Face Mask Detection using CNN and OpenCV

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Abstract - *The COVID-19 pandemic has accelerated worldwide health concerns and is disrupting our daily lives. Though there is a dilemma in whether wearing a mask can reduce the risks or not, most of the scientists advise that a mask can prevent the disease from spreading. There are other measures like maintaining social distance, checking for the symptoms and sanitizing frequently while we are out in public places. It is difficult to manually check whether the people are wearing their face mask or not. while checking the temperature, there are chances of human error and the person has to come near to check, which is not safe for the health worker. This paper is focused on monitoring one of the protocols which is the detection of face masks. This model is developed using convolutional neural network/mobilenet. The system is trained with over 3801 images obtained from various sources. This might be used to automate door control in real-time and can be employed in places like temples, shopping complex, metro stations, airports, hospitals, etc.*

Key Words*: *Computer Vision, Deep Learning, Convolutional Neural Network (CNN), OpenCV, webcam

1.INTRODUCTION

COVID-19 virus propagation has slowed, although it is not yet eradicated. [1] COVID-19 pandemic has rapidly increased health crises globally and is affecting our day-to-day lifestyle. A motive for survival recommendations is to wear a safe facemask, stay protected against the transmission of Coronavirus. [2] Right now, there are no face mask detectors installed at the crowded places. But we believe that it is of utmost importance that at transportation junctions, densely populated residential area, markets, educational institutions and healthcare areas, it is now very important to set up face mask detectors to ensure the safety of the public. [3] This will aid in the tracking of safety violations, the promotion of face mask use, and the creation of a safe working environment. [4] focused on the real-time automated monitoring of people to detect both safe social distancing and face masks in public places by implementing the model on raspberry pi4 to monitor activity and detect violations through camera. [5] The system is trained with over 1000 image of people with mask and people with no mask. The images are used to create trained model using convolutional neural network.

[6] A deep learning architecture is trained on a dataset that consists of images of people with and without masks collected from various sources. [7] The research study uses deep learning techniques in distinguishing facial recognition and recognize if the person is wearing a facemask or not. [8] Even after the pandemic, everyone should abide by the same protocols for a hygienic life. Institutions must put in place pre-emptive measures before people return. These include marking the presence of employees and monitoring their health status. [9] According to survey reports, wearing a face mask at public places reduces the risk of transmission significantly. The proposed model can be used for any shopping mall, hotel, apartment entrance, etc. [10] This paper introduces face mask detection that can be used by the authorities to make mitigation, evaluation, prevention, and action planning against COVID-19. The face mask recognition in this study is developed with a machine learning algorithm through the image classification method: MobileNetV2.

2. PROPOSED WORK

In this paper, we proposed a convolutional neural network model which assures whether people in public are wearing their face mask or not fig 1 describes how our technology works automatically to prevent Covid-19 from spreading.

We begin by training the system using Keras and TensorFlow with the dataset obtained from Kaggle. After the training, the face detector is applied and the face mask detector model is loaded to detect from a live video stream.

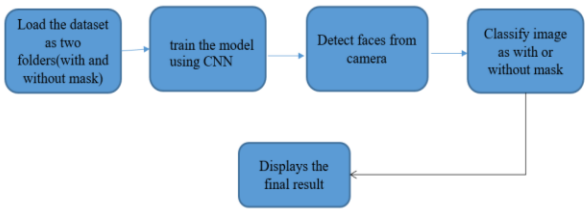

Fig -1: Block diagram

A dataset of 3801 images of two classes are used for training and building the model- the first class is with images and the second class contains images of people not wearing masks and improper wearing of masks. For data augmentation, a training image generator is built. The image dataset is loaded and the images are converted into arrays and the images are preprocessed using mobilenet and append to the data list. A rectangular box is displayed outside the person's face. Based on the result, the box is green if the person is detected to wearing a mask or red if the person is detected as not wearing a face mask. The developed model detects the face continuously and detects the availability of facemask

3. EXPERIMENTAL RESULTS AND ANALYSIS

3.1 COLLECTION OF DATA AND PREPROCESSING

The proposed system uses different images of faces with different angles and different poses. The proposed system is trained using convolutional neural network with mobilenet. The dataset contains 3801 images. The model is trained with two different classes-with and without masks. The category with masks includes faces with masks of different angles and different poses and different color masks. The category without masks contains faces without masks, hands used as masks and improper wearing of facemasks. 80% of the dataset are used for training and 20% for testing.

3.2 BUILDING AND TRAINING THE MODEL

The dataset is loaded and the model is trained using convolutional neural network with mobilenet. The images are resized and converted into arrays. Here the initial learning rate value is 1e-4, the batch size value is 32 and the number of epochs is 20.

Table -1: Model Evaluation

	precision	recall	Fi score	support
With mask	0.95	0.99	0.97	358
Without mask	0.99	0.95	0.97	403
Accuracy			0.97	761
Macro average	0.97	0.97	0.97	761
Weighted average	0.97	0.97	0.97	761

Precision= $TP \div TP + FP$ (1)

Recall= $TP \div TP + FN$ (2)

Where, TP = True Positives, FP = False Positives, FN = False Negatives

F1 score= 2 × ((precision × recall) ÷ (precision + recall)) (3)

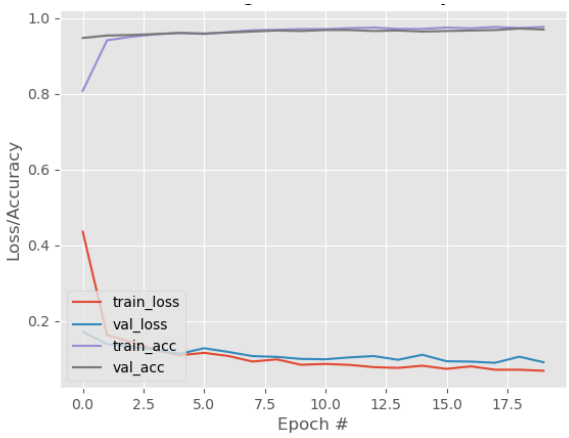

Chart -1: Training Loss and Accuracy

3.3 TESTING

The model checks for the availability of face mask and displays green rectangular box if mask is detected or red rectangular box if mask is not detected. The model is tested in real-time using webcam.

4. RESULTS

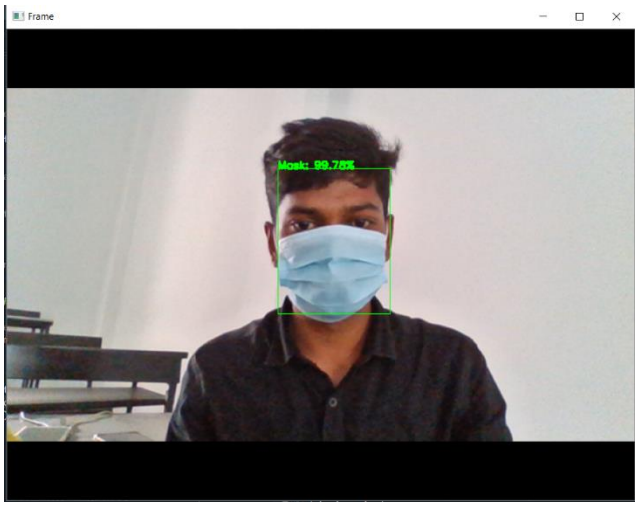

Fig -2: Detected model with face mask

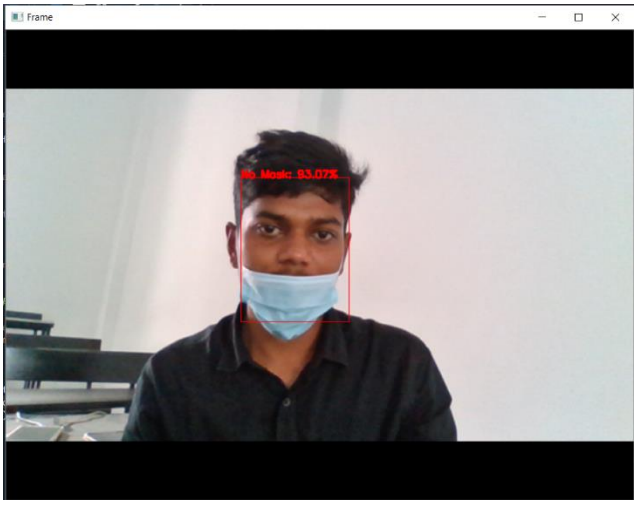

Fig -3: Detected model with improper wearing of face mask

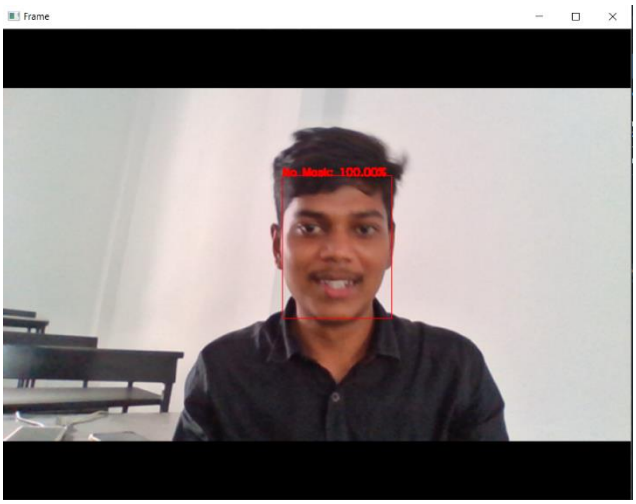

Fig -4: Detected model without face mask

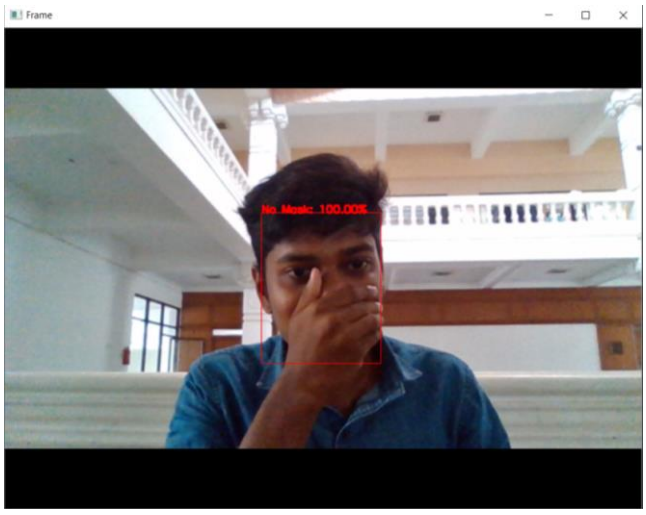

Fig -5: Detected model with hands as mask

5. CONCLUSION

We proposed a technique in our research that automatically detects whether or not a person is wearing a face mask. The proposed system employs convolutional neural network model to detect the availability of face mask. This can be employed anywhere such as shopping malls, metro stations, airports, and other public places. The solution aids in public safety and health by reducing the spread of corona virus.

6. FUTURE SCOPE

In the future, the system can be employed in ways like, the model can be improved to detect transparent masks. Further the model can be developed for real-time monitoring using raspberry pi along with temperature screening

7. REFERENCES

[1] K. Suresh, M. Palangappa and S. Bhuvan, "Face Mask Detection by using Optimistic Convolutional Neural Network," 2021 6th International Conference on Inventive Computation Technologies (ICICT), 2021, pp. 1084-1089, doi: 10.1109/ICICT50816.2021.9358653.

[2] S. Sakshi, A. K. Gupta, S. Singh Yadav and U. Kumar, "Face Mask Detection System using CNN," 2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE), 2021, pp. 212-216, doi: 10.1109/ICACITE51222.2021.9404731.

[3] A. Chavda, J. Dsouza, S. Badgujar and A. Damani, "Multi-Stage CNN Architecture for Face Mask Detection," 2021 6th International Conference for Convergence in Technology (I2CT), 2021, pp. 1-8, doi: 10.1109/I2CT51068.2021.9418207.

[4] Yadav, Shashi. (2020).” Deep Learning based Safe Social Distancing and Face Mask Detection in Public Areas for COVID-19 Safety Guidelines Adherence.” International Journal for Research in Applied Science and Engineering Technology. 8. 1368-1375. 10.22214/ijraset.2020.30560.

[5] Isa, Omar and Rasha Abdalhameed. “Automated Realtime Mask Availability Detection Using Neural Network.” (2021).

[6] 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), 2020, pp. 1-5, doi: 10.1109/IEMTRONICS51293.2020.9216386.

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

[8] P. Ulleri, M. S., S. K., K. Zenith and S. S. N.B., "Development of Contactless Employee Management System with Mask Detection and Body Temperature Measurement using TensorFlow," 2021 Sixth International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), 2021, pp. 235-240, doi: 10.1109/WiSPNET51692.2021.9419418.

[9] BVarshini , HR Yogesh , Syed Danish Pasha , Maaz Suhail , V Madhumitha , Archana Sasi , "IoT-Enabled Smart Doors for Monitoring Body Temperature and Face Mask Detection," Global Transitions Proceedings (2021), doi: https://doi.org/10.1016/j.gltp.2021.08.071

[10] A. Sanjaya and S. Adi Rakhmawan, "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), 2020, pp. 1-5, doi: 10.1109/ICDABI51230.2020.9325631.