Social Distancing and Face Mask Detection

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Abstract: In the case of a Covid pandemic, it is important to avoid the disease by keeping a safe distance and using a mask. In this paper, our purpose is to develop and implement a system to determine whether a person is socially distancing or wearing a mask. As the pedestrians are being recorded, the system will detect objects and recognize their faces. Several algorithms are used YOLOv3, DBSCAN, and DSFD for face mask detection and social distancing. Our main aim is to find the minimum distance maintained by each person wearing a face mask and to recognize and notify the user to follow the rules given by authorities. If a person is not wearing a mask and keeping a social distance, then our system will recognize and advise the individual.

Keywords: YOLOV3,DBSCAN,DSFD,Covid-19, Face mask Detection,Mobilenet.ResNet50.

1. INTRODUCTION

People typically spread COVID-19 by breathing in respiratory droplets. When people cough, sneeze, talk, shout, or sing, respiratory droplets enter the air. It is possible for people to inhale these droplets or to breathe them in by landing on their mouths or noses. Masks are therefore essential to prevent the spread of the virus. The mask from which respiratory droplets are prevented from reaching others is a simple barrier. As well as maintaining social distance in order to avoid close contact with those around you. In order to prevent such panic situations in pandemic, advanced methods should be implemented. Different deep learning and computer vision techniques are used to detect face mask and finding social distancing

2. LITERATURE REVIEW

Safa Teboulbi, Seifeddine Messaoud, Mohamed Ali Hajjaji, and Abdellatif Mtibaa[1] introduced a new embedded vision system. They used mobile networks, ResNet classifiers, and VGG transfer learning models to detect masks and social distancing and to detect the separation of humans. The results of their experiments showed that the models were almost as accurate as the human face recognition models.

Sethi S, Kathuria M, Kaushik T [2] developed two stage ensemble detectors for face mask detection.The authors aimed to develop a new system which is really helpful to the nation and peoples. They have initially used ResNet transfer learning model to get semantic information for multiple future maps. Later, they have explored bounding box generation by considering other models like, Alex Net and Mobile Net .

Nagrath P and co-authors[3] used image processing ,computer vision and deep learning technologies to find the face mask. The framework they have developed is Single Shot Multibox Detector as a face detector and MobilenetV2 (SSDMNV2).This proposed framework can also be used in embedded systems and InternetofThings(IoT).

Sikakulya et.al[4] reviewed wearing face masks in western Ugandans. This analysis has given great impact on western Ugandans attitude, behavior, knowledge regarding face masks.

Keniya et.al[5] suggested maintinaing social distancing is better to avoid panic situations in pandemic. They developed new self detecting model for social distancing called as SocialdistancingNet-19 for frame detection of a person and generating labels, as safe or unsafe .

3. PROPOSED METHODOLOGY

In proposed methodology, the dataset were collected and the dataset is preprocessed to detect face masks and to find distance between persons. we divide 1 second video into 26 frames and extracts persons from the frame and divide them into two groups. One group for with mask and one for without mask. We give threshold for calculating distance between people. Finally, we label

them according to the violations and then we cluster all frames together and save them as a video
The proposed model has shown in figure 3.2.

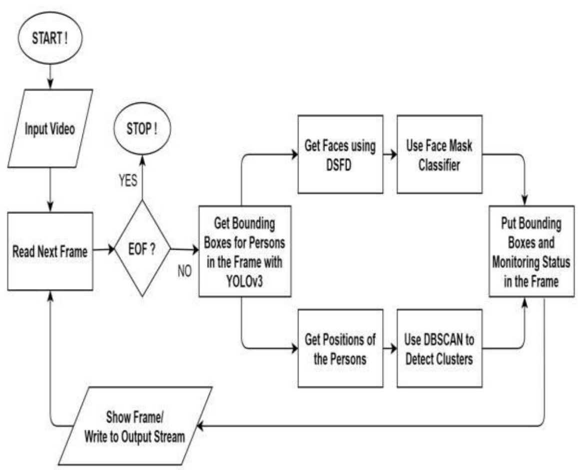

Figure 3.1: Flowchart for proposed model.

A video stream is given to the model, and the frames are generated to identify objects and providing augmentation, then generating bounding boxes. This section is divided into two phases.
Two phases have been defined in the proposed model:
Phase 1:
Within the first phase, YOLOV3 object detection model is used to generate bounding boxes within the frame. The initial phase involved collection of frames and the use of YOLOV3 based models for the detection of objects in the images. The pertained weights are stored to train on real-time video.
Phase 2:
A second phase of analysis involved detecting faces based on DSFD and detecting clusters based on DBSCAN to detect persons' positions. Finally, implement monitoring system for detecting masks and setting threshold value for distancing socially. The proposed model recognizes objects even if no mask is worn, and if the distance set by threshold value is not maintained.

Algorithms Used:

YOLOV3 for object detection: Person detection was performed using the Yolov3 model. In YoloV3 model, total there are 106 layers of fully connectd deep Convolutional networks in Darknet 53 model, including 53 layers for feature extraction and 53 layers for detection, giving a total of 106 layers.

DSFD for Face Detection : Face detection algorithms such as Haar Cascades, Dlib, MTCNN, and DNN typically offer less accuracy than Dual Shot Face Detector (DSFD).

DBSCAN for Distance Calculation : DBSCAN clusters points based on density and distance by measuring their proximity. Monitoring distance between humans are calculated by using DBSCAN clustering algorithm.

4. IMPLEMENTATION

The implementation section will explains the some of the important steps to execute. These steps are given below shown in figure.

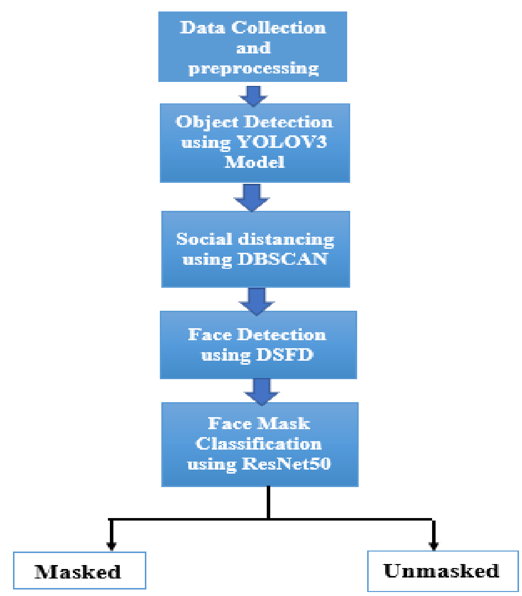

Figure 4.1: Implementation of our proposed model

Step 1: Data Collection and preprocessing
In any kind of model, the dataset collection is important. We have collected image data with mask and with out mask. The dataset is having mask and unmasked faces. The sample diagram of data is shown in figure4.2.

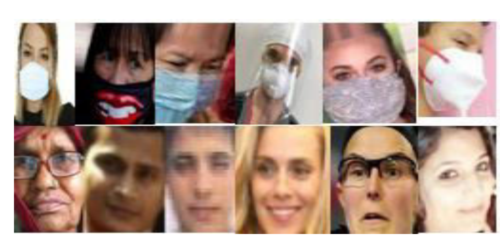

Figure 4.2 : Mask and unmasked dataset

Data augmentation is done by taking pictures of people without masks. In the first step of data augmentation is to apply blurring effects to the faces. A second step of data augmentation involves applying different types of masks to the data we have received from the first step To create the Augmented Dataset, greyscale and Gaussian blur are used to preprocess the images. We prepare data in 2 folders (with and without mask). Once the data is preprocessed, proposed models are applied. Next, testing was performed on the video data.

Step 2: Object Detection

By using the powerful YOLOV3 algorithm, object detection in images or videos has been performed. This is a real-time object detection technology using Convolutional Neural Networks (CNNs). Input images can be processed as structured data categories in a CNN system, which can identify patterns between them. Faster speeds and higher accuracy make Yolo an advantage over other networks. The video is divided into 26 frames and the person is extracted from each frame.

Step 3: Social distancing using DBSCAN

In order to determine whether or not the social distance has been maintained between the detected individuals, the DBSCAN algorithm was used. A number of closely related points are gathered together in the algorithm. A DBSCAN algorithm does not require the number of clusters to be adjusted ahead of time. Moreover, when creating clusters it ignores noisy data.

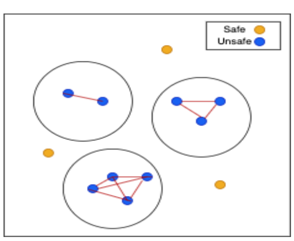

Figure 4.3 : Social distancing

Step 4: Face Detection using DSFD

Facial recognition and image processing are among the applications that require face detection. Because faces in real-world images are highly variable in scale, pose, occlusion, expression, appearance, and lighting, it is difficult to create a realistic face subtraction pipeline. In this proposed model a dual shot face detector (DSFD) is used. With its inheriting Feature Enhancement Module (FEM), SSD can be extended to a dual shot detector by transferring the original feature maps.

Step 5: Face Mask Classification using ResNet50

By using a ResNet50 pretrained model, we finally recognized who is safe and who is unsafe by separating masked and unmasked faces.

5. Results

The results obtained by using YoloV3 ,DBSCAN and DFSD models has been shown in Figures 5.1 to 5.4.The model has been trained and tested on video which is shown in figure 5.1.

```
In [15]: # Train the Model

         mask_classifier.fit(x=Train_Data_Generator,
                             steps_per_epoch=(Train_Data_Generator.n//mini_batch_size),
                             epochs=n_epochs)

         Epoch 1/5
         335/335 [==============================] - 2977s 9s/step - loss: 0.1274 - accuracy: 0.9489
         Epoch 2/5
         335/335 [==============================] - 2954s 9s/step - loss: 0.0442 - accuracy: 0.9827
         Epoch 3/5
         335/335 [==============================] - 2979s 9s/step - loss: 0.0409 - accuracy: 0.9830
         Epoch 4/5
         335/335 [==============================] - 2989s 9s/step - loss: 0.0361 - accuracy: 0.9844
         Epoch 5/5
         335/335 [==============================] - 2958s 9s/step - loss: 0.0337 - accuracy: 0.9848

Out[15]: <keras.callbacks.History at 0x182820612d0>
```

Figure 5.1: Model training

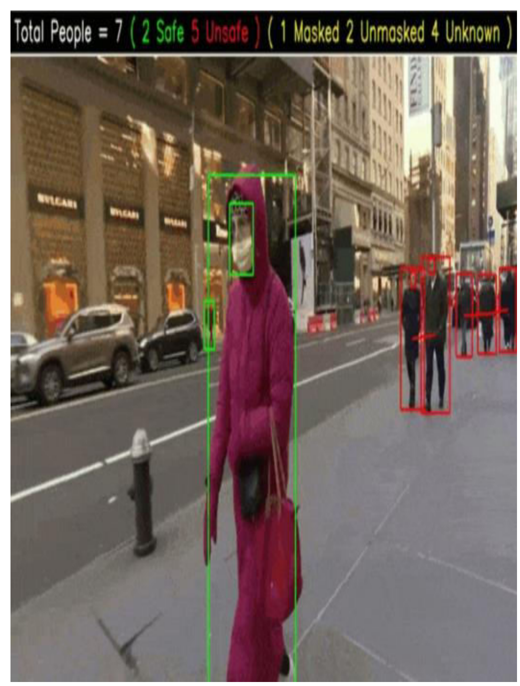

Figure 5.2: Face mask detected Sucessfully

In figure 5.2,we can observe that ,the detection of persons were identified by using YOLOV3 algorithm, the face has been identified with mask and without mask with labels and their count also displayed by using DSFD face detection algorithm. Those people are maintaining distance labeled as safe and not maintaining distance has been labeled as Unsafe.

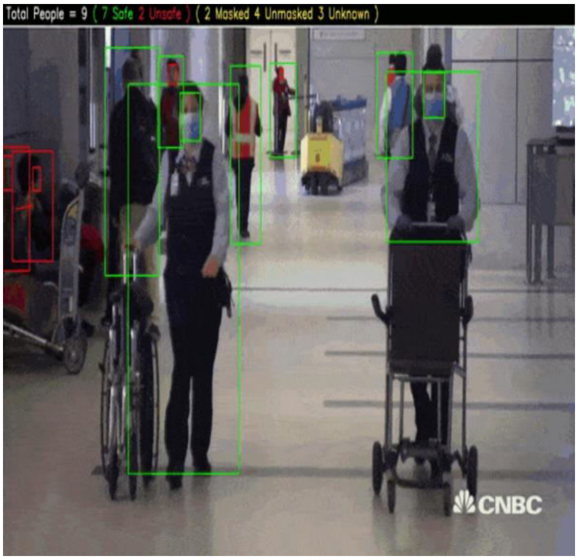

Figure 5.3: Detection of face mask with safe and unsafe labels.

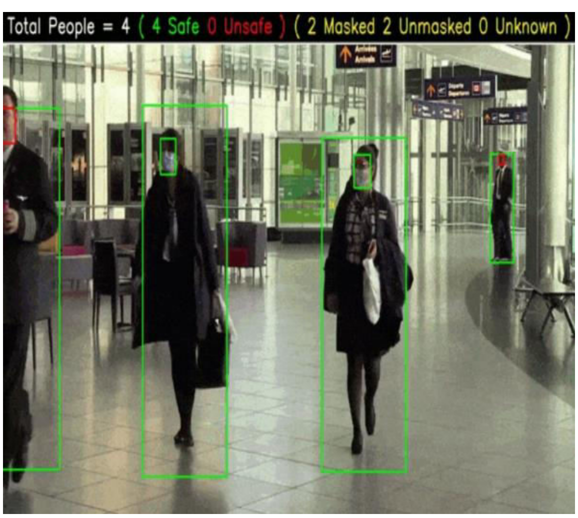

Figure 5.4:Detection of face mask and distance between people .

By using our proposed model, we got good accuracy of 98% ,hyper parameter tuning has been done for better results.

6. CONCLUSION

Face masks and social separation between people have been successfully recognised using the proposed methodology. Our work has been divided into two sections. In the first phase, data augmentation was used to preprocess the data, and the humans were recognised using the YOLOV3 algorithm. Face detection with or without mask was detected and labels were assigned in the second phase using DSFD. The next step was to execute social distancing by clustering the data and determining a threshold value. In the future, we'll use different algorithms and train additional data.

REFERENCES

[1] Safa Teboulbi, Seifeddine Messaoud, Mohamed Ali Hajjaji, Abdellatif Mtibaa, "Real-Time Implementation of AI-Based Face Mask Detection and Social Distancing Measuring System for COVID-19 Prevention", Scientific Programming, vol. 2021, Article ID 8340779, 21 pages, 2021. https://doi.org/10.1155/2021/8340779.

[2] Sethi S, Kathuria M, Kaushik T. Face mask detection using deep learning: An approach to reduce risk of Coronavirus spread. J Biomed Inform. 2021;120:103848. doi:10.1016/j.jbi.2021.103848

[3] Nagrath P, Jain R, Madan A, Arora R, Kataria P, Hemanth J. SSDMNV2: A real time DNN-based face mask detection system using single shot multibox detector and MobileNetV2 [published correction appears in Sustain Cities Soc. 2021 Aug;71:102964]. *Sustain Cities Soc*. 2021;66:102692. doi:10.1016/j.scs.2020.102692

[4] Sikakulya FK, Ssebuufu R, Mambo SB, Pius T, Kabanyoro A, Kamahoro E, et al. (2021) Use of face masks to limit the spread of the COVID-19 among western Ugandans: Knowledge, attitude and practices. PLoS ONE 16(3): e0248706. https://doi.org/10.1371/journal.pone.0248706.

[5] Keniya, Rinkal and Mehendale, Ninad and Mehendale, Ninad, Real-Time Social Distancing Detector Using Socialdistancingnet-19 Deep Learning Network (August 7, 2020). Available at SSRN: https://ssrn.com/abstract=3669311 or http://dx.doi.org/10.2139/ssrn.3669311.

[6] J. Li *et al.*, "DSFD: Dual Shot Face Detector," *2019 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2019, pp. 5055-5064, doi: 10.1109/CVPR.2019.00520.

[7] Elbarawy, Yomna & Mohamed, Ramadan & Ghali, Neveen. (2014). Improving social network community detection using DBSCAN algorithm. 2014 World Symposium on Computer Applications and Research, WSCAR 2014. 10.1109/WSCAR.2014.6916792.

[8] Meng'Ao, Li & Dongxue, Meng & Songyuan, Gu & Shufen, Liu. (2015). Research and Improvement of DBSCAN Cluster Algorithm. 537-540. 10.1109/ITME.2015.100.

[9] Prusty, Manas & Tripathi, Vaibhav & Dubey, Anmol. (2021). A novel data augmentation approach for mask detection using deep transfer learning. Intelligence-Based Medicine. 5. 100037. 10.1016/j.ibmed.2021.100037.

[10] Varsha E Dahiphale, Satyanarayana R, A Real-Time Computer Vision System for Continuous Face Detection and Tracking, IJCA, Volume 12 Number 18, July 2015

[11] Lippert, Prof & Bergner, Benjamin & Ahmed, Akhyar & Ali, Raza & Adeel, Saniya & Shahriar, Md Hasan & Mojumder, Md. (2020). Face Mask Detector. 10.13140/RG.2.2.32147.50725.