Face Mask Detection

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Abstract— The Corona virus has caused a global pandemic resulting in deaths of millions of people around the globe. The WHO also released reports on how fast it has been spread from the country China where it was first discovered and from where it eventually spread around the world. The COVID-19 caused people to have difficulty breathing resulting in low oxygen and blood level In the present scenario due to COVID-19, there are no efficient face mask detection applications which are now in high demand for transformation means, densely populated areas, residential districts, large-scale manufactures and other enterprises to ensure safety. Our goal is to identify whether the person on image/video stream is wearing a face mask or not with the help of computer vision and deep learning. This model then can help to be alert and recognize the person before entering any public places. Therefore, face masks detection has become a crucial task to help society.

Keywords— Deep Learning, Computer Vision, OpenCV, TensorFlow, Keras, MobileNetV2.

I. Introduction

On February 2021, India recorded its first corona case, which led to the illness of the people countrywide. The corona virus is caused by acute respiratory syndrome (SARS - CoV2) which has infected more than 6 million people worldwide. WHO imposed certain restrictions on the public, regarding maintaining social distance, washing hands, and putting masks on the face. A study has proven that putting a mask on the face is a great way to reduce the impact of coronavirus and to suppress the spread by 90%. Putting on a mask eliminates the risk of inhaling the virus and spreading from one person to the another. A study has shown that wearing a mask which is as effective as 20% can also reduce the peak in the deaths in the country by 34 - 58%. The study also strongly recommends that if people are let to go in public, a mask is very important, as it will help in reducing the spread.

As the country has reopened from the lockdown, the government has put a restriction on the people who are going in public without a mask. Masks have become an essential measure to keep all the people safe. To mandate that if all people wear the mask, it has become essential to devise some techniques to detect if the person wears the mask. Face mask detection means to detect whether the person is wearing a mask or not.

The problem with this technology is that this approach includes high complexity and leads to low detection accuracy. Recently with the help of convolutional Neural Network (CNN) the technology is redesigned, and CNN gives a much better result than the past technology. There have been numerous studies on the algorithms used in face recognition, but the old ones were not that precise to detect the “Face under the mask” or “Mask over the face”, thus leading to the research. Hence, work related to accurately detecting the face in public areas (airports, railway stations, etc) to suppress the spread, and thereby contributing to the society.

II. Literature Survey

Recent study shows that, In the recent times, the Coronaviruses, which are a big family of different viruses, have become very common, contagious and dangerous to the whole human kind. It spreads human to human by exhaling the infection breath, which leaves droplets of the virus on different surfaces which are then inhaled by another person and catches the infection too. So, it has become very important to protect yourself and the people around us from this situation. We can take precautions such as social distance, washing hands every two hours, using sanitizer, maintaining social distance and the most important wearing a mask has become very common everywhere in the whole world now. From that the most affected and devastating condition is of India due to its extreme population in small areas.

The model uses the Convolutional Neural Network. It takes the image data as input, captures all the data, and sends it to the layers of neurons. The Convolutional neural network model used in the study paper is the MobileNetV2 architecture. Mobile Net model is a network model using depth wise separable convolutional has two layers: depth wise

convolutional and point convolution. The intermediate expansion layer uses lightweight depth wise convolutional to filter features as a source of non-linearity.

Further the different hyper parameters are tried for the model. The hyper parameters that are used in optimization models determine the step size of the model and help to reduce the loss function. It is a very important hyper parameter as it results in either convergence or overshoots the model. The other hyper parameters used are batch size, epochs etc. The model has used OpenCV to fulfil the purpose of using the video stream for capturing the frames in the video stream.

The pre-prepared MobileNet takes a shading picture and creates a multi-dimensional component map. The worldwide pooling block that has been used in the proposed model changes the element map into an element vector of 64 highlights. At long last, the SoftMax layer performs paired order utilizing the 64 highlights. The proposed model has accomplished 99% and 100% exactness on DS1 and DS2 separately. The worldwide pooling block that has been utilized in the proposed model dodges overfitting the model.

The computer vision-based application can be used in any working environment such as public place, station, corporate environment, streets, shopping malls, and examination centres, where accuracy and precision are highly desired to serve the purpose. It can be used in smart city innovation, and it will boost up the development process in many developing countries.

III. METHEDOLOGY

DESIGN: -

Face Mask Detection system built with OpenCV, Keras/TensorFlow using Deep Learning and Computer Vision concepts in order to detect face masks in static images as well as in real-time video streams.

The major requirement for implementing this project is using python programming language along with Deep learning, Machine learning, Computer vision and also with python libraries. The architecture consists of Mobile NetV2 as the backbone, it can be used for high and low computation scenarios.

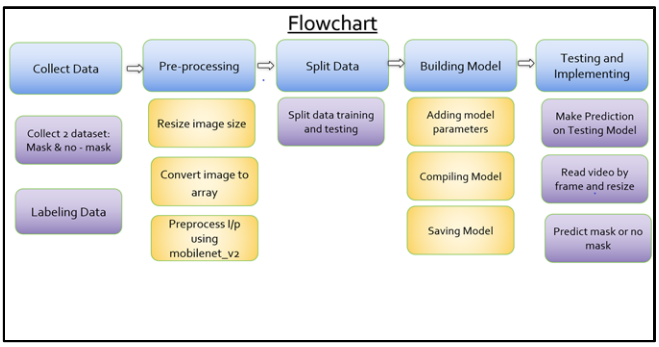
The software we require for the building of this project are listed below: -

1. **OpenCV**
2. **Caffe-based face detector**
3. **Keras**
4. **TensorFlow**
5. **MobileNetV2**

There are some steps for building these projects: -

1. **Data collection**
2. **Pre-processing**
3. **Spilt data**
4. **Building Model**
5. **Testing and Implementation**

You can understand the process of building of this model in the flowchart given below: -
:-



DEVELOPMENT: -

1. **Data Collection: -**

In the data collection process, we create a dataset with two classes. The class contains images with masks and others without masks. The dataset used is in the dataset directory. This dataset consists of 4095 images belonging to two classes: -

- with mask: 2165 images
- without mask: 1930 images

Then after collecting the dataset with images of with masks and without masks data labelling is done.

2.Pre- Processing: -

In pre-processing are some stages to go through: -
(1) Resizing of the images
(2) insert the input in MobileNetV2
(3) Convert the images in the datasets into an array
(4) Pre-processing of these images is done.

After Pre-processing of images, then we label them because many machine learning algorithms cannot operate on data labelling directly. The labelled data will be transferred into numerical labels, so the algorithm can understand and process the data.

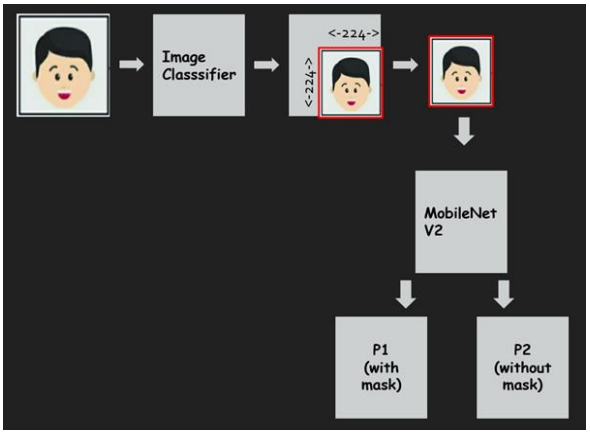
3.Split Data: -

In order to train a face mask detection, we need to break our dataset into two batches.

- **Training: -**
  Here we will focus on loading our face mask detector dataset from the disk, training a model using Keras/TensorFlow on this dataset, and then serializing the face mask detector to disk.
- **Testing: -**
  Once the face mask detector is trained, we can then onto loading the mask detector, performing face

detection and then classifying each face as with masks and without masks.

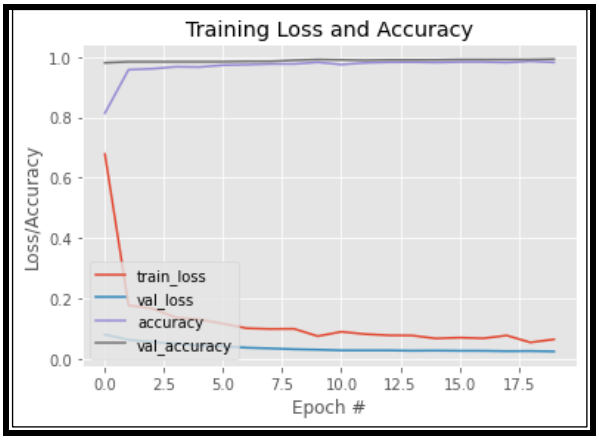
Given below is the pictorial representation of the model: -



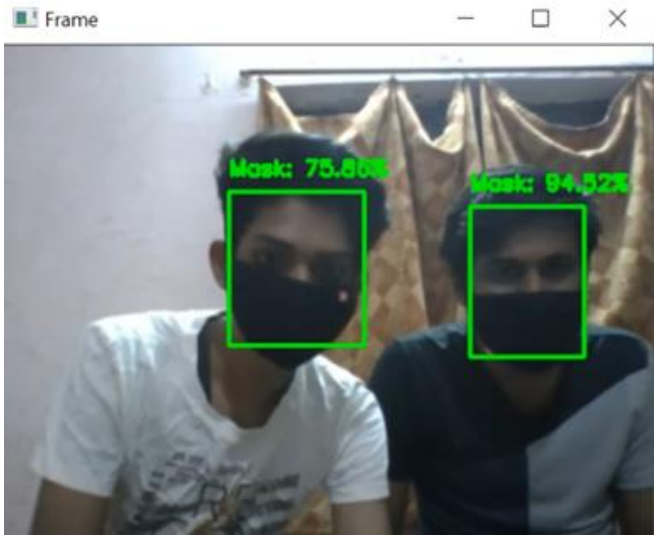
IV. RESULT

```
[INFO] evaluating network...
              precision    recall  f1-score   support

   with_mask       0.99      0.86      0.92       383
without_mask       0.88      0.99      0.93       384

    accuracy                           0.93       767
   macro avg       0.93      0.93      0.93       767
weighted avg       0.93      0.93      0.93       767

[INFO] saving mask detector model...
dict_keys(['loss', 'accuracy', 'val_loss', 'val_accuracy'])
```

Tests are carried out using the recall metrics, Precision, F1-score, and the corresponding macro average and weighted avg as the experiments are carried out has to have the purpose of demonstrating the potential use of the system. The objective of using these metrics in the system is to evaluate from different perspectives. Recall and Precision indicate the ability of the model to detect true positives Correctly. The Precision detects the false positives and Recall detects the false negatives by the model. False positives occur when an object is labelled as a face. False negatives occur when a face is not detected in the first stage because the face is in the covered areas that makes it difficult and, in this proposal, the initial classifier is a pre-developed tool. The F1-score is a combination of Precision and Recall with 0 being low performance and 1 being the best performance. The F1-score provides a global measure of the system's performance. In the macro avg metric, SD can get an idea of the average of all the experiments and the weighted avg uses an average measure of all of the experiments by considering The number of each class of observations.



For training the facial recognition models, a set of observations made up of 4095 images is generated; 52.9% images with a face mask and 47.1% images without a face mask. The experimental results show that there is an accuracy of 98.65% in determining whether a person is wearing a mask or not. An accuracy of 99.52% is achieved in the facial recognition of 10 people with masks, while for facial recognition without masks, an accuracy of 89.95% is obtained.



V. CONCLUSION

For detecting facemasks, a deep learning-based approach is being used in public places to overcome the spread of Coronavirus. The technique which is used for face mask detection handles the situation densely and makes an ensemble of single and two-stage detectors at the pre-processing level. The approach helps in achieving high accuracy for face detection and also improves detection speed efficiently. Resulting in a strong and low-cost system, the application of transfer of learning on pre-trained models with extensive experimentation over an unbiased dataset is useful. People who are violating the face mask norms will be in trouble as the

system will identify their faces as well as the system will increase the utility for public benefits.

VI. FUTURE SCOPE

The work further creates interesting future directions for the researcher to work on the system.

1. The system is not only used for face mask detection but it can be also used for any high video surveillance devices.
2. The system can also be used to detect faces with a facemask for biometric purposes in places such as hospitals, colleges and many more places.

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