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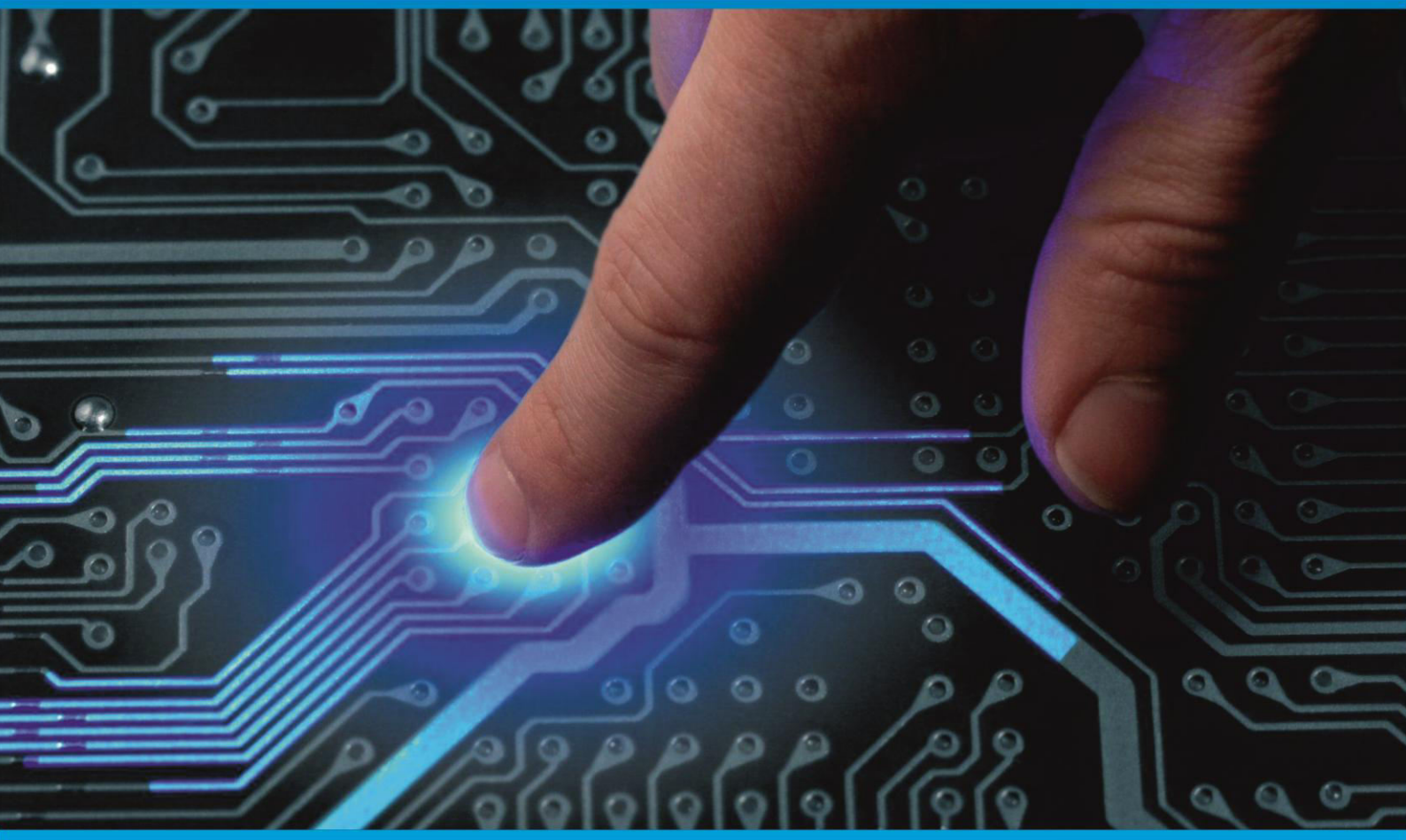

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Covid-19: Face Mask Detector using Machine Learning

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ABSTRACT: COVID-19 pandemic has deeply affected our daily life by disrupting the world trading and travelling. Wearing a face mask has become mandatory. In future, many public as well as private service providers will also ask the customers to wear masks perfectly to avail of their services. Therefore, face mask detection has become a crucial task to help global society. In this paper we have shown a simplified approach to achieve our goal using some basic Machine Learning packages like TensorFlow, Keras, OpenCV and Scikit-Learn. Our method detects the face from the image and then identifies if it has a face mask on it or not. We can also use this to detect a face along with a mask in motion. This method attained an accuracy of 91% and 96% respectively on two different datasets. We have minimized values of parameters using the Sequential Convolutional Neural Network model to detect the masks on face efficiently without overlapping.

KEYWORDS: CNN, Deep Learning, Keras Tensorflow, Machine Learning, Open CV

I. INTRODUCTION

The year 2020 has shown mankind some mind-boggling series of events amongst which the COVID-19 pandemic is the most life-changing event which has startled the planet since the year began. Affecting the health and lives of masses, COVID-19 has involved strict measures to be followed so as to stop the spread of disease [1].

From the very basic hygiene standards to the treatments within the hospitals, people do all they will for his or her own and therefore the society's safety; face masks are one among the private protective equipment. People wear face masks once they exit their homes and authorities strictly make sure that people are wearing face masks while they are in groups and public places. The first step to acknowledge the presence of a mask on the face is to detect the face, which makes the strategy divided into two parts: to detect faces and to detect masks on those faces.

Face detection is one among the applications of object detection and may be utilized in many areas like security, biometrics, enforcement and more. There are many detector systems which are being developed around the world and are being implemented. However, all this science needs optimization; a far better, more precise detector, because the planet cannot afford any longer increase in corona cases.

With the ever-swift development of machine learning algorithms and methodologies in recent times, the task of face detection has been addressed to an outsized extent. Thanks to the advancement of facial detectors, numerous applications like real-time face recognition systems, security surveillance systems, etc. are developed.

II. THEORY

In the face detection method, a face is detected from an image that has several attributes in it. According to [2], research into face detection requires expression recognition, face tracking, and pose estimation. Given a solitary image, the objective is to identify the face from the picture. Face detection is quite a difficult errand because the faces differ in size, shape, color, etc. and they are not immutable. It becomes a laborious job for an opaque image impeded by some other thing not confronting the camera, then forth. Authors in [3] think occlusive face detection comes with two major challenges: 1) unavailability of sizably voluminous datasets containing both masked and unmasked faces, and 2) exclusion of facial expression in the covered area. Utilizing the locally linear embedding (LLE) algorithm with the dictionaries trained on a large dataset of masked faces, with non-masked faces, several mislaid expressions can get better and the primacy of facial cues can be reduced to great extent. According to the work reported in [4],

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convolutional neural networks (CNNs) in computer vision comes with a strict constraint regarding the size of the input image. The prevalent practice reconfigures the images before putting them into the network to surmount the inhibition.

Here the main challenge of the task is to detect the face from the image correctly and then identify if it has a mask on it or not. In order to perform surveillance tasks, the proposed method should also detect a face along with a mask in motion.

To monitor that folks are following this basic safety principle of wearing masks, a technique should be developed. A mask detector system is often implemented to see this. mask detection means to spot whether an individual is wearing a mask or not.

III. SOFTWARE SPECIFICATION

1. Python:

Python is an interpreted, object-oriented, high-level programing language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for rapid application development, also as to be used as a scripting or glue language to attach existing components together.

In this paper, we are using Python language to write all our codes as Python is the most prevalent language to develop projects related to Machine Learning.

Some of the libraries used in our project are:

1.1 Keras/tensorflow:
Tensorflow is an end-to-end open-source platform for machine learning. it's a comprehensive, flexible ecosystem of tools, libraries and community resources that lets researchers push the state-of-the-art in ML and developers easily build and deploy ML powered applications.
Keras is a Python library used for deep learning and can run on top of TensorFlow.
In the proposed model we will be using Tensorflow and Keras to load and fine tune the MobilNetV2 classifier and also to load and pre-process the image data.
Tensorflow is used to reshape the image data in data processing.

1.2 OpenCV:
OpenCV supports a variety of programming languages like C++, Python, Java, etc., and is out there on different platforms including Windows, Linux, OS X, Android, and iOS. Interfaces for high-speed GPU operations based on CUDA and OpenCL also are under active development.
In the proposed model we will be using OpenCV for color conversion and resizing the given image input data.

1.3NumPy:
NumPy is a Python library that provides a simple yet powerful data structure: the n-dimensional array. This is the inspiration on which just about all the facilities of Python's data science toolkit is made. In the proposed approach NumPy library is used to construct arrays and to find the maximum value along a given axis.

1.4Pygame:
Pygame is a free and open-source cross-platform module for Python specifically used to make games and other multimedia applications. It is built upon the SDL (Simple DirectMedia Layer) library and several other popular libraries to abstract the most common functions, making writing these programs a more intuitive task.
In this proposed model, we will be using the Pygame library to initiate a warning sound notification if the user is not wearing/ properly wearing the mask.

2 Deep learning:
Deep Learning is an AI function that simulates the workings of the human brain. Deep Learning is a class of machine learning algorithm and it is used to process data for use in detecting objects, recognizing speech, making decisions and translating languages.
Deep learning AI is also capable of learning without human supervision and drawing that from data that is both unstructured and unlabeled.

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In the proposed model we will be using the Deep Learning concept to use different types of library files like Keras/Tensorflow and Opencv. They are used to apply Artificial Intelligence to detect faces.

IV. WORKING

The proposed approach is divided into two parts:
Training the Face Mask Detector and Applying the Face Mask Detector over live video stream.

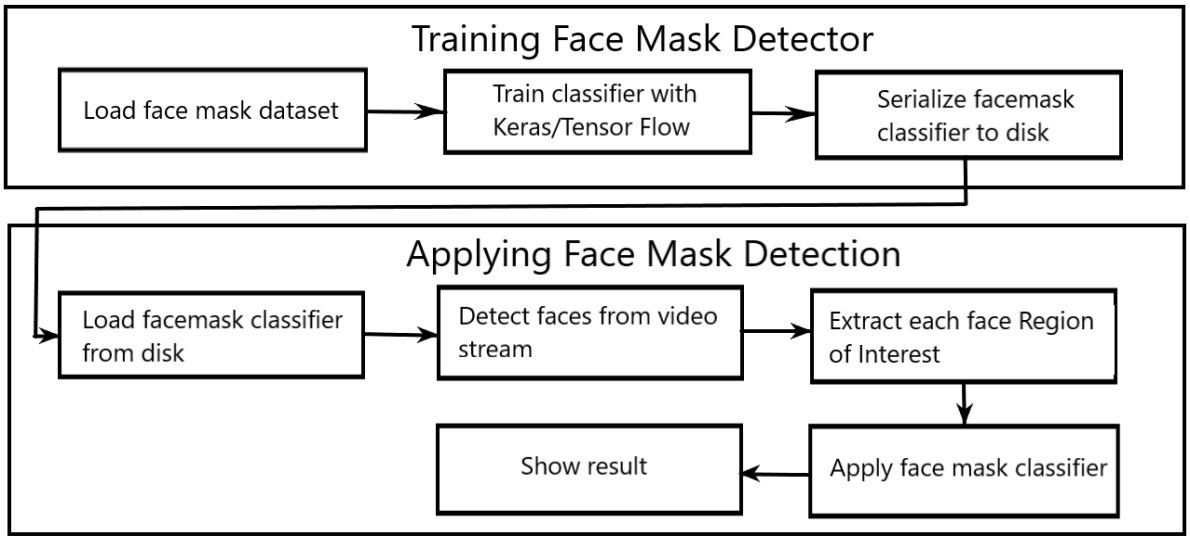

Fig. 1 Block Diagram

Algorithm for Training the face mask detector:
1. Resizing of input images.
2.Converting the RGB image into Black and White image.
3.Scaling and Center cropping of the input images with value 224x224x3.
4.Converting these images into NumPy arrays.
In this phase we are training our face mask detector. For this purpose, a database is created containing human faces with or without a face mask. As we know, a human face has many distinguishable features such as the distance between their eyes, length of their nose, width of their lips etc. Here with the help of tensorflow which works similar to a neural network can determine these features and create a plot of a human face.

Algorithm for Applying the Face Mask Detector:
1. Loading the trained data from disk and feeding it with raw input in the form of an image or a video.
2. Extract face Region of Interest.
3. Detect nose and mouth of the face.
4. Determine and classify as 'mask' or 'no mask'.
5. Display probability of face mask.
In the next phase after we have trained our face mask detector, we load this trained data from the disk and feed it with raw input in the form of an image or a video. From there on we extract the face ROI (Region of Interest) and based on the previous trained data we can compute whether the particular face in question has its nose and mouth visible or not. If this software is not able to detect a person's nose and mouth then it is quite possible that this person is wearing a face mask. This probability is displayed as a result on screen and may also throw a warning message on screen if the probability of the mask present is very low.

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V. RESULT

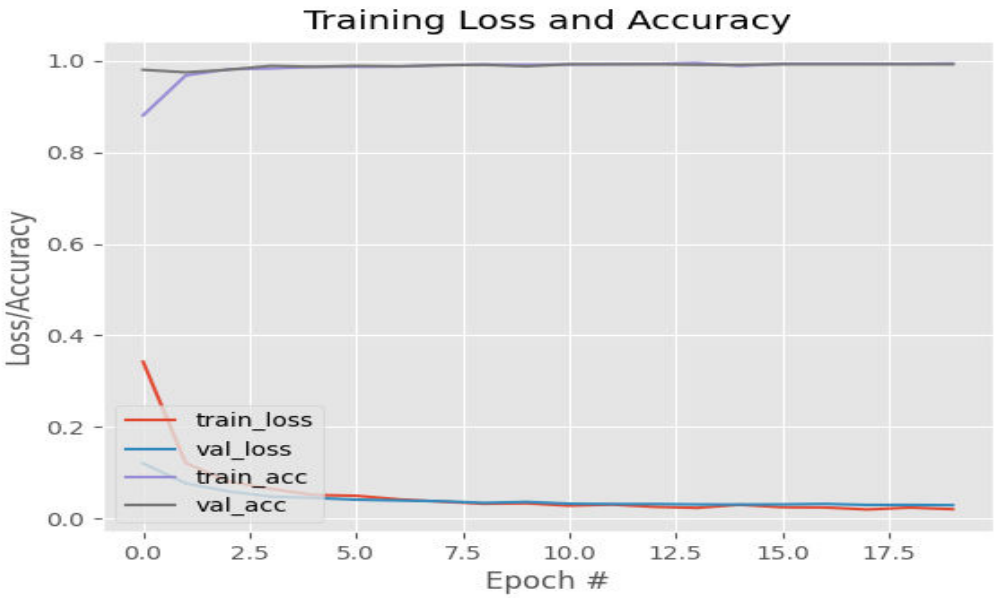

Fig.2 Accuracy Curve

Epoch is once all images are processed one time individually of forward and backward to the network, then that is one epoch

From this fig, we can see that as the number of epochs increases the train accuracy also increases and the training loss keeps on decreasing. We can also see there are little signs of overfitting, with the validation loss lower than the training loss.

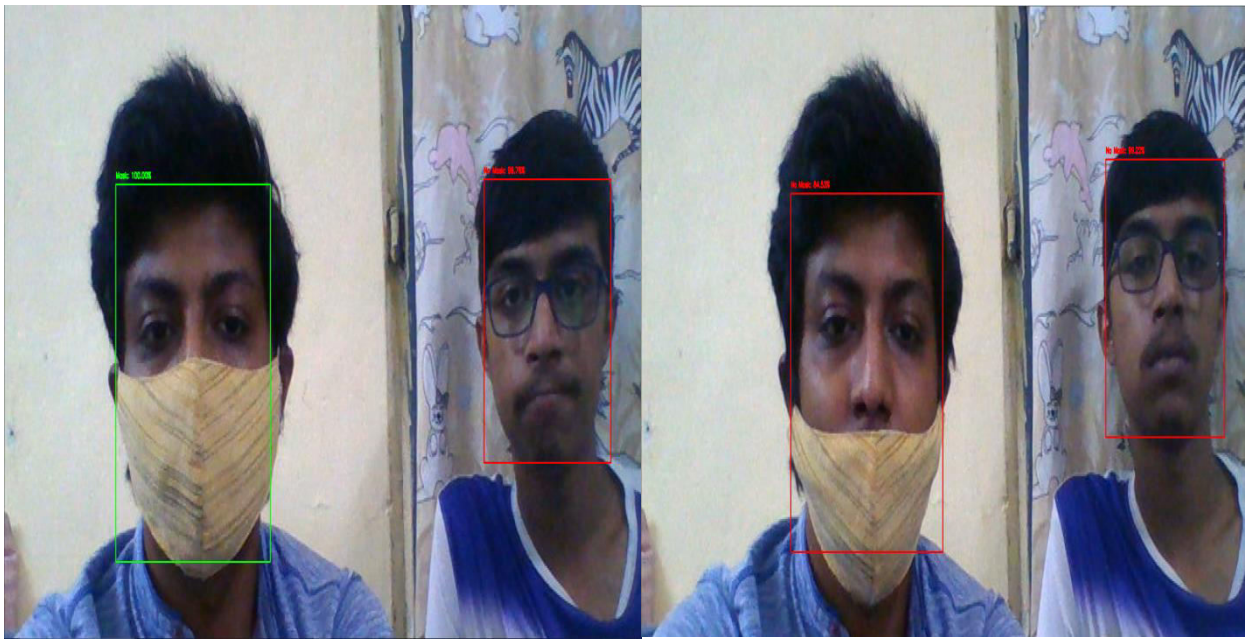

Fig.3 Result

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- Our project has an accuracy of 99%.
- It is detecting multiple faces at a time.
- It is showing a warning on screen as a red box on whoever is not wearing masks.
- It can also access external cameras as an input.

VI. CONCLUSION

In this paper, we have tried to explain our approach to develop a face mask detector. A highly effective face detection model is used to detect faces and then deep learning is used to construct a facial classifier that determines the presence of masks in the faces detected. The proposed approach is found to display high accuracy and precision on our selected dataset which contained images with varying facial angles.
Considering the COVID-19 crisis, wearing masks has become an obligation. This method can contribute immensely to the public health system and in future it may even be improved to detect if the mask is virus prone or not i.e. to detect the type of mask.

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