Mask Detection Using Machine Learning and Image Recognition

# **Brandon Sams Winter 2021 https://brandonsams.github.io**

# Which Domain?

What domain is this data going to come from? Please list 10 references (with a brief annotation) to use to make sense of what you’re doing with these data.

There are quite a few datasets of images of people wearing facemasks. Not surprisingly, there is plenty of interest from the domain of computer vision. Detecting if a person is wearing a facemask can help a business comply with local laws and regulations regarding masks in public. It can, in theory, also help to limit the spread of SARS-COV-2. (and other viruses and infections, as well).

Academy, Pink. “Wolrd’s Most Complete Masked Face Recognition Dataset Is for Free.” *Medium*, 16 July 2020, <https://medium.com/the-programming-hub/wolrds-most-complete-masked-face-recognition-dataset-is-for-free-10d780eed512>.

A large dataset of images of people wearing masks and not wearing masks. Seems to come from China, as the readme is in Chinese.

“Applications in Response to COVID-19: Mask Detection.” *Deep Learning*, https://blogs.mathworks.com/deep-learning/2020/06/11/mask-detection-using-deep-learning/. Accessed 16 Jan. 2021.

A blog post from the mathworks team about their efforts to create a mask detection model. Uses MatLab model, rather than a traditional Tensorflow model for training and inference.

“COVID-19: Face Mask Detector with OpenCV, Keras/TensorFlow, and Deep Learning.” *PyImageSearch*, 4 May 2020, <https://www.pyimagesearch.com/2020/05/04/covid-19-face-mask-detector-with-opencv-keras-tensorflow-and-deep-learning/>.

Provides source code for a mask detection algorithm that can function on images and video streams. Details the entire image processing pipeline, which includes detection of faces, and the serialization of those faces into the model for inference.

Escarlate, Alberto. “My Quarantine Project: A Real-Time Face Mask Detector Using Tensorflow.” *Medium*, 16 June 2020, <https://towardsdatascience.com/my-quarantine-project-a-real-time-face-mask-detector-using-tensorflow-3e7c61a42c40>.

Describes the efforts of one person’s quarantine project to build a mask detection algorithm. Tensorflow is used, but no source code is provided.

*Face Mask Detection*. https://kaggle.com/andrewmvd/face-mask-detection. Accessed 16 Jan. 2021.

Data source for face mask images. Contains images of not only mask/maskless people, but also of subjects who are wearing a mask incorrectly. Could be used to make a more nuanced classifer.

*Face Mask Detection in Street Camera Video Streams Using AI: Behind the Curtain | Tryolabs Blog*. https://tryolabs.com/blog/2020/07/09/face-mask-detection-in-street-camera-video-streams-using-ai-behind-the-curtain/. Accessed 16 Jan. 2021.

Describes a technique for face mask detection that detects human poses, then human faces, and then detects if a mask is being worn. Starting from human poses is useful for surveillance footage.

“Face Mask Detection with ML/AI on Cisco Industrial Hardware.” *Cisco Blogs*, 25 Aug. 2020, <https://blogs.cisco.com/internet-of-things/face-mask-detection-with-ml-ai-on-cisco-industrial-hardware>.

A developer at Cisco describes his attempt at making a mask classifer. A link to a docker image is given.

“How to Build a Face Mask Detector Using RetinaNet Model!” *Analytics Vidhya*, 24 Aug. 2020, <https://www.analyticsvidhya.com/?p=69192>.

Provides a fairly in-depth explanation for the math and architecture behind RetinaNet, and justifies its use for this application.

“Implementing a Real-Time, AI-Based, Face Mask Detector Application for COVID-19.” *NVIDIA Developer Blog*, 18 Aug. 2020, <https://developer.nvidia.com/blog/implementing-a-real-time-ai-based-face-mask-detector-application-for-covid-19/>.

Provides a developer recipe for how one would build a mask detection model for use in healthcare facilities.

Loey, Mohamed, et al. “A Hybrid Deep Transfer Learning Model with Machine Learning Methods for Face Mask Detection in the Era of the COVID-19 Pandemic.” *Measurement*, vol. 167, Jan. 2021, p. 108288. *PubMed Central*, doi:10.1016/j.measurement.2020.108288.

Researchers made a model for mask detection. Results are published with helpful graphs that would be helpful for informing how I would like to disply the information at the end of this project.

Mujtaba, Hussain. “Real-Time Face Recognition| Real Time Face Recognition OpenCV Python.” *GreatLearning*, 14 Jan. 2021, <https://www.mygreatlearning.com/blog/real-time-face-detection/>.

Describes an implementation of mask detection using the OpenCV library. This library is useful for face detection in general, but also can help with mask detection.

“(PDF) A FACEMASK DETECTOR USING MACHINE LEARNING AND IMAGE PROCESSING TECHNIQUES.” *ResearchGate*, https://www.researchgate.net/publication/345972030\_A\_FACEMASK\_DETECTOR\_USING\_MACHINE\_LEARNING\_AND\_IMAGE\_PROCESSING\_TECHNIQUES. Accessed 16 Jan. 2021.

Describes a mask detection model that was constructed using keras. Several different types of Neural Networks were used and compared.

# Which Data?

What is the dataset you’ll be examining? Please provide a codebook if there is one or a link to the dataset as well as a detailed description.

A fairly extensive dataset is provided at the following URL: <https://github.com/X-zhangyang/Real-World-Masked-Face-Dataset>

This, I anticipate, will be the big source of data, just because of the size of the dataset. (This is actually a link to several related datasets. But all of them have quite a few images.) It features several thousand photos, all of which are labeled. However, I anticipate that this dataset will have at least one problem. The dataset includes mostly people from China, so I am curious to see how this would bias the resulting model.

If that dataset turns out to be useful, I will also plan on using the dataset from this URL: <https://www.kaggle.com/andrewmvd/face-mask-detection>

This dataset appears to have a wider range of ethnicities included, but is a smaller dataset to work with, containing only 853 images. This dataset has the unique benefit of being partitioned into three distinct classes. Mask/No Mask/Mask Worn Incorrectly. In the research that I have done already, there has been very little in the way of detecting if a person is wearing a mask incorrectly or not. So perhaps there is an area of novel research here.

# Research Questions? Benefits? Why analyze these data?

How are you proposing to analyze this dataset? This is about your approach. Here, you’ll be proposing your research questions as well as justifications for why you’d offer these data in this way.

I propose that this dataset should be analyzed to see if there is a way to see if a mask is being worn or not. How would a model handle the case where a person is wearing a mask, but it is incorrectly worn? How can a model trained on images function on a video stream? In what sort of instances would a model give false results?

In facilities where masks are required to be worn, this requires the attentiveness of a person of some degree of authority. If a model could be trained to function on security camera footage, for example, it could alert those who need to know that a person is not wearing a mask in that facility.

# What Method?

What methods will you be using? What will those methods provide in terms of analysis? How is this useful?

Neural networks are likely the best way to solve this problem. In terms of analysis, these methods will provide an opportunity to create confusion matrices, and determine what types of hyperparameters work best for this specific application. I am also interested to see how competing neural network libraries solve this problem such as pytorch and tensorflow.

# Potential Issues?

What challenges do you anticipate having? What could cause this project to go off schedule?

I anticipate that this project will have a hard time during the analysis phase. I feel like I need a more nuanced research question, rather than something along the lines of “Can a model be built that solves this problem?” The answer is yes, but that doesn’t provide a lot of depth for analysis. If there was a more quantitative question that I was trying to answer, I feel like there would be more room for analysis.

# Concluding Remarks

Tie it all together. Think of this section as your final report’s abstract.

In the age of Covid-19, one of the simplest ways to mitigate the spread of the virus is to wear a mask. This is especially true in public spaces. Despite this, many choose to test the limits and refuse to wear a mask while in public spaces. If there was an automated way to monitor whether a person is wearing a mask, then many companies and public spaces could benefit from this additional information. By using machine learning techniques, a two distinct models were created. One was trained on a dataset that contained pictures of people wearing masks, and not wearing masks. The other model was trained on data that contained images of people also wearing masks improperly, in addition to the standard mask/no mask setup. It was determined that yes, a model could be created that could determine if a person was wearing a mask. Determining if a mask was being worn improperly is a more difficult Machine Learning problem, but shows promising results.