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Research paper



Hybrid framework for detection of human face based on haar-like feature

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Abstract

Augmentation in computer technology has made attainable to prompt incipient video processing practices in territory of biometric identification. Applications embroil face detection and face recognition consolidated to examination framework, signal investigation etc. Face detection is broadly utilized as a part of intuitive user interfaces and assumes an essential part in the area of computer vision. In order to build a fully automated system that can analyze the information in face image, there is a requirement for powerful and productive face detection algorithms. In this paper a framework is proposed for human face detection in images acquired under various illumination conditions. The features established on Gabor filters extracted from local image are applied to be the input of the Haar like classifier. At last, the experiment indicates elite in both accuracy and speed of the created framework.

Keywords:*Biometrics; Face Detection; Gabor Filter; Haar Like Features.*

1. Introduction

Face identification is the essential stage toward automated face recognition. Potential uses of face detection and extraction are in intuitive user interfaces, promoting industry, excitement administrations, and video coding. This exploration is principally inspired by the face detection issue, which implies how to discover, in light of visual data, the whole events of appearances despite who the individual is. Face detection is likely a standout amongst the most difficult issues in computer vision and no arrangement has been accomplished with execution similar to humans each in accuracy and speed. Face detection can be seen as a two-class characterization issue in which a image region is named either a face or non-face[1]. There are over in excess of 150 methodologies for face detection. These methodologies are characterized into four distinct classifications, they are Knowledge-based, Feature invariant, Template matching, and Appearance-based [2]. In the accompanying, a short audit of these four classifications is given. (1) Knowledge based strategies are control based techniques, which encode human learning about what a face is. For instance, in our human personality, symmetric eyes, ears, nose and mouth are key face highlight. Building up these techniques in various circumstances is in some cases troublesome on the grounds that not all states are countable. (2) Feature invariant strategies are changing techniques with goal to discover robustious auxiliary highlights which are invariant to posture, lighting, and so on. This strategy is a standout amongst the most vital strategies for face detection. (3) Template matching strategies register the connection between's examples of a face and an information picture so as to discovery. In these techniques, the connection of a few examples of face in various postures and the information pictures are put away to be a model for face approval. (4) Appearance based strategies utilize models gained from preparing sets to speak to the changeability of facial appearance. Entirely these strategies the formats are found out from face image samples. For the most part, appearance-based techniques use measurable investigation and machine learning how to discover qualities identified with face or non-face images [3]. These days the field of face detection has gained noteworthy ground in reality applications. Specifically, the work by Viola and Jones has made face detection feasible in digital cameras and photograph association programming [4]. In this paper, a compelling constant face detection framework in view of Viola Jones approach is displayed. The rest of this article is organized as follows. Section 2 gives the related works on face detection. Section 3 we will give brief overviews on feature extraction for our face detection task using Gabor feature extraction and Haar-like features in our proposed system. Section 4 gives experiments and results of proposed system. Section 5 discusses the conclusions of our work.

2. Related works

Earlier endeavors of face detection research have been focused on relationship or layout coordinating, matched filtering, subspace strategies, deformable formats, etc. Neural network and convolution neural network are utilized for face detection of static images individually. These strategies have great location execution, yet they experience the ill effects of high computational multifaceted nature [5].C. Ding et al. proposed brisk face detection based on skin shading and pattern plate. This technique can do well in recognizing the frontal face. However the above work neglects to distinguish look under the illumination changes, occlusion and faces with discretionary poses [7]. Stan Z. Li et al. proposed Recursive Nonparametric Discriminant Analysis (RNDA) to separate facial features. The Adaboost classifier was utilized to distinguish faces with self-assertive postures. Because of facial skin shading carelessness some wrong protests are identified as a face [8]. Manminder Singh et al. exhibited that face images with the similar

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pose, under various illumination conditions, shape a showed that face images with the similar pose, under different illumination conditions, form a convex cone, the illumination cone [9]. H.Nanda et al. have presented a face identifying strategy for template matching, this technique is anything but difficult to accomplish, yet it has low recognition rate for both pose-varied face and decorations [6]. Ke Yan et al. proposed new color local surface highlights including color local Gabor wavelets and color local binary for face recognition and that could give fantastic acknowledgment rates, yet this examination was restricted to separate highlights from settled shading component configuration [10].

3. Proposed methodology

The preferred technique of face detection in the given paper is inferred on multi-phase architecture. As appeared in Figure the setup has two phases: first phase is initial stage where we utilize Viola and Jones algorithm to identify faces from continuous web camera or still pictures obtained from device storage, and the consequence of this phase will be the candidate images which will be either face or non- face

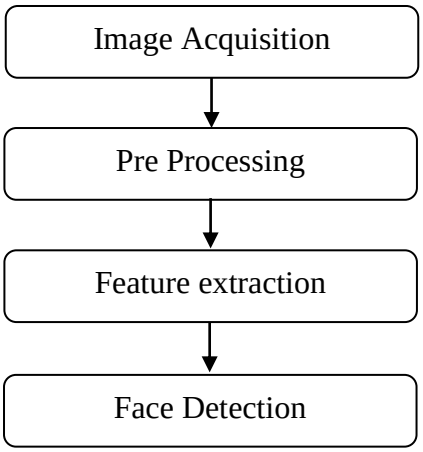


Fig. 1: Block Diagram of Proposed System.

At that point, these applicant images will be the contribution for the next phase i.e. second phase which comprises of 3 sub-phases; Gabor filters for feature extraction and haar like feature extraction for face detection. So first sub-phase of the second phase will be Gabor filter feature extraction, where the feature will be extracted from the applicant pictures by employing the Gabor filters wavelet. From that point forward, the originated feature vector is utilized as a contribution to the second sub-phase Haar like feature extraction, to identify the face. Viola and Jones technique desires initially to change the pictures from RGB to grey scale. Contrast and illumination modification tasks will be accomplished to include great outcomes. Now and again, facial images are frequently tainted by different kinds of noise. To avoid this facial image will be handled with the best possible filters to remove the noise.The yield of this phase will be the cropped applicants faces or non faces from the source picture. In our examination we will embrace the execution of Viola and Jones utilizing worked in Matlab libraries.Viola and Jones face identification technique comprises of a gathering of calculations for continuous face detection. It ended up a standout amongst the most essential and powerful face detection techniques. In this strategy, the preparing steps and the tasks are conveyed in view of the basic picture method which permits quick calculation and quick reaction.In common Viola and Jones is proper for our anticipated procedure, and was picked in this manuscript for its vigor, pace of discovery [11].

3.1. Gabor feature extraction

Individuals can perceive faces since adolescence. It is a simple procedure for our brains; we can identify faces and perceive individuals regardless of whether they are wearing glasses or having mustaches [12]. Along these lines, the way toward distinguishing faces for person is inconsequential and simple; however it isn't as simple for machines to do as such. The principle test of face detection is the way to remove highlights from a picture with a specific end goal to choose whether the image implies a face or not [13]. We can characterize the way toward separating helpful critical information from a image as a feature removing process, having as a primary concern that the separated data must be helpful, profitable and representative, with the goal that it can be passed to different phases of the face detection procedure [14-15]. Additionally, the procedure of highlight extraction must not put a weight on the framework with the goal that it expends long time to be computed. In our planned procedure, we will utilize Gabor wavelet change to extricate certain nearby highlights of the image. Gabor wavelet transforms works in both determination and introduction properties and ideal for estimating neighborhood spatial frequencies. The Gabor representation of an image is the convolution of the image with the Gabor filter. Predicated on the Gabor representations, a feature vector is composed [16]. Because of the above reasons Gabor wavelet transform has been utilized as a part of a wide range of picture investigation and handling applications.
The filter principle favorable position is that its representation of frequency and orientation is identically tantamount to the visual view of people. This makes the filter reasonable for texture representation and discrimination. A two measurement Gabor filter is a Gaussian capacity regulated by a sinusoidal wave [17]. The primary objective behind utilizing this two dimensional Gabor wavelet channel is to get the fundamental component vectors that will be the contribution to the following phase of our planned strategy, keeping in mind the end goal to show signs of improvement depictions of the visual substance of facial pictures. The impulse response of the Gabor filter can be characterized numerically by increasing the harmonic function of a sinusoidal wave with the Gaussian capacity. The drive response at that point will have the pair of real and imaginary segment which can be Figureured utilizing conditions (1) (2) and (3).

The Complex Part:

$$g(x,y;\lambda,\theta,\Psi,\sigma,\gamma)=\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\exp\left(i\left(2\pi\frac{x'}{\lambda}+\Psi\right)\right) \quad (1)$$

The Real Part:

$$g(x,y;\lambda,\theta,\Psi,\sigma,\gamma)=\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\cos\left(2\pi\frac{x'}{\lambda}+\Psi\right) \quad (2)$$

The Imaginary Part:

$$g(x,y;\lambda,\theta,\Psi,\sigma,\gamma)=\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\sin\left(2\pi\frac{x'}{\lambda}+\Psi\right) \quad (3)$$

λ: Wave length of the Sinusoidal wave.
θ: The orientation angle of the parallel stripes angle of the Gabor function.
Ψ: Phase offset
σ: Sigma of the Gaussian index
γ: Spatial aspect ratio

$$x' = x\cos\theta + y\sin\theta$$

$$y' = -x\sin\theta + y\cos\theta$$

3.2. Haar like features

A course of classifiers is utilized for face identification on an image. Classifiers examine a similar window of the underlying image consecutively. On the off chance that the first classifier returns genuine, the second classifier will examine a present window and so on. On the off chance that the classifier returns false, the cascade quits analyzing the present window and swings to the following window. The following window is moved to one pixel right or down as indicated by the present window. The classifier is based on Haar-like features [18]. The customary Haar-like feature set utilized, which is made out of four essential sorts of rectangle highlights. The facial appearance can situate at any zone inside a scanning picture window. A component is assessed by the contrast among the summed pixel estimations of black rectangular and that of white rectangular. The rectangular element can characterize the nearby emergence of object [19]. Feature A and feature B in Figureure 2 is intended to amplitude the distinction in power among two neighboring rectangular regions. For instance, feature B can measures the distinction in intensity between the region of the eyes and an area over the upper cheeks. The most vital normal for the Viola-Jones framework is that the Haarlike features can be Figureured quickly at all dimensions in consistent time by utilizing the integral image. The Haar-like features of a gray-level picture is inherently the gray contrast of neighborhoods [20]. The shading complexity to skin shading or the distinction of gray gradient can be view as another type of gray image, this sort of particular esteemed component represented in the type of gray image [21]. Along these lines, the Haar like features are reached out in their structures as well as in their substantial natures, which add extra area information to the learning system and which is difficult to gain from gray-level image. All highlights illustrated in the type of gray like image can be utilized as a part of the Viola-Jones framework, as they can be changed over to Haar like features effectively subsequent to processing their fundamental pictures.

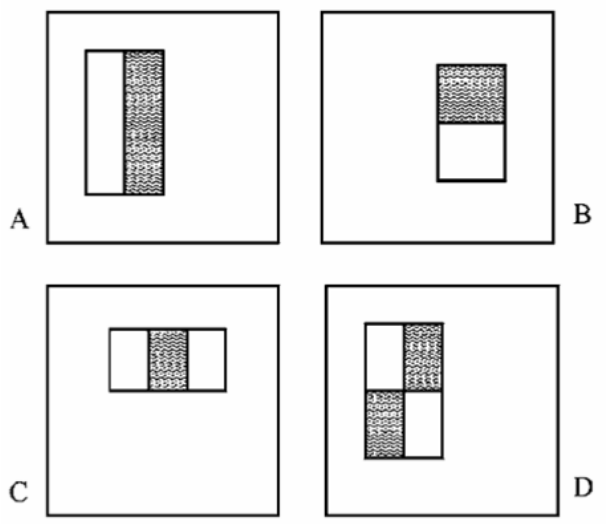


Fig. 2: Examples of Rectangle Features.

A basic picture has been utilized to quicken feature sum computation (1). The integral image is an exhibit with an indistinguishable size from a source image. Essential image component esteem is an aggregate of all pixels situated left and higher than a present component in the source image. For instance, component 1 (Figure.3) is a total of all pixels in region A. Eqn (4) is utilized to ascertain the entirety of pixels of any rectangle territory in the image.

$$sum = pt_4 - pt_3 - pt_2 + pt_1 \quad (4)$$

Coefficient records demonstrate relating area angles (see Fig.3). A classifier window has a settled size. Consequently, the classifier can identify look with a practically identical size. There are two methodologies for looking through a face with a subjective size; they are classifier scaling and an image scaling.

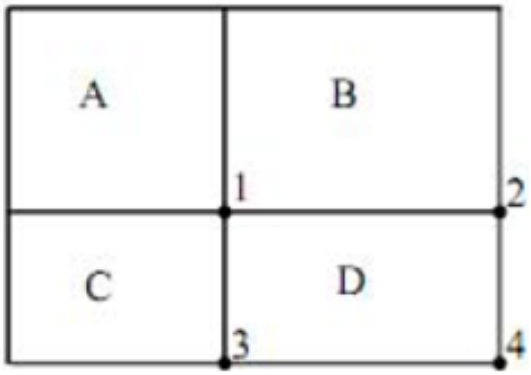


Fig. 3: Example for Calculating Sum.

4. Experiments and results

We assess the execution of the face detector on FDDB database [22]. We additionally give an examination of the proposed method, report the face identification speed, and report unconstrained face detection exhibitions under illumination variations, pose variations, occlusion, and blur, separately. The FDDB dataset [22] covers testing situations for face detection. An image in FDDB originates from the Faces in the Wild dataset, which is an extensive accumulation of Internet pictures gathered from the Yahoo News. It contains 2,845 images with a total of 5,171 faces, with an extensive variety of testing situations including subjective pose, occlusions, different lightings, expressions, low resolutions, and out-of-focus faces [8]. All faces in the database have been explained with circular areas. We compared our strategy and different calculations in FDDB database and the outcomes are appeared in Table, Which indicates are proposed work outperforms different techniques.

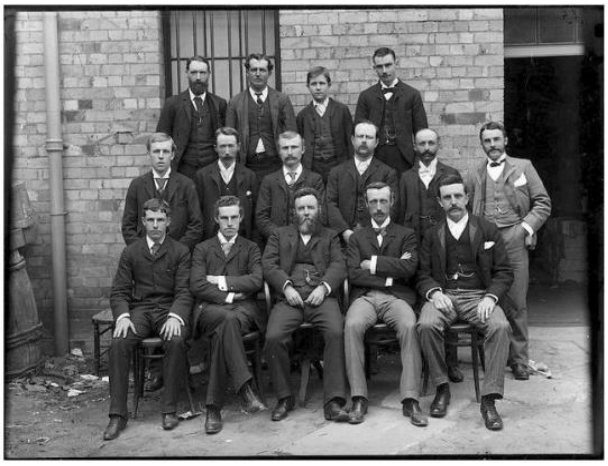


Fig. 4: Input Image.



Fig. 5: Preprocessed Image.

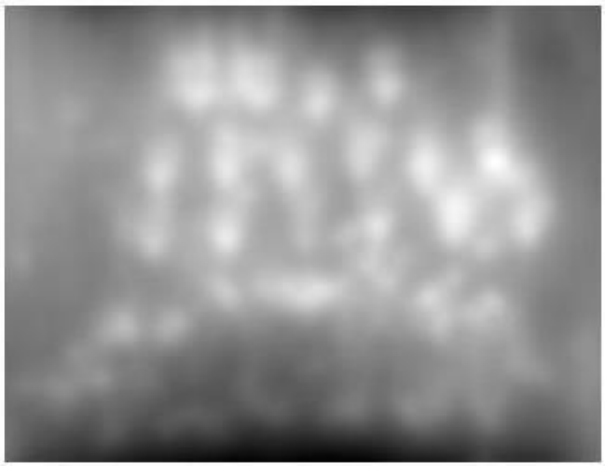


Fig. 6: Gabor Feature Extraction.

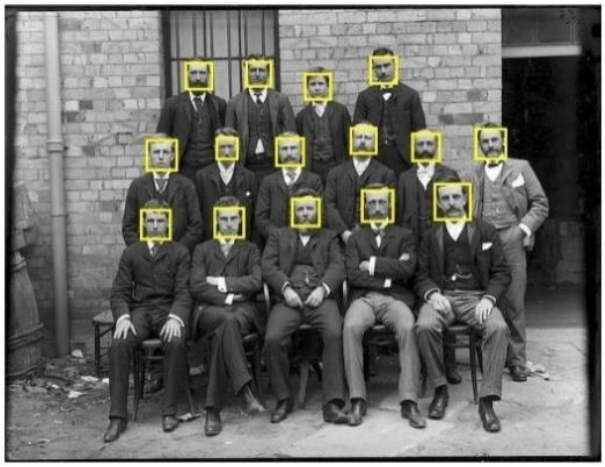


Fig. 7: Face Detection.

Table 1: Comparison of Detection Rate

Method	Precision	Recall	Detection rate
SMQT Features and SNOW classifier (SFSC)	0.26792	0.26792	93.3
Neural Network (NN)	0.33945	0.037582	86.5
Proposed method (PM)	0.69538	0.68286	95.25

5. Conclusion

We introduced a compelling and strong strategy for distinguishing faces in images under different illumination conditions in view of Haar features. Gabor feature extraction strategy is joined into an ordinary face identifier to mitigate illumination variation issue. It is enhanced the face identification rate and decrease the preparing time and the dimension of the bounding box more precisely joined to the detected face. Face detection in the video sequences is a vital research branch of face recognition. In future our research will focus on face recognition obtained from the video sequences under different light conditions.

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