[CS-F425: Deep Learning]

Instructions for the Class Project

1 The Database

The database could be downloaded from the course webpage[1]. Please note you are not suppose to distribute it and must delete it after the submission of your report. The same would be removed from the website on Feb 10, 2021 at 5PM. Make sure that you download it before this deadline.

The database has files with name like `10_P1_S1_4.jpg` what it signifies is explained below.

- Subject identity is `10`. So you can take it as the data provided by the subject ID number 10

- Our Forehead app was taking two images in one go. First one from distance and the second one from near. `P1` signifies the image taken from distance and `P2`, the second image capture when phone is brought near to the forehead. (So the image `10_P1_S1_4.jpg` is taken from far).
  For Teeth there is NO far and near data so all the file name has P1 only.

- `S1` signifies session one. You know our app was taking images in two sitting. First it takes five pair of images (10 images) and then after an interval of 12 hours it allowes second session. Images taken after 12 hour are having `S2` in their name. So the image `10_P1_S1_4.jpg` was taken in first session. Similarly an image `10_P1_S2_4.jpg` is taken in second session.

- In every session, the face app takes 5 pair of images. The value `4` signifies that this was 4th pair of the image.

Based on the above explanation all 20 images provided by subject id say 31 are named as follows

`31_P1_S1_1.jpg`, `31_P2_S1_1.jpg`, `31_P1_S1_2.jpg`, `31_P2_S1_2.jpg`, `31_P1_S1_3.jpg`, `31_P2_S1_3.jpg`, `31_P1_S1_4.jpg`,
`31_P2_S1_4.jpg`, `31_P1_S1_5.jpg`, `31_P2_S1_5.jpg`,
`31_P1_S2_1.jpg`, `31_P2_S2_1.jpg`, `31_P1_S2_2.jpg`, `31_P2_S2_2.jpg`, `31_P1_S2_3.jpg`, `31_P2_S2_3.jpg`, `31_P1_S2_4.jpg`,
`31_P2_S2_4.jpg`, `31_P1_S2_5.jpg`, `31_P2_S2_5.jpg`

There could be challenges in the database such as missing images and variations in the data acquisition environment.

2 What need to be done

We expect following experiments to be done. However, the list is neither exhaustive nor exclusive.

1. Do $n \times n$ matching using popular feature extractor like SIFT/SURF/ORB/ArcFace/CosFace

2. $n \times n$ matching here means the following
   take any image with name S1 and match with all other having names S2

3. Prepare genuin/imposter histogram

4. Explain how scores are obtained

5. Plot ROC

6. Report EER and the corresponding threshold.

7. Report CRR

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[1]Link: `http://www.ktiwari.in/dl` by Oct 10, 2021

8. Do some ablation study and modify parameters

9. NOTE: matching should be done between the images of different sessions only. One should NOT match image having (S1 with S1) or (S2 with S2).
However matching P1 with P1 is fine, similarly P2 with P2 is also fine, so as P1 with P2 and P2 with P1.

10. General recognition pipeline include RoI extraction, engancement, feature extraction and matching.

Explain what are your observations and conclusions. You can take the help from the paper arxive paper [2] on teethphoto.

2.1 Definitions

Standard performance parameter are,

- **Correct Recognition Rate (CRR):** It is defined as the number of actual matches that are obtained at rank one recognition.

$$CRR = \frac{Number\ of\ matches\ correctly\ recognized}{Total\ number\ of\ matches}$$

- **False Acceptance Rate (FAR) and False Rejection Rate (FRR):** FAR refers to the likelihood of the biometric system to incorrectly accept an unauthorized user as an authorized one *i.e.* the rate of false acceptance over the number of imposter attempts. It is defines as:

$$FAR = \frac{Number\ of\ incorrect\ matches\ recognized}{Total\ number\ of\ matches}$$

FRR on the other hand, is the likelihood of biometric system to incorrectly reject an authorized user by considering him to be an unauthorized user, which is defines as the rate of false rejection over the number of genuine attempts by the user.

$$FFR = \frac{Number\ of\ correct\ matches\ not\ recognized}{Total\ number\ of\ matches}$$

- **Equal Error Rate (EER):** It is the point at which the False Acceptance Rate (FAR) and False Rejection Rate (FRR) are equal. It gives a threshold to evaluate the recognition performance of a system. Also, a system with lower EER is considered better.

- **Accuracy:** is maximum value of $(100 - (FRR + FAR)/2)$ across all thresholds.

- **ROC Curve:** An ROC curve is obtained by plotting FRR vs FAR, by varying the decision threshold. The area under the curve gives the error rate of the system. A system having less area under the curve is better at classification.

3 Submission

A single .zip file on Nalanda containing .pdf and code. Report need not to be very large, talk about the experimental findings and results only. Result-score file need not to be submitted. Keep it with you. Will be asked if needed. Deadline is Oct 19, 2021

4 Evaluation

Would be done based on the results obtained, number of experiments done, insights gained.

5 Help

Use already shared whatsApp group to ask for any doubt.

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[2]https://arxiv.org/abs/2107.13217 'DeepTeeth: A Teeth-photo Based Human Authentication System for Mobile and Hand-held Devices'