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A Novel Approach for Developed Face Recognition System using Neural Network

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Abstract

The face is one of the easiest ways to distinguish the individual identity of each other. Face recognition is a personal identification system that uses personal characteristics of a person to identify the person's identity. Human face recognition procedure basically consists of two phases, namely face detection, where this process takes place very rapidly in humans, except under conditions where the object is located at a short distance away, the next is the introduction, which recognize a face as individuals. Stage is then replicated and developed as a model for facial image recognition (face recognition) is one of the much-studied biometrics technologies and developed by experts. There are two kinds of methods that are currently popular in developed face recognition pattern namely, Eigen face method and Fisher face method. Facial image recognition Eigen face method is based on the reduction of face-dimensional space using Principal Component Analysis (PCA) for facial features. The main purpose of the use of PCA on face recognition using Eigen faces was formed (face space) by finding the eigenvector corresponding to the largest eigenvalue of the face image. The area of this project face detection system with face recognition is Image processing. Face detection involves separating image windows into two classes; one containing faces (turning the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin color and facial expression. The problem is further complicated by differing lighting conditions, image qualities and

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Vol-21-Issue-1-January-March-2018

geometries, as well as the possibility of partial occlusion and disguise.

Keywords: face detection, Eigen face, PCA, mat lab

Introduction

Face recognition is the task of identifying an already detected object as a known or unknown face. Often the problem of face recognition is confused with the problem of face detection Face Recognition on the other hand is to decide if the "face" is someone known, or unknown, using for this purpose a database of faces in order to validate this input face.

1.1 Face Recognition:

Different Approaches of Face Recognition:

There are two predominant approaches to the face recognition problem: Geometric (feature based) and photometric (view based). As researcher interest in face recognition continued, many different algorithms were developed, three of which have been well studied in face recognition literature.

Recognition algorithms can be divided into two main approaches:

1. **Geometric:** Is based on geometrical relationship between facial landmarks, or inother words the spatial configuration of facial features. That means that the main geometrical features of the face such as the eyes, nose and mouth are first located and then faces are classified on the basis of various geometrical distances and angles between features. (Figure 3)
2. **Photometric stereo:** Used to recover the shape of an object from a number ofimages taken under different lighting conditions. The shape of the recovered object is defined by a gradient map, which is made up of an array of surface normals (Zhao and Chellappa, 2006) (Figure 2)

   Popular recognition algorithms include:

   1. Principal Component Analysis using Eigen faces, (PCA)
   2. Linear Discriminate Analysis,
   3. Elastic Bunch Graph Matching using the Fisher face algorithm,

2 Literature Review

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Vol-21-Issue-1-January-March-2018

Face detection is a computer technology that determines the location and size of human face in arbitrary (digital) image. The facial features are detected and any other objects like trees, buildings and bodies etc are ignored from the digital image. It can be regarded as a ‗specific' case of object-class detection, where the task is finding the location and sizes of all objects in an image that belong to a given class. Face detection, can be regarded as a more ‗general' case of face localization. In face localization, the task is to find the locations and sizes of a known number of faces (usually one). Basically there are two types of approaches to detect facial part in the given image i.e. feature base and image base approach. Feature base approach tries to extract features of the image and match it against the knowledge of the face features.

2.1Feature Base Approach:

Active Shape Model Active shape models focus on complex non-rigid features like actual physical and higher level appearance of features Means that Active Shape Models (ASMs) are aimed at automatically locating landmark points that define the shape of any statistically modeled
object in an image. When of facial features such as the eyes, lips, nose, mouth and eyebrows. The training stage of an ASM involves the building of a statistical

facial model from a training set containing images with manually annotated landmarks. ASMs is classified into three groups i.e. snakes, PDM, Deformable templates

1.1)Snakes: The first type uses a generic active contour called snakes, first introduced by Kass et al. in 1987 Snakes are used to identify head boundaries [8,9,10,11,12]. In order to achieve the task, a snake is first initialized at the proximity around a head boundary. It then locks onto nearby edges and subsequently assume the shape of the head. The evolution of a snake is achieved by minimizing an energy function, Snake (analogy with physical systems), denoted as snake = Internal + ExternalWhere internal and External are internal and external energy functions. Internal energy is the part that depends on the intrinsic properties of the snake and defines its natural evolution. The typical natural evolution in snakes is shrinking or expanding. The external energy counteracts the internal energy and enables the contours to deviate from the natural evolution and eventually assume the shape of nearby features—the head boundary at a state of equilibria.Two main consideration for forming snakes i.e. selection of energy terms and energy minimization. Elastic energy is used commonly as internal energy. Internal energy is vary with the distance between

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Vol-21-Issue-1-January-March-2018

control points on the snake, through which we get contour an elastic-band characteristic that causes it to shrink or expand. On other side external energy relay on image features. Energy minimization process is done by optimization techniques such as the steepest gradient descent. Which needs highest computations. Huang and Chen and Lam and Yan both employ fast iteration methods by greedy algorithms. Snakes have some demerits like contour often becomes trapped onto false image features and another one is that snakes are not suitable in extracting non convex features.

2.2 Constellation Method

All methods discussed so far are able to track faces but still some issue like locating faces of various poses in complex background is truly difficult. To reduce this difficulty investigator form a group of facial features in face-like constellations using more robust modeling approaches such as statistical analysis. Various types of face constellations have been proposed by Burl et al. . They establish use of statistical shape theory on the features detected from a multistate Gaussian derivative filter. Huang et al. also apply a Gaussian filter for pre-processing in a framework based on image feature analysis. Image Base Approach.

2.3 Neural Network

Neural networks gaining much more attention in many pattern recognition problems, such as OCR, object recognition, and autonomous robot driving. Since face detection can be treated asa two class pattern recognition problem, various neural network algorithms have been proposed. The advantage of using neural networks for face

detection is the feasibility of training a system to capture the complex class conditional density of face patterns. However, one demerit is that the network architecture has to be extensively tuned (number of layers, number of nodes, learning rates, etc.) to get exceptional performance. In early days most hierarchical neural network was proposed by Agui et al. [43]. The first stage having two parallelsub networks in which the inputs are filtered intensity values from an original image. The inputs to the second stage network consist of the outputs from the sub networks and extracted feature values. An output at the second stage shows the presence of a face in the inputregion.Propp and Samal developed one of the earliest neural networks for face detection [4]. Their network consists of four layers with 1,024 input units, 256 units in the first hidden layer, eight units in the second hidden layer, and two outputunits.Feraud and Bernier presented a detection method using

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Vol-21-Issue-1-January-March-2018

auto associative neural networks [15], [18], [7]. The idea is based on [12] which shows an auto associative network with five layers is able to perform a nonlinear principal component analysis. One auto associative network is used to detect frontal-view faces and another one is used to detect faces turned up to 60 degrees to the left and right of the frontal view. After that Lin et al. presented a face detection system using probabilistic decision-based neural network (PDBNN) [20]. The architecture of PDBNN is similar to a radial basis function (RBF) network with modified learning rules and probabilistic interpretation.

3 PROBLEM STATEMENT & METHODOLOGY:

The aim of this research is to present and identify design and develop efficient face recognition system in MATLAB

- To design a new model for an ideal facial recognition system.
- To enhance the model for a high-speed facial recognition system.
- To develop a program based on the designed model in MATLAB.
- To create a database of face images.
- To test and validate the facial recognition system.

To perform tests for program optimization and accuracy.

Face recognition has become a popular and useful area of research in computer vision from last one or two decades, mainly due to increasing security demands and its commercial and potential and law enforcement applications in various fields. After a extensive research of 40 year still face recognition is a very challenging problem and up to date and there is no technique that provides a robust solution to all situations and different applications that face recognition may encounter. This dissertation focuses on developing a technique that provides a solution for an efficient high-speed face recognition system in different applications.

All these biometric technologies stated above cannot be work in environment where human interaction is low with security system. They work best in high security applications where human interaction is present but actually they are the opposite of what is required when building a store that recognizing its customers or we can say best customers, or a house that knows the persons who live there. A well-known biometric technique is face recognition which is non-intrusive and highly useful for human surveillance. It would allow user to be identified by simply walking past a surveillance camera. Facial recognition technology is one of the fastest

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Vol-21-Issue-1-January-March-2018

growing fields in the biometric industry, is being used to improve human efficiency when recognizing faces. Interest in facial recognition is being fueled by the ever-increasing number of video cameras being placed in the workspace, the availability and low cost of video hardware, and the noninvasive aspect of facial recognition systems. Although the face recognition system is still in research phase and with our dissertation we will step further in this research phase.

4. IMPLEMENTATION:

Fully automated face detection of frontal view faces is implemented using a deformable template algorithm relying on the image invariants of human faces. This was chosen because a similar neural-network based face detection model would have needed far too much training data to be implemented and would have used a great deal of computing time. The main difficulties in implementing a deformable template based technique were the creation of the bright and dark intensity sensitive templates and designing an efficient implementation of the detection algorithm.

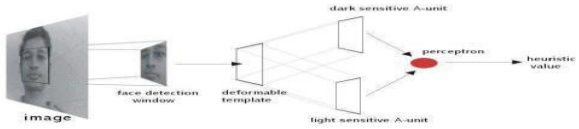

Figure 4.1 Implemented fully automated frontal view face detection model

A manual face detection system was realised by measuring the facial proportions of the average face, calculated from 30 test subjects. To detect a face, a human operator would identify the locations of the subject's eyes in an image and using the proportions of the average face, the system would segment an area from the image

A template matching based technique was implemented for face recognition. This was because of its increased recognition accuracy when compared to geometrical features based techniques and the fact that an automated geometrical features based technique would have required complex feature detection pre-processing.

Of the many possible template matching techniques, Principal Component Analysis was chosen because it has proved to be a highly robust in pattern recognition tasks and because it is

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Vol-21-Issue-1-January-March-2018

relatively simple to implement. The author would also liked to have implemented a technique based on Elastic Graphs but could not find sufficient literature about the model to implement such a system during the limited time available for this project.

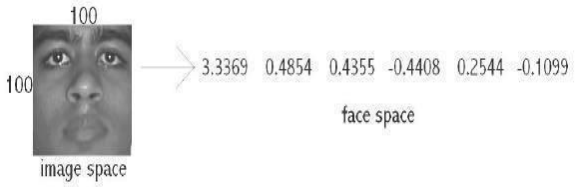

Figure 4.2: Principal Component Analysis transform from 'image space' to 'face space'. Using Principal Component Analysis, the segmented frontal view face image is

transformed from what is sometimes called 'image space' to 'face space'. All faces in the face database are transformed into face space. Then face recognition is achieved by transforming any given test image into face space and comparing it with the training set vectors. The closest matching training set vector should belong to the same individual as the test image. Principal Component Analysis is of special interest because the transformation to face space is based on the variation of human faces (in the training set). The values of the 'face space' vector correspond to the amount certain 'variations' are present in the test image

Face recognition and detection system is a pattern recognition approach for personal identification purposes in addition to other biometric approaches such as fingerprint recognition, signature, retina and so forth. Face is the most common biometric used by humans applications ranges from static, mug-shot verification in a cluttered background.

5 CONCLUSIONS

The computational models, which were implemented in this project, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with manual face detection and automatic face recognition did not have recognition accuracy over 90%, due to the limited number of Eigen faces that were used for the PCA transform. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate. The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's

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Vol-21-Issue-1-January-March-2018

opinion further work need not be conducted in this area. The fully automated face detection and recognition system was not robust enough to achieve a high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale rotation or shift errors of the segmented face image. This was one of the system requirements identified in section 2.3. However, if some sort of further processing, such as an eye detection technique, was implemented to further normalize the segmented face image, performance will increase to levels comparable to the manual face detection and recognition system. Implementing an eye detection technique would be a minor extension to the implemented system and would not require a great deal of additional research. All other implemented systems displayed commendable results and reflect well on the deformable template and Principal Component Analysis strategies. The most suitable real-world applications for face detection and recognition systems are for mug shot matching and surveillance. There are better techniques such as iris or retina recognition and face recognition using the thermal spectrum for user access and user verification applications since these need a very high degree of accuracy. The real-time automated pose invariant face detection and recognition system proposed in chapter seven would be ideal for crowd surveillance applications. If such a system were widely implemented its potential for locating and tracking suspects for law enforcement agencies is immense.

The implemented fully automated face detection and recognition system (with an eye detection system) could be used for simple surveillance applications such as ATM user security, while the implemented manual face detection and automated recognition system is ideal of mug shot matching. Since controlled conditions are present when mug shots are gathered, the frontal view face recognition scheme should display recognition accuracy far better than the results, which were obtained in this study, which was conducted under adverse conditions.

Furthermore, many of the test subjects did not present an expressionless, frontal view to the system. They would probably be more compliant when a 6'5" policeman is taking their mugshot! In mugshot matching applications, perfect recognition accuracy or an exact match is not a requirement. If a face recognition system can reduce the number of images that a human operator has to search through for a match from 10000 to even a 100, it would be of incredible practical use in law enforcement.

The automated vision systems implemented in this thesis did not even approach the

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Vol-21-Issue-1-January-March-2018

performance, nor were they as robust as a human's innate face recognition system. However, they give an insight into what the future may hold in computer vision.

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Vol-21-Issue-1-January-March-2018

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