DEEP LEARNING BASED OFF-ANGLE IRIS RECOGNITION

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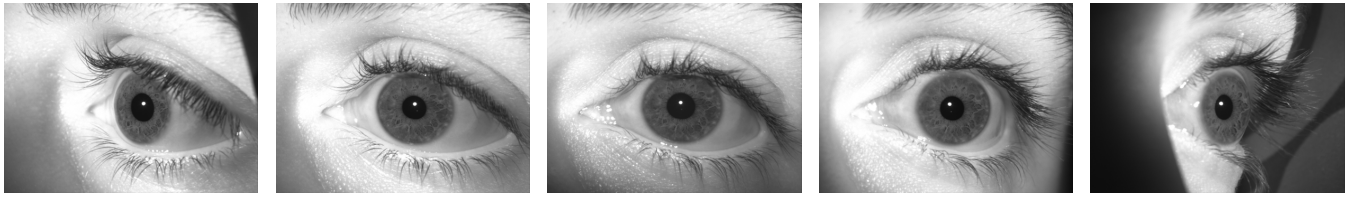
Topics

- Off-angle Iris recognition
- Which parts of the eye are most suited for CNN based recognition systems
- Method: CNN trained with Triplet loss

Dataset

- 4400 iris images captured from 40 subjects
- images from -50° to $+50^\circ$ in angle with a 10° step-size
- 10 (gray scale) iris images per angle



(a) -50 (b) -20 (c) 0 (d) 20 (e) 50

Figure: Eye image at different gaze angles

Q1: Are different gaze angles easier or harder for iris recognition

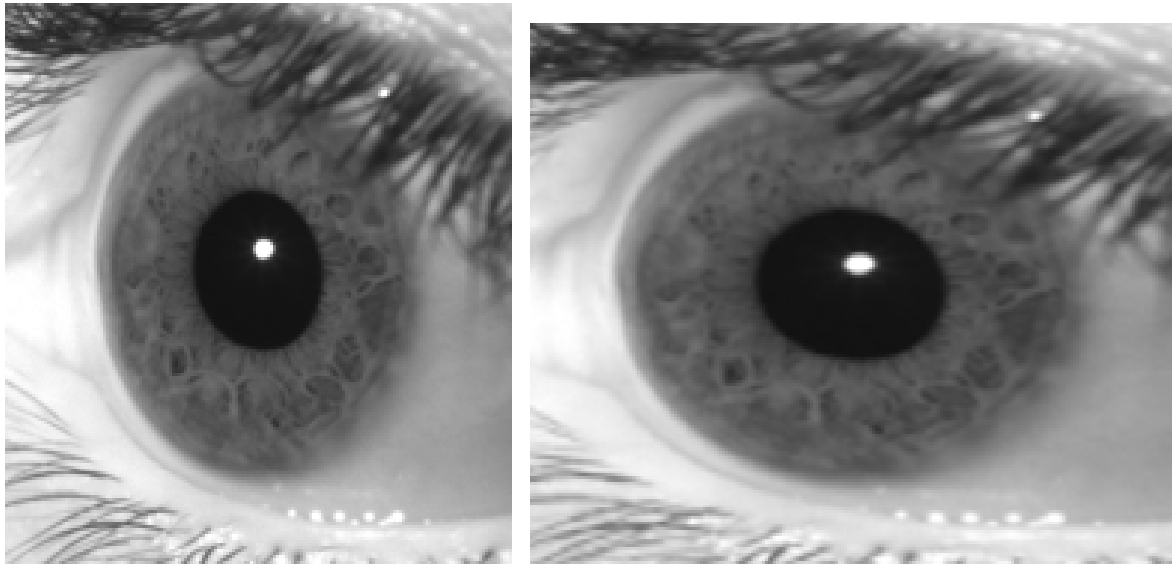
- EER is computed separately for the images of 11 different gaze angles ($-50°, -40°, ..., +40°, +50°$)
- Only similarity scores between images of the same gaze angle

Q2: What is the impact of differences in the gaze angle between image

- EER is computed using only similarity scores between images with a maximum gaze angle difference of θ with $\theta \in \{0°, 10°, 20°, 30°, 40°\}$

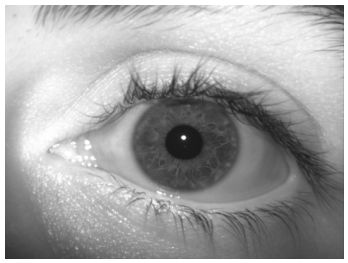
Q3: Does gaze angle correction improve the results?

- Gaze angles are corrected by bringing them to the frontal view (0°).

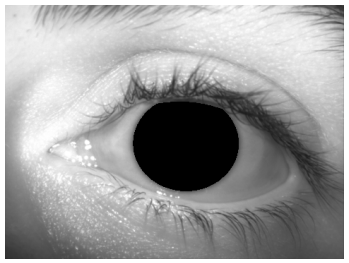


(a) Angle: -50° (b) Corrected to 0°

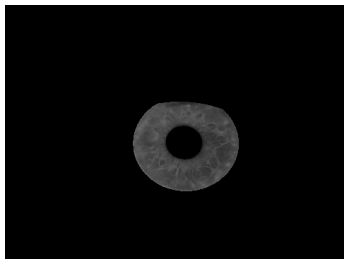
Q4: Which parts of the eye work best for the triplet loss based CNNs



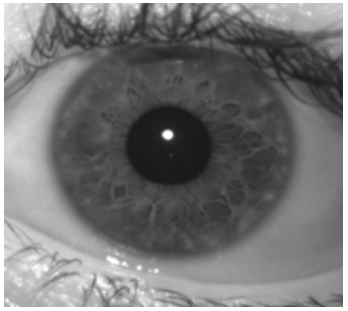
(c) full eye



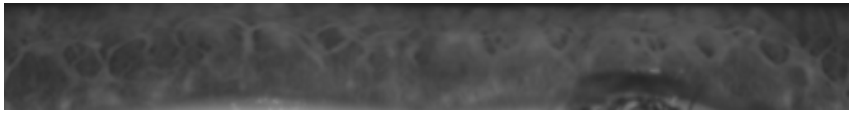
(d) without iris



(e) iris only



(f) iris zoomed



(g) normalized iris

CNN Training

- 2-fold cross validation
- All images of the training fold are used for training
- Which images of the evaluation fold are used/compared depends on the research question (Q1,Q2)
- CNN architecture: SqueezeNet
- Loss function: Triplet Loss

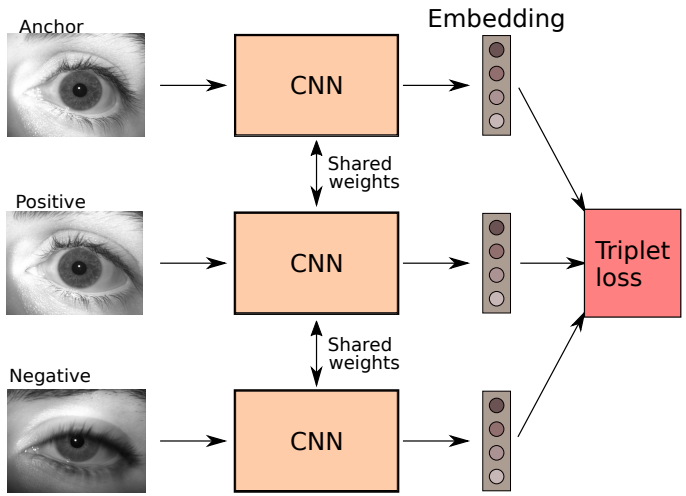
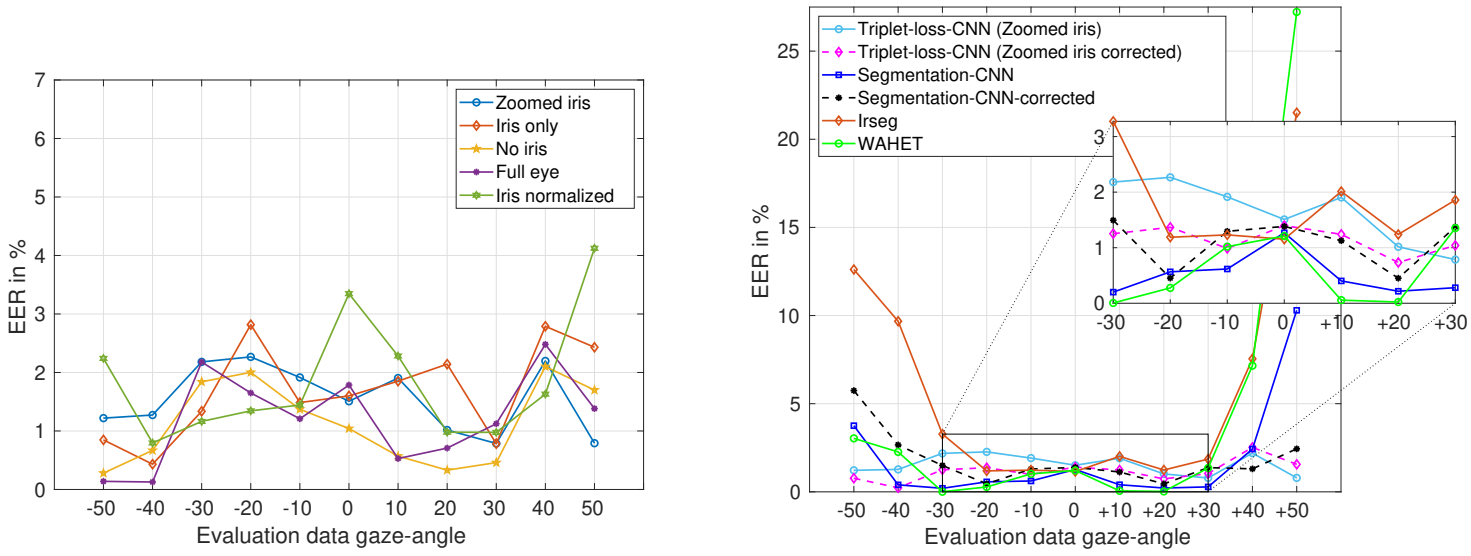


Figure: Triplet loss training

Results for different gaze angles separately

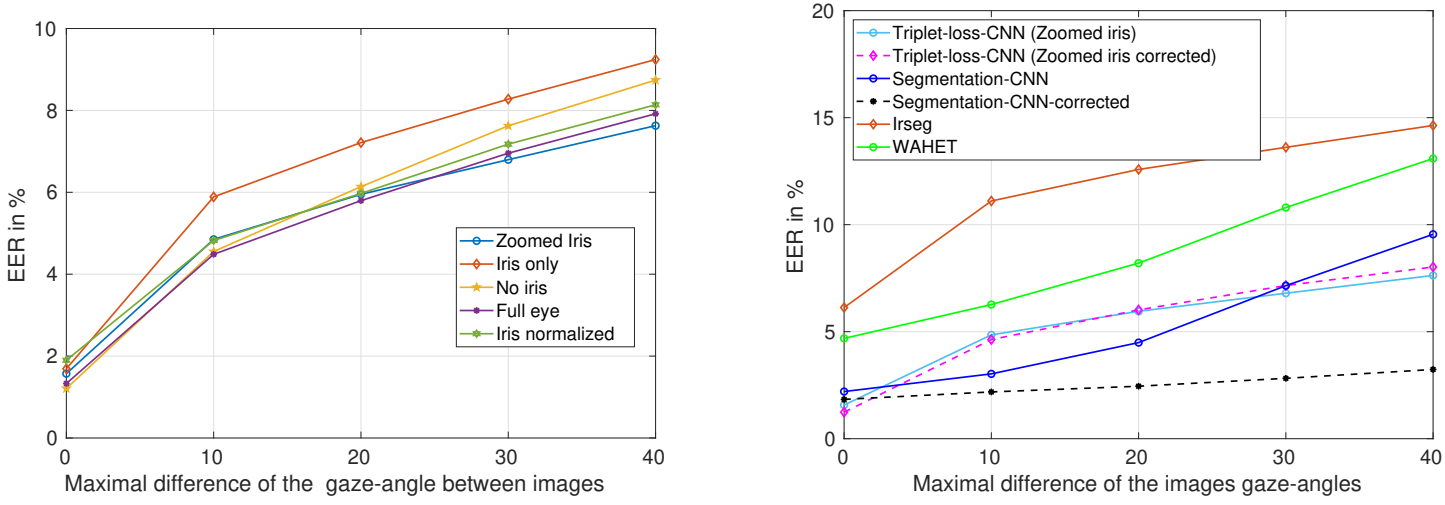


(a) Triplet Loss CNN for different parts of the eye

(b) Triplet CNN vs Comparison methods (Zoomed Iris, original and gaze angle corrected images)

Figure: Recognition results (EER in%) of the triplet loss CNN network (left) and the comparison methods (right). Only similarity scores between images of the same gaze angle are employed for EER computation

Results for differences in the gaze angle between image



(a) Triplet Loss CNN for different parts of the eye

(b) Triplet CNN vs Comparison methods (Zoomed Iris)

Figure: Recognition results (EER in%) of the triplet loss CNN network (left) abd the comparison methods (right) using only similarity scores between images with maximal gaze angle differences between 0° and 40°

Conclusion

- Q1: Results of the proposed CNN approach did not decrease at stronger gaze angles
  $\longrightarrow$ better choice than comparison methods for more extreme off-angle iris images ($\geq 30°$).
- Q2: Higher differences in the gaze angles between images deteriorate the results of our CNN approach (EER 2% at $0°$ difference and EER 8% at $40°$ difference) $\longrightarrow$ Segmentation-CNN combined with gaze angle correction provides better results
- Q3 : Gaze angle correction did not improve the results of our CNN, but for the method Segmentation-CNN.
- Q4: It is not so important which parts of the eye images are used, as the results remain similar.

Thanks for your attention.
Any questions?