Realtime Quality Assessment of Iris Biometrics under Visible Light

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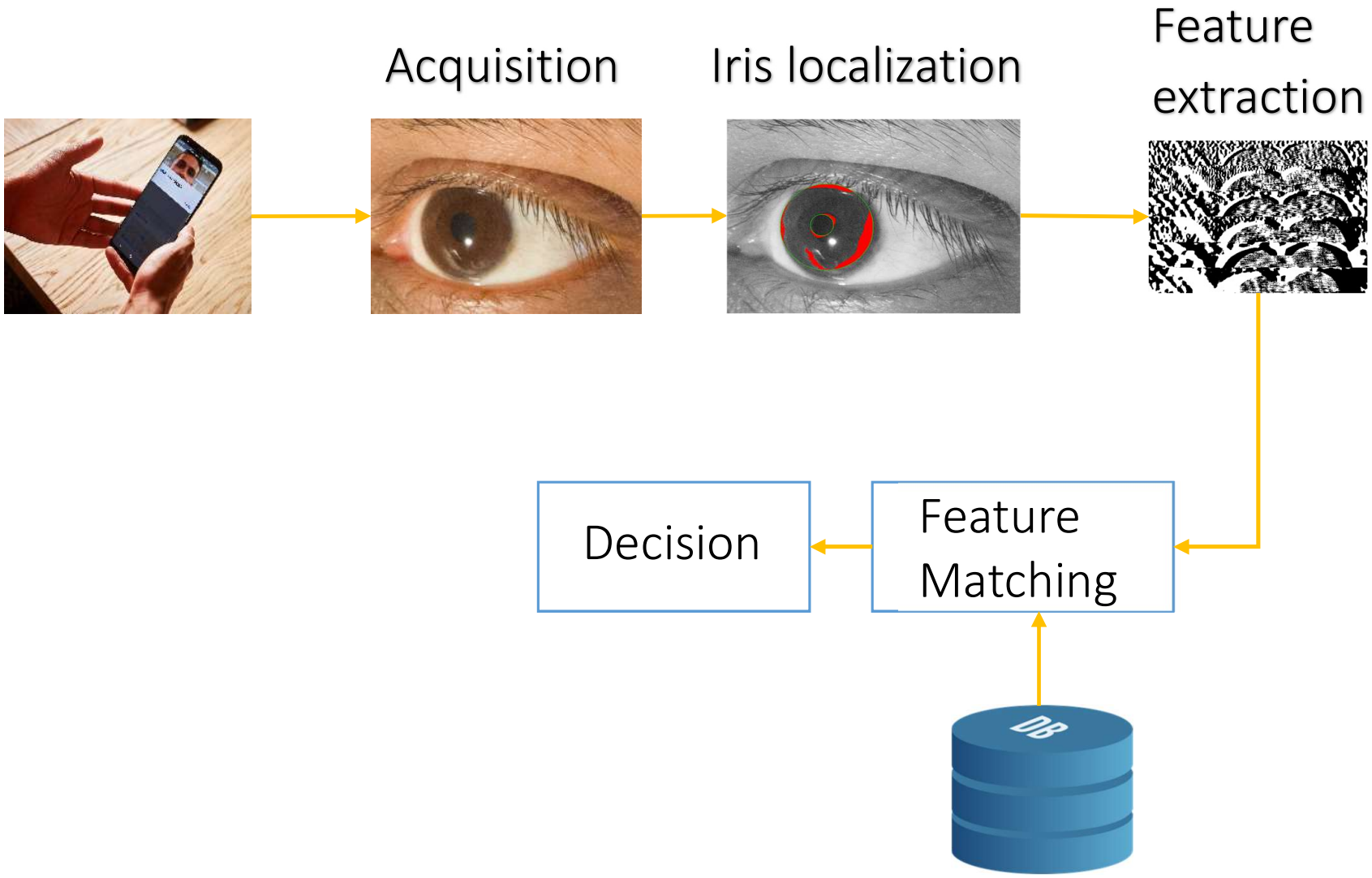
Introduction: Iris recognition system

General model



Motivation

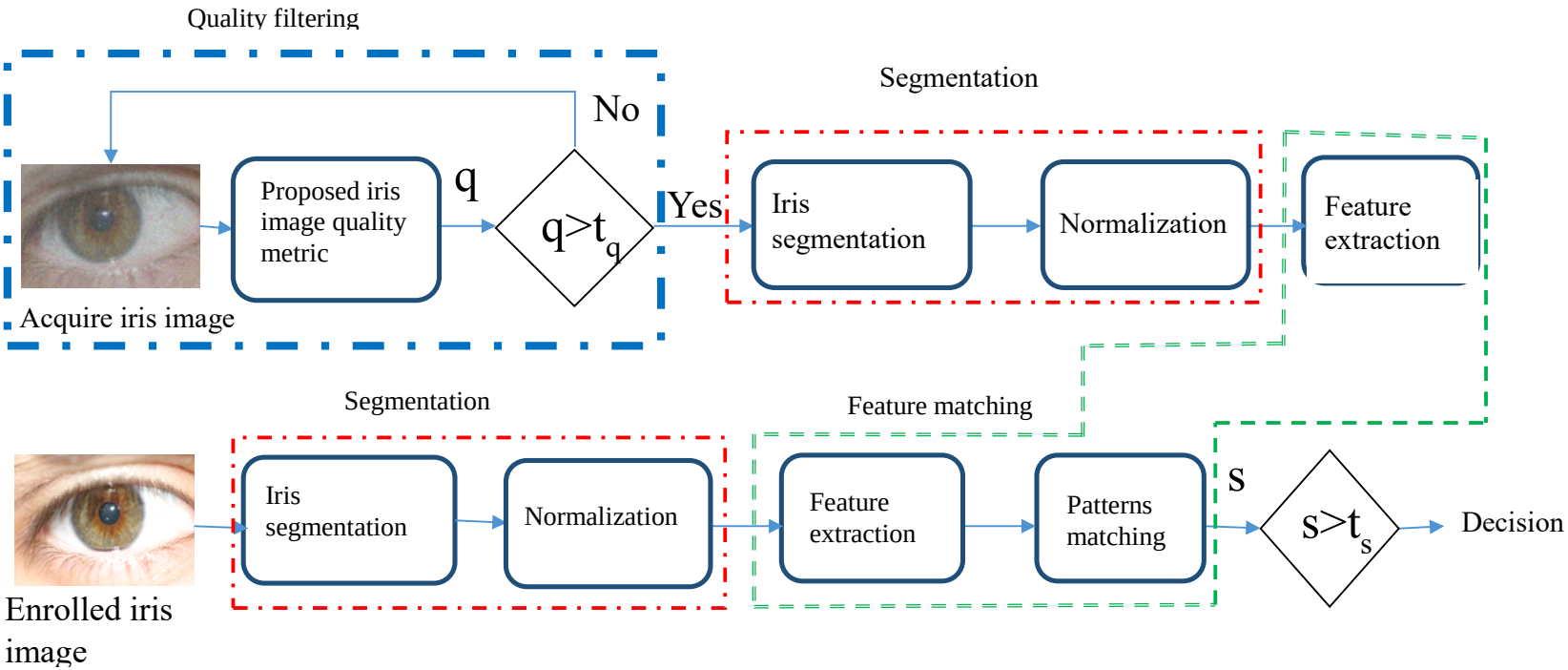
Why iris image quality is important?

- One of the major challenges of automated iris recognition in the wild is to capture an iris image with sufficient quality
- Concerns on the image acquisition in the wild
  - Difficult mixture of image distortions usually occur
  - Content dependent deformations such as glare, off-angle, etc.
- Measuring quality is important for fast and accurate recognition

Related work

- **Limitations of the existing quality metrics**
  - **Limited types of distortion**: Usually only one or a few distortions such as Gaussian blur, noise, motion blur, and defocus are considered
  - **Need segmentation result**: Usually quality assessment is applied to accurately segmented iris images, or at least the result of segmentation module is necessary for iris image quality estimation.

Suggested Approach



- Image segmentation is time consuming. Quality filtering could help reducing miss-segmented irises
- Real-time rejection of poor quality images reduces false rejection rate

Proposed quality metric (1)

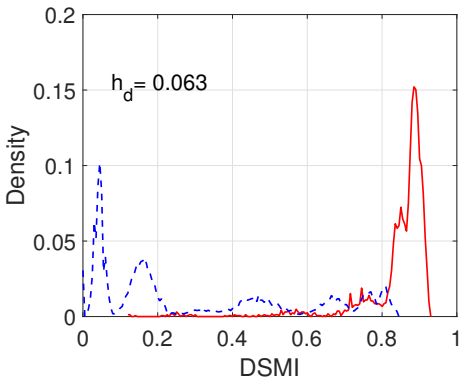
- Based on statistical analysis of local sign-magnitude patterns
- Motivation of using local features
  - Some promising works on pattern recognition applications, such as iris recognition systems, employed block-based operations to obtain their features.
  - most discriminative information in the iris pattern comes from the local patterns of an iris image rather than the global features
  - The local binary patterns and their derivations perform significant improvements in many pattern recognition applications

Proposed quality metric (2)

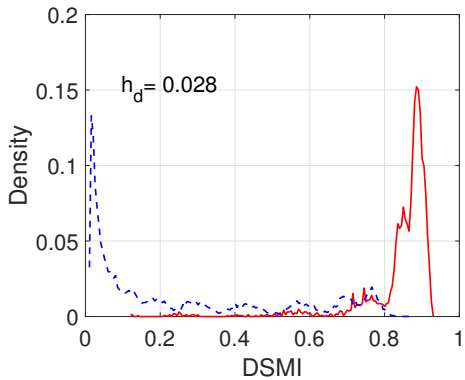
- We exploit the observation that low quality iris images have significantly fewer of these patterns compared with those in high quality iris images.
- Statistical features extracted from uniform patterns of a local difference sign-magnitude transform
- Locally weighted statistics of a specific sign-magnitude coincidence patterns formulate the quality score.

Proposed method justification

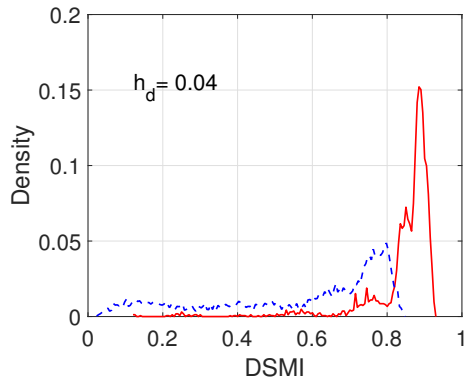
Dataset: 46,800 synthetic iris image dataset of 600 subjects distorted with five frequently seen image distortions



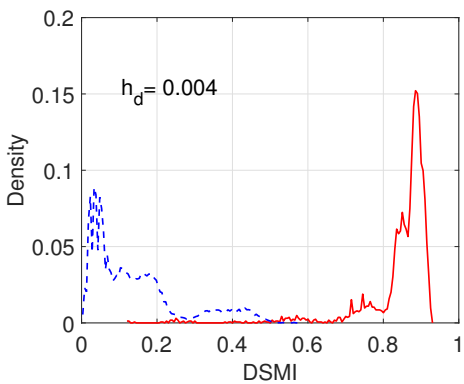
(a) Gaussian blur



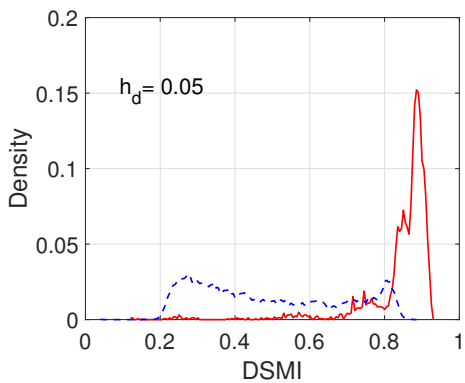
(b) Impulse noise



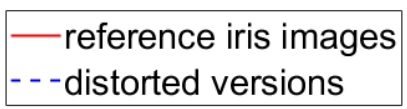
(c) Overexposure



(d) Motion blur



(e) WGN



Test datasets and reference iris recognition system

GC^2 iris database:

- Acquired under visible light
- Consists of three datasets

Datasets	REFLEX	LFC	PHONE
Number of Subjects	48	49	50
Total images	1422	1454	1379
samples per eye	12-15	13-15	12-15
Matching pairs	9457	10045	9092
Non-matching pairs	975450	1056485	941039
Camera	Canon D700	Light field camera	Phone nexus

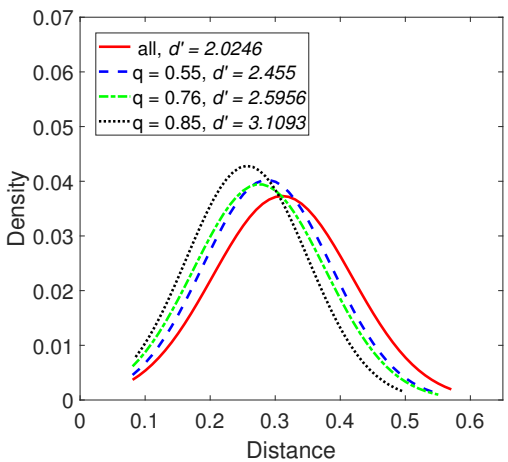
Reference iris recognition system: OSIRIS version 4.1

Othman, Nadia, Bernadette Dorizzi, and Sonia Garcia-Salicetti. "OSIRIS: An open source iris recognition software." Pattern Recognition Letters 82 (2016): 124-131.

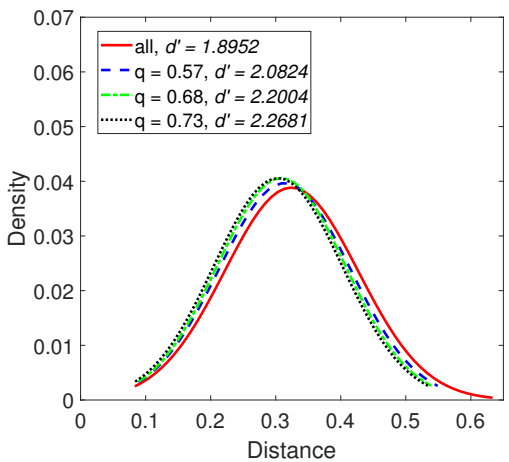
Performance evaluation (1)

Daugman's decidability index

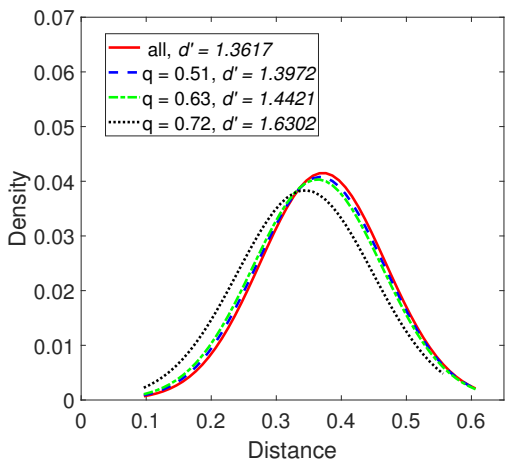
$$d' = \frac{|\mu_E - \mu_I|}{\sqrt{\frac{1}{2}(\sigma_I^2 + \sigma_E^2)}} \tag{1}$$



(f) REFLEX



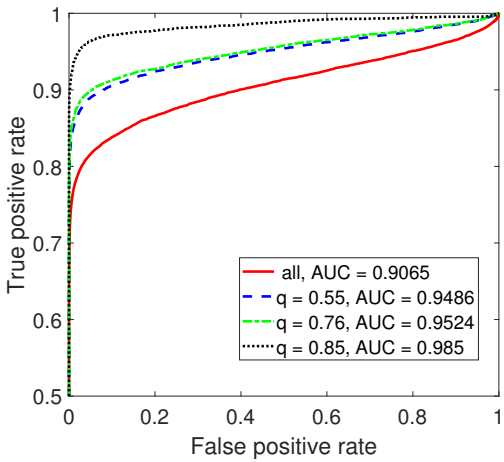
(g) LFC



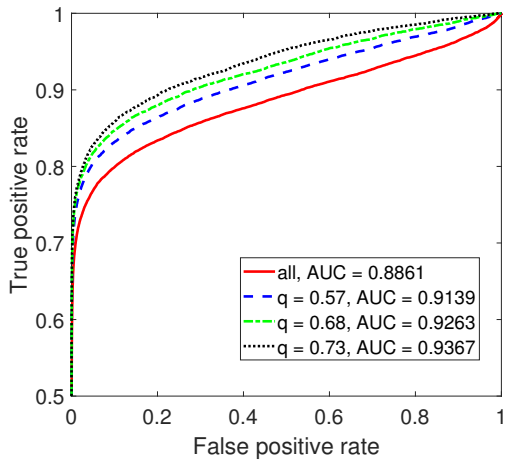
(h) PHONE

Performance evaluation (2)

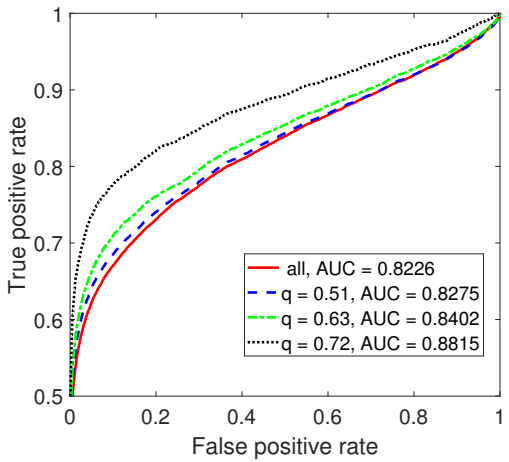
The area under the curve (AUC) of the receiver operating characteristic (ROC)



(i) REFLEX



(j) LFC

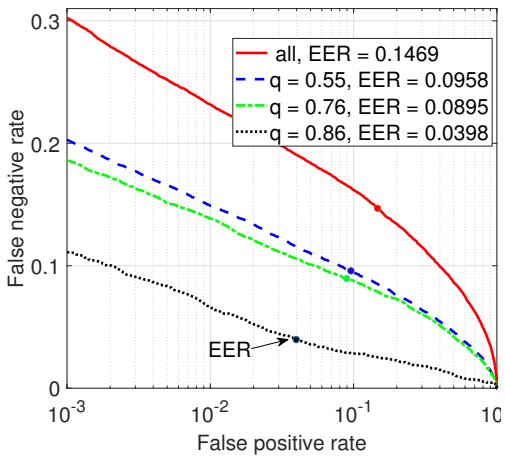


(k) PHONE

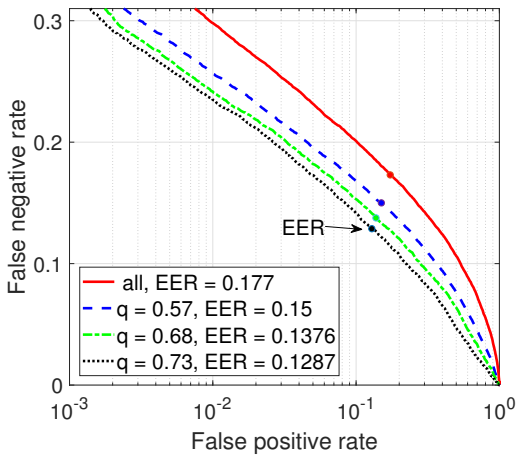
The system with the larger AUC value is considered more accurate.

Performance evaluation (3)

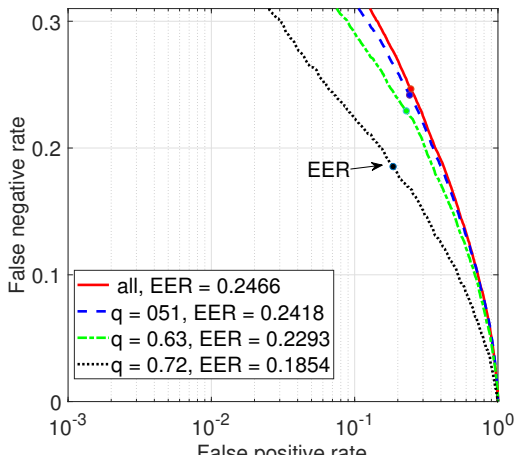
The equal error rate (EER)



(l) REFLEX



(m) LFC



(n) PHONE

The system with the lowest EER is considered the most accurate.

Conclusion

- We presented a new training free, general-purpose, and real-time image quality measure.
- Iris image quality filtering using the proposed DSMI metric improves the recognition performance of the reference iris recognition system.
- The inclusion of the quality filtering step in an iris recognition system, may increase the computational cost.
- Some iris images may be rejected unnecessarily. This could be caused by a failure of the quality measure or by a setting of the quality threshold that is too conservative.

Challenges

- Iris image acquisition in the wild using smartphones
  - real-time iris recognition system is necessary
  - Difficult mixture of distortions
  - Iris deformation
- Modeling image quality in the wild

Thank You