Face Mask Detection In Covid19 Using Machine Learning Technique

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Abstract- *The corona virus COVID-19 pandemic is inflicting a worldwide fitness disaster so the powerful safety techniques is sporting a face masks in public regions consistent with the World Health Organization (WHO). The COVID-19 pandemic forced governments across the global to impose lockdowns to prevent virus transmissions. Reports indicate that sporting facemasks even as at paintings honestly reduces the chance of transmission. A green and monetary method of the usage of AI to create safe surroundings in a production setup. A hybrid version the usage of deep and classical device getting to know for face masks detection may be presented. A face masks detection dataset is composed of with masks and without masks images, we're going to use caffe model to do real-time face detection from a stay circulation via our webcam. We will use the dataset to construct a COVID-19 face masks detector with laptop imaginative and prescient the usage of Python.*

I. INTRODUCTION

The fashion of carrying face mask in public is growing because of the COVID- 19 corona virus epidemic all around the world. Before Covid-19, People used to put on mask to defend their fitness from air pollution. While different humans are self-conscious approximately their looks, they conceal their feelings from the public through hiding their faces. Scientists proofed that carrying face mask works on impeding COVID-19 transmission. COVID19 (called corona virus) is the ultra-modern epidemic virus that hit the human fitness within side the remaining century. In 2020, the rapid spreading of COVID-19 has compelled the World Health Organization to claim COVID- 19 as a international pandemic. More than 5 million instances had been inflamed through COVID-19 in much less than 6 months throughout 188 countries. The virus spreads via near touch and in crowded and overcrowded areas. The corona virus epidemic has given upward push to an extraordinary diploma of global medical cooperation.

Artificial Intelligence (AI) primarily based totally on Machine getting to know and Deep Learning can assist to combat Covid-19 in lots of ways. Machine getting to know lets in researchers and clinicians compare vast portions of facts to forecast the distribution of COVID- 19, to function an early caution mechanism for potential pandemics, and to categories prone populations. The provision of healthcare wishes investment for emerging generation which includes synthetic intelligence, IoT, huge facts and gadget getting to know to address and expect new diseases. In order to higher apprehend contamination prices and to hint and speedy locate infections, the AI's strength is being exploited to deal with the Covid-19 pandemic. People are compelled through legal guidelines to put on face mask in public in lots of countries. These regulations and legal guidelines had been evolved as an motion to the exponential growth in instances and deaths in lots of areas. However, the technique of tracking massive businesses of humans is turning into more difficult. The tracking technique includes the detection of everyone who isn't carrying a face mask. Here we introduce a masks face detection version thatis primarily based totally on pc imaginative and prescient and deep getting to know. The proposed version may be incorporated with surveillance cameras to obstruct the COVID-19 transmission through permitting the detection of humans who're carrying mask now no longer carrying face mask. The version is integration among deep getting to know and classical gadget getting to know techniques.

Machine learning (ML) is the study of computer algorithms that improve automatically through experience. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to do so.

Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop conventional algorithms to perform the needed tasks. Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a related field of study, focusing on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.

A. Fig. Machine learning outlook

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of- the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmental bodies.Along with well-established companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota that employ the library,

II. LITERATURE SURVEY

In the yr 2018, Suma S L [1] applied a actual time face popularity set of rules the use of Linear Binary Pattern Histogram (LBPH) and Viola Jones set of rules. This technique includes com fusion and popularity. is achieved the use of Viola Jones set of rules is implemented is for Face detection, characteristic extraction is achieved via way of means of LBPH approach and Euclidean Distance Classifier is used for face popularity. These paintings have popularity charge of approximately “85%-95%”. These paintings can be similarly amended to choose in all situations such as brightness, in case of twins, beard and carrying goggles.

In the yr 2017, Li Cuimei applied a human face detection set of rules the use of 3 vulnerable classifiers including Haar cascade classifier. Skin hue histogram, Eye detection and Mouth detection are the 3 classifiers followed via way of means of this technique. This yields sufficiently excessive detection. The proposed technique generates a function prediction value (PPV) to approximately 78.18% - 98.01%. This may be amended to locate human faces handiest of more than one races and decrease the put off for detecting and spotting diverse faces among distinct photos of humans with variant in mild and historical past situations.

In the yr 2017, Souhail Guennouni [4] put into effect a face detection device via way of means of collating with Haar cascade classifiers and part orientation matching. Edge orientation matching set of rules and Haar-like characteristic choice blended cascade classifiers are the 2 strategies used on this device. This set of rules produces a higher matching however the detection pace is relatively less.

In the yr 2015, Jiwen Lu [5] the use of getting to know CBFD proposed a face popularity device. The face representation and popularity is applied thru Compact Binary Face Descriptor (CBFD) characteristic getting to know technique even as coupled CBFD is accomplished for heterogeneous face matching via way of means of minimizing the modality hole of characteristic level. Collating with different Binary Codes Learning strategies, CBFD extracts compact and discriminative characteristic, consequently produces a higher popularity charge of approximately 93.80% is obtained. In this painting, characteristic is discovered handiest from one unmarried layer. This device can reap higher overall performance via way of means of Learning Hierarchal functions in deep networks.

III. PROPOSED METHODOLOGY

A. Dataset Creation

Our goal is to train a custom deep learning model to detect whether a person is or is not wearing a mask. For this firstly we have to create a real time dataset. After creating the dataset, the dataset has to be train and then by applying Caffe model the model will be train the output will be the result of model.

Following will be the process of developing the dataset.

1. **To create a dataset a normal image of faces will be taken.**
2. **The facial landmarks will automatically allow the infer location of facial structures, which includes, Eyes, Eyebrows, Nose, Mouth, Jawline.**
3. **To use facial landmarks to build a dataset of faces wearing face masks, we need to first start with an image of a person not wearing a face mask.**

Figure 1: To build a COVID-19/Coronavirus pandemic face mask dataset, we'll first start with a photograph of someone not wearing a face.

4. **From there, we apply face detection to compute the bounding box location of the face in the image:**

Figure 2: The next step is to apply face detection. Here we've used a deep learning method to perform face detection.

5. **Once we know where in the image the face is, we can extract the face Region of Interest (ROI):**

Figure 3: The next step is to extract the face ROI.

6. **And from there, we apply facial landmarks, allowing us to localize the eyes, nose, mouth, etc.:**

Figure 4: Then, we detect facial landmarks, so that we know where to place a mask on the face.

7. **Next, we need an image of a mask (with a transparent background) such as the one below:**

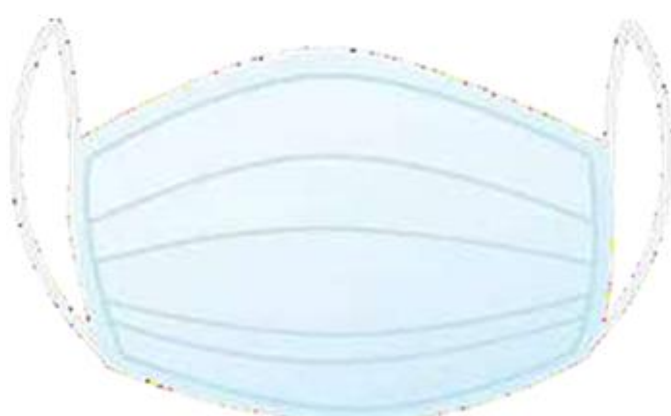

Figure 5: An example of a COVID-19/Coronavirus face mask/shield. This face mask will be overlaid on the original face ROI automatically since we know the face landmark locations.

8. **This mask will be automatically applied to the face by using the facial landmarks (namely the points along the chin and nose) to compute where the mask will be**

placed. The mask is then resized and rotated, placing it on the face:

Figure 6: In this figure, the face mask is placed on the person's face in the original frame. It is difficult to tell at a glance that the COVID-19 mask has been applied with computer.

9. **We can then repeat this process for all of our input images, thereby creating our artificial face mask dataset:**

Figure 7: An artificial set of COVID-19 face mask images is shown. This set will be part of our "with mask" / "without mask" dataset for COVID-19 face mask detection with computer vision and deep learning using Python.

B. Flow of Work

In the proposed system the image will be taken from camera and it will be resize according to the set limit and then the Caffe model will find all the possible match against the data base and the match will be find, if the match does not get found then the process will get repeated. If the image is recognized the bounding box will draw on the face region and the image will be displayed.

1. Training: Here the focus is, on loading our face mask detection dataset from disk, training a model using real time dataset, and then serializing the face mask detector to disk.
2. Deployment: Once the face mask detector is trained, we can then move on to loading the mask detector, performing face detection, and then classifying each face as with mask or without mask. Following figure will show the flow of proposed work.

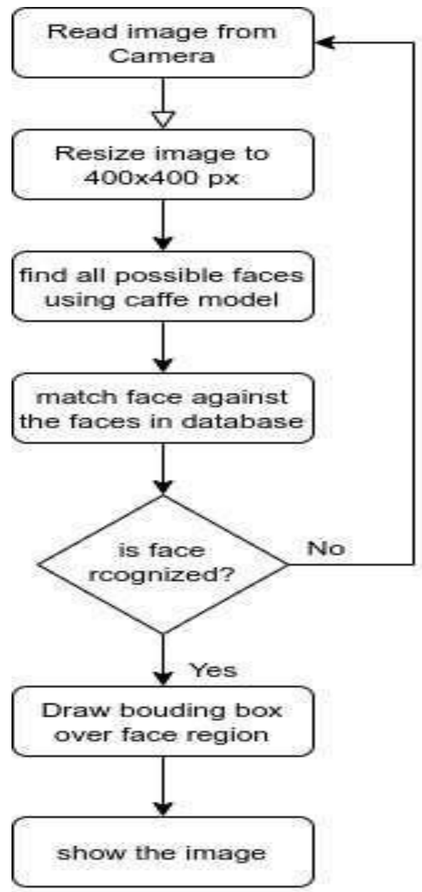

Figure 8: Flow of Proposed Methodology

Caffe is a framework of Deep Learning and it was made used for the implementation and to access the following things in an object detection system.

- Expression: Models and optimizations are defined as plaintext schemas in the caffe model unlike others which use codes for this purpose.
- Speed: for research and industry alike speed is crucial for state-of-the-art models and massive data.
- Modularity: Flexibility and extension is majorly required for the new tasks and different settings.

- Openness: Common code, reference models, and reproducibility are the basic requirements of scientific and applied progress.

IV. RESULT

A. RESULT ANALTSIS

By preserving a reasonable proportion of different classes, the dataset is partitioned into training and testing set. The dataset comprises of 1539 samples in total where 80% is used in training phase and 20% is used in testing phase. The training and testing dataset contains 1231 and 308 images respectively. The developed architecture is trained for 100 epochs since further training results cause over fitting on the training data. Over fitting occurs when a model learns the unwanted patterns of the training samples. Hence, training accuracy increases but test accuracy decreases. Fig. C and Fig. D show the graphical view of accuracy and loss respectively. The trained model showed 98.7% accuracy and AUC of 0.985 on the unseen test data.

In the accuracy curve of training and testing is shown for about 100 epochs. From Fig. C, it is realized that the training and testing accuracy are almost identical. This means the model has a decent generalization ability for previously unseen data and it does not cause over fitting of the training data. In loss curves of training and testing phases are shown. Here, it is evident that the training loss is decreasing over increasing epochs. The testing loss is lower than training loss for about 30 epochs but after that, it started increasing w means the confidence of prediction started decreasing. The testing loss fluctuates between an acceptable range and it falls about at 98th epoch.

Table II represents the confusion matrix of the testing phase. The developed architecture misclassifies only 04 samples out of 308 samples. It classifies 01 sample as with mask while it is in without mask class and classifies 03 samples as without mask while these were in with mask class. The main aim of the system is to identify samples within without mask class and this architecture misclassified only 01 sample of this class that shows the reliability of the developed system.

Depicts the receiver operating characteristic (ROC) curve of the proposed framework. This illustrates the prediction ability of the classifier at different thresholds. Two parameters are plotted in the ROC curve; one is the true positive rate (TPR) and other is the false positive rate (FPR) measured using (1) and (2) respectively. TPR and FPR are calculated for different threshold and these values are plotted as ROC curve. The area under the ROC curve (AUC) measures the performance of the binary classifier for all possible thresholds. The value of AUC ranges from 0 to 1. When a model predicts 100% correct its AUC is 1 and when it predicts 100% wrong then its AUC is 0. The AUC achieved form our classifier is 0.985 that points towards a decent classifier.

$$\text{True Positive Rate} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}} \quad (1)$$

$$\text{False Positive Rate} = \frac{\text{False Positive}}{\text{True Negative} + \text{False Positive}} \quad (2)$$

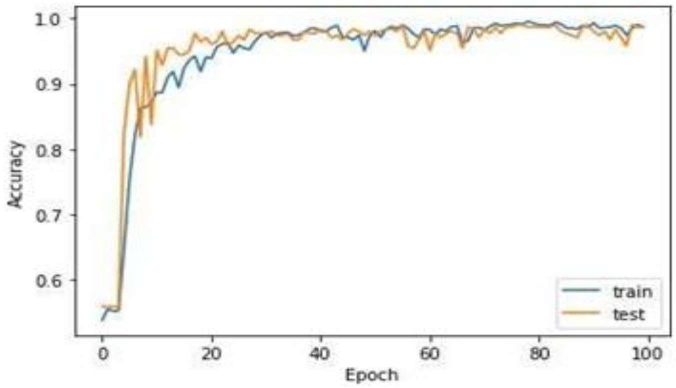

Fig. A. : Accuracy of the developed system for training and testing phase.

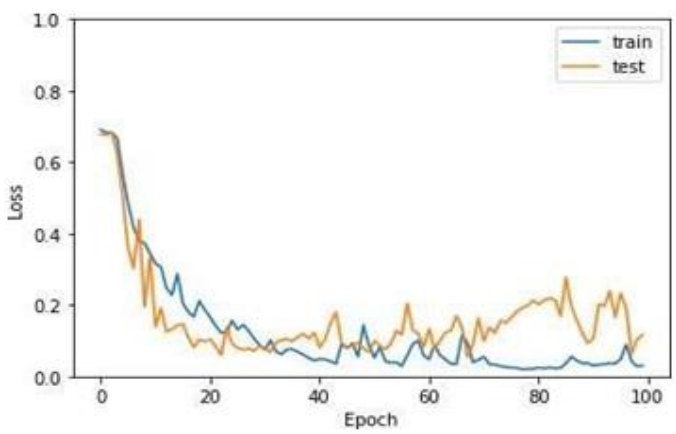

Fig. B: Loss of the developed system for training and testing phase.

Table 1: The Confusion Matrix Of The Developed System

		Predicted Class	
		Without Mask	With Mask
True Class	Without Mask	134	1
	With Mask	3	170

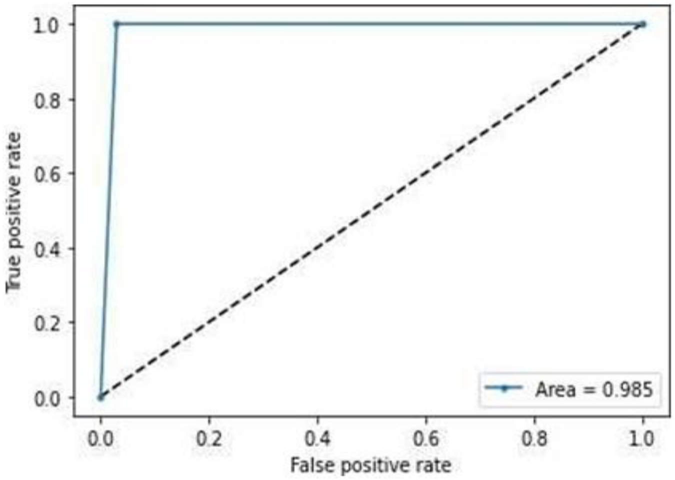

Fig. C: ROC of the classification network.

B. EXPERIMENTAL RESULTS

All the experimental trials have been conducted on a laptop equipped by an Intel i7-8750H processor (4.1 GHz), 16 GB of RAM with 1050ti max-Q with 4 GB of VRAM. The Jupyter Notebook software equipped with Python 3.8 kernel was selected in this research for the development and implementation of the different experimental trails.

The metrics selected for evaluation of SSDMNV2 model is explained below.

$$Accuracy = \frac{Tp + Tn}{(Tp + Fp + Fn + Tn)}$$

$$Precision = \frac{Tp}{(Tp + Fn)}$$

$$Recall = \frac{Tp}{(Tp + Fn)}$$

$$f1\ score = 2 * \frac{Recall * Precision}{(Recall + Precision)}$$

Where Tp = True positive,
Tn = True negative,

Fp = False positive, Fn= False negative

In above formulas, True positive values refer to images which were labelled true and after prediction by model gave true result. Likewise, for True negative refers to images which were labelled true but after prediction resulted in false result. False positive refers to images which were labelled false and after prediction resulted in false hence false positives. False negative refers to images which were labelled false and after prediction resulted in true hence false negatives.

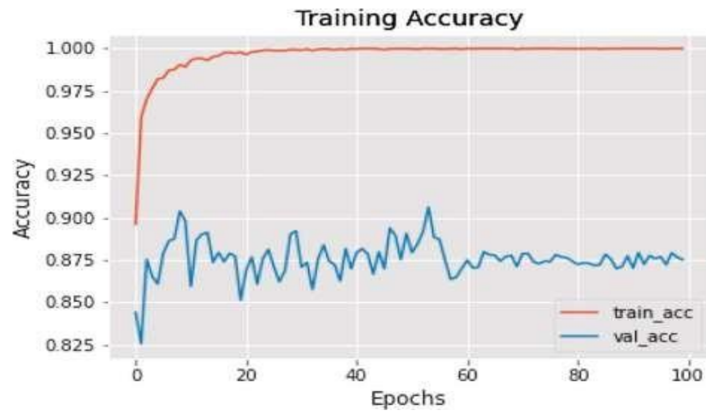

Fig. D: Training accuracy curve (Without data augmentation).

Fig. E: Training loss curve (Without data augmentation)

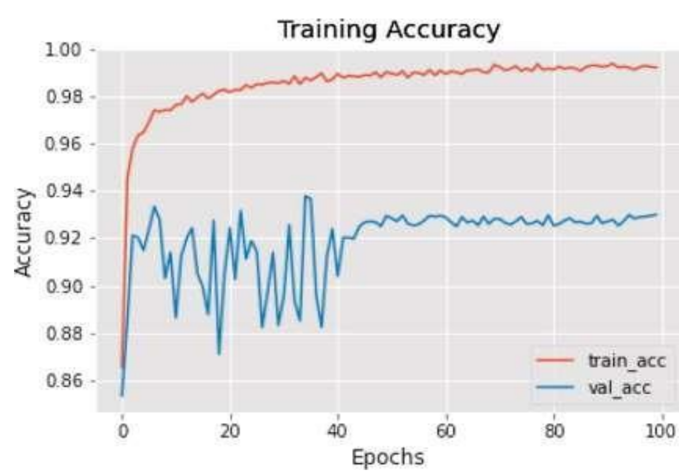

Fig. F: Training accuracy curve.

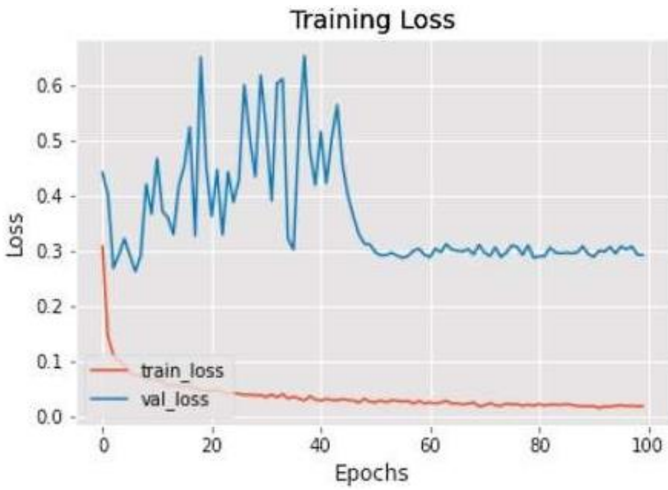

Fig. G: Training loss curve on the train.

After prediction resulted in true hence false negatives. The accuracy was a good measure to start with, because the classes were balanced. Pre-cision gave the measure of positive predicted values. Recall gave the ability to a classifier to find all positive samples and f1 score gave the measure of test accuracy. These evaluation metrics were chosen because of their ability to give best results in balanced dataset.

V. CONCLUSION

Deep learning-based face mask detection has been a research hotspot in recent years. This project starts on generic face mask detection which provide base architectures for other related tasks. With the help of this the three other common tasks, namely object detection, face detection and pedestrian detection, can be accomplished. Authors accomplished this by combing two things: Object detection with deep learning and OpenCV and Efficient, threaded video streams with OpenCV. The camera sensor noise and lightening condition can change the result as it can create problem in recognizing the object. The end result will be a deep learning-based object detector system which will detect whether the person wear the mask or not.

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