ISSN 2278-3091
Volume 10, No.3, May - June 2021
International Journal of Advanced Trends in Computer Science and Engineering
Available Online at http://www.warse.org/IJATCSE/static/pdf/file/ijatcse051032021.pdf
https://doi.org/10.30534/ijatcse/2021/051032021

Face Mask Detection

Justin Ipe Abraham[1], Celia Mary Augusty[2], Gayathri Devi S[3], Greeshma Gopan[4], Greeshma Sabu[5], Libin M Joseph[6]

[1]PG Student,Department of Computer Applications-,Saintgits College of Engineering(Autonomous) Pathamuttom Kottayam Kerala,India, justinabraham36@gmail.com

[2]PG Student,Department of Computer Applications-,Saintgits College of Engineering(Autonomous) Pathamuttom Kottayam Kerala,India, celiamaryaugusty1998@gmail.com

[3]PG Student,Department of Computer Applications-,Saintgits College of Engineering(Autonomous) Pathamuttom Kottayam Kerala,India, gayathridevineduvelil@gmail.com

[4]PG Student,Department of Computer Applications-,Saintgits College of Engineering(Autonomous) Pathamuttom Kottayam Kerala,India,greeshmagopan27@gmail.com

[5]PG Student,Department of Computer Applications-,Saintgits College of Engineering(Autonomous) Pathamuttom Kottayam Kerala,India, igreeshmasabu@gmail.com

[6]Assistant Professor,Department of Computer Applications-,Saintgits College of Engineering(Autonomous) Pathamuttom Kottayam Kerala,India, libin.mj@saintgits.org

ABSTRACT

Businesses are constantly overhauling their existing infrastructure and processes to be more efficient, safe, and usable for employees, customers, and the community. With the ongoing pandemic, it's even more important to have advanced applications and services in place to mitigate risk. For public safety and health, authorities are recommending the use of face masks and coverings to control the spread of Coronovirus. The COVID-19 pandemic is devastation to the mankind irrespective of caste, creed, gender, and religion. Using a face mask can undoubtedly help in managing the spread of the virus. COVID-19 face mask detector uses deep learning techniques to successfully test whether a person is wearing a face mask or not. Using a deep learning method called Convolutional Neural Network, got an accuracy of 98.6 %. It can work with still images and also works with a live video stream. Cases in which the mask is improperly worn are when the nose and mouth are partially covered is considered as the mask is not worn. Our face mask identifier is the least complex in structure and gives quick results and hence can be used in CCTV footage to detect whether a person is wearing a mask perfectly so that he does not pose any danger to others. Mass screening is possible and hence can be used in crowded places like railway stations, bus stops, markets, streets, mall entrances, schools, colleges, etc. By monitoring the placement of the face mask on the face, we can make sure that an individual wears it the right way and helps to curb the scope of the virus.

Key words : Coronovirus, COVID-19,face mask detector, Convolutional Neural Networks

1. INTRODUCTION

The world is fighting the Covid-19 pandemic. There is so much essential equipment to fight against Coronavirus. One of the most essential is Face Mask. Firstly face mask was not mandatory for everyone but as the day progresses scientists and doctors have recommended everyone to wear a face mask.

Now to detect whether a person is wearing a face mask or not, we will use a face mask detection technique Wearing a face mask will help prevent the spread of infection and prevent the individual from contracting any airborne infectious germs. When someone coughs, talks sneezes they could release germs into the air that may infect others nearby. Face masks are part of an infection control strategy to eliminate cross-contamination. The trend of wearing face masks in public is rising due to the COVID-19 coronavirus epidemic all over the world. Before Covid19, People used to wear masks to protect their health from air pollution. While other people are self-conscious about their looks, they hide their emotions from the public by hiding their faces. Scientists proofed that wearing face masks works on impeding COVID-19 transmission we introduce a face mask detection model that is based on deep learning and convolution neural networks.

2. LITERATURE SURVEY

Sammy V. Militante and Nanette V. Dionisio [1] proposed the project “Real-Time Facemask Recognition with Alarm System using Deep Learning”.

In this research study, deep learning techniques are applied to construct a classifier that will collect images of a person wearing a face mask and not from the database and differentiate between these classes of facemask-wearing and not facemask-wearing. The artificial neural network has been demonstrated to be a vigorous procedure for feature extraction from unprocessed data. This study proposes the use of a convolutional neural network to design the facemask classifier and to include the effect of the number of the convolutional neural layer on the prediction accuracy. This project is implemented in a Raspberry Pi using OpenCV, TensorFlow, and Python programming language. Raspberry Pi (RPi) is designed as a Chip System (SoC) where the critical circuits such as the Central Processing Unit(CPU), the Graphics Processing Unit (GPU), input, and output are carried by a single circuit board. The GPIO pins provide an essential element to help enable the RPi to be accessible to hardware programming for controlling electronic circuits and data processing on input/output devices. Add a power adapter, keyboard, mouse, and monitor that works on the Raspberry Pi in compliance with the HDMI connector. New models are available to interact via WiFi to the internet. The RPi can be run using the Raspbian operating system.

The first step of the real-time facemask recognition system is image acquisition. High-quality images of the person posing with facemask wearing and not wearing facemask are Face Mask Detection obtained through digital cameras, cellphone cameras, or scanners. A Knowledge-based dataset is created by proper labeling of the captured images with unique classes. The obtained images that will be engaged in a preprocessing step are further enhanced specifically for image features during processing. The segmentation process divides the images into several segments and is utilized in the extraction of facemask-covered areas in the person's face from the background. Feature-Extraction section involves the coevolutionary layers that obtain image features from the resize images and is also joined after each convolution with the ReLU. Max and average pooling of the feature extraction decreases the size. Ultimately, both the convolutional and the pooling layers act as purifiers to generate those image characteristics. The final step is to classify images, to train deep learning models along with the labeled images to be trained on how to recognize and classify images according to learned visual patterns. The authors used an open-source implementation via the TensorFlow module, using Python and OpenCV including the VGG-16 CNN model. supervised model of learning, with training and test sets, divided to 80% for instruction and 20% for research. Three metrics were used to measure the model's performance: accuracy, training time, and learning error. In the conduct of experiments, the input parameters were set equal to 224 according to its input image width and height, batch size during training is set to 64 images and 100 iterations is set to the number of epochs. ADAM optimizer with a learning rate of 0.0001 is set for optimization. The study applies 12,500 images per class and this data is enough to train a deep learning model. The 96% validation accuracy was achieved during the training of the CNN model.

Toshanlal Meenpal, Ashutosh Balakrishnan, and Amit Verma [2] proposed the project "Facial Mask Detection using Semantic Segmentation". This paper proposes a model for face detection using semantic segmentation in an image by classifying each pixel as a face and non-face i.e effectively creating a binary classifier and then detecting that segmented area. The model works very well not only for images having frontal faces but also for non-frontal faces. The paper also focuses on removing the erroneous predictions which are bound to occur. Semantic segmentation of the human face is performed with the help of a fully convolutional network. This paper with the twin objective of creating a Binary face classifier that can detect faces in any orientation irrespective of alignment and train it in an appropriate neural network to get accurate results. The model requires inputting an RGB image of any arbitrary size to the model. The model's basic function is feature extraction and class prediction. The output of the model is a feature vector that is optimized using Gradient descent and the loss function used is Binomial Cross Entropy. a method of obtaining segmentation masks directly from the images containing one or more faces in different orientations. The input image of any arbitrary size is resized to $224 \times 224 \times 3$ and fed to the FCN network for feature extraction and prediction. The output of the network is then subjected to post-processing. Initially, the pixel values of the face and background are subjected to global thresholding. After that, it is passed through a median filter to remove the high-frequency noise and then subjected to a Closing operation to fill the gaps in the segmented area. After this bounding box is drawn around the segmented area. the model consists of a total of 17 convolutional layers and 5 max-pooling layers. The initial image size which is fed to the model is $224\times224\times3$. As the image is processed through the layers for feature extraction it's passed through convolutional layers and max-pooling layers. t the gaps in the segmented region are filled and most of the unwanted false erroneous prediction removed. All the experiments have been performed on Multi Human Parsing Dataset containing about 5000 images, each with at least two persons. Out of these, 2500 images were used for training and validation while the remaining were used for testing the model. this model has also shown great results in recognizing non-frontal faces. Along with this, it is also able to detect multiple facial masks in a single frame. The post-processing provides a large boost to pixel-level accuracy. The mean pixel-level accuracy for facial masks 93.884%.

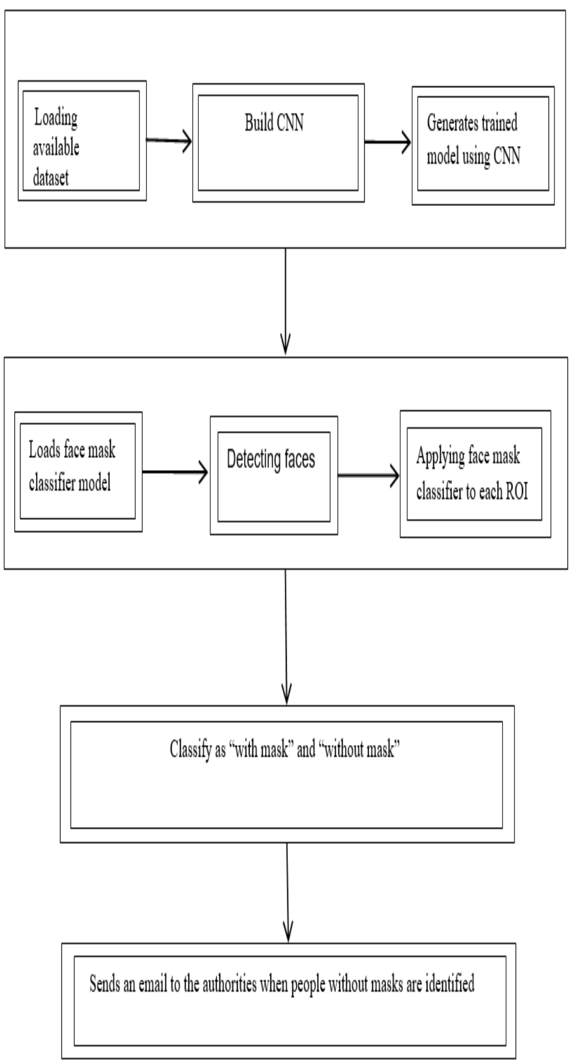
Joshua Gisemba Okemwa Victor Mageto2[3] proposed the project "Using CNN and HOG Classifier to Improve Facial Expression Recognition". Facial expression recognition (FER) is growing in a large scope due to the diversification of its field of application. FER is now applicable in crime prevention, smart city development, as well as other economic sectors like transportation, advertising, and health. Many feature extraction methods and classification techniques have previously been developed to give better accuracy and performance in face recognition. A convolution neural network CNN is an unsupervised deep learning algorithm with the ability to learn image characteristics and make differentiation of one aspect to another. We applied HOG classifier for feature extraction and CNN to detect and classify the expressions. Overall we achieved high accuracy and optimization results of 77.2%. This method achieved higher results than previous work is done using the SVM algorithm and HOG classifier with an accuracy of 55%. The dataset was selected for analysis which contained 35887 images. This open-source dataset was created by Pierre Luc Carrier and

Aaron Courville for the Kaggle competition in 2013. The dataset is made up of 48x48 sized grayscale images with 7 different emotions. The expressions present include anger, sadness, happiness, surprise, neutral, disgust, and fear. Emotions such as Angry, Disgust, Fear, Happy, Sad, Surprise, and Neutral are given indexes as 0, 1, 2, 3,4, 5, and 6. These images were further classified into two groups; the training phase and the testing phase. It was done to verify the performance and accuracy of our results.

3. PROPOSED SYSTEM

The proposed system can be integrated with CCTV cameras and that data may be administered to see if people are wearing masks. When the person appears at the entrance. This person might be wearing a mask or not wearing the mask. The CCTV camera looks for the faces and detects persons without masks. That person will be denied access and he/she could see a message appearing on the screen or panel showing some kind of alert message. The access will be denied till he/she wear a mask. The authorities will be alerted via an email in real-time if the person is not wearing the mask.

4. FLOW CHART



5. TEST REPORTS/COMPARISON REPORTS AND ACCURACY

The experimental results of the system performance are evaluated with the following classifiers and optimizer.

Table 1: Results of the proposed system with Haar cascade classifier:

Classifier	**Filter**	**Optimizer**	**Train Loss**	**Train gain**	**Test Loss**	**Test gain**
Haar Cascade	No Filter used	ADAM	0.2033	0.9960	0.0138	0.9869

From the Table 1 it is observed that performance of ADAM optimizer is good in both training and testing.

Table 2: Results of the proposed system with HaarCascade classifier and Bilateral filter:

Classifier	**Filter**	**Optimizer**	**Train Loss**	**Train gain**	**Test Loss**	**Test gain**
Haar Cascade	Bilateral	ADAM	0.0067	0.9875	0.0557	0.9869

From the Table 2 it is observed that performance of ADAM optimizer with Bilateral filter is not good in both training and testing when compared with ADAM in Haar cascade classifier

Table 3: Results of the proposed system with Haar cascade classifier and Gaussian Filter.

Classifier	**Filter**	**Optimizer**	**Train Loss**	**Train gain**	**Test Loss**	**Test gain**
Haar Cascade	Gaussia n	ADAM	0.0214	0.9826	0.0686	0.9743

From the Table 3 it is observed that performance of ADAM optimizer is good with Gaussian filter.

Result:

From the results of two classifiers it is observed that ADAM optimizer of Haar cascade classifier performance is very good .While testing, it is observed that Haar cascade classifier is yielding the best results with high accuracy.

6. METHODOLOGY

The proposed system uses a transfer learning approach to performance optimization with a deep learning algorithm and a computer vision to automatically monitor people in public places with a camera and to detect people with mask or no mask. We also do fine tuning, which is another form of transfer learning, more powerful than just the feature extraction.

In this process camera video feeds are converted to grayscale to improve speed and accuracy and are send to the model for further processing. We employed a convolutional neural network. The CNN model is a form of neural network that allows us to extract higher representations for image information. Unlike conventional image recognition, which allows you to define the image features manually, CNN takes the raw pixel data from the image, trains the model, and then extracts the features for better classification automatically. CNN uses full pooling to replace output.

7. CONCLUSION

Our work distinguishes face masks from images and live video streams.This classifier can be used to classify images as well as live video streams. Faces were extracted from photographs and videos after they were identified. Then, our face mask classifier was applied to achieve the required results. The green and red rectangular frame respectively represent the detected face and mask. Our face mask identifier has the simplest structure and provides instant results, so it can be used in CCTV footage to determine if an individual is wearing a mask correctly and thus poses no risk to others. In crowded places such as train stations, bus stops, markets, highways, mall exits, schools, colleges, and so on, mass screening is possible and can be used.

8. FUTURE SCOPE

On a CPU, the model currently provides 5 FPS inference speed. We hope to increase this to 15 FPS in the future, making our solution suitable for CCTV cameras without the use of a GPU. In the field of mobile deployment, Machine Learning is becoming increasingly common.. As a result, we want to convert our models to TensorFlow Lite versions. Tensor can be integrated into our architecture.

We believe there are a number of other scenarios that could be included in this approach to provide a more comprehensive sense of security. Here are a couple of the features that are currently being worked on: Coughing and Sneezing Detection, According to WHO guidelines, chronic coughing and sneezing is one of the primary signs of COVID-19 infection and one of the main routes of disease transmission to non-infected people.Coughing and Sneezing Detection: According to WHO recommendations, chronic coughing and sneezing is one of the main symptoms of COVID-19. Secondly, thermal screening is performed with handheld contactless IR thermometers, requiring health workers to come in close proximity to the person to be screened, putting them at risk of infection and making it nearly impossible to capture temperature for each individual.

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