Facial Expression Recognition Based on Co-ordinate and Bezier Curves

M.Swathi	**P.A Ashoka Vardini**	**T.Bharat Kumar**
Department of CSE, JNTUA	*Department of CSE, JNTUA*	*Software Engineer TCS, Chennai*
India	*India*	*India*

Abstract— Communication happens between Human to human and human to computer are two different terminologies which are depends on the same properties of human like face, color, expression. Ancient face representation is a key to any additional examination. From face, facial feature detection and tracking to face classification problems (face recognition, gender, age, race, facial expression detection), there have been a variety of face representations used, all of them covering their advantages in their definite domain. In this paper we present a work of fiction on face representation for determining the color of a variety of features, like skin, hair and eyes of face. In order to cope with the numerous complicating external factors like varying lighting conditions and camera settings, the full color range of the segmented face image will be reduced to color categories based on human cognition principles Such a representation of colors in face-images makes it easier of color extraction from given image. The efficiency of color information on FER using low-resolution and facial expression images with illumination variations is assessed for performance evaluation. Investigational domino effect express that color information has significant prospective to improve emotion recognition performance due to the corresponding characteristics of image quality. In addition, the perceptual color spaces CIELab and CIELuv are better overall for FER than other color places, provided that more competent and vigorous presentation for Facial Expression Recognition using facial images with illumination variation.

Keywords— Co-ordinate transformations, Bezier Curve, CIELab, CIELuv, facial expression recognition (FER), perceptions color spaces.

I. INTRODUCTION

In human-human communication the face conveys a lot of information. People are identified by their face and it also has a strong eject on rest impressions. We can be on familiar terms with gender, estimate age, or deduce some cultural characteristics based on face to face communication [1]. In advanced technologies and implementations Human computer-Interaction plays an important to improve the more friendly interactions between user and computers.

Analysing faces in human-computer communication is also becoming increasingly important. Facial Expression Recognition (FER) in human computer interaction will place most significant role in Border security systems, forensics, virtual reality, computer games, robotics, machine vision, user profiling for customer fulfilment, distribution, and web services are but a few different real world applications. Author Seyed Mehdi Lajevardi he had presented a paper on this facial expression recognition the basic details of this FER is extracted from that paper only. In his paper he represented that the use of facial expression for measuring people's emotions has subjugated psychology since the late 1960s when Paul Ekman bring back the study of emotion by concerning expressions to a group of fundamental emotions (i.e., anger, disgust, fear, happiness, sadness, and surprise) [2]. The research study by Mehrabian [3] has designated that 7% of the communication information is shifted by linguistic language, 38% by paralanguage, and 55% by facial expressions in human face-to-face communication. This shows that facial expressions provide a large amount of information in human communication.

Several approaches have been proposed for FER in the past several decades [1], [4]. The current state-of-the-art techniques for facial expression classification mostly focus on gray-scale image features [1], while rarely considering color image features [5]–[7]. Taking account of color feature data may lead to more robust classification results. Recent research reveals that color information improves face recognition and image retrieval performance [8]–[11]. It was first reported in [8] that taking account of color information improves recognition rate when compared with the same scheme using only the luminance information. It was shown in [9] that color components helped to improve face retrieval performance. Liu and Liu proposed a new color space for face recognition [10]. Young, Man, and Plataniotis demonstrated that facial color cues significantly improved face recognition performance using low-resolution face images [11]. It was reported in [7] that the RGB color tensor has improved the FER performance; however, it did not consider the images with different illuminations. Although recent research has shown improved performance by embedding the color mechanism, the efficiency of color in sequence of RGB color space in terms of recognition performance depends on the type and angle of light source, often making credit impossible. Therefore, the RGB color space may not always be the most desirable space for color information processing. This issue can be addressed using perceptually uniform color systems [12]. This paper introduces a novel tensor perceptual color framework (TPCF) for FER based on information contained in color facial images, and investigates performance in perceptual color space under slight variations in illumination. This paper narration has been happened in the following way. Section I explains about

the components which done in past on the Facial Expression Recognition based on different aspects. Section III explains what we will consider for finding FER based on Co-ordinate and Bezier curves. Section IV analyses the algorithmic approach for identification of features in face. Section V shows the experimental results of the FER related to Co-ordinate System considerations. Section VI gives the conclusion for the paper and what we can do for further based on the root work fallowed by Acknowledgement.

II.   LITERATURE SURVEY

A.   Image Analysis and Compression of Discrete 2-D Color Transforms by Neural Networks

Transforming 2-D discrete signals into generalized non orthogonal 2-D "Gabor" representations of 3-Layered neural network is described. These transforms are conjoint spatial spectral signs, which provide a complete image explanation in terms of locally windowed 2-D spectral coordinates embedded within global 2-D spatial coordinates. Because intrinsic redundancies within images are taken out, the outcome image codes can be very dense. However, these conjoint transforms are inherently difficult to compute because the elementary expansion functions are not orthogonal. One orthogonal approach developed for 1-D signals by Bastiaans , based on bi-orthonormal expansions, is restricted by constraints on the conjoint sampling rates and invariance of the windowing function, as well as by the fact that the supplementary orthogonal zing role are non local infinite series. In the present "neural network" approach is foundation upon inter laminar communications involving two layers with fixed weights and one layer with modifiable weights, the network locates coefficients for complete conjoint 2-D Gabor transforms without these restrictive conditions. For arbitrary non complete transforms, in which the coefficients might be interpreted simply as signifying the presence of certain features in the image, the network discovers best coefficients in the sense of minimal mean-squared-error in representing the image. In one algebraically complete scheme permitting exact reconstruction, the network finds expansion coefficients that reduce entropy from 7.57 in the pixel depiction to 2.55 in the total 2-D Gabor transform.

In "wavelet" extensions based on a biologically inspired log-polar ensemble of dilation, revolutions, and transformations of a single underlying 2-D Gabor wavelet pattern, image compression is demonstrated with ratios up to 20:1. Also verified is image segmentation derived from the clustering of coefficients in the complete 2-D Gabor transform. This coefficient-finding network for implementing useful non orthogonal image transforms may also have neuroscientific relevance, because the network layers with fixed weights use empirical 2-D receptive field profiles obtained from orientation-selective neurons in cat visual cortex as the weighting functions, and the resulting transform mimics the biological visual strategy of embedding angular and spectral analysis within global spatial coordinates.

B.   Quality Assessment of Image : From Error Visibility to Structural Similarity

Objective methods for assessing perceptual image quality traditionally attempted to quantify the visibility of errors (differences) between a distorted image and a reference image using a variety of known properties of the human image system. Under the conjecture that human visual perception is highly adapted for extracting structural information from a scene, we pioneer an substitute balancing frame work for quality assessment based on the degradation of structural information. For exact example of this idea, we expand a Structural similarity Index and demonstrate its promise through a set of spontaneous examples, as well as assessment to both slanted ratings and state-of-the-art objective methods on a database of images compressed with JPEG and JPEG2000.

C.   Using of Color Subspace LDA approach for Face Recognition

Face recognition using color as an important clue in humanizing the exactness of recognition. To carry out recognition of color images, we apply the uniqueness of a 3D color tensor to produce a color LDA subspace, which in turn can be used to know a new probe image. To examine the correctness of method, we calculated the recognition rate across two color face databases. Usage of LDA color subspace appreciably develops recognition accuracy over the standard gray scale approach without sacrificing computational efficiency.

D.   Primitive Surface Feature Distribution used to find 3D Facial Expression Recognition

The creation of facial range models by 3D imaging systems has led to extensive work on 3D face recognition. However, little work has been done to study the usefulness of such data for recognizing and consideration of facial expressions. Shape of a human face is shown by Psychological research, a highly portable facial surface, is critical to facial expression awareness. We examine the significance and convenience of 3D facial geometric shapes to symbolize and recognize FE using 3D facial expression variety data.

One author proposes a novel approach to extract primitive 3D FE features, and then be relevant the feature distribution to classify the prototype facial expressions. In order to authenticate our proposed approach, Author have conducted experiments for person-independent facial expression recognition using our newly created 3D facial expression database. We also exhibit the advantages of our 3D geometric based approach over 2D texture based approaches in terms of various head poses.

III.   CREATION OF AN IMAGE-SUPPORTED FER STYLE

Image supported facial expression recognition on static images basic principle is explained in the below diagram [1].
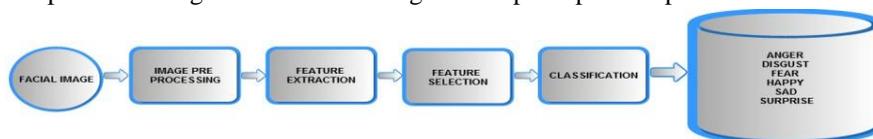

Fig 1: Process for Facial Expression Recognition based on Co-ordinate and Bezier Curves

Model supported methods effort to recover the volumetric geometry of the scene, those are naturally slow and compound but Image-Supported methods take out features from images without relying on widespread facts regarding the entity of interest, which are typically fast and simple[1].The Facial Expression Recognition of geometric features present the shape and locations of facial components that includes mouth, eye, eye brows and nose. Feature vector is very important for face geometry which is used to extract feature points from feature vector. The appearance features present the appearance (skin texture) variation of the face, such as crumple and groove. The exterior facial appearance can be taken out from either the complete face or precise area in a face image.

This paper focuses on the static color images and a holistic technique of the image-based method is used for feature extraction. The image based FER systems consist of several components or modules, including detection of face normalization, classification by means of Skin color maintenance, Face deduction, Eyes deduction, Lip deduction, Apply Bezier curve, Database & Training, Emotion deduction.

A. Skin Color Maintenance

First we contrast the image. Then we perform skin color segmentation. Then, finding of largest region is very important. After finding largest region we need to check for the probability that how much the connected region can be become as face. If the maximum connected region has the probability to identify as face then it will open a new form with maximum connected region. If the maximum connected regions height & width is greater or equal than 50 and the ratio of height or width is amid of 1 to 2, then it can be shown as face.

B. Face Detection

For face detection, first we convert binary image from RGB(Red ,Green, Blue) image. For converting binary image, we compute the mean value of RGB for every pixel and if the mean assessment is less than 110, we substitute it by black pixel and if not we substitute it by white pixel. From above process we can get binary image. Now we have to find the forehead from the binary image. The process of identification of image will be started from the middle of the image; one constraint of this is we have to find the continuous consecutive white pixels after uninterrupted black pixel.

Find the white pixel maximum width by vertically both from left and right side. Continue the process until new width is smaller half of the previous maximum width. If it is found there just stop the scan because if we reach the eye brow then this case will comes into the existence. At this instance where we need to cut the face from the starting position of the forehead and it will be multiply of 1.5 of width.

C. Eyes Detection

For eyes detection, we convert the RGB face to the binary aided face. Let us consider the width of the face by W. We scan from the W/4 to (W-W/4) to find the two eyes middle position. The maximum white continuous pixel along the height between the ranges is the middle position of the two eyes. Then we find the starting high or upper position of the two eyebrows by the process of searching vertically. For left eye, scan w/8 to mid and for right eye we scan mid to w – w/8. Here w is the width of the image and mid is the middle position of the two eyes.

There might be some sort of white pixels between the eyebrow and the eye. To construct the eyebrow and eye associated, some continuous set of black pixels are positioned vertically from eyebrow to the eye. For left eye, the black pixel-lines which are located vertically in between mid/2 to mid/4 and for right eye the lines are in among mid+(w-mid)/ 4 to mid+3*(w-mid)/ 4 and black pixel-lines height from the eyebrow starting height to (h- eyebrow starting position)/4. Here width is W of the image and middle position of the two eyes is mid and height of the image is h. First we find the lower location of the two eyes by searching vertically black pixel. For left eye, we search in the range of mid/4 to mid - mid/4 width and for right eye, the range is between mid + (w-mid)/ 4 to mid+3*(w- mid)/ 4 width from image lower end to the eyebrow starting position.

Then we find the right side of the left eye by searching black pixel horizontally from the mid position to the starting position of black pixels in between the left eye upper position and lower position. And left side for right eye we search mid to the starting position of black pixels in between the right eye of upper position and lower position. The left side of the left eye is the starting width of the image and the right side of the right eye is the ending image width. Then we cut the part of image from RGB image of upper position, lower position, left side and the right side of the two eyes.

D. Lips Detection

In the Facial Expression recognition lips will plays an important role, in this aspect we need to find out the lip box first to identify the Lip detection. We have to find out the lip which must be inside the lip box. To identify the lips we need to find out the distance between the forehead and eyes. We will do the process that to find lip as, affix the distance with the lower height of the eye to agree on the upper height of the box which will enclose the lip.Now, the initial point of the box will be the ¼ location of the left eye box and ending point will be the ¾ location of the right eye box. And the conclusion height of the box will be the lower end of the face image.

So, this box will include only lip and may part of the nose. From here we are concentrating on the cutting the RGB image according to the box. So, For identification of eyes and lips, we need to get a binary image from RGB image and doing some sort of searching in the binary image.

E. Apply Bezier Curve

In the process of lip detection through lip box there may be chance of getting some part of nose in the lip box. Around the lip box there is an existence of skin color or the skin. As soon as we identified this we will convert the skin pixel to white pixel and other pixel as black. We will apply the same process to identify and conversion of the pixel to white pixel. The main concern comes here is how we can decide similar pixel. It's the RGB difference values of two pixels less than or equal to 10. Histogram is the best way to represent or identify the average distance between the RGB values. We find distance between lower average RGB value and higher average RGB value. If the distance is identified as 70 then we use

7 for finding similar pixel and if the distance is greater than or equal 70 then we use 10 for identifying similar pixel. The value for finding the similar pixel is depends on the quality of the image .If the image quality is high we generally use 7 and if it low we generally use 10 for finding similar pixels.

In the whole binary image there may be chance of occurrence black regions on lips, nose and might have little part of which have little different than color of skin. From here we are going to identify the big connected region for identifying the black region which contains lip in binary image. With this identification we are sure that the big connected region is the lip in the lip box. It is identified based on lip is the largest connected region which is different than skin.

Once the largest connected region is identified then we will apply the concept of Bezier curves on the binary lip. To start this process we will find the starting and ending pixel of the lip in horizontally. Here we depend on the tangents, drawing two tangents on upper lip from pixels of staring to ending and then we will find two points on the tangents which are not part of the lip. We fallow the same process which we fallow for upper lip to lower lip also to find points. Here we will use Cubic Bezier curves to draw Bezier curve of the lip. Almost in this process we will draw two Bezier curves for upper lip and lower lip.

In the same way we will apply Bezier curves on eyes also, In this process we first remove eyebrow from eye. For this we will identify sequence of black pixel then set of continuous white pixel from the binary image of the eye box. To identify only the eye we first continuous black pixels from the box, from this at last we can identify a box with only eye. Eye in the Eye box is associated with some skin color around the box. Here we will apply process which we used for lip. This process involves finding skin color and identification of big connected region and applying Bezier curve and getting shape of the eye.

F. Database & Training

In this we can consider the data base in tables. Here we consider two tables as person and position. Person table is for storing the name of the people and their emotions will be stored in the position table. For each index of position table there will be 6 control points for each lip Bezier curve, left eye Bezier curve and right eye Bezier curve, height and width of lip, height and width of left eye, and height and width of right eye. So, by this method we can know the emotion of the *people.*

G. Emotion Detection

Emotion detection of an image was depends on the Bezier curve of the main parts of face like lip, left eye and right eye. Here we are applying the process in such a way that we will convert each width of the Bezier curve to 100 and height according to its width. The value which is found here is compared with the values that are present in the data base, then the written program will try to match with   emotions height which is nearest the present height and the program will give the nearest emotion as output. In case if the emotion information is not available in the predefined set of data based, then the written program will calculates the average height for each emotion in the database for all the people and then takes a decision according to the average height.

IV. ALGORITHM FOR IMAGE-SUPPORTED FER SYSTEM

A. RGB/Skin Tone Detection

Skin tone color algorithm is the Simplest algorithm for detecting skin pixels. The human color will be varied as a function which was in the relative direction of the illumination. Normalized colored histogram is used to find the pixels for skin region, and can be further normalized for changes in intensity on dividing by luminance. And thus converted an [R, G, B] vector is converted into an [r, g] vector of normalized color which provides a fast means of detection of skin. This type of process will give the colored skin region which identifies the face. As in, the output is a face detected image which is from the skin region. This algorithm will not be matched to the skin regions like legs, arms, etc.

After face detection stage, the face images are scaled to the same size (e.g., 64×64 pixels).The color values of face images are then normalized with respect to RGB values of the image. The purpose of color normalization is to reduce the lighting effect because the normalization process is actually a brightness elimination process.

B. Feature Selection

The utterance-length feature statistics include mean, variance, range, quantile maximum, quantile minimum, and range of quantile. The features of quantile were used instead of the maximum, minimum, and range because they tend to be less noisy. The pitch features were extracted only over the voiced regions of the signal. The video motion-capture derived features were occasionally missing values due to camera error or blockages. To conflict this lacking data problem, the features were extracted only over the recorded data for each utterance. These audio-visual features have been used in previous emotion classification problems. Refer Fig 2.

C. Feature Extraction

There were a total of 685 features extracted. However, there were only 3000 prototypical and non-prototypical MV utterances utilized for testing and training. The feature set was reduced using information gain on a per emotion class basis (e.g., the features for the class of anger differed from those of happiness).

Information gain describes the difference between the entropy of the labels in the data set (e.g., "happy") and entropy of the labels when the behavior of one of the features is known (e.g., "happy" given that the distance between the mouth corner and nose is known). This feature selection method permit as ranking of the features by the amount of emotion-class-related randomness that they explain. The top features were selected for the final emotion-specific feature sets.

The feature selection was implemented, a Java-based data mining software package Information gain has previously been used to select a relevant feature subset in Information gain does not create an uncorrelated feature set, which is often preferable for many classification algorithms. However, humans rely on a redundant and correlated feature set for

recognizing expressions of emotions. Information gain was chosen to approximate the feature redundancy of human emotion processing.
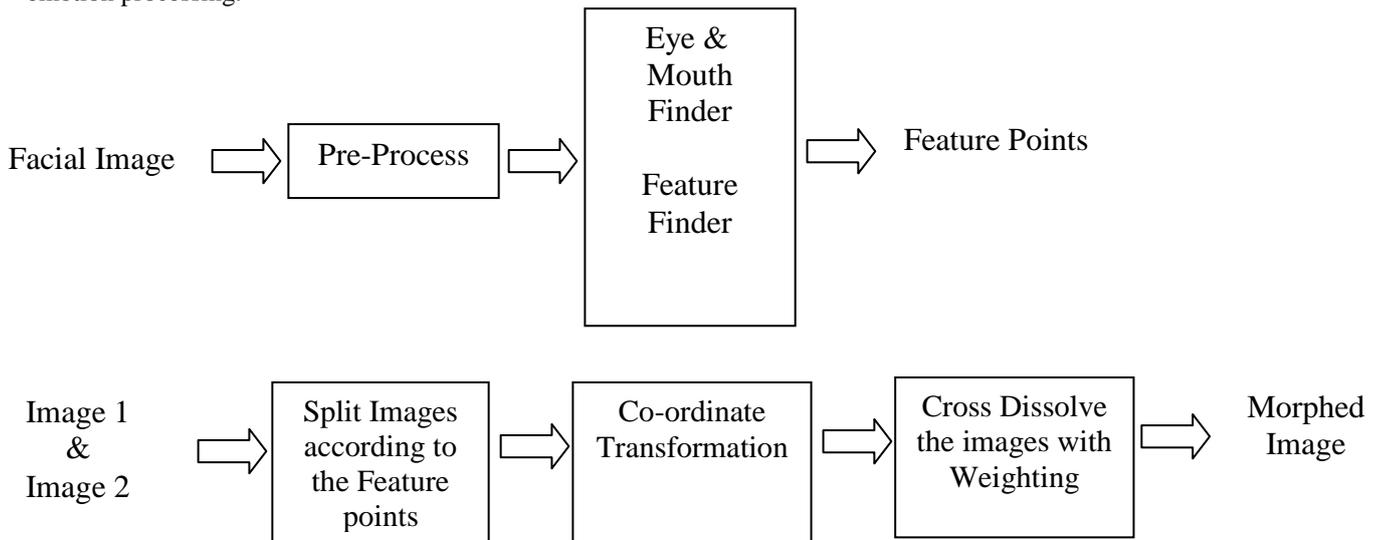
Facial Image ⟹ Pre-Process ⟹ Eye & Mouth Finder / Feature Finder ⟹ Feature Points

Image 1 & Image 2 ⟹ Split Images according to the Feature points ⟹ Co-ordinate Transformation ⟹ Cross Dissolve the images with Weighting ⟹ Morphed Image

Fig 2: Internal process of Face Selection

V. EXPERIMENTAL RESULTS

This part of the paper will show how the results have been generated according to the input of the image. In this process first the image will be scanned into the database and the process of scan to find expression will be started (Fig 3).

Once the image is scanned into the data base then the face will be identified from the image. In case if the image was not identified then it will prompt a message as the given image is not human image (Fig 4).
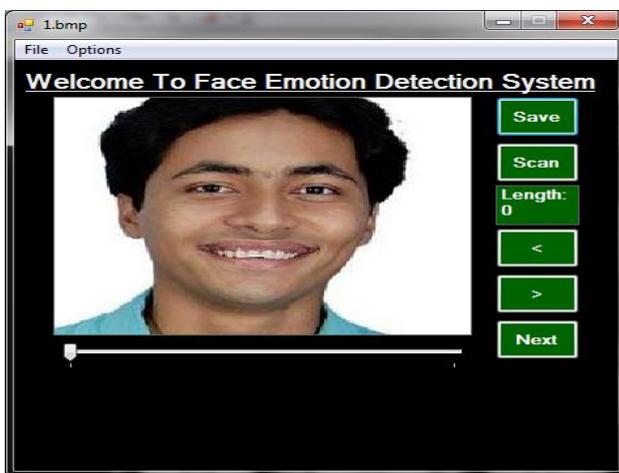
Fig 3: Loading Image into Data base   Fig 4: Identifying face from input image
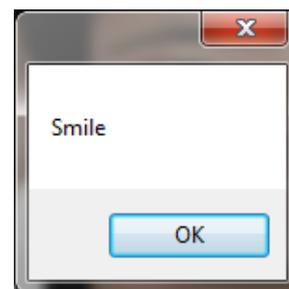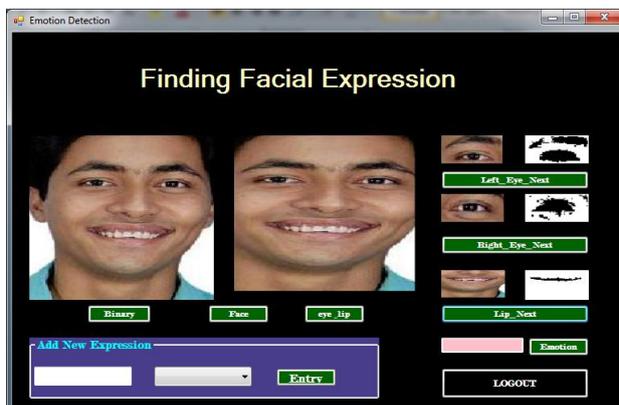
Fig 5: Conversion of RGB to Binary Image and showing Expression of image

Once face has been identified then the face will be converted from RGB image to binary image. Identification of lips, eyes will be takes place according to the algorithmic approach. The identified parts will be converted to binary image and the we will apply Bezier curve to identify the expression (Fig 5).

VI. CONCLUSION AND FUTURE WORK

A novel TPCF was proposed for FER system in perceptual color space. Based on TPCF, the RGB color images were first transformed to perceptual color spaces after which the horizontal unfolded tensor was adopted to generate the 2-D tensor for feature extraction. The 2-D tensor was normalized before the features were extracted using a bank of 24 Log-Gabor filters, and the optimum features were selected based on MIQ algorithm. The images under slight illumination variation were used to test robustness of the FER system performance. Experimental results show that the color components provide additional information to achieve improved and robust performance of the system in terms of recognition rate for all expressions. Furthermore, the TPCF in perceptual color space has more desirable average recognition rate for facial images under varying illumination situations. In addition, the performance of the TPCF has marked advantages in FER for low-resolution facial images in terms of recognition rate and error rate. To the best of author's knowledge, the achieved average recognition accuracy of the TPCF for FER system is better than any other reported in the literature so far using the BU-3DFE database which contains list of tables and the Oulu-CASIA NIR&VIS database. In this paper we just concentrated on the static images of the human. The extension of this work can be done in such a way that we can capture the video and the we can analyze the expression of the human present in the human.

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