



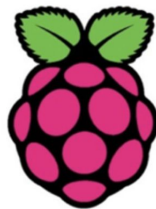
ML-powered Facial Recognition Scanner

Byte & Toby

Growth Session #20 - XX - December 20-21 2018

Facial Recognition Scanner

- **Raspberry Pi**
 - Small computer
- **Android Things**
 - IoT operating system
- **Firebase MLKit**
 - ML SDK for mobile platform
- **Tensorflow**
 - Open source ML framework



RaspberryPi



androidthings



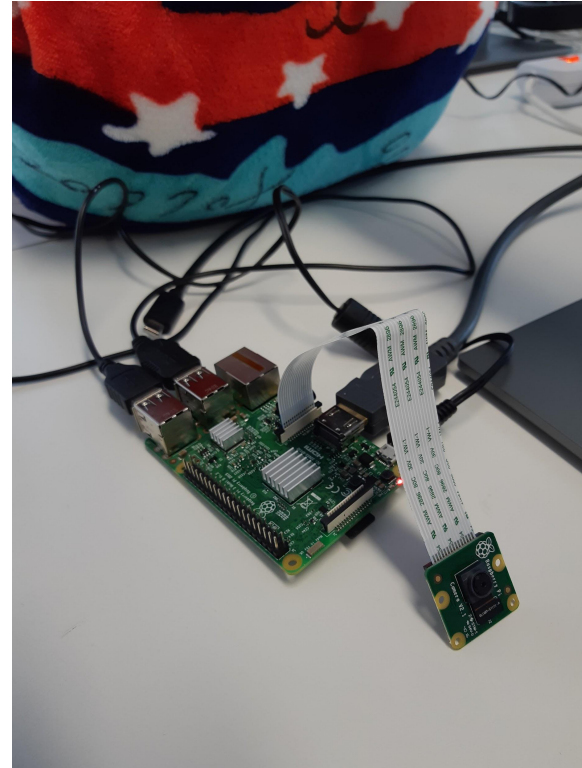
ML Kit
for Firebase



TensorFlow

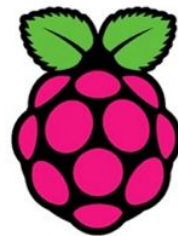
Raspberry Pi

- Small computer
- Various devices / services
 - Keyboard, Mouse
 - Bluetooth/Wi-Fi
- Raspbian



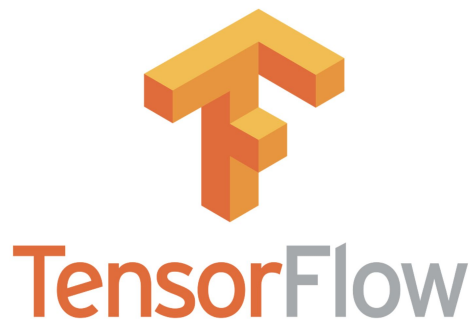
Android Things

- Operating System
- Lets you build smart, connected devices for a wide variety of consumer, retail, and industrial applications.
- Extensions/Libraries

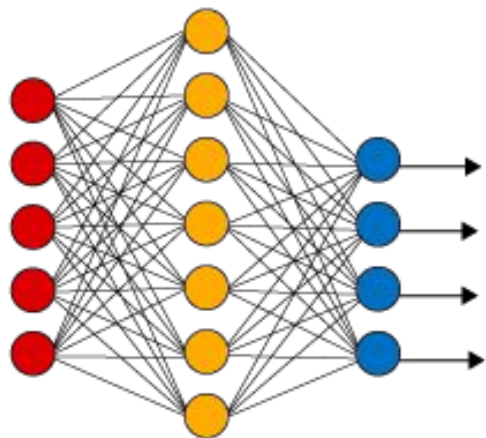


RaspberryPi

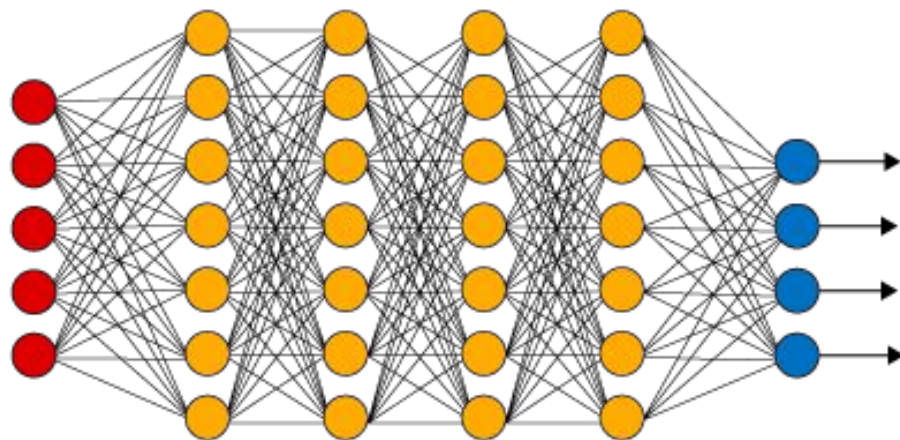
- Open source Machine Learning framework by Google.
- Deep learning model creation.
- Multiple layers of neural network.



Simple Neural Network



Deep Learning Neural Network



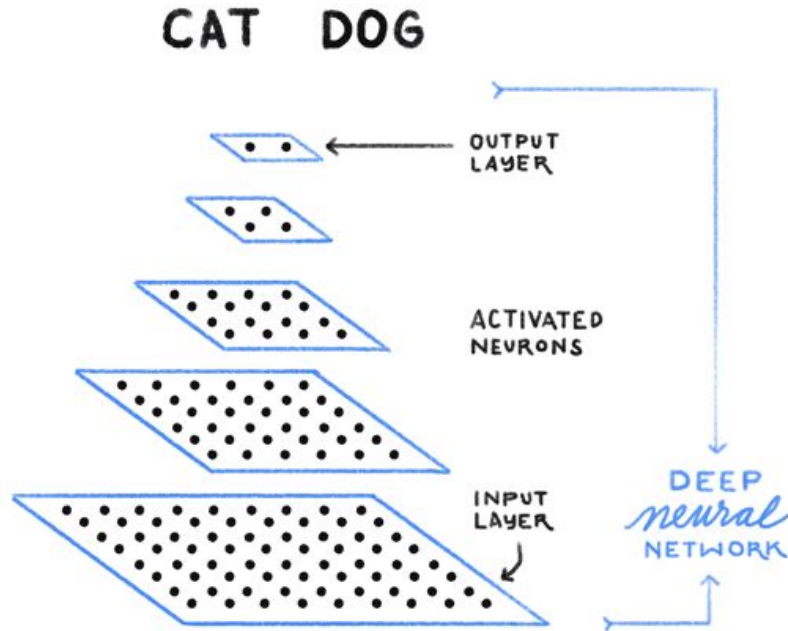
● Input Layer

● Hidden Layer

● Output Layer

<https://becominghuman.ai/deep-learning-made-easy-with-deep-cognition-403fbe445351?gi=7820fe00aa24>

IS THIS A
CAT or **DOG**?



<https://www.google.com/about/main/machine-learning-qa/>



- Google's Mobile SDK, with basic ML Functionality



Text
recognition



Image
labeling



Barcode
scanning



Face
detection



Landmark
recognition

- Custom Model



- ✗ Google's Mobile SDK, with basic ML Functionality



Text
recognition



Image
labeling



Barcode
scanning



Face
detection



Landmark
recognition

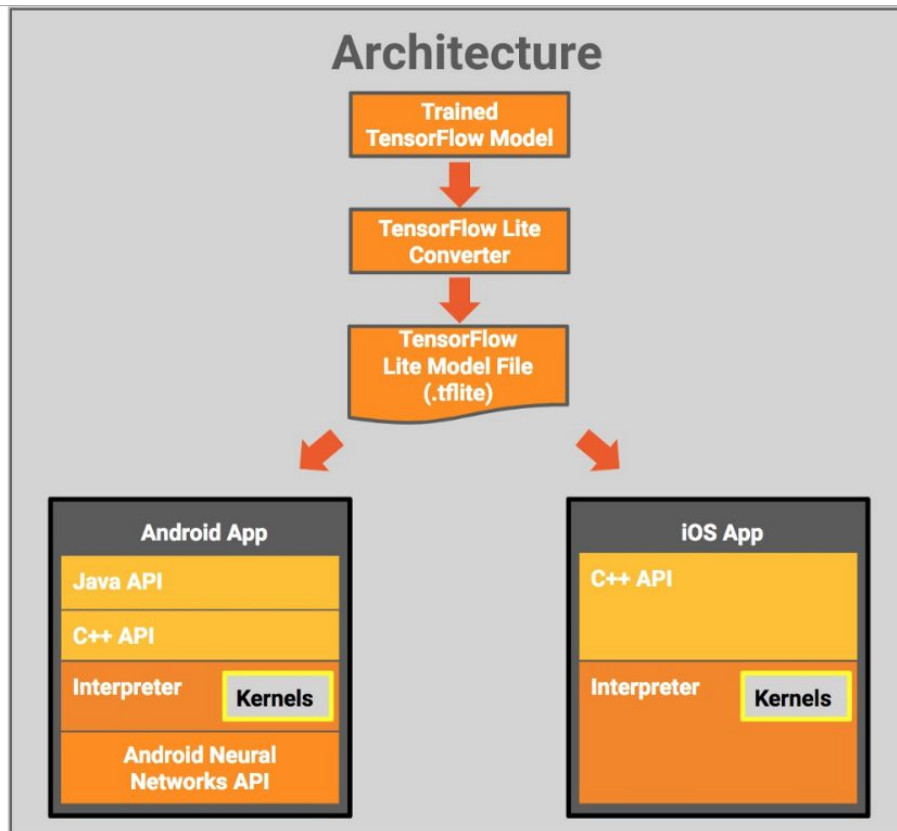
- ✓ Custom Model

- New model on the fly.
- Model optimized.

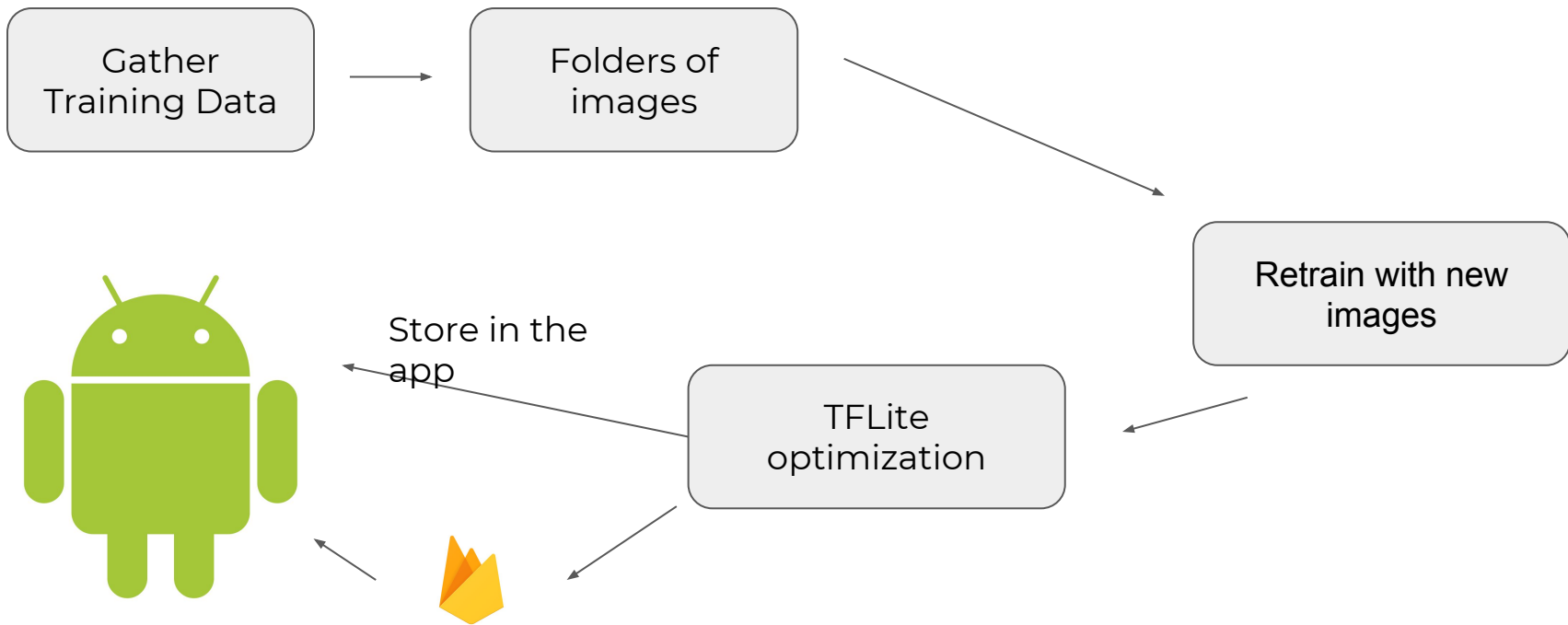


- Official solution for running machine learning models on mobile and embedded devices.
- It enables on-device machine learning inference.
- Low latency and a small binary size on Android, iOS, and other operating systems.





Firebase MLKit, Custom Modeling



<https://www.google.com/about/main/machine-learning-qa/>

Model Training

arnold-schwarzenegger

barak-obama

dwayne-johnson

issarapong-poesua

prayut-chanocha

vin-diesel

_93339875_obamalaughing.jpg

1cubby.jpg

5c6cfec2f15f409eba6a935de4695f33.jpg

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JPEG image - 21 KB

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<https://www.google.com/about/main/machine-learning-qa/>



```
python tensorflow/example/image_retraining/retrain.py
--bottleneck_dir=tf_files/bottlenecks # cache output, avoid recalculation
--how_many_training_steps=5000 # number of layers
--model_dir=/tf_files/inception # pre-trained model
--output_graph=/output/retrained_graph.pb
--output_labels=/output/retrained_label.txt
```

Model Training

```
docker Downloads — root@b47e75758645: /tensorflow — docker exec -it b47e75758645 bash — 144x31
...b47e75758645: /tensorflow — docker exec -it b47e75758645 bash bazel build tensorflow/python/tools...
Q: Final test accuracy
INFO:tensorflow:2018-12-20 17:57:29.220355: Step 3970: Validation accuracy = 78.0% (N=100)
INFO:tensorflow:2018-12-20 17:57:29.944570: Step 3980: Train accuracy = 100.0%
INFO:tensorflow:2018-12-20 17:57:29.944776: Step 3980: Cross entropy = 0.058494
INFO:tensorflow:2018-12-20 17:57:30.021828: Step 3980: Validation accuracy = 87.0% (N=100)
INFO:tensorflow:2018-12-20 17:57:30.750852: Step 3990: Train accuracy = 100.0%
INFO:tensorflow:2018-12-20 17:57:30.751074: Step 3990: Cross entropy = 0.068778
INFO:tensorflow:2018-12-20 17:57:30.826804: Step 3990: Validation accuracy = 78.0% (N=100)
INFO:tensorflow:2018-12-20 17:57:31.482338: Step 3999: Train accuracy = 100.0%
INFO:tensorflow:2018-12-20 17:57:31.482518: Step 3999: Cross entropy = 0.057080
INFO:tensorflow:2018-12-20 17:57:31.558116: Step 3999: Validation accuracy = 78.0% (N=100)
2018-12-20 17:57:32.890889: W tensorflow/core/graph/graph_constructor.cc:1265] Importing a graph with a lower producer version 26 into an existi
ng graph with producer version 27. Shape inference will have run different parts of the graph with different producer versions.
INFO:tensorflow:Saver not created because there are no variables in the graph to restore
INFO:tensorflow:Restoring parameters from /tmp/_retrain_checkpoint
INFO:tensorflow:Final test accuracy = 84.2% (N=101)
INFO:tensorflow:Save final result to : /retrained_graph.pb
2018-12-20 17:57:39.106814: W tensorflow/core/graph/graph_constructor.cc:1265] Importing a graph with a lower producer version 26 into an existi
ng graph with producer version 27. Shape inference will have run different parts of the graph with different producer versions.
INFO:tensorflow:Saver not created because there are no variables in the graph to restore
INFO:tensorflow:Restoring parameters from /tmp/_retrain_checkpoint
INFO:tensorflow:Froze 378 variables.
INFO:tensorflow:Converted 378 variables to const ops.
root@b47e75758645:/# ls
bin      dev      lib      mnt      people   retrained_graph.pb  run      srv      tmp
boot     etc      lib64    notebooks proc      retrained_labels.txt run_jupyter.sh  sys      usr
bottlenecks home     media    opt      retrain.py root              sbin     tensorflow-1.12.0-cp27-cp27mu-manylinux1_x86_64.whl var
root@b47e75758645:/# mkdir output
root@b47e75758645:/# cp retrained_* output
root@b47e75758645:/# cd output/
root@b47e75758645:/output# ls
retrained_graph.pb  retrained_labels.txt
```

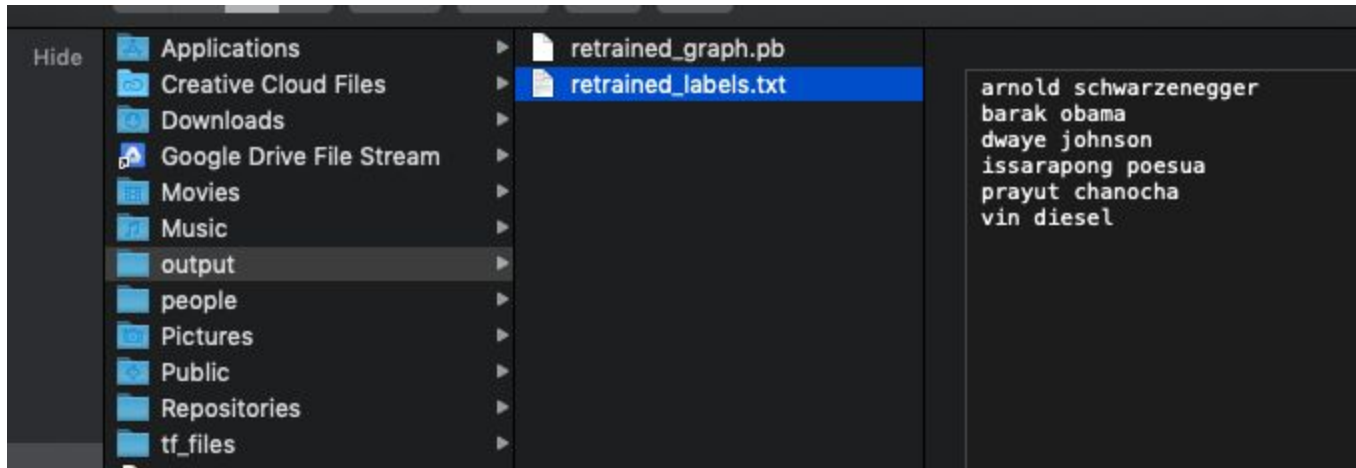
400 layers training

Model Training

```
docker Downloads — root@b47e75758645: /tensorflow — docker exec -it b47e75758645 bash — 144x31
INFO:tensorflow:2018-12-21 05:53:29.929438: Step 3950: Train accuracy = 100.0%
INFO:tensorflow:2018-12-21 05:53:29.929694: Step 3950: Cross entropy = 0.083614
INFO:tensorflow:2018-12-21 05:53:30.059903: Step 3950: Validation accuracy = 76.0% (N=100)
INFO:tensorflow:2018-12-21 05:53:31.460546: Step 3960: Train accuracy = 100.0%
INFO:tensorflow:2018-12-21 05:53:31.460849: Step 3960: Cross entropy = 0.088940
INFO:tensorflow:2018-12-21 05:53:31.604307: Step 3960: Validation accuracy = 75.0% (N=100)
INFO:tensorflow:2018-12-21 05:53:32.959977: Step 3970: Train accuracy = 100.0%
INFO:tensorflow:2018-12-21 05:53:32.960267: Step 3970: Cross entropy = 0.091016
INFO:tensorflow:2018-12-21 05:53:33.120015: Step 3970: Validation accuracy = 77.0% (N=100)
INFO:tensorflow:2018-12-21 05:53:34.412356: Step 3980: Train accuracy = 100.0%
INFO:tensorflow:2018-12-21 05:53:34.413041: Step 3980: Cross entropy = 0.087183
INFO:tensorflow:2018-12-21 05:53:34.595601: Step 3980: Validation accuracy = 73.0% (N=100)
INFO:tensorflow:2018-12-21 05:53:35.963228: Step 3990: Train accuracy = 100.0%
INFO:tensorflow:2018-12-21 05:53:35.984536: Step 3990: Cross entropy = 0.081251
INFO:tensorflow:2018-12-21 05:53:36.094474: Step 3990: Validation accuracy = 75.0% (N=100)
INFO:tensorflow:2018-12-21 05:53:37.518646: Step 3999: Train accuracy = 100.0%
INFO:tensorflow:2018-12-21 05:53:37.530061: Step 3999: Cross entropy = 0.065558
INFO:tensorflow:2018-12-21 05:53:37.722365: Step 3999: Validation accuracy = 70.0% (N=100)
INFO:tensorflow:Final test accuracy = 91.5% (N=106)
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.
root@b47e75758645:/tensorflow# python tensorflow/examples/label_image/label_image.py --graph=output/retrained_graph.pb labels=output/retrained_labels.txt -input_layer=Mul --output-layer=final_result --input_mean=128 --input_std=128 --image=../issarapong_0528.jpg
usage: label_image.py [-h] [--image IMAGE] [--graph GRAPH] [--labels LABELS]
                    [--input_height INPUT_HEIGHT]
                    [--input_width INPUT_WIDTH] [--input_mean INPUT_MEAN]
                    [--input_std INPUT_STD] [--input_layer INPUT_LAYER]
                    [--output_layer OUTPUT_LAYER]
label_image.py: error: unrecognized arguments: labels=output/retrained_labels.txt -input_layer=Mul --output-layer=final_result --input_std=128
root@b47e75758645:/tensorflow# bazel
bash: bazel: command not found
```

400 layers training

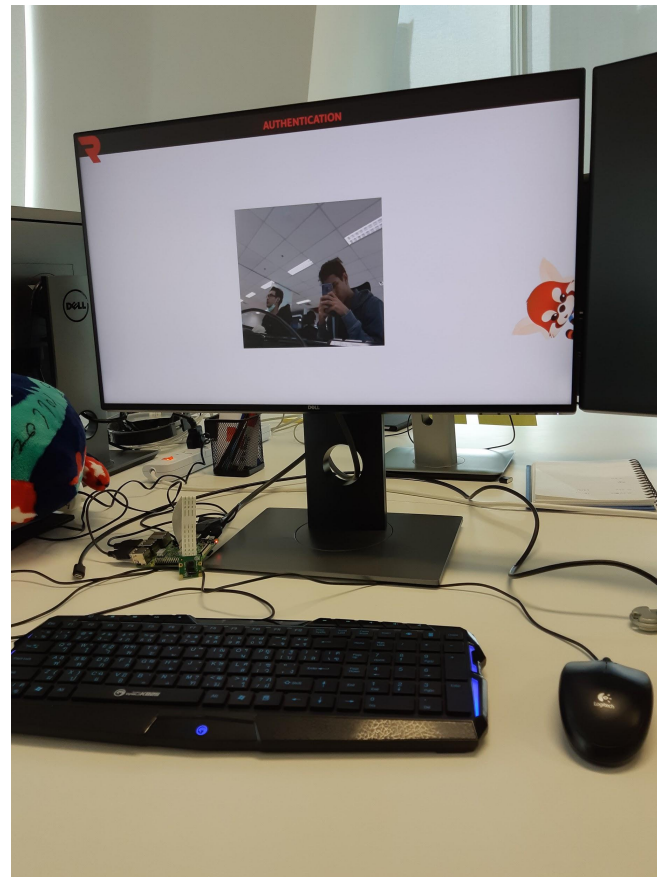
Model Training



Output files

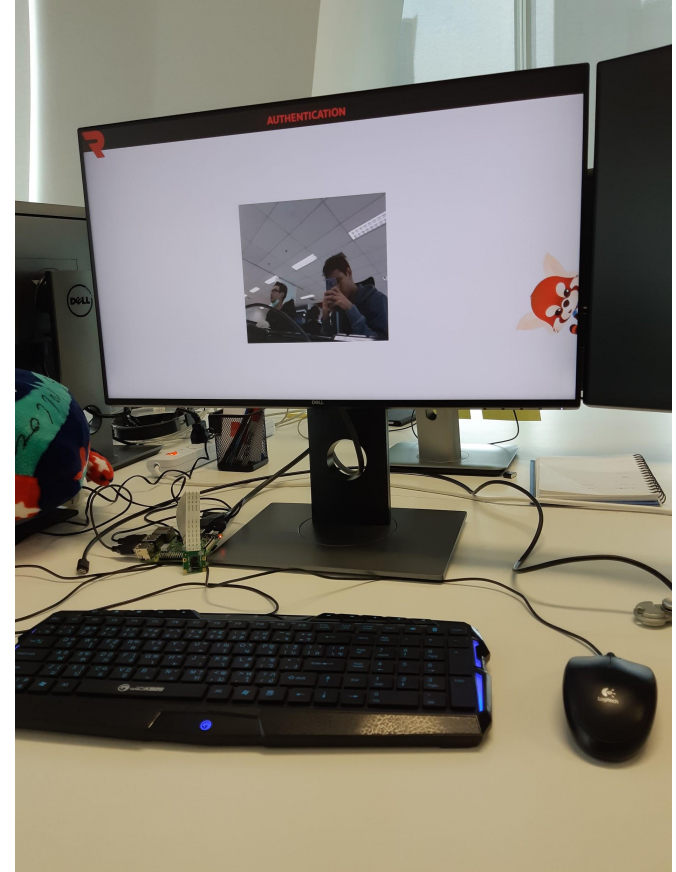
Goals

1. Get Raspberry Pi working with Android Things
2. Show camera-output on display
3. Create custom-models with TensorFlow
4. TensorFlow Lite Mobile Optimization
5. Integrate custom-models in to Firebase
6. Communication between App & Firebase
7. Create Authentication-flow
8. Style-Up



Achievement and Progress

1. **Get Raspberry Pi working with Android Things**
2. **Show camera-output on display**
3. **Create custom-models with TensorFlow**
4. **TensorFlowLite Mobile Optimization**
5. **Integrate custom-models in to Firebase**
6. **Communication between App & Firebase**
7. **Create Authentication-flow**
8. **Style up**



Next Steps

- Integrate custom-models in to Firebase
- Communication between App & Firebase
- Create Authentication-flow
- Style up



Thanks!

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