

# Engineering Calibrated Biometrics Systems

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Army-Contract MOIE

The logo for the MITRE Technology Program, featuring a stylized graphic of stacked blocks in yellow, orange, and blue to the left of the text.

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The MITRE logo, consisting of the word "MITRE" in a bold, black, sans-serif font inside a white rectangular box.

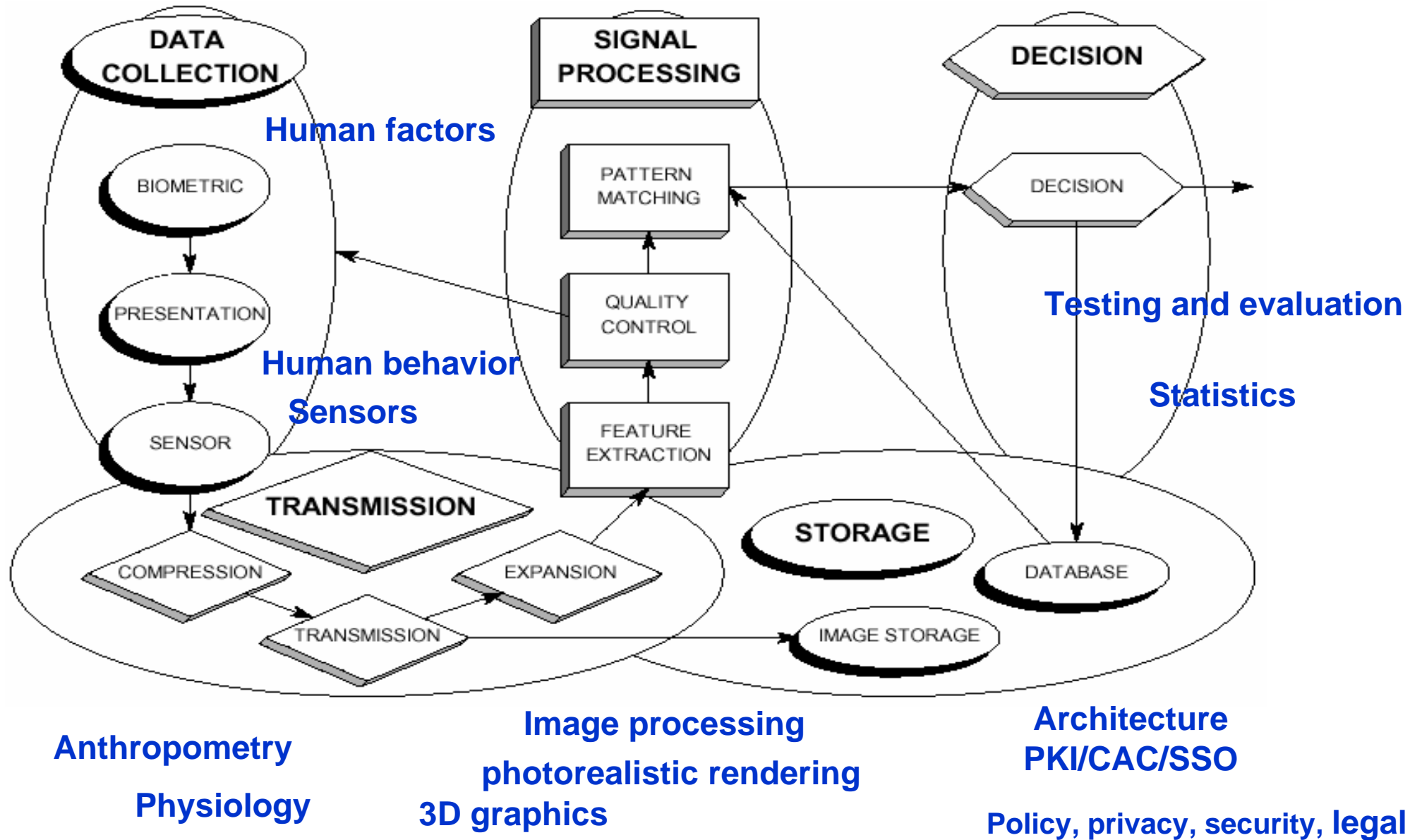
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# Problem

- **Performance gap between technology tests and fielded systems**
  - Integration into exiting processes and systems (e.g., isolated watch list systems)
  - Environmental factors, quality, data interchange
  - Accounting for human behavior and operational controls (intent and tactical variances)
- **Systems level performance predictions are desired**
  - Bayesian models
    - Human intent and sensor performance
    - Alternate explanations
    - Prior probabilities
- **Systems level engineering method is desired**  
*(assume security policy in effect)*
  - Determine system boundaries
  - Define physical environment (e.g., room, facility, vicinity)
  - Sensor model development
  - Define assessment software, all {Sensor-Software-Application}-tuples
  - List infrastructure needs
  - Define collection, alerts, and reporting plans

# Background (systems)



# Objective

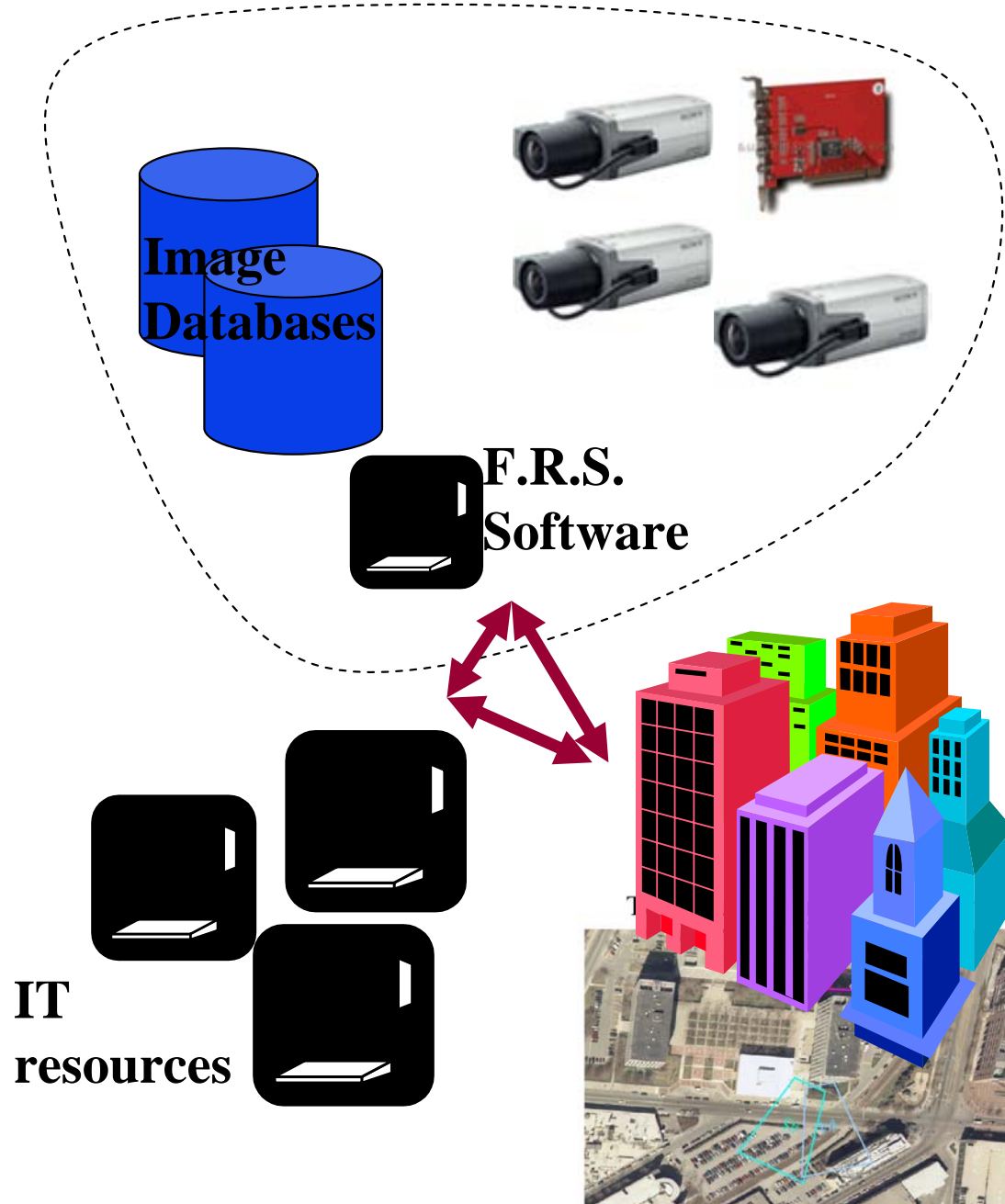
- **Overall:** To explore scenarios for authentication, identification, and detection of furtive behavior using a predictive model in conjunction with an actual sensor environment
  - Understand the appropriate uses of biometrics per environment and mission
  - Identify integration and interoperability issues for data, scoring, decisions, alarm management, and reporting
  - Perform targeted studies into major performance factors that compromise system robustness
- **Current Fiscal Year Objectives:**
  - Biometrics laboratory
  - Systems taxonomy
  - Use synthetic 3D face models to augment and extend biometric test methodology (FERET)

# Activities

| Problem   | Proposed Solution/Goal   | MOIE progress toward goal  | MOIE Products ( <i>Tech Transfer</i> )  |
|---|--|--|---|
| Realistic testing, reflecting real world variances and operational difference | Synthetic data generation                                      | 3 targeted FaceGen experiments<br>(Papers, Demo)                                   | Papers documenting approach and experimental results<br><br>2 papers released, 1 published (ACM), 3 in draft      |
| System level performance predictions  | Bayes nets for performance modeling                            | Developed nets for several lab & hypothetical systems, informal prediction testing | Paper articulating approach w/ Demo ( <i>ITIC tradeoff study; CAASD, CEM requests to brief to DHS sponsors.</i> ) |
| System level engineering method   | System component representations that 'feed' performance model | Examined Sensor modeling UML and system taxonomy                                   | Paper articulating framework<br><br><b>MITRE</b>  |

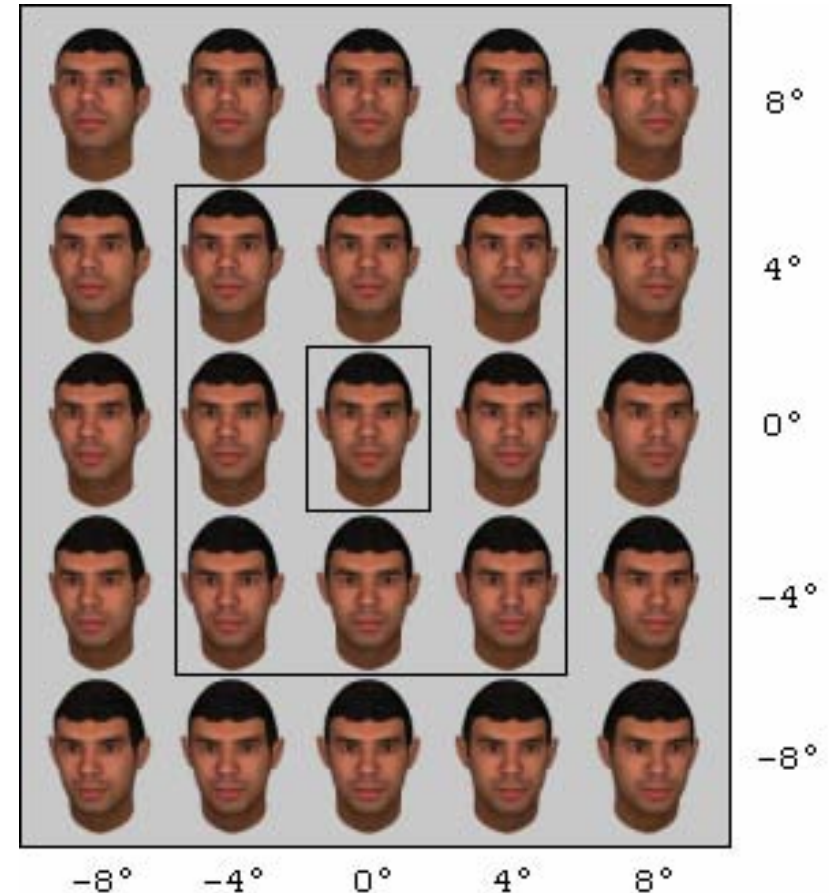
# Highlight (taxonomy)

- **Illustrative Example:** Face Recognition System
- **Elements of Face Recognition System (f.r.s.):**
  - Sensors for Image Capture
    - E.g., camera(s)
  - Software pertinent to sensor functioning
  - Software application program
    - Contains heuristics/algorithms for face matching
  - Database of Images to match
- The f.r.s. will be situated in a physical environment
- The f.r.s. will likely use infrastructure resources:
  - Network resources
  - IT resources



# Highlight (face testing)

- Use synthetic imagery to control all variation except what we wish to test
  - Data gathering not practical in real world
- Construct 25 enrollments for each of 100 subjects by varying pose angles
  - Frontal only class
  - Frontal and  $\pm 4^\circ$  poses
  - Frontal,  $\pm 4^\circ$ , and  $\pm 8^\circ$  poses
  - Up to 2,500 enrollments
- Create probe (match and imposter) imagery to exercise system
  - Poses don't coincide with enrollments
  - 14,400 matching probes
  - 14,400 imposter probes (new subjects)
- Evaluate operational use scenarios
  - Watch list template selection
  - Performance impacts, conditions



# Impacts

## ■ Collaboration & Coordination with related projects

- US-Visit (Biometrics, Standards, and MRTDs)
- Perceptive Assistive Agents
- DoD Biometrics Management Office (R. White)
- ITIC Biometrics

## ■ Papers

- (FY03) “Parametrically Controlled Synthetic Imagery Experimentation for Facial Recognition”, FY03
- (FY03) “Effects of Eye Position on Eigenface-based Face Recognition Scoring”, FY03
- (FY04) A Systems-Oriented View of Biometrics Capabilities in Monitoring/Security Systems, draft as of Feb 2004
- (FY04) Improving Face Recognition Watch List Performance with Template Diversity, March 2004
- (FY04) Survey of Synthetic Biometric (accepted for publication at IC-IA’04)

## ■ Biometrics Community, Industry and standards

- Worked directly with NIST and Aerospace Corp.
- FR companies (Viisage, others), M1 standards (DHS) **MITRE**

# Future Plans

- **Biometrics Laboratory**
  - Initiate validation of biometrics systems taxonomy (basic machine vision techniques)
  - Extend sensor coverage (add complexity)
  - Relate performance models to systems models
- **Targeted Face Recognition Experimentation**
  - Complete planned experiments, generate additional test data per request
  - Support and technology transfer techniques to interested sponsors
- **Knowledge Management Efforts (continued)**
  - Internal:
    - Biometrics site <http://biometrics.mitre.org>
    - Biometrics mailing list
    - Initiated Biometrics speaker series
    - Coordination and collaborated with sponsor work
  - External:
    - Three Papers for peer-review or publication