Advances in 3D Face Recognition and Multiple Biometric Identity Systems

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Geometrix, Inc.
Shape-Based Positive Identity

- Robust & Convenient Automated Matching
- Powerful Automated Verification and Identification
- Forensic Level ID Tools for Law Enforcement
- NIST FRGC Top Performer
Stereo Face Capture for Real 3D

- Pair of cameras known with respect to each other
- Automated calibration and exposure
- Visual features are found in both images and matched
- 3D position of a matched feature is uniquely determined by its position on both focal planes
- Only Passive Stereo Solution Available
2D (texture) Adds 3D Extrusion

- 2D is used to extrude an estimated 3D shape data
- Use data to apply to pose and lighting challenges
- Some improvement in performance
Rapidly Improving Recognition with 3D
Enabled by FaceVision™
3D Regions of Interest for Fusion

Compare the face on the right to a gallery, four months apart
blue=match, red=non-match
18 Months minus 40Lbs minus Full Beard
Verified with 3D Face

beforeafter

Positive ID Established: Rick
3D Template Creation : 12.46 sec.
Verification : 00.08 sec.
Outdoor Scenarios
Only 3D Adapts to Extremes Conditions

Sun Facing Subject  Sun Behind Subject  Sun To Side Of Subject
Advancing Face Recognition Performance for DoD/DHS Needs

Sources: DARPA/NIST FRVT 2002 Test Report; Tests on 20,000 subjects
Merging Texture and Shape

• Each is its own biometric with additional information
• Alignment of pictures and models provides performance improvement
• Fusion enables use of 3D performance where 2D fails
Exp. 3 - Neutral vs Neutral and Small Facial Expressions (Jan 2005)

- 3D Only, EER = 1.4%
- 3D and 2D Fused, EER = 1.0%
- 3D and 2D Aligned, EER = 0.9%

Verification Rate in % vs FAR in %

10^3 10^2 10^1 10^0 10^1 10^2
3D Enhances Existing 2D Recognition
Leverage Existing 2D Image Databases

3D Acquisition
At Probe

Render & Export
Pose & Lighting
Variants

Extract 2D
Templates & Store

Existing 2D Facial
Recognition Database & Engine

Improved Recognition Performance
Multiview Rendering
Bridge To 2D Legacy Photos
Watch Lists  Passports  Surveillance Systems

Pose

Frontal model acquired from single image pair
Maturing Market Segments

Value Chain Market Sizing

@Acuity Market Intelligence

Core Technology - Sensors, Devices, Algorithms, SW
Integrated Technical Solutions
Application/Enabling Solutions
Integrated Identification Solutions
**Products Required for Multiple Biometric Identity Management Systems**

**ActiveID™**

- Enrollment Station with Alias Search
- Biometric Camera
  - 3D Camera and Shape Recognition Software
- Verifier (1:1 matching)
- Verifier Plus
  - Verification and search for aliases
- Identifier (1:many matching)
  - Database on Server searches 1M faces/sec.
- Identifier Plus
  - Checks Identity and if not in database enrolls person for watch lists
- Render 3D to 2D Models for Legacy Matching
- 3D, 2D and Fingerprint Fused
ActiveFusion™
The Multimodal Biometric Solution

- Infrastructure Designed to Fuse multiple biometrics
- Scores from statistical assessment and weighted combination of different biometrics
- Fuses regions of facial shape into an accurate template including 2D
- Face and fingerprint fusion deployed today
  - operational use at County Detention Center
  - Large Government facilities deployment testing.
- The most robust and accurate solution on the market includes scaleable security
Multiple Fused Biometrics Implementation

ActiveFusion™
Multi-Biometric FUSION

- 3D Face Shape
- 2D Face Texture
- Fingerprints
- Iris

geometriX
3D Biometric Identity Solutions
Detention Center Identity Management System

Intake

Enrollment Station(s)

Identity Server
Raid-5 Array

JMS

FBI AFIS

Visitor

Face
Fingerprint
• Smart Card
• Trustees

Visitation

GCIC

Release

Ethernet

Internet
Atlanta Deployment
Multiple Counties

- 1,925 bed facility, 3,000 inmates
- Remove repeated release of incorrectly identified inmates
- Fused Fingerprint, mugshot, and 3D Face recognition to verify and identify
  - Intake - Visitors
  - Release - Trustees
- 120,000 Face Database
- 250,000 Identity Transactions
- Zero incorrect releases for over 1.5 years of operations
Atlanta Deployment

• Designed Process to Amplify & Automate the Human’s Abilities
• Trained 100 Guards
• Used portable systems internally to enroll existing inmates
• Increased throughput by 50 a day
• Zero false releases to date
• Significant increase in morale
Unique 3D Capabilities

- Large improvement in false accept & false reject rates
- Tolerates wide range of lighting conditions
- Identifies from large pose angles
- Provides Forensic Quality measurements
- Independent of Skin Color
- ActiveFusion™ is the first Multimodal Biometric Solution
- ActiveID™ System Solution is fully Scaleable for Distributed IP Requirements: small, medium or large
Conclusions

• Face Recognition is Rapidly Maturing

• Biometrics is Part of a Human process
  – Each type of Biometric has different process requirements for effective deployment

• Good System Process Design Yields Good to Excellent Deployment Results