ATTRIBUTE AND SIMILE CLASSIFIERS FOR FACE VERIFICATION

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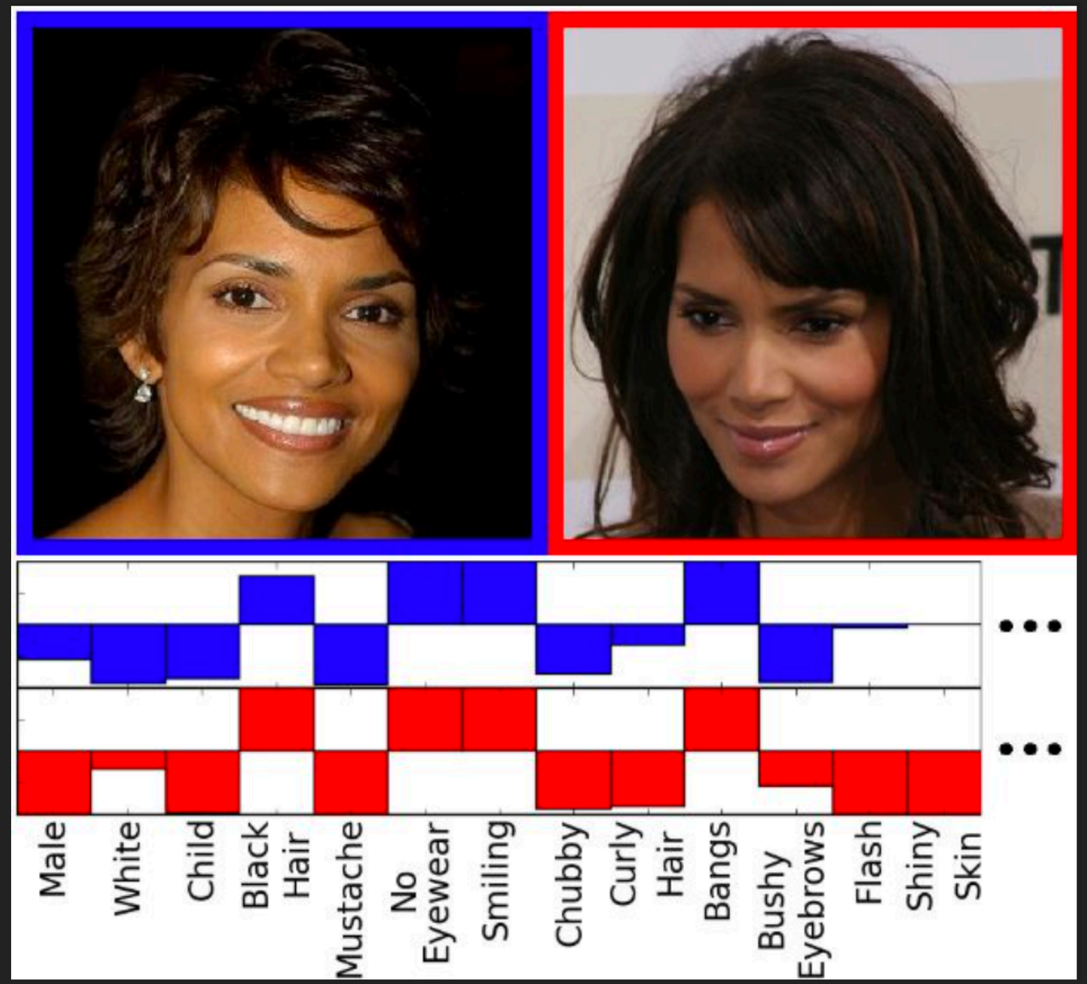
FACE RECOGNITION V/S VERIFICATION

- **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 colour, etc.)
- The first histogram gives values of attributes for left image.
- The second histogram gives values of attributes for right image.

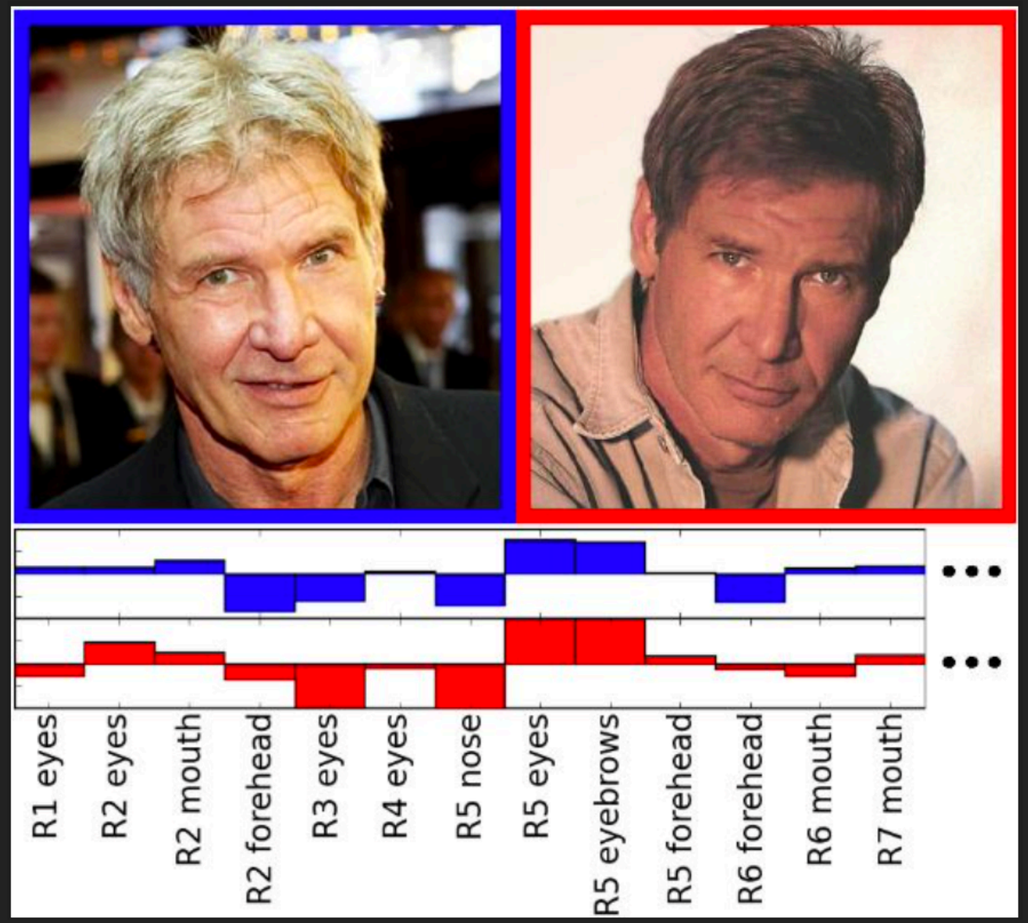
Examples of ATTRIBUTES ——————————————————>



SIMILE CLASSIFIER

- Removes the manual labelling required to train attribute classifiers. They are binary classifiers trained to recognize the similarity of faces, or regions of faces, to specific reference people.
- An unseen face might be described as having a mouth that looks like Barack Obama's and a nose that looks like Owen Wilson’s.

Examples of SIMILES ––––––––––––––––––––––––>



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

Step1: Extract low level features from different regions of the face

Step2: Use low-level features to compute high-level visual features (or traits). These high-level features are insensitive to changes in pose, illumination and expression.

Step3: Perform face verification on a pair of images by comparing the scores (visual traits) in both the images.

Summary: 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 denoted by I, we extract the output of k low-level features $f_{i=1...k}$ and concatenate these vectors to form a large feature vector given below

$$F(I) = \langle f_1(I), f_2(I), \ldots, f_k(I) \rangle$$

- We first detect faces and fiducial point locations using a commercial face detector (OKAO vision). This was previously open source but then it became proprietary, so we will think of using some other open source tool available or use opencv inbuilt functions. 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 given by $C_{i=1...n}$ to produce a trait vector which is given below

$$C(I) = \langle C_1(F(I)), C_1(F(I)), \ldots, C_1(F(I)) \rangle$$

- 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 denoted by v

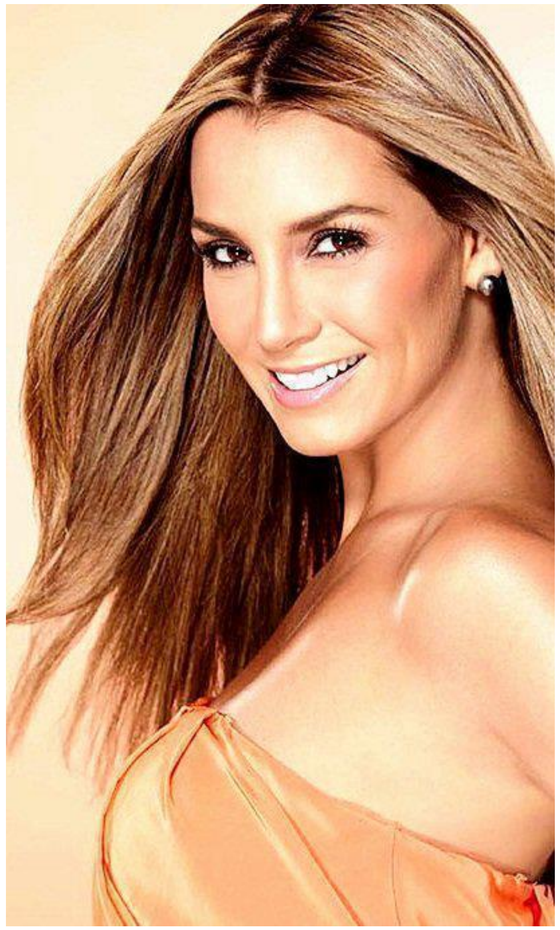
$$v(I_1, I_2) = D(C(I_1), C(I_2))$$

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

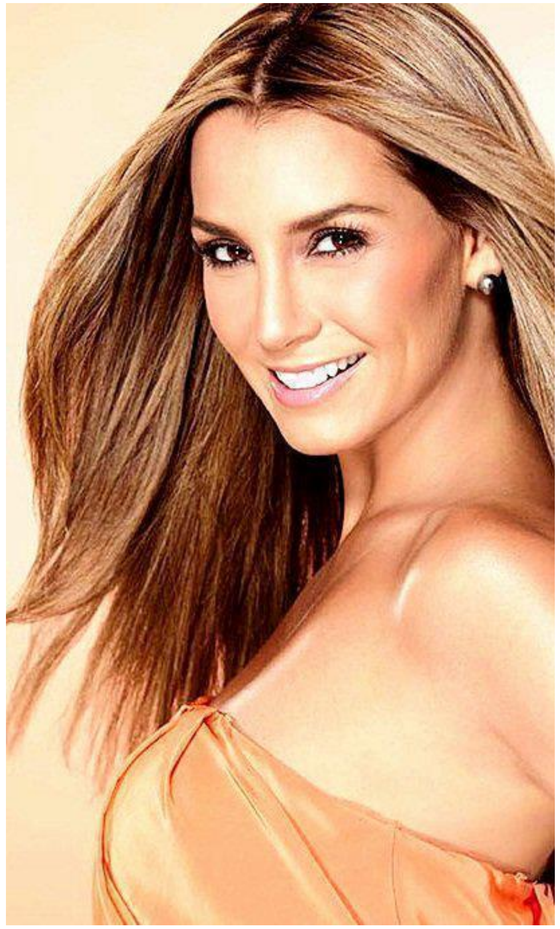
MID-LEVEL EVALUATION: GOALS ACHIEVED

- Low level feature extraction
- The incoming slides shows the output

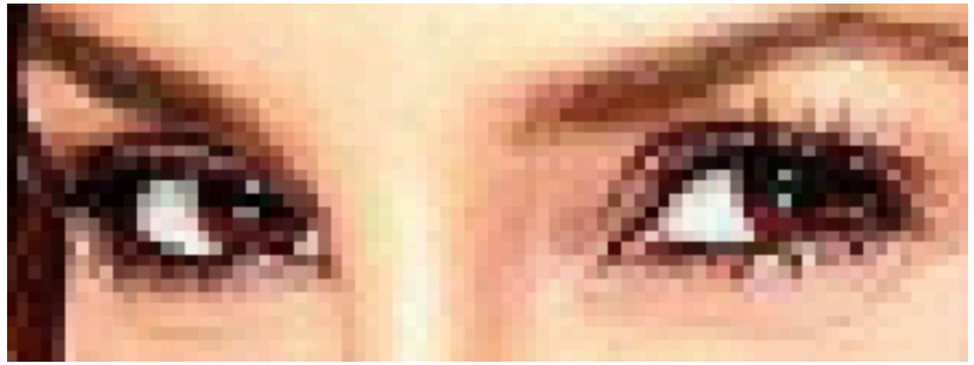
RESULTS – 194 LANDMARK POINT ADDITION

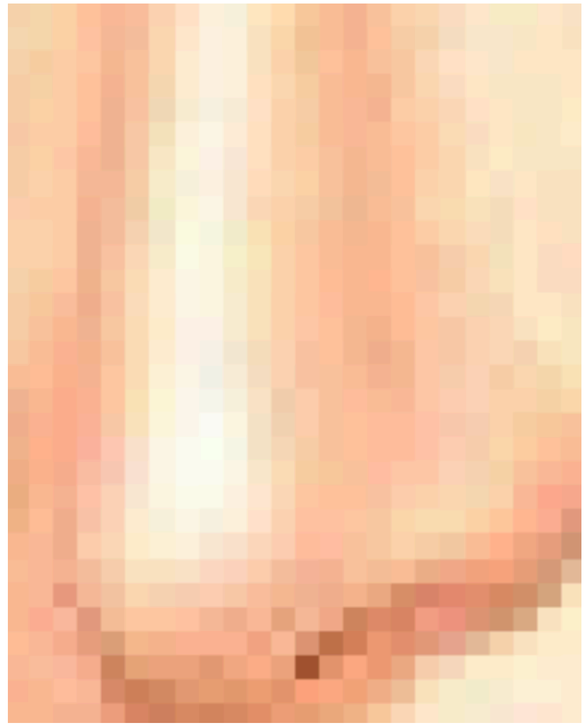


RESULTS - RECTIFICATION AND ALIGNMENT

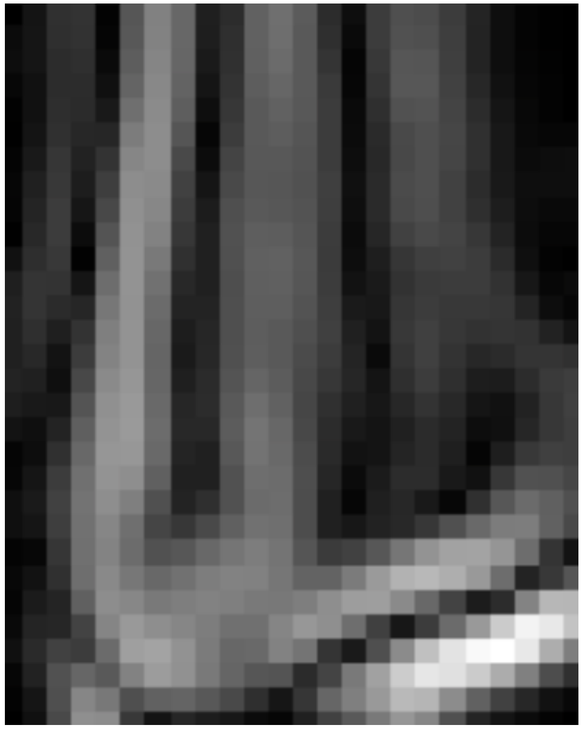


RESULTS – FEATURE EXTRACTION





RESULTS – GRADIENT MAGNITUDES



RESULTS – GRADIENT ORIENTATIONS

GOALS TO BE ACHIEVED

- Build and Train simile classifier
- Train attribute classifier for more attribute
- Construct verification classifier
- BONUS: Attempt deep learning