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Analysis of Hybrid Strategies for Human Face Detection and Recognition in Complicated Backgrounds that are Focused on Authentication using Biometrics

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Abstract: *Biometrics is seeing a lot of interest in face recognition from images or videos. In this research work, a new hybrid approach to detecting and recognize faces is proposed and implemented. The suggested approach makes use of the Viola-Jones method to separate the facial area from a complicated background before building a database of images from the same image. Once more detecting the face region, the recognition section calculates the Euclidean Distance between the present face and the face photos in the training database.*

The right face is identified using the lowest Euclidean distance parameter, if it is present in the database. When compared to certain earlier projects in the field, the system displays good recognition rate results.

Over the past few decades, interest in theories and algorithms for face recognition has been growing rapidly. Video surveillance, criminal identification, building access control, and unmanned and autonomous vehicles are just a few examples of concrete applications that are gaining attraction among industries.

Various techniques are being developed including local, holistic, and hybrid approaches, which provide a face image description using only a few face image features or the whole facial features. The main contribution of this survey is to review some well-known techniques for each approach and to give the taxonomy of their categories. In this study, a detailed comparison between these techniques is exposed by listing the advantages and disadvantages of their schemes in terms of robustness, accuracy, complexity, and discrimination. One interesting feature mentioned in this research is about the database used for face recognition. An overview of the most used databases, including those of supervised and unsupervised learning, is given. Numerical results of the most interesting techniques are given along with the context of experiments and challenges handled by these techniques. Finally, a solid discussion is given in the research about future directions in terms of techniques to be used for face recognition..

Keywords: Face Recognition System, Face Detection, person identification, biometric systems, Euclidean Distance, Recognition Rate, Viola Jones

I. INTRODUCTION

Applications in the field of computer vision include face recognition, face localization, face tr acking, facial expression recognition, video surveillance, content-based image and video retrieval, video conferencing, intelligent human-computer interfaces, applications for intelligent homes, passport control, visa control, and per sonal identification authority.

- Face detection methods have been studied for many years, and the literature has proposed sev eral advancements.
- Face recognition from image or video is a popular topic in biometrics research.

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- Advantages of face-based identification over other biometrics like fingerprint or voice are uniqueness and acceptance.
- Many public places usually have surveillance cameras for video capture and these cameras have their significant value for security purpose.
- Face recognition from picture or video is a well-known theme in biometrics. Numerous open places ordinarily have cameras for video catch and these cameras have their huge incentive for security reason.

Principle Component Analysis (PCA), Linear Discriminator Analysis (LDA), Skin Color, Wa velet,and Artificial Neural Networks are the five most wellknown face identification techniqu es.The vast majority of face identification methods concentrate on identifying frontal faces in photos or videos with adequate lighting.

Challenges faced by face detection algorithms often involve the following:

- Presence of facial features such as beards, moustaches and glasses.
- Facial expressions and occlusion of faces like surprised or crying.
- Illumination and poor lighting conditions such as in video surveillance cameras image quality and size of image as in passport control or visa control.
- Complex backgrounds also make it extremely hard to detect faces.

II. LITERATURE SURVEY

Faizan Ahmad et.al [1] have discussed the various challenges around image-based face detection and recognition. In this Research, the authors have evaluated several face detection and recognition methods existing and developed a system for the proposed method's evaluation as the first milestone for video-based face detection and recognition for surveillance.

Amr El Maghraby et.al [2] in their paper have discussed a hybrid face detection method using Viola-Jones method and skin colour detection. In this paper, a fast, reliable automatic human face and facial feature detection is one of the initial and most important steps of face analysis and face recognition systems for the purpose of localizing and extracting the face region from the background.

This paper presents a Crossed Face Detection Method that instantly detects low resolution faces in still images or video frames. Experimental results evaluated various face detection

methods, providing a complete solution for image-based face detection with higher accuracy, showing that the present method efficiently decreased the false positive rate and subsequently increased the accuracy of face detection system in still images or video frames especially in complex backgrounds. The proposed method can process different kinds of images and under different lighting conditions. The experimental results showed that our new approach was

able to achieve a higher detection rate than any of the 2 methods mentioned prior, and clearly improved Viola-Jones face detection accuracy and decreasing false negative rates.

K. M Poornima and Ajit Danti [3] have proposed human face recognition of still images using face detection by AdaBoost face detector, region of interest (ROI) extraction, feature extraction using discrete wavelet transform (DWT), dimensionality reduction by employing independent component analysis (ICA) and classification using k-Nearest Neighbourhood (k- NN) classifier. The proposed system is evaluated by conducting the experiments on Faces 94 database. For experimenting the proposed system, 40 classes from "Faces94" database are chosen. For training and testing, 40 class each and each class containing 10 images are

considered. Out of 10 images, 5 images from each class are used for training and remaining are used for testing. Out of 40 classes,13 classes are taken from the female dataset, 21 classes are from the male dataset and 6 classes are from the male-staff dataset.

Therefore, total 400 images are considered, out of which 200 images are used for training and remaining 200 images are used for testing. The proposed system achieved about 83.5% of recognition rate when k value is 1. Recognition rate decreases ask value increases.

Zahra Sadri Tabatabaei, [4] present a hybrid face detection system using a combination of appearance-based and feature-based methods. They have combined Viola and Jones face detection method with a colour-based method to

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propose an improved face detection method. They discuss a pixel-based skin detection methods, that classify each pixel as skin or non-skin individually, independently from its neighbours and combine it with Viola and Jones based face detection to improve the performance of face detection systems in terms of increasing the face detection speed and decreasing false positive rate. The results as shown that the proposed method efficiently increases face detection speed as well as decreases false positive rate.

Robert J. Baron, [5] Mechanisms of human facial recognition paper presents an extension and refinement of the author's theory for human visual information processing, which is then applied to the problem of human facial recognition. Several fundamental processes are implicated: encoding of visual images into neural patterns, detection of simple facial features, size standardization, reduction of the neural patterns in dimensionality, and finally correlation of the resulting sequence of patterns with all visual patterns already stored in memory. In the theory presented here, this entire process is automatically "driven" by the storage system in what amounts to a hypothesis verification paradigm.

Neural networks for carrying out these processes are presented and syndromes resulting from damage to the proposed system are analysed. A correspondence between system component and brain anatomy is suggested, with particular emphasis on the role of the primary visual cortex in this process. The correspondence is supported by structural and electrophysiological properties of the primary visual cortex and other related structures.

The logical (computational) role suggested for the primary visual cortex has several components: size standardization, size reduction, and object extraction. The result of processing by the primary visual cortex, it is suggested, is a neural encoding of the visual pattern at a size suitable for storage. (In this context, object extraction is the isolation of regions in the visual field having the same colour, texture, or spatial extent.) It is shown in detail how the topology of the mapping from retina to cortex, the connections between retina, lateral geniculate bodies and primary visual cortex, and the local structure of the cortex itself may combine to encode the visual patterns. Aspects of this theory are illustrated graphically with human faces as the primary stimulus. However, the theory is not limited to facial recognition but pertains to Gestalt recognition of any class of familiar objects or scenes.

III. PROPOSED WORK

The proposed method in this research work is based on the Eigenfaces technique in which the Principal Component Analysis (PCA) is used. PCA is a statistical method which is used to reduce the high dimensional data space to the low dimensional characterized space. This method is best suited for data compression and removal of redundancy. It is the most successful technique that is prevalent in image recognition and compression.

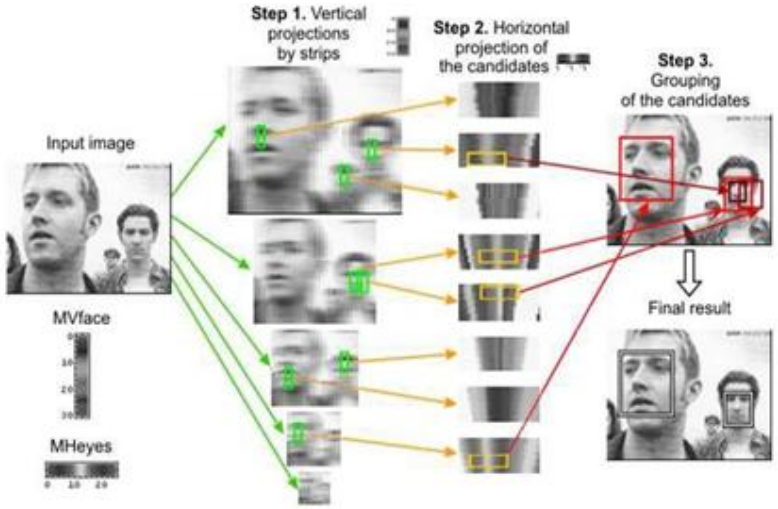

Figure 1: Viola Jones Algorithm

The foundation of using Eigenfaces in face recognition is since each image can be represented as a matrix. A matrix has a set of eigenvectors that represents the principal components of the matrix. Eigenfaces are the eigenvectors of the

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covariance matrix of all faces. Similar faces can be described in a space with lower dimensionality. In mathematical terms, Eigenfaces are the principal components that divide the face into feature vectors (or we can say that basic approach of using PCA in a face recognition is to put across the large 1- D vector of pixels built from the 2-D facial image into its discrete components of the feature space. This can be said to be as an Eigen Face projection. A covariance matrix gives us the information about these feature vectors. These eigenvectors are the basis for measurement of variation among several faces. The faces are described by a linear combination of highest Eigenvalues.

Methodology:

• This research work proposes a real time face detection and recognition method using Viola Jones for detection and eigen face matching for recognition process.
• The system will be implemented, simulated and analysed in MATLAB software with several test images.
• Performance Evaluation in terms of Mean Square Error, Peak Signal Noise Ratio etc.
• Face detection in images

Most of the face detection systems try to extract a fraction of the whole face, thereby removing most of the background and the other areas of an individual's head as like hairs that are not important for the face recognition task. With the static images, this is often done by executing a 'window' across the image. The face detection system then checks if a face is present inside the window [7]. Unfortunately, with the static images there are the very large search space of the possible locations of a face in an image. The Faces can be large or small and may be positioned anywhere from upper left to the lower right of an image. Most of the face detection systems apply an example depending upon learning approach to judge whether a face is present in the given window at that given instant [8]. The neural network or some other type of classifier is trained using the supervised learning with the 'face' and 'non-face' examples, thereby enabling to find in an image (window in the face detection system) as a 'face' or 'non-face'. Therefore, the face detection systems using example depending on learning need of the thousands of 'faces' and 'non-face' images for effective training.

Figure 1.2 A successful face detection in an image with a frontal view of a human face

There is also another technique for determining whether there is the face inside the face detection system's window is by using the Template Matching techniques. The difference between the fixed target pattern (face) and window is computed and then it is threshold. If the window has a pattern which is closely related to the target pattern(face) then the window is judged as containing a face. An implementation of the template matching is called as Correlation Templates that uses a whole bank of the fixed sized templates to detect the facial features in an image [10]. By applying several templates of the different sizes, faces of different scales (sizes) are detected. The other implementation technique of the template matching is by using a deformable template. In place of using the several fixed size templates, we can use a deformable template (which is non-rigid) and there by vary the size of the template hoping to detect the face in an image.

Face recognition

Over the past few decades many schemes have been introduced for the face recognition. Many of the techniques suggested during the early stages of the computer vision cannot be considered as successful, but almost all the recent approaches to the face recognition problem have been appreciable. According to the researchers, Brunelli and Poggio (1993), all the approaches to the human face recognition can be classified into two strategies:

(1) Template matching
(2) Geometrical features

1.1 Face recognition using template matching techniques

This technique is similar to the template matching technique used in the face detection scheme, except here that we are not trying to classify the image as a 'face' or 'non-face' but we are trying to recognize a face. The basics of the template matching technique is to extract the whole facial regions (matrix of pixels) and then compare these with the stored images of the known individuals. Once again, the Euclidean distance can be applied to find out the closest match. The simple method of comparing grey-scale intensity values for the face recognition was used by the Baron (1981). However, there are far more sophisticated techniques of template matching for the face recognition. These involve an extensive pre-processing and the transformation of the extracted grey-level intensity values.

IV. CONCLUSION

Research on face detection and recognition from complex backgrounds is always fascinating. This study presents a method that uses the Viola-Jones face detection technique to make it easier to detect human faces. The faces are then recognized by comparing their attributes with a database of trained faces. In a restricted setting and with a small number of individuals, the system exhibits a good identification rate of over 85%. To create an effective system of security and surveillance in multiple application areas, the work can be expanded to include appropriate hardware and software scaling.

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