Research Article

Student Expression Recognition by Machine Learning Techniques

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Abstract

Sentiment Analysis is an intellectual process of extricating user's feelings and emotions. Automatic recognition of face and identifying emotions of individual plays significant role in the development of human being- computing machine interaction (HCI). Facial expression recognition in real time should be accurate and efficient. The proposed approach consists of two modules. The first module detects the face in the group of people and in the second module the classification of emotion is performed. To detect face Haar feature based cascade classifier is used, since it is real time and performs better after compared to other face detectors. Support Vector Machine, KNN and Neural Network classifiers are used for training and classification of emotion. Model is trained on Indian Spontaneous Emotion Dataset (ISED). Model is trained to detect 7 emotions i.e. Angry, Fear, Disgust, Sad, Happy, Surprise, and Neutral.

Keywords: *Face Detection, Person Identification, Emotion Recognition, Neural Network, Local Binary Pattern Histogram, Sentiment Analysis*

Introduction

This Facial Expression is a significant mode of communicating human emotions. Sentiment Analysis deals with natural language processing to study peoples opinion, attitude or emotions about a product, service, person, circumstances or a thing.

Ages ago, opinions of friends and relatives were used to perform sentiment analysis about any product or services by conducting surveys and polls. For past few years textual format is used to expression sentiments. The topic of spontaneous facial expression recognition was relatively neglected till 2011. But nowadays people prefer in expressing emotions through videos through Instagram, Facebook, etc.

Facial emotions is challenging to determine the state of mind of an individual. Humans cannot keep eye surveillance on an individual, where automated emotion recognition system plays an important role.

Large number of people can be observed in closed area like office and determine emotion of employees and find out whether the employee is having a suitable environment at home as well as office.

Emotion recognition using image involves central step of detection of face. Since human face have influential behavior, hence high degree of inconsistencies which leads to a challenge for face detection. Face detection involves segmentation, extraction and verification[1] of faces and facial features from background images

After detecting face in video, features are extracted from human face, used to determine emotions expressed in these images. Real time data-set is used to determine the identity of the person and train the model to identify the 3 expressions namely happy, sad and surprise.

The objective of this research paper is to develop a system which can automatically recognize the face of an individual in a closed area in a video displaying the identity of the person and classify the emotion of person. The proposed system will first detect the face in video by using haar feature based cascade classifier and then extract facial features to identify person and classify emotions in video. For feature extraction local binary pattern method is used and to classify emotions supervised machine learning algorithm. The results obtained by supervised machine learning algorithm is compared with the results obtained by using neural network technique.

It can be used for automatic detection of a person in office and can be useful in recognizing the state of mind of employee and how it could affect the performance of the company.

Literature Survey

To perform feature extraction various techniques like geometry based, appearance based, color based and template based can be used. Emotion classification can be done by machine learning and neural network techniques. Tessy Mathew and Jayalekshmi J [1] have used Viola Jones Face Detection algorithm for face localization. Local Binary Pattern, Zernike moments and DCT Tramsform methods are used to extract facial features. Features are combined by subset feature

selection algorithm and hence trained and classified using SVM, KNN classifier and Random classifer with the recognition rate of 90.1%.

Urvashi Bakshi and Rohit Singhal [6] concludes various methods to perform feature extraction. Geometric feature based approach perform analysis based on local features such as nose, eyes, lips and their geometric relationships. Template based techniques detects and describes features of faces using appropriate energy function template. Appearance based approach process image as two dimensional pattern.

M. Shamim Hossain and Ghulam Muhammad [2] proposed an emotion recognition for mobile applications. Viola jones algorithm is used to detect face in real-time. Bandlet transform is applied to geometric structure of image by calculating the geometric flow to deal with sharp fetaures of face in the form of bandlet bases. Feature selection is done by Kruskal-Wallis technique and fed into a Gaussian mixture model based classifier for emotion classification with the recognition rate of 99.7%.

Mostafa K. Abd El Meguid and Martin D. Levine[3] proposed a system uses PittPatt for feature extraction based on appearance based approach. A collection of random classifier is used for emotion classification.

Divya Mangala B.S and Prajwala N.B[4] proposed a methodology to perform emotion recognition using eigen faces based on calculating euclidian distance.

Michael and Sam[5] performed a survey on the various techniques for preprocessing, feature extraction and classification on various databases of images. Region of Interest segmentation method, gabor filter and Support vector machine gave remarkable results respectively for preprocessing , feature extraction and classification. JAFFE and CK database are used for efficient performance.

Caifeng et al. [7] evaluted LBP features for personindependent for feature extraction, classifying expression on several databases. In this paper author have formulated boosted-LBP by learning discriminative LBP histograms with Adaboost for all expressions and hence improving the recognition performance and extracting LBP features in low resolution image.

Pawel Tarnowski et al. [8] proposed a model based on 121 specific points of the face storing the spatial coordinates of the points. Recorded by kinect device in the form of matrix. Changes in the facial expression describes as Action Units. Kinect device provides six action units derived from Facial Action Coding System. Classification of emotion is performed by 3-NN and Neural networkusing back propogation algorithm resulting in 3-NN giving higher accuracy.

Happy *et al.* [9] proposed a new spontaneous expression database consists of posed expression. The database consist of 428 segmented video clips of 50 participants. Grayscale intensities, Local Binary Pattern, Gabor Wavelets and PHOG derscriptor techniques are used for feature extraction techniques.

PCA is used to reducing dimensionality of feature vector. Multiclass Adaboost is used to perform emotion classification.

Proposed Methodology

The system consists of input of image or video. Using the input the model is trained by machine learning and neural network techniques, determines the identity of person and emotional status. The system uses face dataset for training the model after preprocessing of images which involves grayscaling, resizing and labelling. Later pre-processed images are used for extracting features where it generates a feature vector of images. Classifier model helps in identifying the person and recognizing emotions in real-time. The block diagram of proposed system is shown in Figure 1.
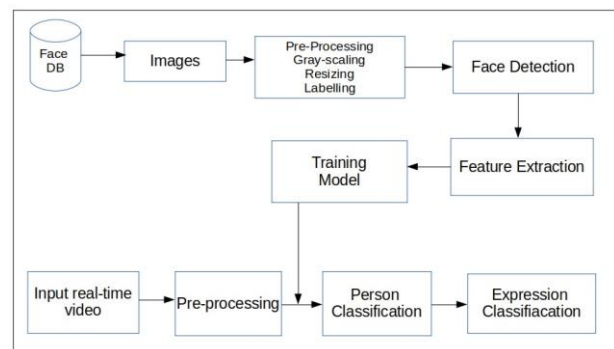

Fig 1: Architecture

A. Database

For person identification real-time data is used. For emotion classification Indian Spontaneous Emotion Dataset(ISED) is used. ISED consists of facial expression videos and still images of 50 participants[6] and tagged six emotions namely happy, sad, fear, surprise, disgust and anger with their intensity on a scale of 0-5. ISED database is prepared by S L Happy, Priyadarshi Patnaik, Aurobinda Routray and Rajlakshmi Guha[9].

B. Face Detection

Face detection is done by using geometric feature based approach since prime component of face like nose, eyes, lips and chin are required for classification. Viola Jones Object Detection Algorithm is used to extract feature points of face.
Viola Jones is a object detection algorithm works by sliding window across the selected image and evaluate a face model at every location. This algorithm includes four stages. First stage is Haar feature selection used to find consistencies in human faces. There are mainly three haar features i.e. edge features to detect edges is represented by first and second, line feature by third and four rectangle feature to detect a slant line as demonstrated by fourth in below figure.
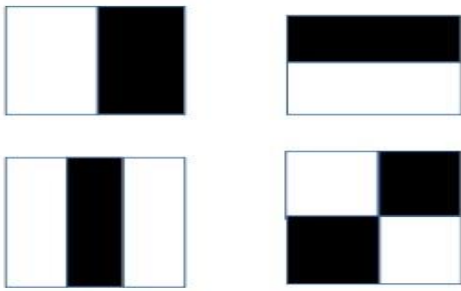
Fig 2Haar Features[1]

The value of any given feature is the sum of the pixels within clear rectangle subtracted from sum of pixels within shaded rectangle. Next stage is to create an integral image to convert the input into a representation. Third stage is to select the valuable features by performing Adaboost training. During detection window of target size is moved over each section the input image calculating haar features. Object is separated from non-objects by the difference to learned threshold. Hence making a strong classifier from a weak classifier by learning multiple times

Fourth stage is cascading classifier consist of collection of stages where each stage is an ensemble of strong classifier. If the input to next classifier is a face then previous classifier is selected otherwise a non-face object is detected, previous classifier is removed.

For a single stage classifier false negatives rate is considered. Initially false positive are accepted to reduce the number of false negatives in later stages.

C. Feature Extraction

For facial emotion recognition, primary components of face are extracted. Among several existing methods for feature extraction Local Binary Pattern is used in proposed system.

Local Binary Pattern is a texture descriptor which will effectively summarize the local structure of image[]. In LBP entire image window is separated into different units. Since this method operates on 3X3 pixel image, compare each pixel with neighbor pixel. Assign 0 to neighbor pixel if the value of pixel at middle is greater than its corresponding neighbor position otherwise assign value 1. Each cell value is multiplied by corresponding power of 2 (2^n). This step is called histogram calculation. Addition of all histogram values gives the feature vector for the image.

D. Expression Classification

Expression classification can be performed by various machine learning techniques which can be supervised or unsupervised. Mostly used classifier are Support Vector Machine(SVM), K-Nearest Neighbour(KNN) and Random Forest(RF) classifiers and Neural Network Techniques.

• K-Nearest Neighbour(KNN) Classifier

K-Nearest Neighbour(KNN) is a supervised learning algorithm. Classifier is trained by classified training data and is recorded based on which classification of unclassified data is performed. In KNN, k is a user defined constant, greater the value of k prediction of each class becomes more smooth. The distance between the new instance with labeled classes is calculated by commonly used distance metric called Eucledian Distance.

$$D(x,y) = \Sigma \, ^n_{j=0} \, (x_j - y_j)^2$$

New instance belongs to the class when the distance is less. The cost of learning process is zero. For large dataset, to find k nearest neighbours is computationally expensive.

• Support Vector Machine(SVM)

Support vector machine is a discriminative classifier where the labeled data is used to output an optimal hyperplane dividing a plane in number of classes. Among variations of SVM classifier are Soft Margin, Non-Linear and Multiclass SVM, for proposed system multiclass SVM is used. SVM algorithm is effective when number of dimensions are more than number of samples. SVM requires preprocessing for missing value in dataset.

• Neural Network

Neural Network or Artificial Neural Network(ANN) is a biologically inspired network of artificial neurons configured to perform specific tasks. Parameters/weights are used by neural network to find hidden features.

Conclusions

Emotion Recognition is a natural way of communicating with machines. The system is proposed to identify the person in a closed area and recognize his emotion. Real-time dataset is used to train the model for identity recognition of the person. ISED dataset is used to train model for emotion recognition on Indian face. For face detection Viola Jones algorithm is used identifying important facial components. Feature point extraction is performed by Local Binary Pattern. Emotion classification is performed by training system and classify using SVM and KNN classifier. According to the research higher accuracy is given by KNN and SVM classifier.

References

[1]. Jayalekshmi J, Tessy Mathew. "Facial Expression
[2]. Recognition and Emotion Classification System for Sentiment Analysis". International Conference on Networks Advances in Computational Technologies, 2017 IEEE
[3]. M. SHAMIM HOSSAIN, GHULAM MUHAMMAD,."An Emotion Recognition System for Mobile Applications". Digital Object Identifier 10.1109/ACCESS.2017.2672829.
[4]. Mostafa K. Abd El Meguid and Martin D. Levine, Life
[5]. Member, IEEE. "FullyAutomated Recognition of Spontaneous Facial Expressions in Videos Using Random

Forest Classiers". IEEE Transactions on Affective Computing, VOL. 5, NO. 2, 2014.

[6]. Divya Mangala B.S and Prajwala N.B. "Facial Expression Recognition by Calculating Euclidian Distance for Eigen Faces using PCA", International Conference on Communication and Signal Processing, 2018.

[7]. Michael Revina, W.R. Sam Emmanuel. "A survey on human face expression recognition techniques", Journal of King Saud University - Computer and Information Sciences. 2018

[8]. Urvashi Bakshi, Rohit Singhal. "A Survey on Face Detection Methods andFeature Extraction Techniques of Face Recognition", International Journal ofEmerging Trends Technology in Computer Science, 3.3 (2014)

[9]. Caifeng Shan, Shaogang Gong, Peter W. McOwan, "Facial expression recognition based on Local Binary Patterns:A comprehensive study", Image and Vision Computing, Elsevier(2008).

[10]. Pawel Tarnowski *et. al. "*Emotion Recognition using facial expressions*".* Internation Conference on Computational Science. Elsevier(2017)

[11]. S L Happy, Priyadarshi Patnaik, Aurobindo Routray and Rajlakshmi Guha, "The Indian Spontaneous Expression Database for Emotion Recognition", IEEE Transactions on Affective Computing (2015)