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Computer-Based Facial Expression Recognition

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Abstract: Face recognition and its classification is a rapidly growing field in the area of image processing and machine learning. Object recognition is a key feature of image classification and has its own numerous commercial implications. Facial gesture plays important role in many aspect, such as presence system, security and access system, and identification system. Model trained on diverse dataset to generalize better. Using deep region of interest (ROI) convolutional neural networks (CNNs) along with transfer learning are exploited. The Haar-Cascade is trained by superimposing the positive image over a set of negative images which is used to detect countenance.

Keywords: Machine learning, Image processing, Facial emotion recognition, convolutional neural networks.

I. INTRODUCTION

Facial gesture has effect on cognitive science and human psychology, where it can come up as an area which can bridge the between the more abstract areas of psychology. Facial expression recognition can be applied in cognitive science field. Facial expression recognition is not just a theoretical field but also finds practical implications in many fields.

Extracting and understanding of emotion has a high importance of the communication between human and machine. Emotions are reflected from speech, hand and gestures of the body and through facial expressions.

Facial Emotion Recognition is a research field that has been studied extensively because of its imperative applications for human-computer interaction, medical treatment, virtual reality and many more. The objective of face emotion recognition (FER) is identifying emotions of a human. The emotion can be captured either from face or from verbal communication. Psychological characteristics such as heartbeat and blood Pressure, speech, hand gestures, body movements, Facial expressions identify emotions of a person. The characteristic feature points of a face are located at different positions of human face such as in eyebrows, cheeks, eyelids, lips, chin and forehead. The feature points after being extracted from these face regions help in recognizing the various emotions of a face. Smart Devices like computers or robots can recognize the expressions. Image classifiers will increasingly be used in replacement of passwords with facial recognition, in cognitive science field, allow autonomous vehicles to detect obstructions and identify geographical features from satellite imagery.

II. DATA SET

The data consists of grayscale images (48×48 pixel) of 5 different emotions namely angry, sad, happy, surprise and neutral. The faces have been registered automatically so that the face is almost centred and occupies about the same amount of space in each image. The task is to categorize each face based on the emotion shown in to one of five categories (0=Angry, 1=Happy, 3=Sad, 4=Surprise, 5=Neutral). The training data consists more than 35000 examples. After downloading the dataset i.e. fer2013, we train our CNN model.

III. CONVOLUTIONAL NEURAL NETWORKS

We use the Conv2D class to implement the convolution neural network, which is used for emotion classification. Then we take the dataset and train the network and evaluate the network and evaluate its performance.

Let us see the parameters of Conv2D class that we will be using to build a Convolution Neural Network.

1) *The first Parameter we are using is the Filters:* It indicates the number of filters that the convolution layer will learn. Layers beginning in the Architecture of the network i.e. nearer to the input image learn fewer convolutional filters than layers deeper in the convolutional neural network. Filters specifies the number of kernels to convolve with the input volume.
2) *The next Parameter we have used is Kernel Size:* Kernel size is 2-tuple integer indicating the height and width of the 2D convolution window. Also, the size should be odd integer. The values may include (1,1), (3,3), (5,5), (7,7). As the input dataset we are using is of 48x48 we have chosen (3,3).

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3) *The third Parameter is Stride:* The stride is 2-tuple integers indicates the convolution in x and y axis steps. We have used (2,2) to minimize the output volume size.
4) *Padding:* Usually it takes two parameters i.e. valid or same. We have used same as a parameter to preserve the dimensions such that input volume size matches the output volume size.
5) *Activation:* Activation parameter allows us to specify the type of activation function we are applying after performing the convolution. We have used as a activation function.

IV. MODEL ARCHITECTURE

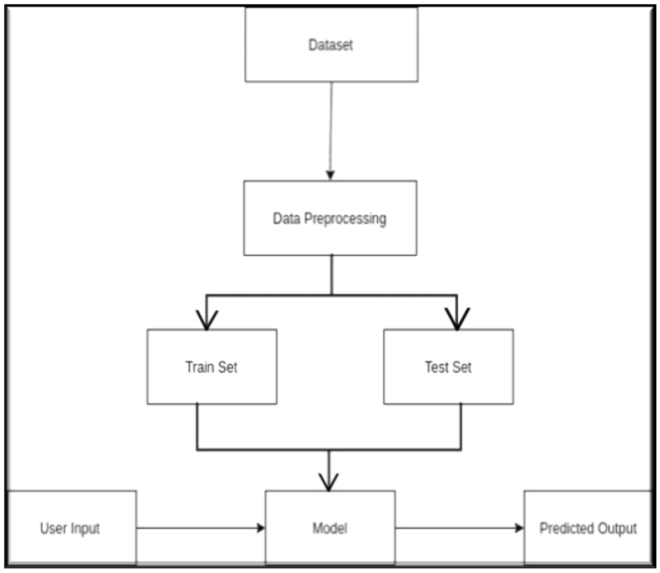


Fig. 1: System Architecture Design

Data set is generated using the training set by applying different transformations. It is required if the training set is not sufficient enough to learn all the representations. Hence the image data is generated by transforming the actual training images by shifts, rotation, crop, shear, reflection, zoom, flip, normalization. We stored these images as raw data in different files and train them accordingly. Images are un normalized RGB images, which means values of pixel lies between 0-255. Mean normalization is a common practice to perform. Luckily, Keras provides a class Image Data Generator which can automatically perform the function of scaling. Our job is to give rescale value of 1/255 then every image will be multiple by this ratio, thus scaling the pixels down to [0: 1].

We use the Conv2D class to implement the convolution neural network, which we use for emotion classification. Then we take the dataset and train the network and evaluate the network and examine its performance.

The architecture of a large-scale service can get really complex. It can have several micro services deployed running in conjunction with each other in a distributed environment. The comprehensive architecture of the service that involves several different components is called the system architecture.

TensorFlow is usually used for Classification, Perception, Prediction and creation. We have used EarlyStopping, ModelCheckpoint, Callbacks, ReduceLRonPlateau.

EarlyStopping: It is a technique used to terminate the training before overfitting occurs.

ModelCheckpoint: It is used in conjunction with training using model.fit() in order to save the model.

Callback: It is a set of functions that should be applied at given stages of the training procedure.

ReduceLRonPlateau: It is used to reduce the learning rate when a metric has stopped improving.

Whereas OpenCV is used to capture real time human expression. Numpy, Pandas are the other libraries that are used.

Haar_cascade_frontalface is used for detection of face region.

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V. FACE DETECTION AND FEATURE EXTRACTION

A. Face Detection

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. It has a programming functions mainly for real time computer vision. The library is cross-platform and is free to use under BSD license. OpenCV application areas include Facial Recognition System, Gesture Recognition, Human-computer interaction, Object identification and many more. Here OpenCV is used to capture real time human expression.

B. Feature Extraction

Feature Extraction is an extract to the identify face and face recognition. Face recognition is an evolving area, changing and improving constantly. After the pre-processing of the image, the facial features are recognised and extracted from the input image.

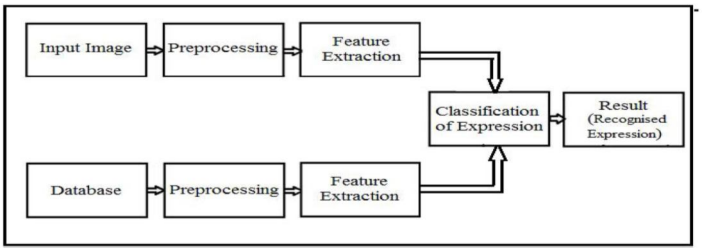


Fig. 2: System Flow of Facial expression recognition system

VI. RESULTS

Once the code has been executed and the model has trained, we will execute the program. Input for the processing is taken from system camera or external camera. Processing of the video or photo is done continuously.

The output of human facial expression is displayed on the top of the rectangle box which is formed around the detected human face of the video in real time. It keeps on changing based on the placement of human face on screen at that instance of the video being played.

Testing is done and various input images are given by web camera or system image. We got maximum efficiency with this algorithm. More than 60% accuracy is observed.



VII. CONCLUSIONS

The proposed systems use Facial Emotion Recognition using machine learning. Convolutional neural network minimizes the input data pre-treatment and uses various layer hence makes increasing accuracy.

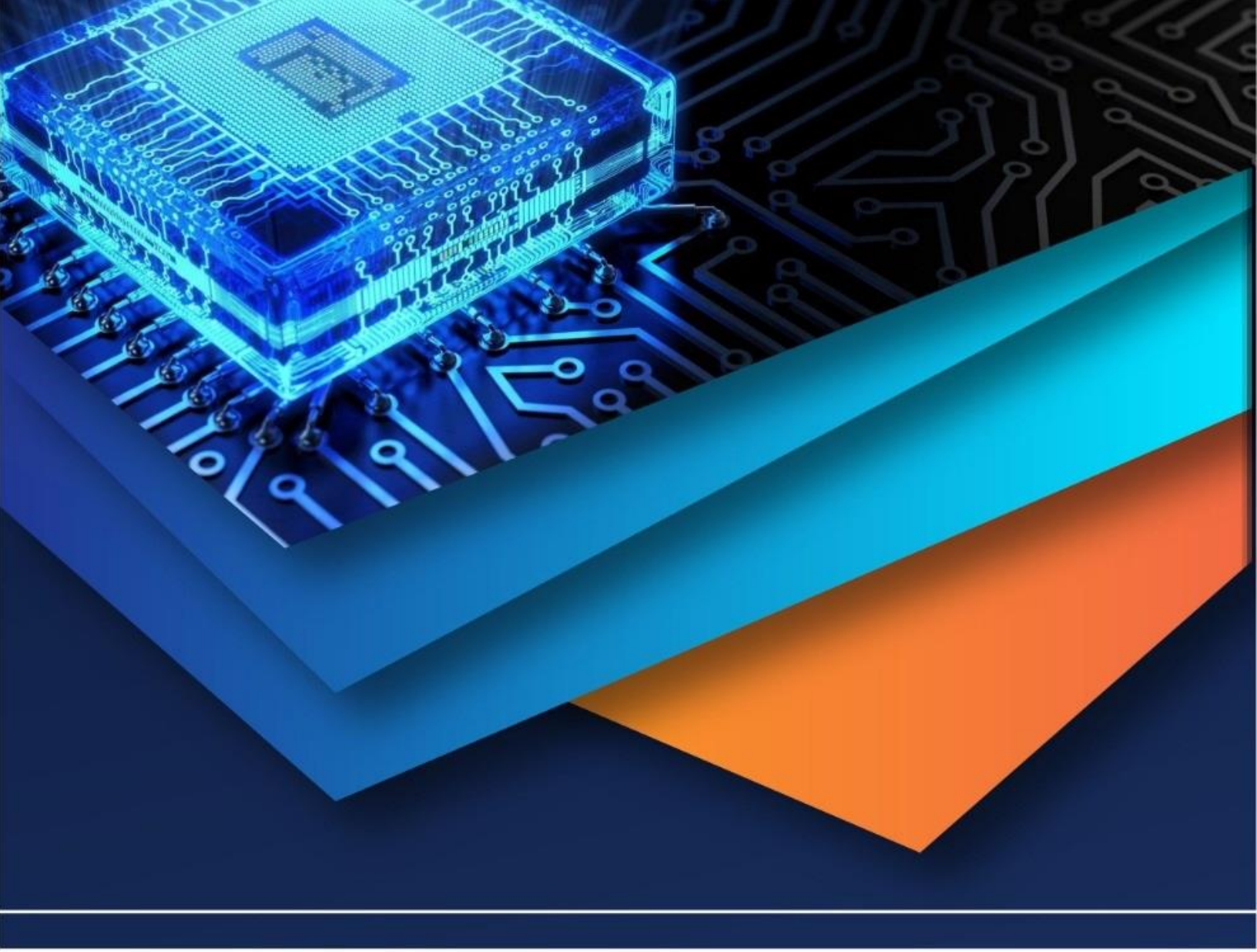
As we all know that the accuracy of the models can never be 100% so the results that are generated will always have a possibility of providing improper output as is the case with all machine learning classifications so if we can increase the data to improve the overall efficiency of detection of human emotion we can do so in future models where a huge data set is used to train the developed models. It could be applied to predict whether the driver is fatigue or not based on the facial emotion. Other future enhancements can include the use of IOT based smart devices that can perform pre-programmed expressions based on actions performed and provide automated solutions to simple problems.

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