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Face Mask Detection System

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Abstract – Face Mask Detection System finds important application in the current situation of pandemic. Governments all over the world have made it compulsory to wear a face mask while going in public to reduce the spread of the virus. But unfortunately, many people do not wear face mask while going outside. This face mask detection system can be used to identify those people by installing it on the entrance gate. In this paper, we present a survey of recent work related to face mask detection. We used Convolutional Neural Network (CNN) to build this deep learning model. HAAR cascade frontal face classifier, NumPy, and OpenCV have been used to implement this model. In this model, we used Binary Face Classifier to predict whether a person is wearing a face mask or not. It gives two outputs, one wearing the face mask and the second not wearing the face mask. When a person not wearing face mask appear in front of the camera it displays a warning message and a pop up is displayed mentioning the same. Pop up disappears only when the person wears the face mask. This type of system can be installed on the entrance of many public places. We also identified the challenges we faced and present it for further research opportunities.

Key Words: Face Mask Detection, CNN, Deep Learning, OpenCV, Machine learning, Binary Face Classifier.

1. INTRODUCTION *(Size 11, Times New roman)*

The Covid-19 pandemic has affected the whole mankind regardless of country, gender and religion. Until a vaccine is discovered, we should do our bit to constrain the expanse of the coronavirus. To minimize the spread of the virus governments of many countries have made it mandatory to wear mask while going in public places. But some people do not follow these rules so it has become important to monitor that everyone wears facemask while going in public. In order to make sure that every person is abiding by this most important rule, it is necessary to continuously monitor a crowd of people and making sure they have their face-masks on. Coronavirus has spread all over the world from the last two years. It is believed that novel corona virus has originated from bats in Wuhan, China on the 17th of November 2019 and rapidly spread from one country to another. Being an infectious disease it spreads rapidly from human to human. Those who do not follow the guidelines of the health department can act as a super spreader and can create problem for rest of the society. So to monitor these issues authorities can use this system at CCTV installed on the public places. This facemask detection system helps authorities to ensure the same. As per the study of Union Ministry of Health (MOHFW) and family welfare, 44 percent of people in India do not wear a mask, only 14 percent of people wear it correctly [5]. Statistics show that globally more than 178 million covid-19 cases have been recorded, in which 3.8 million people died.

The paper purpose is to design a face mask detection system which can identify whether a person is wearing a mask or not. The face mask detection system uses image recognition technology to detect the person with or without mask. It can be connected to any surveillance camera system installed at the premise. The authorities or admin can check the person through the system to confirm their identity. The system sends an alert message to the authorized person if someone is trying to enter the premise without a face mask. The accuracy of detecting a person with a face mask can be improved. The data has been transferred and stored automatically in the system to enable reports whenever required. When a person approaches an entrance he will face the camera mounted at the entrance. The Face Mask Detection System will detect the face and show a message whether he is wearing a mask or is without mask. When the person is not wearing mask entry will not be allowed to him and an alert will be generated to wear mask in order to get entry. After denying entry authorities or admin can get a message or email about the violation of the rule, depending upon the choice.

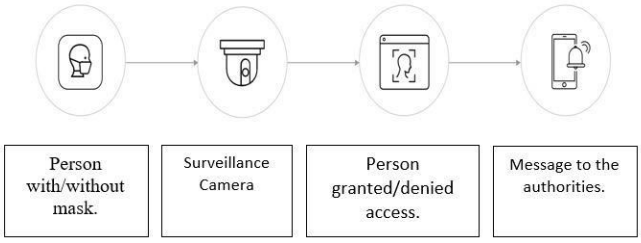

Fig -1: Work Flow

2. LITERATURE REVIEW

The developed system is a real time system. It uses image processing and OpenCV for face mask detection. Deep learning technique has been useful for big data analysis and has its applications in computer vision, pattern and speech recognition, etc. [6]. According to the paper 'Binary Face Classifier', given by Toshanlal Meenpal, Ashutosh Balakrishnan, Amit Verma [1]. They performed experiment on Multi Parsing Human Dataset and obtained Accuracy of 93.884%. In this paper they used Gradient for training while Binomial cross Entropy used as a loss function. Further the output image from the FCN is processed to remove the unwanted noise and avoid the false predictions if any and make bounding box around the faces. The main feature of that modal was to detect multiple faces from a single frame. Another paper 'Detecting Masked Faces in the Wild with LLE-CNNs' introduced by Shiming Ge, Jia Li, Qiting Ye, Zhao Luo [2]. They introduced dataset i.e. MAFA and LLE – CNNs for masked face detection. The model consists of 3 separate modules. Pre-trained modal for extract candidate facial regions from the input image, and represent them with high dimensional descriptors, Embedding Modal is incorporated to turn such descriptors into a similarity-based descriptor by using locally linear embedding (LLE) algorithm, and Verification Modal for identify candidate facial regions and refine their positions by jointly performing the classification and regression tasks within a unified CNN. Another Paper 'Retina Face Mask Detection or Noval Face Mask Detector' was introduced by Mingjie Jiang, Xinqi Fan, Hong Yan in 2020 [3]. The architecture of Retina Face Mask consists of Resnet and MobileNet as the backbone. "Real-time face mask identification using Facemasknet deep learning network which is Deep Learning Method" has been introduced by Madhura Inamdar and Ninad Mehendale [4]. Facemasknet gives highest accuracy of 98.6% among all the previous papers. The modal uses three class classification – a person is wearing a mask or improperly worn mask, or no mask detected. The proposed model can work with still images and also works with a live video stream. Case of improperly worn mask arises when the nose and mouth are partially covered. Excellent feature of this modal is that it is less complicated and it works on still as well as live video streams.

3. METHODOLOGY

Our methodology has mainly two parts, first one deals with building the model and second one is using that model to predict whether someone is wearing a mask or not. In this face mask detection system we used convolutional neural network (CNN) to build the face mask detector model.

First module is further divided into following three parts:

A. Data Preprocessing - In this part we first load the data. Dataset is divided into two parts one part is with mask and other one is without mask. Which is further divided for training and testing purpose respectively. After loading the dataset we performed data preprocessing. We converted the images into grayscale using cvtColor function. After grayscaling we normalized images by dividing with 255.0. Since the labels (with_mask and without_mask) are in textual form, we performed one hot encoding to convert it into binary labels.

B. Building the CNN Model – We used the Sequential API of the Keras package to build the CNN Model. It contains 2D convolution layer, ReLU as activation function and Max pooling to reduce the feature maps. ReLU stands for Rectified Linear Unit and is a commonly used activation function in deep learning. It returns zero for any negative input and for non-negative input it returns the value itself. Flatten and dropout layer reduce the overfitting. We used softmax classifier to get the probabilities of each class.

C. Training the CNN Model – Once the model is built using CNN, it gets trained on the GPU. For training purpose we used Adam as optimizer and value of learning rate as 0.001. Adam optimization is an stochastic gradient descent method which is based on estimation of first and second order moments.

In second module we are using OpenCV, NumPy and tkinter. Load_model function of the TensorFlow has

been used to load the already trained deep learning model. Using tkinter we are displaying the pop up when someone is not wearing mask. We are using haar cascade frontal-face to detect the face of a person.

Haar cascade classifier is based on machine learning technique. In this classifier, cascade function is trained on a lot of images. After the training it is used to detect objects in other images. To detect the face we used haarcascade_frontalface_default.xml file. First we load this xml file using CascadeClassifier function of OpenCV. In the second step we take live video feed from camera frame by frame and convert the images into grayscale. We convert the images into grayscale because it is computationally less intensive since it contains only one channel of black-white. Then detectMultiscale function is used to find the features in new images. This function returns four values – x-coordinate, y-coordinate, width and height. Using these values rectangle is drawn around the face.

Once the face is recognized, CNN model will be used to predict whether person is wearing the mask or not. And accordingly results will be shown.

4 ARCHITECTURE

This face mask detector follows the following architecture:

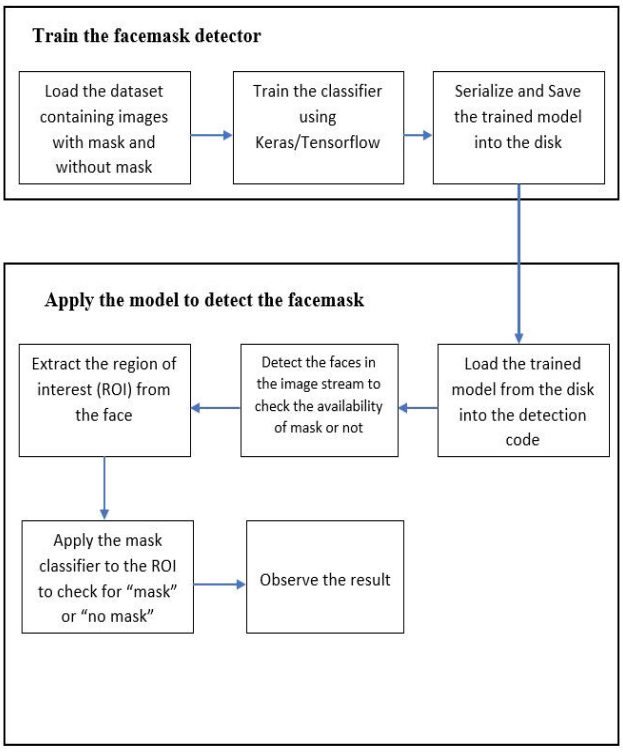

Fig -2: Architecture

4. CONCLUSION

This paper studies other papers related to face mask detection system and presents a solution to detect whether a person is wearing a mask or not. This provide a solution to the problem of monitoring the public at a large scale.

In this we started with data which contain with and without mask images, build the CNN model using Keras sequential model and TensorFlow as backend. And then trained it on GPU. Then loaded the trained model with OpenCV and haarcascade frontal face classifier to detect the mask on person's face. We have been able to achieve 98% accuracy with 20 epochs although the validation accuracy is 86%.

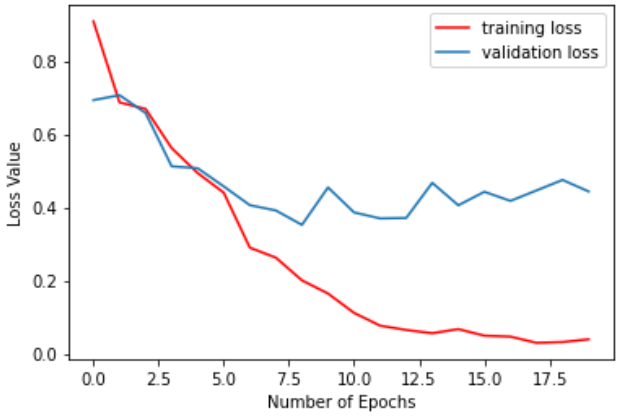

Fig -3: Loss

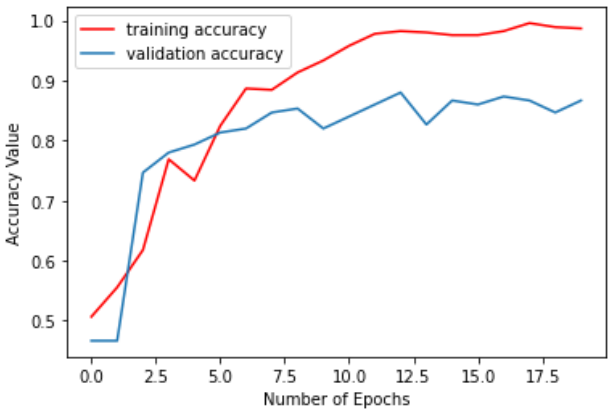

Fig -4: Accuracy

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