strong></td>
</tr>
<tr>
<td>4</td>
<td>90.2</td>
<td>90.7</td>
<td>91.1</td>
</tr>
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<td>93.4</td>
<td>94.2</td>
<td><strong>94.6</strong></td>
</tr>
</tbody>
</table>
Mini-QWERTY Blind Typing Evaluation

• 8 expert mini-QWERTY typists from original study
• 20 minute sessions
• 3 typing conditions
  – Normal
  – Hands blind (single blind)
  – Fully blind (double blind)
• Total of 100 minutes of typing (5 sessions) per condition
Visibility Factors

the bus was very crowded
the bus was _

<table>
<thead>
<tr>
<th></th>
<th>avg</th>
<th>last</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPM</td>
<td>10.25</td>
<td>10.81</td>
</tr>
<tr>
<td>ACC</td>
<td>88.8%</td>
<td>72.3%</td>
</tr>
</tbody>
</table>

fine but only in moderation

<table>
<thead>
<tr>
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<th>last</th>
</tr>
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<tbody>
<tr>
<td>WPM</td>
<td>26.4</td>
<td>38.64</td>
</tr>
<tr>
<td>ACC</td>
<td>95.1%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Mini-QWERTY Results

Typing Rate and Accuracy

- Typing rate and accuracy initially drop
- Neither blind conditions recover
- Significant differences: Normal & Blind
Which is Better?

- Twiddler and Mini-QWERTY offer fast expert rates
- Mini-QWERTY
  - Fast to learn, but two handed
  - Significant performance drop for blind typing
- Twiddler
  - Slower to learn, one handed
  - No blind drop in performance
Outstanding Issues
(aka potential projects)

• MQ & Twiddler
  – Twiddler Phone & BT Twiddler
  – MQ error correction
  – Update Fitts' Law for MQ?
• What error rate is good enough?
• A unified metric
  – Combining typing rate & error rate
• Mobile evaluation
  – Rates while on the go
  – Learning while on the go
Further Reading


- Zhai's work on Shark2 and predecessors

- MacKenzie and Soureroff's work on method