Computer-Vision Based Expression Recognition in Classroom

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Abstract **–** Human emotional facial expressions play an important role in interpersonal relations. This is because humans demonstrate and convey a lot of evident information visually rather than verbally. Although humans recognize facial expressions virtually without effort or delay, reliable expression recognition by machine remains a challenge as of today. To automate the recognition of the emotional state, machines must be taught to understand facial gestures.

This paper gives a survey of different techniques for recognizing facial expression. The abstract view of the proposed system is given here for recognizing the emotions with higher accuracy. It helps to detect the face from the input image using Haar-Cascade face detection algorithm and to evaluate the face and Emotion from Students Face using the SVM classifier.

Keywords: Facial Expression Recognition, Face Detection, SVM Classifier, HAAR Classifier,

I. INTRODUCTION

Face plays a significant role in social communication. According to the psychological research nonverbal part is the most informative channel in social communication. The verbal part contributes about 7% of the message, vocal – 34% and facial expression about 55% to the effect of the speaker's message [11].

Emotional aspects have a huge impact on communication. Emotion recognition is carried out diversely, it may be verbal or non-verbal.Voice (Audible) is a verbal form of communication & Facial expression, action, body postures, and gesture is a non-verbal form of communication. Social intelligence like communication understanding, decision making and also helps in understanding the behavioral aspect of humans. Emotion plays a pivotal role during the analysis of facial expression plays fundamental roles for applications that are based on emotion recognition like Human-Computer Interaction (HCI) [12], Social Robot, Animation, Alert System & Pain monitoring for patients.

Student engagement is a key concept in contemporary education, where it is valued as a goal in its own right. We explore approaches for automatic recognition of engagement from students' facial expressions. We studied whether human observers can reliably judge engagement from the face; analyzed the observers of the signal used to make these judgments; and automated the process using machine learning. Machine learning plays a vital role in image processing projects where images captured in the form of frames are given as input to the algorithms where they can classify or cluster similar images based on some user-specified criteria or requirements and the result can be represented in user understandable graphical user interface. There are various machine learning techniques to classify data efficiently.

Live data capture and then processing it in real-time to produce result sets is the main aim behind this concept of students' facial expression detection. Capturing frames from video gives the required input to the application. Emotions expressed by the student are depicted by detecting the facial expression of the student that can be used as one of the aids for taking an overview of the lecture that is conducted in educational institutes. Accordingly, the teaching strategies can be modified and new teaching techniques can be evolved.

Facial expression is one or more motions or positions of the muscles beneath the skin of the face. These movements express the emotional state of the person to observers. The figure shows the expression classification of an image.

Figure: 1 Expression Classification

It is a form of non-verbal communication. It plays a communicative role in interpersonal relations. The different facial expressions are given in the figure 2.The common ones are

Facial expression recognition is composed of three major steps:

(1) Face detection and pre-processing of image.

(2) Feature extraction.

(3) Expression classification.

Figure:2 Facial Expressions.

II.LITERATURE REVIEW

Dolly Reney et al.[5] presents gives an efficient method to detect the face and emotion of the person. Mel frequency components of the human voice are used for detecting the voice features along with the Viola-Jones face detection algorithm and KNN classifier.

Yuan-Chih Yu et al.[6] proposes a feedback system in the Digital Classroom Environment. Here the learning agent provides instructional and social feedback to the teaching agent. The head movement as a kind of social feedback system is a unique feature of the proposed system by using Rule-based classification.

Hamdi Dibeklio˘glu et al.[7] gives "Combining Facial Dynamics With Appearance for Age Estimation". Age estimation is an active topic today due to the growing necessity of understands requirements or preferences in different aspects of the daily life of a person. The proposed system can extract and use dynamic features for age estimation with the help of a person's smile. Since the smile is one of the most frequently used facial expressions, as well as the easiest emotional facial expression to pose voluntarily In addition the novel hierarchical age estimation architecture based on adaptive age grouping including an exploration of spontaneous versus posed smile dynamics, and gender-specific age estimation which gives the error reduction up to 21\% in appearance-based age estimation.

Yun-Fu Liu et al.[8] gives simple and fully automatic panoramic image based pose-invariant face recognition method is presented which gives the face image captured at an arbitrary angle within ±45° in yaw and ±22.5° in pitch during identification to give an excellent accuracy with low complexity. The local morphing treatment is used to deal with all of the possible geometric distortion problems in the recognition phase.

Xiang-Yu Li, Zhen, et al.[9] demonstrated proposed that recognition face using HOG features and PCA algorithms[14]. By applying the recognition algorithm to cropped faces images from that we get similarity b/w taken image and database image. In this paper the PCA algorithm used for face detection and recognition.

Jyh-Yeong Chang et al.[10] proposed an automatic facial expression recognition system using neural network classifiers. The author uses the rough contour estimation routine, mathematical morphology, and point contour detection method to extract the precise contours of the eyebrows, eyes, and mouth of a face image. Here 92.1\% accuracy is obtained by facial characteristic point's movements, as the input vectors for two different neural network-based expression classifiers including radial basis function network and multilayer perceptron network.

Raja Ghasemi et al.[10] proposed a system for facial expression recognition based on Fuzzy logic. The system can recognize seven basic facial expressions namely fear, surprise, happy, sad, disgust, Neutral and anger. First, a method for facial region extraction from a static image is explained. Integral projection curves are used to determine face effective areas. This method has a high ability in the intelligent selection of areas in the facial expression recognition system. Extracted facial features fed to a fuzzy rule-based system for facial expression recognition.

A. Techniques Used

a. Ada Boost Algorithm

Adaboost is a machine learning boosting algorithm capable of constructing a strong classifier through a weighted combination of weak classifiers. (A weak classifier classifies correctly in only a little bit more than half the cases.) To match this terminology to the presented theory each feature is considered to be a potential weak classifier. A weak classifier is mathematically described as:

$$h(x, f, p, \theta) = \begin{cases} 1 & \text{if } pf(x) \rhd p\theta \\ 0 & \text{otherwise} \end{cases}$$

Where x is a 24*24 pixel sub-window, f is the applied feature, p the polarity and the threshold that decides whether x should be classified as a positive (a face) or a negative (a non-face) [1].

b. VIOLA-JONES FACE DETECTION [2][5][13]

Voila Jones is the oldest and most recognized face algorithm available for the face detection from the image. The basic principle of the Viola-Jones algorithm is to scan a sub-window capable of detecting faces across a given input image. The standard image processing approach would be to rescale the input image to different sizes and then run the fixed size detector through these images. This approach turns out to be rather time consuming due to the calculation of the different size images. [2] Viola-Jones has devised a scale invariant detector that requires the same number of calculations whatever the size. This detector is constructed using a so-called integral image and some simple rectangular features reminiscent of Haar wavelets.

c. k Nearest Neighbor (KNN) [3][14][15]

The k Nearest Neighbor (KNN) is one of the most commonly used methods for pattern recognition and has been applied in a variety of cases [3]. KNN Classifier works as follows. First for each one of the training set elements a classification of it is performed based on various neighborhoods. The k value that maximizes the DC of each classification is found. Therefore, for each training set there corresponds a particular k value which is considered the best available. Afterwards, for each unknown element, the nearest neighbor is found and its k value is assumed (based on the "optimum" k array). Then, the KNN classifier is applied on that test element, using that k value. As a concept, this is something similar to one of the ideas presented in [3].

d. HoG algorithm[4][9]

The first step in emotion detection is the extraction of the facial region. To accomplish this HoG algorithm is implemented. However, some small adaptations are made in the original algorithm. The initial step of the HoG algorithm [4]: color normalization with a power law equalization, can be discarded. The reason is due to the modest effect it has on performance because similar results are obtained by the subsequent descriptor normalization. The pixel gradients in the x- and y-direction are now calculated for a n *n pixel cell. Therefore two 1-D point centered masks are used.

III. PROPOSED SYSTEM

Here we propose an efficient, reliable system to calculate boredom on student face which can be also a feedback generation system from student facial expression.

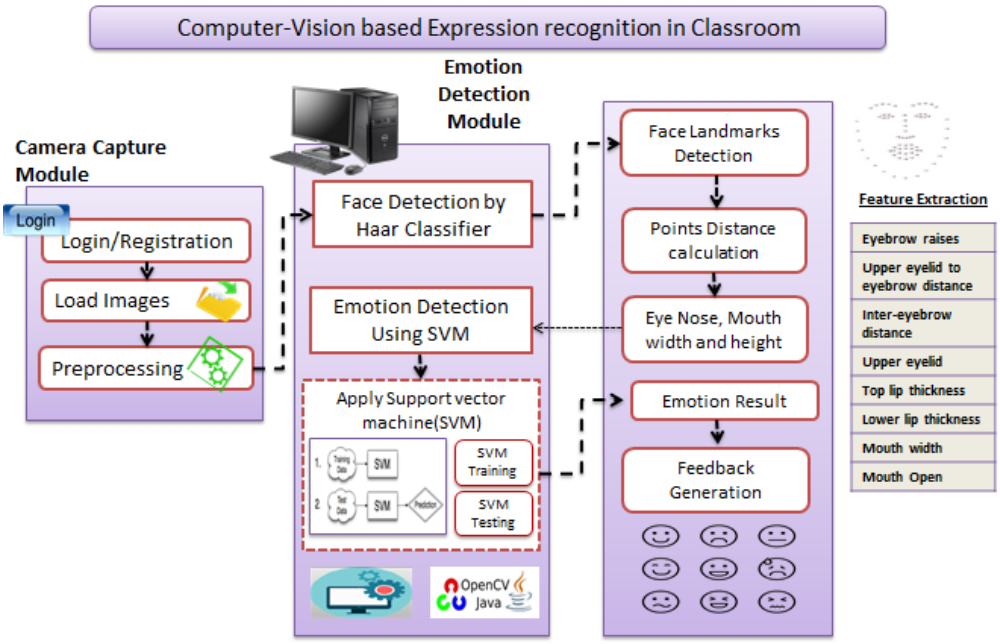

Figure 3: System Architecture

1. **Frame Extraction / Live Camera:**
   User uploads a video / grabs images using live camera on the application, application then extracts frames from the video. These frames are saved on local machine. Frames are usually in 640x480 formats.

2. **Face Detection :**
   Apply the Haar cascade Classifier for the face detection in images.

3. **Pre-Processing on images :**
   Once we get the faces apply the preprocessing on images like noise removal, normalization etc.

   a. **RGB to Gray Scale Image :**
   Convert the image into Gray scale by taking the average of the each pixel RGB.
   b. **Image Normalization :**
   Normalization is a process that changes the range of pixel intensity values to avoid mental distraction or fatigue from the images.
   c. **Noise Removal :**
   Removing errors in the image acquisition process that result in pixel values that do not reflect the true intensities of the real scene.

4. **Feature Extraction**
   A SVM consists of an input and an output layer. SVM will classify the features on the basis of training dataset. Extracts the Features of faces from the image like nose, lips, and eyes in the form of points as follows,
   i. Eyebrow raises
   ii. Upper eyelid to eyebrow distance
   iii. Inter-eyebrow distance
   iv. Upper eyelid
   v. Top lip thickness
   vi. Lower lip thickness
   vii. Mouth width
   viii. Mouth Open

5. **Feature Calculation**
   In the phase all extracted features are calculated and determine the eyes, mouth and nose location on person face. On basis of this calculation face motion is detects.

6. Emotions Detection and Boredom Calculation:

By applying SVM classifier on the extracted features Happy, Neutral, Sad emotions also called as boredom can be calculated.

VI. CONCLUSION

This survey is investigating various face detection, feature extraction and expression classification methods and techniques we conclude that effective facial expression recognition can be achieved using various algorithms and feature extraction techniques. Various classifiers have been discussed. Hence, the extension of this work will review all the above-mentioned techniques and methods to detect the faces.

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