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Face Detection and Recognition in Video

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Abstract:

The goal of this paper is to present a critical survey of existing literatures on human face detection and recognition over the last 4-5 years. An application for automatic face detection and tracking in video streams from surveillance cameras in public or commercial places is discussed in this paper. Prototype is designed to work with web cameras for the face detection and tracking system based on Visual 2010 C# and Open CV. This system can be used for security purpose to record the visitor face as well as to detect and track the face.

Keywords:- **Face Detection, Face Recognition, Open CV, Face Tracking, Video Streams.**

I. INTRODUCTION

Human have a remarkable ability of identifying faces in a variety of poses. It is highly desirable that this ability be replicated in computers and can be utilized at the basic levels. Face detection and recognition is an application of biometrics. Face recognition is becoming an active research area in several disciplines such as image processing, pattern recognition, computer vision, neural networks, psychology and physiology. It is a dedicated process and an application of the general object recognition process.

Automatic face recognition is an attractive biometric approach, since it focuses on the same identifier to distinguish one person from another that is their faces. One of its main goal is to understanding complex human visual system and the knowledge of how humans represent faces in order to discriminate different identities with high accuracy.

Face detection and recognition from video is an application that uses new method for detecting and recognizing faces from video frames which provided from video cameras. The best result obtained by using Principal Component Analysis. In this approach the overall face detection, feature extraction and face recognition is carried out in a single step.

II. FACE DETECTION

Face detection [1] is necessary to know whether an image contains a face or not. Automatic detection of image is the first step in most atomic vision system.

Generally, automatic face detection [6] and recognition systems are comprised of three steps as shown in fig 1.

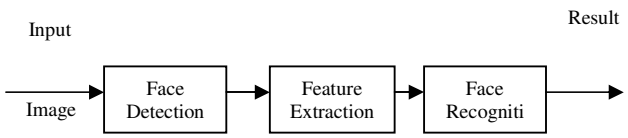

Fig1. Basic flow of Face Detection and Recognition System

It is an effective computer of a complete system and allows for both demonstration and testing in a real environment as identifying the sub-region of the image containing a face will significantly reduce the subsequent processing and allow a more specific model to be applied to the recognition task. Face detection is to locate a face in a given image and to separate it from the remaining scene. Several approaches have been proposed to fulfill the task.

A. Elliptical Structure

The elliptical structure method locates the head outline by the edge finder and then fits an ellipse to mark the boundary between the head region and the background. However, this method is applicable only to frontal views, the detection of non-frontal views needs to be investigated.

B. Face Space

In face space approach, images of faces do not change radically when projected into the face space, while projections of non face images appear quite different. This basic idea is used to detect the presence of faces in a scene. At every location in the image, calculate the distance between the local sub images and face space.

The detection uses a cascade of boosted classifiers working with Haar-like features[1] to decide whether a region of an image is a face. Haar–likes features are the input to the basic classifier. The feature used in a particular classifier is a specified by its shape, position within the region of interest and the scale.

III. FACE RECOGNITION

Face Recognition generally involves two stages: Face Detection [5], where an image is searched to find any face, then image processing cleans up the facial image for easier recognition.

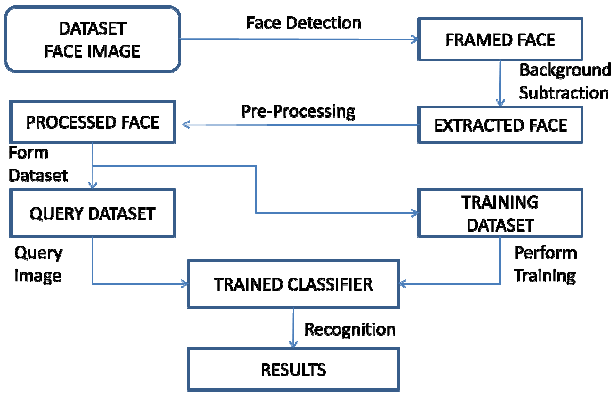

Fig 2. Block Diagram of Face Detection and Recognition System

Face Recognition [5], where that detected and processed face is compared to a database of known faces, to decide who that person is. The first stage in Face Recognition is Face detection from an Image.

The Open CV library makes it fairly easy to detect a frontal face in an image using its Haar-Cascade Face Detector. The Block diagram of a face recognition system is as shown in fig 2 [1]. Face detection systems are example of general class of pattern recognition systems require similar components to locate and normalize the face, extract a set of features and match these to a database of stored examples [5]. All faces recognition systems perform which typically places a rectangular bounding box around the face or faces in the images. This can be achieved robustly and in real time.

We can use 2D feature extraction method [4] that is Eigen faces that operate on all the image pixels in the face detected recognition. This allows the systems to better extract out the required face features and to deal with pose. There are five general phases [4] in face recognition system. The phases are:

1. Capture image
2. Detect face in image
3. Feature extraction
4. Compare with database
5. Recognize face

IV. PROPOSED SYSTEM

The system is to build that will recognize faces and highlight the detected face in video. The system should be able to identify and track the person with his name. The system should take live input from camera and should be able to detect faces, recognize them in video and compare it with the database. System should keep track of people. It should also count the people present in video. The application is based on Visual 2010 C# and Open CV.

The different modules and their working used in application are shown in above tables I, II, III.

TABLE I. FACE DETECTION MODULE

Model Name	Face Detection module
Input Given	Real Time Video Stream
Output Given	Faces in Frame
Procedure Steps	1. System takes continues video stream from camera 2. It detects human face from frame and returns its co-ordinates 3. After the co-ordinates are obtained, it performs the logical operation to get faces from images.

TABLE II. FEATURE EXTRACTION MODULE

Model Name	Face Detection module
Input Given	Set of detected Faces.
Output Given	Feature vector
Procedure Steps	1. The system takes set of detected faces 2. It Spatial Features using the Eigen faces and return the feature Vector.

TABLE III. FACE RECOGNITION MODULE

Model Name	Face Detection module
Input Given	Captured faces
Output Given	Matching Person faces
Procedure Steps	1. The System then takes in captured faces and confirms the face co-ordinates. 2. If the Captured face matches with faces in Video then they are tracked in Video.

V. PRINCIPAL COMPONENT ANALYSIS

PCA [3] is a dimensionality reduction technique based on extracting the desired number of principal component of the multidimensional data. The first principal component is the linear combination of the original dimension that has the maximum variance; the n th principal component is the linear combination with the highest variance, subject to being orthogonal to n-1 first principal component.

The basic vectors constructed by PCA had the same dimension as the input face in images; they were named "Eigenfaces". PCA is an information theory approach of coding and decoding face image may give insight into the information content of face image, emphasizing the significant local and global features. We want to extract the relevant information in a face image, encode it as a efficiently as possible and compare one face encoding with a database of models encoded similarly.

VI. EIGEN FACES

Eigen face approach [3] is one of the earliest appearance-based face recognition methods. This method utilizes the idea of the principal component analysis and decomposes face images into a small set of characteristic feature images called eigenfaces as shown in Fig 3 [7]. There are a variety of approaches for face representation, which can be classified into three categories: template-based, feature-based, and appearance-based.

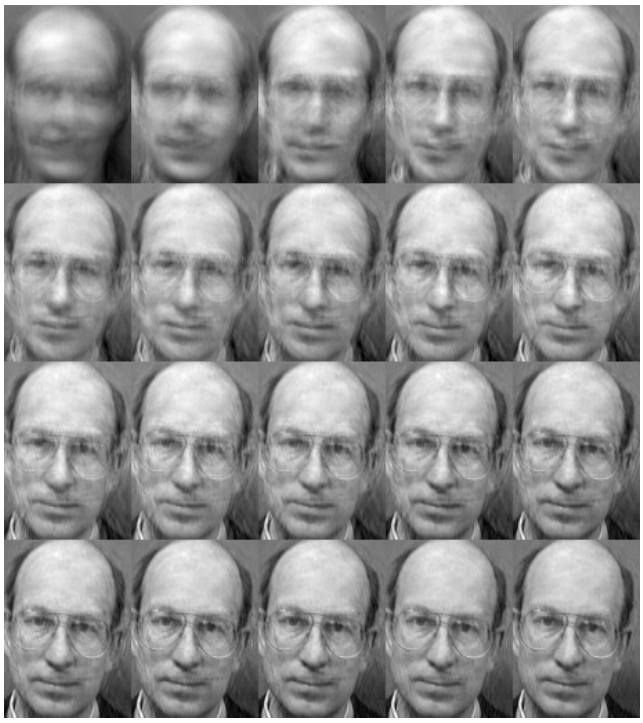

Fig 3. Eigen Faces

A. Template-Matching

The simplest template-matching [2] approaches represent a whole face using a single template, that is, a 2-D array of intensity, which is usually an edge map of the original face image. The advantage of template-matching [3] is the simplicity; however, it suffers from large memory requirement and inefficient matching.

B. Appearance-Based

In appearance-based [2] approach the face images are project onto a linear subspace of low dimensions. Such a subspace is first constructed by principal component analysis on a set of training images, with eigenfaces as its eigenvectors. Now, the concepts of eigenfaces were extended to Eigen features, such as Eigen eyes, Eigen mouth etc. for the Detection [3] of facial features.

C. Feature-Based

In feature-based [2] approaches, geometric features, such as position and width of eyes, nose, and mouth, eyebrow's thickness and arches, face breadth, or invariant moments, are extracted to represent a face. Feature-based [3] approaches have smaller memory requirement and a higher recognition speed than template-based approach.

VII. OPEN CV

Open CV (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real time computer vision. It is free for use under the open source BSD license. The library is cross-platform. It focuses mainly in real-time image processing. If the library finds Intel's Integrated Performance Primitives on the system , it will use these proprietary optimized routines to accelerate itself. The library was originally written in C and this C interface makes Open CV portable to some specific platform such as digital signal processors. Wrappers for languages such as C#, Python, Rubyand Java (using Java CV) have been developed to encourage adoption by a wider audience.

However, since version 2.0, Open CV includes both its traditional C interface as well as a new C++ interface. This new interface seeks to reduce the number of lines of code necessary to code up vision functionality as well as reduce common programming errors such as memory leaks that can arise when using Open CV in C. Most of the new developments and algorithms in Open CV are now developed in the C++ interface. Unfortunately, it is much more difficult to provide wrapper in a other language to C++ code as opposed to C code; therefore the other language wrappers are generally lacking some of the newer Open CV 2.0 features.

Emgu CV is a cross platform .Net wrapper to the Intel Open CV image processing library. Allowing Open CV functions to be called from .NET compatible languages such as C#, VB, VC++, Python etc. Emgu CV has two layers of wrapper:

- Layer 1: The basic layer contains function, structure and enumeration mappings which directly reflect those in Open CV.
- Layer 2: The second layer contains classes that mix in advantages from the .NET world.

The CvInvoke class (Emgu.CV.CvInvoke) provides a way to directly invoke Open CV within .NET languages. Each method in this class corresponds to a function in Open CV of the same name. Emgu CV also borrows some existing structures in .NET to represents structures in Open CV.

VIII. ADVANTAGES

1. It enables real time detection of person's in video.
2. It provides advanced query to detect person in video.
3. It provides a multiple face detection and recognition in a video.
4. Processing time is comparatively fast.

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