Emotion recognition using facial expression

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Abstract

This paper presents emotion recognition using facial expression. Emotion recognition is widely used in industrial applications where emotion of humans are used to derive conclusions on products and detection of suspective behaviour. In this project we have detected seven emotions of humans which are Happiness, Anger, Sadness, Disgust, Neutral, Surprise and fear. We have taken a set of still images, detected the facial region and the features are extracted. Features are extracted using Bag-Of-Features (BOF) and Histogram of Oriented Gradients (HOG). The feature vectors created by these techniques are used to train Support Vector Machines (SVM) and results are verified against a given test input. We have achieved satisfactory results for emotion recognition. We have found that HOG gives a better result the BOF

Index Terms *– Emotion recognition, features, BOF, HOG, SVM*

I. INTRODUCTION

Face reflects a person's emotion and hence considered as the strongest identifier of emotion. Facial expression recognition techniques can help to detect the emotion of humans. Based on emotion detection further application could be implemented, like chatbots, getting feedback for test of gaming, products, softwares.
The seven facial expressions are detected, these expressions are neutral, anger, disgust, fear, happiness, sadness and surprise. We detect the face region from an image so as to get more accurate results.
There are many features exactions techniques available to improve the accuracy of the system. This paper mainly focuses on two techniques Bag-of-Feature and Histogram of Oriented Gradient. On the basis of feature extraction techniques accuracy is compared and we got some satisfactory results.
The remaining section of this paper is organized as follows. Section II describes the methodology. Section III explains results obtained. Section lV concludes the paper.

.II. METHODOLOGY

The emotion recognition is done in three stages viz. face detection, facial feature extraction and classification.

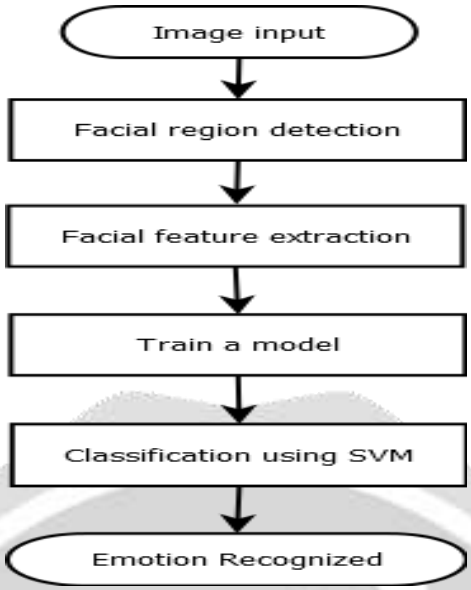

FIG 1. FLOWCHART

The image is preprocessed firstly before going through any of the above mentioned stages. The images are resized to a predetermined same size and converted to a grayscale image. Then the image goes through the first stage that is face detection.

A. Face detection :

Face detection is done using the Viola-Jones algorithm for face detection. The coordinates of the facial region are obtained by using the algorithm. This algorithm uses Haar features and uses adaboost algorithm for selection of features.

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B. Feature extraction :

Features represent the information present in the image. There are various types of features such as FAST, speeded-up robust features(SURF), Harris features, Bag-Of-Features (BOF), LBP features and Histogram of oriented gradients (HOG). We have used BOF and HOG features.

1. *Bag of Feature (BOF)*

Bag of Feature is method of classifying image based on the information given in the image. Bag of Feature is also called as Bag of words. It extracts main features from all images of the training set and constructs the visual vocabulary which is further used for comparison with the features of test set images. The entire image is represented by histogram of word occurrence and we get the suitable class to represent the test image. The vocabulary size is the number of visual words which are set to 250. The feature points are selected using SURF detector.

2. *Histogram of oriented gradients(HOG)*

In the proposed work we have taken a cell size of 8×8 pixels and block size of 2x2 cells. The features are extracted from each block and the window of which features are extracted overlaps by 50 per cent over the previous window. The sobel x and y masks are applied and then gradients are calculated. The orientation of each cell is calculated. The angles are grouped into 9 bins of 20 degree each, giving a range of 0 to 180 degrees. Any orientation less than zero degree is added 180 and then categorized under a bin. The number of features extracted in an image depends upon the block size and the cell size and also size of the image. The larger the size of the cell and block, the lesser will be the number of features.

C. Classification:

There are various classifiers used for classification such as support vector machine(SVM), K
The main objective of the support vector machine algorithm Is to find a hyperplane that distinctly classifies the data points in an N-dimensional space where 'N' denotes the number of features.
For the separation of two classes of data points, there are many possible hyperplanes to choose from, but the ideal hyperplane for this purpose is the one that has maximum margin i.e. the maximum distance between data points of both classes.
By further maximizing the margin distance, it provides some reinforcement so that further data points can be classified with confidence.

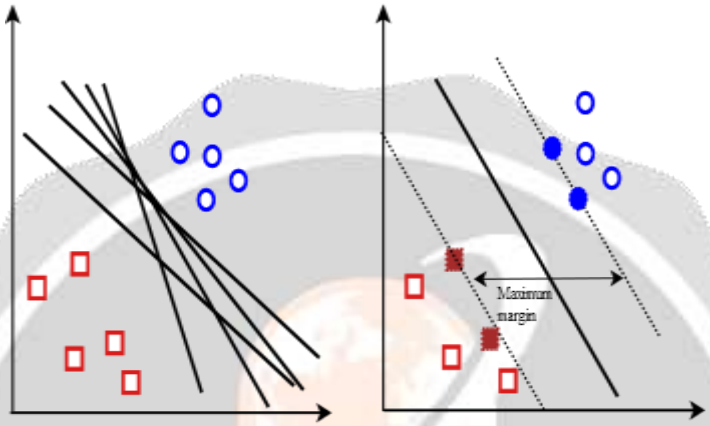

FIG 2. SVM HYPERPLAES

It can be deduced that hyperplanes are the decision boundaries which ultimately help classify the data points. The data points residing on the other side of the hyperplane are attributed to different classes.The dimension of the hyperplanes directly depends upon the number of feature categories or the number of classes.
For example, if the number of input feature categories is 2, then the hyperplane is just a line. If the number of input feature categories is 3, then the hyperplane becomes a two dimensional plane, when the number of feature categories exceeds 3, it becomes a difficult task to imagine the plane.
Support vector are the data points which are closer to the hyperplane and they influence the position and orientation of the hyperplane.
These support vectors are used to maximize the margin of the classifier and deleting the support vectors will also change the position of the hyperplane.

III. RESULTS

1. RESULTS USING BAG OF FEATURES

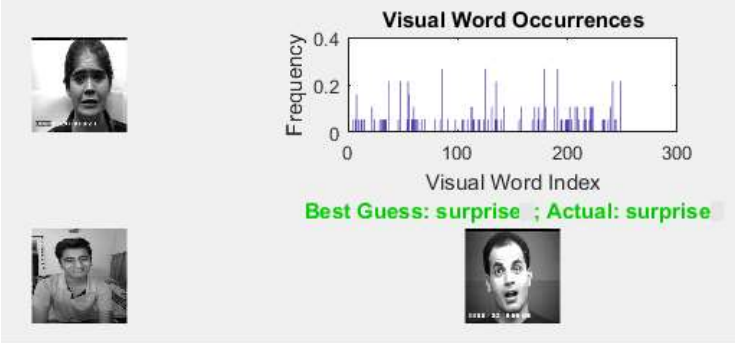

FIG 3. PLOT OF FREQUENCY OF VISUAL WORDS

FIG 4. TRUE PREDICTION USING BOF

FIG 5. FALSE PREDICTION USING BOF

Dataset	CK	Jaffe	CK+Jaffe
Training set	140	105	329
Test Set	34	70	70
Validation accuracy (In %)	54.29	34.29	51.43

Table 1. ACCURACY USING BAG OF FEATURES

2. RESULTS USING HISTOGRAMS OF ORIENTATION GRADIENTS WITH FACE DETECTION ALGORITHM

FIG 6. ORIGIAL vs HOG VISUALIZATION

FIG 7. TRUE PREDICTION USING HOG

FIG 8 . FALSE PREDICTION USING HOG

Dataset	CK	Jaffe	CK+Jaffe	CK+Jaffe
Training set	140	161	329	399
Test Set	35	42	70	35
Validation accuracy (In %)	62.85	61.9	54.29	60

Table 1. ACCURACY USING BAG OF FEATURES

IV. CONCLUSION

In this study, we have presented emotion recognition technique based on the feature extracted by BOF and HOG, the SVM classifier classifies the input face image into their relative emotions. To show effectiveness of proposed framework we have compared the performance of CK+, Jaffe databases and got promising results for this framework. It was suggested that to combine all the databases to improve accuracy of the system. We are extending the current approach by recognising the facial parts like nose, mouth, eye pair and further perform the procedure to get the greater accuracy.

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VI. REFERENCES

[1] Faheema, A. G., and Subrata Rakshit. "Feature selection using bag-of-visual-words representation." In *2010 IEEE 2nd International Advance Computing Conference (IACC)*, pp. 151-156. IEEE, 2010.H. Simpson, *Dumb Robots*, 3rd ed., Springfield: UOS Press, 2004, pp.6-9.

[2] Ali, Nursabillilah Mohd, Soon Wei Jun, Mohd Safirin Karis, Mariam Md Ghazaly, and Mohd Shahrieel Mohd Aras. "Object classification and recognition using Bag-of-Words (BoW) model." In *2016 IEEE 12th International Colloquium on Signal Processing & Its Applications (CSPA)*, pp. 216-220. IEEE, 2016.

[3] Julina, J. Kulandai Josephine, and T. Sree Sharmila. "Facial recognition using histogram of gradients and support vector machines." In *2017 International Conference on Computer, Communication and Signal Processing (ICCCSP)*, pp. 1-5. IEEE, 2017..

[4] Kumar, Pranav, S. L. Happy, and Aurobinda Routray. "A real-time robust facial expression recognition system using HOG features." In *2016 International Conference on Computing, Analytics and Security Trends (CAST)*, pp. 289-293. IEEE, 2016.Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," *IEEE Translated J. Magn. Japan*, vol. 2, pp. 740-741, August 1987 [*Digest 9th Annual Conf. Magnetics Japan*, p. 301, 1982].