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# Deep Perusal of Human Face Recognition Algorithms from Facial Snapshots

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***Abstract***

*Face recognition having so many application in security, access control, gaming, aging effect, health issues, and internet communication and so on. It has been perform by using different face recognition algorithms on different field of application. When we use face recognition in real-world scenarios with unfavorable conditions such as occlusion and pose variations, illumination and expressions. Here also study the challenges during face recognition under immoral conditions such as facial expression recognition with poses variations, occlusion and lightning condition. Basically it proposes several possible future direction which is excluded from the challenges used in it. Thus, it is a beneficial developing ping point for research project on face recognitions able to be used for a practical purpose or in several ways.*

***Keywords:****-Face Detection, Face Recognition, Digital Image Processing, PCA, KPCA, Neural Network, Pose Invarian*

## 1. Introduction

Face recognition system is having recent research topic for researchers. The task of face recognition is too challenging because we have to make our system smart enough to detect the faces in the unfavorable conditions too like low light, wet faces, faces wearing accessories like goggles and specs, and face change due to beard *etc*.

In mid of 1964 and starting of 1965, Bledsoe, along with Helen Chan and Charles Bisson, worked to recognize human faces using the computer by vision techniques (Bledsoe 1966a, 1966b; Bledsoe and Chan 1965). It can sounds easy to achieve the task but on the research and development phase, it is the most challenging to achieve the desired task not only once but also making our system precise and reliable every time it is used although it is not an easy task for the researchers and developers.

In the recent phase of development in [1] face detection and recognition technology, we have achieved that level of success in the respective field but it also has a limit. It is precise and reliable enough to generate the desired result but up to a limited range of inputs, beyond this limit the system is not much reliable and precise. Developers are continuously working for pushing its range of work and yes, it also inspires the developers to introduce the new and new technics in the respective field. Face recognition faces problem to find actual face because of changeability in head rotation and slant, lighting intensity in the images due to photometric distortion and angle, facial expression , aging variation which imposes on face, *etc*.

Most of our present technology works on the landmarks on the human faces. It detects some of the pre-defined points on the faces like the eyes detection, nose points and lips, eyebrows, position of the ears *etc.*, It also identifies the features on the faces due to the different positions of face muscles. For the feature detection on the faces the system have to identify the predefined points on the faces and construct a graph on the later stage using the face detection algorithm to overcome any error occurred in the results due to the

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reposition on any muscle on the face. The number of points u can allocate on the face is directly proportional to the precision of the result.

The face detection technology can be divided into two approaches, one is photometric and the other one is geometric.

### 1.1. Face Recognition System

A facial recognition is a system [18] which is generally used purpose by the computers for pic out a human from an image which is stored in the database. The process of face recognition is take an input which is given by outside and compare that image to the stored database. Database is in the form of digital image or a video frames. When we compare two images facial features is to be selected first by applying different facial feature algorithms.

Face recognition system mainly used in security system biometric system used for face recognition. When we have to detect faces basically features of the face, fingerprint as well as jaw shape and iris recognition help to find exact image.

Face detection algorithms are used to identify the face by extracting the facial features by using the conditional position, its shape size of the eyes, nose, chubbiness, and jawbones. These features of the face are helpful to compare the input image through the stored images and the result is quite correct by using it.

### 1.2. Difficulties To Detect Faces

During the face recognition or detecting a face many difficulties face by the user. First problem which is faced during face detection is frontal face. If the frontal face is stored in image database and as input some degree is changed of the face then face is not recognized by the system this is very common problem during detecting the face.

Second problem face during detection of the face is poor lightning condition, sunglasses, long/short hair, beard, low resolution *etc*.

Another serious problem occurred when the facial expression of the same face is to be changed in between input image and stored image. Even a smile or sadness effect the face detection system.

## 2. Literature Review

In any research paper main part is literature survey through which developer find out the further research. Here basically we fully focused on the face recognition system.

In [5] A human expression recognition method has been repeated using facial feature recognition where individual emotion state has been utilized while interaction for recognition purpose. SVM has been used to classify the expression and output of this concept is various emotional expression of the individual. It is also possible from recorded video files to recognition the expression behaviors.

In [6] Authors have been repeated an automatic face feature point detection methods, which provides easier way to locate the position of various face features like eyes *etc*. The method is repeated to be accurate and fast to locate the feature points.

In [7] Study of main four postures of human have been done using principal component analysis KG-rule emanative variance test. Multiple comparisons procedure and homogeneous subset test are also performed for determining the number of optimized Eigen postures for classification employee ANN and SVM.

In author [8] have proposed a feature extraction methods on the basis of statistical descriptors of curve coefficients. The current transform consider as multi scale pyramid with many directions, position and other features according to pre-determined scale dimensions. The coefficient low and high frequency in matrix form are defined out of this

 

transform and approximation of face images is done, which is used in facial feature extraction.

In a mechanism [9] for recognition expression of the face in various postures and gestures was proposed. The suggested disposal is based on add boosted classifier and back propagation network. The proposed approach is considered to be adaptive to the gesture changes while detecting the expressions from images.

In [10] a new approach for emotion recognition using various facial expression has been proposed with fuzzy interface system. It is also repeated that this approach is also capable of recognizing emotion from partially occurred facial images. In this approach the genetic algorithms has also been used for parameter turning of membership functions.

In [11] three face recognition approaches have been repeated and claimed to be on the hairs of geometrical approach, elastic matching and neural network. In this work image normalization has been taken up in first stage, then iris is detected as distance has been taken as normalizing factor, in other concept is on the basis of elastic face matching, which comes under geometric face recognition approaches where specific frontage face dots and horizon between these points are used for face recognition. It is used neural network approach which has been considered for access control of the recognition system.

In [12] a model of face recognition system has been proposed using genetic algorithm and step error tolerance back propagation NN. SET-BPN has been used to evaluate the system efficiency has been claimed to be more efficient system but result analysis is on the basis of some existing data sets and lacks in ability.

In [13] a face recognition for secret testimony and evidences using principal component analysis (PCA) using back propagation neural network (BPNN) by using PCA measurement of face images is decreases by PCA and face recognition is done using BPNN. The working model has been presented using various steps like PCA/BPNN and face recognition.

In [14] a comparative study of thinning algorithms has been done. Iteratively thinning algorithms and non-iterative thinning algorithm has been studied for their importance of thinning algorithms has also been explicitly narrated which helps in developing various recognition system.

In [15] author has proposed a system to recognize face based on probabilistic decision based neural network emphasizing on the ability of neural network to generate in less computation duration. The PDBNN face recognition system was proposed with three steps having individual models; the feature in face detector, which recognize position of face of the human in the given image. In second module eye localization is taken into consideration, which is localizes both eyes in this step included other parts of the face and in the last but not the least module is face diagnoses. This system always theoretical network architecture with non-aligned basis functions.

In [16] the author have presented review of various facial recognition techniques. In this work the face detection and recognition also have been taken used for head state and eye, lips, eyebrows, chicks and other transient component have been considered for highlighting the performance of the existing recognition methods.

## 3. Transformation of Face Recognition

The way in which the transforming or the number of steps are followed to recognition of the face in a systematical manner.

### 3.1. Face Detection

Face detection is used in variety of application with the help of computer technology that verify or identify human face images from the given database. Face detection algorithms basically focus on detect the exact face with the help of face detection algorithms. These algorithms basically focused on frontal faces. In this images are store in

matric in pixel form. Image is match every pixel bit wise input image with stored database image. Any change in the bit due to problem occurred during taking input image will deny the matching process.

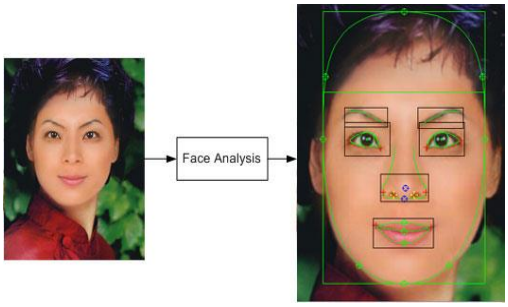


**Figure1. Face Image Analysis Through Feature Selection**

### 3.2. Preprocessing

The purpose of preprocessing step in any face detection system is to increase the FAR (False Acceptance Ratio) and to increase the speed of the system. By using preprocessing step increases computational efficiency and number of false positives.

### 3.3. Feature Extraction

Feature extraction is a processing which is used after preprocessing step in feature extraction process developer/ researcher extract the feature from the human face like mouth shape, jaw line, nose, eyes, eyebrow *etc*., these are the features which is compared to detect exact face from the given data base.

It also extract facial feature that can be used to differentiate facial expressions. Feature extraction is divided into three sub categories 1. General feature extraction 2. Feature selection & 3. Feature decomposition. In the first category general information about features is to be extracted after that feature selection is done through different algorithms like PCA, LDA & ICA *etc*. Last category is feature decomposition in which filters are used like information gain & mutual information.

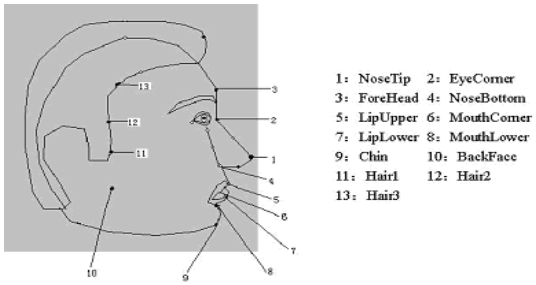


**Figure 2. Facial Feature Image by Using Different Located Points**

In Figure 2, twelve different features points are located by comparing of these features we extract the exact image from our database and get whole information about that particular image.

 

# 4. Description of Face Detection

## 4.1.Eigen Faces

Eigen faces generally refers to an AAM (appearance-based approach) to recognition the face from the images set. Individually, the Eigen faces Use Principal Component Analysis (PCA) to categorize of faces, or identically, the eigenvectors of the set of face images, where an image of the face with *N* pixels is considered a point (or vector) in *N*-dimensional space. The concept of using principal components to represent human faces was developed by Sirovich and Kirby (Sirovich and Kirby 1987) and used by Turk and Pentland (Turk and Pentland 1991) for find out facial images by face detection and recognition.

An Eigen faces [2] generate by employing the mathematical calculation process which also called as principal component analysis (PCA) on a large images dataset of faces. The Eigen faces which created help to present as light and dark areas that are step by step arranged in a particular in successive templet. [18] This templet is to recognize how different features of a face are assigned to calculate and mathematically scored is find out. There will be a sequence to recognize symmetry, if there is style of facial hair color is changed, where the hairline also changed, or evaluate the size of the nose or mouth. Other Eigen faces have sequence that are quite less easy to identify the faces, and the facial image of the Eigen face look little like a face.

- Eigen face work on large databases.
- Eigen face has difficulty capturing expression changes.
- Eigen face reduced complexity in image representation
- Eigen face database is to be calculated easily
- Eigen face vary sensitive to the lightning condition, transformation and scale variation

## 4.2. Fisher Faces

Fisher faces is basically based on the algorithms LDA (Linear Discriminant Analysis) it is a static method which is basically used on the dimensional reduction and classification of the images. It was invented by the great mathematician and researcher **Sir R. A. Fisher**, which find out auspiciously used it for defining flowers pattern in his **1936** paper. In recent years we have a dimensionality reduction method which is called PCA (Principal Component Analysis) now the question arises if we are having such a same method then why we want another reduction method for the same purpose. [19] The solution is the PCA which basically used by Eigen faces finds a straight unification of features that raises the total variety in data. In other way LDA having a strong path to present data, it doesn't scrutinize any classes and a lot of discriminative useful information *may* be lost when toss some parts away.

**Figure 3. Fisher Face Database**

A mixture of features that differentiate between classes the Linear Discriminant Analysis rather than maximizes the variation of different-classes to within-classes segments.

LDA (Linear Discriminant Analysis) is based on supervised learning and PCA (Principal Component Analysis) is depend on unsupervised learning. PCA is also called as Karhunen Loeve methods.

### 4.3.PCA

PCA is called Principal Component Analysis which is depend on the covariance matrix which is also based on supervised learning.

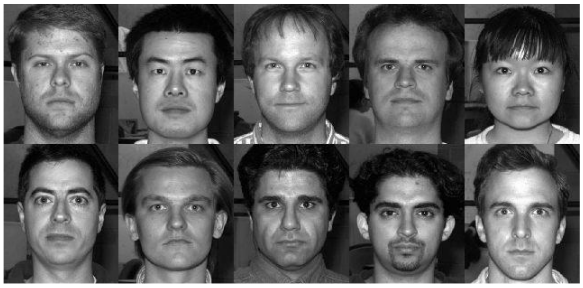

**Figure 4. Face Database (Yale Database)**

In Figure 4, image database from the yale database in which we used a mean image and after compare it with the stored database we get the Eigen database which is based on the covariance matrix with D dimension.

**Figure 5. Mean Image**

Figure 5, the mean image which is applied to the stored database and getting Eigen images with the help of matrix.

**Figure 6. Eigen Vectors from Mean Images from the Database**

### 4.4. Artificial Neural Network (ANN)

Face recognition is a visual recognition problem. In a review of ANN based face detection system has been reported with an emphasis various available biometric system. Frame work of face recognition system has also been reported. Retinal connected neural network, rotational invariant neural network, principal component analysis, fast neural network and other neural network techniques have been investigated.

Face recognition is a visual recognition problem. In a face recognition system the input image calculated the similar image in the stored database for output people's identification image. A face recognition system depend on basic methods these are as

 

follows first one is detection, alignment, feature extraction, and matching, where localization and normalization (face detection and alignment) are main execution steps before face recognition (facial feature extraction and matching) is performed. For face detection methods, a two layer as well as three-layer feed forward artificial neural network (2D or 3D AAN) is proposed that merge Ada Boost algorithm to detect human faces so that face detecting rate which is also called as FAR and FRR is comparatively high. Generally selected neural network here is three-layer feed forward neural network with back propagation algorithm.

## 5. Applications of Face Recognition

There are so many application of face recognition which is used in our day to day life. Human being recognize face by using there find and with the help of their own memory but in case of face recognition by computer or by the machine it required stored database and an input image. With the comparison of two images we getting the correct result.

1) **Face Identification:-**To identify the face with the help of input image compare it with the stored database.

2) **Surveillance:-**Surveillance basically used for the observing an area with the help of camera or satellites. These cameras are connected to a recording device or IP network, under the observation of an expert and take care by a security guard or law enforcement officer. Surveillance is the monitoring of the area under security activities, or other changing information, generally for the security of the people purpose of bring to bear, organizing, controlling, or cover them.

3) **Access Control:-**Permission to access a resource is called authorization. And the control over to access anything called access control

4) **Private Security:-**Private or official security guards make sure the escape of people, property and places. Here with the help of face recognition system we strongly secure our data privately.

5) **General identity verification:-**Identity verification is the main step in all the field with the help of all biometric check as well as document verification. In this phase face recognition play a very important role.

6) **Image database investigation:-**Image database which is basically used by the police, forensic or in CID department used for the investigation purpose. In that case face identification is very important.

7) **Easy people tagging:-**Tagging basically used in social networking site with the help of face recognition.

8) **Gaming**:-In gaming all biometric functions are used face recognition is one of them.

## 6. Challenges Facing in Face Recognition

Below mentioned challenges in field of face recognition system developer and researchers basically work on the following elaborated points.

1. **Facial aging**:- In the human body, many changes occurs with respect to the time and it can also be noticed on the face of the person due to hormonal and biological changes. This is a challenge for researchers to make our system sufficiently smart to overcome this problem. As a result we don't have to update our system with time and our database can never be outdated.

2. **Accessory used during input images:-** In some cases, peoples uses many accessories on their faces like goggles , specs , some type of nails in nose, boys can have beard *etc.*, these factors can affect the desired result which is an important challenge for this technology.
3. **Pose invariant:-** Sometimes the person standing in front of the camera makes some angle which can be horizontal or vertical which effects the desired result. In real means we are developing a technology which should be user friendly. Being a user friendly technology, it should have a wide range of detection but at present it can be allow the pose variation up to a very limited range.
4. **Lighting conditions: -** The lightening conditions like background light, brightness, contrast, shadow *etc.* are not always same for the input. So the system must be smart enough to adjust these changes accordingly.
5. **Plastic surgery:-** In some special cases, due to some accidental reasons or so, many peoples have gone through the plastic or cosmetic surgery as a result of which the inputs of their faces can be unknown for the system. But for researchers it is a challenge to make the system able to detect the same person after the above mentioned changes.
6. **Accidental face detection: - Due** to some emergency conditions or some accidents, the face of the victim damaged enough to lose his identity. If the researchers can do some needful and if they could make the system able to detect these faces, It will be the milestone for the forensic field.

## 7. Further Work

After the deep study of literature survey and the challenges on face recognition technology, it is to be noted that there are many challenges in this field and if the researchers could find the solutions of these challenges in future, it can surely effect the accuracy and precision of the system positively.

## 8. Conclusion

Face recognition technique having so many future scope for further researchers and developers. So many work is done in the field of face recognition and left work is more than published at present. For further betterment of the result basically focused on the literature survey as well as work on challenges in field of it. Face recognition is a daring problem in the field of computer vision or in case of identification which has acquired a nice arrangement of attention in the past years because of its many practical applications is in different domain. In this area research I going on to achieve accurate face recognition system with less percentage of error in different situations in real world. This paper work on the face recognition arrange as a survey on problem faced during recognition of the face. In this paper we have reviewed the past and recent research on face detection and for better adjustment of the challenges mentioned by the developer. Finally this paper is draw to closer by find out challenges during research different face recognition algorithms are required for better result and improve accuracy

## References

[1] C. C. Aggarwal and P. S. Yu, “A survey of uncertain data algorithms and applications”, IEEE Trans. Knowl. Data Eng., vol. 21, no. 5, **(2009)** May, pp. 609-623.
[2] B. Qin, Y. N. Xia, S. Prabhakar and Y. C. Tu, “A rule-based classification algorithm for uncertain data”, in Proc. IEEE 25th Int. Conf. DataEng., **(2010)** April, pp. 1415-1418.
[3] G. Cormode and A. McGregor, “Approximation algorithms for clustering uncertain data”, in Proceedings 27th PODS, **(2008)**, pp. 191-200.

 

[4] L. E. Ghaoui, G. R. G. Lanckriet and G. Natsoulis, "Robust Classification with Interval Data", Technical Report UCB/CSD-03-1279, Comput. Sci. Div., Univ. California, Berkeley, **(2003)** October.
[5] G. Lanckriet, L. Ghaoui, C. Bhattacharyya and M. Jordan, "A robust minimax approach to classification", J. Mach. Learn. Res., vol. 3, **(2002)** December, pp. 555-582.
[6] C. Bhattacharyya, K. Pannagadatta and A. Smola, "A second order cone programming formulation for classifying missing data", in Proceedings NIPS, **(2005)**, pp. 153-160.
[7] P. Shivaswamy, C. Bhattacharyya and A. Smola, "Second order cone programming approaches for handling missing and uncertain data", Mach. Learn. Res., vol. 7, **(2006)** July, pp. 1283-1314.
[8] J. Bi and T. Zhang, "Support vector classification with input data uncertainty", Adv. Neural Inf. Process. Syst., vol. 17, no. 5, **(2004)**, pp. 161-168.
[9] J. Yang and S. Gunn, "Exploiting Uncertain Data in Support Vector Classification", KES, vol. 3, **(2007)**, pp. 148-155.
[10] Y. Yang, Z. G. Ma, Z. W. Xu, S. C. Yang and A. Hauptmann, "How related exemplars help complex event detection in web wideos?", in Proceedings of ICCV, **(2013)**.
[11] S. C. Yang, D. Xu, B. Y. Zhang, H. J. Zhang, Q. Yang and S. Lin, "Graph embedding extensions: A general framework for dimensionality reduction", IEEE Trans. Pattern Anal. Mach. Intell., vol. 29, no. 1, **(2007)** January, pp. 40-50.
[12] J. Yang, D. Zhang, A. F. Frangi and J. Y. Yang, "Two-dimensional PCA: A new approach to appearance-based face representation and recognition", IEEE Trans. Pattern Anal. Mach. Intell., vol. 26, no. 1, **(2004)** January, pp. 131-137.
[13] S. Z. Li, X. W. Hou and H. J. Zhang, "Learning spatially localized,parts-based representation", Proc. Int. Conf. CVPR, **(2001)** December, pp. 207-212.
[14] M. Mahmoudi and G. Sapiro, "Sparse representation for range data restoration", IEEE Trans. Image Process., vol. 21, no. 5, **(2012)** May, pp. 2909-2915.
[15] L. Zhang, M. Yang, Z. Z. Feng and D. Zhang, "On the dimensionality reduction for sparse representation based face recognition", Proceedings ICPR, **(2010)** August, pp. 1237-1240.
[16] J. Z. Huang, X. L. Huang and D. Metaxas, "Simultaneous image transformation and sparse representation recovery", Proceeding of CVPR, **(2008)** June, pp. 1-8.
[17] A. Wagner, J. Wright, A. Ganesh, Z. H. Zhou and Y. Ma, "Towards a practical face recognition system: Robust registration andillumination by sparse representation", Proceedings of CVPR, **(2009)** June, pp. 597-604.
[18] Y. Peng, A. Ganesh, J. Wright, W. Xu and Y. Ma, "RASL: Robust alignment by sparse and low-rank decomposition for linearly correlated images", Proceedings of CVPR, **(2010)** June, pp. 763-770.
[19] J. Wright, A. Y. Yang, A. Ganesh, S. S. Sastry and Y. Ma, "Robust face recognition via sparse representation", IEEE Trans. Pattern Anal. Mach.Intell., vol. 31, no. 2, **(2009)** February, pp. 210-227.
[20] L. Zhang, M. Yang and X. C. Feng, "Sparse representation or collaborative representation: Which helps face recognition?", Proceedings of ICCV, **(2011)** November, pp. 471-478.

 