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 and security, 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 unsolved.

Motivation

Research on face detection followed by recognition is confronted with many challenges. Algorithms must deal with varying illumination, pose, rotation angles, 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, from a bank of

large number of algorithms, which gives the most optimal recognition results for the characteristic (dynamic) scene.

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 performs optimally, instead of executing all the algorithms. We break up our approach into two parts:

1. The learning algorithm (which uses a neural network based algorithm to learn characteristics of a dynamic scene).
2. Various Face-Recognition algorithms like SIFT (Scale Invariant Feature Transform) , LPP[2] (Locality Preserving Projections) and PCA (Principle Component Analysis)[1] which perform the actual recognition. (These algorithms are a representative set, many more such algorithms can be implemented.)

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** : The Computer Vision Library being used.
- **LaTeX** : For Documentation Needs. Latex is a very effective document processor , which produced well formatted documents.
- **GIT** : This is a Revision Control Software for the collaborative Development of the Project.
- **Linux** : The Host Operating System on which the development and deployment will be done.

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 (may be more if a lot of images are there in the database)
- **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 hybrid learning model takes care of all the above mentioned parameters. Then depending on the challenge identified, performs the computation and minimises the error rate in recognition. Thus in theory giving better recognition results than any of the above mentioned algorithms.

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.*