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Facial Emotion Recognition System Using Machine Learning

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***Abstract*: FER system is growing attention in the research field. The face emotions are rely upon facial expressions and its classification. Emotions play crucial role in silent communication which involves gestures, postures, expression, etc. There are eight universal facial emotions i.e. happy, sad, anger, fear, surprise, disgust, neutral, contempt [1]. The emotion detection of face image is highly used in the field of machine learning and artificial intelligence. Many researches are in progress to get the human sentiments on facial emotions. In the field of robotics the classification of facial emotion play a vital role in improving human-machine interaction [2]. In this paper, we are detecting facial emotions based on real time as well as static images. In this paper, we have used Japanese female face expressions database (JAFFE), Extended Cohn-Kanade (CK+) Database that contains many images with 640 x 480 pixels. In this paper we are using Haar feature classifier for face detection and feature extraction purposes and it is further preprocessed for facial landmarks. These facial landmarks with the dataset is trained using SVM algorithm and then classify them on the basis of eight universal emotions.**

***Keywords*: Haar, Support vector machine, Facial emotion recognition.**

1. Introduction

Detecting the emotions of human is demanding topic in the field of machine learning. Facial Emotions can be negative as well as positive. The positive emotions are love, joy, happy whereas negative emotions are lonely, anger, rage and disgust. The basic steps of recognising facial Emotion are: the raw image is taken for the detection of face, then facial features are extracted and then classifiers are used for the recognition of emotion as result. In this project, datasets should be well defined and sorted. Then the face is identified in all the images using the Haar feature classifier [3] and then pre-processing of image is done. The classification is done using the Support vector machine classifier [4] because it provides accurate results.

The training of dataset is performed on 80% of the data and classification is done on the remaining 20%. These process are done on the Japanese female face expression datasets of still images. Emotions can also have detected using sequence of images, where the facial landmarks which will consist the eyebrows, nose, jawlines, mouth corners of the face. These facial landmarks is used for feature extraction by calculating the distance between facial points [4]. After the extraction of these features, the machine learning algorithms were applied for training and classifying the different emotions.

2. Literature Review

The challenges faced by researchers in the field of face detection and emotions prediction is the shortage of spontaneous expression of data. Capturing spontaneous expressions on images and video is the biggest challenge [5]. Zhang et al is one of the researcher who found two types of features, the geometry-based features and Gabor wavelets based features for emotion recognition. Appearance based method was used for face detection strategies and Local Binary Pattern, Haar classifier, AdaBoost, are the feature extraction in related field [3]. Histogram of Oriented Gradient (HOG), SIFT, Gabbor Fitters and Local Binary Pattern (LBP) are the releated algorithms used for representation of extracted facial features [6], [7]. Local binary pattern is a simple and effective algorithm used for labelling the pixels of an image by thresholding the neighborhood of each pixel and gives the output as a binary number [9]. HOG was first proposed by Dalal and Triggs in 2005 which is used in the appearance of gradient orientation in a local path of an image. The Classification is done by different algorithms like Neural Network, Machine learning, Support Vector Machine, Naive Bayes, Deep Learning. The histogram is formed by using the representation of facial feature that will also use Support Vector Machine (SVM) for emotion recognition. SVM builds a hyperplane to separate the high dimensional space. A good separation is gained by ensuring the largest distance between the hyper plane and the training data [8]. The local binary pattern gives the highly accurate testing results.

3. Dataset

We have taken the Extended Cohn-Kanade Database (CK+) database which contains the set of static images with different emotions. In this project, we have used Python and OpenCV (open source computer vision for implementation. We have used python 3.6 (Anaconda + spyder ide). Dlib library was installed for extracting facial features.

4. Methodology

The emotions are detected using the different features associated with the face. The facial emotion recognition system is categorised into 3 steps: face detection, feature extraction, and classification. The Haar feature classifier is used for feature extraction then image is preprocessed properly for converting it into greyscale. Then the training of dataset and classification set is done for the estimation of performance of classifier. The emotion is then predicted using fisher face classifier [10]. The Support Vector Machines (SVMs) classifier technique is used to classify the eight facial emotions. SVMs are supervised learning methods, which is used to find the optimal separating plane that analyzes data and recognize pattern used for regression analysis. In SVM, the optimal hyperplane is used for separating the clusters of vectors. The cases with one category of the variable are on one side of the plane and cases with the other category are on the other side of the plane. A separation between the two classes is done by building a maximal margin hyperplane. The margin maximizes the distance between the classes and the nearest data point of each class. The greater is the separation, the lower is generalization error of the classifier [11].

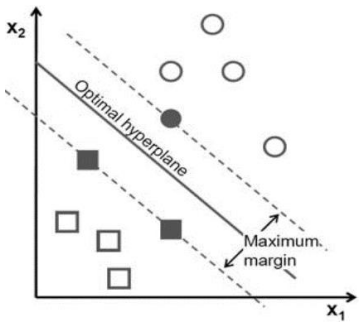
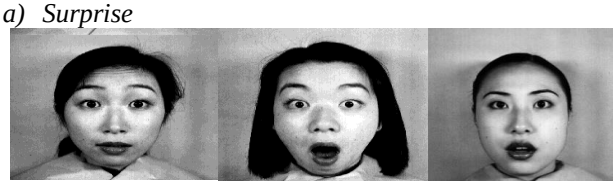


Fig. 1. Working of SVM

5. Result

In the series of still images from the Japanese female face expression datasets, the facial emotion are detected with high accuracy rate. All the images of datasets are detected and feature are extracted using haar feature classifier and were converted to grayscale and further preprocessed [12]. The figure 2 shows the images from the datasets which consist images with recognised emotions. In real time emotion recognition, the webcam is used for recording the video and facial points were marked for extracting the facial features and support vector machine classifier is used for recognising the resultant facial emotion as shown in figure 3.

a) Surprise



b) Angry

Fig. 2. Recognised emotions with high accuracy

Fig. 3. Facial landmarks for emotion recognition

6. Conclusion

In this paper, we described facial emotion recognition using machine learning algorithms which classify these eight different emotions. Here both the still images as well as sequence of images are used. we have used many algorithms for the classification purpose but the best result has come by using support vectors machines with the accuracy rate of approximate 91.3% and also SVM has reduced the computation complexity and improved the performance. Facial emotion recognition is a very complicated and challenging task. More efforts need to be made so as to improve the performance rate for important applications. Our future work will focus on enhancing the performance of the system and finding more accurate classifications which may be useful in many real life applications.

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