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Classroom Attendance using Face Detection and Facial Organs

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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 technology and developed by experts. There are two kinds of methods that are currently popular in developed face recognition pattern namely, Eigenface method and Fisherface method. Facial image recognition Eigenface 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. The software requirements for this project is matlab software*

Keywords: face detection, Eigen face, PCA, matlab

I. 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.

II. FACE RECOGNIZATION

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:

Geometric: is based on geometrical relationship between facial landmarks, or in other 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)

Photometric stereo: used to recover the shape of an object from a number of images 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 eigenfaces, (pca)
2. Linear discriminate analysis,
3. Elastic bunch graph matching using the fisherface algorithm,

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2.1 Face Detection

Face detection involves separating image windows into two classes; one containing faces (taming the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin colour and facial expression. The problem is further complicated by differing lighting conditions, image qualities and geometries, as well as the possibility of partial occlusion and disguise. An ideal face detector would therefore be able to detect the presence of any face under any set of lighting conditions, upon any background. The face detection task can be broken down into two steps. The first step is a classification task that takes some arbitrary image as input and outputs a binary value of yes or no, indicating whether there are any faces present in the image. The second step is the face localization task that aims to take an image as input and output the location of any face or faces within that image as some bounding box with (x, y, width, height).

The face detection system can be divided into the following steps:-

- Pre-processing: to reduce the variability in the faces, the images are processed before they are fed into the network. All positive examples that is the face images are obtained by cropping
- Images with frontal faces to include only the front view. All the cropped images are then corrected for lighting through standard algorithms.
- Classification: neural networks are implemented to classify the images as faces or nonfaces by training on these examples. We use both our implementation of the neural network and the matlab neural network toolbox for this task. Different network configurations are experimented with to optimize the results
- Localization: the trained neural network is then used to search for faces in an image and if present localize them in a bounding box. Various feature of face on which the work has done on:• position scale orientation illumination

III. LITERATURE SURVEY

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. While image base approach tries to get best match between training and testing images.

IV. DIGITAL IMAGE PROCESSING

Interest in digital image processing methods stems from two principal application areas:

1. Improvement of pictorial information for human interpretation
2. Processing of scene data for autonomous machine perception

In this second application area, interest focuses on procedures for extracting image information in a form suitable for computer processing.

Examples includes automatic character recognition, industrial machine vision for product assembly and inspection, military recognizance, automatic processing of fingerprints etc.

Image: Am image refers a 2d light intensity function f(x, y), where(x, y) denotes spatial coordinates and the value off at any point (x, y) is proportional to the brightness or gray levels of the image at that point. A digital image is an image f(x, y) that has been discretized both in spatial coordinates and brightness. The elements of such a digital array are called image elements or pixels.

V. FUNDAMENTAL STEPS IN IMAGE PROCESSING

Fundamental steps in image processing are

1. Image acquisition: to acquire a digital image

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2. Image pre-processing: to improve the image in ways that increases the chances for success of the other processes.
3. Image segmentation: to partitions an input image into its constituent parts of objects.
4. Image segmentation: to convert the input data to a from suitable for computer processing.
5. Image description: to extract the features that result in some quantitative information of interest of features that are basic for differentiating one class of objects from another.
6. Image recognition: to assign a label to an object based on the information provided by its description.

5.1 Face Detection Process

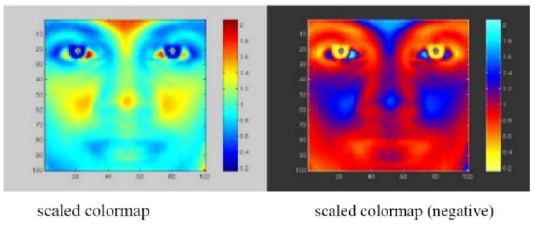

Fig 5.1 face detection

It is process of identifying different parts of human faces like eyes, nose, mouth, etc ... This process can be achieved by using matlab codeln this project the author will attempt to detect faces in still images by using image invariants. To do this it would be useful to study the grey-scale intensity distribution of an average human face. The following 'average human face' was constructed from a sample of 30 frontal view human faces, of which 12 were from females and 18 from males. A suitably scaled colormap has been used to highlight grey-scale intensity differences. Caled colormap

5.2 Face recognition using geometrical features

This technique involves computation of a set of geometrical features such as nose width and length, mouth position and chin shape, etc. From the picture of the face we want to recognize. This set of features is then matched with the features of known individuals. A suitable metric such as euclidean distance (finding the closest vector) can be used to find the closest match. Most pioneering work in face recognition was done using geometric features (kanade, 1973), although craw et al. (1987) did relatively recent work in this area.

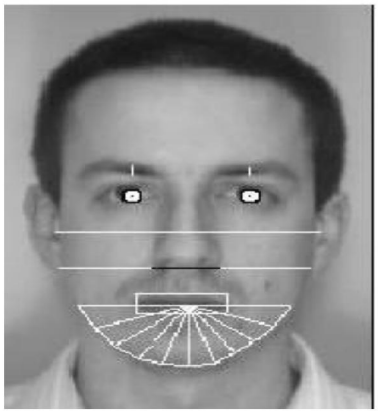

Figure 5.2 geometrical features (white) which could be used for face recognition

The advantage of using geometrical features as a basis for face recognition is that recognition is possible even at very low resolutions and with noisy images (images with many disorderly pixel intensities). Although the face cannot be viewed in detail its overall geometrical configuration can be extracted for face recognition. The technique's main disadvantage is that automated extraction of the facial geometrical features is very hard. Automated geometrical feature extraction based recognition is also very sensitive to the scaling and rotation of a face in the image plane (brunelli and poggio, 1993). This is apparent when we examine kanade's(1973) results where he reported a recognition rate of

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between 45-75 % with a database of only 20 people. However if these features are extracted manually as in goldstein et al. (1971), and kaya and kobayashi (1972) satisfactory results may be obtained.

5.3 Face recognition using template matching

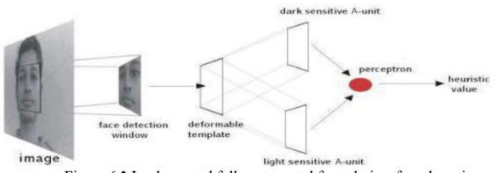
This is similar the template matching technique used in face detection, except here we are not trying to classify an image as a 'face' or 'non-face' but are trying to recognize a face.

Figure 5.3 face recognition using template matching

Whole face, eyes, nose and mouth regions which could be used in a template matching strategy.the basis of the template matching strategy is to extract whole facial regions (matrix of pixels) and compare these with the stored images of known individuals. Once again euclidean distance can be used to find the closest match. The simple technique of comparing grey-scale intensity values for face recognition was used by baron (1981). However there are far more sophisticated methods of template matching for face recognition. These involve extensive pre• processing and transformation of the extracted grey-level intensity values. For example, turk and pentland (1991a) used principal component analysis, sometimes known as the eigenfaces approach, to pre-process the gray-levels and wiskott et al. (1997) used elastic graphs encoded using gabor filters to pre-process the extracted regions. An investigation of geometrical features versus template matching for face recognition by brunelli and poggio (1993) came to the conclusion that although a feature based strategy may offer higher recognition speed and smaller memory requirements, template based techniques offer superior recognition accuracy.

VI. OUTLINE OF THE IMPLEMENTED SYSTEM

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.



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 relatively simple to implement. The author would also

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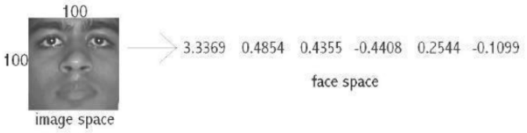
liked to have implemented a technique based on elastic graphs but could not find sufficient literature about the model to implement such a system during the limited time available for this project.

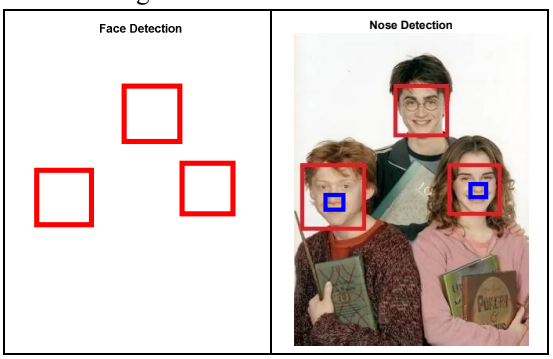
6.1 Using principal component analysis, the segmented frontal view face image is

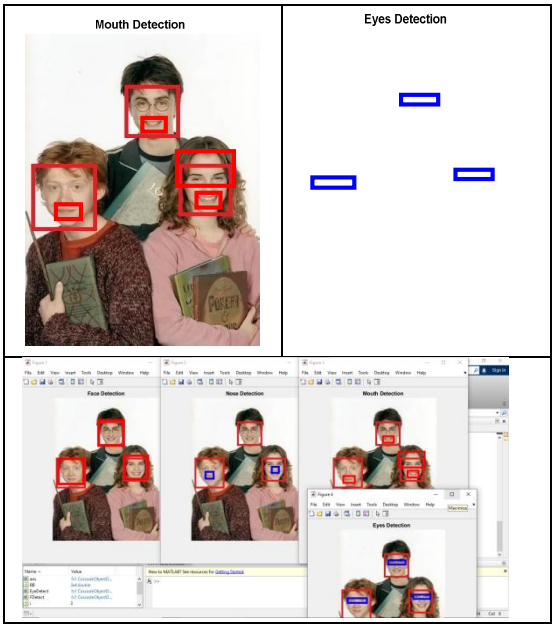
Transformed from what is sometimes called 'image space' to 'face space'. All faces in the face database are transformed into face space. Then face recognition is achieved by transforming any given test image into face space and comparing it with the training set vectors. The closest matching training 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



VII. RESULTS AND DISCUSSION

The following are the results obtained after the processing of the images. The first result shows the detection of faces. The second image shows the detection of nose in image. The 3rd showing the detection of mouth. The 4th image shows the detection of eyes. This algorithm is capable of detecting multiple faces in a single image. In a single image, multiple features of multiple people can be extracted. Figure ex shows the results obtained.





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VIII. CONCLUSION

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 a recognition accuracy over 90%, due to the limited number of eigenfaces 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 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 normalise 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 mugshot 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 mugshot matching. Since controlled conditions are present when mugshots are gathered, the frontal view face recognition scheme should display a 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 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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