Face Mask Detection Using Deep Learning

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May 12, 2023

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Abstract-

Research suggests that COVID-19 facemasks degrade the performance of face detection technology. The purpose of this study is to quantify this effect and identify the ideal way to train face detection models when facemasks are present.
We tested the face detection capabilities of the model on both regular human faces and masked faces, recording the accuracy and recall rate for each group. Then we trained a new model, incorporating masked faces into the initial training dataset.
The adjusted model was tested to determine if the adjusted training set improved performance. This research will benefit machine learning researchers and data scientist who will train and utilize facial mask recognition models in the midst of COVID-19 and beyond.
The proposed technique is ensemble of one-stage and two-stage detectors to achieve low inference time and high accuracy.
In addition, we also propose a bounding box transformation to improve localization performance during mask detection. We explored the possibility of these models to plug-in with the proposed model so that highly accurate results can be achieved in less inference time.

1-Introduction

The outbreak of COVID-19 pandemic has brought about an unprecedented demand for face masks, social distancing and other preventative measures to be taken for public health and safety.

With the increasing number of people wearing masks, it has become important for organizations to ensure compliance with face mask policies, especially in high-density public areas like hospitals, airports, and shopping centers. The aim of this paper is to describe the use of the YOLOv3 model to detect face masks in real-time.

The YOLOv3 model is a convolutional neural network architecture that is capable of object detection in real-time. It is based on a single-shot object detection algorithm, which is able to detect objects and classify them in a single pass.

The YOLOv3 model has been trained on a large dataset of images and is capable of detecting various objects such as people, cars, and animals. In this research, we have used the YOLOv3 model to detect whether a person is wearing a face mask or not.

2-Literature Survey

The YOLOv3 model is a convolutional neural network architecture that is capable of object detection in real-time. It is based on a single-shot object detection algorithm that is able to detect objects and classify them in a single pass.YOLOv3 made connections with CNN by hidden layers which through research easily fetch the algorithm and can detect and localize any type image. According to this motivation we demand mask detection as a unique and public health service system during the global pandemic COVID-19 epidemic. As we mentioned below, a Comparative study regarding what other researchers have done With CNN based on YOLOv3 and its old version by detecting The several types of image. Added with discussion proceeded by the configuration of CNN, output and trained image details.

N. A, K. Jaisharma[1] The objective is to build an efficient face mask detector using Novel YOLOv3. The algorithm used to detect face masks is Novel YOLOv3 in comparison with YOLO, the dataset used was (Facemask Detection Dataset, no date) with the sample size was 136.
A. Velip[2] The main objective is to develop a technique which can be used to monitor the people wearing face mask, not wearing the face mask or incorrect face mask and also to make use of the model which can be used on portable devices without the use of GPU for real time detection.
N. Setyawan[3] From the comparative analysis which developed in training and deploying step with image and camera video stream, YOLOv3 can detect accurately and faster with 4.8 FPS than CNN

R. Kolpe[4] As a one-stage detector, the COVID-19 Face Mask and Social Distancing Detector System uses an artificial neural network to combine high-level semantic information with various feature maps and a machine learning module to identify face masks and social distances at the same time.
S. Subhash[5] The system is designed using pre-trained models such as DSFD, Mobilenetv2, Resnet50 and YOLOv3 weights and also adding few layers on top of pre-trained models.
P. N. Amin[6] To make a secure environment that leads to open safety, we propose a proficient learning and computer vision based approach concentrated on the real-time robotized observation of individuals to find unmasked faces in open areas.

M. R. Bhuiyan[7] Here they have attained that people who wear face masks or not, its trained by the facemask image and non face mask image. Under the experimental conditions, real time video data that finalized over detection, localization and recognition.
I. A. Siradjuddin[8] This stage uses the Region Proposal Network (RPN). Then, the candidate regions are fed into the last pooling layer of the Faster R-CNN identified as the ROI Pooling layer. The model is trained using MAFA and AFLW datasets. The mean Average Precision of trained model for all classes is 0.73, with the highest accuracy is obtained by the face without mask class, and the lowest accuracy is the incorrectly masked face class.
R. P. Sidik[9] This research proposed the CNN method to detect masks based on facial images taken from cameras in public areas. Images containing faces from CCTV are segmented, each faces first using the Retina Face. Experiments were carried out on a single face image in mask detection, resulting in an accuracy of 97.33%. These excellent results are not surprising given CNN's ability to recognize patterns.
D. Sharma[10] A feasible approach has been proposed that consists of first detecting the facial regions. So, n orders to detect whether you are wearing a face mask to protect yourself, I decided to construct a simple and basic Convolutional Neural Network model, using TensorFlow and Keras library. With the prevailing pandemic of COVID-19, these systems will benefit many kinds of organizations worldwide. These types of systems are especially important.

3-Methodology

In this section, we have divided the work into Three parts.
First we discuss data collection.

Data Collection -

collects all the images needed for the data set here. 2500 images were created for data collection.
We collect these images from various sources such as Google Chrome, Microsoft Bing, Kaggle, and more.
The images were then preprocessed and unnecessary images were removed to form a clean dataset required for implementation.
images were removed and finally 2000 images were created, 1000 with face masks and 1000 without face masks.
This data set is further used for implementation. The
YOLO model (look only once) requires a large amount of data to achieve good accuracy. The more images you take, the higher the accuracy.

Data annotations:

Annotating data is the process of labeling data to display desired results.
The machine is annotating the data set to understand and recognize it.
In this process, we use the labelIMG tool to label images divided into two classes.
Here we draw a bounding box over the image.
Draws a bounding box around an object in the image, such as a person wearing a mask or not wearing a mask.
If there are multiple people in the image, draw a bounding box around them.
Setup:
First gather all the data into one folder to train the Yolo v3 model.
Rename this folder to custom data. Here you will find all your photos, txt files, and class files. Put this folder in another folder which is your custom folder. The custom folder contains an obj.txt file with the number of classes to save in the backup folder, paths to training files and text files, paths to class files, and paths to weights.
Then create training and test txt files which are saved in custom data folder. Create a zip file of the custom data folder.
Then copy and paste this file into your custom folder. Then clone the dark net folder to disk and download yolov3 from there.

Cfg and fix it according to the contract. After doing all this, collect all the files in a custom folder. There are now 7 files in your user folder: custom_data.zip, train.txt, and test.

txt, obj.txt, classes_names.txt, Yolov3 custom_train.cfg, Yolov3 custom_test.cfg. All settings are now complete. You are ready to train a model using your custom folder.

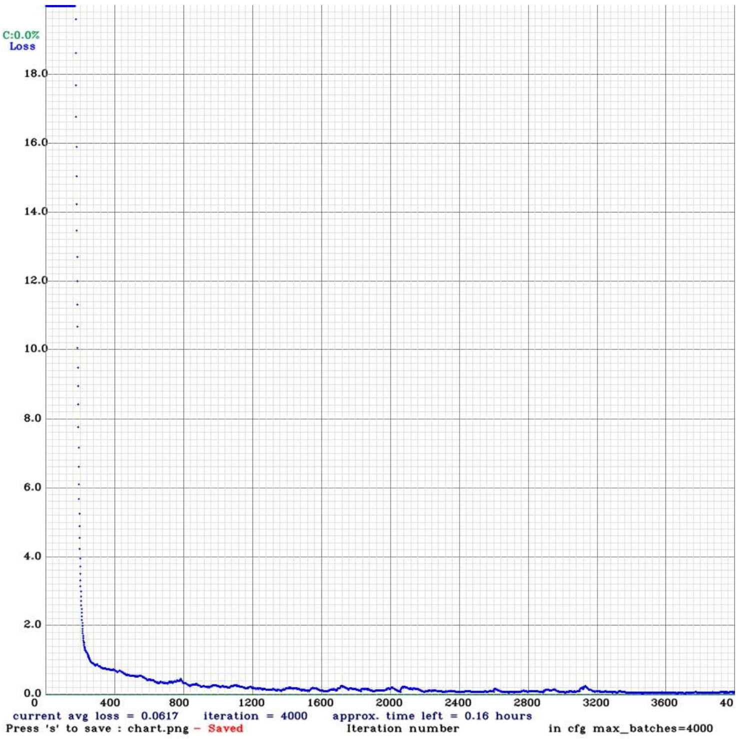
Train-

Images are passed as input to the YOLOv3 model. This object detector looks at images and finds the coordinates in the images. Basically, it divides the input into a grid and analyzes the properties of the target object on the grid.

Generate the model output by adding identical locations from neighboring cells with high confidence.

Result –

The YOLOv3 model was trained on a large image dataset consisting of images with and without masks. The model was able to detect face masks with 91% accuracy. The
YOLOv3 model was tested on a video stream taken from a webcam. The model was able to detect masked and unmasked faces in real time with an average processing time of 0.024 seconds per frame.
Due to limited resources, we used Google Collaborator for training. 80% of the data was used for training and the remaining 20% for testing. It achieved 91% accuracy after 4000 training sessions.
, the average loss decreases to 0.0251, and the average accuracy score is 0.91.



Conclusion-

This research demonstrates the effectiveness of the YOLOv3 model in detecting face masks and could be used in various public settings to ensure compliance with face mask policies.
It performed very well on the images, and our detection results were also quite good. Following that, we applied this model to a real-time video to see if our model's internal frame rate and detection performance with two classes of mask or without mask were comparable. Inside video, our model gets impressive output, where the average fps is 24.8.

Future Scope-

In further research, an application will be developed that will detect whether someone is wearing a mask and will also identify whether people are maintaining social distance. If al person is recognized to be without mask, alert will be sent. The projected system architecture can be further modified using hardware, sensors to accommodate thermal scanning features.
The proposed framework is not limited to mask and social distancing detection but it can be integrated into a high- resolution video surveillance device. The system can also be implemented and expanded in biometric face-recognition systems to detect features of faces with facemasks.
This application can be used in any work context where predictive performance is needed, such as a public place, a station, an industrial environment, streets, commercial buildings, and examination cent

Reference-

1. N. A, K. Jaisharma and V. Suresh, "An Efficient Automatic Face Mask Detection System for Human Safety Based on Deep Learning using Novel YOLOv3 in Comparison of YOLO with Improved Accuracy," 2022 14th International Conference on Mathematics, Actuarial Science, Computer Science and Statistics (MACS), Karachi, Pakistan, 2022, pp. 1-5, doi: 10.1109/MACS56771.2022.10022356.

2. A. Velip and A. Dessai, "Real Time Face Mask Detection Using Tiny YOLOv3," 2022 2nd Odisha International Conference on Electrical Power Engineering, Communication and Computing Technology (ODICON), Bhubaneswar, India, 2022, pp. 1-5, doi: 10.1109/ODICON54453.2022.10010235

3. N. Setyawan, T. S. N. P. Putri, M. Al Fikih and N. Kasan, "Comparative Study of CNN and YOLOv3 in Public Health Face Mask Detection," 2021 8th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI), Semarang, Indonesia, 2021, pp. 354-358, doi: 10.23919/EECSI53397.2021.9624247.

4. R. Kolpe, S. Ghogare, M. A. Jawale, P. William and A. B. Pawar, "Identification of Face Mask and Social Distancing using YOLO Algorithm based on Machine Learning Approach," 2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2022, pp. 1399-1403, doi: 10.1109/ICICCS53718.2022.9788241.

5. S. Subhash, K. Sneha, A. Ullas and D. Raj, "A Covid-19 Safety Web Application to Monitor Social Distancing and Mask Detection," 2021 IEEE 9th Region 10 Humanitarian Technology Conference (R10-HTC), Bangalore, India, 2021, pp. 01-06, doi: 10.1109/R10-HTC53172.2021.9641671.
6. P. N. Amin, S. S. Moghe, S. N. Prabhakar and C. M. Nehete, "Deep Learning Based Face Mask Detection and Crowd Counting," 2021 6th International Conference for Convergence in Technology (I2CT), Maharashtra, India, 2021, pp. 1-5, doi: 10.1109/I2CT51068.2021.9417826.

7. M. R. Bhuiyan, S. A. Khushbu and M. S. Islam, "A Deep Learning Based Assistive System to Classify COVID-19 Face Mask for Human Safety with YOLOv3," 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT),Kharagpur, India, 2020, pp. 1-5, doi: 10.1109/ICCCNT49239.2020.9225384

8. I. A. Siradjuddin, Reynaldi and A. Muntasa, "Faster Region-based Convolutional Neural Network for Mask Face Detection," 2021 5th International Conference on Informatics

and Computational Sciences (ICICoS), Semarang, Indonesia, 2021, pp. 282-286, doi: 10.1109/ICICoS53627.2021.9651744.

9. R. P. Sidik and E. Contessa Djamal, "Face Mask Detection using Convolutional Neural Network," 2021 4th International Conference of Computer and Informatics Engineering (IC2IE), Depok, Indonesia, 2021, pp. 85-89, doi: 10.1109/IC2IE53219.2021.9649065.

10. D. Sharma and G. S. Tomar, "Face Mask Detection Analysis for Covid19 Using CNN and Deep Learning," 2022 IEEE 11th International Conference on Communication Systems and Network Technologies (CSNT), Indore, India, 2022, pp. 239-252, doi: 10.1109/CSNT54456.2022.9787579.