FACE MASK DETECTION AND ALERTING THE PERSON

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Abstract— Covid 19 is the vastest and worsely spreading disease till date all over the world and still continuing. The main reason for the spread is lack of awareness and not following rules properly though awared. To stop the spread many governments have imposed lockdowns. Mainly in our India though we had lockdowns we failed in feeding the poor due to which lockdowns were removed but couldn't control the spread.

Many kinds of vaccinations have been invented namely covaxin, covishield, sputnik V, etc. and people are being vaccinated in two doses all over India and the only way to stop the spread is to wear a face mask and maintain social distance.

Already some projects exist which detects face mask of a person by using many algorithms such as CNN, YOLO V4, MOBILE NET V2 using machine learning and deep learning. We are proposing a method to alert the person in a mall who is either violating the rule of wearing a face mask by focusing a red light on the person with a small announcement as wear your mask properly.

The Person who is violating the rules is alerted along with that others also get aware and try to follow the rules of wearing the mask in proper way. We are using an algorithm of deep neural network as CNN (Convolution Neural Network) to detect the face mask and python libraries as tensorflow, imutils, tinker, PIL, playsound and prtsc to focus the light, announce the announcement and take the screenshot of screen when a person is not wearing the mask using the camera that scans the view and it has a red light that is focused on the person and as soon as the light is focused the announcement is heard as wear your mask properly.

Keywords— Face Mask Detection, Machine Learning, Deep Learning.

I. INTRODUCTION

Corona Virus is the most spread disease that everyone is aware of. In Wuhan, a city in China, the first corona virus case was identified in December 2019. This spreaded throughout the world.

Covid 19 causes coughing, headaches, tiredness, trouble breathing, and a loss of smell and taste. Symptoms can appear anywhere from one to fourteen days following viral contact. Infected people do not show any signs immediately away. Those who develop symptoms are characterized as having mild to moderate symptoms in 81 percent of cases, severe symptoms in 14 percent of cases, and critical symptoms in 5 percent of cases. People in their later years are more likely to acquire severe symptoms. Even after months of recuperation and organ damage, some people continue to suffer greatly.

COVID-19 mainly spreads when people breathe contaminated air by droplets and small airborne particles that contains virus. When people are close together, the risk of breathing is greatest. Physical contact with contaminated fluids through the eyes, nose, or mouth, as well as contaminated surfaces, can result in transmission. People should be isolated for a minimum of fourteen days.

Covid can be detected utilizing a nasopharyngeal swab and a conventional diagnostic procedure such as TMA (Transcription-Mediated Amplification), rRT-PCR (real-Time Reverse Transcription Polymerase Chain Reaction), or Reverse Transcription Loop-Mediated Isothermal Amplification (RT-LAMP).

Some of the vaccines developed for COVID-19 are BNT162b2/COMIRNATY Tozinameran, mRNA-1273, Ad26.COV2. S, AZD1222, SARS-CoV-2 Vaccine, Inactivated, Covishield approved by World Health Organization and Vaccines have been distributed in a number of nations that have begun widespread vaccination programmes. In our India Covishield, Covaxin and Sputnik V vaccines are

available. Separation in terms of distance Other precautions include hand washing and keeping unclean hands away from the face, quarantining, ventilation of indoor spaces, cough and sneeze covers, hand washing, and keeping dirty hands away from the face.

Recently, many machine learning algorithms have been developed for image pattern recognition that can be used in almost all the fields. Face mask recognition, which may be used to detect a person's face mask in a crowd, has improved with the continued development of medical imaging technology, resulting in an increase in the accuracy and reliability of medical diagnosis. Deep learning, in particular, has showed promise in automated classifications, as Convolution Neural Network technique. CNNs were created primarily to speed up the processing of images and to do image classification.

Using a Convolution Neural Network to detect the face mask and some Python libraries like tensorflow, imutils, tinker, PIL, and playsound to focus the light and announce this is done using a camera that scans the view and has a red light focused on the person and as soon as the light is focused the announcement is heard by everyone as long as you wear your mask properly.

II. RELATED STUDY

In past few months, the number of people suffering from covid-19 increased and due to lack of awareness among people, many are still suffering from the disease. And now maximum number of the people are awared but are not following the basic rules of covid such as maintaining social distance, wearing a mask and sanitizing their hands frequently. To atleast detect the mask and make people not to remove a mask, many algorithms have been developed to detect the mask of a person such as CNN, YOLO V4, MobileNetV2, etc.

Samuel Ady Sanjaya, Suryo Adi Rakhhmawan, et al. proposed image classification method named as-MobibeNetV2 machine learning algorithm. Collecting data, pre-processing it, separating the data, testing the model, and applying it were some of the procedures they took to construct a model. The researchers have implemented this model and got accurate results of detecting the face mask of the person. This technique was used to create anonymized statistical data that will aid authorities in predicting future covid-19 outbreaks.

Arjya Das, Mohammad Wasif Ansari, Rohini Basak, et al. used Machine learning tools such as TensorFlow, Keras, OpenCV, and Scikit-Learn can accurately detect and mask a person's face. They scored 95.77 percent for detecting a person's face and 94.58 percent for detecting a person's mask.

Mohammad Marufur Rahman, Md. Motaleb Hossen Manik, Md. Milon Islam, Safuddin Mahmud, Jong-Hoon Kim, et al. proposed a strategy to control COVID-19 proliferation in smart cities by monitoring people with closed-circuit television (CCTV) cameras. They used deep learning architecture to distinguish people wearing and not wearing mask by achieving 98.7% accuracy.

Susanto, Febri Alwan Putra, Riska Analia, Ika Karlina Laila Nur, et al. used a real-time application, the YOLO V4 (You Only Look Once) method is used to check the face with precision and speed. The YOLO V4 is a deep learning system that recognizes items accurately. This device is used in a real-time application at Politenik Batam to prevent the spread of covid by distinguishing between people who are wearing masks and those who are not. This device assists the guard and makes his job easier by indicating whether or not a person is wearing a mask.

Suresh, Palangappa, Bhuvan, et sl. used CNN machine learning algorithm to find the face mask of a person and they notified the individuals personally by a text message and also notify police and higher authorities so that they can easily identify the person not wearing a mask and they will also have victims photo to identify.

S. Balaji, B. Balamurugan, T. Ananth Kumar, R. Rajmohan, P. Praveen kumar, et sl. used AI, Dl and ML and keras, tensor-flow and opencv python libraries to find mask of a person on his face using a toll-way gate and it will allow the person only if he wears a mask and detect a green light when the person is having a mask and if not then red light.

Shilpa Sethi, Mamta Kathuria, Trilok Kaushik, et al. used 1-stage and 2-stage detectors to detect the mask by adding a bounding box transformation using three baseline models named as ResNet50, AlexNet and MobileNet among which MobileNet gave the highest accuracy of 98.2% with 6.44% recall and 11.07% precision.

Saini Pooja, Saini Preeti. Et al. used a simple implementation of a surveillance system to locate a person's face mask in public, using revolutionary neural network methods such as the ML, DL, and DL frameworks.

G. Jignesh Chowdary, Narinder Singh Punn, Sanjay Kumar Sonbhadra, Sonali Agarwal, et al. used an automation process to identify people without mask. They developed a fine-tuning pre-trained state-of-the-art deep learning model called Inception V3 and used an image augmentation technique to improve model training and testing, achieving 99.9% and 100% accuracy.

III. CONVOLUTION NEURAL NETWORK

Our work is implemented using built-in python libraries namely tensorflow, imutils which internally uses Convolution Neural Network.

CNN is one of the DL neural network that is used to process the structured arrays like images. CNN takes image as input in matrix form. This uses three colours as red, green and blue panels and it enables a bit as 1 if picture is enabled and -1 if picture is not enabled for each panel. The input is read in matrix form using filters and each matrix is filter based on the features.

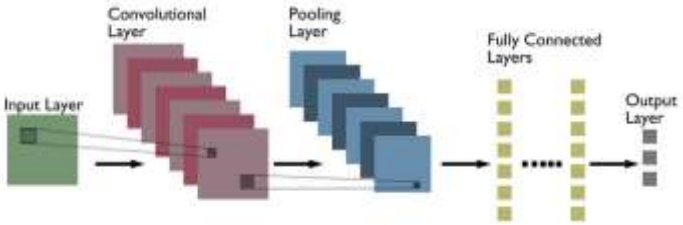

Fig 1. Convolution Neural Network

In figure 1, Convolution layer, pooling layer, flattening layer, and fully connected layer are the four layers in CNN along with the input and output layers.

In convolution layer, depending on character we select filter. There are three types of convolution as one-dimensional, two-dimensional and three-dimensional that are used to process inputs as text, gray-scale image and color images respectively. There are four operations in convolution layer as filter/kernal, stride, padding and number of filters. Filter/kernel is a weight matrix, stride is the number of steps (pixels) the filter is to be moved horizontally or vertically over the input matrix, if stride is 1, we move the filter 1 step at a time, if stride is 2, we move the filter 2 steps at a time, etc., padding is the process of padding the input matrix with zeros, and number of filters is only for 3D input.

In pooling layer, we reduce each feature map by factor of 2 suppose the input is of size is 4x4 then after applying pooling operation then size of output will be 2x2.

In flattening layer, the matrix is converted into a vector i.e. the output of before layer is flattened and turned into single vector that is sent as input to next stage.

In fully connected layer, the vector is passed into the hidden layer using an activation function called ReLU, and we retrieve the output from this layer.

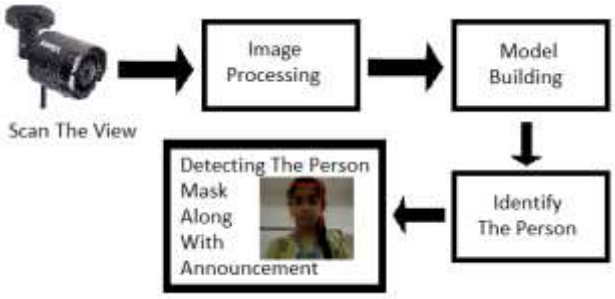

Fig 2. Block Diagram Of Proposed System

Any project can be executed based on a dataset. For out project its name is detection of face mask.

The detection of face mask dataset contains 1900 images without mask.

To detect the face and mask of a person the dataset should include the images with mask, so to create the images with mask, we have used the concept of computer vision and deep learning.

To begin, an artificial dataset is created by capturing regular images of faces and using a python script for computer vision to add masks to them.

To create the artificial dataset, i.e. to add masks to face, applied facial landmarks on eyes, eyebrows, nose, mouth, jawline, this creates a box around the face. Now from these landmarks, we are able to localize the eyes, nose, mouth, etc. and then added an image of mask on face that covers the landmarks as nose, mouth and surrounding parts.
This created face mask detection dataset.

Fig 3. Sample Images from Dataset

Algorithm 1: Face Mask Detection

Input : Dataset including faces with mask

Output : Detecting the face of a person with or without mask along with percentage and announcement

1 Consider the frame dimensions then construct a blob (a Binary Large Object that is stored by databases in special way as image files)
2 Pass blob through network and obtain face detections
3 **for** each image in dataset do
4 Extract confidence (a probability for calculating percentage)
5 Filter weak detections
6 Compute (x,y) coordinates of images
7 Ensure bounding boxes within the frame
8 Extract faces, resize to 224x224 and preprocess
9 Add faces to bounding boxes
10 **end**
11 Detecting a face
12 This is serialized face detector model
13 Load face detector model from disk
14 Initialize video stream
15 **while**
16 Grab frame from video stream and resize it with minimum 400 pixels
17 Detect faces and their mask
18 **for** each face on detection
19 Unpack bounding box
20 Determine class label and color(red for not wearing a mask and green for wearing a mask) along with a probability of percentage
21 If mask is not found a announcement is heard as wear your mask properly and a screenshot of screen is saved into downloads
22 Display rectangular bounding box on output
23 **end**
24 Press 'q' to break from loop
25 **end**

Algorithm 2: Video Stream

Input : Image for the GUI window

Output : A video is streamed

1 initialize Tkinter window
2 set background using image
3 create a button for mask detection
4 the button redirects to face mask detection algorithm

IV. IMPLEMENTATION

A GUI window is created using Tkinter a python library that can be used for creating a GUI, where an image is displayed which has 2 people wearing a mask and a message is displayed as stay safe and wear a mask. Along with that a button is created, which on click will direct to a window where the video is streamed using imutils python library that contains Video Stream function is used to stream the video. Our dataset is loaded from the disk then trained a model and then I have serialized face detector model to the disk. The video stream is initialized and the video stream will continuously scan the view and

detects the person first then the face of the person and finally checks for a mask based on a trained model.
When the face is detected, it displays a square box around the face of the person with a red or green colour based on that information and if person is not wearing a mask or wearing a mask respectively. It also displays the mask percentage as how much it is weared properly or not weared properly using a confidence (confidence is the probability threshold that is set to override 50% to filter detection of weak faces).
This is calculated using a formula
label = "{}: {:.2f} %". format (label, max (mask, withoutMask) * 100)
(1)
If the mask is detected by the camera, the person's face is encircled by a green colored box, with the percentage of the person wearing a mask displayed above the box, and the camera continues to scan the view.
If the mask is not found, the person's face is encircled by a red colored box, with the percentage of not wearing a mask above the box, and an announcement is played as wear your mask properly, which we have given as an audio to the code using the playsound python library's playsound function.
It also takes a screenshot of the screen using the prtsc function from prtsc python library when the person is found without a mask and saves those screenshots into the local file directory specified along with the name as first image will be saved as filename.png and the others as filename1.png, filename2.png, and so on.

V. RESULTS

Fig 4. Pop-Up Window

In figure 2, this is the screen that appears first. It is the pop up window that appears with a button names Mask Detector.
When we click on that button, a screen is opened. That screen is a live video stream where the person, then the face and the mask is detected.
It scans the view, first it checks for the person, then the face and then it detects the mask.
It continues scanning the view if the mask is visible by showing the percentage of wearing the mask.
Once the person mask is not detected, can be seen the percentage of not wearing the mask.
Along with percentage of not wearing the mask, an announcement as Wear Your Mask Properly is announced.
When mask is not detected a screenshot is taken to check people wearing mask or not. These are the screenshots.


Fig 5. A Screenshot Without and with Mask

Figure 3 shows two people, one of them is wearing a mask and the other is not, as well as the percentages: face mask found is 100.00 percent and mask not found is also 100.00 percent.

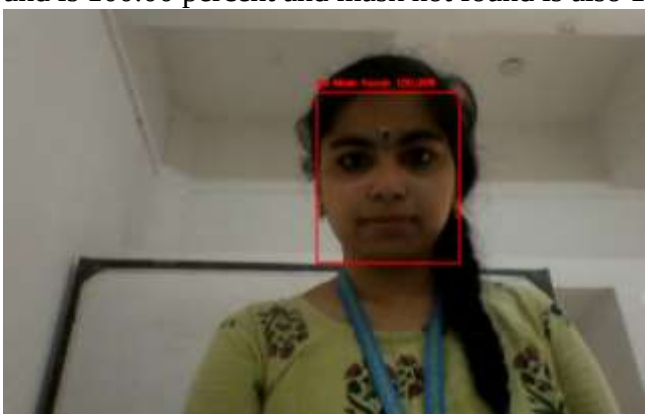

Fig 6. A Screenshot Without Mask

Figure 4 shows one person who is not wearing a mask, coupled with the proportion of 100.00 percent.

VI. COMPARISON OF VARIOUS TECHNIQUES TO DETECT FACE MASK

An alerting system has included along with an image capturing system that can be used by higher authority people to punish the person for not wearing a mask for more number of times.

The following is the comparison between the accuracy values of different papers with our work that I have used in this references.

[2]: COVID-19 Face mask detection using tensorflow, keras and opencv.

[3]: An automated system to limit COVID-19 using facial mask detection in smart city network

[7]: Face mask detection using deep learning: An approach to reduce risk of corona virus spread.

[9]: Face mask detection using transfer learning of inceptionV3.

This Paper: Face mask detection and alerting the person.

To compare this research with other researches we have used four reference papers along with this paper, all their accuracy scores and the algorithms and the python libraries used. To display the accuracy scores we have used a pie chart as shown in Fig 5 and to display the algorithms and python libraries, a tabular comparison as shown in Table 1.

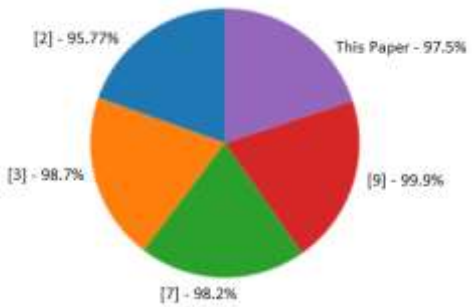

Fig 7. Accuracy Comparison Using a Pie Chart

COVID-19 Face mask detection using tensorflow, keras, and opencv, An automated system to limit COVID-19 using facial mask detection in smart city networks, Face mask detection using deep learning: An approach to reduce risk of corona virus spread, Face mask detection using transfer learning of inceptionV3, and Face mask detection and alerting the person are the research papers we used for comparison.

COVID-19 Face mask detection utilizing tensorflow, keras, and OpenCV has 95.77 percent accuracy, and each research article has 95.77 percent accuracy. Face mask detection using deep learning: An strategy to reduce the danger of corona virus propagation has 98.2 percent, Face mask detection using transfer learning of inceptionV3 has 99.9 percent, and Face mask detection and notifying the individual has 97.5 percent.

Using python matplotlib library we have plotted a piechart that displays the percentages along with the research paper number as shown in fig 5.

TABLE 1. Tabular Comparison of Above Graph

Reference Number	Python Libraries Used And Additional Packages Concepts Used
[2]	TensorFlow, Keras, OpenCV, and Scikit-Learn
[3]	Convolution Neural Network And Monitoring System
[7]	ResNet50, AlexNet and MobileNet
[9]	InceptionV3
This Paper	Tensorflow, Imutils, Tinker, PIL, Playsound and PrtSc

In COVID-19 Face mask detection using tensorflow, keras and OpenCV research paper, the researchers have used tesnsorflow, keras, OpenCV and scikit-learn python libraries, in An automated system to limit COVID-19 using facial mask detection in smart city network research paper, the researchers have used Convolution Neural Network algorithm and a monitoring system, in face mask detection using deep learning: An approach to reduce risk of corona virus spread research paper, the researchers have used ResNet50, AlexNet and MobileNet algorithms, in Face mask detection using transfer learning of inceptionV3 research paper, the researchers have used inception V3 algorithm and in face mask detection and alerting the person research paper we have used Tensorflow, Imutils, Tinker, PIL, Playsound and PrtSc python libraries that internally uses convolution neural network.

In our research the accuracy scored is 97.5% and we have implemented a method to focus a red light and an announcement is heard whenever the person without mask is detected as wear your mask properly also a screenshot of the screen is captured to know who exactly is not wearing the mask.

VII. CONCLUSION AND FUTURE ENHANCEMENTS

In own work, we have used deep learning techniques and python libraries to identify the person then identifies the face and then detects the mask of the person using a live camera. Whenever the camera finds a person not wearing the mask, it is gives an announcement as to wear mask properly and captures a screenshot of that screen.

It is implemented using a web camera of a laptop but can be implemented in a mall or any supermarket where people try to reach many things and try to remove their masks and feel as no one is seeing. It can also be implemented in schools and colleges to make students remind of wearing a mask properly as it is very crucial to use them in this pandemic. It can be further used in traffic where people usually neglect to wear a mask as they are in their own vehicle.

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