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FACE MASK DETECTION SYSTEM USING MOBILENetV2

Radheya Deshmukh[1], Atharva Tanpure[2], Viraj Sarode[3], Sanket Patil[4], Lect. S. S. Patil[5]

[1,2,3,4]Student, Dept. of Computer Technology, B.V.J.N.I.O.T, Pune, Maharashtra, India.

[5]Lecturer, Dept. of Computer Technology, B.V.J.N.I.O.T, Pune, Maharashtra, India.

Abstract: The coronavirus COVID-19 pandemic is causing a worldwide health crisis. One of the effective protection methods is wearing a mask publicly areas consistent with the planet Health Organisation (WHO). Many regulatory authorities have instituted the mandatory use of face masks especially publicly places where massive contact of individuals is frequent and inevitable, particularly inside conveyance facilities, sports arenas, shopping malls and workplaces. The technique of detecting people's faces and segregating them into two classes namely the people with masks and other people without masks is completed with the assistance of image processing and deep learning. Many face detection models are created using techniques. The proposed approach during this paper uses deep learning, TensorFlow, Keras, and OpenCV to detect face masks. This model are often used for safety purposes since it's very resource efficient to deploy. The dataset provided during this paper was collected from various sources. This project are often utilized in schools, hospitals, banks, airports, etc. and also can be used by researchers for further development of the project.

Keywords: COVID-19,TensorFlow, Keras,OpenCV,Image Processing,Deep learning,Resource efficient,Dataset

I. INTRODUCTION

The trend of wearing face masks publicly is rising thanks to the COVID-19 coronavirus epidemic everywhere the planet. In 2020, the rapid spreading of COVID-19 has forced the World Health Organisation to declare COVID-19 as a global pandemic. Regulatory authorities have instituted the mandatory use of face masks especially publicly places where massive contact of individuals is frequent and inevitable, particularly inside conveyance facilities, sports arenas, shopping malls and workplaces. It is found that the spread of COVID-19 is especially among people that are in immediate contact with each other (nearly about 6 feet). When worn properly, the mask reduces coughing droplets' momentum and prevents the spreading of the virus through talking, coughing, or sneezing. Facemasks provide personal protection against infection. Face masks are reasonably affordable and are easier to use. The process of monitoring large groups of individuals is becoming harder. The monitoring process involves the detection of anyone who isn't wearing a mask. Computer science supported machine learning and deep learning will facilitate to fight Covid-19 in several ways, one of them being the Face Mask Detection system which takes video as an input and classifies the video feed into two parts, people who are wearing masks and people who aren't wearing any kind of protection. This model is based on deep transfer learning and machine learning classifiers such as OpenCV, TensorFlow and Keras. We have used deep transfer learning for feature extractions. We have sourced our dataset from various sources and also have created some of our own. The dataset can be updated with time later on but needs to be trained. And these accuracies were based on real time video feed. This project is open for development for anyone. Our Project will also help for identification of masks in future pandemics

II. LITERATURE SURVEY

In this paper, a hybrid model using deep and classical machine learning for mask detection are going to be presented. The proposed model consists of two components. The first component is meant for feature extraction using Resnet50. While the second component is designed for the classification process of face masks using decision trees, Support Vector Machine (SVM), and ensemble algorithm [1].

The study adopted a systematic literature review to achieve the primary research goal of synthesizing the literature on artificial intelligence models that have been used to detect face masks [2].

With the assistance of this project, an individual who is meant to watch the people are often seated during a remote area and still can monitor efficiently and provides instructions accordingly. Various libraries of python like Open CV, Tensor flow and Keras. In Deep Learning Convolution Neural Networks is a class Deep Neural Networks which is used to train the models used for this project [3]

This model are often used for safety purposes since it's very resource efficient to deploy. The SSDMNV2 approach uses Single Shot Multibox Detector as a face detector and MobilenetV2 architecture as a framework for the classifier, which is extremely lightweight and may even be used in embedded devices (like NVIDIA Jetson Nano, Raspberry pi) to perform real-time mask detection[4].

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III. PROPOSED MODEL

The proposed model includes two main components, the first component is deep learning as a feature extractor and the second component is MobileNetV2. The face mask detection model is developed with a machine learning algorithm through the image classification method: MobileNetv2.

The DataSets for this model were collected from two different sources. The first dataset was taken from the Kaggle dataset and the second dataset is the RealWorld dataset used for the training, validation, and testing phase so the model can be implemented to the dataset.

The model can be produced by following some steps which are:

1. Data Visualisation
2. Pre-processing
3. Splitting the data
4. Building the model
5. Training the model
6. Testing the model
7. Implement the model (Detecting the Faces with and without Mask on real time video stream).

The dataset was taken from some sources, for instance, public places, shops, colleges etc.

Step 1. Data Visualisation

In this first step, development of the Face Mask detection model begins with collecting the dataset. The dataset is used to train the model how to recognize n people who use masks and who do not. The model will differentiate between people wearing masks and not. The data collected is classified into two categories- With mask and without mask.

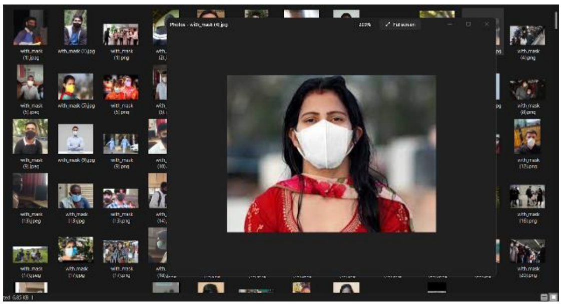

Figure 2: With mask image dataset

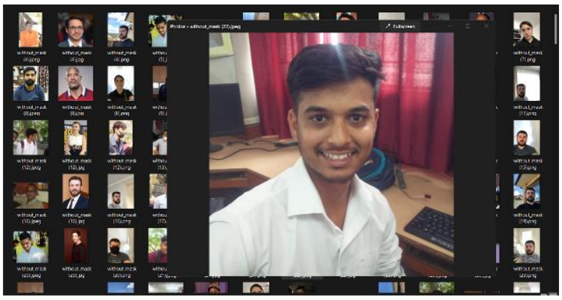

Figure 3: Without mask image dataset

Step 2. Pre-processing

Pre-processing is carried in four steps which are resizing image size, converting the image to the array, pre-processing

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input using MobileNetV2, and the last is performing hot encoding on labels. The smaller size of the image, the better the model will run therefore images are resized into smaller images. The next step is to convert all the images in the dataset into an array and calling them by the loop function. After that, the image will be used to pre-process input using MobileNetV2. And the last step in this phase is performing hot encoding on labels . The labelled data is transformed into a numerical label, so that the algorithm can understand and process the data.

Step 3. Splitting the Data.

After the pre-processing phase, the data is split into two batches, which are training data namely 75%, and the rest 25% is testing data. Each batch contains both with-mask and without-mask images.

Step 4.Building the Model.

In the next step the model is built . There are six steps in building the model which consist of constructing the training image generator for augmentation, the base model with MobileNetV2, adding model parameters, compiling the model, training the model, and therefore the last is saving the model for the longer term prediction process.

Step 5.Training the model

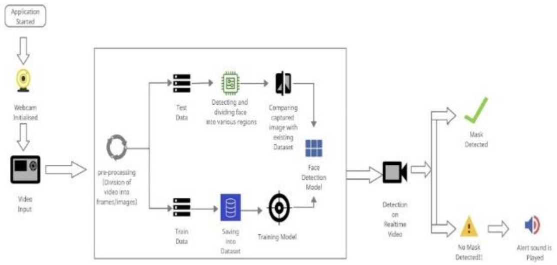
After creating the model the training phase begins. This is the main step in which we put images into the training set and a test set to use the sequence model built by the Keras
Library. We see a total 1165 images in the training set and a total 388 images in the test set.

Step 6.Testing the Model.

To make sure the model can make predictions accurately, there are steps in testing the model. The first step is making predictions on the testing set. The result for 20 iterations in checking the loss and accuracy when training the model.

Step 7. Implementing the model

From now on, we plan to use it to detect the presence or absence of a mask through the pc's webcam.For this, we need to implement a face detection model.The video captured is divided into frames, then the face detection algorithm works. If a face is detected, it proceeds to the next process. From detected frames containing faces, processing is carried out ,converting images to the array, preprocessing input using MobileNetV2. The next step is to Predict the input image that has been processed using a previously built model. Besides, the video frame will also be labelled whether the person is wearing a mask or not ,with the predictive percentage


Application Started
Webcam Initialised
Video Input
pre-processing (Division of video into frames/images)
Test Data
Detecting and dividing face into various regions
Comparing captured image with existing Dataset
Face Detection Model
Train Data
Saving into Dataset
Training Model
Detection on Realtime Video
Mask Detected
No Mask Detected!!
Alert sound is Played

Following Python Libraries were used in the proposed model :

<u>TensorFlow</u>

TensorFlow is an open-source library developed by Google primarily for deep learning applications.TensorFlow accepts data in the form of multi-dimensional arrays of higher dimensions called tensors. Multi-dimensional arrays are very handy in handling large amounts of data.TensorFlow works on the basis of data flow graphs that have nodes and edges.

<u>MobileNetV2</u>

MobileNetV2 is a very effective feature extractor for object detection and segmentation.MobileNetV2 is used for mobile visual recognition including classification, object detection and semantic segmentation. MobileNetV2 is a convolutional neural network architecture that seeks to perform well on mobile devices

<u>CNN (Convolutional Neural Network)-</u>

A Convolutional Neural Network (CNNs) are a form of deep, feed-forward artificial neural network used to analyse visual imagery. These networks' architecture was loosely influenced by biological neurons that interact with one another and produce outputs based on inputs.

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Open- CV (Open Source Computer Vision Library)

It is a collection of algorithms for computer vision.OpenCV is a great tool for image processing and performing computer vision tasks. It is an open-source library that can be used to perform tasks like face detection, objection tracking, landmark detection, and much more.OpenCV plays a major role in real-time operation which is very important in today's system.

Keras -

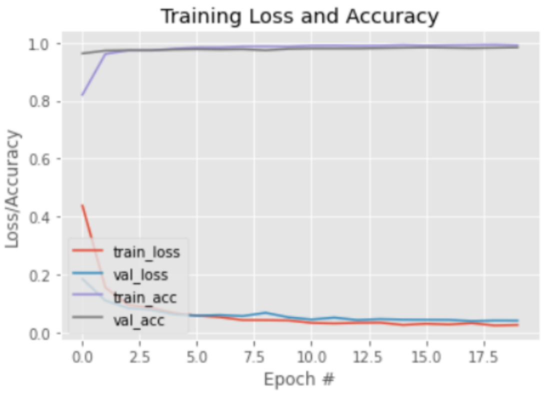
Keras acts as an interface for the TensorFlow library.Keras is a neural network API.It works with other libraries and packages such as tensorflow which makes deep learning easier. Keras is a powerful and easy-to-use free open source Python library for developing and evaluating deep learning models.

Scikit-learn

Scikit-learn (Sklearn) is the most useful and robust library for machine learning in Python. It provides a selection of efficient tools for machine learning and statistical modelling including classification, regression, clustering and dimensionality reduction via a consistent interface in Python. This library, which is largely written in Python, is built upon NumPy, SciPy and Matplotlib.

IV. CONCLUSION

In the current pandemic, after the rapid outspread of Covid-19 outbreak globally. People all over the world have understand drastic disruption to their daily lives. One idea to manage the outbreak is to impose people to wear a face mask in crowded places. Therefore, automated face mask detection system are essential for such enforcement. In this paper, we have used the Deep Learning technique for our proposed face mask detection technique. For real time videos, it has been done which categories the images as "with mask" and "without mask" using MobileNetV2. Half of the data set is evaluated using the kaggle data set and the remaining are real world data set.This is the best solution for determining the spread of Covid-19 pandemic. By using Keras , OpenCV and CNN ,the proposed system is able to detect the person wearing a mask or not with an accurate and quick result. The trained model gives correct accuracy of around 98%. Many existing systems face some problematic results. In this proposed the problem of various wrong result or accuracy have been successfully removed from the system.



V. RESULTS

The results are more of what was expected of the model. We used deep learning model that have been used to construct this Face Mask Detection system.The Face mask recognition is implemented using the camera as a medium and shows accurate results.When the person's face is in the camera frame, model will detect the face and a green or a red frame will appear over the face (as shown in Fig.1) A person who is not wearing a mask will get a red frame over his face in camera while the person who is wearing a mask will get a red frame. The model works albeit the view of the face is visible to the camera. It can also detect more than one face in a single camera frame. Overall, the model shows the accurate results.

Combining all the elements of our architecture, we tend to observe systems. Mobile NetV2, classifier employed in this system. The resultant "Face Mask Detection System" performs and has the potential to detect face masks in image with multiple faces over a large angle. The system performs an accuracy of 98%. Hence, this solution tracks the people with or without masks during a real-time scenario and ensures social distancing by generating an alarm if there's a violation within the scene or in public places.

Output Image:

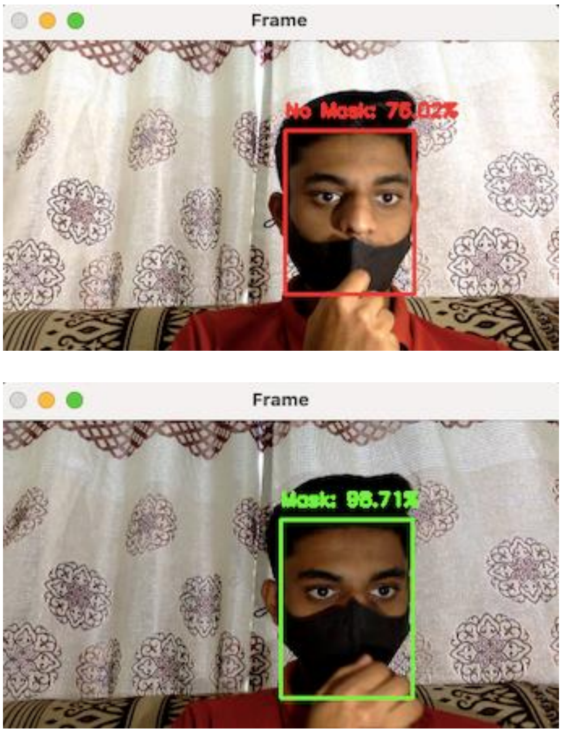


Figure 2. Detect face without mask and with mask in real time video stream

VI. FUTURE SCOPE

Across the world more than 70 countries have made it mandatory to wear masks at all public places. If you want to go out you have to cover your face with a mask in schools, supermarkets, transports, offices, stores and at all public or crowded places. Most retail stores use software to count the total number of customer visits to the store. For this reason, we decide to update the mask recognition system and announce it as an open source project. This system can be implemented in these retail shops and the result can be seen on the digital and promotional screens This app can be used with any current USB, IP, or CCTV cameras for identifying people that don't wear a mask. The live video mask detection function are often introduced in web and desktop applications in order that the operator may know whether users aren't wearing masks and warning messages can be lost. If anyone is not wearing a mask, images should be submitted to software operators. Furthermore, we will mount an alarm device which will emit a beep sound if anyone enters the world without wearing a mask. Only those people wearing face masks can enter using this software, which can be linked to the entrance gates. This system could be connected in hospital gates, schools, malls and at many more public places or crowded areas.

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BIOGRAPHY

Student- **Mr. Radheya Deshmukh**, Dept.of Computer Technology, B.V.J.N.I.O.T, Pune.

Student- **Mr. Atharva Tanpure,** Dept. of Computer Technology,B.V.J.N.I.O.T, Pune.

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Student- **Mr. Viraj Sarode** Dept. of Computer Technology,B.V.J.N.I.O.T, Pune.

Student- **Mr. Sanket Patil** Dept. of Computer Technology, B.V.J.N.I.O.T, Pune

Lecturer – **Mrs. Sheetal Patil**, Dept. of Computer Technology, B.V.J.N.I.O.T, Pune