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Masked Face Recognition System

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Abstract: Wearing masks has become compulsory for everyone nowadays. Thus, existing face recognition systems have become inefficient. So we have decided to develop a deep learning model which can properly detect masked faces.
We have used the MAFA dataset with 30, 811 Internet images and 35, 806 masked faces. Faces in the MAFA dataset have different orientations and occlusion degrees, and at least one part of the face is occluded by mask.We have used CNNs for masked face recognition. It comprises various convolutional layers, several pooling layers, non-linear layer and classification layer units. Deep CNN networks are typically trained on large labeled datasets like ImageNet to pick out general features which are appropriate into several detections and recognition jobs like image classification and verification, object detection, segmentation to texture identification

***Index Terms* - CNN-Convolutional Neural Network, Masked Face Recognition, Mask Detection, Occluded face detection.**

I. INTRODUCTION

The world is currently under the impact of COVID-19. Wearing face masks has become mandatory for all. Face recognition systems have become inefficient as most of the face remains covered so it becomes difficult to identify the faces. With our project we aim to solve this problem by training our model with occluded faces. We plan to use CNN i.e. Convolutional neural networks to extract the features of the face and identify it.

II. LITERATURE REVIEW

2.1.Masked Face Recognition Dataset and Application:

This paper takes the existing face detection technology and reworks it to be able to detect masked faces. MAFA dataset is used for experimentation. Overall, this system has an accuracy rate of 85% and is useful for detecting masked faces.

2.2. Detecting Masked Faces in the Wild with LLE-CNNs:

In this paper, they introduce the dataset MAFA and LLECNNs for masked face detection. It is found that MAFA is very challenging for existing face detectors, while the proposed model achieves the best performance in all settings. This may imply that the data-driven framework may be a feasible solution for finding robust and effective features for masked face detection. They believe this dataset can facilitate the development of face detectors that can effectively detect faces with occlusions. In addition, predicting facial attributes of MAFA like mask type and occlusion degree also has practical meaning in many real-world applications which will be one of their future research directions.

2.3.Masked Face Recognition for Secure Authentication:

This paper addresses the issue of recognizing masked faces through existing face recognition systems with reliable accuracy. It presents an open-source tool, MaskTheFace which can be used to mask faces. This results in the creation of a large dataset of masked faces. The dataset generated with this tool can then be used towards training an effective facial recognition system with target accuracy for masked faces. Using MaskTheFace, we report an increase of ∼ 38% in the true positive rate for the existing Facenet system for both masked and unmasked faces. The accuracy of the re-trained system was also tested on a custom real-world dataset MFR2 and reported similar accuracy, hence being able to extend out to real life masked faces.

2.4.Masked Face Recognition using convolutional neural network:

In this work, the FaceNet pre-trained model has been used for improving masked face recognition. They have used two other well-known datasets.. Their approach tested on those datasets shows better accuracy. The FaceNet model trained on masked and unmasked faces gives better accuracy for simple masked face recognition.

III. PROPOSED WORK

The proposed Masked Face Recognition system identifies the masked face by extracting the features of face which are not occluded using the deep learning approach of convolution neural network. Our work consists of three steps: Detecting faces from the stream and cropping it, extracting the unoccluded parts of the face and then using those features to recognize the person.

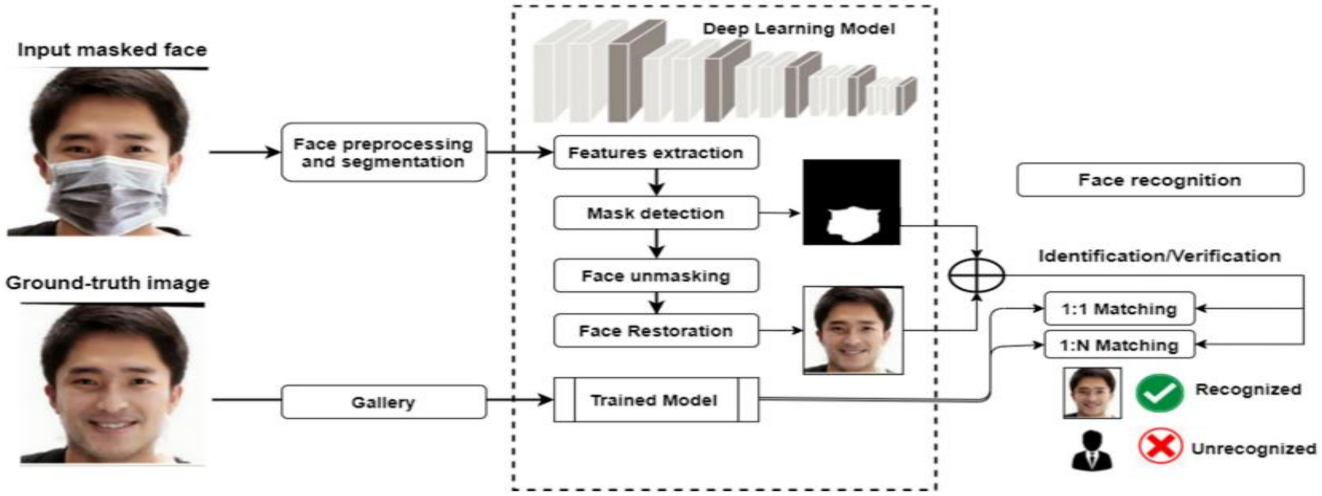

Fig.1. Pictorial representation of masked face recognition system

IV. SYSTEM ARCHITECTURE

The system architecture is given in Figure 2. Each block is described in this Section.

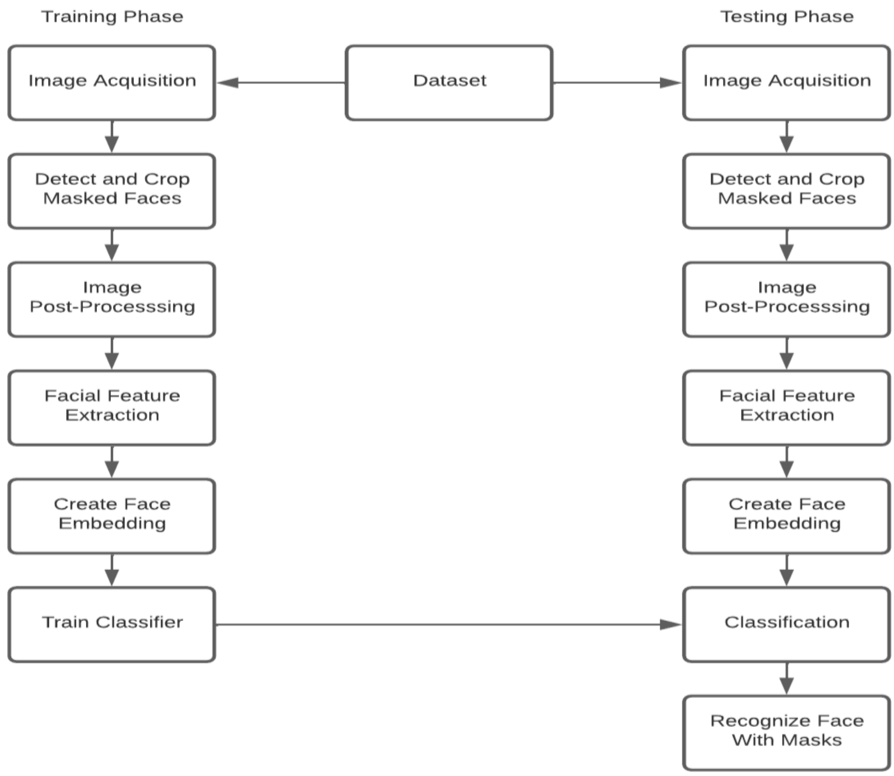

Fig.2. System Architecture

a. Data Processing:
Convolution Neural Network(CNN) algorithm is used to detect all the faces in image with their landmarks. Here we will use a pair of eyes as a landmark for similarity check and its transformation.The image will be discarded if the detection fails. Once all images which do not have any match in the database gets discarded the testing dataset minimizes to roughly 5000 images of 400 to 500 people.

b. Face Segmentation:1
To segment the parts of the face which are visible from their context and occlusion we will use deep face segmentation technique which implies a fully connected convolutional network(FCN).

c. Face Recognition:

The proposed deep learning structure is based on convolutional neural networks (CNN) . The higher capacity networks such as ResNet provide better prediction accuracy compared to older architectures like VGG. Nowadays, advanced technology makes training deeper networks faster and hence extract a large amount of facial data (feature vector) with various attributes (locations, gender, age, pattern). The CNN model works to map face images into 100-dimensional encodings, by using a 100-neuron fully connected layer as its last layer. I believe if we specify the full 100-dimensional encoding only for the upper part of the face, we will get more distinctive details about a person's face. These details, such as distance between the eyes or texture, the color of skin, and eyebrow shape are then converted into a mathematical representation and compared to data on others.

d. Training Data:

The visible parts of the face which we segmented are cropped and arranged into 96 x 96 RGB images.These images are flipped horizontally for augmentation of data. Afterwards each pixel in these images is subtracted by 127.5 and then divided by 128 for normalization of images.

e. Loss Function:

Loss function plays an vital role in CNN trainingThe main goal of classifiers to increase intra_class compactness is to enlarge the inter-class separation. Cross entropy loss function is always used in classification, also called as cost or log function which basically measures the model performance whose output value is probability between 0 and 1. It is used during the training phase to reduce loss by managing the weights of the model

It can be given as:

$$L_{\mathrm{CE}} = -\sum_{i=1}^{n} t_i \log(p_i), \quad \text{for n classes,}$$

where t_i is the truth label and p_i is the Softmax probability for the i^{th} class.

Fig.3. Mathematical equation of Cross-Entropy

V. RESULTS AND PERFORMANCE EVALUATION

In this work, we have trained models using Jupyter Notebook with batch size 196 and Adam optimizer for 100 epochs. The learning rate for the best model we got was 0.0005 and the average epoch time was around 25 minutes. The loss function used is Cross-Entropy and the inference method is Inception-ResNet-V1.

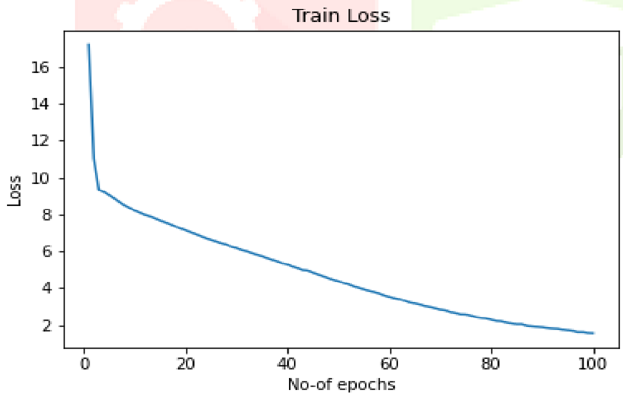

Fig.4. Training Loss

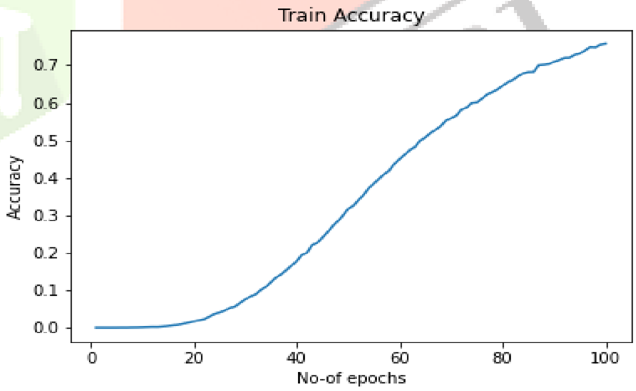

Fig.5. Training Accuracy

Figure 4 shows the training loss which is decreasing as the number of epochs is increasing and figure 5 shows the training accuracy which shows the accuracy of the trained model which increases as the number of epochs increases. The plot of the best model is shown below in figure 6 with the best accuracy during the testing phase.

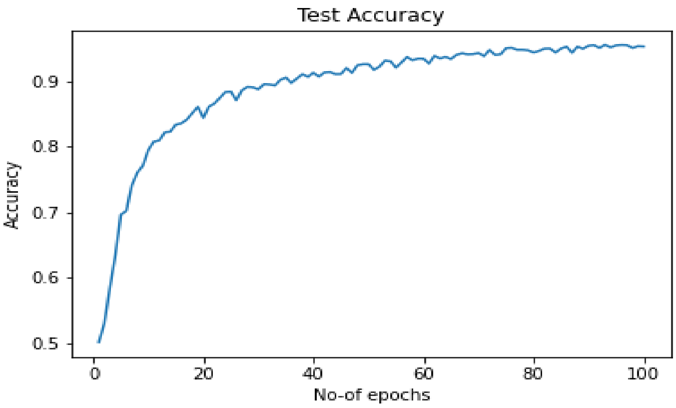

Fig.6. Test Accuracy

Fig.7. Face Mask Detection and Recognition Without Mask

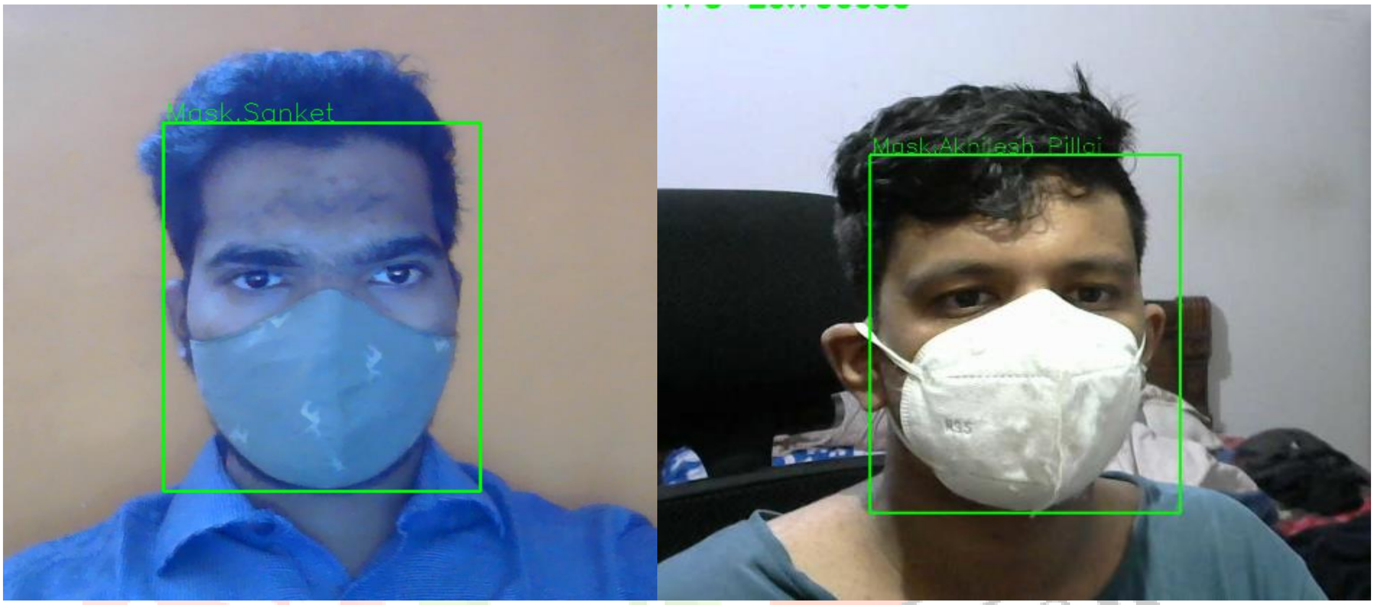

Fig.8. Face Mask Detection and Recognition With Mask

VI. CONCLUSION

Masked recognition application requires subjects to be approaching and facing up to the camera. Hence high-quality frontal face images will be readily acquired due to which the masked face recognition task will be no longer difficult. Even if the mask covers part of the face, the features of the upper half of the face, such as eye and eyebrow, can still be used to improve the availability of the face recognition. Finally, Face recognition uses in last years increased exponentially with numerous use cases. It can be used for everything from surveillance to marketing. More than ever , Face recognition represents an important problem that should be studied with the utmost priority.

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