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A STUDY ON FACTORS AFFECTING FACIAL RECOGNITION ACCURACY

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ABSTRACT

The system of biometric security is very essential for providing safety and security to people against frauds, theft etc. One of the most essential and secured biometric system is Face recognition; It can be used for identification and surveillance to prove the identity of a person and spot individuals. The aim of this analysis is to study some factors which affect the perfection and accuracy of the face recognition. The outcomes we get that regardless of the continuous research, a perfect face recognition system is needed that can perform its functions in natural as well as unnatural environment.

Keywords: Face detection, Face recognition

I. INTRODUCTION

Face recognition system is considered as one of the best and essential identification system which is commonly based on the biometric that can also be used for the identification process as well as surveillance. As the number of frauds and thefts are increasing day by day, face recognition is emerge as a important system for us. Many types of applications of efficient face identification system are forensic, fraud exclusion, identification of criminals, surveillance etc. A plenty of researches has been done on both international and national standards, but even after consistent research. a efficient and better resilient system is yet not available that can perform better in both real time and natural conditions. Face recognition has always observed as a challenging task for humans. The original test that lies in outlining an automatic network which parallels the human capability to recognize faces. Therefore, a automatic programmed based on electric framework with comparatively higher recognition perfection and fast processing is needed.

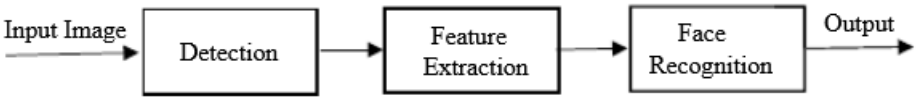

Figure 1: Steps of face detection and recognition

There are three steps which basically involve in the process of the face recognition and detections are:

1) Face detection: To authenticate the faces in an image r video by using the main points of face such as eyes, nose, mouth etc.
2) Feature extraction: normalization of the faces with accurate alignment for better detection perfection.
3) Face recognition: To observe a specific person in an image or video by comparing with the data base.

a. Objective of the Study

The aim of the study is to analyze the factors that make impact on the perfection of facial recognition.

II. FACTORS AFFECTING FACE RECOGNITION ACCURACY

Face detection and recognition form the videos and images is a frightening task. A plenty of researches has been done to attain 100% accuracy but still we are not getting any satisfactory result with regard to the various factors challenging this system. It has been found that the factors that affect the perfection of face detection systems are:

a) Noise
b) Illumination

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c) Occlusion
d) Lower resolution
e) Pose variation
f) Plastic surgery
g) Aging
h) Expressions

All these factors can be divided into two types of categories:

A) **Intrinsic factors:** Intrinsic factors incorporate the physical state of the face of human like facial expression, aging etc that influence the system.

B) **Extrinsic factors:** This factors are responsible to modify the appearance of the face like low resolution, noise, illumination, occlusion given in figure below:

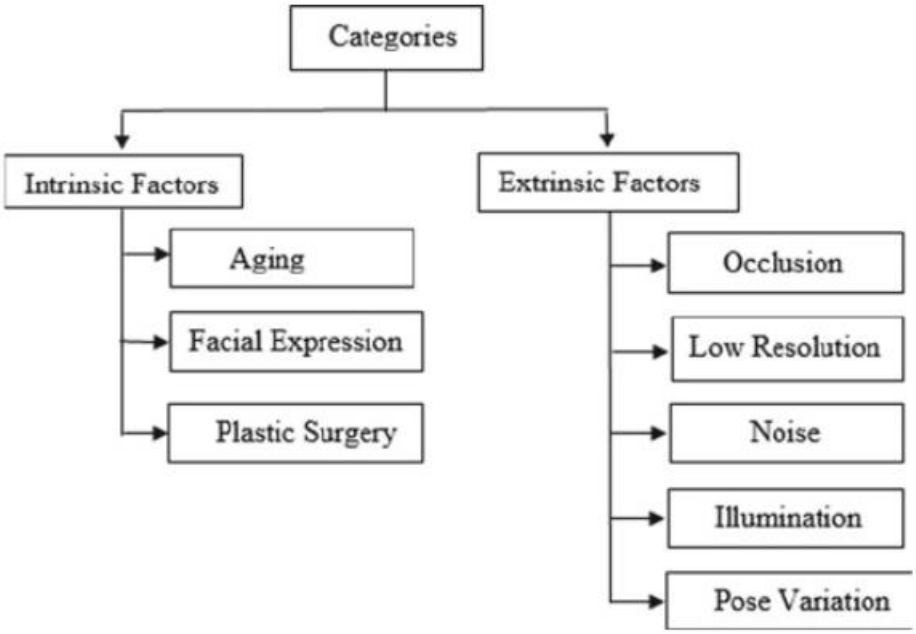

Figure 2: Categories of factors affecting face recognition accuracy

a. Occlusion

Face occlusion is also known as the face obstruction. It would be difficult to detect or recognize the face if some part of the face is missing. For example : Scarfs can hide half face, mustaches and beard of boys can hide half of the face, earning and hairs can hide ears whereas sunglasses can hide eyes etc as shown in the below figure. All these factors can affect the system. Various approaches are being proposed by the researchers to overcome these issues.

Figure 3: Partial occlusion in the face

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b. Low Resolution

The pictures taken from surveillance video cameras embrace small faces; therefore, it pixels and resolution are very low as shown in below figure. To compare the low resolution query image with the high resolution gallery image is a difficult task. Such a low resolution picture image comprises an extremely constrained data as the major part of the points of interest is lost. This can be highly affecting the detection rate. Separate methodologies being proposed by the researchers to tackle with these issues.

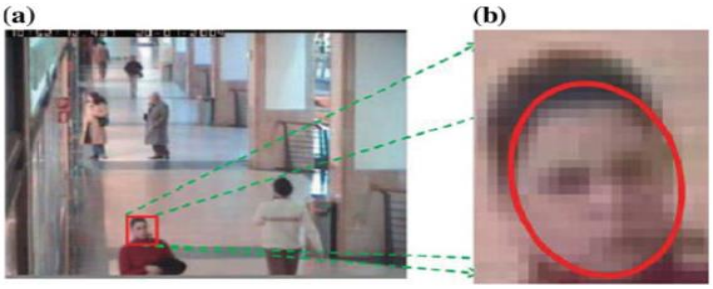

Figure 3: Frame from surveillance video. a) Video, b) Captured face

c. Noise

Digital images are liable to different types of noises. This noise decreases the perfection of recognition and detection. Noise can be implemented to the images a many ways that are rely on the image creation. The pre process is an essential factors in the common face detection and recognition system as in the below figure, Figure b explains the salt and pepper noise present in an image.

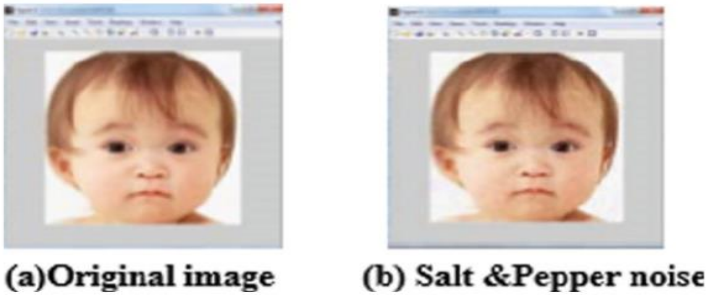

Figure 4: Noise in face image

d. Illumination

The variation and inconsistency in illumination can highly affect the performance of the face recognition and detection system. The main reasons for these types of variation could be background light, shadow, brightness etc. Many images which are taken in the different lightning conditions are shown in figure below:

Various types of ways reacted to illumination are being discussed also:

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Figure 5: Effect of illumination in face images

e. Pose Variation

Many types of poses are also one of the major concerns of the face detection system. Reconstruction of Front side of face is needed to match the profile face with the gallery face. This reconstruction is needed only because of the database image comprises of front view and non front profile face can show fault results. Various ways are explained by the researchers to transform the non front face to front face could increase the perfection of recognition and detection. Many researchers are now researching on how the pose variations affect the performance of the algorithm dramatically. Different poses variations of an individual are shown in figure below.

Figure 6: Pose variations

f. Expressions

We can express our feelings with the help of expressions of our face as shown in figure below. Expression changes geometry of the face. A small variation in the face can create blurriness in the face recognition framework. Facial expression is a fast signal that is affected because of the contraction of muscles and changes the aspects of face such as cheeks, mouth, eyebrows etc. Consistent research is being done for the detection of face by taking face expression into consideration.

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Figure 7: Different facial expressions

g. Aging

As we know, Aging is one of the natural components that affect his face detection system as it changes completely with the increasing of the age. The face is formed with the mixture of skin tissue, bones and facial muscles. At a point, when the muscles contract with the increase in age, it leads to the twisting in the facial structure. As similar to that, maturity also causes critical changes in appearances of face of an individual, like Face shape and facial surface with the increase of time. The face detection system should be enough skilled in related to this needs. Various texture if the faces of the same person at the various ages is given below;

Figure 8: Aging variations

h. Plastic Surgery

It is also a big challenging factor that highly affects the face detection perfection. Most of the incidents are happened that only because of accidents, as most of people have to go through the plastic surgery and it lead to their face completely change to the existing face detection system. Mostly the criminals adopt the idea of plastic surgery to hide their identity. So, as this discussed in 21, we need an identification system that is able to recognizing faces even after reconstructive plastic surgery. The result of the plastic surgery is shown in figure below.

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Figure 9: Surgery effects

III. CLASSFICATION OF FACE RECOGNITION METHODS

Techniques of the face detection can be explained into following 3 categories :

a) Appearance based frameworks
b) Feature based matching techniques
c) Hybrid Techniques

The categorization of the face recognition and detection techniques and the algorithm used in the above discussed methods is shown in figure below:

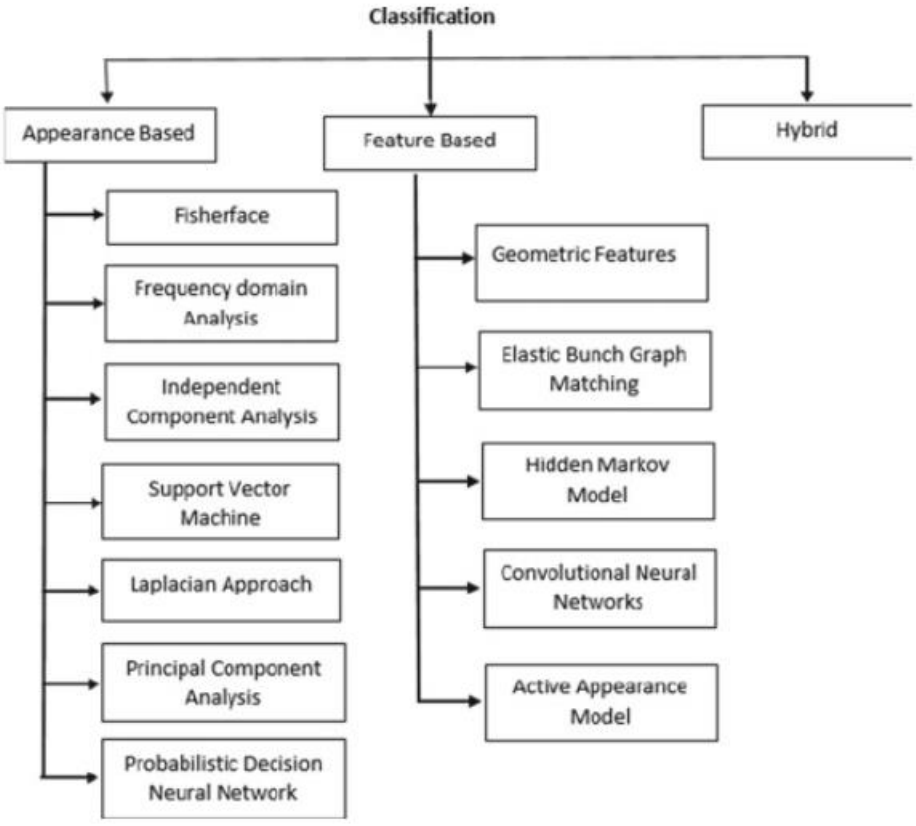

Figure 10: Classification of face recognition algorithms

a. Appearance-Based Methods

Appearances based frameworks techniques are also known as the comprehensive method where an entire face is matched with the gallery face. The benefits offered by the comprehensive ways are:

1) The mainly focus on only limited areas or points of face without destroying any data in images.

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2) No information related to geometry and reflection of faces are needed
3) Detection and recognition is simple as compared to other matching way
4) Fast and easy to execute and implement.

But they are little bit liable to the limitations that caused by facial expressions such as illuminations, pose variations etc. Also, the perfection of detection and recognition is low in an unnatural environment.

b. Feature-Based Matching Methods

In this method, matching of probe face with the gallery face has been done by using the local aspects of the face like eyes, mouth, nose etc. The points and local statistics of the extracted aspects have fed into the structural classifier to recognize face.

IN feature based matching techniques, detection perfection is better than appearance based techniques. Therefore, high memory usage is needed in these methods and also a high amount of clean and labeled data for training.

c. Hybrid Methods

Hybrid techniques are an integration of both appearance based method and feature based matching techniques. Both previous techniques are combined together to enhance the detection rate. Nonetheless, this technique is composite and very difficult to execute as it is the amalgamation of both types of methods.

IV. PAST STUDIES ON APPEARANCE-BASED APPROACHES OF FACE RECOGNITION METHODS

As per the theory proposed by the Khan et al., (2018) The PCA Eigen face algorithm has been used for the face recognition. Investigation outcomes showed that the given approach attained 86% detection perfection in a natural environment and 80% detection accuracy in unnatural environment [1].

As per the Chawla and Trivedi (2018), the comparative analysis of AdaBoost, PCA, LDA and elastic bunch graph matching algorithm for face detection has been explained with their limitations, advantages and success rate. All the explained algorithms are appropriate only for smaller simple databases [2].

As per the Abdullah (2017), an application of face detection given for criminal identification. In this explained techniques, a main element analysis has been used to detect the faces of criminal. The outcomes showed the 80% detection perfection but a plenty of testing is required for this work [3].

As per the Dhameja et al. (2017), a combination of PCA, fisher face and SVD methods for face detection. The proposed techniques was tested on AT&T face recognition database and accomplished about 99.5% recognition rate by leaving one out techniques and 93.92% by the hold out method [4].

As per the theory of Kavitha and Mirnalinee (2016), an algorithm to formalize the non-frontal appearances. Fitting, reflecting, and extending activities are done to get the frontal face. Investigations are done on FERET, HP, LFW, and PUB-FIG datasets to prove the desired approach recreation perfection. The proposed approach can handle only up to ±22.5° pose variation [5].

As per the explanation of Gao and Jong (2015), the writers proposed a face recognition algorithm which depends on different virtual perspectives and alignment error. In the proposed work, Lucas Kanade algorithm and SIFT algorithm were utilized. Dataset of FERET has been utilized to compute the performance of the proposed approach. As per the reports, approximately 38% improvement in the performance when compared and the results obtained from other face recognition algorithms. However, the proposed approach can control just up to ±60° present distribution. Also, recognition perfection is poor past 40°. Time intricacy is high in comparison with other comparing algorithms [6].

As per the Ahonen et al. (2006), the techniques which was applied on FERET datasets. The outcomes showed that the given approach attained 97% perfection for images with various facial expressions but did not perform well for other factors [7].

As per comparative analysis of Sharif et. al. (2017) on various methodologies and application of face recognition utilized till 2014. Various approaches discussed in this paper depend on Eigen face, Gabor wavelet, neural organization, and hidden Markov framework. In this survey paper, it has been explained that (I) Eigen face-based techniques function well only for frontal faces, (ii) Gabor wavelet-based techniques do not give better recognition perfection because of excess in Gabor filters, (iii) neural network-based strategies improve the recognition perfection, however it requires greater time

for the training purpose, (iv) support vector machine is slow in classification, yet in combination with different methodologies it gives great outcomes [8].

V. PAST STUDIES ON FEATURE-BASED APPROACHES OF FACE RECOGNITION METHODS

As per the proposed theory of Luo et al. (2018), threatening datasets for actual learning methods should be labeled and cleaned. The analysis reported about 17% improvement in the performance when it compared from the outcomes of various techniques. The technique applied to GBU and FERET datasets. CASIA web face was also used to perform the DCNN. But, the outcomes were not enough for detailing of video datasets. The given research was only concentrate on various illumination, expression and age [9].

The key idea of the investigation by Zhou and Lam (2018) was to give an age-invariant face recognition system. The algorithm works on three stages: extraction of local features, personality subspace, and aspect fusion utilizing canonical connection analysis (CCA) for face coordinating. Investigations results were conducted on FGNET, MORPH, and CACD datasets to introduce the efficiency of the proposed way. They achieved approximately 51% improvement in recognition perfection when applied on FGNET dataset and 13% enhancement for CACD and MORPH datasets [10].

The paper composed by Gosavi et al. (2018) managed the review of various feature extraction strategies. Various component extraction approaches like geometrical based element extraction, appearance-based element extraction, template based feature extraction, and artificial neural network for face recognition are assessed in this explanation. Among examined approaches, template based element extraction provides more detection perfection. Back propagation neural network and convolutional neural network are more productive than other component extraction approaches based on neural network. It has presumed that the discussion about methodologies were not as much as efficient [11].

In the work proposed by Fu et al. (2017) a deep learning model dependent on guided CNN has been utilized for cross-resolution and occluded picture recognition. The proposed system comprises of two sub-models: one is utilized as a guide who is now trained with high-resolution pictures and the other is utilized as a student for low-resolution input images. CASIA-Web face dataset and LFW dataset were utilized for preparing and testing purposes. This system perfectly perceives the cross-resolution and somewhat occluded pictures. They accomplished 9% improvement if there should be an occurrence of cross-resolution pictures and 4% improvement in the case of halfway partially pictures. The proposed approach needs a lot of preparation for each picture in the database; the method should be prepared for corresponding low-resolution picture [12].

As per the study of Bhavani et al. (2017), the technique of representation for the detection of faces in a video. Viola-Jones algorithm was utilized to recognize the faces in an picture. All types of expression have done on a real time dataset. They accomplished 75-80% recognition perfection. Nonetheless, they can work only frontal face pictures [13].

Kakkar and Sharma (2018) gave a satisfactory face recognition framework for criminal identification by utilizing Haar feature based cascade classifier and local binary pattern histogram. The limitation of their framework is that it can perceive only frontal faces [14].

The examination done by Harsing et al. (2017) proposed new methodology called entropy-based volume SIFT (EV-SIFT) for the detection of medical surgery faces. The framework was explained for the following surgeries: blepharoplasty, brow lift, liposhaving, malaraugmentation, mentoplasty, otoplasty, rhinoplasty, rhytidectomy, and skin peeling. They accomplished various detection rates for the various sorts of plastic surgeries [15].

The observation in the work proposed by Sameem et al. (2016) was to give an efficient face detection framework using Viola–Jones algorithm and MSAC algorithm. To perform tests, Graz 01 dataset was utilized. Detection accuracy of the proposed approach was compared and the methodology proposed by Hong et al and accomplished a 10% improvement in the detection rate. It has been inferred that the proposed framework is able to take care of pictures in an unconstrained or unnatural environment [16].

As per the explanation of Gaikwad and Sonawane (2016), various perceptions on face detection and recognition from the video surveillance. They also have not executed their approach to compute the algorithm on the dataset. Nonetheless, it has been achieved that the recommended technique can cope with illumination, plastic surgery, pose, resolution and shape [17].

Ding and Tao (2015) proposed a system which mainly depended on the convolutional neural networks (CNN) to manage with the difficulties/issues related to video-based face detection. Trunk-Branch Ensemble CNN (TBE-CNN) model has been utilized to confront the pose and occlusion variations. Mean distance regularized triplet loss (MDR-TL) function has been utilized to prepare TBE-CNN. The achievement of the proposed strategy was evaluated on single dataset but also for various video datasets like COX face, PaSC, and YouTube faces. They accomplished around 95% detection accuracy on YouTube faces database, 96% detection perfection on PaSC dataset and 99.33%accuracy for V2V, 98.96% for V2S, and 95.74% for S2V on COX database. In BTAS2016 Video Person Detection Evaluation, their methodology gained the first position. The explained approach easily handles the issues like haze, incomplete occlusion, and presents varieties [18].

According to the conclusion of the study of Ding et. al. (2015) a pose invariant face detection system by performing multiple tasks aspects transformational learning plan to prepare the transformation word for each patch. Trial results shown that the proposed technique accomplished 100%detection perfection for ±44° yaw point on CMU-PIE dataset, 98% perfection for + 65° on FERET dataset, around 87.75% detection perfection for ±60° present point with illumination on MULTI-PIE dataset, 98% detection perfection for ±45° present point with recording session on MULTI-PIE dataset, 91.78% perfection on LFW challenging dataset. It has been inferred that the proposed approach out performs single-task-based techniques. They were the first to utilize perform various tasks learning in pose invariant face detection [18].

As per the investigation of Hu et al. (2015) the reason for the accurate performance of convolutional neural network in face detection. They also proposed 3 CNN frameworks of various sizes: CNN-S (Small), CNN-M (Medium), and CNN-L (Large). The investigation result shown that the explained approach is far better than some present approaches but also gives worse results than other present approaches. Metric learning is also responsible to enhance the face detection perfection [19].

As per the introduction of Huang et al. (2015) a video database for face recognition called COX face database. They also showed the introduced database in comparison with various present databases. They also explained a point of set correlation learning (PSCL) techniques to prove the face recognition accuracy on explained COXface database. Experimental outcomes showed that the perfection of proposed approach is higher than the present approaches. More efforts can be done to enhance the detection perfection of the proposed approach. To identifying the mobile user for mobile payments [20].

As per the statement of Wang et al. (2017) face detection approach based on higher reinforcement learning with convolutional networks. The proposed techniques give 100% recognition perfection when the gamma correction value is 1. It concluded that, the proposed approach performs far better than various present CNN based approaches [21].

VI. PAST INVESTIGATIONS ON HYBRID APPROACH OF FACE DETECTION METHODS

Banerjee et al (2018) explained that deep learning methods for facial detection. They also clarified whether or not to prepare the framework for various posesis beneficial or to frontalize the profile face is advantageous. They also compared the face detection perfection utilizing their proposed formalization algorithm with existing Hassner and Enbar formalization algorithm and simple 2D alignment (i.e., no formalization) on PaSC video dataset and CW picture dataset. It has also been explained that the value of formalization is dependent on the facial detection framework utilized and may not generally give better outcomes [22].

Fathima et al. (2015) proposed a hybrid approach utilizing Gabor wavelet and linear discriminant examination for face detection. AT&T, MIT-India, and Faces94 datasets are used to assess the detection rate of the proposed approach. They achieved88% detection perfection on AT&T, 88.125% on MIT-India, and 94.02% on Faces94datasets. Results indicated that the proposed approach gives better outcomes in comparison with Gabor and efficient for the unconstrained environment [23].

As per the theory of Lei et al (2009) an efficacious face detection framework. The framework works in two stages: detection stage and the recognition stage. In the detection phase, they utilized modest AdaBoost algorithm that keeps up a low computational cost. Improved independent elements investigation approach was utilized in the recognition stage. Hausdorff distance was utilized in the detection stage to compute the similarity measure between the face and different

items present in a picture. An experiment has done on CMU-MIT face database to assess the identification pace of the algorithm. Exploratory outcomes indicated that the proposed approach gives better detection rate in comparison with other existing face detection algorithms. The proposed approach can be utilized for other object detection and recognition tasks [24].

VII. CONCLUSION

After some years of the continuous research, it has been seen that plenty of analysis is going on in face recognition and detection area but yet we are not getting any satisfactory result. The classifications are widely categorized on appearance-based approaches, feature-based approaches, and hybrid approaches. All of these techniques have their own advantages and disadvantages which mainly depend on their area of application and datasets used. Appearance based techniques don't gives better outcomes for low resolution video and pose variation. The method in which a supervised learning way is used to give satisfactory outcomes, but it needs a large amount of clean and labelled training data to perform the system for the detection state. Most of the techniques do not perform well for non frontal sides of face, i.e., faces with various pose distribution. It has been also explained that regardless of continuous research, an efficient face detection system is needed that can perform well in natural as well as unnatural environment.

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