Attribute and Simile Classifiers for Face Verification

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Face verification vs. Face recognition

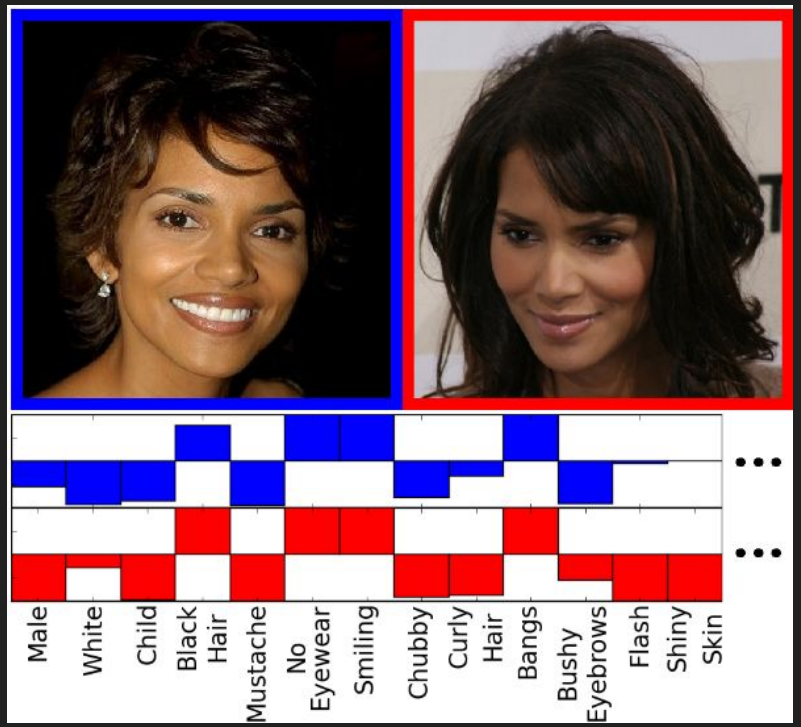
Face recognition: Scanning a face and matching it with a database of known faces

Face verification: Confirms that the physical face matches the one present on the ID document

This research paper presents two novel methods of face verification.

Attribute classifier

Uses binary classifiers to recognize the presence or absence of descriptable aspects of visual appearance (gender, race, age, hair color, etc.).



Values of attributes for left image

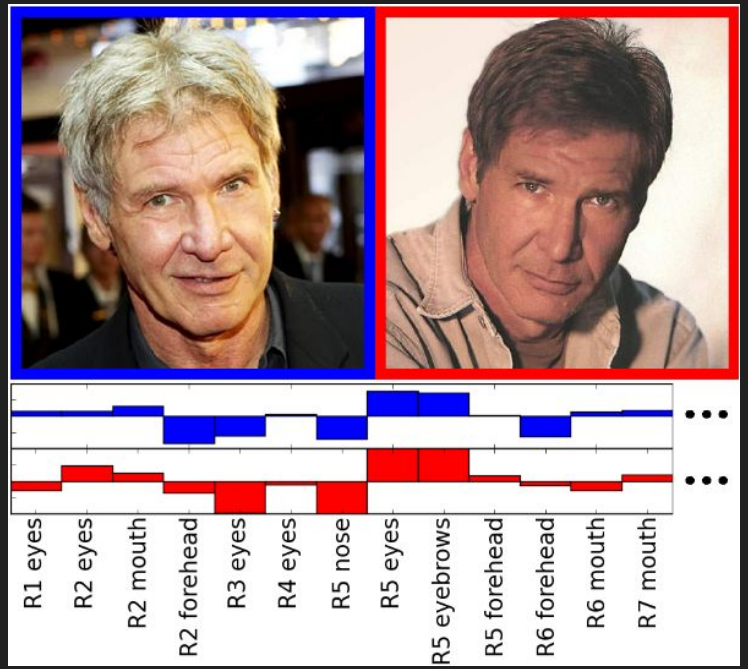
Values of attributes for right image

Attributes

Gives 65 describable visual traits

Simile classifier

Removes the manual labeling required to train attribute classifiers. They are binary classifiers trained to recognize the similarity of faces, or regions of faces, to specific reference people.



Similes

Uses similarities to a set of 60 reference faces

Datasets

1. Labeled Faces in the Wild (LFW): It is a public benchmark for face verification. This dataset consists of 13233 images of 5749 people and around 1680 people have two or more images.

   Source: http://vis-www.cs.umass.edu/lfw/

2. PubFig: This dataset consists of real-world images of public figures (celebrities and politicians) acquired from the internet. Consists of 58,797 images of 200 people (300 images per individual).

   Source: https://www.cs.columbia.edu/CAVE/databases/pubfig/

Enormous variability in the dataset

The same face images can have enormous variability in the following manner:

1. Pose of the same face changes
2. Expression of the same face changes
3. Hairstyle changes
4. Illumination of the image changes
5. Flashy image
6. Shiny skin due to applied makeup
7. Image compression

Both the attribute classifier and simile classifier improves the current state-of-the-art for the LZW dataset, reducing the error rates compared to the current best by 23.92% and 26.34% respectively, and 31.68% when combined. As the attribute and simile classifiers offer complementary information, combining them further lowers the error rate.

Algorithm details

1. Extract low level features from different regions of the face
2. Use these low-level features to compute high-level visual features (or traits). These high-level features are insensitive to changes in pose, illumination and expression.
3. To perform face verification on a pair of images, we compare the scores (visual traits) in both the images.

Summary of the algorithm:

The relatively short (65–3000 dimensional) vector of outputs from the trait classifiers (attribute and simile classifiers) are computed on each face independently.

Comparing two faces is simply a matter of comparing these trait vectors.

Algorithm details: Extract low-level features

For each face image I, we extract the output of k low-level features $f_{i=1...k}$ and concatenate these vectors to form a large feature vector $F(I) = \left\langle f_1(I), f_2(I), \ldots, f_k(I) \right\rangle$

We first detect faces and fiducial point locations using a commercial face detector (OKAO vision). The faces are then rectified to a common coordinate system using an affine warp based on the fiducials. The low-level features are constructed by choosing a face region, a feature type to extract from this region, a normalization to apply to the extracted values, and an aggregation of these values.

Algorithm details: Compute visual traits

For each extracted feature vector $F(I)$, compute the output of n trait classifiers $C_{i=1...n}$ to produce a trait vector $\mathbf{C}(I) = \left\langle C_1(F(I)), C_2(F(I)), \ldots, C_n(F(I)) \right\rangle$

This step makes use of attribute and simile classifier.

Algorithm details: Verification classifier

To decide if two face images I_1 and I_2 are of same person, we compare their trait vectors using a final classifier D which defines our verification function v:

$$v(I_1, I_2) = D(\mathbf{C}(I_1), \mathbf{C}(I_2))$$

Should be positive when both the face images show the same person and negative otherwise.

Doubts

- The PubFig Database isn’t available; which database are we supposed to use?
- OKAO (used in the paper) is no longer available, are we allowed to use OpenCV face detection functions?
- Labels used in attribute classifiers for the supervised learning aren’t available, what else can we use?

Goals

- Mid evaluation : complete the low level feature extraction and make all the attribute classifiers.

- Final evaluation : Make simile classifiers and verification classifier thus completing the whole paper.