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Identification Method for Face Masks and Social Distancing Infractions

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***Abstract*— One of the biggest humanitarian issues facing the world today is the COVID-19 pandemic. The pandemic has spread rapidly, stopping global travel, and the number of cases is still rising. Governments from all across the world are attempting to contain, if not totally halt, the pandemic's spread. Face masks and social separation are two of the many measures that have been put into place. As the only known methods of avoiding the virus until immunizations are widely available are social separation and mask wearing. Using computer vision and deep learning approaches, real-time mask identification and social distance violation is achieved. We gathered a dataset of with-mask and without-mask labels in order to detect face masks.**

***Index Terms*— Computer vision, Deep learning, OpenCV**

I. INTRODUCTION

The World Health Organization received reports of several pneumonia cases with unclear causes from Wuhan, China, in December 2019. The 2019 novel coronavirus, which was previously unidentified, was discovered in January 2020. Samples of the virus were gathered, and analysis was conducted. Formerly known as 2019_nCoV, COVID-19 was dubbed as severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). The COVID-19 has been deemed a pandemic by the WHO. The global economy is being badly disrupted by the coronavirus outbreak. Nearly every country is fighting to stop the spread of illness by implementing random testing, limiting public gatherings, and immunizing its citizens. In a span of 18 months, COVID-19 infected almost 100 million cases.
Technology is starting to help speed up the process. Encouraging individuals to take the required precautions and ensuring they are informed during a pandemic. To cast light on the pandemic, numerous organizations are utilizing new technologies such as artificial intelligence, machine learning, and many others. Emerging technologies like artificial intelligence (AI) and machine learning (ML) are crucial to comprehending the COVID-19 crisis. With the use of machine learning technology, computers can now mimic human thought processes and process vast amounts of data to find trends and insights. Chatbots that utilize machine learning to enable them to respond to public inquiries.
Now is the moment to take the initiative more than ever. Governments everywhere have realized that using AI and ML to combat the virus can be highly effective. Until immunizations become widely available, the only known methods to prevent infection are by social separation and face mask use. Here, we present the face mask identification system and the computer vision and deep learning based social distance violation detection system. By enabling the recognition of faces with and without masks, CCTV can be integrated into the system to slow down the COVID-19 transmission identifying persons within prohibited zones and sending out a warning message

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if there is a safety infringement.
Machine learning is one use of artificial intelligence (AI) that gives a system the ability to automatically learn from experience and get better without explicit programming. The development of computer programs that access data and utilize it to learn for themselves is the primary goal of machine learning. Artificial intelligence's deep learning subset of machine learning uses networks that can learn unsupervised from unlabeled or unstructured data. Fraud detection can benefit from the application of deep learning, a type of machine learning. AI's field of computer vision teaches machines to see and comprehend visual stimuli. Machines are able to recognize and categorize items utilizing digital photos from cameras and movies along with deep learning models.
With over 2500 algorithms, OpenCV is an open-source computer vision and machine learning software library. These methods are used for object recognition and face detection and identification.

II. Background And Related Works

For face image classification, Bosheng ET al.in [1] combines an SR network with a classification network (SRCNet). Pre-processing, facial detection and cropping, SR, and identification of the wearer's face mask were applied to the input photos. For their experiment, they employed a dataset of medical masks. Mobilenet-v2 was also utilized for object detection.
In [2], Aniruddha et al. presented a framework for face detection using multi-task cascaded convolutional neural networks, which allows for the recognition of faces and associated facial landmarks inside a video frame. Following the processing of these facial photos and hints, a neoteric classifier analyzes masked regions by using the MobileNetV2 architecture as an object detector. Video capturing is used to monitor people in public spaces, and the captured data is loaded into a suggested framework designed to detect face masks.
A client and server application were used in the social distance violation detecting system proposed by Adlen Ksentini et al. in [3]. The client application is really basic; it sends GPS coordinates on a regular basis and is connected to the distant server (at the edge). The primary functionality of the service is server-side, where users' approved GPS coordinates are used to compute distances and, if necessary, provide warning messages.
In [4], Sammy et al. suggested a model for real-time face mask recognition utilizing a Raspberry Pi to capture facial images. The convolution neural network (CNN) is used by the system.
According to Jakub Kudela et al. in [5], they formulate the problem as a p-dispersion problem by leveraging the space that is available in a particular location to ensure that social distancing is satisfied. A set number of people is the input; arrange them in a predetermined area so that the minimal distance between any two individuals is maximized.
A social distance violation detecting system that satisfies the needs of energy conservation, population management, and social distancing in public areas such as theaters and shopping centers was proposed by Archana et al. in [6]. If the total head count exceeds the hall's capacity, the mechanism activates.

III. System Architecture

We are working on a system that can detect whether someone is wearing a face mask or not and warn others to keep their distance.

A. Facemask Detection

The system's goal is to determine whether or not a person is wearing a face mask by analyzing images and real-time streaming videos.
The dataset that this system analyzes consists of 1918 photos without a mask and 1915 images with one.
The YOLOV3 algorithm was taken into consideration for detection, and the mobilenet-V2 architecture served as the primary model.

1 MobilenetV2 Architecture

A CNN architecture called MobilenetV2 is designed to function well on mobile devices. smaller in volume and more rapid in operation than any other well-known model. A type of compact, low-power, low-latency models known as mobile nets can be utilized for tasks like detection and classification, which are frequent applications for CNN. These are excellent deep learning models for usage on mobile devices because to their modest size. Thus, this architecture is what we've utilized for our system.

B. YOLOV3

The most effective object detection model for picture detection is YOLOV3. You only look once, or YOLO. When it comes to object detection, this module is the fastest. This module makes use of a darknet variation. It is employed

in the 53-layer training of neural networks. An additional 52 layers in the stack form are used for detection. It builds up 102 layers in all. Because the bounding box-detected images are accurate, we have employed a pre-trained detection algorithm.

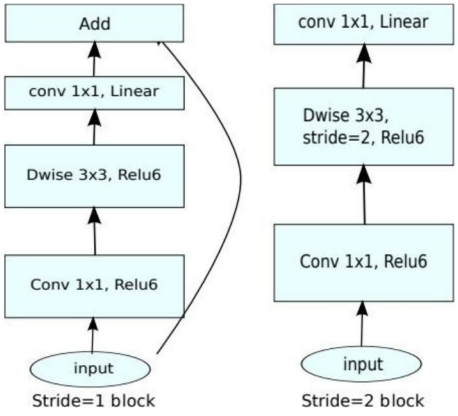

Figure 1 MobilenetV2 Architecture

The following steps are involved in facemask detection:
1. Bringing up a disk image or video stream for input
2. Look for faces in the picture or video clip.
3. Using a face-mask detector model to identify whether or not a mask is worn, the images are classified, and an output warning is generated.

We must divide our system into two sections in order to develop our facemask detection method.
1. Training
2. Implementation

1. Training

We employ techniques like Keras, TensorFlow, and deep learning to train face mask detector. Keras is a deep learning framework written in Python that serves as Tensorflow's high-level API. It facilitates the implementation of neural networks and enables numerous backend neural network computations. The model is provided by Keras.Fit_generator() is a function that allows a custom Python generator to produce training images from disk. But starting with keras 2.0.6, we can train the model using fit_generator() and the sequence object rather than a generator.

2 Deploying Face mask detector

Prior to fine-tuning, Mobilenet-V2 must be ready. A three-step approach is put up for fine-tuning.
1. Adding pre-trained ImageNet weights to the mobilenet without include the network head.
2. Freezing the network's foundational layers.
3. The head layer weights will be adjusted during backpropagation, but the base layer weights won't be changed.

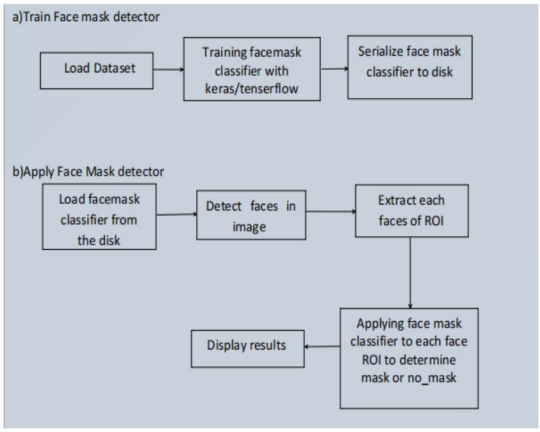

Figure 3 Phases and Individual Steps For Building A Face Mask Detector

C. Social Distancing monitor system

We are building a social distance monitoring system with deep learning, computer vision, and OpenCV. To construct a social distance monitoring system, follow these steps:
1. Use object detection to find individuals who are only filtering individuals in a certain class.
2. determining the separation between individuals and notifying them of it.

1. OpenCV

A collection of Python bindings called OpenCV is intended to help with computer vision issues. Numpy, argparse, scipy, matplot-lib, and imutils are used by OpenCV Python. For numerical computations, Numpy is a very useful tool, while Scipy is employed for optimization. The greatest Python object detection API is this one.

2. Tensor Flow

An open-source library for high-performance numerical computation is called Tensor Flow. created by the Google Brain Team, a division of Google AI. Its adaptable architecture makes it simple to deploy on a range of systems. Deep learning and machine learning are supported by Tensorflow. Although there is access to the underlying C++ API, the API is for the Python programming language. It was intended to be used in production systems as well as research and development. Data flow and operations in the structure of a directed graph are used to represent computation.

D. Implementation

1. Detecting object (people class)

The YOLO object detection model's initial step is to identify the object. A set of end-to-end deep learning models called "YOLO" (you only look once) are intended for quick object detection. YOLOV3 forecasts boxes on three distinct scales. Using a notion akin to feature pyramid networks, the system pulls features from those scales. YOLOV3 uses logistic regression to predict an objectness attribute for every bounding box. It will learn the bounding box coordinates and associated class label probabilities from the supplied photos. This provides the likelihood of predicting a person together with the centroid and bounding box coordinates.

2. Computing the Pairwise Distance Between People

We must determine the distance between the individuals in the video after classifying them. Finding the Euclidean distance between each drawn bounding box's centroid will help you do this. In order to do this, we must compute the ratio of pixels to centimeters, measured at a known distance for a known object reference.

$$(q-p)2+(q2-p2)2+(q3-p3)=d(q,p) \quad \ldots \quad (1)$$

The formula for calculating Euclidean distance is as shown in (1). The coordinates are x, y, and z. We compare the distance with the predetermined distance specified in the implementation code after obtaining the Euclidean distance. The people will be notified if the predetermined distance is exceeded, up to a specified threshold value. An administrator receives a mail asking them to take additional action if there are more violators.

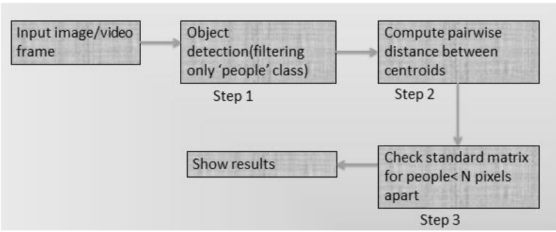

Figure 3 Phases Included in Social Distancing Monitor System

IV. RESULTS

We have created a website for both the functionalities. That will guide the common people to maintain social distancing and wear facemasks. The way the system recognizes the facemask is shown in Figure 4.
Additionally, the system gives information on how individuals should keep their social distance. The alert message shall appear in the event that the social distance is broken. The social distancing function of the system is illustrated in Figure 5.
Additionally, the system offers data on the current global case count. Figure 6 provides an illustration of this.

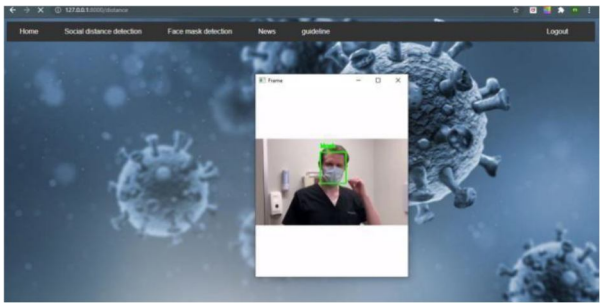

Figure 4 Facemask detection

Figure 5 Social Distancing Detection

Figure 6 News about current Covid-19 cases

V. CONCLUSION

Our nation faced trivial issues during Covid-19 and we need to stop the transmission of Covid-19 among humans. As a result, we launched a product to keep an eye on mask wearers and enforce social distance. For schools, colleges, and other places where there are larger crowds, this is incredibly helpful. If somebody violates any of the conditions, our system will notify the users by producing some sound. In this research, we devised a method that protects individuals and upholds a secure environment through the use of deep learning algorithms. People are alerted to prevent the COVID-19 virus from spreading if any infractions are found.

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