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Face Mask Detection

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Abstract: COVID-19 pandemic has rapidly affected our day-to-day life disrupting the world trade and movements. Wearing a protective face mask has become new normal in our life. In the near future, most of the public service providers will ask their customers to wear masks correctly for availing their services. Therefore, face mask detection has become a crucial task to help our society. This method detects the face from the image correctly and then identifies if the person is wearing a mask or not. As a surveillance task performer, it is also able to detect a face along with a mask in motion. We explore optimized values of parameters using the Sequential Convolutional Neural Network model to detect the presence of masks correctly.

I. INTRODUCTION

According to the World Health Organization Official Situation Report – 205, coronavirus disease 2019 (COVID-19) has globally infected over 20 million people causing over 0.7million deaths. To curb certain respiratory viral ailments, including COVID-19, wearing a clinical mask has become necessary. The public should be made aware of wearing the mask for source control and aversion of COVID-19. Respiratory problems like shortness of breath or difficulty in breathing is one of the main problems. Elder people having lung disease can possess serious complications from COVID-19 illness as they tend to appear to be at a higher risk. Potential points of interest of the utilization of masks lie in reducing vulnerability of risk from a noxious individual during the "presymptomatic" period and stigmatization of discrete persons putting on masks to restraint the spread of virus. Before debilitating individuals, viruses like 2019-nCoV, SARS-CoV, and MERS-CoV infect animals and evolve to human coronaviruses.

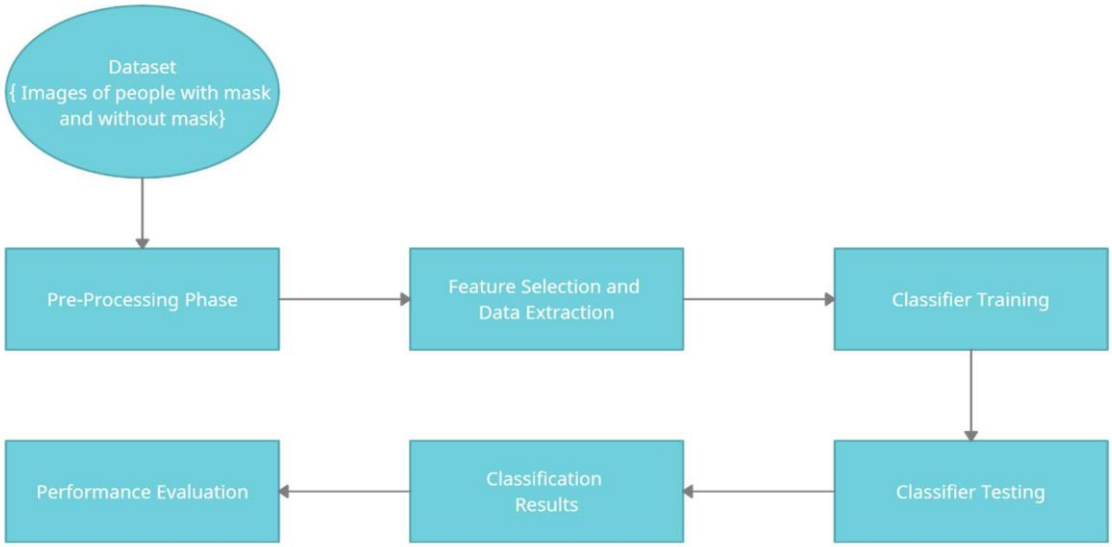
Face mask detection involves detecting the location of the face and then determining whether it has a mask on it or not. The issue is proximately similar to general object detection which consists of detecting the classes of objects. Face identification categorically deals with distinguishing a specific group of entities i.e. Face. It has numerous applications, such as autonomous driving, education, surveillance, and many more. This paper presents a simplified approach to serve the above purpose using the basic Machine Learning (ML) packages such as TensorFlow, Keras, OpenCV and Scikit-Learn.

This paper proposes the applications of the machine learning for face mask detection method for accurate detection. Machine learning focuses on applications that learn from their own experience and improve their decision-making or predictive accuracy over time. We have used various machine learning classifiers to identify the faces with mask and without mask from the collected dataset.

Many developed and underdeveloped nations worldwide have made it compulsory for people in their countries to wear masks while leaving home or visiting public places. Many different precautionary measures are also being advocated by the government to maintain safety and hygiene, apart from shielding faces. Further, millions of people are learning to make their own face masks due to the short supply of masks in the market. On the other hand, it will be challenging to recognize faces with masks on any monitoring systems, while maintaining touchless access control in buildings. Covering faces with masks has posed a challenge for face detection algorithms and has hindered its performance.

The Face Mask Detection System can be used at airports to detect travelers without masks. Face data of travelers can be captured in the system at all the times. If a traveler is found to be without a face mask, their picture is sent to the airport

authorities so that they will be able to take quick action. If the person's face is already stored, like the face of an airport worker, it can send the alert to the worker's phone and also to their senior directly so as to maintain safety.



Hospitals can monitor if their staff is wearing masks during their shift or not. If any health worker is found without a mask, they will receive a notification to remind them to wear the mask. People who are quarantined are required to wear a mask, so the system can keep an eye and detect if the mask is being worn or not and send notification automatically to that person and also report to the authorities.

The Face Mask Detection System can be used at office premises to detect if employees are following the safety protocols at work. It will monitor employees and in case it finds any employee without mask, it will send them a reminder to wear a mask. The reports can be downloaded and sent at the end of the day to capture people who are not complying with the regulations of the company.

II. Theoretical framework

The different algorithms which are useful in face detection task-

AdaBoost:
Adaboost is an algorithm which is used for constructing a strong classifier as a linear combination. Adaboost, which is short for Adaptive Boosting, is a machine learning algorithm, it is a meta-algorithm and can be used in conjunction with many other learning algorithms to improve their performance. It is adaptive in the sense that the subsequent classifiers built can be tweaked in favor of those instances misclassified by previous classifiers. Adaboost generates and calls a new weak classifier in each of a series of rounds from a set of training images. This method can be used for face detection and also for face locating faces. In this method, a standard face such as frontal can be used and the model can be trained. The advantages of this method are that it is a simple algorithm and can be implemented easily, and it is easily able to determine different face locations such as nose, eyes, mouth, etc. based on the correlation values.

Haar-like feature:
Haar-like wavelets are in the form of binary rectangular representations of 2D waves. A common visual representation is using black for value minus one and using white for value plus one rectangles. The square above the 0-1- interval shows the corresponding Haar-like wavelet in common black-white representation. The rectangular masks used for visual object detection are rectangles which are tessellated by black and white smaller rectangles. Those masks are designed such that the visual recognition tasks can be solved, and are known as Haar like feature. With each call, a distribution of weights is updated that indicates the importance of examples in the data set for the classification. During every round, each incorrectly classified example weights are increased, and each correctly classified example weights are decreased, so the new classifier focuses on the examples which are far off from the correct classification.

MobileNet:
MobileNet uses depth wise separable convolutions. As the name applies, this model was made so that it can be used in mobile applications, and it is TensorFlow's first mobile computer vision model. It significantly reduces the number of parameters when compared to the network with regular convolutions with the same depth in the nets. This leads to the formation of lightweight deep neural networks. In Dense-MobileNet models, convolution layers with the same size of input feature maps in MobileNet models are taken as dense blocks, and dense connections are carried out within the dense blocks. The new network structure is able to use the output feature maps which are generated by the previous convolution layers in dense blocks, so as to generate a large number of feature maps with fewer convolution cores and repeatedly use the features.

III. Design of the project

The first step of designing is collecting the dataset. For this project the dataset which was suitable was collected from Kaggle. The next step was preprocessing of the dataset. Data preprocessing includes cleaning, resizing all the images to the same size, Converting all images to arrays. Storing these arrays into a list. Then we convert with mask and without mask to categorical variables. It also consists of importing all the necessary libraries needed for the detection task. The images were resized to 224*224, and the images were converted into an array of pixels. The model is divided into two stages- the training and the testing stage.
Training stages:

The training set would contain the data which will be fed into the model. In simple terms, the model would learn from this data. Collection of known Images –for training of image filter, collection of images is needed whose classification labels are known. This collection should be from several and different kind of sources. Pre-processing of Images- Resizing and conversions to array. Augmenting the images - construct the training image generator for data augmentation, Flips images, creates many images from single image.

Load the MobileNetV2 network, ensuring the head FC layer sets are left off. Input tensor is the shape of the image. We divide our model into head model and base model. Activation function used is Relu and softmax is used for binary classification. Place the head FC model on top of the base model (this will become the actual model we will train). Loop over all the layers in the model and freeze them so they will not be updated during the first training process. Compile the model using the Adam optimizer and train the model.

Classification Testing stages:

The testing set contains the data on which we test the trained and validated model. It tells us the efficiency of our overall model and also can inform us how likely is it going to predict something which does not make sense. There is a plethora of evaluation metrics (like precision, recall, accuracy, etc.) which can be used to measure the performance of our model.

- Prepare a set of images for testing
- a collection of images is needed for testing our face mask detection. Preprocessing those images.

IV. Conclusion and Future Scope:

Using basic ML tools and simplified techniques the method has achieved reasonably high accuracy. It can be used for a variety of applications. Wearing a mask may be mandatory in future, considering the Covid-19 crisis. Many officials, shop-owners, government agents will ask the customers to wear masks correctly to avail of their services. The deployed model will contribute immensely to the public health care system. In future this can be extended to detect if a person is wearing the mask properly or not. The model can be further improved to detect if the mask is virus prone or not i.e. the type of the mask is surgical, N95 or not.

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