FACE MORPHING DETECTION: ISSUES AND CHALLENGES

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MAD schemes

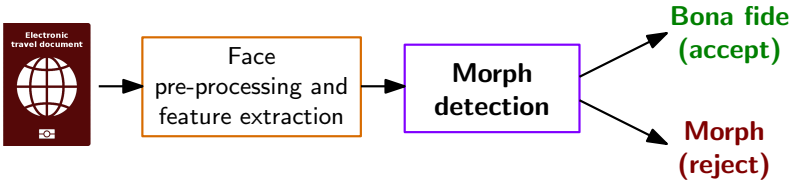
MAD approaches

MAD based on deep face representations

Questions and Challenges

MAD schemes

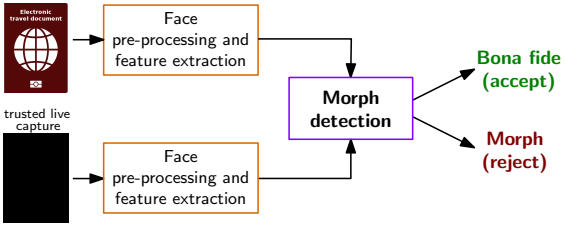
No-Reference Detection (single image MAD)



- single image, e.g. at application desk
- detection of certain artefacts (e.g. ghost artefacts)
- carefully created morphs contain only a few recognizable artefacts
- sensitive to post processing, e.g. print-scan transformation

MAD schemes

Reference Based Detection Scheme (differential MAD)



- compares the potentially morphed reference image with a trusted probe image, e.g. at eGates
- differences between potential morph and trusted live capture are analyzed
- less sensitive to post-processing

MAD approaches

Categories of MAD approaches

Single image MAD:

- Texture descriptors
- Forensic image analysis
- Deep-Learning approaches

Differential MAD:

- comparison of two facial images (e.g. differences in deep face representations)
- reversing of the morphing process (De-Morphing)

MAD based on deep face representations

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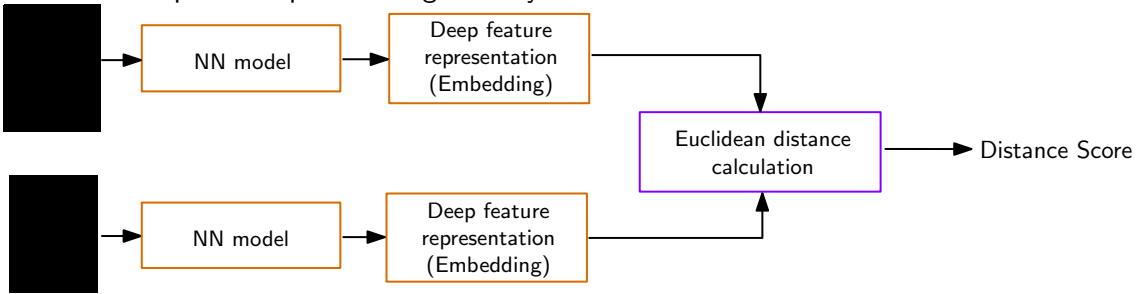
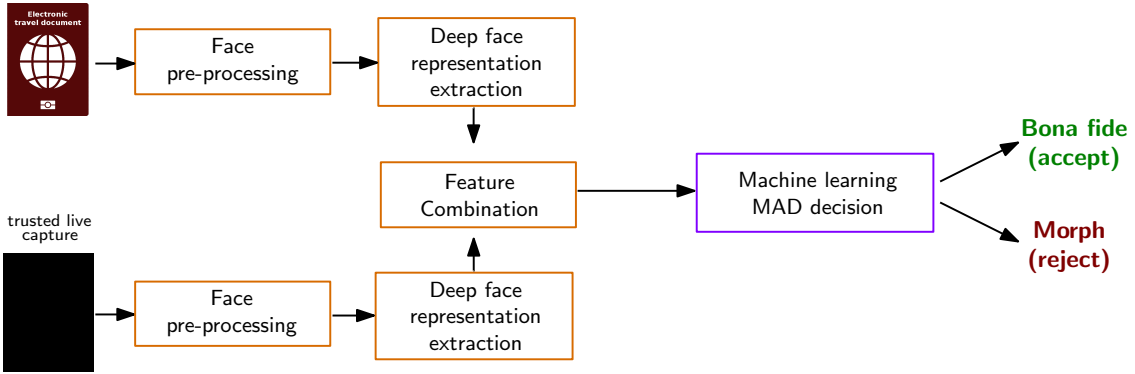
Deep face representation

General concept of Deep face recognition systems



MAD based on deep face representations

System Scheme



Advantages of MAD based on deep face representations

- CNNs are trained to extract relevant features from face images
- no expensive training of new CNNs required
- CNNs are not trained on morphed face images (no over-fitting)
- the feature extractors are highly robust to various changes in the image

MAD based on deep face representations

Database

Requirements for realistic databases:

- Passport images:
  - ICAO compliant
  - may be printed and scanned
  - JPEG 2000 compression
- Probe images (Gate images):
  - semi-controlled environment
  - may be grayscale
  - pose variations
  - different expressions
  - lack of sharpness

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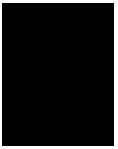
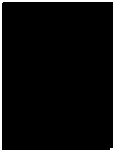
Reference



Printed & Scanned

Probe 1



Probe 2

MAD based on deep face representations

Database

Database parameters:

- two databases
- selection of potential probe and reference images
- four different morphing algorithms (Open Source and Commercial)
- carefully created image pairs (e.g. glasses)
- resized to passport format
- print and scan (300dpi and 600dpi)
- JPEG-2000 compression (digital and print-scan) (15kB)

MAD based on deep face representations

Database Examples

Bona Fide

original | resized | jp2 | print-scan | ps + jp2

MAD based on deep face representations

Database Examples

Morph Algorithms

Algorithm 1 Algorithm 2 Algorithm 3 Algorithm 4

Conclusions regarding performance/generalizability

- *Performance:* Promising performance and robustness to post-processing (image compression, print-scan transformation, ...)
- *High quality morphs:* Morphs generated by morphing algorithms avoiding obvious artefacts are generally harder to detect than morphs comprising these artefacts
- *Morphing algorithms:* The morphing algorithms used for creating train data are less relevant
- *Realistic databases:* Probe images with higher variations in pose and illumination are more challanging for MAD algorithms

MAD based on deep face representations

Further Conclusions

- *Machine learning algorithms:* Support Vector Machines (SVMs) reveal the most competitive performance among the tested classifiers (AdaBoost, Gradient Boosting, Random Forest)
- *Open-Source vs. Commercial:* in contrast to the face recognition task, MAD algorithms based on open-source feature vectors might outperform those of commercial systems.

Questions and Challenges

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Open questions and challenges

- Evaluation metrics
- Evaluation protocols
- Generalizability of MAD approaches
- Databases
- Transparency of results

Questions and Challenges

Thank you!