THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

Face Mask Detector

Group 5

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DATS 6203 ML2: Final Project
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Source

Motivation

Source

- COVID-19 is a global pandemic that has claimed approximately 1.5 million lives in the year 2020.
- Wearing a face mask has been identified as a successful method of preventing the spread of COVID.
- Most people wear mask but some people wear it incorrectly and some don’t wear a mask.

Introduction

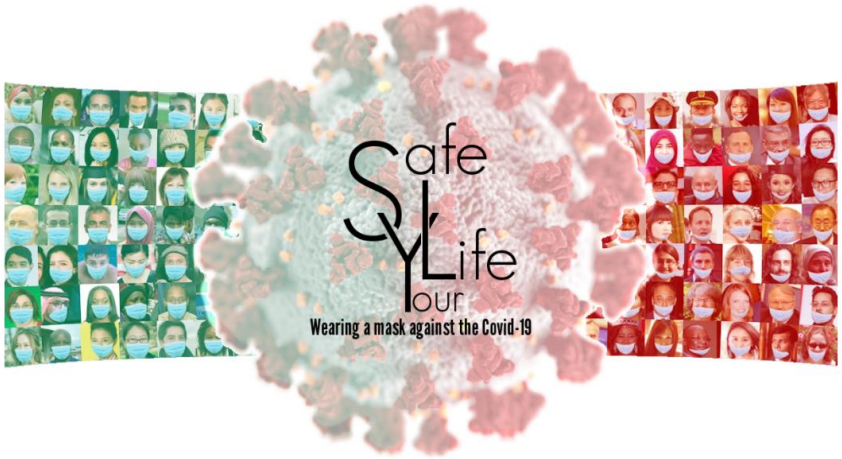
Source

- Our project aims to identify faces of people:
  1. Wearing the mask correctly
  2. Wearing it incorrectly
  3. Not wearing a mask

- Thus we can efficiently recognize whether people are masked correctly or not in regulated areas.

Dataset

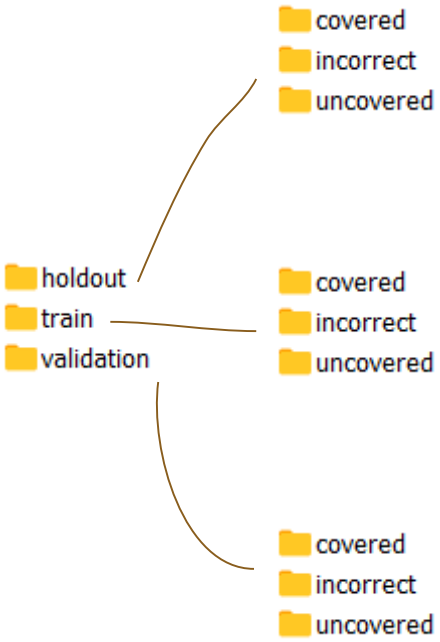
MaskedFace-Net



Source

- For our project we used the synthesized dataset from MaskedFace-Net.
- This dataset is created using Generative Adversarial Network(GAN) on the Flicker Faces Dataset.
- Since the dataset only had correctly and incorrectly masked faces we added the original Flicker Faces Dataset to identify people not wearing a mask.

Data distribution and Train-Test Split



- 15 GB of image Data
- Of the total 60,000 images we used
  - 20,000 images of **correctly** masked images
  - 20,000 images of **incorrectly** masked images
  - 20,000 images of **uncovered** faces

- We performed 80-20% split for train and test(holdout) and additionally performed 80-20% for validation.

- The data was organized so that the ImageFolder API of Pytorch could be used.

Deep Learning Network & Fine Tuning

- ResNet50 worked best for the dataset in the initial run - Validation Accuracy 88.91
- The data was split into 80:20 train and test, validation was 20% of train.

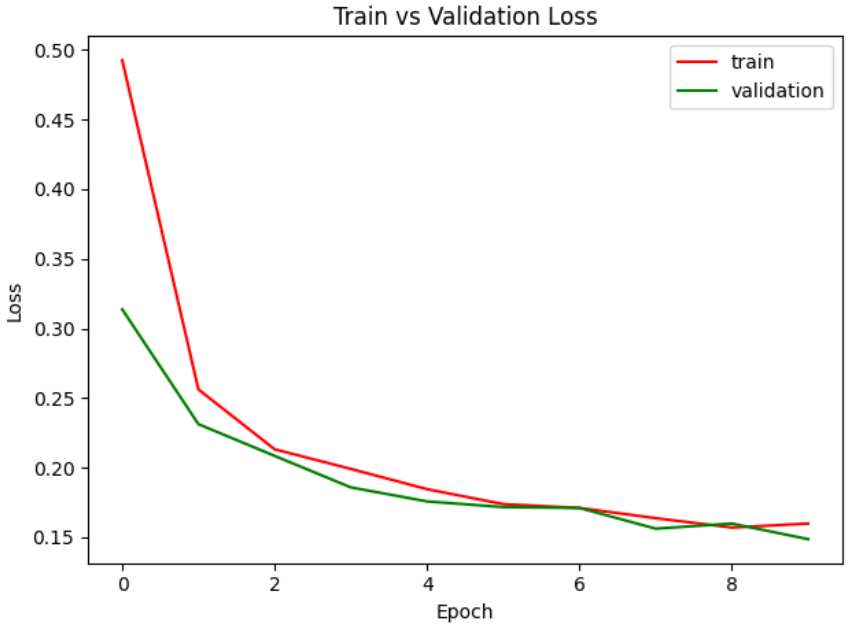
- **Transformations**
- Resize
- Color Saturation

- **Hyperparameters**
- Batch Size - 512
- Learning Rate - 0.001
- Epochs - 10
- Optimizer - Adam

- **Regularization**
- Dropout Rate - 0.3

Model Evaluation & Results

- The model was evaluated using Accuracy and Loss.

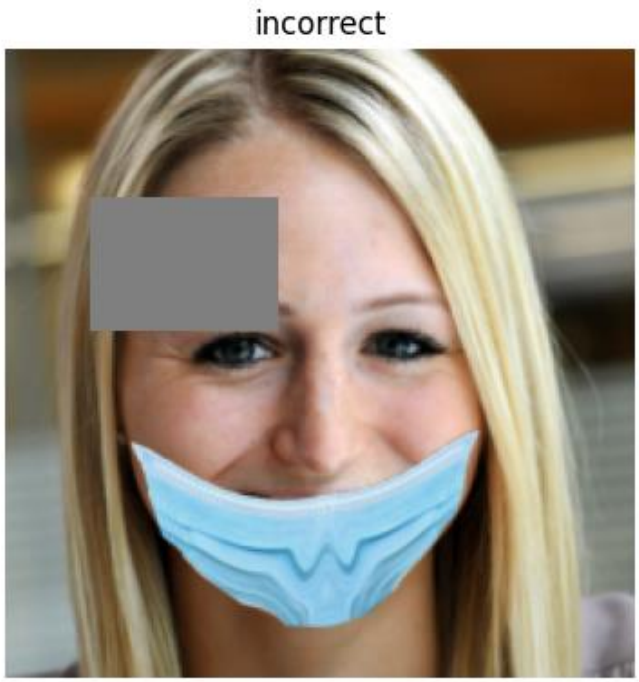


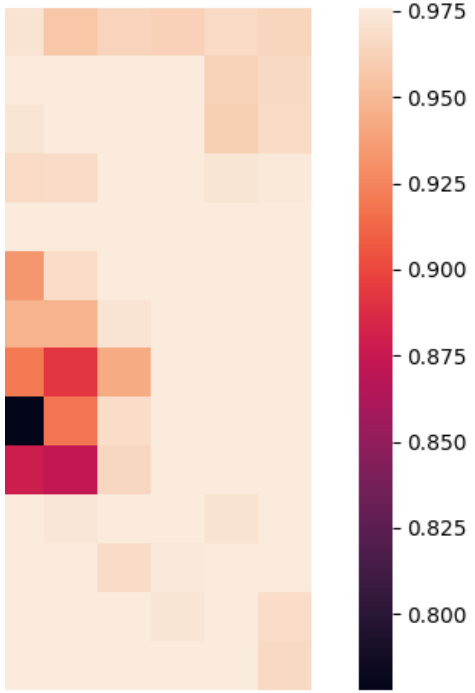

```
Train Evaluation Metrics
----------
Accuracy::0.9545066666666666

Validation Evaluation Metrics
----------
Accuracy::0.9509228635442227

Holdout Evaluation Metrics
----------
Accuracy::0.9522143527604744
```

Model Interpretation using Occlusion Experiment

- Occlusion Experiment is performed to determine which patches of the image contribute maximally to the output of the network.

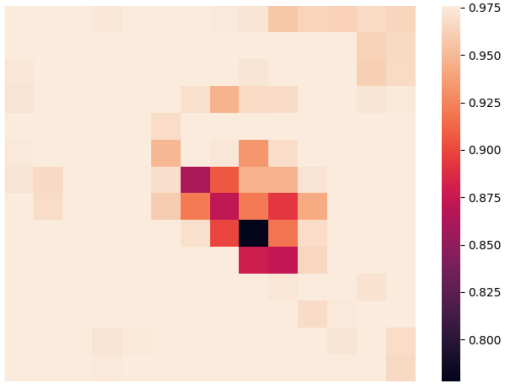
- We iterate over all the regions of the image by occluding part of it with a grey patch and monitor the probability using a heatmap.

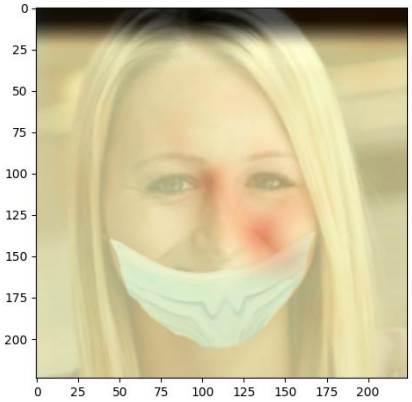




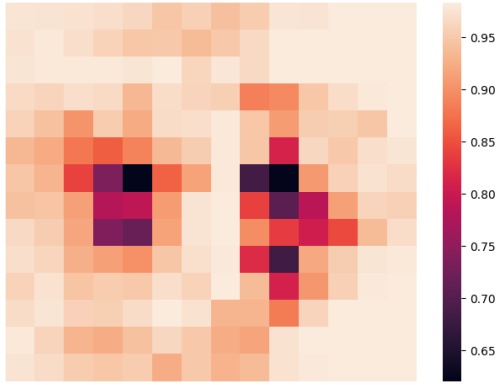
Occlusion Experiment Results

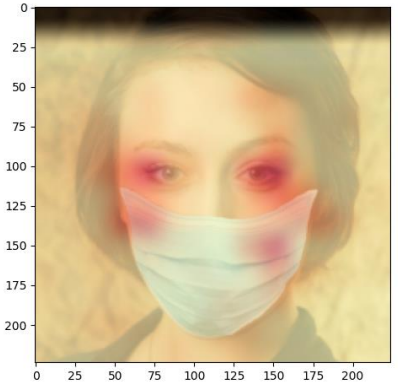
incorrect



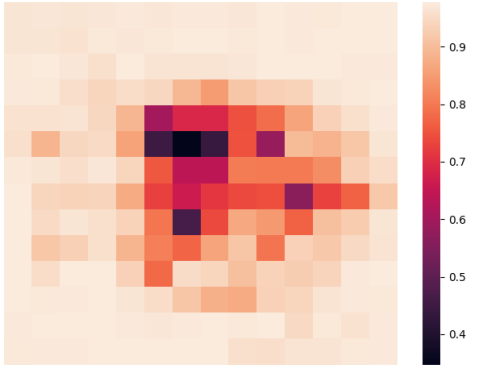


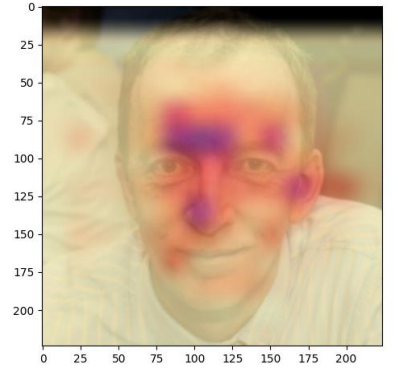
covered





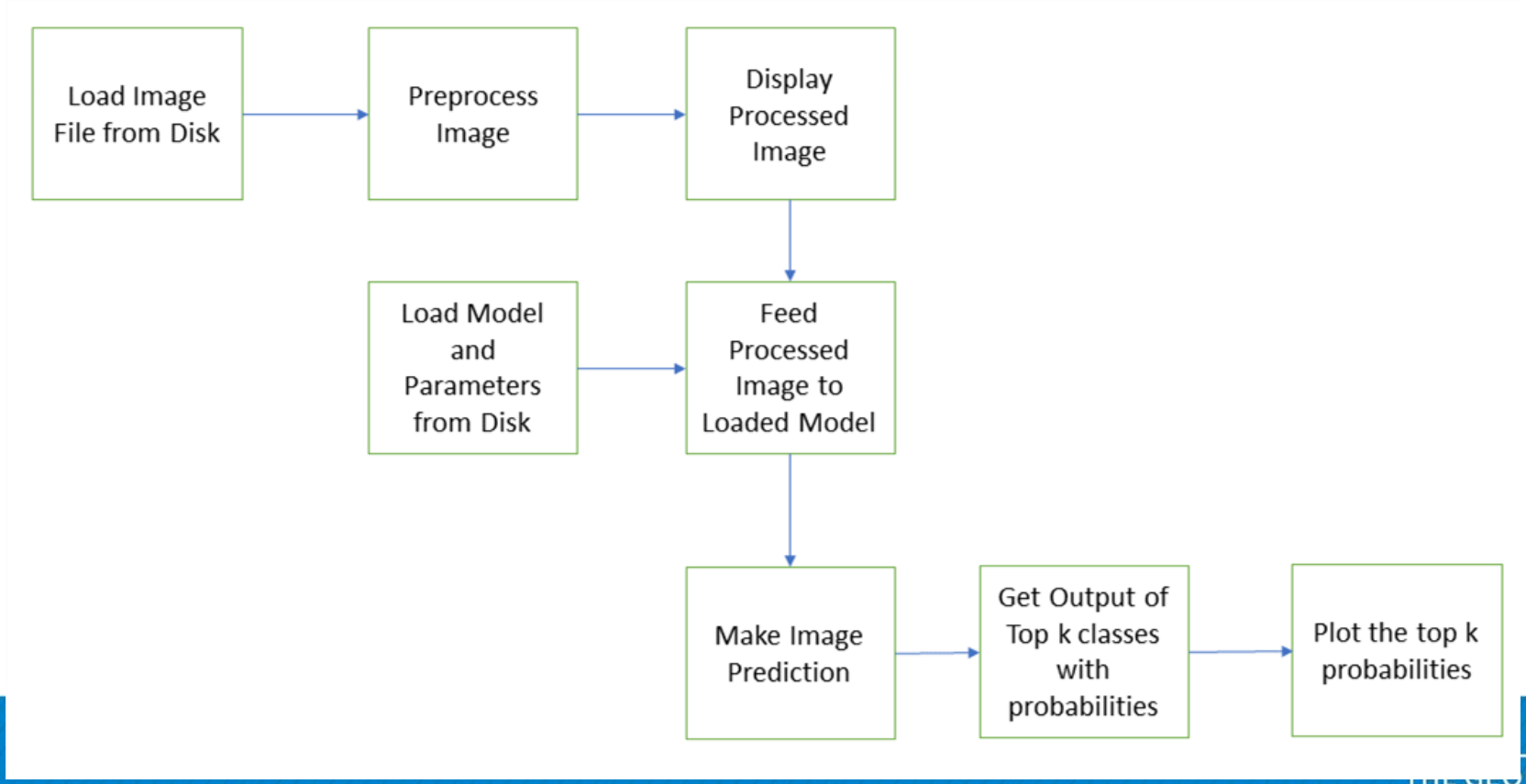
uncovered



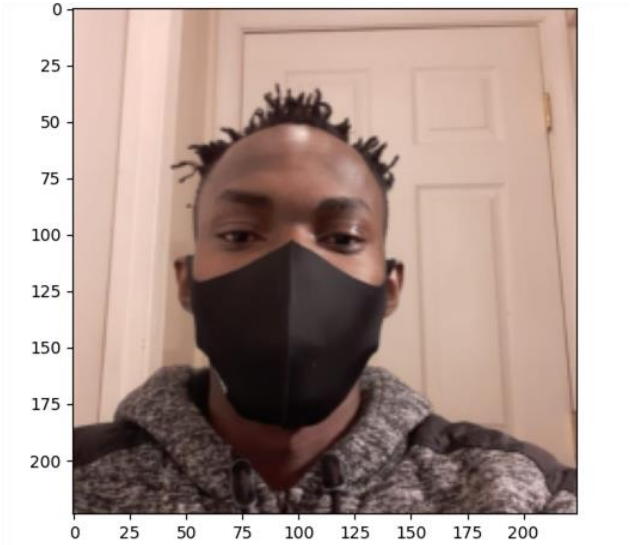


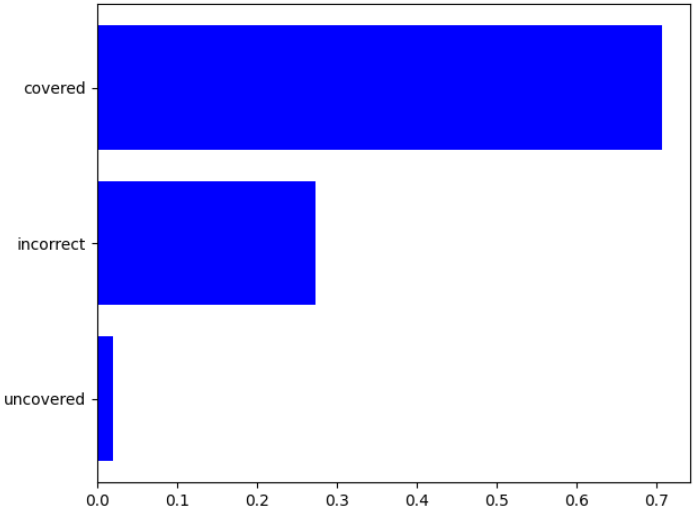
Results: Inference for Classification

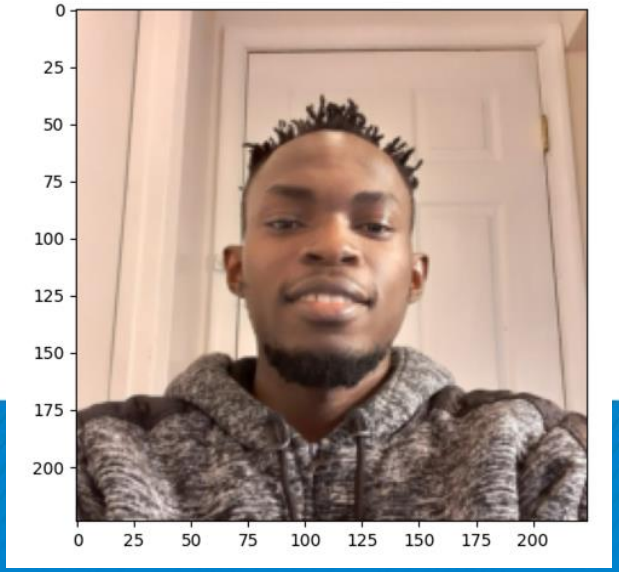
- Investigate the performance of the model on the real world image taken with a phone camera

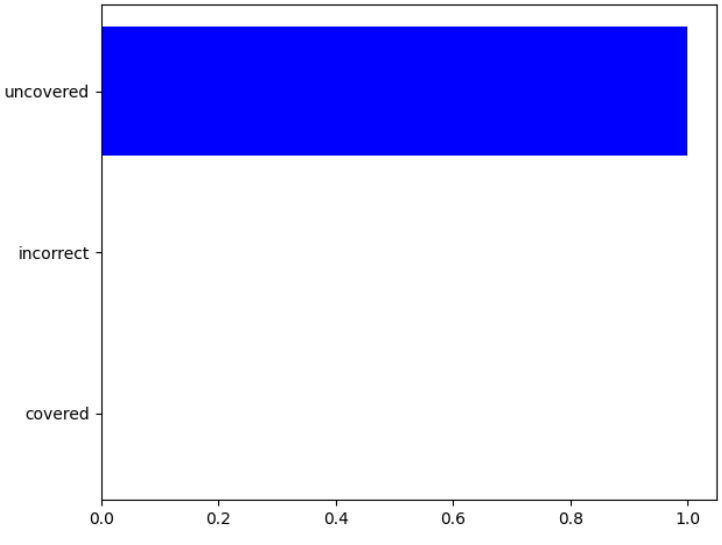


Results: Inference for Classification









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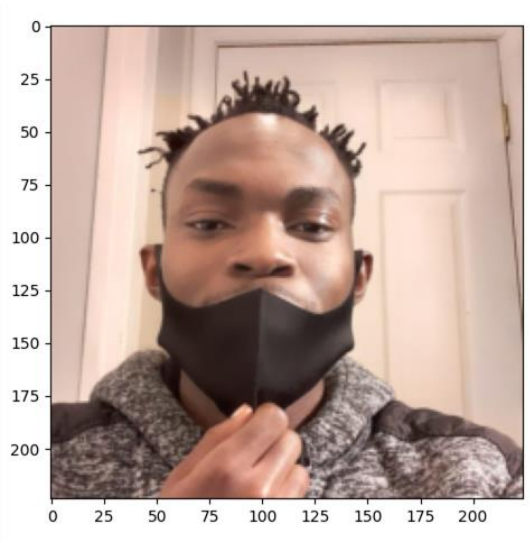

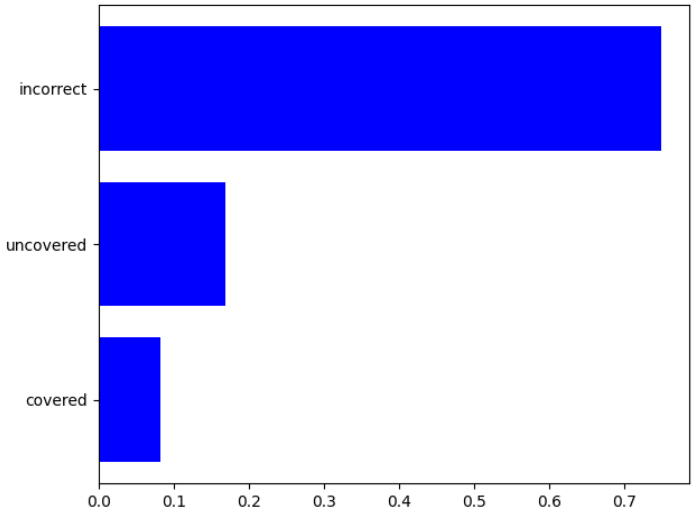

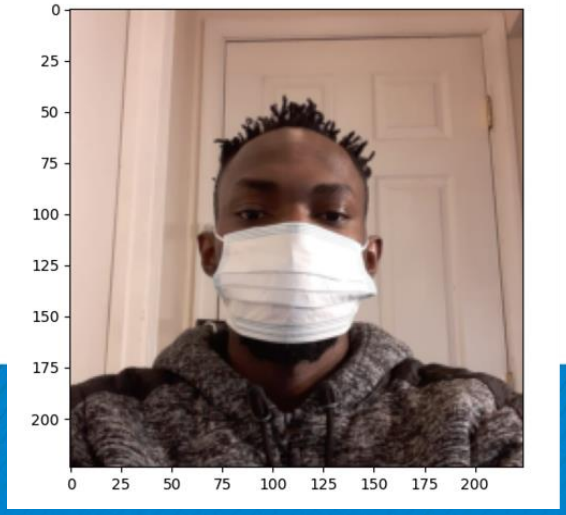

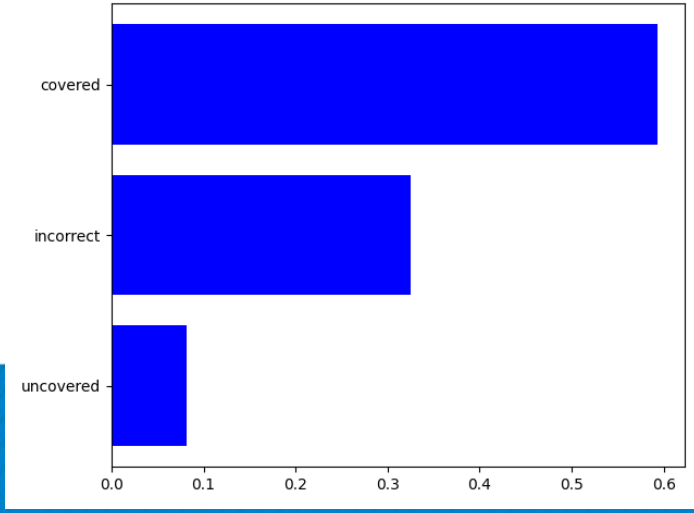

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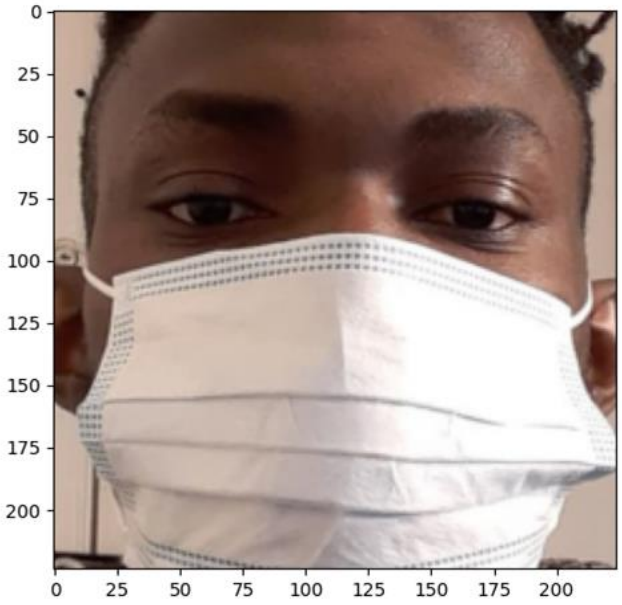

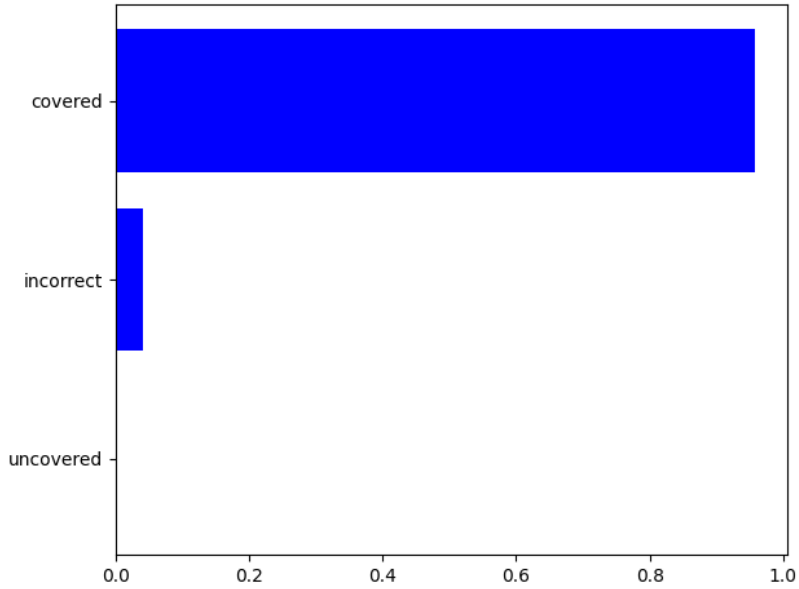

Summary & Conclusion

- The face mask detector model was developed to detect if a face mask is correctly worn (covered), incorrectly worn (incorrect) or not worn (uncovered)

- The model produced an accuracy of 95.22% on an held-out test set

- Occlusion experiments performed on the training dataset showed the model learned the relevant features for face mask detection

- On real world images taken with a camera, the model showed a good performance, making the correct predictions of the images fed

- A better model performance was obtained when an image is cropped to reveal the face only

Future Work

- To develop a primary model to detect the face from a live image/video, before feeding to the face mask detector model

- To research more methods to improve the model accuracy