ENHANCING THE USABILITY OF THE HUMAN MACHINE INTERFACE

HANDHELD INTERAGENCY
IDENTITY DETECTION EQUIPMENT (HIIDE)

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Agenda

- HIIDE 4
  - System Analysis
    - Purpose
    - Functions
    - HMI Factors
  - Task Analysis
    - Task Deficiencies & Proposed Redesigns

- HIIDE 5
  - System Analysis
    - Relevant Modifications

- Conclusions and Process

HIIDE 4 System Analysis

HIIDE 4 System Analysis - Purpose

- Handheld multimodal biometric device
  - Collection & matching of iris and fingerprint biometrics
  - Collection of face biometrics & document information and images

- Deployed by the Department of Defense in the war zone
  - Fix the identity of unknown individuals (assist in friend/foe decision)
  - Packaging requirements (size, weight, battery life, etc)

HIIDE 4 System Analysis - Functions

- Enrollment
  - Collects fingerprint, face, iris and document (biographic information)
  - Creates new record with unique id
  - Stored according to EBTS standard and including timestamp

- Match
  - Collect fingerprint and iris information
  - Match local watchlist, result conveyed in red/green alert
  - No record match result allows for enroll
  - Record kept of all matches

- Upload/Download
  - Uses laptop docking station
  - Synch with authoritative database

HIIDE 4 System Analysis – HMI Factors

- Device Form Factor
  - Tactical device
  - Light weight, small (fit in BDU)
  - Two hands required for operation

- Quality Control of Biometric Capture
  - Controlled by user
  - Awkward subject positioning
  - Untrained user, harsh environment
  - Ability to override quality requirements

- Biographical Data Entry
  - 3x2 inch touch screen + stylus to enter tasks and data
  - Alternate approach is offline through laptop docking station

Two Motivations in Design:
- **Military**
- **Biometrics**

Data

- Type
  - First hand knowledge and observation of training and novice interaction
  - Data collected on novice, moderate and experienced users

- Collection
  - Observation
    - Training courses
    - Demonstrations
  - Unstructured interviews
    - Discussions with operators returning from field
    - Discussions with trainers
  - Personal experience
    - Biometric expertise
    - Training instructor

Human Functions

- HIIDE Function Decision
  - Provides the function direction to the device (enrollment, matching or upload/download)
  - Controls the transitions between each function

- Decision Processing
  - Process the match decision by considering the quality of the match and the contextual information

Human Functions (cont.)

- Data Collection
    - Essential to the accuracy of biometric matching
    - Position the subject and the device to capture a high quality face, iris or fingerprint image

- Acceptable Quality Determination
    - Provides quality decision for face, fingerprint or iris image to be stored/matched
    - Override poor quality indicators

- Data Entry
    - Enter the biographic and contextual encounter information
    - Essential information for most utility from device

# Deficiencies for Redesign Consideration

- Decrease of Sequential Tasking

- Capturing High Quality Biometric Data

- Reduce Collection Errors from Mislabeled Data

- Modify Device Form Factor

Decrease of Sequential Tasking

- Tug/Pull
  - Biometrics – I need a lot of data
  - Military – I need to do this quickly

- Deficiency
  - Tasks completed in high stress environment
  - Many repetitive tasks
  - Difficult to complete on 3x3 touch screen with stylus & gloves

Decrease of Sequential Tasking (cont.)

- Proposed redesign
  - Audio recording for contextual information to be entered at docking station
  - OCR of identity document data
  - Addressed via software and hardware modifications


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┌──────────────┐      ┌──────────────┐      ┌──────────────────────┐
│  Biometric   │ ──►  │     OCR      │ ──►  │ Enrollment Information│
│  Algorithm   │      │  Algorithm   │      │    Automatically      │
│              │      │              │      │     Populated         │
└──────────────┘      └──────────────┘      └──────────────────────┘
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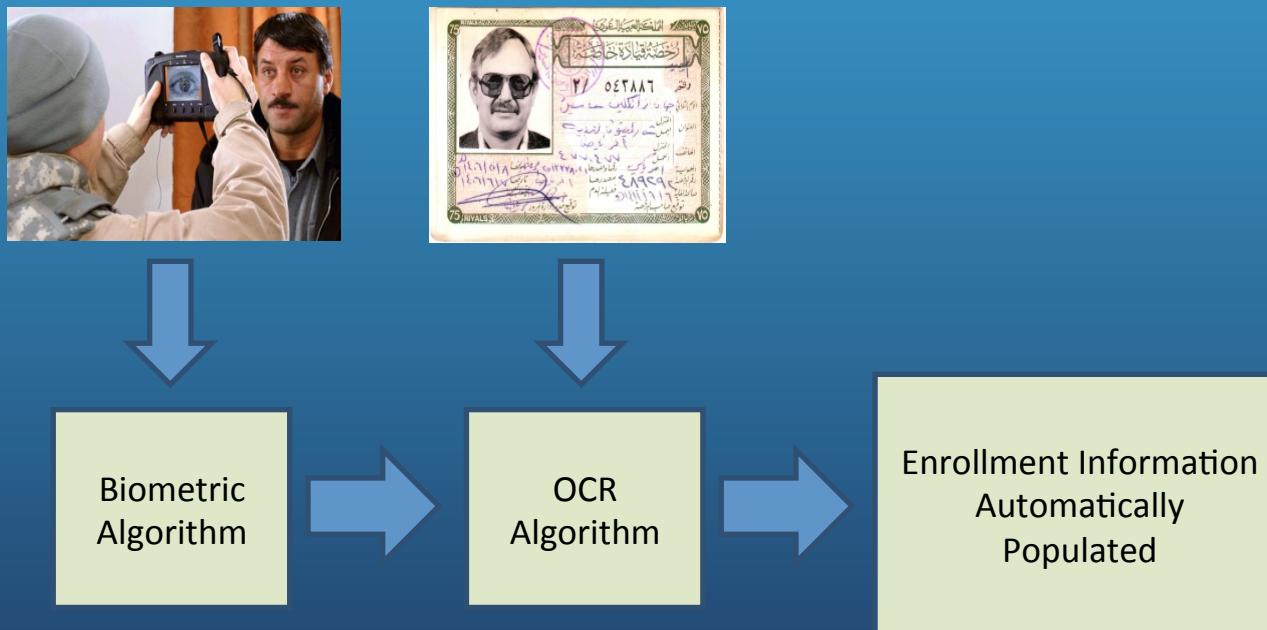
Capturing High Quality Biometric Data

- **Tug/Pull**
  - **Biometrics – I need good data**
  - **Military – I need to do this easily**

- **Deficiency**
  - Capturing high quality data requires a patient and well-trained operator
  - Poor quality data leads to 'Garbage in, Garbage out'

Capturing High Quality Biometric Data (cont.)

- **Proposed Redesign**
  - Remove quality control from hands of user
  - Allow device software to collect video stream of face, iris or document
    - Analyze each frame (or every n^{th} frame) and generate a quality score.
    - Top quality Image used for matching or stored for enrollment
    - The operator is notified when an image of sufficient quality is obtained,
      - Retry using video streams
      - Use default manual process
  - Addressed by a software modification.

Reduce Collection Errors from Mislabeled Data

- Tug/Pull
  - Biometrics – I need accurate data
  - Military - I need to put this in the hands of people who it will help most, in the field.

- Deficiency
  - Collection errors often occur due to incorrect collection of fingers or irises (subject's or operator's right)
  - Significant implications in binning applications

Reduce Collection Errors from Mislabeled Data (cont.)

- Proposed redesign
  - Fingerprint redesign through multi-finger collection
  - Iris redesign through multi-eye collection
  - Requires software and hardware modifications

Modify Device Form Factor

- Tug/Pull
  - Biometrics – I have complicated sensors, bound by the laws of physics, they need space in order to operate
  - Military – I need it small and easy to use

- Deficiency
  - Bulky and heavy design difficult to collect high quality images
  - Two handed design difficult in war zone environments

Modify Device Form Factor

- Proposed Redesign
  - Leverage developments in cell phone industry
    - Small, cheap, compact, high quality lenses and sensors
    - Gyroscopes for position awareness and device reversal
  - One handed use
    - Re-balance device for one-handed operation

HIIDE 5 System Analysis - Purpose

- Modifications
    - Largely the same
    - Slight Departures from HIIDE 4 System Purpose:
    - Removal of Identification
        - Performed as a part of Enrollment function
    - Renewed Emphasis on 'cross-matching' biometrics

HIIDE 5 System Analysis - Functions

- Enrollment
  - Descriptive Images
  - Collection of multiple iris
  - Collection of multiple fingerprint

- Match
  - Biometric match removed as a standalone function
  - Biographic match only
    - Relies on proper spelling
    - Truthful responses

- Upload/Download
  - Unchanged
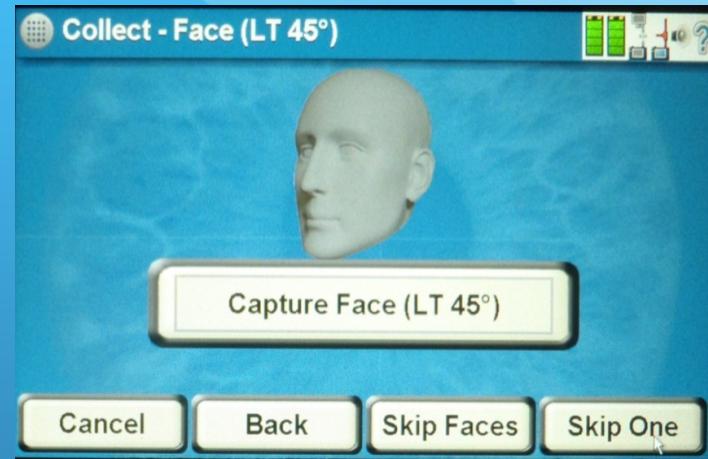
HIIDE 5 System Analysis – HMI Factors

- Device Form Factor
  - Threefold increase in size
  - Fourfold increase in weight

- Quality Control of Biometric Capture
  - Optical fingerprint scanner
    - Multiple collections
    - More prone to errors in harsh light
  - Dual iris camera
    - Independent Autofocus
    - Quality indicator removed

- Biographical Data Entry
  - Drop down menus
  - Ability to capture documentation
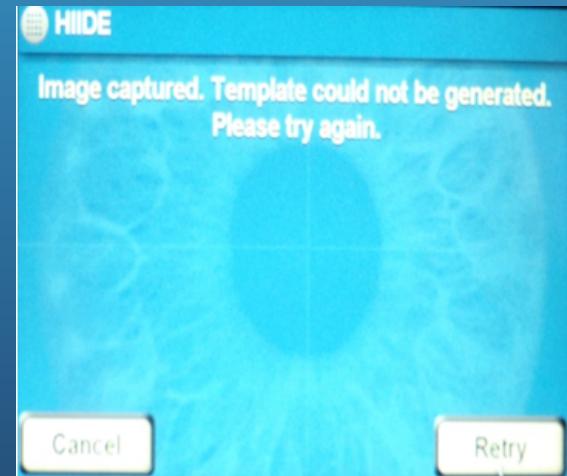
Process and Conclusions

Systems Engineering Process
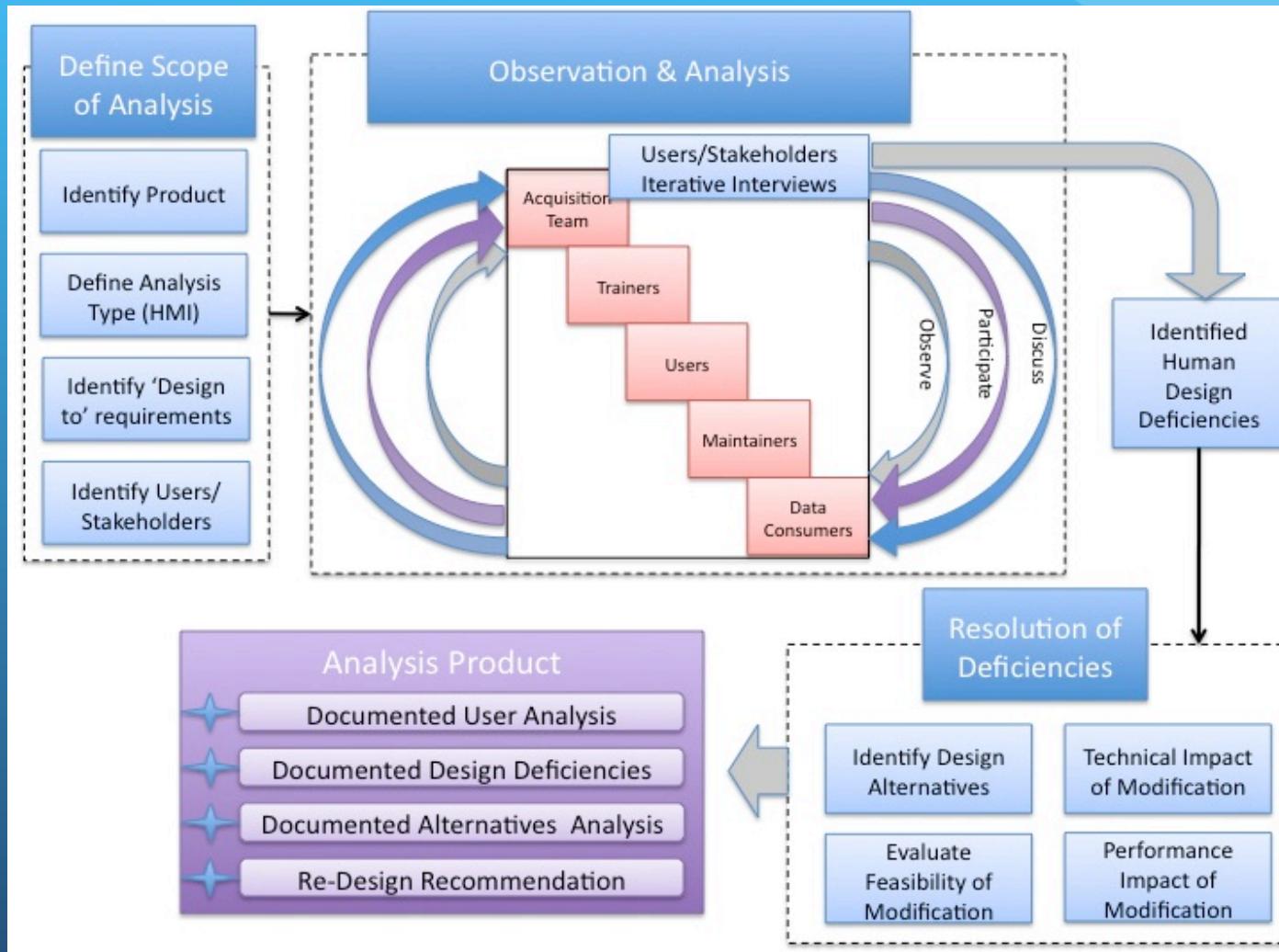
Conclusions

- Biometrics serve as an enabling technology in the war zone

- Usability should be considered to improve device and biometric system performance

- Identify design conflicts (Military Application vs. Biometric Application)

- Must examine the tradeoffs between system elements early in the design process.

- Will result in INCREASED PERFORMANCE from both a Biometric and Military perspective.

- Features of HIIDE 5 address some of these concerns.

Questions?

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