Various Face Recognition Techniques and their Application in Airport Security

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ABSTRACT

Now days, Image Processing is gaining large popularity and demand due to its vast number of applications in various fields. One such important application is the field of Airport Security, where various concepts of Image processing such as Face Recognition and Detection, iris scan, finger print and speech recognition are used. The accuracy of techniques involved has increased manifold, due to Availability of various viable concepts after many years of research. This paper provides a Survey of face recognition techniques available, along with various pros and cons in its implementation in airport security.

Keywords

Face recognition, Feature extraction, Segmentation.

1. INTRODUCTION

Image processing is an ever emerging discipline in recent time. Human Face recognition is one of the vital concepts of Image Processing, that also include face recognition, individual identity, Content Base Image Retrieval (CBIR) etc. Facial recognition is a method to identify an individual by comparing Digital or Live Image with pre-existing database. It can also be used to identify an individual from video source. Face recognition has gained attention not only by engineers but also by computer vision communities, forensic experts and neuroscientists. Therefore, various disciplines have contributed differently according to its application in its domain. Now days, various Face recognition software are available in market for security purpose, video surveillance, gaming system and few mobile payment systems etc. The accuracy in various face recognition has increased in recent times. Independent evaluations have shown that various algorithms of face recognition are capable of providing reliable results in controlled and real life situations. Face detection is an important concept in face recognition. It is a technique to check if a human face is present in image and if so, to find its position. Various problems in face detection are associated with image orientation, face expression, pose variation etc. Occlusion and light effects also plays an important role in it.

In today's world, it is important to have a user oriented system that can protect and secure our assets. Although many efficient biometric methods such as retina scans, finger print analysis etc. is available, most of these methods involve voluntary participation and efforts of people involved. These methods cannot be implemented in situations, where surveillance and identification process need to be remained unknown to person concerned. For example: Immigration, national identity, welfare fraud, CCTV surveillance, post event analysis, shop lifting and suspect tracking and investigation etc. In all these situations, face recognition and detection plays an important role.

The technique provides a reliable method to identify and verify people from a given database of faces. The process involves face detection from a scene, extraction of features from face and informing whether person is in database or not. Face recognition technique is implemented in two scenarios: static matching and video matching. The difference between these two scenarios occurs due to image quality, availability of feature matching criterion and extend to which segmentation is required. In both cases, techniques have their own share of problems, such as Face angle (the angle to which camera can shoot photographs due to high mounting), Face aging (the effect of age on features and change in features in early age), Face expressions (the effect of expression on features), background (difficulty in recognizing face in dynamic background) etc.

Human have an efficient method of remembering faces. We can remember face of a person by associating the face with various stimuli. If a stimulus is strong, the face can be recognized and recalled immediately. However, in case of weak stimuli, some efforts may be required to remember it. It is not possible to create an algorithm that can mimic human brain capabilities, using existing techniques. The only constraint to human brain is the number of faces that it can store or remember. Computer can handle large database of faces, compare them with given features and provide result in very less time.

2. BACKGROUND

The method of identifying and verifying a face from a given database is done in three steps:

Fig 1: Steps of face recognition system.

2.1 Face Detection

Face detection is also known as face segmentation. It can be considered as an example of object class detection. Here, the aim is to find size as well as location of all objects belonging to same class in an image. The algorithms of face detection are focused on detecting front view of human face. Matching could not be done if there is a change in any facial features..

2.2 Feature Extraction

Feature extraction is an important part of face detection and recognition. It can be considered as a specific example of dimensionality reduction. It starts with initial set of data and then developing derived values that must be non- redundant and information generating. It leads to various steps of generalization and learning. Feature selection is a process that

produces features vector in case input data is redundant or too large. Now, only information which is relevant is used in place of initial complete set of data. In the technique, initially face detection is performed. Then main features are extracted in the form of patches from given image. It is important to extract features from image patches as the images that are compared are taken from different angles, location and expression. In order to eliminate effects of these factors, noise cleaning and dimension reduction is done. This process of converting large input data in to feature vector is called feature extraction and is important for effective results.

2.3 Face Recognition

Face recognition is a technique that is used for verifying and identifying person from image or video. It has become popular due to its various implementation in variety of domains ranging from driving license identification to national security issues. Various alternative biometric methods such as finger print analysis etc. are available. But, most of them need cooperation of person of interest. Face recognition technique can be used to identify and observe a person without his/her knowledge.

3. ALGORITHMS USED FOR FACE RECOGNITION TECHNIQUE

3.1 Statistical Approach

This method use eigenfaces, where each face in database is represented in the form of vector of weight. Here, the weight of feature is obtained by applying product operation and projecting the image as its components. Whenever, a new image is obtained for identification, it is also converted into in to weight vector and compared with given database. The images having weight vector close to that of test image are selected for verification. The method works efficiently with change in illumination intensity. However, its efficiency decreases if the scale of images is changed. It means that the method is able to generate a correlation with in images having different lightening situation, but it is difficult to correlate images having different scales. The method also deals with probability of similarities between two images, taking in to account the situation where appearance of an individual may change due to different expressions or other factors. It also deals with probability of similarity between two different individuals due to lightening conditions, similar features etc.It is a machine learning based approach where a cascade function is developed from a lot of positive and negative images. It is then used to detect same objects in other images. This method use change in contrast values among neighboring pixels. We can easily scale the features by changing the size of test pixels. Therefore, the object of different size can be recognized.
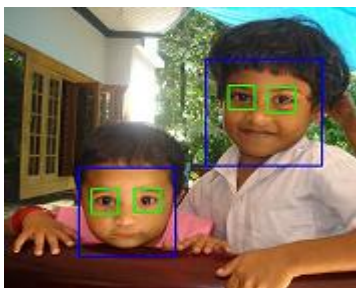

Fig 2: Haar feature based recognition

3.2 Neural Network Approach

Neural network is used to perform classification of facial expressions and gender to solve the problem of face recognition. The technique is implemented with the help of associative maps that provide effective results even if few portion of image are missing or image is blurred. It implement the concept of gender classification based on 16 attributes such as distance between eyes, nose width etc. Two different networks are generated, one for each gender. The technique is so effective that the success rate up to 87% is reported for non- test data.

3.3 Principal Component Analysis

In principal component analysis is used to find a subspace where basic vector values are generated to correspond maximum variance in real image. The elements of image are represented by variable whereas basic vector is represented as scatter matrix.

3.4 Principal Component Analysis

DSB involve the concept of masking, illumination gradient correction and equalization based on histogram. Masking is done to minimize unwanted background noise . Gradient correction is done to determine best brightness plane and then subtracted from it to reduce heavy shadows caused by extreme lighting angles. However, histogram equalization compensates the imaging effects due to changes in illumination.

3.5 Independent Component Analysis

The technique reduces various dependencies and attempt to find the basis on which data is independent. Two different architectures are provided for Face recognition. First architecture is based on independent basic images whereas second architecture deals with representation of factorial code.

3.6 Support Vector Machine

SVM create its database by solving a complex quadratic equation using optimization technique. Due to the concept of solving various complex equations, the process could be slow. In some cases, speedup techniques may be required. It involve the usage of reduced set of support vectors and involve geometric configuration.
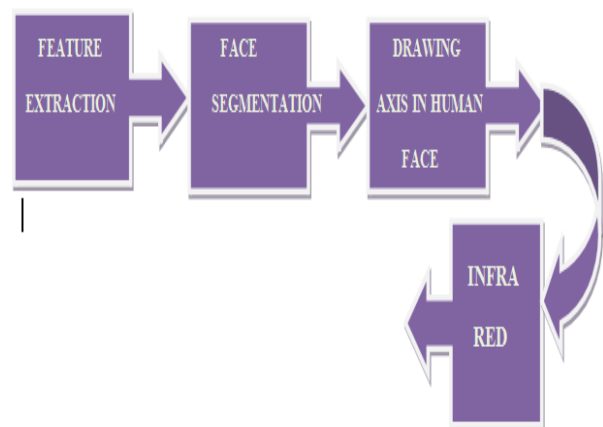
3.7 New Idea to Recognize The Face

Fig 3: New model for face recognition

3.7.1 Feature Extraction

In new technique, the human face is divided into various regions to reduce the region for searching. The overall speed of complete process is reduced due to reduced number of comparisons.

3.7.2 Face Segmentation

The step involves detecting the face and then locating the face using facial scan. The face area is normally taken from forehead to chin for segmentation. Final extraction of features is done within the segmented face area.

3.7.3 Drawing (X, Y) Axes In Human Face

To draw axes on face, we require a center. For this an algorithm may be used to find the location of feature with maximum height. Normally, this feature would be the nose. However, in some situations, feature with maximum height may be beard, hair etc.

For drawing (x, y) axes in human face we have to set the center rst. A nose is a special point in human face and also holds the maximum height of the face. Sometimes other factors can affect the nose extract as beard, hair, other objects in the eld of view, sensor noise, and so on. In A the beard will be detect as a maximum height and in B the hair. To avoid such confusion, a nose tip extraction scheme is developed. This scheme provides location of nose in the form of coordinates. The point is considered as center and horizontal and vertical scanning is done to determine relative location of other features.

3.7.4 Infra-Red

Thermal infra-red images are used to recognise the face. It is done due to various reasons. One of the reasons is that infra red images shows various tissues and veins present in face. This feature helps in recognising the face easily. Further, these images are insensitive to light variations, and thus can be recognised more effectively.

4. DISCUSSION

As already discussed in previous sections, there are various face recognition techniques are available. The technique is gaining popularity due to its application in various domains. However, the overall result of face recognition is less than satisfactory. There is always a possibility of either incorrect matching or non-matching of images. Each technique has its own advantages and disadvantages.

4.1 Knowledge based method

The method has major advantage of developing simple rules to describe features of face. The method is effective for face localization with noisy background. However, it fails to convert human knowledge into rules. It may also fail to identify faces in different poses.

4.2 Feature based methods

Feature based methods are effective as they can recognize a face in spite of having different pose and angle. But, the method is ineffective in presence of noise, illumination etc.

4.3 Appearance based methods

The methods can provide as much variation as possible. It can crop every image to a given standard size manually. However, a large image subspace is required for its implementation.

4.4 Linear Discriminant Analysis

The method does not work in change in poses of person. However, the method is effective in case of different

This technique is extensively explored the illumination change and synthesis for facial analysis using appearance-based approaches to achieve an illumination-invariant but Not works properly under variations in pose and different lighting conditions.

5. APPLICATION OF FACE RECOGNITION IN AIRPORT SECURITY

One of the most complicated public places where face recognition system can be fruitful is Airport. There are various agencies which are involved in security and function control of airports such as police, various airlines, Border control agencies and retailers. The number of people using air transport has increased many folds in past few years. Therefore, a method has to be devised that may provide efficient identification but also ensures passenger mobility. Various biometric techniques involving retina, iris and fingerprint scans may cause hindrance in passenger movement and may not be feasible to implement at all places. However, in case of face recognition technique, CCTV camera surveillance can be used to apply an efficient software to recognize a person of interest without informing him about the surveillance. It has also been established by various independent studies that with proper handling and implementation, measurable accuracy and benefits can be achieved.

As we all know, there is a big difference between Laboratory and real world conditions, thus, the promising results in controlled conditions may not be attained in real life. In this case also, it is good to develop a software that provide good result in comparing different photos taken under similar conditions. But, these results cannot be compared with result obtained by applying same software on images by CCTV camera in real life. It is so because the images are not taken in same conditions. Obviously the results tend to be less effective.

However, in recent few years, significant research has been done to improve the efficiency of face recognition system in real world. Therefore, the software are now able to deal with various problems of real life images. Various studies have shown that the results are promising and these software can be implemented in real world tangible gains. Now days, the software are more effective with different poses. Various issues involved due to low resolution, compressed images and due to difference in time interval are also effectively handled.

Currently, the face recognition technique is implemented at airport at various levels:

1. Controlling of border gates at Immigration point
2. Departure and Boarding gates
3. Generating alerts when a person on waiting list is identified

6. CONCLUSION

It is true that the area of face recognition technique is fast developing and has shown promising results in various fields especially security. With the increase of security threats in past few years, it is important to have a security system that enable us to identify and surveillance various people without interfering and without causing much trouble. However, the issue of privacy also need to be addressed. It is important to strike a balance between our requirement of security and individual privacy. If this, area of concern is properly addressed, the concept of face recognition can solve our

problem in security area effectively.

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