Face detection using region descriptors

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Abstract—*This is a proposal paper that different features can also be used in place of already existing [1] NPD based face detection. We have attempted to describe strategy for face identification and detection of frontal and close frontal faces in an image. Here the face detection is done by utilizing a region descriptor feature that is Normalized pixel as highlight. The concept of Normalized pixel is every pixel intensity value is normalized by its sum with every other pixel intensity value in an image. Combination of adaboosting and quadratic tree structured cascade classifier is used to train the detector .We have attempted to deal with the bottle necks of in multiple face detection and presented the results to demonstrate the performance of this detector*.

Keywords—face detection, normalization, pixel, adaboosting.

1. INTRODUCTION

The first and foremost goal of face detection is to find and locate all frontal and close frontal faces. There are many problems the face detection in real time is yet to overcome like occlusion, blurred image, illumination problems, different expressions, partial faces with different poses etc. Most of the face detectors fail to do the task when they have to deal with the images with such problems. Previously proposed techniques like viola Jones method and their extensions are able to deal with the problems and perform to that satisfactory but no method has been proposed till today that can deal with all problems and perform detection. They also take long time in detecting objects or faces; whereas speed of detector is also a major issue that has to be kept in context. Major detectors fail in achieving acceptable detection speed because they usually take get trained with large sample set of databases and multiple cascade classifiers are run for every window considered in detection which take very long time. Instead only single cascade classifier framework can be designed to achieve speed. This algorithm goes with major concepts like Normalized pixel feature and adaboosting along with deep quadratic tree classifier to design a single cascade classifier.

- Deep quadratic regression tree structures can solve the problem can be solved different poses and expressions. Where pose variations and different expressions are represented in the form of leaves of the regression tree.
- Normalized pixel deals with the problems like occlusion, illumination, blur and low resolution of image as the normalization is done by using two pixel intensity values and ordinal relationship [21] [22] concept is considered which deals with difference of a pixel relative to other.
- Rate of face detection is increased by using framing lookup tables for reference in testing process instead of repeating the complete process multiple times and a single cascade classifier is framed in order to reduce time taken for identifying faces.

2. RELATED WORK

The Most popular face detection techniques already exist as mentioned in survey [23] such as Viola Jones face detection,[7][9] SURF, SIFT etc has their own backdrops. Firstly the most famous technique Viola Jones [2] proposes Haar like features along with multi stage AdaBoost classifier to identify faces. But it fails in recognizing all faces accurately in real time where it has to deal with identifying faces in crowd, pose variations, expression variations, illumination changes, occlusions, blur etc. Based on Viola Jones number of face detection techniques were proposed as an extension which works with different types of features. [3] Later Viola Jones proposed extension to his algorithm in order to deal with pose variations of face in 2001. Here decision tree concept is used in which each face profile uses only particular detector from set of detectors that is appropriate for it. Joint Haar like features [8] proposed were able to remove little pose variation problems but where not so successful. Whereas normalization of pixel intensity with relative sum offer better support to detection. In this multi-view face detection [5] a new boosting technique called flatboost instead of adaboost is used. Flatboost set of detectors are framed in the form of pyramid called detector pyramid .Flatboost is more accurate and fast in detection but requires more training still lags in fair results of detection. Local gradient pattern (LOG) [6] and Binary histogram of oriented gradient (BHOG) uses intensity values, local binary patterns (LBP) [10] introduced so as to deal with texture and pose variation along with illumination problems but rate of detection is lower. A reference table called lookup [16] can also be considered so as to increase speed of the detector in balance with its performance. Concepts like neural networks [20] and fudical points of face are near to accuracy but they are very slow process.

Multi view face detection[11] can be achieved by using by width-first-search (WFS) which is a tree structure along with vector boosting instead of adaboosting and domain pattern(DPM) based feature learning. SIFT [19] considered the pixel intensity values directly with different structures as features, intensity values of pixel in multiple scales which do not provide generalized concept for the detection, Tree based learning and provides generalization which is used as part of adaboosting in this paper. There are many other not so popular techniques like image retrieval [12], exemplar-based face detection [13], probabilistic elastic part (PEP) [14], Aggregate channel features [15] have their own unique advantages but fail in some or the other aspect. The Normalized pixel region descriptor tries to give attention to all aspects where other detectors fail. So we can say the technique proposed summarizes all the unique aspects of all previous face detection concepts in fairly satisfactory manner.

3. FACE DETECTION

3.1 Normalized pixel feature:

The Normalization of Pixel feature between two pixels in an image is given by

$$f(x,y) = \frac{X}{X+Y}$$

Where x, y are intensity values. f(x, y) ranges from 0 to 255 grey level values. For example if we take 3x3 image we get 1x36 features i.e., for m x n image m(n-1)/2 features are obtained.

3.2 Learning deep quadratic tree:

Features can be obtained from lookup table and then deep quadratic tree is learned by using these features [1] .This describe the edges of face .Thus here deep quadratic tree obtained is used as single gentle cascade classifier.

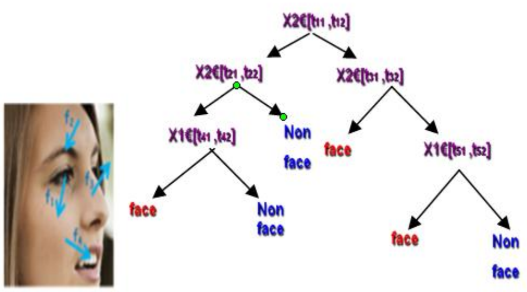

Fig-1: Branching of quadratic tree at face edges

3.3 Adaboosting:

The deep quadratic tree is combined with adaboosting so that face features obtained are boosted in weight than that of non face features.

3.4 Bootstraping:

Bootstraping is finding face like structures in non faces. Run the learned face detector on a sequence of random images. Collect the false positives and Add these non-face patterns to the training set.

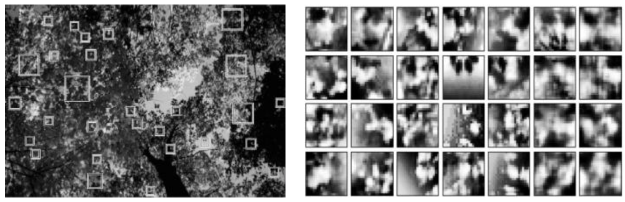

Fig-2: Bootstraping and taking nonface training set

4. RESULTS

The proposed detector is demonstrated on real time class room image. Where in fig-3 we can see 19 out of 25 faces are detected. Fig-4 is image perfect frontal faces so all faces got detected showing cent percent detection rate.

Fig -3: Face detection on a class room image

Fig-4: Face detection on a perfect frontal image

The ROC curves of this method are plotted for FDDB database. Numbers of non faces are wrongly identified as faces is plotted against number of true faces identified as a curve. Both discrete and continuous score metric are presented in the plot.

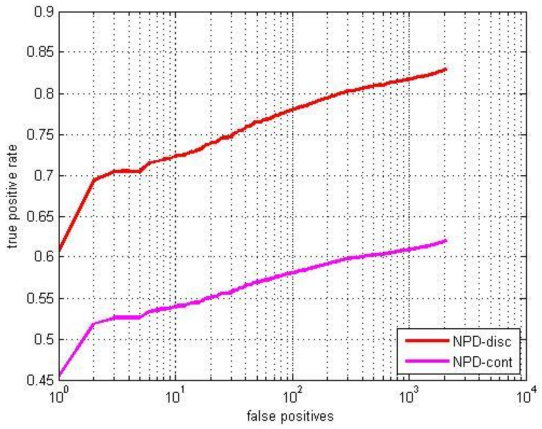

Fig-4: ROC curves for discrete and continuous metric.

Table-1: Comparison of detection rates

	Continuous metric			Discrete metric		
False Positives	FP=0	FP=10	FP=100	FP=0	FP=10	FP=100
Normalized pixel[1]	40.64	53.93	58.04	54.15	72.31	77.97

The table illustrates the ROC curves and compares the detection rates for continuous and discrete metric.

Table-2: Comparison of detection speed

Detector	Frontal face detector	Unconstrained face detector
Speed(frames per second)	29.6 (for resolution 1920 x1080)	70.06

By the above readings we can say that the detector outperforms consistently in every criteria required.

5. CONCLUSION AND FUTURE WORK

The proposed detector is also efficient and faster .It handle general issues in real time face detection in a satisfactory manner. Still different features f(x,y) are to be used in detection and compared. The procedure can be tested for different new features to select the best feature with few computations to increase the speed of detection. This method can also be extended to the face recognition and future to face detection or face recognition for multi view videos.

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