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A Novel Hybrid Face Recognition Algorithm Based On Neural Network with Fuzzy Sets

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Abstract: ***Biometrics is the science and technology of measuring and analysing biological data. Face Detection is one of the types of biometric technique which refers to the detection of face automatically by computerised systems by taking a look at his/her face. It is a popular feature used in biometrics, digital cameras and social tagging. Face detection and recognition has gained more research attentions in last few years. The different types of face detection techniques algorithms have been studied and described and is followed by what changes we will make in order to develop a new hybrid algorithm for face detection technique, which will overcome the false positive result in face detection and recognition technique.***

Keywords: Back propagation neural network, Face detection, Fuzzy logic, artificial neural network, Normalise Cross-Correlation, Principle Discriminate analysis, adaboost, Moire Pattern

1. Introduction

Biometrics is the science and technology of measuring and analysing biological data. It refers to the technologies that refer to technologies that measure and analyse human body characteristics such as DNA, fingerprints, eye retina and iris, voice patterns, facial patterns and hand measurements for authentication purposes.

Types of Biometric Devices

There are various types of biometric devices.

a. DNA Matching: It is also known as chemical biometric. This is done using the analysis of segments of DNA.
b. Retina scanner: These scan the unique biometric pattern in each person's iris and match it with the identification marks set for that person.
c. Finger print scanner: Fingerprint scanner scans the actual print of the finger or can scan the presence of blood in the fingerprint, the size and shape of the thumb and many other features. A 3d image of the fingerprint can also be captured.
d. Face Detection: Facial detection and recognition recognises the relative position of eyes, nose, mouth and ears from an individual face.
e. Voice recognition: Through voice recognition tiny differences in each person's voice is noted, tested and authenticated to allow access only to that person.

Out of these techniques we are studying and implementing face detection and recognition technique.

Face detection is an almost unique biometric identity. There are very few chances of having similar faces practically. But still for hardening the security factor we can combine this biometric technique with smart key or key card. By FD technique in digital camera we mean that when we click the picture it controls the contrast on face and helps us to view the face very clearly. In social networking site face tagging is used to tag the many number of people in a single picture.

Face detection is basically a pattern recognition technique which can be made on using mathematical model.

The face is a biometric identity and the face recognition is the process of using the face properties in the biometric systems. The face recognition applications can be merged with the fingerprint, finger-vein, iris or other biometric systems in order to increase their level of security. The face recognition systems usually work in two parts: face region extraction (Face detection) and face recognition. Both of the components of the face recognition systems should be highly accurate to offer the higher level of user satisfaction with low response time.

In existing face detection algorithms, various face detection algorithm methods use various face detection methods like knowledge-based method, feature invariant approaches, template matching method and appearance based methods. In this proposed algorithm we are using template matching face detection method. Knowledge based methods uses the already programmed characteristics to detection the face, whereas appearance based method learn the face shapes by reading various training templates. Feature invariant method uses the object features for the feature detection in an image. Template based method uses the active template comparison, which provide the most accurate results in case of face detection.

In signal processing or image processing, there are a number of methods for template matching are used for various purposes. In example of Google image search, the algorithm used is an image template matching algorithm. In speaker detection application, there are various voice template matching algorithms are used for various properties of voice. All of these template matching techniques consist of various small feature code segments. These feature code segments may offer noise reduction, light normalization, computer vision anti blurring, feature extraction, feature analysis or feature detection.

Out of these all template matching features, the popular among all is cross correlation and there are various cross correlation algorithms used for the template matching. There are normalized cross-correlation and generalized cross-

correlation. Normalized cross-correlation for image-processing applications in which the brightness of the image and template can vary due to lighting and exposure conditions, the images can be first normalized. This is typically done at every step by subtracting the mean and dividing by the standard deviation.

Image cross-correlation compares two image matrices based on various mathematical techniques. Cross correlation in images can be based upon various image characteristics like color patterns, color pixels, matrix coordinates, etc.

A generalized cross-correlation adds a windowing (or filtering) function prior to the inverse transform. Its purpose is to improve the estimation of the time delay, depending on the specific characteristics of the images and noise (broadband or narrowband interference, Gaussian noise, etc.). Since there are many different types of images and noise, there are many different window functions (eg. SCOT, Ekhart, etc.) Each one is designed for specific problems. Understanding these differences is not trivial, nor is proper calculation of the window function. They are typically dealt with in graduate-level time delay estimation or sonar/radar courses in the signal processing.

The paper describes the various researches done so far on face detection and recognition technique using various techniques. This also describes the model proposed by us to overcome the false positive result in the face detection and recognition technique which uses FL also through which the result speed can be improved and through neural network they can be further used to detect the face image and can be checked with the database and identity can be revealed of the person.

2. Related Work

The new implementation of PCA for fast face detection is designed by El-Bakry[1] is based on cross correlation in the frequency domain between the input image and Eigen values (weights). Simulation results show that the proposed implementation of PCA is faster than the conventional one.

Kyu-Dae Ban[2] proposed that the normalised cross correlation can be used to detect the exact face region in the low resolution face image. The experiments showed that the method using NCC gives the much better face recognition rate.

Face detection using cross-correlation and image decomposition approach is developed by El-Bakry[3] to reduce the computation required by fast PCA. The principle of divide and conquer strategy is applied through image decomposition. Each image is divided into small in size sub-images and then each one is tested separately by using a single fast PCA, the speed up ratio is increased with the size of the image when using fast PCA and image decomposition. Simulation results demonstrate that the proposal is faster than the conventional and fast PCA.

Zakaria z.[4] proposed a combination of two well known algorithms i.e. Adaboost and Neural Network that can be used to detect face in static images which is able to reduce the false-positives drastically. This method utilizes Haar-like features to extract the face rapidly using integral image. A cascade Adaboost classifier is used to increase the face detection speed. Due to this cascade Adaboost produces high false-positives, neural network is used as the final classifier to verify face or non-face, for a faster processing time, hierarchical neural network is used to increase the face detection rate.

Zhiwei zhang[5] proposed a regularised transfer boosting for face detection technique which can be used to tackle the issue of multispectral face detection by proposing a combination of existing large scale visible face images and a few multispectral face images. They have cast the transfer learning framework and try to learn the robust multispectral face detector by exploring relevant knowledge form data domain.

Xinjun Ma[6] proposed an algorithm based on skin colour model with modification it. There is a traditional skin model which is improved by experiments and applied on the proposed model to design a fast eye algorithm on frontal view face. The distance between face and camera is limited and it was realised that passive face detection is related to the distribution of skin-colour and the distance of two eyes. Different from the conventional methods, this algorithm makes full use of the relationship between the distance of two eyes and the distance between face and camera to assist in face detection, it devises a feasible way to promote efficiency in lip-reading and other non-specific face recognition applications. The skin colour based face detection can be proved as more efficient in terms of accuracy, speed and the false positives. The false positive are the results obtained on the basis of statistical type 1 and type 2 errors. The false positive results represent the detection of wrong face detection.

C. Saravan[7] proposed a face matching algorithm using normalised cross-correlation. Which allows a template called extracted face of person which is the region of interest from one image and start search for matching with the different image of same person taken at different times, form different viewpoints, or by different sensors using Normalise Cross-Correlation (NCC).They observed that the maximum cross-relation coefficient values indicate the perfect matching of extracted face with the image that has been targeted. But this algorithm was not suitable to the sensed images that have any rotation or scaling.

Fernandez,Ma[8] gave Viola jones Algorithm. The study presented the aims to design and develop a face recognition system. The system utilized Viola jones Algorithm in detecting faces from a given image. The system used artificial neural networks in recognising face detected from the input. Upon experimentation the system generated can recognise human face with accuracy of 87.05%. The existing system is using the viola-jones algorithm for the purpose of face detection combined with the neural network for the purpose of the artificial neural network (ANN). The existing system is offering the accuracy of 87.05 percent which makes it less efficient for the live applications. Viola-jones is an accurate and fast algorithm for the purpose of face detection. But viola-jones is not efficient in terms of false positives as it

produces large number of false positive results. Also it needs learning in the initial stages, which is not possible in all of the times. This makes is not suitable for the face recognition systems. In case the face detection algorithm does not extract the face region, the system will not be capable of recognizing the person.

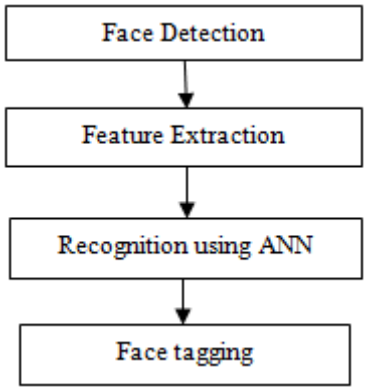

Figure 1: The general Block diagram of the system

Toufiq rizoan[9] used the back propagation neural network in face detection and edge detection technique. In this system, the performance has been analysed based on the proposed feature fusion technique. At first, the fussed feature has been extracted and the dimension of the feature vector has been reduced using principle component analysis method. The reduced has been classified by back propagation neural network based classifier. In recognition stage, several steps are required. Finally it was concluded with the analyses of the performance of the system for different size of the train database. The performance of the system was 94% but that was only for some cases. The existing system processes all of the training samples with neural network. The neural network processes the data on slow speed, which pushes the algorithm to take longer processing time. The neural network is also a learning based bio-inspired algorithm, which is accurate, robust but slow.

Garcia,D.C.[10] proposed the latest research till date on face detection and recognition. The paper focused on spoofing of face. Face spoofing detection uses Moire patterns. Moire pattern is used due to the overlap of the digital grids. The paper first describes the conditions under which these kind of patterns arises and later their detection is proposed which is based on peak detection in the frequency domain. The result of this algorithm is presented for an image detection of facial shots under several conditions.

3. Proposed Work

The existing system is using the viola-jones algorithm for the purpose of face detection combined with the neural network for the purpose of the artificial neural network (ANN). The existing system is offering the accuracy of 87.05 percent which makes it less efficient for the live applications. Viola-jones is an accurate and fast algorithm for the purpose of face detection. But viola-jones is not efficient in terms of false positives. Also it needs learning in the initial stages, which is not possible in all of the times. Whereas the skin color based face detection can be proved as more efficient in terms of accuracy, speed and the false positives. The false positive are the results obtained on the basis of statistical type 1 and type 2 errors. The false positive results represent the detection of wrong face detection. The neural network is also a learning based bio-inspired algorithm, which is accurate, robust but slow. The slow speed of the neural network can be mitigated using the fuzzy sets for the preprocessing of the face templates and short-listing the most matching templates before going with the neural networks. With a pre-processing using the fuzzy sets will make the process faster and efficient than the existing algorithm.

The system begins with the image acquisition process in which the image is loaded in the MATLAB, which has to be used with the new algorithm. The face detection method is used to detect and extract the face from the image to perform the further computations. The ROI has to be perfectly fetched out of the loaded image to get the better results. The next step is to detect the person after the face region extraction from the original image. The face recognition is the process used to identify the people by analysing their face properties automatically using computer driven algorithms. The cross correlation mechanism will be used for the face recognition process. The face recognition technique will produce the results by matching the face features (low-level, colour based and shape based features) with the template database.

In this paper, an effective and energy efficient Face detection technique by improving existing face detection algorithms is proposed. This face detection algorithm must be effective, accurate and energy efficient. The new algorithm will be adaptable to various image capturing conditions like lighting levels, head positions, different angles, expressions, etc. This algorithm would be designed using combinations of Normalized Cross Correlation, Generalized Cross Correlation or Generalized Normalized Cross Correlation. To make this algorithm energy efficient the mathematical computations has to be fine-tuned and limited. So it may require a new algorithmic structure which will limit the number of computations to achieve the face detection goal.

The first step begins, when user selects the testing sample for system demonstration. Once the user selects the face recognition testing sample, the face detection and face matching modules run in the in the defined sequence to return the decision logic in the end.

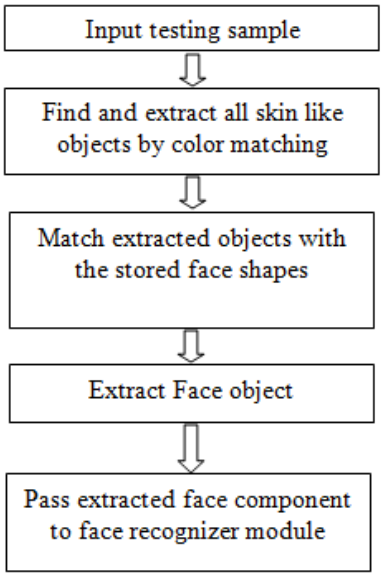

Figure 2: The technical overview of the face detector module

4. Result and Future Scope

The computational models, which were implemented in this project, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with manual face detection and automatic face recognition have proved to be with recognition accuracy over 95% even after a wider number of face images that were used for the training purposes. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate.

The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area. The fully automated face detection and recognition system was not robust enough to achieve high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale rotation or shift errors of the segmented face image. This was one of the system requirements identified in section.

The implemented fully automated face detection and recognition system could be used for simple surveillance applications such as ATM user security, while the implemented manuals face detection. The frontal view face recognition scheme should display recognition accuracy far better than the results, which were obtained in this study, which was conducted under adverse condition.

In this research, we worked with some still pictures but we will try to develop a system using video camera that will work with real time face recognition. Here we have used 400 face images of 20 random persons, but in future one may like to work with huge database than the one tested under this research project. A effort can be made to overcome the problem of different size face image recognition. Also a comparison for the performance analysis of the proposed model with other face recognition techniques like, the FUZZY NEURAL NETWORK APPROACH based method or others existing face recognition methods.

The face recognition algorithm is using cross correlation combined with normalization, generalization and various other MATLAB's built-in image processing modules. The proposed face recognition algorithm is capable of recognizing the person from various angles. The proposed model matches the testing sample (face image) with all of the training samples in the face recognition database. We have drawn the research objectives after a thorough research survey. The implementation has been done in the following phases. We have achieved the following objectives, which were designed during the designing phase of research work. We will extract the face image. Firstly we extract the face images and then load the training N-samples in the memory. Then the loop for index I is runned. Then the testing is done and if the sample matches we return the decision logic. And if not we check the next sample on the index till the result is found.

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