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A Review over Face Detection And Recognition For Frontal Face Images

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***Abstract*— The growth of population and technology demand security surveillance behind abnormal human behaviors .Human face detection is a prelude required step of face recognition systems as well as very important process in security based applications. Human often uses faces to recognize persons and advancement in computing capability over the past few decades. The development of face detection system is quite essential in a variety of application such as robotics, security system, and intelligent human-computer interfaces, etcThe growth of population and technology demand security surveillance behind abnormal human behaviours. Now a day's colour human face detection is complicated task in the field of biometrics research. This paper gives an birds eye over different face detection technique and methods.**

***Keywords*— Face detection, YCbCr colour model, edge Detection, C 4.5**

I. INTRODUCTION

Face detection system is a part of facial image processing and their consequence as a research area has increased rapidly in these days. Biometric information of the humans can applicable easily instead of fingerprint, iris, signature etc., because these types of biometrics are not much suitable for non-collaborative people [1]. Face detection systems are usually applied and preferred for people and security cameras in metropolitan life. These systems can be used for crime prevention, video surveillance, person verification, and similar security activities. Basically, there are three types of methods in automatic face detection: verification, identification and watch-list. In the verification method, a comparison of only two images is considered. The comparison is positive if the two images are matched. In the identification method, more than one comparison should be done to return the closest match of the input image. The watch-list method works similar to the identification method with a difference that the input face can also be rejected (no match) [2] .

There are many Computational models are available for face detection because these model contributes not only to theoretical knowledge but also to practical applications in order to recognize face from the given picture or video. Computers that detect and recognize faces could be applied to a wide variety of tasks including criminal identification, security system, image and film processing, identity verification, tagging purposes and human-computer interaction. Unfortunately, developing a computational model of face detection is quite difficult because faces are complex, multidimensional and meaningful visual stimuli [3].

Face detection is used in many places now a day's especially the websites hosting images like Picassa, Photobucket, Orkut and facebook. The automatically tagging feature adds a new dimension to sharing pictures among the people who are in the picture and also gives the idea to other people about who the person is in the image[1,3].

Face detection is the first step of face recognition as it automatically detects a face from a complex background to which the face recognition algorithm can be applied. But detection itself involves many complexities such as background, poses, illumination etc [1]. There are many approaches for face detection such as, color based, feature based (mouth, eyes, nose), neural network.

Finally we used a face verification method. In this paper, Section2 deals a YCbCr colour model, edge detection and C 4.5. Section3 deals combined approach for face detection. Section4 deals the detection results of our combined method on several face images. Conclusions and future scope deals in Section5

II. FACE DETECTION

Face detection is the problem of determining whether a sub-window of an image contains a face. Looking from the point of view of learning, any variation which increases the complexity of decision boundary between face and non-face classes will also increase the difficulty of the problem [2]. For example, adding tilted faces into the training set increases the variability of the set, and may increase the complexity of the decision boundary. Such complexity may cause the classification to be harder. There are many sources introducing variability when dealing with the face. They can be summarized as follows. There are three basic steps of face detection that are pre-processing, face detection and post processing [4].

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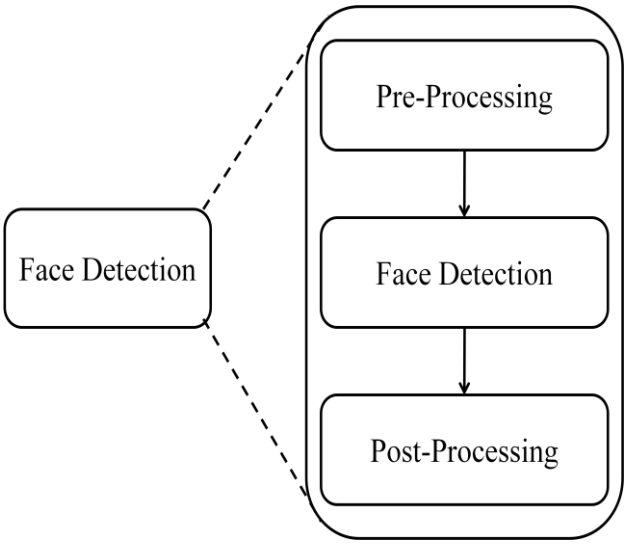

Figure 1.1 General Face Detection System Processes

Image plane variations, Pose variations, Lighting variations and Background variations are the four major variations in the face detection technique.

III. APPLICATIONS OF FACE DETECTION

There are many exiting technique available but some of them are discussed below. There techniques are use for security, safety and make our life easy and luxurious [1,2,3,4,5].

Security (access control to buildings, airports/seaports, ATM machines and border checkpoints computer/network security, email authentication on multimedia workstations).

Surveillance (a large number of CCTVs can be monitored to look for known criminals, drug offenders, etc. and authorities can be notified when one is located.

General identity verification (electoral registration, banking, electronic commerce, identifying newborns, national IDs, passports, drivers' licenses, employee IDs).

Criminal justice systems (Post-event analysis, forensics science).

Image database investigations (searching image databases of licensed drivers, benefit recipients, missing children, immigrants and police bookings).

"Smart Card" applications (in lieu of maintaining a database of facial images, the face-print can be stored in a smart card, bar code or magnetic stripe, authentication of which is performed by matching the live image and the stored template) .

Multi-media environments with adaptive human computer interfaces (part of ubiquitous or contextaware systems, behavior monitoring at childcare or old people's centers, recognizing a customer and assessing his needs).

Video indexing (labeling faces in video).

Witness faces detection.

IV. CHALLENGES IN FACE DETECTION

There is a huge demand of face detection the current scenario. Apart from that it seems to be that there are several problems in face detection which deter the industry from accessing this technology. We listed some of such challenges which are the most significant problems in this era [5].

- **Illumination challenge**

Although the performance of face detection systems in indoor platforms has reached a certain level, face detection in outdoor platforms still remains as a challenging topic. Face detection performance is significantly affected by the problems caused by variations in illumination, face pose, expression, aging and etc. Especially, the effect of variation in the illumination conditions, which causes dramatic changes in the face appearance, is one of the most challenging problems that a practical face detection system needs to achieve. More specifically, the variations between the images of the same face due to illumination and viewing [4,5].

- **Face pose**

In a surveillance system, the camera is mostly mounted to a location where the people cannot reach to the camera. Mounting a camera a high location, the faces are viewed by some angle degree. This is the simplest case in city surveillance applications. The next and the most difficult case is that people naturally pass through the camera view. They do not even look at the camera lens. Authorities cannot restrict people behaviors in public places. Detection in such cases must be done in an accurate way. However, even state-of-the-art-techniques have 10 or 15degree angle limitation to recognize a face. Recognizing faces from more angles is another challenge. The most significant face features are lost after an angle of 25 degree or 30 degree. Hence, the system reliability decreases exponentially [3,5].

- **Face expression**

Face expression is less significant issue compare with angle and illumination but it affects the face detection results. Although a close eye or smiling face does affect the detection rate by 1% to 10 percent, a face with large laugh has an influence as more as 30% since a laughing face changes the face appearance and distorts the correlation of eyes, mouth and nose. Hence, the features are grouped as a different class. This suddenly increases the false alarms. Many research papers focus on small changes on the face surface. However, huge changes in expression are still an unsolved problem [4,5].

- **Face aging**

Face detection algorithms are using either geometrical techniques or feature-based approaches or holistic

methods. All of them do not solve the aging problem. Almost all of them give an age tolerance as long as 20 years after the training. Faces between 1 year and 15 years cannot be recognized since face appearance changes fast. Face appearance becomes stable after teenage years. A detection algorithm that can recognize faces for all ages does not exist[4.5].

- **Speed**

Detection speed is very important. In a surveillance system, it is important that megapixel images should be used for the quality of the face detection scores. Increasing the image size slows down the detection of the face, facial feature extraction. In addition to this, the matching speed becomes slow if the number of enrolled people increases to several millions of records. There are some accurate 3D-based face detection methods but they take more than 5second per face. However, in a crowded environment, people movement is so fast that face detection in a 100ms is necessary which includes the DB matching, image acquisition, face detection, image normalization and alarm reporting [5].

V. CLASSIFICATION

In the process of face detection we used C 4. 5 classifier for data separation for background and human face .by this method we classify the pixel values of our approach based on training and test of pixel here discuss the method of C 4.5 classifier. C4.5 builds decision trees from a set of training data in the same way as ID3, using the concept of information entropy. The training data is a set S = s1,s2,... of already classified samples. Each sample si = x1, x2,... is a vector where x1,x2,... represent attributes or features of the sample. The training data is augmented with a vector C = c1,c2,... where c1,c2,... represent the class to which each sample belongs. At each node of the tree, C4.5 chooses one attribute of the data that most effectively splits its set of samples into subsets enriched in one class or the other. Its criterion is the normalized information gain (difference in entropy) that results from choosing an attribute for splitting the data. The attribute with the highest normalized information gain is chosen to make the decision. The C4.5 algorithm then recurs on the smaller sub lists. This algorithm has a few base cases .All the samples in the list belong to the same class. When this happens, it simply creates a leaf node for the decision tree saying to choose that class .None of the features provide any information gain. In this case, C4.5 creates a decision node higher up the tree using the expected value of the class. Instance of previously-unseen class encountered. Again, C4.5 creates a decision node higher up the tree using the expected value.

VI. EDGE DETECTION

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. Classical methods of edge detection involve convolving the image with an operator (a 2-D filter), which is constructed to be sensitive to large gradients in the image while returning values of zero in uniform regions [6,7]. There is an extremely large number of edge detection operators available, each designed to be sensitive to certain types of edges. Variables involved in the selection of an edge detection operator include:

- **Edge orientation**: The geometry of the operator determines a characteristic direction in which it is most sensitive to edges. Operators can be optimized to look for horizontal, vertical, or diagonal edges.
- **Noise environment**: Edge detection is difficult in noisy images, since both the noise and the edges contain high-frequency content. Attempts to reduce the noise result in blurred and distorted edges. Operators used on noisy images are typically larger in scope, so they can average enough data to discount localized noisy pixels. This results in less accurate localization of the detected edges.
- **Edge structure**: Not all edges involve a step change in intensity. Effects such as refraction or poor focus can result in objects with boundaries defined by a gradual change in intensity. The operator needs to be chosen to be responsive to such a gradual change in those cases. Newer wavelet-based techniques actually characterize the nature of the transition for each edge in order to distinguish, for example, edges associated with hair from edges associated with a face

VII. RELATED WORK AND PROBLEM STATEMENT

In recent year researchers attracted towards automatic human face detection from colour image or from video sequence, but automatic human face detection from images for surveillance and biometric applications are still a mind hunting task due to the computation inaccuracies that lead higher degree of false negative rate and false positive rate.

Literature survey on the existing face detection technique. We studied various research paper and journal and find-out some research work carried out by various researchers in the field of face detection, image processing and other face reorganization methods. All methodology and process are not described here. But some related work in the field of Image processing and face detection techniques discuss by the name of authors and their respective title.

By Eanes Pereira, Herman Gomes, Eduardo Moura, Jo ao Carvalho and Tong Zhang “Investigation of Local and Global Features for Face Detection”, IEEE 2011. [8] : This work is concerned with the empirical evaluation of a set of local and global features under the context of frontal (including semi-profile) and full profile face classification.

Integral LBP, Integral Histograms, PCA and Optimized Face Ratios features have been evaluated using SVM classifiers. The proposed results indicate that the evaluated features are very suitable to the problem of face detection and that a simple classifier combination improves individual classifiers performance. A dataset of about 14, 000 face and 300, 000 non-face images has been constructed and used in the experiments. For profile faces classification, the classifier SVM-OFR obtained highest TPR and the SVM-INTLBP obtained highest TNR. The classifiers trained with OFR obtained poor results of TNR (lower than 80%), but excellent TPR results. As the OFR

Padma Polash Paul and Marina Gavrilova, "PCA Based Geometric Modeling for Automatic Face Detection", IEEE 2011, pp 33-38 [9]: Here the author has presented the PCA based modelling of geometric structure of the face for automatic face detection. The method improves the face detection rate and limits the search space. Skin Colour Modelling (SCM) is one of the best face detection techniques for image and video. However, feature selection is very important for even better template matching performance in terms of detection rate and time. In the future, the author will use more complex geometric structure for better understanding of the important facial features and threshold values. Complex structure will also help to obtain a better and more generalized threshold for the face.

Jing-Ming Guo, Chen-Chi Lin, Min-Feng Wu, Che-Hao Chang, and Hua Lee, "Complexity Reduced Face Detection Using Probability-Based Face Mask Prefiltering and Pixel-Based Hierarchical-Feature Adaboosting", IEEE 2011, pp- 447-450.[10]: In this letter, a hybrid face detector with the Probability-based Convolutional Face Mask (PFMPF) and the Pixel-Based Hierarchical-Feature Adaboosting (PBHFA) is proposed. The goal is to improve the processing efficiency for the classification of face and non face candidates. As documented in the experimental results, the training time is significantly reduced, and the detection rate remains competitive to the traditional Adaboosting method. In summary, the proposed method is an effective approach and the implementation is straightforward. The simplicity and computation efficiency make this approach an excellent candidate for real-time surveillance system.

Anima Majumder, L. Behera and Venkatesh K Subramanian, "Automatic and Robust Detection of Facial Features in Frontal Face Images" IEEE 2011, pp 331-336 [11]. The proposed a robust algorithm for automatic and accurate detection of different facial features. An improvement over AdaBoost detection of eyes, mouth and nose are done by estimating the probable region for each features. Geometrical interpretation of location of facial features, used in the algorithms is described with pictorial descriptions. It is observed that, with the use of facial geometry, the accuracy of features (eyes, nose and mouth) detection is greatly improved over that of using only AdaBoost algorithm in whole face image. The proposed lip detection algorithm is found to be accurately detecting the lips corners for both neutral face images and smiling face images. The eye pupil detection method using H-plane of the HSV color planes image is found to be robustly detecting the pupil in spite Automatic detection of facial features in an image is important stage for various facial image interpretation works, such as face recognition, facial expression recognition, 3D face modeling and facial features tracking. Detection of facial features like eye, pupil, mouth, nose, nostrils, lip corners, eye corners etc., with different facial expression and illumination is a challenging task. In this paper, the author presented different methods for fully automatic detection of facial features. Viola- Jones' object detector along with haar-like cascaded features is used to detect face, eyes and nose. Novel techniques using the basic concepts of facial geometry are proposed to locate the mouth position, nose position and eyes position.

VIII. CONCLUSION

In recent year researchers attracted towards automatic human face detection from colour image or from video sequence, but automatic human face detection from images for surveillance and biometric applications are still a mind hunting task due to the computation inaccuracies that lead higher degree of false negative rate and false positive rate. Among many face detection algorithms, the method based on skin colour model has been widely used for its convenient use, simple performance and high detection speed. It is unreliable to make face detection only using skin colour features when there are a large number of objects similar to skin colour. Same as Changes in lighting and background color have much effect on colour face image.

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