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Face Mask Detection Using Machine Learning Algorithms

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Abstract: COVID-19 pandemic has rapidly increased health crisis globally and affected our day-to-day lifestyle. So, by wearing a facemask, the foremost effective preventive care must be taken against COVID-19. Identifying individuals whether they are wearing facemask and to notify the victim in public and crowded areas may be a difficult task. The goal of this study is to develop a simplified method of object detection and face mask detection techniques to automate the process of identifying individuals who are not wearing masks and generating the E-challans by directly requesting vehicle information from the RTO after extracting the number plate data (number plate detection), and delivering the E-challan via Email and SMS. This paper includes some basic Machine Learning packages like TensorFlow, OpenCV together with the Convolutional Neural network model. Here, the well-known YOLO method is used to find the license plate. One of the quickest real-time object identification algorithms is YOLO, which uses a neural network to predict bounding boxes and their probabilities throughout the entire image.

Keywords **- Face Mask Detection, Convolutional Neural Network, MobileNetV2, Image Processing, Face Recognition, YOLO V3.**

I. INTRODUCTION

The pandemic illness COVID-19, which quickly spread over the world had a significant impact on people's daily lives, humanity, and daily lifestyles. The World Health Organization (WHO) stated that face masks and social distancing is the answer to it, until a cure is invented. Wearing a face mask can significantly reduce the risk of getting infected by a great extent, not only to the one wearing it but also to the others that he comes in contact with. This simplified technique uses the basic machine learning tools like TensorFlow, OpenCV, and YOLO V3 algorithm. The Convolution Neural Network (CNN), a subclass of Deep Neural Network (DNN), is most frequently used in picture classification and recognition. Tensor flow is mainly used in the backend. It is also to reshape the data (image) in the data processing. Open CV is essentially used for the movements of things as well as detect objects, faces.

Once the person is found without wearing mask, then license plate of person is localised, then the system further performs character segmentation on the license plate. Finally, Character Recognition takes place. Once the system gets the characters of the license plate, it can be used to generate the electronic challan by cross referencing the license plate with the Database and getting the information about the owner of the vehicles.

II. LITERATURE SURVEY

In the paper [1] Shubham Kumar Chandravanshi, Hirva Bhagat, Manan Darji, Himani Trivedihas proposed License Plate Detection method using heterogeneous data by using different algorithm. The author applied machine learning techniques to actual datasets so that their accuracy could be examined and useful conclusions could be made. The dataset for License Plate images have been compiled by combining Kaggle Number Plate Datasets, Smart India Hackathon 2020 Training Dataset, Google Images. The author conducted a comparison of the used License plate Detection (YOLOv3), Character Segmentation (YOLOv3) and Character Recognition (ResNet50 + ResNet50V2 +DenseNet169. When compared to other methods, good and accurate results are produced by using Character Segmentation i,e YOLOv3 algorithm. The author suggested that these findings could be applied to the detection of license plate detection.

In the paper [2] Chhaya Gupta, Nasib Singh Gill used face cropped data containing images with different angles and different poses of face with and without masks that are labelled and is used to train our model. The Author used Convolutional Neural Network (CNN) algorithm which is used to detect face masks in real time. Convolutional Neural Network (CNN) which helps for feature extraction from the dataset images as well the images captured by cameras in real-time. It is clear from the analysis done in this paper that the CNN algorithm can be effectively used to determine whether or not persons are wearing face masks.

In the paper [3] Bhadani, Amrit & Sinha, Anurag developed a face mask wearing condition identification method. They are classified into three categories of face mask-wearing. The categories include face mask- wearing, incorrect face mask-wearing and no face mask-wearing. In order to determine the whether a person is wearing a mask or not, the author used the MobileNetV2 classifier and ADAM optimizer. MobileNetV2 is the latest technology of mobile visual recognition, including classification, object detection and semantic segmentation. When compared to other algorithms, the author wishes to illustrate that MobileNetV2 produces the greatest results.

In the paper [4] A S Mohammed Shariff, Raghav Bhatia, Raghwendra Kumar & Sarthak analyses and presents research on number plate detection using various machine learning algorithms. In the paper, the Author proposed a method Open CV library along with python language which is used for image processing by using py tesseract. The input image was tested through bilateral filter and was prepossessed under various methods. In this paper some important machine learning techniques have been analysed and their results are compared and the best model for number plate detection is found as the OpenCV, which also provides the most accurate results when compared to other models.

In the Paper [5] The technique proposed by Nivethitha T, Ashwath P, Hari Prasath E, Chandru M, Chandru S, and Baskar D would stop the spread of COVID-19 by identifying people who do not use masks in public areas. To determine if a person was wearing a mask or not, the author used the CNN and Viola Jones algorithms. In comparison to CNN, Viola-Jones has slightly better accuracy, requires less calculation time, classifies images more quickly, and is simpler to construct. The Viola Jones model offers results with an accuracy rating of 97%, making it the most accurate when compared to other models.

III. METHODOLOGY

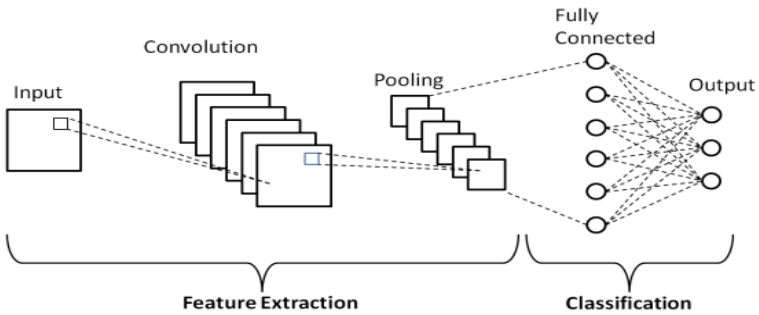
In this Paper, identifying whether people are wearing mask or not is the major factor determining the issue. The data are divided into two different categories: Faces with mask and Face without mask. Faces with Masks gives us the benefit to improve dataset variants since it includes masks with hands, masks, and other items that cover the face. YOLOv3, Convolutional Neural Network (CNN), MobileNetV2, Open CV library, and Viola Jones are machine learning techniques that can be used to train a model with dataset to determine if the individuals are wearing masks. If not generating the E-challans by directly extracting the number plate data and deliver the E-challan via Email and SMS.

YOLOv3:

Figure 3 (a): Results of Character Segmentation and Character Recognition

YOLOv3 [1] is one of the most popular algorithm, when compared to the R-CNN family, YOLO is one of the real-time object identification algorithms that detects objects the faster (45 frames per second). YOLO follows a completely different approach. Instead of picking only a few areas, it uses a neural network to predict bounding boxes throughout the entire image. Without the usage of any GPU, YOLOv3 provided us with a nice balance of speed and precision. Once the licence plate has been located, character segmentation is then carried out on the plate. The process of character segmentation breaks down an image of a string of characters into smaller images representing individual symbols. Optical character recognition is another name for character recognition. The characters on the segmented licence plate are recognised via character recognition. Optical character recognition is the process used to convert a text image into a machine-readable text format (OCR).

Convolutional Neural Network (CNN):



Convolutional Neural Network [2] is a Deep Learning method that can take in an input image, give various elements and objects in the image importance and be able to distinguish between them. Due to its low computational cost and spatial extraction capability, CNN plays a crucial role in pattern recognition. The process to identify a face of a person's image can be initially branched into 2 divisions-Feature Extraction and Classification. The results obtained in apply the convolution operations on the image helps to achieve the desired result. In order to identify the faces of people, first cropped dataset from Kaggle is taken. Then we use the concept of filter. Then it will return Feature map that has a particular feature detected. Now we flatten them using 1D arrays. Then Pooling is used to reduce the size and dimensions of an image. Finally, the main idea behind the CNN is Feature extraction.

MobileNetV2:

MobileNetV2 [3] is based on the concept of mobileV1, and it effectively constructs itself utilising deeply intelligent separable convolution. But V2 added two additional features for construction:

1) Linear bottlenecks between the layers

2) Shortcut connection between the bottlenecks.

MobilenetV2 is a model which does the same convolution as done by CNN to filter images but in a different way than those done by the previous CNN. It uses the concepts of depth convolution and point convolution, which are distinct from the standard

convolution used by conventional CNNs. In order to perform object identification tasks, the backbone network functions as a straightforward feature extractor, taking input in the form of images and producing feature maps for each input image. This makes CNN more effective at predicting images, allowing them to compete in mobile systems as well. As a result, it reduces the time needed for comparison and recognition, giving better results quickly.

OPEN CV:

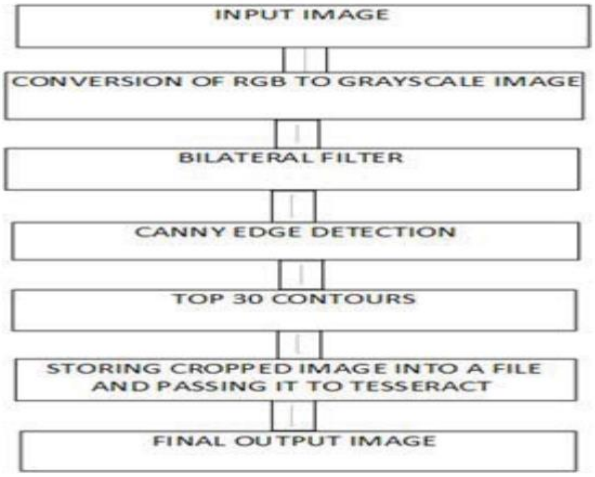


Fig. 1. Flow chart for image processing

OpenCV [4] is a library which focuses on application like real time. It is a type of computer vision that is used to recognise image context. Projects like face detection and object detection are well suited for OpenCV. RGB image is initially transformed into a greyscale image. After applying the bilateral filter on the image, we can notice some smoothness while still maintaining the edges and removing background noise. To find the edges of the number plate, we use the Canny edge detection technique. The process of finding each contour comes next. The main function of top 30 contours is detecting the rectangular contours. Next, storing the cropped image of the license plate and sending it to the tesseract. Tesseract will take a string from a picture, read that text, and then display the results.

Viola-Jones:

The use of Viola-Jones [5], which has demonstrated to be extremely significant in real-time face identification, is quite strong. Although it is incredibly long to train, this algorithm has an impressively quick real-time face detection rate. There are four main steps in the Viola Jones algorithm:

1. Selecting Haar-like features
2. Creating an integral image
3. Running AdaBoost training
4. Creating classifier cascades

Haar-like features are visual features that are utilised in object recognition. Viola and Jones found three different forms of Haar-like features in their analysis. They consists of edge, line, and four-sided features. For the detection of edges and lines, respectively, edge features and line features are helpful. Diagonal features are discovered using the four-sided characteristics. The rectangular portion of an image's or an image's sum of its pixel values can be quickly and effectively calculated using an integral picture. Adaboost is used to find the distinguishing characteristics of a face in a picture. Once the image has approved from the classifiers, it is eventually identified as a human face and displayed to the user as a detection.

IV. RESULTS

The images and data in the table below shows the final outcome, which is utilised to train and test the predictive models. Apply machine learning techniques to the final dataset after it has been prepared. Finally, apply machine learning algorithms after creating the final dataset to obtain accuracy.

S.NO	MODEL	ACCURACY
1	Open CV	98%
2	MobilenetV2	98.77%
3	YOLOv3	93.86%
4	Character Segmentation	97.38%
5	Character Recognition	89.11%
6	Viola-Jones	98%
7	Convolutional Neural Network	95%

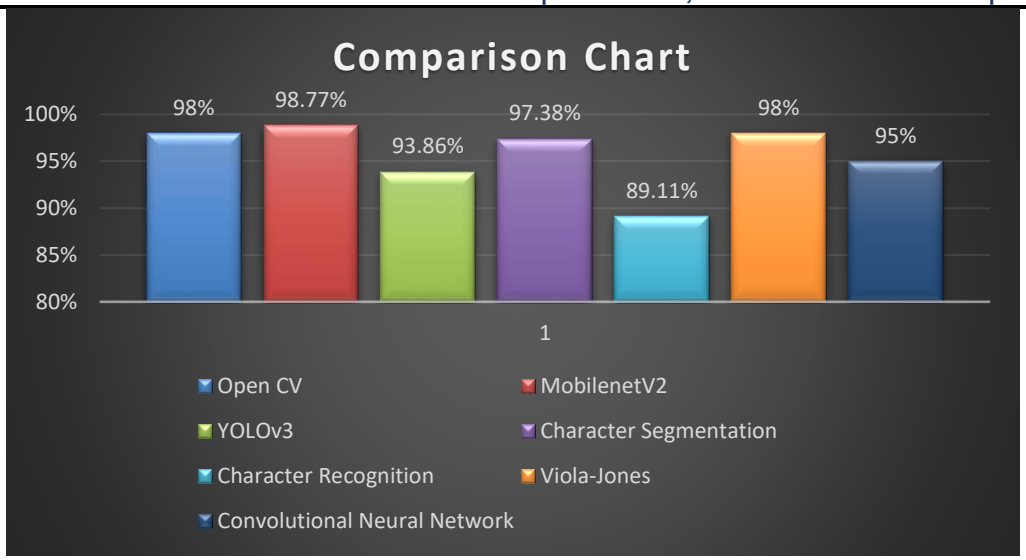


Fig1: Analysis of ML Algorithms

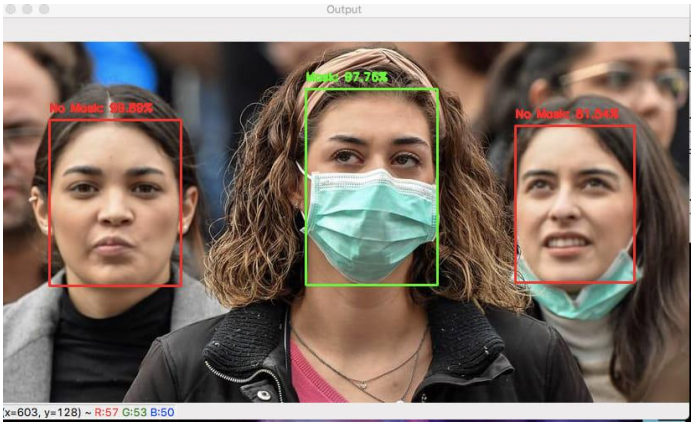


Fig2: Test result of Model

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