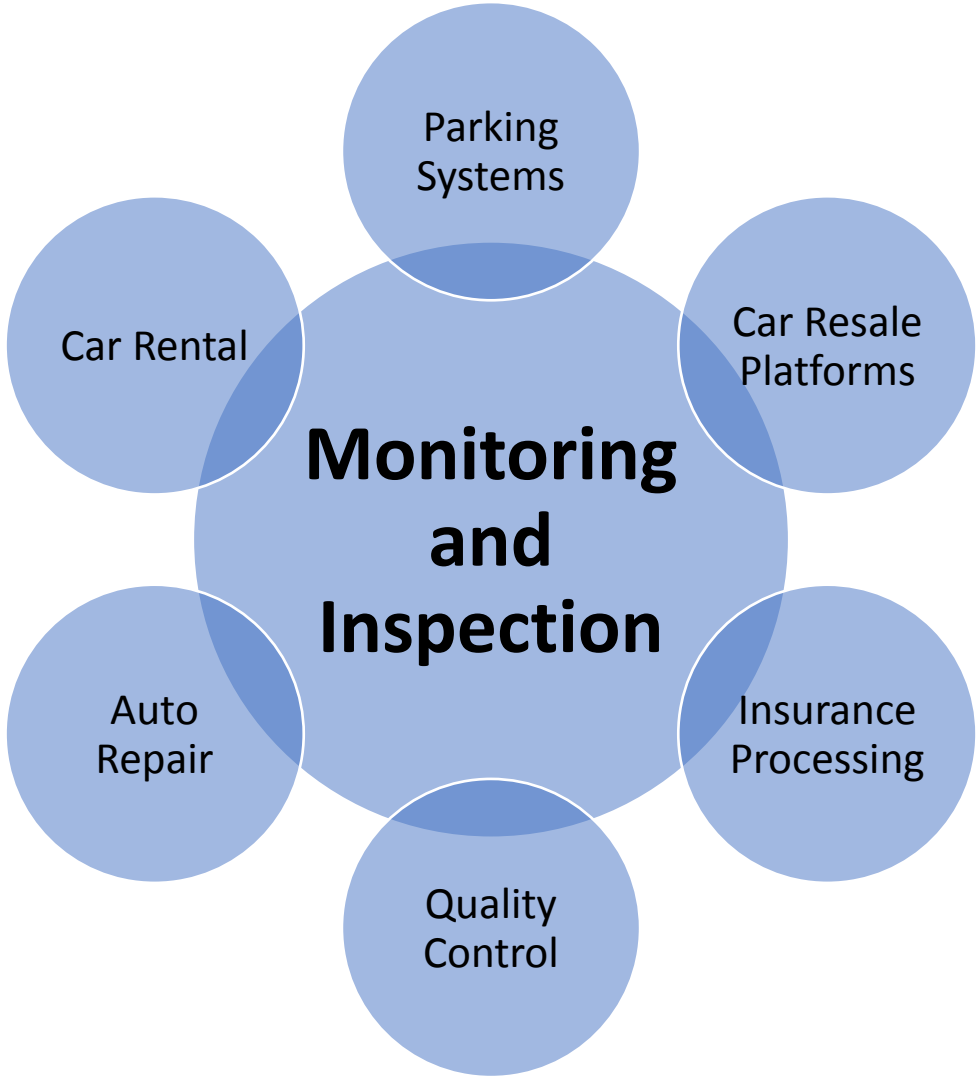
Car Damage Detection

By Rahul Purswani

Project overview

- Develop a model to automatically detect/classify car damage.
- Input – Image of the car
- Output – Kind of damage.
- Focused on external damages such as scratch, dent, flat tire, etc.



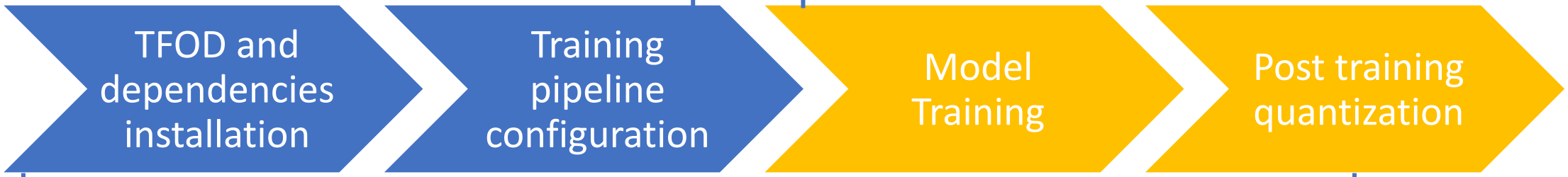
About the dataset

- Dataset – CarDD-Really Real Image dataset.
- No. of Train/Val/Test images – 3501/1000/500 images.
- Classes – crack, dent, scratch, glass shatter, lamp broken, tire flat (6).
- Sourced from Roboflow.

Training workflow for object detection model

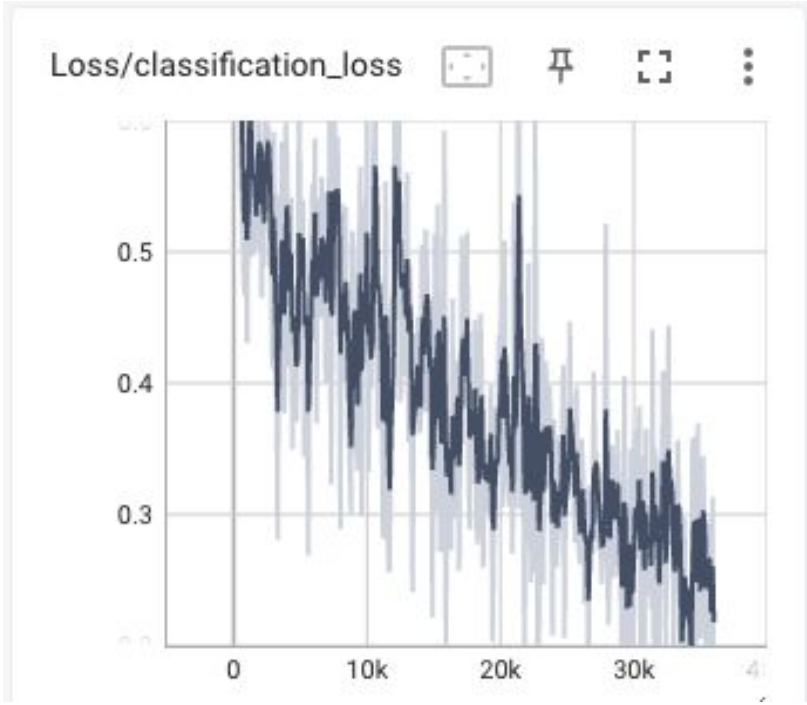
- Load the pretrained model weights and configure the pretrained model file.
- Configure training pipeline file, eg. Classification type, no_of_classes, learning rate, etc.

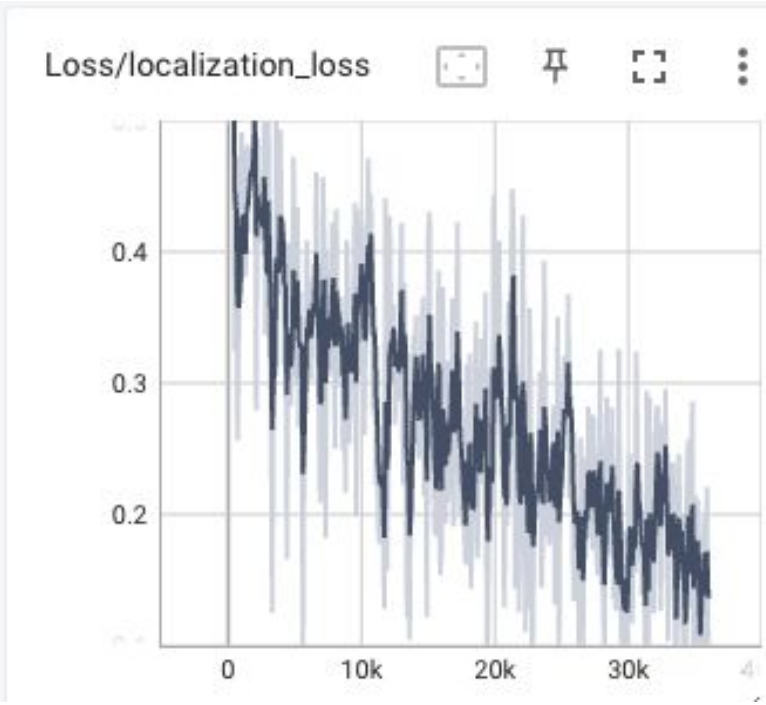
- Train the model with TFOD API
- num_of_steps = 70,000

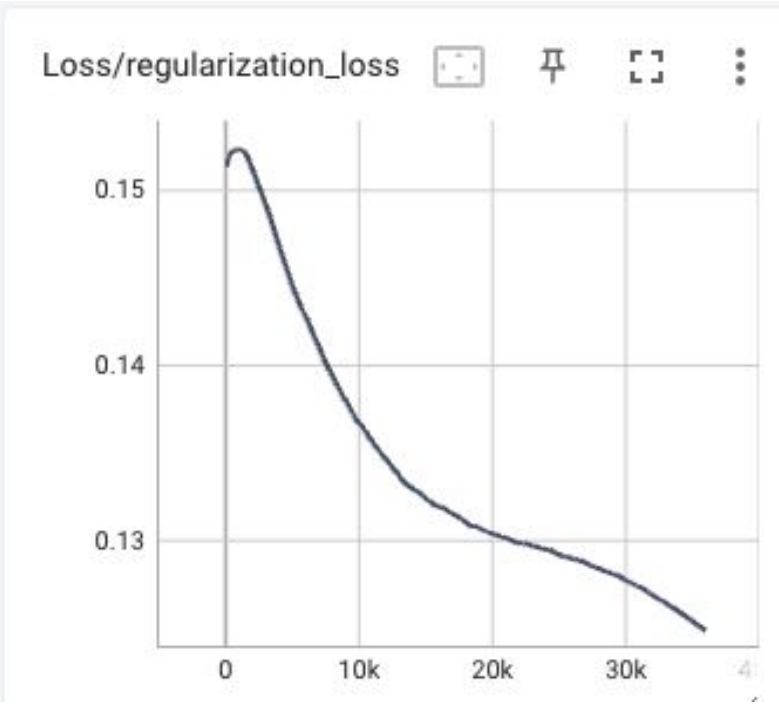


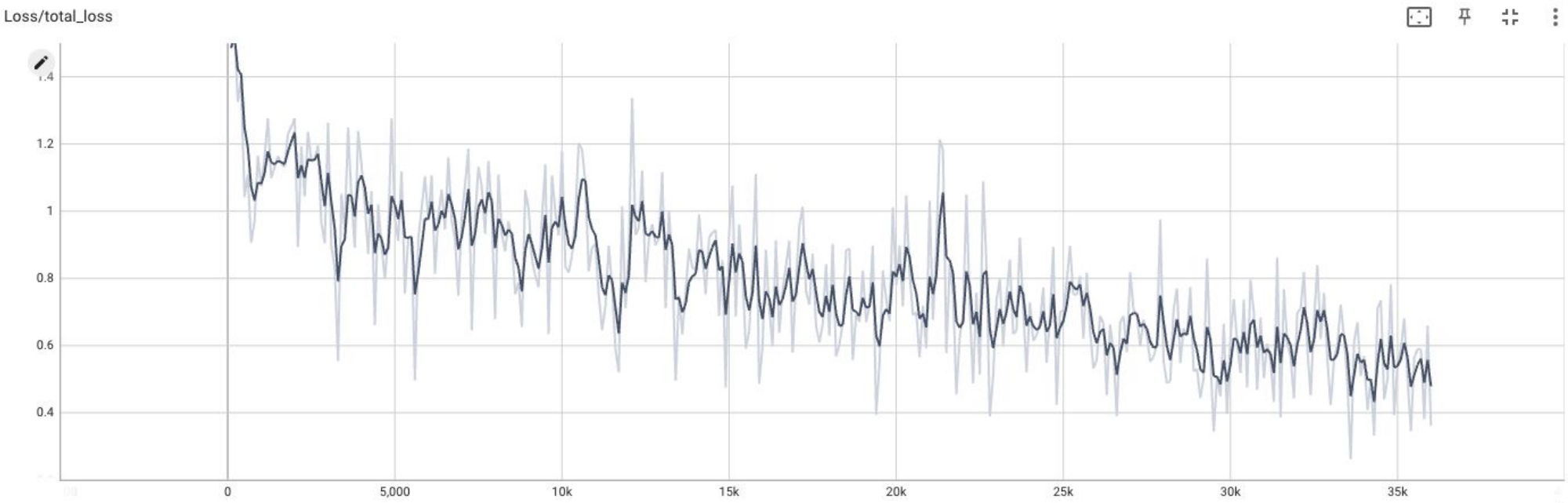
- Clone and install the TensorFlow Object Detection API.
- Install the right versions of dependencies.
- Download the right pretrained model. checkpoints compatible with TFOD.

- Create a representative dataset.
- Convert the original model into tflite model.

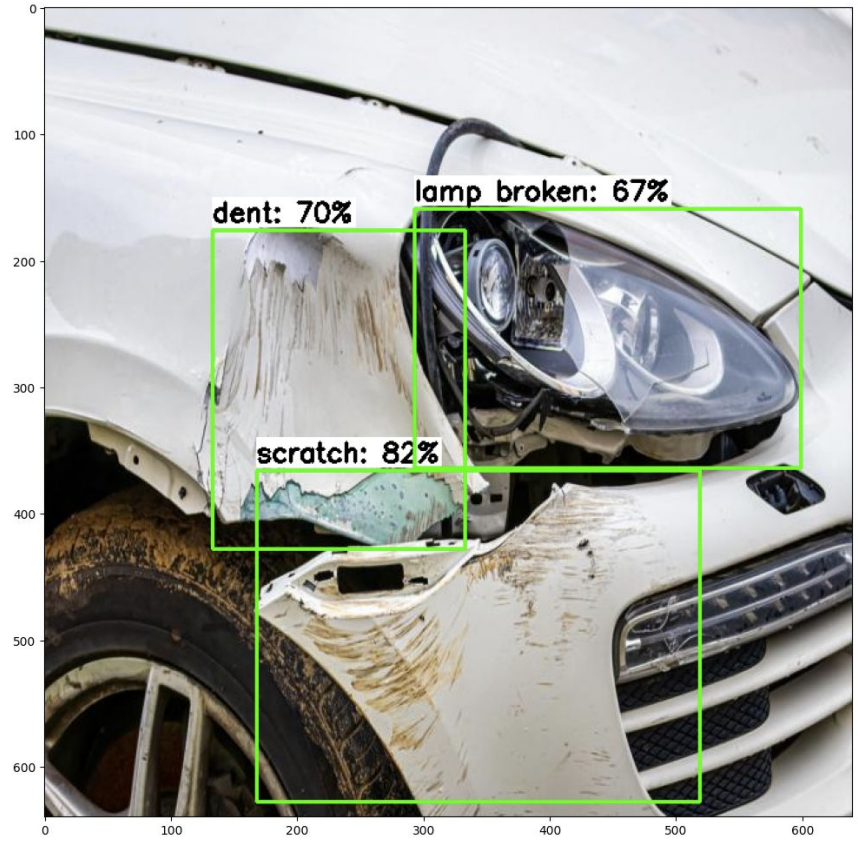

Loss/classification_loss
0.5
0.4
0.3
0
10k
20k
30k

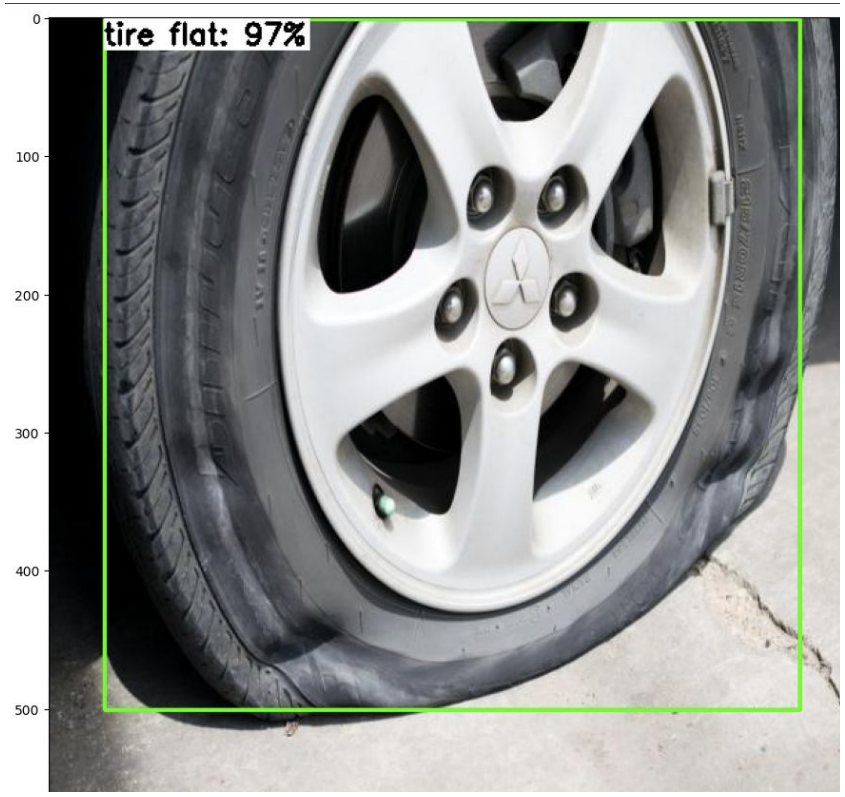

Loss/localization_loss
0.4
0.3
0.2
0
10k
20k
30k


Loss/regularization_loss
0.15
0.14
0.13
0
10k
20k
30k

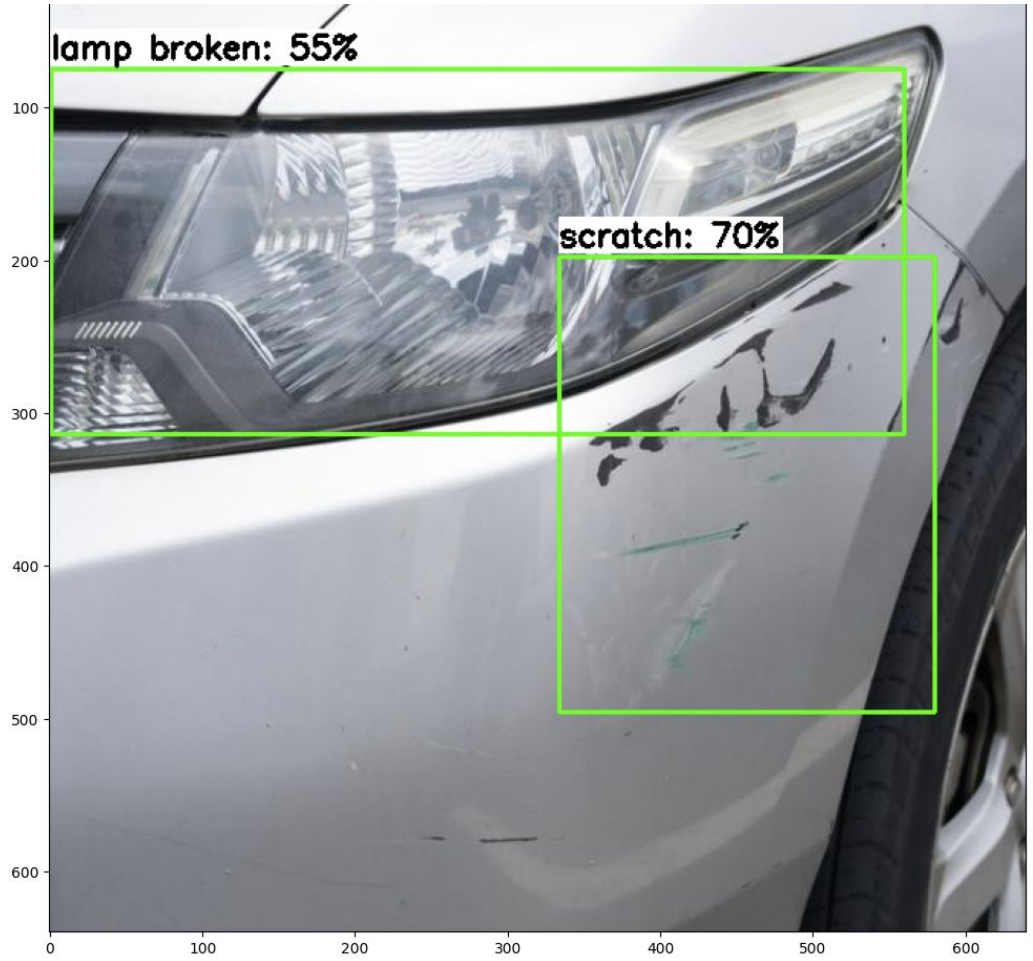

Loss/total_loss
1.4
1.2
1
0.8
0.6
0.4
0
5,000
10k
15k
20k
25k
30k
35k

Some examples of good detections



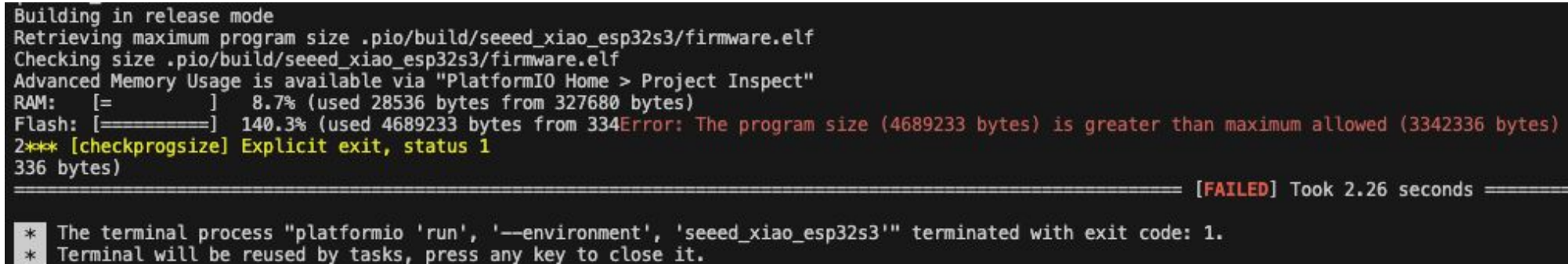


Some examples of bad detections

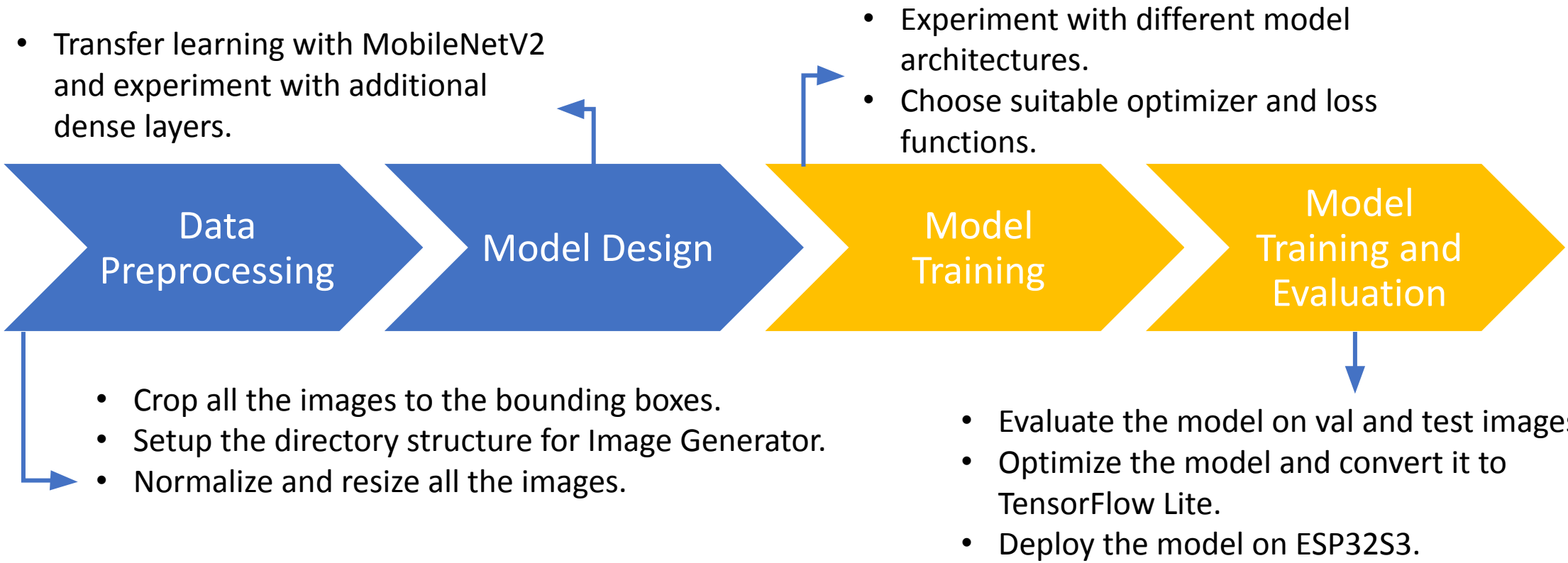


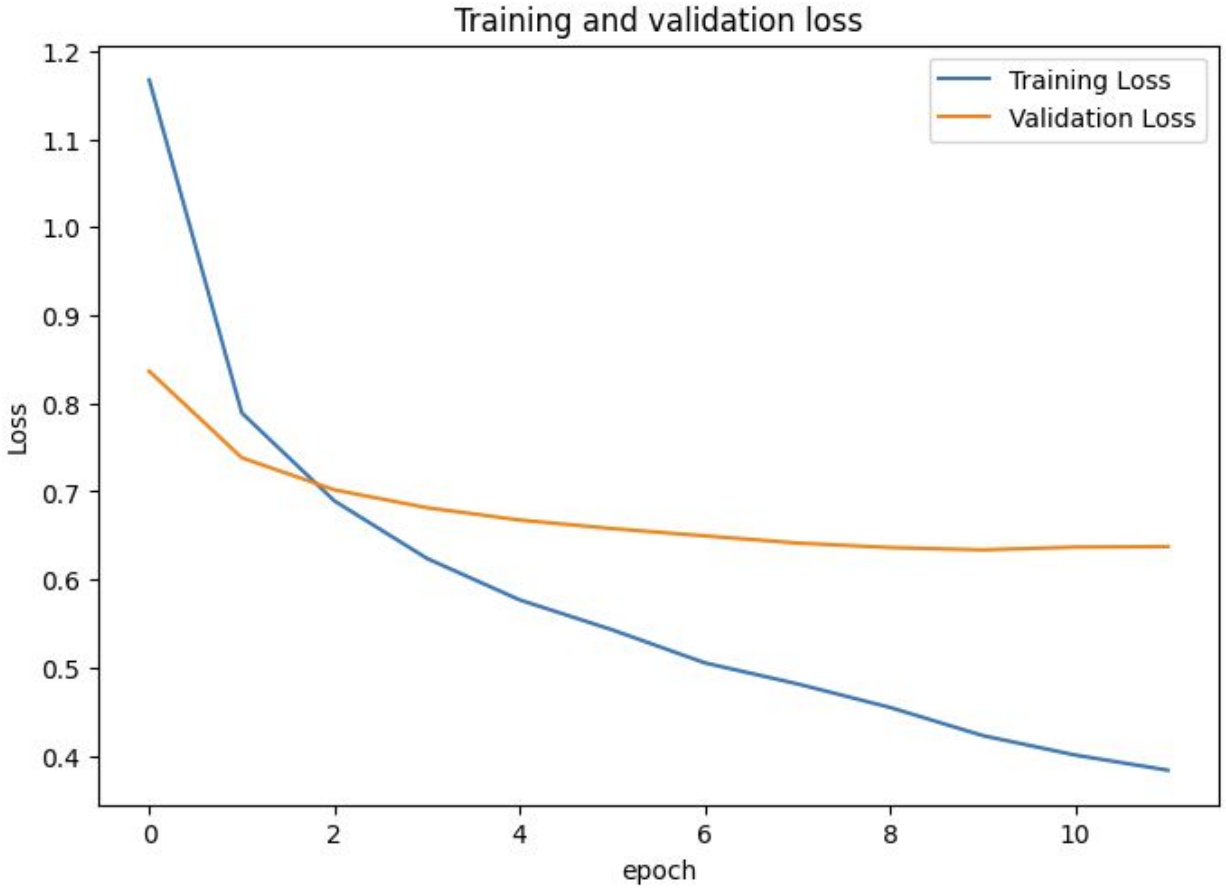
Challenges in deployment on ESP32(S3)

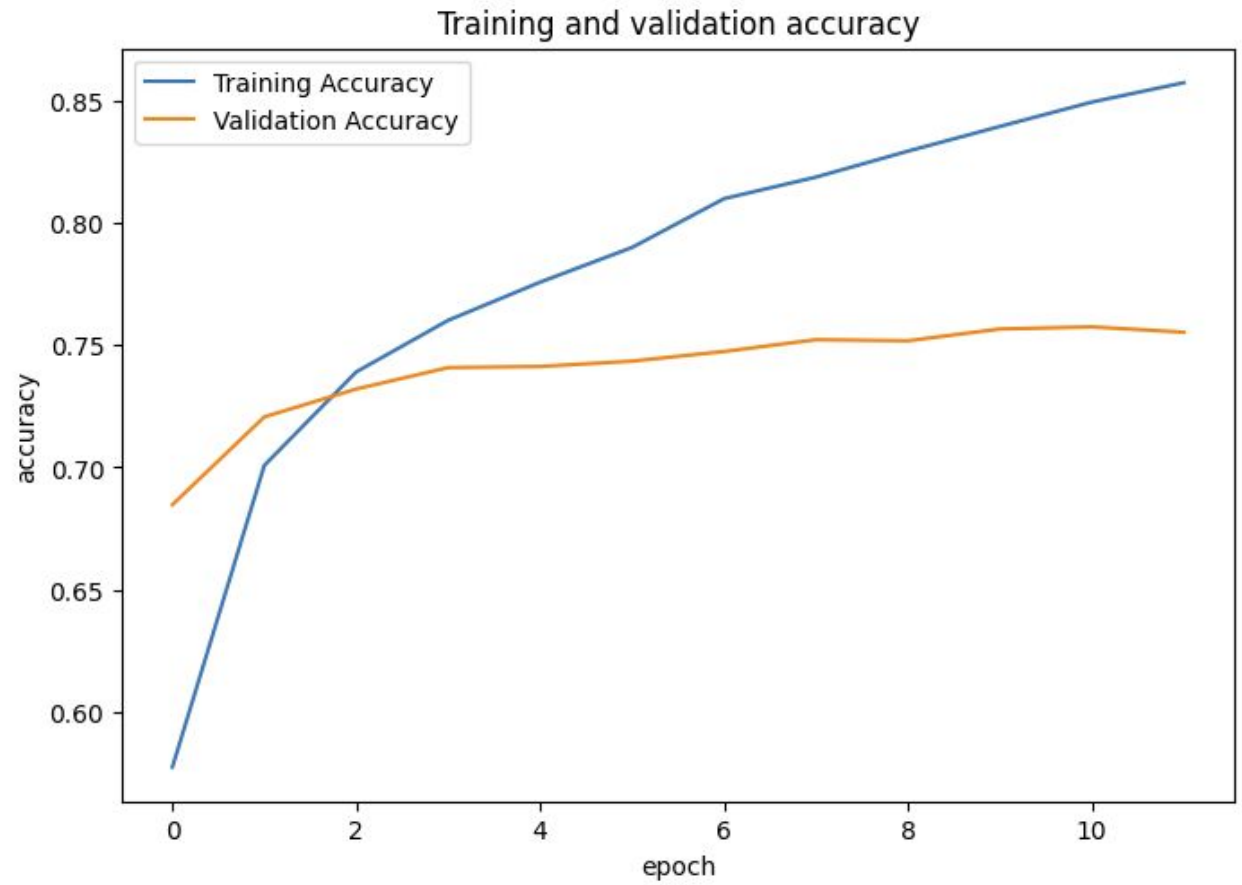
- Model Architecture - ESP32 (S3) support for FPN layers in MobileNet.
- Lack of documentation for tflite models trained using TFOD.
- Solution -
  - Use microprocessor like RaspberryPi or Jetson Nano.
  - Use mobilenet FOMO for deployment on ESP32 (Although I haven't tried this approach).



Training workflow for classification




Training and validation loss
Training Loss
Validation Loss
Loss
epoch
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0
2
4
6
8
10


Training and validation accuracy
Training Accuracy
Validation Accuracy
accuracy
epoch
0.85
0.80
0.75
0.70
0.65
0.60
0
2
4
6
8
10

Model architecture and evaluation

- Training –
  - 7829 images
  - Accuracy – 86.5%
- Validation –
  - 2284 images
  - Accuracy – 76%
- Testing –
  - 1184 images
  - Accuracy – 76.5%

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_2 (InputLayer)        [(None, 64, 64, 3)]       0

 tf.math.truediv (TFOpLambd  (None, 64, 64, 3)         0
 a)

 tf.math.subtract (TFOpLamb  (None, 64, 64, 3)         0
 da)

 mobilenetv2_0.35_224 (Func  (None, 2, 2, 1280)        410208
 tional)

 global_average_pooling2d (  (None, 1280)              0
 GlobalAveragePooling2D)

 dropout (Dropout)           (None, 1280)              0

 dense (Dense)               (None, 256)               327936

 dropout_1 (Dropout)         (None, 256)               0

 dense_1 (Dense)             (None, 6)                 1542

=================================================================
Total params: 739686 (2.82 MB)
Trainable params: 329478 (1.26 MB)
Non-trainable params: 410208 (1.56 MB)
_________________________________________________________________
```

Some examples of classifications

dent

glass shatter

tire flat

dent

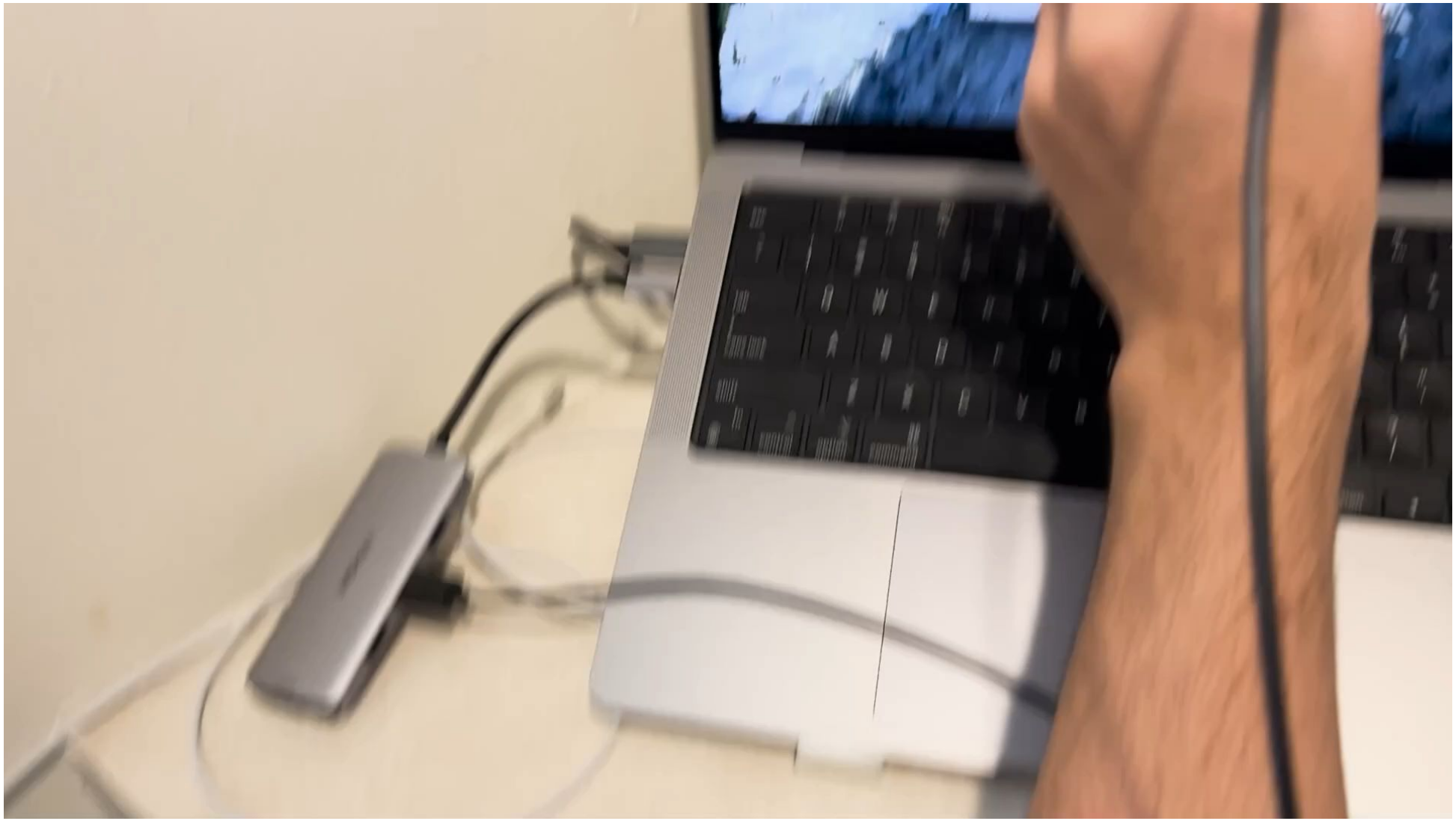
dent

lamp broken

crack

lamp broken

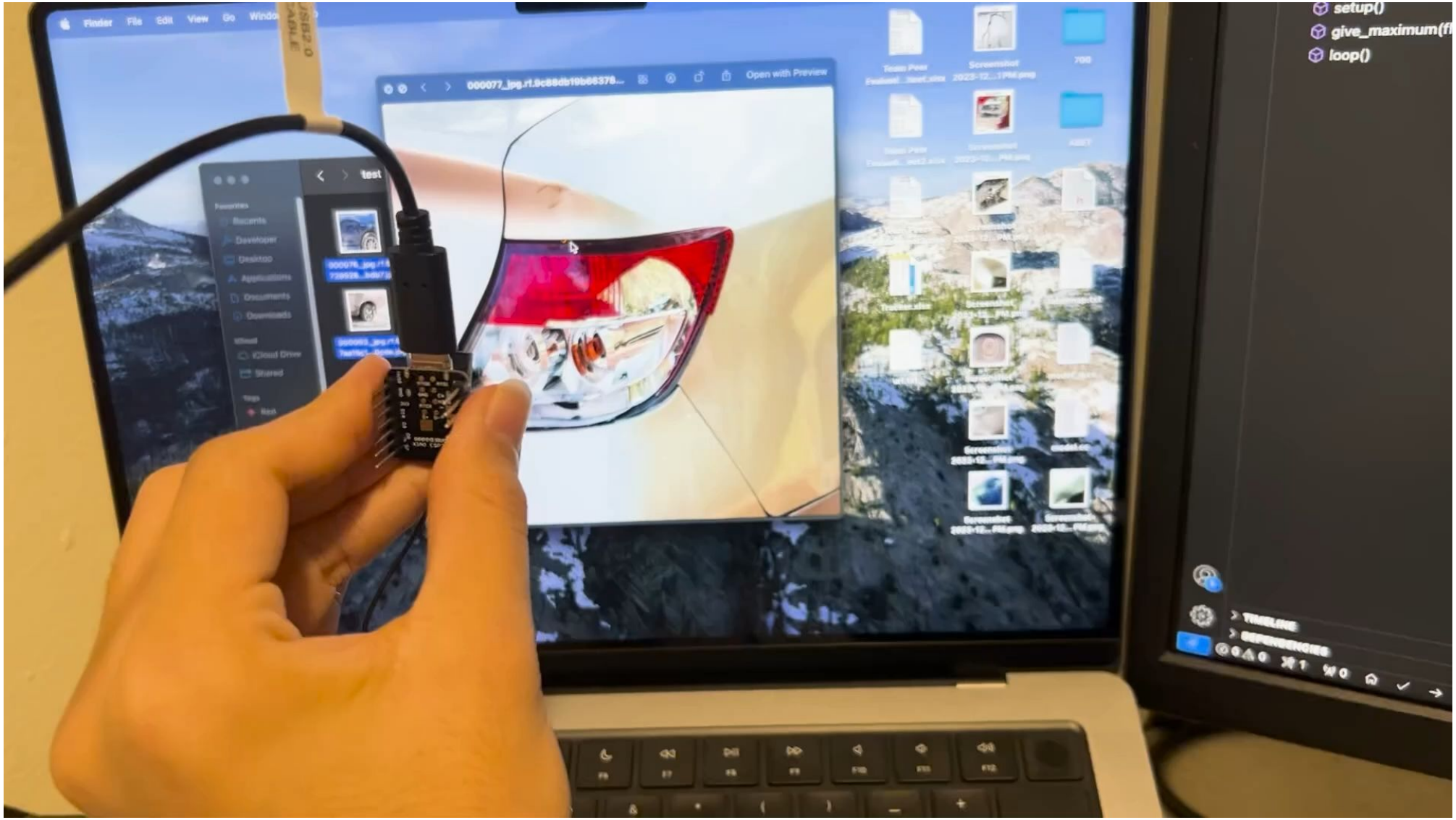
Demo 1



Demo 2


Finder File Edit View Go Window Help
Wed Dec 6 9:05 PM
Open with Preview
test
Recents
Developer
Desktop
Applications
Documents
Downloads
iCloud
iCloud Drive
Shared
Tracker.xlsx
700
ABET
setup()
loop()
TIMELINE
DEPENDENCIES
esc
delete

Demo 3



References

- Wang, X., Li, W., & Wu, Z. (2023). CarDD: A New Dataset for Vision-Based Car Damage Detection. *IEEE Transactions on Intelligent Transportation Systems.*
- *Muktar, M. (2023, October). CarDD-ReallyReal Dataset. Roboflow Universe. Retrieved from https://universe.roboflow.com/moizuddin-muktar-stt7g/cardd-reallyreal*
- *Capstone. (2023, August). Car Damage Detection Dataset. Roboflow Universe. Retrieved from https://universe.roboflow.com/capstone-nh0nc/car-damage-detection-t0g92*
- *https://forum.edgeimpulse.com/t/can-we-use-mobilenetv2-model-with-an-esp32-camera-to-detect-objects/5651/2*