Mask-19: Convolutional Neural Network for Face Mask Detection

Term Project for CSCE 4604

Seif Shalan and Mohamed Naggar

ABSTRACT

The COVID-19 pandemic has truly stopped the all nations of the world in its tracks. To limit the spread of the disease, scientists and governmental bodies have recommended the use of face masks. Although many have contributed to the elimination of the disease by wearing masks, some have failed to wear it correctly or not wear it at all. Many areas open to the public demand people to wear masks to be allowed entry. This process has been done manually by other humans. Some researchers have decided to automate this process using deep learning techniques. But, all available solutions are only capable of classifying people wearing masks and people not wearing masks. In this research, we have reached a solution that is capable of detecting if a person is wearing a mask, not wearing a mask, or is wearing the mask incorrectly with a state-of-the-art ACCR of 97.5%.

METHODOLOGY

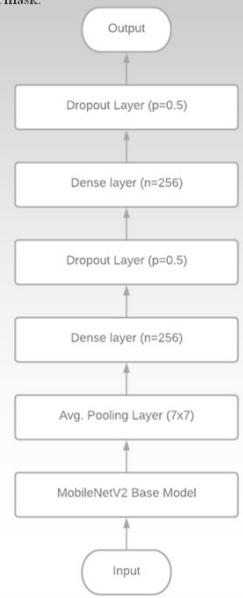
Our proposed face mask detector consists of two models. The first model is responsible for detecting the faces in the video stream at a sampling rate of 20 frames per second. The model analyzes each input frame and returns an array of bounding boxes where each bounding box contains a face. The detector then preprocesses the faces to fit the second model. The second model is responsible for classifying each face. Each face detected is inputted into the model and the model returns the detected class. The detector then displays a bounding box around the subject's face with a label and color indicating the inferred classification.

Face Model Detection

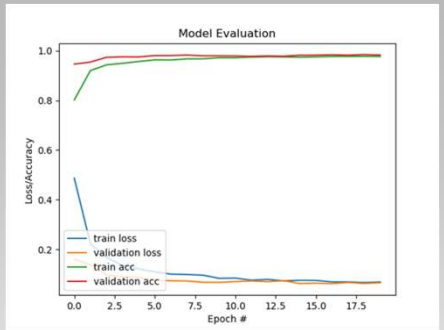
As achieving the highest average accuracy is our main goal, we opted for using an existing model to detect faces instead of creating our own. OpenCV's DNN face detector was our best choice for this scenario. The model is known to work well with occlusion, quick head movements, and can detect side faces. The DNN face detector is a Caffe model based on the Single Shot-Multibox Detector and utilizes the ResNet-10 architecture as its backbone.

NETWORK ARCHITECTURE

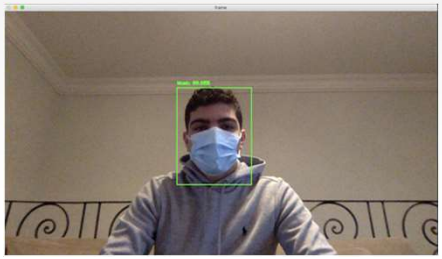
The Mask Classification Model is based on the MobileNetV2 convolutional neural network. Our model architecture consists of the base MobileNetV2 model without its existing dense layers. An average pooling layer with a pool size of 7x7 was added. Two dense layers were added as well. Each dense layer consists of 256 neurons with a dropout layer following it. In terms of preprocessing, MobileNetV2 comes with its own preprocessing function to make the input data suit the model. During training, data augmentation was utilized to increase the dataset size. This in return improved our model accuracy and performance. The model is capable of predicting 3 classes: without mask, with mask, or incorrectly worn mask.



RESULTS



Class	Precision	Recall	F1	# of Test images
Incorrect_Mask	0.97	0.98	0.98	661
Mask	0.98	0.97	0.98	661
No_Mask	0.99	1.00	1.00	660



CONCLUSION & FURTHER RESEARCH

It is safe to say that Mask-19 has resulted in state-of-the-art accuracies in comparison to our counterparts. We were able to introduce a new classification of detecting incorrectly worn masks. But, due to constraints in resources and health hazards, we were unable to test Mask-19 in a real-time scenario. There were also dataset limitations where most of the masks were blue surgical masks. This due to the fact that all public datasets have not taken this issue into consideration when building it. Such an issue may affect our model's accuracy when detecting non-surgical masks. We encourage future researchers to improve our model in terms of throughput and to train it on a more diverse dataset that may be available in the future.

REFERENCES

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