CSE666 Programming Assignment 2

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Goal: Segment fingerprint region from the hand selfie images

1. Data collection (10 points): Collect a set of your own hand image (minimum 10 images for each hand) at multiple orientations and distances (see the example below)

Hand-Tagged Images For Task-3 and Task-4

Sample folder

my_test folder

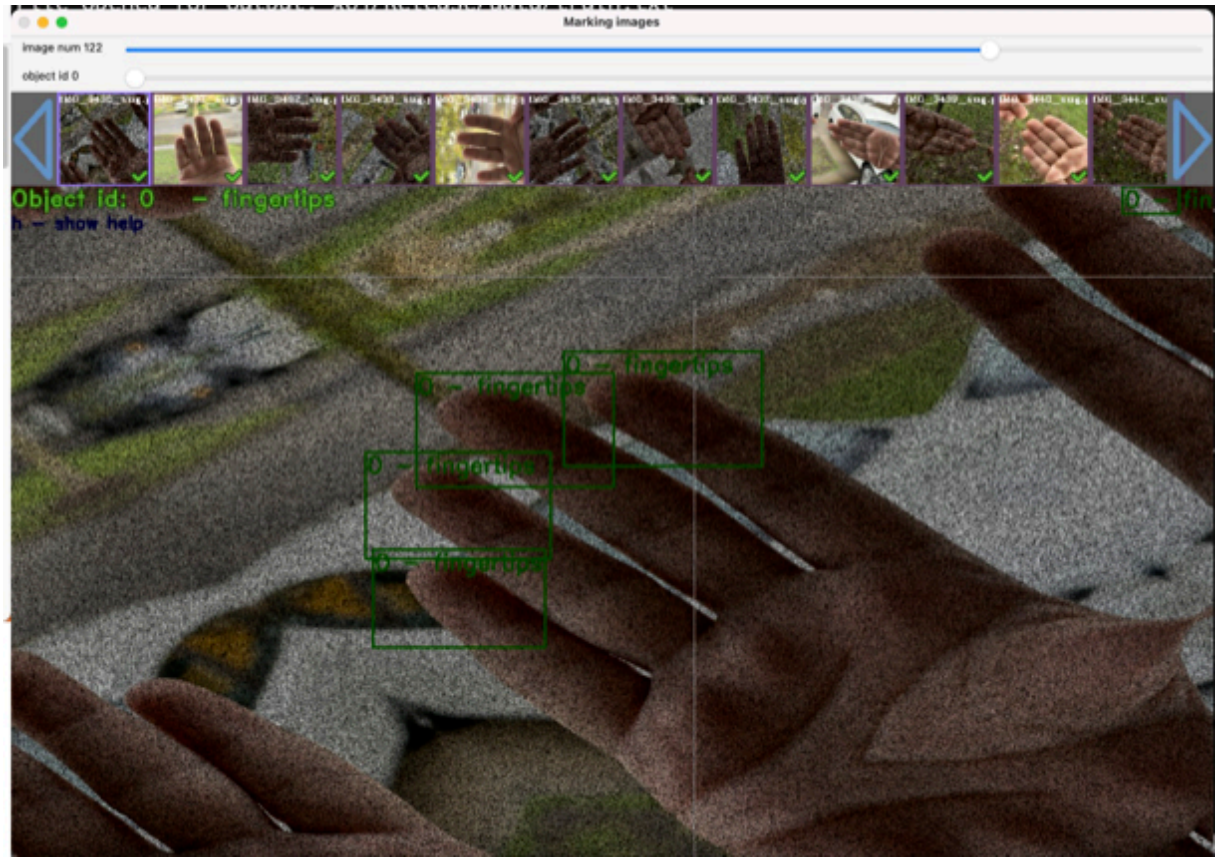
I have used Albumentations to augment the dataset I have just employed a small augmentation pipeline but we can expand this pipeline to more complex augmentation.

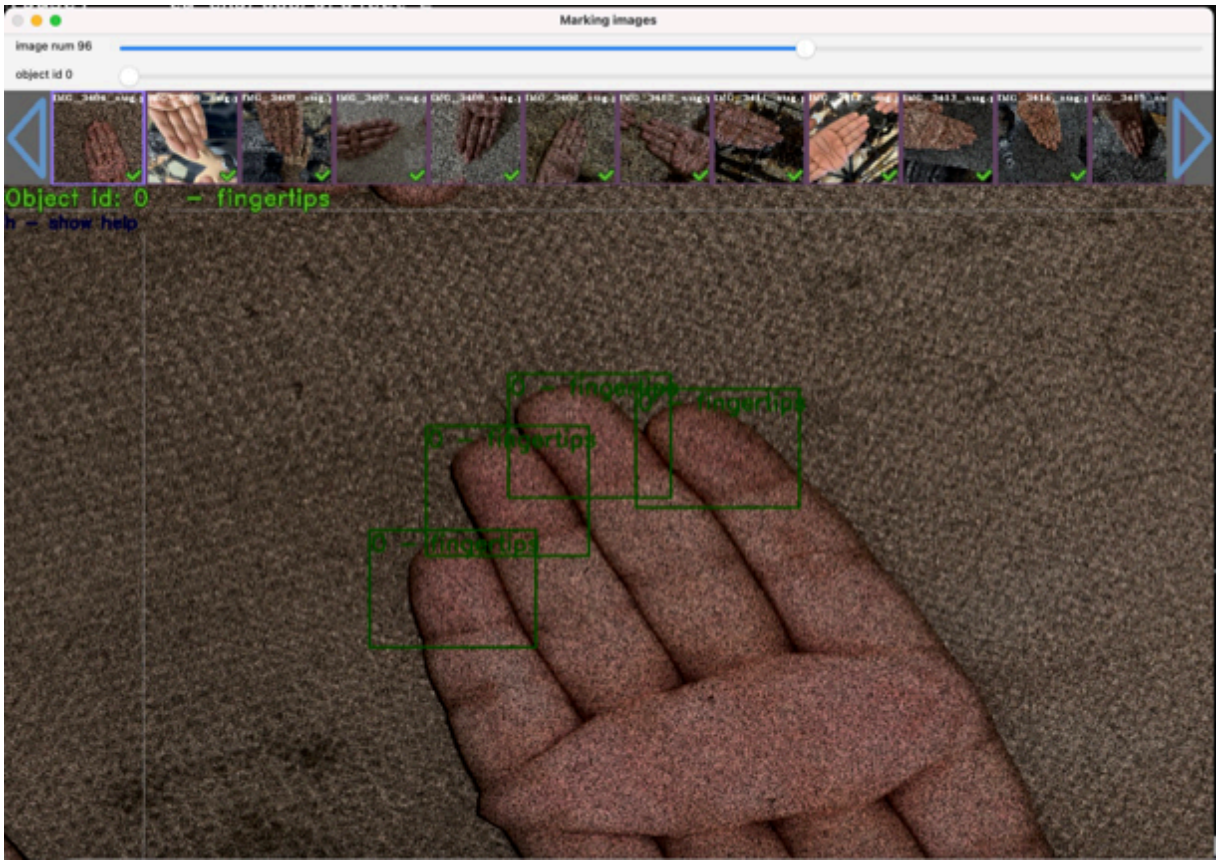
Please see augmentation.ipynb for more details.

2. Annotation (10 points): Mark the box around each visible fingerprint region (See the example below)

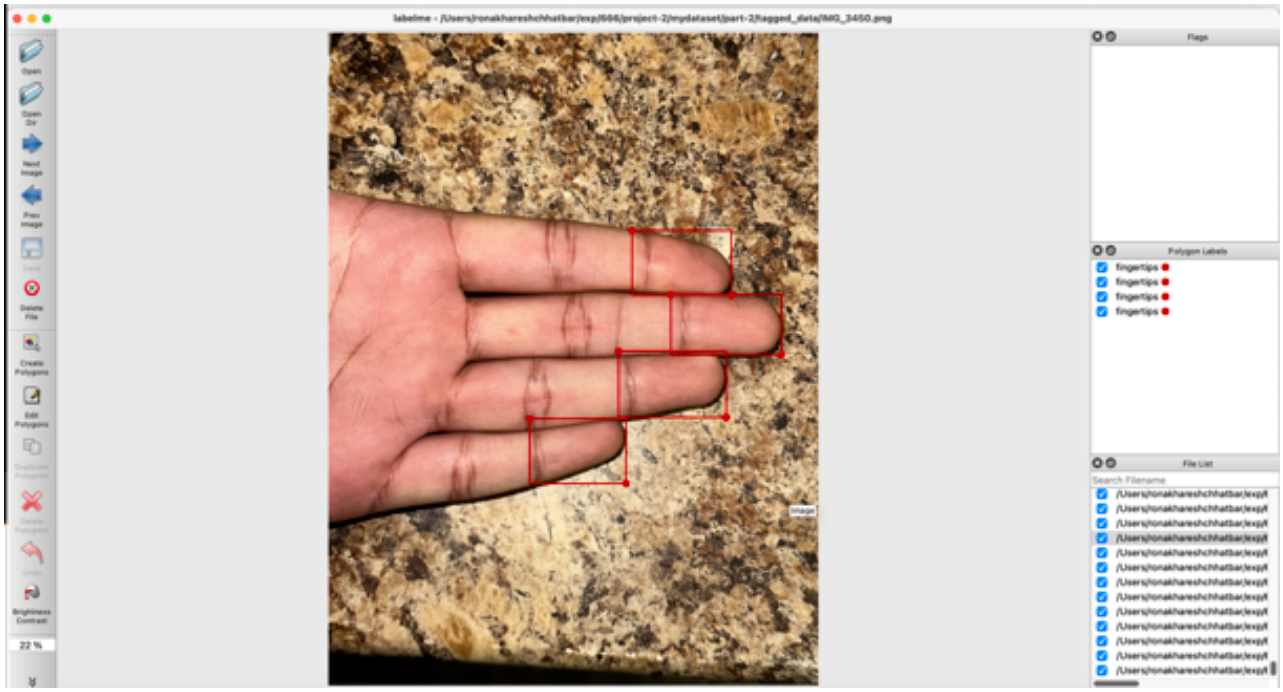
- **Used** labelme and [YoloMark (https://github.comAlexeyAB/Yolo_mark) to label the data set

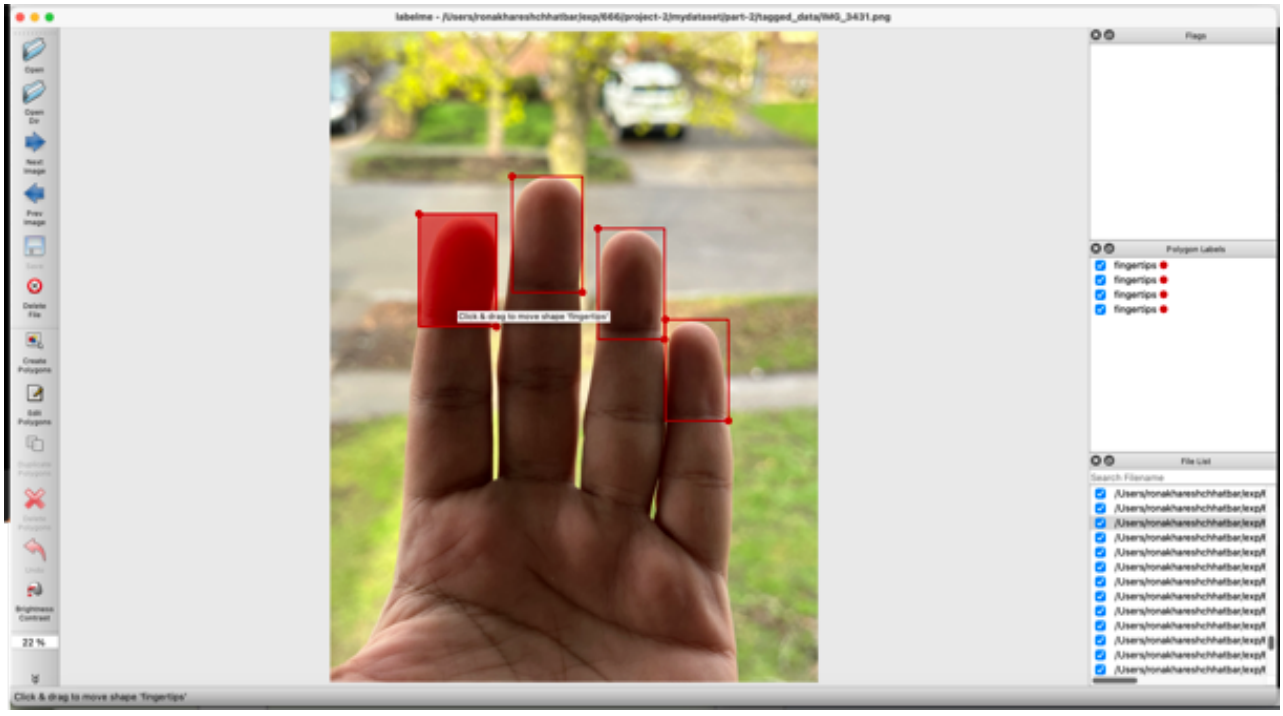
Augmented-Images





Hand-Tagged Images



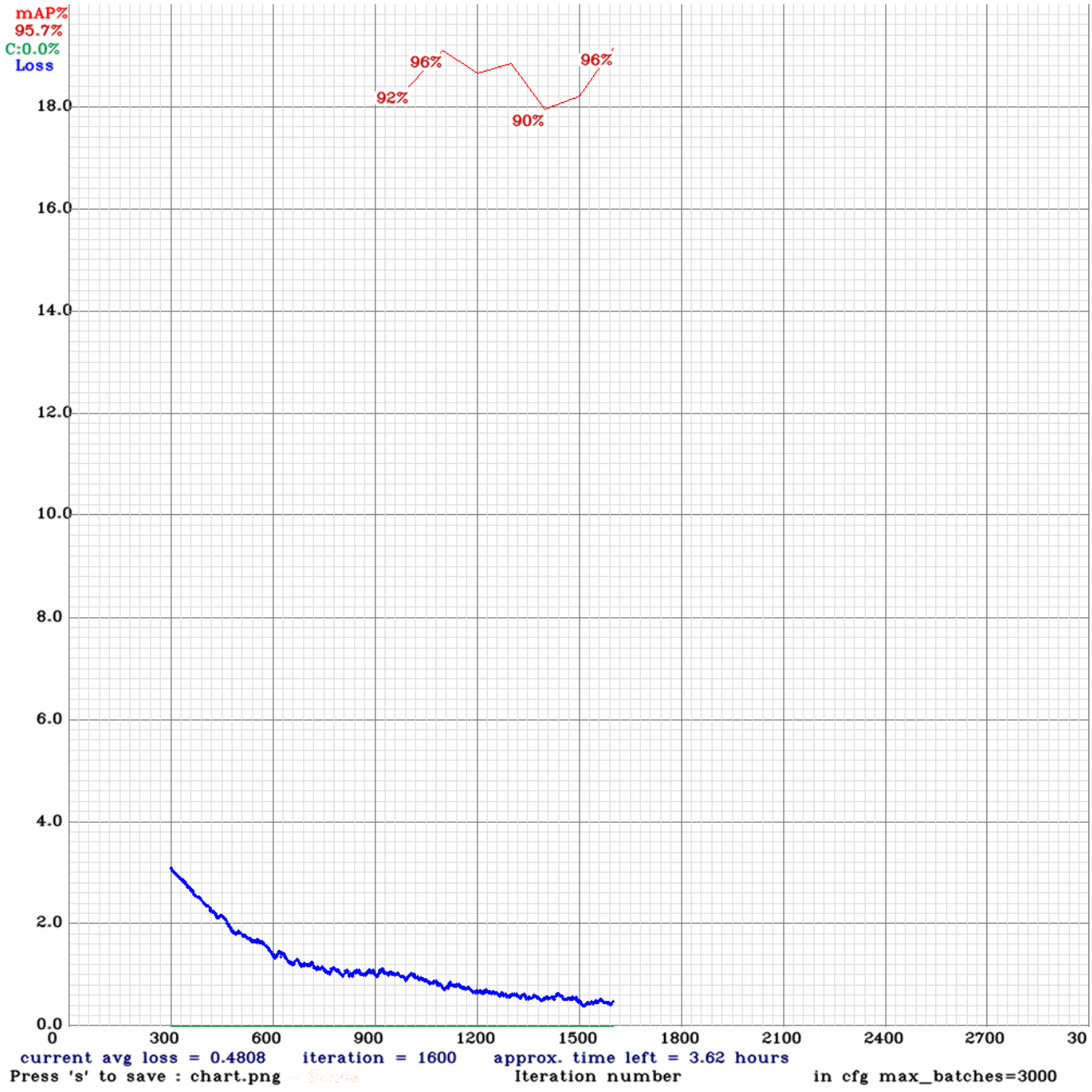


3. Detection (35 points): Write an algorithm to detect automatically

Trained a object detector using [darknet]

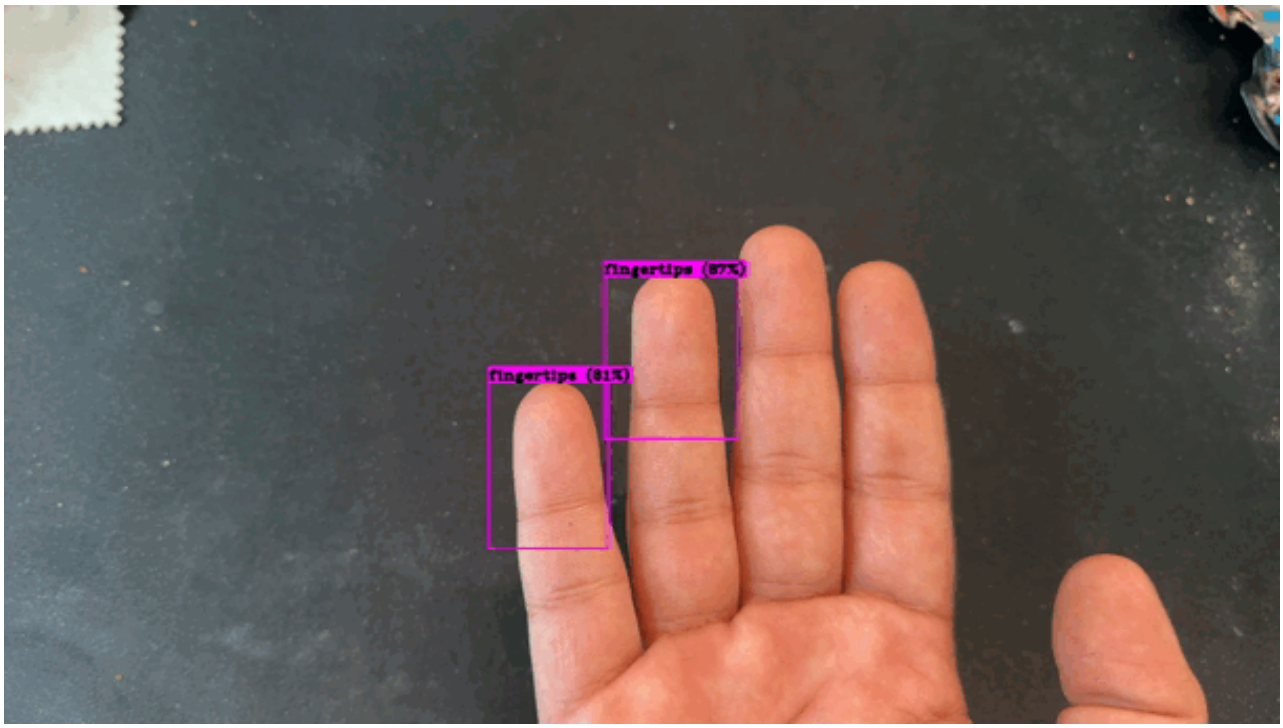
I am using Yolov4-tiny as an object-detector, I have preprocessed data accroding to requirments of darknet

```
submission is base directortry
├── darknet #after cloning darkent
└── fingertips
    ├── my_test # sample detection images generated by hands and their labe
    ├── my_test_detection # Output of sample detection
    ├── obj $training data for yolo and in yolo format
    ├── sample # imagedata provided for detection and their generated label
    └── sample_detetction # Output of sample detection

git clone https://github.com/AlexeyAB/darknet



cp fingertips to darknet/ # move all the necessary files to the darknet */
cd darknet/

# make darknet (builds darknet so that you can then use the darknet executa
make -j 12

#Also make image and labes files using darknet requirments it is available

# to train the models
./darknet detector train fingertips/fingertips.data fingertips/fingertips_t
```



4. Validation (10 points): Evaluate your algorithm performance against the annotation my*test.txt this has unseen hand images and out put of these detections are in fingertips/my*test_detection

```
./darknet detector test fingertips/fingertips.data fingertips/fingertips_ti
```




```
./darknet detector map fingertips/fingertips.data fingertips/fingertips_tin
```

calculation mAP (mean average precision)... on my_test annotation

```
Output:calculation mAP (mean average precision)...
 Detection layer: 30 - type = 28
 Detection layer: 37 - type = 28
12
 detections_count = 114, unique_truth_count = 48
class_id = 0, name = fingertips, ap = 76.71%      (TP = 6, FP = 0)

 for conf_thresh = 0.80, precision = 1.00, recall = 0.12, F1-score = 0.22
 for conf_thresh = 0.80, TP = 6, FP = 0, FN = 42, average IoU = 70.44 %

 IoU threshold = 50 %, used Area-Under-Curve for each unique Recall
 mean average precision (mAP@0.50) = 0.767116, or 76.71 %
Total Detection Time: 5 Seconds
```

5. Testing (20 points): Test your algorithm against the sample*test*images*distal*segmentation provided

sample.txt and out put of these detections are in fingertips/sample_detection folder.

```
./darknet detector test fingertips/fingertips.data fingertips/fingertips_ti
```

```
./darknet detector map fingertips/fingertips.data fingertips/fingertips_tin
```

calculation mAP (mean average precision)... on sample*test*images*distal*segmentation Sample.txt

```
calculation mAP (mean average precision)...
 Detection layer: 30 - type = 28
 Detection layer: 37 - type = 28
52
 detections_count = 246, unique_truth_count = 200
class_id = 0, name = fingertips, ap = 100.00%        (TP = 194, FP = 0)

 for conf_thresh = 0.80, precision = 1.00, recall = 0.97, F1-score = 0.98
 for conf_thresh = 0.80, TP = 194, FP = 0, FN = 6, average IoU = 80.97 %

 IoU threshold = 50 %, used Area-Under-Curve for each unique Recall
 mean average precision (mAP@0.50) = 1.000000, or 100.00 %
Total Detection Time: 16 Seconds
```

Report (10 Points): Write a report describing your algorithm and its performance

```
To make predictions using the best weights
./darknet detector test fingertips/fingertips.data fingertips/fingertips_ti

# batch-inference

cd darknet/

cp fingertips/infer.sh darknet/

bash inference.sh ../submission/fingertips/sample # path/to/folder/of/image
```

I have taken Yolov4-tiny with batch siz eof 32, with input image size = (608,608) and the original images I have trianed on were 4K and I am attching compressed images for the sake of sharing.

I have trained on the model on 204 images That includes 102 augmentd images The example of augmented image is shown above.

On my local machine (M-1) I got 3,fps as througput on 608x608 yolo tiny.

For task-4 I have taken 12 images of unseen data *my_test.txt* refere ### calculation mAP (mean average precision)... on my_test annotation

For task-5, we were given 50 images as data *Sample.txt* refere ### calculation mAP (mean average precision)... on sample annotation

6. Future scope (5 points): How would you improve the detection performance?

We can Improve this algorithm and make it more robuts by Adding more data. Lots more data atleaset 5000 images per class.

Take a bigger network, full-yolov4 and increase input for the bigger network 864,864 since we are training with 4k images we can trainer the network with bigger input image. While the detction has good chances of improving we will have to deal with slower training time and faster cheaper hardware.

We can use this detector and pusdeo label data and deal with faster the data tagging process.

We can train it for better robust detection and the can develop contact less fingerprint reader.

We can optimize network for specific hardware like nvidia or openvino

References

https://github.com/AlexeyAB/darknet

https://github.com/AlexeyAB/Yolo_mark

https://github.com/wkentaro/labelme

https://albumentations.ai/docs/getting*started/bounding*boxes_augmentation/