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IMPLEMENTATION ON HUMAN RECOGNITION WITH FACE MASK

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Abstract- During pandemic COVID-19, World health organization has made wearing masks compulsory to protect against this deadly virus. In this pandemic, the precautions are the only solution available for now, one of the most important ones being wearing a mask. Our project detects humans whether the person is wearing a mask or not. Adding to human detection we are aiming at detecting the presence of face mask which is much required for the society now. So, it is advised to wear a face mask at a public setting for people's safety. Keeping all these necessities in mind detecting the presence of face mask would greatly help one's own and other's health too. Especially at work places or schools, where the face needs to be identified for various reasons such as attendance it is a constraint. As such project with this mechanism is very much in need currently, we believe it could give a solution for the health and safety of the society.

Keywords—Face mask detection, neural network, haar cascade classifier, tkinter.

1. INTRODUCTION

Our project detects humans whether the person is wearing a mask or not. In this project, we will develop a deep learning model using Python, Keras, and OpenCV along with network architecture. So to detect whether a person is wearing Face Mask or not is an essential process to implement in the society currently which can be used for various applications like at the airport, hospitals, offices, schools, etc. This system can be of great importance at airports to detect travelers whether they are wearing a mask or not and at schools to ensure students are wearing a face mask for their safety.

Neural networks take in data, train themselves to recognize patterns in this data through layers and predict the output for the set of similar data. Then we will load the model and use haarcascade classifier considering rectangular regions at specific locations in a detection windows sums up pixel coordinates and calculates the difference between these sums. This difference is then used to categorize subsections of an image. Through our project we make sure that any person in front of the camera is detected whether face mask is present or not. If not, we have added the feature of warning box to be displayed till the person wears the mask correctly and send the mail to the authorities about the same.

However, wearing the mask face causes the following problems: i) fraudsters and thieves take advantage of the mask, stealing and committing crimes without being identified. ii) community access control and face authentication have become very difficult tasks when the most part of the face is hidden by a mask. Hence, detecting the face mask and recognizing the person behind the face mask is very important.

A. Issue identification: -

Masks are a key measure to suppress transmission and save lives. Masks should be used as part of a comprehensive 'Do it all!' approach including physical distancing, avoiding crowded, closed and close-contact settings, good ventilation, cleaning hands, covering sneezes and coughs, and more. Depending on the type, masks can be used for either protection of healthy persons or to prevent onward transmission.

B. Objectives: -

- To develop a Convolution Neural Network Model to train the captured image with the dataset to detect the presence or the absence of face mask in a human.
- To develop a Real Time Testing Model to indicate the presence or absence of face mask and inform the authorities about the person not wearing mask.

2. METHODOLOGY

A. Software Requirements: -

Python is a deciphered, undeniable level, broadly useful programming language. Its language develops and object situated methodology intend to help software engineers compose clear, intelligent code for little and enormous scope projects. Python is powerfully composed and trash gathered. It upholds numerous programming standards, counting organized (especially, procedural), object- arranged, and utilitarian programming.

Convolutional Neural Network – CNN: In profound learning, a convolutional neural organization (CNN) is a class of profound neural organization, most generally applied to examine visual symbolism. hey have applications in picture and video acknowledgment, recommender frameworks, picture arrangement, picture division, clinical picture investigation, common language handling, mind PC interfaces, and monetary time arrangement series. CNNs are

regularized versions of multilayer perceptron's. Multilayer perceptron's usually mean fully connected networks, that is, each neuron in one layer is connected to all neurons in the next layer. The "full connectivity" of these networks makes them prone to over fitting data.

Haar Cascade: It is an AI based methodology where a course work is prepared from a great deal of positive and negative pictures. It is then used to recognize objects in different pictures. Falling classifiers are prepared with a few hundred "positive" example perspectives on a specific article and self-assertive "negative" pictures of a similar size. After the classifier is prepared it very well may be applied to an area of an picture and distinguish the article being referred to. To look for the item in the whole casing, the hunt window can be gotten across the picture and check each area for the classifier. This interaction is most regularly utilized in picture handling for object discovery and following, essentially facial location and acknowledgment.

OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects etc.

Keras API: Keras is an API intended for individuals, not machines. Keras follows best practices for lessening intellectual burden: it offers predictable and basic APIs, it limits the quantity of client activities needed for basic use cases, and it gives clear and significant mistake messages. It likewise has broad documentation also, designer guides. Keras is an open-source programming library that gives a Python interface to fake neural organizations. Tool stash, Theano, and PlaidML. As of adaptation, just TensorFlow is upheld. Intended to empower quick experimentation with profound neural organizations, it centers around being easy to use, measured, and extensible.

Tkinter UI: Tkinter is the standard GUI library for Python. Python when joined with Tkinter gives a quick and simple approach to make GUI applications. We have used public dataset of size 357 mb consisting of around 4120 images of with mask and 4213 images of without masks.

B. Equipment requirements:

- Active webcam is needed to distinguish people entering a specific area.
- Screen to demonstrate if an individual is wearing a veil.
- According to the applications we may require distinctive equipment interfaces for instance: we can utilize blare sound to show not wearing a cover or we can likewise control shutting and opening passage relying upon if an individual is wearing cover. A few other thoughts can be expanded.

C. Proposed system

As videos are basically made up of frames, which are still images. The face detection is performed for each frame in a video. Different layers of CNN is used to detect faces. Haar cascade classifier is loaded to detect the faces. To show the detected face, a rectangle is drawn over it. It needs to know the pixel coordinates of the top-left and bottom- right corner. The coordinates indicate the row and column of pixels in the image. We can easily get these coordinates from the variable face. The next step is to read all the images and assign them to some list. Here all the paths associated with these images and then label them accordingly is extracted. Then Image data Augmentation is done. Image data augmentation is a technique that can be used to artificially expand the size of a training dataset by creating modified versions of images in the dataset. As images of this dataset are already cropped there is no need of face detection to localize faces from each image. The process consists of importing all the necessary libraries, loop over the image paths, Converting the image into gray scale, resizing the gray scaled image into size 56x56 in order to keep size of the images consistent, Exception Handling in case any error occurs, perform one hot encoding on the labels since the label are in textual form, Defining model parameters.

CNN - Convolutional Neural Network Layers consists of: Activation - The activation function does the non-linear transformation to the input making it capable to learn and perform more complex tasks and help the network learn complex patterns in the data. Dense - A dense layer represents a matrix vector multiplication. The values in the matrix are the trainable parameters which get updated during back propagation. Flatten - Flattens the input. Does not affect the batch size. If inputs are shaped (batch,) without a feature axis, then flattening adds an extra channel. Dropout - Dropout refers to ignoring units (i.e., neurons) during the training phase of certain set of neurons which is chosen at random. Maxpooling2D - Max pooling is a sample-based discretization process. The objective is to down- sample an input representation reducing its dimensionality and allowing for assumptions to be made about features contained in the sub-regions binned.

After training the model, since the faces contains the top-left corner coordinates, height and width of the rectangle encompassing the faces, that can be used to get a frame of the face and then pre-process that frame so that it can be fed into the model for prediction.

After loading the Haar Cascade model, CNN built model is loaded. Then video is captured using OpenCV imports. If wearing mask display green rectangle around the face, else display red rectangle. While(true): loop to continuously detect camera feed. If not wearing mask throw a warning message and deny access to that particular person. Send email to administrator of access denied/not wearing mask.

Else Continue, allow person to enter. If (live feed to be stopped) release all resources. After getting the predictions,

we draw a rectangle over the face and put a label according to the predictions and determine whether the person is wearing mask or not. Classify green and red rectangles for with and without mask and send the mail to the authorities if not wearing mask.

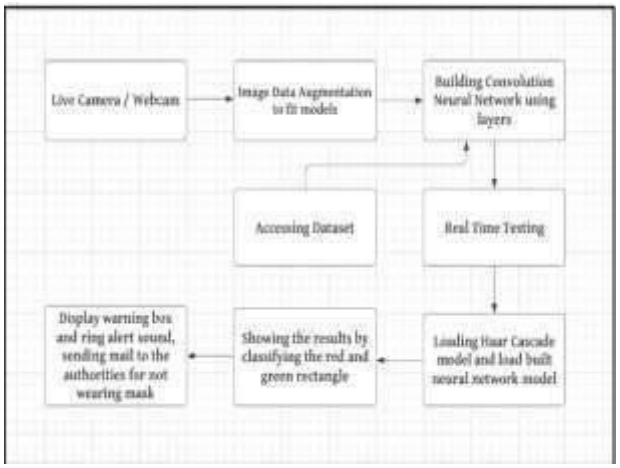

Fig-1: Architectural Design of human recognition with face mask

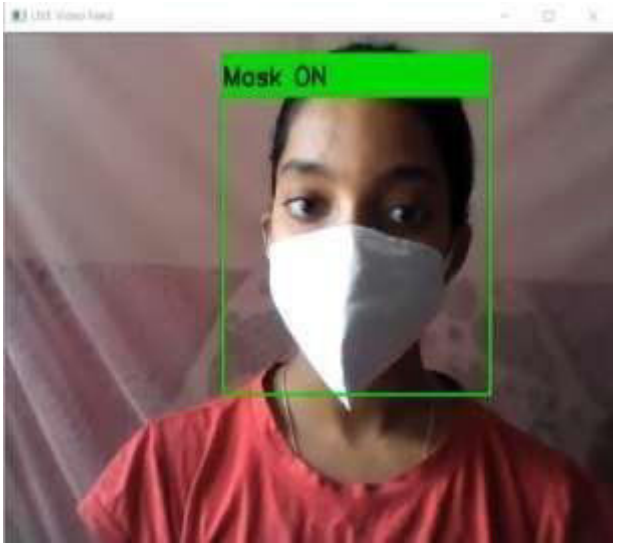

Fig-2: Output showing for the person with mask.

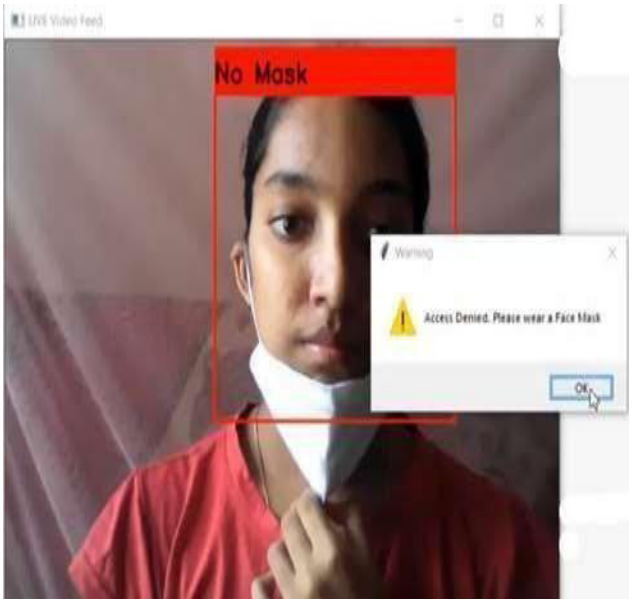

Fig-3 Output showing for person without mask.

It tests the faces on screen captured as with masks and without mask. The model can detect more than one faces on screen, and then compare the captured images with the dataset (with mask and without mask). While the system detects the faces as with mask and without masks, it labels as "mask on" in green rectangle for wearing mask and without mask labelled as “no mask" in the red rectangle. Then the model, checks for without mask, if so the system is designed well to display the warning pop-up notification, ring alert beep sound, and immediately send a mail to the admin (authorized person).

3. DISCUSSION

A. Different *types of testing carried out:*

Automated Testing**:** While the system detects the faces as with

and without masks, our Keras CN Model works at the background and finds the human face and represents with the green or red rectangles based on wearing masks and no masks condition. The alert sound is also followed by a warning box if the person does not wear a mask properly. All the detections work at background and detect the face whenever required.

Black Box Testing: Black box testing method relies on testing software with various inputs and validating results against expected output. As with the black box testing it was successful as we tested with various input combinations of different color masks and designs along with different postures the outputs were as expected.

Compatibility Testing: Compatibility testing checks if the software can be run on different hardware, operating system, bandwidth, databases, web servers, application servers, hardware peripherals, emulators, different configuration, processor, different browsers and different versions of the browsers etc. Regarding our project requirements we have few constraints in the hardware and components used. We require high GPU speed with good quality webcam and large disk space in the system.

End-to-End Testing: End to end testing involves testing information flow across applications. As our project itself involves real life application end -to-end testing produced great results as expected.

GUI (Graphical User Interface) Testing: Aims at testing the software GUI (Graphical User Interface) of the software meets the requirements as mentioned in the GUI mock-ups and Detailed designed documents. Our project's GUI testing ensures GUI elements of the software are as per approved GUI mock-ups, detailed design documents, and functional requirements.

B. *Test cases*: We have carried out testing over several test cases. Following are the important test cases of our project:

Occlusion: Face mask is detected even if a person is wearing several accessories like spectacles.

Multiple faces: System is able to check the face masks even if more than one person is present in the frame.

Different types of masks: System detects masks of different types such as surgical masks, colored masks, etc.

Proper wearing of mask: System detects as wearing mask only if the mask is properly covering nose and mouth region.

C. Applications:

The face detection model can be used for attendance purpose in institutions like colleges and other educational centers and also check whether student is wearing mask or not.

This system can be of great importance at airports to detect travelers whether they are wearing mask or not. It can be integrated with CCTV cameras and that data may be administered to see if their staff is wearing mask or not.

This system can help in maintaining safety standards to prevent the spread of Covid-19, to detect whether the person is wearing mask or not. Factories and operational plants where people work 24*7 and are exposed to harmful chemicals have the necessity of wearing the mask, where this model would be useful.

D. Strength and Limitations:

The strength of the proposed system is: The proposed system is tested for various Occlusions.

Face mask on the face is detected even with the accessories The limitations of the system are:

The system needs a proper amount of light exposure to detect faces. Proper distance should be maintained between the system and the individual person to detect. Poor image quality limits facial recognition's effectiveness. Small image sizes make facial recognition more difficult. Different face angles can throw off facial recognition's reliability.

B. Comparisons

Existing system: There are many approaches to handle the face detection. Few of them are:

Matching approach: Aims to compare the similarity between images using a matching process. Generally, the face image is sampled into a number of patches of the same size. Feature extraction is then applied on each patch. Finally, matching process is applied between probe and gallery faces.

Other methods detect the key points from the face image, instead of local patches. To accomplish this task, they firstly detect key points and extract their textural and geometrical features. Next, point set matching is carried out to match the obtained features. Finally, the similarity of two faces is obtained through the distance between these two aligned feature sets.

Restoration approach: The occluded regions in the probe faces are restored according to the gallery ones. The detection of the occluded regions is carried out by thresholding the depth map values of the 3D image. Then the restoration is taken on by Principal Component Analysis (PCA).

Discard occlusion-based approach: In order to avoid a bad reconstruction process, these approaches aim to detect regions found to be occluded in the face image, and discard them completely from the feature extraction and classification process.

4. FUTURE SCOPE

Extension of database can be done for our project because when facial detection is used in a crowd, it requires a significant database of profiles against which to compare the main image. As our project is built for real time applications, we can extend the applications by using IOT hardware to attach it to the door or any entry to restrict if not wearing face masks. Entry control can be extended as desired, for example connecting to an automatic door which allows the person to enter only if he is wearing mask.

This project's performance can be increased by using the best GPU and large disk space available in desktops. Our project can still be used after this covid pandemic at chemical factories, operational plants, hospitals etc. where wearing masks is a necessity for people's safety.

5. CONCLUSION

Public use of face masks has been common since the beginning of the new coronavirus disease outbreak. Now that all the sectors are gradually opening it is mandatory for people to wear masks and take preventive measures. We have used public dataset of size 357 mb consisting of around 4120 images of with mask and 4213 images of without masks. We have developed our project in two phases where first phase includes building CNN model and second phase includes real time testing of the model. Our project detects humans whether the person is wearing a mask or not. If not, we have added the feature of warning box to be displayed till the person wears the mask correctly and send the mail to the authorities about the same. These applications can be used for government and social welfare. It is worth stating that this project is not just limited to this pandemic period since a lot of people are self – aware constantly, they take care of their health and wear masks to protect themselves. As such project with this mechanism is very much in need currently, we believe it could give a solution for the health and safety of the society.

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