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FACE RECOGNITION IN VIDEO STREAMS ON HOMOGENEOUS DISTRIBUTED SYSTEMS

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ABSTRACT:

Video-based face recognition has been one of the hot topics in the field of pattern recognition in the last several decades. The main advantage of the video based face recognition method is that more information is available in a video sequence than in a single image. This system is aimed at building a fast, parallel video face recognition system based on client server technique, where each frame of video is processed by client computers attached to the server, which acquire and distribute frames. Face recognition is done after face detection in each frame of the video, individually.

Keywords: Video-based face recognition, client-server technique, video frames

[I] INTRODUCTION

Within today's environment of increased importance of security, identification and authentication methods have developed into a key technology in various areas; entrance control in buildings; access control for computers in general or for automatic teller machines in particular; day-to-day affairs like withdrawing money from a bank account or dealing with the post office; or in the prominent field of criminal investigation. Such requirement for reliable personal identification in computerized control has resulted in an increased interest in biometrics. In today's world security is main issue of every individual and even nation. Increase in security demand has added a new cost and factor for every project, but with high cost of sector equipments and services, reach of every man to opt for it, is still difficult.

Technology has always been appreciated when it's for mankind. Following the same path many biometric equipments already exist in the market like Fingerprint, Hand geometry, Retina, Face Recognition, Voice Signature etc.

Biometric identification is the technique of automatically identifying or verifying an individual by a physical characteristic or personal trait. Biometric characteristics and traits are divided into behavioral or physical categories. Behavioral biometrics encompasses such behaviors as signature and typing rhythms. Physical biometric systems use the eye, finger, hand, voice and face for identification.

A facial recognition system is a computer application for automatically identifying or verifying a portion from a digital image or a video frame from a video source [1]. A face

recognition system would allow user to be identified by simply walking past a surveillance camera. Human beings often recognize one another by unique facial characteristics. One of the newest biometric technologies, automatic facial recognition, is based on this phenomenon. Facial recognition is the most successful form of human surveillance. It is being used to improve human efficiency when recognizing faces, is one of the fastest growing field in the biometric industry. Interest in facial recognition is being fueled by the availability and low cost of video hardware, the ever increasing numbers of video cameras being placed in the workspace, and the non invasive aspect of facial recognition systems and systems already exist in the markets which claim to provide accurate, effective and fast human face recognition, but following limitations exists:

• Have some error when conditions like intensity of light, angle of face changes

• Most of Them lack accuracy with different gestures.

[II] MATERIALS AND METHODS

2.1. Image based recognition verses Video based recognition

Face recognition using visual images is gaining acceptance as a superior biometric [2].One problem with the image-based method is that it is possible to use a pre-recorded face photo to pretend as a live subject. The second problem is that the image-based recognition accuracy is still too low to be used in some practical applications. In order to overcome these problems, video based face recognition has been proposed recently. One of the major advantages of video-based face recognition is to prevent the fraudulent system penetration by pre-recorded facial images. The great difficulty to forge a video sequence in front of a live video camera may ensure biometric data come from the actual user. Another key advantage of the video based method is that more information is available in a video sequence than in a single image. Automatic face recognition for still images with high quality can achieve satisfactory performance, but for video-based face recognition it is hard to attain similar levels of performance. Compared to still images face recognition, there are several disadvantages of video sequences. First, images captured by CCTV cameras are generally of poor quality. The noise level is higher, and images may be blurred due to movement or the subject being out of focus. Second, image resolution is normally lower for video sequences. If the subject is very far from the camera, the actual face image resolution can be as low as 64 by 64 pixels. Last, face image variations, such as illumination, expression, pose, occlusion, and motion, are more serious in video sequences. These effects are illustrated in Figure 2. Images in the first row are CCTV images with relatively good quality. The second row shows degraded images, where the left-hand side picture shows the effect of out of focus, the middle picture displays the effect of interlacing due to object movement and the right-hand side one illustrates the combination of out of focus and interlacing. To comparison with the still image shown in Figure 1, it can be seen that the image quality of CCTV cameras (even high-end ones) is much worse than still images [3]. In addition, the poor quality, low resolution, and large variation will result in uncertainty of the face detector, which is the first important step of any automatic face recognition system. Faces extracted from poor-quality videos can have higher false detection rate and larger alignment errors, which may have great influence on the performance

Figure 1: Normalized still face images captured by normal cameras.

CCTV images taken with better quality


CCTV images taken with better quality

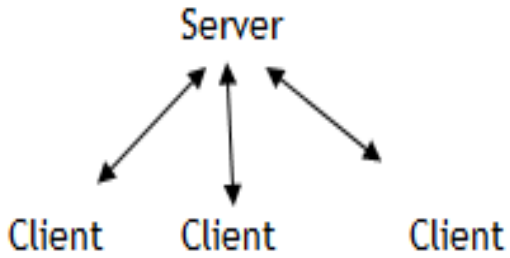
Figure 2: Normalized video face images captured by CCTV cameras.

However, there are some major advantages of video sequences. First, we can employ spatial and temporal information of faces in the video sequence to improve still images recognition performance. Second, psychophysical and neural studies have shown that dynamic information is very crucial in the human face recognition process. Third, with redundant information, we can reconstruct more complex representations of faces such as a 3D face model or super-resolution images and apply them to improve recognition performance. Fourth, some online learning techniques can be applied for video-based face recognition to update the model over time.

2.2. Need for Parallel Processing

Parallel processing is the simultaneous processing of the same task on two or more microprocessors in order to obtain faster results. The computer resources can include a number of data through shared memory. With the help of parallel processing, a number of computations can be performed at once, bringing down the time required to complete a project. Parallel computing can be effectively used for tasks that involve a large number of calculations, have time constraints and can be divided into a number of smaller tasks.

Parallel processing techniques also provide for load balancing increasing the availability of the system. In the event of a client failure within a cluster computing farm, the load balancer automatically resubmits job on another client on the cluster farm, which seamlessly continues the core functionality of the application.



Parallel computing can be effectively used for the face recognition problem in video streams as it involves a large number of calculations, have time constraints and can be divided into a number of smaller tasks.

2.3. General Framework

In most cases, a face recognition algorithm can be divided into the following functional modules: **a face image detector** finds the locations of human faces from a normal picture against simple or complex background[4],.f**ace recognizer** determines who this person is; they both have a **feature extractor** that transforms the pixels of the facial image into a useful vector representation, and a **pattern recognizer** that searches the database to find the best match to the incoming face image as shown in fig 3.

1) Detecting a face: Detecting a face in a probe image may be a relatively simple task for humans, but it is not so for a computer[5]. The computer has to decide which pixels in the image is part of the face and which are not. In a typical passport photo, where the background is clear, it is easy to do, but as soon as the background becomes cluttered with other objects, the problem becomes extremely complex. Traditionally, methods that focus on facial landmarks (such as eyes), that detect face-like colors in circular regions, or that use standard feature templates, were used to detect faces.

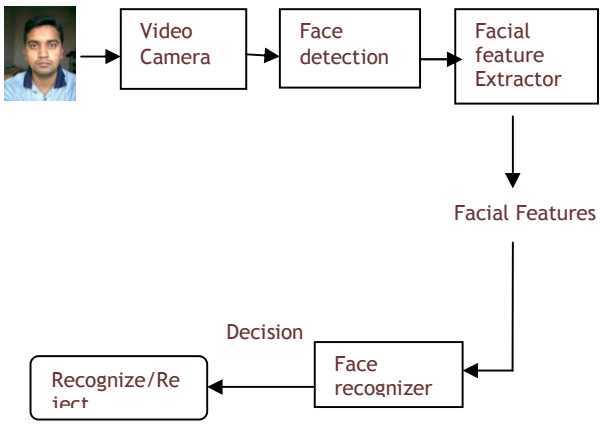


Fig 3: Face Recognition Algorithm

2) *Normalization:* Once the face has been detected (separated from its background), the face needs to be normalized. This means that the image must be standardized in terms of size, pose, illumination, etc., relative to the images in the gallery or reference database. To normalize a probe image, the key facial landmarks must be located accurately. Using these landmarks, the normalization algorithm can re orient the image for slight variations. Such corrections are, however, based on statistical inferences or approximations which may not be entirely accurate. Thus, it is essential that the probe is as close as possible to a standardized face. Recognition can only succeed if the probe image and the gallery images are the same in terms of pose orientation, rotation, scale, size, etc. Normalization ensures that this similarity is achieved—to a greater or lesser degree.

3) Feature extraction and recognition: Once the face image has been normalized, the feature extraction and recognition of the face can take place. In feature extraction, a mathematical representation called a biometric template or biometric reference is generated, which is stored in the database and will form the basis of any recognition task.

2.3. General Framework

Face recognition is done after face detection in each frame of the video, individually. The master-slave technique is employed as the parallel computing model. Each frame is processed by different slave Personal Computers (PC) attached to the master, which acquire and distribute frames.

Parallel processing speeds up the image processing computations.

Complete system is consisted of 'n' clients and one server. All the clients are connected to the server using different ports. Each frame is send to individual client, which apply face recognition technique on the image and send similarity calculation of the image, with all the database images, to the server as shown in fig 4.

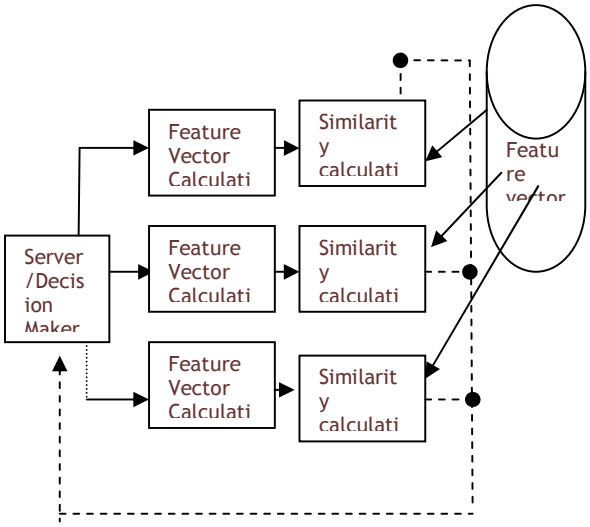


Fig 4: Face Recognition on distributed system architecture

Algorithm:

1. 'N' frames of the video are sent to 'n' clients connected to the server, each frame to a different client.
2. The server records the time at which the frames were sent in 'n' different files server_send_time$_1$… server_send_time$_n$.
3. Each client records the time at which it receives the frame in the file client_recv_time.
4. Each client records the process start time in the file client_start_time.
5. The clients process the images sent to them and later records the process end time in file client_end_time.

6. The results of similarity of the frame received by the client, with all the files stored in the client database, are sent to the server.

[III] RESULTS

3.1. Processing time

1. Faster processing results in comparison to serial processing.
2. Totalprocessingtime=server_recv_time$_n$-server_send_time$_1$
3. The total processing time includes the process time at clients and the time lost during transmissions.
4. Time taken by the process at each client=client_end_time-client_start_time
5. Time delay during transmissions

Delay1$_i$=client_recv_time$_i$-server_send_time$_i$

Delay2$_i$=server_recv_time$_i$-client_send_time$_i$

Where i=1,2,3,..n

6.Total_delay=$\sum$(Delay1$_i$+Delay2$_i$) for i=1 to n

7. The received times are recorded by the server in 'n' different files client_recv_time$_1$… client_recv_time$_n$

[IV] DISCUSSION

Speedup Performance can be increased for face recognition by parallel processing than sequential processing.

[V] CONCLUSION

The design of an efficient modular architecture for detection and recognition of faces in video streams has been presented in this paper. This paper briefly described a parallel design framework for efficient and real-time video based face recognition system. An efficient video based face recognition system has high computational cost. With our design framework, the real-time performance can be achieved on regular computers, such as those found in a student cluster

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