Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection

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Overview

This project aims to implement and evaluate a face recognition algorithm called "Fisherface". Face recognition typically means that given a database of face images of people, and a new test image, we need to find whether the test image contains the face of which individual from the database. We have already learnt a technique called Eigenfaces (which uses PCA) for this task. However, face recognition has some challenges such as illumination variations or facial expressions. In comparison to eigenfaces, the fisherface algorithm is designed to be insensitive to large variations in lighting direction and facial expression, making it a promising candidate for robust face recognition applications. The Fisherface approach is based on linear projection and is a derivative of Fisher's Linear Discriminant (FLD). Along with the Fisherface method, we also aim to implement some other methods also (which are described in the same paper) and evaluate their performances on varying conditions.

Paper & Datasets

We will be primarily implementing this paper, and evaluate different algorithms on the following datasets in our analysis -

- "Yale face datasets" (Yale face database) which includes 165 images (15 individuals) with different lighting, expression, and occlusion configurations.
- "Extended Yale B" (Yale face database B) which contains 5760 single light source images of 10 subjects each seen under 576 viewing conditions (9 poses x 64 illumination conditions).
- CMU dataset (CMU PIE database): A database of 41,368 face images of 68 people captured under 13 poses, 43 illuminations conditions, and with 4 different expressions.
- The German Fingerspelling database, containing 35 gestures & consists of 1400 image sequences that contain gestures of 20 different persons recorded under non-uniform daylight lighting conditions.

Description of Experiments and their Evaluation

After thoroughly going through the paper, we will implement the algorithms described in the paper. This will include the 4 methods of face recognition - Correlation, Eigenfaces, Linear Subspaces and Fisherfaces. Now, we will evaluate these methods on the datasets for -

1. Variation in Lighting: To test algorithms under variable illumination. The algorithms which exploit the fact that images of a Lambertian surface lie in a linear subspace are expected to perform better
2. Variation in Facial Expression, Eyewear, and Lighting: We evaluate the performance under a different range of conditions, including expressions, eye-wears, illumination and image cropping
3. Glasses Recognition: When using class-specific projection methods, the learning set can be divided into classes in different manners. Hence, we can use these techniques to classify whether people are wearing glasses or not.

In each of the experiments, we will analyze/plot the recognition error rates (for example, by using the "leaving one-out" strategy) to compare the performance of various methods, find out insights/conclusions about them, that is, how better they perform when subjected to variations in face recognition challenges.