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FACE MASK DETECTION SYSTEM USING DEEP LEARNING

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ABSTRACT

The pandemic of corona virus is still extending worldwide. It affecting every possible sector due to which economy of many countries drastically decreased and still decreasing. According to WHO (World Health Organization) we can reduce the impact of Covid-19 by simply wearing the face mask. So, in this project we proposed a model which will control the growth of corona virus by detecting the persons in public places like offices, shopping malls, schools etc. These places will be under the surveillance of CCTV (Closed circuit television cameras). The system will generate the warning sound as it detects the person with no masks and also for situation like if someone is violating the rule of social distancing. A deep learning module is train with dataset of large amounts of images of Masked & Non-masked faces. The module also contains many confusing so as to get accuracy better. This model is built by using computer vision libraries in Python.

1. Introduction

Facial mask detection is one of the most important area in today's pandemic situation. Detecting facial mask, identifying person with mask and without mask, face cover.

World is going through Covid-19 pandemic & in this situation wearing mask to protect others and ourselves from this virus and to stop spreading of virus is indeed.

By the fast improvement and changing technology, facial mask detection is possible. Deep learning has various vision areas such as object detection, object classification, face detection etc. Deep learning algorithm do not require manual design. By training images using CONVOLUTION NEURAL NETWORK(CNN) is very widely popular method.

CNN successively apply filters and leads to create the train data set which help to save time and human resources. Data set with huge data/images can be easily trained using CNN which is not possible manually. The key feature of face mask detection that we can help various organization and countries to detect people violating rules and regulation. By using computer vision like face mask detection, we can help our society and maintain social health. Facial recognition is now using for security purpose.

There are many techniques like fingerprint sensor, voice (recognition) sensor for security purpose. But Facial Recognition is full proof technique for identification

of person. Face detection is one of the techniques of Facial Feature Recognition. Face detection is to locate the facial area in the image and to extract features so as to recognize face. We can use face recognition techniques to extract these features from the image. In applications like image database management, video surveillance, face recognition, the first step is human face localization and detection. Though it is assumed that normalized face image is available locating and tracking human

face is a precondition for face recognition or facial expression analysis. Following are steps for locating human face - "by using capture an image, use frame grabber for processing of the image, use the features from searched image to determine the location of the image. "Knowledge based, image based and feature based are three categories of technique for face detection.

Machine learning is developing at a rapid speed, but the face detection yet to address well. For example, by using cascaded Convolutional Neural Networks face detector achieves an average precision of 98.0% on the public image benchmark AFW. Speed of some face detectors can reach up to 35 FPS even it can be 400 FPS.

Many face detectors got great success, so they have been integrated into application to facilitate auto-focusing, human computer interaction and image database management.

As the success of existing work, it is more and more difficult now to develop better face detector. The detection of masked faces can be very helpful for applications like video surveillance and event analysis is challenging task for many existing models. Masked faces may have different orientations, degrees of occlusion and diversified types of masks. Making accurate detection of masked faces a really challenging task even for the state-of-the-art face detectors. As the classic task of normal face detection, models often have a sharp performance drop in detecting masked faces. That can be mainly caused by two reasons, first reason is there lacks a large dataset with massive masked faces for exploring the key attributes that is shared by various masked faces and identifying the models with the state of the-art performance.

Second reason is facial features from the occluded parts are no longer available in the detection process as the existence of masks inevitably bring in certain kinds of noise. With insufficient training and testing data and inaccurate features, masked face detection has been becoming a widely recognized challenging task in face detection. It is still necessary to construct large datasets and develop effective and efficient models for masked face detection.

To detect face mask dataset which is denoted as MAFA is created. The dataset consists of 30,811 internet images, in which 35,806 masked human faces are manually annotated. Annotation process ensure that each image contains at least one face occluded by various types of masks. The six main attributes of each masked face, including locations of faces, eyes and masks, face orientation, occlusion degree and mask type, are manually annotated and cross-checked by nine subjects.

Main characteristics of masked faces in MAFA is that most facial attributes can be lost in heavily occluded faces, while the highly diversified masks can bring in various types of noises. We propose LLE-CNNs for masked face detection, because of that recovery of missing facial cues and suppressing non-facial cues in the feature subspace. Proposed approach consists of proposal module, embedding module and a verification module. Proposal module first extracts a set of face proposals and then they characterize each proposal with a 4096d descriptor with a pre-trained VGG-Face model. The descriptor of a masked face can be incomplete or noisy, further embedded it into a feature subspace formed by two dictionaries that consist of the descriptors from representative normal faces and non-faces. Dictionaries are learned from a large pool of normal faces, masked faces and non-faces from previous datasets and the training set of MAFA. So, this similarity-based descriptor is fed into the Verification module that consists of a Deep Neural Networks with only Fully-Connected layers so as to identify the real faces.

Main contributions of this paper are -

1. The dataset that we present have masked faces which can be used as additional training source for developing new face detectors.
2. For masked face detection we propose LLE-CNNs which outperforms 6 state-of-the-art face detectors in detecting masked faces.
3. We have done comprehensive analysis on the challenges in masked face detection, which can be helpful for developing new face detection in future.

1.1 Related Work

To detect whether the person is wearing the mask or not, for that we have to extract the facial features of person's face. There are lots of work done on face detection, but the good accuracy is the problem. To detect human face there is lot of problem for us like lightning position of face expressions.

The two major technique to detect the faces of a person are feature-based and image-based.

In the paper “Detecting Masked Faces in the Wild with LLE-CNN”, Shiming Ge, Jia Li, Qiting Ye, Zhao Luo created large data set which they named MAFA (Masked Faces) which contained many masked and non-masked face images by many degree such as “Left , Left Front , Front,Right, Front,Right”. They define four categories of masks that can be frequently found in Internet images, including: Simple Mask (man-made objects with pure colour), Complex Mask (man-made objects with complex textures or logos), Human Body (face covered by hand, hair, etc.) and Hybrid Mask (combinations of at least two of the aforementioned mask types, or one of the aforementioned mask type with eyes occluded by glasses).They proposed LLE-CNNs technique, which consists of three modules Proposal module, Embedding module and Verification module”. The proposal module extracts face proposals and characterize them with noisy descriptors. After that, the embedding module transfers the noisy descriptors into similarity-based vectors by embedding the proposals into the feature subspace formed by representative normal faces and non-faces. Finally, the verification module jointly performs regression and classification tasks so as to refine the location and scale of a proposal and identify whether it is a real face. They also have done experiment on existing face detection models that can be roughly grouped into three categories, in which models are based on boosting, Deformable Part Model (DPM) [6] and Convolutional Neural Network (CNN). From these 3 categories they selected “SURF and NPD from Boosting based category”,” ZR, HH, HPM from Deformable Part Model (DPM)” and “MT from CNN based detector”. After this experiment the noticed that from among above techniques, the overall performance of MT is very impressive compared with other approaches. But the frame rate of MTCNN is low about 1.4FPS.

In another paper "Rapid Object Detection using a Boosted Cascade of Simple Features", Paul Viola and Michael Jones suggest a machine learning approach for object detection technique which pre-process images very quickly and uses " Integral Image" allowing us to extract feature which we required for detection. It also uses a method that combines more complex classifiers in "cascade" to remove background from the image more quickly and more computational power can be used in object detection. Viola and Jones used Haar-like features to detect faces in this algorithm, although this algorithm is fast and pretty accurate this method fails to tackle real-world problems like non-frontal image, face position, expressions, orientation, accessories wearable on face which can influence results and some people can use this to fail the accuracy of our system.

Many Face recognition algorithms are available to keeping track of a single person like Facenet, YOLO, BlazeFace, and OpenCV which very helpful for constantly monitoring the same person for how often he removes mask and violet the laws. The model is an integration of deep learning and conventional machine learning techniques using OpenCV, tensor flow and Keras. We used a deep learning methodology for feature extraction and combined it with the Convolutional Neural Network (CNN) algorithm

2.Methodology:-

2.1 Creating dataset: while creating dataset we have included around 25000 masked and non-masked images. The images are collected from internet. The images were collected with different facial expression, position. we also included images with different position of mask. We had created 2 classes of images i.e. Mask wearing faces and non-mask wearing faces. All images are in jpg format and of good resolution. Furthermore, we have split the images in the ratio of 8:2 i.e. 80% images were in used in the training set and 20% images were used in testing set of total dataset images.

2.2 Training model: While training the model we use various libraries. We used TensorFlow and keras libraries. We used sequential model which is pre-trained model. Sequential model is pretrained model which keep adding layers of cnn. We also used opencv library for training the model. While, training the model the epoches were prepared to gain the greater precision. if first epoch produces the greater accuracy then that epoch produce model. Furthermore, if next epoch produces greater accuracy than the

first then next number model is created. If accuracy is high which indicate model is well trained. Now these images will be use in a training process. once the training process is completed 4-5 models with good accuracy will be generated. This 4-5 models are created during train epochs. Every time we train the images different model numbers will be considered as good accuracy model as compare to remaining other.

2.3 Testing model: Among the 4-5 good accuracy model generated you have to select manually only one model for the test set. in the testing set we used "haarcascade_frontal_default.xml" file which contains many different values for purpose of detecting the face. When the camera starts with the help of xml file, we can detect the facial region in the video or image. Now this intermediate result will be compared with the model which we have selected manually after comparison it will show whether the face in video is masked or non-masked. If it seems face is non-masked the system will show message non-masked and will generate the alarming sound. Also, if more than one face comes in the specific region of camera it will generate the alarming sound as they are violating rule of social distancing. This system is specially trained for detecting the mask. So, if the face is covered with any other thing than the mask, then it will not be considered as a mask although that specific face region is covered (lower part of nose, chin, lips). Here we have trained the model with tremendous amount of face images dataset of tremendous amount of face images so as to get best accuracy.

Output :-

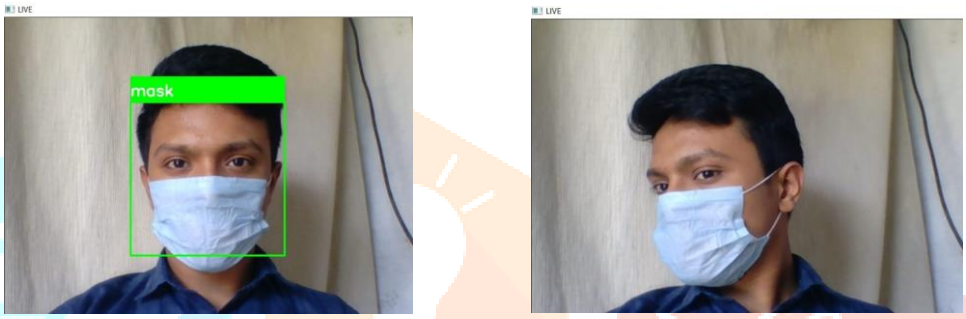

Fig 1. Output after training of old dataset (8000 images)

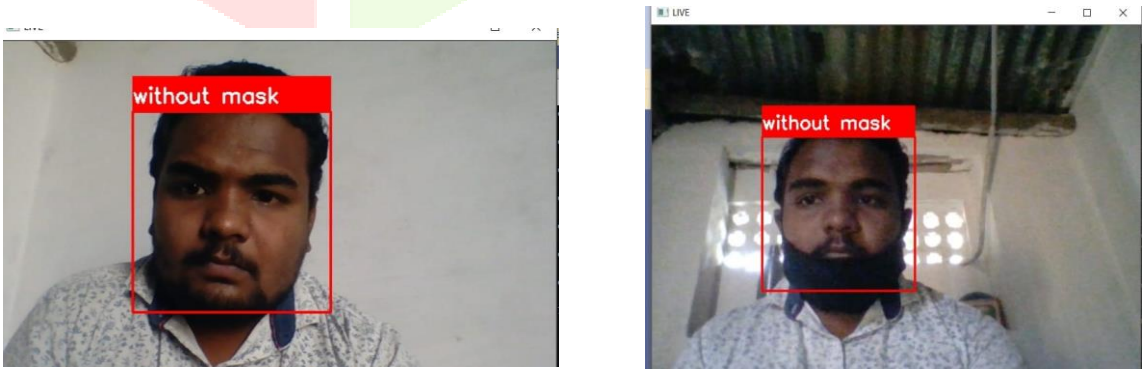

Fig 2(a). Output after training of new dataset(30000 images)

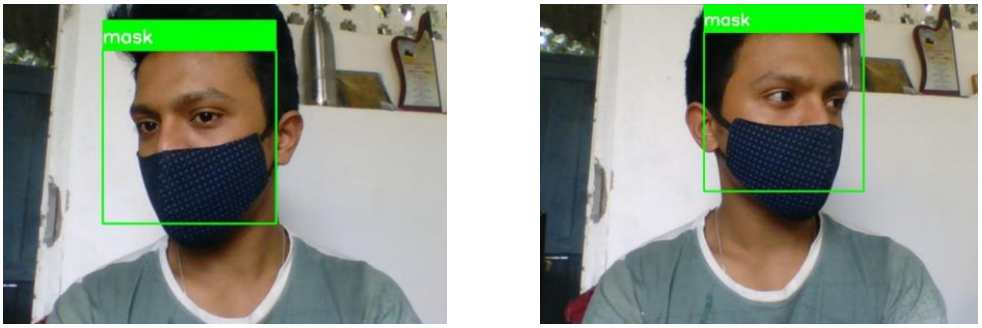

Fig 2(b). output after training of new dataset (30000 images)

3. Conclusion

In this paper, we researched method of face mask detection and compared with other methods, it was providing better result and accurate.

we used cnn model for training the model. While testing we used haarcascade classifier. We used around 24000 images for model training and 5000 images for model testing in our dataset which consist of images with various position, angles. As a result it provides best result while detecting face mask. The proposed system can detect masked faces at different position, different angles and more consitant.

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