

Face Mask Detection

PLIN069 Project

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Introduction

- Project goal
 - Train a model that would be able to detect a person not wearing a mask.
- Use of the model
 - Monitor places with high risk of virus spread

Used models

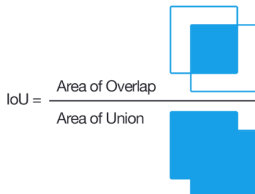
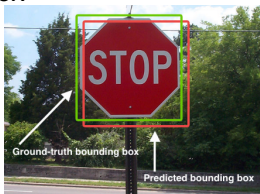
- Two different approaches
 - Haar cascade (face detection) + VGG19 (mask on/off detection)
 - Faster-RCNN
- Haar cascade
 - Light-weight object detection model
 - Cascade function trained from a lot of positive and negative images
 - Full documentation - OpenCV
- VGG19
 - Convolutional neural network
 - Pretrained network, 1000 object categories
 - Fine-tuned with additional face mask dataset
- Faster-RCNN
 - Region-based convolutional neural network
 - Pre-trained on COCO dataset
 - Fine-tuned with our face mask dataset

Evaluation

- Issue - Multiple faces in a single image
 - Order of the model output face coordinates and its labels does not always match the order of the annotation face coordinates and its labels

```
Prediction boxes
[289.57043  97.09577 355.6581 232.76892]
[ 98.6173   89.08514 176.85394 166.1369 ]
[177.82425  52.63085 274.81403 161.35594]
Prediction labels
[2 2 3]
Annotation boxes
[181, 54, 273, 162]
[99, 87, 176, 165]
[289, 99, 355, 233]
Annotation labels
[3, 2, 2]
```

- Solution
 - Jaccard distance - find and match the closest annotation box



Evaluation - Metrics and Results

■ Face box coordinates evaluation

- Box overlap: Jaccard distance between prediction and annotation boxes

- Face box coordinate evaluation = $\frac{\text{Sum of overlaps}}{\text{Number of boxes}}$

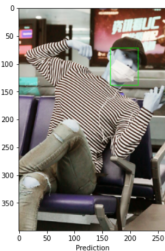
■ Labels evaluation

- Label overlap: prediction equals ground truth
- Overall label overlap = $\frac{\text{Number of overlapping}}{\text{Number of labels}}$

	Haar cascade + VGG19	Faster-RCNN
Face boxes overlap	0.49	0.8
Labels overlap	0.20	0.97

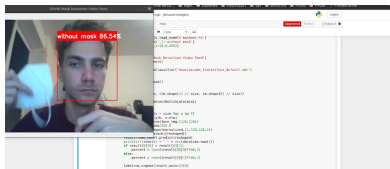
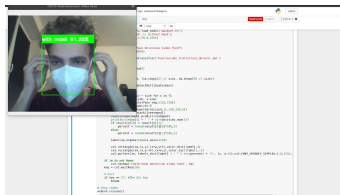
Incorrectly predicted labels

- Issue with "Mask worn incorrectly" label - imbalanced classes - only 3% of samples



Testing model using webcam

- The model recognize the mask whenever we put it on or off with very high probability



References

- [1] <https://www.kaggle.com/code/nageshsingh/mask-and-social-distancing-detection-using-vgg19/data>
- [2] <https://www.kaggle.com/datasets/ashishjangra27/face-mask-12k-images-dataset>
- [3] <https://keras.io/api/applications/vgg/>
- [4] https://docs.opencv.org/3.4/db/d28/tutorial_cascade_classifier.html
- [5] <https://arxiv.org/abs/1506.01497>

Thank You for Your Attention!

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