Research Article

Face Mask Detection in Classroom using Deep Convolutional Neural Network

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Abstract: Wearing a mask has become mandatory to protect ourselves from infectious diseases caused by viruses. Today, we are facing a pandemic crisis due to COVID-19 virus. It worsens the lives of living things particularly human beings. The whole world felt stagnant from its normalcy. The educational institutions are particularly affected by this pandemic situation for not conducting the direct classes. To avoid this scenario, they are willing to conduct classes with some guidelines such as social distancing, wearing masks, and sanitizing the hands. We have considered wearing a mask is more important than the remaining two aspects. We are providing a solution with the help of the ResNet50 deep learning network to check whether the students have worn a mask in a classroom in order to prevent them from illness. Deep learning is an advancement of machine learning technique which gives more accurate results than the machine learning algorithms. The performance of our implemented deep learning based face mask detection system is discussed. The live video of the classroom is taken and analysed for recognizing the student's face with and without mask and generating the name of the students without wearing a mask.

Keywords: Deep Learning, Face Mask Detection, ResNet50 Model.

1. Introduction

The global impact of COVID-19, the disease caused by the novel coronavirus has taken many lives and the only preventive measure is to maintain physical distancing and wearing a face mask in public places. Before places of worship, restaurants, and shops began to close in response to the coronavirus pandemic, college campuses sent students home which lasted for a year and some institutions had begun to conduct online classes and exams. But it is not as effective as compared to physical education. So, the educational institutions have been opened by taking the rules and regulations insisted by the government in which one of the important rules is wearing a face mask inside educational institutions becomes mandatory. It is not possible to monitor the students all the time whether they wear masks or not. Hence, we thought that a computer vision based solution is the best for monitoring the students. An automated face mask detection system implemented in a classroom will give a better solution for this problem.

This paper introduces a deep learning based face mask detection system using ResNet50 CNN architecture and also generates the list of students who did not wear the mask inside the classroom. The model uses the live video taken from the camera fitted in the classroom for the face mask detection which impedes the transmission of COVID19 transmission.

1.1 ResNet50 Architecture

ResNet-50 is a 50 layers deep CNN. The network trained on more than a million images from the ImageNet database. The Architecture [6] consists of a convolution with a kernel size of 7 * 7 and 64 distinct kernels all with a stride of size 2. Next there will be a max pooling layer with stride 2.In the next convolution, there is a 1 * 1, 64 kernel, 3 * 3,64 kernel and finally a 1 * 1,256 kernel. These three layers are rehashed in absolute 3 time. Next there is a kernel of 1 * 1,128, 3 * 3,128 kernel and finally 1 * 1,512 kernel, this progression was rehashed 4. Next to that there is a kernel of 1 * 1,256 and two additional kernels with 3 * 3,256 and 1 * 1, 1024 and this is rehashed 6 times. And then again a 1 * 1,512 kernel with two a greater amount of 3 * 3,512 and 1 * 1, 2048 and this was rehashed 3 times. After that we do an average pool layer and end it with a fully connected layer containing 1000 nodes and toward the end the architecture has a softmax function. So adding up to these layers provides 50 layers of Deep Convolutional Network.

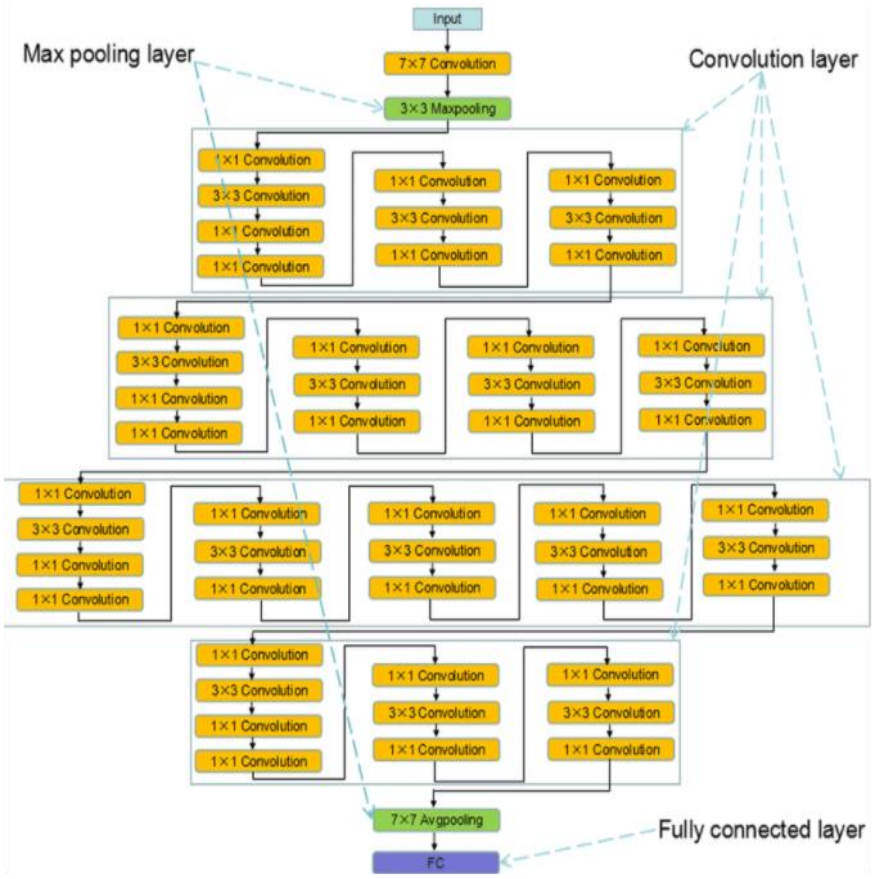

Fig 1. Resnet50 Architecture (Source [7])

2. Related Works

G. JigneshChowdary et.al. proposed a transfer learning model to distinguish individuals without masks. They fine-tuned the pre-trained Inceptionv3 architecture and Simulated Masked Face Dataset (SMFD) is used for training and testing. This model achieved accuracy of 99.9% during training and 100% during testing.

The author ToshanlalMeenpal et.al. proposed a system to recognize multiple people with masks in a single frame, for which they designed a classifier called binary face, to detect the people face independent of their face arrangement and also put forward a technique to produce exact masks for face segmentation of input images of any subjective size. Their model achieved 93.884% accuracy on Multi-Parsing Human Dataset.

Mohammad Marufur Rahman et.al. proposed a framework for identifying the persons without masks in public. CCTV cameras fitted in public places are used to capture the images and these images are fed into the deep learning architecture to identify the people without masks. Then, this information is sent to the public authority with the location of that person to take appropriate actions. This framework achieves 98.7% accuracy.

AdySanjaya et.al. built up an AI algorithm through the image classification architecture MobileNetV2, detects people who are wearing a face mask and not wearing it at an accuracy of 96,85 percent.. The building of the model includes the following steps: a. collecting the data, b. pre-processing, c. splitting the data, d. testing the model, and e. implementing the model. After that this model is used to identify the people not using a face mask in a public place.

The author Susanto et.al. developed the face mask detection system by using YOLOv4 algorithm. The YOLOv4 algorithm consists of a deep learning method which is able to detect the object properly. They experimented this system with real-time application and the device has been installed at PoliteknikNegeriBatam. This device is able to detect the people who wear or do not wear the face mask accurately even if they are moving to various positions.

3. Block Diagram

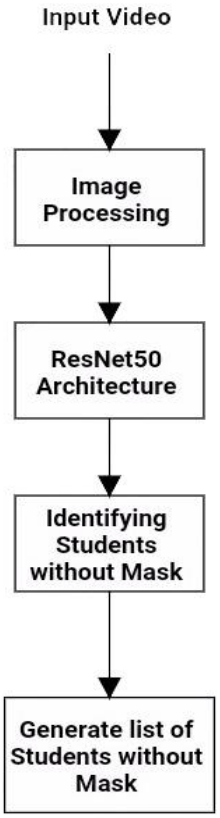

Fig 1: Face Mask Detection System

4. Proposed System

We proposed a system which will recognize the students without masks inside the classroom. For this we chose CNN architecture ResNet50 which was pre-trained on ImageNet database. Through this training, the model can learn how to recognize the students with and without masks. First, we have to capture the images of the students using OpenCV and these images are pre-processed and then we should save those images with corresponding student names.

Now, the Opencv will capture the live video in the classroom with which will be converted into frames. The Facial images are excerpted and these images are utilized to distinguish the students without masks on the face. The CNN model ResNet50 is utilized for performing extraction of facial features from the images then these features are learned by numerous hidden layers. At whatever point the model recognizes students without a mask, the name will be added to the list of students without a mask. Then, the model generates the list of students who did not wear the mask.

5. Experimental Results

Model Implementation

The live classroom video will be captured by the camera fitted in the classroom. The video is read from frame by frame by the model and is labelled as person with mask and without mask. The results are shown in figure 2 and 3.

Fig 2: Implementation Results

```
No_Mask
{'kishoor'}
No_Mask
{'kishoor'}
No_Mask
{'kishoor'}
No_Mask
{'kishoor'}
No_Mask
{'kishoor'}
```

Fig 3: Generated students list of the given input data frame by frame

5. Future Work

The proposed deep learning based face mask detection system can be connected with the student database for contact information. Then, the generated students list can be compared and identifies the student to notify them with a fine amount for not wearing the mask in the classroom.

6. Conclusion

In this paper a deep learning based face mask detection system using the ResNet50 model is implemented. The model generates the name of the student who didn't wear a mask in the classroom from the live video taken from the camera fitted in the classroom. From the generated list, the students are warned by the authorities to wear the mask in order to protect the environment from transmission of viruses

References

1. G. JigneshChowdary, Narinder Singh Punn, Sanjay Kumar Sonbhadra , and Sonali Agarwal. (20 Oct 2020).
2. Face Mask Detection using Transfer Learning of InceptionV3. aeXiv:2009.08369v2 [cs.CV].
3. Mingjie Jiang, Xinqi Fan, Hong Yan. (8 Jun 2020). RETINAFACEMASK: A FACE MASK DETECTOR.
4. aeXiv:2005.03950v2 [cs.CV] .
5. Mohammad Marufur Rahman, Md. MotalebHossenManik, Md. Milon Islam, Saifuddin Mahmud, Jong-Hoon
6. Kim.(2020). An Automated System to Limit COVID-19 Using Facial Mask Detection in Smart City
7. Network. IEEE.
8. Samuel AdySanjaya, SuryoAdiRakhmawan.(2021). Face Mask Detection Using MobileNetV2 in The Era of
9. COVID-19 Pandemic. IEEE.
10. Susanto, FebriAlwan Putra, Riska Analia, IkaKarlina Laila NurSuciningtyas.(2020). The Face Mask Detection
11. For Preventing the Spread of COVID-19 at PoliteknikNegeriBatam. IEEE.
12. Kaiming He, Xiangyu Zhang, ShaoqingRen, Jian Sun. (2016). Deep Residual Learning for Image Recognition.
13. 2016 IEEE Conference on Computer Vision and Pattern Recognition.

14. JiePeng.et,al. (2019 July). Residual convolutional neural network for predicting response of transarterial
15. chemoembolization in hepatocellular carcinoma from CT imaging. Computed Tomography.
16. Hong Lin, Rita Tse, Su-Kit Tang, Yanbing Chen, Wei Ke, Giovanni Pau. (2021). Near-Realtime Face Mask
17. Wearing Recognition Based on Deep Learning. IEEE 18th Annual Consumer Communications &
18. Networking Conference (CCNC).
19. Xiangjie Kong, Kailai Wang, Shupeng Wang, Xiaojie Wang, Xin Jiang, Yi Guo, GuojiangShen, Xin Chen, Qichao
20. Ni. (2021). Real-time mask identification for COVID-19: an edge computing-based deep learning framework. IEEE Internet of Things Journal.
21. Saini Pooja, Saini Preeti. (2021). Face Mask Detection Using AI. Predictive and Preventive Measures for Covid-
22. 19 Pandemic, 293-305.
23. BeenaUllala Mata.(2021). Face Mask Detection using Conventional Neural Network. Journal of Natural Remedies
24. 21 (12 (1)), 14-19.
25. Lingxue Song, Dihong Gong, Zhifeng Li, Changsong Liu, Wei Liu. (2019). Occlusion robust face recognition
26. based on mask learning with pairwise differential siamese network. Proceedings of the IEEE/CVF
27. International Conference on Computer Vision, 773-782.
28. Yuzhen Chen, Menghan Hu, Chunjun Hua, GuangtaoZhai, Jian Zhang, Qingli Li, Simon X Yang. (2021). Face
29. mask assistant: Detection of face mask service stage based on mobile phone. IEEE Sensors Journal.
30. SnehaSen, KhushbooSawant .(2021). Face mask detection for covid_19 pandemic using pytorch in deep learning.
31. IOP Conference Series: Materials Science and Engineering 1070 (1), 012061.
32. Ssvr Kumar Addagarla, G KalyanChakravarthi, P Anitha. (2020). Real Time Multi-Scale Facial Mask Detection
33. and Classification Using Deep Transfer Learning Techniques. International Journal 9 (4).
34. ToshanlalMeenpal, AshutoshBalakrishnan, Amit Verma. (2019). Facial Mask Detection using Semantic
35. Segmentation. 2019 4th International Conference on Computing, Communication and Security (ICCCS), 1-5.