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FACIAL MASK DETECTION IN SMART CITIES USING DEEP LEARNING AND CNN AGAINST CORONA PANDEMIC

SINGH S.[1]

[1]*Student, Department of Electronic and Communication Engineering, G.B.P.U.A&T, Pantnagar, Uttrakhand*

Abstract - *The world has been fighting with the pandemic of coronavirus with great spirit, with the unlocking phase being in motion. The need to be proactive now is more than ever. Governments all around the world recognized the power of AI and ML in order to fight the pandemic. Since wearing a mask and avoiding crowded places are the only practical alternative until majority of individual are vaccinated. In this paper an approach is presented to restrict the growth of the corona virus by detecting people on streets or any people gathering place and to find who all are not wearing a mask. Deep learning methods are used to train the model based on dataset containing many images of people with mask and without mask. The accuracy achieved with this method at 97% for the mask detection and 96.5% for the unmasked detection, though the accuracy keep varying in the live video*

Key Words: **Artificial Intelligence**, **Computer Vision**, **OpenCV**, **imutils**, **Python**, **Keras**, **MobileNet**

1. INTRODUCTION

More and more strains of the new COVID virus are emerging in various parts of the world and the whole world is suffering from the curse of this global pandemic. The first infected patient of coronavirus was identified in December 2019. Since then, COVID-19 has become a pandemic all over the world [1]. Though many precautionary measures have been taken from than to stop the spread of the virus but wearing the mask is the most effective and simplest among them.

The technique used is to detect the live streams of CCTV or any other monitoring device to know whether a person is wearing mask or not and the approach is somewhat similar to detecting the object. Deep learning techniques are highly used in medical applications [2], [3].

The paper aims to detect the presence of mask on the face of a person and to set a kind of alert if the mask is not found to prevent other persons nearby to have contact with them. The dataset containing thousands of images with people having mask and without mask which will be used to train the model is obtained from Kaggle [4].

From the trained model when video stream input is given it will extract the various frames in it and identify the face in these images and then the learning algorithm Convolutional Neural Network(CNN) is used for feature extraction from the images then these features are learned by multiple hidden layers. Various techniques of Keras, Tensorflow and MobileNet for providing the server interface for the weights are also integrated for the detection of mask.

1.1 Keras

Keras is a minimalist python library for deep learning that can run on top of Theano or TensorFlow [5]. There are three basic guiding principles that are used in the Keras-

1- Modularity- A model that can be understood as a sequence or a graph alone. All the concerns of a deep learning model are discrete components in it which can be combined in arbitrary ways.

2- Minimalism- The library has enough to achieve the outcome and no frills and maximizing readability.

3- Extensibility- The new components are easy to add and are intentionally made in that way so that the researchers can explore and add new ideas in the framework.

1.2 MobileNetV2

MobileNetV2 is a convolutional neural network architecture [6] that has an advantage that it can run on pretty moderate devices or even on mobile phone as well. It is based on an inverted residual structure where the residual connections are made between the bottleneck layers. It uses an intermediate expansion layer that uses lightweight and depthwise convolutions to filter features as a source of non linearity. It contains 32 filters and followed by 19 residual bottleneck layers.

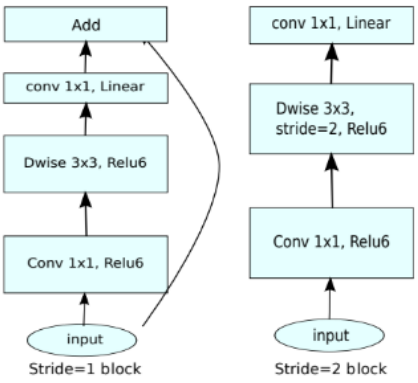

Fig -1: MobileNetV2

2. Methodology

The proposed system is for a smart city to stop the spread of COVID-19 with the help of automated machines. Firstly the CCTV cameras will take the video input from various crowded places and from it the people with and without mask will be identified and then the necessary information will be sent to higher authorities for the desired action. The flowchart of the system is shown in Fig 2

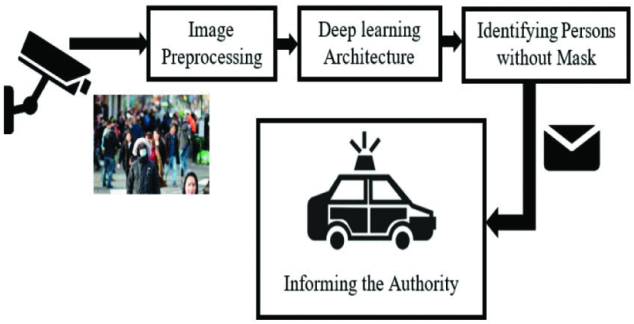

Fig -2: Block Diagram

Image Preprocessing

The images that are captured from the CCTv cameras are in the RGB format that stores 24 bit memory for each photo and contain many insignificant data that is of no use for the machine learning algorithm. So we first convert it into the grayscale image that stores only 8 bit of memory and contain sufficient information needed for the classification. Then the images are reshaped into (64x64) shape to maintain uniformity of the input images. After all this the images are normalized due to which the pixel of the image is constrained in between 0 and 1.

Deep Learning Architecture

The deep learning architecture learns various important non-linear features from the given samples. After the learning of the architecture it is then made to try on the unseen sample. In the architecture CNN and MobilenetV2 are integrated on the data collected and then the model is checked upon the live stream video for the accuracy results.

Dataset collection

The data is collected from source [4] which contains images of people with mask(1915) and without mask(1918) and the train-test split of 80% is done. The sample of photos of people with mask and without mask is shown in fig 3.

WITH MASK

WITHOUT MASK

Fig -3: Dataset collection

Architecture Development

The learning model is based on CNN which is very useful for pattern recognition from images [7]. In it the network consist of a input layer, many hidden layers and an output layer. The hidden layer consist of many convolutional layers that contains suitable filters for the feature extraction process. The features that are extracted by the process are then used by multiple dense neural networks for the classification process and the epoch size is adjusted for the predictions to be made. The table-1 shows the architecture developed. The architecture consist of 3 pairs of convolutional layers each followed by the max pooling layer This layer decreases the spatial size of the representation and thereby reduces the number of parameters. As a result, the computation is simplified for the network. Then, a flatten layer reshapes the information into a vector to feed into the dense network. Three pairs of dense and dropout layers learn parameters for classification. The dense layer comprises a series of neurons each of them learn nonlinear features. The dropout layer prevents the network from overfitting by dropping out units. Finally, a dense layer containing two neurons distinguishes the classes [8]

Table -1: Architecture of learning network

Layer	Type	Kernel	Kernal size
1	Convolution2D	32	(3x3)
2	Convolution2D	32	(3x3)
3	MaxPooling2D	-	(2x2)
4	Convolution2D	32	(3x3)

5	Convolution2D	32	(3x3)
6	MaxPooling2D	-	(2x2)
7	Convolution2D	32	(3x3)
8	Convolution2D	32	(3x3)
9	MaxPooling2D	-	(2x2)
10	Flatten	-	
11	Dense	-	
12	Dropout	-	
13	Dense	-	
14	Dropout	-	
15	Dense	-	
16	Dropout	-	
17	Dense	-	

Screening

The main purpose is to identify the person and inform the higher authorities so that they can take necessary actions and more people will then follow the rules and corona can be controlled upto some extent. The GPS location of the CCTv who gave the information must be sent with the SMS immediately so that the authorities can reach the locality and action can be taken.

Result analysis

The graph showing the epoch and the true value and the accuracy is shown in the chart-1. The 20% samples were used in the testing case The trained model shows 97% accuracy though it will vary as the live stream continues and the red and green boxes are made which indicate the without mask and mask alerts respectively. The snippet of the video stream is shown in fig 4.

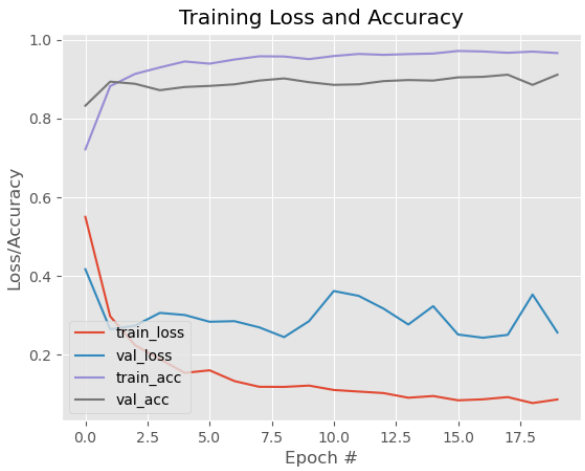

Chart -1: Result analysis

Fig -4: Snippet of the system.

3. CONCLUSION

This paper presented a smart approach with AI to stop the spread of COVID-19 upto some extent. Various previous works had been done in this regard but this system has an approach to alert the concerned authorities to take the necessary steps after the detection. To train the model, labeled image data are used where the images were facial images with masks and without a mask. The proposed system detects a face mask with an accuracy of 97%. The decision of the classification network is transferred to the corresponding authority. The system proposed in this study will act as a valuable tool to strictly impose the use of a facial mask in public places for all people.

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