International Journal of Scientific Research & Engineering Trends
Volume 7, Issue 2, March-April-2021, ISSN (Online): 2395-566X

# Survey on Detection and Identification of Face Mask

**J. Jenitta, Shrusti B K, Vidya D Y, Vinay S Sinnur, Shivesh Varma P**
Department of ECE,
AMC Engineering College,
Bangalore, India

***Abstract*- The world is coming out of lockdown and starting its new normal. As Education plays a key role in every student's life, the Government is planning to reopen schools and colleges after the COVID-19 pandemic situation. It is mandatory for the educational institutions to follow Standard Operating Procedure(SOP) to reduce the risk of spread of COVID-19 in the institution campus. In SOP one important point is wearing a face mask because the virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or exhales. These droplets are too heavy to hang in the air, and quickly fall on floors or surfaces. This paper aims to review various state of art methods available to find whether the person who is entering the institution is wearing a face mask or not, using various machine learning techniques.**

***Keywords*- COVID-19, face mask, Machine Learning.**

## I. INTRODUCTION

COVID-19 or Coronavirus has been declared as a pandemic by the World Health Organization (WHO) on 11th March 2020. There was a drastic loss of economic growth of the entire nation around the world. It basically originated as a cluster of cases of pneumonia in the city of Wuhan, Hubei province in China in the beginning December 2019. The common signs of COVID-19 infection are similar to the common cold and include respiratory symptoms such as dry cough, fever and breathing difficulties. This disease is similar to MERS-CoV and SARS-CoV. In more severe cases, infection can cause pneumonia, severe acute respiratory.

Now the entire world is starting a new normal. A new normal is a state to which an economy, society, syndrome & kidney failure and may lead to death. This virus is referred to as SARS-CoV-2 and the associated disease is COVID-19 [1].

The COVID-19 infection is spread from one person to others via droplets produced from the respiratory system of the infected people, often during coughing or sneezing. According to the current scenario, the incubation period of COVID-19 symptoms is usually between two to fourteen days, with anaverage of five days. As of 7 November 2020, over 49,708,031 cases have beenidentified globally in 221 countries with a total of over 1,251,009 fatalities. Also 35,026,214 were recovered from the virus [2] etc. settles following a crisis, when this differs from the situation that prevailed prior to the start of the crisis.

All citizens have started working and the educational institutions are about to reopen. This may lead to the spread of COVID-19 at a faster rate. To counter the transmission of the virus, the World Health Organization (WHO) enforced people to follow certain protocols such as maintaining social distancing in public places, wearing face masks is mandatory and sanitizing hands & to be hygienic. To prevent the spreading of COVID-19, wearing a face mask is one of the essential and effective methods [3].

The trend of wearing face masks in public areas has risen since the spread of COVID-19 pandemic. Earlier, people used to wear masks to protect their health from air pollution. Scientists have proved that wearing face masks work on the impending COVID-19 transmission. Lawmakers are facing a lot of challenges and risks in facing the spreading and transmission of viruses. People are forced by the government to wear face masks in public in many countries.

These rules were developed as an action to reduce the exponential growth in cases and deaths in many areas. The process of monitoring the people is becoming a tough task to handle. The monitoring process involves the detection of any person who is not wearing a face mask and sending information to higher authorities [4].

In this paper, the face mask detection is done using machine learning classification and Convolutional Neural Networks (CNN) algorithms. The alert notification is done by IOT techniques. In this research study, using proposed feature extraction with machine learning classifier algorithms face mask detection is implemented.

This study also proposes the CNN to design the facemask classifier and to get higher accuracy in detection of face masks.The organization for the rest of the paper is as follows. Section 2 reviews previous related works and Section 3 presents the conclusions and possibilities of future work.

© 2021 IJSRET

## II. RELATED WORK

Face construction and identity recognition when wearing face masks is very difficult in the current scenario. In this research paper our focus is on detecting and recognizing the people who are not wearing face masks to help in decreasing the transmission and spreading of the COVID-19. Researchers and scientists have proved that wearing face masks help in minimizing the spreading rate of COVID-19.

**Wei Bu et al. [5]** proposed a masked face detection algorithm. Detecting masked faces accurately and effectively is increasingly meaningful, since it can be applied on tracking and identifying criminals or terrorists. This is a CNN based cascade structure face detector. It consists of three convolutional neural networks –"Mask - 12","Mask-24-1" and"Mask-24-2", each of which is a binary CNN classifier with classification ability from low to high. After sending an image into the detector, the three CNNs will evaluate the image and eliminate the false detection windows by sequence, after each CNN, Non Maximum Suppression (NMS) is employed to merge highly overlapped candidate windows. Testing onthe MASKED FACE has achieved the best performance of 86.6% accuracy at 87.8% recall, some qualitative detection results.

**Gayatri Deore et al. [6]** Proposed a method for masked face detection using four different steps of estimating distance from camera, eye line detection, facial part detection and eye detection to detect if a person is wearing a mask or not. If a person is detected, but their face is not detected, it is a mask. Analysis of the algorithm's performance on test video sequences which gives useful insights to further improvements in the masked face detection performance. From four different aspects the accuracy of each is different where Distance from camera is 90%, Eye line detection with 69.8%, Facial part detection with 46.6%, and Eye detection with 40% accuracy. When a person is wearing a mask or face is covered with hand or cloth, detection of face might not take place in certain cases.

**Mohammad Marufur Rahaman et al. [7]** Proposed a technique to find out whether someone is wearing a mask or not in this paper. Public places in a smart city network are monitored by CCTV cameras. When a person without a mask is detected, then the issue is reported to the authority of the city network. The images captured by CCTV cameras are processed and normalized.

Convolutional Neural Network (CNN) is used as a deep learning architecture. The proposed system detects a face mask with an accuracy of 98.7%. The developed system faces difficulties in classifying faces covered by hands, people travelling on vehicles and there may be problems like system failure in the network when sending SMS to authority. Furthermore, people near to the person not wearing a mask may be alerted by an alarm signal on that location and displaying the rule violator's face in a LED screen would be a further study.

**Md. Sabbir Ejaz and Md. Rabiul Islam [8]** have proposed an approach in detecting the face mask. They used Masked face Database from IIIT-Delhi face database. The face detection problem has been detected by Multitask Cascaded Convolutional Neural Network (MTCNN) which is used to detect and align faces from an input image. It consists of three networks cascading models, namely P-Net network, R-Net network used for bounding boxes and O-Net network, which can perform classification of face, regression of the bounding box and localization of facial landmarks. The facial feature extraction is performed by using the Google FaceNET embedding model. The facial recognition is performed using the Support Vector Algorithm (SVM). The test accuracy of masked and non-mask face detection using FaceNET is 98.50%. It is found that when the complexity increased the detectiondecreased to 90.24%. FaceNET model implies that it gives better accuracy for simple masked facerecognition.

**Bima Sena Bayu Dewantara and DhiskaTwinda Rhamadhaningrum [9]** proposed Adaptive Boosting (AdaBoost) and Cascade Classifier based methods to detect someone wearing a mask or not on various facial poses. There are many methods available for object detection, in that some of the popular methods are Haar-like features, Local Binary Pattern (LBP) and Histogram of Oriented Gradient (HOG). Haar like feature is used to distinguish objects, LBP is a feature used to describe a surface texture of an object, HOG is a feature in the form of histogram visualization.AdaBoost and Cascade Classifier are used for filtering object features. Based on the results the accuracy obtained are 86.9%, 81.7% and 74.5% for Haar like features, LBP and HOG methods respectively. This paper uses static images from the dataset hence for future work we need to combine the system with face detection used in real terms.

**Shuang Li et al. [10]** proposed a head pose classification using HGL method, it is a combination of H-channel of the HSV color space and with the face portrait and grayscale image, the CNN is trained to extract features for classification. This method distinguishes the face and mask in the image. The evaluation on MAFA dataset shows that the proposed method has achieved a better performance (Front accuracy: 93.64%, Side accuracy: 87.17%).

**Md. Raffiuzzaman Bhuiyan et al. [11]** proposed an approach to detect face masks. They had acquired data of 650 images using a web-scraping tool from the website. The data annotation is done using LabelIMG. YOLOv3 is used for object classification and detection. YOLOv3 uses

© 2021 IJSRET

Darknet-53 for feature extraction. An input image is passed into YOLOv3 where the object detector is going through the images and finds the coordinates that are present in the image. It basically divides the input images to grid and from that object features are targeted and the resultant output is produced. Google Colaboratory is used for training purposes. The experimental results show that an average loss of 0.0730 is obtained after 4000 epochs with detection accuracy of 96%. Later they applied this model into real time video; they obtained an average fps output of 17. The dataset which they have collected does not contain any complexity in the images.

Table 1. Existing face mask detection systems using image processing techniques.

| S.No | Objectives | Feature extraction | Classifier | Accuracy | Feasibility | Author | Year |
|---|---|---|---|---|---|---|---|
| 1 | Masked face detection | CNN (Mask-12, mask-24-1,mask-24-2) | Binary CNN classifier | 87.8% | The test images are evaluated in PASCALvisual object classes. | Wei Bu et al.[5] | 2017 |
| 2 | Masked facedetection | Histogram of gradients (HOG) | AdaBoost training andcascade | Distance from the camera- 90% | Facial part detection is robust and time consuming when wearing a face mask. | Gayatri Deore et al.[6] | 2016 |
| 3 | Facial maskdetection in smart city network | CNN | Binary classifier | 98.7% | The area under the ROC curve measures the performance of thebinary classifier. Complex network. | M. M. Rahaman et. al. [7] | 2020 |
| 4 | Masked facerecognition | FaceNet model | Support VectorMachine (SVM) | 90.24% | This face detection method has benefits over different lighting conditions, poses and visual variations of the face. | Md. SabbirEjaz et al. [8] | 2019 |
| 5 | Detecting multipose masked face | Haar like feature, LBP, HOG | AdaBoost andCascade Classifier | Haar like feature-86.9% | GPU is needed. Haar-like feature and the HOG feature with a relatively constant computing time below30 msec for all image sizes. | B.S. Bayu Dewant ara et al. [9] | 2020 |
| 6 | Multi-angle head pose classification | CNN | Softmaxclassifier | HGL method ,Front face - 93.64% Side face-87.17% | To classify the head pose into front face and side face in videoanalytics. Less complex. | Shuang Li etal. [10] | 2020 |
| 7 | Face maskdetection using YOLOv3 | YOLOv3 | YOLOv3 | 96% | Annotation of images consumes more time. In real-time video analysis it produces output with average fps. | M.R. Bhuiyan et al.[11] | 2020 |
| 8 | Face maskdetection | ResNet-50 | Decision Trees,SVM, Ensemble | SVM classifier, RFMD- 99.64% SFMD- 99.49% LFW- 100% | More complex. Consumes less timefor training and detection. | MohamedLoey et al.[12] | 2020 |

**Mohamed Loey et al. [12]** introduced a mask face detection model that is based on deep transfer learning and classical machine learning classifiers, it consists of two components. The first component is designed for feature extraction using Resnet50 and the second component is designed for the classification process of face masks using classical machine learning algorithms. The Authors used three different types of dataset namely, Real-World Masked Face Dataset (RMFD), Simulated Masked Face Dataset (SMFD) and Labeled Faces in the Wild (LFW).

There are three types of machine learning classifiers, namely Decision Trees, Support Vector Machine (SVM) and Ensemble methods. The SVM classifier gives the highest testing accuracy (99.64%, 99.49% and 100%

© 2021 IJSRET

testing accuracy in RMFD, SMFD, and LFW respectively) and it consumes less time in the training process.

The Table 1 shows the comparative study of all the existing methods of face mask detection techniques discussed in this paper. The method used in [5] depends on the distance between camera and image, and that disadvantage is overcome in [6]. In [6] the accuracy is less and a time consuming process are the drawbacks. This drawback is overcome in [7]. Images of masks induced with hats, sunglasses, mustache etc are easily classified in [8]. Multi pose mask detection and multi- angle face recognition when wearing face mask is not possible in the above mentioned methods it is overcame by the [9] and [10] respectively. The methods used in [11] and [12] classify the images more accurately with less and more different types of images respectively.

## III. CONCLUSION

This paper gives a comparative study of various methods of CNN's and machine learning techniques for the detection and identification of a person wearing a face mask, to prevent the spread of COVID-19. The detection of frontal face masks with various types of datasets using tools like CNN's, Google FaceNET and YOLOv3 gives above 98% of testing accuracy, the detection of face masks in multipose andmulti angle using AdaBoost andcascadeclassifiers and HGL method with CNN gives 90% of frontal accuracy and 87% of side accuracy. The SVM classifier gives the highest testing accuracy of 99.64%, 99.49% and 100% testing accuracy in RMFD, SMFD, and LFW respectively and it consumes less time in the training process along with CNN.

These methods can therefore be used in real- time applications which require face-mask detection for safety purposes due to the outbreak of COVID-19. These approaches can be integrated with embedded systems for application in airports, railway stations, offices, schools, and public places to ensure public safety.

## REFERENCES

[1] Wu, Yi-Ch; Chen, Ching-Sung; Chan, Yu-Jiun, Journal of the Chinese Medical Association: March 2020 Volume. 83 Issue. 3 p: 217-220, doi:10.1097/ JCMA.0000000000000270

[2] S. V. Militante and N. V. Dionisio, "Real-Time Face mask Recognition with Alarm System using Deep Learning," 2020 11th IEEE Control and System Graduate Research Colloquium (ICSGRC), Shah Alam, Malaysia, 2020, pp. 106- 110.doi: 10.1109/ ICSGRC49013.2020.9232610

[3] S. Feng, C. Shen, N. Xia, W. Song, M. Fan, B.J. Cowling, Rational use of face masks in the COVID-19 pandemic, Lancet Respirat. Med. 8 (5) (2020) 434–436, https://doi.org/10.1016/S2213-2600(20) 30134-X.

[4] M. Loey, F. Smarandache, N.E.M. Khalifa, Within the lack of chest COVID-19 X-ray dataset: a novel detection model based on GAN and deep transfer learning, Symmetry 12 (4) (2020) 651.

[5] W. Bu, J. Xiao, C. Zhou, M. Yang and C. Peng, "A cascade framework for masked face detection," 2017 IEEE International Conference on Cybernetics and Intelligent Systems (CIS) and IEEE Conference on Robotics, Automation and Mechatronics (RAM), Ningbo, 2017, pp. 458-462. doi: 10.1109/ICCIS. 2017.8274819.

[6] G. Deore, R. Bodhula, V. Udpikar and V. More, "Study of masked face detection approach in video analytics," 2016 Conference on Advances in Signal Processing (CASP), Pune, 2016, pp.196-200. doi:10.1109/CASP.2016.7746164

[7] M. M. Rahman, M. M. H. Manik, M. M. Islam, S. Mahmud and J. -H. Kim, "An Automated System to Limit COVID-19 Using Facial Mask Detection in Smart City Network," 2020 IEEE International IOT, Electronics and Mechatronics Conference (IEMTRONICS), Vancouver, BC, Canada, 2020, pp. 1-5. doi:10.1109/IEMTRONICS51293.2020.9216386

[8] M. S. Ejaz and M. R. Islam, "Masked Face Recognition Using Convolutional Neural Network," 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI), Dhaka, Bangladesh, 2019, pp. 1-6. doi: 10.1109/STI47673. 2019.9068044.

[9] B. S. Bayu Dewantara and D. Twinda Rhama dhaningrum, "Detecting Multi-Pose Masked Face Using Adaptive Boosting and Cascade Classifier," 2020 International Electronics Symposium (IES), Surabaya, Indonesia, 2020, pp. 436- 441.doi: 10.1109/IES50839.2020.9231934.

[10] S. Li et al., "Multi-angle Head Pose Classification when Wearing the Mask for Face Recognition under the COVID-19 Coronavirus Epidemic," 2020 International Conference on High Performance Big Data and Intelligent Systems (HPBD&IS), Shenzhen, China, 2020, pp. 1-5, doi:10.1109/HPBDIS49115. 2020.9130585.

[11] M. R. Bhuiyan, S. A. Khushbu and M. S. Islam, "A Deep Learning Based Assistive System to Classify COVID-19 Face Mask for Human Safety with YOLOv3," 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Kharagpur, India, 2020, pp. 1-5. doi: 10.1109/ICCCNT49239.2020.9225384.

[12] Mohamed Loey, Gunasekaran Manogaran, Mohamed Hamed N. Taha, Nour Eldeen M. Khalifa, "A hybrid deep transfer learning model with machine learning methods for face mask detection in the era of the COVID-19 pandemic", 0263-2241/© 2020 Elsevier Ltd. https://doi.org/10.1016/j.measurement.2020. 108288.

© 2021 IJSRET