

COGENT  SYSTEMS
BEYOND COMPARISON™

“Image Quality On Purpose”

**Presented to:
NIST Image Quality Workshop
November 7-8, 2007**

Agenda

- 1 Image Quality Assessments For Different Purposes
- 1 Fingerprint Image Quality Case Study & Analysis
- 1 Photograph Image Quality Case Study & Analysis
- 1 Summary
- 1 Contact Information

Cogent Fingerprint Image Quality Scoring Scale

COGENT  SYSTEMS



Good



- Calibration of Capture Device*
- Even Grayscale Distribution
- Few Low Confidence Minutiae Points
- Large Useful Image Area
- Low Noise Level of Useful Image Area
- Core Position/Core Confidence
(Used For Quality, Not Matching)

Average



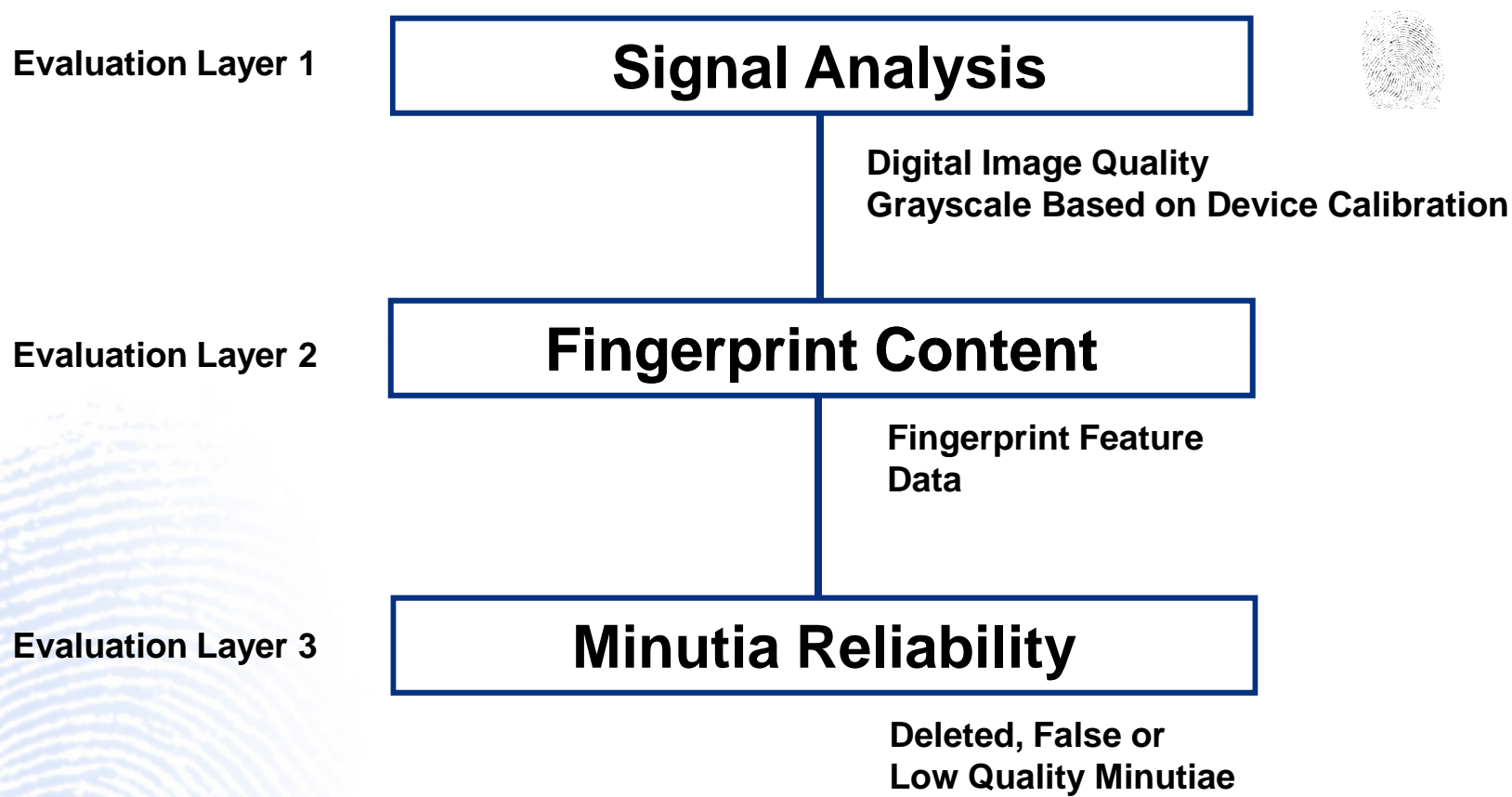
Poor



- Calibration of Capture Device
- Un-Even Grayscale Distribution
- Many Low Confidence Minutiae Points
- Small Useful Image Area
- Noise Level of Useful Image Area
- Low Core Confidence
(Used For Quality, Not Matching)

Image Quality Score Has Direct Relationship to Matching Accuracy

Image Quality Evaluation Layers



Multiple Image Quality Evaluation Layers Improves Score Reliability

Fingerprint Image Quality – Improved Matching Algorithms

- 1 Key Premise: Matching Accuracy (2Print/10Print) Starts With Fingerprint Image Quality
- 1 Image Quality Measurement is a *Good Predictor* of Matching Accuracy
- 1 Use Of Advanced Matching Algorithms (Galaxy+) as Replacement or In Conjunction With Feedback Improves Matching Accuracy of Poor Quality Prints



Cogent Quality Score	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8-Q127
Feedback Single Finger TAR	99%	99%	98%	98%	94%	88%	82%	54%

Cogent Quality Score	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8-Q127
Galaxy+ Single Finger TAR	99%	99%	99%	99%	98%	98%	96%	82% Galaxy+

Advanced Matching Algorithms Increase Ability to Match Poor Quality Prints

Four Finger Slap Capture For Segmentation


COGENT  SYSTEMS

- 1 Slap Orientation
- 1 Ability to Rotate +/- 90 Degrees Critical for Slap Segmentation Algorithm.
- 1 If Orientation +/- 10 Degrees No Rotation Necessary.



Ability of Segmentation Algorithm to Rotate Is a Key Attribute

Segmented Slap – Poor Quality/Segmentation Identification

LiveScan
COGENT  SYSTEMS

Evaluate Document
Click Zoom in Button to display image!

ID No.

Finger Position:















Cancel

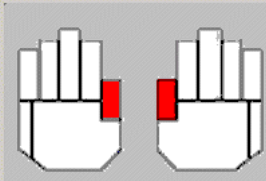
Zoom In

Recapture

< Confirm >

Back

R. Thumb	R. Forefinger	R. Middle Finger	R. Ring Finger	R. Little Finger	
					
Poor Quality :6	Good Quality :11	Good Quality :11	Good Quality :9	Good Quality :10	
L. Thumb	L. Forefinger	L. Middle Finger	L. Ring Finger	L. Little Finger	
					
Poor Quality :7	Good Quality :11	Good Quality :11	Good Quality :11	Good Quality :9	
L. Flats		L. Thumb	R. Thumb	R. Flats	
					



Segmentation Confidence Scoring Used In Addition to Image Quality

Typical Good Quality Digital Fingerprint

COGENT  SYSTEMS

- 1 Good Quality Fingerprint
 - 1 Quality = 1 (Very Good)
 - 1 Minutia Count = 104
 - 1 Even Grayscale Distribution
 - 1 Proper Capture Device Calibration
 - 1 Evenly Rolled Fingerprint

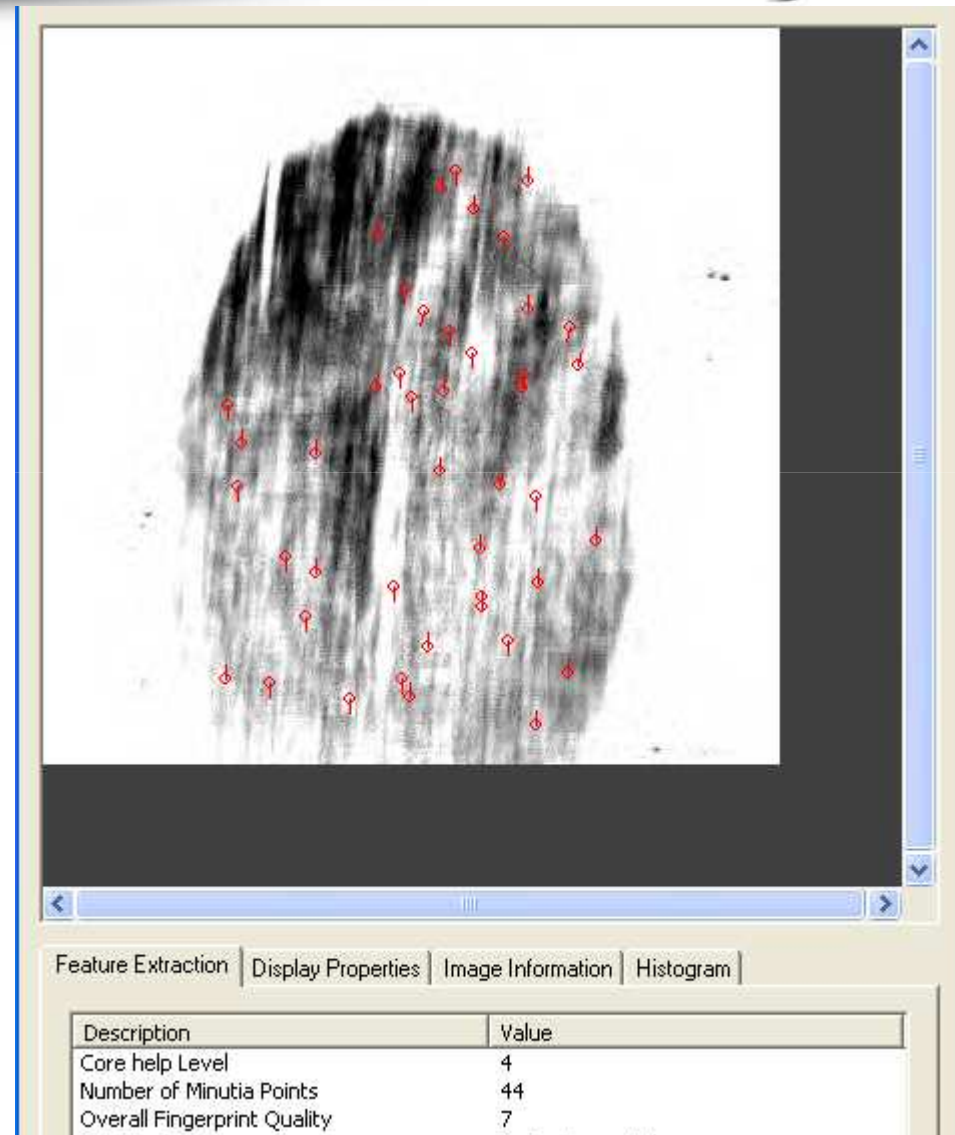


Description	Value
Core help Level	1
Number of Minutia Points	104
Overall Fingerprint Quality	1

Fingerprint Quality – Smear Print

COGENT  SYSTEMS

- 1 Smear Print
- 1 Quality = 7 (Average)
- 1 Minutia Count = 44
- 1 Solution:
 - 1 Smear Detection Algorithm
 - 1 SDA Used In Capture Application to Prompt For re-Capture of Print

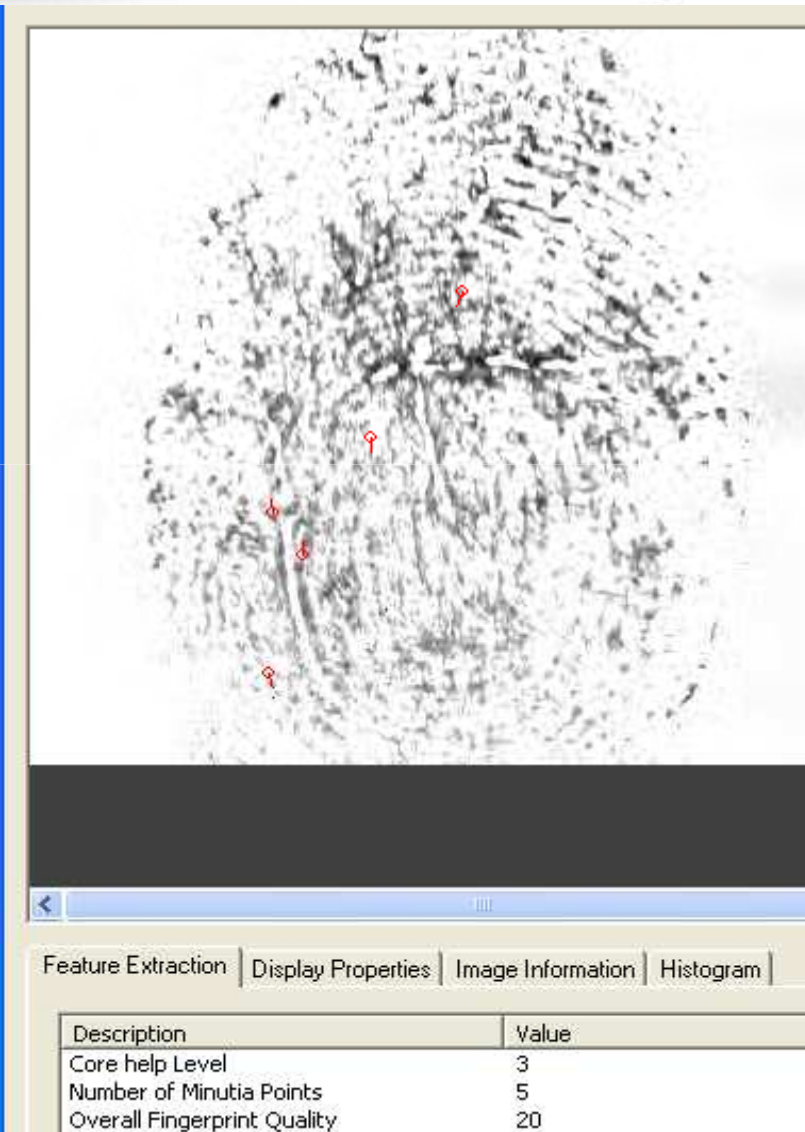


The software interface displays a grayscale image of a smearable fingerprint. The fingerprint is heavily smeared, with many red circular markers indicating detected minutia points. Below the image, there is a navigation bar with tabs for 'Feature Extraction', 'Display Properties', 'Image Information', and 'Histogram'. A table below the navigation bar shows the following data:

Description	Value
Core help Level	4
Number of Minutia Points	44
Overall Fingerprint Quality	7

Fingerprint Quality – Light Print

- 1 Light Contrast Fingerprint
 - 1 Quality = 20 (Very Poor)
 - 1 Minutia Count = 5
 - 1 Poor Grayscale Distribution
- 1 Solution:
 - 1 Ensure Capture Device Is Properly Calibrated
 - 1 Normal Distribution is 128 (88-168) on 0-255 Scale.



Description	Value
Core help Level	3
Number of Minutia Points	5
Overall Fingerprint Quality	20

Fingerprint Quality – Dark Print

COGENT  SYSTEMS

- 1 Dark Contrast Fingerprint
 - 1 Quality = 11 (Very Poor)
 - 1 Minutia Count = 27
 - 1 Poor Grayscale Distribution
- 1 Solution:
 - 1 Ensure Capture Device Is Properly Calibrated
 - 1 Normal Distribution is 128 (88-168) on 0-255 Scale.
 - 1 Ensure Too Much Finger Pressure Not Applied to Platen



Feature Extraction | Display Properties | Image Information | Histogram

Description	Value
Core help Level	1
Number of Minutia Points	27
Overall Fingerprint Quality	11

Client Application – Centering Algorithm

COGENT  SYSTEMS

1 Core Centering Versus Geometric Centering Algorithm

- Two Primary Fingerprint Centering Algorithms
- Core Centering
 - Identifies Core Center of The Print and Centers Image
 - Core NOT Used by Cogent For Matching. Only for Image Centering
- Geometric Centering
 - Utilizes x,y Coordinates of the Print Image and Centers Image

1 Recommendation :

- Core Centering Algorithm Should Be Used to Obtain More Useful Image Area than Geometrics Centering Algorithm
- Core Centered Fingerprints Provide Higher Quality Scores

Geometric Centered Quality- 12



Core Centered Quality- 6

Photograph Image Quality Assessment

COGENT  SYSTEMS

- 1 UK-Visas Application
 - Biometrics Capture & Matching System Used In >140 Countries
 - Captures 10Print Slaps, Biographic Data & Digital Photo
- 1 UK-Visas Program Case Study For Photograph Quality
- 1 Photograph Quality is Pre-Cursor For Face Recognition
 - Uniform Lighting
 - Frontal View
 - Head Length/Width Ratio
 - Eyes Open


Several Attributes Contribute to a High Quality Photograph Image

Photo Image Quality Assessment


COGENT  SYSTEMS


- Failed Quality Check
 - Eyes Closed
 - Uneven Lighting


Photo Capture

 **UKvisas Biometric Enrolment - Facial Image**

Method:

















Show Guidelines

Quality Assessment

Eyes Open:	
Exposure:	
Frontal View:	
Greyscale Density:	
Uniform Lighting:	
Head Width:	
Head Length:	
Width / Height Ratio:	
Resolution:	
Vertical Position:	
Horizontally Centred:	

Failed

Failed the Quality Assessment
Please instruct the applicant to perform the following:

- Failed quality assessment. Please instruct the applicant to open his/her eyes and look at the camera.
- Failed Uniform Lighting category - Please check the lighting for any shadows or glare.


Photo Image Quality Assessment – Case 2

COGENT  SYSTEMS

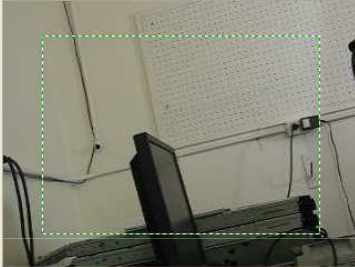
- Failed Quality Check


- Non Frontal View
- Head Width/Height Ratio

Photo Capture

 **UKvisas Biometric Enrolment - Facial Image**

Method:





Show Guidelines

Quality Assessment

Eyes Open:	<input checked="" type="checkbox"/>
Exposure:	<input checked="" type="checkbox"/>
Frontal View:	<input checked="" type="checkbox"/>
Greyscale Density:	<input checked="" type="checkbox"/>
Uniform Lighting:	<input checked="" type="checkbox"/>
Head Width:	<input checked="" type="checkbox"/>
Head Length:	<input checked="" type="checkbox"/>
Width / Height Ratio:	<input checked="" type="checkbox"/>
Resolution:	<input checked="" type="checkbox"/>
Vertical Position:	<input checked="" type="checkbox"/>
Horizontally Centred:	<input checked="" type="checkbox"/>

Failed

Failed the Quality Assessment
Please instruct the applicant to perform the following:


- Failed Frontal View category - Have the applicant look directly at the camera and ensure that his/her face is at the same height as the camera.
- Failed Head Width category

Photo Image Quality Assessment – Case 3


COGENT  SYSTEMS


- Passed Quality Check
 - Full Frontal View
 - Consistent Lighting
 - “Eye Contact”
 - Head Width/Height Ratio

Photo Capture

 **UKvisas Biometric Enrolment - Facial Image**

Method:





Show Guidelines

Quality Assessment

Eyes Open:	<input checked="" type="checkbox"/>
Exposure:	<input checked="" type="checkbox"/>
Frontal View:	<input checked="" type="checkbox"/>
Greyscale Density:	<input checked="" type="checkbox"/>
Uniform Lighting:	<input checked="" type="checkbox"/>
Head Width:	<input checked="" type="checkbox"/>
Head Length:	<input checked="" type="checkbox"/>
Width / Height Ratio:	<input checked="" type="checkbox"/>
Resolution:	<input checked="" type="checkbox"/>
Vertical Position:	<input checked="" type="checkbox"/>
Horizontally Centred:	<input checked="" type="checkbox"/>

Passed

Passed the Quality Assessment

Image Quality Assessment Summary

COGENT  SYSTEMS

- 1 Fingerprint Image Quality Considerations
 - Calibration of Capture Device
 - Grayscale Distribution
 - Segmentation Confidence
 - Centering Algorithm

- 1 Photograph Image Quality Considerations
 - Lighting
 - Pose
 - “Eye Contact”

Image Quality Has Direct Relationship to Matching Accuracy

Cogent Contact Information



COGENT  SYSTEMS

Corporate Headquarters:

Cogent, Inc
209 Fair Oaks Dr.
South Pasadena, CA
626-799-8090

Washington, DC Metro

Cogent, Inc.
11480 Commerce Park Dr
Reston, VA 20191
(703) 476-9381

JJasinski@Cogentsystems.com

RBillups@Cogentsystems.com