Indian Institute of Technology Indore

Discipline of Computer Science and Engineering

Computational Intelligence Minor Project

Spring 2024

Final Report

Title

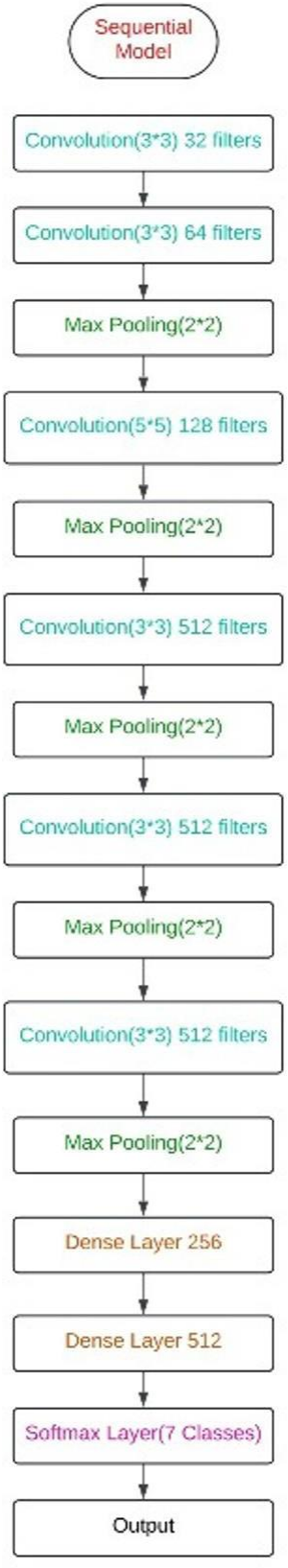
Real-time Face Detection Model with Emotion Prediction

Final Report

Problem Statement:

In real-world scenarios, maintaining awareness of the individuals in our vicinity is essential. Face detection plays a vital role in gathering information about individuals present at a specific location and time, particularly for real-time identification of human faces captured by cameras. Furthermore, we aim to analyze the facial expressions of individuals within the frame to gain deeper insights into their emotions and reactions.

Block Diagram/Flow diagram



Data Collection

https://www.kaggle.com/datasets/msambare/fer2013

Preprocessing

The dataset comprises images of uniform size (48x48 pixels) and grayscale format.
It is structured into directories for both training and validation, further categorized into seven distinct classes.
Each class contains a sufficient number of images for training purposes, although the quantity may differ across classes.
Therefore, data augmentation techniques can be applied to certain classes to enhance training diversity.
The dataset's organization is well-structured, eliminating the need for any preprocessing steps.

Algorithm

The Basic task is to detect the faces:

1) Algorithm: Haar Cascade Classifiers - Pre trained

Using the Haar Cascade Classifier to detect the faces present in front of the camera andsurrounding the detected faces with a rectangular box.

2) Trained CNN - Emotion Detection

Training our own CNN Model for predicting the emotions of the individuals.
DeepFace is used for age and gender prediction on the faces determined using Haar Cascade Classifiers.

CNN Model-

Contains 6 Convolutional layers with kernel size(3*3) with varying filters and 5 MaxPooling layers with kernel size (2*2). Finally, two dense layer and a softmax layer – for predicting the output.

Training-

The model is trained for 50 epochs with a batch size of 64. Image size – 48*48. Images are Gray scaled.

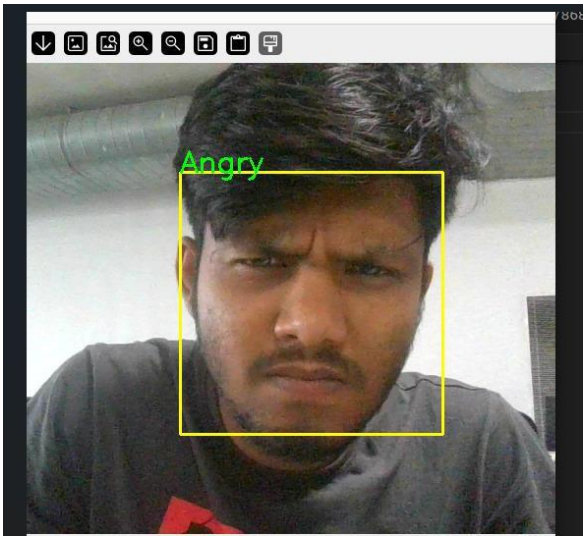
Performance

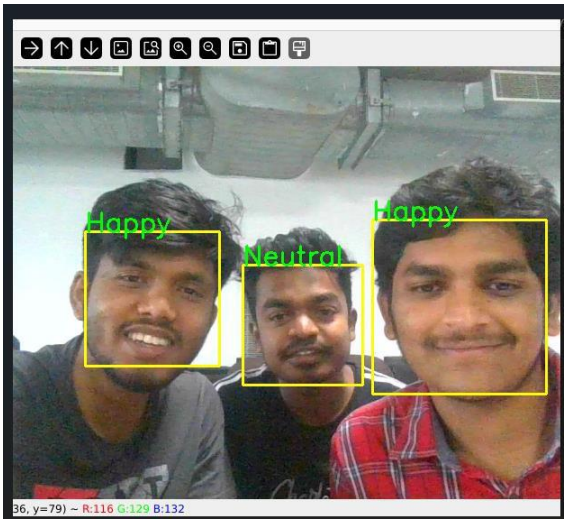
Metrics – Accuracy, Categorical Cross Entropy Loss.

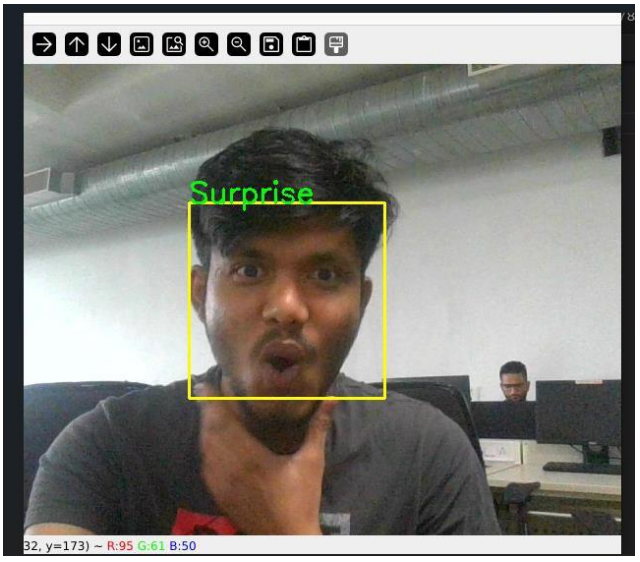
- Training Accuracy – 65.82%
- Training Loss – 1.5118
- Validation Accuracy – 65.72%
- Validation Loss – 1.5352

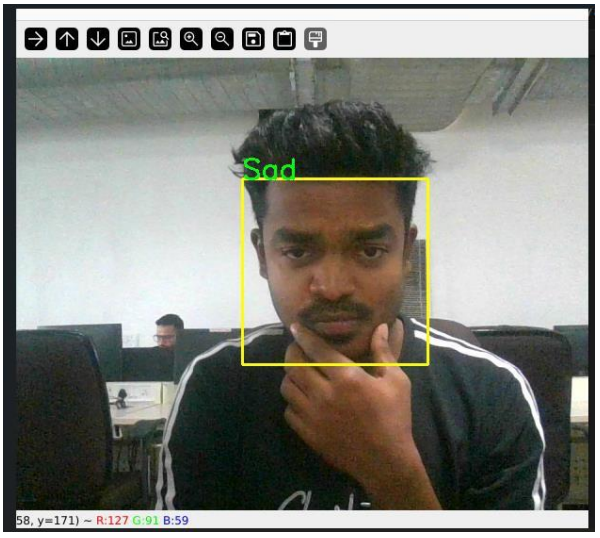
```
Epoch 00005: val_accuracy improved from 0.31948 to 0.34082, saving model to best_model.h5
Epoch 6/50
448/448 [==============================] - 49s 110ms/step - loss: 5.6123 - accuracy: 0.3357 - val_loss: 5.2410 - val_accuracy: 0.3147

Epoch 00006: val_accuracy did not improve from 0.34082
Epoch 7/50
448/448 [==============================] - 49s 109ms/step - loss: 4.6237 - accuracy: 0.3660 - val_loss: 4.1158 - val_accuracy: 0.4219
...
Epoch 50/50
448/448 [==============================] - 49s 109ms/step - loss: 1.5118 - accuracy: 0.6582 - val_loss: 1.5352 - val_accuracy: 0.6572

Epoch 00050: val_accuracy improved from 0.65430 to 0.65723, saving model to best_model.h5
```

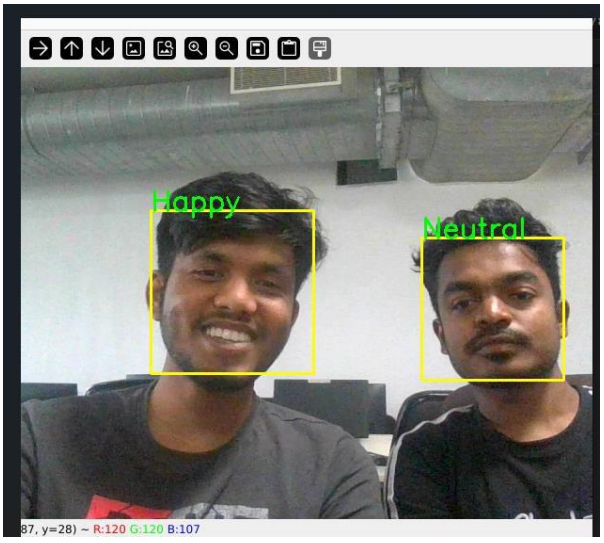
Experimentation & results

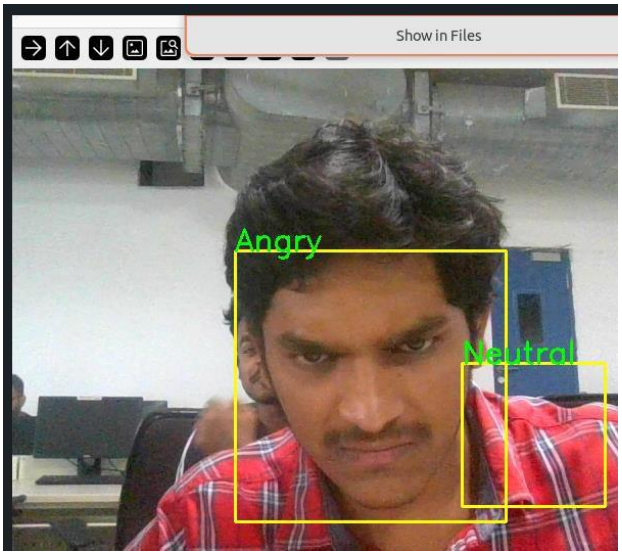












Conclusion:

Limitations/Challenges faced:

• The dataset that we are using for emotion prediction has images of small size (48*48). Training these images to extract the features was difficult and not many features were extracted. Also, the images are gray scaled.

• Our laptop's processing speed is pretty much low. So, the models weren't trained for huge number of epochs. So, the accuracies aren't that close to 100%. Also, the training time is too high.

Further Improvements:

• Implement other detection and predictions on the detected human faces such as race etc. Facial identification can also be performed.

• Collect and prepare a proper dataset for emotion prediction and then train the model on that dataset for better validation accuracy rather than the standard FER-2013.

References:

[1] Viola, P., & Jones, M. J. (2004). Robust real-time face detection. *Internationaljournal of computer vision*, *57*(2), 137-154.

[2] Zhang, C., & Zhang, Z. (2010). A survey of recent advances in face detection.

[3] Rafique, I., Hamid, A., Naseer, S., Asad, M., Awais, M., & Yasir, T. (2019, November). Age and gender prediction using deep convolutional neural networks. In *2019 International conference on innovative computing (ICIC)* (pp. 1-6). IEEE.

[4] Arriaga, O., Valdenegro-Toro, M., & Plöger, P. (2017). Real-time convolutional neural networks for emotion and gender classification. *arXiv preprint arXiv:1710.07557*.

[5] https://github.com/balajisrinivas/Gender-Detection/tree/master/gender_dataset_face.

Github link of our Project

https://github.com/pvs444/Face_Emotion_Detection/tree/main

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