Programming Assignment - HAI

Healthcare and AI Internship

May 28, 2021

1 Description

1.1 Objective

The objective of this assignment is to get you familiarize with the problems of "classification" and "verification" with a popular problem space of "face".

What is expected at the end

- Familiarity with this (a specific) problem space and the associated nuances.
- Some exposure to the visualization of data
- conduct experiments and report results
- use of graphs/tables to present results
- decide parameters yourself ("best" according to you) and defend your choices.
- creating a brief report, with examples/arguments.

You can download and use data from original sources.

1.2 Dataset

You are given 3 different datasets. Each dataset has faces images of humans. You need to perform experiments on these images.

Yale Face Database This is a classical data set. See original data and description at [1]. Worth reading. We have subsampled the following data for this experiment.

- You are given faces images of 15 subjects.
- Each subject has 11 images with different emotions.
- An emotion.txt is also given which contains mapping the emotion of each image.

Indian Movie Face Database This is an Indian dataset. See original data and description at [2]. Worth reading. We have subsampled the following data for this experiment.

- You are given face images of 8 Indian movie actors.
- 50 images are provided for each actor.

IIIT Cartoon Face Dataset This is not natural face. But you still recognize. See original data and description at [3]. Worth reading. We have sub-sampled the following data

- Cartoon faces of 8 subjects.
- 100 images are provided for each subject.

You can download and use data from original sources. However, to make life simple, a version is downloaded and shared with you. For each dataset you are given files a, b.png which is the b^{th} face image of a^{th} actor.

1.3 Image Features

You are expected to use 6 different features/representations. These features are: (a) PCA/Eigen face (b) KernelPCA (c) LDA/Fisher face (d) Kernel Fisher Face (e) VGGFace (f) ResNet features

You are given a sample code for all the above six representations/features. You can modify or find a better implementation, if you prefer. If there are computational issues, we will consider giving you the features itself directly.

Refer to *scikit-learn* documentation to build appropriate functions and return the features as output.

Eigen Face - `https://scikit-learn.org/stable/modules/generated/sklearn.decomposition.PCA.html`

KernelPCA - `https://scikit-learn.org/stable/modules/generated/sklearn.decomposition.KernelPCA.html`

Fischer Faces - `https://scikit-learn.org/stable/modules/generated/sklearn.discriminant_analysis.LinearDiscriminantAnalysis.html`

For VGG - `https://arxiv.org/pdf/1409.1556.pdf`

For RESNET - `https://arxiv.org/pdf/1512.03385.pdf`

2 Questions

2.1 Basic Questions

1. Understand the "Eigen Faces". How many eigen vectors/faces are required to "satisfactorily" reconstruct a person in these three datasets? (Don't forget to make your argument based on eigen value spectrum. Show appropriate graphs, qualitative examples and make a convincing argument.)

   Which person/identity is difficult to represent compactly with fewer eigen vectors? Why is that? Explain with your empirical observations and intuitive answers. Which dataset is difficult to represent compactly with fewer eigen vectors? Why is it so? Explain with your empirical observations and intuitive answers.

2. Use an MLP classifier and find the classification accuracy. Which method works well? Do a comparitive study.

3. Use t-SNE based visilization of faces? Does it make sense? Do you see similar people coming together? or something else? Can you do visualization dataset wise and combined?

4. In practice "face" is used for verification. i.e., input is "identity/classID) and the face image" and response is "Yes" or "No". (i) How do we formulate the problem using KNN (ii) How do we analyze the performance ? suggest the metrics (like accuracy) that is appropriate for this task. Show empirical results with all the representations and variations in K.

2.2 Technical Report

Submit a technical report (Not more than two page) text in the same/similar template of this question sheet with additional two pages of figures/plots/graphs.

You should learn/attempt how to create "nice" and "impressive" figures, plots, visualizations, insighful graphics to explain the methods etc.

You should learn/attempt to write technical content. Preferably use latex. (learn that too.).

3 Submissions Instructions

1. All the code should be done in the Jupyter/Python Notebook provided. You are free to use Google Collab, Kaggle for computational resources if GPU/TPU is needed.

2. Ensure that the notebook runs without errors if the code cells are run in sequence.
3. The notebook submitted should have the figures, plots and comparison graphs as required in the question so can be verified during the time of assessment.
4. Rename the completed notebook to "name.ipynb" and share it as a Github Repo

4 References:

[1] Yale Face Database,Url:https://vismod.media.mit.edu /vismod/classes/mas622-00/dataset

[2] Shankar Setty, Moula Husain, Parisa Beham, Jyothi Gudavalli, Menaka Kandasamy, Radhesyam Vaddi, Vidyagouri Hemadri, J C Karure, Raja Raju, Rajan, Vijay Kumar and C V Jawahar. "Indian Movie Face Database: A Benchmark for Face Recognition Under Wide Variations", NCVPRIPG-2013

[3] Mishra, A., Nandan Rai, S., Mishra, A. and Jawahar, C. V., "IIIT-CFW: A Benchmark Database of Cartoon Faces in the Wild", VASE ECCVW-2016

*The assignment has been adapted from SMAI Coursework, IIIT-Hyderabad