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Facial Emotion Recognition

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***Abstract:** Facial Emotion Recognition plays a significant role in interacting with computers which help us in various fields like medical processes, to present content on the basis of human mood, security and other fields. It is challenging because of heterogeneity in human faces, lighting, orientation, poses and noises. This paper aims to improve the accuracy of facial expression recognition. There has been much research done on the fer2013 dataset using CNN (Convolution Neural Network) and their results are quite impressive. In this work we performed CNN on the fer2013 dataset by adding images to improve the accuracy. To our best knowledge, our model achieves the accuracy of 70.23 % on fer2013 dataset after adding images in training and testing parts of disgusted class.*

I. INTRODUCTION


Happy


Fearful


Disgusted


Angry


Surprised


Sad


Neutral

Facial Emotion recognition recognizes thefacial expression type such as angry, sad,happy etc. It plays an important role in human-computer interactions in various fields like medical field, advertisement,security, online gaming, customer feedback and non-verbal communication [1]-[9].

There are many ways to inspect the recognition of human expressions, ranging from facial expressions, body posture, voice tone etc. In this paper we have focused on facial expression recognition. Facial Emotion Recognition (FER) is a thriving research area in which lots of advancements like automatic translation systems, machine to human interaction are happening in industries. Facial emotion recognition helps to know the feedback of customers, based onemotion advertisements served tocustomers.

In this paper we had used the fer2013 dataset and modified it to improve the accuracy. We have added some images in this dataset since this dataset had lowamounts of images of disgusted class. Before moving to the further process we should be aware of facial emotion recognition since it is a research topic and it makes a great impact on human-computer interaction. It is challenging because human faces differ with respect to age, environments, culture, fashion, light etc.

II. PROBLEM DEFINITION

In the introduction part we have discussed briefly about emotions and now we are moving to problem definition. As per older research theresearcher used the same data and they achieved the highest accuracy of 65.5 % with 7 different types of emotion [16]-[21]. Since this dataset has too few images for the disgusted class and we have added some more images in it and perform the CNN operation, in image classification, Convolution Neural Networks (CNNs) have shown great potential due to their computational efficiency and feature extraction capability [13]-[22].

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They are most widely used deep neural network for FER (facial emotion recognition dataset) [10]-[16]. Facial emotion recognition recognizes the emotion by the image; wehave used CNN for classification. But in CNN, choosing the number of hidden layers,filter size, learning rate and number of iteration are challenging and it has to be done manually. It depends upon the types of the data.

III. PROPOSED MODEL

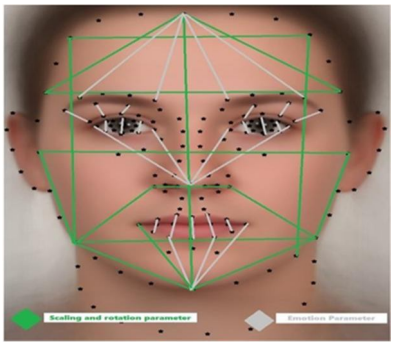
The fer2013 dataset we have used in ourexperiments, since it has seven different types of classes of emotions and has a significant amount of images. The imagesare 48x48, gray and containing only faces which are already preprocessed. First we hadchecked the accuracy of the dataset with various hidden layers and achieved thehighest accuracy of 66.05% after 50 iterations. We have proposed two modelsand performed them.

A. By Modification of Dataset

We had proposed a model since it has too low images for the disgusted class, we had assumed that by adding images in the disgustedclass, we could improve the accuracyand we had tried it. We downloaded the disgusted images and added themto the dataset and performed the CNN.

B. By using Position and Shape

Since in different situations faces look different the position and shape of mouth, nose, eyebrow, chicks and forehead varies. We proposed a model that we'll recognize the emotion by these factors. We were aware of "Google's Mediapipe" package which identified the points on the faces. We used this package todetect points on the faces and calculate the shape and position ofthe different parts of the faces and after this we made it relative to the face size. Because if a face size is smaller in an image and bigger inanother image the model will not work. For the relative parameter we calculated the face height and facewidth ratio and by using this parameter we scaled the shapes and position of the face parts.



IV. EXPERIMENT SETUP

To perform the experiment, we havea windows laptop with 16GB ram, i7processor and 4GB of graphics card which isable to fulfill our needs. We have installed python 3.8, tensorflow package and otherrequired packages and Cuda.

For the first proposed model we havedownloaded 1500 images of disgusted class, some of the images had multiple faces and these images had various different sizes. Wewrote a python program which picked one image at a time and searched the faces in the image, after finding the faces it cropped the face and scaled the cropped images to 48x48size and converted it to grayscale images. After performing this step, the images arepreprocessed and ready to merge in the olderdataset.

For the second proposed model we had downloaded 70,000 images having high quality of faces. We had classified the images with 7 different classes manually. For classification we created software having 7 buttons. It displayed one by one image and we manually identified the class of image, according to the class we pressed the button and that image moved to that class folder.

V. RESULTS AND ANALYSIS

The first experiment achievedaccuracy was 70.6% after 50 iterations with 6 hidden layers. We added images in disgusted class up to 1660 images. Duringthis experiment the model had shifted towards the disgusted class. To resolve this issue, we had made the size of the disgusted class to 1200 images and again performed the experiment. Now this time the accuracy was 67.89%. We kept the learning rate to 0.01. During the experiment we had changed the number of layers, sizes of the filter, dropout values and size of the max pooling.

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The results are below –

1) By using 3 hidden layer (Accuracy 54.1%)
a) Layer 1 { Filter size (48), kernelsize(3,3)}
b) Layer 2 { Filter size (64), kernelsize(3,3), dropout(0.10)}
c) Layer 3 { Filter size (128),kernel size(3,3), dropout(0.10)}

2) By using 3 hidden layer (Accuracy 59.3%)
a) Layer 1 { Filter size (64), kernel size(5,5)}
b) Layer 2 { Filter size (64), kernel size(3,3), dropout(0.10)}
c) Layer 3 { Filter size (128),kernel size(3,3), dropout(0.10)}

3) By using 4 hidden layer (Accuracy 62.05 %)
a) Layer 1 { Filter size (64), kernel size(5,5)}
b) Layer 2 { Filter size (128), kernel size(3,3), dropout(0.10)}
c) Layer 3 { Filter size (128), kernel size(3,3), dropout(0.10)}
d) Layer 4 { Filter size (256),kernel size(3,3), dropout(0.10)}

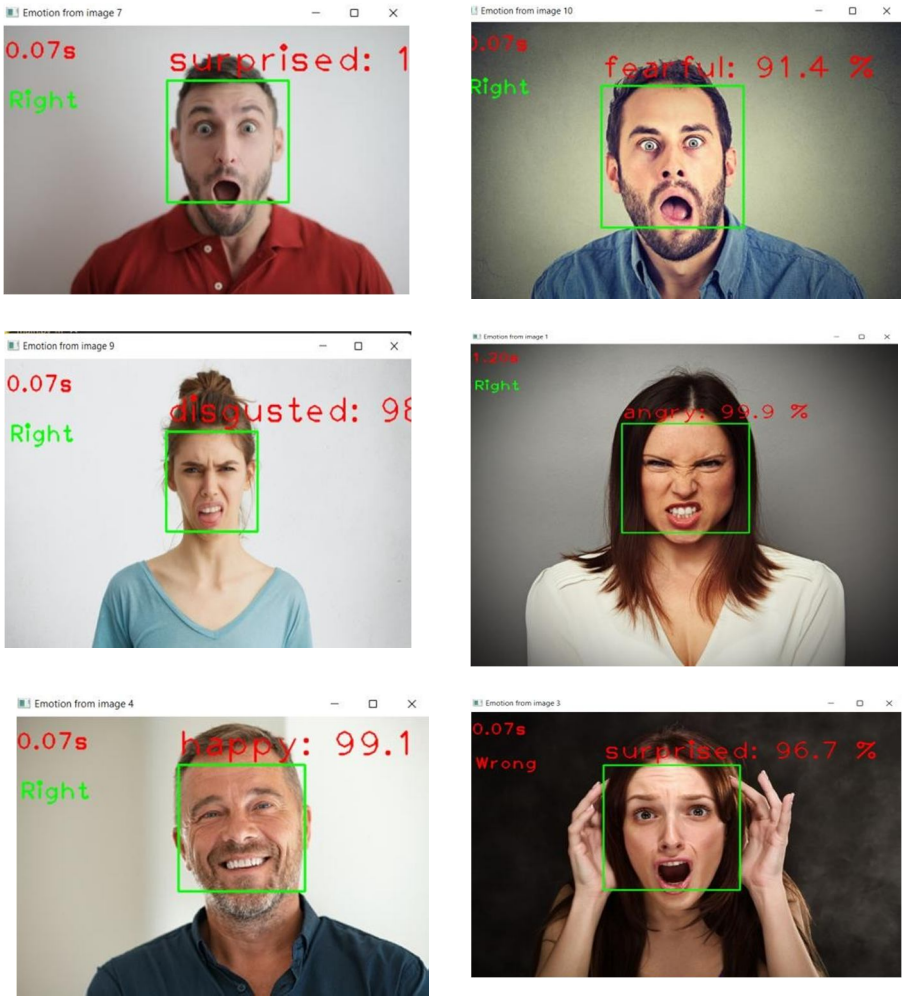
4) By using 4 hidden layer (Accuracy 63.84 %)
a) Layer 1 { Filter size (64), kernel size(5,5)}
b) Layer 2 { Filter size (128), kernel size(3,3), dropout(0.10)}
c) Layer 3 { Filter size (128), kernel size(3,3), dropout(0.10)}
d) Layer 4 { Filter size (256),kernel size(3,3), dropout(0.10)}

5) By using 5 hidden layer (Accuracy66.27 %)
a) Layer 1 { Filter size (64), kernel size(5,5)}
b) Layer 2 { Filter size (128), kernel size(3,3), dropout(0.10)}
c) Layer 3 { Filter size (128), kernel size(3,3), dropout(0.10)}
d) Layer 4 { Filter size (256), kernel size(3,3), dropout(0.10)}
e) Layer 5 { Filter size (512),kernel size(3,3), dropout(0.10)}

6) By using 6 hidden layer (Accuracy 70.6%)
a) Layer 1 { Filter size (64), kernel size(5,5)}
b) Layer 2 { Filter size (128), kernel size(3,3), dropout(0.10)}
c) Layer 3 { Filter size (128), kernel size(3,3), dropout(0.10)}
d) Layer 4 { Filter size (256), kernel size(3,3), dropout(0.10)}
e) Layer 5 { Filter size (256), kernel size(3,3), dropout(0.10)}
f) Layer 6 { Filter size (512), kernel size(3,3), dropout(0.10)}

7) By using 7 hidden layer (Accuracy 69.05 %)
a) Layer 1 { Filter size (64), kernel size(5,5)}
b) Layer 2 { Filter size (128), kernel size(3,3), dropout(0.10)}
c) Layer 3 { Filter size (128), kernel size(3,3), dropout(0.10)}
d) Layer 4 { Filter size (256), kernel size(3,3), dropout(0.10)}
e) Layer 5 { Filter size (256), kernel size(3,3), dropout(0.10)}
f) Layer 6 { Filter size (512), kernel size(3,3), dropout(0.10)}
g) Layer 7 { Filter size (512), kernel size(3,3), dropout(0.10)}

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In the second proposed model after classification of the dataset the difference in the amount of images in classes was too high. Happy class had >50000 images and <300 images in the sad class and disgusted class. Due to the imbalance of images we quitted the experiment.

VI. APPLICATION

In the rapid growth oftechnologies, the demands of emotion recognition have increased. There are many areas where it is used-

1) Medical fields
2) Security
3) Advertisement
4) Feedback system
5) Online teaching
6) Mood music
7) Psychological studies
8) Filter suggestion
9) Social media
10) Advisory system
11) Food feedback
12) Child care
13) Automatic system of advice

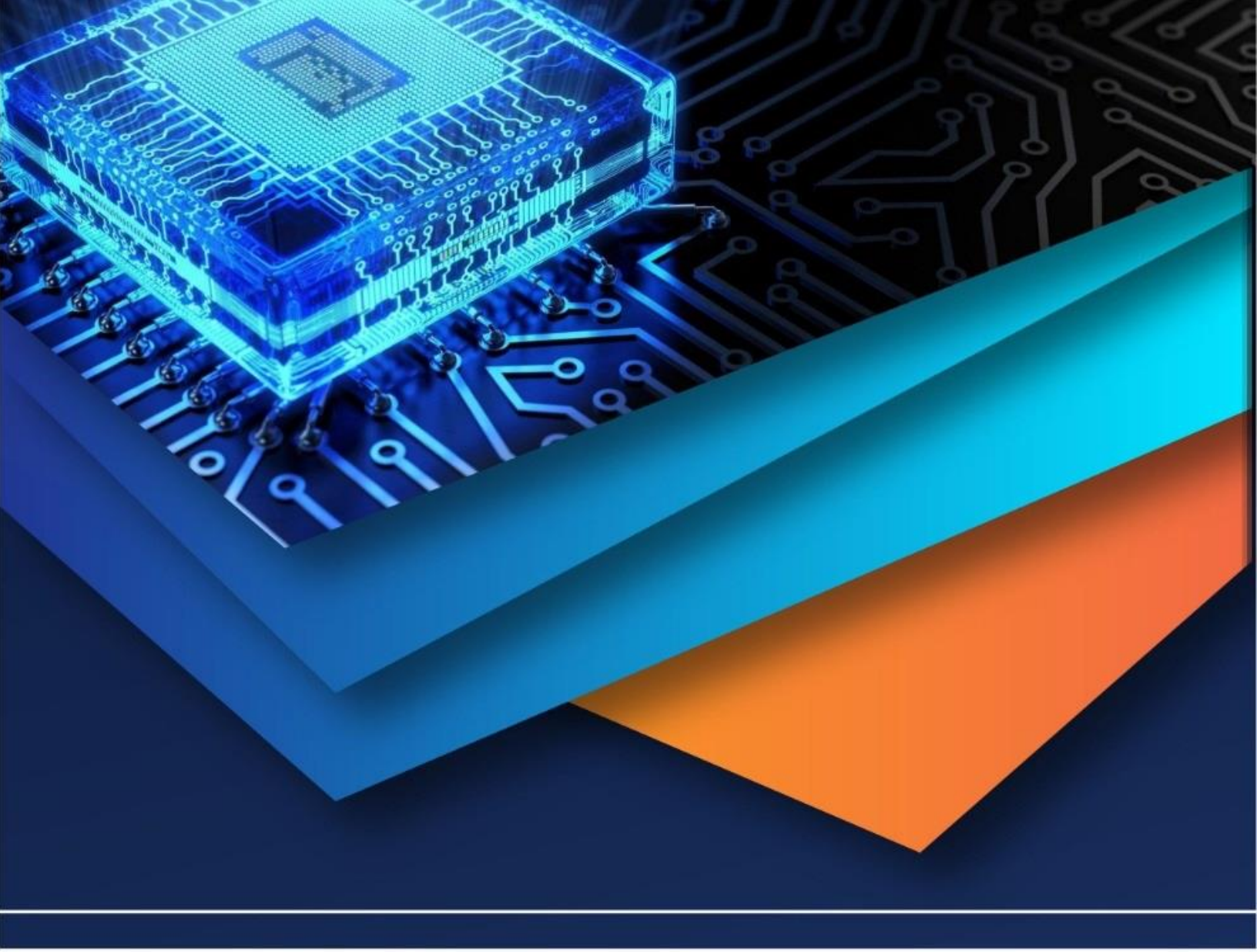
VII. CONCLUSION

This paper has achieved the highest accuracy of 70.6 % which is far improvement than older research andstudies. In the future by using the second proposed model we can achieve much better accuracy. We can also use the first proposed model structure to improve. Emotions are caused by brain activities which are expressed through face and voice. The purpose of this paper is to improve the accuracy, introduce briefly about methods, implementation and application of facial emotion recognition.

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