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COVI SCAN (Face mask detection and social distancing violation detection)

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Abstract*— COVID-19 pandemic is a great humanitarian challenge faced by the world today. The pandemic has spread widely causing the world to halt and the number of cases continues to rise. Governments all round the world are working to slow down if not completely stop the spread of this pandemic. Many protocols have been implemented, crucial ones are face masks and social distancing. Since social distancing and wearing a mask are the only monitored ways to avoid the infection till vaccinations become accessible to all. Real times mask detection and social distance violation using computer vision and deep learning techniques. For face mask detection we collected a dataset consisting of with-mask and without-mask labels.

***Keywords*—** *Computer vision, Deep learning, OpenCV*

1. INTRODUCTION

In the month of December 2019, a number of cases of pneumonia of unknown cause, in the city of Wuhan, China, was reported to the WHO. In January 2020, a previously unknown new virus was identified, named the 2019 novel coronavirus, and they collected the samples and analysis of the virus. COVID-19 was called as severe acute respiratory syndrome coronavirus 2(SARS-Cov-2), earlier it was named to as 2019_nCoV. The WHO has declared the covid-19 as a pandemic. The coronavirus outbreak is severely disrupting global economy. Almost all the nations are struggling to slow down the transmission of disease by making random testing , restricting large gatherings and provide vaccination to the people. More than 100 million cases were infected by covid-19 in 18 months across the world.

Technology is becoming an assistant to make the process faster. During a pandemic, providing necessary information to the people and making sure they are reminded to take appropriate precautions. Many groups are using drift technologies like AI, ML and many more, to provide visibility on the outbreak. Trending technologies such as ML and AI are playing an important role in understanding the COVID-19 emergency. Machine learning technology permits computers to imitate human intelligence and feed large volumes of data to identify patterns and insights. Machine learning enabler chatbots to answer questions from the public.

With the unlocking phases being in motion. This is the time to be more proactive than ever. Governments all round the world have recognized the power of AI and ML in order to battle the virus. Since social distancing and wearing a face mask are the only monitored ways to avoid the infection till vaccinations become accessible to all. Here we introduced the face mask detection system and social distance violation detection system using deep learning and computer vision technology. The system can be accommodated with CCTV to slow down the COVID-19 transmission by allowing detection of face with mask and without mask. Detecting people in restricted areas that will generate a warning message in the event of safety violation.

Application of AI is Machine learning, which provides a system to automatically learn and improve from experience without being programmed explicitly. The main focus of ML is on advancement of computer programs which access data and use the data to learn for themselves. Deep learning is a subset of ML in artificial intelligence that has networks capable of learning unsupervised from data that is unstructured or unlabeled. Deep learning, a form of machine learning, can be used to help fraud

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detection. Computer vision is a field of AI that trains computers to interpret and understand the visual world. Using digital images from videos and cameras and using deep learning models, machines can identify and classify the objects.

OpenCV is the open-source computer vision and machine learning software library and contains more than 2500 algorithms. These algorithms are used to detect and identify faces, recognize objects.

2. BACKGROUND AND RELATED WORK

Bosheng ET al.in [1] combines an SR network with a classification network (SRCNet) for facial image classification. The input images were processed with pre- processing of image, facial detection and cropping of the image, SR, and condition of face mask wearing identification. Here they used a medical mask dataset for their project. Also used Mobilenet-v2 for object detection.

Aniruddha et al in [2] proposed a framework that capitalizes on multi-task cascaded convolutional neural networks face detection models to recognize the faces and corresponding facial landmarks present in the video frame. These facial images and clues are then processed by a neoteric classifier which utilizes the MobileNetV2 architecture as object detector for analysing masked regions. The people in public places are monitored using video capturing, fed into a proposed framework for face mask detection.

Adlen Ksentini et al in[3] proposed a social distance violation detection consisting of a client and a server application. The client application is very simple, connected to the remote server (at the edge) and periodically transmitting GPS coordinates. The main part of the service is at the server side, which uses the accepted GPS coordinates of users to calculate the distances and generate warning messages if deemed appropriate.

Sammy v et al in[4] proposed the model for capturing the facial image using raspberry pi based real time face mask recognition. System makes use of the convolution neural network(CNN).

Jakub Kudela et al in[5] describes how they pose the problem by using the available space in a given place, such that the social distancing is satisfied, as a p-dispersion problem. The input is a fixed number of people, fit them into a predefined space in such a way that the minimum distance between any two people is maximized.

Archana et al in[6] proposed a social distance violation detection system which meets multiple requirements of energy saving, crowd control and social distancing in public places like shopping malls, theatres. The system triggers if total head count exceeds the capacity of the hall.

3. SYSTEM ARCHITECTURE

We are developing a system which will identify whether a person is wearing a face mask or not and also alert people to maintain social distance.

3.1 Facemask Detection

Systems objective is to detect a person is wearing a face mask or not by analysing through

- Images
- Real time streaming videos

This system considers a dataset consisting of 1915 images with-mask and 1918 images without-mask.

We used mobilenet-V2 architecture as the core model for the detection and considered the YOLOV3 algorithm for detection.

3.1.1 MobilenetV2 Architecture: MobilenetV2 is a CNN architecture that aims to perform well on mobile devices. smaller in size and faster in performance than any other popular models. Mobilenets are a class of small, low latency, low power models that can be used for classification, detection, and other common tasks CNN are good for. Because of their small size, these are considered great deep learning models to be used on mobile devices. So, we have used this architecture for our system.

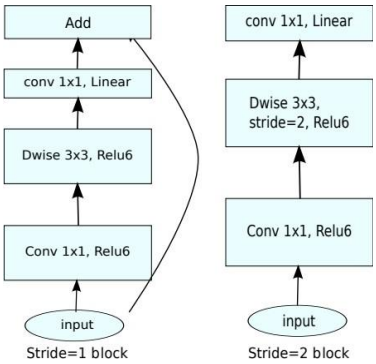

Fig 3.1 MobilenetV2 architecture

3.2 YOLOV3

YOLOV3 is the best object detection model for detecting images. YOLO- you only look once. This module is fast and best for object detection. This module uses a variant of darknet. It is used for training neural networks, which has 53 layers. For the detection it uses extra 52 layers in the stack form. It accumulates a total of 102 layers. The detected images with a bounding box are accurate so we have used a pre-trained detection model.

Steps included in facemask detection:

1. Loading an input image or video stream from the disk
2. Detect faces in the image or video stream
3. Applying face-mask detector model to classify the images as either with-mask or without-mask and alert will be given as output

In order to implement our facemask detection system, we need to break our system into 2 phases

1. Training
2. Deployment

3.2.1 Training: To train face mask detector we use techniques such as keras, tensorFlow, and deep learning. Keras is a python deep learning framework which is actually the high-level API of tensorflow. It supports multiple backend neural network computations and makes implementing neural networks easy. Keras provides the model.fit_generator () method, using which a custom python generator yield images from disk for training. However, as of keras2.0.6, we can use the sequence object instead of a generator together withfit_generator() to train the model.

3.2.2 Deploying Face mask detector: First we need to prepare Mobilenet-V2 for fine-tuning. Fine- tuning is a setup of a 3-step process.

1. Loading the mobilenet with pre-trained ImageNet weights, leaving off the head of the network.
2. Freezing the base layers of the network.
3. During the backpropagation, the weights of these base layers will not be updated whereas the head layer weights will be tuned.

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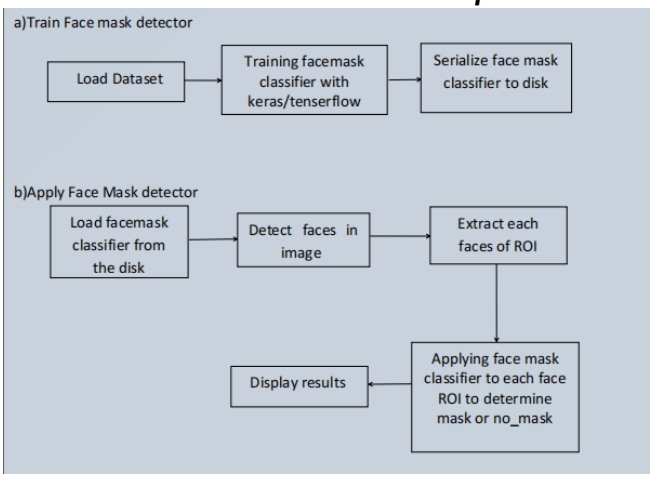

Fig.3.2 Phases and individual steps for building a face mask detector

3.3 Social Distancing monitor system

We are using deep learning, computer vision and OpenCV to implement a social distance monitoring system. The steps to build social distance monitoring system includes

1. Apply the object detection to detect people that is filtering only people class
2. Calculating the distance between people and alerting the people.

3.3.1 OpenCV: OpenCV is a library of python bindings designed for solving computer vision problems. OpenCV python makes use of numpy, argparse, scipy, matplot-lib and imutils. Numpy which is highly usable for numerical calculations and scipy is used for optimization. This is the best API for detecting objects in the python language.

3.3.2 Tensor Flow: Tensor flow is an open-source library for high performance numerical computation. Developed by Google Brain Team within Google's AI Organization. Its flexible architecture allows easy deployment of computation across a variety of platforms. Tensorflow supports machine learning and deep learning. The API is for the Python programming language, although there is access to the underlying C++ API. It was designed for use in both research and development and also in production systems. Computation is described in terms of data flow and operations in the structure of a directed graph.

3.4 Implementation

3.4.1 Detecting object (people class): The first step is to identify the object that is done by the YOLO object detection model. YOLO: you only look once" is a series of end-to-end deep learning models designed for fast object detection. YOLOV3 predicts boxes at 3 different scales. The system extracts feature from those scales using a similar concept to feature pyramid networks. YOLOV3 predicts an objectness feature for each bounding box using logistic regression. It will take input images and learn the bounding box coordinates along with corresponding class label probabilities. This gives the probability for predicting a person and bounding box coordinates and centroid.

3.4.2 Computing the pairwise distance between people: After identifying the class of people in the video we need to calculate the distance between them. This can be achieved by computing the Euclidean distance between the centroid of each bounding box drawn. To accomplish this, we have to calculate the ratio between pixels and cm measured from a known distance for a known object reference.

$$(q-p)^2+(q^2-p^2)^2+(q^3-p^3)=d(q,p)$$

This is the equation for computing Euclidean distance. Coordinate values are x, y, z. After getting the Euclidean distance we are comparing the distance with the predefined distance mentioned in the implementation code. If it violates the predefined distance system will alert the people until up to a given threshold value. If the number of people violating is more, then a mail is sent to an admin for taking further actions.

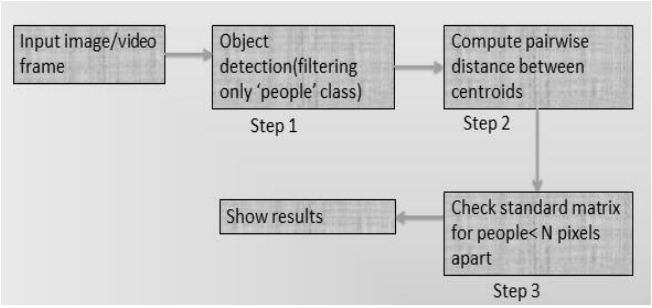

Fig. 3.3 Phases included in social distancing monitor system

4. RESULTS

We have created a website for both the functionalities. That will guide the common people to maintain social distancing and wear facemasks.

Fig 4.1 Front page of the website

In the front end we are having a home page, social distance detection, facemask detection, news about covid, and guidelines to follow. Login section is also there. After successfully login users can check facemask detection programs and social distancing also.

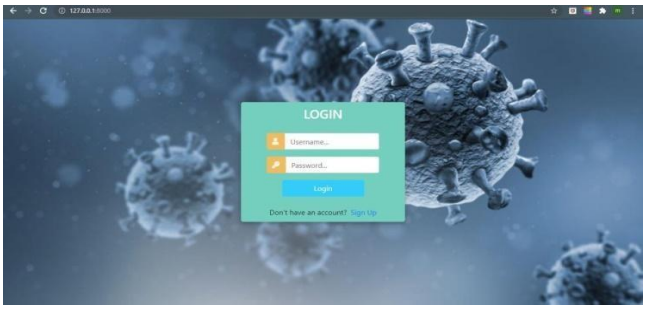

Fig 4.2 Login page

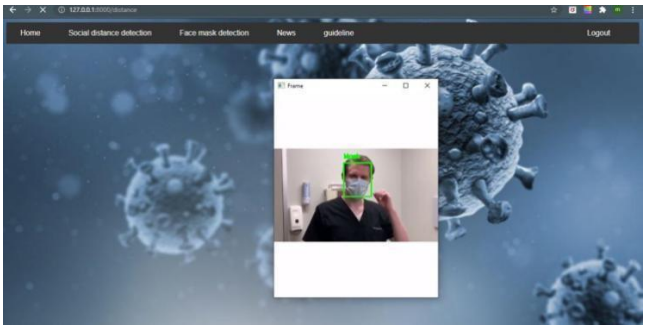

Fig 4.3 Facemask detection

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Fig 4.4 Social distancing Detection

It will give the current cases around the world if you tap the news button.

Fig 4.5 News about current Covid-19 cases

5. CONCLUSION

Nowadays our country is facing the second wave of Covid-19. So it is very essential to prevent the spread of Covid-19 among people. Thus we implemented a project which will monitor the people who wear masks and maintain social distance. This is very useful for schools, colleges and other institutions where the crowd is more. Our system will alert the people by giving some sound output if they violate any conditions. In this project, we developed an approach that uses deep learning techniques to maintain a secure environment and ensure individual protection. If any violations are observed, then it alerts the people to avoid the spread of the COVID-19 virus.

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