CNN MODEL USING SEQUENTIAL API FOR FACE MASK DETECTION

in The Era of COVID-19 Pandemic

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Abstract: Covid-19 caused due to the corona virus, this virus was first discovered in Wuhan In December 2019 now it is a pandemic affecting almost every country in the world. This virus transmitted from one person to another person through droplets spawned when a Covid-19 patient sneezes, coughs, exhales. One of the solutions to prevent covid-19 is wearing the face mask, many governments trying their best to educate citizens to wear the mask in public places, even that made it mandatory, but a majority of people are violating this rule. In the current scenario of police frequently checking for a face mask in public placesan imposing fine on the people who were not wearing the face mask. On the other hand, some government introduced technology to detect people about face mask and center details, petrol them, then they will catch them.

In this paper, we propose a model which detects whether a person is wearing a face mask or not using a facial detection system using CNN model we have detected persons with and without the mask and we will identify the pixel level by comparing it with many other algorithms available, CNN works more accurately. We implemented a model with 3 convolution layers and applied a dropout of 0.5% and used Relu, softmax as activation functions at hidden and fully connected layers respectively, Cross entropy is used as a loss function. Adam is an optimizer and it is working with 95.6 accuracies. This AI-based detection system will create awareness in minds of the public and they will start wearing masks in public so that the spread of the Covid-19 pandemic can be controlled for the wellbeing of society.

The main goal of the project is to implement this system at colleges, hospitals, and offices where chances of spread of COVID- 19 through contagion are relatively higher. Here we give a summary of datasets and how we cleaned up the data.

Index Terms **- Convolution Neural Network(CNN), Face Mask, Sequential API, Covid-19, Deep Learning.**

I. INTRODUCTION

This year 2020 has shown mankind some mind-blogging series of events amongst which the COVID-19 pandemic is the most life-changing event which has startled the world since the year began. Affecting the health and lives of masses, COVID-19 has called for strict measured to be followed to prevent the spread of disease. From the very basic hygiene standards to the treatmentin the hospitals, people are doing all they can for their own and society's safety; face masks are one the personal protective equipment. People wear face masks once they step out of their home and the authorities ensure that people are wearing masks while they are in groups and public places.

To monitor that people are following this basic safety principle, a strategy should be developed. A face mask detector system can be implemented to check this. Face mask detection means identifying whether a person is wearing a face mask or not. The first step to recognize the presence of the mask on the face is to detect the face, which makes the strategy divided into two parts: to detect face and to detect mask on those faces. Face detection is one of the applications of object detection and can be used in many areas like security, biometrics, law enforcement, and more. There are many detector systems developed around the world and being implemented. However, all this science needs optimization; a better, more precision detector, because the world cannot afford any more increase in Corona cases.

In this project, we will be developing a face mask detector that can distinguish between faces with masks and faces with no mask. The implementation of an algorithm is on images.

Dataset has two folders with_mask and without masks containing images of with mask and without masks respectively. It consists of about 1151 images with 700 images containing people with face masks and 451 images containing people without face masks. The training set will be having 863 samples and the testing set will be having 288 samples. The training set will be having 863 samples and the testing set will be having 288 samples.

II. LITERATURE OVERVIEW

In this paper, we Predict whether a person wearing a face mask or not in the user input image. In [6], the authors developed a deep learning classifier to check the performance evaluation of intelligent face mask detection systems. Here the performance of face mask detection using different deep learning classifiers can be analyzed. In[9], The face mask detection system developed with the image classification methods: MobileNetv2, MobileNetV2 is a method based on convolution Neural networks. In [3], this model predicts people having a liver disease like Fatty liver, Cirrhosis, Hepatitis A, B, etc. This system was developed with the help of Data mining, classification algorithm, convolution neural network, Deep learning methods. In [4], The Keras documentation includes complete information about Keras. This includes keras introduction, keras ecosystem, keras API, Utilities, code examples, etc. In[8], This includes tensor flow white papers. Tensor flow is used to developed machine learning applications. It is designed in a python programming language. In [2], a model has been made for the prediction of liver disease using the Deep Learning Test Classifier. Best accuracy is provided by detaining sequential information from the input dataset.

III. PROPOSED SYSTEM

Figure 1:Proposed System

3. PROPOSED SYSTEM: The model is divided into 9 steps as shown in Figure 1. The details of Figure 1 are givenbelow from 3.1 to 3.9 points.

& 3.2: Loading the Dataset and Importing the Libraries:

The Dataset for Training and Testing has been taken from kaggle.com. The link for the same is- https://www.kaggle.com/ashishjangra27/face-mask-12k-images-dataset. . It consists of about 1151 images with 700 images containing people with face masks and 451 images containing people without face masks. The training set will be having 863 samples and the testing set will be having 288 samples.

Libraries Imported are:

- Keras is a neural network library.
- TensorFlow is the open-source library for various tasks in machine learning.
- The sklearn library contains a lot of efficient tools for machine learning and statistical modeling including classification, regression, clustering, and dimensionality reduction.
- Matplotlib is a plotting library for Python. It is a plotting library used for 2D graphics in a python programming language.

- NumPy is a Python library used for working with arrays
- OpenCV-Python is a library of Python bindings designed to solve computer vision problems.

Preprocessing the Images:

A separate Array has been made for storing the images and their labels. The images of the dataset are converted to grayscale format as color images are complicated and hard to process. After that, the grayscale images are resized into 56x 56 to keep the size of the image consistent. Then the images are converted into arrays using the NumPy function.

Perform One-Hot Encoding on Labels:

One Hot Encoding is used for encoding categorical data into vectors 0s and 1s. By using the label Binarizer function. Images with masks are encoded to 0 and without masks are encoded to 1.

Splitting the Dataset:

A whole dataset consisting of 1151 images of which 700 images containing people with face masks and 451 images containing people without face masks. The training set will be having 863 samples and the testing set will be having 288 samples.

Building Convolution Neural Network using Sequential API:

Convolution Neural Networks (CNN) can be thought of as an artificial neural network that can detect patterns. Here we have used Sequential API which allows us to create layer-by-layer models. In our models, we have three convolution layers. Each layer contains convolution, Relu, and Max-pooling layers. For training, the Model Adam Optimizer is used with a learning rate of 0.001 and for calculating the loss Categorical_cross entropy function.

& 3.8.Evaluation and Accuracy of the fitted model.

After using the model fit function Training loss and Accuracy have been plotted using the Matplot library. And the model has been saved in pkl format. After saving the model is loaded using the load_model function and the accuracy y of the model is 0.89 is printed.

3.9 Testing the model on User Input data:

After loading the model has been tested on user input images of the same person with and without the mask and the model predicts correctly for the input samples.

IV. RESULTS:

In Figure 2, the output shows the Loss value VS the Number of epochs. Loss Value is defined as how poorly or well a model behaves after each epoch(iteration) of optimization. In Figure 3, the output shows the Accuracy value VS the number of epochs. An **accuracy** metric is used to measure the algorithm's performance in an interpretable way. The **accuracy** of a model is usually determined after the model parameters and is calculated in the form of a percentage.

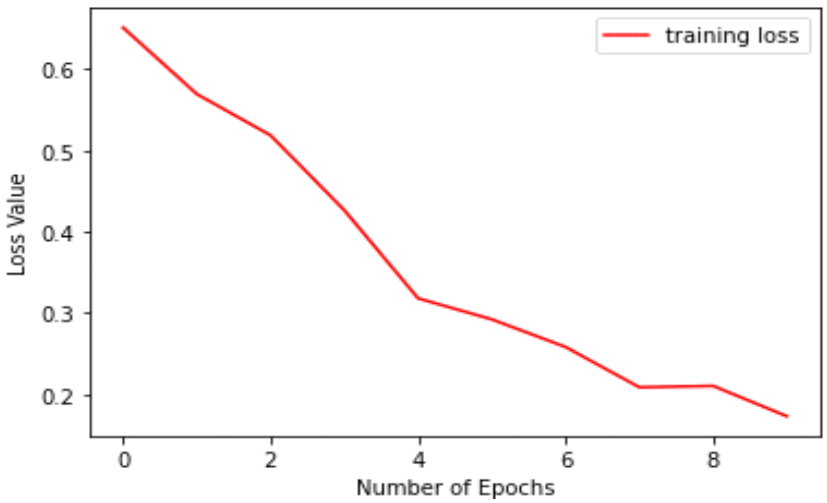

Figure 2: Training Loss

The above, Figure 2 show the training loss for each epoch. in this we have plotted numbers of epochs with loss value. here x-axis shows the number of epochs and the y-axis defines the Loss value.

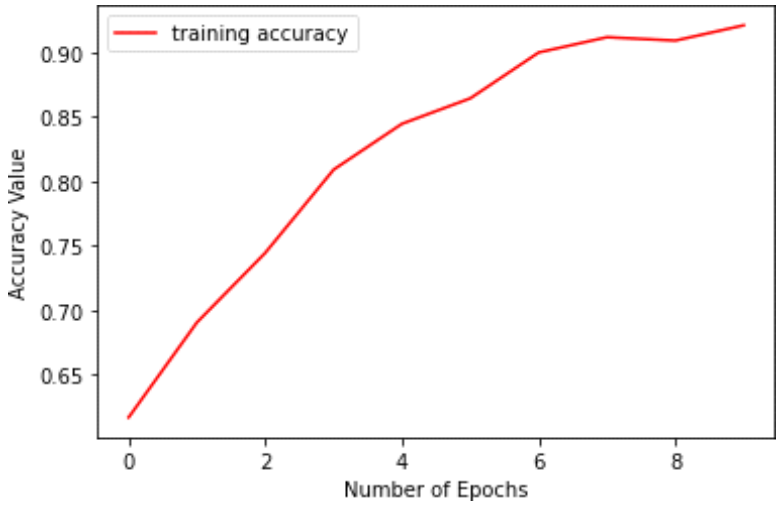

Figure 3: Training Accuracy

The above Figure 3, shows the training accuracy for each epoch. in this we have plotted numbers of epochs with accuracy value. here x-axis shows the number of epochs and the y-axis defines the accuracy value.

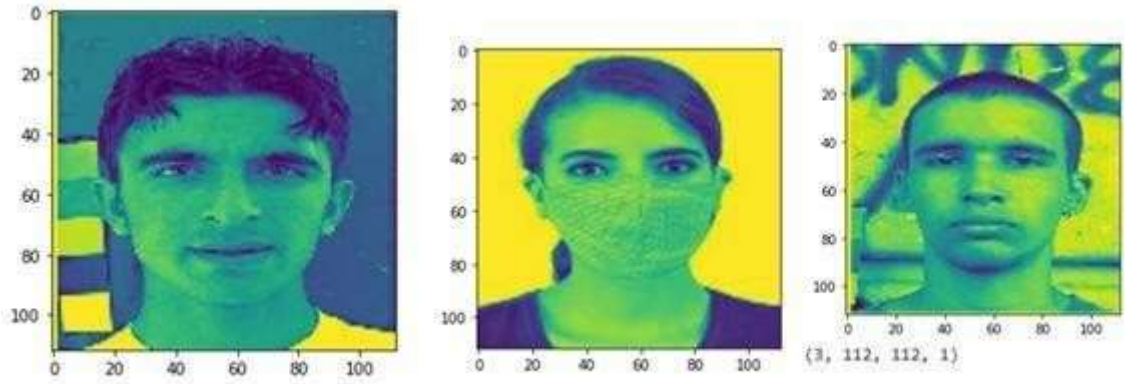

Figure 4: Testing on some sample images of train dataset

```
# Generate predictions for samples
predictions = model.predict(samples_to_predict)
print(predictions)
# Generate arg maxes for predictions
classes = np.argmax(predictions, axis = 1)
print(classes)
```

```
[[0.03822049 0.9617795 ]
 [0.6333097  0.36669022]
 [0.01442137 0.98557866]]
[1 0 1]
```

Figure 5: Predictions for above samples

Above, Figure 5 showing the prediction of test data of the sample images which are presented in Figure 4, and in Figure 4 some randomly selected images from the training data set are taken. As we can see we are getting output [1 0 1]. here one (1) value showing the person has not worn the mask and value zero (0) shows that the person has worn the mask.

Sample	With Mask	Without Mask	Prediction
Sample 1	0.03822049	0.9617795	1
Sample 2	0.6333097	0.36669022	0
Sample 3	0.01442137	0.98557866	1

Table 1:Prediction on Sample values with mask and without a mask of train dataset

Above table 1: shows the prediction of test data of the sample images which are presented in Figure 4, and in Figure 4 some randomly selected images from the training data set are taken. As we can see we are getting sample1 value with the mask as 0.038 and for without mask the sample1 value is 0.9617 and prediction value as 1 which means the person has not worn the mask. similarly, sample 2 and sample 3 are shown in table 1.

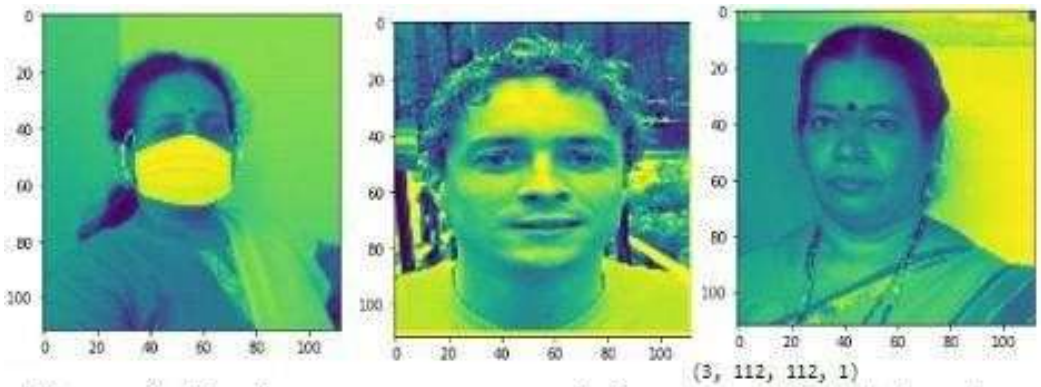

Figure 6: Testing on some sample images of test dataset

The below Figure 7, showing the prediction of test data of the sample images which are shown in Figure 6. in this the output value zero (0) means "MASK" and the output value one (1) Showing the Person wears a "NO MASK".

```
[ ]  # Generate predictions for samples
     predictions = model.predict(samples_to_predict)
     print(predictions)
     # Generate arg maxes for predictions
     classes = np.argmax(predictions, axis = 1)
     print(classes)

     [[0.98676    0.01323994]
      [0.22055529 0.7794447 ]
      [0.09153092 0.9084691 ]]
     [0 1 1]
```

Figure7: Prediction for above sample images

Above, Figure 7 showing the prediction of test data of the sample images which are presented in Figure 6, and in Figure 6, some randomly selected images from the testing data set are taken. As we can see we are getting output [0 1 1]. here one (1) value showing the person has not worn the mask and value zero (0) shows that the person has worn the mask.

Sample	With Mask	Without Mask	Prediction
Sample 1	0.98676	0.01323994	0
Sample 2	0.2205529	0.7794447	1
Sample 3	0.09153092	0.9084691	1

Table 2:Prediction on Sample values with mask and without a mask of the test dataset

Above table 2: shows the prediction of test data of the sample images which are presented in Figure 6, and in Figure 6 some randomly selected images from the training data set are taken. As we can see we are getting sample 1 value with the mask as 0.98676 and for without mask the sample1 1 value is 0.013 and prediction value as 0 which means the person has worn the mask. similarly, sample 2 and sample 3 are shown in table 2.

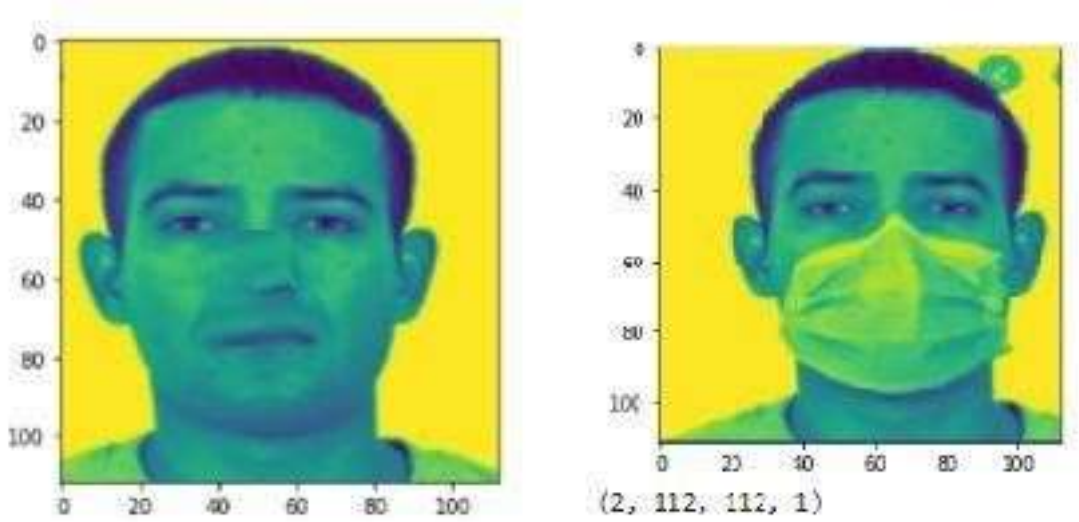

Figure 8: Predicting on some sample images of user- input

```
# Generate predictions for samples
predictions = model.predict(samples_to_predict)
print(predictions)
# Generate arg maxes for predictions
classes = np.argmax(predictions, axis = 1)
print(classes)
```

```
[[0.04822854 0.95177144]
 [0.9501578  0.04984216]]
[1 0]
```

Figure 9: Predictions for above samples

The above Figure 9, showing the prediction of user input data of the sample images which are shown in Figure 8. in this the output value zero (0) means "MASK" and the output value one (1) Showing the Person wears a "NO MASK".

As you can see in Figure 8 we have taken some sample images outside of our database and testing for the same we are getting the required result. as in figure 8 left-hand side person has "No Mask" the output value is 1 (we can verify from Figure 9). and in Figure 8 right-hand side the person is "WITH MASK" we are getting output 0. (we can verify from Figure 9)

V. CONCLUSION

In this paper, we have looked at a dataset of Face Masks Detection. With the widespread of Covid-19 disease, it's our major responsibility to take care of ourselves as well as our society. The face mask is an important shield for protection against Covid-19. To detect whether a person is wearing a face mask or not is the major goal of our project. And this goal has been successfully achieved with better results using Convolution Neural Networks and Sequential APIs. The applications of this Face Mask Detection System are used especially for the prevention of Covid-19 and can be implemented at Hospitals, Offices, Restaurants, etc. By using a Deep Neural Network, we can easily detect facial masks.

VI . REFERENCES

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