

Pattern of face is recognized by using back propagation algorithm.

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Abstract

Face recognition is an effective way for the personal identification of human being. Person identification is based upon reliable, unique, stable or behavioral characteristics. In this paper face print is used as new method for the identification and verification of human being. Functionally Face print recognition is divided into face detection, face matching and face recognition. Implementation of face detection systems is based upon deformable template algorithm which is based upon image variant. Implementation of deformable template algorithm is based upon perceptron. To create the Perceptron's A-units, Kohonen Feature Maps of unsupervised learning is used. Efficiency of face detection model is improved by natural symmetry of faces. The deformable template was run down the line of symmetry of the face in search of the exact face location.

Principal Component Analysis is used to realize automated face recognition, which is called as Karhunen-Loeve transform. The implementation of automated face recognition system is tested by using Manual face detection. Under controlled conditions the also successfully implemented recognition is Pose invariant face recognition.

Keywords: Karhunen-Loeve transform, Perceptron, unsupervised learning

INTRODUCTION

One of the key challenges of face recognition is finding efficient and discriminative facial appearance descriptors that can counteract large variations in illumination, pose, facial expression, ageing, partial occlusions and other changes. In comparison with other identification methods, face recognition has more convenient features. Human can visually identify people by human face. People can be fairly identified even in the very serious visual stimulated situation. Automated face recognition is an interesting computer vision problem with many commercial and law enforcement applications. Mugshot matching, user verification and user access control, crowd surveillance, enhanced human computer interaction all become possible if an effective face recognition system can be implemented. The inadequacy of automated face recognition systems is especially apparent when compared to our own innate face recognition ability. We perform face recognition, an extremely complex visual task, almost instantaneously and our own recognition ability is far more robust than any computer's can hope to be. We can recognise a

familiar individual under very adverse lighting conditions, from varying angles or view points.

An Analysis of the Face Detection Problem:

This is essentially a segmentation problem and in practical systems, most of the effort goes into solving this task. In fact the actual detection based on features extracted from these face landmarks is only a minor last step.

There are two types of face detection problems:

- (1) Face detection in images
- (2) Real-time face detection

1) Face detection in images

Most face detection systems attempt to extract a fraction of the whole face, thereby eliminating most of the background and other areas of an individual's head such as hair that are not necessary for the face recognition task. With static images, this is often done by running a 'window' across the image. The face detection system then judges if a face is present inside the window. Unfortunately, with static images there is a very large search space of possible locations of a face in an image. Faces may be large or small and be positioned

anywhere from the upper left to the lower right of the image.

2) Real-Time Face Detection

Real-time face detection involves detection of a face from a series of frames from a video capturing device. While the hardware requirements for such a system are far more stringent, from a computer vision stand point, real-time face detection is actually a far simpler process than detecting a face in a static image. This is because unlike most of our surrounding environment, people are continually moving. We walk around, blink, fidget, wave our hands about, etc.

A Human Face Detection Process:

While some may regard face detection as simple pre-processing for the face recognition system, it is by far the most important process in a face detection and recognition system. However face recognition is not the only possible application of a fully automated face detection system. There are applications in automated color film development where information about the exact face location is useful for determining exposure and color levels during film development. They are even used in face tracking for automated camera control in the film and television news industries.

In this research paper we will try to detect faces in still images by using image invariants. To do this it would be useful to study the grey-scale intensity distribution of an average human face. A suitably scaled color map has been used to highlight grey-scale intensity differences. The grey-scale differences, which are invariant across all the sample faces, are strikingly apparent. The eye-eyebrow area seem to always contain dark intensity such as low gray-levels while nose forehead and cheeks contain bright intensity such as high grey-levels.

Kohonen Feature Maps:

Kohonen (1995) in his famous book *Self Organising Maps* stated that SOMs (i.e. Self Organising Maps) are not intended for pattern recognition but for clustering, visualisation, and abstraction. Out of the many different models described in *Self Organising Maps* are Kohonen Feature Maps (KFMs), also known as Kohonen self-organizing networks or topology-preserving maps, were

found to be amazingly suitable for the problem of creating A-units for a perceptron.

Self-Organizing Maps are competitive networks that provide a "topological" mapping from the input space to the clusters (Kohonen, 1995). These were inspired by the way in which various human sensory impressions are neurologically mapped into the brain such that spatial or other relations among stimuli correspond to spatial relations among the neurons.

So in SOMs, patterns in the input space near to each other will be mapped to output units near to each other. SOMs are one of the many neuro-computational models that use unsupervised learning. Unlike a typical Neural Network which uses supervised learning, the training data for SOMs does not consist of input and desired output pairs.

Eigenfaces:

Any grey scale face image $I(x,y)$ consisting of a $N \times N$ array of intensity values may also be considered as a vector of N^2 . For example, a typical 100×100 image used in this thesis will have to be transformed into a 10000 dimension vector!

Figure A 7x7 face image transformed into a 49 dimension vector

This vector can also be regarded as a point in 10000 dimension space. Therefore, all the images of subjects' whose faces are to be recognized can be regarded as points in 10000 dimension space. Face recognition using these images is doomed to failure because all human face images are quite similar to one another so all associated vectors are very close to each other in the 10000-dimension space.

The vectors that describe faces in face space are eigenfaces. These are in fact the eigenvectors of the covariance matrix of a set of mean subtracted face images (subtract the average face from each of the face images). Since a typical face image used in this thesis is 100×100 (therefore associated vectors 10000×1), and if there are 30 face images in the training set for PCA, the covariance matrix (C) would be:

$$C = X X^T$$

Here X , is a 10000×30 matrix containing the mean subtracted face images. Therefore, the covariance matrices dimensions would be 10000×10000 .

Pose invariant face recognition

Extending the frontal view face recognition system to a pose-invariant recognition system is quite simple if one of the proposed specifications of the face recognition system is relaxed. Successful pose-invariant recognition will be possible if many images of a known individual are in the face database. Three images from each known individual can be taken as shown below. Then if an image of the same individual is submitted within a 30° angle from the frontal view he or she can be identified.

Furthermore, gathering multiple views of an individual for a face database is not realistic since in most situations only a single known face for each subject is available.

Conclusion:

The computational models, which were implemented in this research paper, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with manual face detection and automatic face recognition did not have recognition accuracy over 90%, due to the limited number of eigen faces that were used for the PCA transform. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate.

The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area. The fully automated face detection and recognition system was not robust enough to achieve high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a

slight degree of invariance to scale rotation or shift errors of the segmented face image.

References

1. Adelson, E. H., and Bergen, J. R. (1986) *The Extraction of Spatio-Temporal Energy in Human and Machine Vision*, Proceedings of Workshop on Motion: Representation and Analysis (pp. 151-155) Charleston, SC; May 7-9
2. Beymer, D. and Poggio, T. (1995) *Face Recognition From One Example View*, A.I. Memo No. 1536, C.B.C.L. Paper No. 121. MIT
3. Bichsel, M. (1991). *Strategies of Robust Objects Recognition for Automatic Identification of Human Faces*. PhD thesis, Eidgenossischen Technischen Hochschule, Zurich.
4. Brunelli, R. and Poggio, T. (1993), *Face Recognition: Features versus Templates*. IEEE Transactions on Pattern Analysis and Machine Intelligence, 15(10):1042-1052
5. Craw, I., Ellis, H., and Lishman, J.R. (1987). *Automatic extraction of face features*. Pattern Recognition Letters, 5:183-187, February.
6. Deffenbacher K.A., Johanson J., and O'Toole A.J. (1998) *Facial ageing, attractiveness, and distinctiveness*. Perception. 27(10):1233-1243 105.
7. Frank, H. and Althoen, S. (1994). *Statistics: Concepts and applications*. Cambridge University Press. p.110.
8. Gauthier, I., Behrmann, M. and Tarr, M. (1999). *Can face recognition really be dissociated from object recognition?* Journal of Cognitive Neuroscience, in press.
9. Subhajit Karar, Ranjan Parekh, " Faceprint Recognition using Phase Symmetry " , International Journal of Scientific and Research Publications, Volume 3, Issue 4, April 2013 1 ISSN 2250-3153.
10. Dunteman, G.H. (1989) *Principal Component Analysis*. Sage Publications