DETECTION OF FACE MASK AND GLASS USING DEEP LEARNING ALGORITHM

Kavin Bharathi[1] and Savithadevi M[2]

[1]Vellore Institute of Technology, Chennai
[2]National Institute of Technology, Tiruchirappalli

ABSTRACT

The rapid spread of the coronavirus has been a major health concern for the entire world. Direct human contact is one of the key factors contributing to the virus's rapid transmission. Wearing face masks in public areas is one of the numerous precautions that may be taken to stop the spread of this infection. To reduce the chance of the virus spreading, it is important to find ways to detect face masks in public locations. An automated system for face mask detection utilizing deep learning algorithm has been presented to address these issues and effectively stop the spread of this contagious disease. The proposed method combines a face mask identification model and a glass detection model using an algorithm to assess the results using deep learning models.

KEYWORDS

Face Mask Detection, Glass Detection, Convolution Neural Network

1. INTRODUCTION

For practically everyone, the COVID-19 pandemic had introduced a new way of life. To avoid contacting the virus, the World Health Organization (WHO) advised keeping a safe distance from others and wearing a mask when going out. Nevertheless, a lot of people are still seen in public spaces without face masks, which increases the spread rate of COVID-19. According to a report by Economic Times India, "90% of Indians are aware, but only 44% are wearing a mask."[13] According to this survey, people are aware of the consequences of not wearing a mask but yet choose to disregard it. This carelessness causes COVID19 to spread quickly.

It is very challenging to identify persons who are not wearing a mask and advise them to do so in densely crowded areas, as is the situation with big cities in India. As a result, image processing methods and methodologies has been used in this project to determine whether or not people are wearing face masks. To determine whether someone is wearing a face mask or not, real-time photos from a camera feed are gathered and put up for comparison with a trained dataset. People wearing and not wearing face masks will be detected by the algorithm developed using a training dataset. It can also be used for security purposes as forgery and thefts. The algorithm can identify if customers entering a bank are wearing a mask and remove it.

The immigration section of airports is always very slow to respond to people. There is always a huge crowd at the immigration. The process seemed simple, take a photo of the person. This was the step that usually took very long. There are few automated airports where there wouldn't be an officer interacting with the person. But security would inform us to remove the face mask and any other accessories on the face like glass or hat.

DOI:10.5121/cseij.2022.12602

The automated camera would proceed to take pictures even if the passenger has accessories on their face. For mitigating this issue, this paper has tried to add a filter that would inform the passenger to remove masks or glasses accordingly.

The method to make the detector is by first detecting the faces in real time. Afterward, a classifier is applied after saving the frames that include the faces that were identified from the webcam stream. The next section has a discussion of the many classification algorithms that can be utilized.

2. LITERATURE REVIEW

The researchers focused on development of mask detection models to prevent the spread and prevent the pandemic. With the ease of deep learning algorithms to classify the image and detect the face or specific objects.

Joseph Redmon put forth the "You Only Look Once" (YOLO) method of real-time object detection. It is one of the fastest algorithms. The primary benefit of YOLO is its ability to process frames at a pace of 45 frames per second (larger networks) to 150 frames per second (smaller networks), which is faster than real-time and improves the network's ability to generalize the image. However, in comparison to Faster Recurrence Convolution Neural Network (R-CNN), it has a lower recall and higher localization error, and fails to recognize nearby or small objects because each grid can only suggest two bounding boxes.

Sanzidul Islam developed a classification system for COVID- 19 Face Masks based on a Raspberry Pi 3. This method was able to integrate a mask detection model to a machine which was extremely lightweight in terms of raw power. It was well optimized, but since raspberry pi 3 itself isn’t very powerful,it can’t get around that. The author made an app for mobile phones name Blynk that would vibrate and alert anyone nearby if it detects anyone who are not wearing masks.
Velantina developed a COVID-19 facemask detection using a Caffe model. The models are not actively developed. But they are able to provide remarkable accuracy.

Senthil Kumar compared the Support Vector Machine (SVM) and K-Nearest Neighbor (KNN) algorithms and proposed a speedier approach for facial identification. It is the quickest way for detecting an image's edge. The SVM-KNN approach makes more accurate predictions than the other methods do on average. This method shows promise as a practicable future forecasting model. Despite the photographs' poor clarity and resolution, Hai Huanga offered a method for finding sea species that works quite well. This model was able to clearly find a portion of the image such as animals or plastic underwater. This helps to get a clear idea of what’s happening underwater. He simulated underwater conditions and obtained dataset for his work and also got a few pictures from the National Natural Science Foundation of China.

Alberto Fernandez Villian had developed an algorithm based on the alignment method to detect glasses on photos. The main localization works satisfying, but it also shows a few main problems because of the large differences of the input data (skin color, eyeglasses shape and color, shape of face, etc.). There are still examples of eyeglasses which cannot be detected correctly at all (e.g., frameless eyeglasses).

3. Proposed Method

Officers find it exceedingly challenging to manually observe people to determine whether or not they are wearing masks. Therefore, in this method, a webcam is used to identify faces and stop the spread of viruses. Preprocessing and classification activities are included in the proposed face mask and glass detection model. Fig.1 shows the architecture of the proposed systems.

Preprocessing The real time video input is captured and processed to detect the face, mask,and glass. The Video is extracted to image format in rreal-timeand then scaled to athe ppropriate size by resizing them. The image is enhanced using MobileNetV2, InceptionResnetV2 and Xception preprocessing. Canny segmentation technique is used to highlight the foreground components for easier identification. (Figure 1).

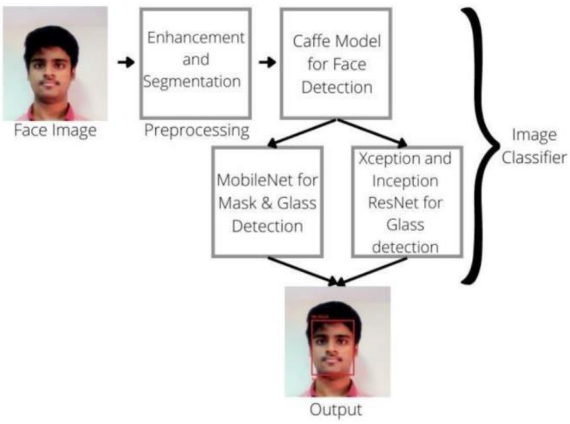


Figure 1 Architecture of the overall proposed system

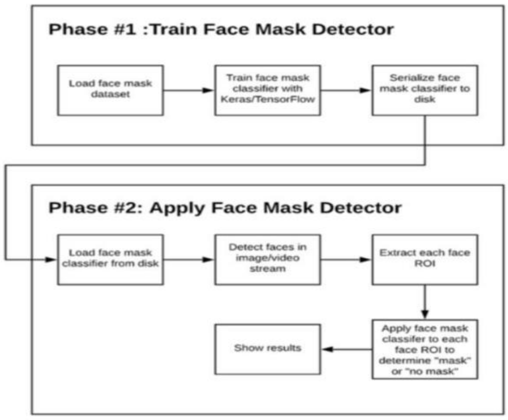


Figure 2 Face Mask Architecture

Classification: The preprocessed input is fed to the detector to detect face, mask and glass using different deep neural network architecture.

i) Mask detector

Firstly, the face mask dataset is loaded and split it into half for training purposes. The next step is to train the model using this dataset with the help of TensorFlow and Keras. The model is then compiled and saved to the disk. For detecting if a person is wearing mask, the mask from disk is loaded and used to detect for mask in the given input (in this case being input from webcam. The model then classifies if the input has mask worn or not and display it on screen with an overlay.

ii) Glass detector

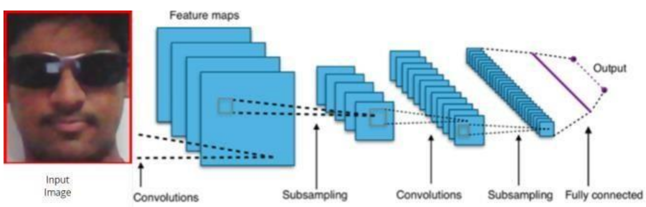


Figure 3 Glass detection Architecture

The Model training: A folder containing "with masks" and "without mask" photographs is used to train the model to identify between people wearing "masks" and those who aren't. Similarly, a folder named "glass" and "without glass" is utilized to identify those who are wearing eyeglasses. The model is evaluated for its capacity to recognize and categorize masks and no-masks, glass and no-glass that were present in the original photographs using the test folder. Finally, the code for detecting mask or glass from a camera feed is given that integrates both the models together. It has fast and high accuracy.

4. Experimental Results & Analysis

The proposed model is implemented and executed using an Intel Core i7 processor, an Nvidia Geforce GTX 1660 Ti graphics card running on Windows 11 Operating System.

Dataset collection: A dataset is created from images from multiple sources. Applying data improvement techniques can increase the size of datasets. A variety of techniques are used to build bounding boxes, also referred to as "data annotations," around a region of interest. Pictures are labelled as "mask" or "No mask" and "glass" or "No Glass."
The results of the proposed method are shown in the Fig 7,8,9 and 5. It is noted that the program can effectively categorize between people wearing a mask and a glass. It is able to produce such results with remarkable accuracy.

The Glass detection model had very weak confidence level of 45% on only using MobileNetV2. On repeating the process using Xception and InceptionResNetV2, the results were similar. The three layers were densened and the average of the layers were considered. This gave 91% confidence for detection of mask and glasses. The architecture of all the 3 modules is given below. (Fig – 4,5,6). The image detection has been improved by using canny filter as demonstrated in figure 10.

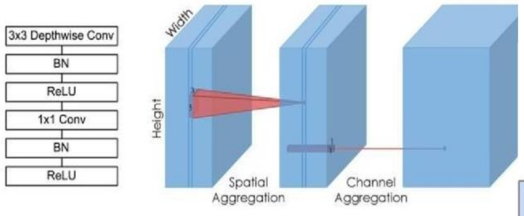
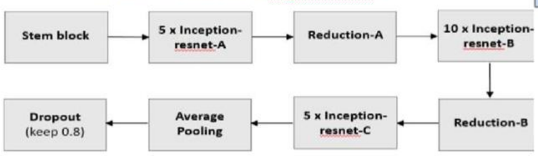


Figure 4Architecture of MobileNet



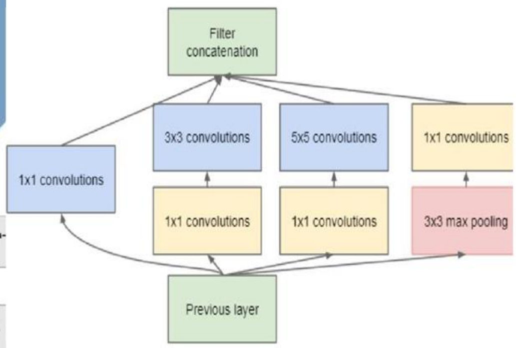


Figure 5 Architecture of Xception

Figure 6 Architecture of Inception ResNet V2

Figure 7 Results when wearing only glass

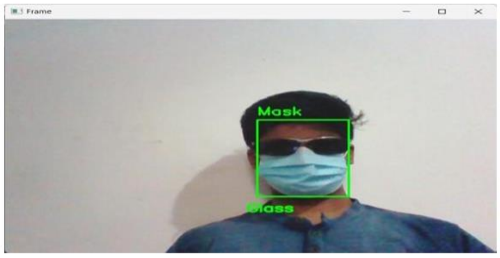


Figure 9 Results when wearing both Mask and Glass

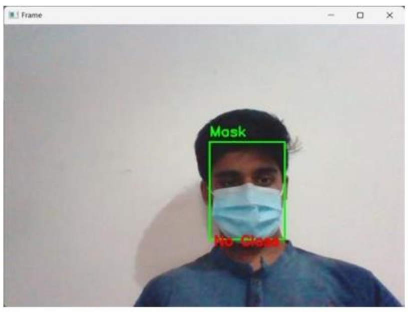


Figure 8 Results when wearing only mask

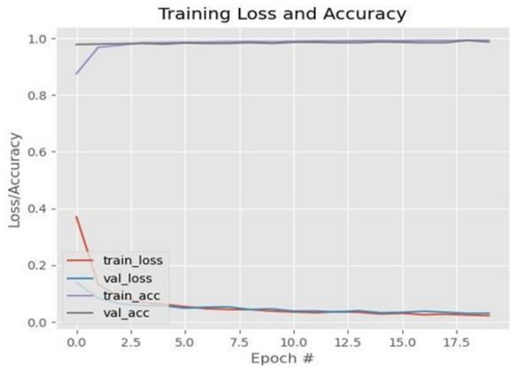
Figure 10 Canny Filter applied on face

4.1. Failure Case

The application may sometimes difficulties when it detects unconventional shaped glasses or when frameless transparent glasses are used in an angle that the camera couldn’t capture the edges of the glass.

5. ANALYSIS

It was found out that the Face Mask detection model is around 99 percent accurate in determining whether or not a person is wearing a mask. (Figure 11)
Figure 12 concludes that the glass detection model is about 91% efficient in detecting if a person has spectacles worn on their face.



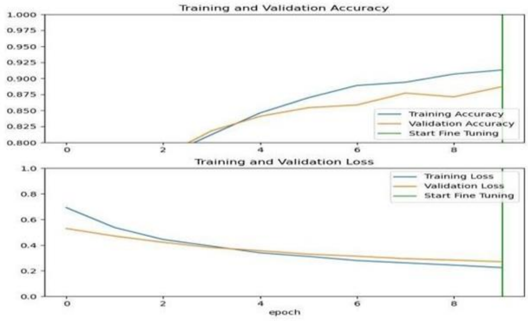


Figure 11 Face Mask Detection results   Figure 12 Glass detection results

6. CONCLUSION

In this study on mask and eyewear detection, firstly, it is necessary to identify mask and glasses wearers and non-wearers. The camera performs remarkably well in terms of photos. The detection outcomes were also quite impressive

7. FUTURE WORKS

With very little modification, this detection can likewise be applied to video stream or camera-fed inputs. The concept is expected to involve identifying someone who is using headphones or earbuds. By using student photographs to train the database and facial recognition technology, this can be utilized in online examination scenarios. The invigilator is informed about the person's identification using a method that is efficient for taking any necessary action against malpractice.

REFERENCES

[1] Ariyanto, Mochammad & Haryanto, Ismoyo & Setiawan, Joga & Muna, Munadi & Radityo, M.. (2019). Real-Time Image Processing Method Using Raspberry Pi for a Car Model. 46-51.

[2] V. K. Bhanse and M. D. Jaybhaye,(2018) "Face Detection and Tracking Using Image Processing on Raspberry Pi," 2018 International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, pp. 1099-1103.

[3] A. Das, M. Wasif Ansari and R. Basak, (2020) "Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV," 2020 IEEE 17th India Council International Conference (INDICON), New Delhi, India, pp. 1-5.

[4] M. S. Islam, E. Haque Moon, M. A. Shaikat and M. Jahangir Alam, (2020) "A Novel Approach to Detect Face Mask using CNN," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), Thoothukudi, India, pp. 800-806.

[5] Joseph Redmon, S. D. (2016) "You Only Look Once(YOLO) Unified, Real Time Object Detection" IEEE.

[6] A. Lodh, U. Saxena, A. khan, A. Motwani, L. Shakkeera and V. Y. Sharmasth, (2020) "Prototype for Integration of Face Mask Detection and Person Identification Model – COVID-19," 2020 4th International Conference on Electronics, Communication and Aerospace Technology (ICECA), Coimbatore, India, pp. 1361 -1367.

[7] Luigi Atzori, Antonio iera and Giacomo Morabito. (2010) 'The Internet of Things: A Survey', Journal of Computer Networks Vol.54 , No.15,pp.2787-2805.

[8] Lu Tan and Neng Wang. (2010) 'Future internet: The Internet of Things', IEEE Xplore Proc., 3rd IEEE Int.Conf. Adv. Comp. Theory. Engg. (ICACTE), pp:1-9.

[9] J. Marot and S. Bourennane, (2017)"Raspberry Pi for image processing education,"25th European Signal Processing Conference (EUSIPCO), Kos, Greece, 2017, pp. 2364-2366

[10] S. A. Sanjaya and S. Adi Rakhmawan, (2020) "Face Mask Detection Using MobileNetV2 in The Era of COVID-19 Pandemic," 2020 International Conference on Data Analytics for Business and Industry: Way Towards a Sustainable Economy (ICDABI), Sakheer, Bahrain, pp. 1-5.

[11] Senthilkumar.R and Gnanamurthy.R.K. (2016) 'A Comparative Study of 2D PCA Face Recognition Method with Other Statistically Based Face Recognition Methods', Journal of the Institution of Engineers India Series B (Springer Journal), Vol.97, pp.425-430.

[12] Senthilkumar.R and Gnanamurthy.R.K. (2017) 'Performance improvement in classification rate of appearance based statistical face recognition methods using SVM Classifier

[13] Survey says 90% Indians aware, but only 44% wearing a mask; discomfort key reason for non-compliance

[14] Senthilkumar.R and Gnanamurthy.R.K. (2018) 'HANFIS: A New Fast and Robust Approach for Face Recognition and Facial Image Classification', Advances in Intelligent Systems and Computing Smart Innovations in Communication and Computational Sciences, Chapter 8, pp:81-99.

[15] S. Susanto, F. A. Putra, R. Analia and I. K. L. N. Suciningtyas, (2020) "The Face Mask Detection For Preventing the Spread of COVID-19 at Politeknik Negeri Batam," 2020 3rd International Conference on Applied Engineering (ICAE), Batam, Indonesia, pp.

[16] S. S. Walam, S. P. Teli, B. S. Thakur, R. R. Nevarekar and S. M. Patil, (2018) "Object Detection and seperation Using Raspberry PI," 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT), Coimbatore, India, pp. 214 - 217.

[17] Yair Meidan, Michael Bohadana, Asaf Shabatai, Juan David Guarnizo and NilsOle Tippenhauer and Yuval Elovici. (2017) 'ProfilloT: a machine learning approach for IoT device identification of network traffic analysis', proc.Sym. App. Comp., SAC, pp: 506 -509.

[18] A comparative study of feature extraction techniques for identifying COVID-19 patients using chest X-rays image

[19] Deep Convolutional Neural Network Model for COVID-19 Detection