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ISSN: 0193-4120 Page No. 5809-5813

Prediction of Satisfaction from Facial Expression: Sentiment Analysis Approach

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Article Info
Volume 83
Page Number: 5809 - 5813
Publication Issue:
May - June 2020

Article History
Article Received: *19 November 2019*
Revised: *27 January 2020*
Accepted: *24 February 2020*
Publication: *17 May 2020*

Abstract

Digital Image Processing (DIP) is the process of digital images using various computer algorithms. This digital image processing has been employed in a number of areas such as pattern recognition, remote sensing, image-sharpening, colour and video processing and medical. Machine Learning techniques like CNN(Convolution Neural Networks) are found helpful in providing accurate prediction, in this paper there is a representation of an automated review system. Reviews are collected specially reviews in two forms as manual entries and video recordings. Both the reviews will be analysed and generalized comparison will be carried out. Basic idea in this paper is to identify the success rate of automatic review systems using facial expressions. It is very essential in determining the satisfaction level of the person with respect to any service or facility provided . Video review captures most of the indirect expressions which is helpful in deciding the emotion through video analysis; much more accurate results are obtained. It can be used in several aspects like movie review, product review, student's feedback, etc. Various technological aspects are touched in this innovative concept of sentiment analysis.

Keywords: *Digital Image Processing, Convolution Neural Networks, Sentiment Analysis, Natural Language Processing, face recognition, facial expression, satisfaction level.*

I. INTRODUCTION

Major intention in this research work is to train a model in such a way that it should be able to determine the satisfaction level of the person who has been considered. There will be three types of feelings predicted: Satisfied, Dissatisfied and Neutral. This application will be working on multiple number of persons if required, The system under consideration will be particularly useful when there is a pool of people leaving from the movie theatre (or any public oriented service) so that we can easily determine their emotions and see whether they are satisfied with the service (movie) or not, on the parallel lines this application can be used in any review system. It will give us accurate results as it captures the indirect emotions and apart from this the user will also be able to give written reviews and here also the satisfaction level will be predicted by using sentiment analysis.

II. WORK DONE SO FAR

Feature extraction method [1]

Here the whole process is divided into three parts: face detection, feature extraction and emotion classification. RGB normalization method is used for face detection, fourteen points in our face are determined from the psychologist's point of view, the emotion state is recognized based on characteristics of these points. For emotion classification, the distance measure is used for determining any change on the characteristics of the

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points and based on the positioning of the points the emotions are classified i.e Happy, Sad, Fear, Surprise, Disgust and Fear. The GMM(Gaussian Mixture Model) is used for identification of the emotion and overall this model gives us pretty decent results.

Image processing and Neural networks techniques [2]

To determine facial emotions, the experiment is separated into four parts: Pre-processing, boundary detection, eye extraction and feature extraction. In pre-processing the image quality is enhanced using histogram equalization also here the RGB image is converted into binary image. In boundary detection method the face region is identified and then in eye extraction method the canny edge detection method is used to determine the x and y coordinates of the eye. The feature extraction technique is based on Ekman's description of emotion states related to facial points which defines several points on our face which is very useful in determining emotion.

Image preprocessing, face detection, feature extraction and classification [3]

In image preprocessing the intensity of the image will be adjusted according to the different environment here average value will be used for calculations. Reference white algorithm is used to adjust the background and normalize the image for face detection. After that eyebrows, eyes and mouth are extracted and as they all have a proper relative distance between them so we detect the eye first and then identify the positions of nostrils, eyebrows and mouth. Then we use the SimNet algorithm to classify various facial expressions, it uses fuzzy logic with a combined Artificial Neural Network. In this experiment it uses two hidden layers with twenty neurons and a third hidden layer with our normalized image. The output layer outputs eight values and each value gives a particular emotion. The highest value in the output will correspond to a facial expression. Overall it gives a good accuracy.

There was use of CNN (Convolution Neural Networks) and Gabor Filters [4]

Gabor filter is used in edge detection,feature extraction and texture analysis when it is applied to the image it gives the highest response at edges and at points where texture changes. Here there were two gabor filters used and then we got the filtered image. After this CNN technique was applied to the images here the dimensions of the image were reduced in each layer and at last we use a flatten function which further reduces the size to seven which is in turn the seven categories of the emotional state. Depending upon the epoch the accuracy of the model varies from sixty percent to ninety percent.

FACS (Facial Action Coding System) method was implemented [5]

It quantifies facial expression of a person by observing the changes in facial muscle when there is an emotion experienced. This approach works by characterizing facial muscle's movement around several areas on the face or so called Action Unit (AU). This is achieved by using Deep Convolutional Neural Network which consists of a filter layer and a classification layer further it comprises a temporal pooling layer and softmax unit. They have used CK+ dataset which has comprehensive data about facial expressions and action units. There are a total of eight emotions predicted: Happy, Sad, Surprise, Fear, Disgust, Angry, Neutral and Contempt. More experiments were done by varying the training and testing images and the accuracy varied accordingly. It was concluded that less the testing images less is the error rate and the system predicts all the emotions correctly.

The use of CNN which consists of seven layers [6]

It is designed to give optimum results, in this architecture there are five convolutional, three fully connected layers and also here we use stochastic pooling to get accurate results. Here in order to improve the system we use the voting system in

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ISSN: 0193-4120 Page No. 5809-5813

which the weights are assigned to the dense layer neuron that help to improve the learning rate. There is minimization of ensembled log likelihood loss in this system and also hinge loss. We use various methods in FER and SFEW validation and testing set and we find out that both gives efficient results.

Natural Language Processing is used for classification of text [7]

As there is a lot of data involved in Facebook, Twitter, it is necessary to get a review of a particular product so that the makers can make further decisions. It further emphasizes the use of subjective analysis rather than objective as it conveys more emotions. It is a three step process: Data Preparation, Review Analysis and Sentiment Classification. In preparation we collect the reviews from various sources, in review analysis we apply various computational tasks to review and then extract opinion and features of the product and at last use machine learning approach to classify the product as positive or negative. Various machine learning algorithms are used like Naive-Bayes, SVM(Support Vector Machine) and Maximum Entropy but SVM turns out to be the most accurate in different scenarios.

Jolly and Pleasant Exercise (JAPE) was implemented [8] easy preprocessing of all the words and bayesian algorithm for classification of positive and negative reviews. The system initially takes the review takes the review from various sources and then in parser module the words are grouped together as phrases and classified as subjects or objects. In the tagger module we use Part of Speech(POS) tagger to words in a sentence. In Domain Ontology we extract nouns, verbs, adjectives and adverbs from the sentences. Then we create a word dictionary based on good and bad words and further we assign a weight to each of them and if weight is greater than zero then sentence is positive or negative. Based on experiments conducted it was concluded that the overall accuracy, precision, recall were satisfactory.

III. METHODOLOGY

Following figure represents the overall setup of the system where the camera is a major equipment to capture the facial expressions. After capturing of various expressions in a group, features and expressions will be identified and will be compared with a knowledgebase to have exact analysis of expressions and emotions of a person. The various tasks involved in this system are as mentioned below.

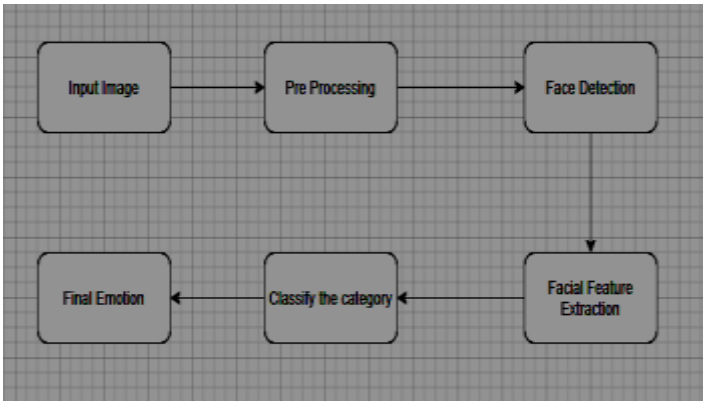

Fig 1. Flowchart of the system

A. **Creating Dataset:** For this application we downloaded images for each emotion i.e Neutral, Satisfied and Dissatisfied from Google images and also we downloaded some of the images from the kaggle website.

B. **Enforce Standard Resolution:** The algorithm is designed in such a way that it works on the image size of 48 x 48 px so thereby we have to compress the size of the image that we are going to train and then finalize the dataset.

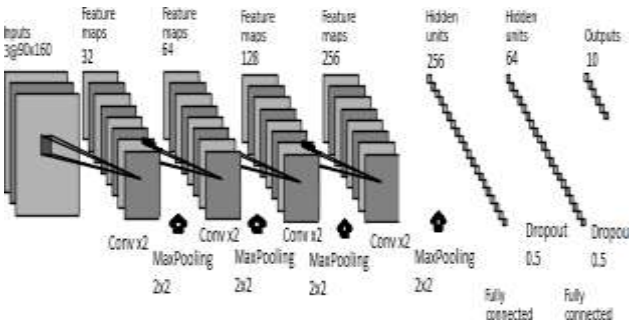

Fig 2. Shows the process of getting the output out of 3 classes

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C. **Train the model(Keras):** We have classified our dataset into two parts: Training and Validation. For training we give eighty percent of images and for validation we give twenty percent of images. We will be specifying the number of classes, the batch size and image size. It uses the Convolutional Neural Networks(CNN) for classifying the images.

D. **Creating h5 file and haarcascade:** Once we have trained our model we will be compiling our program and after that depending upon number of epochs all the data will be stored which will be mandatory while testing the application and also we need to insert haarcascade file as it will help to detect the face of the person during the testing.

E. **Optimizing the model:** In order to avoid validation loss by higher values and also minimizing other errors during the training we need to use optimizers, by default keras includes many optimizers with it they are Adam, RMSprop, SGD and many more.

F. **Testing the model:** Once the model is trained it is now ready to test on the unknown samples so now we can test it on a real time video and depending upon the user's expression it will be determined whether the user is satisfied with the particular thing or not. This model was able to classify most of the expressions and gave accurate results. This model gives successful results even if multiple people are considered at a time hence it is very useful for many people.

IV. CONCLUSION

Considering the setbacks in the numerous existing systems we are trying to create an application which will give the level of satisfaction of customers by analysing facial expression with the help of emotional intelligence and digital image processing. We can overcome the setbacks and apart from that it can also help us to give an efficient solution by indirect means of review by just analysing the expressions. This app will be particularly useful as indirect emotions or feelings are expressed without any pressure so as a consequence it will help all the companies who are wanting their products to be reviewed by customers and also if we ask anybody to give review then there is a chance that customer might not give genuine review therefore our app will be built to capture real time emotions.

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