A close-up photograph of a soldier wearing a tan helmet and tactical gear, looking out of a window in a vehicle. The soldier has a serious expression. The background shows the interior of the vehicle with various cables and equipment.

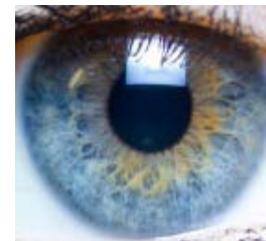
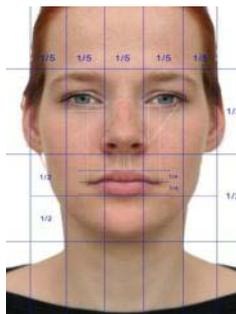
Lessons Learned Biometric Security in a Warzone

Alex Kilpatrick
CTO

Tactical information Systems

Biometrics 101

- Biometrics is the study of human traits that make people unique
 - Fingerprints
 - Face
 - Iris
 - Many others – gait, ears, voice, etc.
- Biometric matching is a probabilistic process that attempts to determine if a sample represents a person

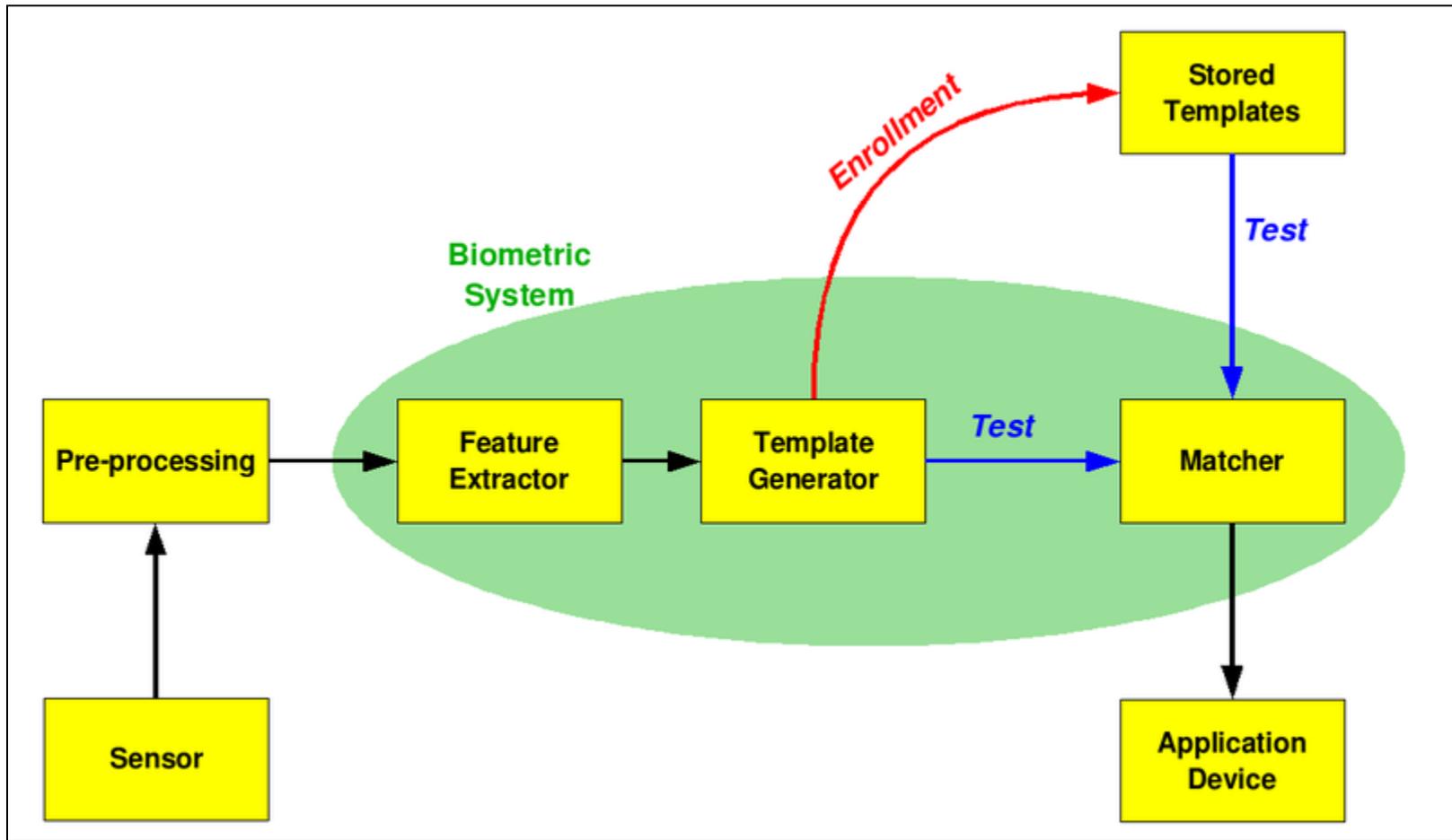




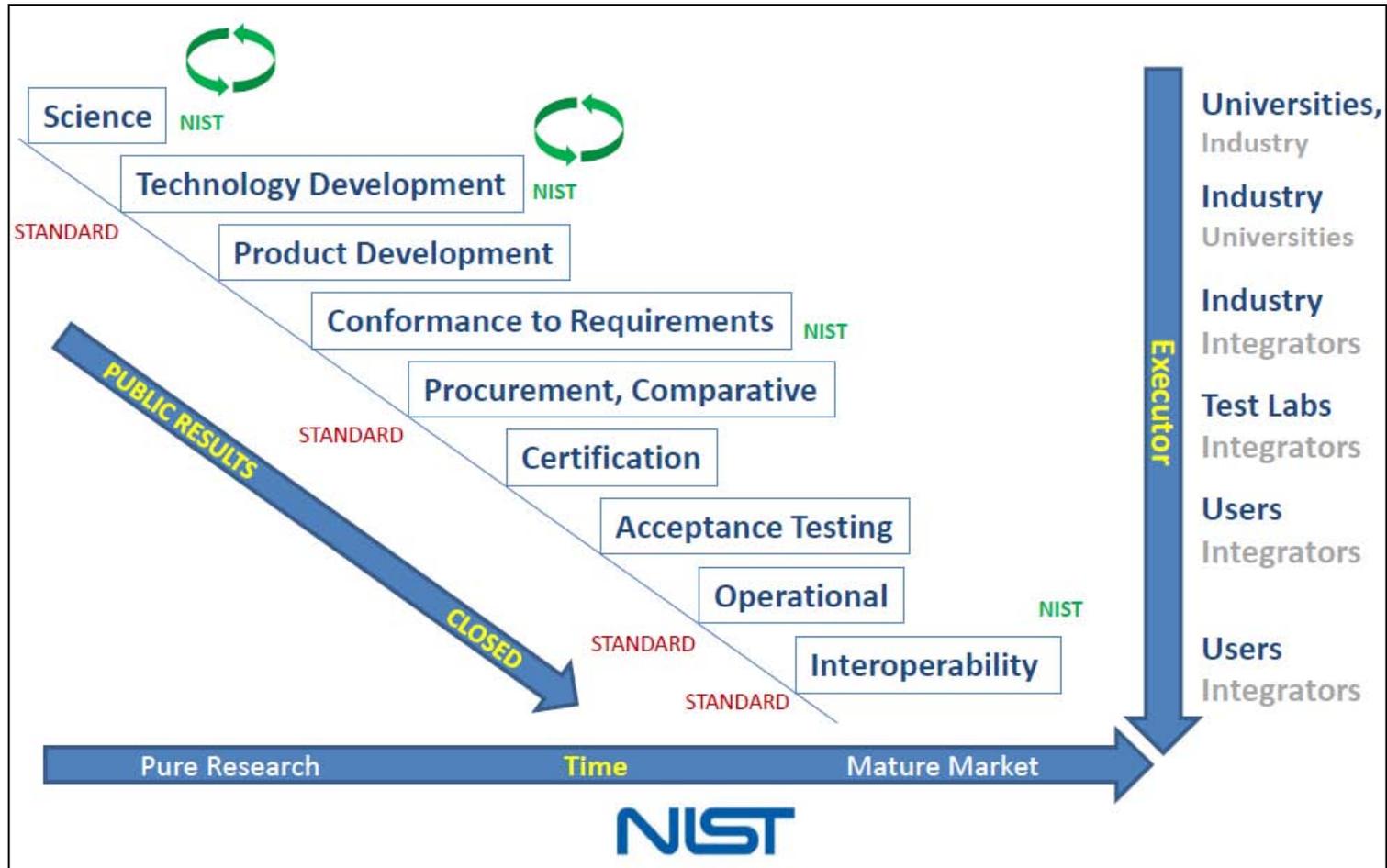
Key Terms

- **Enrollment:** The process of collecting biometric samples (mathematical templates) from a person
- **1:1 (Verification)** Determining whether an identified sample matches an identified person
- **1:N (Identification)** Determining if an unknown sample is present in a database
- **Latent:** a partial fingerprint collected from a crime scene
- **False Accept/False Reject:** when a sample is incorrectly identified as a match, or vice versa

Process



Classes of Tests





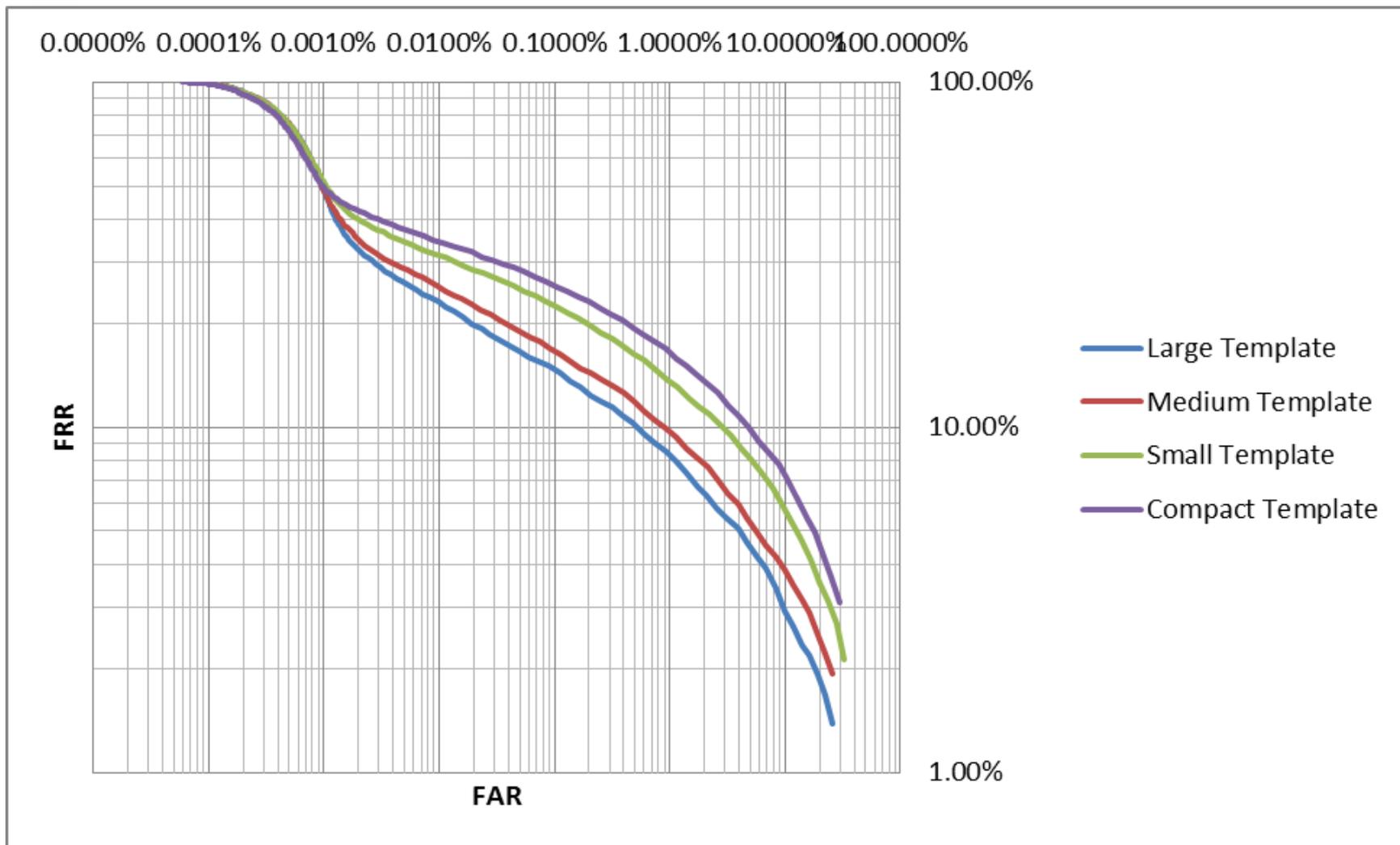
Biometric Challenges

- Usability
- Faster enrollment; collecting biometrics from a distance
- Faster identification or verification
- Working with very large databases (100M+)
- Faster/more accurate matching
- Newer, better modalities

Testing Challenges

- Gathering very large databases (1M+) for testing that are representative
- Operational testing – usability, ruggedness, speed
- Extrapolating performance (accuracy and speed) on large systems from small-scale tests
- Security and data protection
- Data fusion and integration across heterogeneous databases
- Controlled data sharing

Metrics





Operational Systems

- Biometric Identification System for Access
- Ministry of Interior ID card
- Iraqi High Tribunal Court
- Iraqi National ID Card
- Jordan International Police Training Center
- Numerous biometric enrollment systems



Key Focus - Usability

- Usability can have a 10X performance impact on matching
 - Usability issues have eliminated some systems
- Biometric systems often have a continually new population
 - Training has a significant impact
- Usability is typically not considered in design

Lesson Learned – Iris Camera

- Which lens do you look into?
- How do you check alignment?
- Requires special training for every enrollee



Lesson Learned – Iris Camera 2

- Allows for experience in operator, not enrollee
- Still not usable





Iris Camera – Usable!

- Form and function is intuitive
- No real operator OR enrollee expertise



Lesson Learned – Real World

- Lab throughput times do not reflect the real world



Lesson Learned – Culture Matters

- Culture affects usability



Lesson Learned - Environment

- Environment can't be tested in a lab



Lesson Learned – Risk Management

- Must be able to quantify risk for decision makers



Usability

- Effectiveness
 - How easy is it to use?
- Efficiency
 - How fast is it?
- Satisfaction
 - User perception of system
- Learnability
 - How quickly can they learn to use it?
- Memorability
 - How well will they remember when they come back?

Concept – Usability Lab

- Purpose: Perform a wide breadth of usability experiments for biometric systems
 - Develop quantifiable results that can feed into operational system designs
 - Build models that can be used for future designs
 - Provide feedback to hardware manufacturers
 - Support new construction design of biometric security portals

Subject Population

- Must have a continually renewable source of “fresh” subjects
- Subjects become acclimated and skew results
 - Unless that is part of operational concept
- Ideally, subjects represent target population
 - Age
 - Education
 - Experience with technology



Population Factors

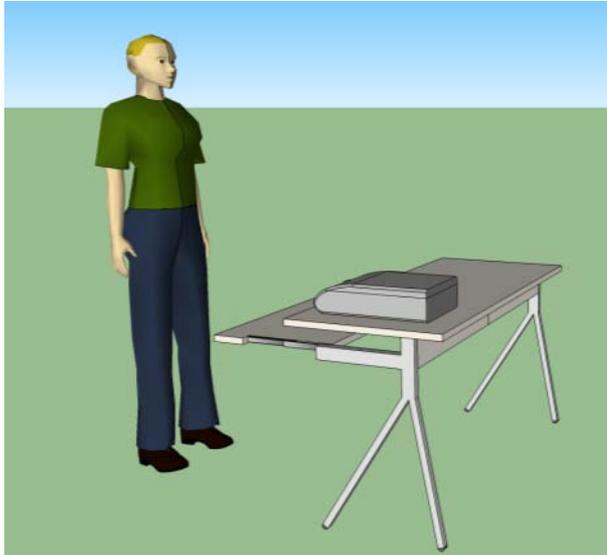
- Age
- Gender
- Anthropometrics
- Ethnicity, Nationality, Language, Culture
- Education
- Experience
- Disability



Usability Experiment

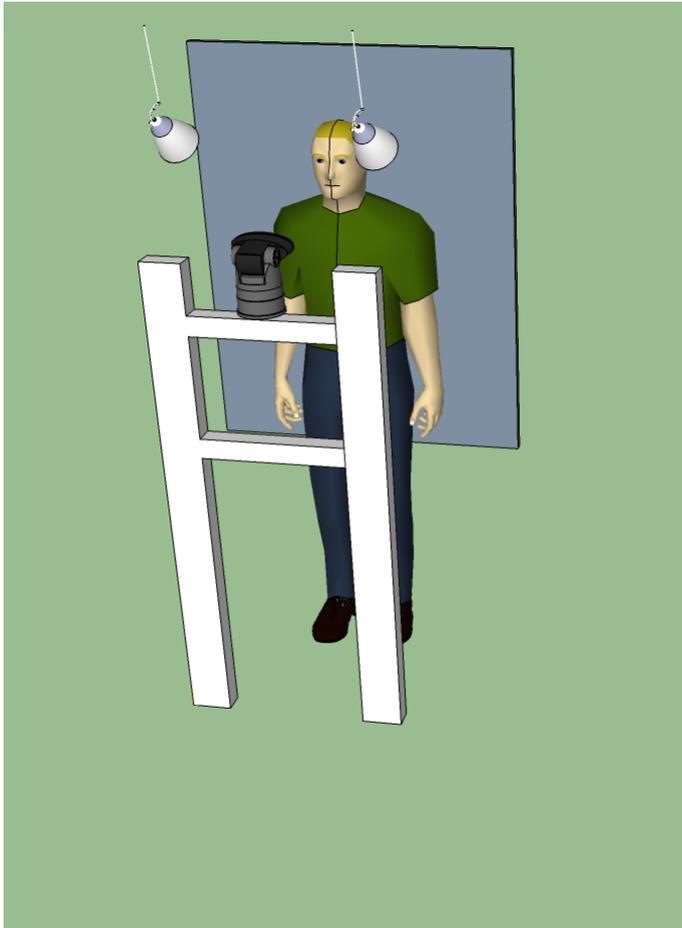
- NIST conducted a fingerprint collection usability study (NISTIR 7403, 2007)
- Interesting findings
 - With only poster training, only 56% of population was able to complete enrollment
 - Operator assistance allowed 98% successful enrollment
 - Range of 30 -64 seconds for fingerprint capture
 - There is a bias for hand order

Fingerprint Usability



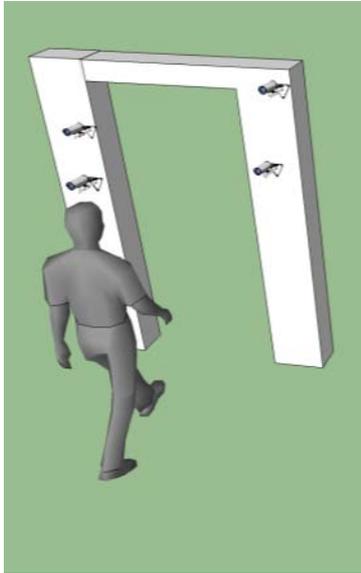
- How much does height affect fingerprint collection?
- What is the best range of height for collection?
- Does a two-tier collection system support better performance than a single height?
- What is the throughput impact of an adjustable collection platform?

Facial Usability



- How significant is pose variance across as a range of heights?
- Which visual cues are effective?
- How does visual cue effectiveness vary across population ages?
- How does lighting variation affect match performance or failure to enroll?
- Are backgrounds relevant to match performance or face-finding algorithms?

Iris Usability - Portal



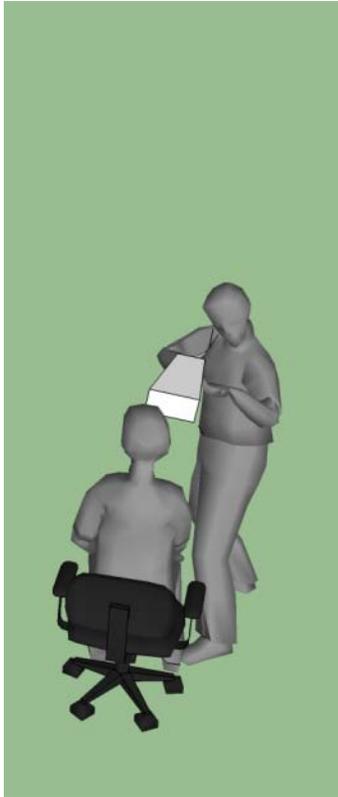
- What range of heights can be accommodated by an iris portal?
- How many cameras are required?
- What effect does lighting have on remote iris capture?
- What is the walking speed range appropriate for iris capture?
- What throughput can be achieved?
- What visual cues are effective for an iris portal?

Iris Usability - Handheld



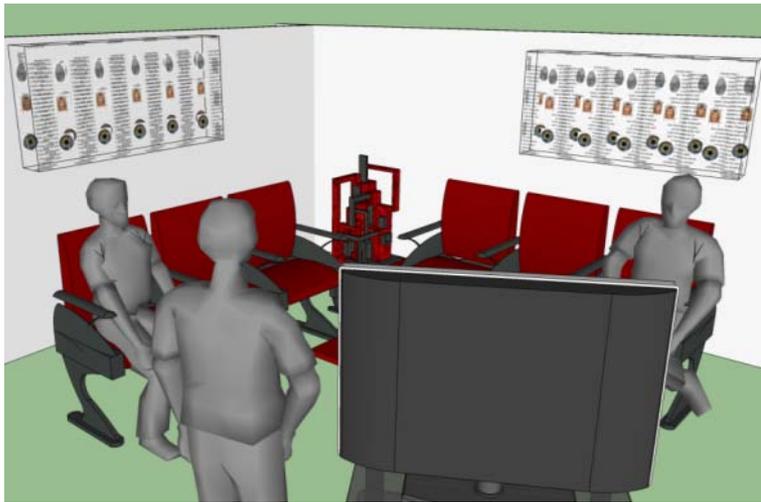
- How does the speed of capture change as a function of operator fatigue?
- What is the throughput of a handheld iris camera system?
- How does operator experience affect throughput and quality?
- What visual cues are appropriate for the subjects?
- How does lighting affect quality?
- Which subjects have difficulty holding still for the camera?

Iris Usability - Affixed



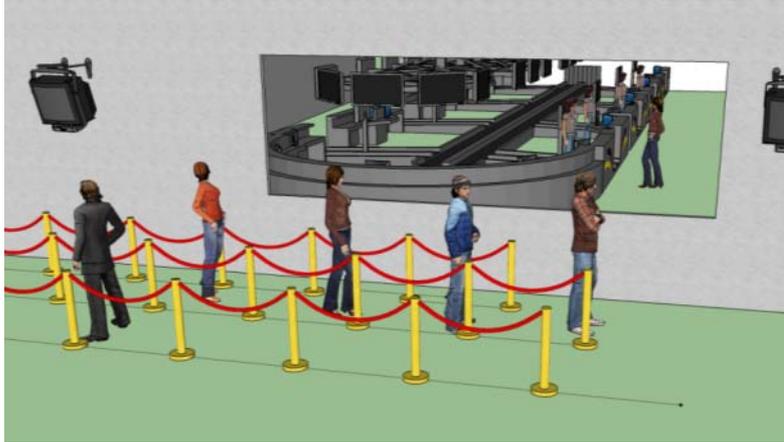
- What is the throughput of a head-affixed camera solution?
- What mechanisms are appropriate for subject training and familiarization?
- Does having the subject seated vs. standing affect quality?

User Staging



- Which is more effective at providing station familiarity and comfort: Posters, video, or human instruction?
- Which is more effective at delivering training and activity at a station: Posters, video, or human instruction?
- Does subject instruction of any kind have a significant impact on biometric quality?
- What is the optimal amount of instruction to provide a subject?
- How does providing practice equipment assist in subject familiarization?
- To what extent does instruction need to be tuned to a particular culture?

Queue Management



- Do queues above a certain length start to degrade biometric quality (e.g. from impatience on the part of enrollers or enrollees)?
- What training mechanisms work best for queues?
- What are the minimum and maximum thresholds for the amount of training material exposure in a queue in regards to their effectiveness?
- To what extent does allowing enrollees to view the actual operation in practice aid or hinder quality and/or throughput?
- Given a staffing level and average throughput, what is a typical queue length?
- What is the optimal trade-off between staffing levels, staffing fatigue, and queue length?

Implementation

- Any described piece could provide valuable insight as a standalone test station
- Instrumentation is key
 - Video
 - Timing
 - System-level
- Full lab would provide useful system-of-systems level detail

Summary

- Biometrics is a critical field for security, but still immature in practice
 - Match performance is well understood, but most other aspects are not
- Usability has a key impact on system performance, typically overlooked
- A usability lab can be constructed that would provide key insight into the effectiveness of systems and design trade-offs