

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

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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

Evaluation Layer 1

Signal Analysis

Digital Image Quality
Grayscale Based on Device Calibration



Evaluation Layer 2

Fingerprint Content

Fingerprint Feature
Data

Evaluation Layer 3

Minutia Reliability

Deleted, False or
Low Quality Minutiae

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

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



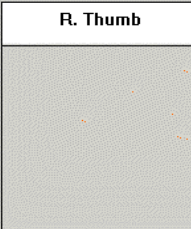
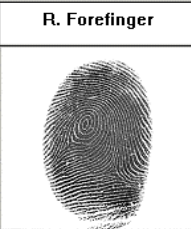
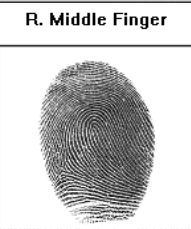
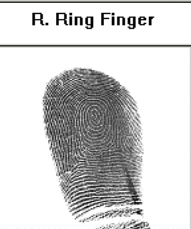
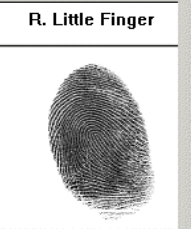

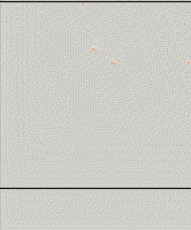







Ability of Segmentation Algorithm to Rotate Is a Key Attribute

Segmented Right Slap

- 1 Segmentation Confidence Scoring
- 1 Key Metric For Image Quality

LiveScan
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Result of Right Flats
Click Confirm to continue!

R. Thumb	R. Forefinger	R. Middle Finger	R. Ring Finger	R. Little Finger
				
	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
				
L. Flats		L. Thumb	R. Thumb	R. Flats
				

ID No.

Finger Position:

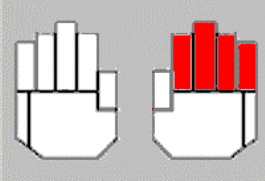
Cancel

Zoom In

Retry


< Confirm >

Back



Segmentation Confidence Scoring Used In Addition to Image Quality

Segmented Slap – Poor Quality/Segmentation Identification

LiveScan
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Evaluate Document
Click Zoom in Button to display image!

ID No.

Finger Position:















Cancel

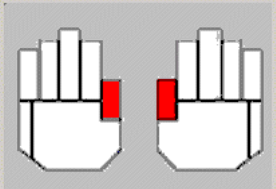
Zoom In

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

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- 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

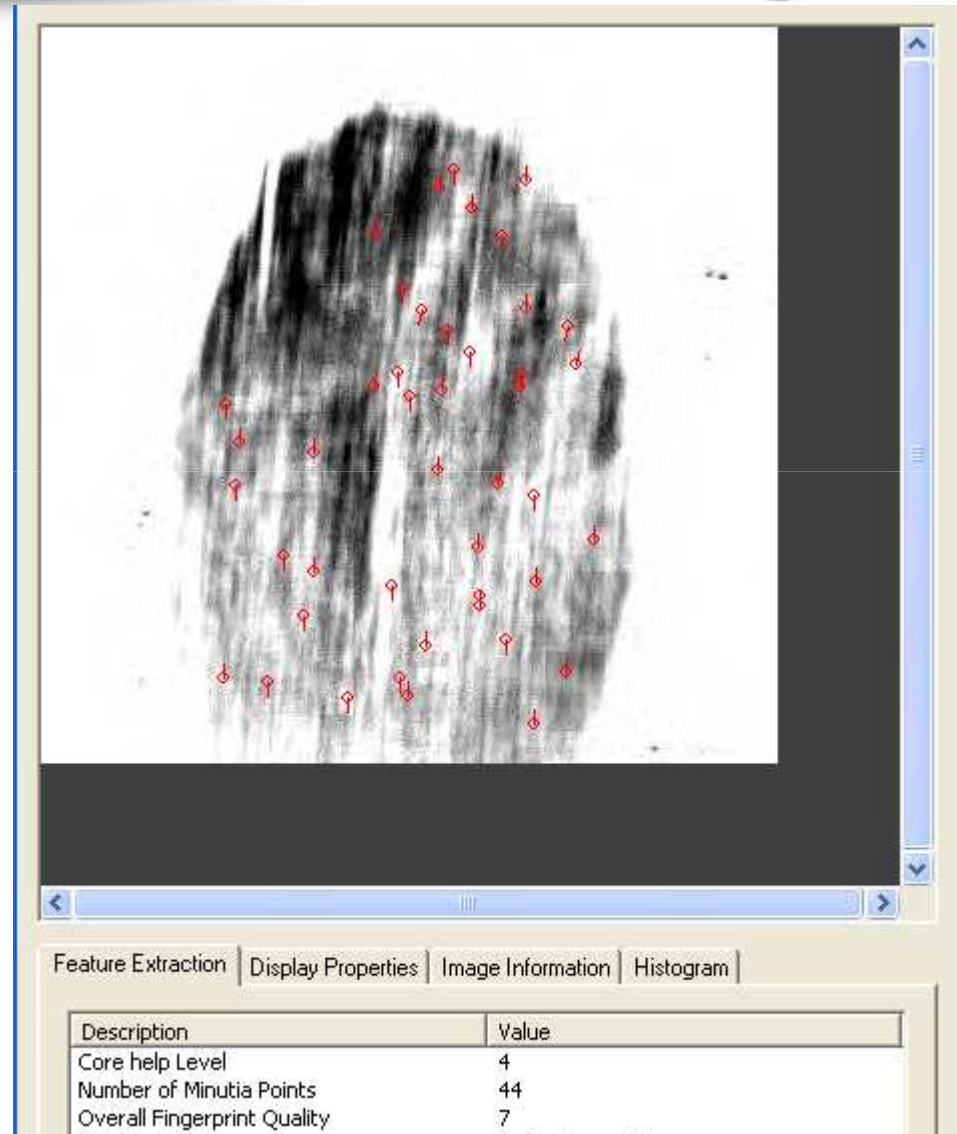


Description	Value
Core help Level	1
Number of Minutia Points	104
Overall Fingerprint Quality	1

Fingerprint Quality – Smear Print

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- 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 table with the following data:

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

Fingerprint Quality – Light Print

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- 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

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- 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

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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

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- 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


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- 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

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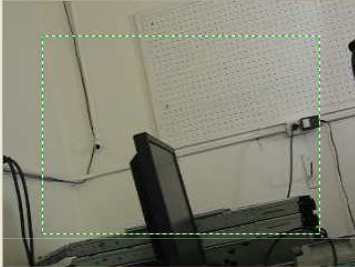
- Failed Quality Check


- 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

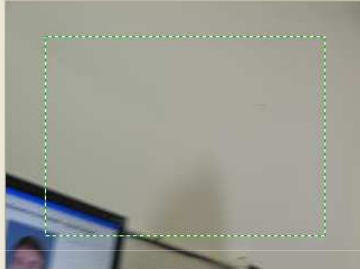
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- Passed Quality Check
 - Full Frontal View
 - Consistent Lighting
 - “Eye Contact”
 - Head Width/Height Ratio

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

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- 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



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