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Real-Time Covid-19 Face Masks Detection Using Convolutional Neural Networks and Artificial Intelligence

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Abstract**—** *we show that the COVID-19 pandemic spread rapidly, having an immediate effect on global commerce and migration. Nowadays, everyone seems to be wearing a face mask as a form of self-defense. Customers of many upcoming public services may soon be required to conceal their identities behind masks. As a result, it is imperative that the civilised world find masks. Using Tensor Flow, Keras, OpenCV, and Scikit-Learn, this paper demonstrates a straightforward method for achieving this objective. This method can be used to identify a person's face in a photograph or video and determine if they are hiding their identity behind a mask. Being able to identify a person in video footage in real time, even if they are wearing a disguise, is a powerful surveillance tool. The method achieves a high degree of precision. Careful analysis of the parameters of the Convolutional Neural Network is required to prevent over-fitting in mask detection. (CNN) Cameras and open-source platforms like webcams and surveillance systems are being used in many current studies in the rapidly developing field of cutting-edge technology to detect and diagnose issues in government core areas like company outlets and airlines in real time. Our goal is to use OpenCV and Convolutional Neural Networks to identify COVID-19 face masks and remove personal identifiers (CNNs). Using pre-processing procedures for data argumentation, we were able to enhance the quality of our dataset and the effectiveness of the recommended models*.

Keywords**—** *Artificial Intelligence (AL), Machine Learning (ML), Deep Neural Learning (ML), Convolutional Neural Network Model (CNNM), Data Augmentation, Image Processing, Artificial Neural Network (ANN)*.

I. INTRODUCTION

COVID-19 (Coronavirus illness 2019) was discovered in Wuhan, China, in 2019, and the World Health Organization proclaimed this virus a global pandemic in March 2020. (WHO). Many people are choosing to hide out underground or assume aliases in order to safeguard their loved ones. In an effort to stop the spread of the virus, some countries have declared a state of emergency and ordered the widespread implementation of preventative measures such as public lockdowns, mask use, social isolation, hand sanitizer use, and hand washing. Researchers in this study used a deep learning algorithm and real-time data to identify mask wearers (image processing). To identify whether or not a person is wearing a mask, the proposed model will be trained using both a static image dataset and a real-time dataset. The model is proposed to use a method of object detection that combines OpenCV and a Convolutional Neural Network (CNN). It is possible to extract features from visual data and use them to determine if someone is hiding their identity behind a mask. OpenCv methods are used for live (streaming) data detection. For real-time (streaming) data detection, we employ OpenCv techniques: In this part, we will discuss the literature survey and the reviews that have come before it. a central concern in this piece. Section four describes each proposed application and how it will be implemented, including experimental results. The essay's final paragraph wraps up the argument and looks ahead to further research or professional pursuits. [1]

Since fresh coronavirus disease outbreak began, her countries have been in the news constantly. Health Canada warns that people infected with coronavirus "can transmit the disease before S they display symptoms". Close contact between infected people, such as while they are coughing, sneezing, or speaking, can spread the virus even if the infected person is asymptomatic. There is new evidence that a corona virus variant with structural changes exists. The current RT-PCR test we use shows no signs of detecting the novel strain. Masks and allowing work to continue are the only options for residents of a densely populated nation like India. No one knows if every employee wearing a mask upon entering the CNN building. Thus, it was decided that full face detection was essential. In this paper, we make use of a "Convolutional Neural Network" ()." This is an example of a model that employs deep neural networks, which may be used to analyses any form of image. It takes in the visual information, analyses it, and then transmits it to the several neuron layers that constitute the human brain. A completely linked layer that processing the final output is utilised for the purpose of making predictions. The bottlenecks layers are connected using residual connections, and an inverting residual structure is used to accomplish this.[2]

II. REVIEW OF LITERATURE

SHILPA SETHI 2021, In order to lessen the negative effects that the COVID-19 pandemic will have on the health of communities and the economy around the world, it is imperative that effective strategies for containing the pandemic be pursued immediately. Numerous methods are advised by the WHO to manage infection rates and prevent exhaustion of available medical resources in the absence of effective antivirals. The principal source of the SARS-CoV2 virus can be cut off by employing non-pharmaceutical intervention measures, such as wearing a mask when exhaling, when an infected individual exhales the droplets. In public, residents of every nation are required to cover their mouths and noses with a mask at all times. This is a matter of policy. This project aims to develop a very accurate mechanism for detecting people who are wear masks in public and for mandating the use of masks in order to improve the overall health of the community. There is evidence in the form of official documentation here. In order to obtain both a rapid inference time and a high level of precision, an array of detectors with one and two stages is utilised. In the

beginning, we combined high-level semantic data from a variety of feature maps by utilising ResNet50 and the idea of transfer learning. We recommend making changes to the bounding box in order to improve the mask recognition process.[3]

KHUSHBOO SAWANT 2021, The World Health Organization (WHO) reports that the COVID 19 virus can be transmitted both through direct contact and through respiratory droplets (WHO). Several prophylactic measures are required to halt the disease's further spread. Isolating sick people from their classmates and having everyone wear masks are two prophylactic measures that have been implemented. There are two options for protecting yourself from any droplets of COVID 19 virus that may be in the air: Prevention measures include using anti-viral hand soap and a face mask. Therefore, it is important to notice if people are hiding behind masks. In order to conform to legal requirements, we developed a system that could identify different types and shapes of face masks in live video feeds. Mask detection in video and picture streams is accomplished with the help of a deep learning Deep learning implemented in the PyTorch Python library allows for mask recognition in real-time video and image streams.[4]

KALLA KIRAN 2021, Using a combination of AI and ML, researchers hope to develop software that can determine if a person is hiding their identity. During treatment, COVID patients must wear a face mask at all times. Face masks have become commonplace as we begin the lengthy process of reopening. You can't go outside or conduct business without a face mask. Using this programme, a camera can tell if an individual is concealed behind a mask.[5]

F.M. JAVED MEHEDI SHAMRAT 2021, The global spread of COVID-19 Coronavirus has resulted in serious health problems for a large number of people. The health care system is in disarray. Several measures were put into place to ensure everyone's safety, including the use of masks, as recommended by the World Health Organization (WHO). Max pooling, Average pooling, and MobileNetV2 Over the course of its training, the deep learning architecture saw over 1800 images from various sources, including 120 shots taken by the authors themselves using webcams and mobile devices. Maximum pooling had a validation accuracy of 96.77%, and a training accuracy of 96.49%. The average train and validate accuracies for the pooled datasets were 95.19 and 96.2%, respectively. The MobileNetV2 testing and validation accuracy is 99.72 and 99.82 present, respectively.[6]

ADARSH DESAI N.D., When it comes to protecting your smartphone, facial recognition is the most effective method. Masks obscure a person's features, making it harder to recognise them. To limit the spread of COVID-19, mask use is mandated in most countries, including on public Face detection and authorization are relatively transportation and in public spaces. new additions to the arsenal of authentication tools for smartphones. In this study, participants wore full-face masks that exposed only their eyes and foreheads to ensure their anonymity. Both the small and large YOLOv3 models, both of which rely on transfer learning, correctly identified participants' unmasked faces. When comparing F1 and map scores, YOLO V3's are 0.85 and 0.88, respectively; it is the superior object identification model. This article shows how easily masked face recognition can be implemented on a Smartphone's hardware using a webcam as an example.[7]

III. METHODOLOGY

A. *Methods*

In order to achieve real-time face mask detection, a model of the facemask detector was trained and developed using datasets with and without masks. The facemask classifier was trained using Tensorflow, and a model was created with the help of datasets. Following that, the model was loaded. When cameras were activated, CV2 and harcascade classifier quickly identified people's faces. Your masks will activate if the database does not contain a facial mask. A survey was used to collect the bulk of the data. Primary data is information that has been collected for a specific purpose, either by the researcher themselves or by other parties. The discipline of research methodology is where you'll find the procedures for actually carrying out the research. Books, journals, previous studies, agency documents, previously gathered information, and regular service delivery records are all examples of secondary sources that can fill in the blanks and provide more context for the research at hand.

To train the model, we used a dataset of approximately 3833 images sourced from Kaggle and github, which included images from both the 1918 and 1915 datasets.

The first step involves loading sets of data and preparing images for training, while the second involves loading trained models from discs. In the third stage, we talk about the output (with or without a mask).

B. *Implementation Details*

a. *Python Modules:*

Importing all the necessary libraries like:

Numpy, Tensorflow, Matplotlib, pillow, OpenCv, Seaborn etc

- Numpy:

NumPy is a programming language that allows for the application of high-level mathematical functions to massive, multi-dimensional arrays and matrices.

- OpenCv

OpenCV is a software framework for computer vision, machine learning, and image processing. Many programming languages, including Python, C++, Java, and many others are supported by OpenCV.

- “Pillow”

“Pillow is a Python Imaging Library that can be used to open, manipulate, and save images. (PIL)”. There is a wide range of formats it can currently read.

- Matplotlib

For data visualisation and plotting, NumPy, Python's numerical extension, relies on the portable library Matplotlib.

- Tensorflow

Like vectors and matrices, tensors are a form of data structure in linear algebra that can be used for computations.

C. *Dataset:*

Here, we aggregate information from a wide variety of sources into a single, unified dataset. Our research data came

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from Kaggle and GitHub. The 3833 photographs from both the 1918 and 1915 datasets (those with and without masks, respectively) are combined first. There is also about 1500 images in a Kaggle dataset that includes both masked and unmasked photos of people's faces. Kaggle's data, the third set, is also segmented into three groups: “masked faces, unmasked faces, and mismasked faces”.

To create a new dataset, we combined the three existing ones and preprocessed the photos so that only the faces were retained. Move a copy of everything there. We have a collection of around 1500 images split into three categories. Without a mask, with an inadequate mask, or without a mask at all.

a. New Dataset description:

- Total number of images: 1438
- Classes: 3
- Class names: with_mask, without_mask, incorrect_mask.
- with_mask images:514
- without_mask images: 517
- incorrect_mask images: 408

D. Sample Images from the New Dataset:

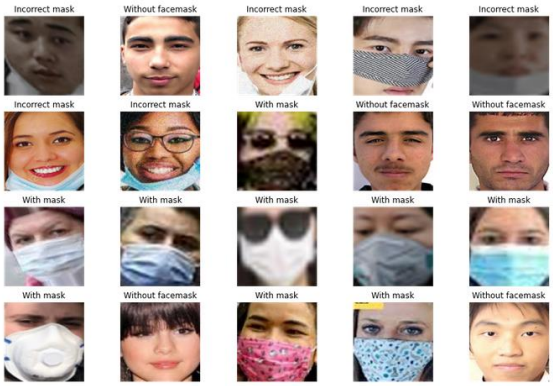

Figure 1: Sample images of dataset

a. Applying Pre-processing on the dataset:

After the new dataset has been loaded, resize all photos to 156 by 156 pixels and convert them from BGR to RGB. (width and height).

At last, catalogue each data point with its respective features and labels.

Here's a chart summarising how many images belong to each category of the dataset:

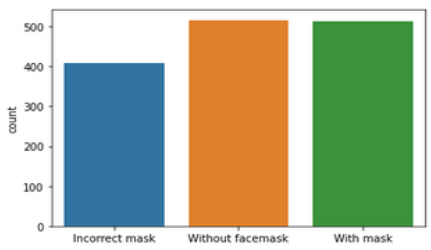

Figure 2: Graph

b. Data splitting:

“To split the data set in two, for use in training and testing, we employ a technique called train test split”. 80 percent of the data is found in the training set, while the remaining 20 percent is found in the testing set.

E. Apply The Data Augmentation:

In order to achieve a more even distribution of data, we used the data augmentation technique. We use various methods of augmentation, such as horizontal and vertical flipping, rotation, zooming, and height and width adjustments.

- “Rotation_range :25”
- “Width_shift_range: 0.1”
- “Height_shift_range: 0.1”
- “Shear_range: 0.2”

Here is the model layer architecture:

TABLE 1: Model Layer Architecture:

Layer (type)	Output Shape	Param #
conv2d_3 (Conv2D)	(None, 156, 156, 96)	14208
activation_5 (Activation)	(None, 156, 156, 96)	0
batch_normalization_4 (BatchNormalization)	(None, 156, 156, 96)	384
max_pooling2d_2 (MaxPooling2D)	(None, 156, 156, 96)	0
dropout_4 (Dropout)	(None, 156, 156, 96)	0
conv2d_4 (Conv2D)	(None, 52, 52, 256)	614656
activation_6 (Activation)	(None, 52, 52, 256)	0
batch_normalization_5 (BatchNormalization)	(None, 52, 52, 256)	1024
dropout_5 (Dropout)	(None, 52, 52, 256)	0
conv2d_5 (Conv2D	(None, 52, 52, 384)	885120
activation_7 (Activation)	(None, 52, 52, 384)	0
batch_normalization_6 (BatchNormalization)	(None, 52, 52, 384)	1536
max_pooling2d_3((MaxPooling 2D)	(None, 26, 26, 384)	0
dropout_6 (Dropout)	(None, 26, 26, 384)	0
flatten_1 (Flatten)	(None, 259584)	0
dense_2 (Dense)	(None, 512)	132907520
activation_8 (Activation	(None, 512)	0
batch_normalization_7 (BatchNormalization)	(None, 512)	2048
dropout_7 (Dropout)	(None, 512)	0
dense_3 (Dense)	(None, 3)	1539
activation_9 (Activation)	(None, 3)	0
Total params: 134,428,035		
Trainable params: 134,425,539		
Non-trainable params: 2,496		

F. Parameters:

a. Batch size: 32

In this case, the error gradient will be estimated using 32 training dataset samples, after which the model's parameters will be fine-tuned.

b. Loss Function: Categorical Cross-Entropy

Categorical cross entropy, or cross entropy, is a loss function used in multi-class classification. Problems like these force the model to make a determination about which of many possible classes an example best fits into. “It's a formally defined way of gauging how different two probability distributions are”.

c. Optimizer: Adam

When attempting gradient descent, the Adam optimizer uses a hybrid of two techniques: With the help of the " weighted average exponential " in order to hasten the decline in gradient. When averages are taken into account, the decline towards zero speeds up.

d. Epochs: 100

On the whole, 11 training epochs are sufficient for the vast majority of datasets. Taking into account failures apart from the

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Early Stopping reversal option: Observations Plot the "training and validation loss values against the number of epochs" for the model after it has been trained for up to 25 epochs. We used 100 no. of epochs in this dataset.

e. Activation Function: Softmax

When neural network models are used to forecast multinomial distributions, the softmax function is used as the activation function in the output layer. In multi-class classification situations where class membership is necessary for more than two class labels, Softmax acts as the activation function.

IV. Results

Researchers are always on the lookout for better ways to teach and assess machine learning. The thesis provides an in-depth analysis of various machine learning training and testing procedures. The results were put to the test in a sample application. The following considerations were made in this application: Classifiers, dataset size, feature selection algorithms, sampling strategies, training and testing frequencies, and so on are all important factors to think about. Here is a table comparing the results of the standard method to those of our modified version which is shown in Table 2.

TABLE 2. Results comparison

Approach	Base results	Proposed results
"Train acc."	95.77%	**98% Approx.**
"Train loss"	0.3312	**0.1042**
"Test Acc"	0.9458	**97% Approx.**
"Test loss"	0.4130	**0.0370**
"Epochs"	100	**100**

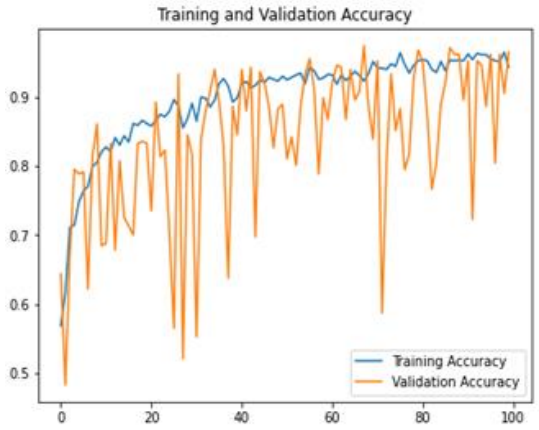

Figure 3: Graph of Training & Validation

A. Accuracy:

The training loss is a metric for evaluating how well a given deep learning model fits the data in the training set. To rephrase, it determines how off-base the model was when applied to the data used for training. A smaller subset of the training set was a more extensive dataset used to train the model. The training loss is determined by summing each sample's error rates across the entire training set. It is measured how much training was lost after each batch of training. This can be seen by constructing a loss curve during training.

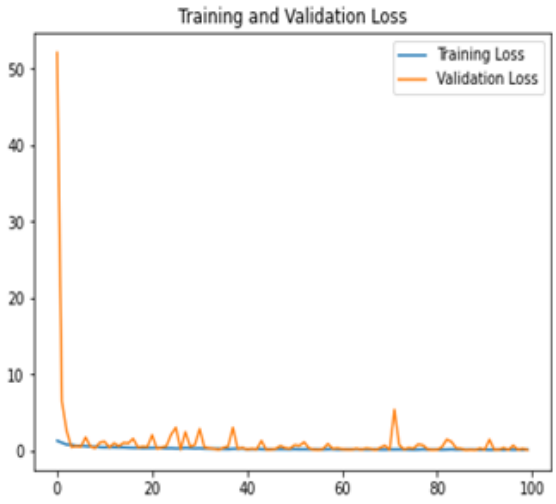

Figure 4: Graph of Training & Validation

B. Loss:

To determine how well an deep learning model does on a validation set, we can use a metric called validation loss. If you want to see how well your model performs, you can do so by comparing it to a "validation set" of data. Like training loss, validation loss is calculated by adding up the number of errors in each validation case. At the end of each time period, the validation loss is determined. This tells us if our model needs any fine-tuning. Most approaches to this problem involve generating a learning curve for the validation loss.

TABLE 3. Classification Report

	Precision	Recall	F1 score	Support
Incorrect Mask	0.93	0.62	0.74	86
With mask	1	0.66	0.8	122
Without Mask	0.59	0.99	0.74	106
Accuracy			0.76	317
Macro avg.	0.84	0.76	0.76	317
Weighted avg.	0.84	0.76	0.76	317

It's a metric for gauging how well a machine learning model does its job of classifying data. Your model's F1 score, along with its support, recall, and precision, are all shown here. Insight into the trained model's overall functionality is improved. A summary of our method's classification performance is provided in Table.

V. Conclusions & Future Work

Do something to stop the COVID-19 epidemic from spreading! . Facial recognition based on a mask In the introduction, we gave a brief overview of why we conducted this research.

We briefly described the goal of our research at the start of this paper. The model's learning and performance challenges were then depicted. Using simple machine learning tools and

methodologies, the system has achieved a decent degree of accuracy.

There is a practically infinite number of possible applications. Because of the conditions surrounding Covid-19, it is possible that donning a mask will become obligatory in the not too distant future. Several providers of public services require their employees to wear masks. The implementation of the strategy will have a significant impact, both positively and significantly, on the public health care system. In the not too distant future, it may be possible for individuals to determine whether or not they are properly donning the mask.

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