International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 4 ǁ April 2023 ǁ PP. 419-425

Face Mask Detection Using Machine Learning

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Abstract— *Everyone on the planet was suffering by the effect of COVID-19. To help prevent the continuous spread of corona virus, people had to adjust and adapt new way of living the lives by working at home, communicating on-line, and practicing good hygiene. Additionally, researches have demonstrated that using a face mask can reduce the likelihood of the corona virus. Several public places are compelled to take precautions to ensure that customers are properly wearing face masks and keep a safe distance from one another. However, it is impractical for providers of public services to determine with absolute certainty whether each customer is using a mask. As a result, as one of the most accurate and efficient face mask detectors, we propose using webcam cameras and image recognition for detecting face mask in this project.*

The propose system for identifying face masks includes the following three methods:

1) Face mask classification
2) face identification and cropping, and
3) image preprocessing.

This strategy can recognize the utilization of a facial covering, the shortfall of a facial covering, and the mistaken facial covering. This strategy will help public service providers ensure that these public spaces are safe, encourage people to wear face masks, and ensure that everyone in the area wears them appropriately.
Keywords—: *Face-Mask Detection, Convolutional Neural Network (CNN), MobileNetV2, Precautions for corona virus.*

Date of Submission: 06-04-2023 Date of acceptance: 18-04-2023

I. INTRODUCTION

COVID-19's impact on the world today is significant. Each day there were more Coronavirus contaminations that brought about death. This situation forced people to adjust to the new normal and take precautions against the Corona-virus. A number of measures were required in order to stop the spread of corona virus, including washing one's hands frequently, avoiding social settings, and, most importantly, wearing face masks. Many public spaces, including malls and parks, have measure for customer service, that is effective only when the customers wear masks correctly because extensive research has shown that using a face mask reduces the risk of viral transmission.

However, providers of public-services aren't always able to tell when someone is wearing a face mask. As a result, technologies that can take a picture of someone's face and display it as text will be used in this project. Machine learning and artificial intelligence, for example, combine a number of technologies to provide practical solutions to difficult problems in these fields. Analytics and a webcam are used by this technology to quickly identify the person wearing a face mask. As a result, ensuring that everyone in this location appropriately wears a face mask will assist public service providers in maintaining public safety and ensuring that these public spaces have a safe atmosphere.

To help reduce the spread of the virus, the project aims to create a webcam-based, face mask detection system in real-time. Image processing, artificial intelligence, and machine learning are all incorporated into this system. This project is able to differentiate between three categories of face masks. First, people who correctly wear face masks make up the class ‘with a mask’. Second, to classify individuals who wear masks where their mouths or noses are not covered which apparently come under the class ‘incorrect mask’. Another illustration of a mask that is appropriate is when people wear face masks appropriately.

The result will be displayed as a percentage of the confidence level and as text on the screen. The screen will display messages like “No Mask” written inside a red-colored box if no face mask is on. If an individual does not wear a face mask properly, then the screen will display the message “Incorrect Mask” inside a blue-colored box. If the person is wearing a mask correctly, a "Mask" inside a green-colored box will be displayed.

Using a mask regularly may help decrease the viral transmission according to many researches. These researches forced almost every place to take precautions to ensure that customers properly wear face masks and keep a safe distance from each other. However, it is impractical for providers of public services to determine with absolute certainty whether each customer is using a mask.

The objective of this venture is to make a framework that can perceive assuming somebody is wearing, or not wearing, a facial covering. This strategy will assist public service providers in encouraging people to wear face masks, ensuring that these public spaces are safe, and ensuring that everyone in the area appropriately wears one.

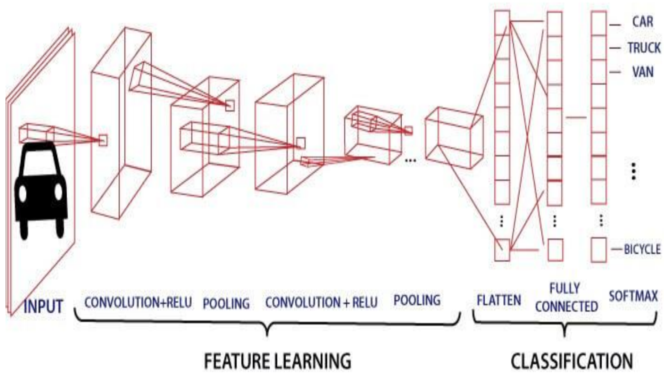
II. PROPOSED ALGORITHM

CNN ALGORITHM:

One of the main categories for photograph kind and reputation in neural networks is convolutional neural network. Face reputation, scene recognition, object detection, and many others. Convolutional neural networks are popular in a select few fields.

Rhino takes an image as input, which is then categorized and processed in accordance with a particular class, such as dog, cat, lion, tiger, and so forth. A PC interprets a picture as being created in pixels and bases its conclusion on the picture. Depending on how the image is chosen, it will look to be h*w*d, where h=top, w=width, and d=size. A grayscale image is structured in a 4*4*1 matrix, whereas an RGB image is set up in a 6*6*3 matrix.

Each image entered in CNN will travel through a series of convolutional layers that include collates, layers, and filters (additionally known as kernels). The soft-max function is then used to increase the object's propensity to report the values 0 and 1.



III. LITERATURE SURVEY

The face mask detection model is especially useful in public areas with a lot of people moving around, like hospitals, airports, and businesses. In hospitals, we can incorporate this model with pre-configured CCTV cameras. If an employee of a hospital is discovered without a mask, the hospital's higher authorities can take the necessary action against the employee. The entrance and exit gates of the airport ought to feature this design. This project is developed in such a way that it will precisely detect whether a person is mask-free. In the scenario where the calculation identifies someone without a face mask, a warning should be issued to notify concerned professionals or bystanders nearby, allowing them for the immediate implementation of appropriate measures against the individuals.

To help stop the spread of infection, such technology can be installed in the passage and exit access frameworks. This technology is applicable not only to the COVID-19 pandemic but also to any location and time when facemasks are required to treat infections transmitted by air. Cameras take real-time videos of people in public places, which are then fed into a system that checks to find who are not wearing a face mask in the area. The concerned authorities are informed and the necessary steps are taken if the system finds someone roaming without a face mask.

The prepared engineering with various layers of convolution and max-pooling coupled to a profound brain network was 98.7% precise at separating between those wearing facial veils and the individuals who didn't. The trained model had an AUC of 0.985 and an accuracy of 98.7% when applied to the unobserved test data.

IV. PROPOSED SYSTEM

Tensorflow, Keras, and OpenCV were utilized in Python to create and develop the model shown here. MobileNetV2 is also used, which is the model of CNN. CNN refers to convolutional neural network. MobileNetV2 is used as the process of transfer learning. Transfer learning is the process of using a trained-model to train our own separate model in the way you want to train and get a prediction. Doing this saves a lot of time and effort and help making it easy to train a lot of models. To get the model run accurately and precisely, we use the hyperparameters learning rate, epochs, and batch size. We train the model by giving it a dataset which is a set of pictures of two classes, one class is with face-mask images and another class without face-mask images. This set of data consists of 1918 images of people not wearing a face-mask and 993 images of people wearing a face-mask. This is to be done is two steps-

- Using the chosen dataset to train the model.
- Sending the model.

Utilizing the libraries recorded above, we made a model for the paper. The following section discusses the outcomes of our tests on the model under various conditions and with various hyperparameters.

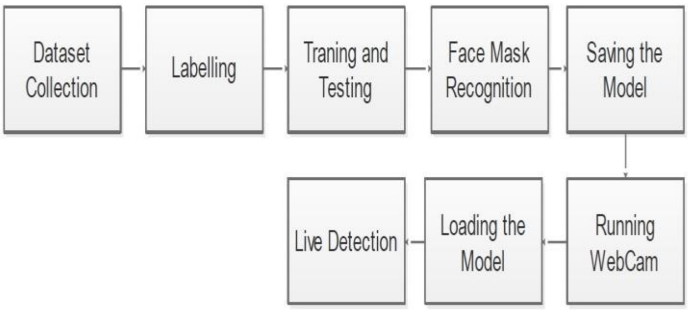
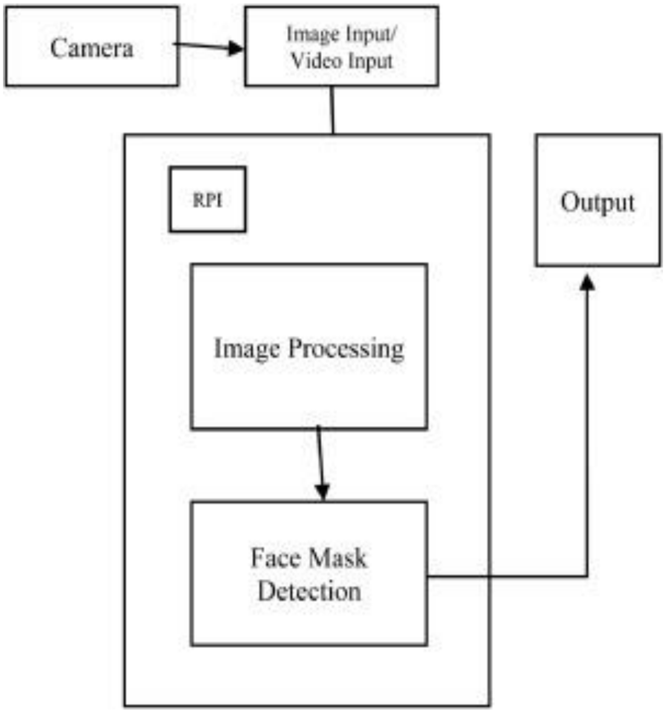


Figure 1. System architecture for detecting face mask

After incorporating the dataset into the model, we run the program to train it with the current dataset. The detection program is then run, activating the video stream and continuously grabbing frames using an anchor box for object detection. By moving the image through its layers, the MobileNetV2 model layers determine whether or not it contains a mask. A green anchor box is shown in the event that the individual is wearing a veil, and a red anchor box in the event that they are not, each with the exactness for a similar showed on the anchor box.



This face mask detection system uses Artificial intelligence to check if a person is wearing a face-mask or not. This system can be connected to any security camera setup you have on your home. Administrators or the police may run a system check on the person to confirm their identity. The technology can help informing the concerned authorities if it finds anyone entering inside the building without wearing a face-mask. The percentage of accuracy for recognizing someone wearing a face mask varies depending on the digital capabilities like the quality of camera and many more, from 95 to 97%. The flow chart of this Detection model is shown in the Figure 2.

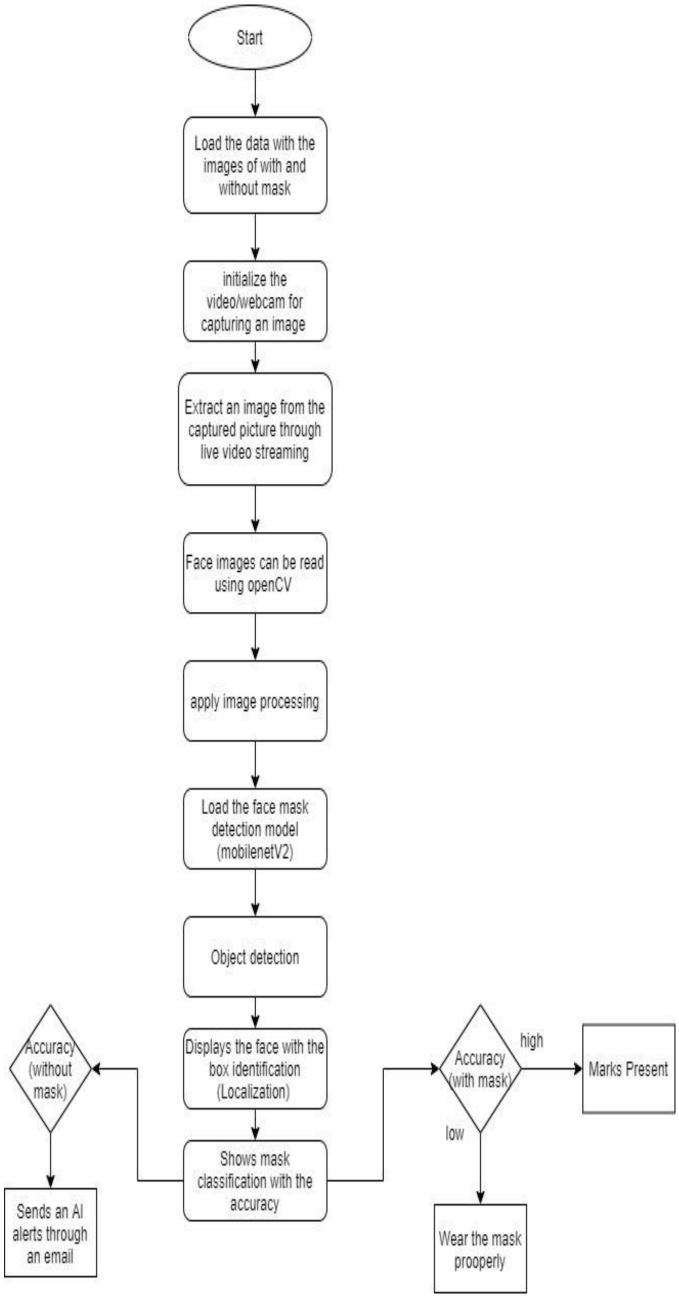
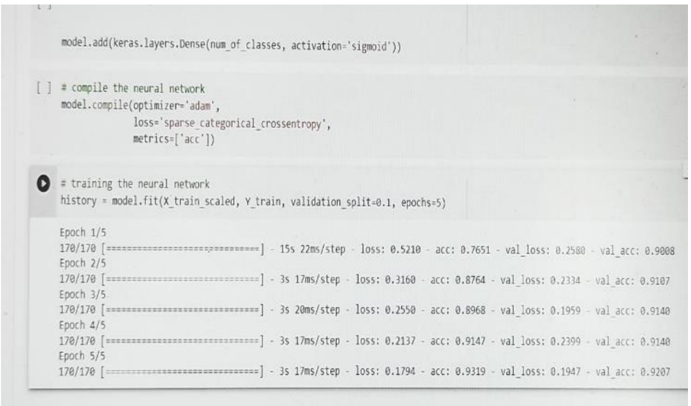


Figure 2. Flow-chart of the model: Face Mask Detection

V. RESULT

We tested the model under various conditions, and the results are shown in the table below. For all three cases, the number of epochs was constant at 20, and the batch size was set at 32. For the purpose of capturing a smooth image, we used average pooling.



```
model.add(keras.layers.Dense(num_of_classes, activation='sigmoid'))

# compile the neural network
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['acc'])

# training the neural network
history = model.fit(X_train_scaled, Y_train, validation_split=0.1, epochs=5)

Epoch 1/5
170/170 [==============================] - 15s 22ms/step - loss: 0.5210 - acc: 0.7651 - val_loss: 0.2580 - val_acc: 0.9008
Epoch 2/5
170/170 [==============================] - 3s 17ms/step - loss: 0.3160 - acc: 0.8764 - val_loss: 0.2334 - val_acc: 0.9107
Epoch 3/5
170/170 [==============================] - 3s 20ms/step - loss: 0.2550 - acc: 0.8968 - val_loss: 0.1959 - val_acc: 0.9140
Epoch 4/5
170/170 [==============================] - 3s 17ms/step - loss: 0.2137 - acc: 0.9147 - val_loss: 0.2399 - val_acc: 0.9140
Epoch 5/5
170/170 [==============================] - 3s 17ms/step - loss: 0.1794 - acc: 0.9319 - val_loss: 0.1947 - val_acc: 0.9207
```

Table 1 shows the result from a comparison of different hyper-parameters and their respective circumstances.

Model	Learning -rate	Distance with face mask	Distance without face mask	Quality of Blur image	Multiple people capturing
A	1e-4	162 cm	192 cm	Good	5 people
B	1e-3	157 cm	189 cm	Average	4 people
C	1e-2	149 cm	182 cm	Bad	4 people

Table 1. Result Comparison Table

The data above in the table clearly shows that the best model among all the models is the first model. An illustration of the first model, as per the study, can be found below. This illustration shows a graph of loss or accuracy against the number of epochs for the loss training, loss validation, accuracy training, and accuracy validation.

Figure 3. No. of epochs plotted against loss or accuracy

The above graph clearly shows that as there is an increase in the number of epochs seen, then there is also an increase in train_acc, val_acc, it fluctuates, then increases again. The fact that the val_acc is greater than the train_acc, it gives an additional proof that this detection model is not overfitted.

VI. EXISTING SYSTEM

[3] recommends a MobileNet which is pre-trained and for the purpose of detecting face masks, it has a global pooling block. The ready MobileNet uses a shading image to produce a map which is multi-dimensional. The element map of the proposed model is converted into a 64-highlight element vector via the global pooling block. Using the 64 highlights, the soft-max layer ultimately executes paired order. Using two publicly accessible datasets, we evaluated our suggested model. For DS1 and DS2, our suggested model has accuracy of 99% and 100%, respectively. The suggested model uses the global pooling block to prevent overfitting.

This model also performs better than the opposition in terms of both the quantity of boundaries and the amount of preparation time. This model, however, is unable to recognise face masks for many faces simultaneously. In order to visually identify each person, they intentionally collected a dataset having 9886 images of persons with face-masks and those who weren't. Then, by utilising multi-scale preparation and picture-error techniques, they improved YOLOv3, a detection computation, to better determine if a face is covered with mask or not.

VII. SUMMARY AND PERSPECTIVES FOR THE FUTURE

For a single face with or without a mask, the currently proposed model provides excellent accuracy. It also provides very good accuracy for many faces. With no additional gear needed, it can be used with any system just by turning on the video camera.

Results from our suggested system were encouraging, but there are many places where it might be strengthened and expanded upon. Here are some ideas for moving forward.

A. Improving the model's accuracy and generalizability requires a larger and more varied dataset.

B. Improving the model's precision by including new elements like genetic and environmental influences.

C. The next step is to put the model to the test in actual environment like public places, both on a bigger scale and in the real world.

D. We are looking at the model's understandability to learn more about the factors that go into mask detecting.

In conclusion, the implementation of our suggested approach has the ability to significantly check if an individual is with a face-mask or without a face-mask and hence enhance outcomes with accuracy. Further work in this field may enhance the standard of precaution by creating more efficient & accurate model.

VIII. CONCLUSION

The COVID-19 pandemic should be slowed down by taking action. We demonstrate the recognition of mask-wearing faces using a Convolutional Neural Network using motion learning techniques in neural organizations. The dataset we utilized to train, validate, and test the model contained 1918 photographs of exposed faces and 993 photos of masked faces. These photos were produced using a variety of datasets, including the RMFD and Kaggle ones. Live video feeds and still photos were used to activate the model. We chose the MobileNetV2 architecture, which had 99% precision and 99% recall, after weighing the metrics for precision, accuracy, and recall to identify the ideal base model. Moreover, MobileNetV2 is computationally effective, which facilitates the model's integration into other frameworks. This face mask detector can be installed at a number of locations, including as shopping centers, airports, and other busy areas, to screen people generally and stop the virus from spreading by identifying those who are and are not following the rules.

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