Unconstrained Periocular Recognition: Using Generative Deep Learning Frameworks for Attribute Normalization

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1. Introduction
   - Periocular Recognition
   - Unconstrained Environments
   - Motivation
2. Methodology
   - Proposed Method
   - Databases
   - Att-GAN Training Process
   - Evaluation
3. Results
   - Qualitative Results
   - Quantitative Results
   - Result Analysis
4. Final Considerations
   - Discussion and Conclusions

Eye regions

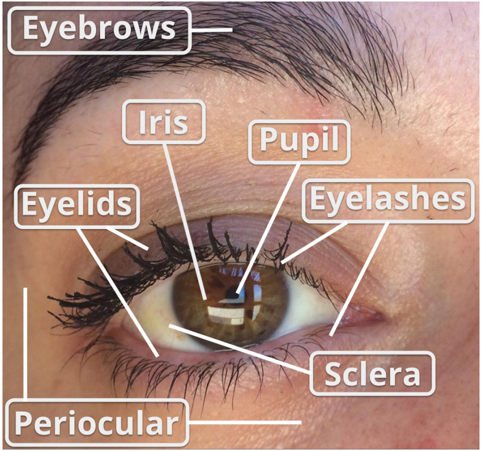
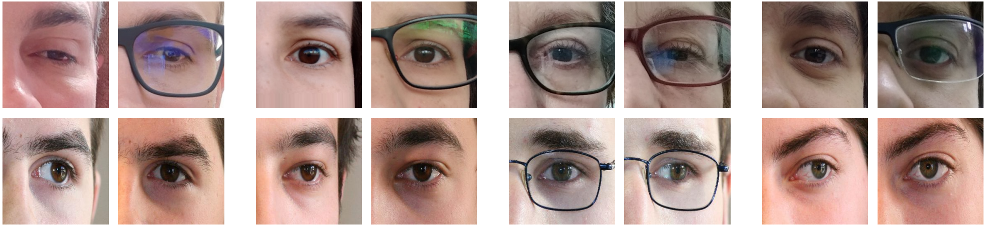


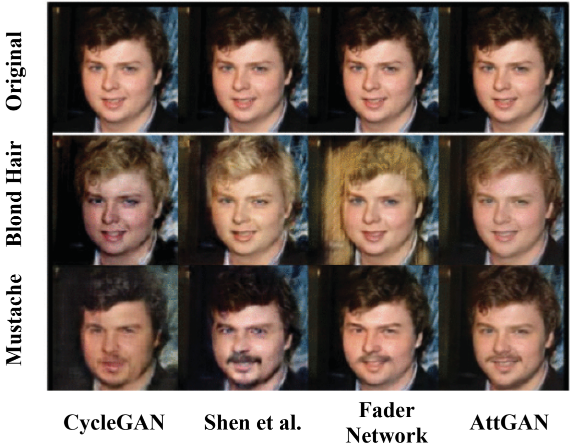
Image from [Zanlorensi et al., 2019].

Problem

- Ocular biometric systems under unconstrained environments:
  - Image: blur, motion blur, lighting, occlusion, specular reflection;
  - Subject: Eye gaze, off-angle, eyeglasses, contact lenses, makeup;
  - Feature extraction quality;
  - High intra-class variability:
- Samples:

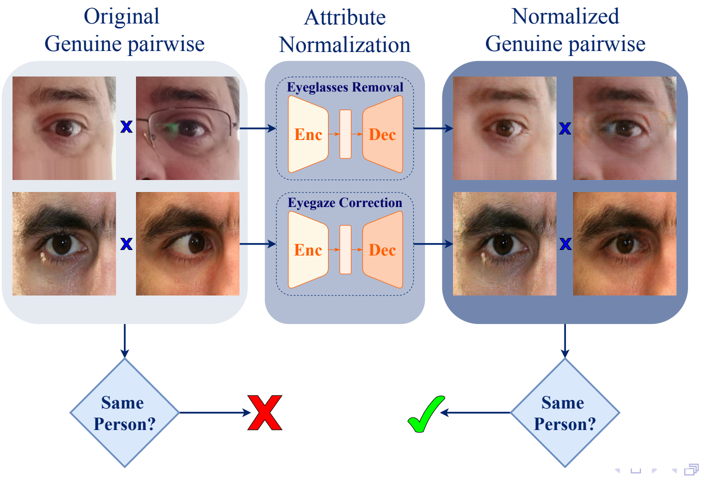


Automatic Image Editing Frameworks - Deep Learning



Adapted from [He et al., 2019].

Proposed Method

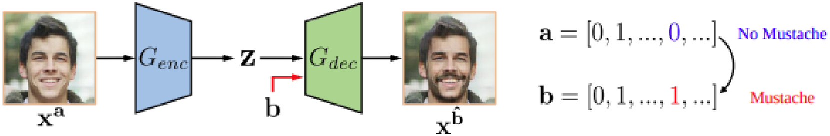


Databases

- UFPR-Eyeglasses (Eyeglasses):
  - 2270 images of both eyes (4540) from 83 subjects;
  - Images collected by the participant himself using a mobile app through 3 sections;
  - Iris bounding boxes manually annotated;
  - Images normalized regarding rotation and scale;
  - Variability factors: illumination, occlusion, distance, reflection, and eyeglasses;
- UBIPr (Eye gaze):
  - 10250 eye images from 344 subjects;
  - Variability factors: distance, scale, occlusion, pose, eye gaze, and eyeglasses;

Attribute GAN training

- Training data:
  - Eyeglasses: Entire UBIPr dataset;
  - Eye gaze: First half of the subjects from the UBIPr dataset;
- The training only used information about Eyeglasses and Eye gaze;
- Simplified process for training and test:



Adapted from [He et al., 2019].

Evaluation

- Protocol:
  - Verification - Open-world: AUC and Decidability;
  - Pairwise with different attributes;
  - All against all comparison;
  - UFPR-Eyeglasses pairs: 3,072 genuine x 274,464 impostors;
  - UBIPr pairs: 22,012 genuine x 6,246,232 impostors;
- Benchmark:
  - Handcrafted features:
    - [Park et al., 2011]: LBP, HOG, SIFT;
    - [Ahmed et al., 2017]: MB-TLBP;
    - LBP, LPQ, HOG, SIFT;
  - Deep learning - based-models:
    - [Luz et al., 2018]: VGG-16
    - [Zanlorensi et al., 2020]: ResNet-50
  - Matching: Cosine distance;

Samples of the normalized images by the Att-GAN model

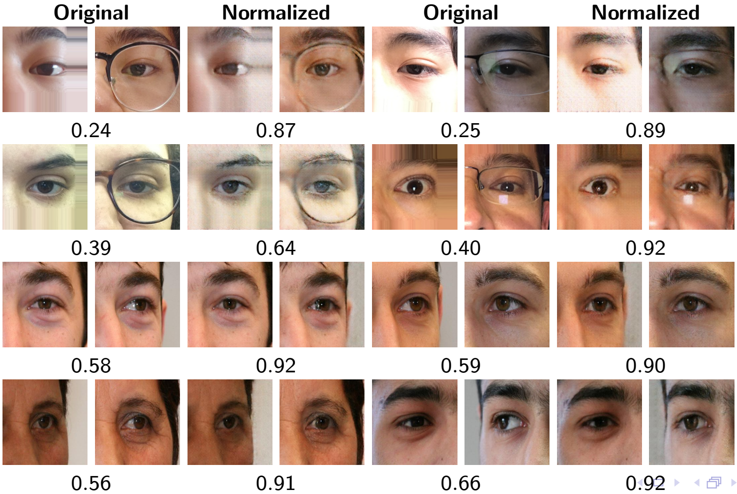
UFPR-Eyeglasses | UBIPr

Quantitative Results

Benchmarks - Agnostic Evaluation

Method - Features	Att. Norm.	UFPR-Eyeglasses AUC (%)	UFPR-Eyeglasses Decidability	UBIPr AUC (%)	UBIPr Decidability
Ahmed et al. [Ahmed et al., 2017]		73.0	0.77	84.9	1.16
	✓	**73.2**	**0.79**	**85.2**	**1.17**
Park et al. [Park et al., 2011]		78.8	1.11	**89.6**	**1.73**
	✓	**85.2**	**1.43**	87.8	1.62
LBP + LPQ + HOG + SIFT		75.9	0.92	**90.2**	1.71
	✓	**87.2**	**1.58**	90.0	**1.77**
Luz et al. [Luz et al., 2018]		85.9	1.57	**98.3**	**3.64**
	✓	**89.0**	**1.81**	98.1	3.50
Zanlorensi et al. [Zanlorensi et al., 2020]		92.2	2.09	99.2	4.00
	✓	**92.9**	**2.16**	**99.4**	**4.14**

Pairwise mathcing score analysis



Discussion and Conclusions

- Attribute normalization scheme (preprocessing) to reduce the intra-class variability;
- Our proof-of-concept was conducted in two datasets and five different baseline;
- The results corroborated our hypothesis that the attribute normalization can reduce the intra-class variabilities, without compromising the discriminability between classes;

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Thank you!

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UFPR

Visão Robótica Imagem

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