GESTURE RECOGNITION TECHNIQUES ON FACE – A REVIEW

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ABSTRACT

The research in the area of gesture recognition is closely related to the social life, as faces are the accessible windows which govern our emotional and social lives and expressions of the face is basic mode of non verbal communication among people. Actually the primary goal of gestures is to identify human gestures and deploy them to convey information through machine. There is huge need of gesture due to its wide application like developing aids for the hearing impaired, enabled very young children to interest with computers, designing techniques for forensic identification, medically monitoring patients emotional states or stress levels, lie detection, communicating in video conferencing etc. Face is key element of human body, emotions on face or facial expressions are very basic thing when human communicate with each other people or when they thinks. It is challenge to computer researcher to recognize the human gesture for general life applications. Most approaches for automatic facial gesture analysis in face image sequences attempt to recognize a set of prototypic emotional facial expressions i.e. happiness, sadness, fear, surprise, anger, disgust.

Keywords
Automatic Gesture Recognition, face, emotions.

1. INTRODUCTION
We ask that authors follow some simple guidelines. In essence, we ask you to make your paper look exactly like this document. The easiest way to do this is simply to download the template, and replace the content with your own material. Gestures plays very important role in communication between humans and machines. In the present day framework of interactive, intelligent computing, an efficient human computer interaction is assuming utmost importance in our daily lives. Gesture recognition can be termed as an approach in this direction. A Gesture is structure of non-verbal communication for visible parts of body actions which corresponding the particular messages wither in place of speech. Gestures allows to humans to communicate a variety of feelings and thoughts from contempt and aggression to approval and affection. Gesture is a movement or position of the hand, arm, body, head or face that is expressive of an idea, opinion; emotion etc. gestures reflect not only emotions, but other mental activities, social interaction and physiological signals. A gesture may be perceived by the environment as a compression technique for the information to be transmitted elsewhere and subsequently reconstructed the by receiver [1].

As the technology increases day by day the gesture recognition research has tremendously increased. The primary goal of gesture recognition research is to create system which can particularly identify human gestures and use them to convey the information or for to use the device control. In gesture recognition technology, a camera reads the movements of the human body and communicates the data to a computer that uses the gestures as input to control devices or applications. Gesture recognition has wide application domains such as device controls in game playing, to easily interface with computers for the children, Directional indication through pointing, recognizing the sign language, lie detection, communicating in video conferencing, in future gesture surgeons use as a system that recognizes hand gestures as commands to control a robotic scrub burse or tell a computer to display medical images of the patient during the operation. Now a day's gesture recognition is become a very important biometric tool which works like a face, eyes, iris. Fingerprint etc...

1.1 Types of Gestures

Gestures can be static (e.g. certain pose or configuration) or dynamic (e.g. prestrike, stroke, and poststroke. Some gestures also have both static and dynamic elements, as in sign languages. Mainly the gestures are divided into three parts:

a) Hand Gesture b) Face Gesture & c) Body Gesture.

Hand Gesture: hand gestures having two types I) Single Hand Gesture (e.g. ok & beautiful sign) ii) Two Hand Gesture (e.g. Praying). Hand gesture use in recognition of hand poses, sign language. Able to children for interact with computer games etc.

Body Gesture: It is the only part where the whole part is conveying the message. It is a form of mental and physical ability of human nonverbal communication [2]. E.g. standing, sitting kneeling Anticipation, Interest Apprehension,

Face Gesture: human face having different organs with their unique specification like shaking of head, direction of eye gaze, opening mouth style, flare the nostrils, poses of surprise, happiness, disgust, fear, anger, sadness, contempt etc.

1.2 Need of Gesture Recognition

Gesture is a very important biometric tool in a day to day's research. In the virtual environment the goal is to provide natural, efficient, powerful, and flexible interaction. Gestures can meet these requirements because human gestures are natural and flexible. Devices which sense body position and a orientation, direction of gaze, speech and sound, facial expression, galvanic skin response, and other aspects of human behavior in state can be used mediate communication between the human and the environment. Combinations of communications modalities and sensing devices can produce a wide range of unimodal and multimodal interface techniques. Gesture can also in virtual environments such as smart rooms, virtual work environments, and performance spaces. In addition gesture may be perceived by the environment in order to be transmitted elsewhere. The mostly gestures used by deaf and dump people they communicate to others by the hand gestures mostly. Gestures are also used in speech also

co speech gestures are considered as an important factor for development , e.g. A child usually points out at objects before it tries to complete the words, whereas adults understand better through gestures along with speech. The human body position, configuration (angles and rotations) and movement need to be sensed. This can be done wither by using sensing devices attached to the user those may be magnetic field trackers, instrumented gloves and body suits or by using cameras and computer vision technique[1]. Each sensing technology varies along several dimensions, including accuracy, resolution, and latency, range of motion, user comfort, and cost. Glove based gestures and 2-D and 3-D gestures are become an important research in the recognition field. Glove based recognition in hand gesture is more used by control the devices, interacting with game playing for the children. Also the tracking the devices can detect fast and subtle movements of the fingers when the user's hand is moving a vision-based system will at best get a general sense of the type of the finger motion. For the paralytic persona gestures are also in use for moving cursor on the computer by moving eyes.

In this paper we provide a survey from last 10 year on gesture recognition with particular emphasis on facial expressions.

2. FACIAL GESTURE

Facial expression goes well back into the nineteenth century. Darwin demonstrated already in 1872 the University Facial Expressions and their continuity in Man and Animals and claimed among other things, that there are specific inborn emotions, which originated in serviceable associated habits. The expression of the face is a basic mode of nonverbal communication among the people. Mainly facial gestures are divided into seven parts:

a) Anger b) Sadness c) Fear d) Surprise e) Disgust f)

Happiness

Faces are much more than keys to individual identity, they play a major role in communication and interaction that makes machine understanding, perception and modeling of human expression an important problem in computer vision. Humans can adopt a facial expression to read as voluntary action. However because expressions are closely tied to emotion, they are more often involuntary. The face is something that can communicate without even using the mouth to speak. Someone who does not enjoy a certain type of food usually will make a face. Personally attractiveness, age, and gender can also be seen from someone's face. Gestures helps coordinate conversation and have considerably more effect on whether a listener feels liked or disliked than the speakers, spoken words. The face displays a complex range of information about identity, age, as well as emotional and attention state facial expression provide information about i) affective state, including both emotions such as fear, anger, enjoyment, sadness, and more enduring moods such as euphoria, dysphoria or irritableness, ii) truthfulness, including the leakage of concealed emotions, and clues as to when the information provided in words about plans or actions is false. Iii) Psychopathology, including not only diagnostic information relevant to depression, mania, schizophrenia and less severe disorders but also information relevant to monitoring response to treatment. The aim of face recognition is to identify or verify one or more persons from still images or video images of a scene using a stored database of faces.

3. GESTURE RECOGNTION TECHNIQUES

Gesture recognition is an ideal example of multidisciplinary research. There are various types tools for gesture recognition based on the approaches ranging from statistical modeling, computer vision and pattern recognition, image processing etc [3]. Computer vision and pattern recognition techniques [4] involving feature extraction, object detection, clustering, and classification have been successfully used for various gesture recognition system. Image processing [5] techniques such as analysis and detection of shape, texture, color, motion, optical flow, image enhancement etc. also shows the effective results.

There are two major approaches to automated face recognition:

a) Holistic methods: These methods identify a face using the whole face image as input. The main thing in this method is how to address the extremely small problems.

b) Local methods: These methods use the local facial features for recognition. Care should be taken when deciding how to incorporate global configurationally information into local face model.

3.1 Holistic Methods

3.1.1 Principal Component Analyses (PCA) approach

Principle Component Analysis is one of the successful techniques used to the original data with lower dimensional feature vectors [6]. This procedure transforms a number of correlated variables into a number of uncorrelated variables called principle components. It is based on the statistical representation of the face space it finds the principal components (Karhunen–Loeve expansion) of the facial image distribution or, the eigenvectors of the covariance matrix of the set of face images. The main advantage of PCA is to find the patterns in the data and reducing the number of dimensions without loss of information. Earlier Researchers have worked on color image and depth match using PCA.

PCA had also worked on color image and depth match [7] the cooperation of depth information resulted in the improvement of performance of recognition upto 5% [8]. 2Dimensional PCA (2DPCA) had given good result than PCA which evaluated with help of covariance matrix for determined corresponding eigenvector [9]. The Direct correlation used as benchmark then result of PCA was not better than direct correlation [10].

3.1.2 Neural Networks approach

An artificial neural network is a system based on the operation of biological neural networks. There are several advantages of neural network such as neural network can perform tasks that a linear program cannot and when an element of the neural network fails, it can continue without any problem by their parallel nature. Neural networks have been applied in many pattern recognition problems like optical character recognition and object recognition. There are many image-based face detection algorithms using neural networks, the most successful system was introduced by Rowley et al. [11].

Neural network was used for frontal as well as side view faces by using Constrained Generative Model technique [12]. Neural network had also worked on color images in complex background [13, 14]. And the back propagation neural technique had also used for face matching technique.

3.1.3 Linear Discriminant Analysis

Linear Discriminant Analysis (LDA) is supervised learning technique because it needs class information for each image in the training process. LDA finds an efficient way to represent the face vector space by exploiting the class information [6]. The basic idea of LDA is grouping of similar classes of data where as PCA works directly on data.

LDA was used with wavelet transform approach [15] which has given better results than other previous methods in manner of complexity and face recognition rate. LDA+PCA combination stated that this combination approach of PCA and LDA leads to better classification performance than single PCA or LDA approach [16]. Double Discrminant Analysis (DDA) result was superior than D-LDA, F-LDA and also found that it was more superior than and effective in extracting the most discriminant individual class specific feature for developing an effective face recognition system.

3.1.4 Independent Component Analysis (ICA)

ICA is a method to transform the observed multidimensional vector into its components which are maintained statically as independent as possible. ICA minimizes both second order and higher order dependencies in the input data and attempt to find the basis along which the data are statistically independent. There are two architecture of ICA for face recognition task. Architecture I – Statistically independent basis image. Architecture II – factorial code representation. To obtain completely independent components, which constitute complete faces.

By using ICA data driven signal processing technique had developed specifically for the engineering purpose for blind source separately and it proved that it had been used in the field of biomedicine, telecommunication, and machine vision [17]. Fast ICA (F-ICA) was a good result (95%) [18] than any linear subspace technique.

3.2 Local Methods

3.2.1 Hidden Markov Model (HMM)

 HMM is a Markov chain with finite number of unobservable states. These states have a probability distribution associated with the set of observation vectors. HMM are as set of statistical models used to characterize the statistical properties of a signal. HMM consist i) an underlying unobservable markov chain with a finite number of states, a state transition probability distribution and ii) a set of probability density functions associated with each state. HMM is a very famous and robust model in all the classification techniques. HMM based unsupervised temporal segmentation for hand gesture and speech prosody and multistream HMM to determine an audio visual mapping model [19] .Gestures spotting algorithm that was accurate and efficient for robustly recognize gestures, even when without any aiding devices in front of complex background [20]. The lightning conditions for Correlation and Mahalanobis distance had accurately recognized the gestures in still images as well as in video sequences [21]. Its classification performed using thresholding method in which correlation and wavelet based classifier technique given a good result [22].

3.2.2 Facial Action Coding System (FACS)

It was developed by Paul Ekman & Friesen and had been considered as a foundation for describing facial expressions. FACS provides linguistic rules describing all possible, visually detectable facial changes in terms of 44 action units.

The primary goal was to create a reliable means for skilled human scores to determine the category or categories in which to fit each facial behavior.

3.2.3 Contour Approaches

Facial features such as nose, eyes, lips, eyebrows are often extracted using active contour models. The main strength of contour's is that here whole part data (e.g. face) is not require only the contours are counted.

4. CONCLUSION

The gesture recognition is a promising area in the day to days research. It is important in the field of biometrics tools, Crime Investigation, government Departments and especially in the crowded area. Basically lot of research has to be done but And still more work remains to be completed for automatic face gesture.

Since few decades researchers are working on several facial gesture recognition techniques, but basically and most frequently PCA technique has been used by the researchers, whether for specialization or we can say comparison. LDA, ICA, CMM, convolution filter, Mahalanobis Distance etc. techniques also used by many authors. There are several online, offline databases are available like FERET, ORL, Iranian database, Indian Database, UMIST etc.

5. ACKNOWLEDGMENTS

6. REFERENCES

[1]   Sushmita Mitra and Tinku Acharya (2007) Gesture Recognition: A Survey", IEEE Transactions on Systems , man, and   Cybenetics- PART C: Applications and Review , VOL. 37, NO. 3

[2]   http://en.wikipedia.org/wiki/Body_language Date: 13/02/2012 time: 8:47 PM.

[3]   Kyungnam Kim, Face Recognition using Principle Component Analysis

[4]   R. O. Duda and P. E.Hart, (1973) Pattern Classification and Scene Analysis, New York: Wiley,

[5]   R. C. Gonzalez and R. E. Woods (1992) Digital Image Processing. Reading,MA: Addison-Wesley,

[6]   V.Radha, Member ,N. Nallammal (2011) Comparative Analysis of Curvelets Based Face Recognition Methods, Proceedings of the World Congress on Engineering and Computer Science 2011 San Francisco, USA, Vol I

[7]   Bo Peng and Gang Qian (2011) Online Gesture Spotting from Visual Hull Data, IEEE Transactions on Pattern Analysis and Machine Intelligence , VOL. 33, NO. 6,

[8]   S. Malassiotis, F. Tsalakanidou, N. Mavridis, V. Giagourta, N. Grammalidis and M. G. Strintzis (2001), A Face And Gesture Recognition System Based On An Active Stereo Sensor, Proc. International Conference on Image Processing. Thessaloniki.

[9]   Yongsheng Gao, Member, and Maylor K.H. Leung, (2002), Face Recognition Using Line Edge Map IEEE Transactions on Pattern Analysis and Machine Intelligence, VOL. 24, NO. 6,

[10] Xiaogang Wang, and Xiaoou Tang, (2004) Unified Framework for Subspace Face Recognition, IEEE Transactions on Pattern Analysis and Machine Intelligence,VOL. 26, NO. 9.

[11] H. A. Rowley, S. Baluja, and T. Kanade (1998) Neural Network Based Face Detection, IEEE Transactions on Pattern Analysis and Machine Intelligence, pp. 23-38.

[12] Raphae FeAraud, Olivier J. Bernier, Jean-Emmanuel Viallet, and Michel Collobert, (2001) A Fast and Accurate Face Detector Based on Neural Networks, IEEE Transactions on Pattern Analysis and Machine Intelligence,VOL.23, NO. 1.

[13] Jian Yang, David Zhang, Alejandro F. Frangi, and Jing-yu Yang (2004) Two-Dimensional PCA: A New Approach to Appearance-Based Face Representation and Recognition. IEEE Transactions on Pattern Analysis and Machine Intelligence, VOL. 26, NO. 1.

[14] Lamiaa Mostafa and Sherif Abdelazeem (2005) Face Detection Based on Skin Color Using Neural Networks, International Conference on Graphics, Vision and Image Processing, Cairo, Egypt.

[15] Neeta Nain, Akshay Kumar, Amlesh Kumar Mohapatra, Ratan Das, Ashok Kumar& NemiChand Singh, (2011), Face Recognition Using LDA with wavelet Transform Approach, International Journal of Information Technology and Knowledge Management, Volume 4, No. 2, pp. 603-607

[16] WeiGE, Dawei Wang,Yuqi Cheng,Ming Zhu (2009) Infrared face recognition using linear subspace analysis, Proc. of SPIE Vol. 7496 74961Z-1

[17] Pilar Poncela (2012) Further research on independent component analysis, International Journal of Forecasting 94–96 Elsvier.

[18] Juwei Lu, K.N. Plataniotis, and A.N. Venetsanopoulos, Face Recognition Using LDA Based Algorithms.

[19] Mehmet Emre Sargin, Yu cel Yemez, Engin Erzinand A. Murat Tekalp (2008) Analysis of Head Gesture and Prosody Patterns for Prosody-Driven Head-Gesture Animation", IEEE Transactions on Pattern Analysis and Machine Intelligence, VOL. 30, NO. 8,

[20] Giorgio Merola (2007) Emotional gestures in sport Springer Journal Language Resources and Evaluation, Vol. 41, No. 3/4, pp. 233-254.

[21] Paul M. Brunet , Catherine J. Mondloch, Louis A. Schmidt (2009) Shy Children are Less Sensitive to Some Cuesto Facial Recognition, Springer Journal, DOI 10.1007/s10578-009-0150-0.

[22] Jagdish Lal Raheja, Umesh Kumar (2010) Human Facial Expression Detection from Detected in Captured image Using Back propagation Neural Network, International Journal of Computer Science and Information Technology, Vol.2, No.1.

[23] S.Sharavanan,M.Azath (2009) LDA Based Face Recognition by Using Hidden Markov Model in Current Trend. International Journal of Engineering and Technology Vol.1 (2), 77-85