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Facial Emotion Recognition using Concept Mapping and Feature Extraction

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ABSTRACT

In recent years there has been a rapid growth in study of emotions. Humans use facial expression as a non-verbal communication channel. Human Computer Interaction(HCI) is a developing and interesting field and is useful for further development in recent technology. We have developed a computer vision system that recognizes human expressions based on various action units of upper and lower face parts. Firstly, the face is detected from the input video clip then preprocessing, feature extraction is done and the classification of expression is obtained. Six primary expressions happiness, sadness, fear, disgust, surprise and anger are classified using Facial Action Units. Our process considers Facial Action Coding System(FACs) for classification. Concept Map is used to improve the expression classification accuracy, speed of execution and to reduce the confusion between emotions.

Keywords : Facial Expression, Human-Computer Interaction(HCI), Video, Concept Map, Facial, Action Units

I. INTRODUCTION

Identifying the facial activities in a video sequence is an interesting and a major challenging problem. Presently, many techniques have been developed for the recognition of the facial expressions. Computer should be made more intelligent for an efficient HCI like the way human interact with other human. Humans interact mostly through speech and some physical gestures which provides sensitive cues about facial emotion and are vital for human interaction and non-verbal communication [Automated Facial Expression Recognition Based on FACS Action Units].

The availability of low cost imaging and computational devices are helpful in automatic facial recognition systems to be used in several day-to-day application environments. Emotions are a feeling to a particular situation, as one smile to show greeting, raise voice when they are angry, frown when they are not pleased. This is because we are able to understand other emotions and interact based on that expression, but computers are emotionally challenged, they need someone to teach them those expressions. Machine with the capability to interact with humans will lead to a better Human Computer Interface. By enhancing the communication that exist between humans and computers we will open variety of possibilities in robotics and human computer interaction.

Facial expressions are recognized by certain facial movements depending on the emotional state of humans. The basic need for the identification of facial expression is Face detection, it is followed by feature extraction which helps us to extract relevant features like eyes, nose, eyebrows and mouth from face. Depending upon the features extracted the facial expression is classified.

II. LITERATURE SURVEY

In [11], Velusamy, Sudha, et al have proposed a feature descriptor which is effective in representing the Facial action units(AUs) by considering only the informative region of interest(ROI) on human face. They had performed an in-depth analysis of the state-of-art FER methods to understand their performance gaps under practical conditions. It develops an appropriate ROI selection strategy for every AU and also designed robust Local Binary Pattern(LBP) based descriptor that applies spatially spinning bin support for histogram estimation. Their method is robust in handling challenges likes tracking errors and achieved an advanced performance. an appropriate ROI selection strategy for every AU and also designed robust Local Binary Pattern(LBP) based descriptor that applies spatially spinning bin support for histogram estimation. Their method is robust in handling challenges likes tracking errors and achieved an advanced performance.

In [10] Maninderjit Singh, Anima Majumder and Laxmidhar Behera proposed a hierarchical technique for modelling emotions from facial expressions images using Bayesian Network.

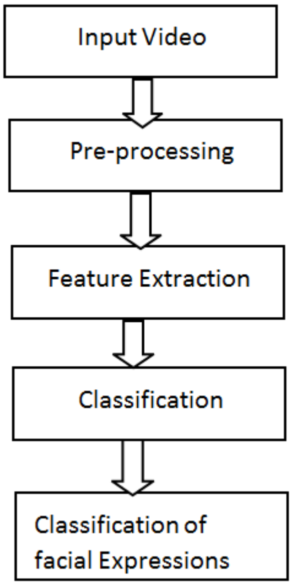

Fig 1: Basic Flow of Facial Expression Recognition System

Probabilistic modelling is used to train the network that draws relationship between facial features, AUs and finally detect six basic emotions. Extended Cohn-Kanade dataset is used which has 327 instances of image sequences from 123 subjects with peak emotions, annotated landmarks and AUs. An average emotion recognition accuracy of 95.7% is achieved.

In [2] Yang Li has introduced a new face recognition algorithm that depends on adaptive 3-D Local Binary Pattern and Singular Value Decomposition technique. This method can successfully extract features of face images with faster recognition rate than other traditional algorithms, they have concentrated on the set of discriminate vectors obtained from test samples as initial knowledge. FEGCv2.0 face database is used which contains 2D face images as well as 3D face images having different expression of different people.

In [3] Latif, M.H,Md.yusof, H.,Sidek,S.N and Rusli,N proposed a method for affective states recognition depended on frontal face(supraorbital, periorbital, mouth and nose region) thermal images. The GLCM features derived from the PCA of the four-level decomposition of 2D-DWT (Daubechies4 Mother wavelet) and LBP features are used to provide useful information related to the affective states.it classified six basic emotions depend on Ekman's Emotion Model exploiting the frontal face thermal images. Thermal image dataset is used which includes six different expression of emotions derived from 30 subjects.

In [9] El Meguid, Mostafa K, Abd and Martin D.Levine discusses the implementation and design of a fully automated comprehensive facial expression detection and classification schema. Proprietary face detector (PittPatt) and a novel classifier including a set of Random Forests paired with support vector machine labellers is used. In addition, this approach achieved real-time performance in a spontaneous environment. For training purpose the acted still-image Binghamton University 3D Facial Expression database was used, while a number of spontaneous expression labelled video database were used for testing.

In [8] Gaus, Yona Falinie A., et al presented an automatic affective dimension recognition system which depends on wavelet filtering and PLS regression for naturalistic facial expressions. Proposed approach is tested on the Audio/Visual Emotion Challenge (AVEC 2014) dataset, the audio and video recordings were divided into three partitions: training, development and testing set of 150 Northwind-Freeform pairs, In total 300 task recordings.

III. CHALLENGES

The challenges related with face expression recognition can be specified as below:

Occlusion: Face may be partially obstructed by other objects. In an Image is the face is obstructed by some other face part or object like mask, glasses or hairs etc. In such case the extraction of expression features is complex.

Pose: The relative camera and face position has a major impact on image of face. There can be a case in which the face has a distinct angle so some facial features such as nose or eyes may become partially or whole occluded. A good pre-processing technique implementation which are invariant to translation, rotation and scaling helps us overcome the above challenges.

Illumination: If the images are taken in different light shades. Then the expression feature can be detected inaccurately and that results in a lower rate of facial expression recognition and thus lead to difficulty in the process of feature extraction. To deal with the variation of light in an input image, image preprocessing techniques like DCT normalization, Histogram Equalization, Rank Normalization can be applied before feature extraction.

IV. PROPOSED APPROACH

The system is working in following phases:

1. Acquiring Video clip as Input
2. Framing of clip
3. Preprocessing
4. Feature Extraction
5. Classification

a) Framing

For input of the expression recognition system, Video clips are randomly taken from YouTube and GitHub database. Firstly, the video clip is divided into number of frames. Xuggler library is used for framing, it allows java programs to modify any format of video. The video is framed at every 0.1th second with the help of Xuggler library. These frames are further used as input to the facial expression system.

b) Preprocessing

In this step, the facial features like face, eyes, nose and mouth is detected from each video. The haar like features (digital image features) are used to detect face, eyes, nose and mouth [11,12], with these features, detection accuracy is improved with less computation time [13]. Haar feature is a single value which is obtained with calculation of pixels. Adjacent rectangular area at a specific location of image is considered for Haar like feature calculation. Then the pixel intensities in each separate region is added and the difference between the sums is obtained. This difference is used as a feature to differentiate the subsections of an image.

Face detection process:

The Video clip is given as input to the system which gets divided into frames and later the face, eyes, nose and mouth is detected.

i. Load the required XML classifiers OpenCV as of now contains numerous pretrained classifiers for confront, eyes, grin and so forth.

ii. Load input picture in grayscale design.

iii. Use vz.cascadeClassifier.detectMultiScale() to discover faces or eyes

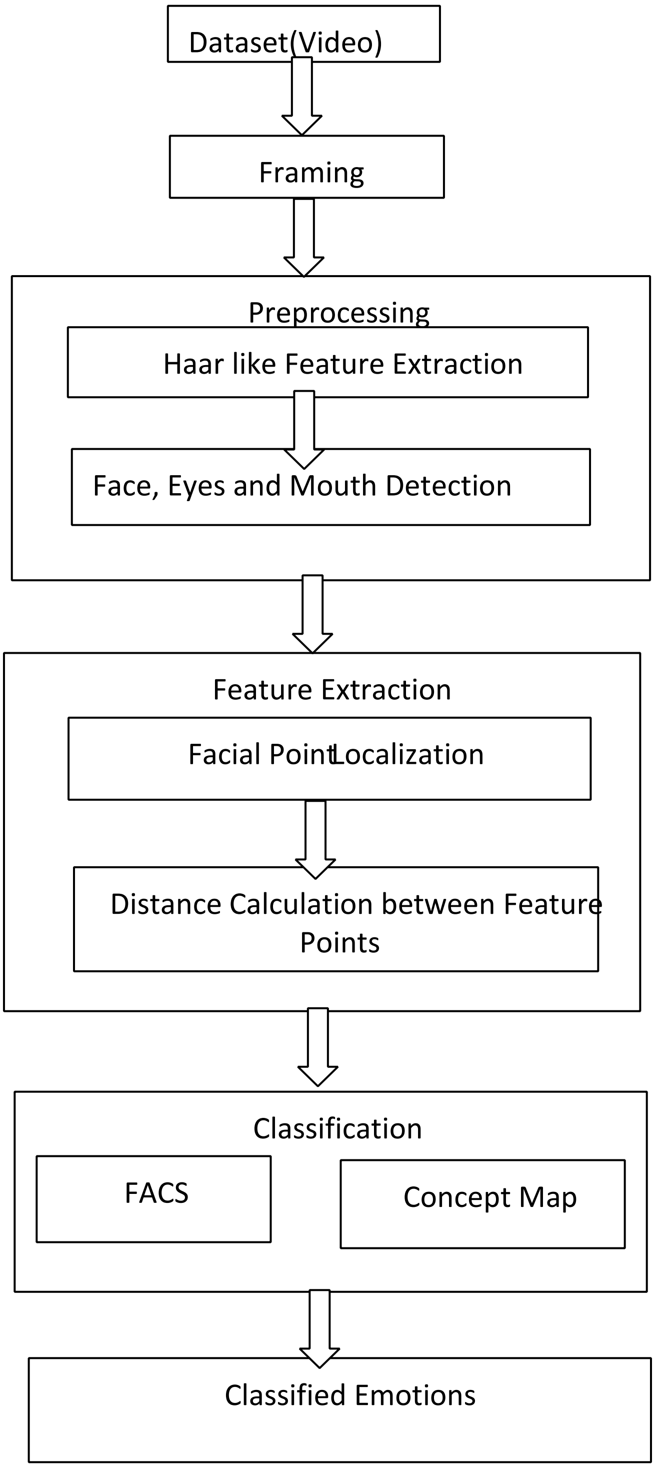

Fig 2: Proposed System Architecture

iv. If faces are discovered, it restores the situation of distinguished faces as Rect(x, y, w, h) Once get areas, make Region of Interest (ROI) for confront and apply eye recognition on the ROI

c) Feature Extraction

In this progression, highlights of eyes, mouth and face are extricated with following strategies:

Feature point Localization: In this progression, boundaries are distinguished and include focuses are restricted on eyes, eyebrows, lips, cheek and nose. Feature point localization is the vital advance for feature extraction. This will assist us with calculating the feature vector. Feature point localization [14] is an iterative technique which at first gauges the underlying position of feature points. At that point look through the neighbouring vertices around each element point on a face picture. In this framework, 17 Feature points are utilized as appeared in figure 3, including:

6 Points on Left and Right eyebrows
4 Points on left and right eyes corner
2 Points on left and right upper eye covers
1 Points on nose 2 Points on left and right cheeks 2 Points on lip corners.

This framework makes utilization of Flandmark model for localization pf points. For each frame, Flandmark_model.dat file is call to put 17 focuses on face legitimately.

Feature Vector Formation:

Here, distance between [15, 16] each feature point is ascertained for each frame picture. As the separation between feature points fluctuates in all condition of emotion and expression. In this manner this feature vector assumes critical part in feeling recognizable proof framework. This separation is figured based of X and Y directions of each component point. Every one of these separations are put away in vector arrange. This feature vector is utilized to choose the emotion label and action unit of each frame.

Feature Vector taken as follows:

FV = {d1, d2, d3, d4, d5, d6, d7} Where, d1 = Distance amongst F1 and F6 d2 = Distance amongst F3 and F4 d3 = Distance amongst F2 and F8 d4 = Distance amongst F5 and F11 d5 = Distance amongst F13 and F16 d6 = Distance amongst F14 and F16 d7 = Distance amongst F15 and F17

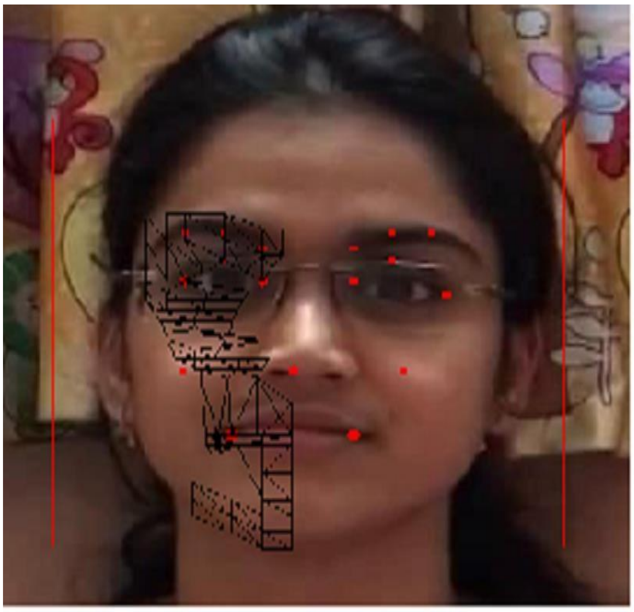

Fig 3: Facial Feature Points

For each picture, we have to distinguish the emotion label. This emotion label is processed with the assistance of FACS [17] and feature vector of each picture. The action units of upper face and lower face are delineated in figure 4 and 5 individually.

Fig 4: Action units of Lower face [18]

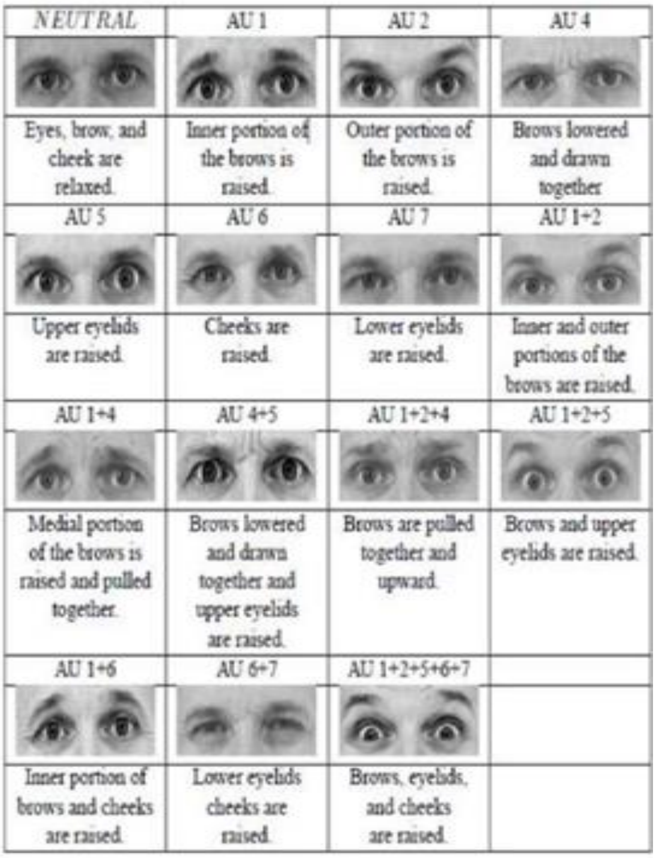

Fig 5. Action units of Upper face [18]

The NetBeans (variant 6.9) is utilized as development tool. The system doesn't require any specific hardware to run; any standard machine is equipped for running the application . For framing of vid eo FFMPEG tool is utilized and for Face detection Haar like features [25] are extricated by utilizing the OpenCV library.

Figure 6 portrays the outcome correlation of classifiers utilized for influence acknowledgment. Classification time is estimated as far as milliseconds. Concept Map is speedier than SVM. since it does not get confused to classify the confusing emotions.

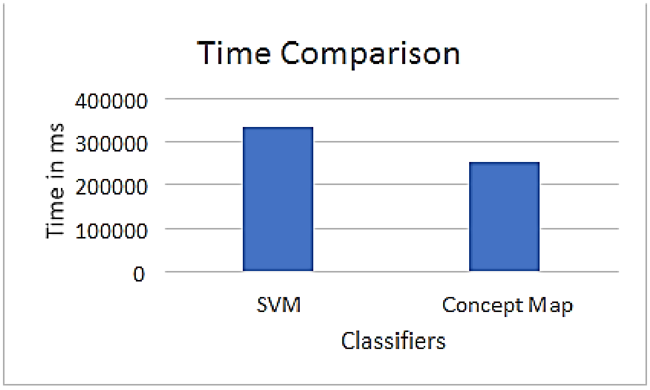

Fig 6: Time Comparison

Figure 7 portrays the precision correlation of Concept Map and SVM classifier. Exactness is estimated as faas rate.Concept Mapprecisely order the feelings like happy, sad, disgust, fear, surprise and angry based on action units. Along these lines, Concept Map is more precise than SVM.

d) Classification with Concept Map.

Here, the test video is ordered by 6 emotions portrayed in table 1. Test video is likewise experiencing framing, preprocessing and feature extraction steps. For classification, Concept Map [19] and FACS is utilized. After feature extraction of all frames of information video, among feature, individual value and distinguished emotion label. This progression is rehashed for all frames. This information is dealt with as training data. For test video, concept map is produced which is classified against the trained concept map. It will restore the fitting emotion label of test video.

V. RESULTS AND DISCUSSION

The system is fabricated utilizing Java framework (version jdk 6) on Windows stage.

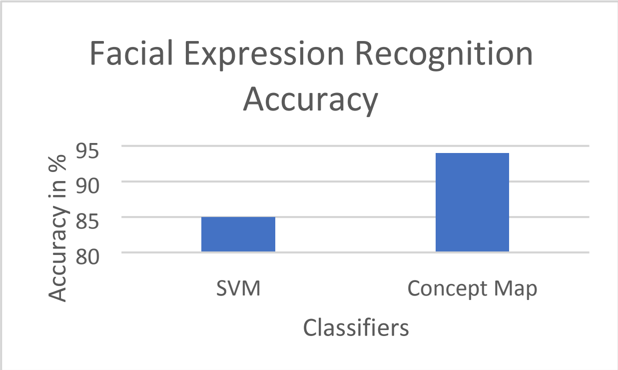

Fig 7: Facial Expression Recognition Accuracy

VI. CONCLUSION

This Paper shows the human facial expression recognition system for given input video. Framework consolidates different strategy to achieve the high recognition rate. At first, framework makes utilization of Xuggler library for framing, after this Haar like highlights are utilized for Face recognition, at that point FACS and feature points are utilized for feature extraction and at last Concept map is used to fitting characterization of human feeling in given video. This system achieves higher speed and precision than SVM classification algorithm.

VII. REFERENCES

[1] Kim, Jonathan C., and Mark A. Clements, "Multimodal affect classification at various temporal lengths," IEEE Transactions On Affective Computing 6.4, 2015, pp. 371-384.

[2] Li, Yang. "Novel face recognition algorithm based on adaptive 3D local binary pattern features and improved Singular Value Decomposition method." Inventive Computation Technologies (ICICT), International Conference on. Vol. 3. IEEE, 2016.

[3] Latif, Mohd, Shahrul Na'im Sidek, and Nazreen Rusli. "Texture descriptors based affective states recognition-frontal face thermal image." (2016): 1-6.

[4] M. Z. Uddin; M. M. Hassan; A. Almogren; A. Alamri; M. AlRubaian; G. Fortino, "Facial Expression Recognition Utilizing Local Direction-based Robust Features and Deep Belief Network," in IEEE Access, vol.PP, no.99, pp.1-1.

[5] Matlovic, Tomas, et al. "Emotions detection using facial expressions recognition and EEG." Semantic and Social Media Adaptation and Personalization (SMAP), 2016 11th International Workshop on. IEEE, 2016.

[6] Mayya, Veena, Radhika M. Pai, and MM Manohara Pai. "Combining temporal interpolation and DCNN for faster recognition of micro-expressions in video sequences." Advances in Computing, Communications and Informatics (ICACCI), 2016 International Conference on. IEEE, 2016.

[7] Das, Arundhati, Mameeta Pukhrambam, and Ashim Saha. "Realtime robust face detection and tracking using extended haar functions and improved boosting algorithm." Green Computing and Internet of Things (ICGCIoT), 2015 International Conference on. IEEE, 2015.

[8] Gaus, Yona Falinie A., et al. "Automatic affective dimension recognition from naturalistic facial expressions based on wavelet filtering and PLS regression." Automatic Face and Gesture Recognition (FG), 2015 11th IEEE International Conference and Workshops on. Vol. 5. IEEE, 2015.

[9] El Meguid, Mostafa K. Abd, and Martin D. Levine. "Fully automated recognition of spontaneous facial expressions in videos using random forest classifiers." IEEE Transactions on Affective Computing 5.2 (2014): 141-154.

[10] Singh, Maninderjit, Anima Majumder, and Laxmidhar Behera. "Facial expressions recognition system using Bayesian inference." Neural Networks (IJCNN), 2014 International Joint Conference on. IEEE, 2014.

[11] Velusamy, Sudha, et al. "Improved feature representation for robust facial action unit detection." Consumer Communications and Networking Conference (CCNC), 2013 IEEE. IEEE, 2013.

[12] Özmen, Gonca. "Facial expression classification with haar features, geometric features and cubic bézier curves." (2013).

[13] Wilson, Phillip Ian, and John Fernandez. "Facial feature detection using Haar classifiers." Journal of Computing Sciences in Colleges 21.4 (2006): 127-133.

[14] Viola, Paul, and Michael Jones. "Rapid object detection using a boosted cascade of simple features." Computer Vision and Pattern Recognition, 2001. CVPR 2001. Proceedings of the 2001 IEEE Computer Society Conference on. Vol. 1. IEEE, 2001.

[15] Guan, Peng, Yaoliang Yu, and Liming Zhang. "A novel facial feature point localization method on 3D faces." Image Processing, 2007. ICIP 2007. IEEE International Conference on. Vol. 3. IEEE, 2007.

[16] Punitha, A., and M. Kalaiselvi Geetha, "HMM Based Real Time Facial Expression Recognition," International Journal of Emergine Technology and Advanced Engineering 3.1 2013, pp. 180-185.

[17] Wang, Liwei, Yan Zhang, and Jufu Feng. "On the Euclidean distance of images." IEEE transactions on pattern analysis and machine intelligence 27.8 (2005): 1334-1339.

[18] Tian, Y-I., Takeo Kanade, and Jeffrey F. Cohn. "Recognizing action units for facial expression analysis." IEEE Transactions on pattern analysis and machine intelligence 23.2 (2001): 97-115.

[19] Lien, James J., et al. "Automated facial expression recognition based on FACS action units." Automatic Face and Gesture Recognition, 1998. Proceedings. Third IEEE International Conference on. IEEE, 1998.

[20] Novak, Joseph D., and Alberto J. Caas. ”The theory underlying concept maps and how to construct and use them.” (2008).