International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 10 | Oct -2017 www.irjet.net p-ISSN: 2395-0072

Different Viewpoints of Recognizing Fleeting Facial Expressions with DWT

VAIBHAV SHUBHAM[1], MR. SANJEEV SHRIVASTAVA[2], DR. MOHIT GANGWAR[3]

ABSTRACT: *Most research of facial expression recognition used static, front view and long-lasting stimuli of expressions. A paucity of research exists concerning recognition of the fleeting expressions from different viewpoints. To investigate how duration and viewpoints together influence the expression recognition, we employed expressions with two different viewpoints (three-quarters and profile views) and showed them to the participants transiently. The duration of expressions was one of the following: 20, 40, 80, 120, 160, 200, 240, or 280 ms. In experiment 1, we used static facial expressions; In experiment 2 we added dynamic information by adding two neutral expressions before and after the emotional expressions. The results showed an interaction effect between viewpoint and duration on expression recognition. Furthermore, we found that happiness is the easiest expression to recognize even under the conditions of fleeting presentation and side-view. This study informed the automatic expression recognition of human data under conditions of short duration and different viewpoints.*

Keywords: Facial Expression, Curvelet Transform, MATLAB

1. Introduction

From the evolutionary perspective, facial expressions can convey much information about feelings (angry or happy) and intentions (hostile or friendly) of strangers we encounter. The accurate interpretation of emotional expression, therefore, can promote both survival and reproduction. Today, facial expressions still play an essential role in human communication. Some of the most influential authors in the field of expressions recognition indicated long ago that recognizing facial expressions was of importance for many practical applications, such as emotion analysis[1], deception detection, human-computer interaction, and so on. There is considerable research in psychology and computer science about recognizing facial expressions. Dynamic surface acknowledgment can be seen as a speculation of appearance based methodologies [2]. At the end of the day, notwithstanding the above exhibited approach dynamic composition based methodology can be respected for outward appearance examination. Outward appearances can be considered as a dynamic composition as a result of face muscles action is powerful. Along these lines, the appearance and movements of dynamic composition can be considered in two headings, it implies that data of spatial and fleeting areas is joined together. Saha et al. [3] were perceived outward appearances by mix of curvelet change and neighborhood parallel examples. Additionally, they utilized curvelet entropy for characterizing facial expressions. Though, they just probed the still picture and performed on JAFFE databases and last picture of picture groupings of Cohn-Kanade databases. Juxiang et al. [4]

An efficient emotion recognition system is essential need in the area of HCI (Human Computer Interaction). If computers are able to recognize (perceive and respond) human emotions efficiently then we can make more interactive, trustworthy and easy to use systems. It means that we can promote multimedia and interactive systems more efficiently if computer sympathetic of human emotion is robust and efficient. Computer vision system cannot obey all the facts of the human vision system it means computer vision system may not work as human vision system, but it is vital need to make out and investigate the real complication behind its supremacy, reliability and elasticity. Computer vision can be explained as the acquirement and analysis of visual information to get desired information for understanding a picture or controlling and responding an action (activity). Modern computer vision research concerns, not only understanding and analysing the course of vision, but also designing efficient vision systems for a range of existent world purpose. Human expression recognition system is an example of machine vision system. Outward appearances is super class of feelings, it implies feelings goes under the classification of outward appearances.

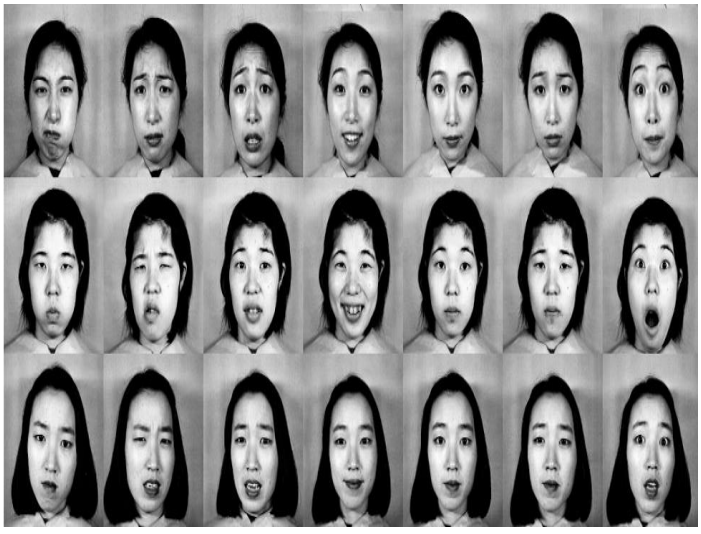

Figure: 1: Six Universal Emotions and a neutral

Facial expression is broad class and emotion is the subclass of facial expression, because facial expression includes some cognitive process like thinking, boredom, drowsiness and so on, but Psychological researches have shown that only six central emotions are collectively coupled with different

facial expressions: sadness, anger, surprise, fear, happiness, and disgust.

This thesis work has mainly addressed to recognition of these 6 central emotions but it can be customized to some added facial expression when needed. These six central emotions are shown in the figure 1.

2. Literature Review

The Automatic Face Recognition (AFR) system is a complex system, because in most of the cases only a few face images are available for training the system and different problems arise when training and test images are obtained under different conditions. The researchers have been facing problems with the sensibility of the classifier to illumination, pose, facial expression, occlusion, and low resolution face recognition. Therefore, recent works on face recognition are classified based on their main contribution in finding solution to some of the above mentioned problems. However, only little work has been done in literature on low resolution face recognition and partial face recognition. After going through literature related to different face recognition techniques and challenges .In this work, a novel face recognition model is proposed to work well with both low and high resolution face images, using hybrid approach and multi-scaling of facial components concept for facial feature extraction, PCA or LDA for dimensional reduction and artificial neural network as classifier. In this chapter literature survey of different face recognition methods (Challenges in Face Recognition, Holistic Face Recognition Methods, Component based Face Recognition Methods, Hybrid Face Recognition Methods, Low Resolution Face Recognition and Partial Face Recognition) and formulation of problem for the proposed work is explained.

NorhaizaBtYa Abdullah et al., "Folder Lock by using Multimodal Biometric: Fingerprint and Signature Authentication", Fourth International Conference on Cyber Security, Cyber Warfare, and Digital Forensic 2015, lock folder is one of method that used to ensure nobody intentionally gets access to your private and confidential information. Presently used password based systems have a number of associated inconveniences and problems such as user needs to remember passwords, passwords can be guessed or broken down via brute force and also there is problem of non-repudiation.. Besides, password authentication method as a keyword permission to access something is breakable. Hence, it can be leaked out and cracked by using any methods such as dictionary attack, or social engineering. Due to the drawback, this method is lack of universality of some characteristics and the recognition performance of the systems is upper limit and it is unacceptable error rates for the single modal authentication system. Multimodal biometric can be at least combination of two types of any physical or behavioral biometric as it applies in the system that has been developed. Therefore, a system is proposed to overcome the aforementioned problems by adding multimodal biometric authentication will provide another layer of security. Those problems encountered have being overcome and it is proven that by adding another layer of security as the authentication is more secure. It has been proved and has been tested that using combination of two biometric methods; fingerprint and signature as an authentication method is more secure and reliable.

NakisaAbounasr et al., "Facial Expression Recognition Based on Combination of Spatial-temporal and Spectral Features in Local Facial Regions", 2013 8th Iranian Conference on Machine Vision and Image Processing (MVIP),this paper presents two new methodologies for outward appearance acknowledgment in light of computerized curvelet change and neighborhood double examples from three orthogonal planes (LBP-TOP) for both still picture and picture groupings. The components are separated by utilizing the computerized curvelet change on facial locales in still picture. In this approach, some sub-groups compare to edge of facial locale is utilized. These sub-groups comprise of more recurrence data. The computerized curvelet coefficients and LBPTOP are spoken to consolidate spatio-worldly and unearthly components for picture arrangements. The got results by our proposed approaches on the Cohn-Kanade outward appearance database have adequate acknowledgment rates of 91.90% and 88.38% for still picture and picture arrangements, individually.

3. METHOD/ APPROACHES FOR FACE DETECTION

In general, FD can be implemented by four methods: knowledge based methods, template matching, invariant feature methods and learning based methods. These methods are as follows [8]:

Knowledge based methods: The models use human knowledge to find face patterns from the testing images. Based on the nature of human faces, algorithms scan the image from top-to-bottom and left-to-right in order to find facial feature. For instance, face should be including two eyes and mouth etc.

- **Pros:** Easily applicable in simple rules
- **Cons:** Difficult to detect in invariant background, such as different pose, uncontrolled illumination etc. Well results based on well-defined rules. This algorithm does not work on the pose.

Template Marching: The method uses several templates to find out the face class and extract facial features. Rules are pre-defined and decide whether there is face in the image.

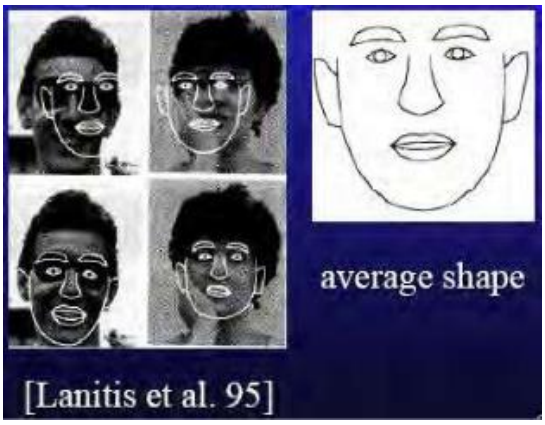

Figure: 3.1: Sample of template marching

- **Pros:** Simple to apply.
- **Cons:** Similar to knowledge based method, hard to detect face in different poses. Algorithms are sensitive to scale size, face shape and pose.

Invariant feature methods: The model is bottom-up approach and is used to find a facial feature (eyebrows, nose), even in the presence of composition, perspective vary, and so it is difficult to find a face in real time using this method. Statistical models are developed to determine the faces. Facial features of human faces are: shape, texture, skin.

- **Pros:** Unlike knowledge-based method, it is invariant to pose and expression.
- **Cons:1**. Not suitable to detect facial features from uncontrolled background
  2. Time consuming algorithms
  3. Detection rate is not accuracy, because of need to combine
  differentfeature and processing it.

Learning based methods: The models are trained from a set of training set before detection. For the large amount of training data, high accuracy recognition rate to resist variation, expression and pose of faces images can be achieved. For instance, many of "non-face" and "face" images import into the system. Machine learning techniques are employed to train the system based on the statistical properties and probability distribution function. Principle Component Analysis (PCA), Support Vector Machine (SVM), Naïve Bayes Classifier, Hidden Markov model, Neural Network and Adaboost are well-known classifiers to use for face detection.

- **Pros:** Fast to detect face. Can detect different pose and orientation if have enough training set. Show good empirical results.
- **Cons:** Need more and more "non-face" and "face" sample for training, need to scan different scale.

4. APPROACH FOR BIOMETRIC FACE AND FINGERPRINT RECOGNITION

Anbiometric face and fingerprint recognition system has four components, namely Face-detection, Features extraction from face, Classification and morphological. Flow chart for proposed system is shown in the figure given below.

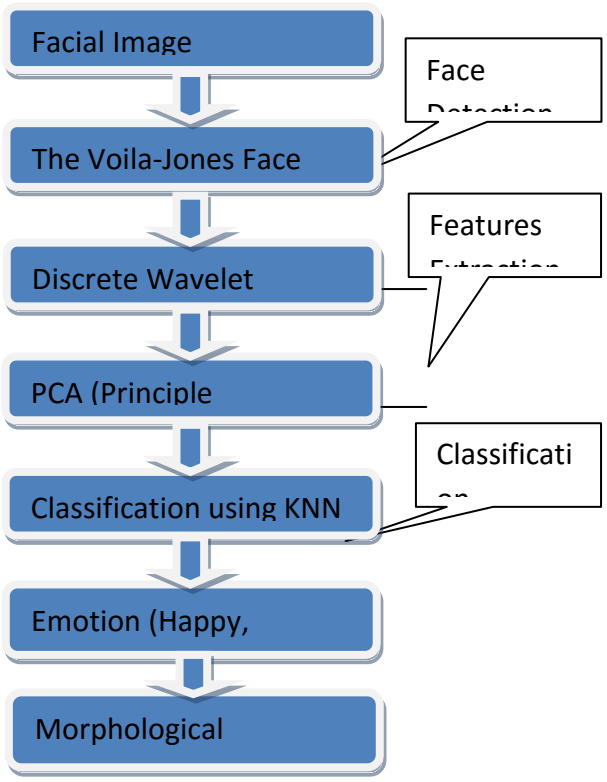

Figure 4.1 (a): Proposed Biometric Face and Fingerprint Recognition System

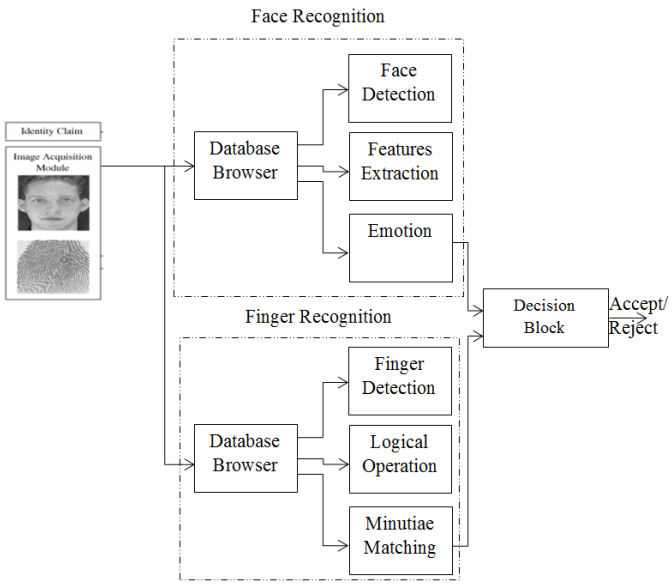

Figure 4.1 (b): Flow Chart of Biometric Face and Fingerprint Recognition System

We have concentrated our implementation on multimodal biometric face and fingerprint recognition. Multimodal biometrics system for identity verification using two traits: face and fingerprint System based on adaptive principal component analysis and multilayer perception A proposed scheme of multimodal biometric face and fingerprint recognition is parallel the multimodal biometric takes the individual scores of two traits (face and fingerprint) which generate range approximate value for training that is in discrete interval form than system will produce good accurate result with high efficiency. Current work deals with an efficient face and fingerprint recognition algorithm combining ridge based and Eigen face approach for parallel execution. Here I am proposing a method to overcome the drawback of earlier problem, which based on combination on neural network an efficient Face and Fingerprint recognition algorithm combining ridge based and Eigen face approach. The main purpose of the proposed system is to reduce the error rate as low as possible and improve the performance of the system by achieving good acceptable rate during identification and authentication.

Database Browser: We combine the biometric traits taken from different sensors to form a composite biometric trait and process. Here an image of an object or a scene is captured by a digital camera or is scanned for use as the input to the system.

Feature level: Signal coming from different biometric channels are first pre-processed, and feature vectors are extracted separately, using specific algorithm and we combine these vectors to form a composite feature vector. This is useful in classification. These are a series of steps which should be taken for making an image suitable for manipulation and interpretation by subsequent stages. The steps include removal of noise and variation of intensity recorded, sharpening, improving the contrast and stringing the texture of the image. Another important aspect is image restoration which extracts image information from a degraded form to make it suitable for subsequent processing and interpretation.

5. Simulation Tools

In the below figure we show the starting screen of MATLAB. We use MATLAB because it is user friendly and it contains a number of libraries which is used in the work.

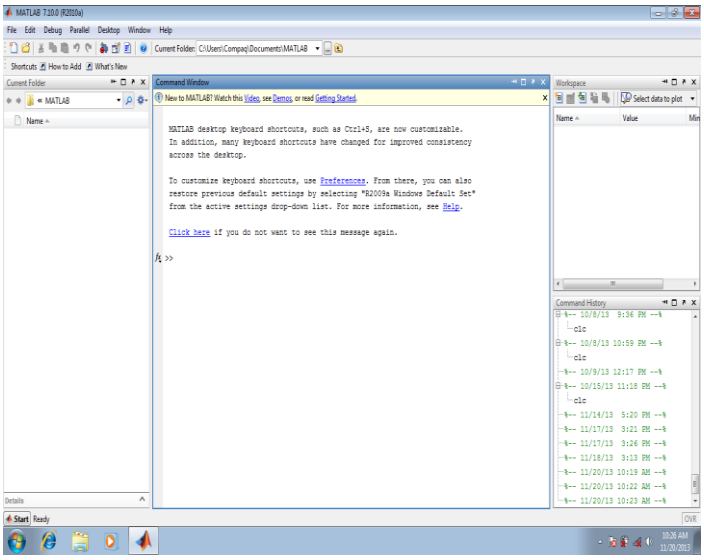

Figure 3: MATLAB Starting Window

This is the screen shot of our application; in this GUI we show the testing and training module.

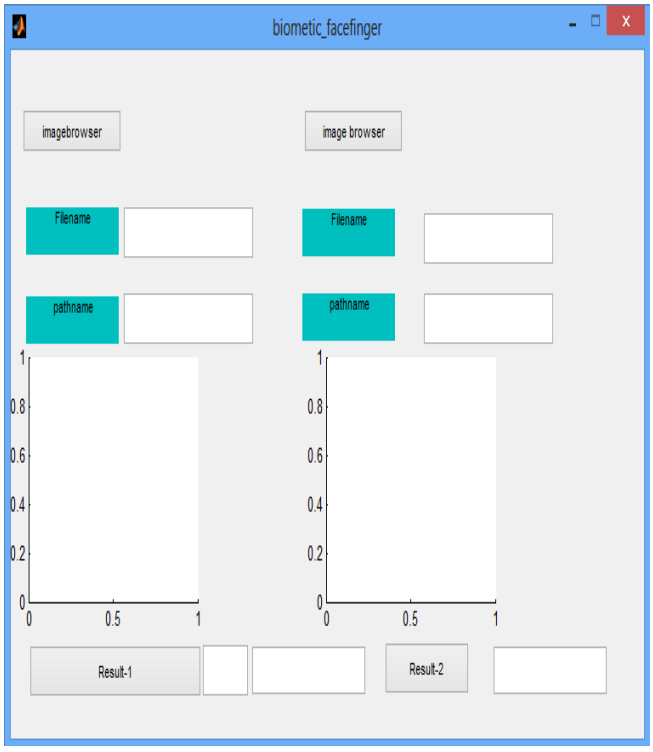

Figure 4: GUI of The Application

6. Simulation

In this section we expose and discuss the results of FER system which is based on proposed methodology for FER. We perform two experiments on proposed FER system with different number of training and testing images of JAFFE dataset. In first experiment out of 213 images, 143 images (on average of 2 images per expression per subject) for training purpose and rest 70 images (on average of 1 image

per expression per subject) for testing purpose. Result of this experiment for 7 expressions is shown in the table below:

Table: 4.1 Result of Experiment FER System

	Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise
Anger	17	2	0	0	0	1	0
Disgust	2	17	1	0	0	0	0
Fear	0	1	16	0	0	1	3
Happy	0	0	0	18	2	1	0
Neutral	0	0	0	1	19	0	0
Sad	0	0	3	1	2	15	0
Surprise	0	0	0	0	0	0	20

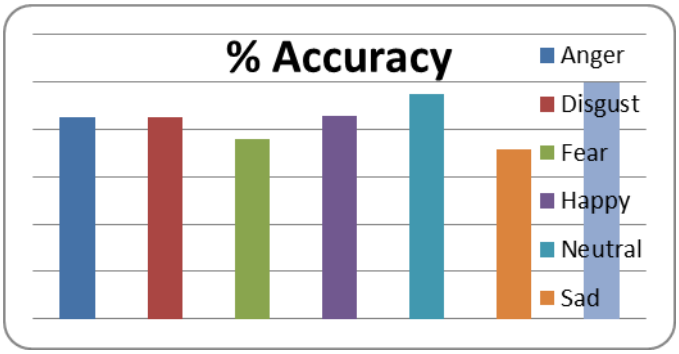

Figure 5: Accuracy of each expression for experiment

7. Conclusion

Our proposed FER system performed better than existing FER systems on JAFFE database. But limitation of our method is that when we test our system on any subject which is not the part of training than it gives very poor results. So we can say that our method for facial expression recognition is person dependent. It means before testing any subject (person) we must have to train our system on that subject. This is due to we take mean of discrete coefficients of all training images for performing PCA (principle component analysis) for feature selection and same mean is used by testing images.

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