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A FrameWork of Video Based Face Recognition Approach

Rekha Tiwari [#1], Mrs.Babita Kubde[*2]

[#] Deptt. Of Computer Science& Engineering , RCET, Bhilai
Chhattisgarh, Bhilai - India

Abstract- Extracting high level features is an important field in video indexing and retrieving. Identifying the presence of human in video is one of these high level features, which facilitate the understanding of other aspects concerning people or the interactions between people. In this paper we are giving approach for face recognition based on video.

Face recognition in videos is a hot topic in computer vision and biometrics over many years. Compared to traditional face analysis, video based face recognition has advantages of more abundant information to improve accuracy and robustness, but also suffers from large scale variations, low quality of facial images, illumination changes, pose variations and occlusions. Related to applications, we divide the existing video based face recognition approaches into two categories: video-image based methods and video-video based methods, which are surveyed and analyzed in this paper.

Key Word: Keywords: - Video Processing, Computer vision, Human detection, Face recognition

I. Introduction

In recent years, face recognition is always an active topic in the field of biometrics. Compared to traditional face recognition in still images, video based face recognition has great advantages listed as follows. Firstly, videos contain more abundant information than a single image. As a result, more robust and stable recognition can be achieved by fusing information of multi frames. Secondly, temporal information becomes available to be exploited in videos to improve the accuracy of face recognition. Finally, multi poses of faces in videos make it possible to explore shape information of face and combined into the framework of face recognition. However, video based face recognition is also a very challenging problem, which suffers from low quality facial images, illumination changes, pose variations, occlusions and so on. Due to its importance and difficulties, many research institutes have focused on video based face recognition with all kinds of approaches proposed, such as Massachusetts Institute of Technology [1] , Carnegie Mellon University [2, 3], University of Illinois at Urbana-Champaign [4, 5], University of Maryland [6–8], University of Cambridge [9–11], Toshiba [12, 13], Institute of Automation Chinese Academy of Sciences [14, 15]. The whole procedure of video based face recognition is shown in Fig. 1. Related to applications, we can divide video based face recognition methods into two categories: video-image based methods and video-video based methods. The first category can be seen as an extension of still image based face recognition. The Face recognition is the ability to establish a subject's identity based on facial char-acteristics. Automated face recognition requires various techniques from different research fields, including computer vision, image processing, pattern recognition, and machine learning. In a typical face recognition system, face images from a number of subjects are enrolled into the system as gallery data, and the face image of a test subject (probe image) is matched to the gallery data using a one-to-one or one-to- many schemes. The one-to-one and one-to-many matching’s called verification and identification, respectively. Face recognition is one of the fundamental methods used by human beings to interact with each other. Attempts to match faces using a pair of photographs dates back to 1871 in a British court [96]. Techniques for automatic face recognition have been developed over the past three decades for the purpose of automatic person recognition with still and video images. Face recognition has a wide range of applications, including law enforcement, civil applications, and surveillance systems. Face recognition applications have also been extended to smart home systems where the recognition of the human face and expression is used for better interactive communications between human and machines. Fig. 1.1 shows some biometric applications using the face. The face has several advantages that make it one of the most preferred biometric traits. First, the face biometric is easy to capture even at a long distance. Second, the face conveysnot only the identity but also the internal feelings (emotion) of the subject (e.g., happiness or sadness) and the person's age. This makes face recognition an important topic in human computer interaction as well as person recognition. The face biometric is affected by a number of intrinsic (e.g., expression and age) and extrinsic (e.g., pose and lighting) variations. While there has been a significant improvement in face recognition performance during the past decade, it is still below acceptable levels for use in many applications.

. Recent efforts have focused on using 3D models, video input, and different features (e.g., skin texture) to overcome the performance bottleneck in 2D still face recognition. This chapter begins with a survey of face recognition in 2D, 3D, and video domains and presents the challenges in face recognition problems.

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(a) (b) (c) (d)

Figure 1.1. Example applications using face biometric: (a) ID cards (from [1]), (b) face matching and retrieval (from [2]), (c) access control (from [2]), and (d) DynaVox EyeMax system (controlled by eye gaze and blinking, from [3]).

We also introduce problems in face recognition due to subject aging. The relevance of facial marks or micro features (e.g., scars, birthmarks) to face recognition is also presented.

II. RELATED WORK

A: *Feature Identification*

Most of the studies in this field use face detection algorithm as the key idea. Jin [15] proposed a method to identify video shots with people based on face detection. The category of the shot was considered to be "people", only if there is at least one image with more than one face within that shot. One of the three features chosen by Huang et al. [16] to be evaluated in the TREC video Evaluation (2003) was "People" feature, Huang et al., state that for a segment of video to have people feature it should contain at least three human faces. Huang et al. used a skin tone filter to detect skin regions, followed by the omni-face detection algorithm which was proposed by Wei and Sethi [12].

B: *Human Detection*

From the literature reviews done, it can be concluded that most common way in human detection is via detecting human face. Human face is the most unique part in human body, and if it is accurately detected it leads to robust human existence detection.

C: *Face Detection methods*

Several studies were done in face detection field since 1970, and lots of surveys addressed the algorithms used in this field under different categories [5], [13], [14] but in general two main classes can be used to classify these algorithms namely, feature based (e.g. Bottom-Up) and image based (e.g. Appearance-Based and Template matching) approaches. Features based approaches extract facial features from an image and manipulate its parameters such as angles, size, and distances. Image base approaches rely on training and learning set of examples of objects of interest. However, dealing with video introduces other approaches for face detection such as motion based approach. A brief description of the most common approaches and examples of algorithms used in each of them is given in the rest of this section.

C1: *Knowledge-based (Top-Down) approach*

In this method the relationship between facial features is captured to represent the contents of a face and encode it as a set of rules. Coarse-to fine scale is used in lots of algorithms classified under this category, in which the coarsest scale is searched first and then proceeds with the others until the finest scale is reached.

C2: *Feature invariant (Bottom-Up) approach*

In this approach, the face's structural features which do not change under different conditions such as varying viewpoints, pose angles and/or lightning conditions. Common algorithms used under this category are: Color-based approach, or so called skin-model based approach. This approach makes use of the fact that the skin colour can be used as indication to the existence of human using the fact that different skins from different races are clustered in a single region. Cezhnevets et al., [20], presented 4 pixel-based skin modeling techniques named as Explicitly defined skin region, Non-parametric skin distribution modeling, Parametric skin distribution modeling, Dynamic skin distribution modeling.

C3: *Facial features based approach*

This method, in which global (e.g. skin, size, and shape) and/or detailed (e.g. eyes, hose, and lips) features are used, has become popular recently. Mostly, the global features first are used to detect the candidate area and then tested using the detailed features. *Texture* The human face differs from other objects in texture. This method, examines the likelihood of sub image to belong to human face texture, using Space Gray Level dependency (SGLD) matrix.

C4: *Template matching methods*

These methods are based on measuring the degree of similarity between the candidate sub image and the predefined stored face pattern. The predefined image might be for the whole face pattern or the individual face features such as eyes, nose and lips. Common algorithms used under this category are: Predefined face templates, in which several tem plates for the whole, individual or both (whole and individual) parts of a face are stored. Deformable Templates in which an elastic facial feature model as a reference model where the deformable template mode of the object of interest, is fitted in.

C5**:** *Appearance-Based Method*

Unlike template matching methods, where the templates are predefined by experts, Appearance-Based method learns the templates from set of images, using statistical analysis and machine learning. Examples of algorithms used by these approaches are:

Eigenfaces, or so called eigenvectors, in which different algorithms are used to approximate the eigenvectors of the auto correlation matrix of a candidate image. [17]

Distributed-Based, where the distribution pattern of an object is learned using the positive and negative image sets of that object.

Neural Networks, where networks of neurons (simple Elements) called nodes are used to perform function in parallel. The idea of neural networks comes from the central nervous system. However, these networks are trained to detect the presence of face by giving it face and no face samples.

Support Vector Machines, these are learning machines that make binary classifications. The idea here is to maximize the margin between positive and negative sets of vectors and obtain an optimal boundary which separates the two sets of vectors. They were first suggested by Vapnik in 1960 [4].

Hidden Markov Model is a statistical model used to model the statistical properties of a signal. The Markov process is used to model the processed system and the Markov parameters are taken from the observed parameters.

D: *Movement Detection*

Unlike still images, video sequences hold more details about the history of moving objects (foreground), which help in isolating the foreground from the background. Generally, the moving areas are detected by finding the changes that happen among the sequences of images [1], [2].Most of the research done in movement detection applied pre-processing steps before applying the change detection algorithms, [2]. Such pre-processing steps involve geometric and intensity adjustments. The problem of variation in light intensity is solved by intensity adjustment in which illumination effect is reduced to some degrees based on the method used. Elgammal et al. [1], state that transforming the RGB values, into chromatic colour space makes the module insensitive to the small changes in the illumination. There are several ways for detecting a change in a video sequence [2]. Recent studies agree that Image differencing method is more effective than others in change detection [3].

III PROPOSED METHODOLOGY

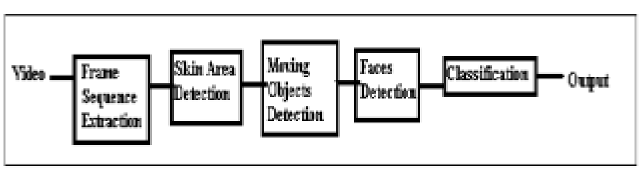

Figure 2: Steps involved in human detection

Our proposed algorithm comprises of following steps.

1. Converting a video sequence in to individual images.
2. Accessing the sequential images and detecting the important features.
3. Allocating those regions (if any) giving indications of human presence such indication is having a human skin like colour.
4. Applying movement detection test for all of the allocated regions.
5. Applying face detector to those detected moving objects to detect if it is a face or not.
6. Select a best face and add this face into Database for matching with train Database.

Stage 1: Frame Sequence Extraction

In this stage video is converted into individual JPG frames

.**Stage 2: Skin Areas Detection**

In this stage colour information of the digital image is utilized to find those areas close to human skin colour. This stage helps in reducing the search space and therefore speeds up the simulation by consuming the processing time efficiently. However, skin test is not enough to detect human faces as it will also detect other parts of the body as well as other non face skin colored objects. Thus, other tests to filter out those unwanted areas should be applied. Further stages in the proposed project are designed to gradually eliminate the false detected areas found at this stage. The first test to remove the unwanted skin like areas was chosen to be movement detection.

Stage 3: Moving Objects Detection

To minimize the errors in face detection we can utilize the human nature that human will have at least small amount of movements such as eyes blinking and/or mouth and face boundary movements. We can get this information easily because we are dealing with video sequence by which the whole sequence of the object's movements can be obtained. Taking that point in to account we can reduce the error that occurs due to false detection of a human face and minimize the time of simulation. This step was designed to be implemented only across those skin regions found in the previous step. Giving those moving pixels different colour than surrounding region (human face skin colour in case of face was detect), these pixels reshape the human face facial features which in turn helps in later stages. However it is important to take in to account that a change may occurs due to several sources such as moving objects, presence or absence of objects camera movement and zooming, brightness changes This means that some changes are significant and others are not and this is varying with the application requirements. For example, the change detected in background is not significant in video surveillance whereas it has a great importance in remote sensing. Although, it is difficult to take decision whether a detected change is significant or not, it is an important step to remove unwanted changes and focus the processing only on those changes of interest, which reduced the processing time and false detected areas. Hence, movement detection was chosen as a vital stage in the proposed design.

Stage 4: Face Detection

To insure that the moving part is a face, additional tests are required. In this stage, the moving objects which were detected in the previous stage are examined to identify if any of them is a face by examining the pass of the following four tests:

Geometric Test

The candidate regions are tested here against some human face geometric features which are governed by the relation between the width and height of the human face. This test is important to eliminate some of those regions which contain non face objects whose colours are similar to the human face skin colour and experience some acceptable movement across the frames sequence.

Temporal Test

In this test the advantage of having the temporal information from the frame video sequence is being utilized to help in constructing additional verification step before applying the further tests which are more computationally expensive. The principle used in this step based on the fact that no face can occur or disappears suddenly in a certain sequence hence, comparison with the previous and next frames (if exist) gives indication whether or not the candidate region is a face. This additional step helps in maximizing the elimination of those detected skin areas that do not include a human face. Therefore, a reduction in the computational efforts as well as simulation time will be achieved.

Facial Feature Test

This stage will examine the existence of the facial features (mainly the moving areas (none skin) such as eyes, lips and face boundary) in the candidate skin areas filtered in the previous test. It is useful to use the fact that the face skin region must have at three separate spots as a test to be applied in order to verify the existence of a human face in the candidate areas. Only those candidates passing this test will be proposed for the next verification tests.

Template Matching Test

Those candidate regions that have passed the previous two tests will be compared (correlated) with a template model of a human face. Only those candidates that achieve a correlation value beyond a pre defined threshold and a distance (from the face space) value less than a pre defined threshold will be considered as a human face.

Stage 5: Classification

Only those allocated faces that have passed all of the verification stages successfully undergo the classification stage where the category of the detected candidate region is classified as either a face or not face in this stage based on the results of the last two tests namely correlation and distance from face space tests. The candidate region to be accepted as a face has to have a correlation value above the specified correlation threshold value and its distance from the face space should be below the specified distance threshold value.

IV CONCLUSION

An algorithm has been proposed to detect the presence of human in video sequence. The main two techniques used in building the proposed algorithm are face and motion detection techniques. A series of stages were implemented in a certain order to promise maximizing the detection of existing faces and eliminating theother objects (noise). The proposed algorithm detects faces of different sizes under different lightning conditions.

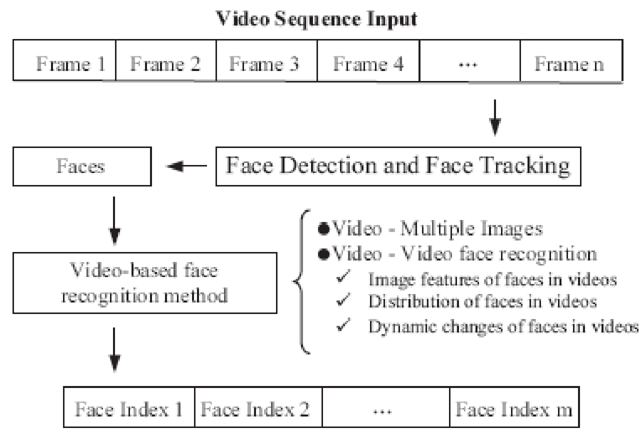

Figure 3: Process of face recognition from video

V FUTURE RECOMMENDATIONS

The proposed work handles the first step in all of those applications concerning human recognition or human activities such as identifying the shots that include different activities such as meeting, running and hand shaking. Further more, its contribution in more advance applications where integration between image processes and audio processing is required to understand the videos and find out different high level features such as identifying the speaker in a certain sense, widens its importance and its applied field.

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