Face Recognition in Video-A Survey Paper

Prof K.H. Wanjale,Saurabh Padmane, Prashant Sethi, Pratik Shah, Sagar Thakur.

Dept. of Computer Engineering
Vishwakarma Institute of Information Technology
Pune,India

kwanjale@yahoo.com, saurabh281992@gmail.com, pratsethi92@gmail.com, pratik27shah@yahoo.in,
sagar_thakur@hotmail.com

Abstract— Face recognition technology is one of the challenging topics in case of computer vision. Face recognition has been developed from past 20 years and various approaches have been developed like, methods that operate on intensity images, methods that deal with video sequences which is the case study of our topic. Given an image with some faces, the task of face detection is to identify all face regions within that image regardless of its three-dimensional positions, orientations, and light conditions. The problems are challenging as the faces are non rigid and have a high degree of variability in size, shape, color, and texture. In this paper a survey of some well known methods such as Viola Jones, Canny's edge detection, HMM (Hidden Markov Model) is provided. The applications, the incentives provided by the said methods have also been provided. The algorithms mentioned give an idea of flow of the paper to be developed. This paper also gives a clear approach of storing an image and detecting that human image from appropriate video frames.

Index terms: **Format pattern , Hidden Markov's Model ,Haar Wavlets**

1. Introduction

In recent years there has been a rapid development of sensing devices, computational powers and intelligent papers face recognition has emerged as a challenging topic in case of image processing. Face recognition is known as one of the physiological biometric which extract the features of the face. If you ask a human to recognize a human face it's quite simple task for that person, but in the case of machines it's a very daunting task. There has been growing interest in machine recognition of faces in last 20 years because of its potential task , such as human computer interface (HCI), security, visual attendance paper etc. Face Recognition in real video consist of steps of face recognition and detection by implementing the algorithmic steps of Viola Jones, edge detector and HMM algorithm for face detection. Recognition Phase: once the image is associated with an array of values, the recognition problem is reduced to a widely studied problem in the past literature [2].

1

The pervious algorithms of face detection consisted of the PCA(principal component of analysis) which provides a 90% accuracy and comes under the method of factor analysis but cannot respond to any environmental changes in external conditions[1]. Neural Networks algorithms are highly efficient but the algorithm fails when the database has to scan more than 500 faces [1].The Eigen case algorithm are 95% algorithm accurate but they do not support any slightest environmental changes [1]. Hence the algorithms of Viola Jones are proposed here as they provide a robust environment and a good accuracy rate as compared to the other algorithms. HMM and Canny's edge detector provide an appropriate mechanism for recognition a face from the database provided.

2. Viola Jones Algorithm

Viola Jones algorithm is a face detection algorithm developed by Paul Viola and Micheal Jones. This algorithm is one of the fastest algorithms for detecting faces. In this algorithm, a detector or window is used like Haar wavelet for feature extraction that detector moves all over the face and finds out the features of the face, the window size minimally should be of 24 x 24 pixels. This algorithm is one of the fastest algorithms to detect face using skin color as a feature. This algorithm also uses AdaBoost for feature selection mechanism [11]. At first, the input image is converted into integral images. This conversion is done by making each of the pixels equal to the sum of all the pixels and this

allows the calculation of all the pixels using only four values of the rectangle [10]. Viola Jones uses adaboost as a machine learning boosting algorithm which is used as an enhancement algorithm, all the weak classifiers are combined together to form a strong classifier. A weak classifier is mathematically described as:

$$h(x, f, p, \theta) = \begin{cases} 1 \ if \ pf(x) > p\theta \\ 0 \ otherwise \end{cases}$$

Where x is a 24*24 pixel sub-window, where f is the applied feature, p is the polarity and θ the threshold that decides whether x should be classified as a positive (a face) or a negative (a non-face) [10][11].

In this paper, Viola Jones is used as a face detection algorithm as it is preferably a faster algorithm than some other face detection algorithms.

3. Hidden Markov's Model (HMM)

HMM is a one-dimensional model and used for face recognition, it is based on the principles of markov's assumption of previous state.HMM is thus termed as a finite state machine. HMMs are usually used to model one dimensional data but in the recent years, they have been used in vision texture segmentation face finding object recognition and face recognition [1]. Hidden Markov Models (HMMs) represent a most famous statistical pattern recognition technique and can be considered as the state-of-the-art in speech

recognition [2]. This is due to their excellent time warping capabilities, their effective self organizing learning capabilities and their ability to perform recognition and segmentation in one single step [2]. They are used not only for speech and handwriting recognition but they are involved in modeling and processing images too [2]. The HMM also has to be trained for each person which needs to be recognize subsequently [2]. The HMM training, requires an enrolment operation for every subject of the database, requires a grey scale image of the face of each person [2].HMM is associated with the hidden states and one dimensional model and face recognition. The HMM elements can be stated by a formula.

- N= S is the number of states in the model, where S={s1,s2,…,sN} is the set of all possible

states. The state of the model at time t is given by $q_t \in$ S.[1] HMM is a one dimensional model, but the images obtained in HMM are always in a two-dimensional form, so the images have to be converted into one –dimensional form[1]. The observation sequence is generated by dividing each face image of width W and height H into overlapping blocks of height L and width W.[1] A L×W window is slid from top to bottom on the image and creates a sequence of overlapping blocks. The number of blocks extracted from each face image is given by T= (H-L/L-P)+1.[1] where P is overlap size of two consecutive blocks. A high percent of overlap between

consecutive blocks significantly increases the performance of the paper consequently increases the computational complexity [1]. Our experiments showed that as long as P is large and L ≈ H/10, the recognition rate is not very sensitive to the variations of L [1]

3.1 Pseudo Two-Dimensional Hidden Markov Models

The pseudo two dimensional hidden markov's model is a further enhancement of the one dimensional model used as it works with stochastic automata but now the arrangement of states is in two –dimensional form[2]. The recognition process achieved by means of P2D-HMMs is pretty similar to the recognition process made with one-dimensional HMM [2]. The P2D-HMMs can be trained using the standard Baum-Welch algorithm and the recognition step can be carried out with the standard Viterbi algorithm [2]. The Viterbi algorithm (VA) is characterized by a graph, which is called as trellis, which defines the transitions between states [12]. A pseudo two dimensional model consist of super states where images form sequence of rows and inside the model are linear state 1D images.

4. Canny's edge detection

Canny's edge detection algorithm is used for detecting edges of any objects in an image. It is a widely used algorithm used in image processing domain. We have studied this

algorithm because of its advantage that it reduces the amount of data to be processed, but still retaining the structural properties to be used for further image processing. This algorithm was developed by John F. Canny in 1986. Since then it has become a standard for edge detection in the field of image processing.

The algorithm was developed with an aim to optimize the performance with regards to detection, localization and the number of responses produced. In other words, as far as possible we have to maximize the probability of detecting the real edges and remove the noise which comes from false non-edges. At the same time we also have to ensure that there should be no more the one edge detected for a single real edge in the input image. One more point to be considered for optimization is that the detected edge should be as close as possible to the edges in the image. Therefore keeping these aims of optimization the said algorithm was developed.

Now, there are some prerequisites required for this algorithm to run efficiently. The first one is converting the input image into a gray scale image so that we can reduce the computational requirements for the algorithm. Another pre-processing task that can be included is determining the region of interest. Like for face detection we can crop the image only for the face. We also have to carry out noise reduction in the input image, since noise in the input image will cause the algorithm to produce falsely detected edges.

4.1 Algorithm

The algorithm runs in 5 separate steps:

1. Smoothing: Blurring of the image to remove noise.

2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.

3. Non-maximum suppression: Only local maxima should be marked as edges.

4. Double thresholding: Potential edges are determined by thresholding.

5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge [3].

5. Artificial Intelligence as a Method

A hybrid neural network which with the help of other methods helps to detect the faces from a huge database. Recognition of faces may seem an easy task for humans, but for machines it is quite difficult [4]. The difficulties are faced due to certain reasons like occlusion, image orientation, lighting conditions etc [5]. A typical face recognition program includes the following stages:

1] Detecting human faces from areas of image.

2] Extraction of face region from the image.

3] It involves the facial image based on the representation of the previous images.

Feature extraction is quite important in a face recognition paper. There are two approaches for the feature extraction process:

A] Face based

B] Constituent based

Face based method uses the Principle Component Algorithm (PCA) for face detection.Haddadnia et. al. developed a new method for face detection viz. Pseudo Zernike Moment Invariants (PZMI) as features and Radial Basis Function (RBF) neural network as classifier [6][7][8].

Elements that are irrelevant to the facial region such as the shoulders, hair and background causes errors that can affect the face recognition results. Also due to the variation in illumination, image orientation and facial expression single feature is not convenient for representation of human face. So due to these drawbacks of the performance of this approach is quite limited. Constituent face based approach is more convenient and more preferred than the face based one.

The constituent based approach deals with the local information like the eyes, mouth, nose etc. and is not affected by the irrelevant information in the image. Yullie et. al. use Deformable templates to extract facial features [9]. The shape and sizes of these templates can be changed so that they can match with different features. The detection of eyes and mouth is done well by these templates whatever may be the orientation, scale and rotation of head. The drawback is that this method is very time consuming and cannot deal with complicated background settings. It is computationally expensive for the searching of features, therefore Canny's is used as search algorithm

6. Conclusion

In this paper, we have presented a survey of face recognition using the various algorithms with applications to combat crime. We have mainly focused on face detection and segmentation using Viola Jones, feature extraction using information drawn from Canny's algorithm and training and recognition using Hidden Markov's Model. The algorithms mentioned has advantages over the PCA (Principal Component Analysis) and Neural Networks. The algorithms of Viola Jones and Hidden Markov's Model provide high speed detection even though they are complex to implement.

References

1] A New Fast and Efficient HMM-Based Face Recognition Paper Using a 7-State HMM Along With SVD Coefficients. Iranian Journal of Electrical & Electronic Engineering, 2008. Revised form 2nd March 2008. The Authors are with the Department of Electrical and Computer Engineering, Babol University of Technology, Babol, Iran.

2] Pseudo 2D Hidden Markov Model and Neural Network Coefficients in Face Recognition Domenico Daleno1,2, Lucia Cariello1,2, Marco Giannini1,2 and Giuseppe Mastronardi1,2

Department of Electrotecnical and Electronics, Polytechnic of Bari, Via Orabona, 4 – 70125 Bari – Italy2 e.B.I.S. s.r.l. (electronic Business In Security), Spin-Off of Polytechnic of Bari,Via Pavoncelli, 139 – 70125 Bari – Italy.

[3] Canny Edge Detection 09gr820 March 23,2009

[4] Chellappa, R.; Wilson, C. L.; and Sirohey, S. 1995. Human and Machine Recognition of Faces: A Survey. Proceedings of the IEEE, 83(5): 705-740.

[5] Yang, M. H.; Kriegman, D. J.; and Ahuja, N. 2002. Detecting Faces in Images: A Survey. *IEEE* Transactions on Pattern Analysis and Machine Intelligence, 24(1): 34-58.

[6] Haddadnia, J.; Ahmadi, M.; and Faez, K. 2002. A Hybrid Learning RBF Neural Network for Human Face Recognition with Pseudo Zernike Moment Invariant. In Proceedings of the IEEE 2002 International Joint Conference on Neural Networks, 1: 11-16. Honolulu, USA.

[7] Haddadnia, J.; Ahmadi, M.; and Faez, K. 2002. An Efficient Method for Recognition of Human Faces using Higher Orders Pseudo Zernike Moment Invariant. In Proceedings of the Fifth IEEE International Conference on Automatic Face and Gesture Recognition, 315-320. Washington, USA.

[8] Haddadnia, J.; Faez, K.; and Ahmadi, M. 2003. An Efficient Human Face Recognition Paper Using Pseudo Zernike Moment Invariant and Radial Basis Function Neural Network. International Journal of Pattern Recognition and Artificial Intelligence

[9] Yullie, A. L.; Cohen, D. S.; and Hallinan, P. W. 1989. Feature Extraction from Faces using Deformable Templates. In Proceeding of the IEEE International Conference on Pattern Recognition, 104-109. SanDiego, USA.

[10]http://www.academia.edu/541186/A_Hybrid _Face_Detection_Paper_using_combination_of_ Appearance-based_and_Feature-based_methods

[11] Robust Real-Time Face DetectionPAUL VIOLA Microsoft Research, One Microsoft Way, Redmond, WA 98052, USA viola@microsoft.com MICHAEL J. JONES Mitsubishi Electric Research Laboratory, 201 Broadway, Cambridge, MA 02139, USA mjones@merl.com Accepted July 11, 2003

[12] High-Performance VLSI Architecture for the Viterbi Algorithm Montse B´oo, Francisco Arg¨uello, Javier D. Bruguera, Ram´on Doallo, Associate Member, IEEE, and Emilio L. Zapata, IEEE TRANSACTIONS ON COMMUNICATIONS, VOL. 45, NO. 2, FEBRUARY 1997