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From Recognition to Generation: Advancements in Biometrics

Peter Peer
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School of Information and Communication Technology, Hanoi University of Science and Technology, Feb. 28 2024


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Location: R2.33

We research the capture, processing and interpretation of 2D and 3D visual data, machine learning in computer vision, and the use of images in computer-human interactions. We work in the following specific areas: interactive visual signage systems, 3D documentation in archaeology and cultural heritage, interpretation of images in biometry, medicine, geology and meteorology, the forensic analysis of images and video, virtual and augmented reality, as well as in the production of computer games and in new media art installations (in cooperation with the Academy of Fine Arts).

Main research topics at the moment:

ear recognition,
sclera and ocular region recognition,
face deidentification,
face privacy preservation

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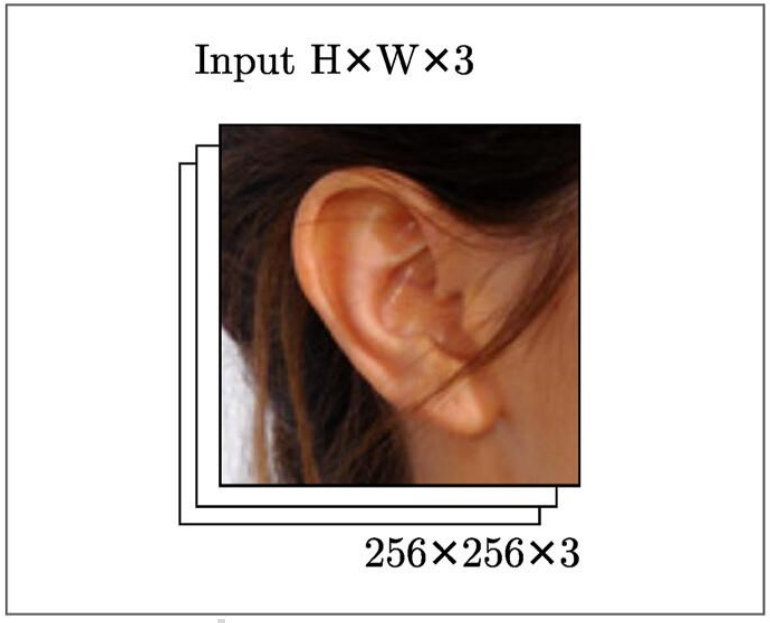
IET Biometrics

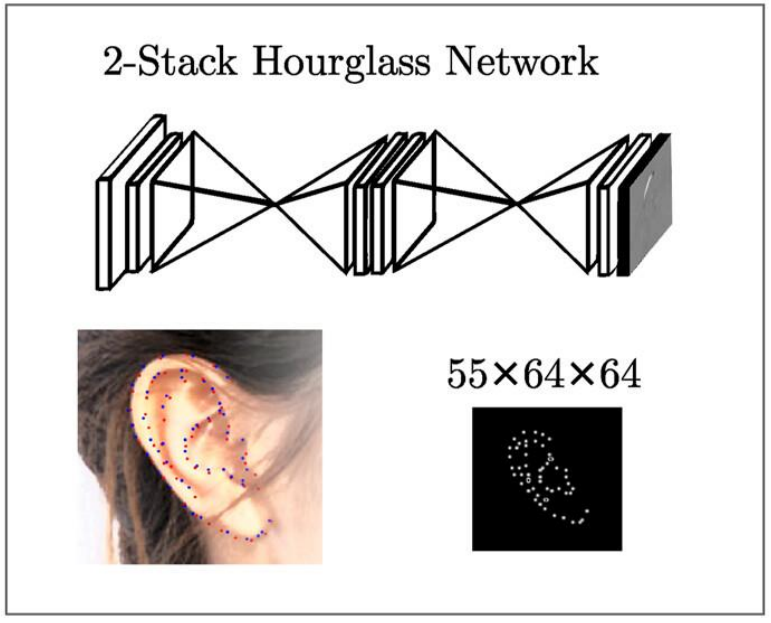
ORIGINAL RESEARCH | Open Access

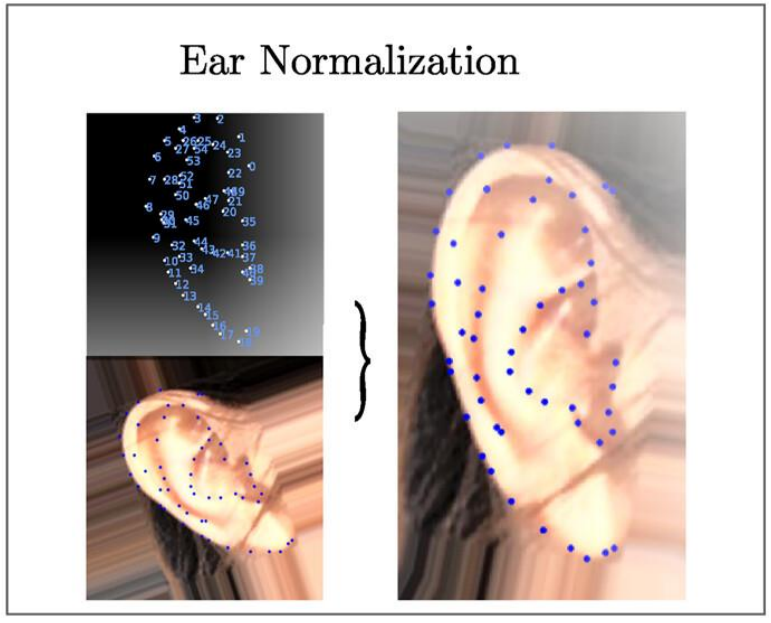
Efficient ear alignment using a two-stack hourglass network

Anja Hrovatič, Peter Peer, Vitomir Štruc, Žiga Emeršič

First published: 13 March 2023 | https://doi.org/10.1049/bme2.12109







framework for ear alignment that relies on a two-step procedure: (i) automatic landmark detection and (ii) fiducial point alignment. For the first (landmark detection) step, the authors implement and train a Two-Stack Hourglass model (2-SHGNet) capable of accurately predicting 55 landmarks on diverse ear images captured in uncontrolled conditions. For the second (alignment) step, the authors use the Random Sample Consensus (RANSAC) algorithm to align the estimated landmark/fiducial points with a pre-defined ear shape (i.e. a collection of average ear landmark positions). The authors evaluate the proposed framework in comprehensive experiments on the AWEx and ITWE

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Image and Vision Computing
Volume 132, April 2023, 104646

Occluded thermal face recognition using *Bo*CNN and radial der descriptor

Sumit Kumar [a], Satish Kumar Singh [a]

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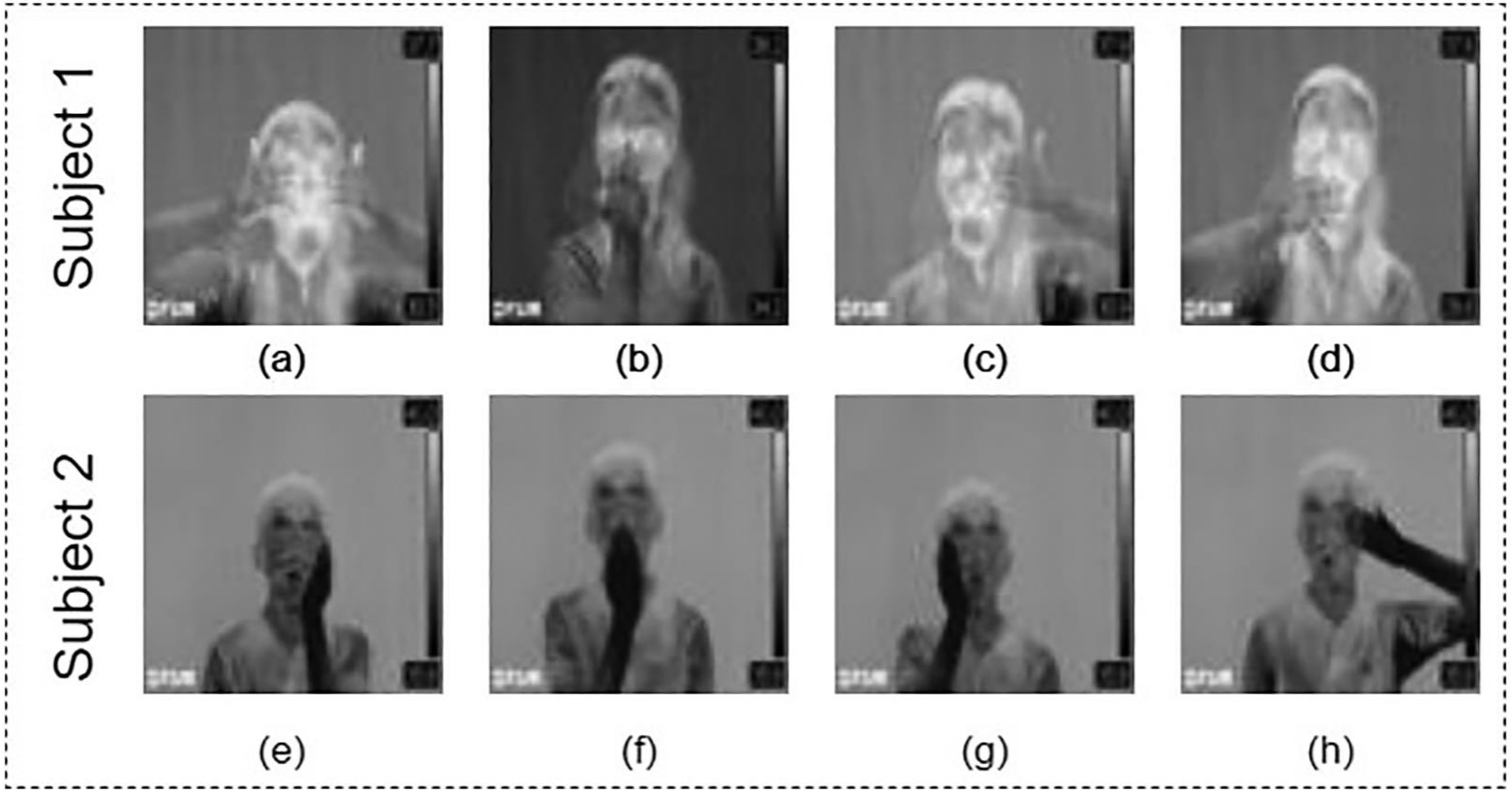
https://doi.org/10.1016/j.imavis.2023.104646



Abstract

In this work, we propose a Radial deriva handcrafted feature descriptor for disgu encoding has been done so that the per well over challenging datasets. We propose a cascaded framework that combines two modules, namely *Bo*CNN and the RDGF descriptor. The cascading architecture estimates the performance of *Bo*CNN before classification. It also uses a dynamic classifier selector in run time to choose between handcrafted features and the CNN framework to enhance the overall performance. We also propose a thermal face dataset with partial occlusion. We have compared the performance of the *RDGF* descriptor with state-of-the-art

Open Access Article

Person-Specific Gaze Estimation from Low-Quality Webcam Images

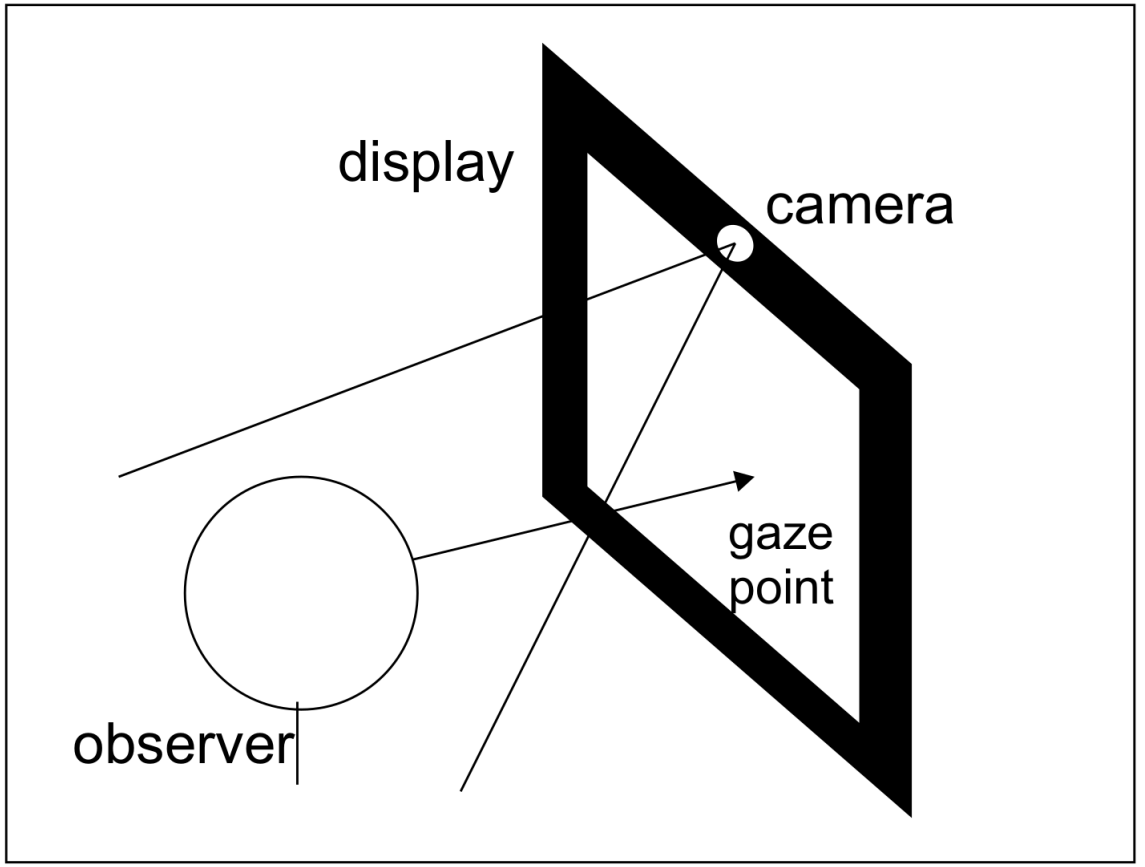
by Mohd Faizan Ansari [1,*], Pawel Kasprowski [1] and Peter Peer [2]

[1] Department of Applied Informatics, Silesian University of Technology, 44-100 Gliwice, Poland
[2] Faculty of Computer and Information Science, University of Ljubljana, Večna Pot 113, SI-1000 Ljubljana, Slovenia
* Author to whom correspondence should be addressed.

Sensors **2023**, *23*(8), 4138; **https://doi.org/10.3390/s23084138**

Received: 24 February 2023 / Revised: 5 April 2023 / Accepted: 11 April 2023 / Publis

(This article belongs to the Special Issue **Eye Tracking Sensors Data Analysis with Dee**



Abstract

Gaze estimation is an established research problem in computer vision. It has various a
human–computer interactions to health care and virtual reality, making it more viable fo
Due to the significant success of deep learning techniques in other computer vision t
classification, object detection, object segmentation, and object tracking—deep learning-
also received more attention in recent years. This paper uses a convolutional neural n
specific gaze estimation. The person-specific gaze estimation utilizes a single model trai
contrary to the commonly-used generalized models trained on multiple people's data. V
images directly collected from a standard desktop webcam, so our method can be applie
equipped with such a camera without additional hardware requirements. First, we used th
dataset of face and eye images. Then, we tested different combinations of CNN parame
and dropout rates. Our findings show that building a person-specific eye-tracking model produces better results with a selection of good hyperparameters when compared to universal models that are trained on multiple users' data. In particular, we achieved the best results for the left eye with 38.20 MAE (Mean Absolute Error) in pixels, the right eye with 36.01 MAE, both eyes combined with 51.18 MAE, and the whole face with 30.09 MAE, which is equivalent to approximately 1.45 degrees for the left eye, 1.37 degrees for the right eye, 1.98 degrees for both eyes combined, and 1.14 degrees for full-face images.

Open Access Article

Probabilistic Fingermark Quality Assessment with Quality Region Localisation

by Tim Oblak [1,2,*,†], Rudolf Haraksim [2], Laurent Beslay [2] and Peter Peer [1]

[1] Faculty of Computer and Information Science, University of Ljubljana, 1000 Ljubljana, Slovenia
[2] Joint Research Centre, European Commission, 21027 Ispra, Italy
* Author to whc
† Tim Oblak is
collaboration

Sensors **2023**, 2

Received: 17 M

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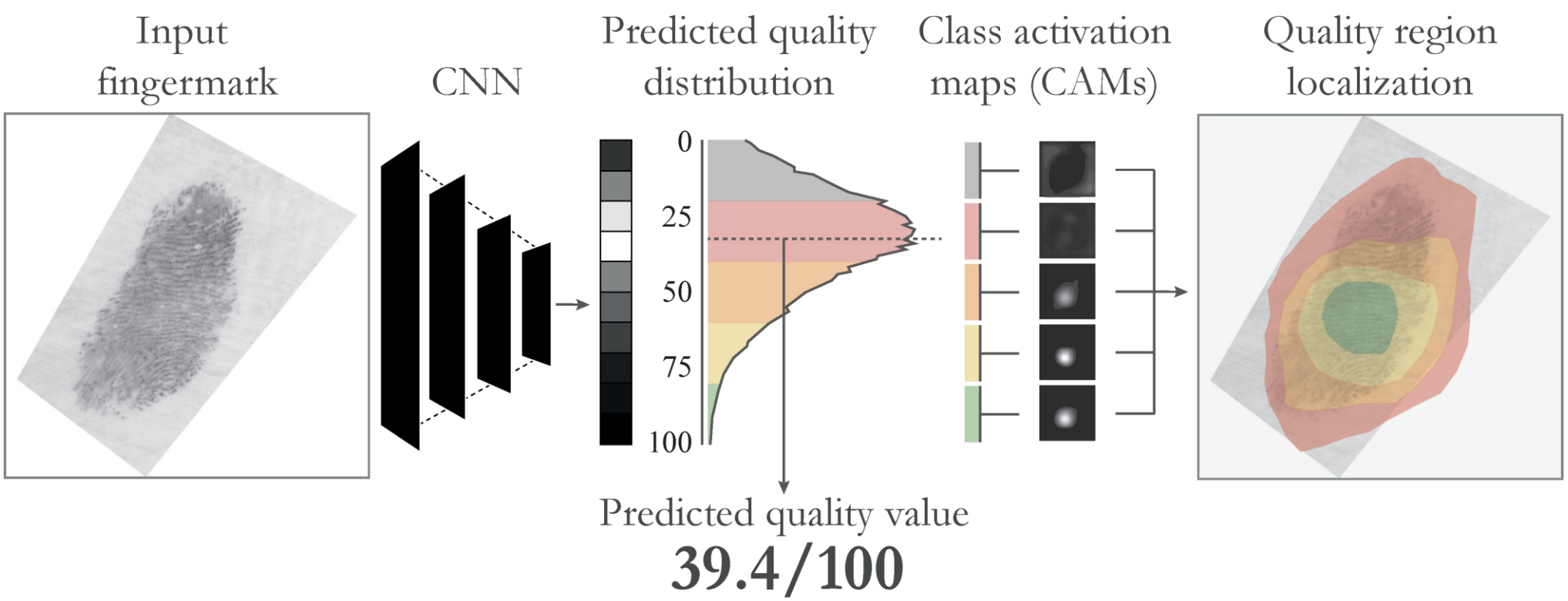

Abstract

The assessment
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ridge pattern. In
(AFQA). We used modern deep learning techniques, which have the ability to extract patterns even from noisy data, and combined them with a methodology from the field of eXplainable AI (XAI) to make our models more transparent. Our solution first predicts a quality probability distribution, from which we then calculate the final quality value and, if needed, the uncertainty of the model. Additionally, we complemented the predicted quality value with a corresponding quality map. We used GradCAM to determine which regions of the fingermark had the largest effect on the overall quality prediction. We show that the resulting quality maps are highly correlated with the density of minutiae points in the input image. Our deep learning approach achieved high regression performance, while

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Image and Vision Computing
Volume 134, June 2023, 104678

Face deidentification with contr protection

Blaž Meden [a], Manfred Gonzalez-Hernandez [b], Peter Peer [a],

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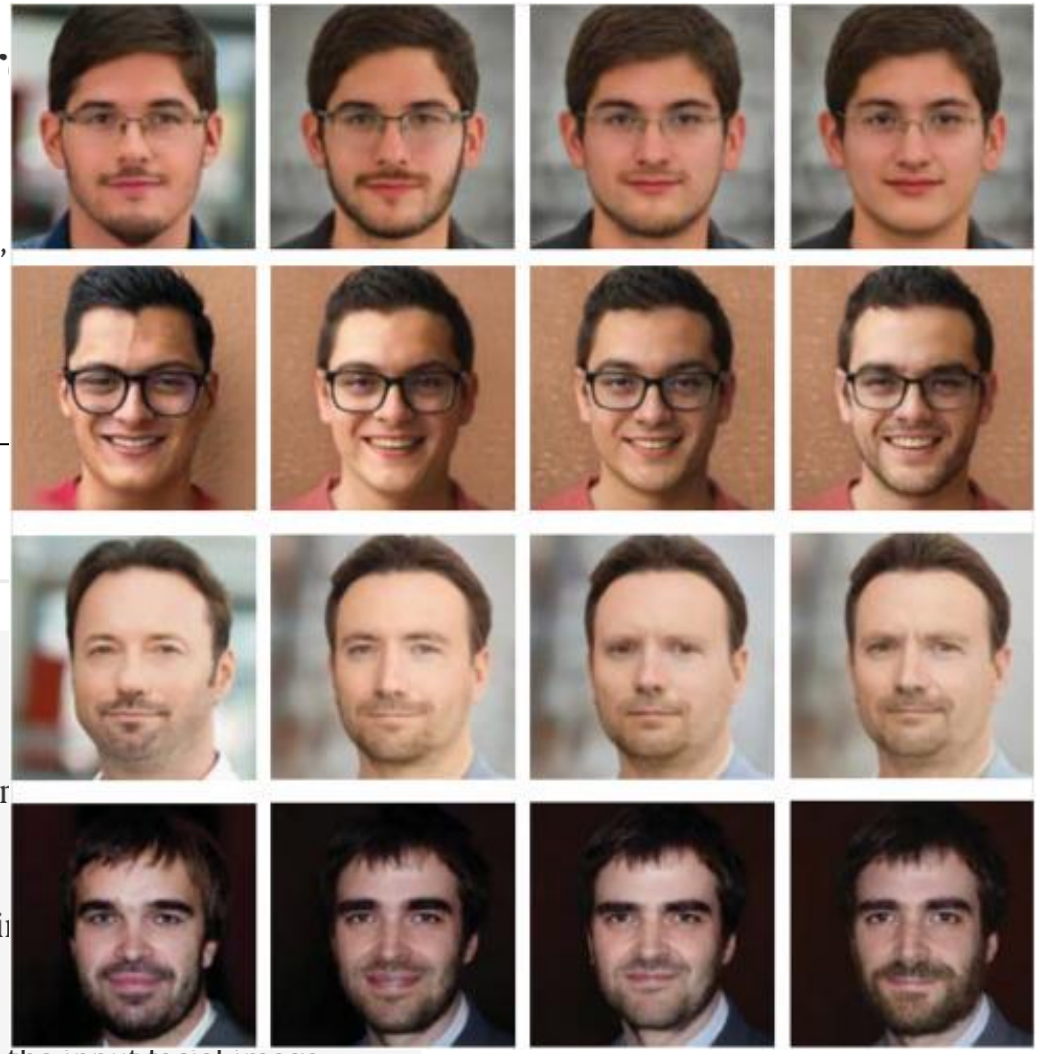
https://doi.org/10.1016/j.imavis.2023.104678



Highlights

- CPP-DeID is a face deidentification algorithm allowir privacy.
- Algorithm performs optimization on the input face i criteria loss.
- Our approach preserves as many visual details from the input facial image as possible.
- It shows competitive performance compared to the state-of-the-art

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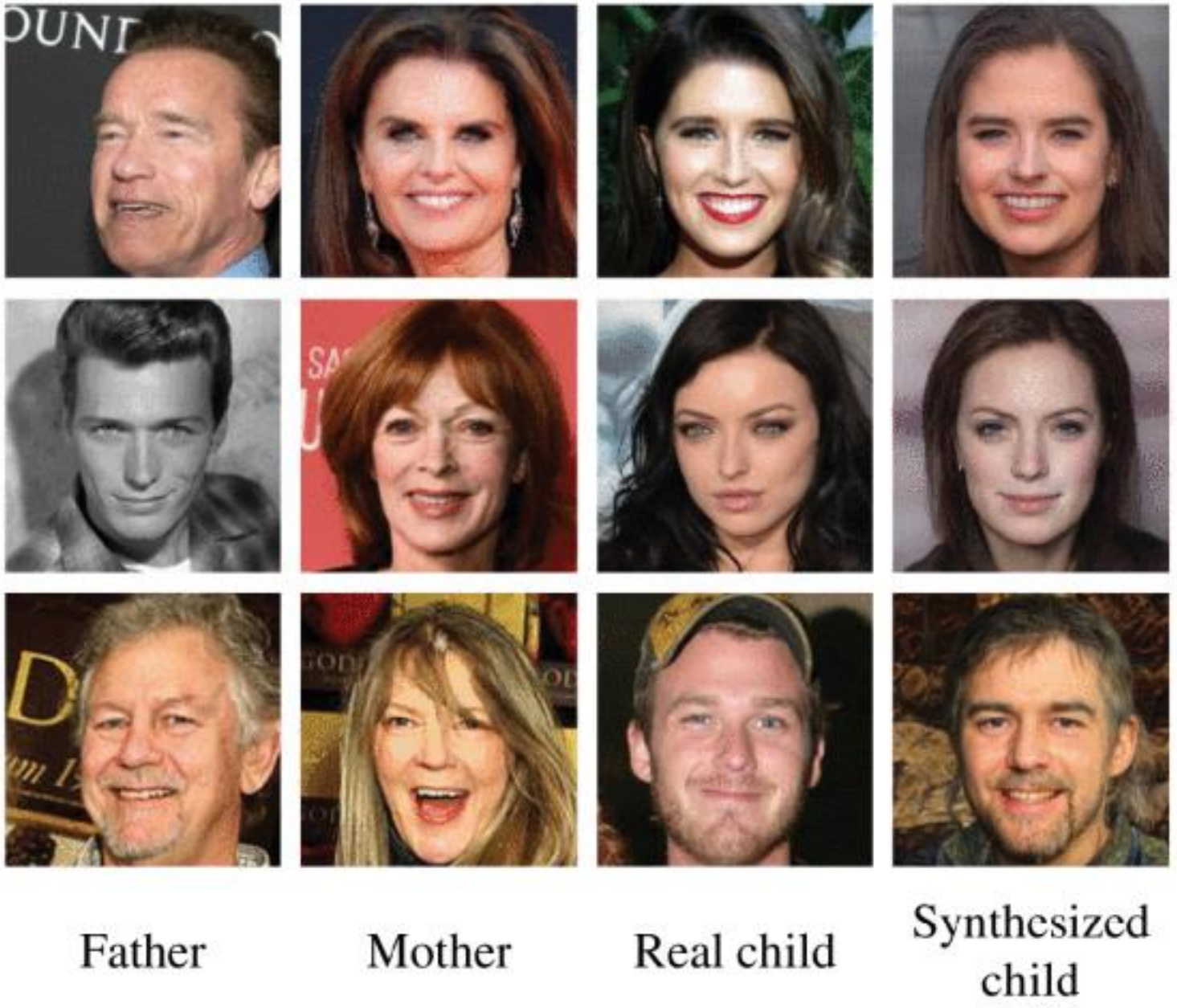
ChildNet: Structural Kinship Face Synthesis Model With Appearance Control Mechanisms

Publisher: IEEE

Cite This

PDF

Martin Pernuš ; Mansi Bhatnagar ; Badr Samad ;



Abstract

Document Sections

Abstract:

Kinship face synthesis is
particularly the task of pr
been limited in terms of
resolution and tightly cro
ChildNet, a method for k
of a state-of-the-art Gen
problems. ChildNet is de
that bears high resembla
age and gender manipul
ChildNet is capable of generating multiple child images per parent pair input, while providing a way to

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Journal of King Saud University – Computer and Information Sciences

IPAD: Iterative

Matej Vitek [a,*], Mati

[a] Faculty of Computer and Inform
[b] Faculty of Electrical Engineering

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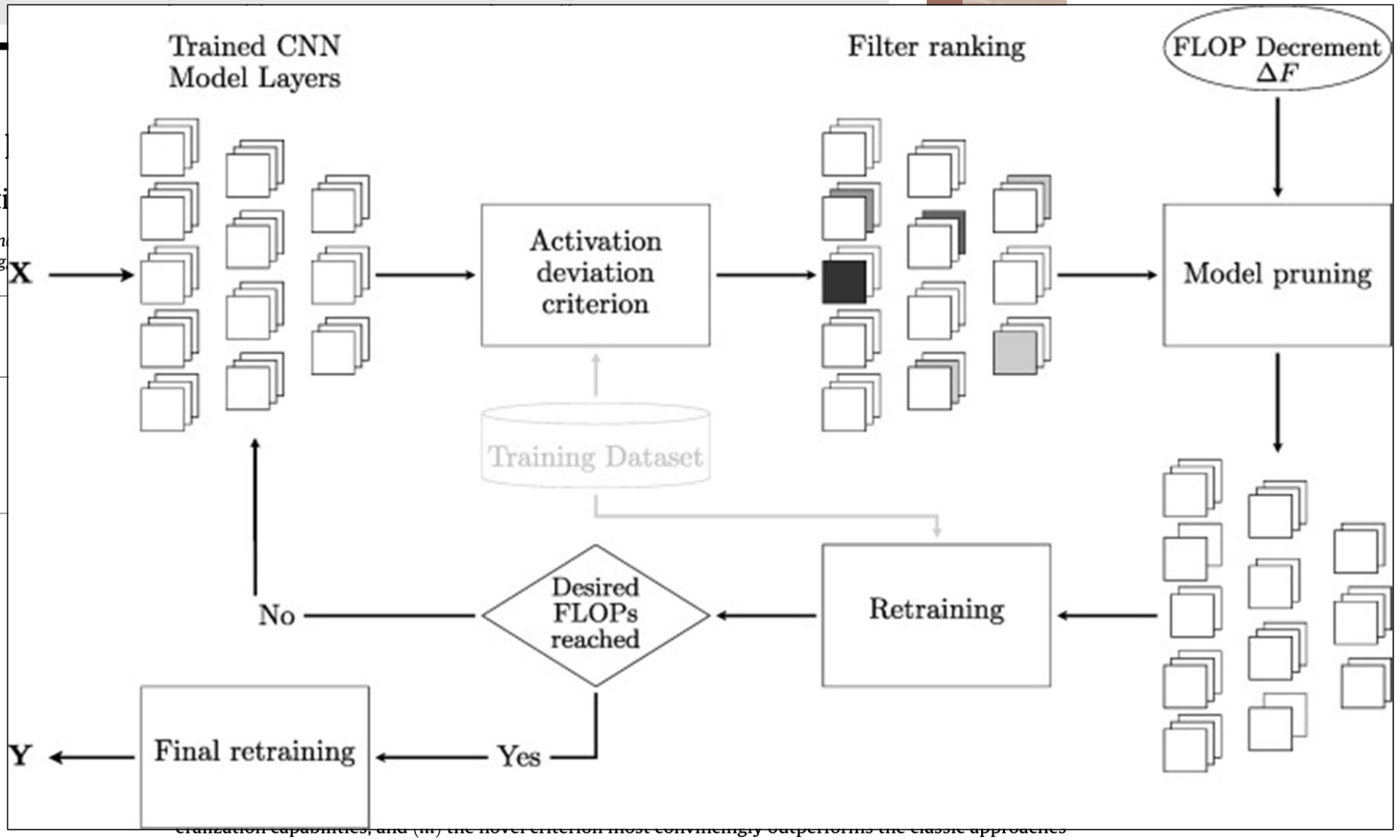
Lightweight deep learning



when sufficient training data is available, implying that the abundance of data leads to more robust activation-based importance computation.

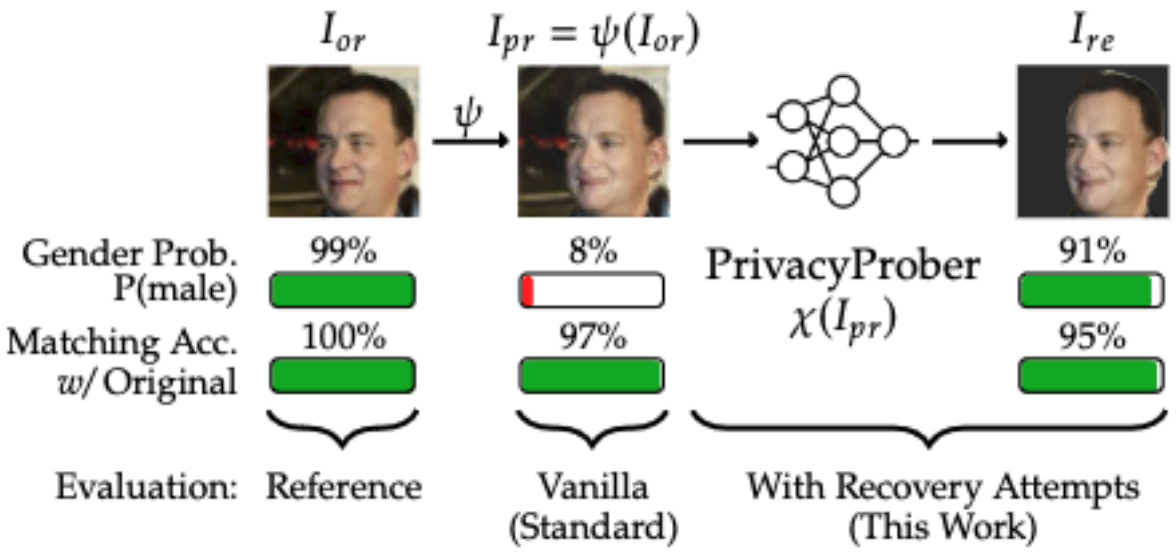
PrivacyProber: Assessment and Detection of Soft–Biometric Privacy–Enhancing Techniques

Publisher: IEEE

Peter Rot ; Klemen Grm ; Peter Peer ; Vitomir Štruc **All Authors**

Abstract:

Soft–biometric privacy–enhancing techniques represent machine learning methods that aim to: (i) mitigate privacy concerns associated with face recognition technology b age, ethnicity) and (ii) make unsolicited extra increasingly used in real–world applications, inverted and how much attribute information they have not been investigated in the literatu the–art soft–biometric privacy–enhancing tec framework for restoring soft–biometric inform comprehensive experiments on three public d proposed framework is able to restore a cons technique used (e.g., adversarial perturbatio between the considered privacy models. The robustness of existing privacy–enhancing tec suppressed information. Additionally, we demonstrate that PrivacyProber can also be used to detect privacy–enhancement in



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BiFaceGAN: Bimodal Face Image Synthesis

Darian Tomašević[1*], Peter Peer[1] and Vitomir Štruc[2]

[1]Faculty of Computer and Information Science, University of Ljubljana, Večna p
[2]Faculty of Electrical E
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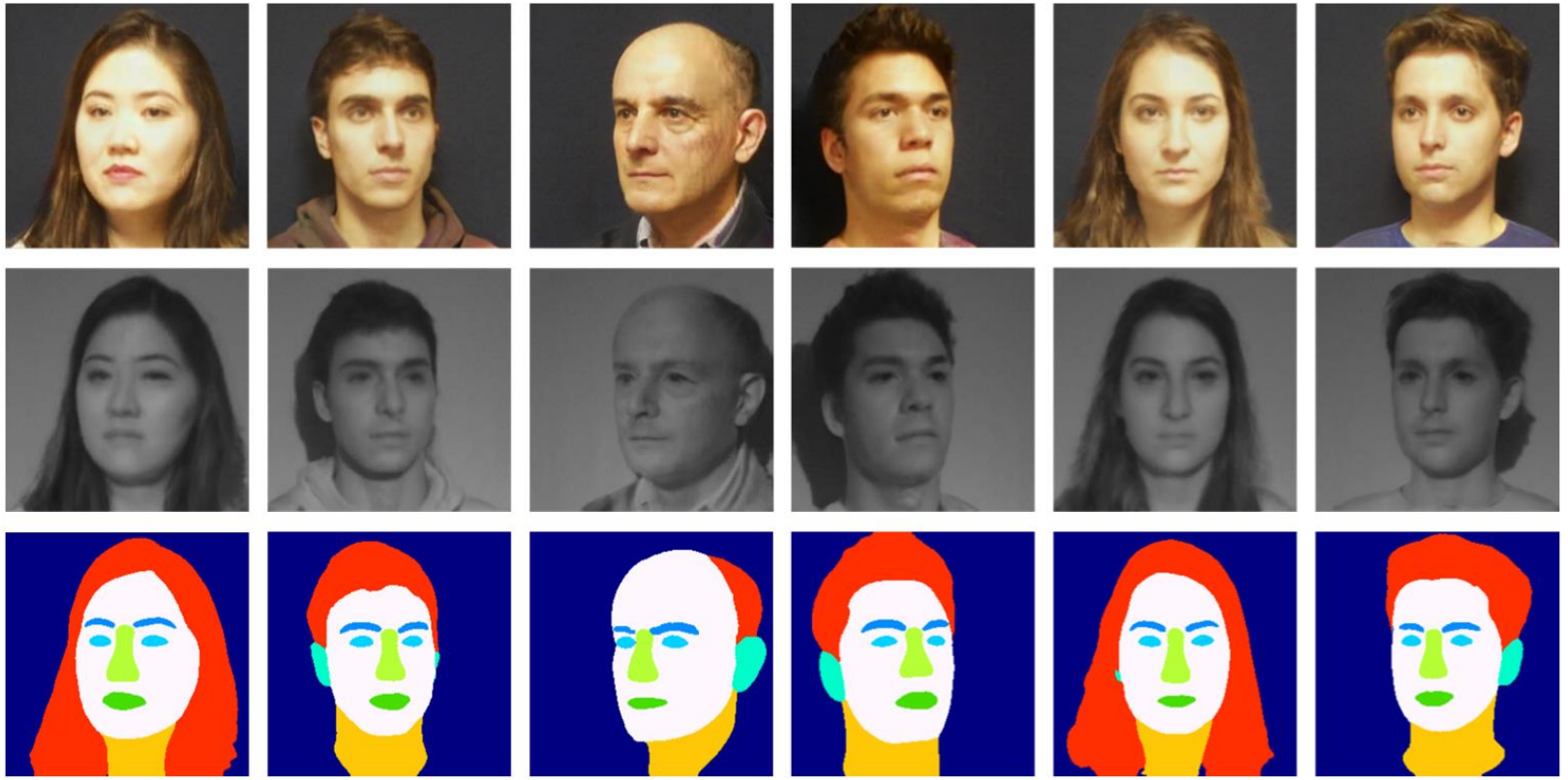

Modern face recognition a
learning approaches, rely on large-scale annotated datasets to achieve competitive performance. However, gathering biometric data often raises privacy concerns and presents a labor-intensive and time-consuming task. Researchers are currently also exploring the use of multispectral data to improve existing solutions, limited to the visible spectrum. Unfortunately, the collection of suitable data is even more difficult, espe

Springer Nature book on Face Recognition Across the Imaging Spectrum, 2024

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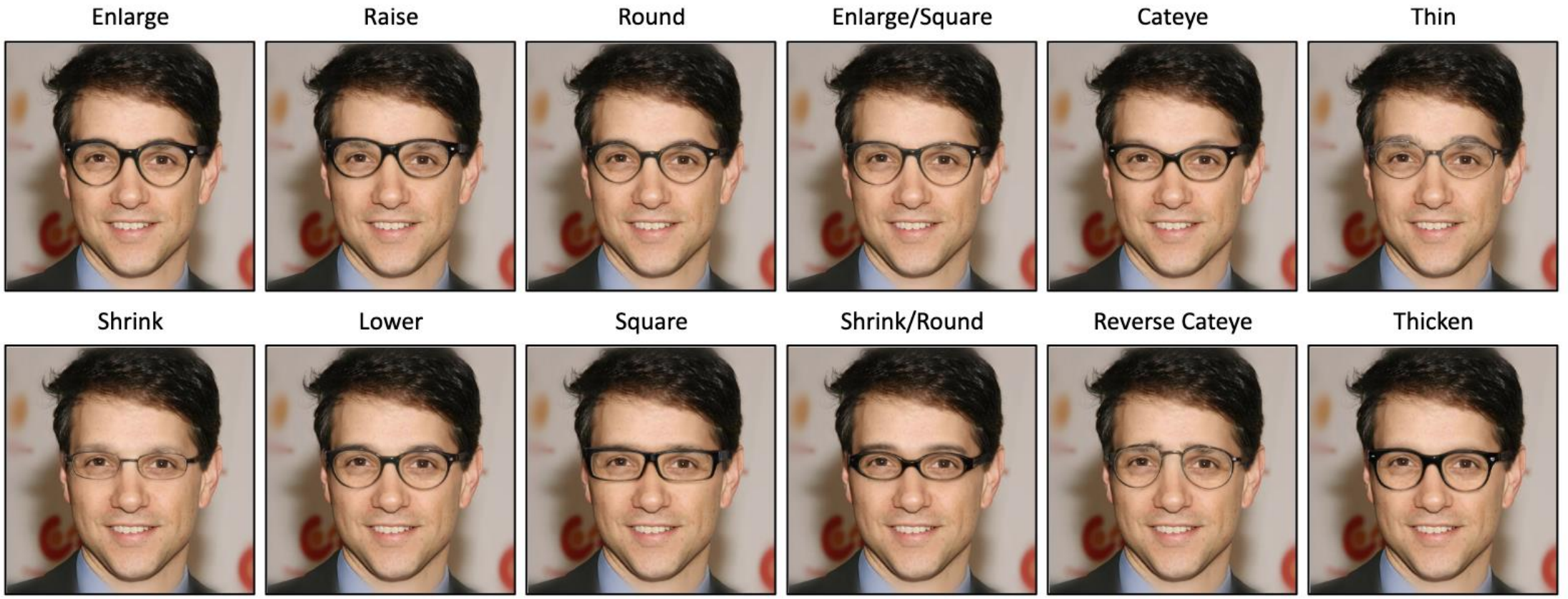
GlassesGAN: Eyewear Personalization Using Synthetic Appearance Discovery and Targeted Subspace Modeling



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convincingly outperforms all competing techniques, while offering functionality (e.g., fine-grained multi-style editing) not available with any of the competitors. The source code for GlassesGAN is made publicly available.

Computer Science > Computer Vision and Pattern Recognition

[Submitted on 21 Nov 2022]

SeeABLE: Soft Discrepancies and Bounded Contrastive Learning for Exposing Deepfakes

Nicolas Larue, Ngoc-Son Vu, Vitomir Struc, Peter Peer, Vassilis Christophides

Modern deepfake detectors have achieved encouraging results, when training and test images are drawn from the same collection. However, when applying these detectors to faces manipulated using an unknown technique, considerable performance drops are typically observed. In this work, we propose a novel deepfake detector, called SeeABLE, that formalizes the detection problem as a (one-class) out-of-distribution detection task and generalizes better to unseen deepfakes. Specifically, SeeABLE uses a novel data augmentation strategy to synthesize fine-grained local image anomalies (referred to as soft-discrepancies) and pushes those pristine disrupted faces towards predefined prototypes using a novel regression-based bounded contrastive loss. To strengthen the generalization performance of SeeABLE to unknown deepfake types, we generate a rich set of soft discrepancies and train the detector: (i) to localize, which part of the face was modified, and (ii) to identify the alteration type. Using extensive experiments on widely used datasets, SeeABLE considerably outperforms existing detectors, with gains of up to +10\% on the DFDC-preview dataset in term of detection accuracy over SoTA methods while using a simpler model. Code will be made publicly available.

Subjects: **Computer Vision and Pattern Recognition (cs.CV)**
Cite as: arXiv:2211.11296 **[cs.CV]**
(or arXiv:2211.11296v1 **[cs.CV]** for this version)
https://doi.org/10.48550/arXiv.2211.11296

ICCV 2023

Sclera Segmentation and Joint Recognition Benchmarking Competition: SSRBC 2023

The Unconstrained Ear Recognition Challenge 2023: Maximizing Performance and Minimizing Bias

DFGC-VRA: DeepFake Game Competition on Visual Realism Assessment

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DifFIQA: Face Image Quality Assessment Using Denoising Diffusion Probabilistic Models


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eDifFIQA: Towards Efficient Face Image Quality Assessment based on Denoising Diffusion Probabilistic Models

IEEE Transactions on Biometrics, Behavior, and Identity Science (to be published)

Žiga Babnik, *Member, IEEE,* Peter Peer, *Senior Member, IEEE,* and Vitomir Štruc, *Senior Member, IEEE*

Abstract—State-of-the-art Face Recognition (FR) models perform well in constrained scenarios, but frequently fail in difficult real-world scenarios, when no quality guarantees can be made for face samples. For this reason, Face Image Quality Assessment (FIQA) techniques are often used by FR systems, to provide quality estimates of captured face samples. The quality estimate provided by FIQA techniques can be used by the FR system to reject samples of low-quality, in turn improving the performance of the system and reducing the number of critical false-match errors. However, despite steady improvements, ensuring a good trade-off between the performance and computational complexity of FIQA methods across diverse face samples remains challenging. In this paper, we present DifFIQA, a powerful
models (DDPMs) and the ex
backward processes of DDP
embeddings for quality predi
expensive. Using eDifFIQA v
approach, by employing labe
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CNN-based FR models and
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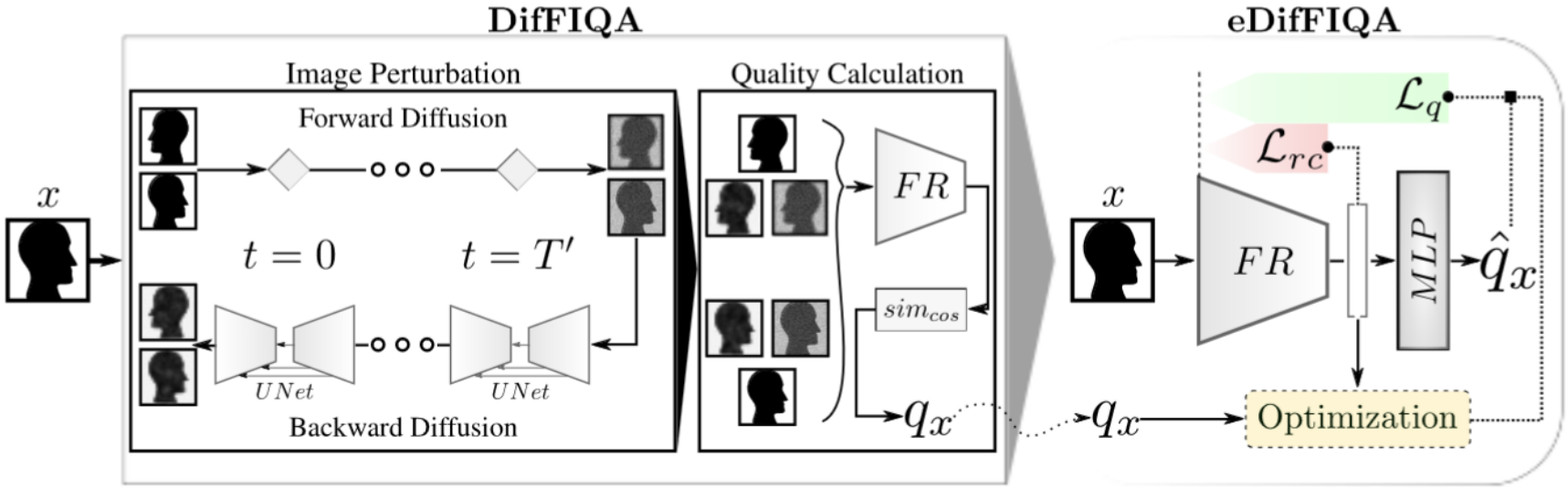
experimental scenarios. Furthermore, we also show that the distilled model can be used directly for face recognition and leads to highly competitive results.



Index Terms—Computer Vision, Face Recognition, Face Image Quality Assessment, Denoising Diffusion Probabilistic Models, Knowledge Distillation, Label Optimization

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- Contact Peter Peer (peter.peer@fri.uni-lj.si) for topics related to computer vision

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