Testing Iris and Face Recognition in a Personnel Identification Application

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15 February 2002

Background

- Personnel/Visitor Identification at DoD Labs & Technology Centers
- Security of DoD Centers a priority
  - Web-based enrollment
  - Establish central repository of identification data
  - Biometric authentication
  - Integration with the security processes
  - Post-visit reporting
  - Conduct a biometrics pilot study

Pilot Study Objectives

- Demonstrate medium-scale personnel/visitor tracking capabilities using biometrics
  - Scalability to enterprise level
  - Level of intrusiveness
  - Long term stability
- Demonstrate web-based approach
- Provide site for review & demonstration for decision-makers
- Assessment of user interactions & reactions
- Fast-track procurement (near COTS)
- Iris and face recognition selected for study

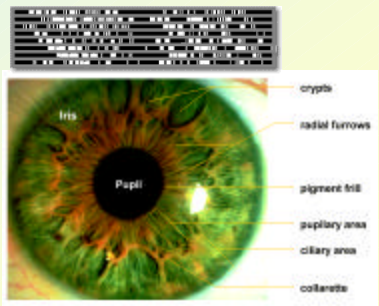
Army Research Laboratory - Adelphi selected to be demo site for the Personnel Identification Pilot Study (PIPS)

PIPS Technologies

- Study conducted in two phases
- Phase 1 - Iris recognition (Oct 2000 – April 2001)
  - Extremely low false accept rate allows one-to-many identification
  - Difficult to deceive
  - Biometric sample can be acquired even with protective clothing
- Phase 2 - Face recognition (July – October 2001)
  - Biometric samples widely available even for non-cooperative subjects (mug shots)
  - Useful in “watch list” applications

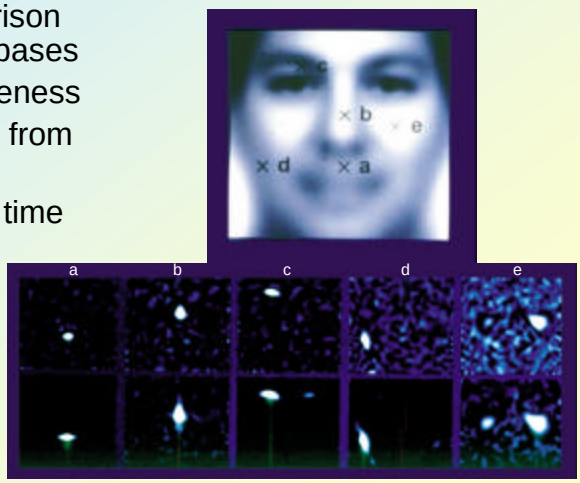
Phase 1 - Iris Imaging

- Technology with the lowest error rates
- Ability to handle large database searches
- Iridian is the technology developer
- Manufacturer specs: False accept error rate as low as 10^{-6} but false reject error rate is scenario dependent (e.g. eyeglasses, user experience)



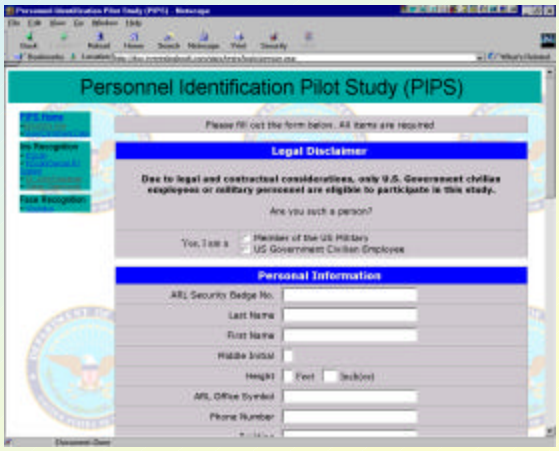
Phase 2 - Face Recognition

- Visionics FaceIt
- Potential for comparison with disparate data bases
- Low level of intrusiveness
- Face characteristics from video image
- Enrollment, capture time near instantaneous
- Identification mode issues
- Error rate:
  - 0.7% - 25%



Pre-Enrollment System

- Improve front end of process
  - Employee/visitor fills in web-based form
  - Sponsor & security automatically informed
  - Accessible from any computer on the ARL intranet



Enrollment System

- Easy operation
  - Keyed on ARL badge
  - Pre-enrollment verification
  - Enrollment (both eyes & face)
  - Controls for operator
- Webcam photo
- Enrollment process takes about 5 minutes

PIPS System

Registration Kiosks

- Two stand-alone systems - do not require operator
- Located in high-traffic areas
- Operation initiated by user's security badge
- Image both eyes and/or face, pluswebcam photo each time
- Instant photo badge produced

Registration (Iris & Face)

System Performance

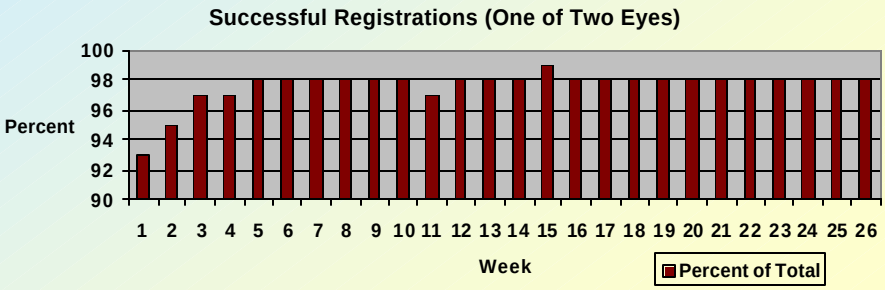
- Reliability (software & hardware)
  - Variety of hardware glitches and software bugs at beginning
  - Face algorithms required “tweaking” during first half of Phase 2
  - Almost all problems fixed; others have work-arounds
- Operator training
  - Enrollment system has user-friendly graphical interface
  - Training easy and painless
- Failures
  - Most failures at beginning of study were software-related
  - Typical mechanical failures (printer jams, etc)
- Downtime
  - During first week, system down time about 5%
  - Current system availability >99%
  - System needs rebooting about once a week (15 minutes)

Phase 1 Results

- Iris recognition (Phase 1) complete
  - Operational for 26 weeks
  - 258 participants
  - 186,918 eye identification attempts (93,459 registrations)
  - Performance below expectations (>99.5% from vendor)
    - 6% false reject rate (2% either eye)
    - 2 potential false accepts
    - Glare & reflections appear to be primary culprits
    - User settling & distraction are also contributors
- Lessons learned
  - Legal (Privacy Act) issues
  - Accommodating disabled users

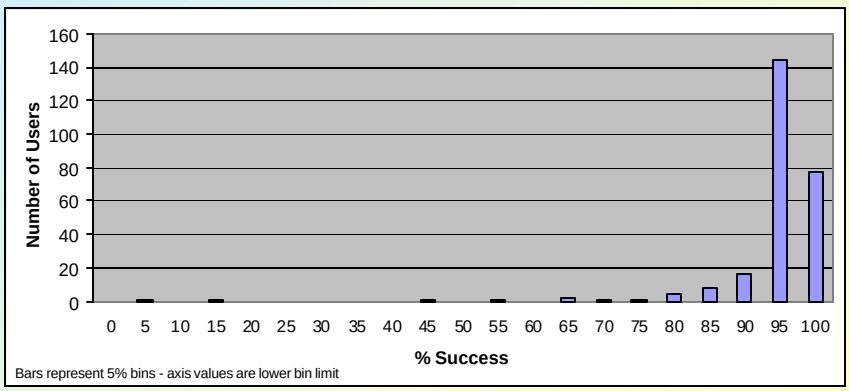
Phase 1 Results
Error Rate Over Time

- 2 week learning curve
- 30% improvement due to increase in eye acquisition time from 10 sec to 15 sec (week 5)
- Current error rate stable at 6-7%
- Error rate drops to 1-2% if one out of two eyes accepted as pass criteria



Phase 1 Results
User Success Rates (Either Eye)

- Vast majority of users at 95% or better
- A few problem users

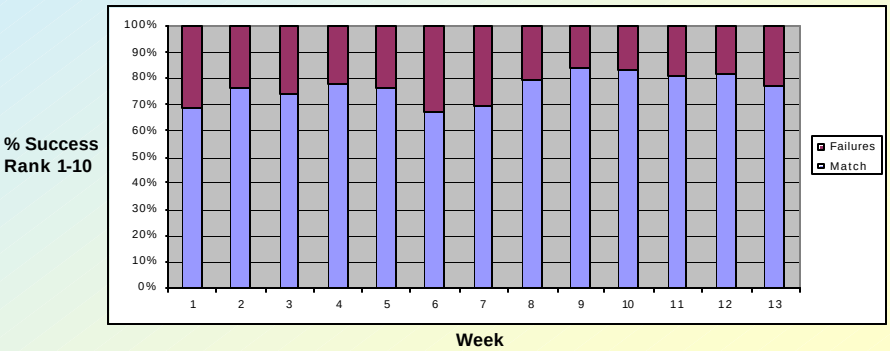


Phase 2 Results

- Face recognition (Phase 2) complete
  - Operational for 13 weeks
  - Software locked for last 6 weeks of study
  - 270 participants
  - 42,270 face identification attempts
  - Performance below expectations (0.7-25% from vendor)
    - 51% correct identification (Rank 1)
    - 81% in "Top 10" (Ranks 1-10)
    - Primary performance issues:
      - Software improvements - face alignment, camera selection
      - User behavior - lack of operator to monitor/assist
      - Inadequate lighting
- Lessons learned
  - Potential for "watch list" use in manned applications
  - Custom PIPS face recognition application not sufficiently accurate for unmanned one-to-many identification, since it was not designed as such

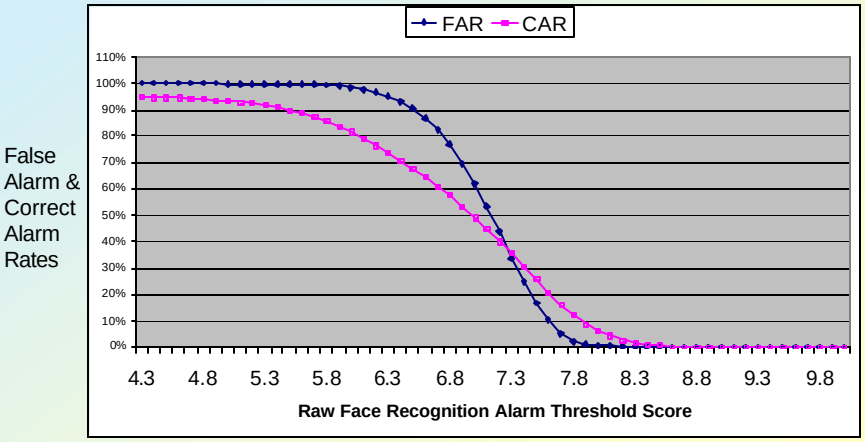
Phase 2 Results
Successful Matches by Week

- "Top 10" success rate about 76% before improvements
- Improved to 81% after software mods
  - Improved face alignment in enrollment templates
  - Improved camera selection algorithm (low/high for short/tall users)



Phase 2 Results
False Alarm and Correct Alarm Rates

- FAR, CAR curves cross at about 35% - “Equal FAR/CAR”
- Based on data from 23-day period (3-25 Sept 01)



User Experiences

- Training
  - 2 minute demo + written instructions
  - Most users catch on quickly; a few do not
- User questionnaire – Iris
  - Only 48 responses out of 214 regular users
  - 81% felt comfortable using system
  - But 31% expressed concern over long-term effect on eyes
  - 60% felt system took too long
- User questionnaire – Face
  - 137 responses - due to incentive
  - 84% comfortable with system
  - Only 2% concerned with safety
  - 34% thought system was not reliable
- A few employees refused to participate
  - Doubts about safety
  - Think collected data may be misused

Summary

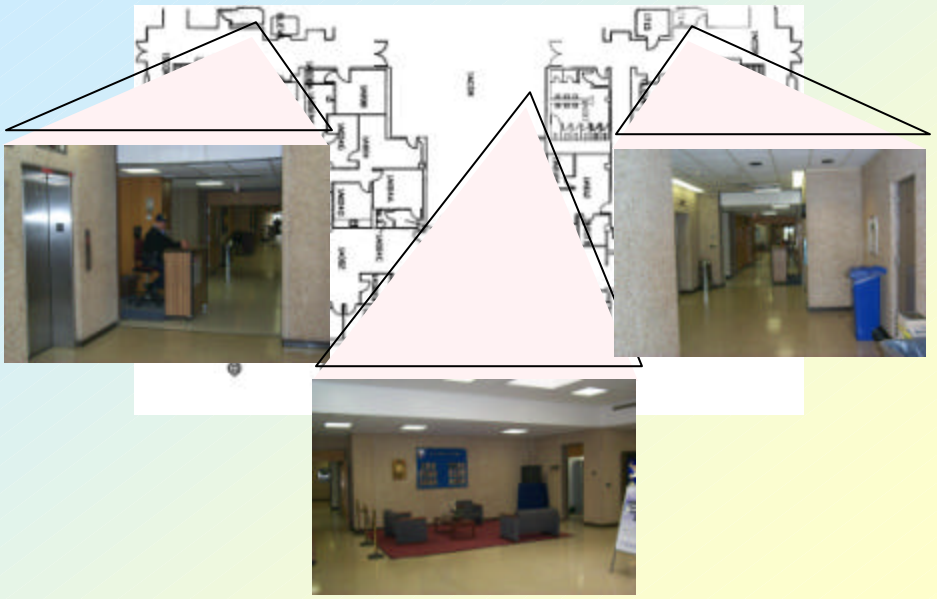
- Iris recognition phase completed in April 2001
  - System Performance
  - User experience – Most users very positive
  - Operator Training - minimal required; user friendly interface
  - Technology is very accurate & viable for facility access
- Face recognition phase completed in October 2001
  - Performance adequate for manned “watch list” application
  - Resolve software performance, lighting issues
  - Continued refinement of method used
- Next steps
  - Scalable architecture
  - Preliminary evaluation of Oki iris system
  - Network security
  - Transition technology to the Biometrics Management Office

BACKUP

Process

- Pre-enrollment (once)
  - Employee fills in web-based form
  - Accessible from any computer on the ARL intranet
- Enrollment (once)
  - Employee proceeds to ARL lobby to enroll
  - Employee badge brings up pre-enrollment record
  - Operator guides employee thru enrollment process
  - Requires about 5 minutes
  - Training & addressing safety questions can double time
- Registration (many, many times)
  - Employee stops at kiosk on each pass thru elevator lobby
  - Employee badge starts registration attempt
  - Biometric system attempts to identify user once for each eye
  - Requires about 5-10 seconds per eye
  - Employee can request printed badge “receipt”

ARL Adelphi Lobby

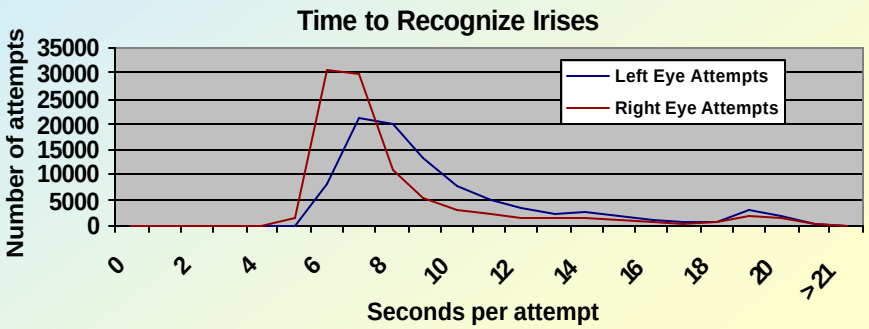


PIPS Progress Report

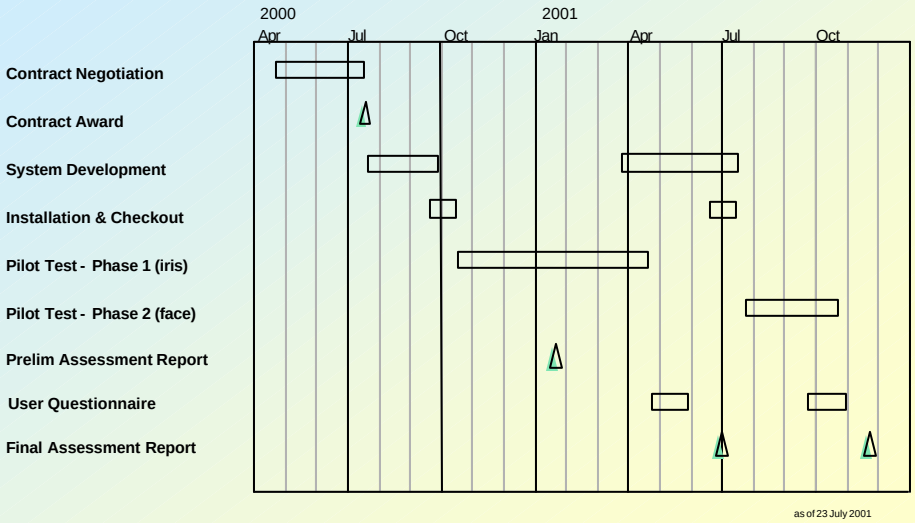
- Phase 1
  - contract awarded 18 July 2000
  - Prime - UNISYS
  - Sub - Iridian
  - Web based enrollment, Iris recognition, webcam & badge printer
  - Started 17 Oct 2000
  - Demonstration to Biometrics Management Office, GEN Coburn (CG AMC), LTG Cuviello (Army DISC4), Bill Leonard, Jeff Gaynor & Toby Sullivan (ASD-C3I), Ms. Roth (USD(P)), Paul Pittelli (NSA), & Dr. Etter
- Phase 2 (joint OSD/NSA sponsorship)
  - Adds face recognition
  - Contract awarded 20 Mar 2001
  - Enrollment started 26 June 2001
  - Study started 23 July 2001

Phase 1 Results
Registration Times

- Left (first) eye takes longer
- Left eye has higher error rate
- Primary cause - users not yet “settled”



Pilot Demo Schedule

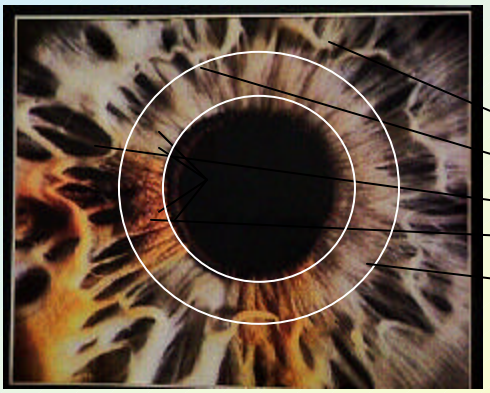


Biometric Terms

- *Enrollment*: A sample of the biometric trait is taken, processed by a computer, and stored
- *Identification mode (or "one-to-many")* Biometric system identifies a person from the entire enrolled population by searching a database for a match
- *Verification mode (or "one-to-one")* Biometric system matches a person's claimed identity to enrolled pattern
- *False Match Rate* Percentage of impostors wrongly matched
- *False Non-Match Rate* Percentage of valid users wrongly rejected
- *Equal Error Rate (EER)* The false match rate equals the false non-match rate

Iris is rich in features

- Robust biometric

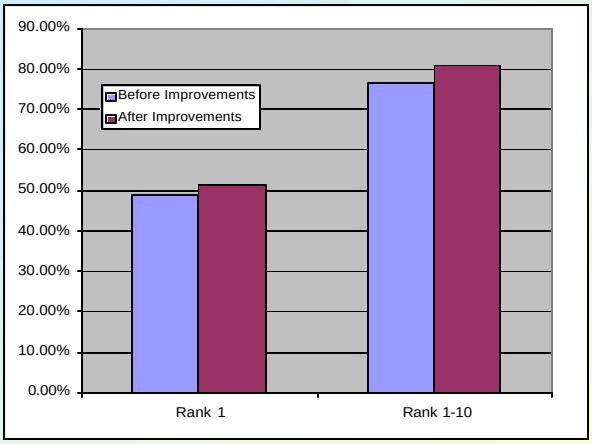


256 characteristics identified

On-Site Pilot Study Procedures

- Enrollment system installed in main lobby
- Registration units installed at ARL -Adelphi lobby entrances
- System operated and monitored by security personnel
- Volunteer ARL employees
- Three-step process
  - Pre-enroll – one time, from any web browser
  - Enroll – one time, in main lobby
  - Register – many times, at lobby entrances

Phase 2 Results
Successful Matches



- Software improvements increased performance by 3-4%
- 51% successfully matched at Rank 1
- 81% matched at Ranks 1-10 (“Top 10”)