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A Virtual Reality System Design for Facial Expression Recognition System for Autism Spectrum Disorders

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Abstract: In human-human communication the face conveys a lot of information using facial expressions we can recognize gender of the person, estimating the age, or deduce some cultural characteristics. In this paper we present a novel architecture for Virtual Reality (VR) for the purpose of facial Expression recognition system for real time face representation for determining the color of various facial features, like hair, skin colors and eyes. In order to process all those factors with the numerous complex external factors like variable lighting conditions and camera settings, color range of the segmented face will be reduced to color categories based on human recognition principles. In this paper we propose Such a representation of colors in face images makes it easier to extract the color of a given The effectiveness of color information on FER using low resolution and facial expression images with illumination variations is assessed for performance evaluation are done. Experimental results show that color information has significant potential to improve emotion recognition using virtual reality design performance due to the complementary characteristics of image textures recognized.

Keywords: 3D Interaction, Multimodal Interaction, Virtual Reality, Psychology, Autism Spectrum Disorders, Expression Recognition Techniques.

I. INTRODUCTION

In this digital age Analyzing faces in human-computer communication is becoming increasingly important for virtual reality systems. From face detection, through face and facial feature tracking, to face classification problems there have been various face representation techniques used, all of them having their advantages in their specific domains. People are identified by their face and it also has a strong impact the rest relies on expressions. Autism Spectrum Disorders (ASD) is characterized by a typical pattern of behaviours and impairments in social communication.A related Survey shows that One in 88 children in the United States has some form of ASD with tremendous familial and societal costs associated with this particular problem. As a result, effective identification and treatment of ASD is considered by many to be a public health emergency. Among the fundamental social addition to the ASD population are challenges appropriately recognizing and responding to nonverbal cues and communication often taking the form of challenges recognizing and appropriately responding to facial expressions. Particularly individuals with ASD have been shown to have impaired face discrimination, slow and atypical face processing strategies reduced attention to eyes and unusual strategies for consolidating information viewed on other's faces [2].Studies have found that children with ASD in a controlled environment were able to perform basic facial recognition tasks as but often failed in identifying more complex expressions as well as required more prompts and more time to respond to facial emotional expression understanding tasks [2]. In general, children with ASD have shown significant impairment in processing and understanding complex and dynamically displayed facial expressions of emotion [2].

II. VIRTUAL REALITY IN AUTISM THERAPY

Virtual reality environments offer benefits to children with ASD mainly due to their ability to simulate real world scenarios in a carefully controlled and safe environment using latest computing technologies. Controlled stimuli consistency, objectivity and presentation, and gaming factors to motivate for task completion are among the primary advantages of using VR-based systems for ASD intervention of the particular system to make the process. While it was shown that these systems can help generalization across contexts, generalization to real-world interactions remains an open question to everybody.

III. PROPOSED SYSTEM DESIGN

A VR-based facial emotional expressions presentation system, which combines eye tracking and peripheral physiological monitoring was developed to study the fundamental differences in eye gaze and physiological patterns of adolescents with autism while presented with emotional expression stimuli is presented in this paper. Entire system is composed of three major applications running separately while communicating via a network in a distributed fashion. There were two phases of this study this application desigm: the online phase represents stimuli presentation and eye tracking and physiological monitoring at the other hand the offline phase consists of offline data processing and analysis.

A. Skin Color Tone Detection

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 given as the input. Several computer vision approaches have been developed for skin detection and recognition purposes. A skin detector typically transforms a given pixel into an appropriate color space and then uses a skin classifier to label the pixel whether it is a skin or a non-skin pixel by pattern matching in color space. 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 which is predefined for recognition purpose.

Important challenges in skin detection are to represent the color in way that is invariant or at least insensitive to changes in illumination and lighting effects. Another challenge comes from the fact that many objects in the real world might have color tone similar to the skin tone color. This causes the skin detector to have much false detection in the background. The simplest way to decide whether a pixel is skin color or not, is to explicitly define a boundary for the color. RGB matrix of the given color image converted into different color space to yield distinguishable region of skin or near skin-tone. Color space used for skin detection is HSV. Sobottaka and pitas defined a face location based on HSV[4]. They found that human flesh can be an approximation from a sector out of a hexagon with the constraints[4], Smin=0.23, Smax=0.68, Hmin=0º and Hmax=50º

B. Feature Extraction

In pattern recognition and in image processing the process of feature extraction is a special form of dimensionality reduction which can be used for further processing techniques. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (e.g. the same measurement in both feet and meters) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction[4]. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size image or signal input. The pitch features were extracted only over the voiced regions of the signals. The video motion-capture derived features were occasionally missing values due to camera error or obstructions caused in the data. To overcome this missing data problem, the features were extracted only over the recorded data for each frame. These audio-visual features have been used in previous emotion classification methods also.

C. Weber's law descriptor for image representation

In this section we give an overview of basic WLD descriptor and its extension [5]. This descriptor represents an image as a histogram of differential excitations and gradient orientations and has several interesting properties like robustness to noise and illumination variations, elegant detection of edges and powerful image representation [5]. WLD descriptor is based on Weber's Law [5]. According to this law the ratio of the increment threshold to the background intensity is constant. Inspired by this law, Chen et.al [5] proposed WLD descriptor for texture representation [5]. The computation of WLD descriptor involves three steps i.e. finding differential excitations, gradient orientations and building the histogram[5].

1. Weber's Law

Ernst Weber, an experimental psychologist in the 19th century observed that the ratio of the increment threshold to the background intensity is a constant data. This relationship, known since as Weber's Law, can be expressed as mentioned below:

$$\frac{\Delta I}{I} = k, \tag{1}$$

Where ΔI represents the increment threshold (just noticeable difference for discrimination); &I represents the initial stimulus intensity and k signifies that the proportion on the left side of the equation remains constant despite variations in the Iterm. The fraction ΔI/I is known as the Weber fraction. Weber's Law more simply stated and mentions that the size of a just noticeable difference (i.e., ΔI) is a constant proportion of the original stimulus value. In this part, we describe the two components of WLD: differential excitation (ξ) and orientation (θ). After that we present how to compute a WLD histogram for an input image (or image region).

2. Differential Excitation

For calculating differential excitation $\mathcal{E}$(xc) of a pixel xc first intensity differences of xc with its neighbors xi, i = 1, 2, …, p are calculated as mentioned in the equation below:

$$\Delta I_i = I_i - I_c . \tag{2}$$

Then the ratio of total intensity difference of xc with its neighbors xi to the intensity of xc is determined as defined below [6]:

$$f_{ratio} = \sum_{i=0}^{p-1} \left(\frac{\Delta I_i}{I_c}\right) . \tag{3}$$

Arctangent function is used as a filter on Equation to enhance the robustness of WLD against noise which results in:

$$\varepsilon(x_c) = \arctan\left[\sum_{i=0}^{P-1}\left(\frac{\Delta I_i}{I_c}\right)\right]. \quad (4)$$

The differential excitation may be positive or negative. The positive value indicates that the current pixel is darker than its surroundings and negative value means that the current pixel is lighter than the surroundings.

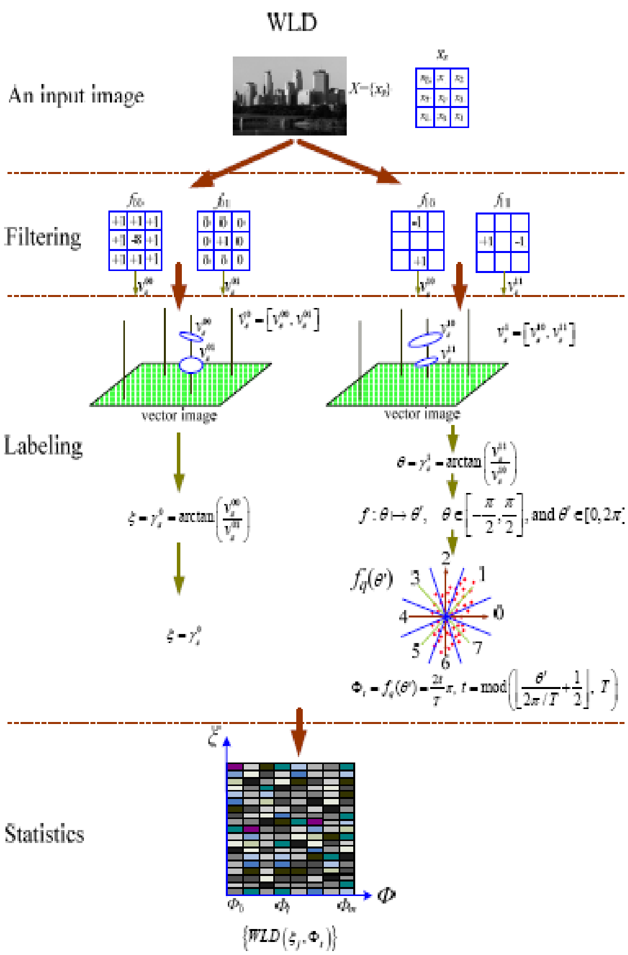


Fig1. Representation of the computation of the WLD descriptor

D. Feature Selection

Feature selection has been an active research area in pattern recognition techniques, statistics analysis, and data mining industries. The main idea of feature selection is to choose a subset of input variables by eliminating features with little or no predictive information from the given samples or data's. Feature selection can significantly improve the comprehensibility of the resulting classifier models and often build a model that generalizes better to unseen points to produce more accurate results. Further, it is often the case that finding the correct subset of predictive features is an important problem in the particular process. For example, physician may make a decision based on the selected features whether a dangerous surgery is necessary for treatment or not by analyzing the disease type and other data's. There were a total of 685 features extracted. However there were only 3000 prototypical and non-prototypical MV sequences that are utilized for testing and training dataset. The feature set was reduced using information gain on a per emotion class basis.

Information gain describes the difference between the entropy of the labels in the dataset (e.g., "happy") and entropy of the labels when the behavior of one of the features 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 in 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 and which is often preferable for many classification algorithms. Information gain was chosen to approximate the feature redundancy of human emotion processing.

IV. FUZZY C MEANS CLUSTERING

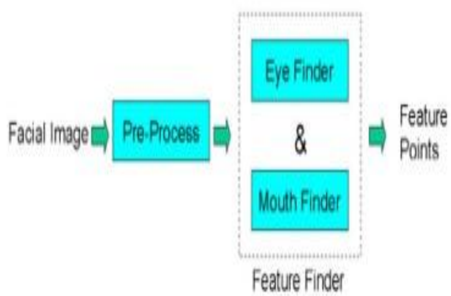
Fuzzy clustering plays an important role in solving problems in the areas of pattern recognition and fuzzy model identification techniques. A variety of fuzzy clustering methods have been proposed and most of them are based upon distance analysis methods. One widely used algorithm is the fuzzy c-means (FCM) algorithm. The FCM program is applicable to a wide variety of geo-statistical data analysis problems from the given data sets. These partitions are useful for corroborating known substructures or suggesting substructure in unexplored data given as the input. The clustering criterion used to aggregate subsets is a generalized least-squares objective function the particular process. Features of this program include a choice of three structures (Euclidean, Diagonal, or Mahalonobis), an adjustable weighting factor that essentially controls sensitivity to noises available in the signal, acceptance of variable numbers of clusters and outputs that include several measures of cluster validity. It uses reciprocal distance to compute fuzzy weights. We have introduced a new algorithm to enhance this particular process a more efficient algorithm is the new FCFM which we have employed in this particular method. It computes the cluster center using Gaussian weights, uses large initial prototypes of inputs, and adds processes of eliminating the noises, clustering and merging of needed data's during the process.

A. Virtual Reality (VR)

Virtual reality is the process of the recognizing the input images and process that input images in the multiple perspective. The VR environment may help facilitate individualization and variation, with possibly speed up the learning of emotional cue. Implied cues offer added understanding of fundamental psychosomatic states which are not be potential using performance-based systems (PBS). This collect the input parameters as a image and image low and high level features. These feature fed into the system of resources. Virtual reality is to calculate the image features and calculate the color distance and gives you the virtual interface for user input. In our proposed work we given virtual reality based output. The objective of this paper is to present an analysis of physiological as well as eye tracking data from a usability study aimed at evaluating the efficacy of an innovative VR-based system for facial emotional expression identification task. These insights will drive development of future adaptive VR-based systems for social interaction.

B. Edge deduction Algorithm for face emotions:

Edge detection is one of the Emotion algorithms used in video segmentation and Human Emotion and its mainly used to find out the edges of a object in image processing and its used for process of determining the shape of a object. Many edge detection algorithms have been proposed in the recent years. An Edge Deduction algorithm for eye detection on face images which includes low resolution ones is presented in this paper. Due to varying lighting conditions the pixel identification may be unreliable in certain conditions. It is main purpose low using resolution images in our project; details of the eyes sometimes are lost due to the unreliable data's in the image. It detects the eyes region on a face initially. Deduction Algorithm consists of a feature finder and a face morphed filter.



$$m_e = \frac{\max(d_1, d_2)}{s} < T \quad (5)$$

D1 and d2 are the distances between the manually labeled eye centers and the eye centers found by the algorithm, s is the distance between the two manually labeled eye centers and T is the threshold used to declare successful detection. Presents the success rates on both databases for various values of the threshold T. Results in those glasses do not introduce significant error in comparison to people not wearing glasses. We are employing the Sobel operator to process the given input image.

Fig2. Grayscale image of a brick wall & a bike rack

Fig3. Edge Detected image of bricks &bike rack

Fig4. X-gradient image of bricks & bike rack

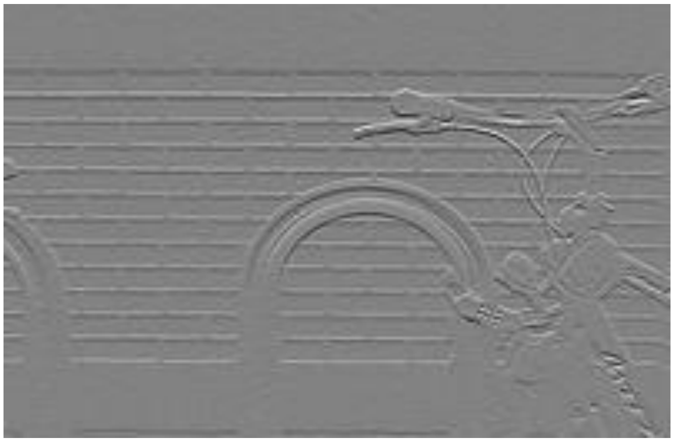


Fig5. Y-gradient image of bricks & bike rack.

C. Final Feature Set

The number of features was determined empirically optimized for accuracy improvement. The final feature set included the top 85features for each emotion class from the database image inputs. The feature sets for anger and sadness are primarily composed of MFBs from the given datasets. The feature sets of happiness and neutrality are composed primarily of a mixture of cheek and mouth features which are identified. The high representation of audio features in the angry and sad feature sets and the low representation in the happy and neutral feature sets reinforce previous findings that anger and sadness are well captured using audio data while happiness is poorly captured using audio data alone from the given set of inputs for feature selection.

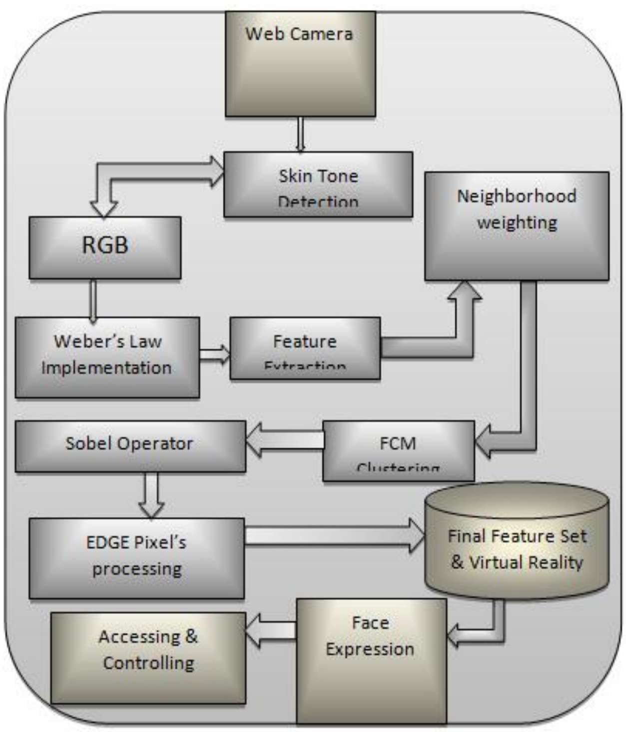


Fig6. Block Diagram of the Proposed Architecture.

D. Background work

Identify unique feature from the face image extract and compare the database feature sets. The purpose of the project is to compare the face image of a person with the existing face images that are already stored in the database and to recognize the faces by finding the closest matching feature. Classification systems designed to output one emotion label per input sequence may perform poorly if the expressions cannot be well captured by a single emotional label at a time. Multiple Algorithms are needed for recognizing the Human emotion and expressions from the given data inputs for ASD applications.Furthermore the TPCF in perceptual colour space has more desirable average recognition rate for facial images under varying illumination situations than existing methods. 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 calculations.

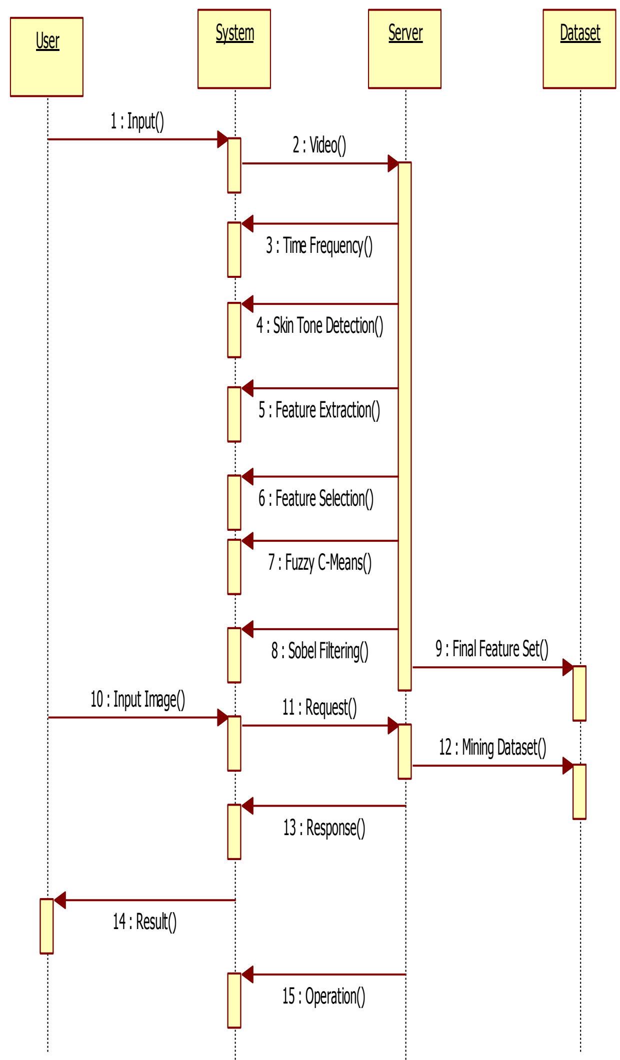


Fig7. Proposed sequence diagram

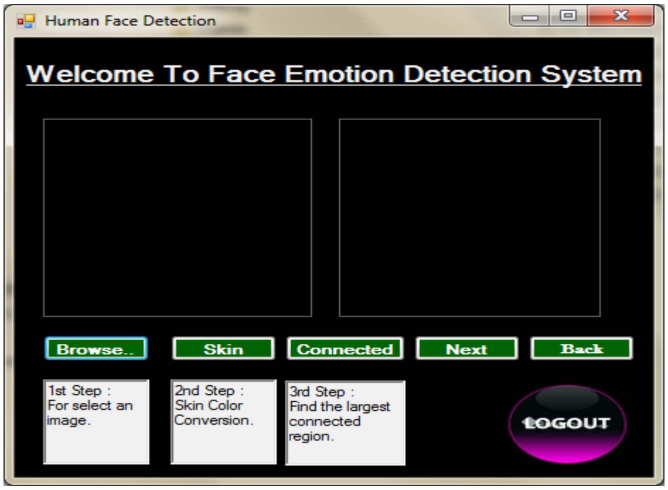


Fig8. Initial window

Fig9. Image Input & Skin detection

Fig10. Detected Face Image

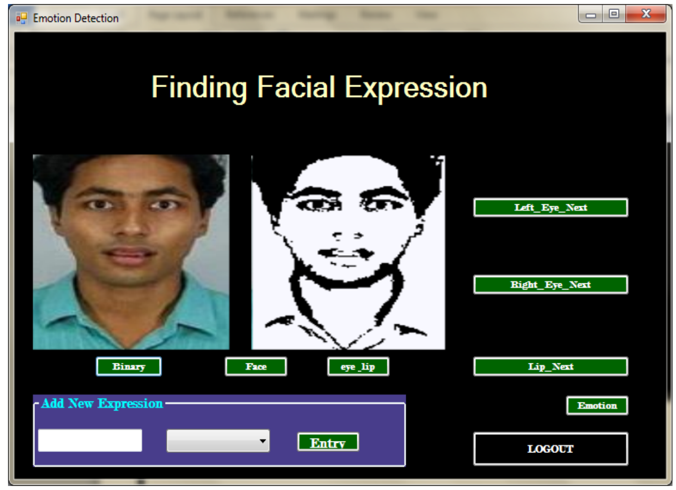


Fig11. Edge Detected Image

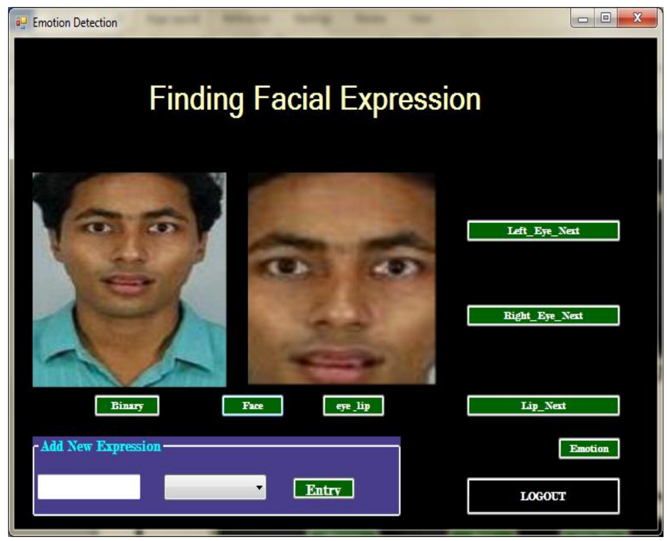


Fig12. Extracted Eye, Nose & Mouth from the Image

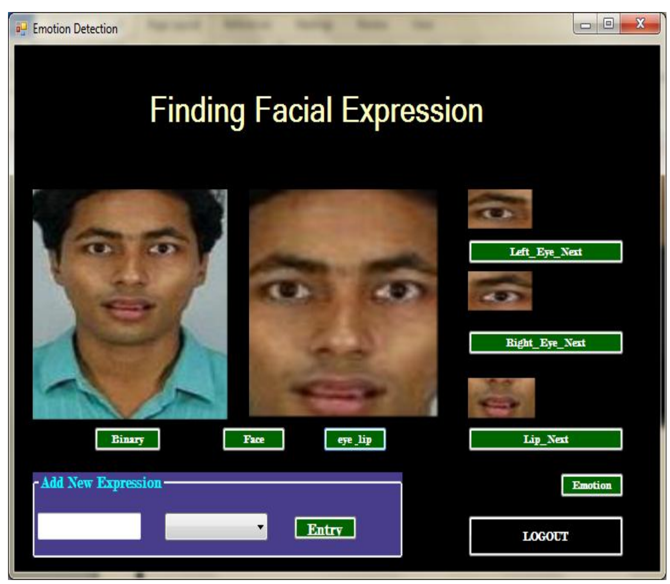


Fig13. Database Matching

V. CONCLUSION & FUTURE ENHANCEMENT

A novel TPCF was proposed for FER system in perceptual colour space. Based on TPCF the RGB colour images were first transformed to perceptual colour spaces after which the horizontal unfolded tensor was adopted to generate the 2-D tensor for feature extraction application. 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. Images taken under slight illumination variation were used to test robustness of the FER system performance which is found to be improved when compared to the existing methods. Experimental results show that the colour components provide additional information to achieve improved and robust performance of the system in terms of recognition rate for all expressions under normal conditions. First this was a static performance driven system and physiological indices were incorporated into online performance and the proposed system modification can be implemented in real time. The overall the method is found to be very effective when compared to the most of the existing techniques. By using High End cameras with less illumination variation the particular process can be done more effectively with the upcoming computing technology for more promising outcomes.

Nanotech Virtual Reality: There is research process is going on about using nanotechnology as a means of allowing us to push beyond the boundaries of the human body and enter into the digital world. So the particular application can be implemented more effectively. This can be used to create illusions (imaginary worlds) that can be simulated on a computer. Various technologies, especially computer games that utilize VR will incrementally reshape how we view society.

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