Face Mask Detector
Final Report
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Introduction

The goal of our project is to identify whether a person is **correctly** wearing a mask or not. A person correctly wears a mask when the mask completely covers his mouth and nose.

COVID-19, as we know, is a pandemic that has claimed millions of lives in the year 2020. Wearing a face mask has been identified as a successful method of preventing the spread of COVID amongst people. It is strongly recommended to wear a mask in public places. Most people follow the guidelines and wear masks. Some people do not wear it while others wear it incorrectly which doesn't cover their nose/mouth as it should.

Our project aims to train a model on images of people wearing masks and develop an interface to identify faces of people wearing the mask correctly, wearing it incorrectly or not wearing a mask.

Description of Individual Work

In the course of this project, I worked on the following task:

Data Download: Before running the initial training job, I downloaded the dataset from my GCP instance (the initial data repository for the group) to my AWS instance by creating a ssh connection to the GCP instance and copied the data.

Model Training: I ran the training job on my AWS instance to produce an initial benchmark. I added scripts to Mask_Detector.py to plot the error during the training job for monitoring and visualization of how the model is learning. I added more scripts to store the model architecture, weights, optimizers parameters and class indices for easy coupling during inference.

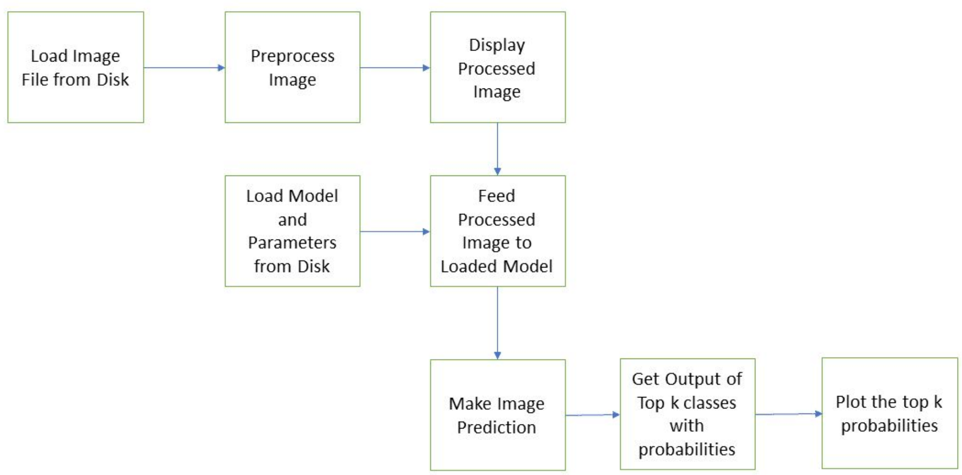
Model Inference for Classification: The bulk of my work was focused here, I loaded several images from the flicker dataset and from images taken with my photo camera. I wrote scripts to process an image loaded from disk, apply transformations, display the image, convert to a tensor and feed to the trained model loaded from disk with all model artifacts. The model made predictions and gave an output of the top 3 classes with their probabilities which I plotted on an horizontal bar chart.

More importantly, I engaged in research at each step of the project and communicated my understanding to the group. I engaged in brainstorming sessions with my group to figure out ways to solve problems such as: getting the dataset from its original source (which was problematic), choice of architecture and model parameters, relevant metrics to use and ways to validate our results.

Detailed Description of Individual Work

Model Inference for Classification: To understand how well the model performs and make predictions on real world face images, I performed an inference for classification on images captured with a camera, with different samples of face images: without a face mask, with a face mask and with an incorrectly worn face mask.

I created a predict function that takes a processed image and returns the top k most likely classes along with their probabilities. The block diagram for this procedure is shown below:



Results

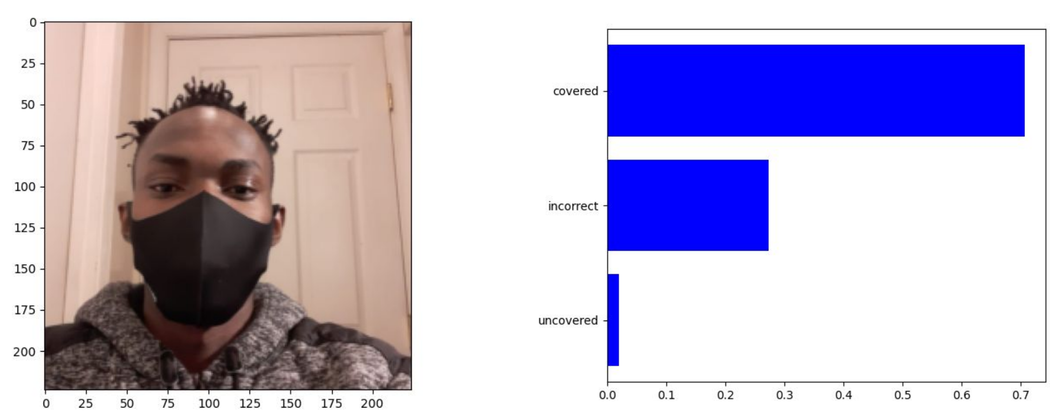


Figure 4.1 Face mask prediction with face image covered

I observed for an image with a face mask, the model gave a correct prediction with a probability of about 0.7. Other predictions were made with the model with the results shown below:

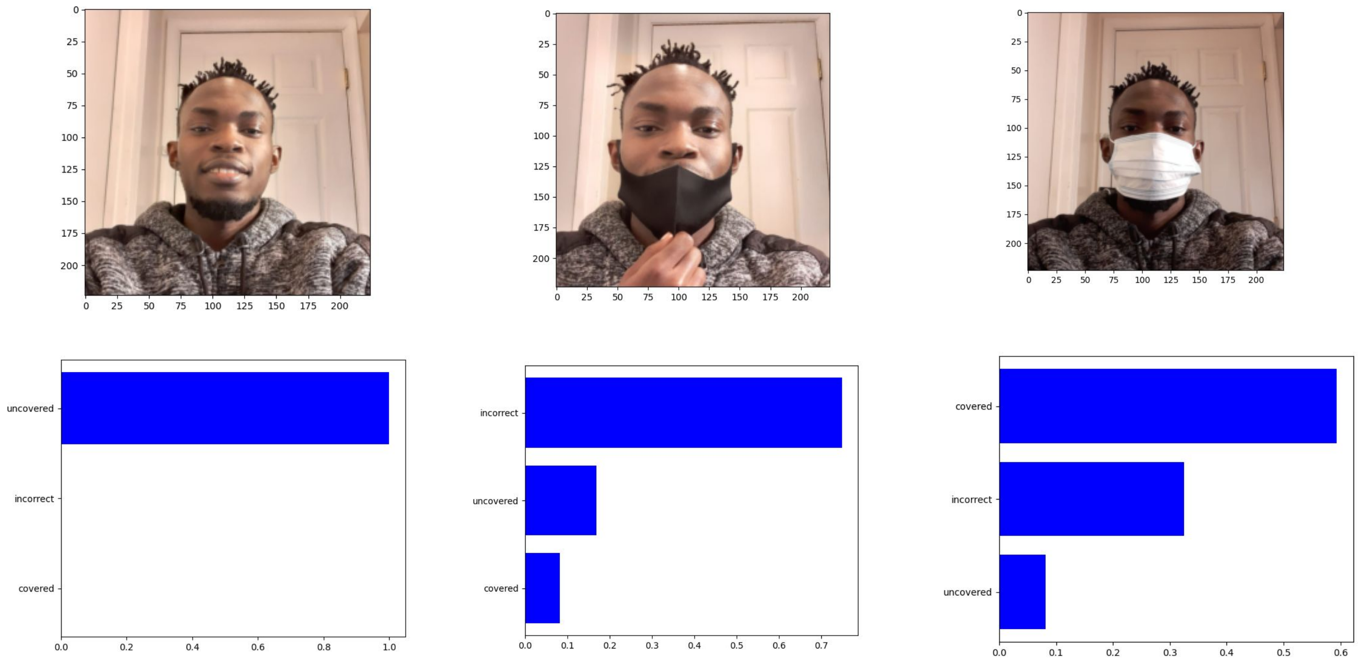


Figure 4.2 Face mask prediction with face image uncovered, incorrect and covered

I observed for an image without a face mask, the model gave a correct prediction with a probability of 1.0, while the prediction with an incorrectly worn face mask gave a correction prediction with a probability of about 0.75. I tested the model with a different color of face mask (white) to observe if there was any significant difference in the prediction with the black face mask used earlier, The model gave a reduced probability of about 0.6 with a correct prediction of a covered facemask.

I investigated further by cropping the image to reveal the face of the person only. The result of the prediction is shown below:

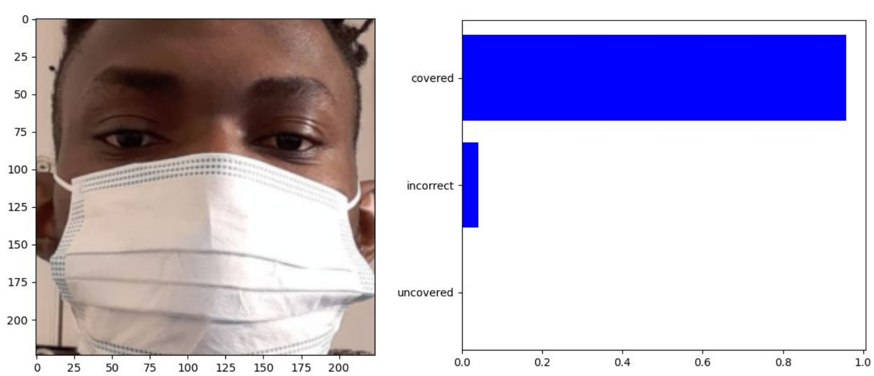


Figure 4.3 Face mask prediction with cropped face image

The model produced a correct prediction for a covered face mask with a probability of approximately 0.95, an improvement on previously classification results.

Summary and Conclusion

From the results, we conclude that the model performs better when the input image is processed to reveal the face only. This is because the model was trained to make classification based on face mask coverings. The cropped face image produced a correct prediction with a probability of approximately 0.95, which is consistent with accuracy of 0.9522 obtained for the held-out dataset. In earlier figures above, other features, like the surrounding environment and the body of the human, contributed to the features fed to the model which reduced the prediction performance.

Further work will require the development of a primary model to detect faces in an image, before applying the face mask model developed in this project. The primary model should be able to predict a bounding box around the face for detection. The face can then be fed to the face mask detector model for classification.

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References

https://www.pyimagesearch.com/2020/05/04/covid-19-face-mask-detector-with-opencv-keras-tensorflow-and-deep-learning/