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The Facial Expression Recognition (FER) Based Restaurants Rating System using Deep learning Techniques

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Abstract:

The advent of artificial intelligence technology has reduced the gap of human and machine. Artificial intelligence equips man to create more near perfect humanoids. Facial expression is an important tool to communicate one's emotions non verbally. This paper introduces an new methodology of deep neural networks for classifying facial expressions in a effective manner. Extensive attention facial expression recognition (FER) has received recently as facial expressions are considered as the fastest communication medium of any type of information. Facial expression recognition gives a better understanding towards a person's thoughts or views and analyzing them with the currently trending deep learning methods boosts the accuracy rate drastically compared to the traditional state-of-the-art systems. This project gives a brief about various application fields of FER and publicly available datasets used in FER and reviews the latest research in the field of FER using Random Forest Algorithm, Convolutional Neural Network (CNN) and deep learning. Lastly, it concludes the efficient method among them.

Key Words: Facial expression recognition, Feature extraction, Deep learning, Convolutional neural network.

I. INTRODUCTION

Now-a-days in advance countries automated unmanned restaurants are more popular as this restaurants will not have any human power to take customer feedbacks about food quality and service and to automate this process author has introduce concept called 'Deep Learning Facial Expression Recognition Based Scoring System For Restaurants' where customers will be asked to give rating to food and upload his photo and based on user facial expression application will inform whether customer was satisfied or not. To extract facial expressions from photo we are using CNN (Convolution Neural Networks) machine learning algorithm. Our Main objective of this project is to predict 3 different expressions from photos such as satisfied, neutral or disappointed.

Figure 1: Different Facial Expressions.

Humans usually employ different cues to express their emotions, such as facial expressions, hand gestures and voice. Facial expressions represent up to 55% of human communications while other ways such as oral language are allocated a mere 7% of emotion expression [5]. Therefore, considering facial expressions in an HRI system enables simulation of natural interactions successfully. Indeed, robots can easily interact with humans in as a friendly a way as possible when they can analyse facial expressions and figure out their emotional

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states. In this way, they can be used in a healthcare system to detect humans' mental states through emotion analysis and improve the quality of life. The mental states are unfolded in daily situations where robots can inspect positive and negative emotions. Positive facial expressions, such as happiness and pleasure, demonstrate healthy emotion states while unhealthy emotion states are represented by fetching negative facial expressions (e.g., sadness and anger). An efficient facial expression system (FER) can significantly help people to improve their mental emotion state by exploring their behaviour patterns. McClure et al. [6] and Coleman et al. [7] have shown that some mental diseases such as anxiety or autism are diagnosed by investigating the emotional conflicts, which appear on the patients' expressions.

II. LITERATURE REVIEW

As there is no staff available in unmanned restaurants, it is difficult for the restaurant management to estimate how the concept and the food is experienced by the customers. Existing rating systems, such as Google and Trip Advisor, only partially solve this problem, as they only cover a part of the customer's opinions. These rating systems are only used by a subset of the customers who rate the restaurant on independent rating platforms on their own initiative. This applies mainly to customers who experience their visit as very positive or negative.

[1] Different kinds of conservative advances contain carried out for Automatic FER systems. To generate a feature vector for training, association among facial apparatus is employed for geometric characteristics found lying on place and viewpoint of 52 degree of facial marker spots. Here primary viewpoint and Euclidean distance is calculated involving every duo of landmarks inside a framework and then distance along with angle values be deducted as of the matching space plus angle values of primary frame in record string. Two classifiers techniques are used here: multi class AdaBoost in the company of dynamic time warping and SVM on the boosted feature vectors.

[2] Diverse face expanses contain diverse styles of detail so look features are habitually mined on or after universal face area. Happy et al. used an approach of Local Binary Pattern (LBP) histogram with dissimilar chunk ranges as of a universal facade region as a characteristic vector plus after that categorized diverse facial expression via Principal Component Analysis (PCA). Though this technique is applied in instantaneous environment, its precision is corrupted as of not able to mirror local differences of facial sections to characteristic vector.

[3]Diverse face regions contain poles apart intensities of significance. For instance, compare to forehead plus cheek, eyes in addition to mouth contains additional information. Ghimire et al. divided whole face region hooked on domain precise local expanses to extract appearance features and using an incremental search method, important local regions were identified which provides improvement in recognition accuracy and reduction in feature dimensions. Many researchers have identified different feature extraction methods and classifiers for conventional approaches. For facial expression recognition well known methods for characteristic mining like Histogram of Oriented Gradients (HOG), Local Binary Pattern (LBP), distance along with angle relation flanked by facial landmarks plus classifiers for instance Support Vector Machine (SVM), AdaBoost, Random Forest are employed founded on mined characteristics. Benefits of conservative approaches are that they oblige inferior computing control with remembrance compared to Deep learning based procedures. Thus these procedures are tranquil mortal employed in real time organizations since of their lower computational difficulty along with higher accuracy [4].In existing algorithm we are use in Haar-adaBoost classification algorithm, in this classification accuracy is less.

Disadvantages of the Existed Techniques

- Consuming More Time due to too many surveys.
- Lagging in Up to Date Feed Back.
- Privacy Issues.
- Classification issue.

III. PROPOSED METHODOLOGY

In order to solve the above problem, all customers must be motivated to give a rating. This paper introduces an approach for a restaurant rating system that asks every customer for a rating after their visit to increase the number of ratings as much as possible. This system can be used unmanned restaurants; the scoring system is based on facial expression detection using pre trained convolutional neural network (CNN) models. It allows

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the customer to rate the food by taking or capturing a picture of his face that reflects the corresponding feelings. Compared to text-based rating system, there is much less information and no individual experience reports collected. However, this simple fast and playful rating system should give a wider range of opinions about the experiences of the customers with the restaurant concept.Here we are using Random Forest classification algorithm better to the existing algorithm accuracy.

A.Convolutional Neural Networks (CNN)

Neural Networks are essentially mathematical models to solve an optimization problem. They are made of neurons, the basic computation unit of neural networks. A neuron takes an input (say x), do some computation on it (say: multiply it with a variable w and adds another variable b) to produce a value (say; z= wx+b). This value is passed to a non-linear function called activation function (f) to produce the final output(activation) of a neuron.

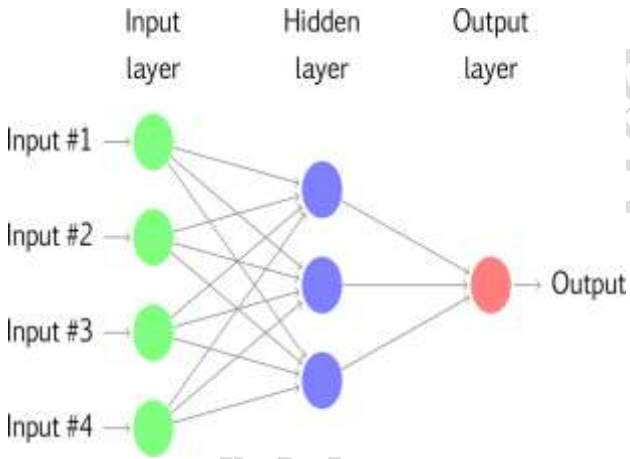


Figure 2: To predict image class multiple layers operate on each other to get best match layer and this process continues till no more improvement left.

There are many kinds of activation functions. One of the popular activation function is Sigmoid. The neuron which uses sigmoid function as an activation function will be called sigmoid neuron. Depending on the activation functions, neurons are named and there are many kinds of them like RELU, TanH. If you stack neurons in a single line, it's called a layer; which is the next building block of neural networks. See below image with layers.

B.Random Forest Algorithm

A big part of machine learning is classification we want to know what class an observation belongs to. The ability to precisely classify observations is extremely valuable for various business applications like predicting whether a particular user will buy a product or forecasting whether a given loan will default or not. The main objective of the random forest is to builds multiple decision trees and merges them together to get a more accurate and stable prediction.

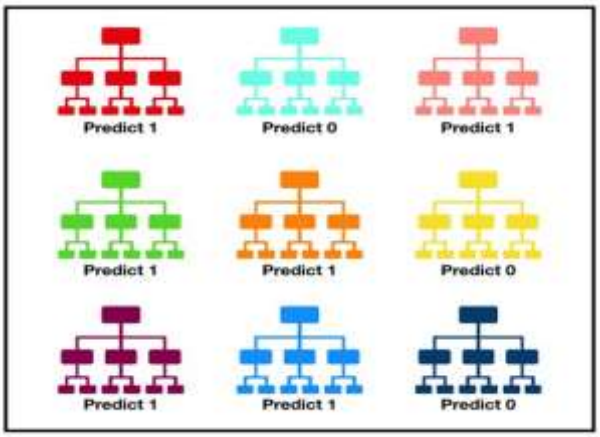


Figure 3: Visualization of a Random Forest Model Making a Prediction (Tally Six 1's and Three 0')

Random forest, like its name implies, consists of a large number of individual decision trees that operate as an ensemble. Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes our model's prediction.

Description of Algorithm

The random forest algorithm is a bagging algorithm: also here, we draw random bootstrap samples from training set. However, in addition to the bootstrap samples, we also draw random subsets of features for training the individual trees; in bagging, we provide each tree with the full set of features . Due to the random feature selection, the trees are more independent of each other compared to regular bagging, which often results in better predictive performance (due to better variance-bias trade-offs), and I'd say that it's also faster than bagging, because each tree learns only from a subset of features.

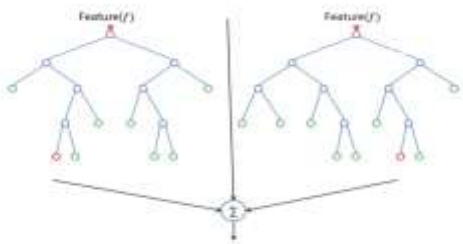


Figure 4: Working of Random Forest Algorithm.

Algorithm for Random forest:

- Randomly select "Q" features from total "K" features.
    - Where Q << K
- Among the "k" features, calculate the node "N" using the best split point.
- Split the node into daughter nodes using the best split.
- Repeat 1 to 3 steps until the "1" number of nodes has been reached.
- Build forest by repeating steps 1 to 4 for "L" number times to create an "L" number of trees.

Design Parametric Requirements:

1. **Mean Absolute Deviation**

It is utilized to degree changeability in the dataset. The proposed outright deviation is the recommend separation between each reality point and mean. By ascertaining how far away the data factors are from the mean encourages us to get completely the deviation esteems.

2. **Mean Squared Error**

We measure the squares of the misfortune or goofs caused. It is essentially the square of the differentiation among the genuine expense and the anticipated expense .

$$x_{norm} = \frac{x - min(x)}{max(x) - min(x)}$$

At the point when the misfortune or mistakes should be anticipated in percent states then we utilize Mean total percent blunder. It is assessed is an unsigned percent mistake that permits us to look at the estimate exactness.

C. How the Random Forest Algorithm works?

One big advantage of random forest is that it can be used for both classification and regression problems, which form the majority of current machine learning systems. Let's look at random forest in classification, since classification is sometimes considered the building block of machine learning. Below you can see how a random forest would look like with two trees: Random forest has nearly the same hyper parameters as a decision tree or a bagging classifier. Fortunately, there's no need to combine a decision tree with a bagging classifier because you can easily use the classifier-class of random forest. With random forest, you can also deal with regression tasks by using the algorithm's regressor. Random forest adds additional randomness to the model, while growing the trees. Instead of searching for the most important feature while splitting a node, it searches for the best feature among a random subset of features. This results in a wide diversity that generally results in a better model. Therefore, in random forest, only a random subset of the features is taken into consideration by the algorithm for splitting a node. You can even make trees more random by additionally using random thresholds for each feature rather than searching for the best possible thresholds (like a normal decision tree does).

Step 1 – First, start with the selection of random samples from a given dataset.

Step 2 – Next, this algorithm will construct a decision tree for every sample. Then it will get the prediction result from every decision tree.

Step 3 – In this step, voting will be performed for every predicted result.

Step 4 – At last, select the most voted prediction result as the final prediction

Table 1: Random Forest Algorithm.

D. Working Description of the Proposed Methodology:

In this project we are using android devices to capture photo and using web server to send capture photo to server where machine learning algorithms will be running to predict expression from photo and this customer data with photo will be saved in MYSQL database. Here we don't have any android devices so we have design this as a web application using python DJANGO web server.

This application can run on user browser where he can upload his photo with rating, uploaded photo will be sent to web server where machine learning algorithm will be used to extract expression from photo and then saved result to MYSQL database. Another user called 'admin' can login to application and see all users visited to restaurant and can view all customer feedback with facial expression and photo. By seeing this result admin can understand whether customers are happy with their services and foods or not.

To demonstrate how to build a convolutional neural network based image classifier, we shall build a 6 layer neural network that will identify and separate one image from other. This network that we shall build is a very small network that we can run on a CPU as well. Traditional neural networks that are very good at doing image classification have many more parameters and take a lot of time if trained on normal CPU. However, our objective is to show how to build a real-world convolutional neural network using TENSORFLOW.

III. Results & Analysis

To run this project install MYSQL and then create database by copying content from 'DB.txt' file and paste in MYSQL.

Figure 5. In above screen click on 'User' link to get below screen where user can upload photo and give ratings.

Install python and then install DJANGO web server and deploy code on DJANGO. After deployment start server and run the code from browser.

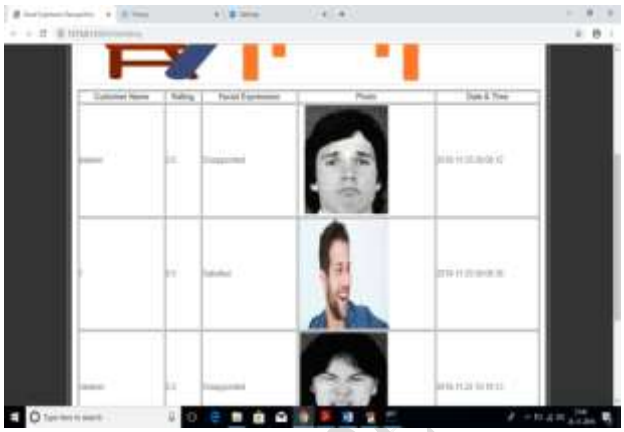
Figure 6. User will fill above from and upload photo

Figure 7. In above screen I filled form and uploading one happy image and then click on 'Open' button and then click 'Submit' button to send data to web server. After processing above data will get below results.

Figure 8. In above screen we can see output message as given rating and from photo extracted facial expression is satisfied. Now go to 'Administrator' link and login as admin by giving username as 'admin' and password as 'admin'. See below screen.

Figure 9. After login will get below screen.

Figure 10. In above screen click admin can click on 'View Users Rating' link to get all customers feedback. See below screen



(a)

(b)

Figure 11(a) & (b). From above screens admin can see photos and their facial expressions.

IV.COCLUSION & FUTURESCOPE

This paper presents a survey of different facial expression recognition techniques and architectures used to extract important facial features. Detailed information of different datasets used in facial expression recognition explained with necessary information. Recent feature extraction techniques with comparison and recent challenges are covered which will be helpful for other researchers to overcome problems of existing methods and improve the results in terms of accuracy. Facial expression recognition (FER) has attracted many researchers in different fields such as human interaction systems, mental disease detection, and affect recognition.

However, most applications are applied to controlled laboratory situations, few existing techniques/methods are applicable in the real world, even with merge recognition rates. We provide a framework of an automatic FER system assisted by multimodal sensor data and theoretically analyze the feasibility and achievability for emotion detection; its effectiveness will probably be demonstrated using real-world experiments in the future. We also point out the open problems in this area that may inspire new approaches to improve the FER systems in the future.

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