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Face Mask Detection in Real Time Based Single Shot Detector Algorithm

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Abstract — Machine learning, the future technology is destined to provide ease of living with its applications spread in all aspects of our day-to-day life. A part of machine learning is Image Processing, another growing field in which images and videos are used to provide information.Use of Image Processing is widespread and one of its applications is for security purposes. Image Processing not only reduces human interference in video surveillance but also provides a more accurate system.This paper is prepared to present the implementation of SSD Mobilenets[14] algorithms and models used in it for carrying out the task of detection and tracking of people whoare wearing masks or not in a public area.

Keywords — Object detection, Object tracking, CNN,Single Shot Detector,SSD-Mobilenets.

1. INTRODUCTION

The job of detecting the physical movement of an object in a certain region or area is known as moving object detection.
Due to its wide variety of applications, such as video surveillance, human motion analysis, robot navigation, event detection, anomaly detection, video conferencing, traffic analysis, and security, moving object detection has gotten a lot of attention in recent years.
During the current epidemic, the government and private groups aim to ensure that everyone working or visiting a public or private location is wearing masks at all times. Deploying human resources for monitoring the same is not possible at all locations. So having a program to do that and thus, having the automated system will save human resources and interaction between

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them.The System will consider frames extracted from a live video feed and thus recognize people without masks sending an alert to the operative as well as the person without mask.

2. RELATED WORK

Faster RCNN and YOLO[15]:

To achieve detection and classification accuracy on datasets , fast RCNN uses 16 architectures in convolution layers [15]. There is a limitation in Faster R-CNN that it has a complicated training procedure and sluggish processing speed.

YOLO V3 is an object detector that detects things inreal time using characteristics learnt by a deepconvolutional neural network[15]. It has 75convolutional layers and up-sampling layers, and itskips connections for the whole picture. The pictureis divided into regions. Later, bounding boxes withprobabilities are presented. The most notable feature of YOLO V3[15] is that it can do detections at three different scales. However, in YOLO v3, speedhas been sacrificed in exchange for increasedaccuracy and it also struggles in detection of small objects that appear in groups.

3. EXISTING SYSTEM

1. *COVID-19: Face Mask Detector with OpenCV, Keras/TensorFlow, and Deep Learning-*

The COVID-19 mask detector has the potential to assure yours and others' safety if deployed appropriately (but that is up to medical experts to determine, implement, and disseminate in the wild).

Face mask dataset is used in this system. Keras and TensorFlow were used to create a classifier that can detect whether or not a person is wearing a mask automatically.

MobileNetV2, a very effective design that can be deployed to embedded devices with low processing resources, was utilised to complete this challenge.

2. *Face Mask Detection System using Artificial Intelligence-*

The Face Mask Detection Platform uses anArtificial Network to determine whether or not a user is wearing a mask. The software may be attached to any existing or new IP mask detectioncameras to detect people who aren't wearing a mask.

Users of the app may also add faces and phone numbers to get notifications if they are not wearing a mask. A notification can be issued to the administrator if the camera records an unidentified face.

Users could see who doesn't wear a mask and examine the pictures or video shot by the camera on a user-friendly website. Users may also build reports that can be downloaded and used with third-partysoftware.

If the face mask detector app detects that a user isnot wearing a mask, the app will notify the user. AI notifications are given along with a photo of the individual.

It enables the programme to operate in the background and enforces the use of the mask.

4. PROPOSED SYSTEM

A. Dataset:

The dataset to be used here is a custom dataset. There are numerous tags in SSD Mobilenets[14]

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model by which it can categorize an image with different tags, but focusing towards our problem statement, we have used custom tags i.e. Masked and Unmasked in this model. This custom dataset contains XML files for each image specifying these tags. There are almost twoto three thousand images of both masked and unmasked people which will be used to train the modelfor Facemask detection.

Sample Images:

1)Masked

Fig.1 Sample from with_mask dataset

2)Unmasked

Fig.2 Sample from without_mask dataset

B. *Preprocessing:*

The first step here is to gather images for creation of our custom dataset. We have around 500 images for each tag. After gathering the images the first step is to identify the tags in the images. The identification of tags includes manually. Once the tags are defined, the next step is converting all the image and tag data into csv format. This helps us in creating a .record file which is later used during the training phase.

Another file to be created is the table map file which the model uses to identify the different classes in our model. All these files contribute to the creation of our custom model.

Once these files are ready we can train the model. For this the first step is to load the records files for training data and the label map.

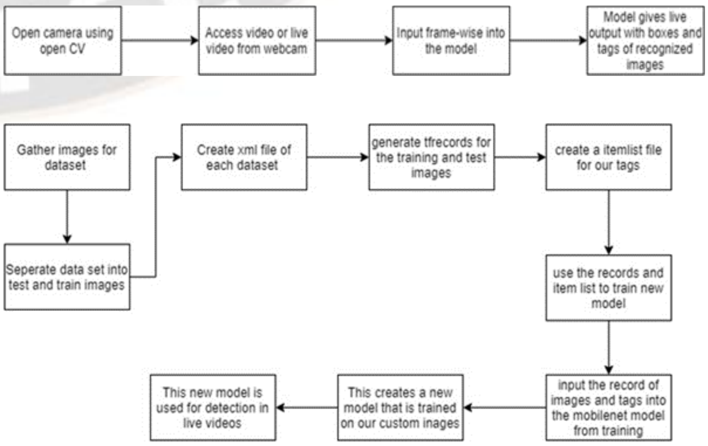

Fig.3 Preprocessing and Training Flowchart

C. Model FaceMask Detection:

SSD MobilenetV2 is a face mask detection model based on OpenCV and TensorFlow deep neural network components. This package includes aSingle Shot Multibox Detector object detection model. [14]. Classification architectures, such asResNet-10, were employed as the backendarchitecture for this model and classifier is an improvement over theMobileNetV1 architecture classifier since it has 3x3convolutional layers as the first laver.which isfollowed bv an average layerof max pooling, and a layer of classification.The residual connection is an upgrade in the MobileNetV2 classifier[14].

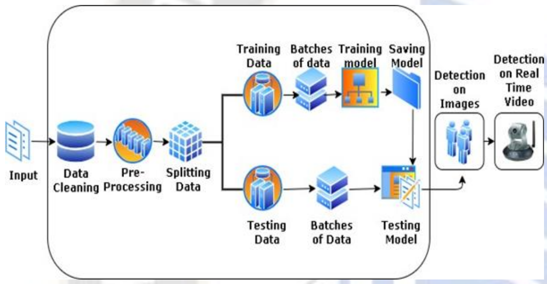

Fig.4 Proposed System

Fig.5 Execution Phase

5. RESULTS

The model's output will be whether the individual in thevideo is wearing the mask or not, as well as the model'saccuracy.

Overtime as the Iterations increase and and after particularnumber of epochs the loss stabilizes at a certain number ofepochs.

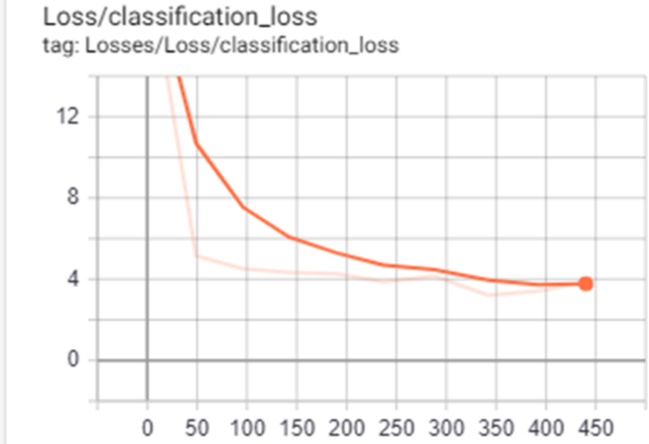

Fig.6 Classification Loss

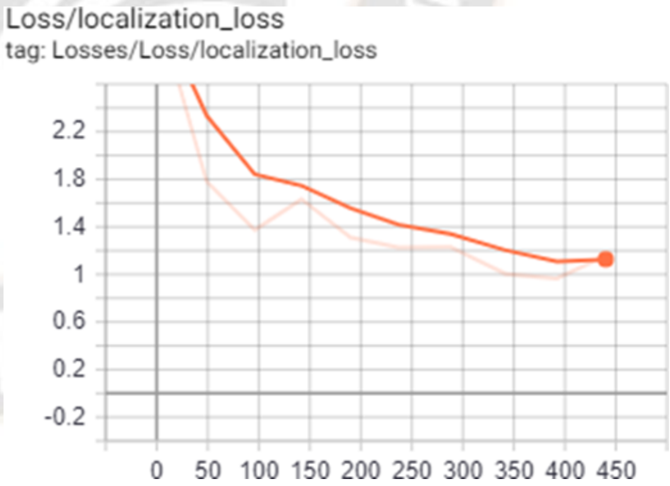

Figure 7: Localization Loss

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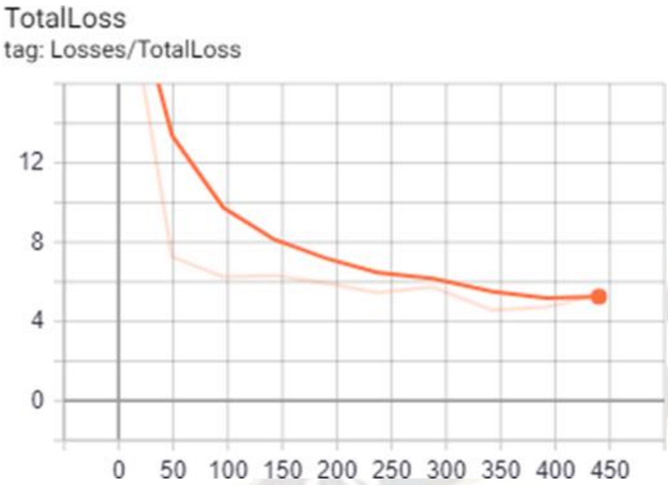

Figure.8: Total Loss

Implementation Results:

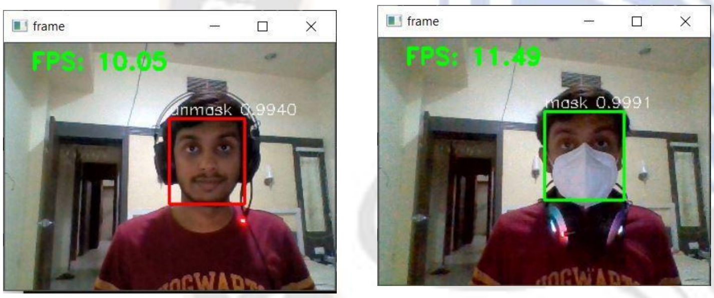

Fig.9 Single Face Mask Detection

Fig.10 Multi-Face Mask Detection

1. The model is detecting and analyzing the videoframe, as well as showing green or red box on the face of person wearing a mask or not respectively, with accuracy more than 95%
2. In environment having more light the accuracy may suffer a bit, the accuracy may range from 90-95% in those cases
3. If the environmental condition and system requirements are up to recommended needs then the fps shown by the model ranges between 15 to 25 fps, if environmental and system requirements are not up to the needs then fps may lag a bit by 5 or 10 frames, ranging from 10 to 20 fps.
4. As you can see it efficiently recognizes single as well as multiple faces in a single frame.

6. LIMITATIONS

For our proposed model we have taken a dataset with limited images, in which for detection it will consider only the first few frames. For detection, the model will consider videos which will detect the face and othervideos will be excluded. For our model parallel processing is used for training purposes, so the proper GPU will be required. For video processing, high processing power computers will be required to detect masked or not on a large amount of dataset.

Also this system at current scale can be implemented only in private areas like cubicles, hospitals, etc.However, this system does not give back an alert to the user about the person not wearing a mask but rather highlights the person not wearing a mask in a videoframe on that given time.

At the current stage this system only gives the detection of masked and unmasked people; an alerting module can be implemented in upcoming versions.

7. APPLICATION

- This proposed system can be used to detect

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masked and unmasked people in small scale areas like hospitals, pharmacies, supermarkets,etc.

- It can be used in Small-scale Industries, where there are many people working under minimum supervision

8. CONCLUSION

Thus, in the proposed model named Face mask Detection model, training is performed on the dataset which is split into with mask and without mask.This dataset was created manually to achieve better results. The model was generated using OpenCV and images are classified using MobilenetV2.
We were successfully able to achieve significant results with the SSD[7] MobilenetV2 model as mentioned above, where the proposed model detects multiple faces in a single video frame and classifies those with orwithout masks.

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