Investigations on reducing the failure-to-enroll rate for fingerprint scanners by means of user-centered interaction design

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"A user interface is like a joke. If you have to explain it, it's not that good."

Martin LeBlanc

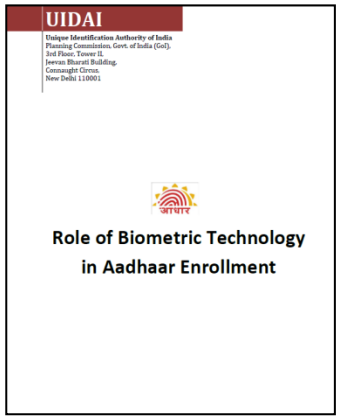
Typical users of fingerprint scanners

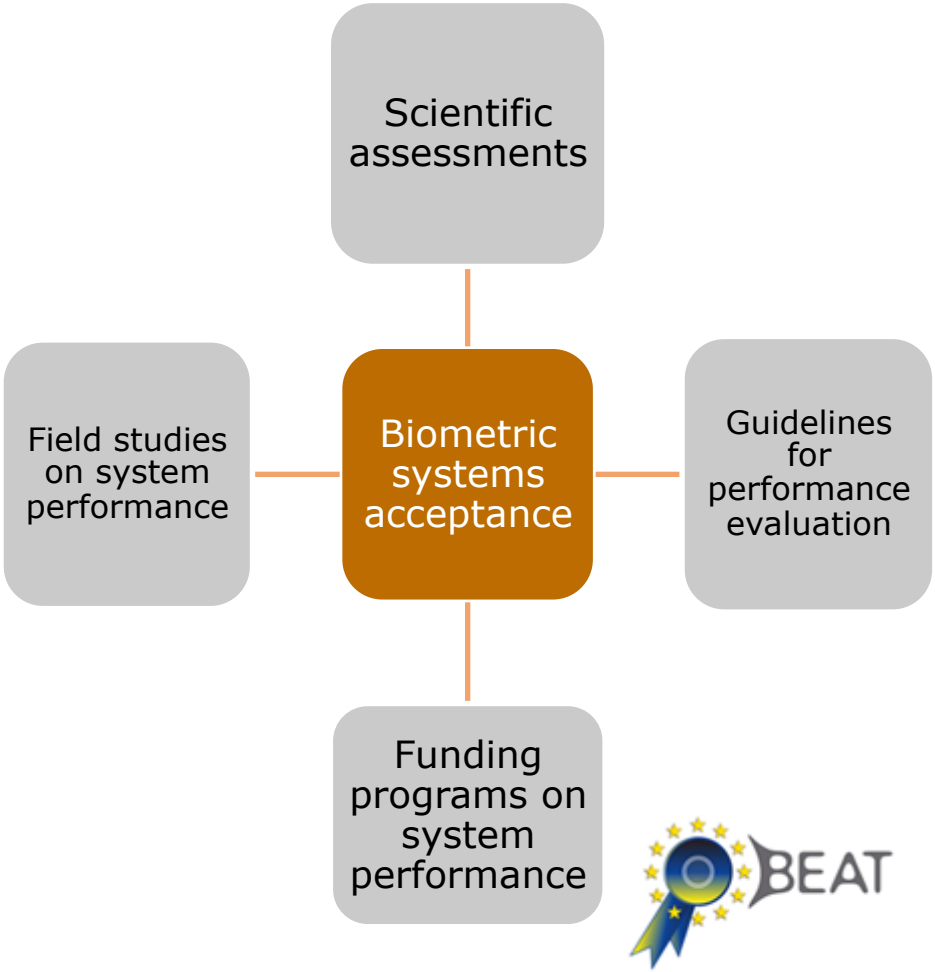
Yesterday

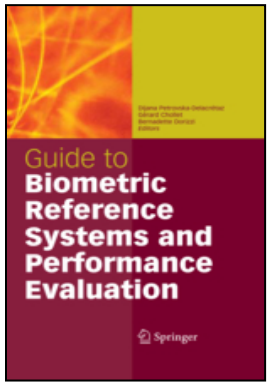
Today

Biometric system assessments

Large-Scale Eval. Multim. Biometric Authentication using state-of-the-art systems
Snelic et al.; IEEE Transactions on pattern analysis and machine intelligence, Vol 27, No 3, March 2005







Lesson learnt from public usability studies

Live image leads to pseudo quality assessment[1]

Habituation only improves the usability if user feedback is provided[1]

Poster does not work for user guidance, best are videos[2]

User feedback needs to be quality based[3]

User feedback needs to be in real-time[4]

1) Does habituation affect fingerprint quality?, Theofanos M et al.; CHI, April 22-27, 2006 Montreal, Canada
2) Usability testing of Ten-print fingerprint capture, Theofanos et al,; NISTIR 7403, March 2007
3) Interactive Quality driven Feedback for biometric systems, Wong et al.; IEEE BTAS, 2010
4) Real-time feedback for usable fingerprint systems, Guan H et al.; IEEE Fifth International Conference BTAS2012

Lesson learnt from testing for Air Entry/Exit Re-engineering

Usability issues identified

Presentation press	Which finger, where to place, how hard to press?
Stability Duration	How long to hold?
Movement	When to start, how fast to move?

Yevgeney Sirotin, Scitor corperation, connect:ID, March 14

Standard development for feedback and user guidance

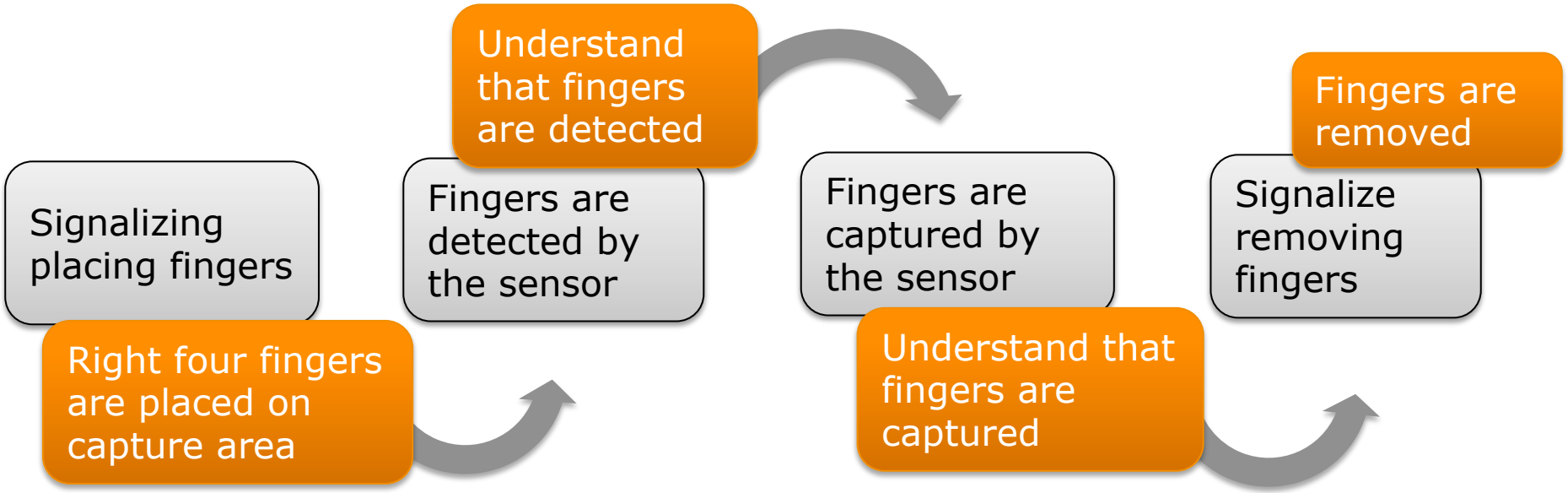
ISO/IEC JTC 1/SC 37 N 5265
24779-1: Cross-jurisdictional and societal aspects of implementation of biometric technologies — Pictograms, Icons and Symbols for use with Biometric Systems

Part 1 General principles	Part 4 Fingerprint applications

Human-Machine-Interaction

Interaction design = conversation between user and device
(WHAT and WHEN)

Example: Capture right four fingers



Interface design = HOW to communicate

Finger sequence error for right middle finger.

Text messages

Audible or haptic

Live images

Guidance by device design

Dynamic feedback

ID Flats scanner

User interface studies

Usability Engineering

User-centered development of a fingerprint scanner

1. **Understand Context of use**
   - Literature review
   - Expert workshop

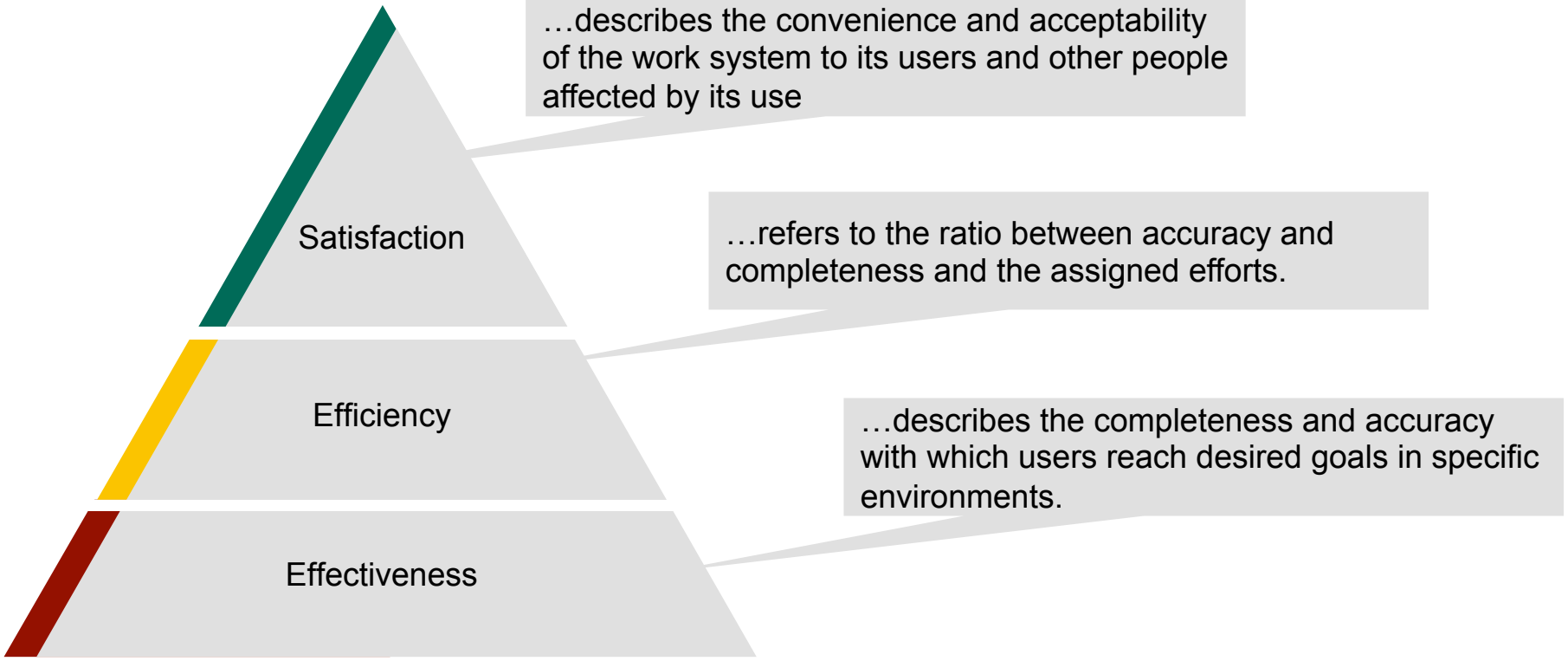
2. **Specify User Requirements**
   - Standard review (i.e. ISO 9241-110, ISO 894-2)

Requirement definition dependent of step 1 and 2

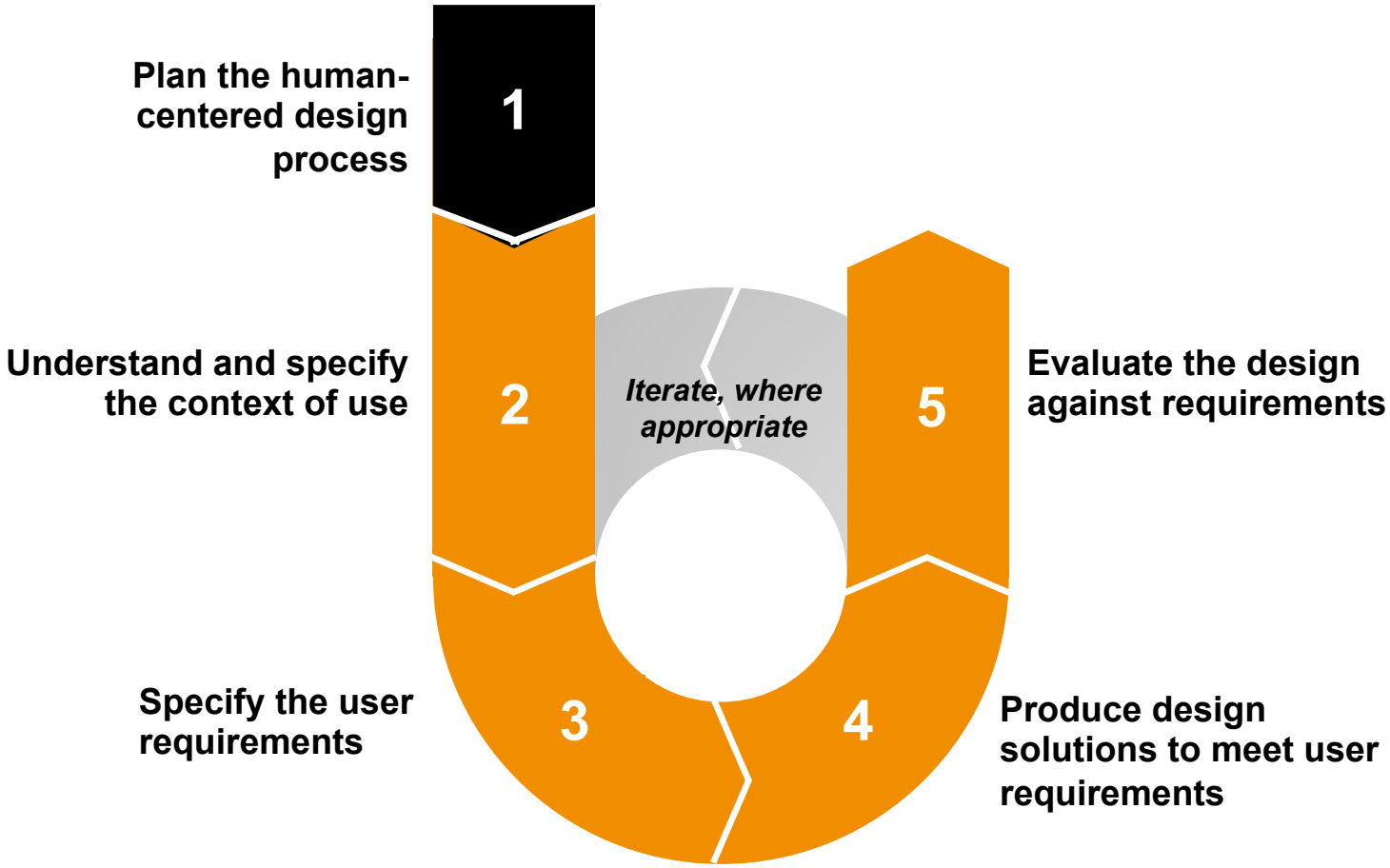
3. **Design solutions**
   - Development of various design solutions base on requirements

Usability (ISO 9241-11)

"*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.*"



Usability Engineering (ISO 9241-210)



Approach of the 1st and 2nd usability study

	Objectives	Methodology	Results
1st Study	**Which design solution is more understandable and cause fewer errors?**	Test design: • User Testing – Wizard of OZ • Retrospective thinking aloud Sample: • 26 Participants • European, Asian, Arab	• Identification and classification of errors (type) • Preferred design solution
2nd Study	**Causes the revised interaction design, fewer errors?**	Test design: • Same test design in order to ensure comparability of results Sample: • 21 Participants	**The revised interaction design causes fewer errors.**

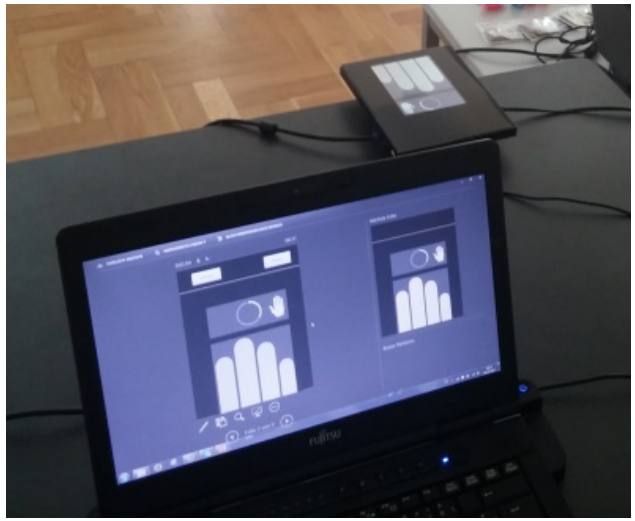
Approach of the 1st and 2nd usability study

Wizard of Oz – Method for usability testing in an early development stage

Definition: '[…] *describe a testing or iterative design methodology wherein an experimenter (the "Wizard"), in a laboratory setting, simulates the behavior of a theoretical intelligent computer application […].'*[1]

- Exploring requirements at an early stage of design process
- Not necessary to create a functional prototype

→ Cost effective and easy way to gain feedback form the user



[1] Kelley, J. F. (1984). An iterative design methodology for user-friendly natural-language office information applications. ACM Transaction son Office Information Systems, 2, 26-41.

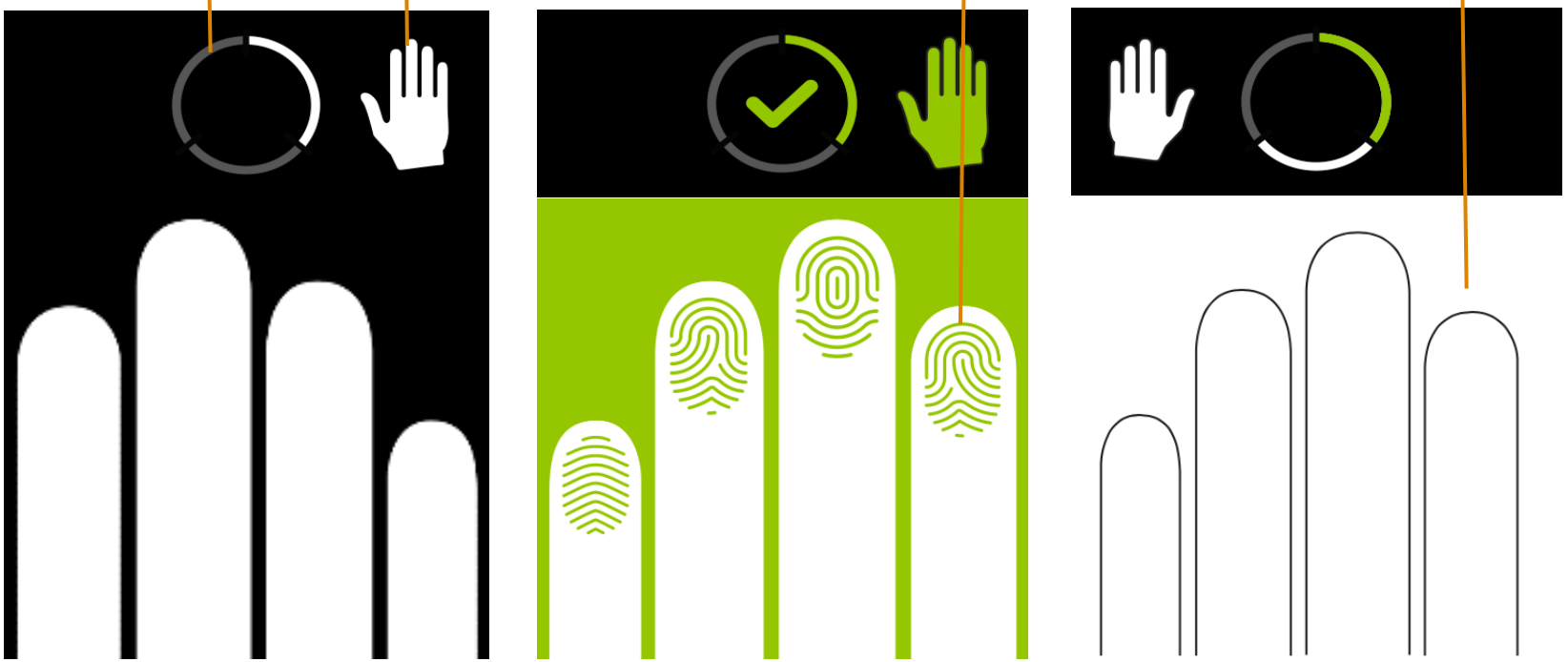
Visual and/or haptic feedback?

Circle for capture progress?

Flashing hand for promting?

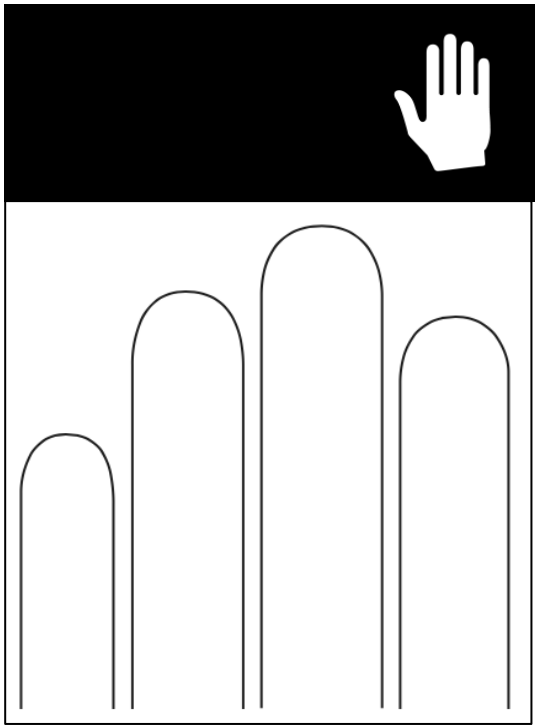
FP ridges or just blank?

White on black or vice versa?



Finally selected design/approach

No progress of capture workflow

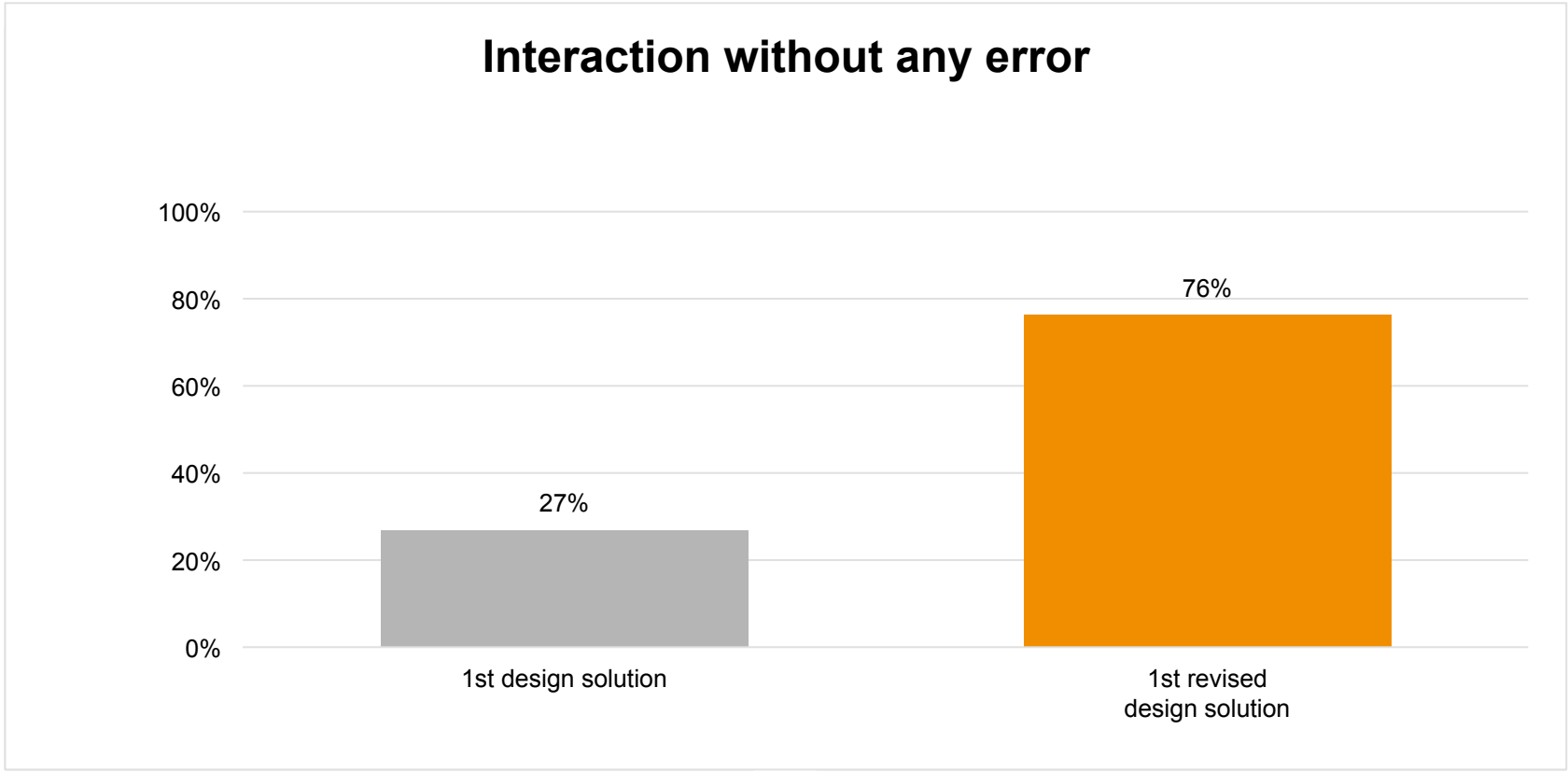


Pulsing hand

White light, black outlines

Results of the 1st and 2nd usability study (1st Iteration)

Error reduction in every process step



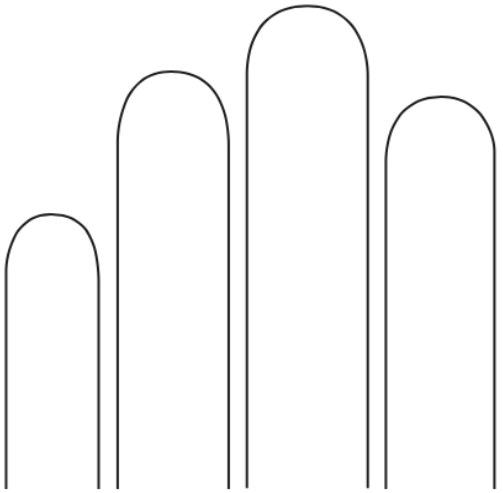
Approach of the 3rd usability study (now with a working scanner)

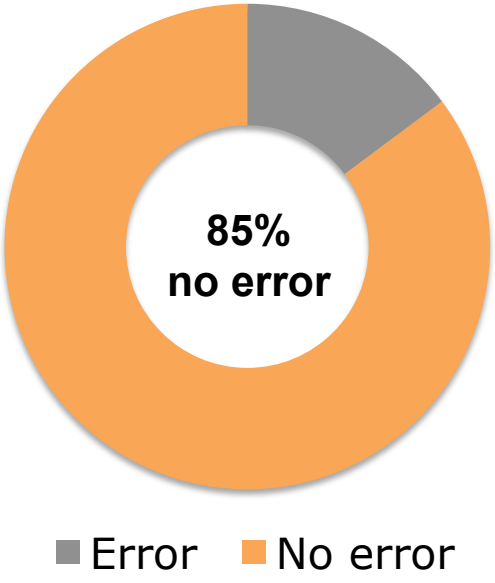
	Objectives	Methodology	Results
3rd Study	**Can users use the scanner without any help?** **Do users understand the corrective actions, if they do an error?**	Test design: • Usability-Test with error counting • Retrospective thinking aloud Sample: • 54 Participants • Age between 16 and 75 years • European, Asian, Arab, American	**Users can use the device without guidance (i.e. guided by an officer)** **Users have problems to interpret some of the corrective actions***

*Interpretation of the corrective actions difficult, because the context for this actions is essential for intuitive understandability

Standard 4-4-2 workflow

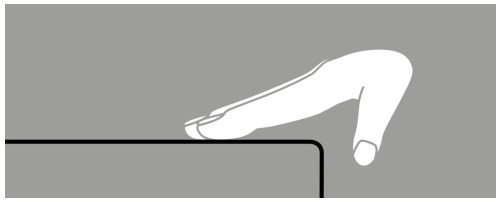
Start right hand

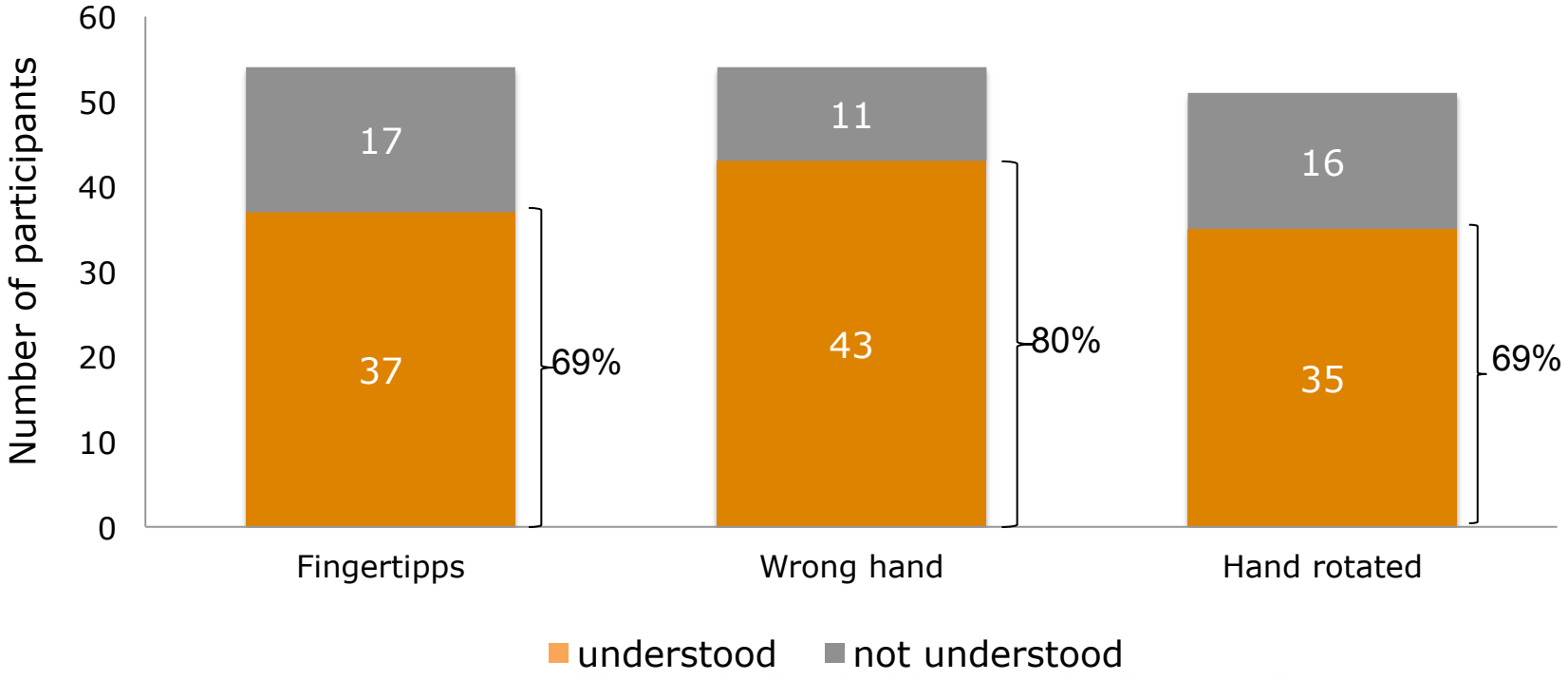




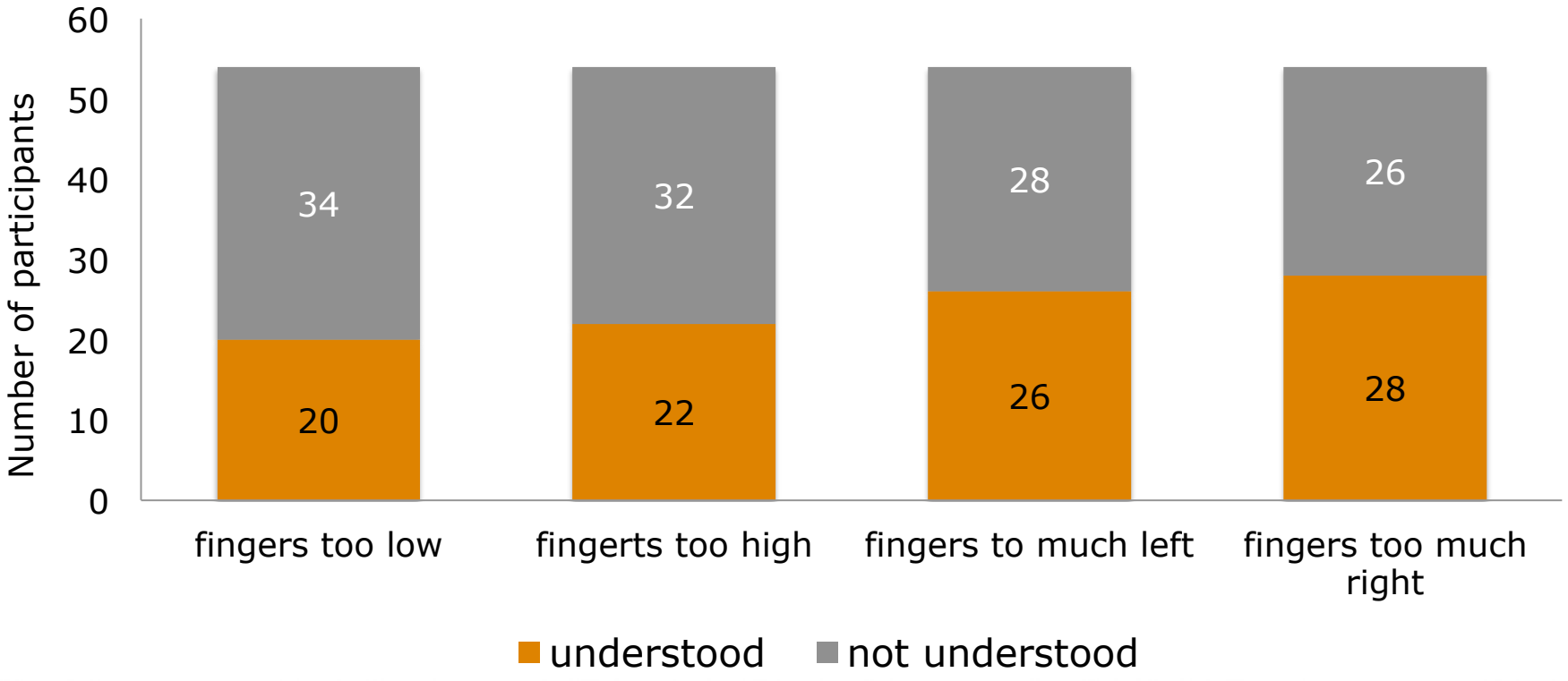
Complete right hand

Well understood corrective actions





Only partially understood corrective actions

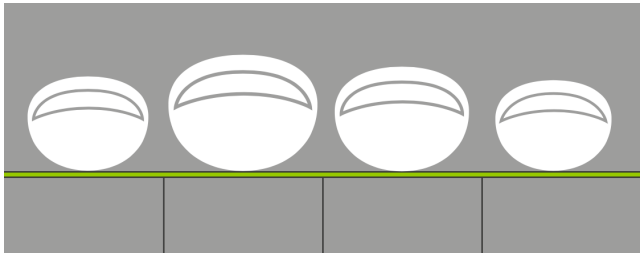


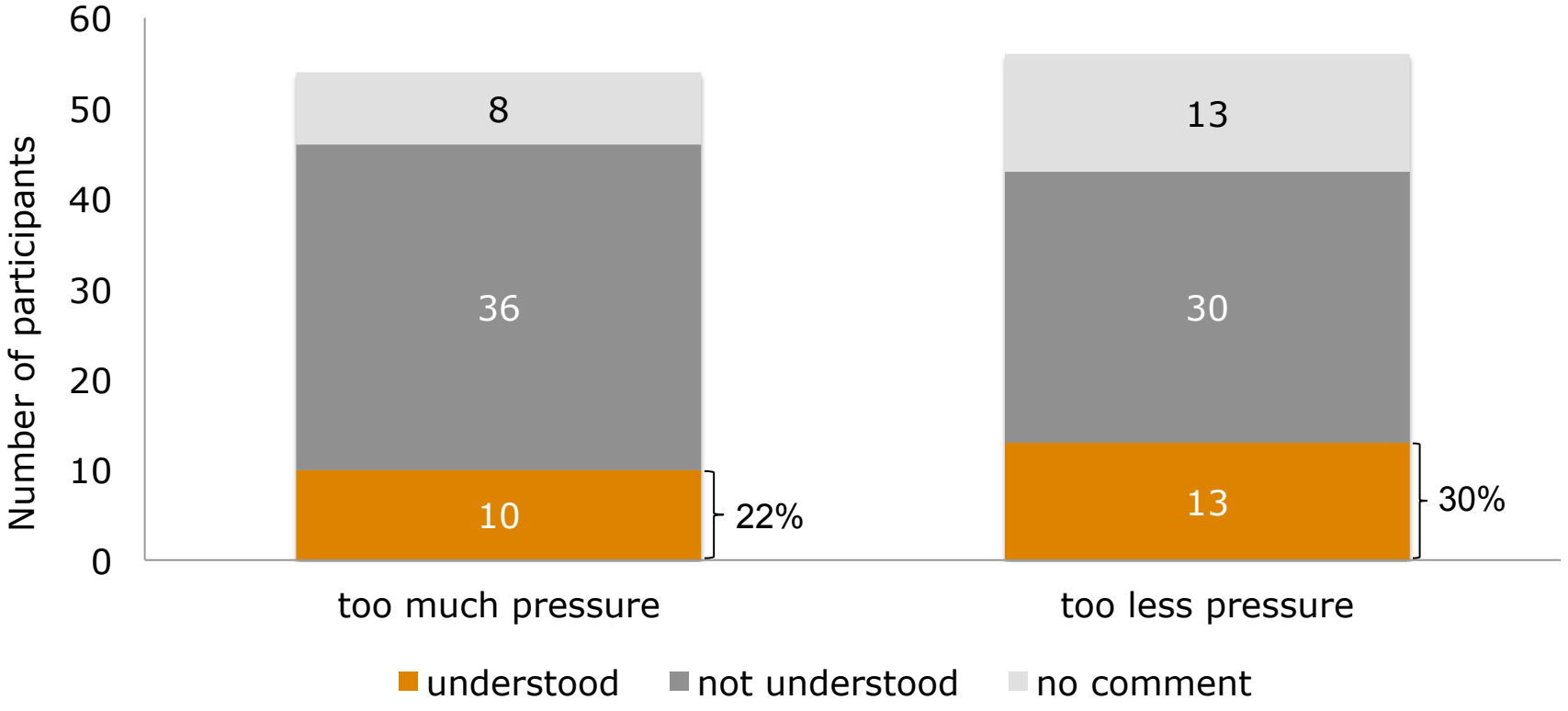
Provide a target – not just the direction

Fingers over the upper edge

Fingers over the right edge

Pressure: Not understood corrective actions





Summary

Don‘t let engineers (only) design the user interface.
Work with pros and real users.

Small details make big difference.

This is an never ending story.
Flexible user interface is essential.

Thank you for your attention!

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