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SKIN DETECTION AND FACE RECOGNITION USING PRINCIPAL COMPONENT ANALYSIS (PCA)

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ABSTRACT

Computer vision is a part of everyday life. One of the most important goals of computer vision is to achieve visual recognition ability comparable to that of human. Object detection has been a focus of research in human- computer interaction. Skin detection is the process of finding skin-colored pixels and regions in an image or a video.

I. INTRODUCTION

Computer vision is a part of everyday life. One of the most important goals of computer vision is to achieve visual recognition ability comparable to that of human**.** Face recognition has long been a goal of computer vision, but only in recent years reliable automated face recognition has become a realistic target of biometrics research

Object detection has been a focus of research in human- computer interaction. Skin area detection has been a key to different recognitions like face recognition, human motion detection, pornographic and nude image prediction**.**

Skin detection is the process of finding skin-colored pixels and regions in an image or a video. This process is typically used as a preprocessing step to find regions that potentially have human faces and limbs in images.

Several computer vision approaches have been developed for skin detection. A skin detector typically transforms a given pixel into an appropriate color space and then use a skin classifier to label the pixel whether it is a skin or a non-skin pixel. A skin classifier defines a decision boundary of the skin color class in the color space based on a training database of skin-colored pixels.

Face recognition has been used primitively in a wide variety of human-related image processing systems such as face recognition, lip reading, hand recognition, tracking and anti-spam system. Nowadays, these applications are classified as security applications for they are very important to human life. Face recognition as a biometric derives a number of advantages from being the primary biometric that humans use to recognize one another. Some of the earliest identification tokens, *i.e.* portraits, use this biometric as an authentication pattern. Furthermore it is well-accepted and easily understood by people, and it is easy for a human operator to arbitrate machine decisions in fact face images are often used as a human-verifiable backup to automated fingerprint recognition systems.

II. SKIN DETECTION

Skin detection plays an important role in tracking people, filtering out adult web images, and facilitating Human Computer Interaction. Recognition of human skin is an important task for both computer vision and graphics. For computer vision, accurate recognition of skin texture can greatly assist algorithms for human face recognition or facial feature tracking. In computer graphics, facial animation is an important problem which necessitates reliable skin texture recognition. In addition to computer vision and graphics, skin recognition is useful in dermatology and several industrial fields. In dermatology, the skin recognition can be used to develop methods for computer-assisted diagnosis of skin disorders, while in the pharmaceutical industry; quantification is useful when applied to measuring healing progress**.**

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III. FACE RECOGNITION

The problem of face recognition can be stated as 'identifying an individual from images of the face' and encompasses a number of variations other than the most familiar application of mug shot identification.**[1]** Face recognition is carried out by comparing selected facial features against a facial database. Over many other biometric systems , it has the benefits of being a passive and non-intrusive system.

What is Face Recognition?

A set of two task:

- Face Identification: Given a face image that belongs to a person in a database, tell whose image it is.
- Face Verification: Given a face image that might not belong to the database, verify whether it is from the person it is claimed to be in the database.

Face recognition has the advantage over other major biometrics, in that everyone has a face and everyone readily displays the face. Uniqueness, another desirable characteristic for a biometric, is hard to claim at current levels of accuracy [2]. The automatic recognition of human faces spans a variety of different technologies. At a highest level, the technologies are best distinguished by the input medium that is used, whether visible light, infra-red [1], [3] or 3-dimensional data [4] from stereo or other range-finding technologies.

Facial recognition records the spatial geometry of distinguishing features of the face. Different vendors use different methods of facial recognition, however, all focus on measures of key features of the face. Because a person's face can be captured by a camera from some distance away, facial recognition has a clandestine or covert capability (i.e. the subject does not necessarily know he has been observed). For this reason, facial recognition has been used in projects to identify card counters or other undesirables in casinos, shoplifters in stores, criminals and terrorists in urban areas

IV. APPLICATION OF FACE RECOGNITION

Many applications for face recognition have been envisaged. Some popular application domain of face recognition are Access Control, Identification Systems, Surveillance, Pervasive Computing [5]. Figure (1) shows the application of face recognition.

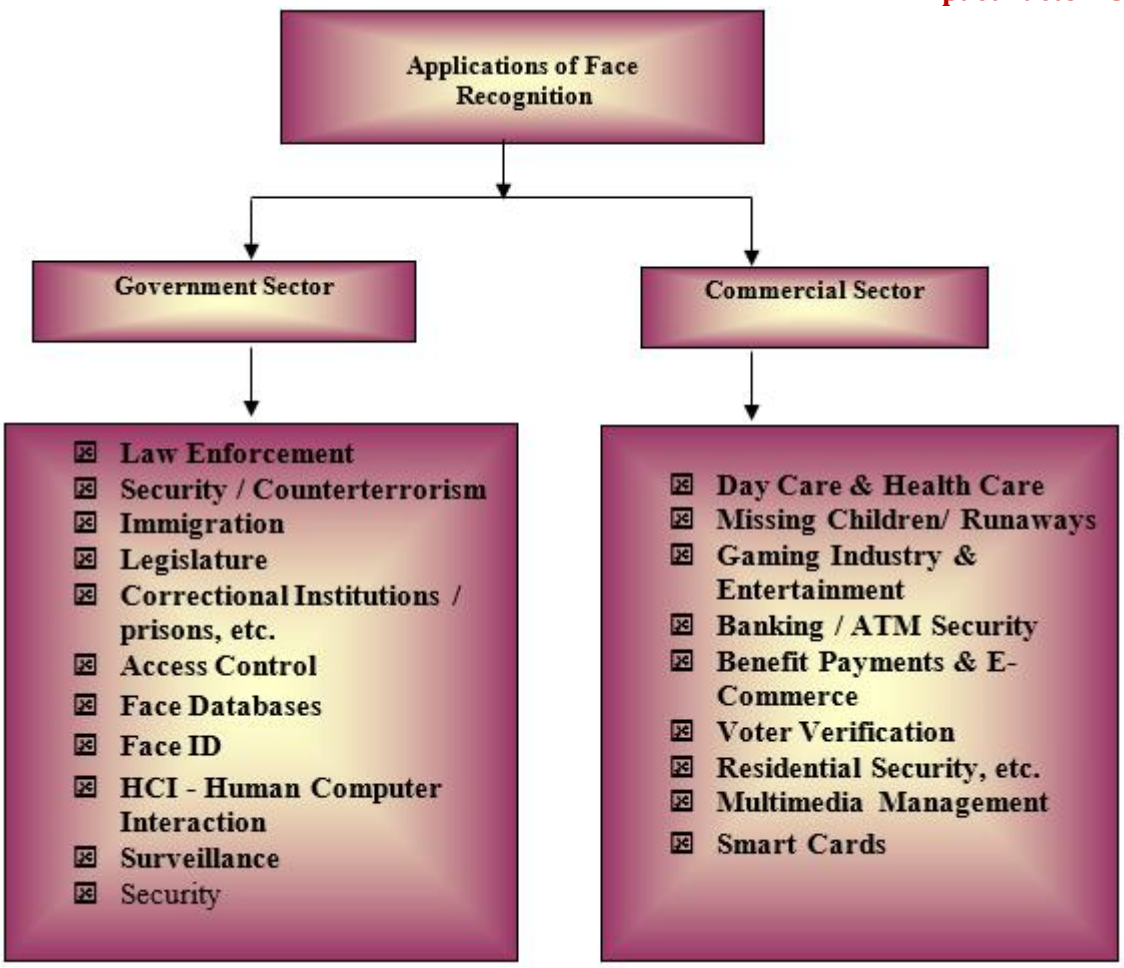

Figure (1): Applications of Face Recognition.

V. CHALLENGES OF FACE RECOGNITION

The great challenge for the face detection problem is the large number of factors that govern the problem space. The long list of these factors include the pose, orientation, facial expressions, facial sizes found in the image, luminance conditions, occlusion, structural components, gender, ethnicity of the subject, the scene and complexity of image's background. The scene in which the face is placed ranges from a simple uniform background to highly complex backgrounds. In the latter case it is obviously more difficult to detect a face. Faces appear totally different under different lighting conditions. Not only do different persons have different sized faces, faces closer to the camera appear larger than faces that are far away from the camera**.**

1. Face Detection

Face detection is a computer technology that determines the locations and sizes of human faces in arbitrary (digital) images. It detects facial features and ignores anything else, such as buildings, trees and bodies. Figure (2) shows faces extracted from an image.

Figure (2): Extracting Faces from an Image

It is principal step in face recognition task.

2. Face Recognition Task

Out Lines of the System

Here, the design and implementation of the face recognition system (FRS) can be sub divided into two main parts. The first part is perform various facial feature extraction from face images, and the second part is the recognition task performed by principal component analysis.

The basic knowledge of the topic assumed:
Two types of images were obtained by digital camera and treated by many computer applications such as (Windows Paint Brush) and (Microsoft Office Picture Management) in order to resize and rotate the images to make the testing and training sets.

Two types of images were used in the experiment:

- Black and white images.
- Color images.

Applied in windows XP using MATLAB 2008a program.

The basic goal is to study, implement, train and test program in order to perform the face recognition from the input image.

The first stage in face recognition is to perform skin detection. Skin detection can be performed in a number of color models such as RGB, YCbCr, HSV, YIQ,… etc.

An efficient skin detection algorithm is one which be able to cover all the skin colors like black, brown, white, …etc., and should account for varying lighting conditions. My experiment used the RGB color model and black and white images to find the robust skin color model.

According to the work requirement, the image to be scaled to the size 200 ×200 pixels with the face centered, and the algorithm can be applied to the color images as well as black and white.

3. Face Detection Algorithm

Training Data Set

For each face and non face image:

- ☒ Subtract out an application of the shading place to correct for single light source effect.
- ☒ Aggregate data into data set.

Facial Feature Extraction

In this part performing of facial features extraction from face image using principal component analysis (PCA) Facial feature extraction consists of localizing the most characteristics face components (eyes, noise, mouth, …etc) within images that depict human face. This step is essential for face recognition.

Face Landmarks

Facial features can be extracted according to various face landmarks on human face . Every face has numerous distinguishable landmarks. It is defined as nodal points :

- Distance between the eyes.
- Width of the nose.
- Depth of the eye sockets.
- The shape of the cheekbones.
- The length of the jaw line.
- Height & Width of forehead and total face.
- Lip height.
- Lip width.
- Distance between nose & mouth.
- Face skin marks, etc.[5]

As shown in figure [3]

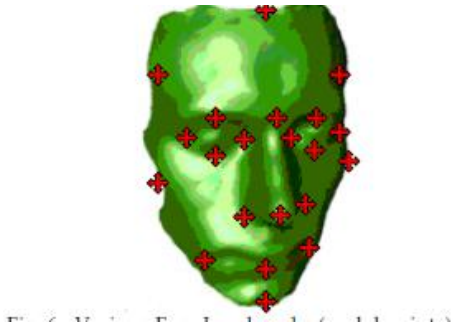

Figure (3) : Landmarks of the Human Face

The (PCA) technique used to simplify dataset into lower dimension while training the dataset.

We can use preprocessing for:

- To reduce noise and possible convolute effects of interfering system.
- To transform the image into a different space , where classification may performed easier by exploration of certain features.

The Proposed Algorithm

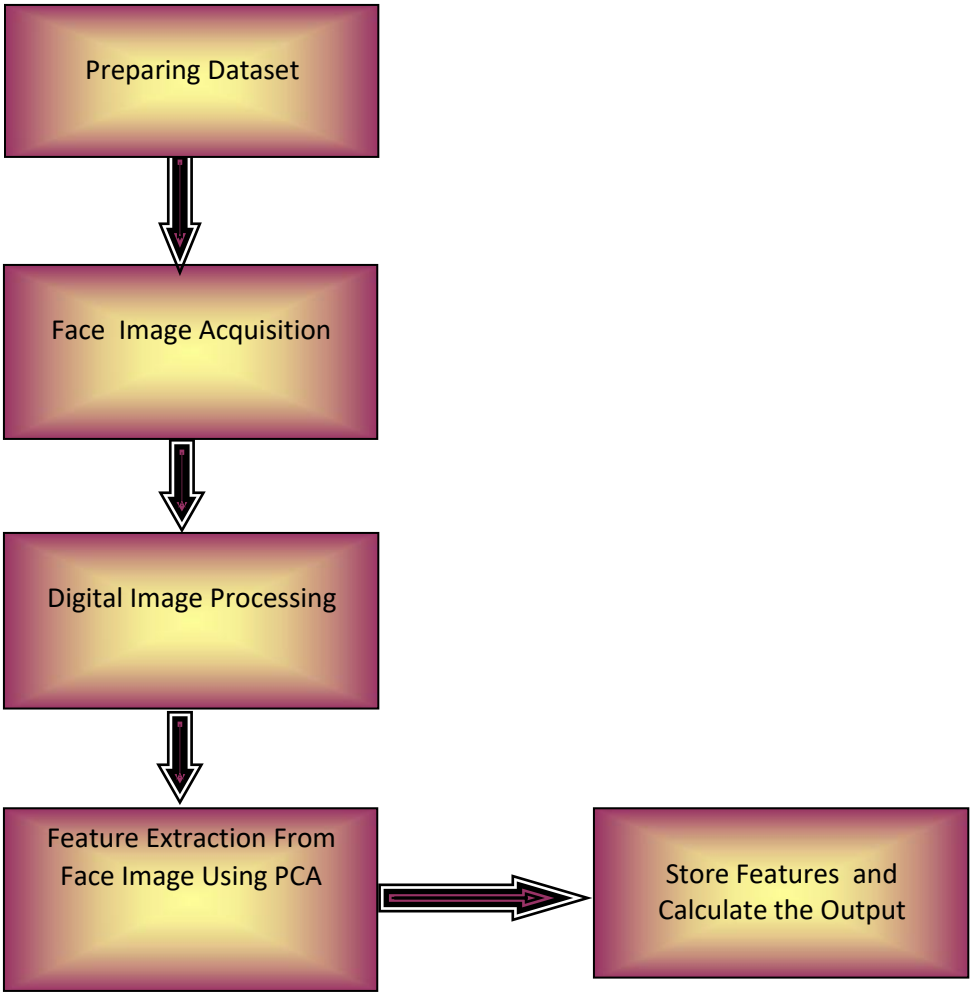

Figure (4): Outline of Proposed Algorithm

VI. EXPERIMENTS AND RESULTS

The program performs the task of face recognition successfully. Here is the original image used in the program and the results of the algorithm, where the images used in the experiment are color image and black and white :
figure (5) shows the original color image in part (a), and the result of the algorithm which is the recognized face in part (b).


Figure (5) (a): The Original *(b):The detected Face*


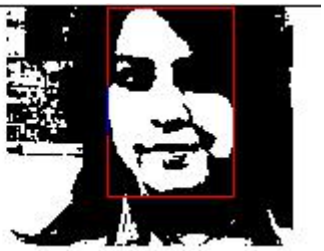

Figure (6): (a): The Original *(b):The recognized Face*

Figure (6) shows the original black and white image in part (a), and the result of the algorithm which is the recognized face in part (b).


Figure (7): (a): The Original *(b):The recognized Face*

figure (7) shows the original of another color image in part (a), and the result of the algorithm which is the recognized face in part (b).

figure (8) shows the original another black and white image in part (a), and the result of the algorithm which is the recognized face in part (b).

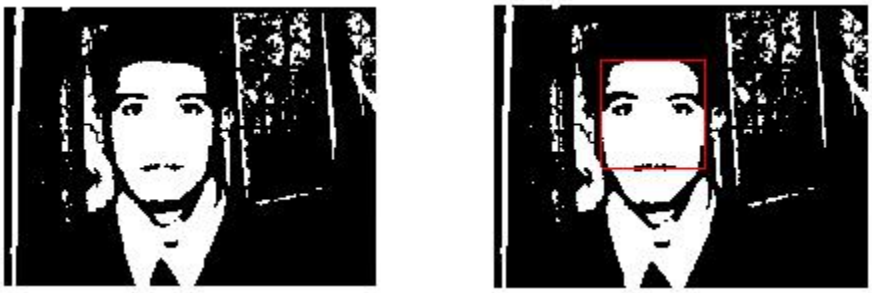

Figure (8): (a): The Original ***(b):The recognized Face***

VII. CONCLUSION

A (PCA) technique is chosen for implementing a face recognition system to recognize human face images with different conditions of illumination and different models of input coding.

The algorithm performs the task of face recognition successfully, it promise a good results in future if we use some extra feature extractors such as backprobagation neural networks or other techniques in the future works in order to improve the recognition of faces.

VIII. SUGGESTIONS FOR FUTURE WORK:

1. Using techniques of image processing such as image segmentation , edge detection , and Histogram Equalization can facilitate the task face recognition, and improve the performance of the recognizer.
2. Extra feature extractors can be combined with (PCA) such as BPNN technique
3. Many types of input models such as gray scales images can be used.
4. Several color models can be used, and a comparison between the results can be made.

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