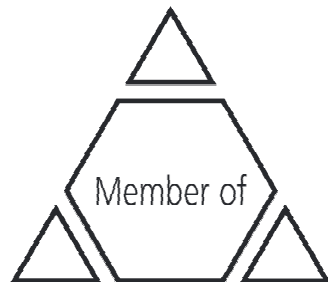

Measuring the Quality of Passport Photos



Fraunhofer Institut
Graphische
Datenverarbeitung



INI-GraphicsNet

Measuring the Quality of Passport Photos

Research and Development

NIST Biometric Quality Workshop

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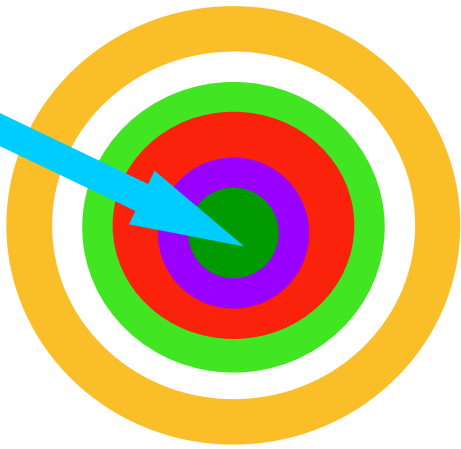
Current Problematic

- There is no method to calculate automatically the Quality of digital passport photos
- There is no defined a Quality metric to measure the Quality of passport photos
- There are subjective qualifications to specify if a passport photo is acceptable or not

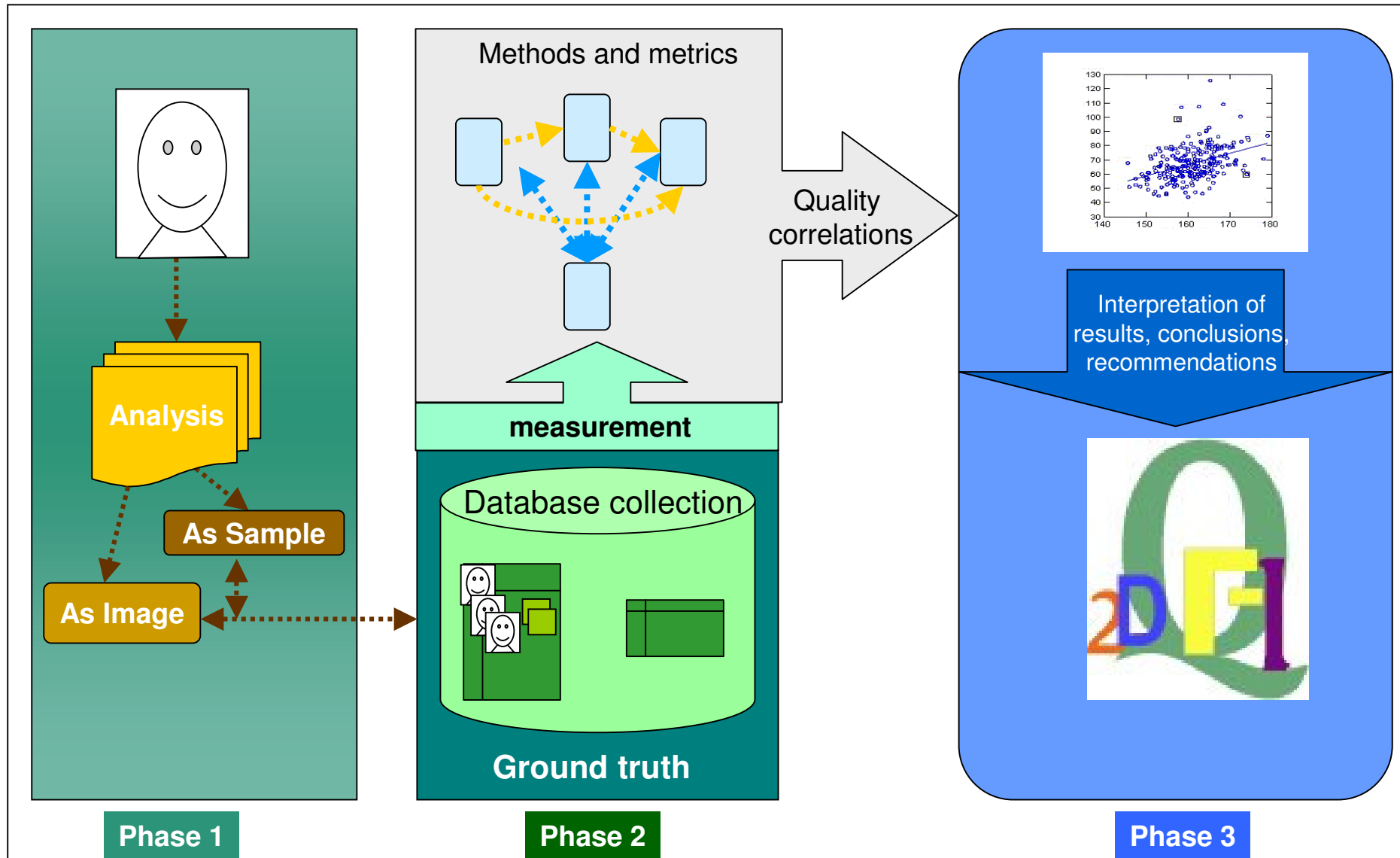


Our Solution Objective

- *To evaluate a digital passport photograph and to obtain its quality metric according to the international standards related*



Conceptual Model



Measuring Quality using the “*Achto Cualli Model*” *

- Identifying conformance requirements
- Identifying constraints of requirements
- Scoring requirements
- Integrating and validating conformance requirements



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Measuring Quality using the “Acho Cualli Model” *

- Identifying conformance requirements

Notation	Grouping Characteristic	Attributes Description
A1. Antiquity	Photograph	must be no more than 6 months old
A2. Size	Photograph	must be 35-40mm in width
A3. Focus	Photograph	must be in sharp focus and clear
A4. Dermis	Photograph	must show the natural individual's skin tone
A12. Mouth	Individual's face	must show individual's face with mouth closed
A13. Procentage	Individual's face	the face must takes up to 70 - 80 %
A14. Looking	Individual's face	the individual's looking must look directly at the camera
A15. Eyes	Individual's face	the individual's eyes must be open and clearly visible -no hair across the eyes
B1. Format	File format	the JPEG sequential baseline mode of operation and encoded in the JFIF file format, the JPEG-2000 Part-1 Code Stream Format and encoded in the JP2 file format
B2. Compression	File Compression	the maximum allowed amounts of compression for full images to be such that 1mm x 1mm features can be discerned



Measuring Quality using the *"Acho Cualli Model"**

- Identifying constraints of requirements

Notation	Requirement type	Constraints related
G1	Photograph	ISO 10526:1999/CIE S005/E-1998, CIE Standard Illuminants for Colorimetry, PIMA 7667:2001, Photography - electronic Still Picture Imaging - Extended sRGB Color Encoding - e - sRGB, ICC 1:2001-12, File Format for Color Profiles
G2.	Individual's face	New Orleans Resolution March 2003
G3.	Data file format	ISO/IEC 19785 Biometric data interchange formats, ISO/IEC 19794-1 Biometric data interchange, ISO/IEC 10918, Digital Compression and Coding of Continuous-tone Still Images, ISO/IEC15444 JPEG2000 Image Coding System



Measuring Quality using the "Acho Cualli Model" *

$$O = \frac{f}{\pi^r}$$

- Scoring requirements

ID	Subtype	Constraint	Relevance	Objective Qualification
I	Brightness	must have the appropriate brightness	2,high	0.03233
I	Contrast	must have the appropriate contrast	1,high	0.064661
I	Color	must be color neutral	5,low	0.012932
I	Red eye	must not show red eye	4,medium	0.16165
I	File	the file type should be in a compressed format such as JPEG2000	3,high	0.021554
B	Looking	the individual's looking must look directly at the camera	3,low	0.035368

where

O is the Objective score of the attribute

f is a fractional value for each relevance type

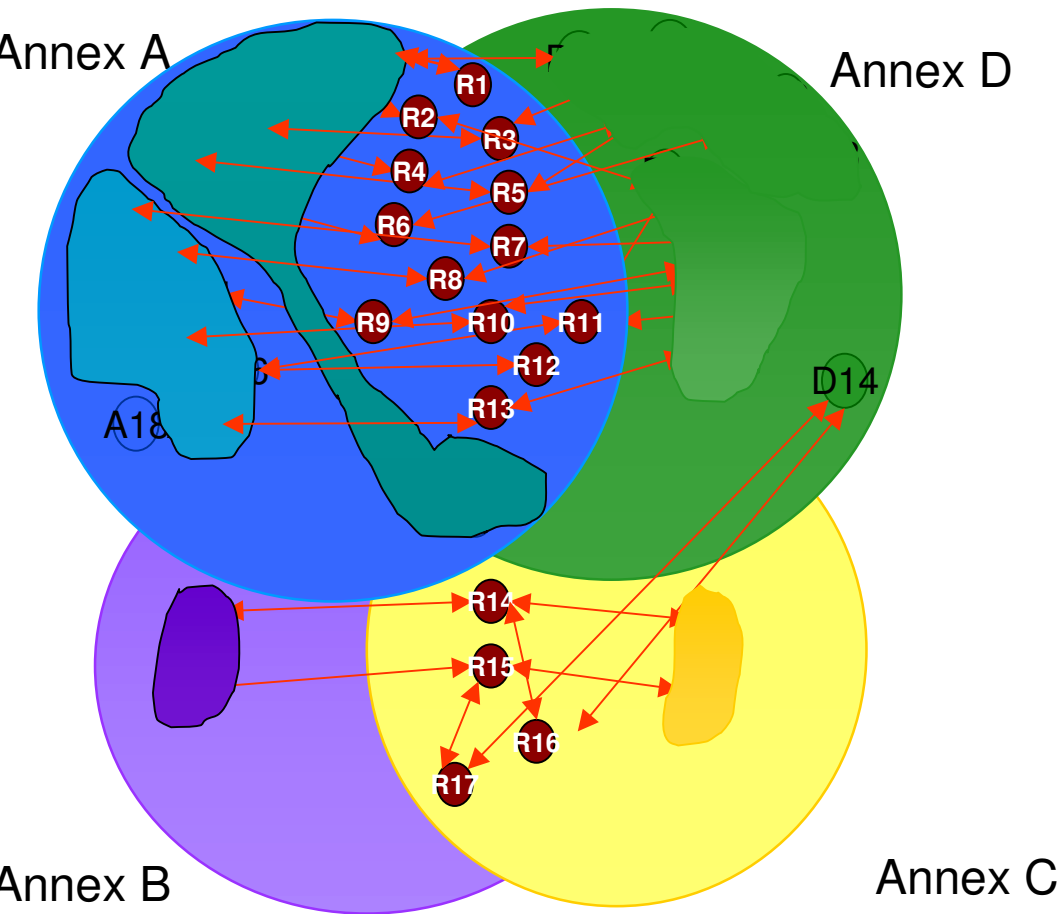
according to the number of elements of each set

r is the relevance precedence number for the attribute to qualify.

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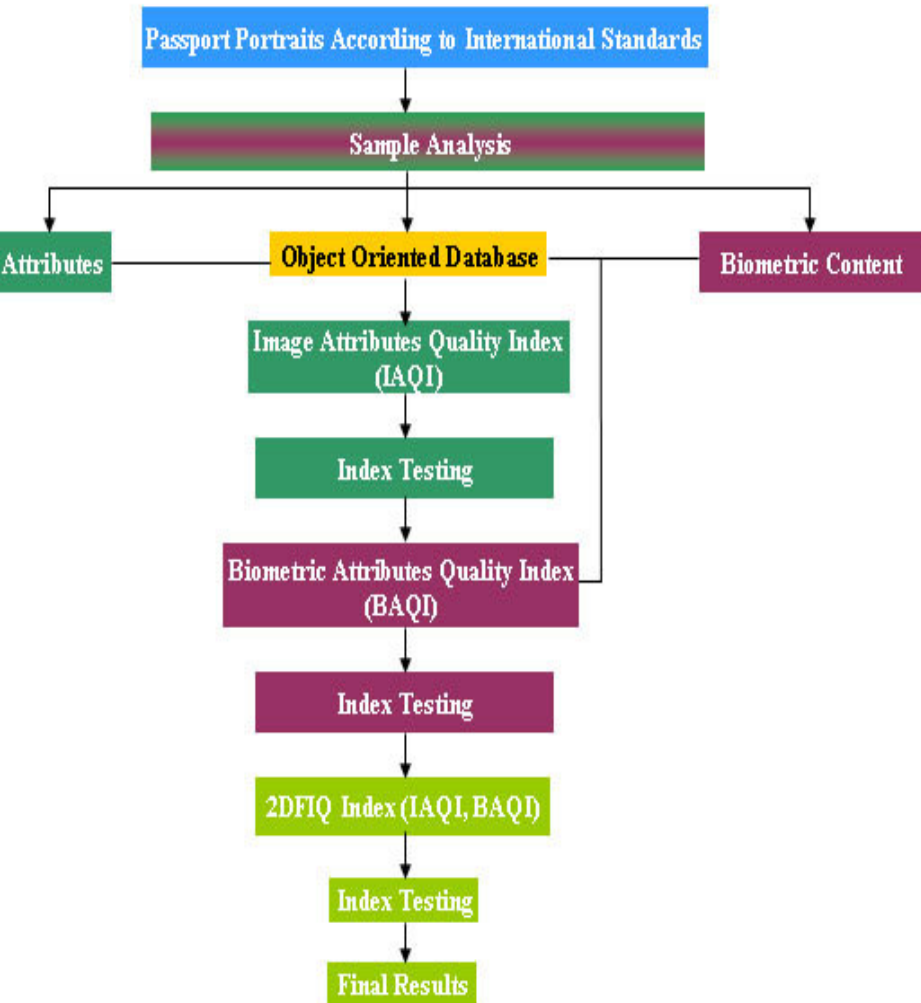


Measuring Quality using the "Achts Cualli Model" *



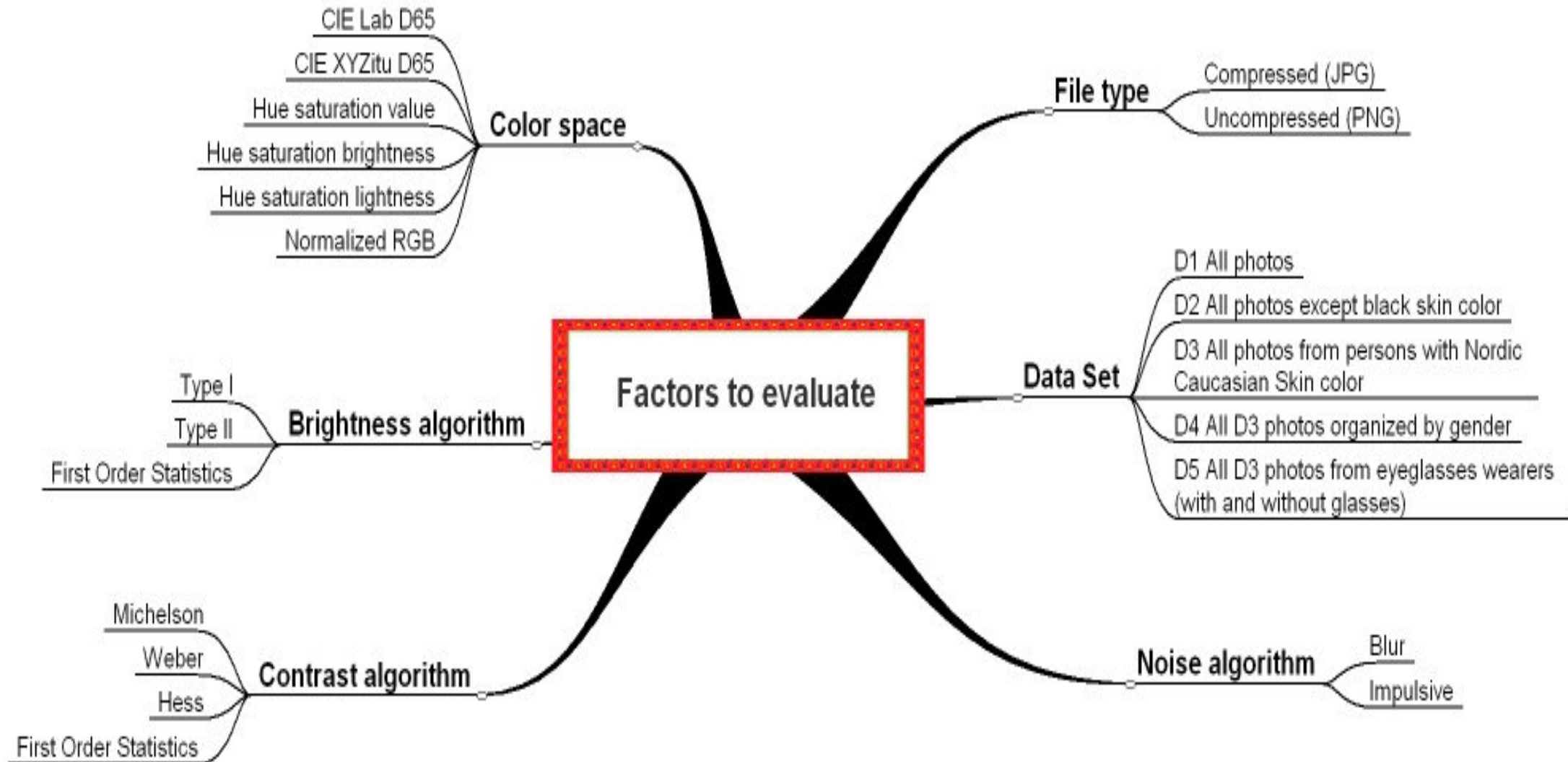
- Integrating and validating conformance requirements
- ICAO "Biometrics Deployment of Machine Readable Travel Documents"
 - Annex A. Photograph Guidelines
 - Annex B. Facial Image Size Study #1
 - Annex C. Facial Image Size Study #2
 - Annex D. Face Image Data Interchange (ISO/IEC CD 19794-5)

Using "Achts Pohua Methodology" * to obtain the passport Photos Quality Metrics

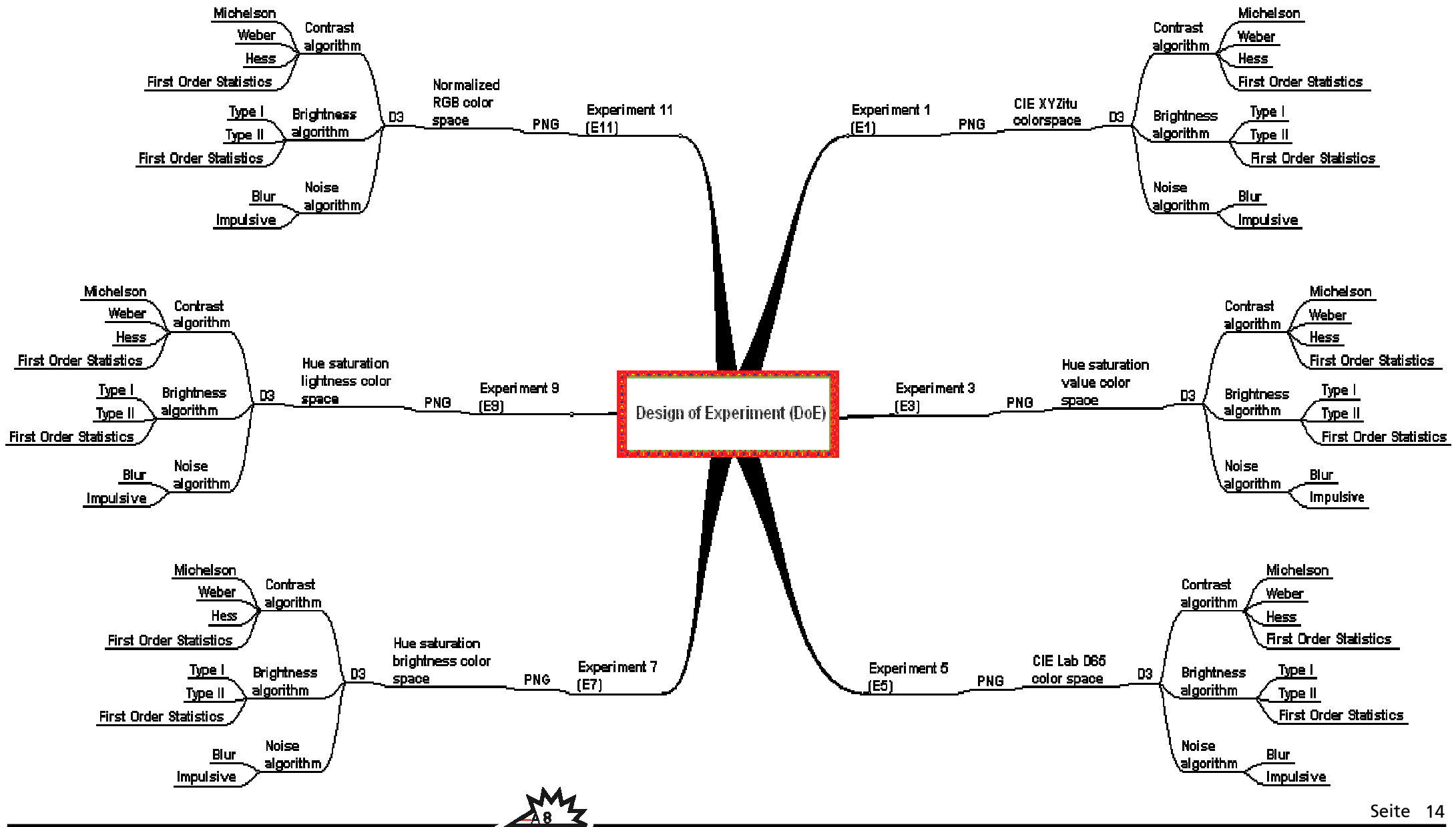


1. Samples enrollment according to conformance requirements
2. Sample database collecting
3. Sample database analysis as image
4. Image Attributes Quality Index specification
5. Image Attributes Quality Index testing
6. Sample database analysis for biometric content
7. Biometric Content Quality Index specification
8. Biometric Content Quality Index testing
9. Two Dimensions Facial Image Quality Index specification and testing
10. Final Results description and conclusions

Sample Database Analysis as Image

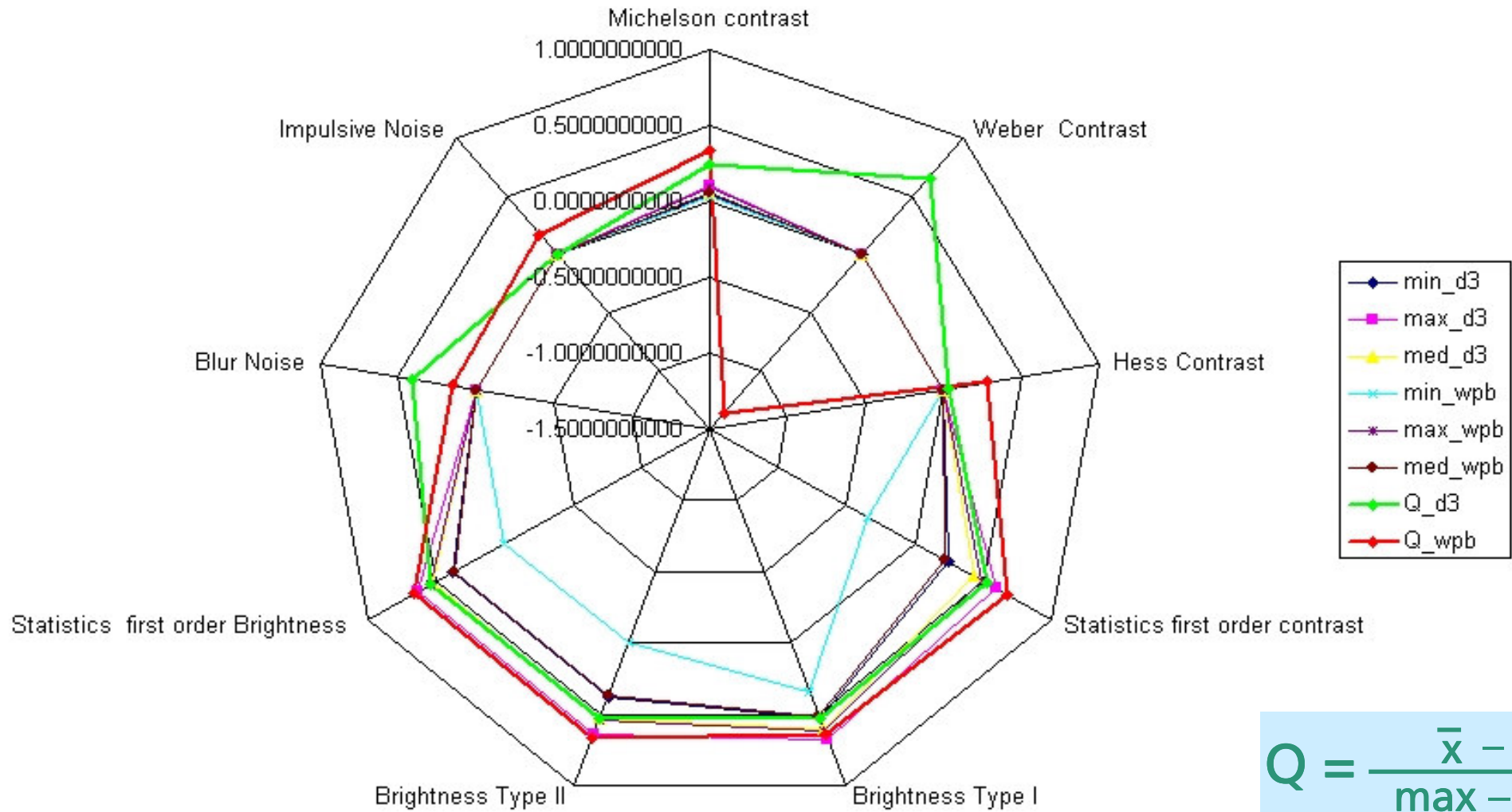


Sample Database Analysis as Image



Sample Database Analysis as Image

Colorspace Normalized RGB



$$Q = \frac{\bar{x} - \min}{\max - \min}$$



Actual Results

Image Attribute Quality Index *

$$IAQI = Q_C O_C + Q_B O_B + N - S$$

where

Q_C is the optimal calculated contrast value

O_C is the objective score for contrast value

Q_B is the optimal calculated brightness value

O_B is the objective score for brightness value

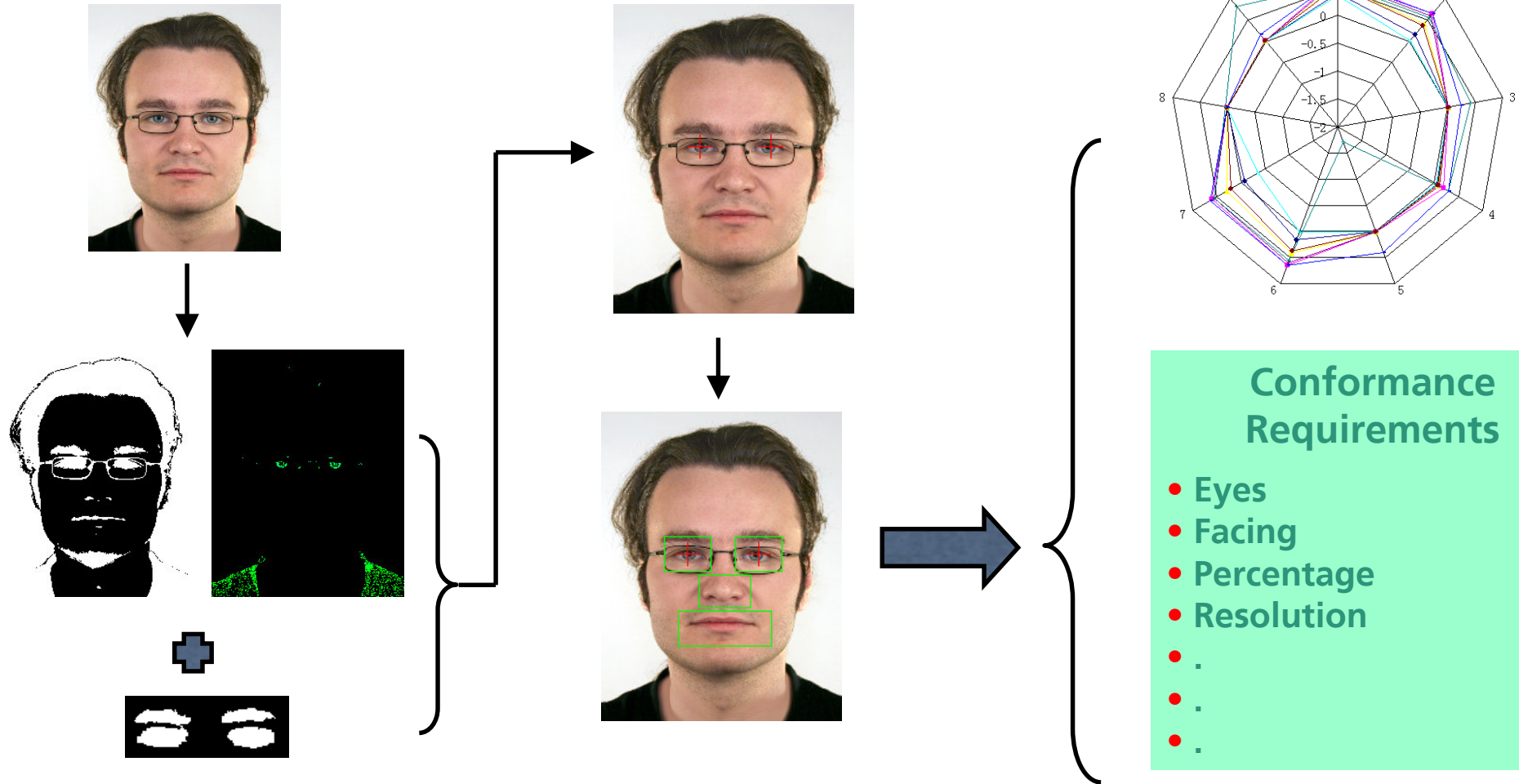
N is the noise value (blur and impulsive)

S is the default compression factor (which value is 0.020)

$$N = w_1 N_b + w_2 N_i$$

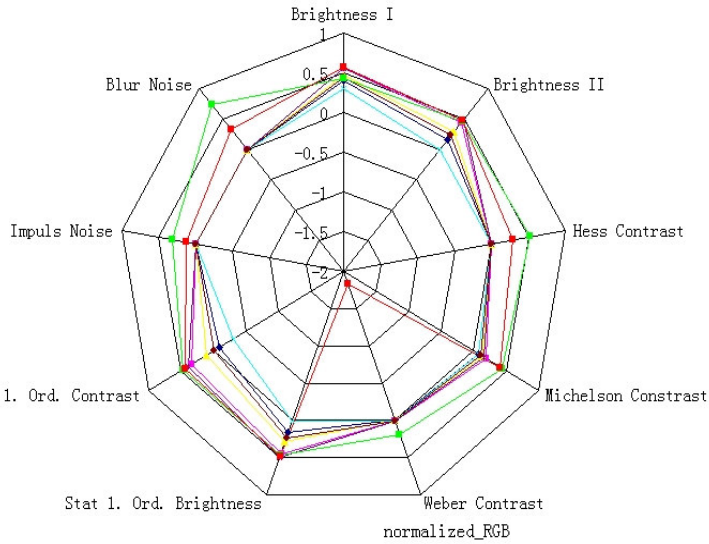


Sample Database Analysis for Biometric Content

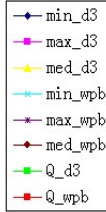


Sample Database Analysis for Biometric Content

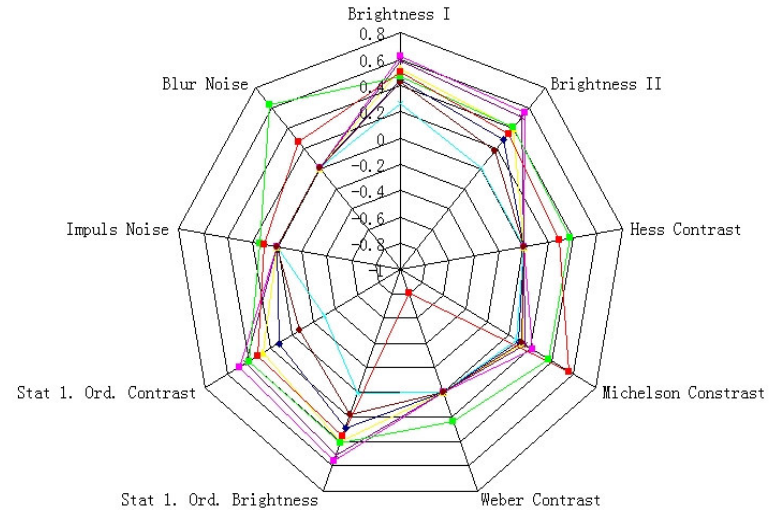
normalized_RGB



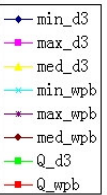
left eye



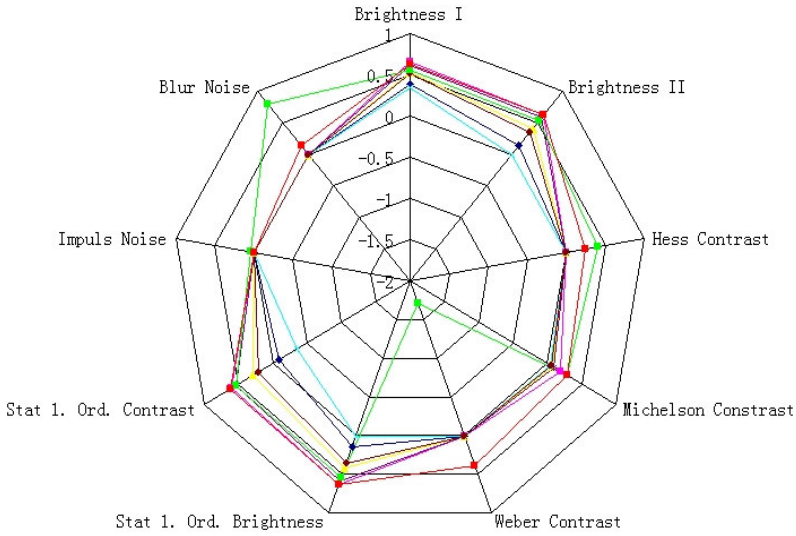
normalized_RGB



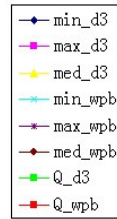
right eye



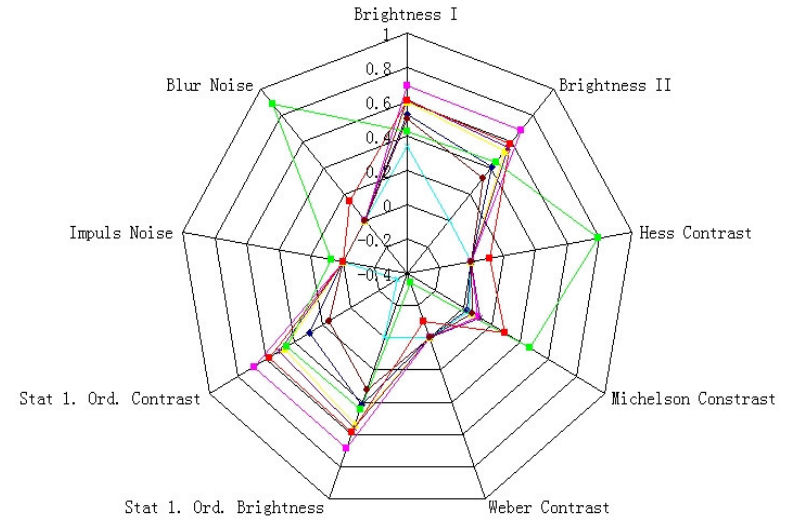
normalized_RGB



mouth



normalized_RGB



nose



Actual Results

Biometric Attribute Quality Index *

$$\text{BAQI} = Q_{le}W_1 + Q_{re}W_2 + Q_{no}W_3 + \dots + Q_nW_n$$

where

Q_{le} is the optimal calculated value for left eye

W_1 is the objective score for left eye

Q_{re} is the optimal calculated value for right eye

W_2 is the objective score for right eye

Q_{no} is the optimal calculated value for nose

W_3 is the objective score for nose

Q_n is the optimal calculated value for feature n

W_n is the objective score for feature n



Actual Results

2DFIQ Two Dimensional Facial Image Quality *

$$2DFIQ = (\overline{IAQI}, \overline{BAQI})$$

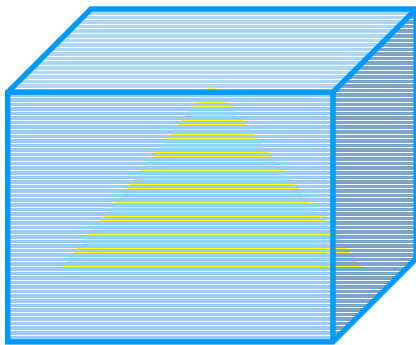


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Future Work

- To test the BAQI index with more features
- To validate what conformance requirements are measured with BAQI index
- To normalize the 2DFIQ
- To “translate” the 2DFIQ results into subjective quality indicators



Summary

- Through the *Achto Cualli* model any kind of Quality can be analyzed
- A new methodology called *Achto Pohua* was designed to obtain the quality metric for the quality of passport photos
- In the analysis of conformance requirements was discovered that some requirements cannot be calculated automatically
- The color space and skin color are determinant attributes to calculate the quality of a passport photo
- The Quality metric for a passport photo is obtained through 2DFIQ which is defined for two linear indexes (IAQI and BAQI) with different dimensions obtained from two types of attributes and biometric content; 2DFIQ can be considered as a multidimensional matrix.



Recommendations

- Invest in formal research
 - Skin color
 - Anthropometry
 - Performance
- A re-evaluation and may be a re-design of the face record format and requirements specified in ISO/IEC CD 19794-5 should be take into consideration





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