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DEEP LEARNING MODEL FOR FACE MASK DETECTION ALERT SYSTEM AND AGE PREDICTION

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Abstract: **COVID-19 has had a negative impact around the whole world. Studies have proved that wearing a face mask is one of the precautions to reduce the risk of viral transmission. And many public places as well as public service providers require customers to use the service and place only if they wear mask correctly/ So, it is not possible to manually track the customer, whether they have the mask or not. That's why this technology holds the key here. In this paper, we propose face mask detection using image processing which is one of the high-accuracy and efficient face mask detector. This proposed system mainly consists of three stages i.e. Image pre-processing , Face detection and Face mask classifier. Our system is capable of detecting masked and unmasked faces and can be integrated with webcam cameras. This system will help to tack safety violations, promote the use of face masks and it ensure a safe working environment.**

Index Terms **-- Face Mask Detection, Convolutional Neural Network(CNN), Datasets, Object Detection**

I. INTRODUCTION

COVID-19 pandemic is the most life-changing event which has startled the world since the year began. In order to tackle the wrongdoings of people, this system will assist the authorities to identify people not wearing masks and thus creating a sense of awareness regarding the virus and to minimize the impact of virus. COVID-19 has called for strict measures to be followed in order to prevent the spread of disease. Face masks are one of the personal protective equipment.

To monitor that people are following this basic safety principle, a strategy should be developed. Because, some people are taking this pandemic very lightly and majority do not wear mask properly. Face mask detection and alert means to identify whether a person is wearing a mask or not. There are many detector systems developed around the world and being implemented. But these systems do not give any alert if the rules are broken and do not show if a person has worn a mask properly or not. In this project, we will be developing a face mask detector that is able to distinguish between faces with masks and faces without masks.

The objective of this study is to reduce the impact of covid-19 and to keep the virus in control, identification of people without masks in the most competent and efficient possible way using Artificial Intelligence (AI) and Machine learning(ML).

II. RELATED WORK

Wearing face masks has become very important to avoid Covid-19. But some people are not taking Covid seriously and are not wearing masks properly. To detect these people and to reduce the impact of covid-19.An architecture is built [1] to find whether people are wearing facemask in live streaming videos and even with human face images using Single Shot Detector (SSD) serves the purse of object detection. Concepts of transfer learning in neural networks used in finding presence or absence of facemask in video streams and in images. Experimental findings indicate that the model performs well with 100% accuracy and 99% precision and recall, respectively. Simplified app roach [2] towards detecting facial masks even in motion using basic machine learning packages such as Tensorflow, Keras and OpenCV. . An automated process [3] for finding whether individuals wear facemask in public. The model is built by fine-tuning the pretrained state-of-the-art deep learning models called InceptionV3. Simulated Face Mask Dataset (SMFD) dataset is used to train the dataset. Here, on the public face dataset mask is put and then it's simulated. This is used to better training and testing of the model.Facial masks form a basic prevention from the virus, hence, [4] hybrid model is built using classical and deep machine learning consisting of two components. The first component is for feature extraction is by using Resnet50 and the second is for classification processing of mask is using Support Vector Machine (SVM) algorithms and Decision tree . Uses three datasets after investigation. Simulated Masked Face Dataset (SMFD) is the first dataset , the second dataset is Labeled Faces in the Wild (LFW) and third one is the Real-World Masked Face Dataset (RMFD). SVM learning algorithm achieved 99.49% accuracy in SMFD. RMFD achieved 99.64% of accuracy, LFW achieved 100% of testing accuracy. Healthcare system is under crisis. List of precautionary measures is being taken care in order to reduce the spread of viruses in which wearing facemasks is one of

them. [5] A system is created to find people not wearing face masks in smart cities using Closed Circuit-Television cameras. The trained system achieved 98.7% accuracy in differentiating people with mask and without mask. [6] An efficient and highaccuracy detector called RetinaFaceMask detector is built to spot whether people are wearing facemasks. The framework is a one-stage detector with a new background attention module to concentrate facemask identification and a pyramid network feature to combine high-level semantic data with several feature maps. An approach to the algorithm for the elimination of new background attention module artifacts to delete projections of high union intersections and poor confidences. Results Of RetinaFaceMask achieves state-of-the art results on face mask dataset with 2.3% and 1.5% higher than the standard result and mask detection precision, with 11.0% and 5.9% higher than the standard results.An efficient system approach towards a computer vision based to detect violation of wearing facemask in public areas using the convergence of advanced deep learning algorithms with geometric techniques resulted in model creation which is robust in nature and covers the aspects of validation, detecting, tracking.

A system is designed to detect people without masks in public areas by monitoring with CCTV cameras and in offices and workplaces also to monitor the staff whether they have wore a mask or not .If any person is detected without a mask 3 times then the alert is send to authorities with the image of that person attached to it. The System is developed using Convolutional Neural Network (CNN) which helps for feature extraction from the dataset images as well as the images captured by cameras in real-time. There is a 99% of accuracy result by the trained Model.

III. EXPERIMENTAL SETUP

In this proposed system, we have satisfied the following Hardware/Software Requirements:

Hardware :

- Operating system (Windows/Mac/Linux)
- RAM (Minimum 4 GB)
- System type (32-bit/64-bit)
- Webcam(if desktop)

Software :

- Python IDE (3.6)

Dataset Used :

1.)with_mask

We have used with_mask dataset for detecting faces with masks.

2.)without_mask

We have used the without_mask dataset for detecting faces without masks.

3.)age-detect

We have used an age-detect dataset for detecting age of the person.

4.)images

We have used an image dataset for recognising the face of a person.

As we can see, the system can be divided into 2 modules:

1. **The Face Mask Detection**:

The face mask detector is a 2 stage pipeline in which the first step is to detect human faces in the given input and the second stage, we classify the image into ”mask” or ”no mask”. If no image is detected, in the first stage, then no classification is done. For the detection of face mask, we have used this Modules: **Tensorflow, MobileNet_v2**, **Keras**, **Tkinter, Opencv, NumPy, Imutils.**

The dataset which we have used consists of two sets of images.Those are the images of people with and without masks.We have 1915 images of people wearing masks and 1921 images of people without masks.Also,we can train our application to take real time images through which we can identify through name,age and gender is also shown.Thereby,an alert is accordingly sent to the authorities if the person is not wearing mask.

2. **Age Prediction:**

In the second module, that is the Age Prediction, we have used Opencv, Numpy Modules. In this Python Project, we use Deep Learning to accurately identify the Age of a person from a video stream. It is very difficult to accurately guess an exact age because of factors like makeup, lighting, obstructions, and facial expressions.

We have Used a Counter in our Code.What the counter does is it checks for 3 times whether the person has been wearing a mask or not.If the system finds for three times that the person is not wearing a mask,then because of the counter,an alert is sent to the respective authority.

IV. METHODOLOGY

In this research work, we proposed an Optimistic Convolution Network that helps to ensure whether in public the people are wearing masks or not . Here in below diagram, we have described an architecture that shows how our system functions automatically to prevent the spread of COVID-19.

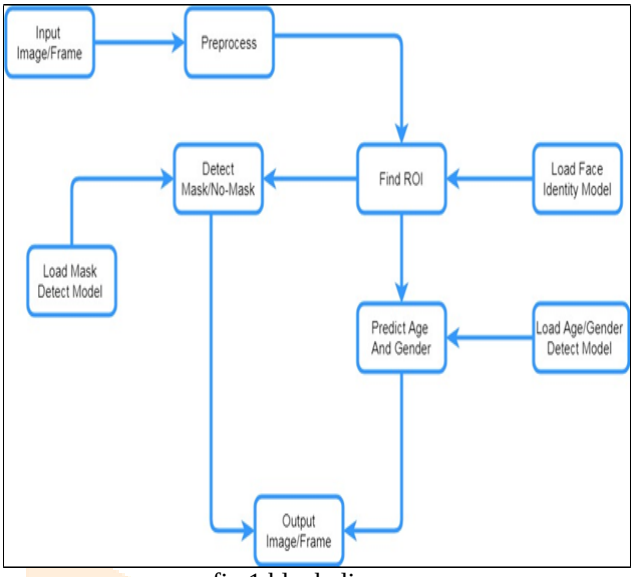

fig 1 block diagram

Our system uses the TensorFlow and Keras algorithm to detect whether an individual is wearing a face mask along with the CNN model . Here we first train the system with the Dataset from Kaggle and train it with Keras and TensorFlow, once the training is done then we will load face mask classifier from the disk, here faces are detected from a real time video stream. This press also involves use of MobileNet in order to train a huge collection of images and classification of high-quality images.

Here image dataset is loaded and then the images are converted into an array, later MobileNet is used to preprocess input image and to append image to the data . In the proposed system the main contribution includes person feidentification and face mask detection. These both are done in real time with the help of MobileNet and OpenCV. A square box is been displayed on every person's face with the color of red and green where red box indicates that the person is not wearing a mask and green box indicates that the person is wearing a mask. We have used dataset of about 3918 images of persons with masks and without masks. These images are used in order to train the model that classifies into two categories: that is, faces with masks and faces without masks. These datasets are then converted into arrays in order to create a Deep Learning Model.

The result of the person from the video displays a person with a square bound box.This system monitors continuously, and whenever a person is detected without a mask then the person's face is been captured and then it is sent to the higher authorities, also to that person. Due to the outbreak of novel CoronaVirus this proposed model can be implemented in public at real-time for monitoring the people . This model is used for monitoring people automatically in public places, that is the reason we picked this architecture. Our system can be used in offices, schools, airports, shopping malls, and other public areas to make sure that in-public people are wearing masks.

A Convolutional Neural Network CNN plays a significant part in computer vision related examples in recognizing patterns, on account of its less computation cost and also the ability of spatial extraction. CNN utilizes convolution portions to combine with the primary images in order to remove top-level features. [9] permits the network to get familiar with the mix of kernels. Planning to build a good Convolutional Neural Network architecture actually remains as a primary inquiry. To prepare a much further neural network, K. He et al. proposed Residual Network (ResNet) [10] that can take in personality planning from the past layer.

As article locators are generally conveyed on portable or any embedded device, where the computing assets are extremely restricted, Mobile Network (MobileNet) [11] is proposed. This utilizes profundity shrewd convolution to remove highlights and channelised convolutions to change channel numbers, so that the computational expense of the MobileNet is a lot lower compared to networks utilizing standard convolutions. In Fig 2 we have shown a Schematic:

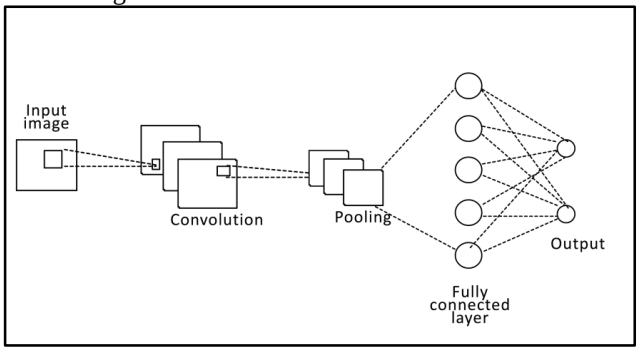

fig 2 diagram for basic convolutional neural network.

V. RESULTS AND ANALYSIS

Our system is based on Convolutional Neural Network (CNN) which is used to detect face masks in real time. In this system we have followed these four steps:

- Collection of Dataset and pre-processing
- Building and training the Model
- Testing the Model
- Model Implementation

A. Collection of Data and pre-processing:

The Dataset of our system contains images with different angles and different poses of face with and without masks that are labelled and are used to train our model. The real time face mask detection has been done by Tensorflow, MobileNet_v2, Keras,Tkinter, Opencv, NumPy and Imutils. Fig 3&4 the dataset is divided into two different categories: Faces with mask and without mask. The with_mask dataset consists of 1915 images and without_mask consists of 1921 images that are used to train our model.

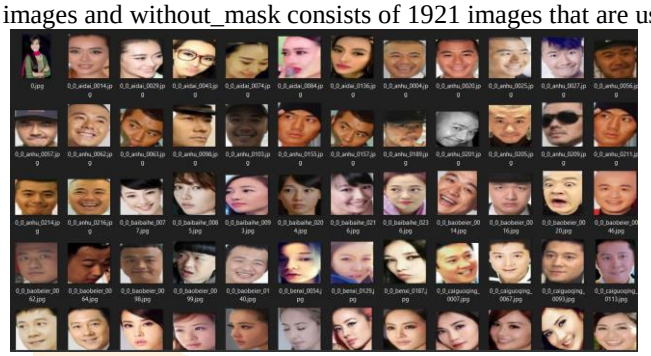

fig 3.without mask dataset

fig 4.with mask dataset

B. Building and Training the Model:

In this System the custom dataset is loaded and the algorithm is being trained based on images of the dataset. In this step the images are resized and it's been converted into a numpy array format. This model uses MobileNet and trains the model using TensorFlow. In the Diagram below, we have shown Model training accuracy/loss curves. Parameters with a learning rate (initial) of INIT_LR = 1e-4, batch size BS = 32 and the number of epoch EPOCHS = 20.

Fig. 5 We have used a quite big dataset. It works efficiently and has an accuracy of 99.95%. For the model webcam is used for face mask detection and once the person is found we mark the person with the square bound box.

```
Epoch 11/20
95/95 [==============================] - 97s 1s/step - loss: 0.0293 - accuracy: 0.9914 - val_loss: 0.0331 - val_accuracy: 0.9909
Epoch 12/20
95/95 [==============================] - 142s 1s/step - loss: 0.0293 - accuracy: 0.9901 - val_loss: 0.0273 - val_accuracy: 0.9909
Epoch 13/20
95/95 [==============================] - 117s 1s/step - loss: 0.0288 - accuracy: 0.9911 - val_loss: 0.0265 - val_accuracy: 0.9896
Epoch 14/20
95/95 [==============================] - 101s 1s/step - loss: 0.0299 - accuracy: 0.9885 - val_loss: 0.0303 - val_accuracy: 0.9922
Epoch 15/20
95/95 [==============================] - 102s 1s/step - loss: 0.0239 - accuracy: 0.9934 - val_loss: 0.0354 - val_accuracy: 0.9896
Epoch 16/20
95/95 [==============================] - 107s 1s/step - loss: 0.0318 - accuracy: 0.9888 - val_loss: 0.0267 - val_accuracy: 0.9922
Epoch 17/20
95/95 [==============================] - 92s 968ms/step - loss: 0.0237 - accuracy: 0.9931 - val_loss: 0.0279 - val_accuracy: 0.9922
Epoch 18/20
95/95 [==============================] - 93s 980ms/step - loss: 0.0255 - accuracy: 0.9927 - val_loss: 0.0270 - val_accuracy: 0.9909
Epoch 19/20
95/95 [==============================] - 102s 1s/step - loss: 0.0215 - accuracy: 0.9937 - val_loss: 0.0253 - val_accuracy: 0.9922
Epoch 20/20
95/95 [==============================] - 97s 1s/step - loss: 0.0254 - accuracy: 0.9914 - val_loss: 0.0294 - val_accuracy: 0.9922
[INFO] evaluating network...
              precision    recall  f1-score   support

   with_mask       0.99      1.00      0.99       383
without_mask       1.00      0.99      0.99       384

    accuracy                           0.99       767
   macro avg       0.99      0.99      0.99       767
weighted avg       0.99      0.99      0.99       767

[INFO] saving mask detector model...
```

fig 5. accuracy epoch

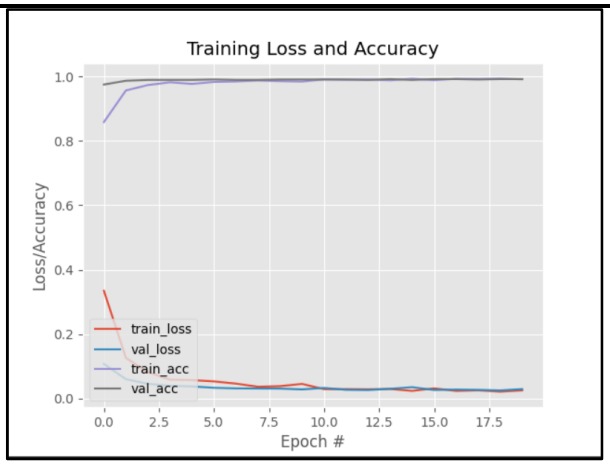

fig 6 . training and accuracy graph

Fig. 6. Face mask detection training accuracy/loss curve demonstrates high accuracy and little sign of overfitting on the data.

C. Model Testing:

Our system works in a real time video stream that helps identify if person is wearing a mask or not and notify the person's image to the higher authorities with the help of an E Mail. Once our model is trained completely with the given data set we test by showing a bounded box with the confidence score on top of the box. From the camera our proposed system identifies all the persons face with a green and red bounding box.

Fig 7&8 that identifies whether a person is wearing a mask or not.

If any of the people are not wearing the mask then the system will capture that person's image and send it to the higher authorities.

fig 7. output with mask

fig 8. output with mask

D. Implementing the Model:

This system uses a Dataset with the input video taken from any camera device. The system feeds with a real time video in public places which automatically monitors and detects whether people have wear a face masks or not. Whenever a person is found without wearing a mask then his/her photo is cap tured, then it is sent to the higher officials/authorities so that they can take any further actions against him/her.

VI. CONCLUSION

As the technology is blooming with emerging trends, the availability of face mask detection and alert systems can possibly contribute to the public health care department. Thus, we have presented an effective and advanced solution during these tough periods we all are facing. This project is going to be an excellent facilitate for the government officials for keeping an eye on the common public to see whether they are following the rules or not . In turn, it'll be helpful for the common public as a result of being safe from the rampant pandemic.

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