Recognizing Frontal Faces Using Neural Networks

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Abstract. In this paper, a neural network based face recognition system is presented. One of the main problems encountered when using neural networks for face recognition is luck of enough training data. This is because, in most cases, only one image per subject is available. Therefore, one of our objectives is to solve the problem of luck of enough data to train neural networks. For each image we "increase" the data available by several processes for example, mirroring of the image, using color, edges information, etc. The neural network is trained using structural learning to reduce its size. To represent the face color, the YIQ and the XYZ color spaces are used.

1 Introduction

Face recognition is without doubt one of the most researched area of computer vision. This is not surprising considering the many applications that can benefit from it. For instance, with more and more transactions being done online, there is a great need for person identification. Face recognition could not only make the transactions more secure but would also win the confidence of many people who have doubts about the security of other methods. Another important and major application of face authentication is in ports of entry to countries and law enforcement databases to identify criminals. However, face recognition is a difficult problem for machines though it is so simple for humans. This is because it is not known for sure what features the human brain uses to identify faces. Although many algorithms have been proposed through the years and good results obtained, work still needs to be done for this technology to be easily available and more practical. In this paper, a neural network based face recognition system is proposed. The objective of this work is to do face authentication using a maximum of only one image per person stored in the database.

Face recognition involves the comparison of a given face with other faces in a database with the objective of deciding if the face matches any of the faces in that database. A fully automated face recognition system would consist of several subsystems like face detection, normalization and authentication. Features of the face to be normalized include the size, orientation and the illumination. Luckily, a good face detection system would take care of the normalization processes necessary and therefore the face recognition problem is reduced to a matching problem.

1.1 Related Work

Face recognition has been the center of research in many a researchers works for a long time. Several methods have been proposed. Qing [1] proposes a method using principal component analysis and neural networks to recognize faces. A 95% recognition rate using 5 subjects was achieved. However, each subject requires his or her own neural network for recognition. For many subjects it is not efficient to train and test these individual neural networks. A detailed look at biologically inspired approaches to face recognition was done by Sukthankar [2]. In this work five other methods namely, neuro-physiological [3], principal component analysis [4], elastic bunch graph matching [5], human perception [6] and nearest neighbor algorithm [7] are discussed. The overall objective was to determine whether distance in face space corresponds to human notion of facial similarity. A summary of face recognition research done between 1995 and 1997 can be found in [8]. Three types of recognition algorithms, namely frontal, profile and view-tolerant, depending on the kind of imagery and according to recognition algorithms, have developed over the years. The paper summarizes the research done over the past 20 years.

2 Face Recognition Problem

Discriminating between faces is not easy because they contain the same features like the eyes, mouth, nose etc. Slight differences can be found in the positions of these features in the faces, the general face shape and in color. Face detection is different from face recognition in that, face detection generalizes the faces and discriminates them against non-faces; face recognition must discriminate between the faces. Therefore if, face detection is a level one problem, then face recognition is a level two or higher problem. In order to develop a useful and applicable face recognition system several factors need to be addressed.

1. The overall speed of the system, from detection to recognition should be acceptable.
2. The accuracy should be high.
3. The system should be easily updated and enlarged, that is, easy to increase the number of subjects that can be recognized.

In [9], a fast and accurate face detection system, called a face locator, for color images is discussed. We adapted this method to extract face positions in our images. Our task is then to design a face authenticator system that can much the speed and accuracy of the face locator. This work therefore concentrates on the design of the face authenticator.

3 The System

The large the size of the image to be used for recognition is, the higher the possibility of achieving better recognition results. Many researchers have used various sizes of images for example, 46x46 and 100x100pixels. Although the information available in