Facial Expressions Techniques using Image Processing

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Abstract—Facial expression, a new thing that has been recently added to the problem of face recognition, poses interesting theoretical and practical challenges to the research field. This common interest from all research working in this field is motivated by remarkable ability to recognize an individual and the fact that human activity is a fundamental concern both in everyday life and cyberspace. Face recognition is an important research problem spanning numerous fields and disciplines such as image processing, pattern recognition, neural networks, computer vision and computer graphics, psychology, statistics, neuroscientist, engineering, computer scientist, etc.

Keywords—Facial Expressions, Feature Extraction, Face Recognition, neural network.

I. INTRODUCTION

Human faces are considerable amount of variations with expressions. Face expressions is generally slow and irreversible process. There are some general changes when people expressions differently and expression show different expression recognition. From child birth to adulthood the changes occur in the face size. The face size changes from the child to adulthood image. The face size changes that is the shape of eyes, nose, mouth, eyebrows and lips changes from child to adulthood.

While face images have conventionally been used in identification documents such as school’s ID, national ID, passports, driver’s license, voter ID cards, etc., in recent years, face images are being increasingly used as additional means of authentication in applications such as credit/debit cards and in places of high security. Since faces images experience gradual variations due to expressions, sporadically updating face databases with more recent images of subjects might be necessary for the success of face recognition systems. Since sporadically updating such large databases would be a dreary task, a better alternative would be to develop face recognition systems that verify the identity of individuals from a pair of age separated face images.

II. OBJECTIVE AND APPLICATIONS

The main objective of this investigation is to identify an individual from ageing images that are stored in a database and to define bio-metric templates containing discriminatory features that are least affected by with-in person types of variations in order to enable accurate identity verification. The specific objectives are:

- To employ Bayesian classifier decision making in the image recognition.
- To use preprocessing techniques such as noise reduction in order to enhance the image of the individual.
- To investigate the ageing on different facial component and categories using a component based face representation and matching algorithm.
- To predict the performance of a face recognition system based on image analysis.
- To integrate the Bayes classifier and face tracking system to build a real time facial ageing recognition system.

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III. LITERATURE REVIEW

Much research has been done on the human face recognition system, and perceptual, developmental, neuro-psychological, neuro-physiological, and functional neuro-imaging studies have indicated that face recognition in primates is a specialized capacity in the ventral portions of occipito-temporal and frontal cortices and in the medial temporal lobes.

In fact, there is a condition called prosopagnosia, which is caused by brain injury, strokes or genetic factors. Suffers are unable to recognize faces while object recognition and other visual skills are largely unimpaired. Similarly there are patients with visual object agnosia, who are impaired at recognizing objects but who have normal face recognition abilities.

Also, when building artificial face recognition systems, scientists try to understand the architecture of human face recognition system. Focusing on the methodology of human face recognition system may be useful to understand the basic system. However, the human face recognition system utilizes more than that of the machine recognition system which is just 2-D data. The human face recognition system uses some data obtained from some or all of the senses; visual, auditory, tactile, etc. All these data is used either individually or collectively for storage and remembering of faces. In many cases, the surroundings also play a vital role in human face recognition system. It is difficult for a machine recognition system to handle so much data and their combinations. However, it is also tough for a human to remember many faces due to storage limitations. For a human face recognition system the important feature is its parallel processing capacity.

The issue “which features humans use for face recognition” has been studied and it has been argued that both global and local features are used for face recognition. The results indicated that it is harder for humans to recognize neither faces which they consider as neither “attractive” nor “unattractive”. Both holistic and feature information are important for the human face recognition system.

Studies suggest the possibility of global descriptions serving as a front end for better feature based perception. Chellappa et al If there are dominant features present such as big ears, a small nose, etc. holistic descriptions may not be used. Also, recent studies show that an inverted face (i.e. all the intensity values are subtracted from 255 to obtain the inverse image in the grey scale) is much harder to recognize than a normal face.

Hair, eyes, mouth, face outline have been determined to be more important than nose for perceiving and remembering faces. It has also been found that the upper part of the face is more useful than the lower part of the face for recognition. Also, aesthetic attributes (e.g. beauty, attractiveness, pleasantness, etc.) play an important role in face recognition; the more attractive the faces are easily remembered. For humans, photographic negatives of faces are difficult to recognize. But, there is not much study on why it is difficult to recognize negative images of human faces.

The statistical technique, which is used in this thesis for automated face recognition will be of special interest because it closely resembles our own innate face recognition system.

This model promises recognition accuracy far in excess of a basic template matching technique, which involves comparing raw pixel intensity values.

IV. TYPES OF FACE RECOGNITION TECHNIQUES

A. Face Recognition

Over the last few decades many techniques have been proposed for face recognition. Many of the techniques proposed during the early stages of computer vision cannot be considered successful, but almost all of the recent approaches to the face recognition problem have been creditable. According to the research by Brunelli and Poggio all approaches to human face recognition can be divided into two strategies:

- Geometrical features
- Template matching.

1) 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, although Craw did relatively recent work in this area.

2) Template Matching

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.
A simple version of template matching is that a test image represented as a two-dimensional array of intensity values is compared using a suitable metric, such as the Euclidean distance, with a single template representing the whole face. There are several other more sophisticated versions of template matching on face recognition. One can use more than one face template from different viewpoints to represent an individual’s face. The simple technique of comparing grey-scale intensity values for face recognition was used by Baron Statistical Approach.

The statistical approach to face recognition using Bayes classifier with high dimensional covariates includes template matching based on the system where training and test images are matched by measuring the correlation. In addition, statistical methods include the projection based methods such as Principal Component Analysis (PCA) approach, Linear Discriminant Analysis (LDA) approach, Independent Component Analysis (ICA) approach and Elastic Bunch Graph Matching (EBGM).

B. Face Recognition by PCA

The Eigenfaces method is one of the mostly used algorithm for face recognition system. Karhunen-Loeve is based on the eigenfaces technique in which the Principal Component Analysis (PCA) is used. The aim purpose of this method is successfully used to perform dimensionality reduction; therefore the Principal Component Analysis is described as low dimensional subspace of an image in the short period of time. This make the principal component analysis more efficient in processing time and storage. Principal Component Analysis is used by face recognition and detection as a statistical criterion for measuring the notion of “best representation of the difference between the training faces”. Mathematically, Eigenfaces are the principal components divide the face into feature vectors. The feature vector information can be obtained from covariance matrix. These Eigenvectors are used to quantify the variation between multiple faces. The faces are characterized by the linear combination of highest Eigenvectors. Each face can be considered as a linear combination of the eigenfaces. The face can be approximated by using the eigenvectors having the largest eigenvalues. The best N eigenfaces define an N dimensional space, which is called as the “face space”.

C. Face recognition by Multilinear Principal Component Analysis (MPCA)

One extension of PCA is that of applying PCA to tensors or multilinear arrays which results in a method known as multilinear principal components analysis (MPCA).

Since a face image is most naturally a multilinear array, meaning that there are two dimensions describing the location of each pixel in a face image, the idea is to determine a multilinear projection for the image, instead of forming a one-dimensional (1D) vector from the face image and finding a linear projection for the vector. It is thought that the multilinear projection will better capture the correlation between neighborhood pixels that is otherwise lost in forming a 1D vector from the image.

D. Face Recognition by Fisher face

Fisherfaces is one the most successfully widely used method for face recognition. It is based on appearance method. In 1930 R.A Fisher developed linear/fisher discriminant analysis for face recognition. It aims to find the most discriminative features maximizing the ratio of determinant of between-class variations to within-class variations. A number of LDA-based methods have been proposed in face recognition. However, due to their parameic nature which assumes that the samples satisfy normal distribution, all these methods suffer from serious performance degeneration for cases of non-normal distribution.

Fisherface is similar to Eigenface but with enhancement of better classification of different classes image. With Fisher Linear Discriminant, one can classify the training set to deal with different people and different facial expression. We have better accuracy in facial expression than Eigen face approach. Besides, Fisherface removes the first three principal components which are responsible for light intensity changes; it is more invariant to light intensity.

E. Face Recognition by Neural Network

The main objective of the neural network in the face recognition is the feasibility of training a system to capture the complex class of face patterns. To get the best performance by the neural network, it has to be extensively tuned number of layers, number of nodes, learning rates, etc. The neural networks are nonlinear in the network so it is widely used technique for face recognition. So, the feature extraction step may be more efficient than the Principal Component Analysis.

To model our way of recognizing faces is imitated somewhat by employing neural network. This is accomplished with the aim of developing recognition systems that incorporates artificial intelligence for the sake of coming up with a system that is intelligent. There have been many efforts in which in addition to the common techniques neural networks were implemented.
For example in a system was proposed that uses a combination of eigenfaces and neural network. First stated that the dimensionality of face image is reduced by the Principal component analysis (PCA) and later the recognition is done by the Back propagation Neural Network (BPNN). The disadvantage of the neural network approach is that when the number of classes increases.

F. Elastic Bunch Graph Matching

All human faces share a similar topological in structure; faces are represented as graphs, with node fiducially points (eyes, nose, etc.) and edgelabelled with 2-D distance vectors. Each node contain 40 sets of complex Gabor wavelet coefficients at different scale and orientations (phase, amplitude), called the "jets". Recognition is based on labeled graph, a labelled graph is a set of nodes connected by edge labeled as jets, and edges are labeled as distance.

G. Trace Transform

The Trace transform, a generalization of the random transform, is a new tool for image processing which be used for recognizing objects under transformation e.g. rotation, translation and scaling; to produce a trace transform one computes a function tracing lines of an image. Different trace transform be produced from an image using different trace functional (Hu L and Wei Z, 2009). Links and Bookmarks

H. Face Recognition across Age progression

Lanitis et al (2002) build ageing functions using PCA coefficient of shape and texture of faces. They further evaluated the performance for different classifiers for age estimation, including Artificial Neural Network (ANN), nearest neighbor classifier. The Active Appearance Model (AAM) method is used for the representation for the face images (used for coding face images). The quadratic function is actually a regression function. This function is used to relate the face representations to age labels and is also called as quadratic function classifier

J. Bayesian Approach

Two-dimensional face recognition suffered from pose changes, while three-dimensional approaches are with high computational complexity. Besides the improvement in recognition rate, this system reduces the misclassification that could occur in traditional single-view systems. ShinYee Tsai and Angela Chih-Wei Tang proposed a system that fuses the individual recognition results of two images of the same identity with different viewing angles based on Bayesian theory.

Bayesian approach uses the similarity of each person and is trained by determining the reliability of each identity of the two channels. Different form traditional PCA based approaches, SVM classifiers are used instead of minimum distance classifier to enhance the robustness. Experimental results show that this two-view face recognition system has achieved a higher recognition rate compared with traditional 2D single-view face recognition systems.

V. METHODOLOGY

The research methodology employed by the study to arrive at the various findings and conclusions. The chapter focuses on the data, research design and statistical framework. The aim of the proposed methodology is to provide the means of comparison of face recognition methods, not the combination of face detection and recognition. Thus the databases used is conductive for the extraction of the face from image. In addition, most theories in face recognition methodology has proved that the human face is geometrically normalized to standard size and projected pixels focus on the eye position.

The study is applied to passport photo identification task that involve 124 Ghanaians university students image pairs, where each pair is the same person taken at different years.

A. Data Acquisition

The objects image of data collection will be Frontal facial images from a labelled faces in the wild. A real time face image database is created for the purpose of benchmarking the face recognition system. Face images from a standard database which is a secondary source data will be extracted from University of Ghana Basic and Computing (UGBC directorate) and used for this study. Specifically 150 facial image will be collected from UGBC directorate with preference to universally accepted facial expression/looks. This facial image will form a standard databases available for research purposes which could be used to test the performance of face recognition system.

The collected image will be resized into a uniform dimension and captured into a face database. For the purposes of this project, the study will use two face data set. Both data sets provide ground truth information on the race and gender of subjects, and contain significant age gaps between multiple face images of a given subject. For each subject, the study will sampled two images with the desired age gap (4 year age difference). The first image of the subjects in each subset are used for training (past image) and then subjects current image will be used for evaluation.
B. Research Design

The pre-processing stages, through the feature extraction stage to the recognition stage. The database shown in the design contains the train image set which are trained per the recognition module and their corresponding information stored in memory for recognition purpose.

The unknown face shown in the design is also called the test image. This is introduced to be recognized in the database per the recognition module. The test image also is exposed to the entire recognition processes shown below and its important information kept in memory for comparison and identification.

C. Recognition Procedure

The study focused on employing Bayesian classifier recognition algorithms on a created face ageing database. The research evaluated the recognition performance of the algorithms and subsequently compared their results on the created face ageing database.

Face image data were passed to face recognition modules as input for the system. The face images passed were transformed into operationally compatible format (resizing images into uniform dimension).

The facial recognition process normally has four interrelated phases or steps. The first step is preprocessing, the second is feature extraction, and the final cumulative step is face recognition. These steps depend on each other and often use similar techniques.

D. Preprocessing

Face images analysis are pre-processed and enhanced to improve the recognition performance of the system. This is to help reduce the noise level and make the estimation process simpler and better conditioned. Based on requirement some of the following pre-processing techniques are used in the proposed face recognition system. Different types of pre-processing/adjustment techniques related to the face recognition process are explained as fallows with the help of flow chart and corresponding face images.

Face images or different candidates with different facial expressions are taken with a Canon Powershot S3 IS 6.0 megapixel digital camera in the size of 1200 × 1600 pixels (2.0megapixels). All face images taken resemble the following general features:

- Uniform illumination condition
- Light color background
- Face is upright and frontal position
- Tolerance for tilting and rotation up to 10 degree

The face image are present in the face ageing databases, considering Ghanaian Frontal View (GFV) in this database that stored and; are captured using a digital Canon camera with pixel (64* 64). The image present in the GFV databases are greyscale or color. The greyscale undergoes preprocessing using the face image, due to noise the GFV face image is converted into grey scale image. There exist two rotations are present in the grey scale image that is in and out-of-scale. To improve the accuracy of the facial component a non-reflective similarity transformation is applied to normalize each face image based in the fiducial point on the face.

Figure an image will be captured using a camera and fed as probe image to the recognition system. The images then are pre-processed to enhance its quality. The features are then extracted using suitable schemes. These features are then classified using appropriate classifying algorithm.

VI. CONCLUSION

Thus these are the different techniques which are used to analysis facial expressions and face detection or recognition effectively. This paper presents a literature survey on the various techniques involved in facial expression recognition. There are various techniques that can be used for the purpose. These methods are measured on the basis of recognition rate. Higher the recognition rate, greater the performance.

REFERENCES