DETECTION OF FACE MASK AND SOCIAL DISTANCING BY USING MACHINE LEARNING ALGORITHM

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Abstract: In this ongoing crisis, it's a necessity for wearing a face mask and maintain social distance. This paper provides the literature assessment on Face-Mask and Social Distancing. The successive part deals with the proposed YOLO and CNN machine learning algorithms. According to the World Health Organization guidelines, every individual should accompany proper social distancing, and wear a face mask. These safety protocols will be worthy for endeavor against the present pandemic. The proposed technical study can help keep track of the social distance and detect unmasked individuals. This paper uses machine and deep learning algorithms like YOLOv3 (You Only Look Once, version 3) and CNN (convolutional neural network) algorithms. This paper uses a CNN algorithmic rule that takes an input image for recognition, pre-processes the image, classifies the image, and detects faces. The pre-processing is essential in a CNN is slightly lesser than as compared to different classification algorithms of machine learning. The YOLO algorithmic rule is popular for the Detection of an Object and Tracking of an Object. In this paper, the YOLOv3 algorithmic rule is employed to calculate the distance between every individual. The proposed technical study in this paper deals with the technology which will pass a voice instruction to those who are not following any of the safety guidelines for the current scenario.

Index Terms **- YOLO (You Simply Look Once), CNN (Convolutional Neural Network), COVID-19, Face-Mask, Social Distancing, Machine Learning.**

I. INTRODUCTION

With the present-day outburst and lively transmission of the COVID-19 infectious disease, it necessitates for every individual should pay attention to sustain social distancing norms and wear a face mask to lessen the widespread transmission of novel coronavirus. Every individual should follow appropriate social distancing. Each individual at public gatherings must requisite to have at least a 3feet or 1meter distance between each other to bring down the contiguity pass of infection [1]. And in addition, wearing a face mask brings to a halt the conveyance of infection spread by airborne droplets in the surrounding [20]. However, keeping in continuance on these guidelines is not too simple. Consciously or unconsciously, many people gather together in public places without following the guidelines. Hence to set an eye on these activities isn't an effortless duty. This paper can help keep track of the social distance and detect unmasked individuals. So the performance of many algorithms related to faces and social distancing is challenged. Therefore, this paper works with algorithms like YOLO-v3 (You Only Look Once, Version 3) real-time detection of an object that points out particular objects in videos, live feeds, or images [4]. Object classification systems are utilized by Artificial Intelligence face portrait and greyscale image, and train the CNN to extract options for classification.

- **PROPOSED WORK OBJECTIVE**

Due to Covid-19 disease, the proposed work in this paper can assist every individual with proposed work principles. The proposed technical study deals with the objectives such as maintaining Covid-19 guidelines, distinguishing unmasked and masked persons, calculating the distance among each person, and correspondingly displaying the notification for sanitizing. These important objectives are targeted to control COVID 19 to some extent.

- **MOTIVATION OF WORK**

Day by day there is adding up of COVID-19 cases[19] and additionally, there is also a rise in the range of COVID-19 tests which provides a lot of information regarding the epidemic unfold, which can cause the chance of surrounding it to prevent additional infections [21]. Therefore, following the guidelines and taking care is the prior duty of each individual. It's determined that several individuals don't follow the guidelines in many public places. Therefore, to overcome such issues the study in this paper is intended to detect people who are unmasked and even calculate the distance between every individual to maintain social distance rule for safety measures. The proposed work also deals with the additional task of notification of sanitizing hands.

II. RELATED WORK

Sr. No.	Title of Paper and Year	Methodology	Findings
1.	Face Mask Detection System- 2020 [5]	OpenCV, MobileNetV2	It defines architecture in two phases and the face mask detection is done in video streams by using some deep learning methods to get proper accuracy [5].
2.	MASK R-CNN for Pedestrian Crosswalk Detection and Instance Segmentation.- 2020 [8]	R-CNN (faster CNN technique)	Two-stage process, the first stage is (RPN) Region Proposal Network, and the second stage is similar to the prediction of class and box offset, each region of interest (RoI) is given a binary mask by Mask R-CNN [8].
3.	Social Distancing Detection with Deep Learning Model.- 2020 [12]	Deep YOLO method and computer vision techniques [12]	The distance between people can be estimated and any non-compliant pair of people will be indicated with a red frame and a red line. The proposed method was validated using a video showing pedestrians walking on a street [12].
4.	SD-Measure: A Social Distancing Detector. – 2020 [10]	Mask R-CNN	Person Detection for detecting social distancing from video footage is proposed [10].
5.	An Edge-Based Social Distancing Detection Service to Mitigate COVID-19 Propagation. 2021 [13]	GPS tracking	Three steps: a) The collection of all the GPS coordinates of users [13]. b) The computation of the distance between users, on a pair-by-pair basis [13]. c) The detection of users not respecting the distance threshold, and the warning message generation [13].

Table-1. Summary of related work

R. Sachdeva, Sonam, H. Sharma [5] have presented a method for remembrance of face masks by using Tensor-flow, Keras, OpenCV, and MobileNetV2 [5]. Here functioning is done in two phases of architecture in which, the first is the train to face mask detector using datasets for converting it into serialize classifier and another phase is to load classifier then detecting image through video then extract face and lastly apply the classifier to display output.[5]

M. A. Malbog [8] has come up with object detection for Pedestrian crosswalks by using Mask Region-Based Convolutional Neural Network (Mask R-CNN) and instance segmentation. For these 500 Pedestrian crosswalks, images were used for validation and training in which 80% images were used for the training set, and the remaining 20% images were used for the validation set [8].

Y. C. Hou, M. Z. Baharuddin, S. Yussof, and S. Dzulkifly [12] has put forward detection of social distancing by using Deep learning methods to evaluate the distance between people through a pre-recorded video feed. For object detection pre-trained model is based on the YOLOv3 algorithm which is used to employ pedestrian detection [12].

S. Gupta, R. Kapil, G. Kanahasabai, S. S. Joshi, A. S. Joshi [10] has proposed detecting social distancing from video footage. The Mask R-CNN deep learning algorithm is used for the detection of the objects. To have excessive correctness in value co-occurrence with a small false alarm rate when tested on Custom Video Footage Dataset (CVFD) and Custom Personal Images Dataset (CPID) for finding out whether or not social distancing limitations were practiced or not [10].

A. Ksentini, B. Brik [13] has brought forward a merge of IoT and multi-access edge computing (MEC) technologies that verify and warn people in near real-time if they are not maintaining social distancing. Here at the client-side, the application is installed on the users' smartphone, which periodically sends GPS coordinates to remote servers including the edge of the network (i.e., at MEC). The remote servers use a local algorithm for detection and give warnings to users who are not maintaining social distancing.

III. PROBLEM STATEMENT

The purpose of this technical study is to raise awareness among people about the safety measures that should be taken due to the COVID-19 pandemic. Instead of using economically higher or using higher methods and techniques which would hard to understand the normal users, hence the proposed study in this paper has made the working process very smooth where CNN and YOLOv3 algorithms play an important role in it.

IV. PROPOSED SYSTEM

This paper utilizes algorithms like- the CNN algorithm which is mainly used for Face-Mask detection, and the YOLOv3 algorithm is mainly used for calculating the social distance between every individual. The working of the module is described in the paper which has been divided into a few sub-modules such as the Admin Module, Pre-processing Module, Segmentation Module, Feature Extraction Module, CNN Module, Classify Dataset Module, and End User.
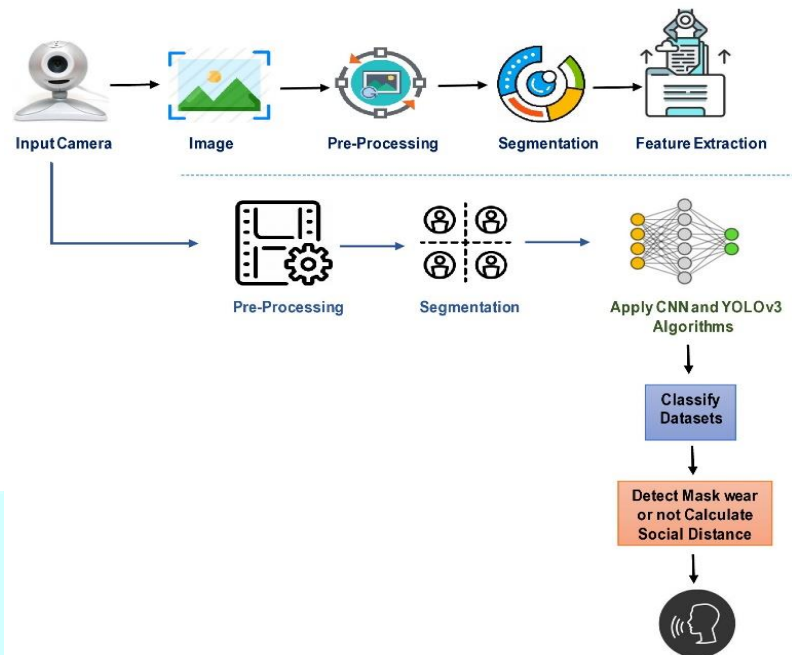

Figure -1: System Architecture

To get more accurate results here splitting technique is used which is the Training and Testing part [8]. From the reference of *Figure -1*, as the camera gets on it will start taking records of video then this video will be going to split into an image. These split images are Pre-Processed for cleaning and organizing image later Segmentation is done on this image in which the image is divided as per object wise then next comes Feature Extraction which performs to remove all unusable objects and take only important objects from the processed image. On this processed image CNN and YOLOv3 algorithms operations are performed to detect whether a person is wearing a mask or not and also calculate social distance. If the person is not wearing a mask and/or if a person is not following social distance the alert voice command is passed from the system.

4.1 Splitting Data:

Here the Splitting data technique is used by having Training and Testing sets which are two different but these both are important in Deep Learning and Machine Learning algorithms. The Training and Testing set has a Pareto ratio of 80:20 or sometimes it may be 70:30 [3] [8]. The Training part has a set of samples (such as a collection of photos or videos). The Training set makes accuracy in the predictions, and to train a model by using a training model means to create or fit a model. The Testing part is a subset to test the trained model or evaluate the fit. The testing set helps to validate the progress of algorithms training and adjust or optimize for improved results.

4.2 Convolutional Neural Network (CNN):

A Convolutional neural network (CNN) also known as ConvNets has one or more sequences of layers that are used mainly for image processing, image classification, segmentation, and image recognition. The CNN is a Feed-Forward artificial network in which the associative pattern between its neurons is motivated by the organization of the **visual cortex [22].** The CNN contains four layers: a convolutional layer, ReLU layer, Pooling layer, and Fully Connected layer [23]. The first layer is Convolutional takes an input image and performs a mathematical operation such as image matrix and kernel or any filter. The second layer is ReLU which separates all negative values from the filtered image and reinitiates them with zero [17]. The third layer is Pooling which is used for pre-processing on any image and Downscaling (decreasing) the number of parameters when images are too large. The pooling is of two types Max and Average Pooling [24]. In Max Pooling, the maximum value from the piece of the image is enclosed by the kernel is returned [17] [24]. On the other side, the Average Pooling comes back with the average of all the values from the piece of the image is enclosed by the kernel. The last or fourth layer is the Fully Connected or Dense layer where input from other layers is lessened into a vector or in short Flattening which transforms the entire pooled feature map matrix into a single column [14].

4.3 YOLOv3 (You Look Only Once Version 3):

More simply, You Look Only Once (YOLO) suggests that just "looking at the object only once" means in the input image it requires only one forward propagation which proceeds through the network for making predictions. It is remarked that YOLO is significant for the detection of real-time objects [14] [18]. It appeals to a one-single forward pass to absolute the image and anticipates bounding boxes and their class possibilities [14]. The characteristics of YOLOv3 are multi-scale detection and a powerful feature extraction network [14] [18]. YOLOv3 has superb speed (as compared to other object detection algorithms) - it's beyond a belief as fast and can process 45 frames per second. YOLOv3 has arisen with superior architecture with feature extractor used was hybrid YOLOv2, Darknet-53 (network trained on ImageNet), and last but not the least is Residual networks (ResNet). The network has 53 convolutional layers (which is named Darknet-53) and is additionally assembled with 53 more layers for detection head, and hence the formation of YOLOv3 is a total of 106 layers fully convolutional underlying architecture [18] [25]. The detection for ultimate results of the output of a fully convolutional network is performed by applying 1x1 detection kernels on a feature map of three non-identical sizes at three non-identical places this process is known to be a Multi-Scale detector. The Multi-Scale detector is used for verifying that small objects are also actually detected.
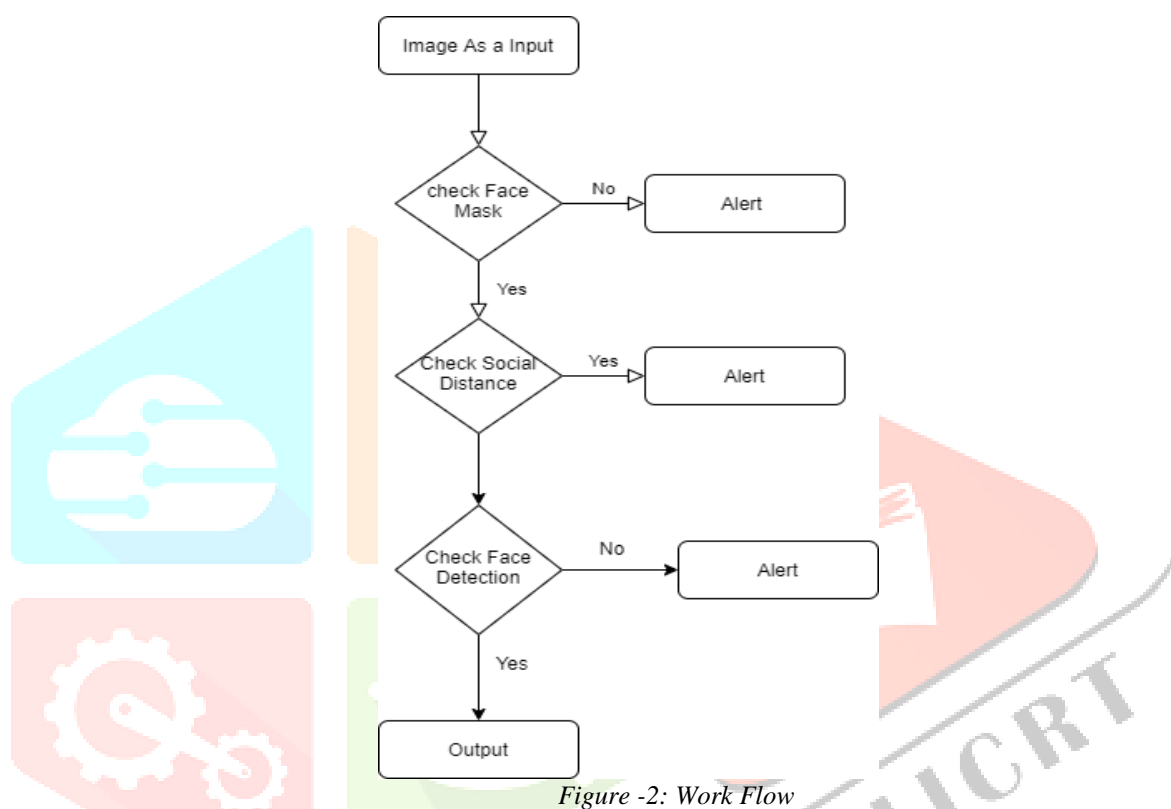

Figure -2: Work Flow

From Figure-2 it is easy to understand the workflow of the title of this paper. The work described in the paper is quite simpler as compared to related work [5] [8] [10] [12] [13]. This paper idea can be affordable by any organization, school, college, etc. The proposed research effort completes the main motive of wearing a Face-Mask and maintaining a Social-Distance.

V. CONCLUSION

The work proposed in this paper deals with measures to control COVID-19 disease. The measures for control are following social distancing, wearing a face mask and other basic sanitary measures are very important to avoid the spread of the Covid-19. Due to the consequences of controlling the COVID-19 pandemic, the application significance of the identification for the real-time face mask and social distancing detection is improving [21]. The proposed work in this paper incorporates the CNN algorithm for Face mask detection and the YOLO v3 algorithm is used for object and social distance detection. Hence, the proposed study in this paper deals with taking care of safety precautions for the COVID-19 pandemic with the proposed machine learning algorithm which is helpful for society.

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