SYNOPSIS

A LEARNING ALGORITHM FOR OPTIMAL FACE RECOGNITION IN DYNAMIC ENVIRONMENTS

By

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Introduction

A general statement of the Face Recognition problem (in computer vision) can be formulated as follows: Given a Still Image or a Video sequence, identify one or more persons' face(s) in the scene using a stored database of faces.

In contemporary applications, Face Recognition systems are becoming increasingly popular and have become integral part of most modern Biometric Systems. Face Recognition has numerous applications including visual surveillance, security and personal authentication etc. Face Recognition systems can be designed to be non intrusive thus making them ideal for military surveillance and public surveillance requirements in crowded areas. In many legacy document archives (e.g. Police Records, Real Estate Documents), Images of people's faces is available and thus using Face Recognition to search through such large databases is a natural choice. Even with so many applications and advancements in the Face Recognition domain, many challenges remain unresolved.

Motivation

Research on Face Recognition is confronted by many challenges. Algorithms must deal with varying illumination, pose, angular rotation, low image quality, occlusion, and background noise in complex real-life situations. The design of face recognition algorithms that can effectively tackle the above said challenges, is an area of ongoing research. Several models have been proposed, from appearance based approaches to sophisticated systems based on Infrared and 3D imaging.Most of the proposed Face Recognition Algorithms deal with a small subset of the challenges mentioned above, here lies the motivation of the proposed project work. In a dynamic scenario (a classroom scene) the lighting keeps varying though the day. People keep moving around in the class. Some lectures are dull , some are enthusiastic which results in different facial expressions of the students. As can be seen, the Face Recognition challenges keep varying in a random fashion in such a dynamic scenario. We propose a learning model which characterises the dynamic scene and identifies the most optimal Recognition Algorithm.

Algorithm

Our Proposed model is a learning Algorithm, which while training runs all the recognition algorithms against faces in a dynamic scene and identifies which algorithm performs the best in the characteristic dynamic scenario. Then while testing, the algorithm again tries to characterize the present scenario. It then matches the characteristic with that of the training phase and executes the algorithm which performed optimally, instead of executing all the algorithms. We break up our approach into two parts:

1. **The learning algorithm** – (which characteristics a dynamic scene).
2. **Various Face-Recognition algorithms** – SIFT (Scale Invariant Feature Transform), PCA[1] (Principle Component Analysis) and LPP[2] (Locality Preserving Projections) to name a few, which perform recognition.

Software Requirements

- **Python** : Implementation Language of Choice , because of its Rapid Prototyping capabilities. Python also has very good Image Processing and Distributed / Parallel Computing libraries.
- **OpenCV** : A Computer Vision Library.
- **LaTeX** : A very effective *Document Processor*.
- **Git** : A Revision Control Software for the collaborative Development of the Project.
- **Linux** : Host Operating System on which the project is developed and deployed.

Hardware Requirements

- **RAM (Primary Memory)** : A minimum of 4GB (most of the algorithms are very memory intensive and store a whole bunch of images on RAM for faster processing).
- **Hard drive (Secondary Memory)** : A minumum of 80 GigaBytes.
- **Processor** : 2.2 GHz 4 Core Processor.
- **Cluster of 4(arbitrary) computers(Optional)** : The idea is to speed up the computations by distributing the calculations over a cluster of computers.

Conclusion

The proposed learning model, evaluates the characteristics of the scene and, chooses the most appropriate algorithm. Thus in theory giving better results than any of the contemporary Recognition algorithms applied individually.

References

[1] M. Turk and A. Pentland, *Eigenfaces for recognition.* Journal of Cognitive Neuro-science, 3(1):71-86, 1991

[2] X. F. He, S. C. Yan, Y. X. Hu, P. Niyogi, and H. J. Zhang *Face recognition using Laplacianfaces.*