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"Face Recognition Technology Today"

before the

NTIA Multi-Stakeholder Process To Develop Consumer Data Privacy Code of Conduct Concerning Facial Recognition Technology

February 25, 2014

Facial Recognition Applications in Use Today

Examples

- *Commercial*:
  - Employers for Time and Attendance Verification
  - Physical Access Control Security (Buildings)
  - Logical Access Control (Computer/Device Access)
  - Document Authentication

- *Government:*
  - Drivers Licenses to reduce duplication and fraud
  - Passport Verification
  - Jail Management Systems and Booking
  - Law Enforcement Investigations

- *Social/consumer:*
  - Photo Organizing Google's Picassa, Facebook
  - Smartphone and App Access Control

Defining Face Recognition

Computer Facial Recognition is the determination of an anonymous or unknown identity of a human being based on the facial characteristics and features derived from camera or digital photo

Methods: 1:1 Verify and 1:Many Search

Other Applications often called Facial Recognition ***but are not***:

- ***Face Detection*** - finding the FACES, not identifying who in the photo
- ***Gender Determination***
- ***Age Range Determination***

Face Recognition is based on Face Biometric Templates

Face Biometric Template is…

- Not the actual facial image
- A vector of numbers which represent the facial image's characteristics including measurements, color, lighting, 2D/3D
- Created by a Face Biometric Algorithm
- Not standard format and varies between different algorithms. Usually proprietary.
- Different for each photo even of the Same Person
- Not a match between two templates, only a degree of statistical closeness

Versus an Identifier

- Social Security No., Drivers License No., Passport No.
  - Binary match or no match
- Biometric Template (face, fingerprint, or iris) + Name and Meta Data together is an Identifier

Why wasn't Dzhokhar Tsarnaev identified by the Massachusetts Department of Motor Vehicles system from the video surveillance images?

DMV Face Recognition System

?

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Controlled Facial Photo

Today’s FR technology will reliably find this photo in a mugshot database of controlled facial images

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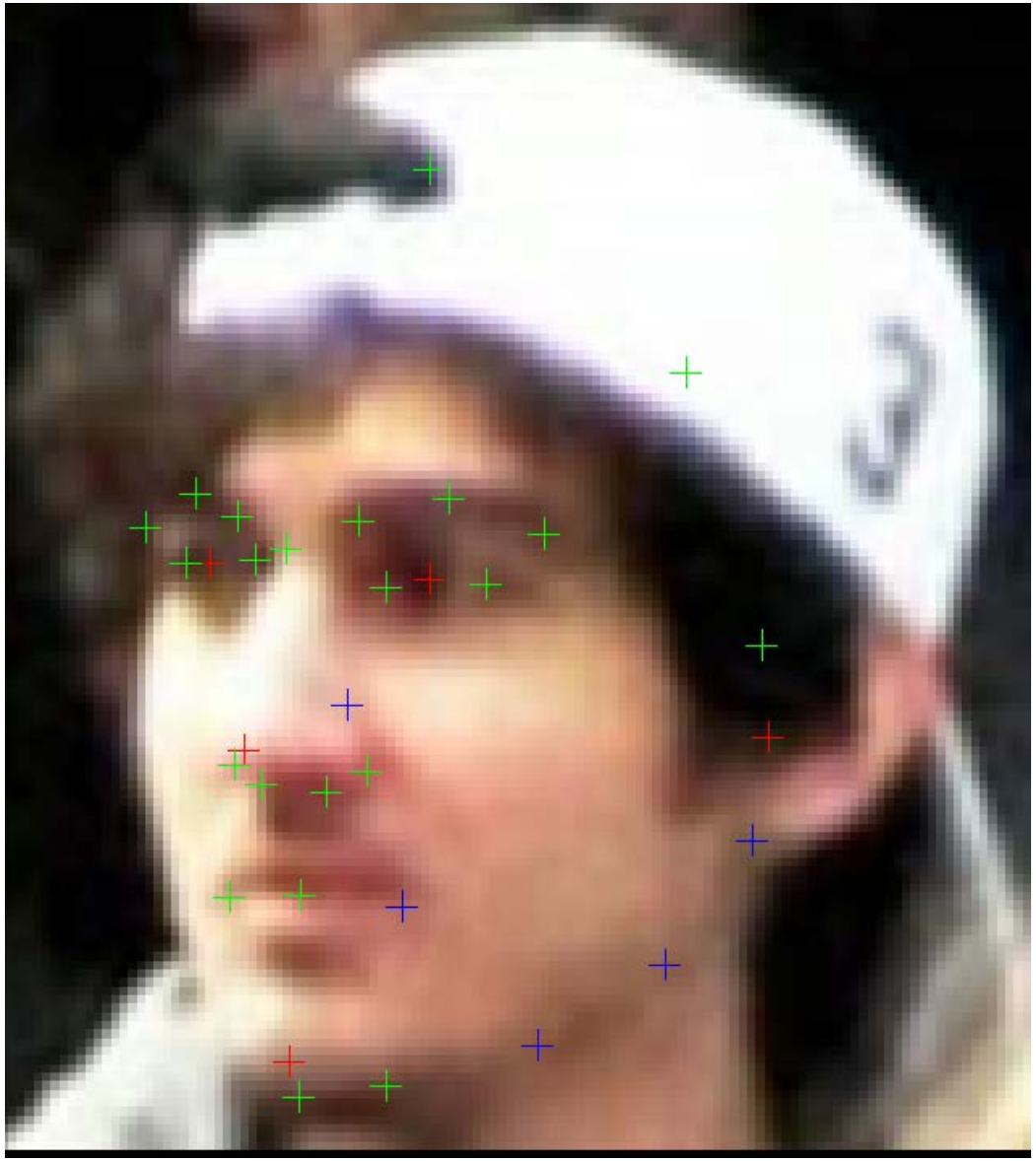
Confounding Variables in Uncontrolled Facial Photos



Problematic variables:

1. **Resolution (not enough pixels)**
2. **Facial Pose – angulated**
3. **Illumination**
4. **Occluded facial areas**

What happens:

- **Facial Feature Points (eyes, etc.) not found or distorted**
- **Algorithm Measurements in Error**
- **Not Enough Data to Process**

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Defining a Facial Recognition MATCH
Degree of Similarity

A statistical score between two face biometric templates

Based on a facial characteristics algorithm determines degrees of SIMILARITY or a Score

If the Score meets a certain threshold, then it is considered a Match

Thresholds are determined by the operating parameters required

Operating Parameters are defined by an acceptable error rate for the applications use

Defining Error Rates

False Accept: System claims a pair of pictures are a match, when they are actually pictures of different individuals.

False Accept Rate (FAR): Frequency that the system makes False Accepts

Example: FAR of 0.1% system will make 1 false accept for every 1000 imposter attempts

False Reject : System claims a pair of pictures are a mismatch, when they are actually pictures of the same individual

False Reject Rate (FRR): Frequency that the system makes False Rejects

ID Rate = 100% minus FRR

E.g.: FRR of 2% or Identification rate of 98% system will reject 2 matches for every 100 authorized attempts

As FAR is lowered, expect ID Rates to lower

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Error Rates in Practice

Operation implications

- Control ID Rate by selecting the FAR operating point
- Desire FAR to be as low as possible….. Minimize imposters
- If ID Rate is too low, then forcing the subject to try again, and again

No standards exist for "acceptable" error rates, or a rating system, meaning "success" is deemed different within every vendor product, and in every application purpose.

Useable Error Rates Vary by App

• App Examples	ID RATE	FAR
• Access Control Normal	90%	0.10%
• Access Control High Security	80%	0.01%
• Time and Attendance	85%	0.10%
• Drivers License/Passport Deduplication	97%	1.00%
• Mobile Phone Authentication	75%	0.20%
• Facebook Private Photo Search	75%	1.00%

Even mugshots will reduce id rates if not “controlled”

Mugshots are subject to control standards, the “Uncontrolled Face Use Standards ISO/IEC 19794-5 “for Enrollments.

Variables like lighting, glasses, background, slight pose, face proportion can cause errors.

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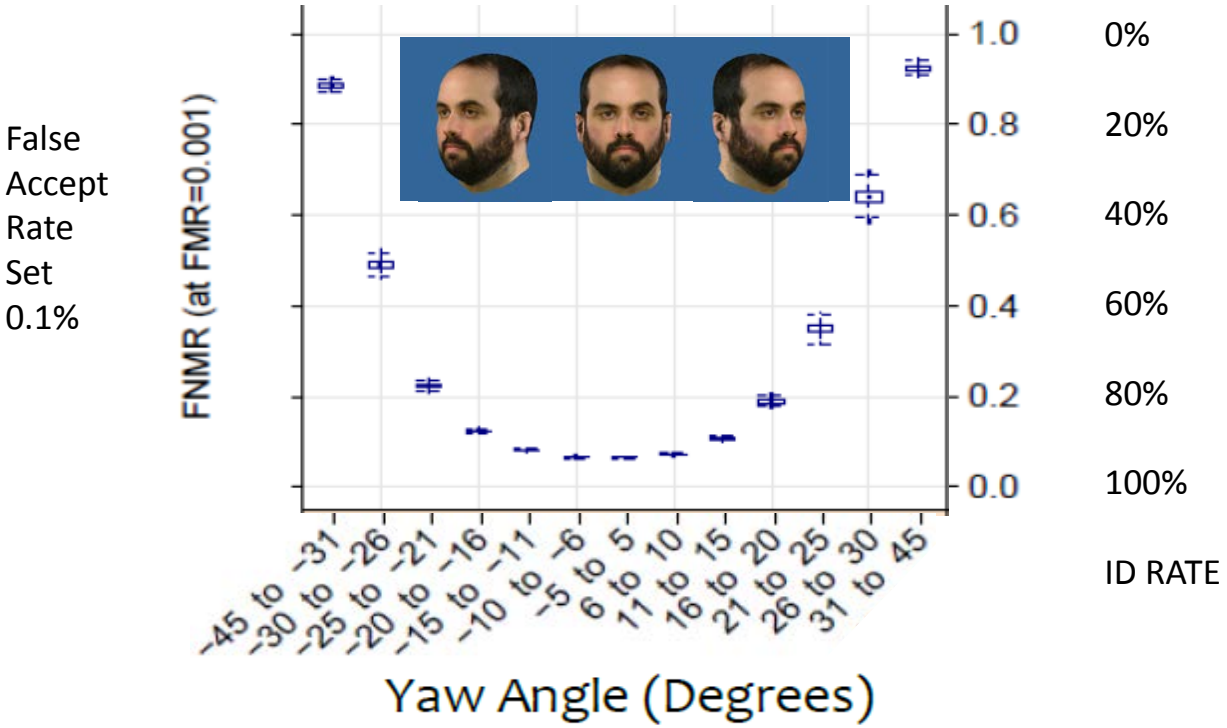
Uncontrolled Facial Imagery = High Error Rates

NIST Multiple-Biometric Evaluation (MBE) 2010

Dependence of accuracy on face yaw angle



False Accept Rate Set 0.1%

0%
20%
40%
60%
80%
100%

ID RATE

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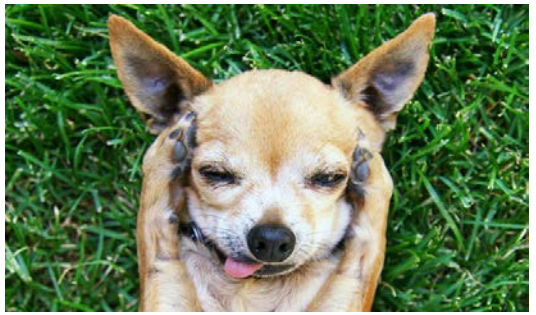
Can a controlled photo find a match **in LinkedIn?**















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LinkedIn Facial Search: Possible but dependent on the input photo and the database enrollment

- LinkedIn are Faces in the Wild
  - Assuming you can scoop all the faces for enrollment into a DB
  - Very low chances in matching

- ***Conjecture: If LinkedIn forced an IEC/ISO Mugshot standard then you'd have a searchable database***

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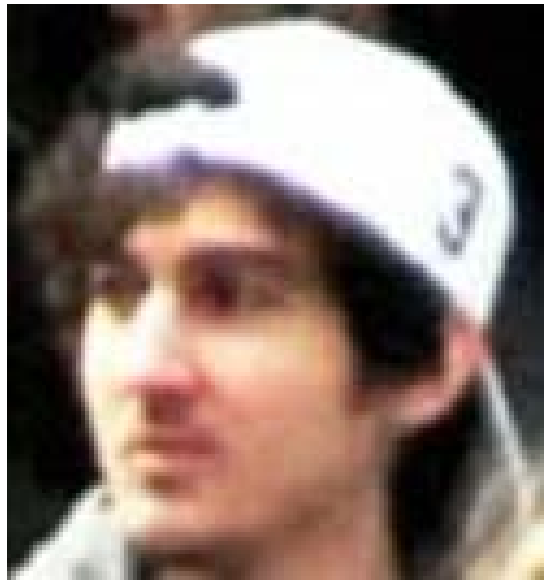
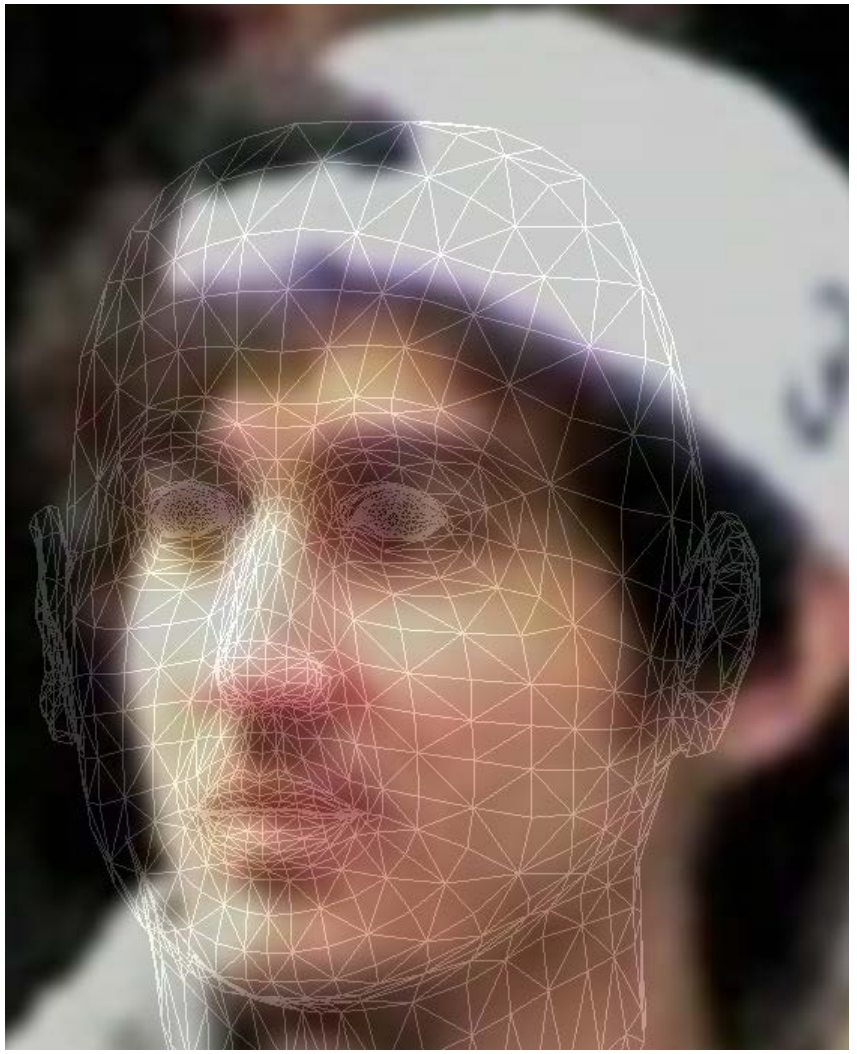
Will new facial technologies solve these problems?





Pose Correction with 3D Model Estimation

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Summary

- ***Fact:*** **As of today, facial recognition technology *can not reliably match* face templates to identites based on photo harvesting of *uncontrolled* images from social networks, let alone in a video surveillance environment, without forensic support.**

- ***Fact: Controlled images* are key to *reliable matching*, and thus the success of current facial recognition technologies.**

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