Factors in Evaluating the Usability of Biometric Systems

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What is Usability?

**usability**

the extent to which a **product** can be used by specified **users** to achieve specified **goals** with **effectiveness**, **efficiency** and **satisfaction** in a specified **context of use**.  
*(ISO 9241-11:1998.)*

- Effectiveness: a measure of the accuracy and completeness (quality)
- Efficiency: a measure of the resources expended (task time)
- User satisfaction: the degree to which the product meets the users’ expectations—a subjective response
What differentiates Usability Testing from Performance Testing?

1. Observation
2. Listening
3. Measuring Properties of Affordance
4. Interaction of User and Device
5. Emphasis that Users are not wrong
6. Performance measures are not the whole story
Opportunity ("please place your hand on the scanner")
Capture thresholding
System starts capture

Capture
Capture thresholding
Capture repeated if unacceptable

Where’s the User?

Traditional Performance View

System

Time
Systems Performance Model

- Participant presents
- Attempt starts
  - Opportunity ("please place your hand on the scanner")
  - Capture thresholding
  - System starts capture
  - Attempt
  - Capture
  - Attempt ends
  - Capture thresholding
  - Capture repeated if unacceptable
  - Next attempt (acceptable attempt)

Demographics
- Age
- Gender
- Height
- Experience
- Ability

System

Time

Instructions
- Anthropometrics
- Affordance
- Accessibility
First Rule: Know thy User

- Understand your users -- Ride along with your PD, sit in an airport and watch
- Observe users in action
- What do and don’t they do
Determining What to Measure:

Examples:
How long does it take to leave a fingerprint?

User Perspective

Technology Perspective
What did we see, why did they do that?

- Mental Models
- Attitudes
- Behaviors
- Past experiences influence their use

How do you design the study to identify these factors?

Let’s look at some examples from testing
Testing Contactless Scanners

- **Task 1:** No instructions on use scanners: Verbally told to step up on to the mat “when you believe the device is ready to collect prints” and to step off “when you think the device has collected both sets of prints”.

- **Task 2:** Watched an instructional video, then asked to complete the collection again using verbal instructions of Task 1.

- **Task 3:** Detailed verbal instructions walking participants through each step of collection process.
Mental Models of Fingerprinting

Participants placed their hands on the glass surface of the contactless scanners.

Peoples’ Mental Model of Fingerprint Collection involves pressing their fingers against a surface.
Talk Aloud involves participants telling us what they are doing

“I don’t know where to press. In the area that’s light green?”

“Is that the target area?”

“Does it need to be in where the little dots are? Or the whole thing?”

<table>
<thead>
<tr>
<th>Captured...</th>
<th>Number of Participants</th>
<th>Percentage of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full set of prints</td>
<td>10</td>
<td>16.13%</td>
</tr>
<tr>
<td>Some but not all prints</td>
<td>9</td>
<td>14.52%</td>
</tr>
<tr>
<td>No prints</td>
<td>43</td>
<td>69.35%</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>100%</td>
</tr>
</tbody>
</table>
Recall Task: please draw on this sheet anything you remember seeing or seeing it do.

There were red lights that did not change. It was probably telling me that I was not doing it correctly and there were no instructions about what to do.

There are no instructions. Hope they don’t use this machine. They will have people lined up all over the place.

It wasn’t really user friendly. The process is not going to be user friendly. I had problems with figuring out what to do. There was nothing to tell me what to do.

There were some LED lights noticed. Provide labeling for lights. Correct labeling for lights.

<table>
<thead>
<tr>
<th>Affordance type</th>
<th>Condition</th>
<th>Prints captured</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED lights</td>
<td>Noticed lights</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Provide labeling for lights</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Correct labeling for lights</td>
<td>4</td>
</tr>
<tr>
<td>Icons</td>
<td>Notice icons</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Provide labeling for icons</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Correct labeling for icons</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Notice beep</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Provide description of beep</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Correct description of beep</td>
<td>4</td>
</tr>
</tbody>
</table>

n=43  n=9  n=10
Observing users positioning

Shorter participants struggling with tall counters and flat scanners.

Taller participants struggling with short counters and the 30° angle.
But Also Observed Hand Positioning Resulting in Thumb Rotations
“It is less daunting as opposed to when doing it in front of a custom agent. So, it feels less criminal. Before I started, I actually thought it would take a longer process and a lot of re-doings. The instructions were very simple and easy to comprehend. It was an enjoyable process. Everything was very easy to use.”

“I like it. It's very user friendly, and easy to follow, so you don't have to do a lot of reading. And, it's right there on the screen so somebody who is even illiterate can say, "move your hand" as the machine kind of indicated. Very easy to follow because you don't have to worry about languages or anything so it'll be easier for anyone just able to follow because they are going by the pictures. It's picture-guided.”
The Users Are Not Wrong

Keep Refining
Performance measures are not the whole story

Measure:
- Efficiency – time to collect image, throughput
- Effectiveness – Quality (NFIQ) and number of errors
- Satisfaction – Semantic Difference Scale

But must Pay Attention to the details of user interaction
- Look
- Listen
- Engage
Contact Information

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