

Research Diary: Cross-device portability of the EMSCA Nordic Experiment

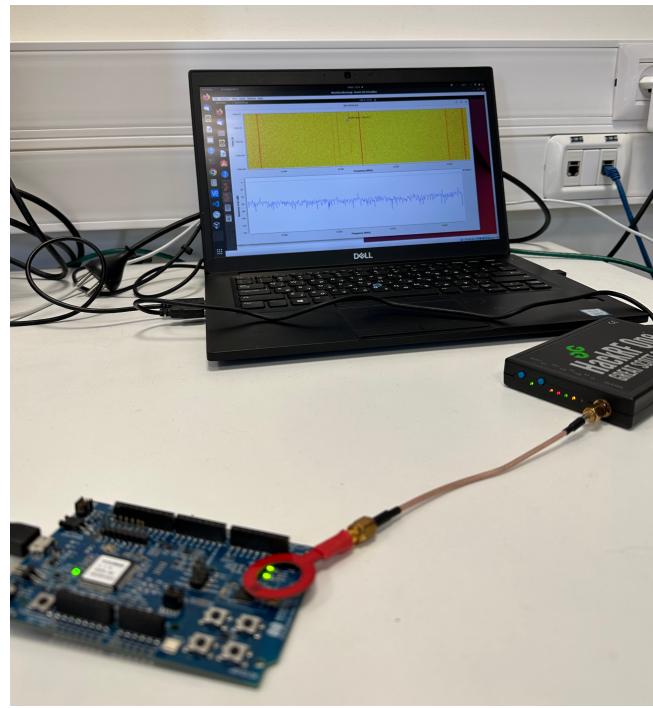
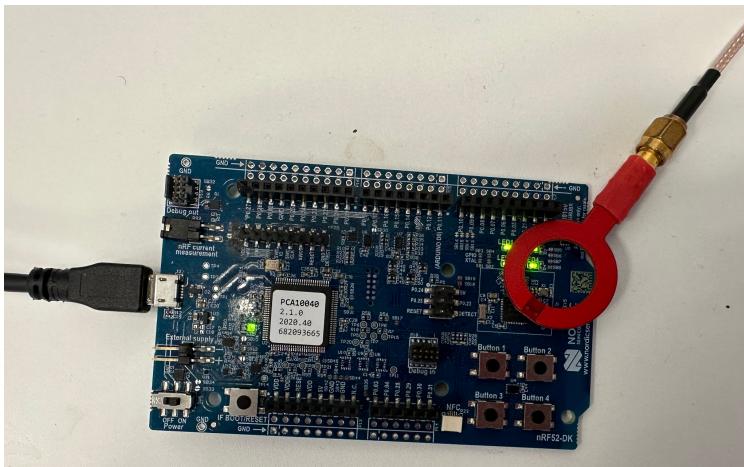
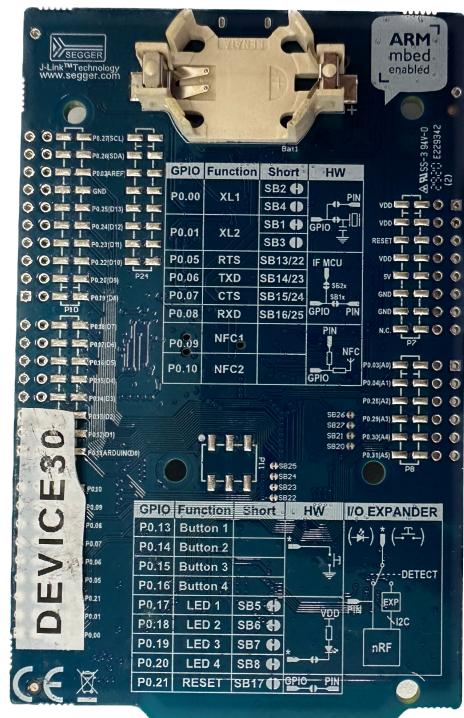
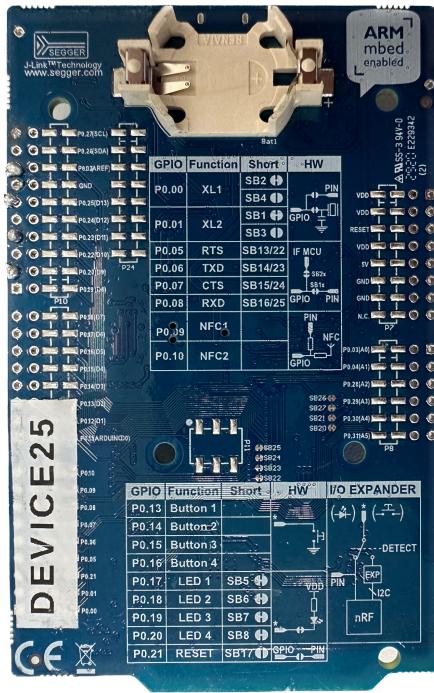
INTRODUCTION

Nordic Semiconductor (nRF52-DK)

- SoC
 - nRF52832
 - 2.4GHz
- PCA10040
- 32MHz Crystal Oscillator
- ARM mbed enabled

Selected Software Activities

- blinky
- blinky_freertos
- blinky_RTC_freertos
- blinky_systick
- led_softblink
- BLINK_new
- IDLE_new
- Matrix_multiplication_new



EXPERIMENT: 1

Experiment with two identical devices of Nordic nRF52-DK semiconductor named as Device-25 and Device-30 which represent the SoC of IoT devices.

Model: "sequential"

| Layer (type) | Output Shape | Param # |
|-----------------------------|--------------|---------|
| ===== | | |
| dense (Dense) | (None, 1400) | 2868600 |
| dense_1 (Dense) | (None, 800) | 1120800 |
| dense_2 (Dense) | (None, 500) | 400500 |
| dense_3 (Dense) | (None, 200) | 100200 |
| dense_4 (Dense) | (None, 100) | 20100 |
| dense_5 (Dense) | (None, 8) | 808 |
| ===== | | |
| Total params: 4,511,008 | | |
| Trainable params: 4,511,008 | | |
| Non-trainable params: 0 | | |

Nordic nRF52-DK Semiconductor

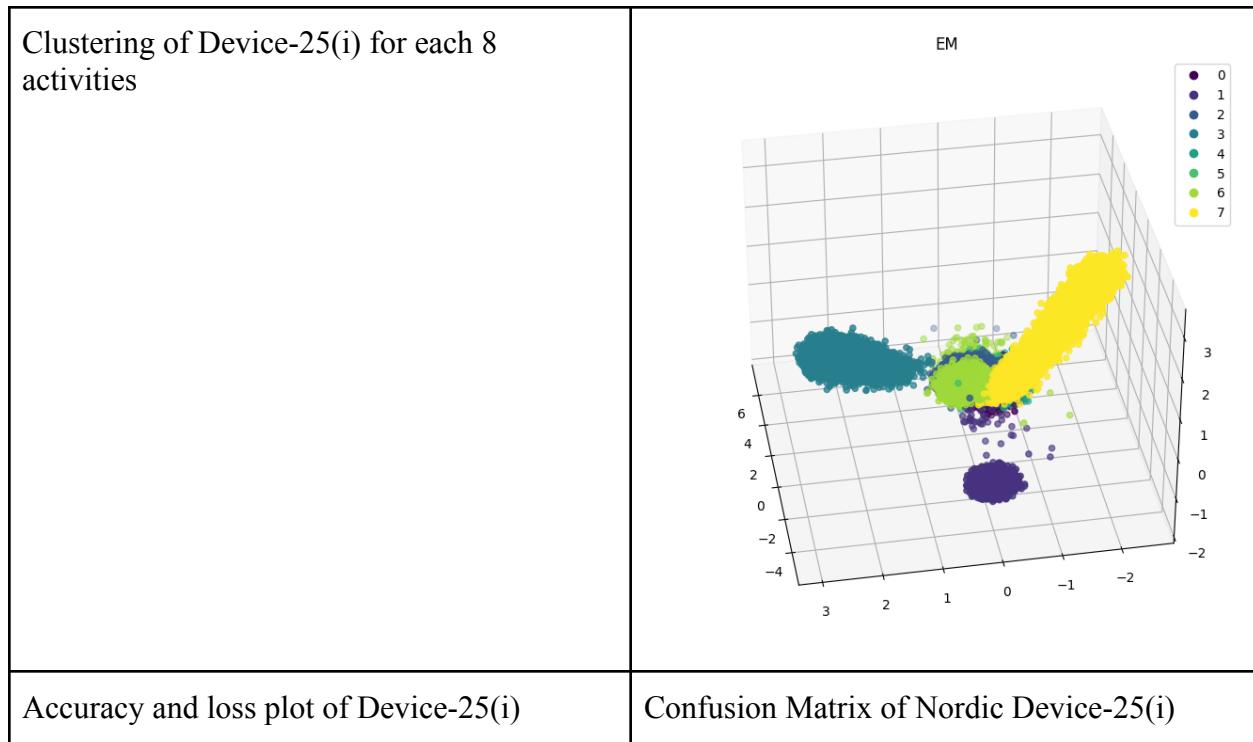
Three nordic (identical devices) were selected to analyze the experiment. Three devices are named Device-25 and Device-30 at 32MHz

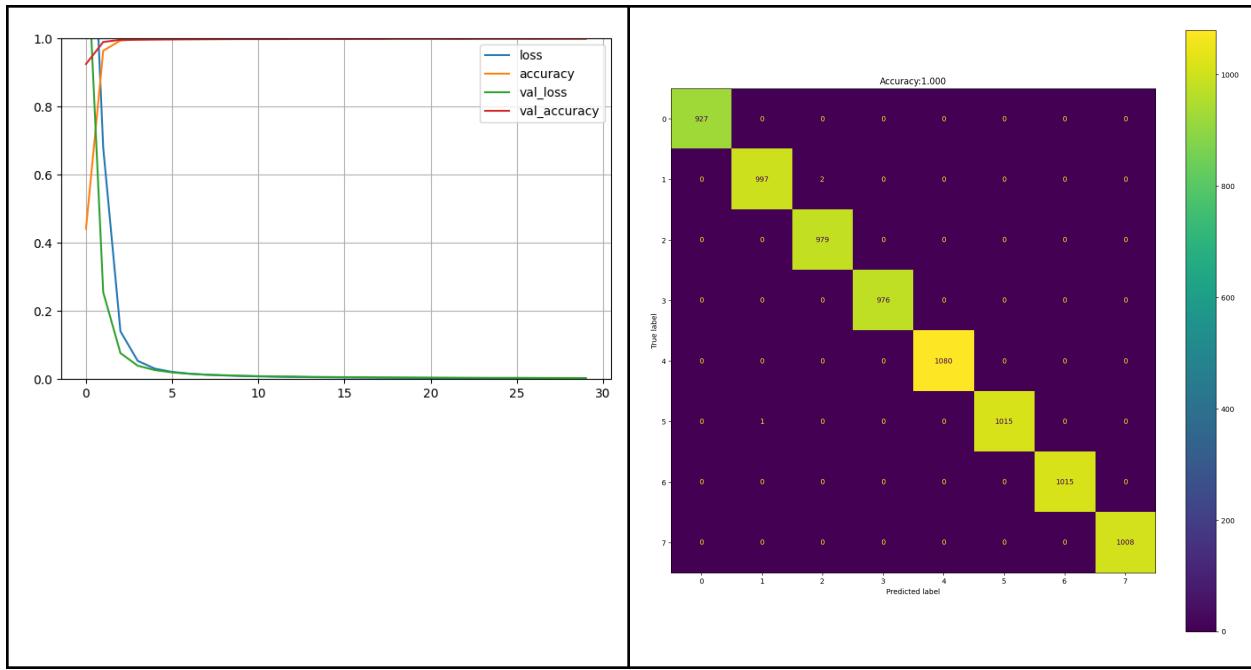
Results Comparison three semiconductors

| Smartphone Name | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
|-----------------|---------------------------------|---------------|------------------|
| Device-25(i) | 0.9998 | 9m 40.9s | 0.9996 |
| Device-25(ii) | 0.9999 | 9m 30.2s | 0.9996 |
| Device-25(iii) | 0.9976 | 9m 2.3s | 0.9979 |
| Device-25(iv) | 0.9981 | 9m 46.6s | 0.9991 |
| Device-25(v) | 0.9982 | 10m 7.1s | 0.9985 |

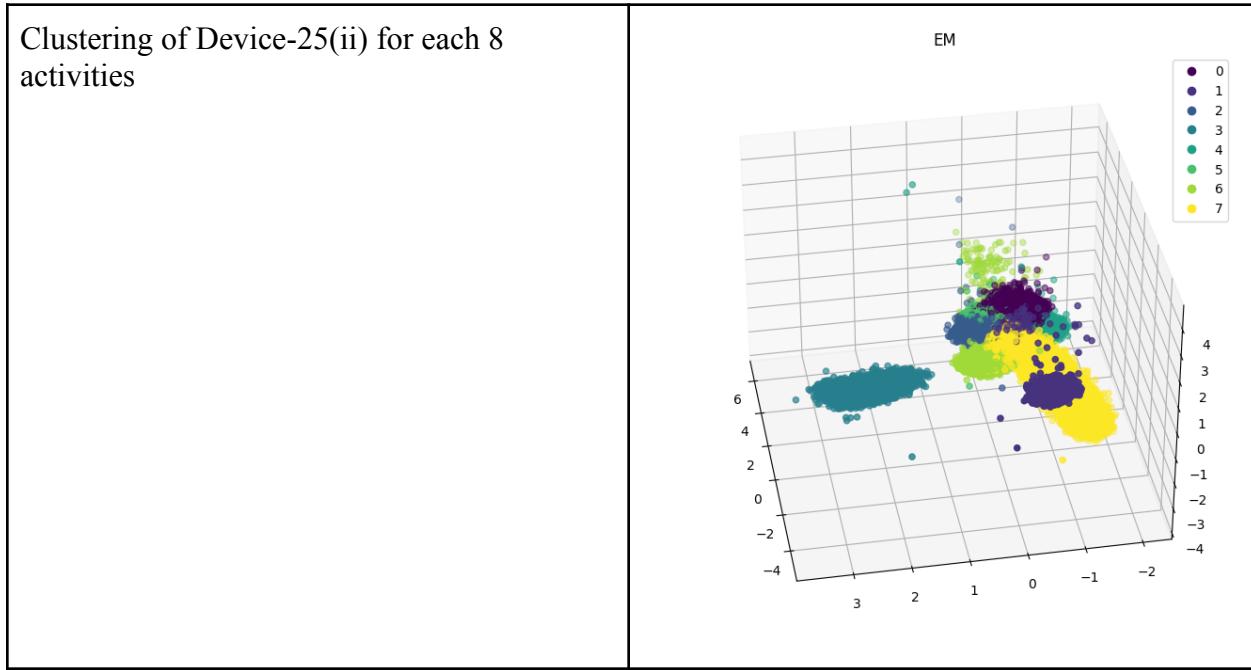
| | | | |
|----------------|--------|----------|--------|
| Device-30(i) | 0.9999 | 9m 28.5s | 0.9996 |
| Device-30(ii) | 1.0000 | 9m 23.8s | 0.9996 |
| Device-30(iii) | 0.9985 | 9m 16.6s | 0.9984 |
| Device-30(iv) | 0.9998 | 9m 16.8s | 0.9979 |
| Device-30(v) | 1.0000 | 9m 16.8s | 0.9996 |

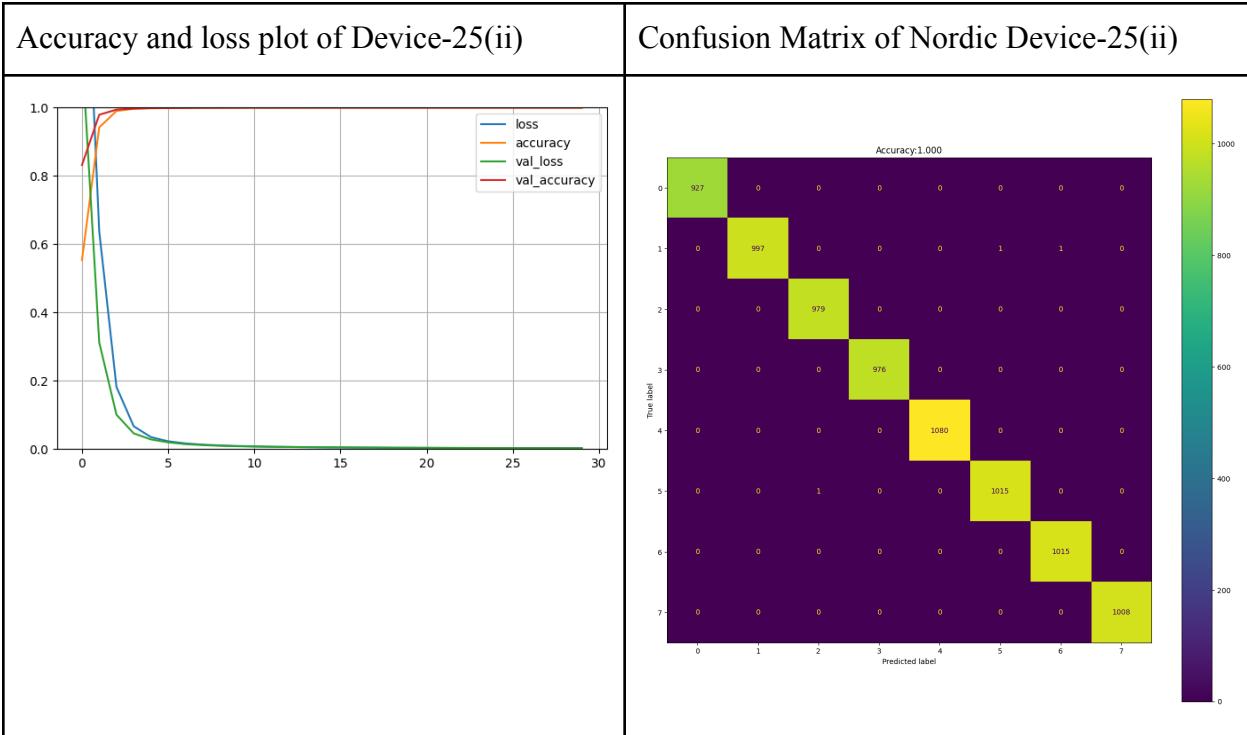
Nordic Device-25(i)



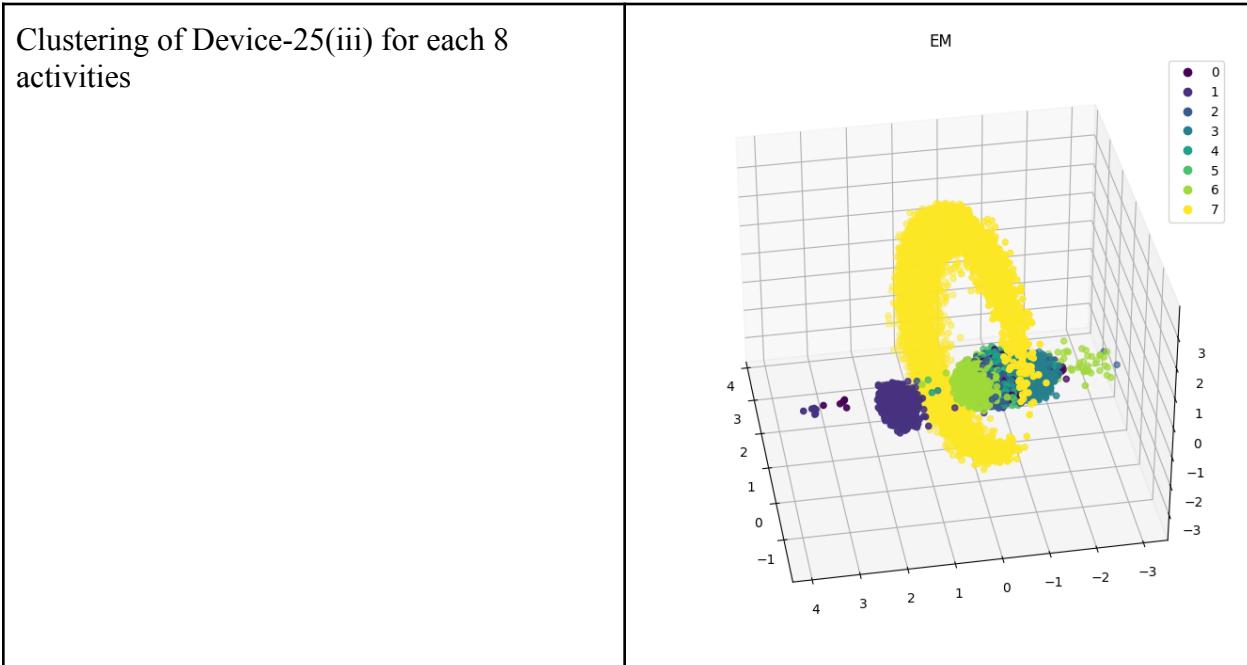


Nordic Device-25(ii)

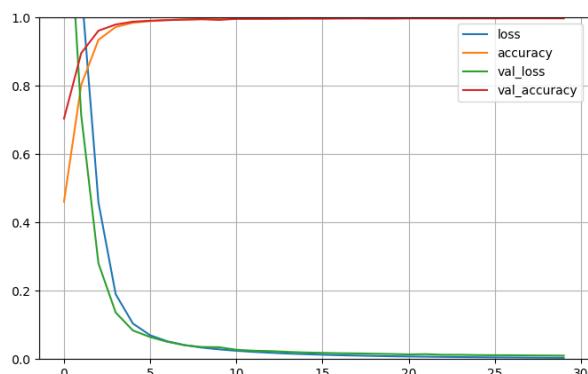




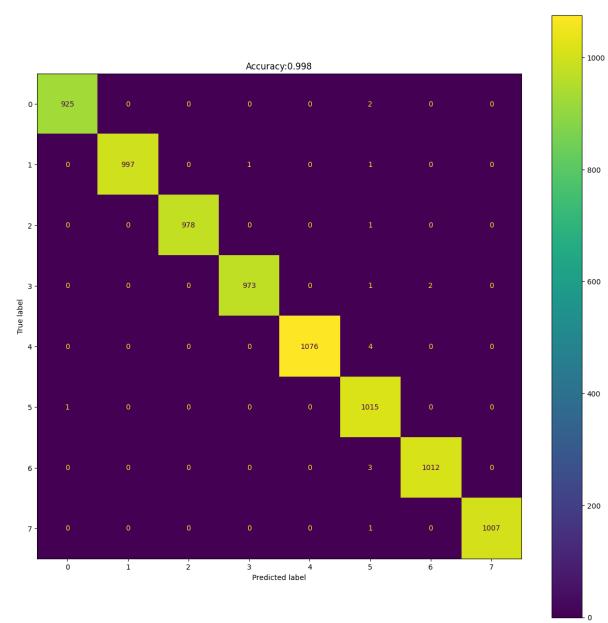
Nordic Device-25(iii)



Accuracy and loss plot of Device-25(iii)

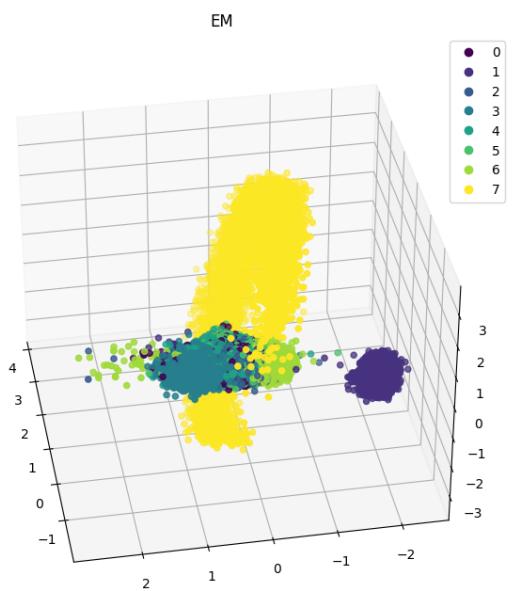


Confusion Matrix of Nordic Device-25(iii)

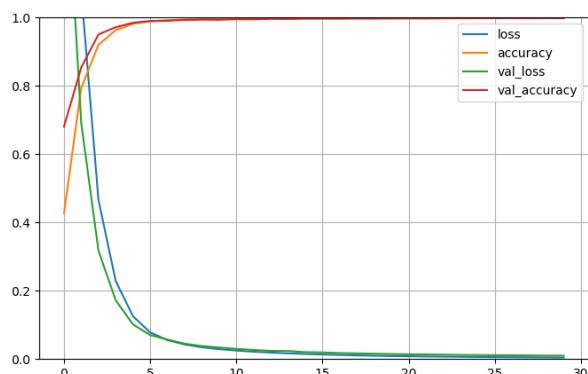


Nordic Device-25(iv)

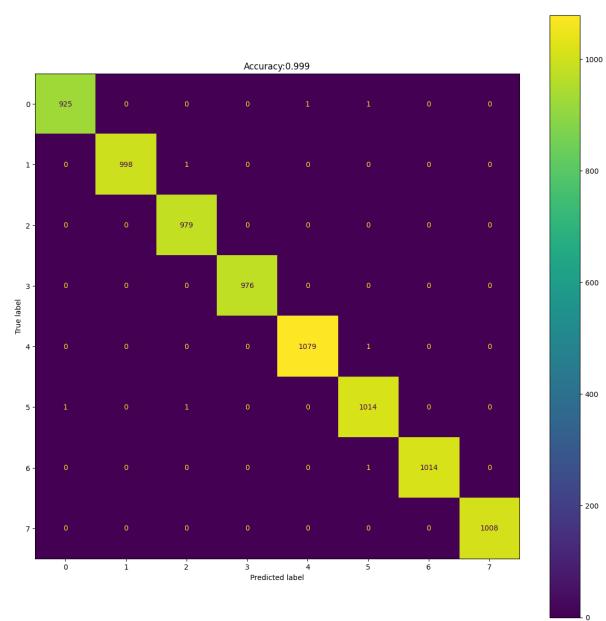
Clustering of Device-25(iv) for each 8 activities



Accuracy and loss plot of Device-25(iv)

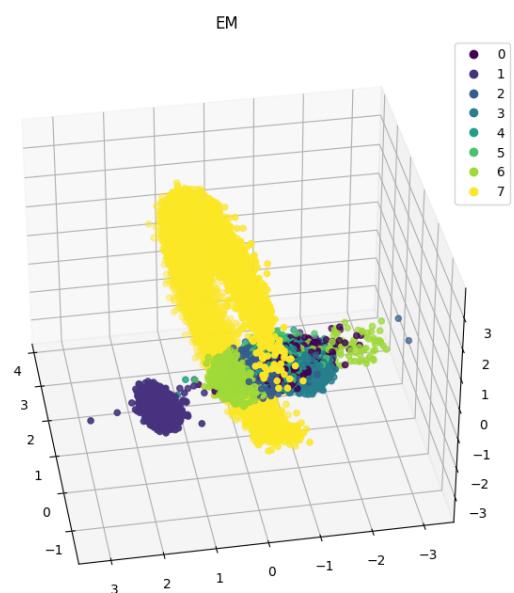


Confusion Matrix of Nordic Device-25(iv)

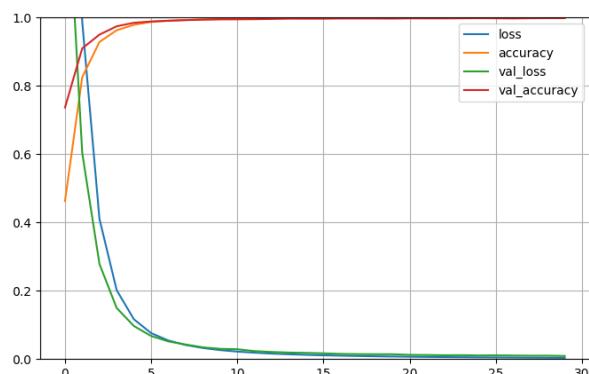


Nordic Device-25(v)

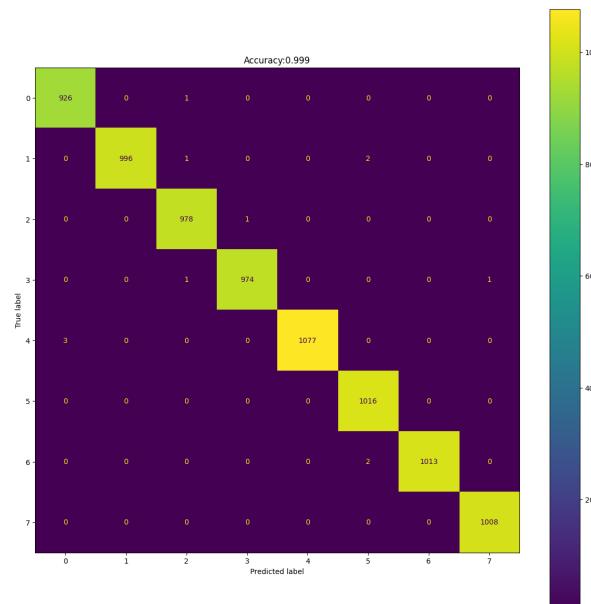
Clustering of Device-25(v) for each 8 activities



Accuracy and loss plot of Device-25(v)

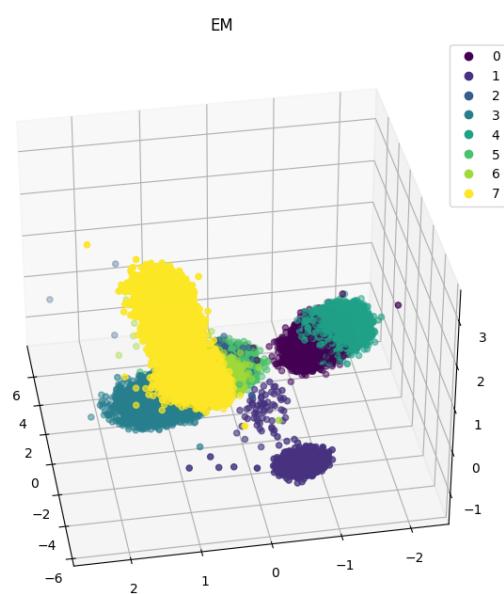


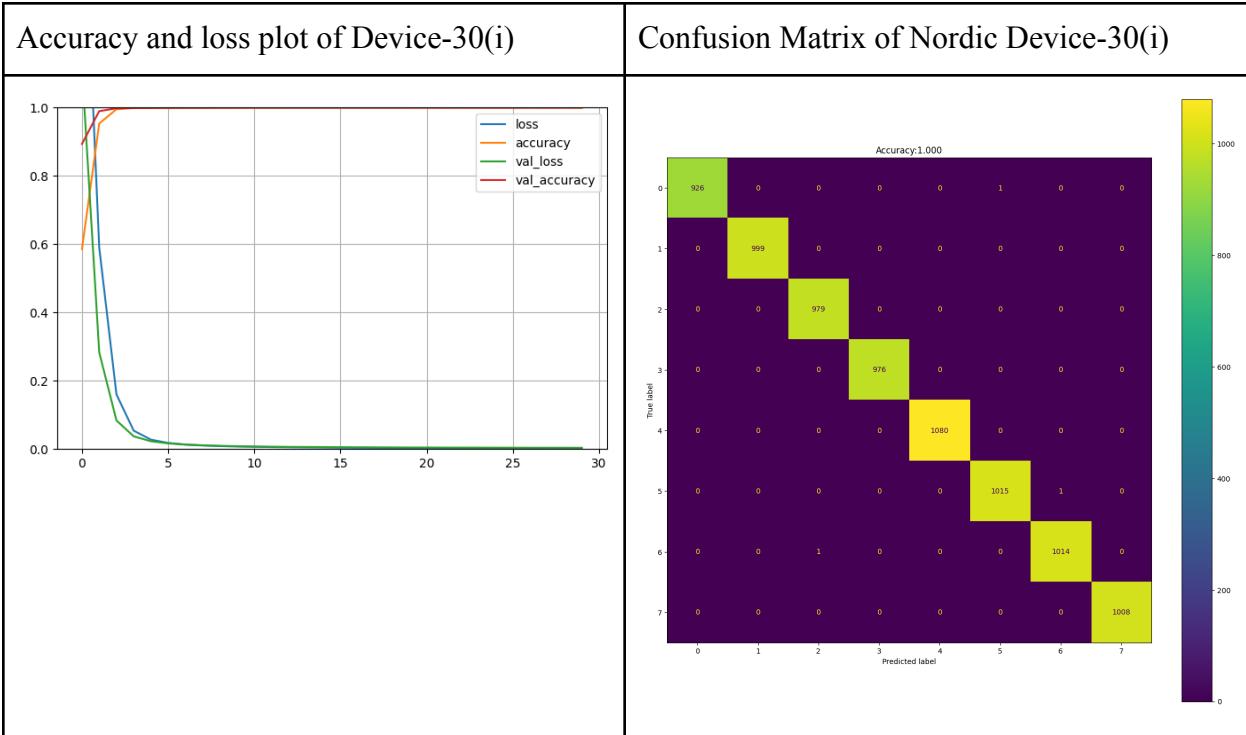
Confusion Matrix of Nordic Device-25(v)



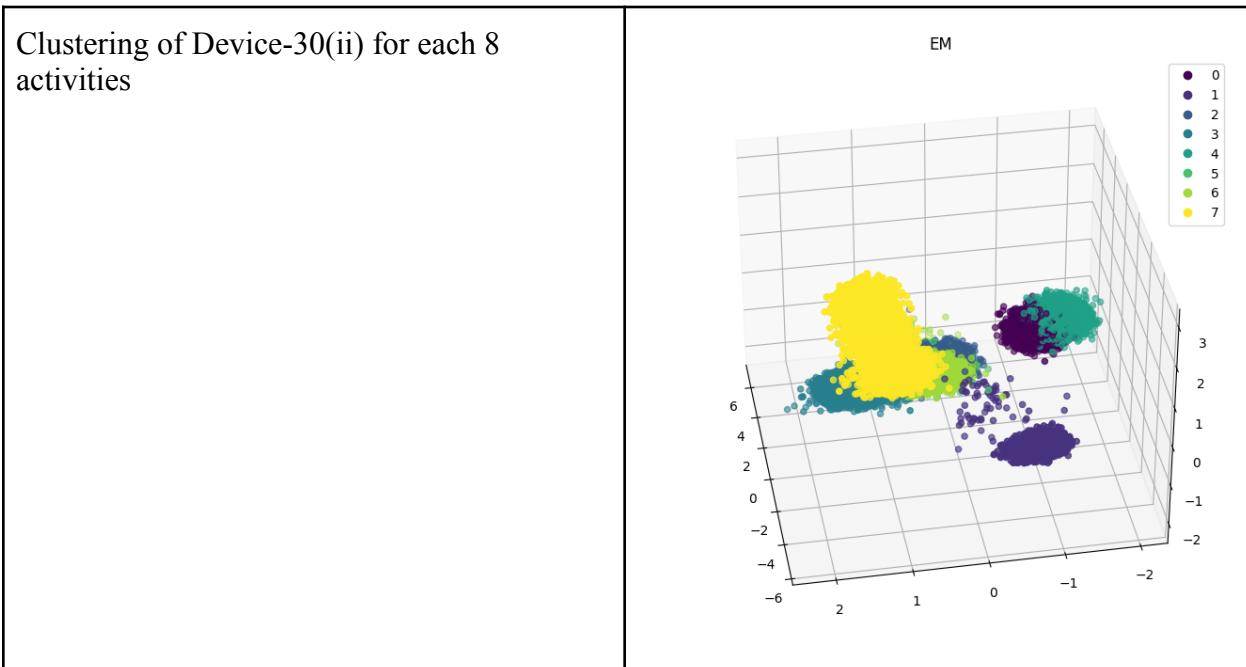
Nordic Device-30(i)

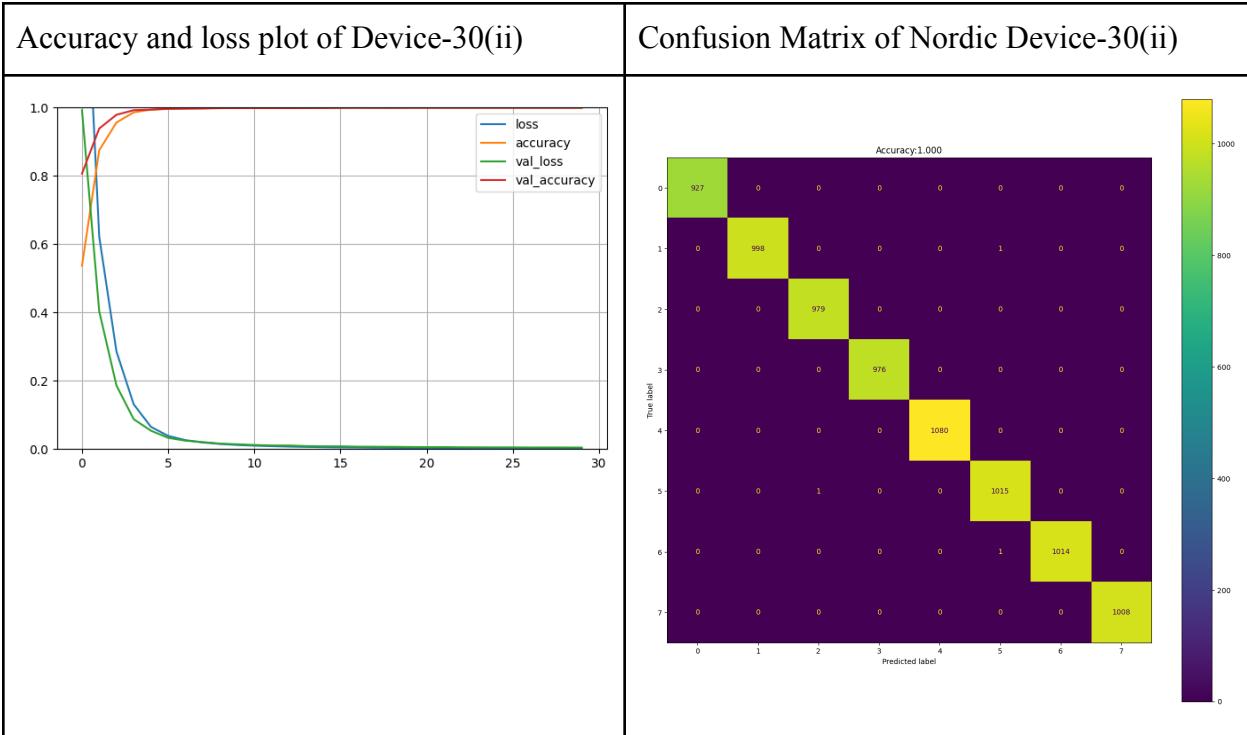
Clustering of Device-30(i) for each 8 activities



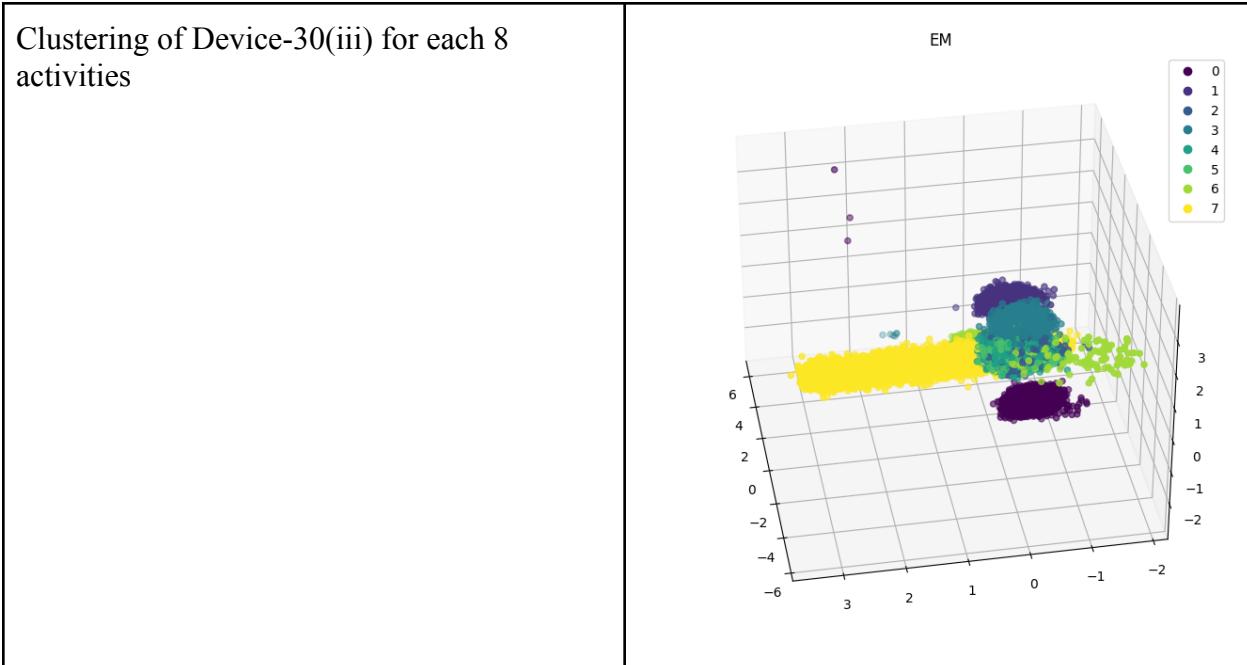


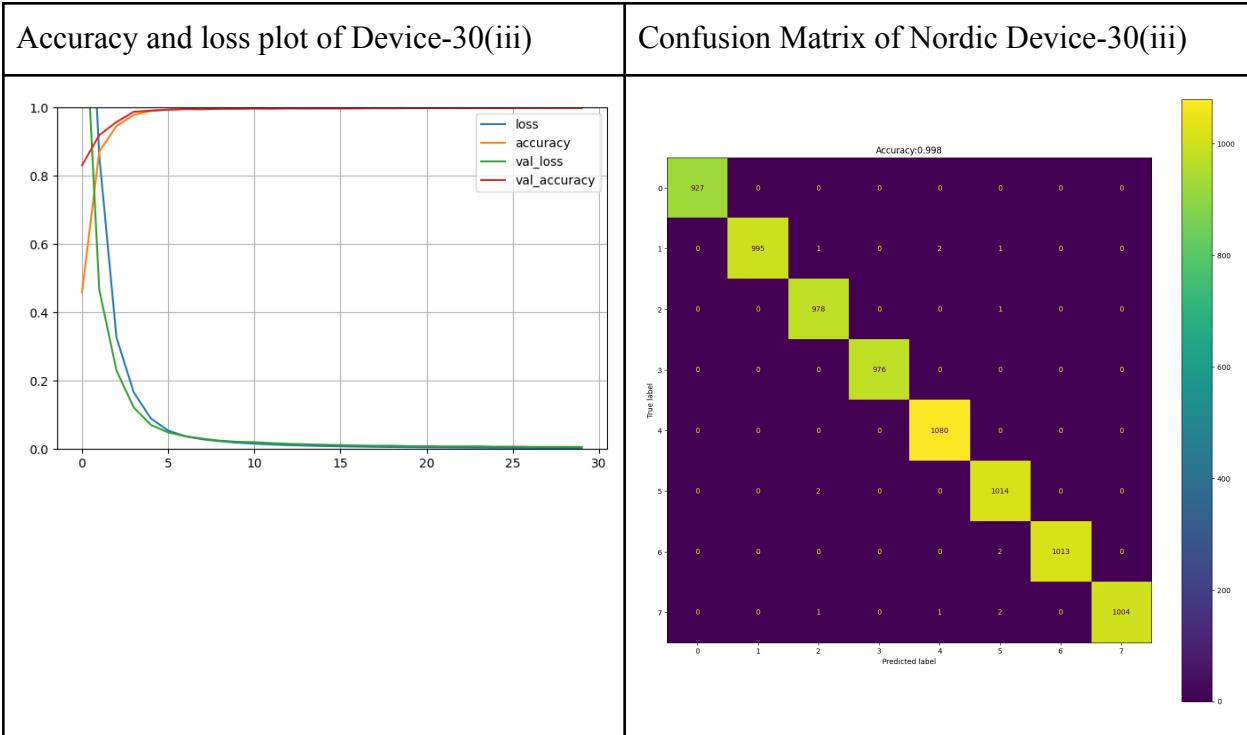
Nordic Device-30(ii)



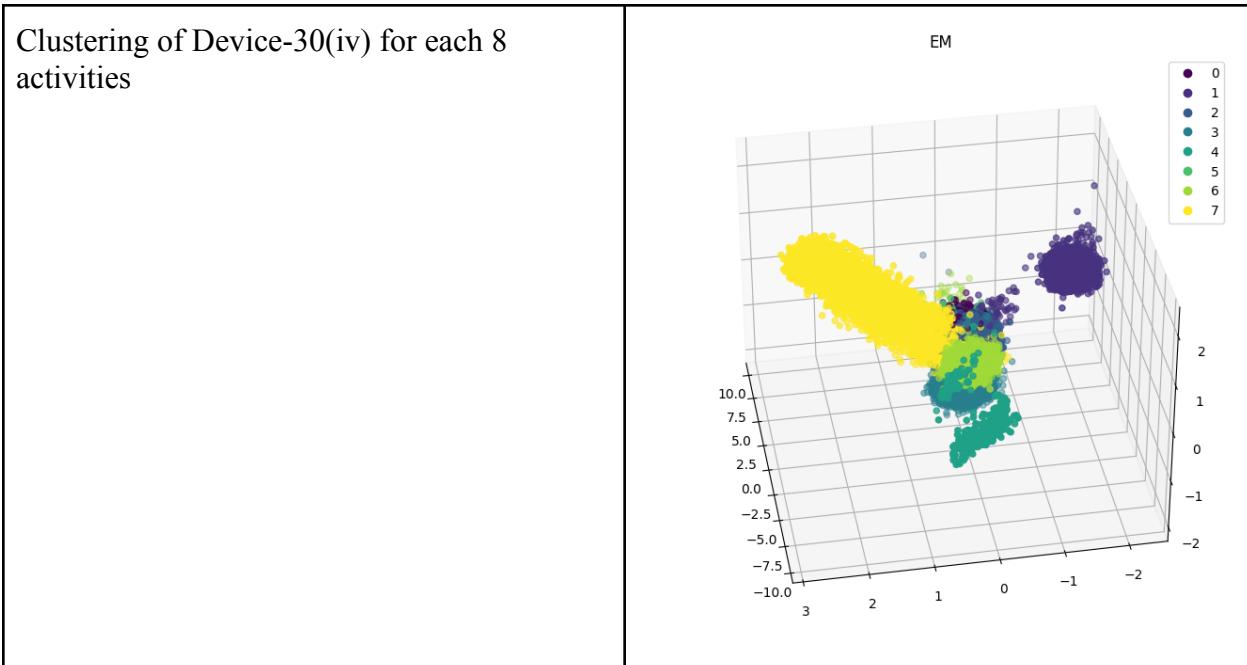


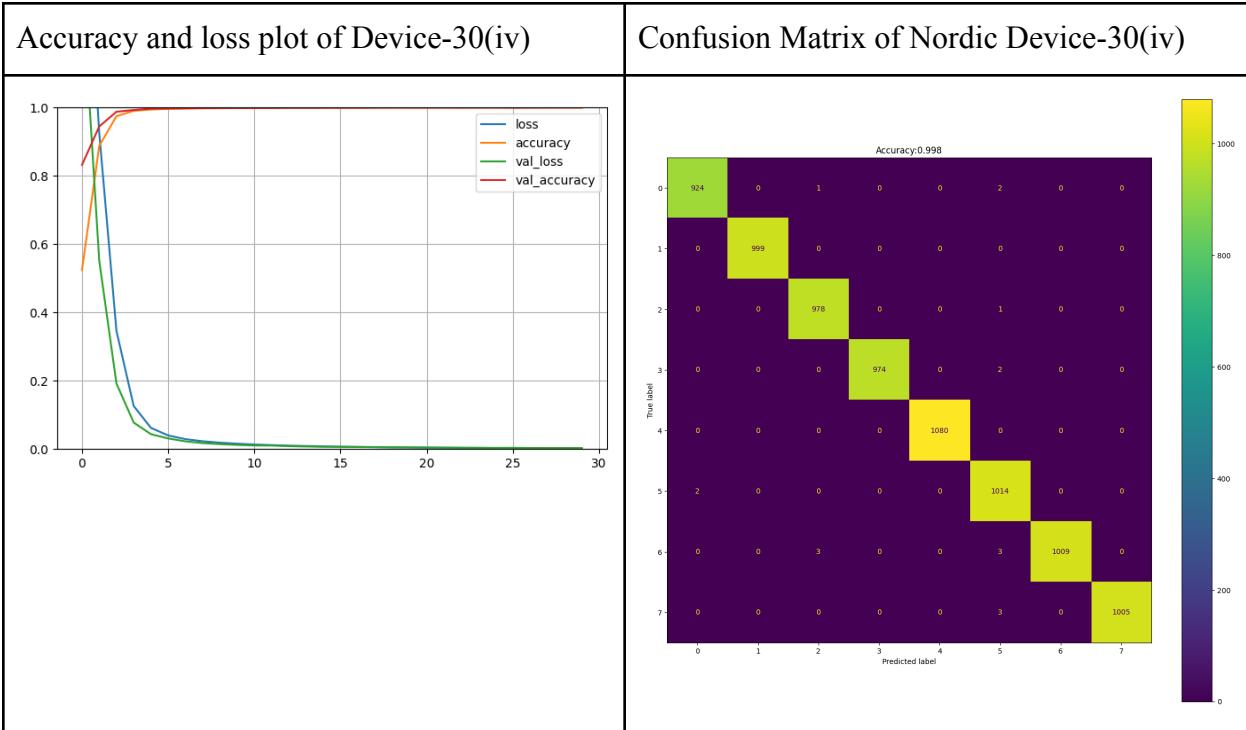
Nordic Device-30(iii)



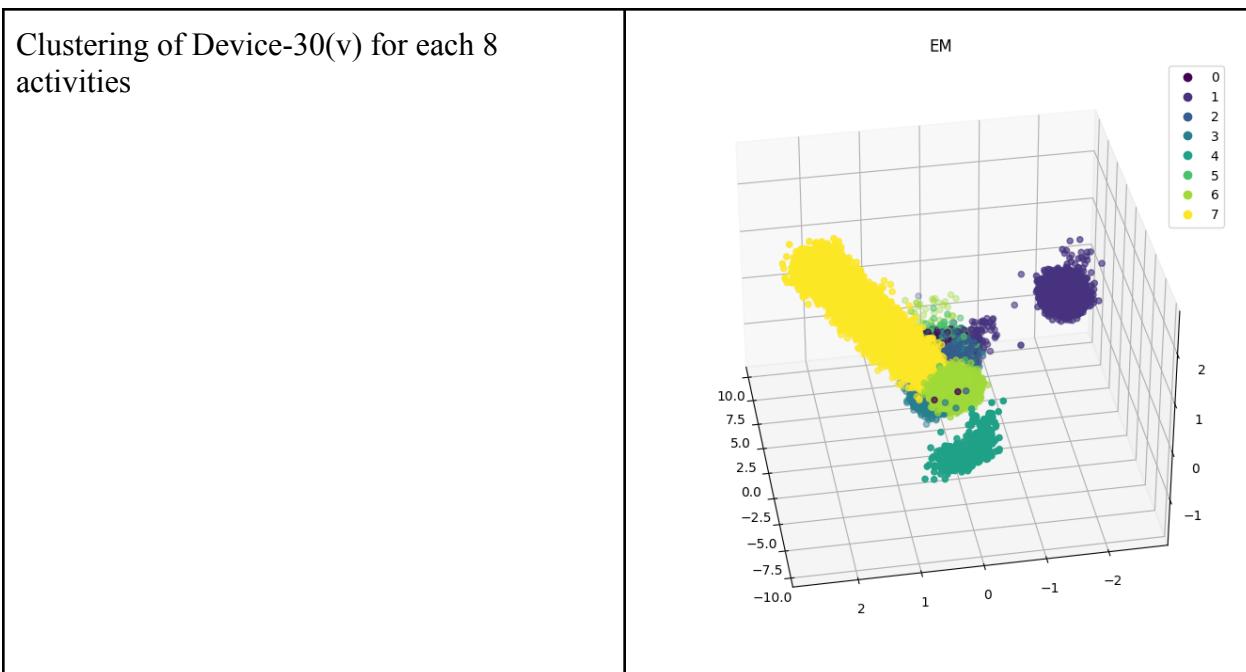


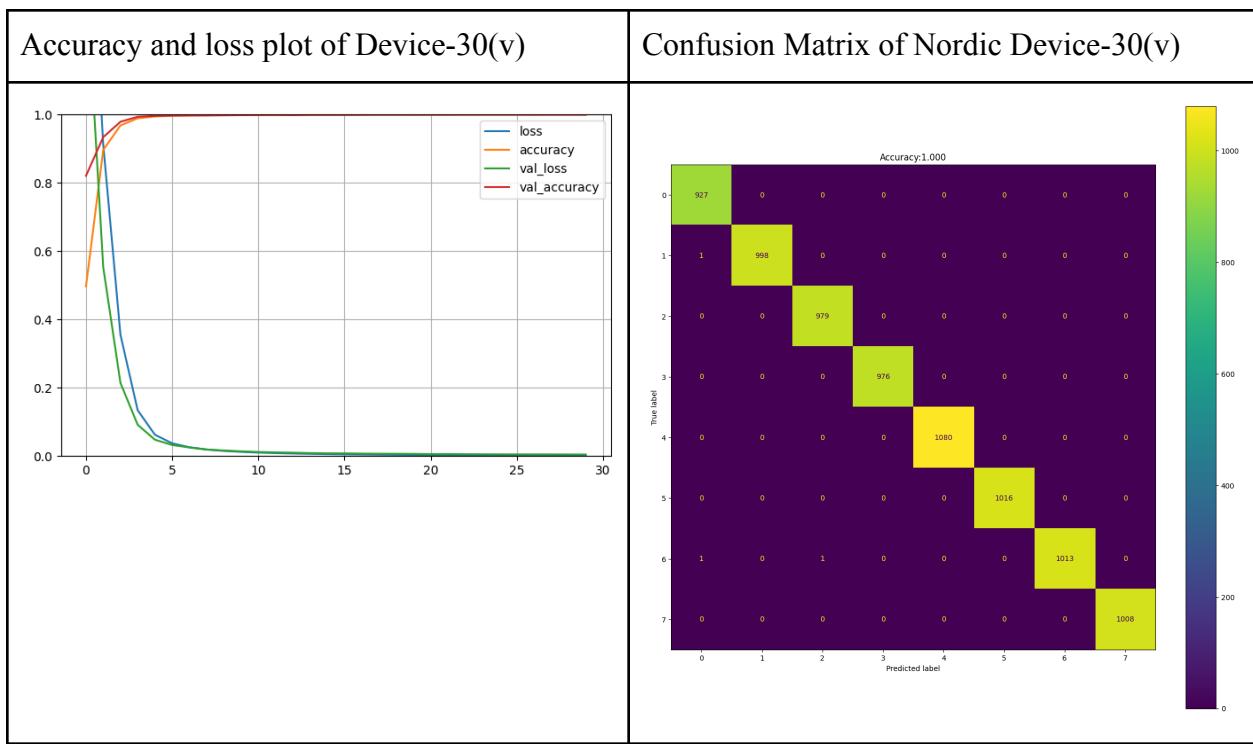
Nordic Device-30(iv)





Nordic Device-30(v)





EXPERIMENT: 2

Cross-model applications by directly applying other dataset model and applying transfer learning in between dataset of Nordic Device-25 and Device-30

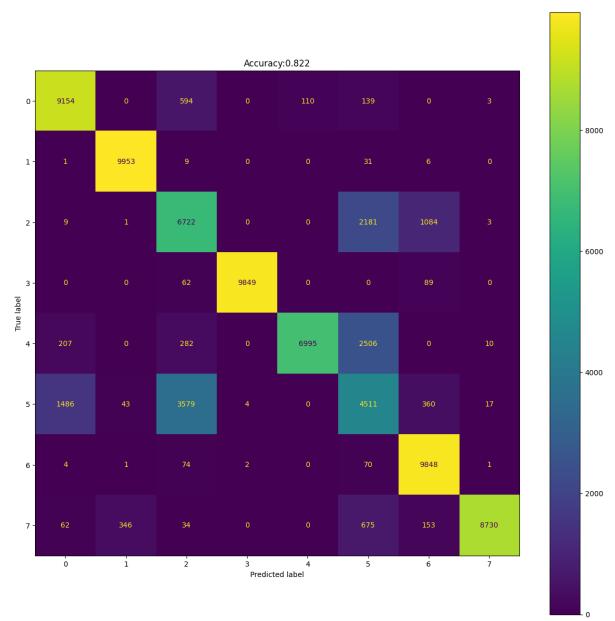
Nordic Semiconductor

Nordic Device-25(i) dataset

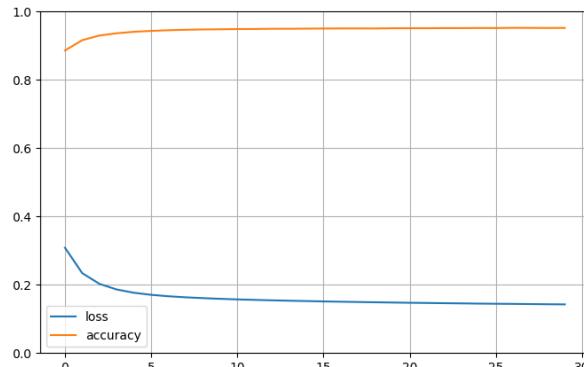
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(ii)_model.h5 | 0.8220 | 0.9521 | 6m 23.3s | 0.9525 |
| Device-25(iii)_model.h5 | 0.1348 | 0.5769 | 5m 1.7s | 0.5797 |
| Device-25(iv)_model.h5 | 0.1384 | 0.5494 | 5m 22.4s | 0.5522 |
| Device-25(v)_model.h5 | 0.1291 | 0.5378 | 5m 14.6s | 0.5370 |
| Device-30(i)_model.h5 | 0.1291 | 0.7034 | 4m 59.8s | 0.7055 |
| Device-30(ii)_model.h5 | 0.1184 | 0.6895 | 5m 24.5s | 0.6842 |
| Device-30(iii)_model.h5 | 0.1120 | 0.6219 | 5m 20.2s | 0.6199 |
| Device-30(iv)_model.h5 | 0.1258 | 0.6486 | 5m 14.8s | 0.6513 |
| Device-30(v)_model.h5 | 0.1258 | 0.6201 | 5m 23.5s | 0.6231 |

Device-25(ii)_model.h5

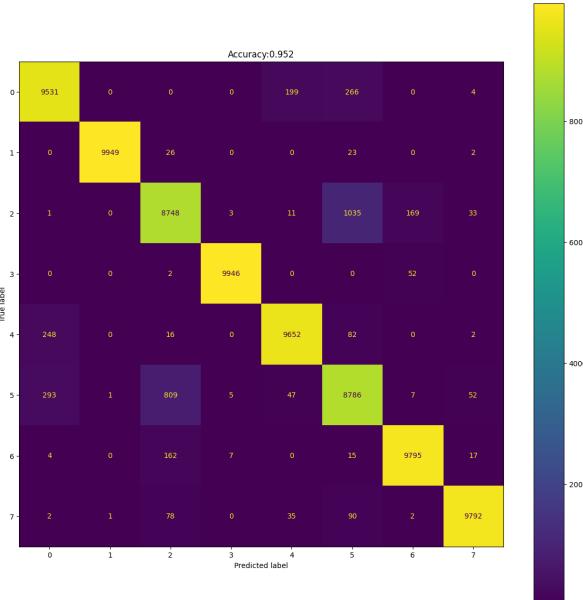
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

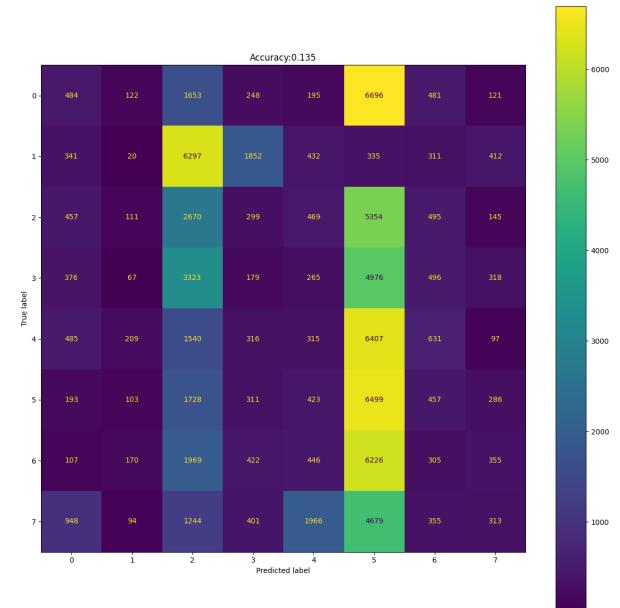


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

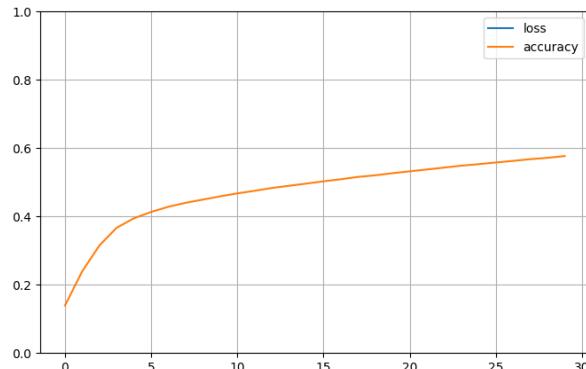


Device-25(iii)_model.h5

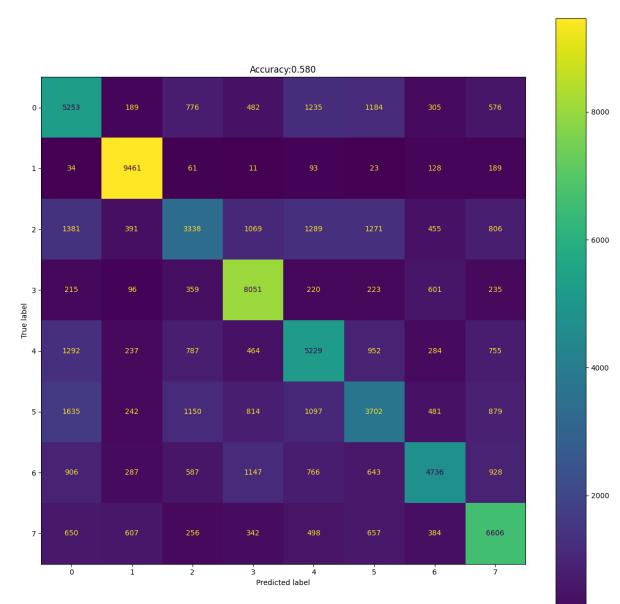
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

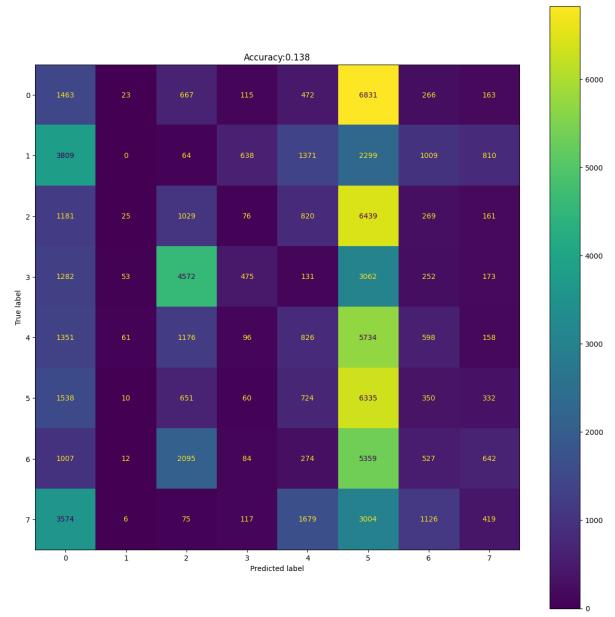


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

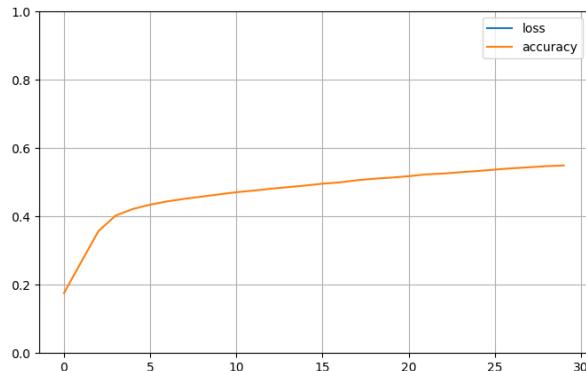


Device-25(iv)_model.h5

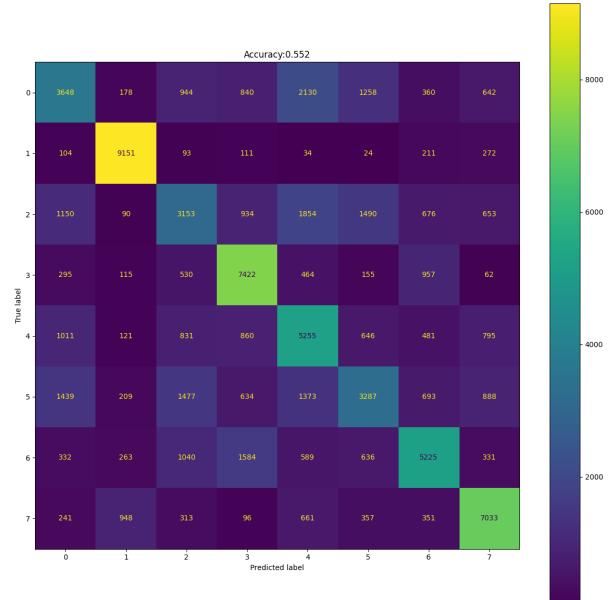
Confusion matrix of by applying the cross-model of Nordic Device-25(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

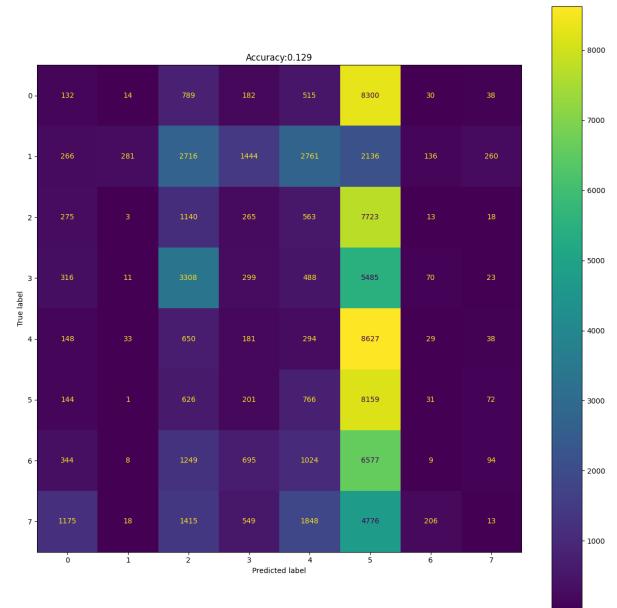


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

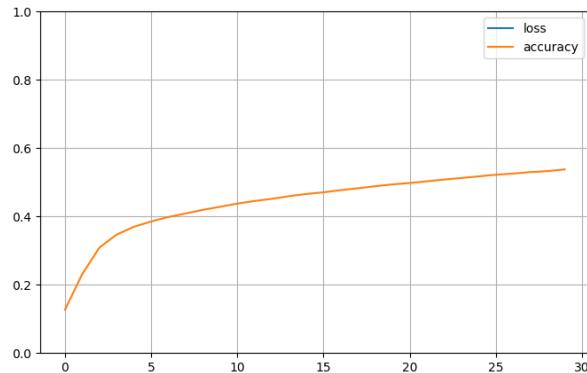


Device-25(v)_model.h5

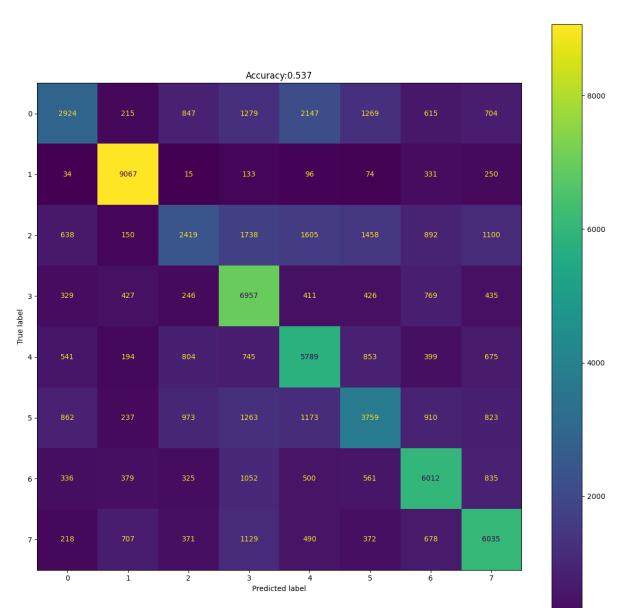
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

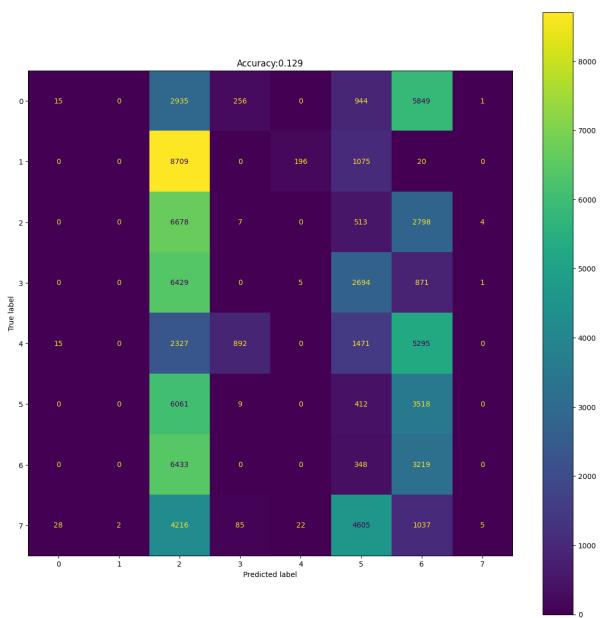


Confusion matrix After apply transfer learning on Nordic Device-25(v) model

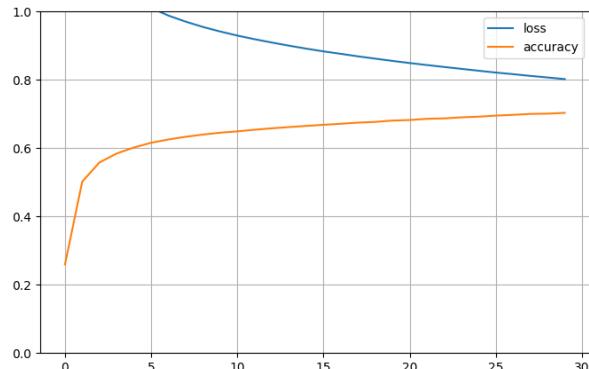


Device-30(i)_model.h5

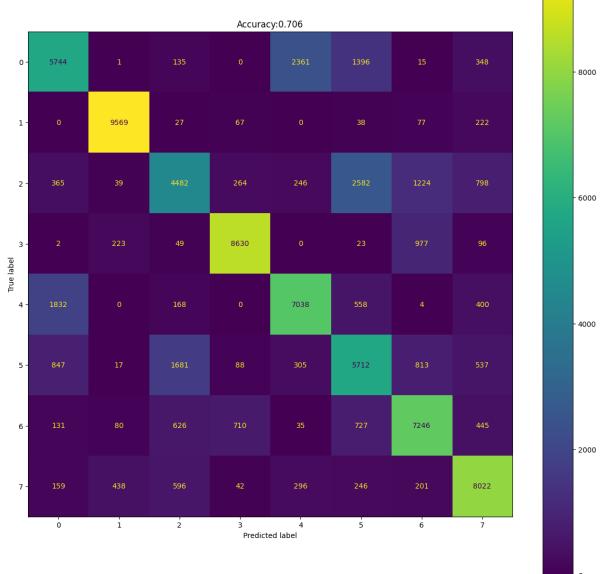
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

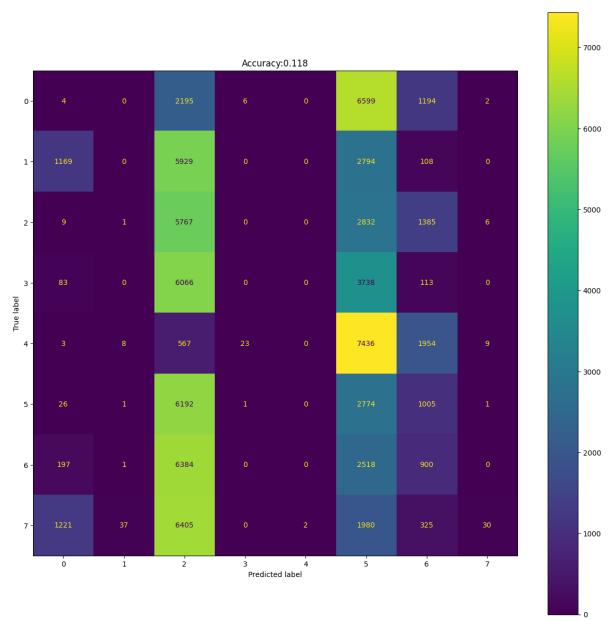


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

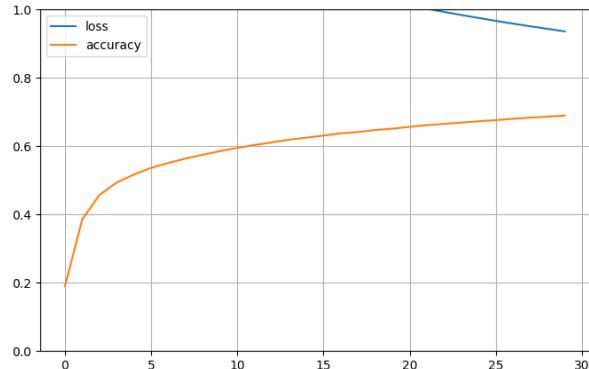


Device-30(ii)_model.h5

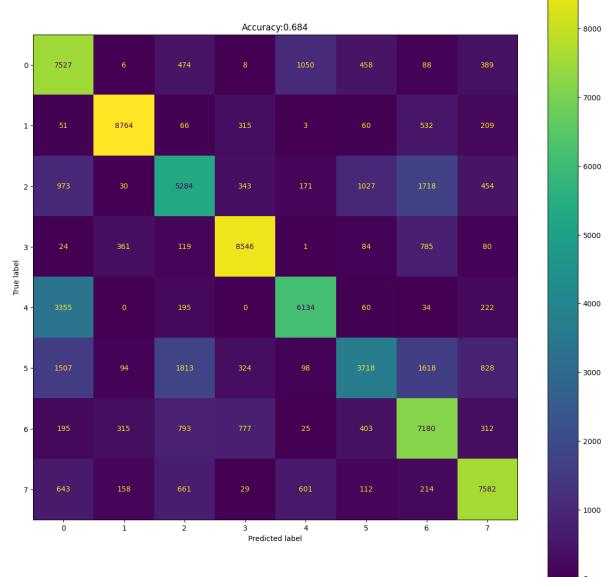
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

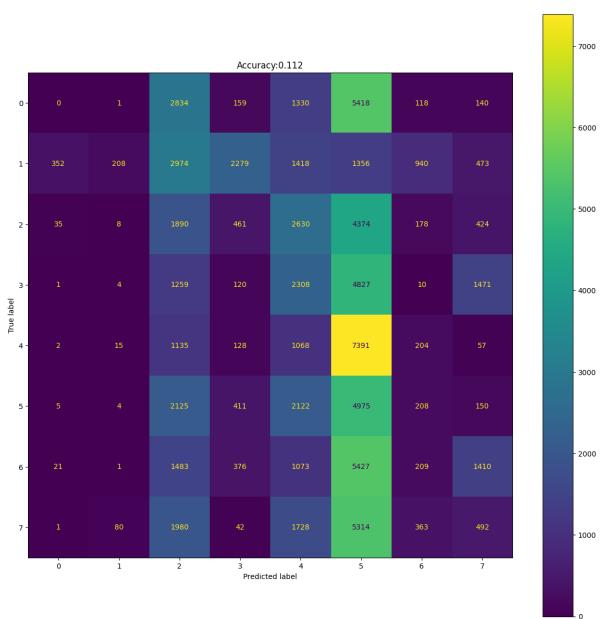


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

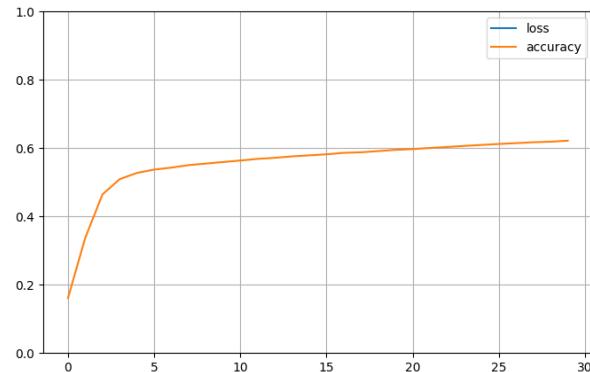


Device-30(iii)_model.h5

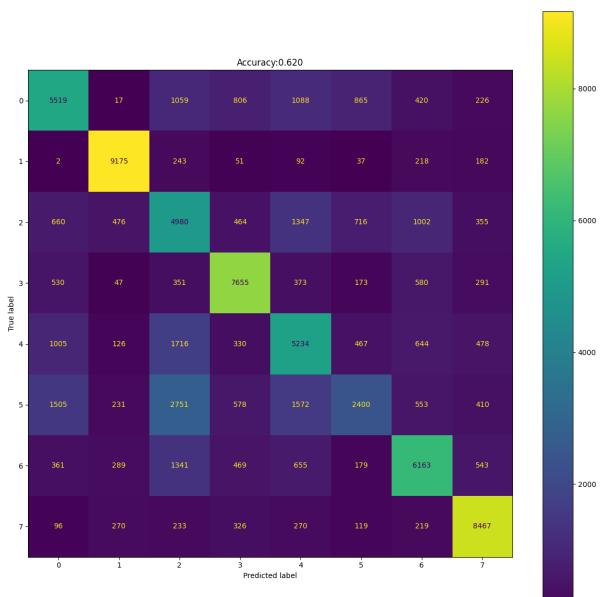
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

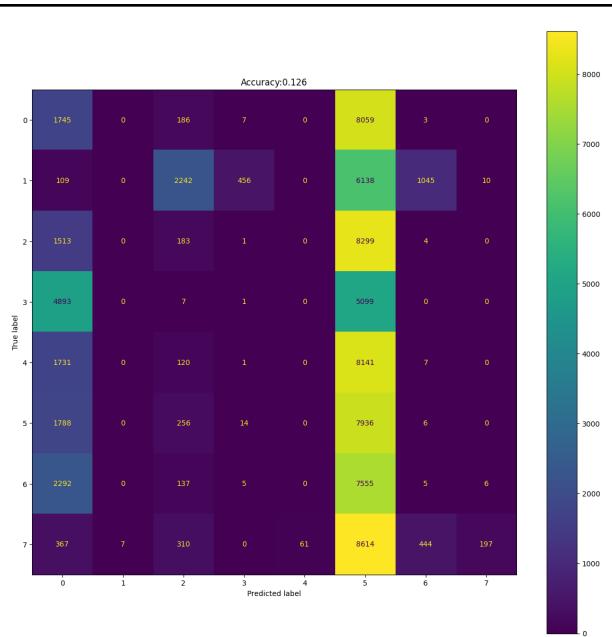


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

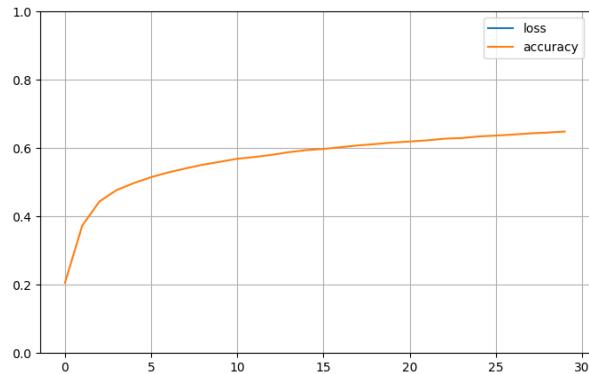


Device-30(iv)_model.h5

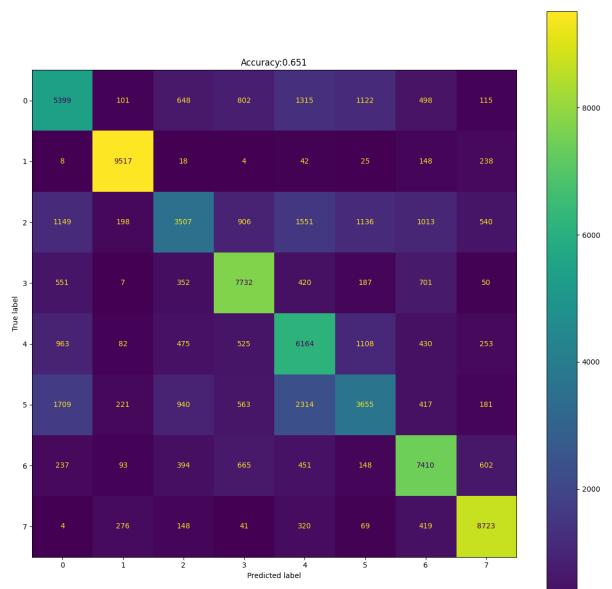
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

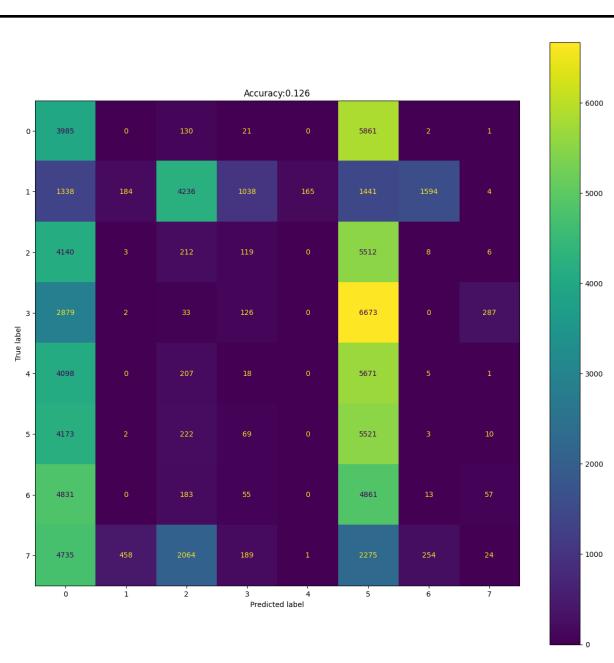


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model

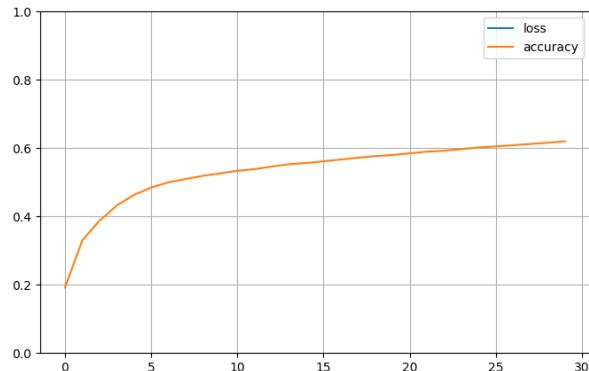


Device-30(v)_model.h5

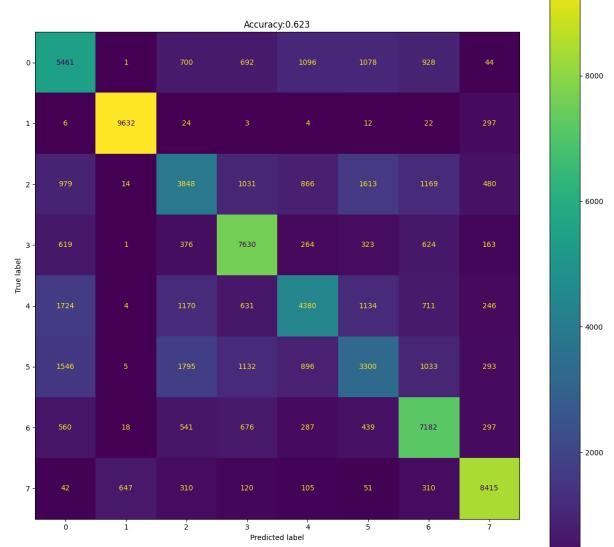
Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model



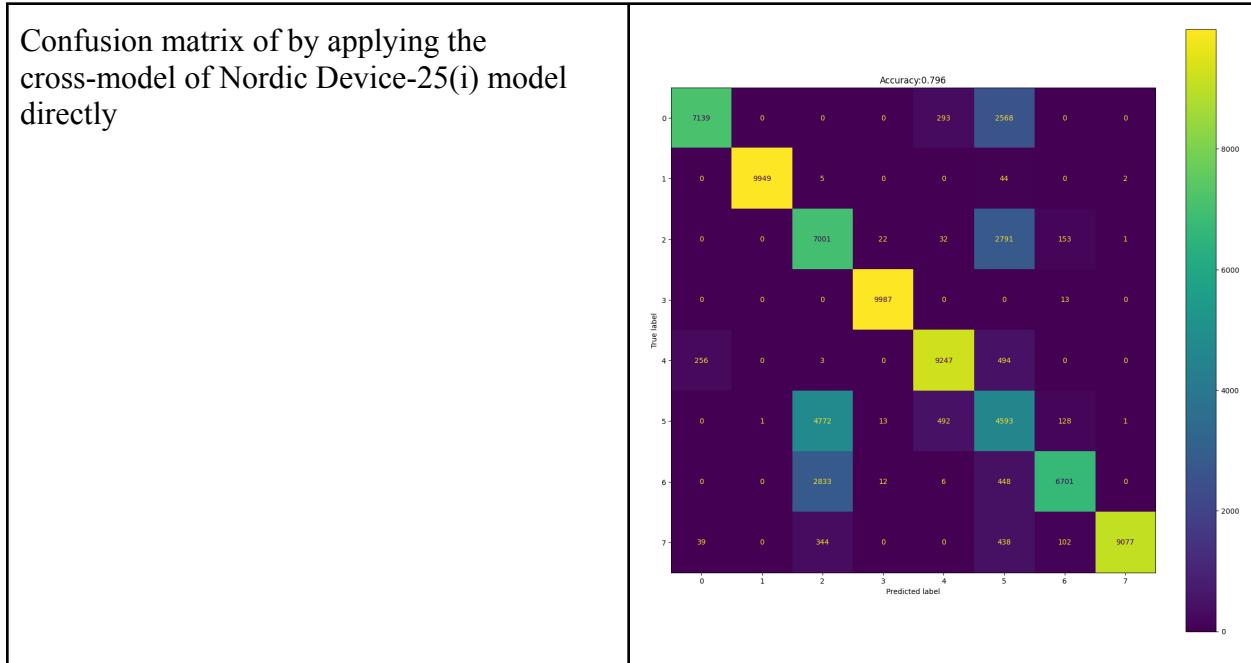
Confusion matrix After apply transfer learning on Nordic Device-30(v) model

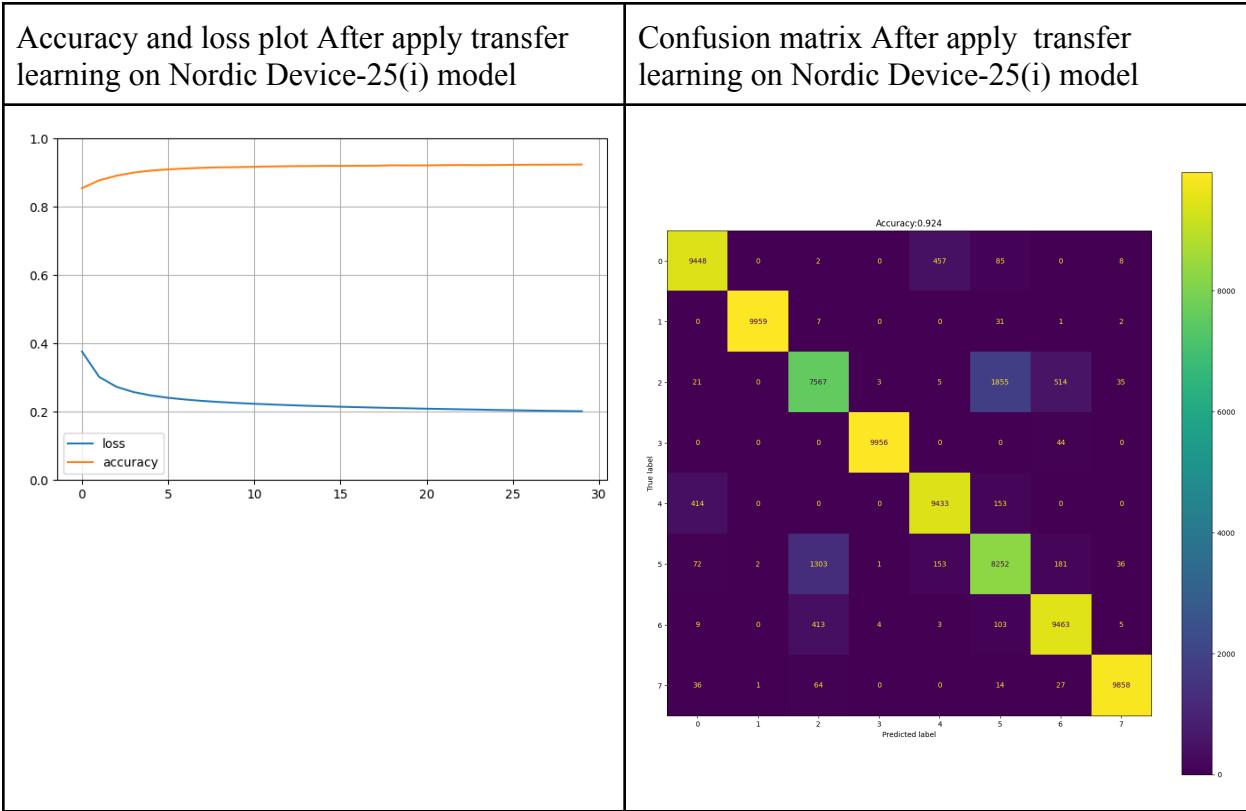


Nordic Device-25(ii) dataset

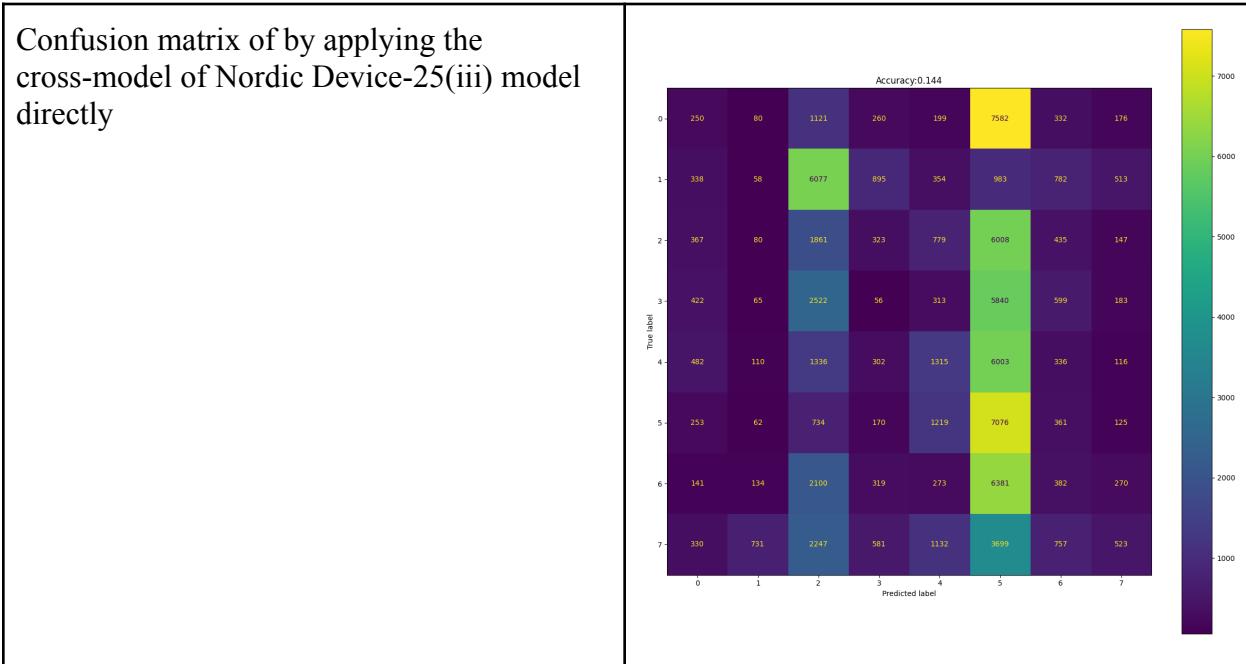
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.7962 | 0.9240 | 4m 49.5s | 0.9242 |
| Device-25(iii)_model.h5 | 0.1440 | 0.5797 | 4m 52.8s | 0.5788 |
| Device-25(iv)_model.h5 | 0.1359 | 0.5561 | 5m 10.5s | 0.5561 |
| Device-25(v)_model.h5 | 0.1291 | 0.5293 | 5m 22.4s | 0.5334 |
| Device-30(i)_model.h5 | 0.1376 | 0.6892 | 4m 59.1s | 0.6924 |
| Device-30(ii)_model.h5 | 0.1294 | 0.6747 | 4m 49.1s | 0.6784 |
| Device-30(iii)_model.h5 | 0.1197 | 0.6101 | 5m 18.6s | 0.6154 |
| Device-30(iv)_model.h5 | 0.1059 | 0.6500 | 5m 14.3s | 0.6522 |
| Device-30(v)_model.h5 | 0.1249 | 0.6298 | 4m 56.9s | 0.6275 |

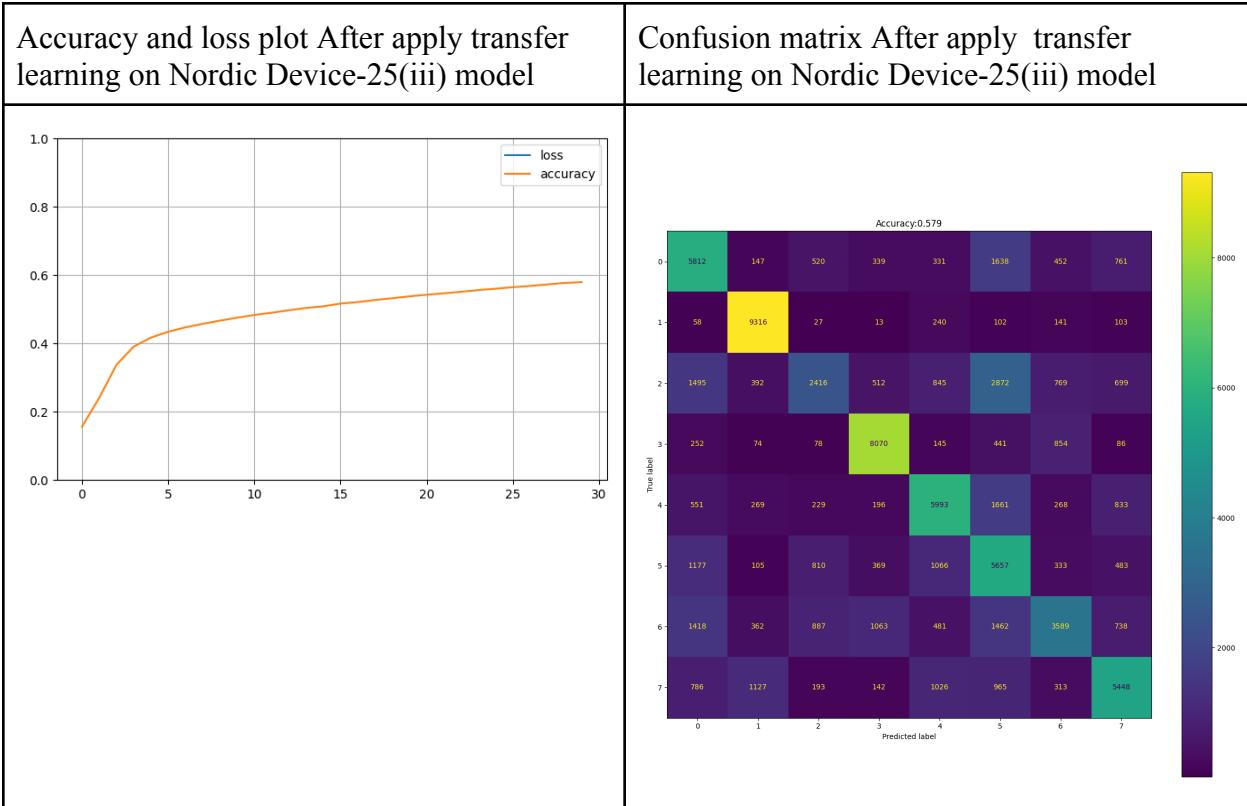
Device-25(i)_model.h5



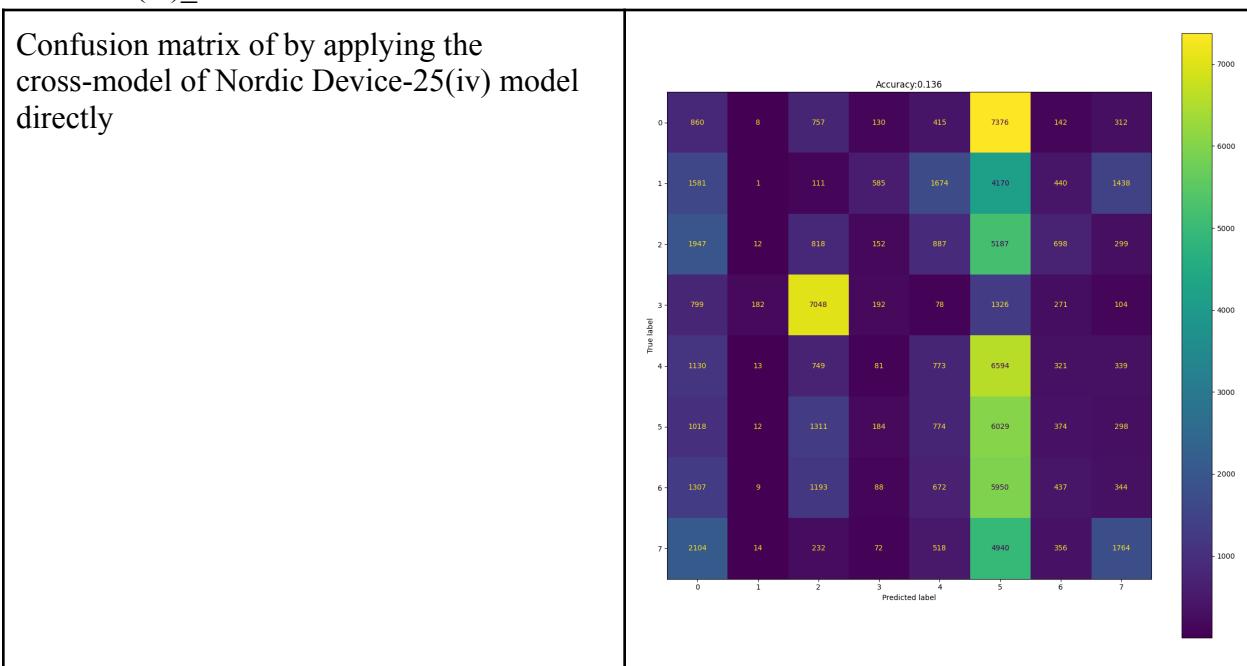


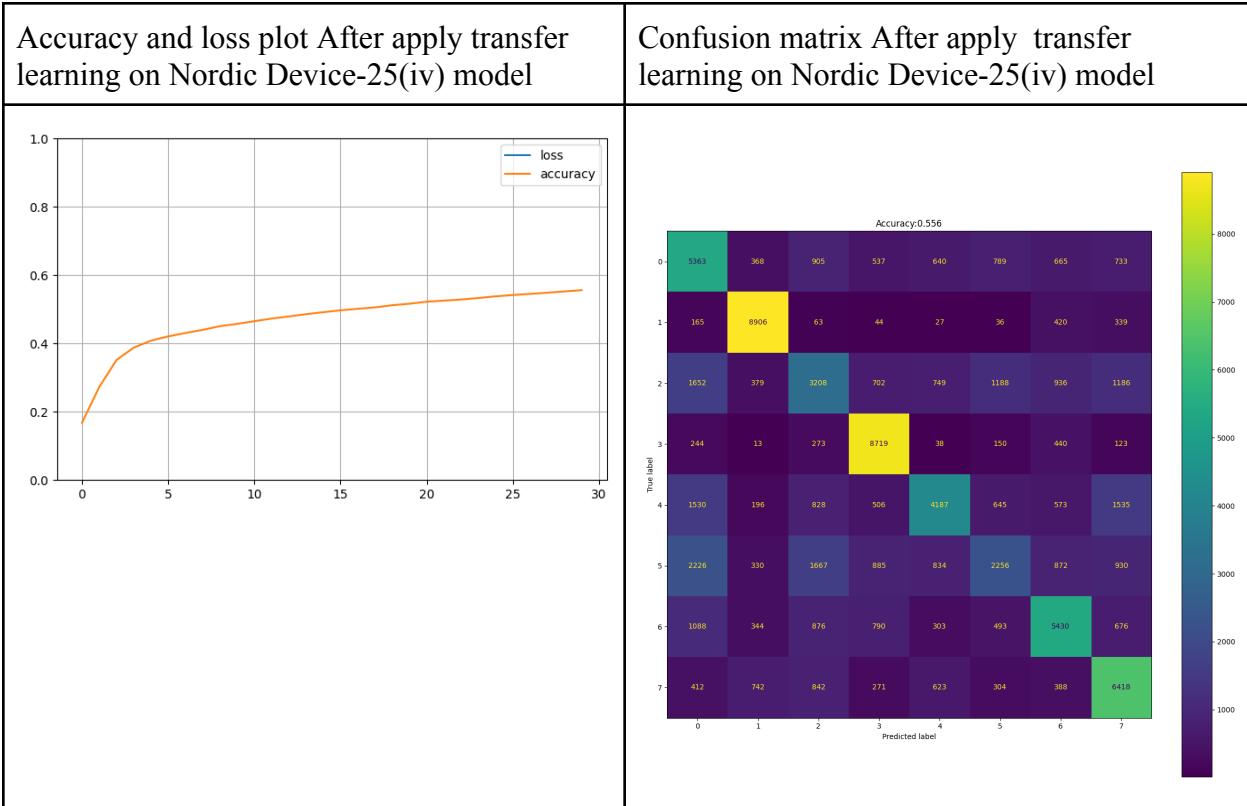
Device-25(iii)_model.h5



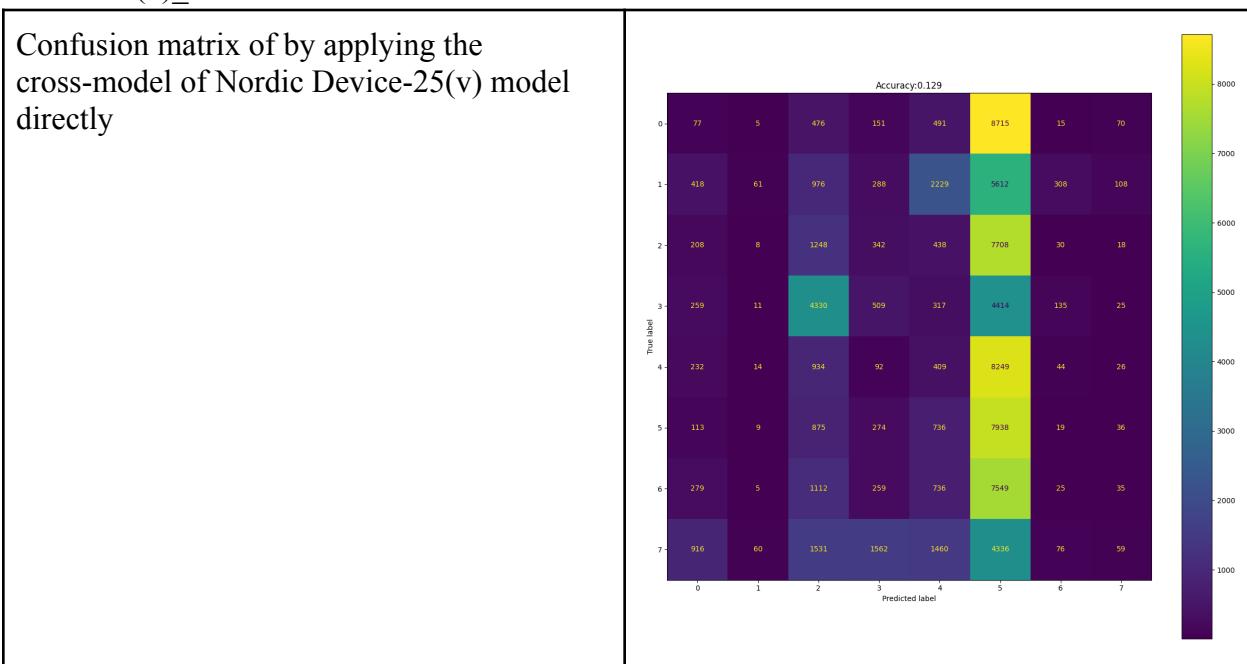


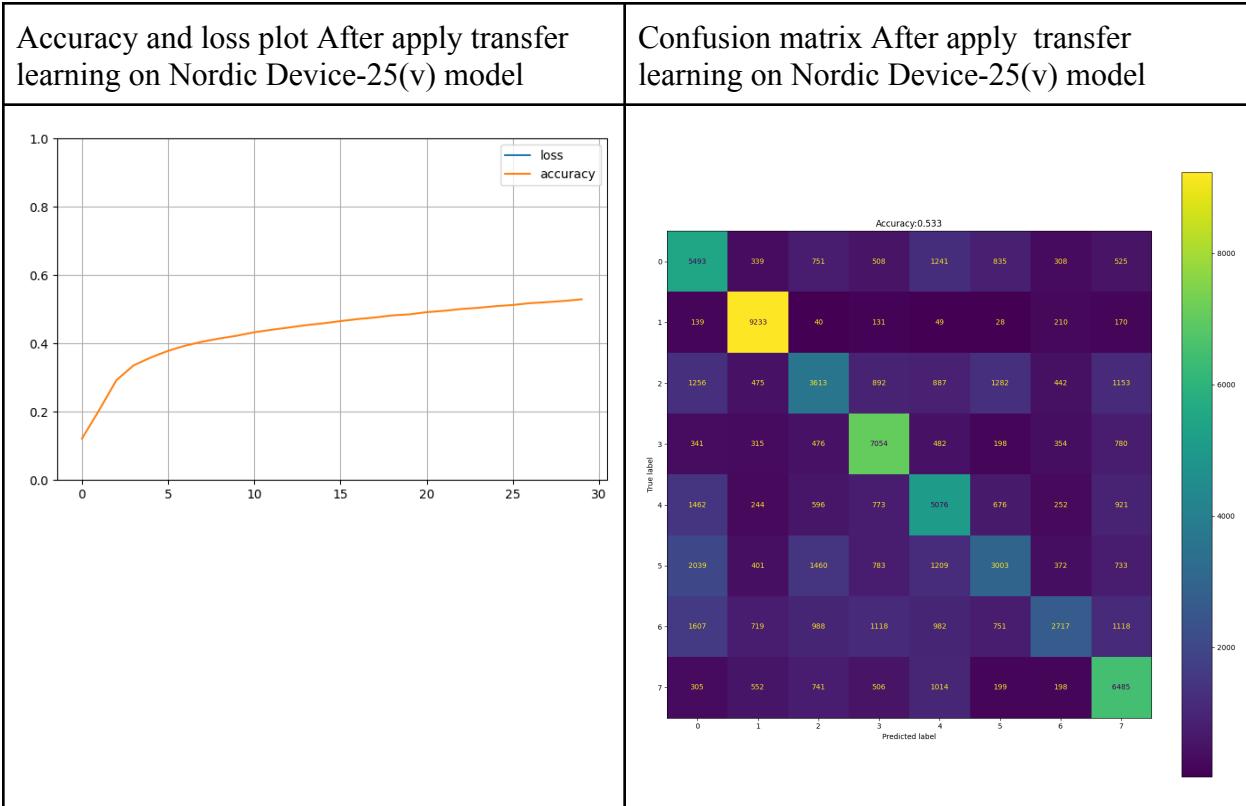
Device-25(iv)_model.h5



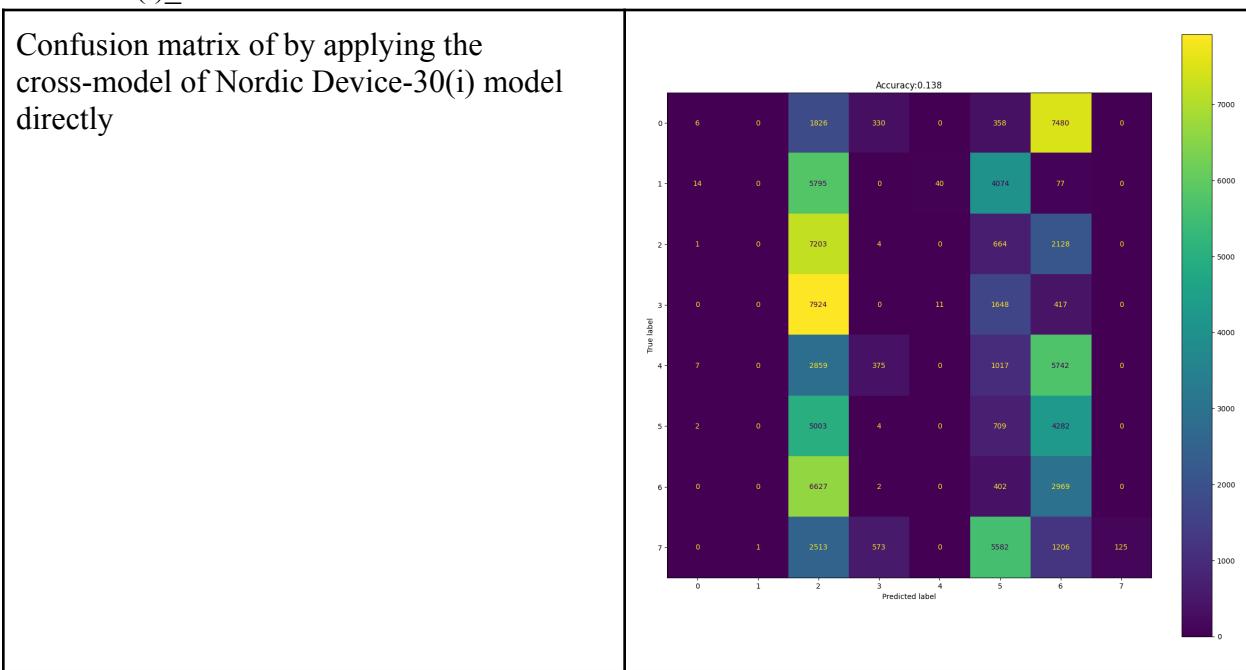


Device-25(v)_model.h5

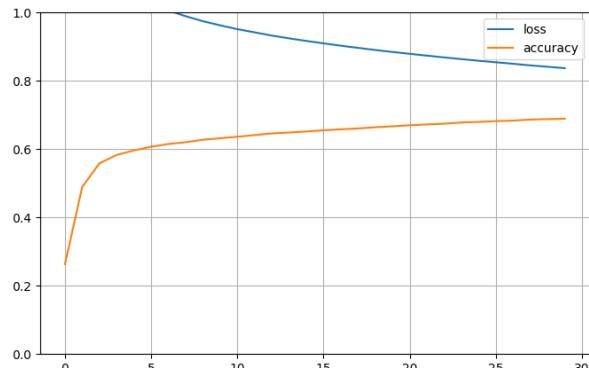




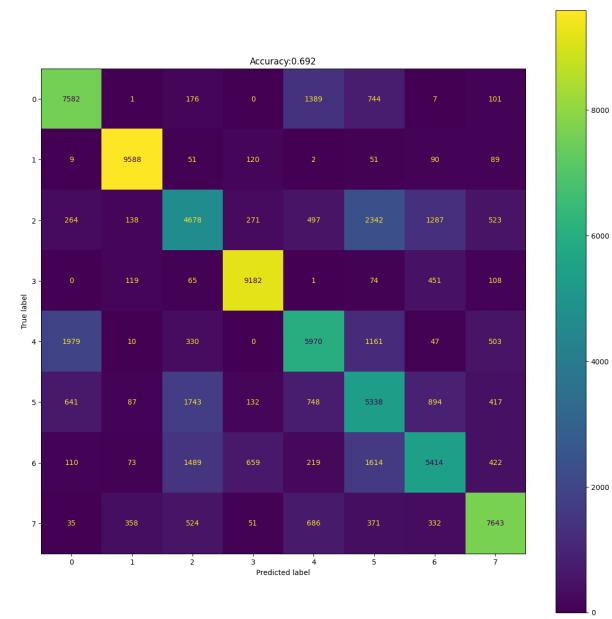
Device-30(i)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

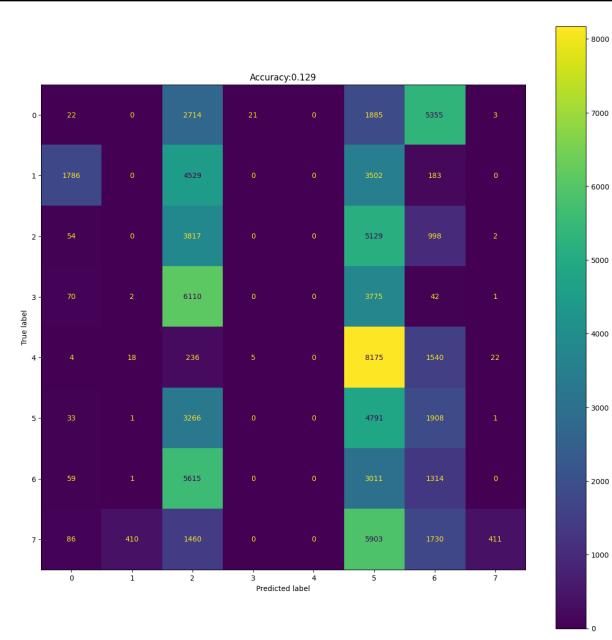


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

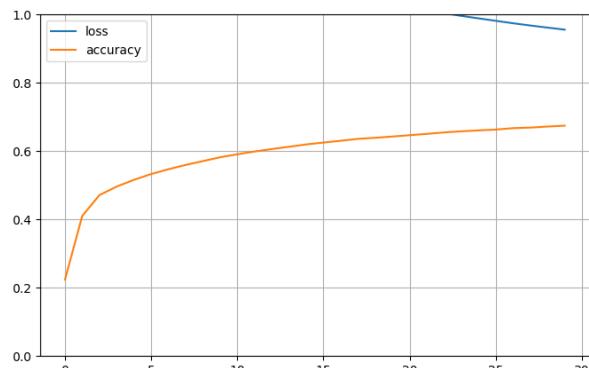


Device-30(ii)_model.h5

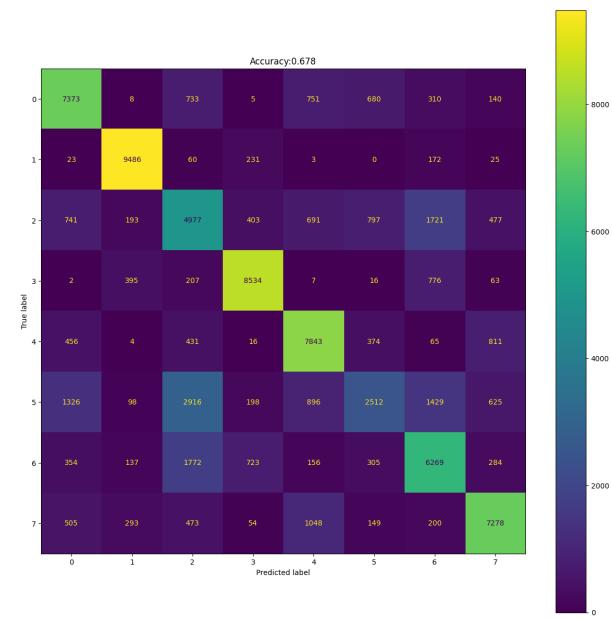
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

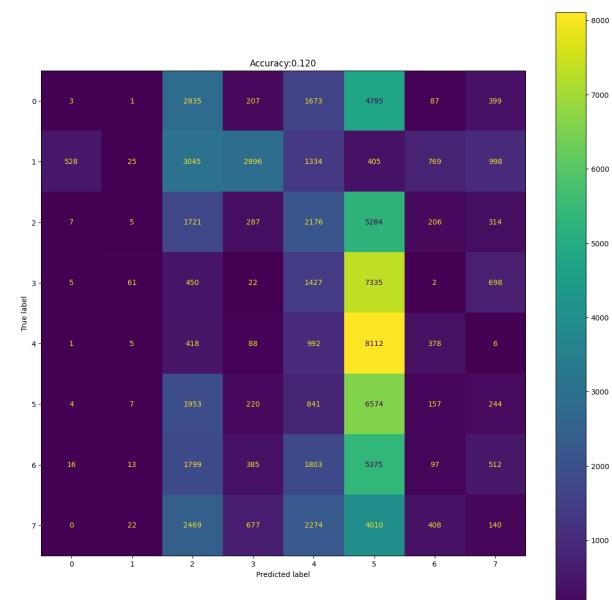


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

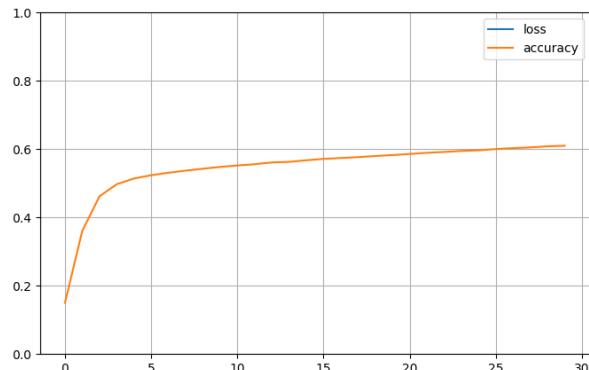


Device-30(iii)_model.h5

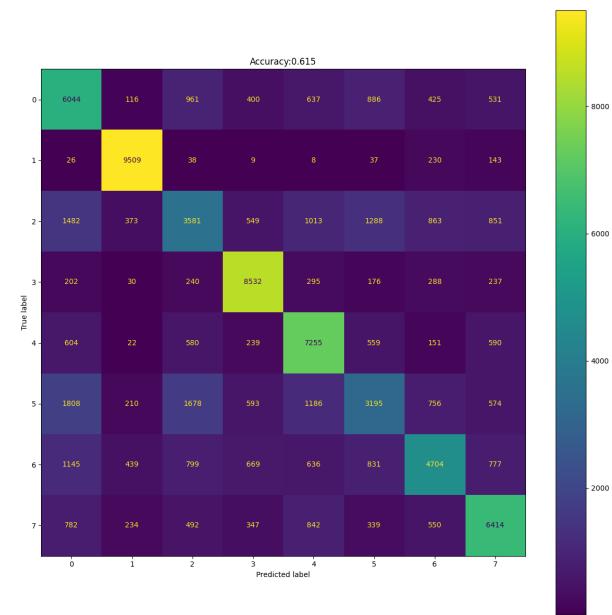
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

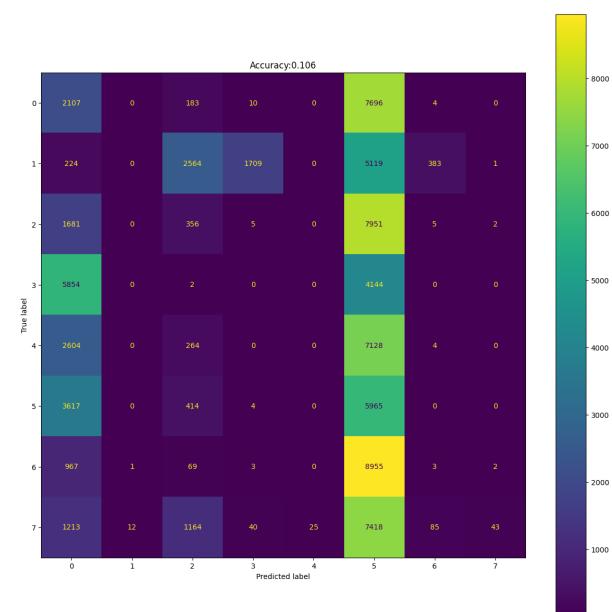


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

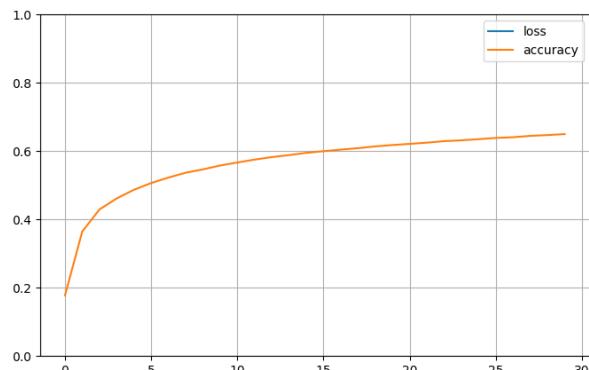


Device-30(iv)_model.h5

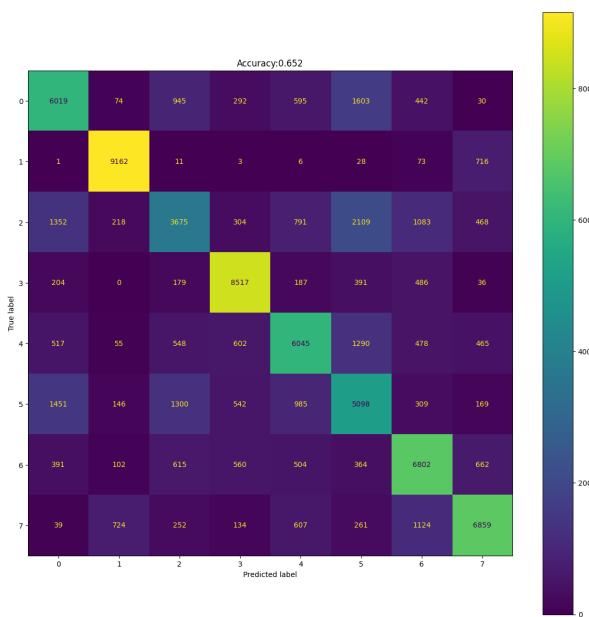
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

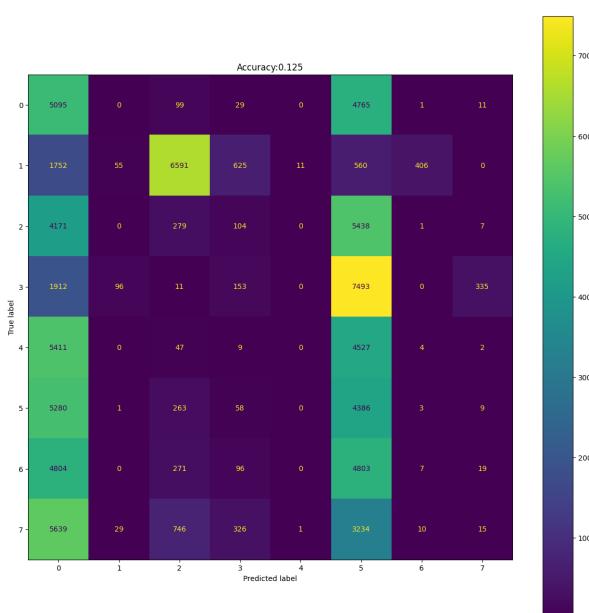


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model



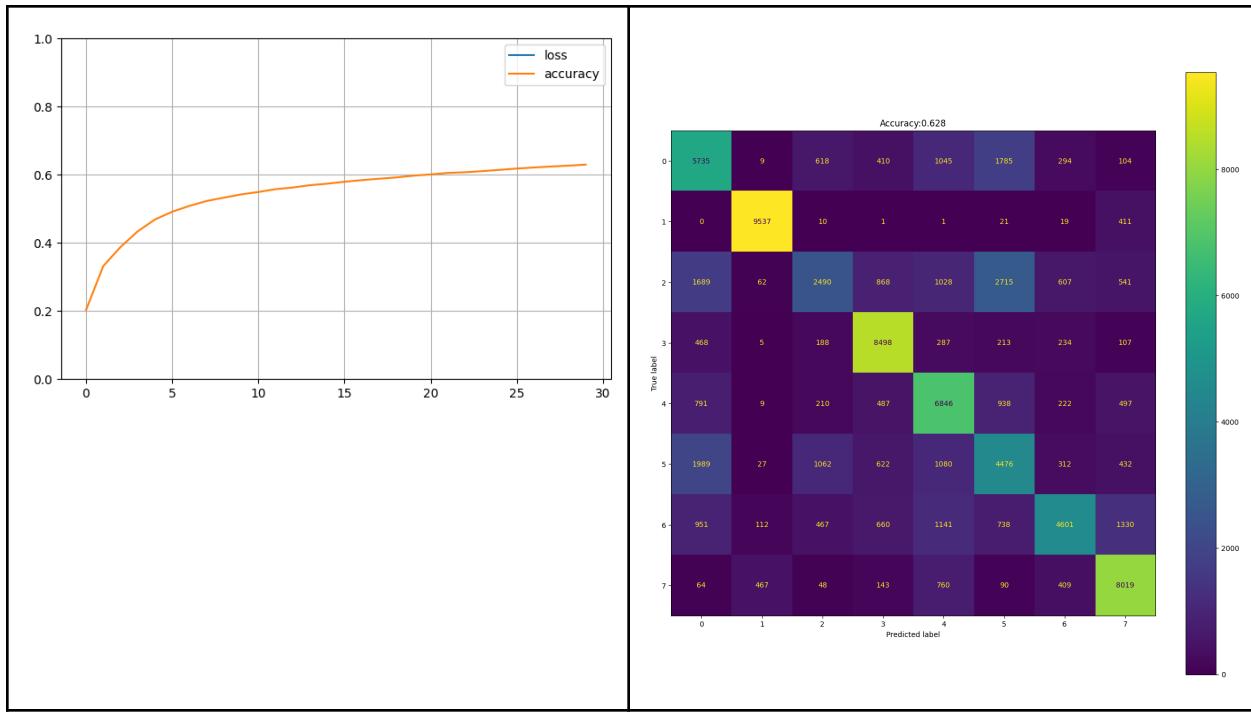
Device-30(v)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model

Confusion matrix After apply transfer learning on Nordic Device-30(v) model

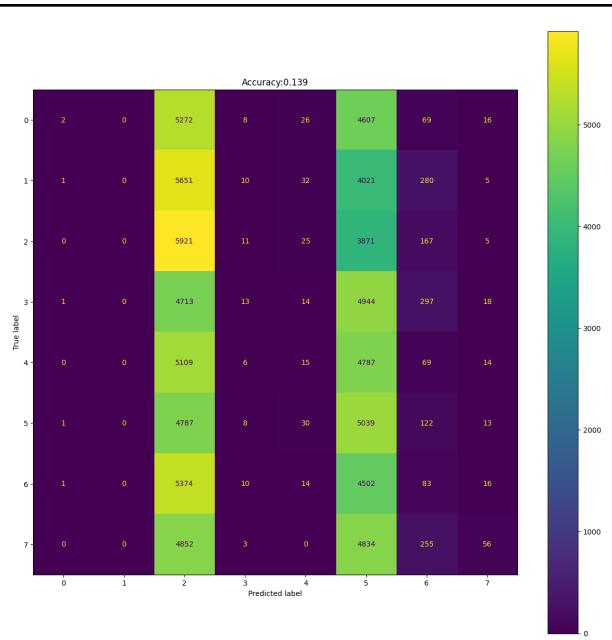


Nordic Device-25(iii) dataset

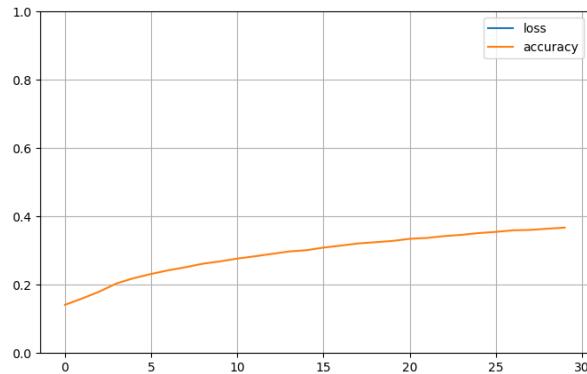
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1391 | 0.3674 | 4m 54.4s | 0.3714 |
| Device-25(ii)_model.h5 | 0.1388 | 0.3733 | 5m 2.5s | 0.3730 |
| Device-25(iv)_model.h5 | 0.6878 | 0.7936 | 5m 8.5s | 0.7943 |
| Device-25(v)_model.h5 | 0.6728 | 0.7846 | 5m 3.4s | 0.7864 |
| Device-30(i)_model.h5 | 0.1210 | 0.4420 | 4m 46.4s | 0.4436 |
| Device-30(ii)_model.h5 | 0.1356 | 0.4543 | 5m 4.1s | 0.4569 |
| Device-30(iii)_model.h5 | 0.1128 | 0.4252 | 5m 1.7s | 0.4290 |
| Device-30(iv)_model.h5 | 0.1206 | 0.4460 | 4m 55.5s | 0.4480 |
| Device-30(v)_model.h5 | 0.1395 | 0.4314 | 5m 3.7s | 0.4329 |

Device-25(i)_model.h5

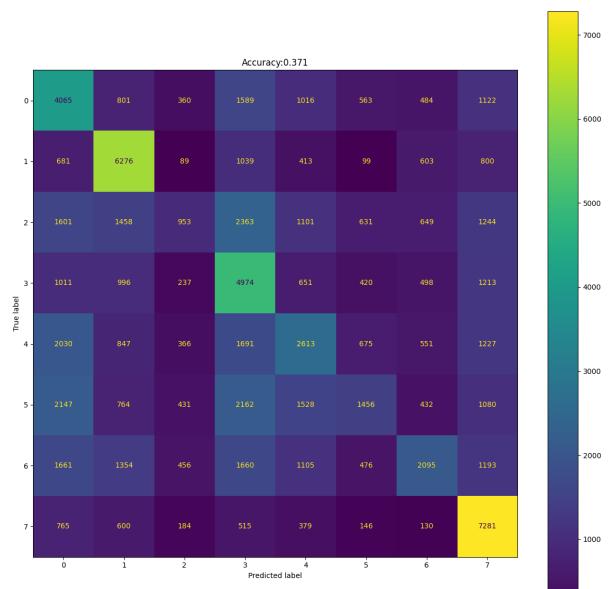
Confusion matrix of by applying the cross-model of Nordic Device-25(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

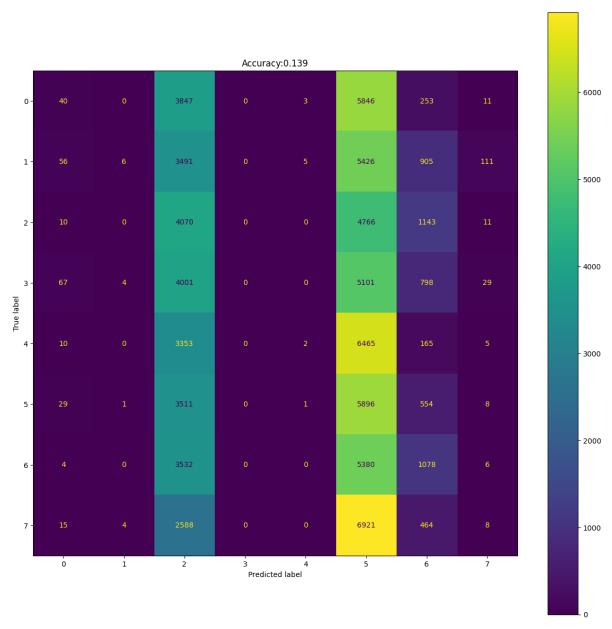


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

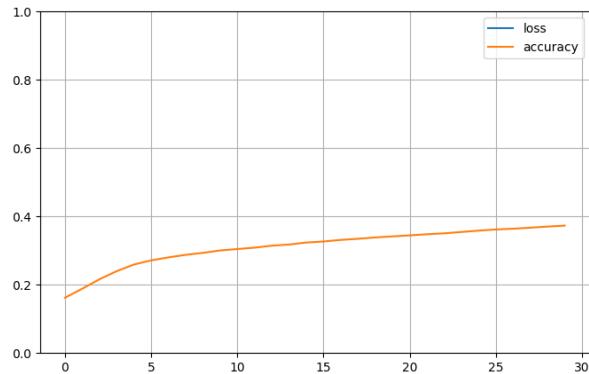


Device-25(ii)_model.h5

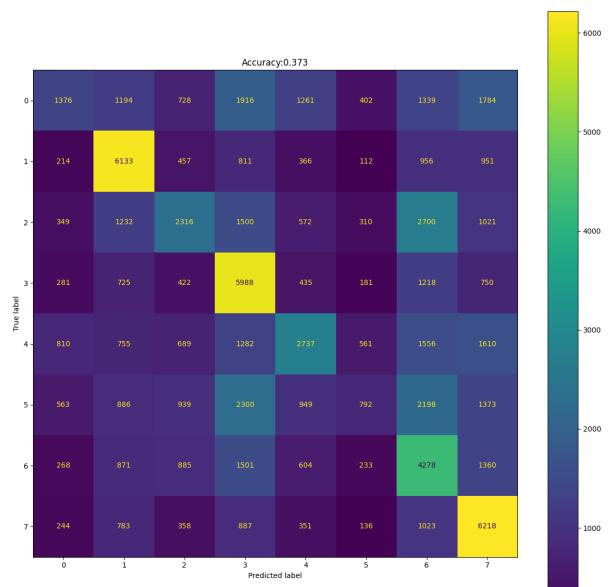
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

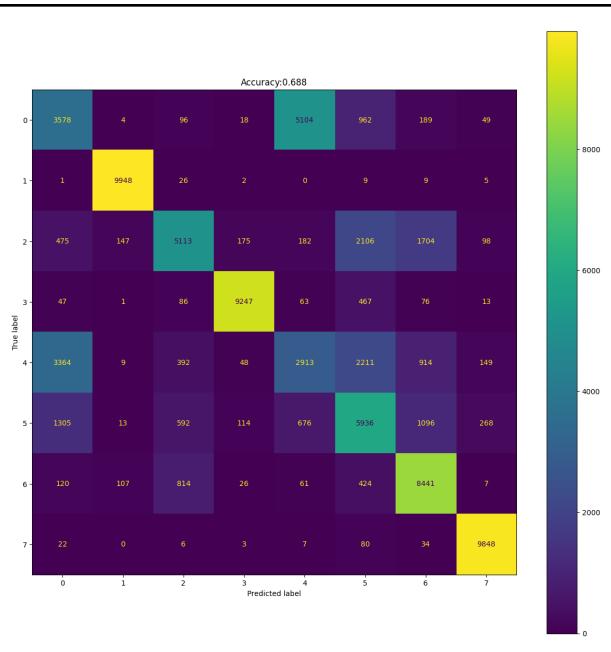


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

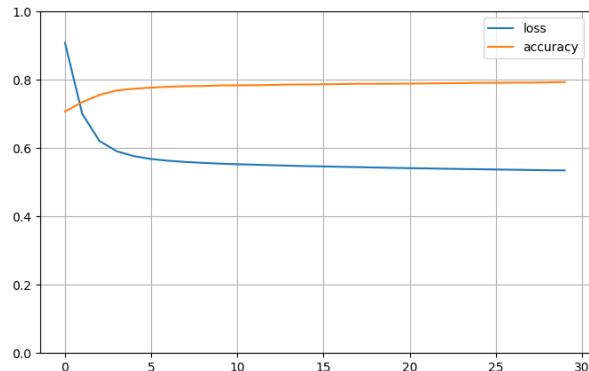


Device-25(iv)_model.h5

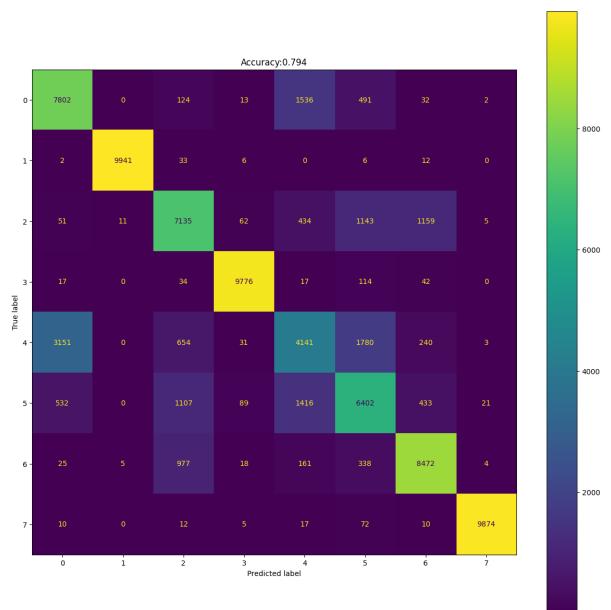
Confusion matrix of by applying the cross-model of Nordic Device-25(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

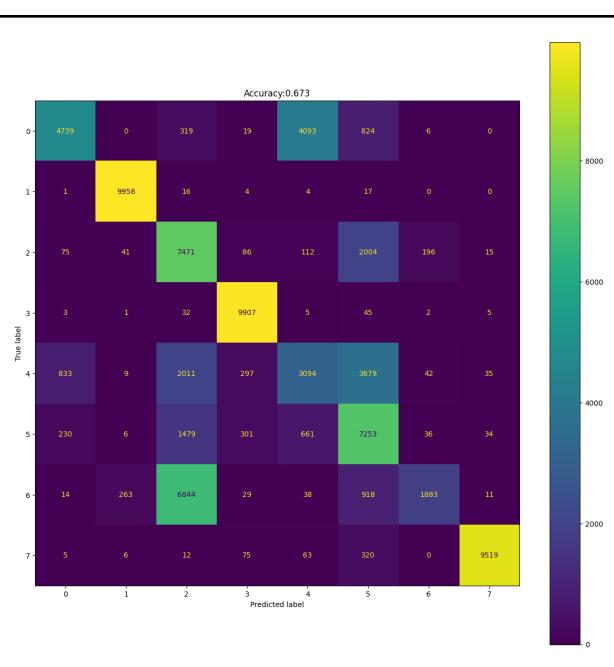


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

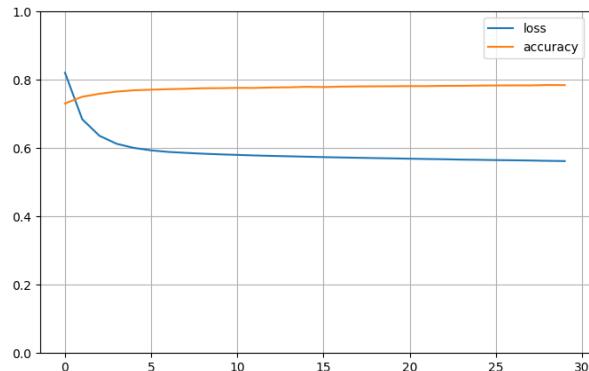


Device-25(v)_model.h5

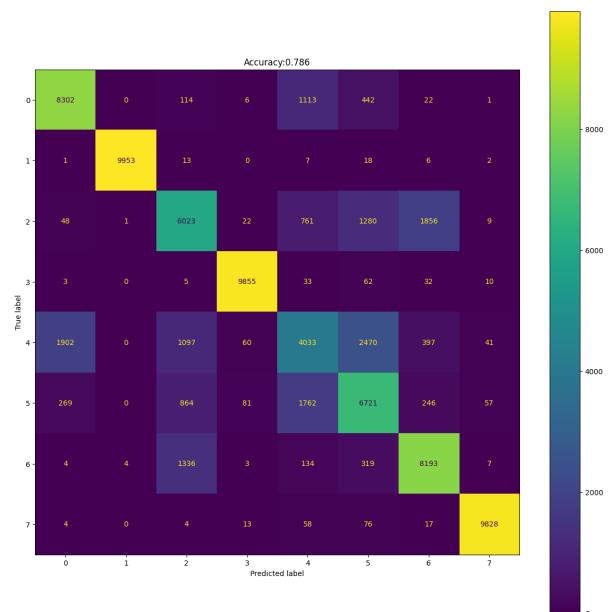
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

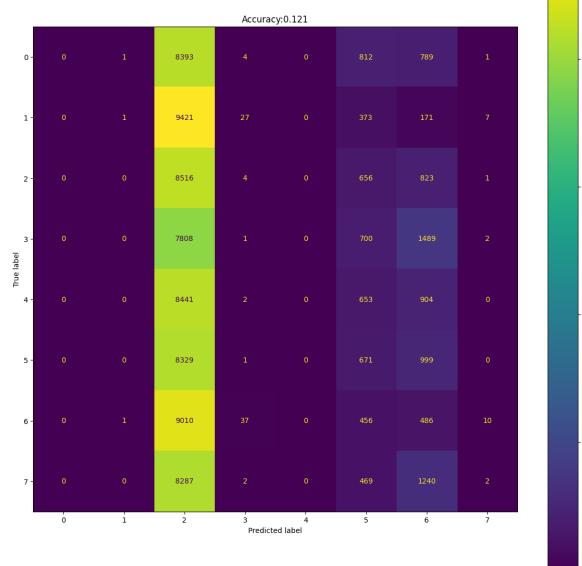


Confusion matrix After apply transfer learning on Nordic Device-25(v) model

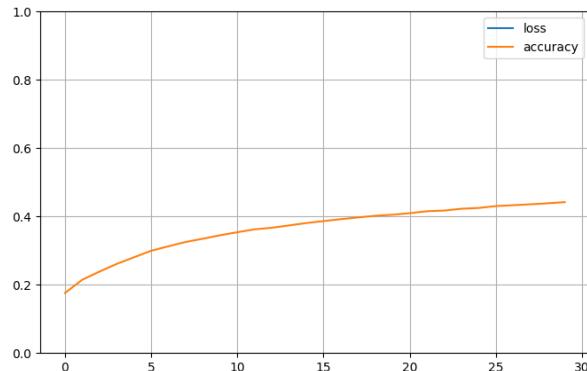


Device-30(i)_model.h5

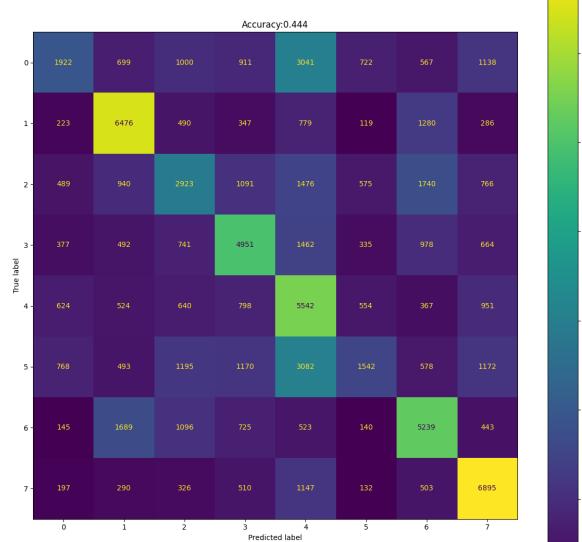
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

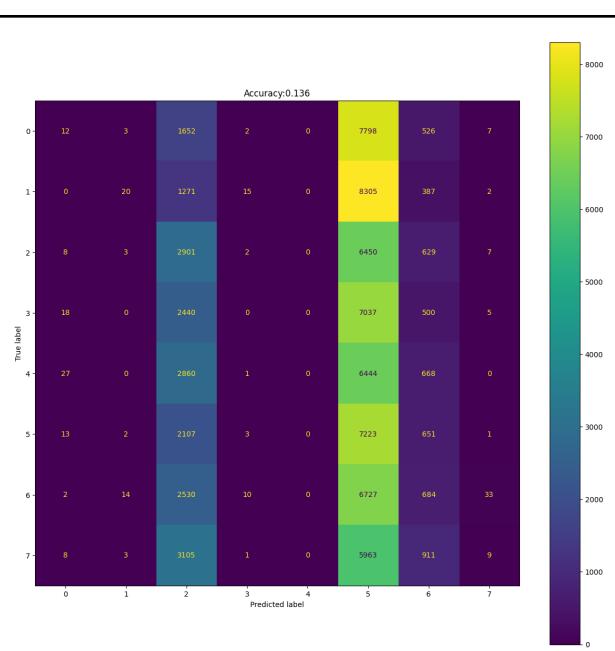


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

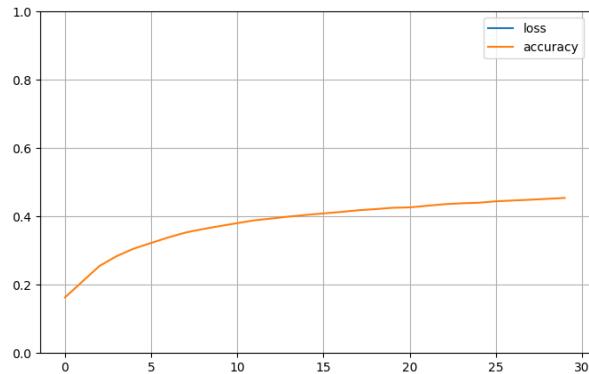


Device-30(ii)_model.h5

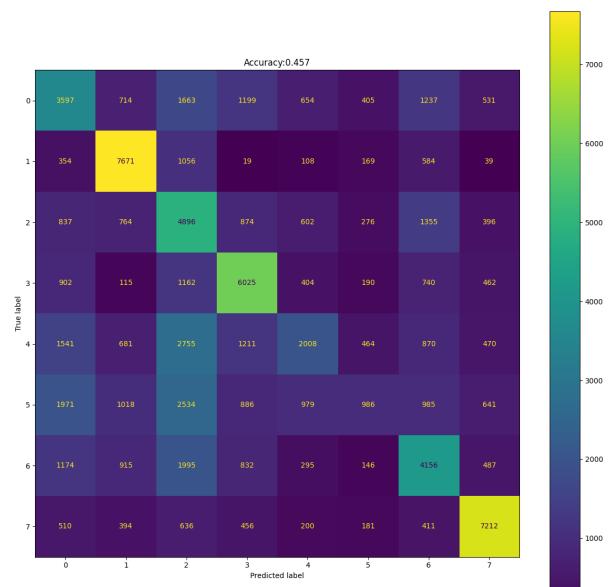
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

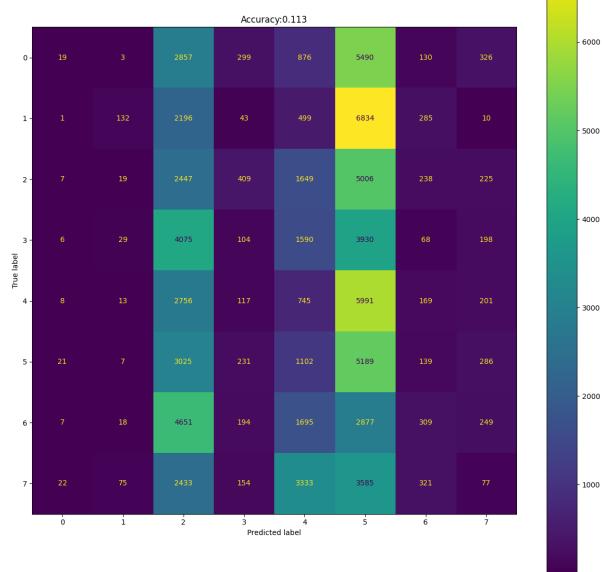


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

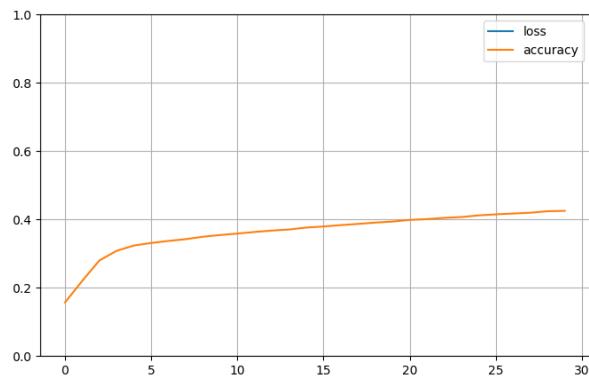


Device-30(iii)_model.h5

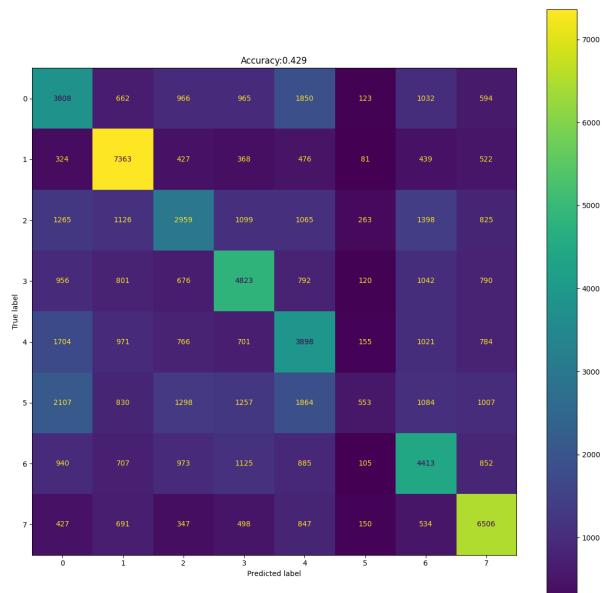
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

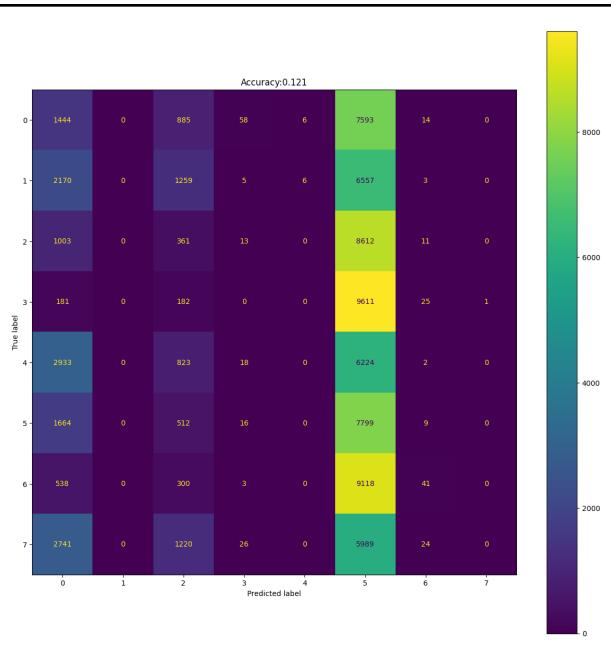


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

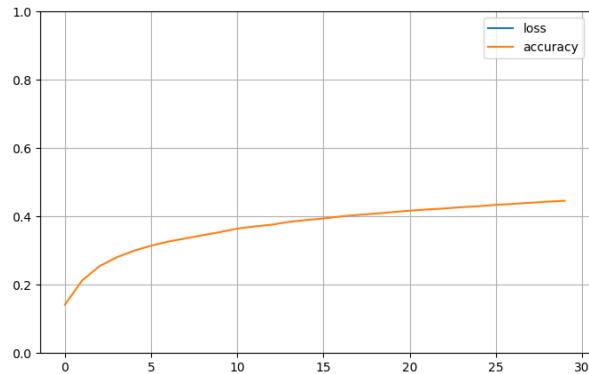


Device-30(iv)_model.h5

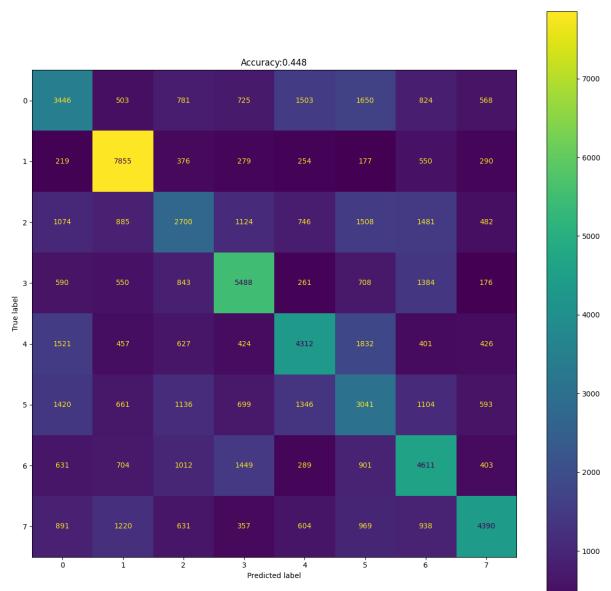
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

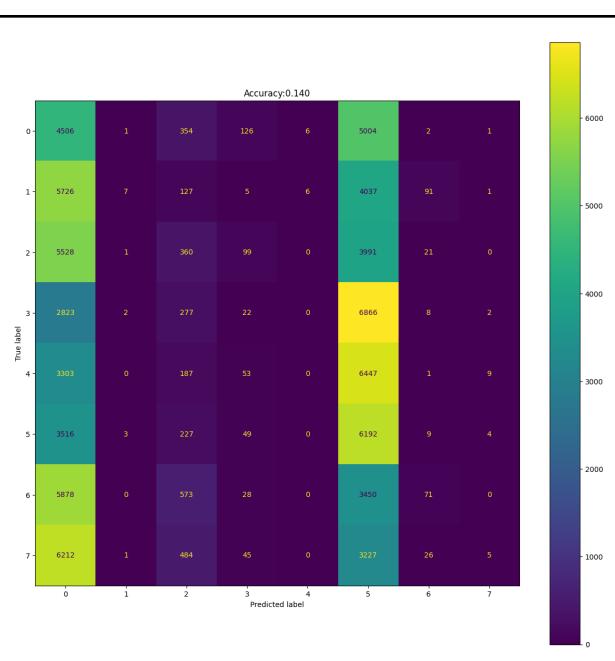


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model

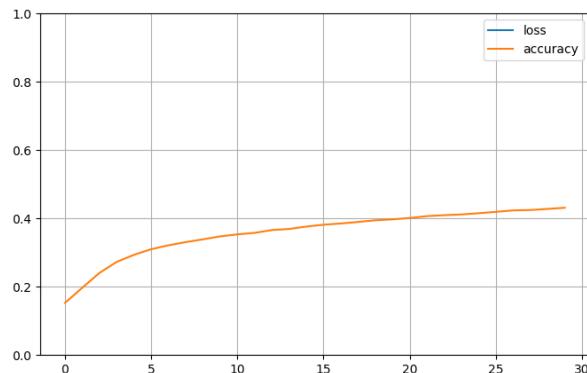


Device-30(v)_model.h5

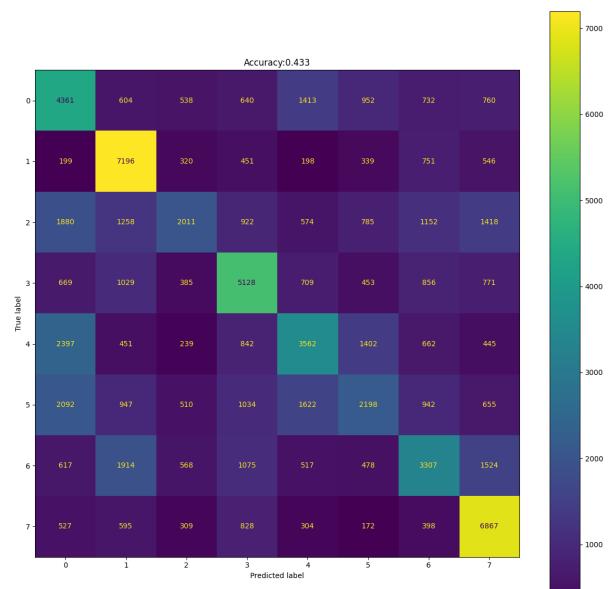
Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model



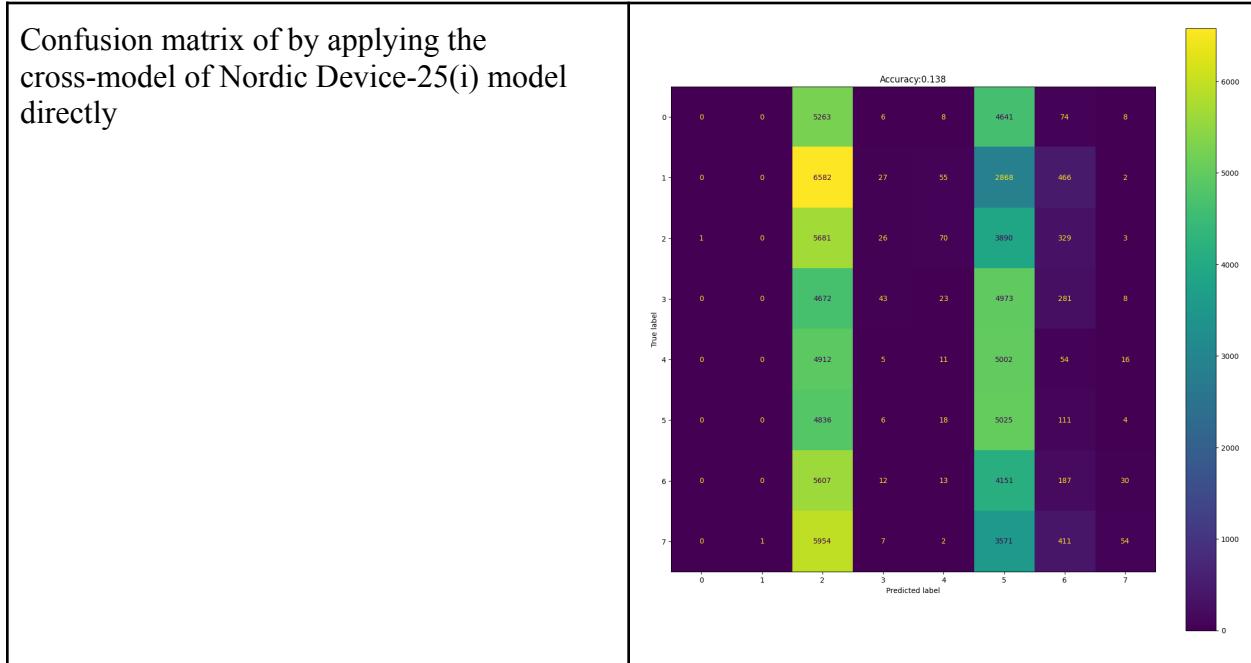
Confusion matrix After apply transfer learning on Nordic Device-30(v) model



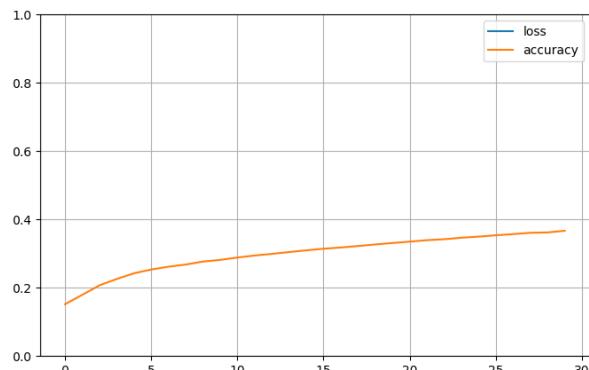
Nordic Device-25(iv) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1375 | 0.3669 | 5m 5.2s | 0.3626 |
| Device-25(ii)_model.h5 | 0.1312 | 0.3857 | 5m 4.3s | 0.3847 |
| Device-25(iii)_model.h5 | 0.7212 | 0.7940 | 5m 11.7s | 0.7949 |
| Device-25(v)_model.h5 | 0.6905 | 0.7846 | 5m 36.7s | 0.7847 |
| Device-30(i)_model.h5 | 0.1217 | 0.4257 | 5m 27.7s | 0.4252 |
| Device-30(ii)_model.h5 | 0.1296 | 0.4290 | 4m 46.8s | 0.4243 |
| Device-30(iii)_model.h5 | 0.1185 | 0.4140 | 4m 46.3s | 0.4150 |
| Device-30(iv)_model.h5 | 0.1274 | 0.4120 | 5m 16.6s | 0.4182 |
| Device-30(v)_model.h5 | 0.1273 | 0.3936 | 4m 30.7s | 0.3965 |

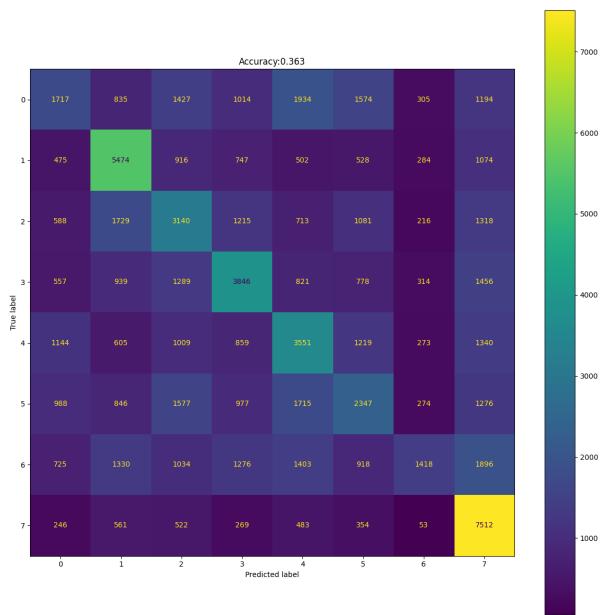
Device-25(i)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

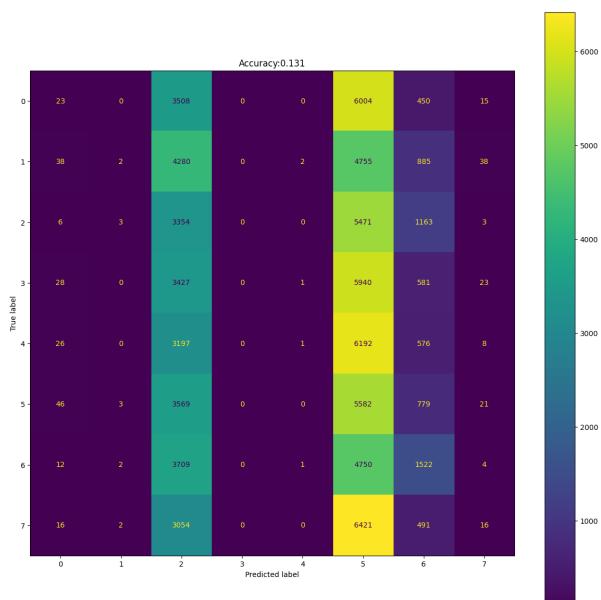


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

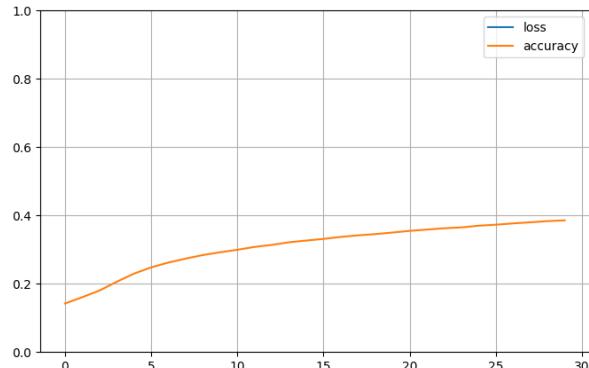


Device-25(ii)_model.h5

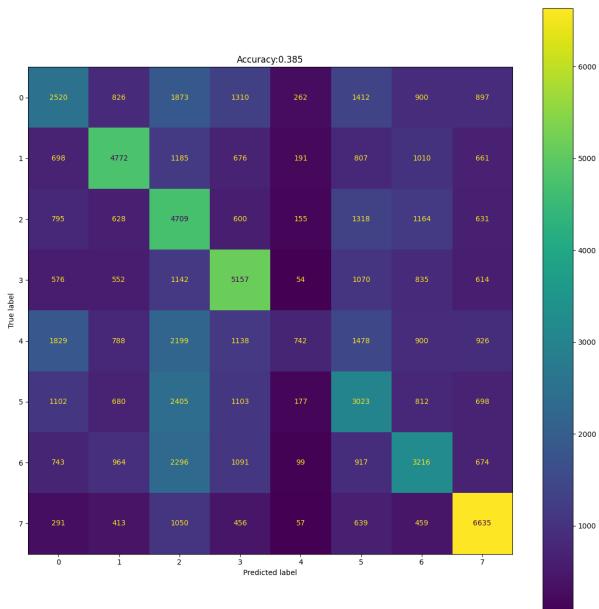
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

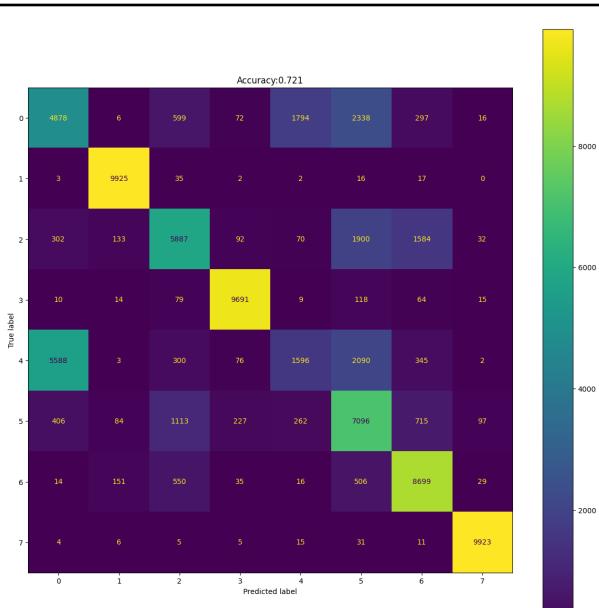


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

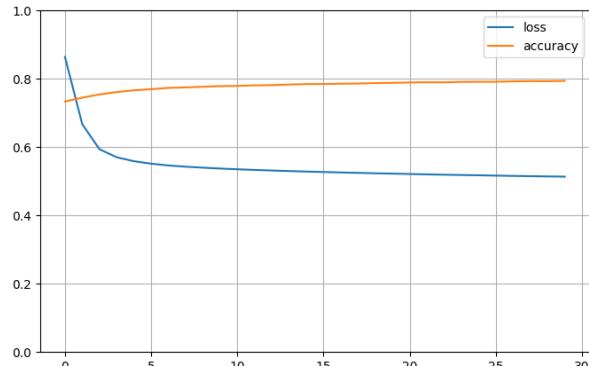


Device-25(iii)_model.h5

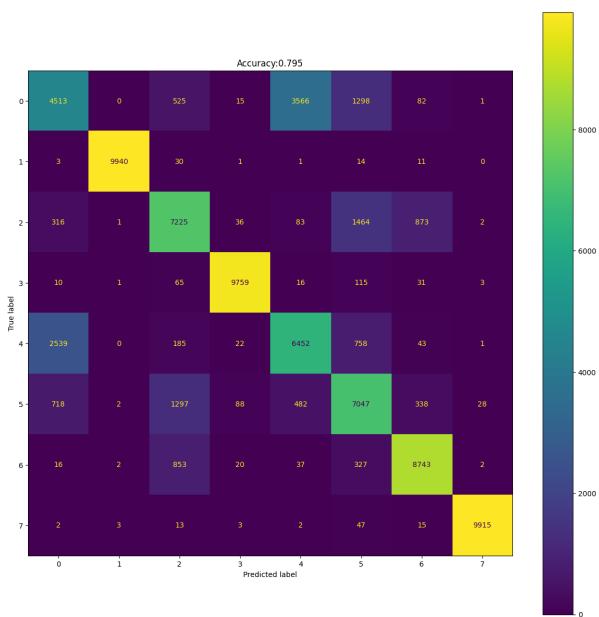
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

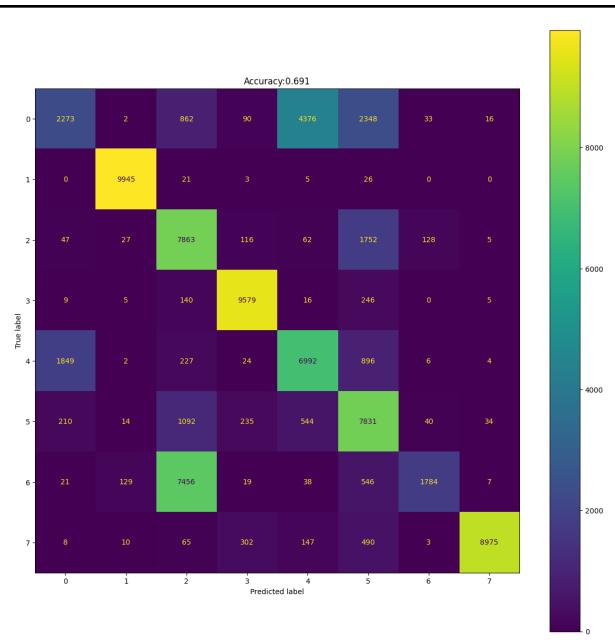


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

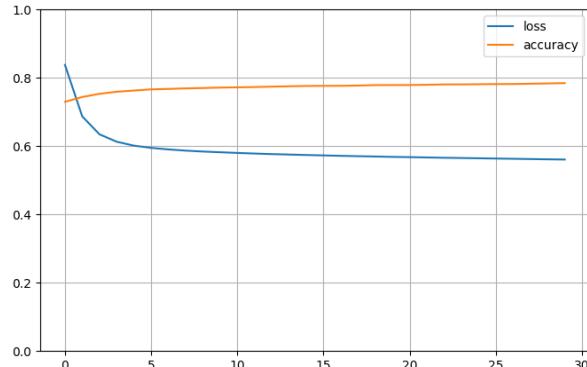


Device-25(v)_model.h5

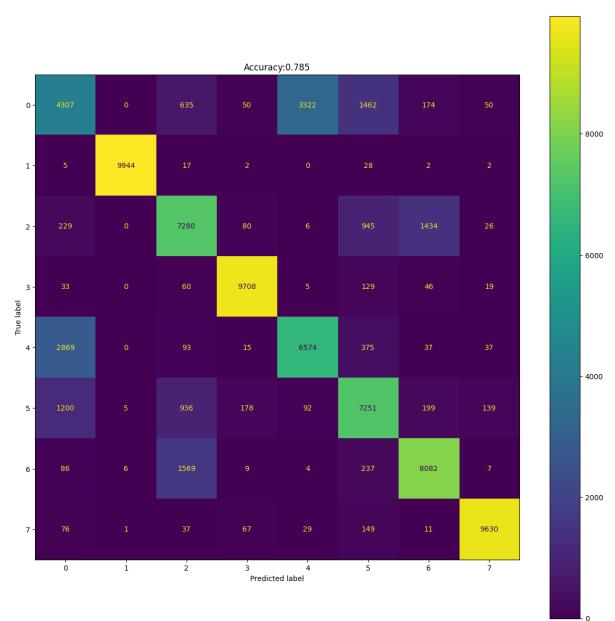
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

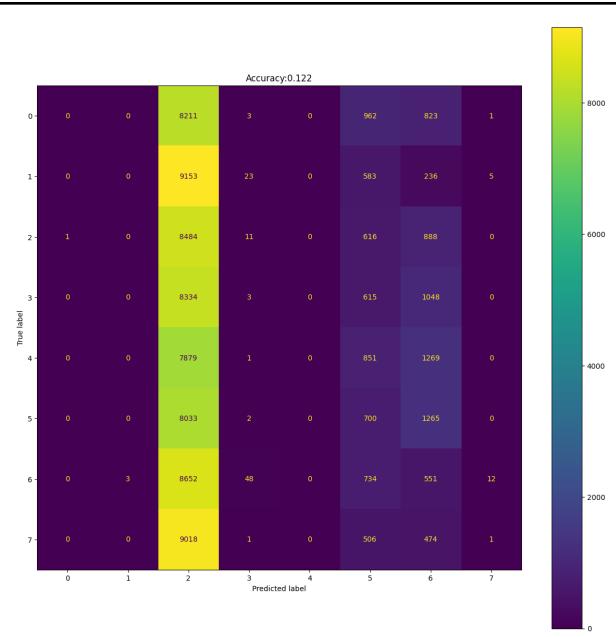


Confusion matrix After apply transfer learning on Nordic Device-25(v) model

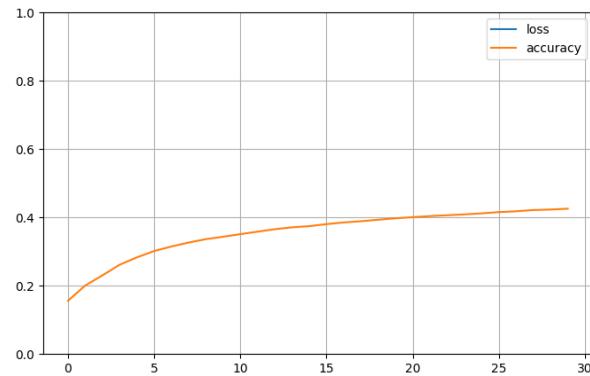


Device-30(i)_model.h5

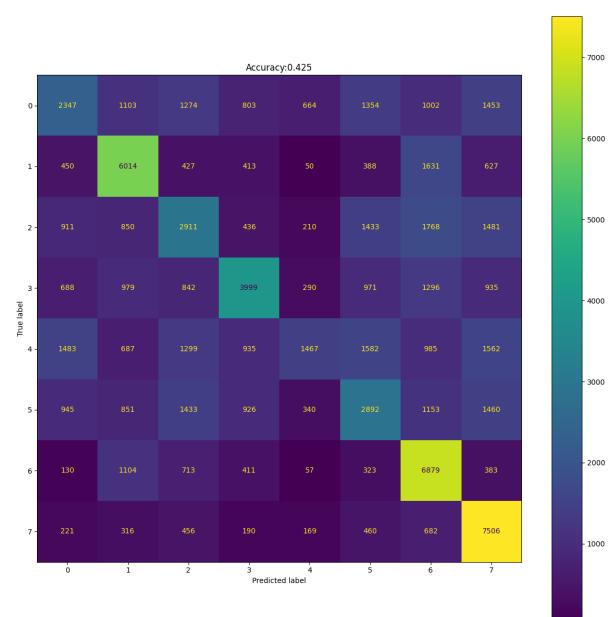
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

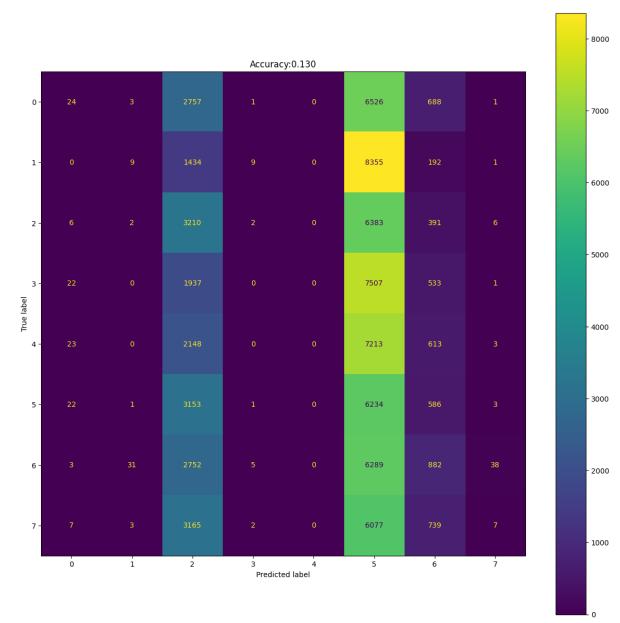


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

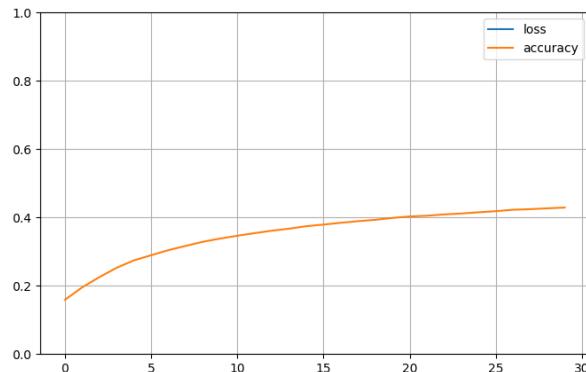


Device-30(ii)_model.h5

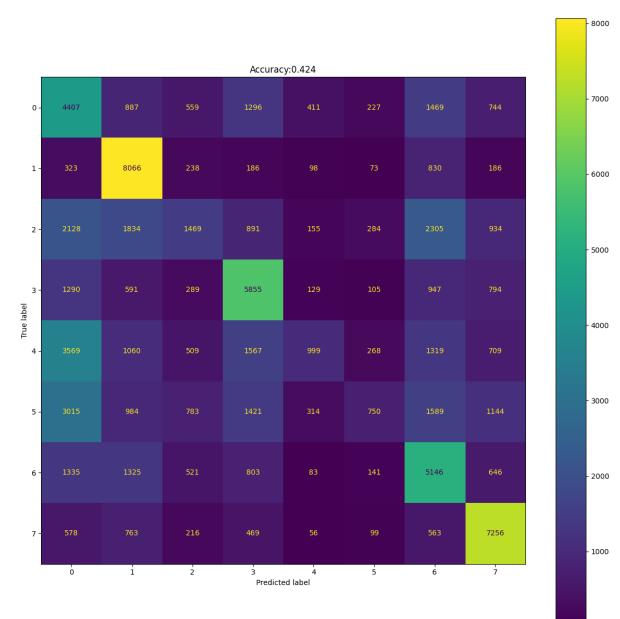
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

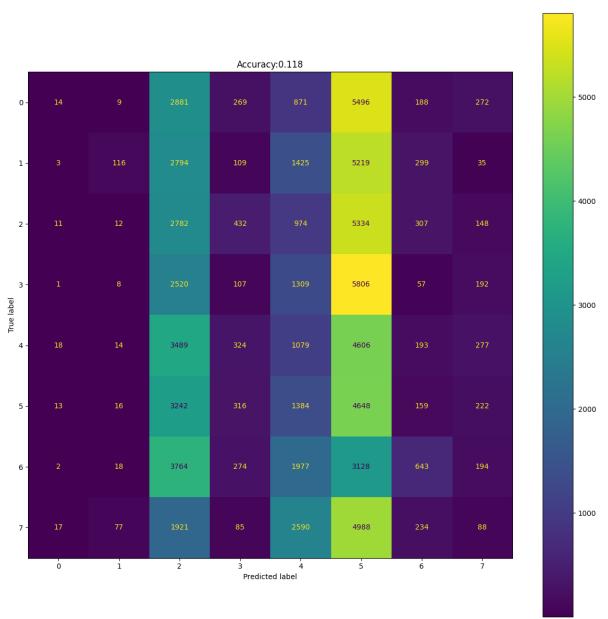


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

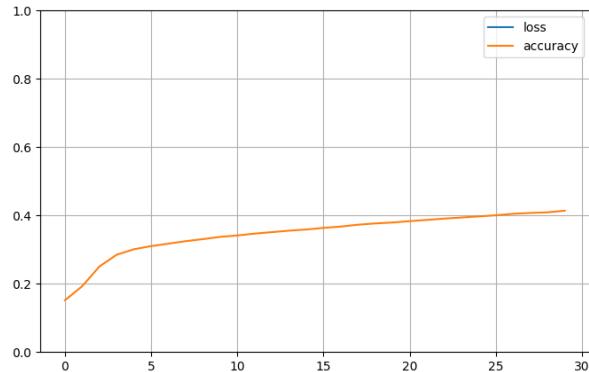


Device-30(iii)_model.h5

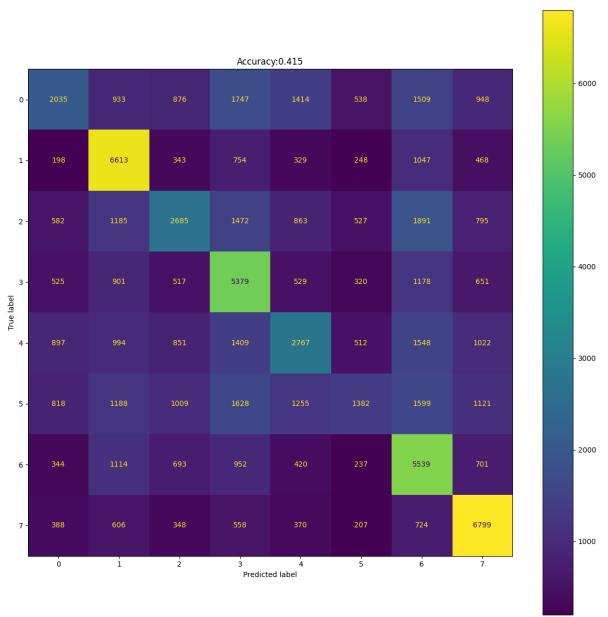
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

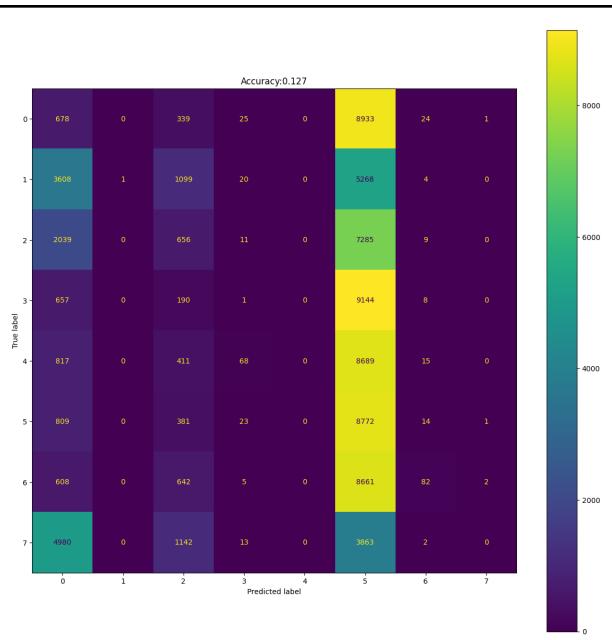


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

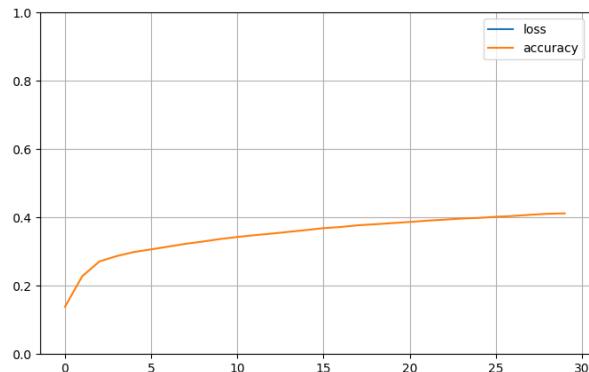


Device-30(iv)_model.h5

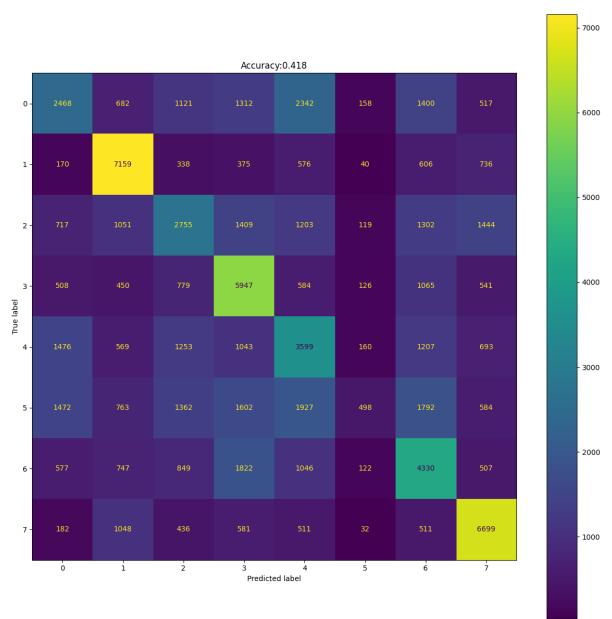
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

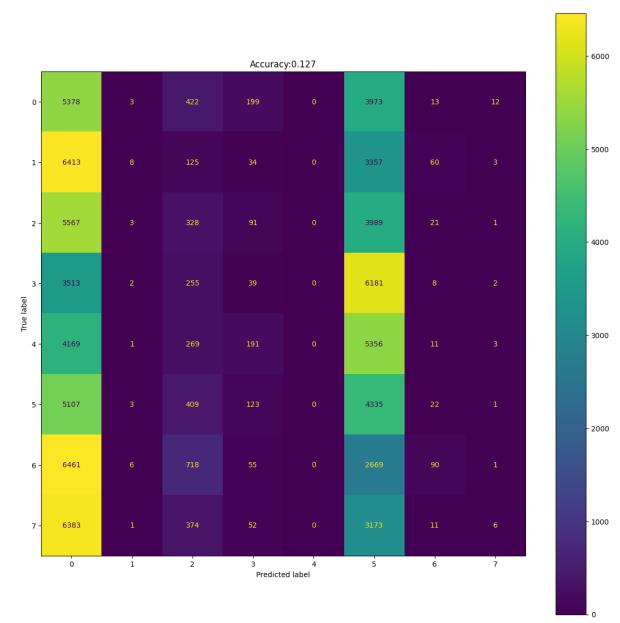


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model

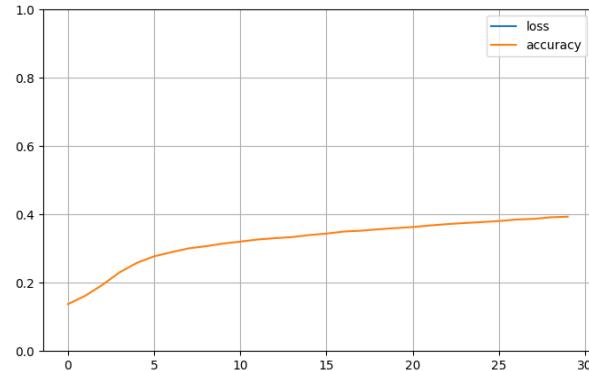


Device-30(v)_model.h5

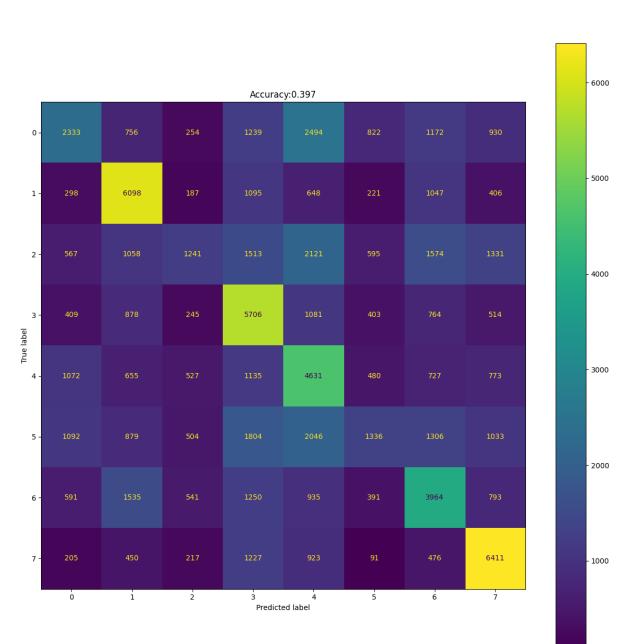
Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model



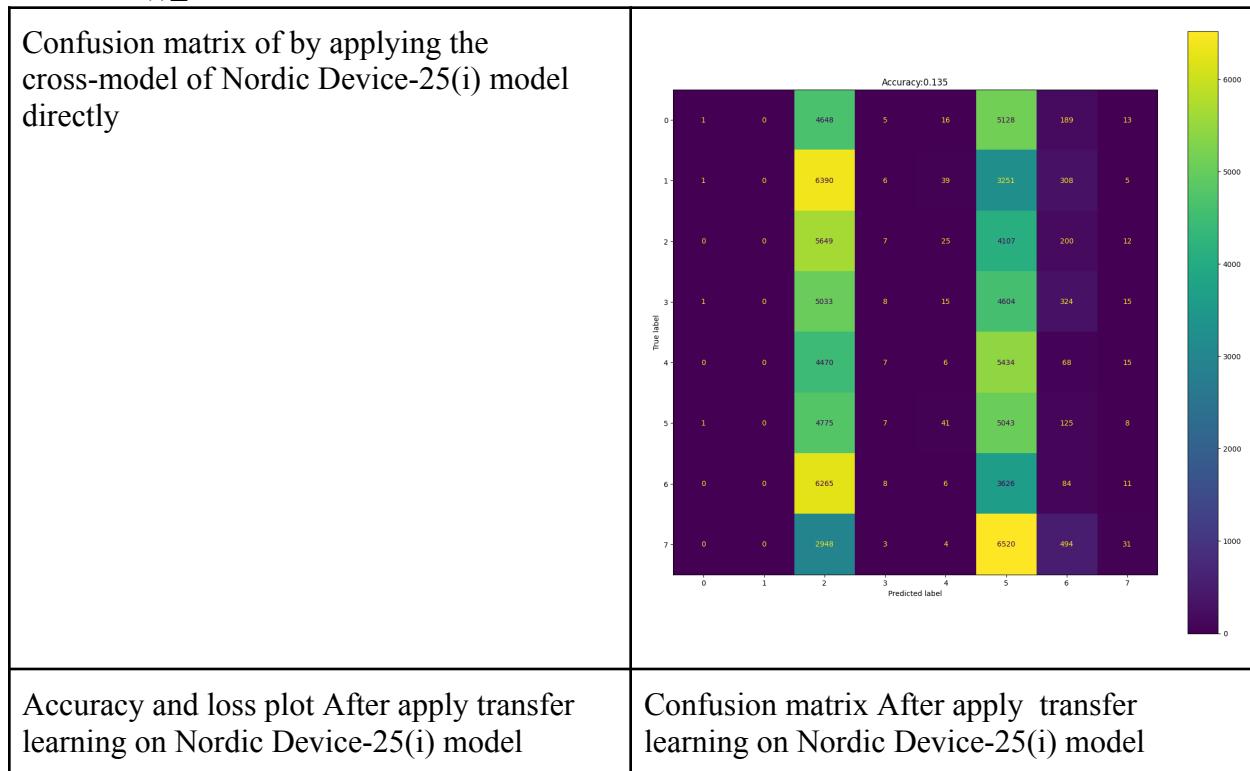
Confusion matrix After apply transfer learning on Nordic Device-30(v) model

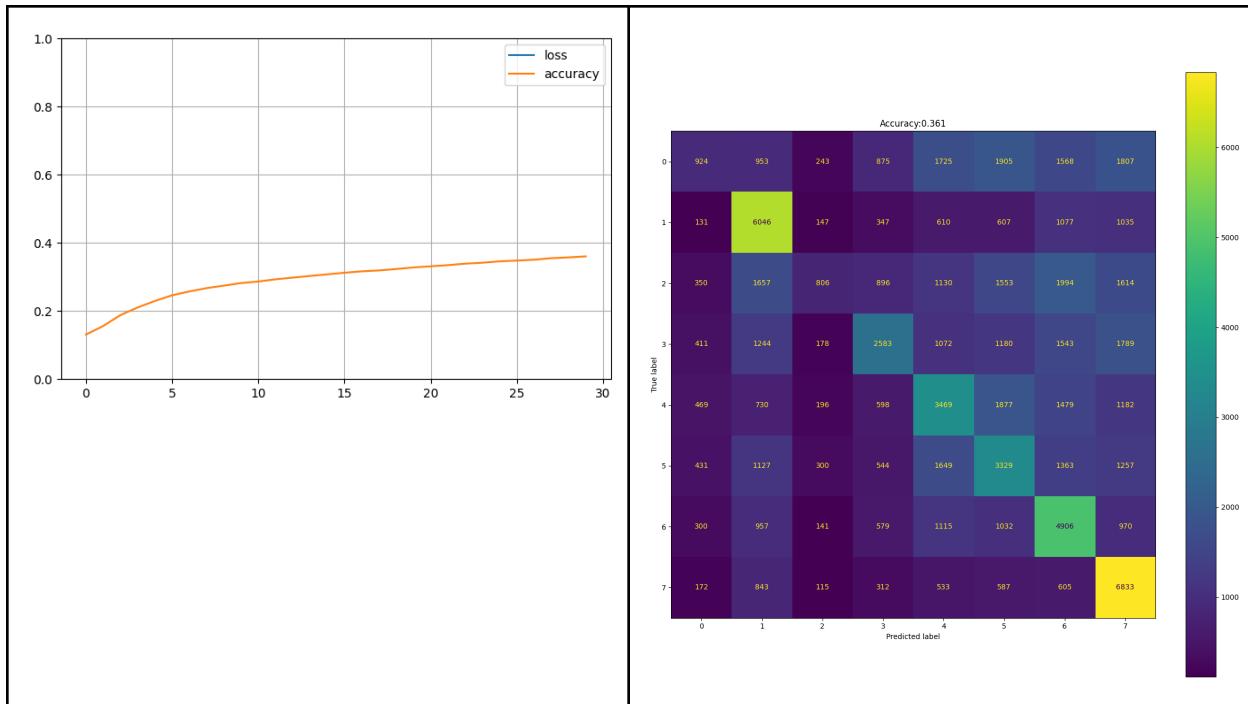


Nordic Device-25(v) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1353 | 0.3605 | 4m 38.4s | 0.3612 |
| Device-25(ii)_model.h5 | 0.1353 | 0.3771 | 4m 44.3s | 0.3856 |
| Device-25(iii)_model.h5 | 0.7174 | 0.8110 | 4m 41.8s | 0.8115 |
| Device-25(iv)_model.h5 | 0.7262 | 0.8025 | 5m 1.5s | 0.8028 |
| Device-30(i)_model.h5 | 0.1245 | 0.4337 | 4m 38.6s | 0.4422 |
| Device-30(ii)_model.h5 | 0.1280 | 0.4381 | 4m 56.4s | 0.4399 |
| Device-30(iii)_model.h5 | 0.1308 | 0.4413 | 5m 4.7s | 0.4438 |
| Device-30(iv)_model.h5 | 0.1192 | 0.4197 | 5m 40.2s | 0.4196 |
| Device-30(v)_model.h5 | 0.1347 | 0.4275 | 5m 4.7s | 0.4319 |

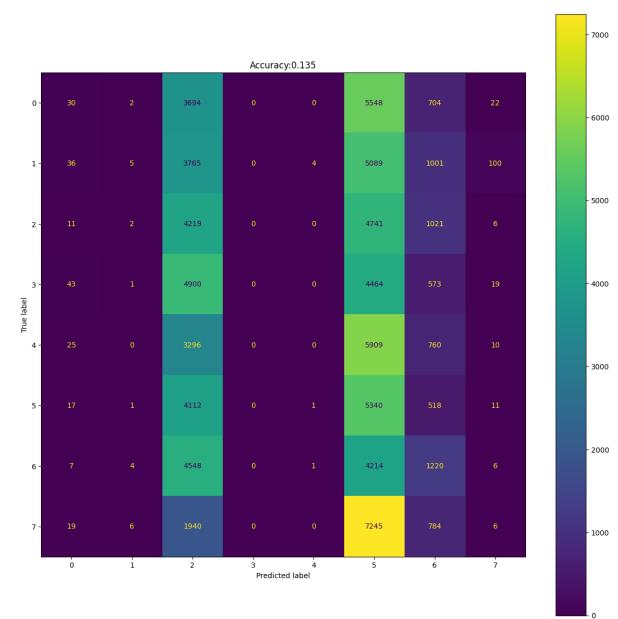
Device-25(i)_model.h5





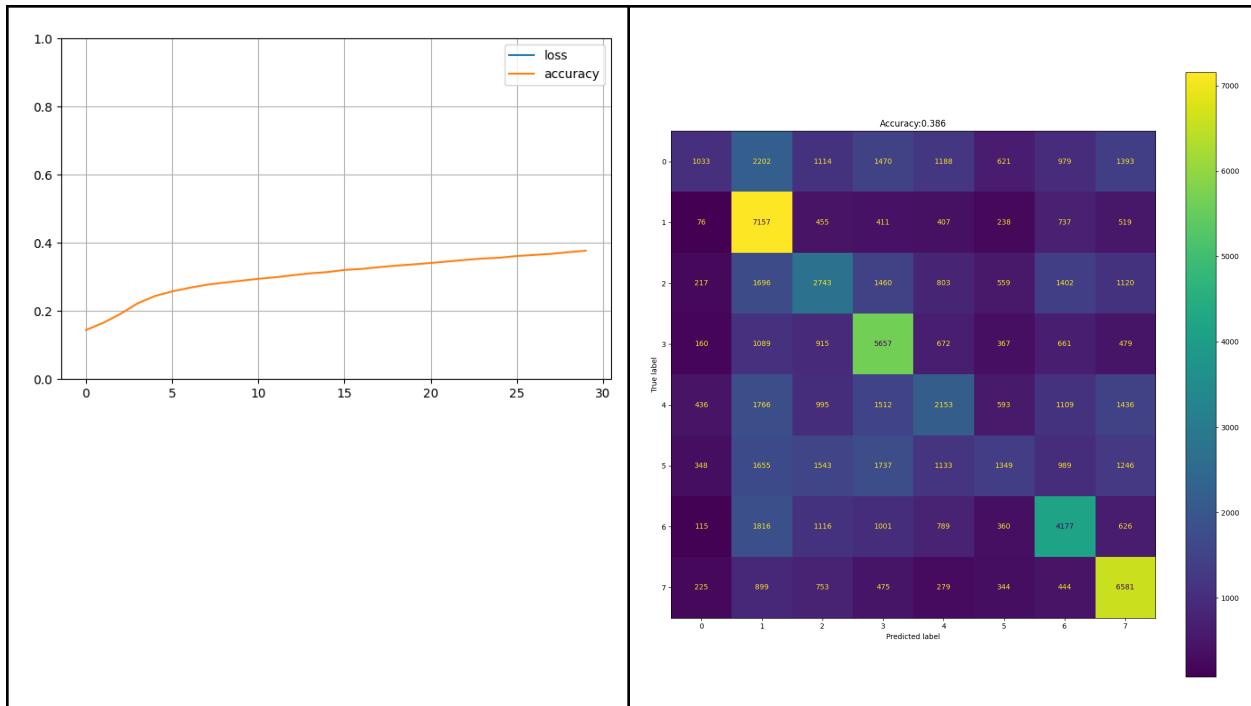
Device-25(ii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

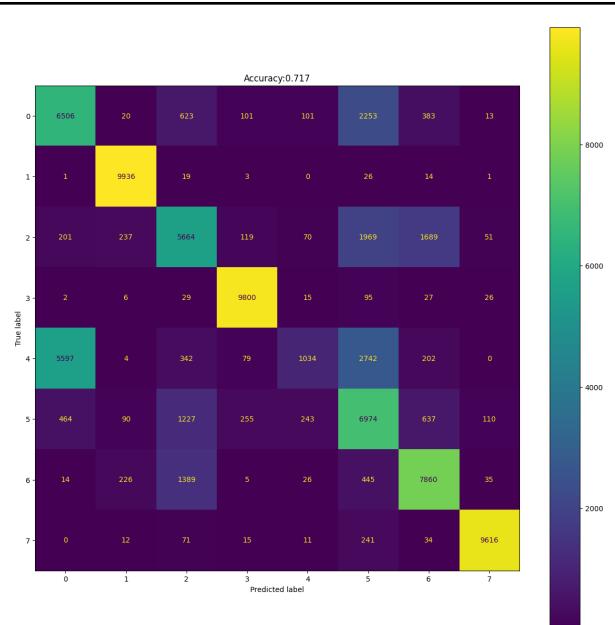
Confusion matrix After apply transfer learning on Nordic Device-25(ii) model



Device-25(iii) _model.h5

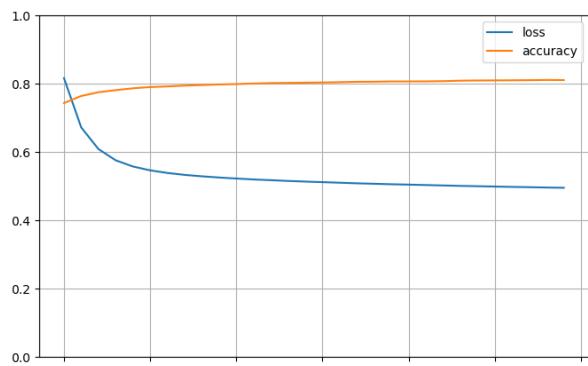
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly

Accuracy and loss plot After apply transfer

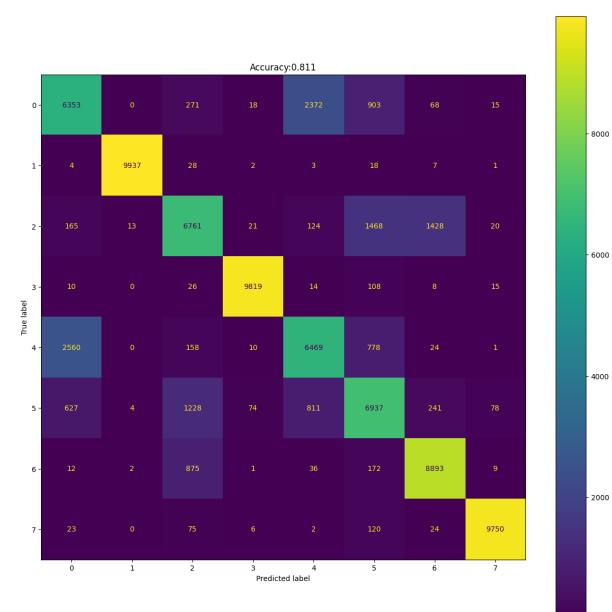


Confusion matrix After apply transfer

learning on Nordic Device-25(iii) model

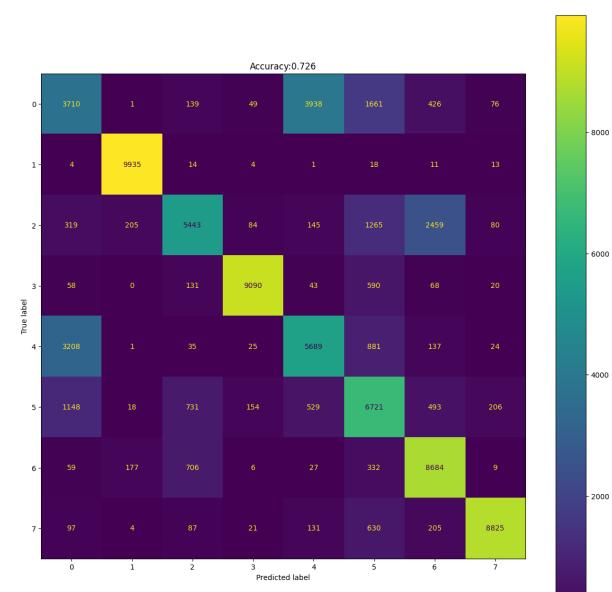


learning on Nordic Device-25(iii) model

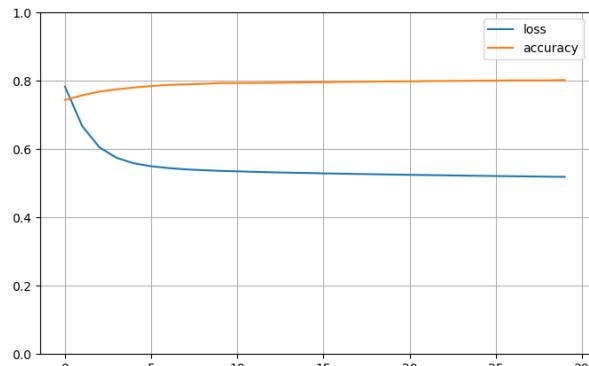


Device-25(iv)_model.h5

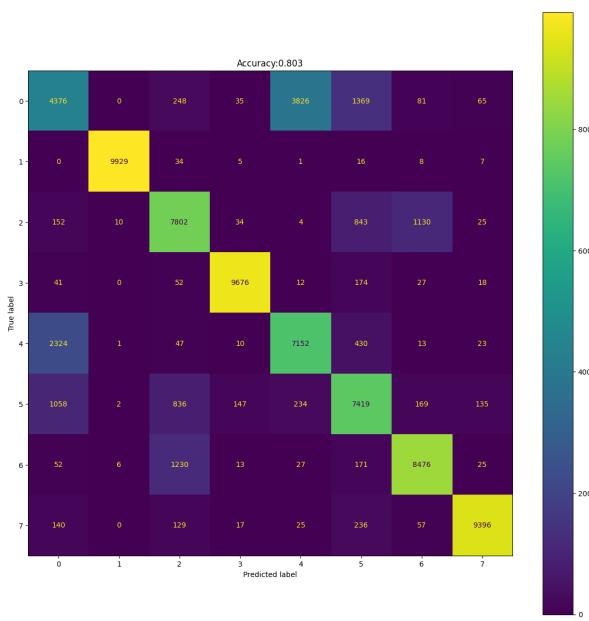
Confusion matrix of by applying the cross-model of Nordic Device-25(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

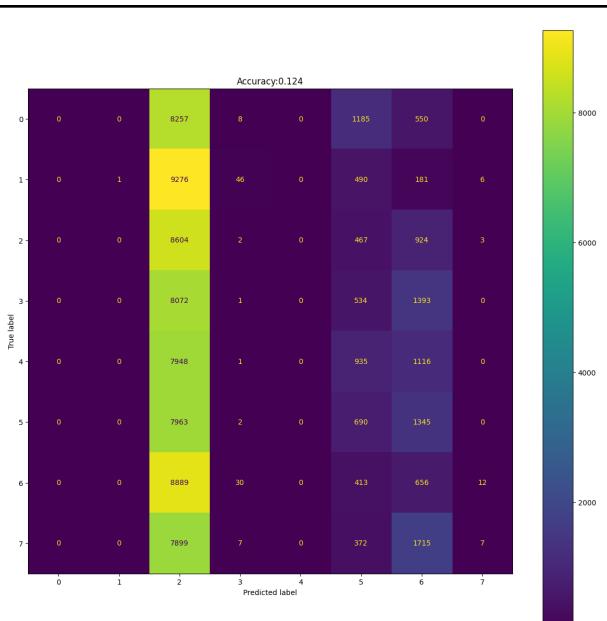


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

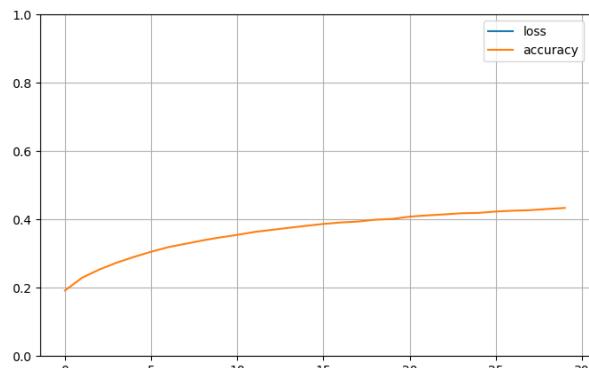


Device-30(i)_model.h5

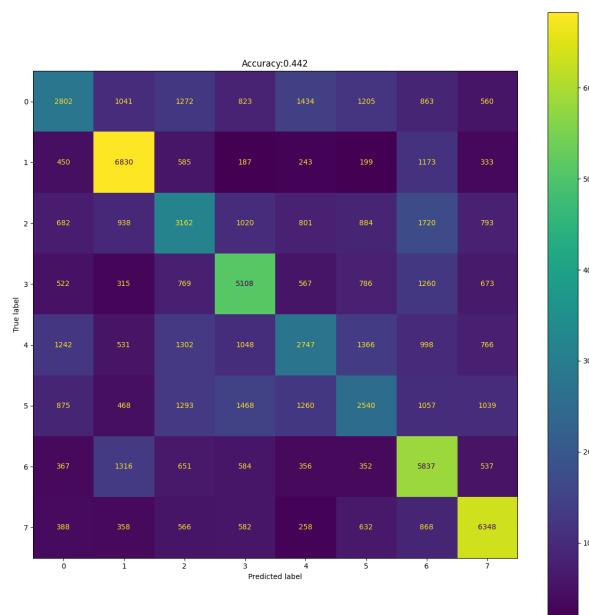
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

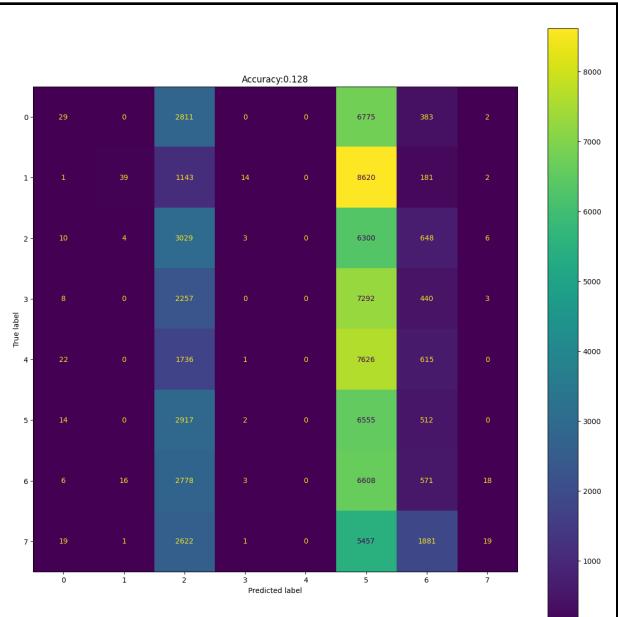


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

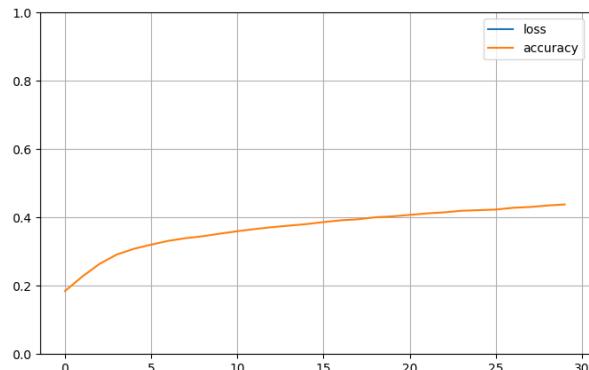


Device-30(ii)_model.h5

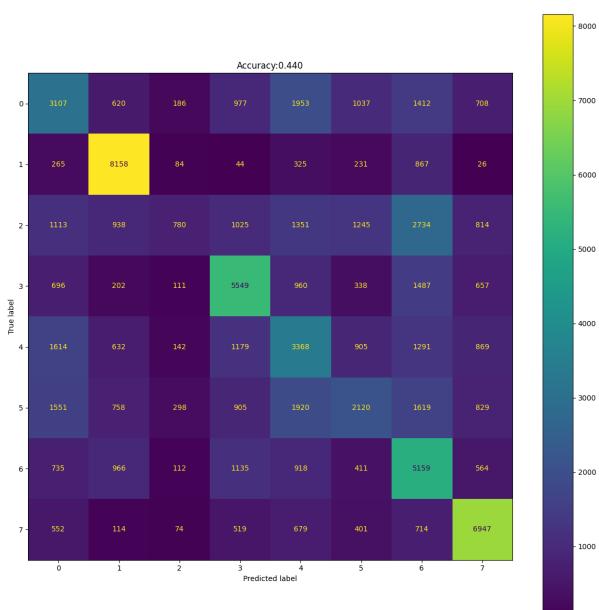
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

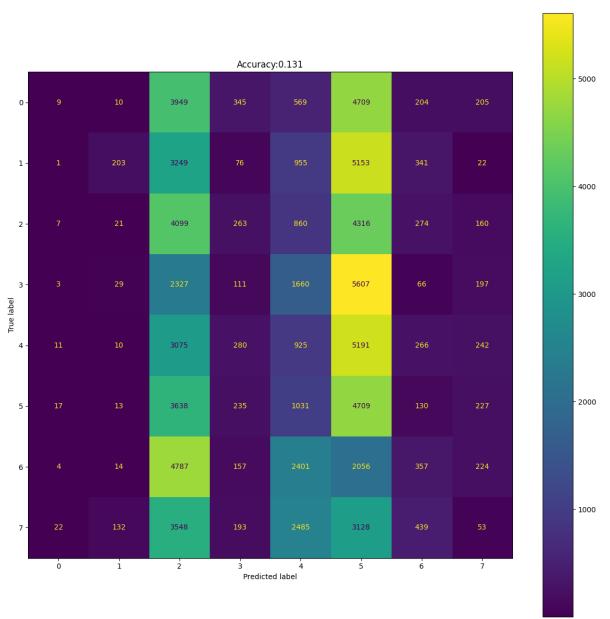


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

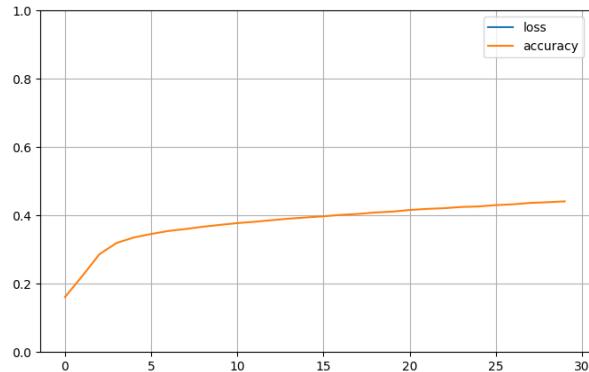


Device-30(iii)_model.h5

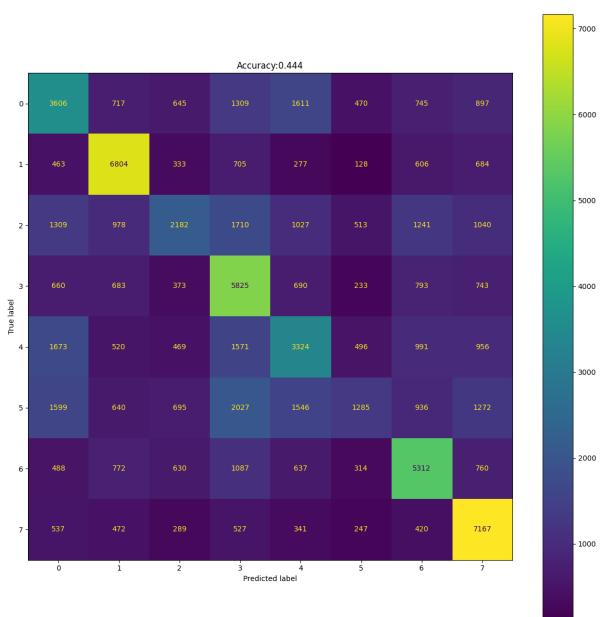
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

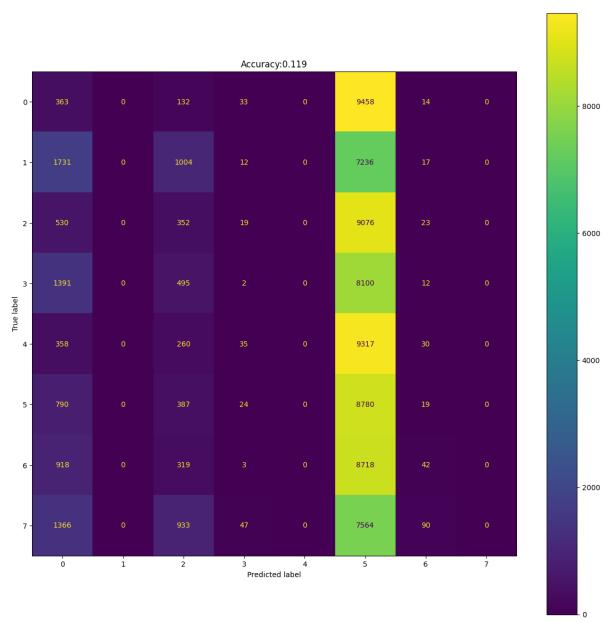


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

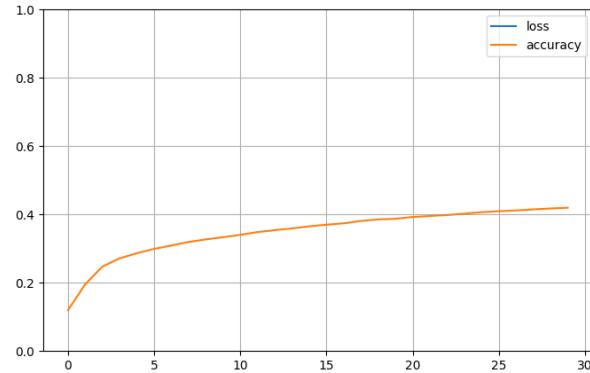


Device-30(iv)_model.h5

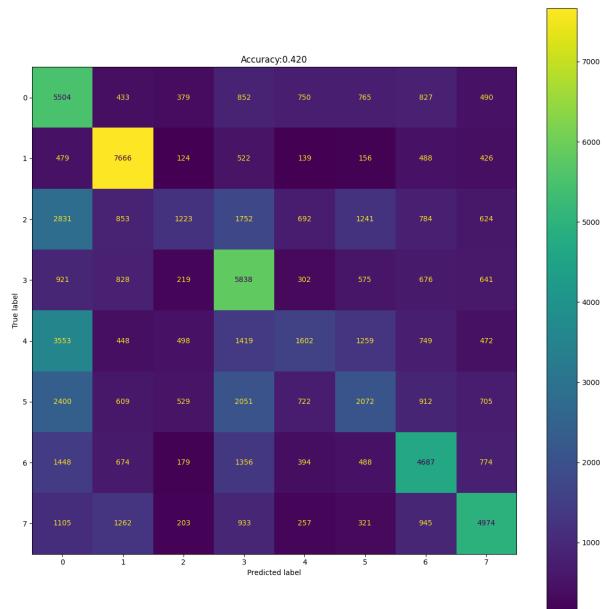
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

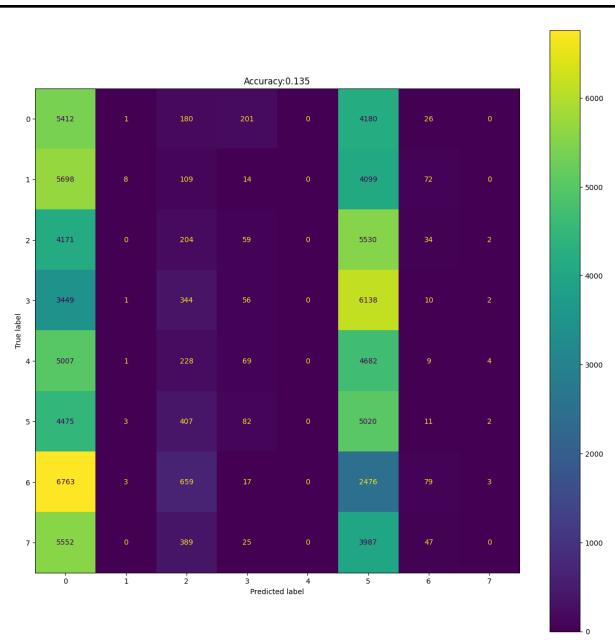


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model

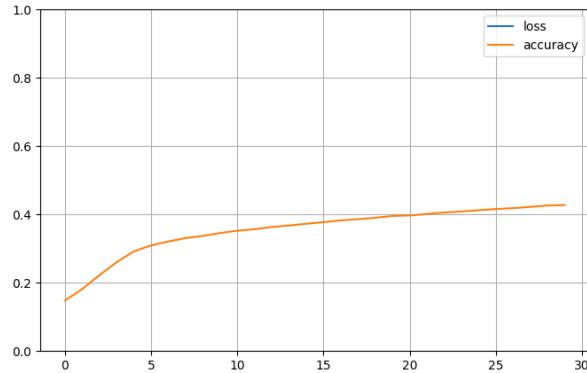


Device-30(v)_model.h5

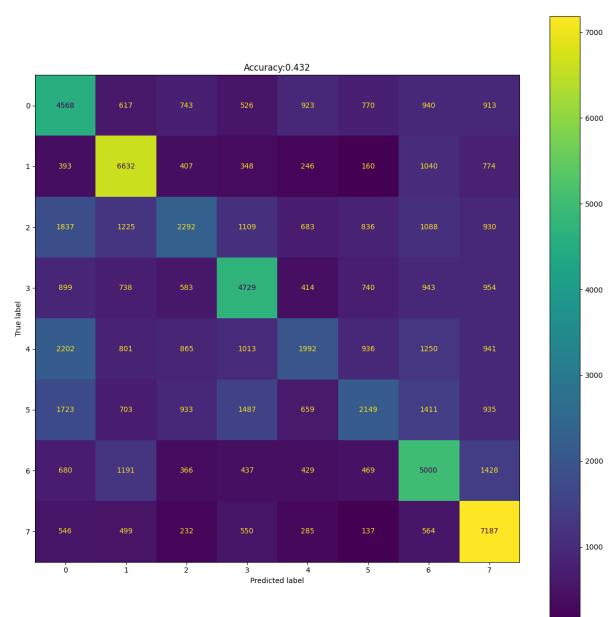
Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model



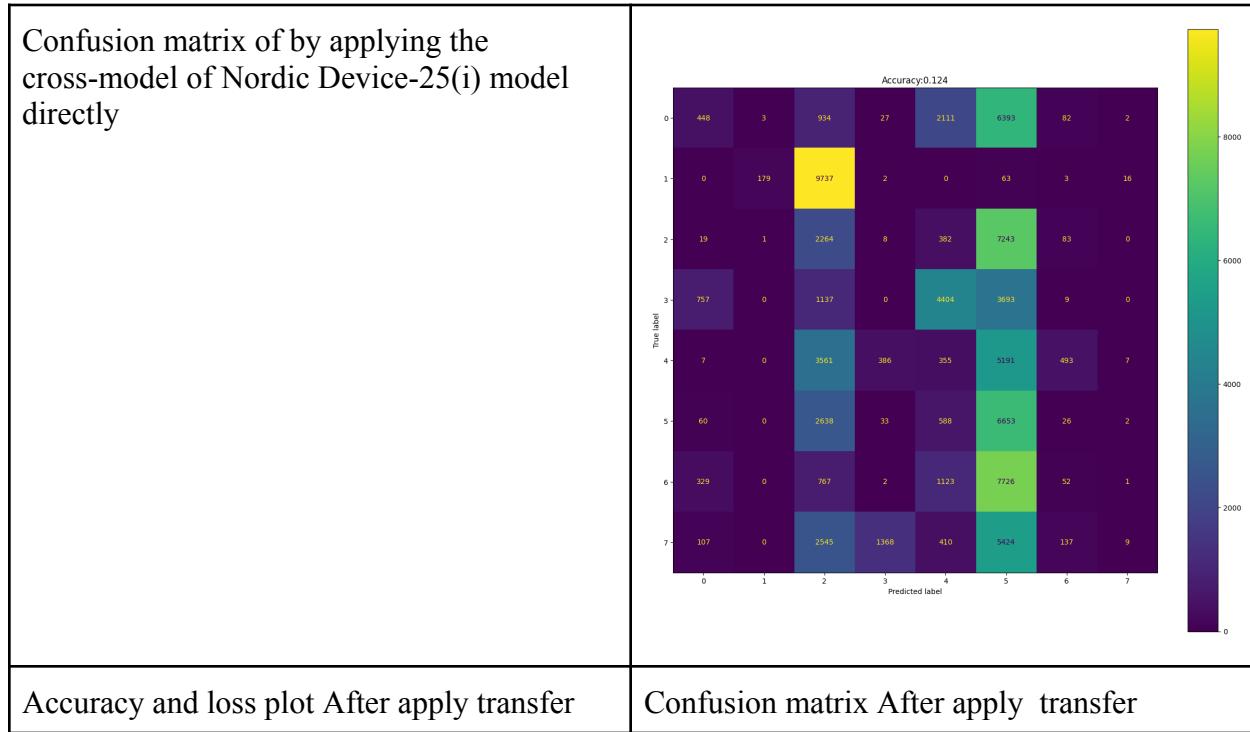
Confusion matrix After apply transfer learning on Nordic Device-30(v) model



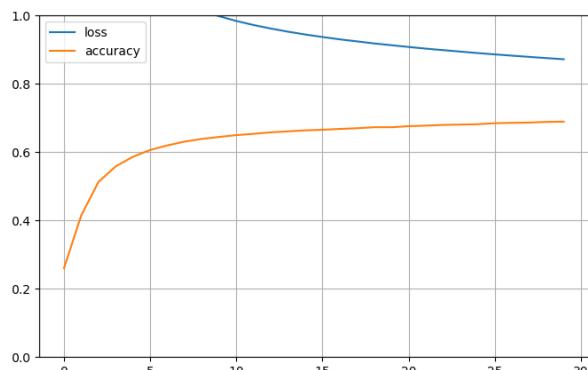
Nordic Device-30(i) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1245 | 0.6894 | 4m 9.2s | 0.6914 |
| Device-25(ii)_model.h5 | 0.1336 | 0.6760 | 4m 51.2s | 0.6758 |
| Device-25(iii)_model.h5 | 0.1654 | 0.5480 | 4m 58.3s | 0.5485 |
| Device-25(iv)_model.h5 | 0.1273 | 0.5273 | 5m 10.7s | 0.5337 |
| Device-25(v)_model.h5 | 0.1469 | 0.5474 | 5m 1.7s | 0.5493 |
| Device-30(ii)_model.h5 | 0.7990 | 0.9131 | 4m 34.2s | 0.9142 |
| Device-30(iii)_model.h5 | 0.1189 | 0.5998 | 5m 1.3s | 0.6032 |
| Device-30(iv)_model.h5 | 0.1952 | 0.6436 | 5m 1.8s | 0.6449 |
| Device-30(v)_model.h5 | 0.1514 | 0.6447 | 5m 2.1s | 0.6447 |

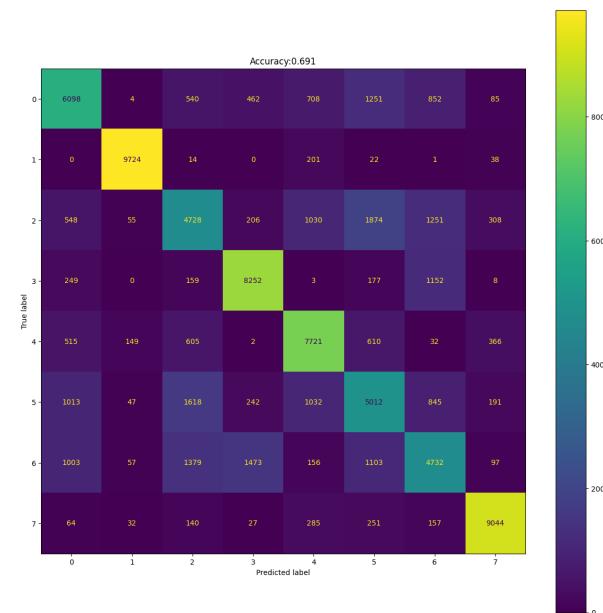
Device-25(i)_model.h5



learning on Nordic Device-25(i) model

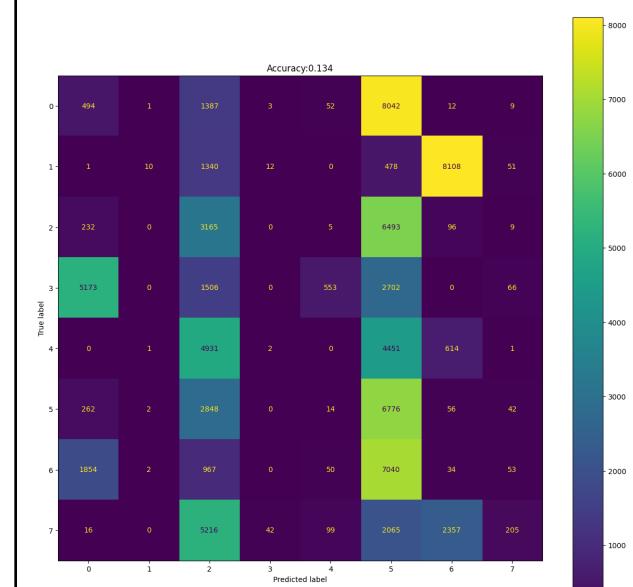


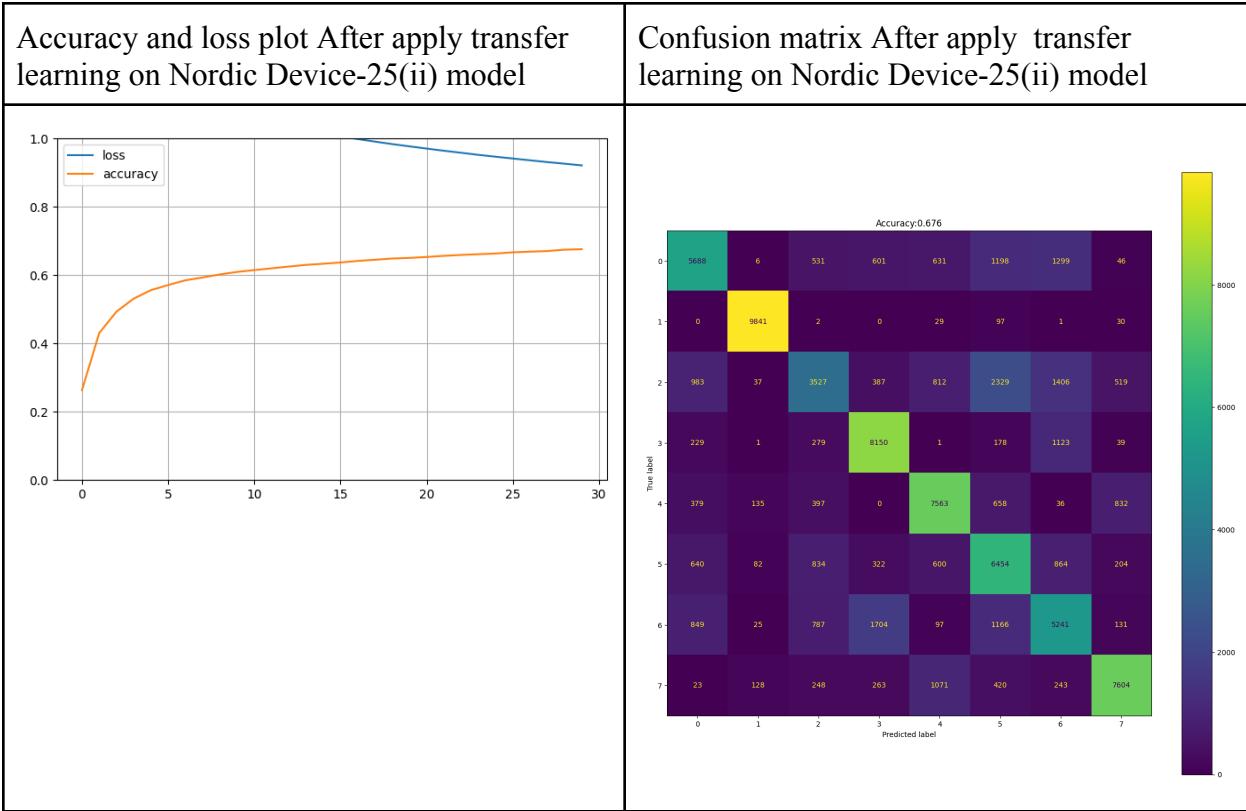
learning on Nordic Device-25(i) model



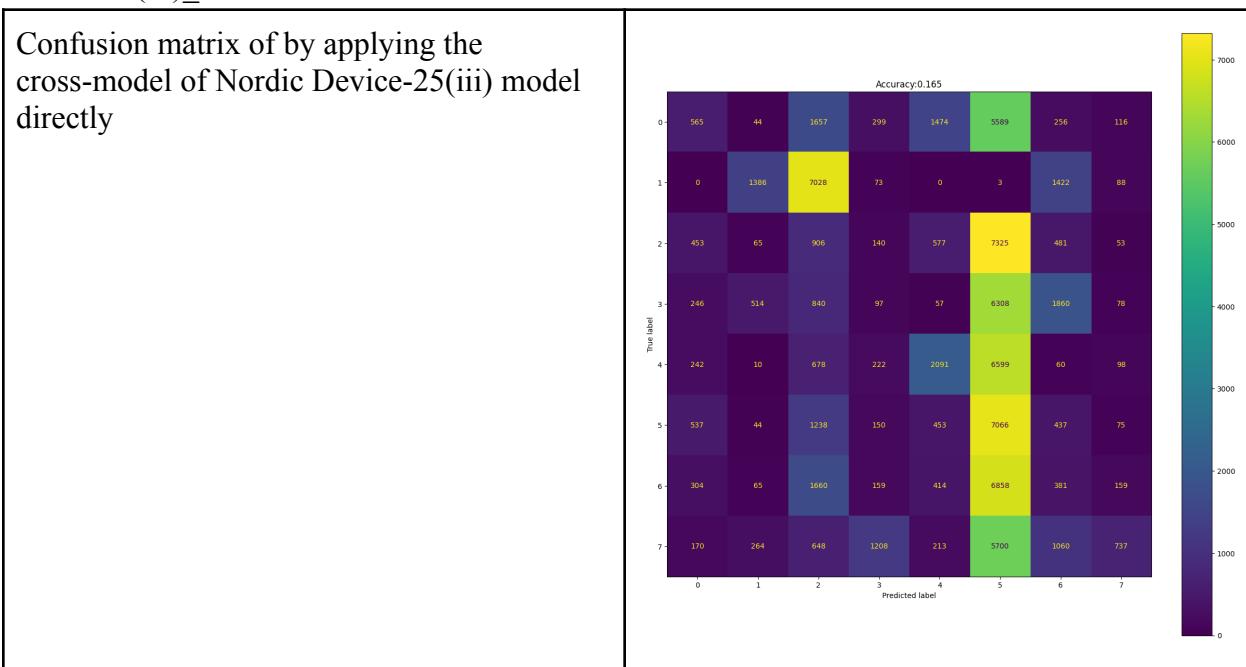
Device-25(ii)_model.h5

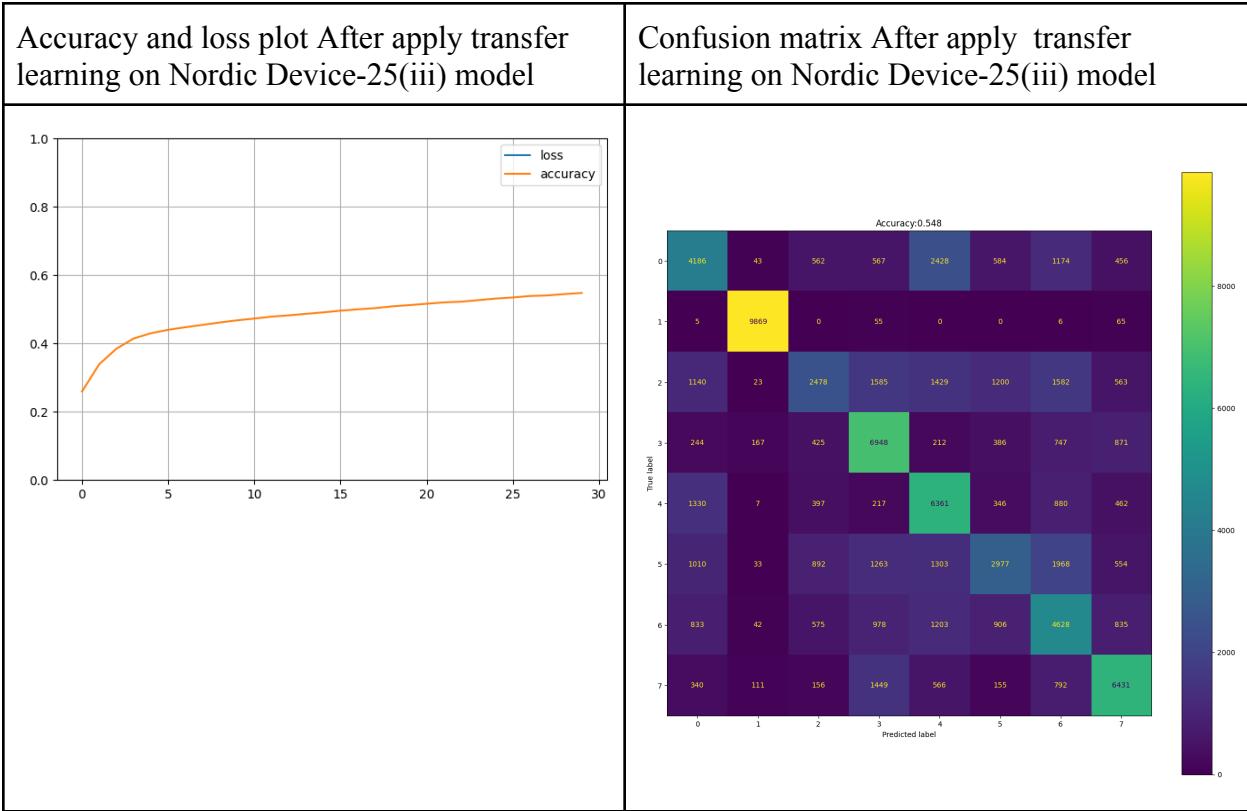
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



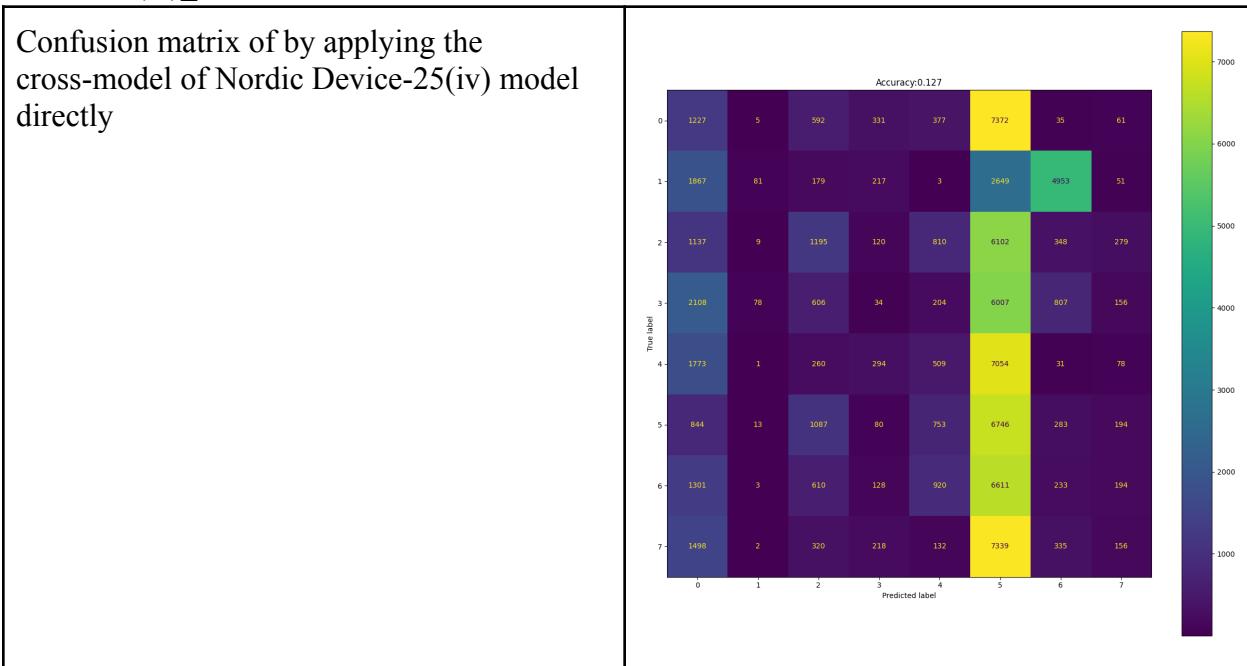


Device-25(iii)_model.h5

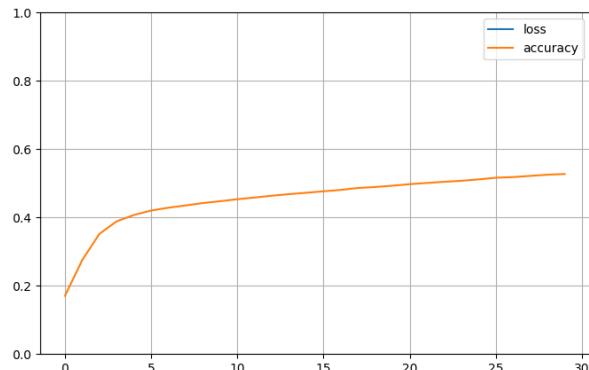




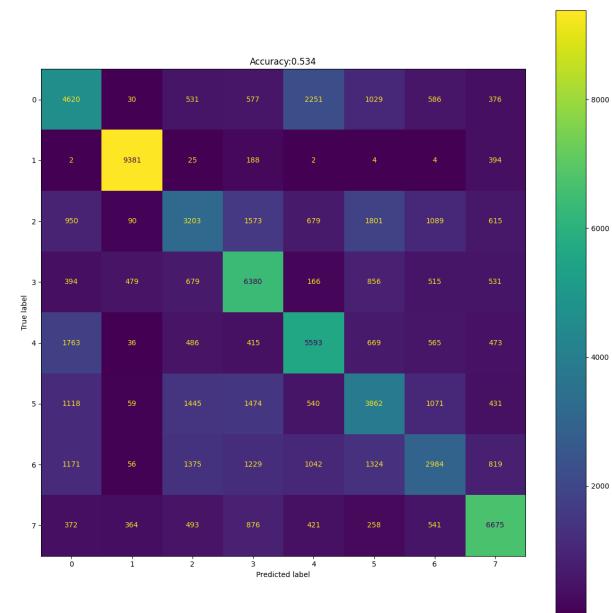
Device-25(iv)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

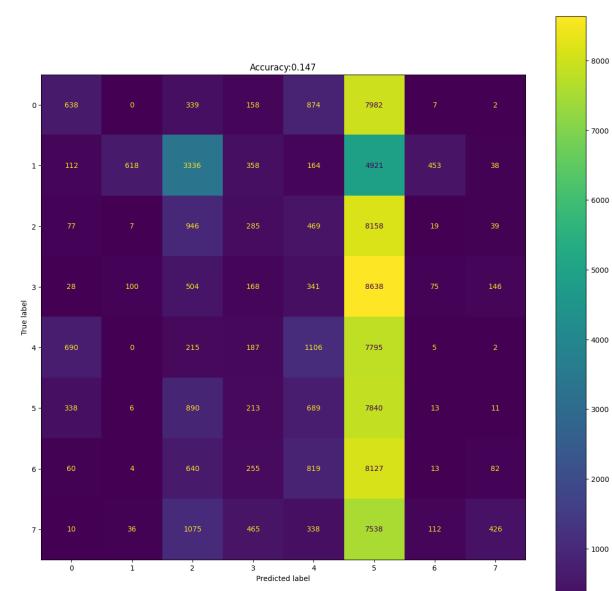


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

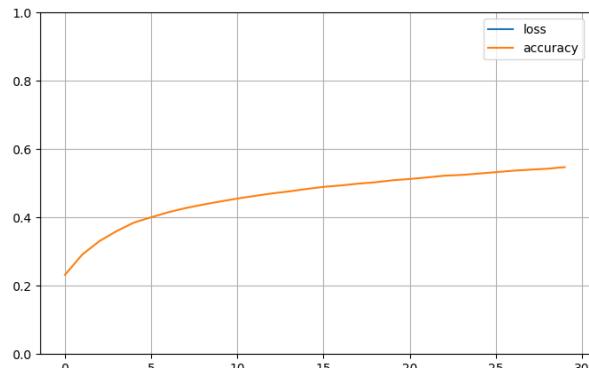


Device-25(v)_model.h5

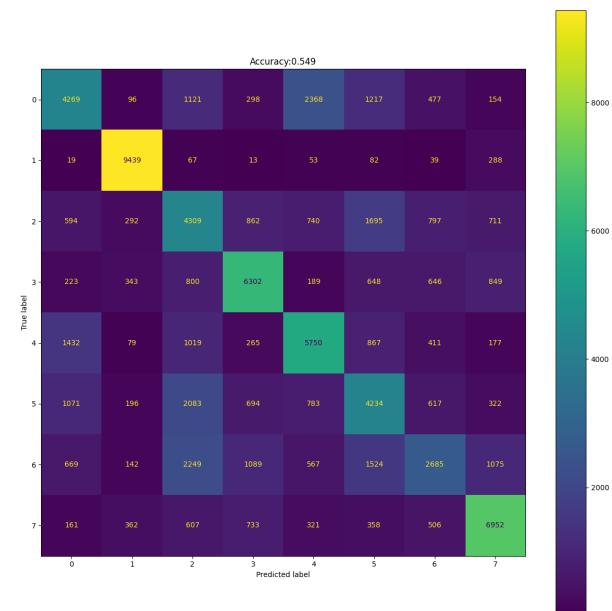
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

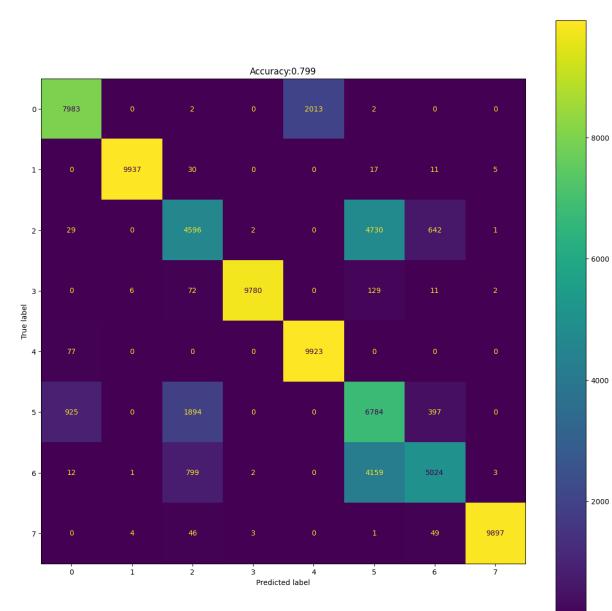


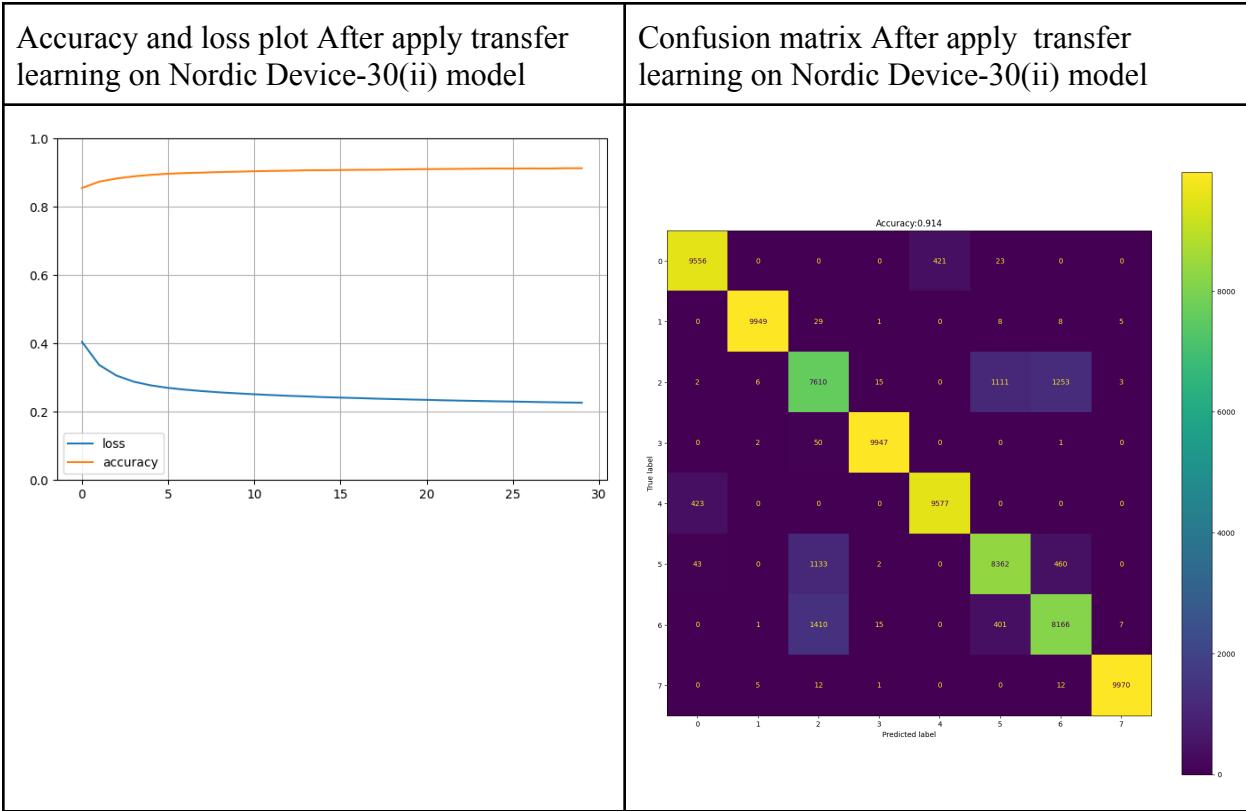
Confusion matrix After apply transfer learning on Nordic Device-25(v) model



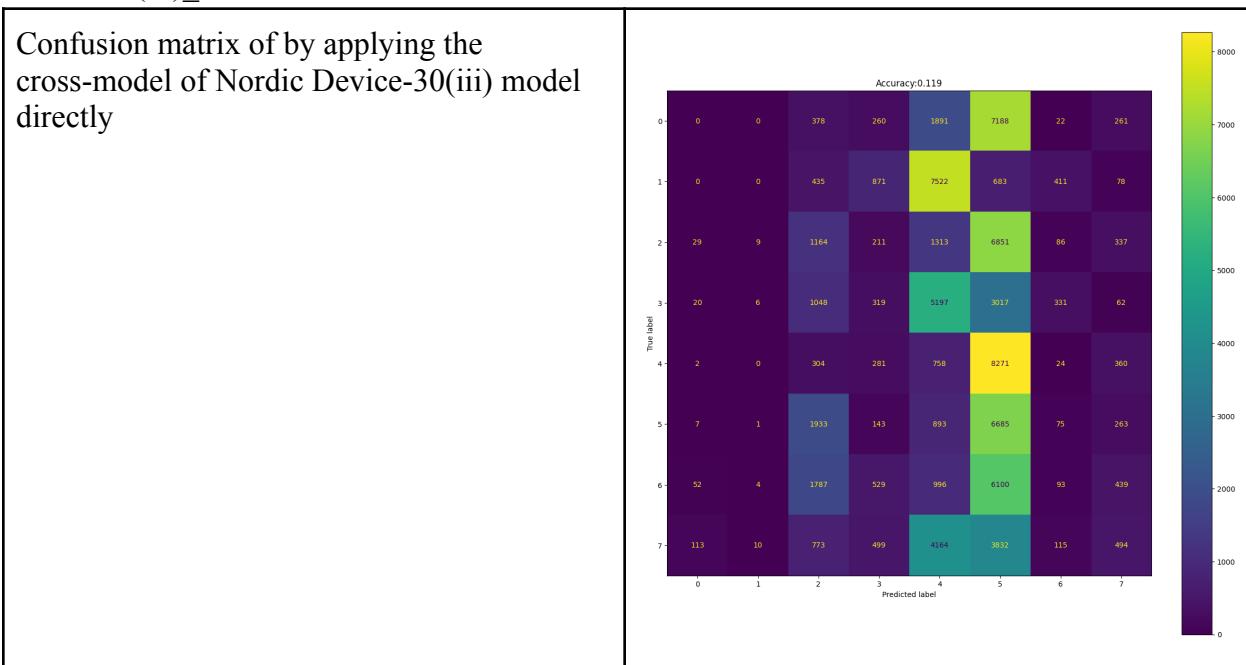
Device-30(ii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly

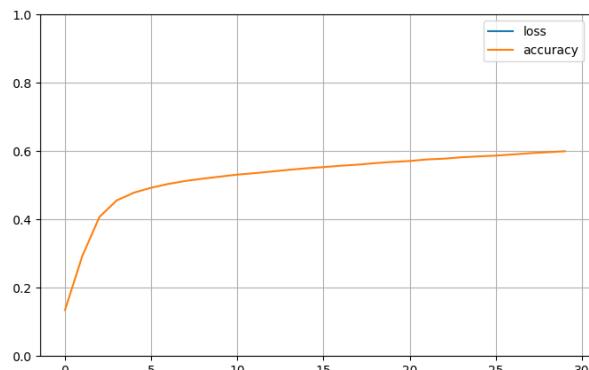




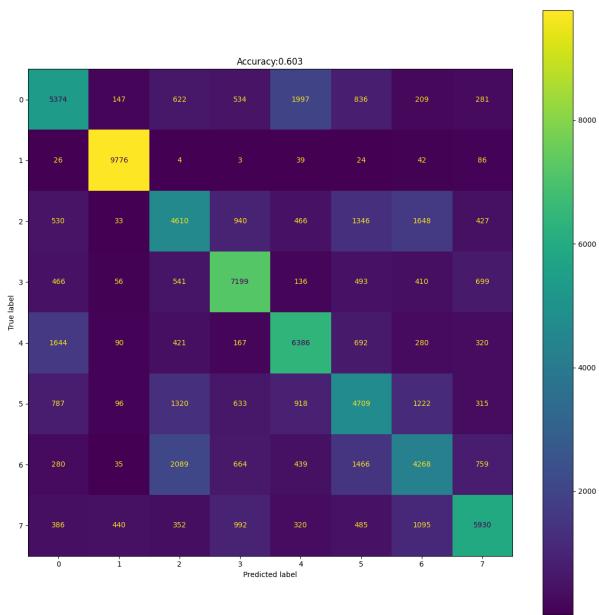
Device-30(iii)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

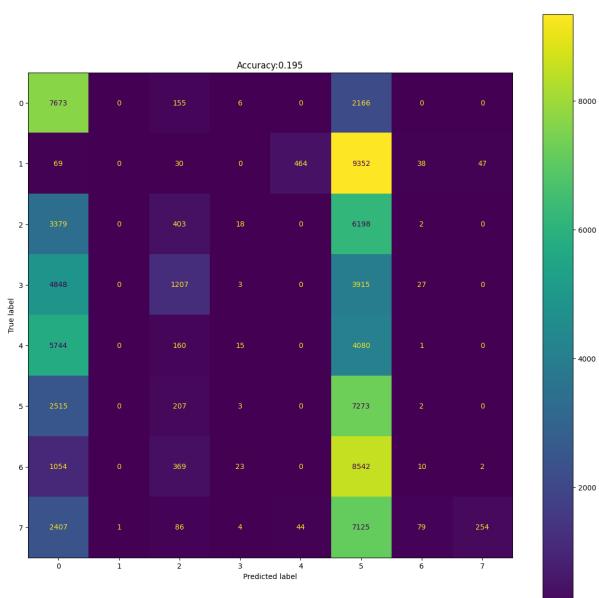


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

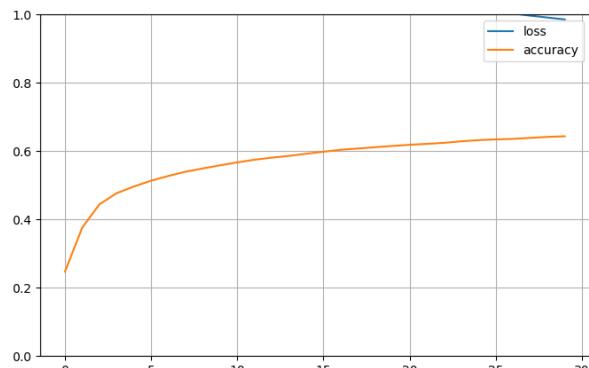


Device-30(iv)_model.h5

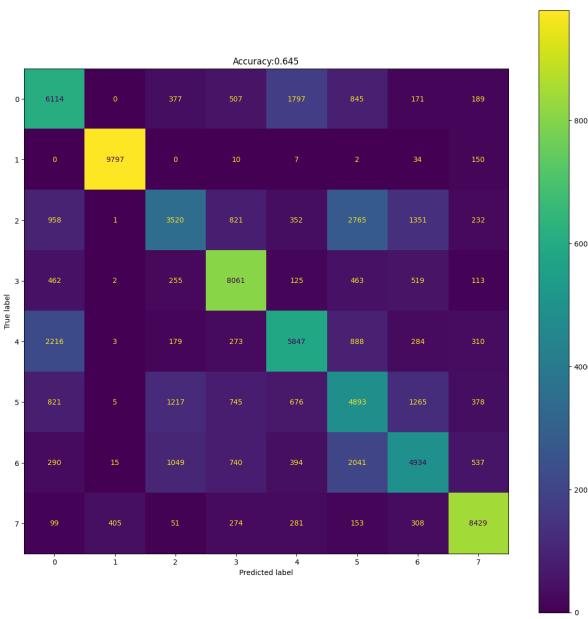
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

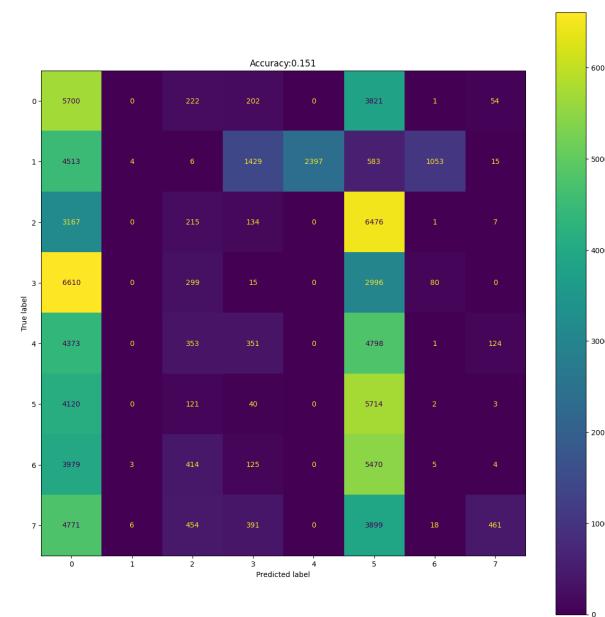


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model



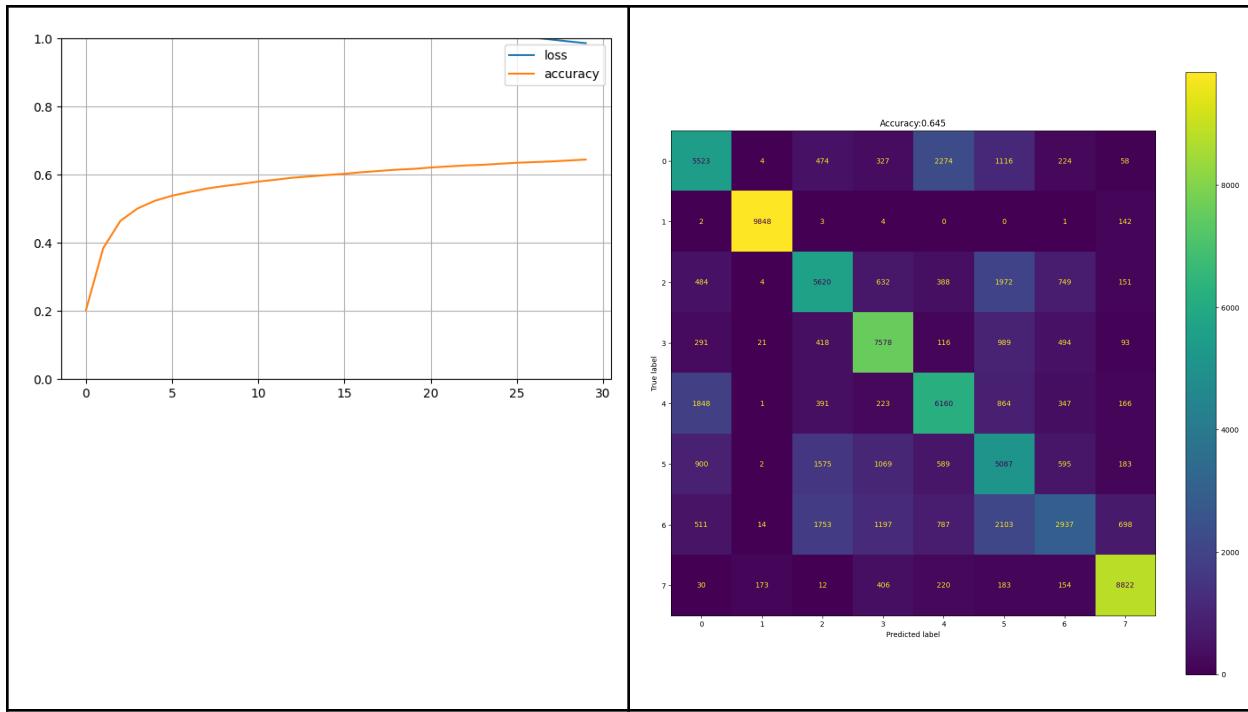
Device-30(v)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model

Confusion matrix After apply transfer learning on Nordic Device-30(v) model

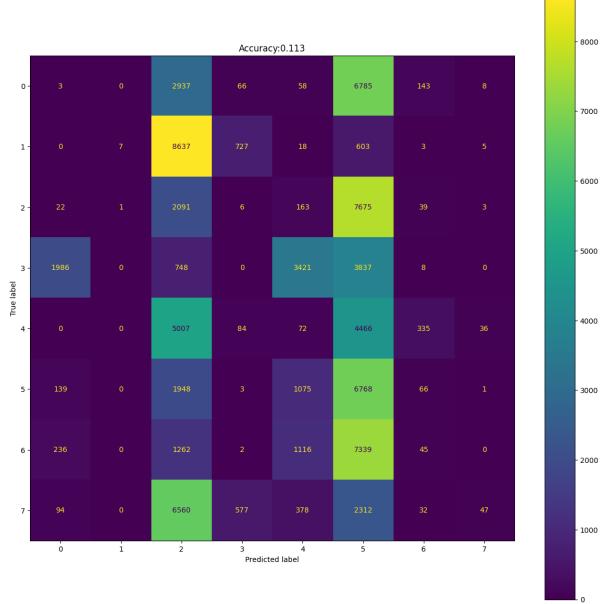


Nordic Device-30(ii) dataset

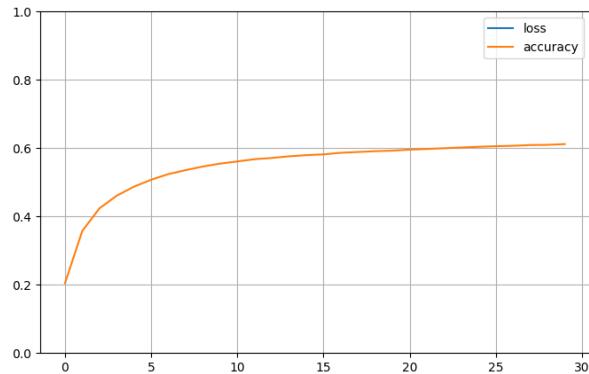
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1129 | 0.6120 | 4m 30.9s | 0.6130 |
| Device-25(ii)_model.h5 | 0.1226 | 0.6226 | 4m 35.7s | 0.6257 |
| Device-25(iii)_model.h5 | 0.1612 | 0.5262 | 4m 49.9s | 0.5252 |
| Device-25(iv)_model.h5 | 0.1296 | 0.4994 | 5m 5.7s | 0.5017 |
| Device-25(v)_model.h5 | 0.1519 | 0.5295 | 4m 57.2s | 0.5255 |
| Device-30(i)_model.h5 | 0.7495 | 0.8641 | 4m 47.4s | 0.8655 |
| Device-30(iii)_model.h5 | 0.1408 | 0.5702 | 4m 46.2s | 0.5767 |
| Device-30(iv)_model.h5 | 0.1342 | 0.6086 | 4m 57.9s | 0.6094 |
| Device-30(v)_model.h5 | 0.1364 | 0.5898 | 5m 2.2s | 0.5902 |

Device-25(i)_model.h5

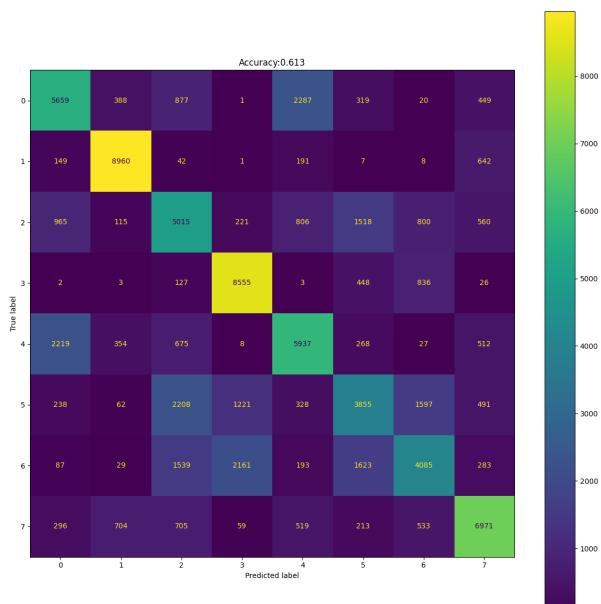
Confusion matrix of by applying the cross-model of Nordic Device-25(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

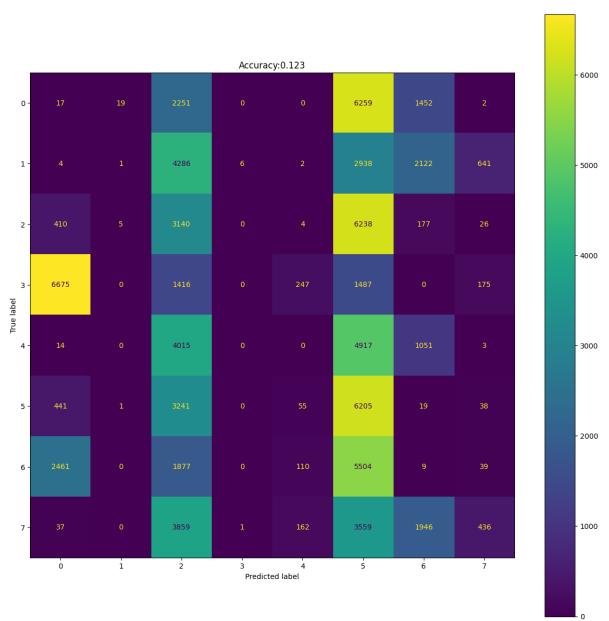


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

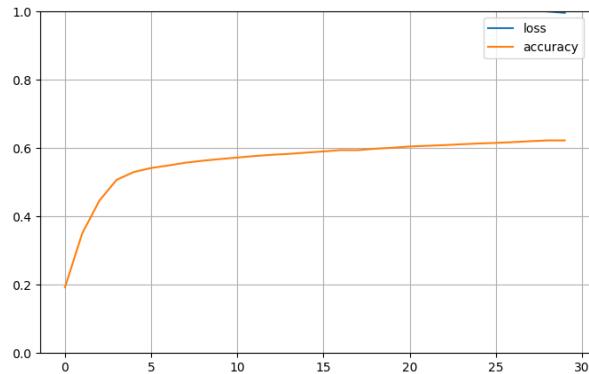


Device-25(ii)_model.h5

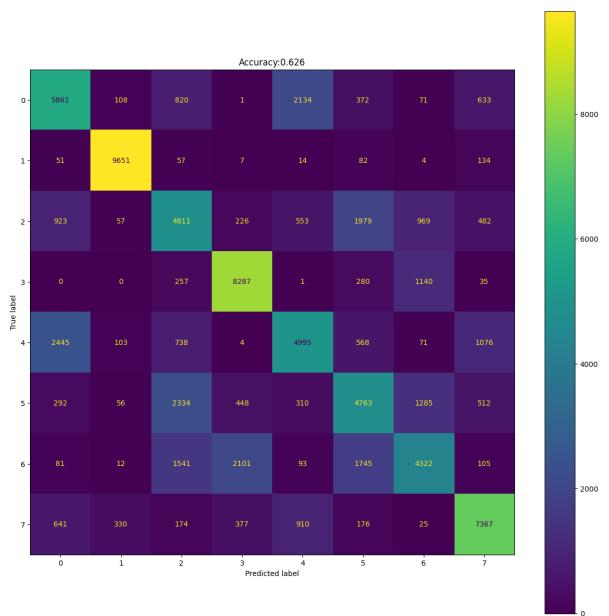
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

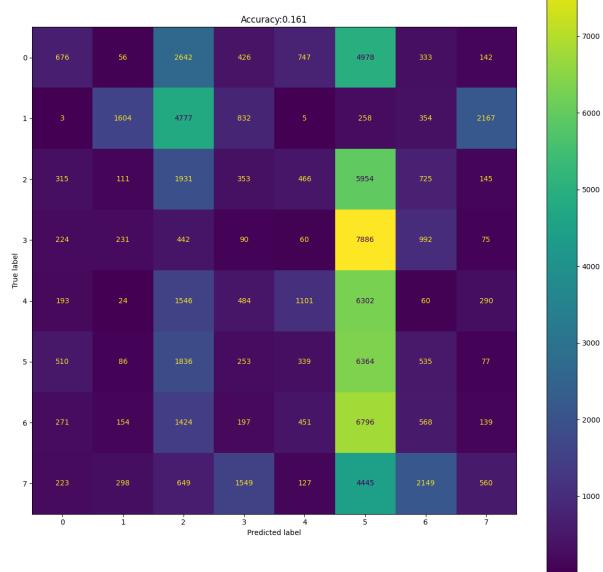


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

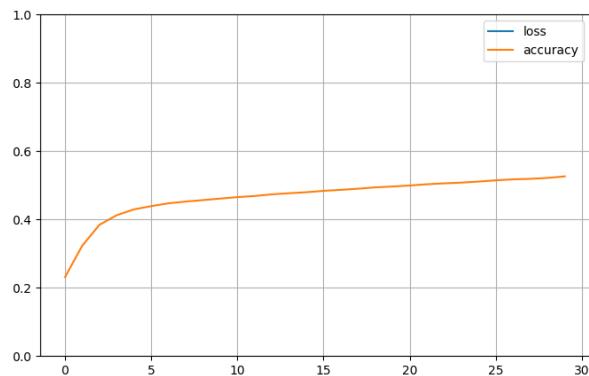


Device-25(iii)_model.h5

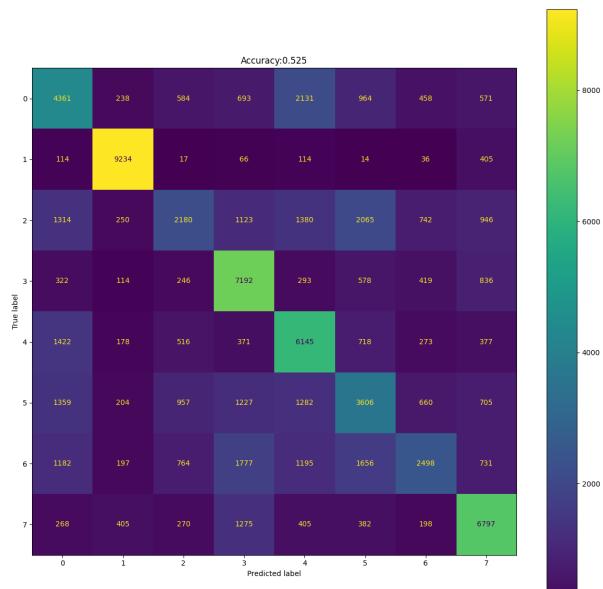
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

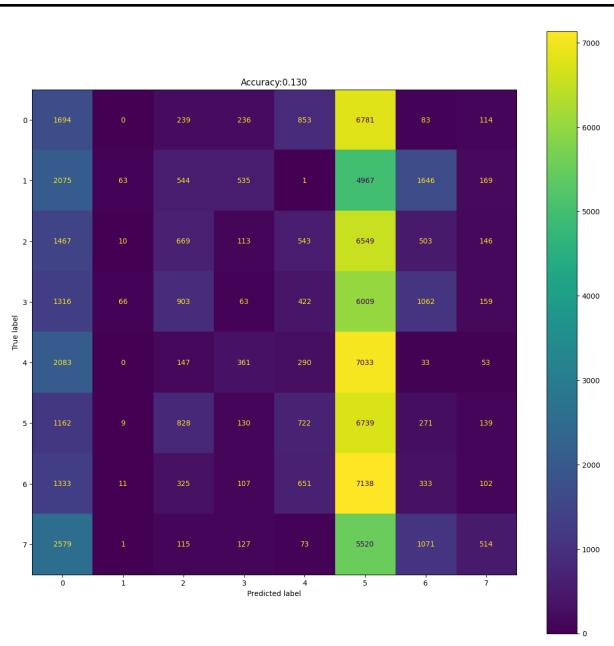


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

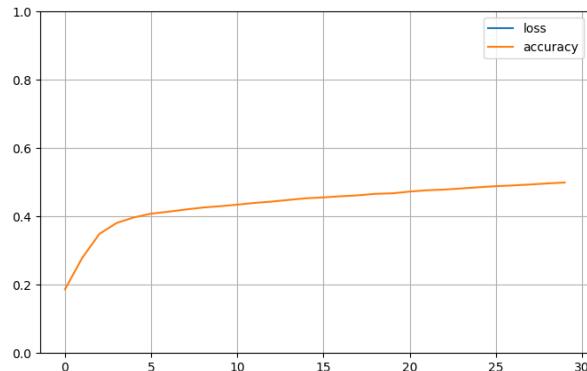


Device-25(iv)_model.h5

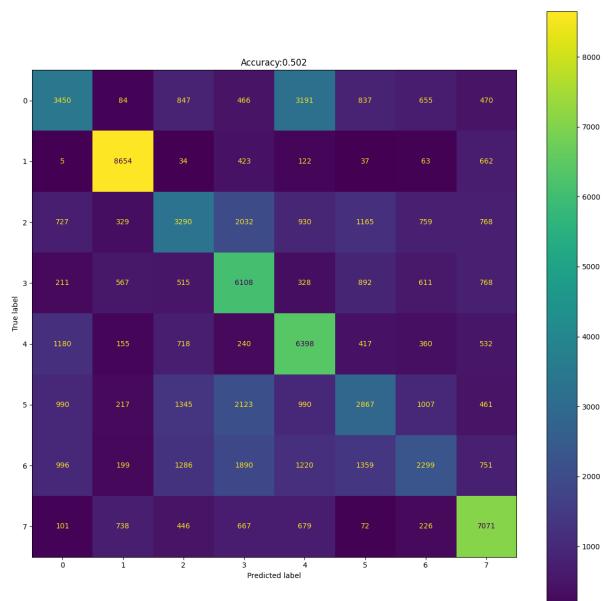
Confusion matrix of by applying the cross-model of Nordic Device-25(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

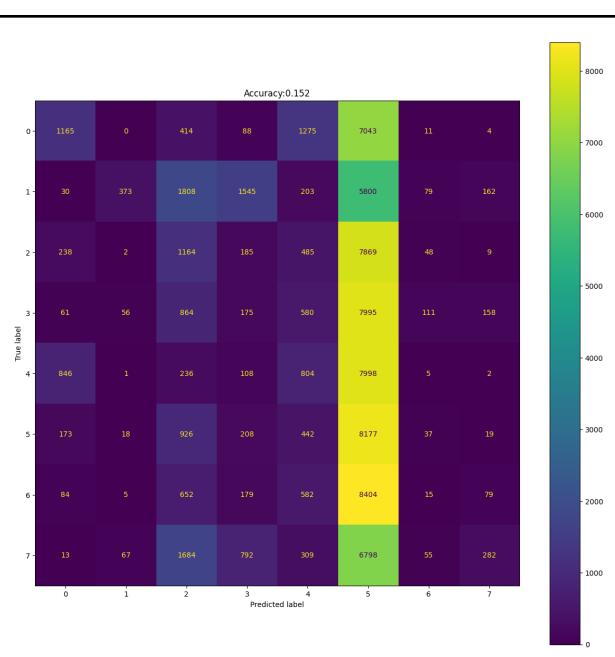


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

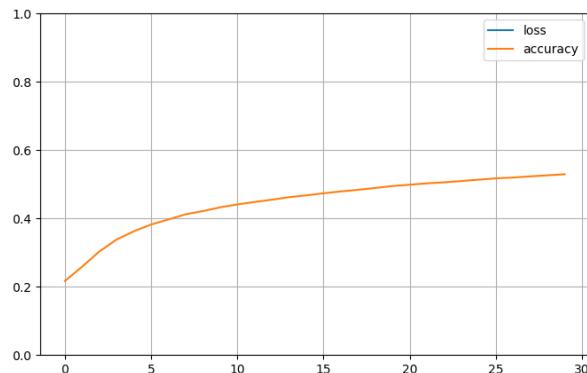


Device-25(v)_model.h5

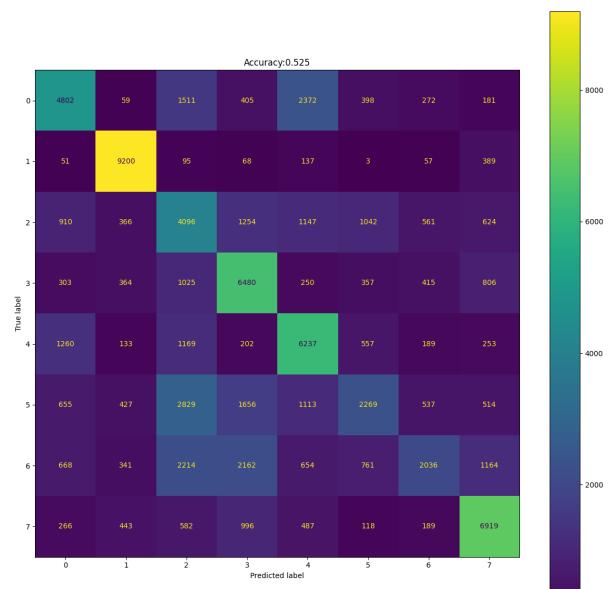
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

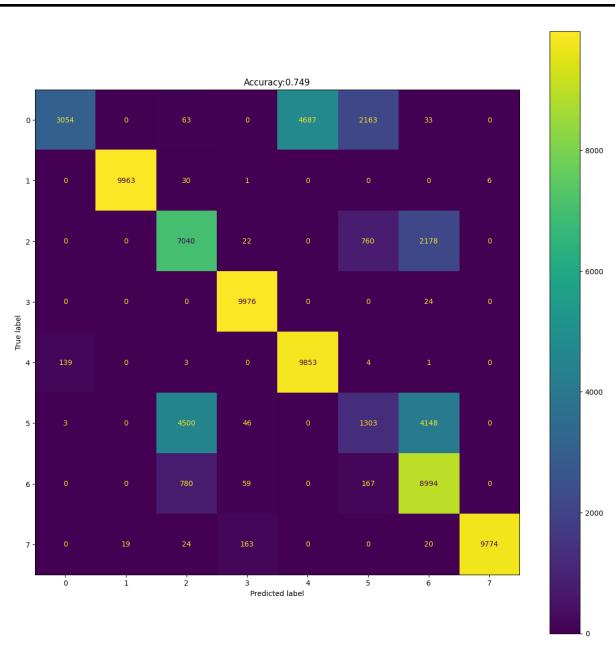


Confusion matrix After apply transfer learning on Nordic Device-25(v) model

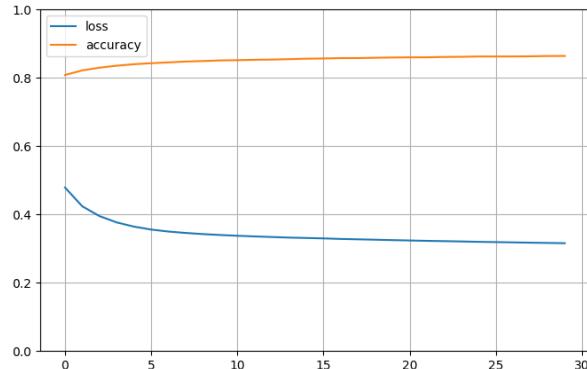


Device-30(i)_model.h5

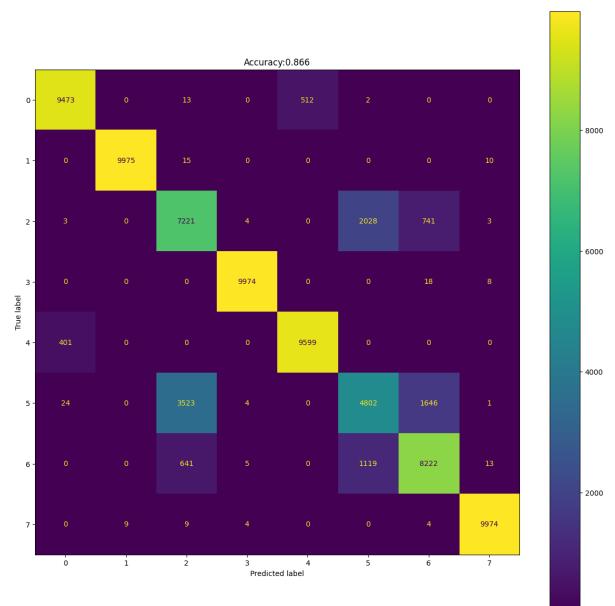
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

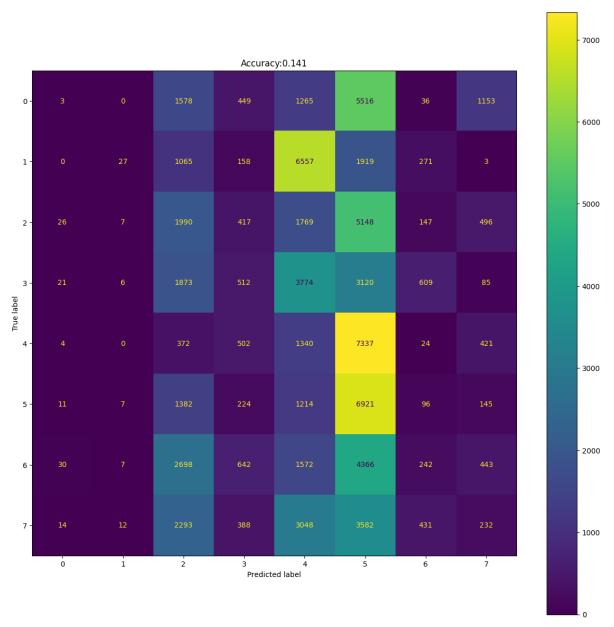


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

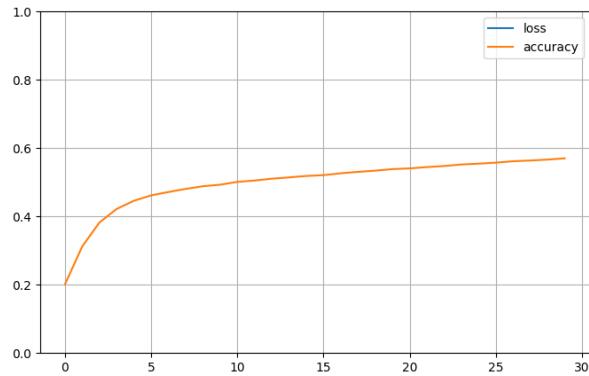


Device-30(iii)_model.h5

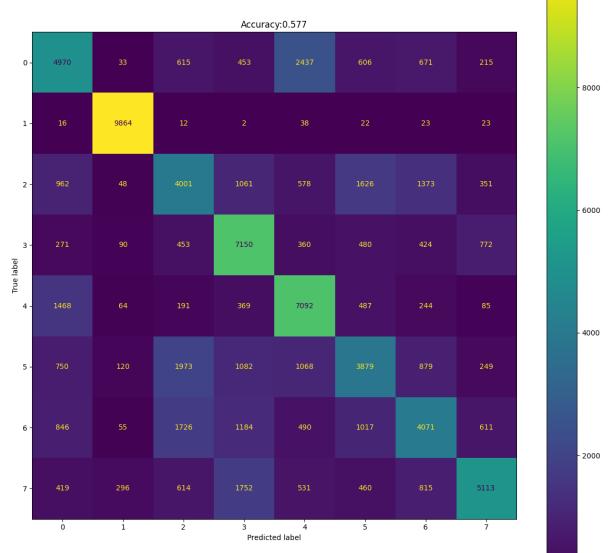
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

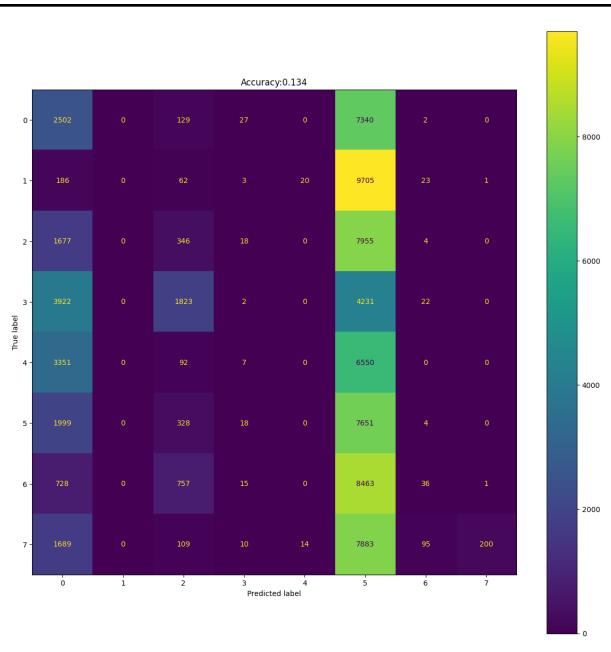


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

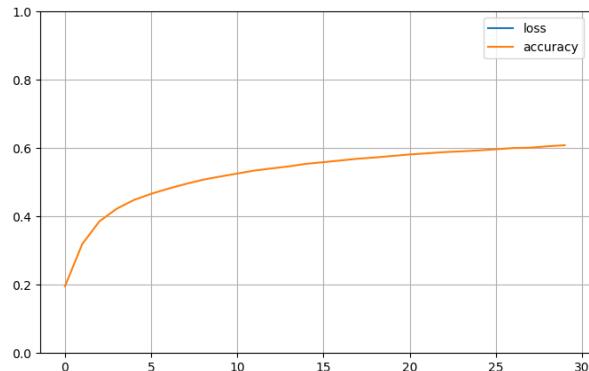


Device-30(iv)_model.h5

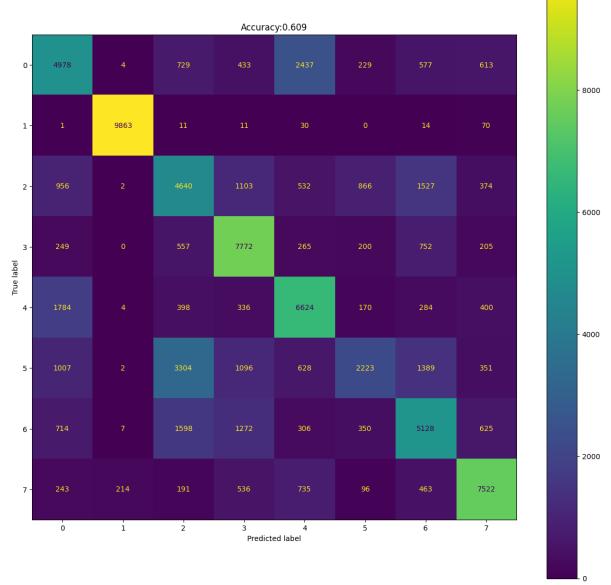
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

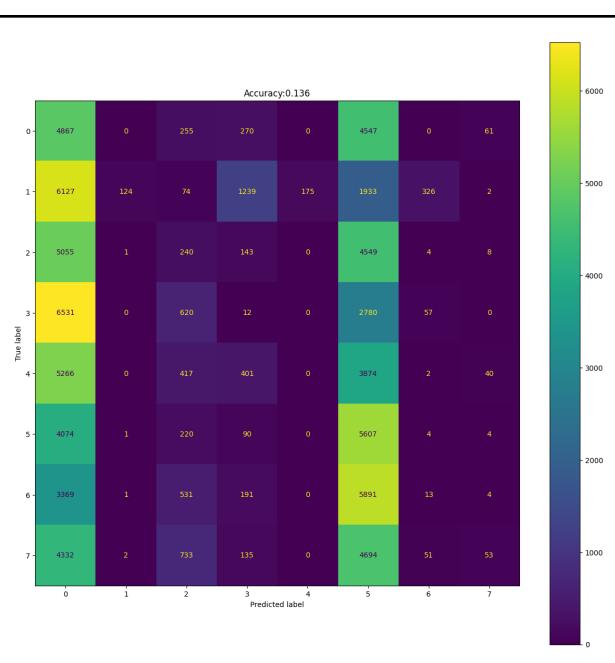


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model

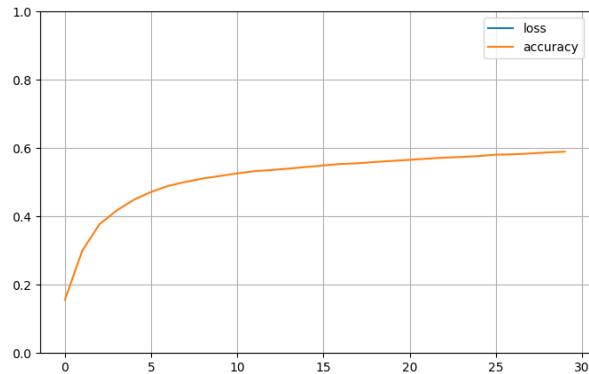


Device-30(v)_model.h5

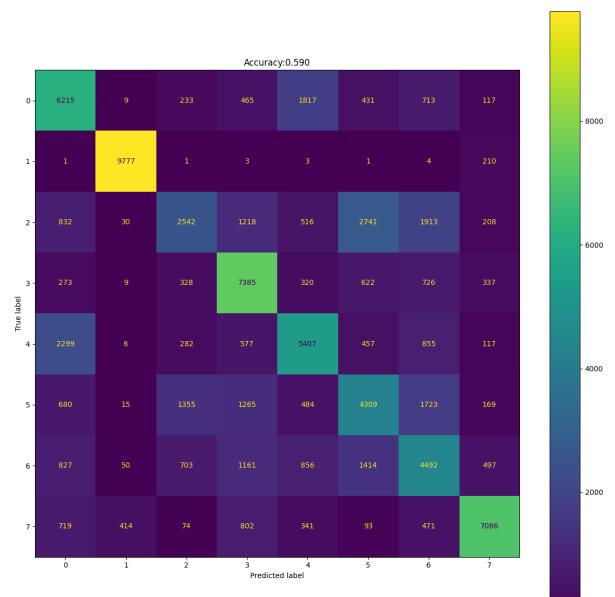
Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model



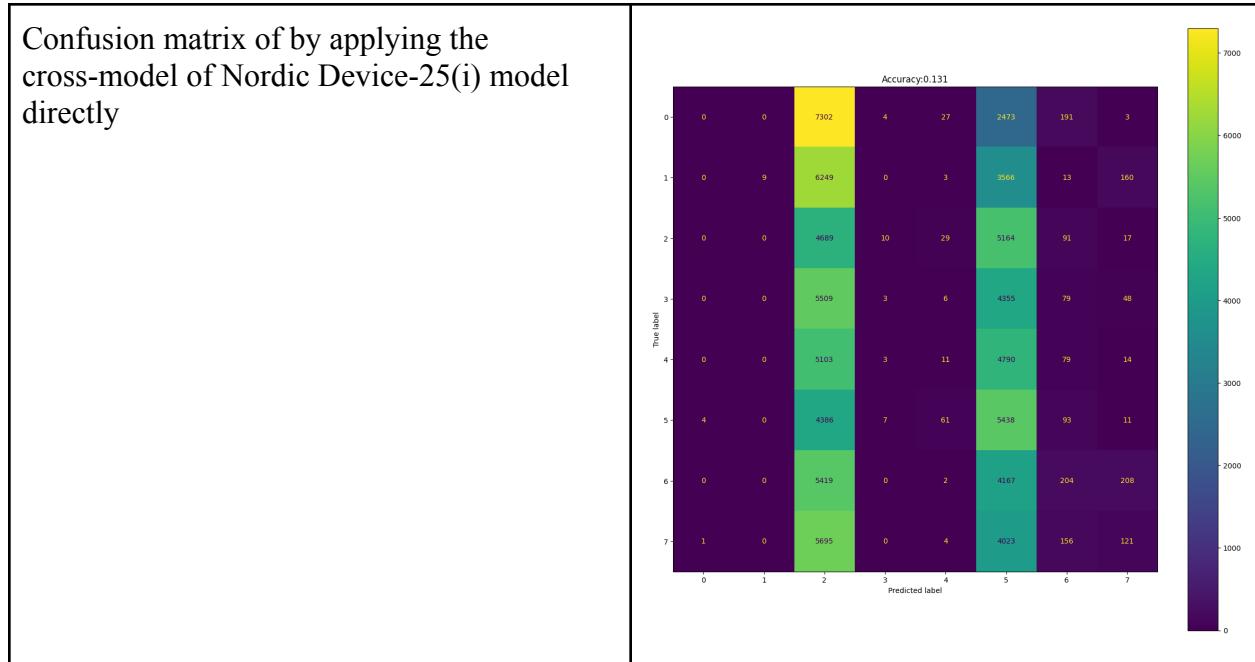
Confusion matrix After apply transfer learning on Nordic Device-30(v) model



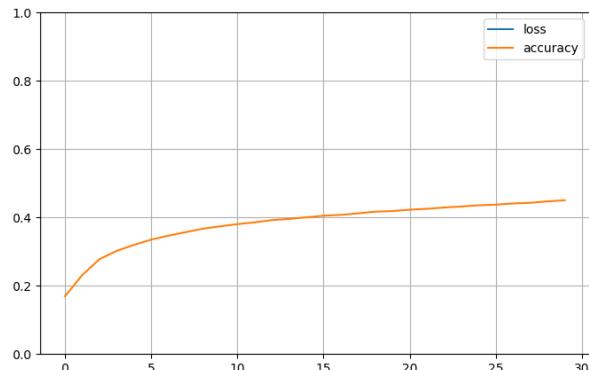
Nordic Device-30(iii) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1309 | 0.4505 | 6m 48.6s | 0.4542 |
| Device-25(ii)_model.h5 | 0.1187 | 0.4814 | 6m 13.9s | 0.4837 |
| Device-25(iii)_model.h5 | 0.1302 | 0.4614 | 5m 19.2s | 0.4604 |
| Device-25(iv)_model.h5 | 0.1340 | 0.4387 | 6m 0.9s | 0.4363 |
| Device-25(v)_model.h5 | 0.1259 | 0.4965 | 6m 17.3s | 0.4954 |
| Device-30(i)_model.h5 | 0.1194 | 0.5224 | 7m 44.5s | 0.5252 |
| Device-30(ii)_model.h5 | 0.1503 | 0.4897 | 6m 30.8s | 0.4893 |
| Device-30(iv)_model.h5 | 0.5894 | 0.7702 | 6m 22.5s | 0.7719 |
| Device-30(v)_model.h5 | 0.5556 | 0.7513 | 6m 33.5s | 0.7521 |

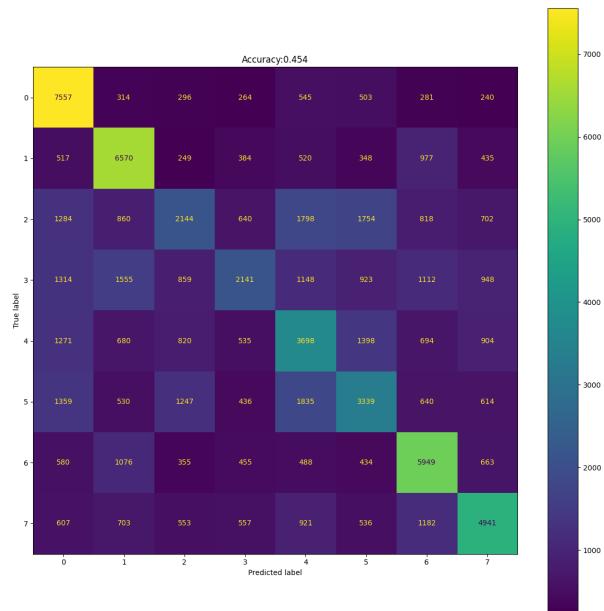
Device-25(i)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

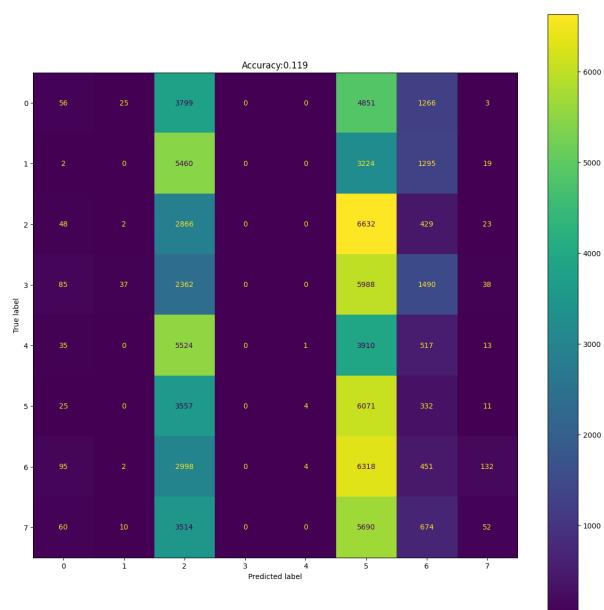


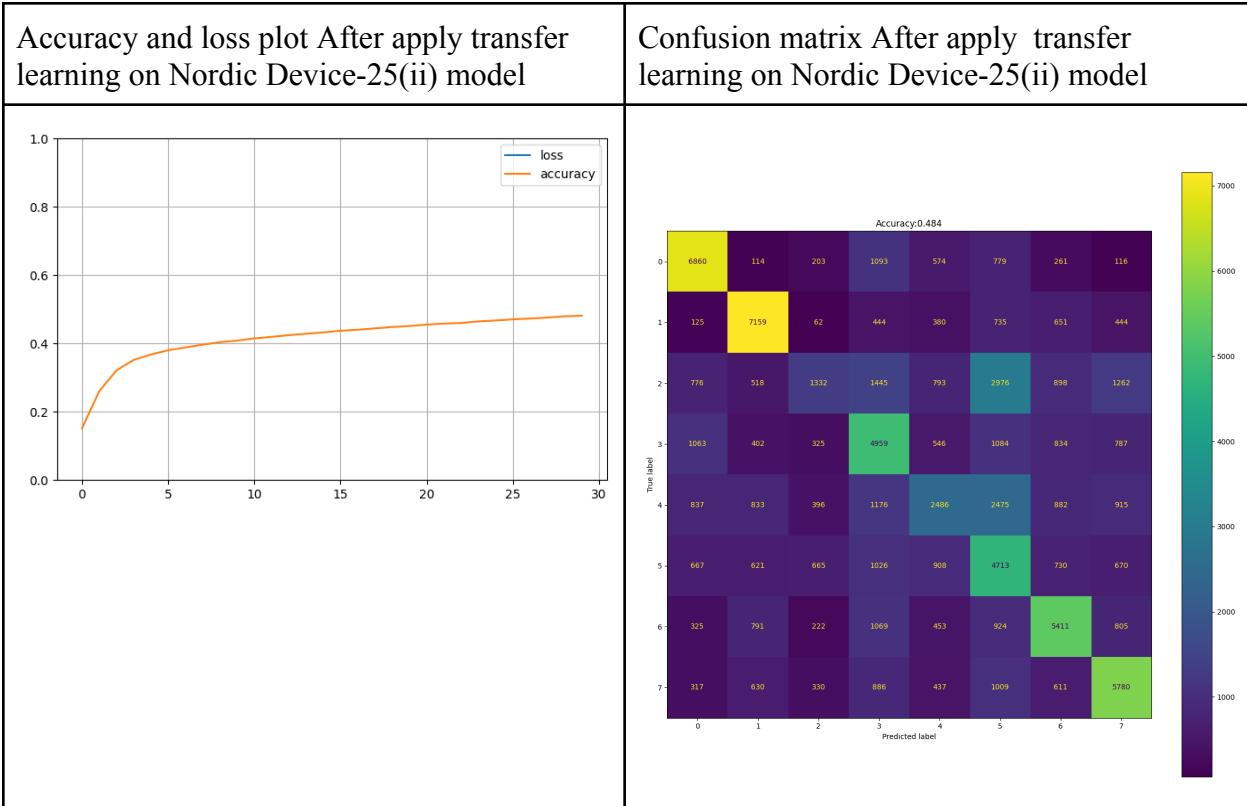
Confusion matrix After apply transfer learning on Nordic Device-25(i) model



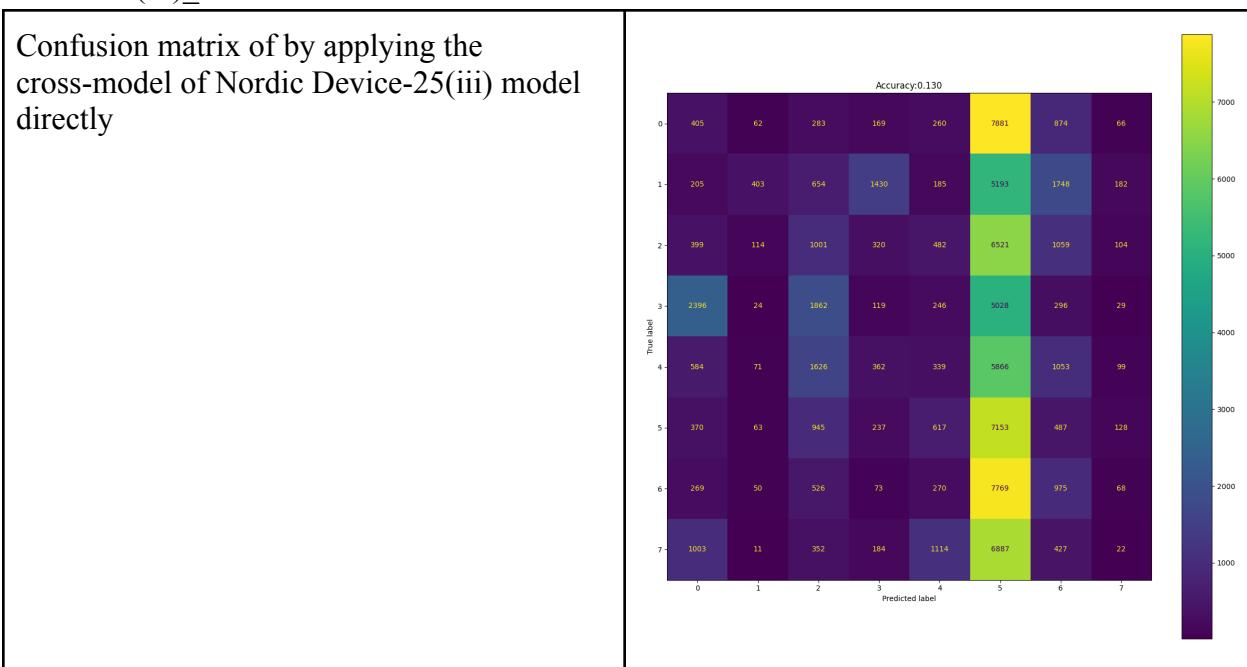
Device-25(ii)_model.h5

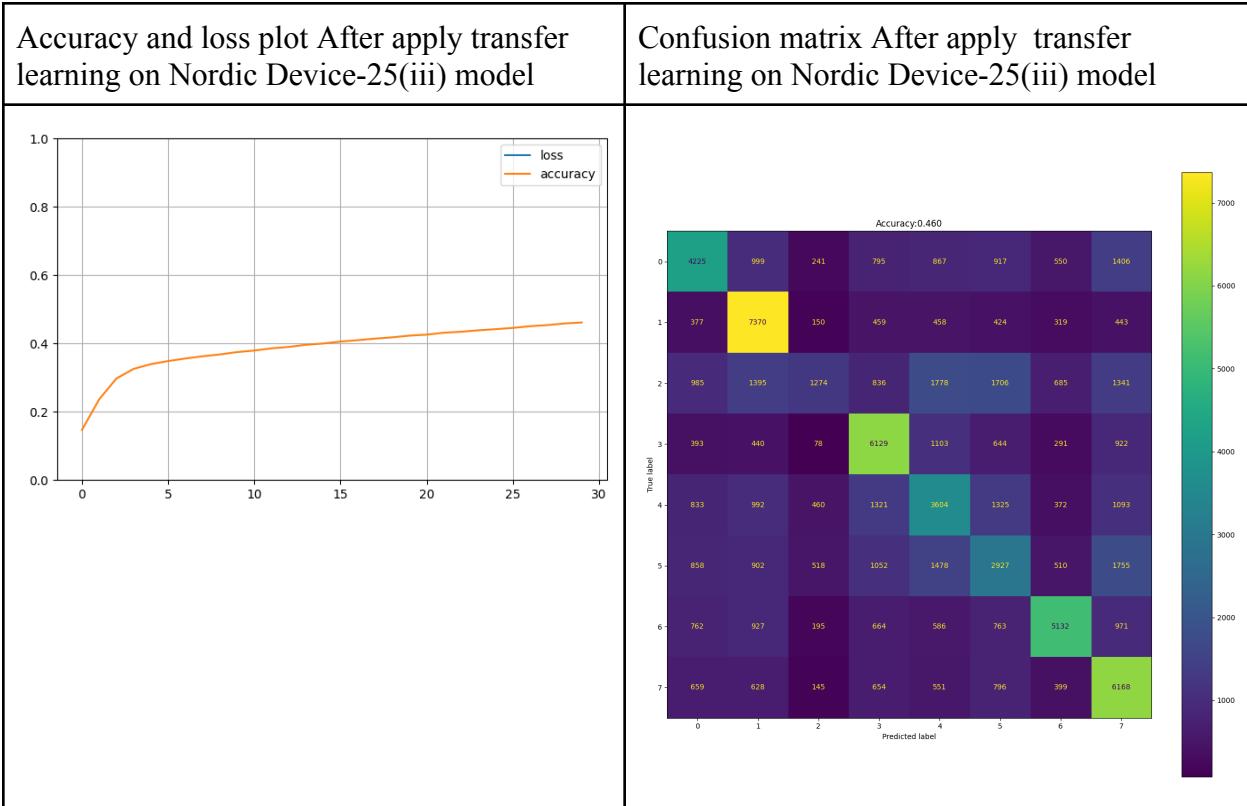
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



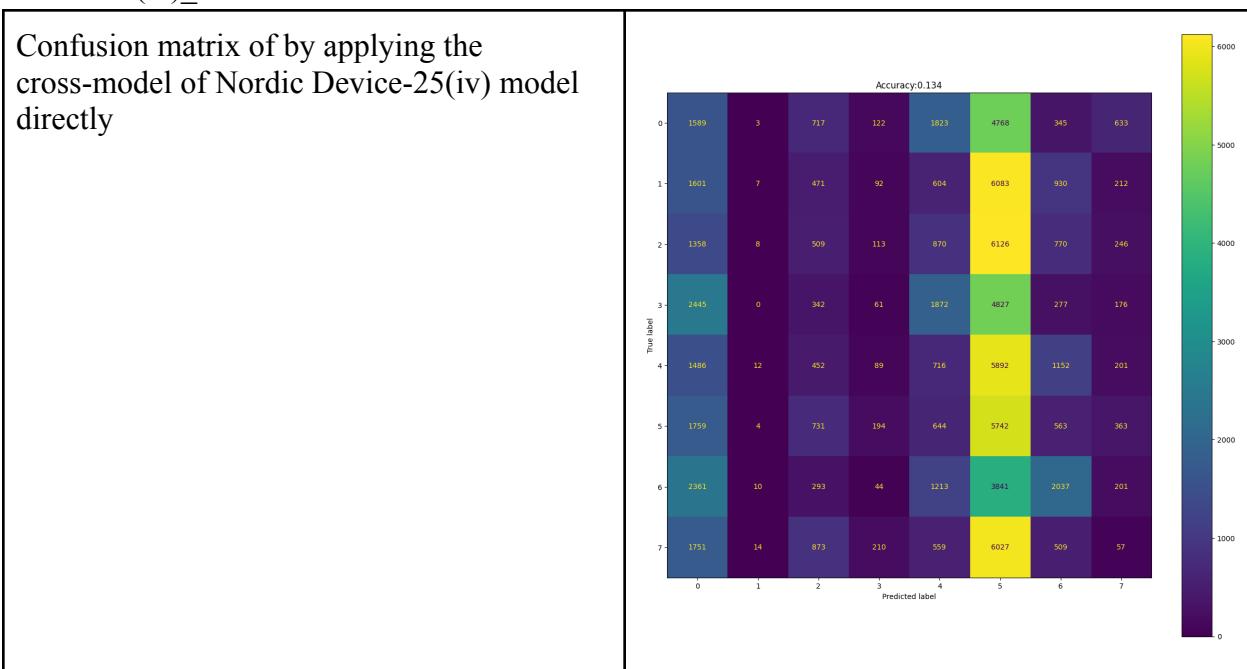


Device-25(iii)_model.h5

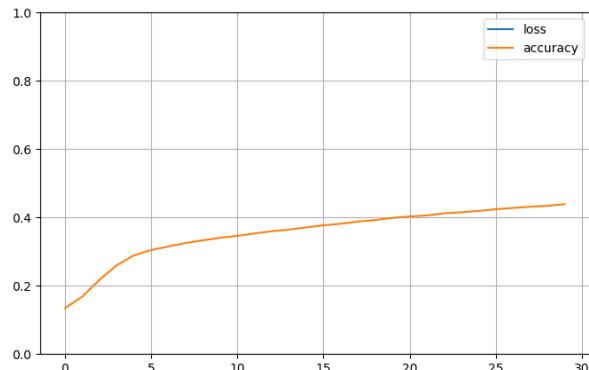




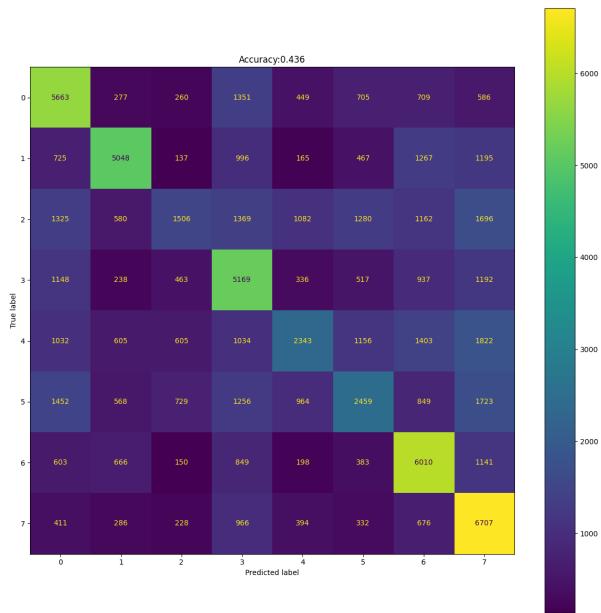
Device-25(iv)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

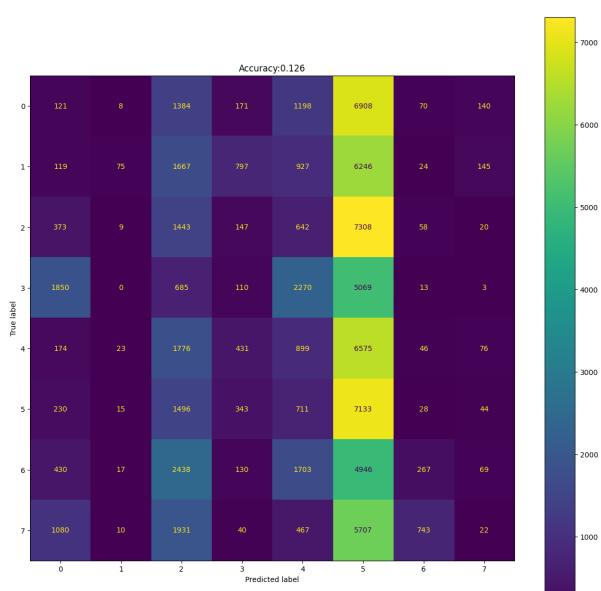


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

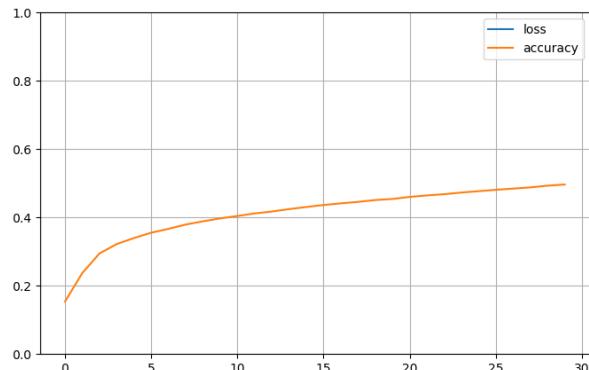


Device-25(v)_model.h5

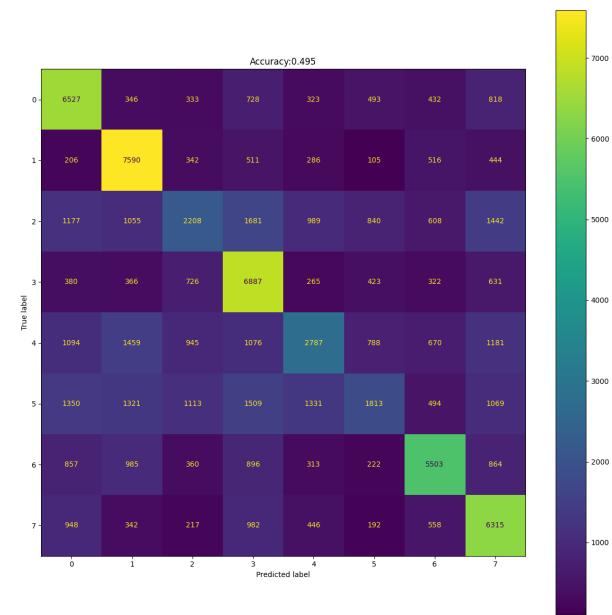
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

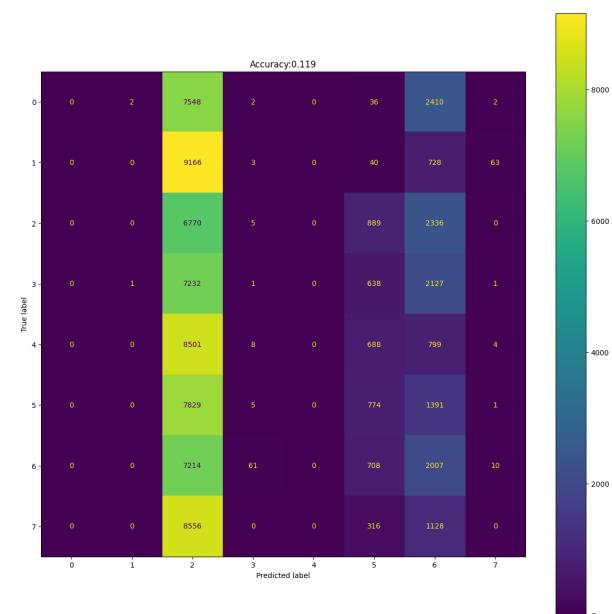


Confusion matrix After apply transfer learning on Nordic Device-25(v) model

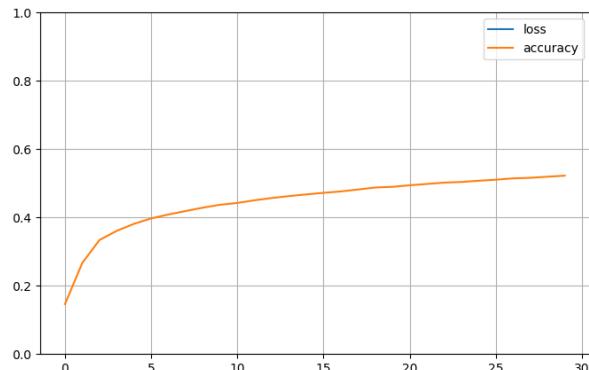


Device-30(i)_model.h5

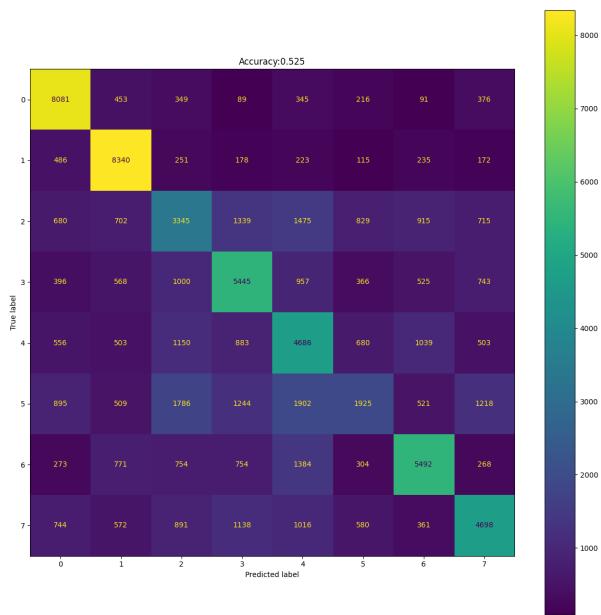
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

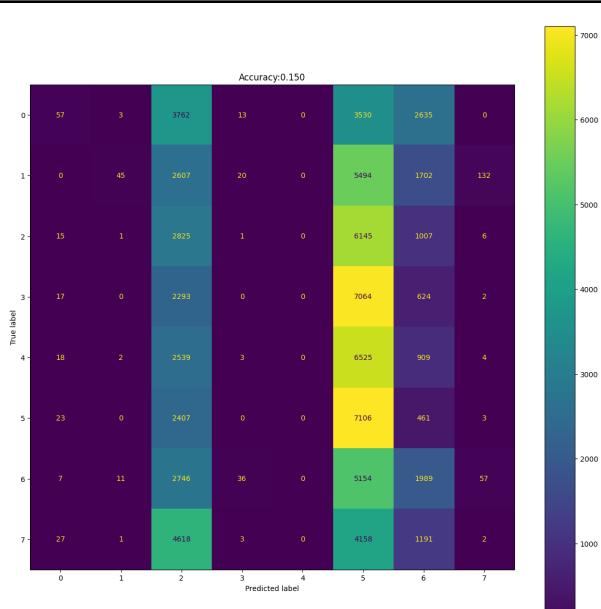


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

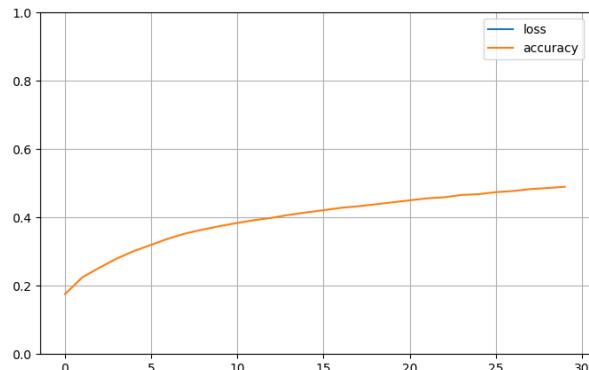


Device-30(ii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

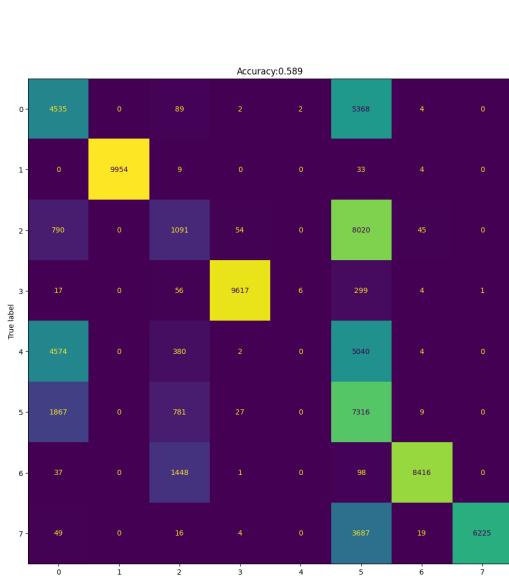


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

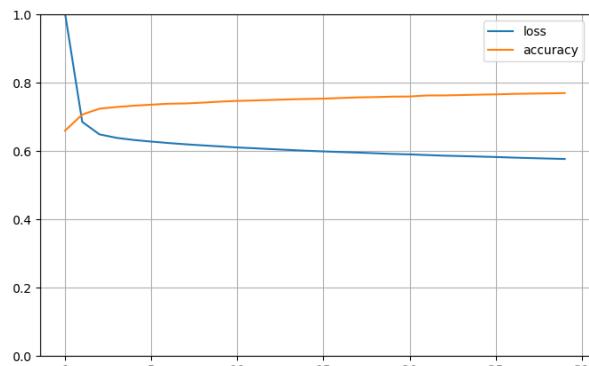


Device-30(iv)_model.h5

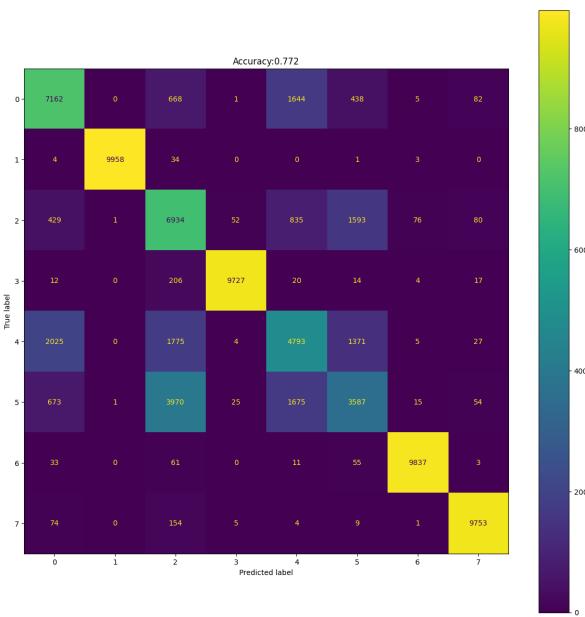
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model

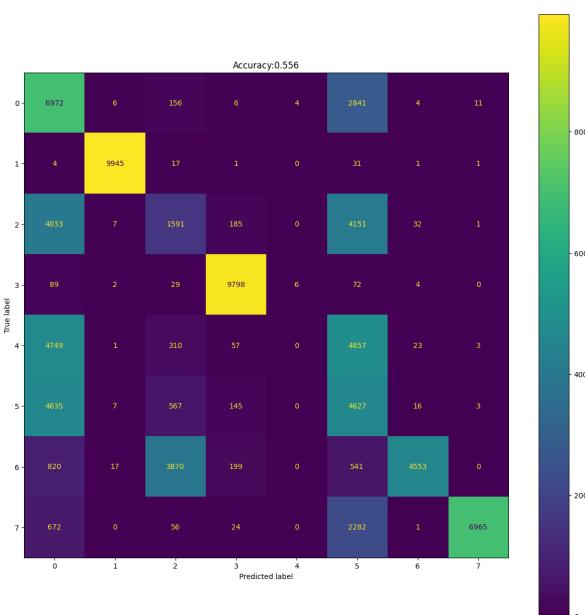


Confusion matrix After apply transfer learning on Nordic Device-30(iv) model



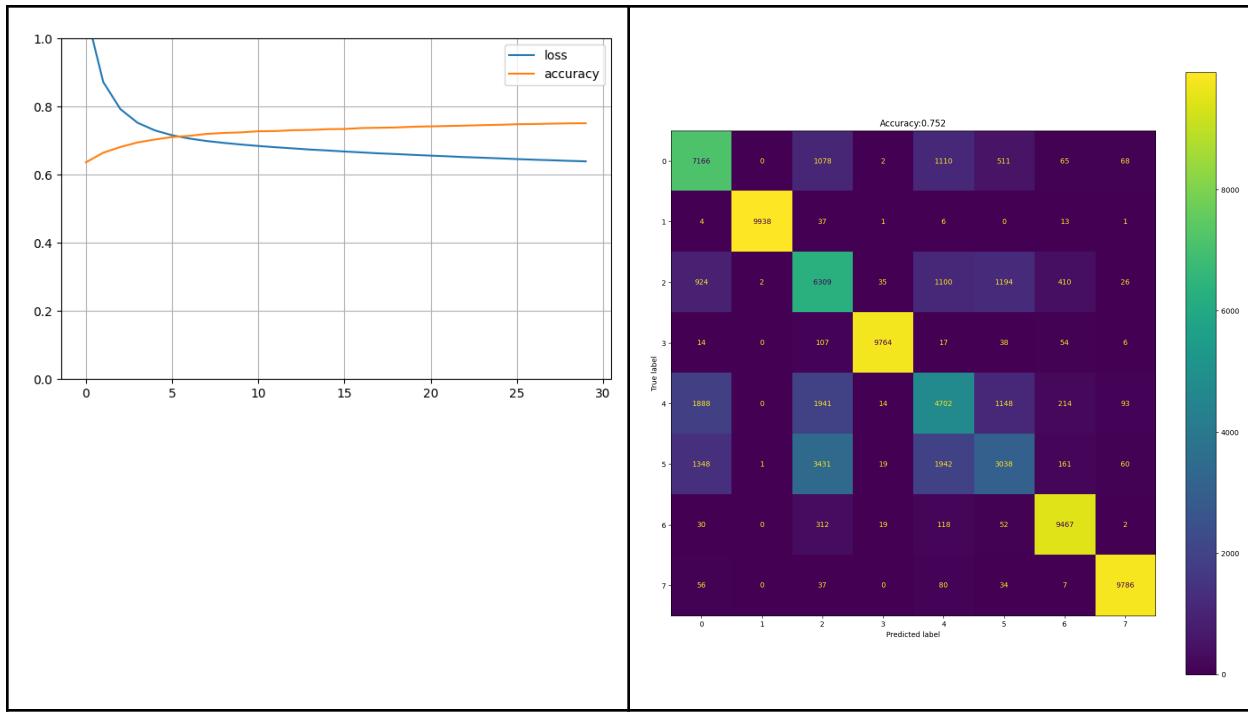
Device-30(v)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model

Confusion matrix After apply transfer learning on Nordic Device-30(v) model

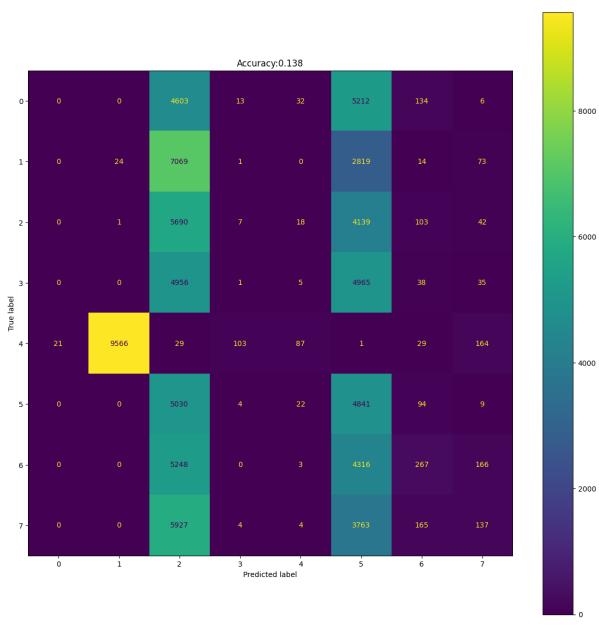


Nordic Device-30(iv) dataset

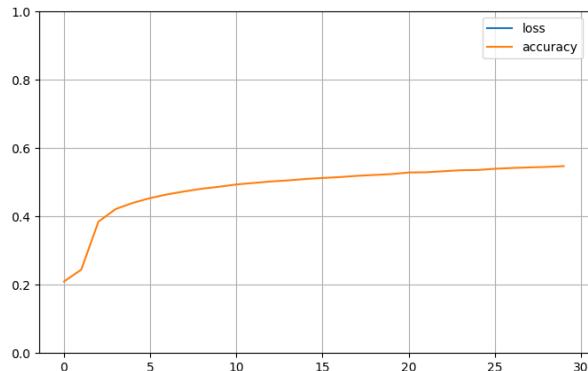
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1381 | 0.5473 | 5m 28.5s | 0.5498 |
| Device-25(ii)_model.h5 | 0.1232 | 0.5686 | 5m 38.3s | 0.5708 |
| Device-25(iii)_model.h5 | 0.1381 | 0.5674 | 5m 52.9s | 0.5692 |
| Device-25(iv)_model.h5 | 0.1289 | 0.5758 | 6m 24.7s | 0.5740 |
| Device-25(v)_model.h5 | 0.1067 | 0.5949 | 6m 7.6s | 0.6008 |
| Device-30(i)_model.h5 | 0.1323 | 0.6066 | 6m 9.6s | 0.6068 |
| Device-30(ii)_model.h5 | 0.1712 | 0.5720 | 6m 7.7s | 0.5778 |
| Device-30(iii)_model.h5 | 0.6041 | 0.8510 | 5m 21.5s | 0.8522 |
| Device-30(v)_model.h5 | 0.8592 | 0.9068 | 6m 9.5s | 0.9074 |

Device-25(i)_model.h5

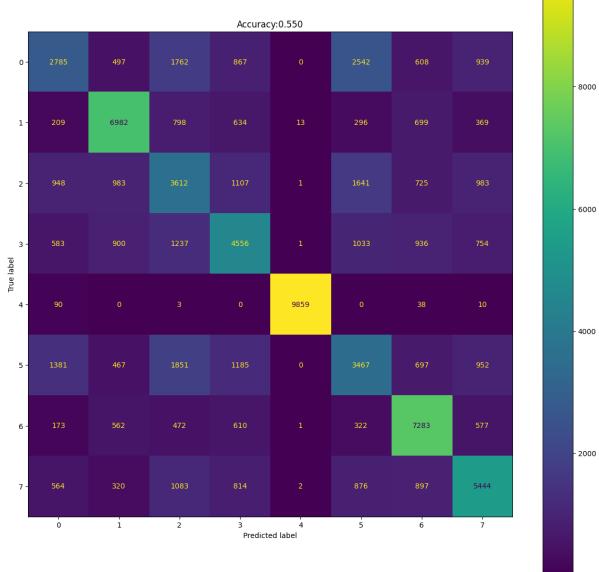
Confusion matrix of by applying the cross-model of Nordic Device-25(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

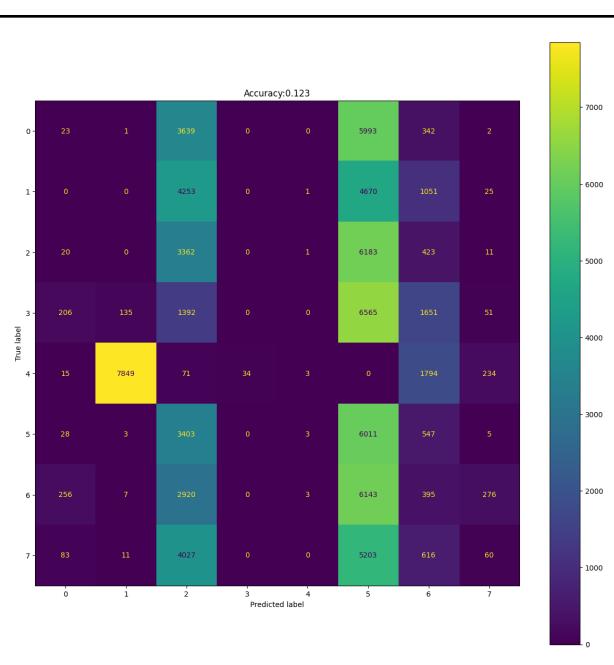


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

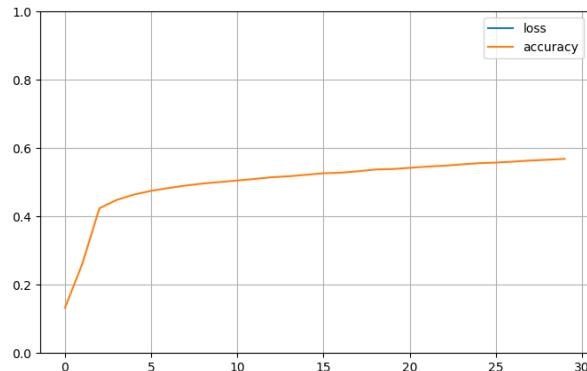


Device-25(ii)_model.h5

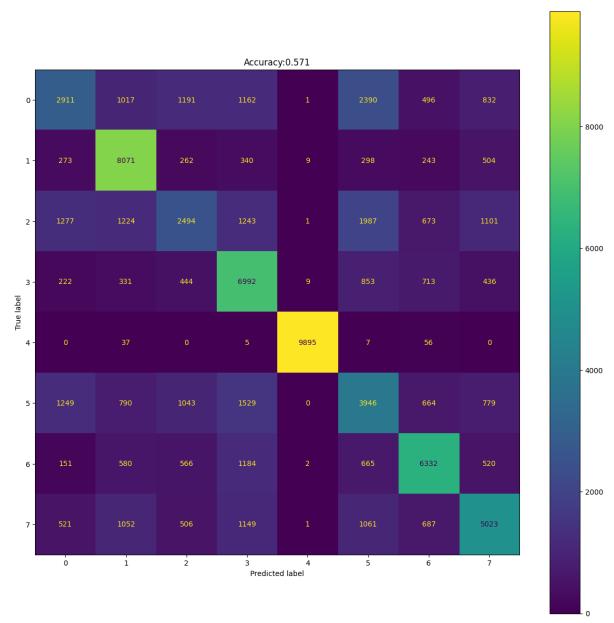
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

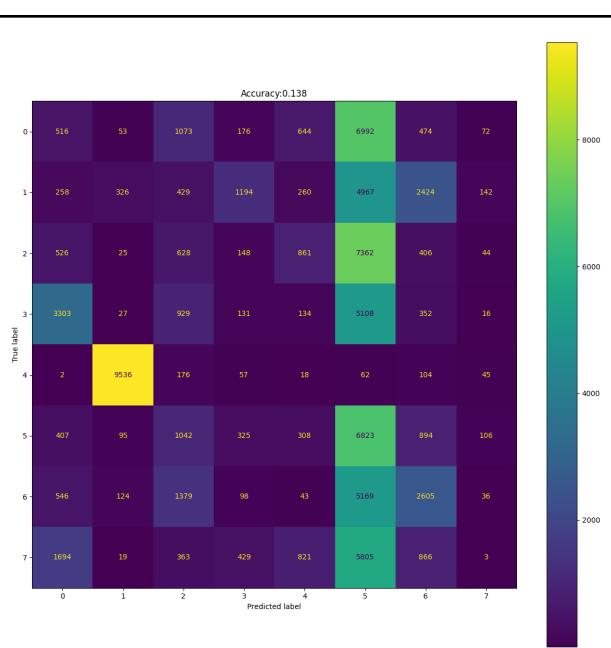


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

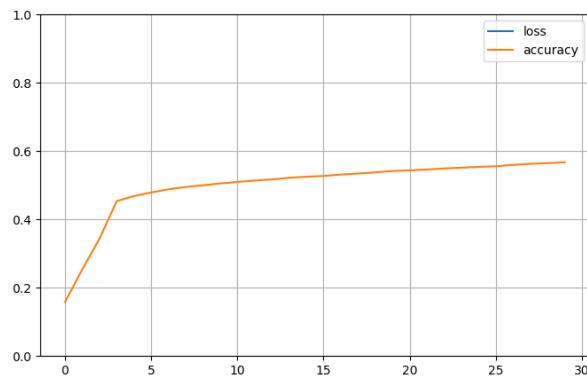


Device-25(iii)_model.h5

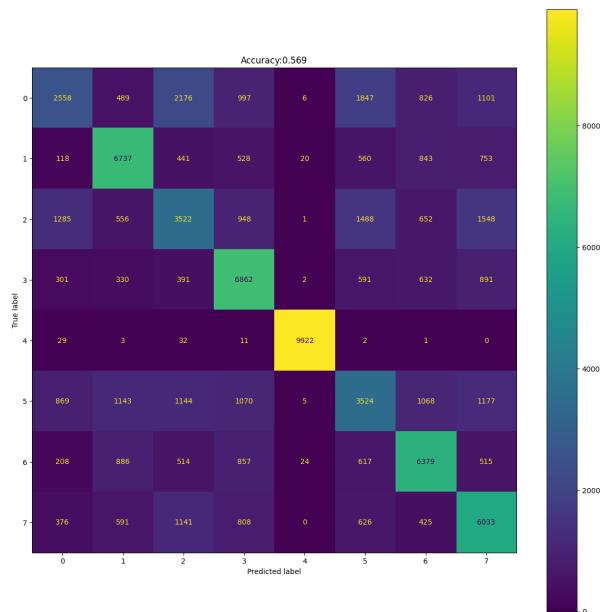
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

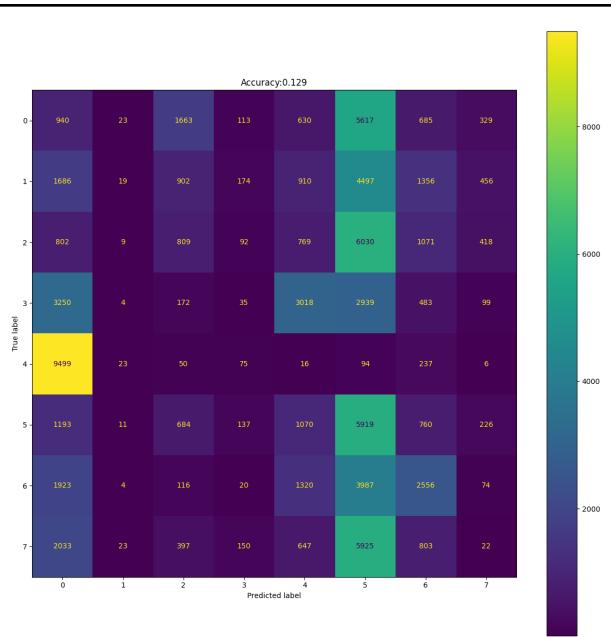


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

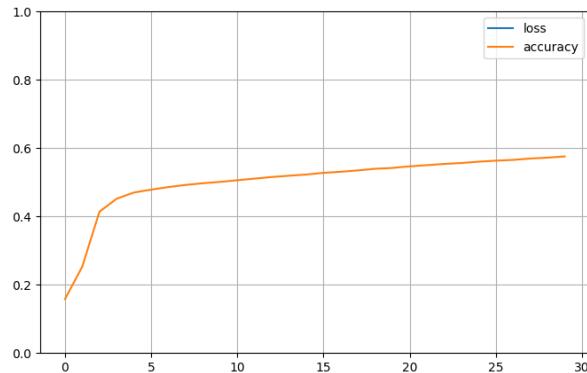


Device-25(iv)_model.h5

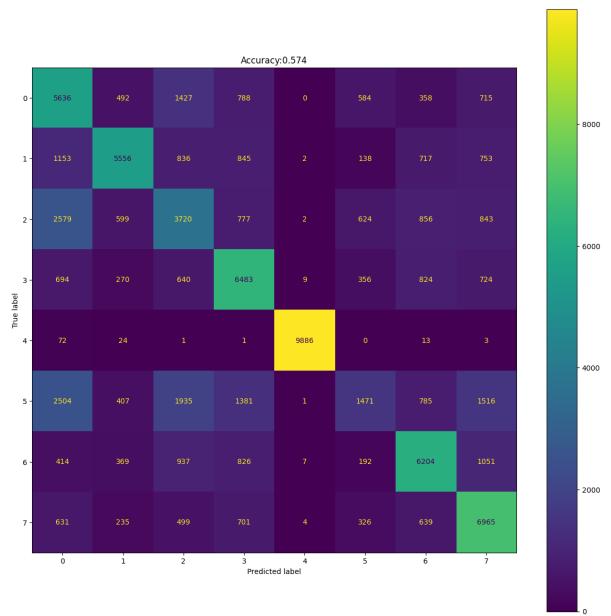
Confusion matrix of by applying the cross-model of Nordic Device-25(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

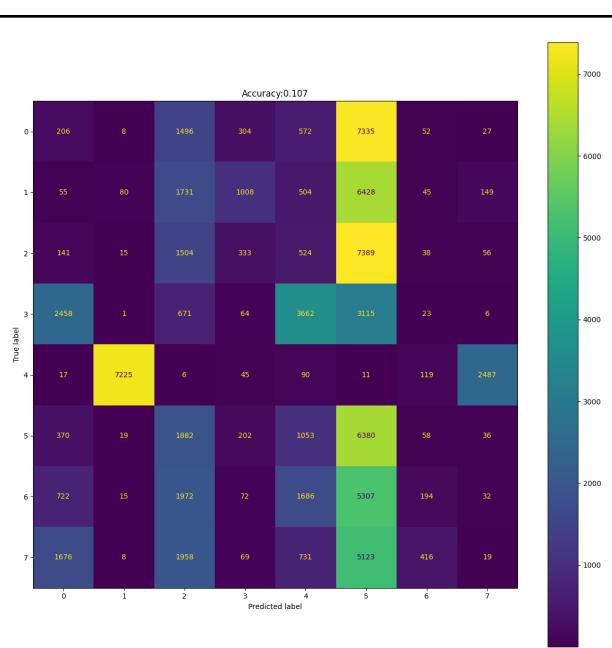


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

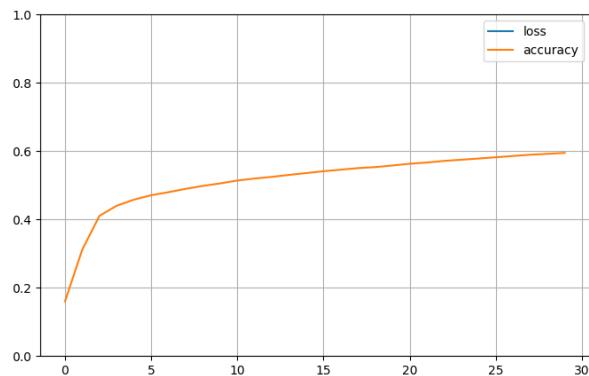


Device-25(v)_model.h5

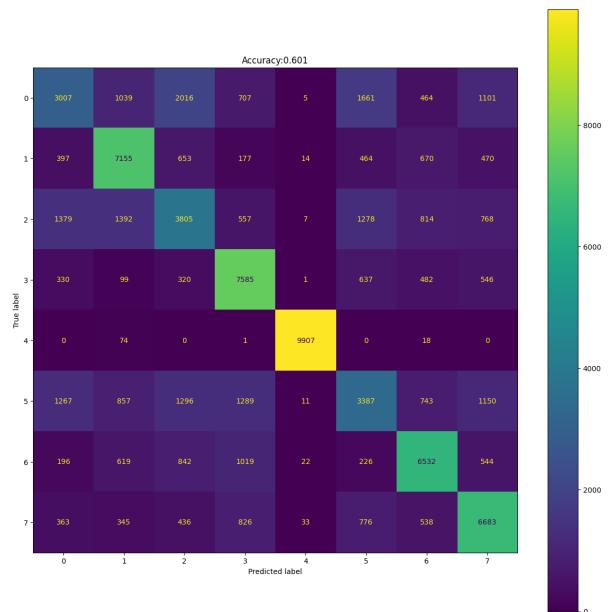
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

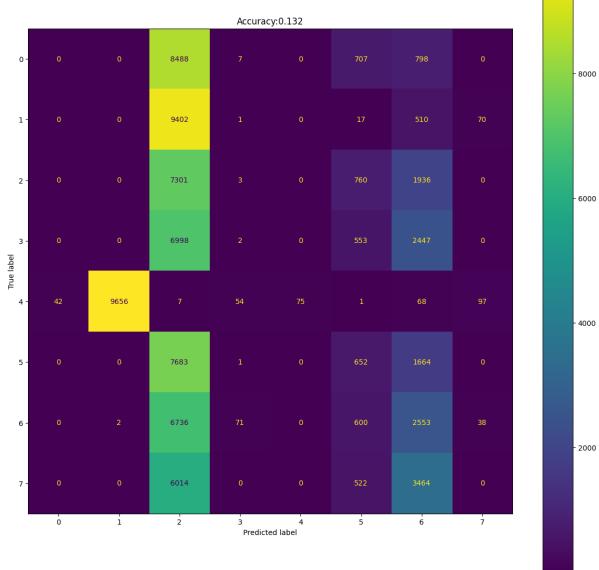


Confusion matrix After apply transfer learning on Nordic Device-25(v) model

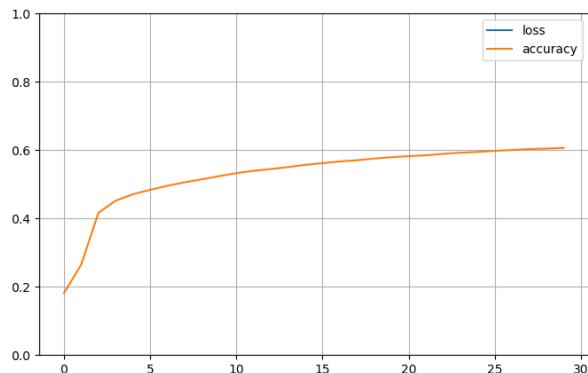


Device-30(i)_model.h5

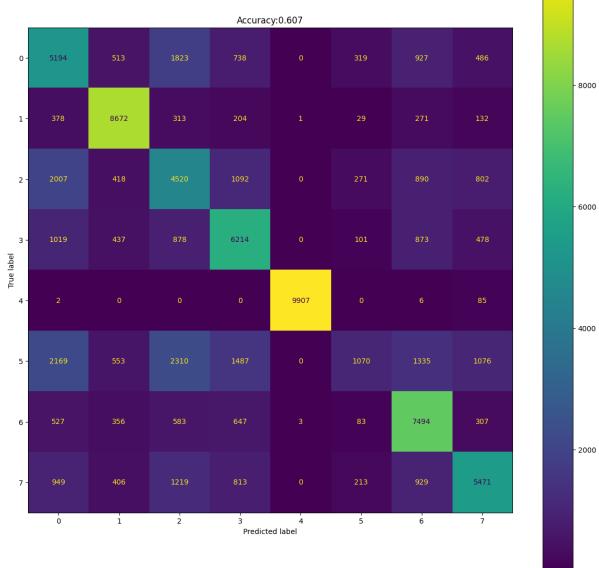
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

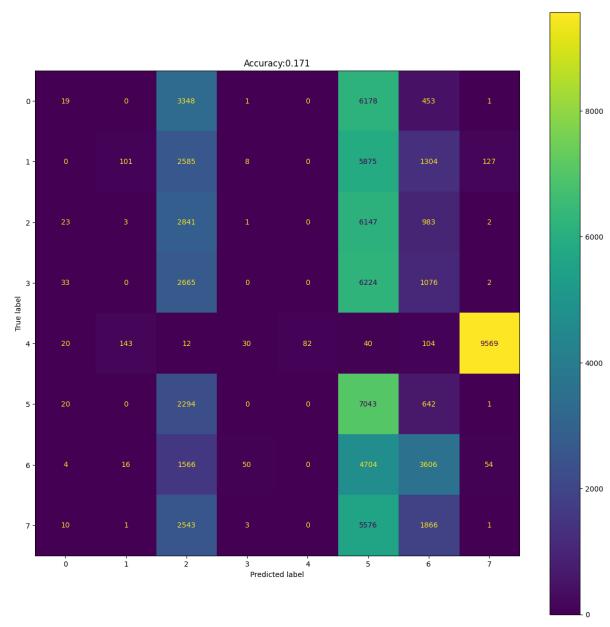


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

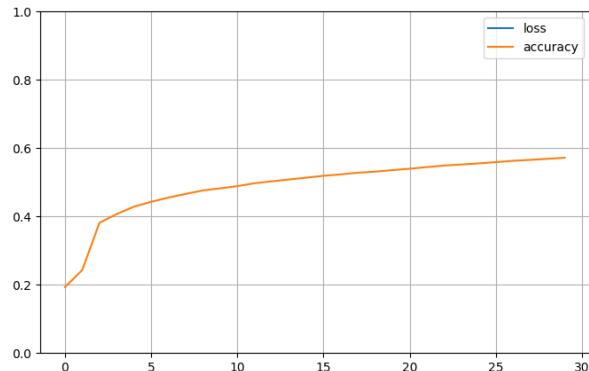


Device-30(ii)_model.h5

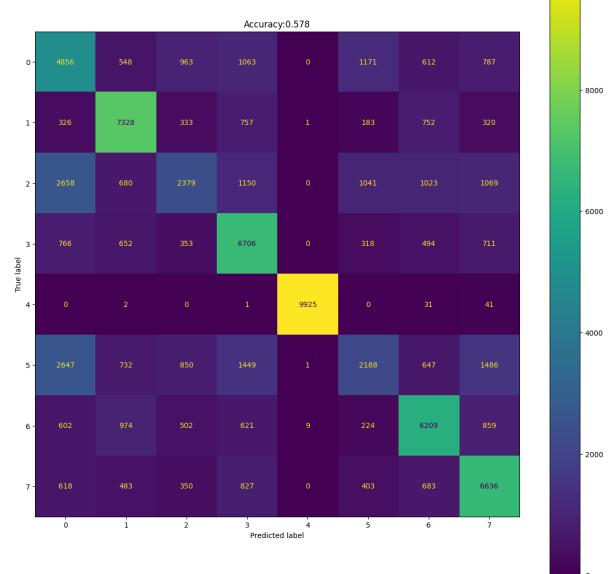
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

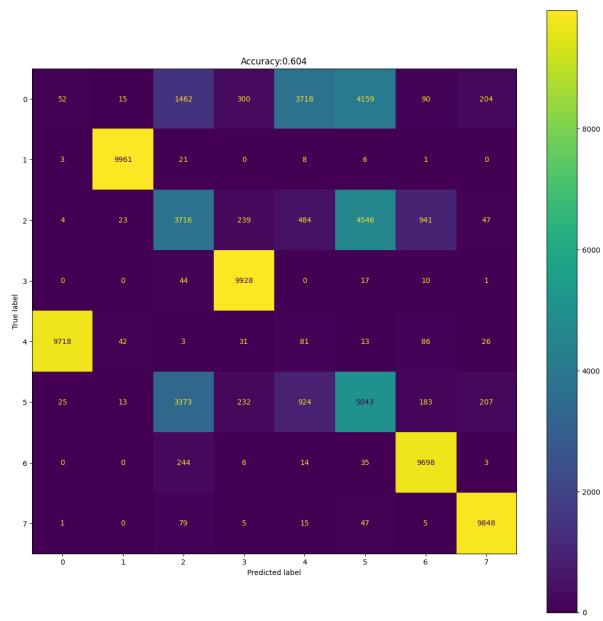


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

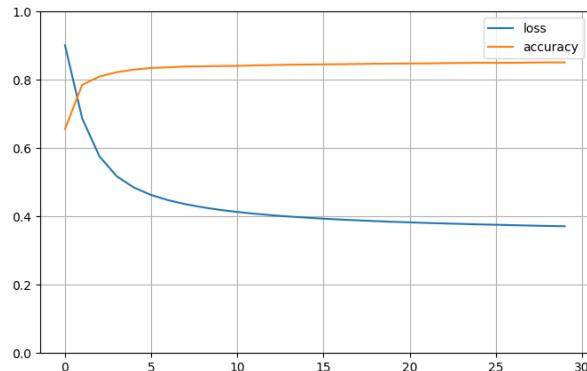


Device-30(iii)_model.h5

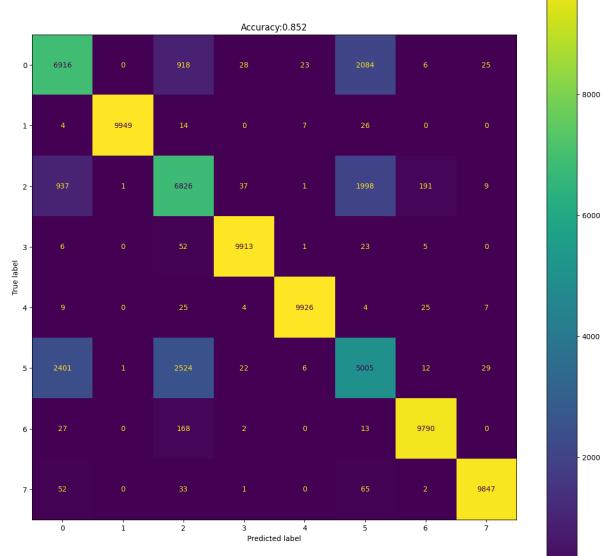
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

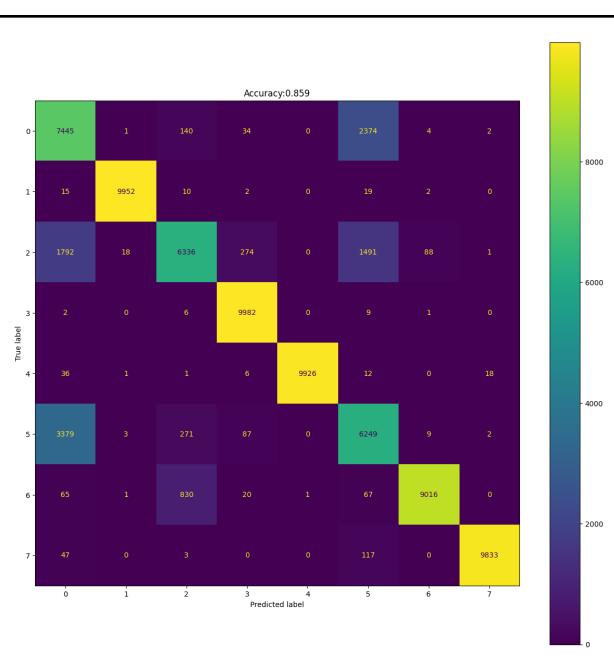


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

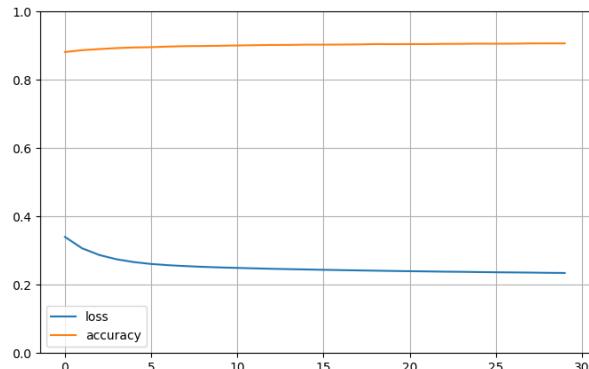


Device-30(v)_model.h5

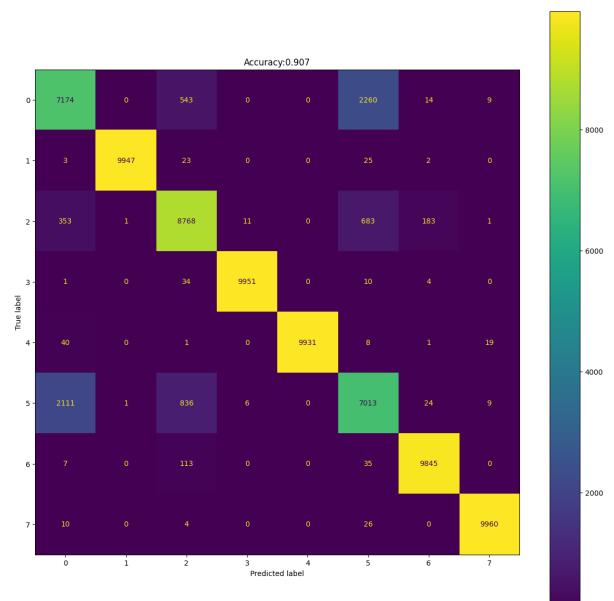
Confusion matrix of by applying the cross-model of Nordic Device-30(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(v) model



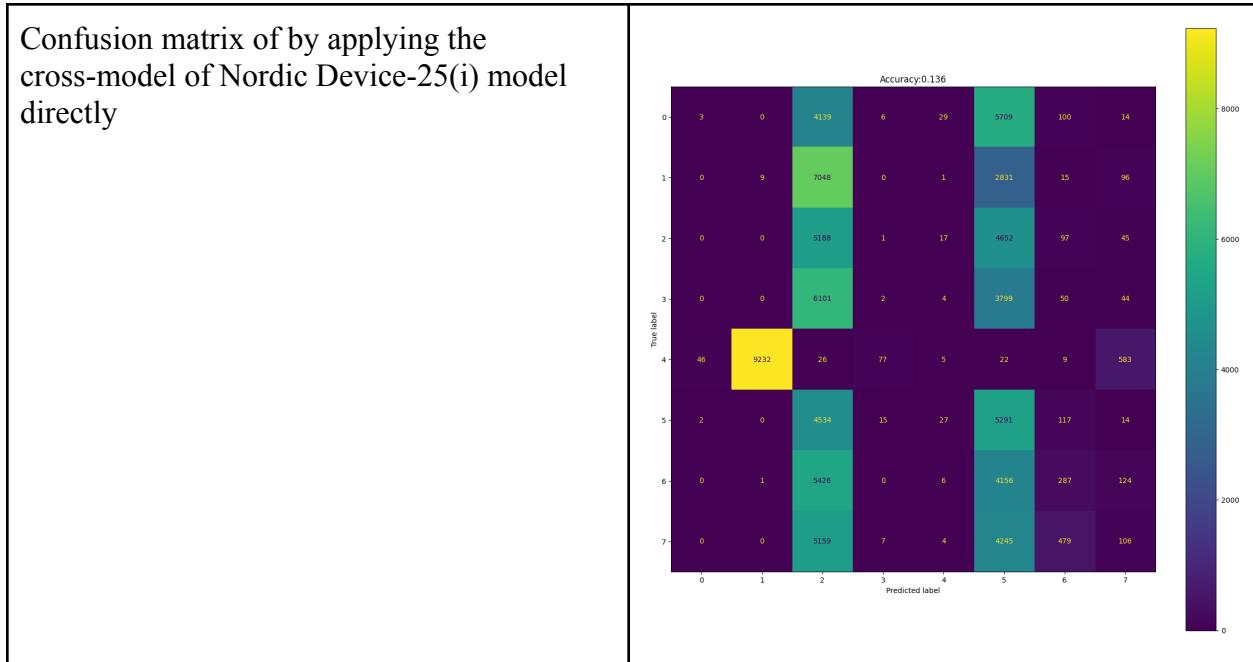
Confusion matrix After apply transfer learning on Nordic Device-30(v) model



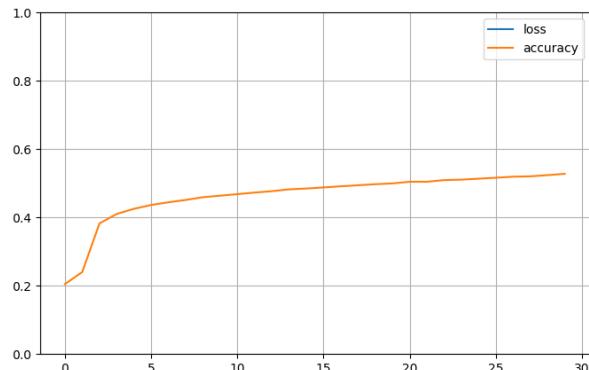
Nordic Device-30(v) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1361 | 0.5278 | 5m 40.8s | 0.5307 |
| Device-25(ii)_model.h5 | 0.1024 | 0.5491 | 6m 36.3s | 0.5428 |
| Device-25(iii)_model.h5 | 0.1408 | 0.5626 | 5m 39.8s | 0.5659 |
| Device-25(iv)_model.h5 | 0.1184 | 0.5591 | 6m 23.7s | 0.5568 |
| Device-25(v)_model.h5 | 0.1123 | 0.5886 | 6m 10.2s | 0.5881 |
| Device-30(i)_model.h5 | 0.1324 | 0.5931 | 6m 24.8s | 0.5970 |
| Device-30(ii)_model.h5 | 0.1609 | 0.5599 | 4m 52.3s | 0.5638 |
| Device-30(iii)_model.h5 | 0.6085 | 0.8273 | 4m 47.8s | 0.8286 |
| Device-30(iv)_model.h5 | 0.8510 | 0.8977 | 5m 2.1s | 0.8978 |

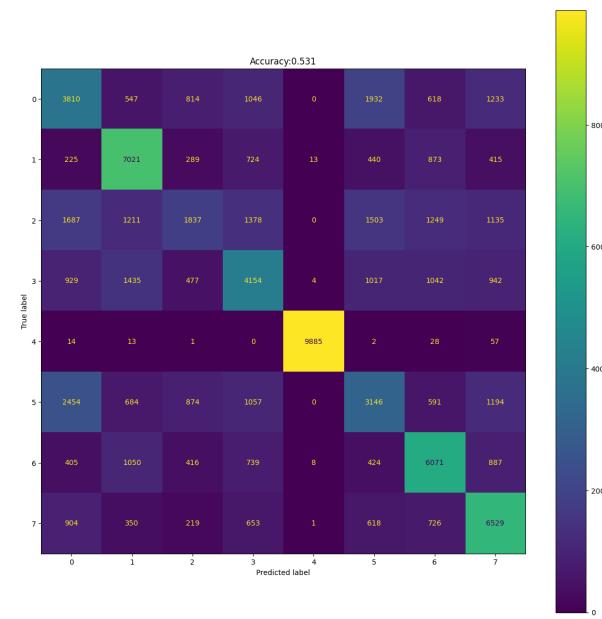
Device-25(i)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

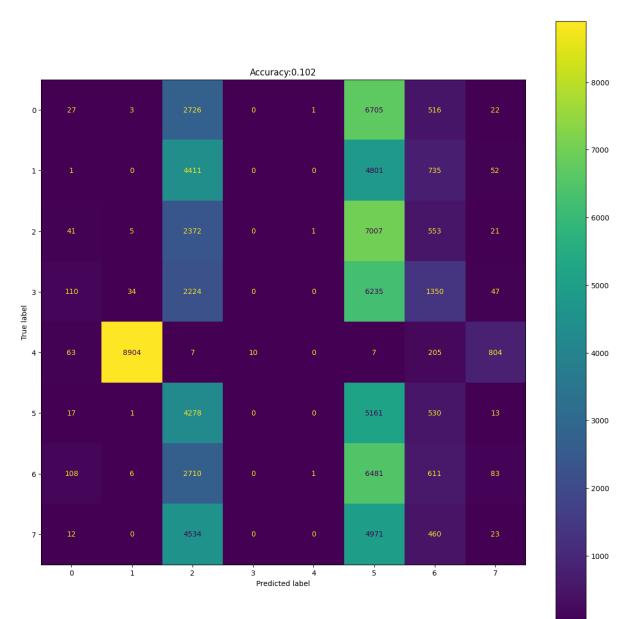


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

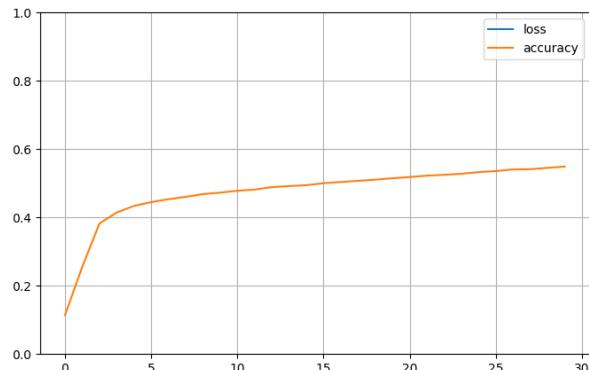


Device-25(ii)_model.h5

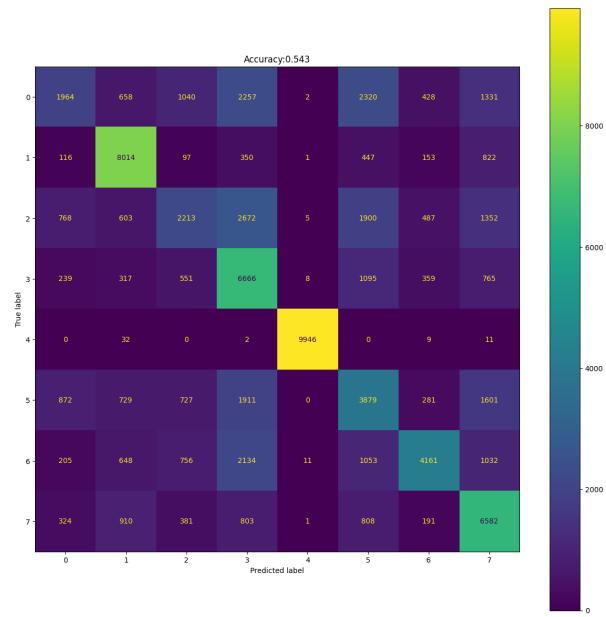
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

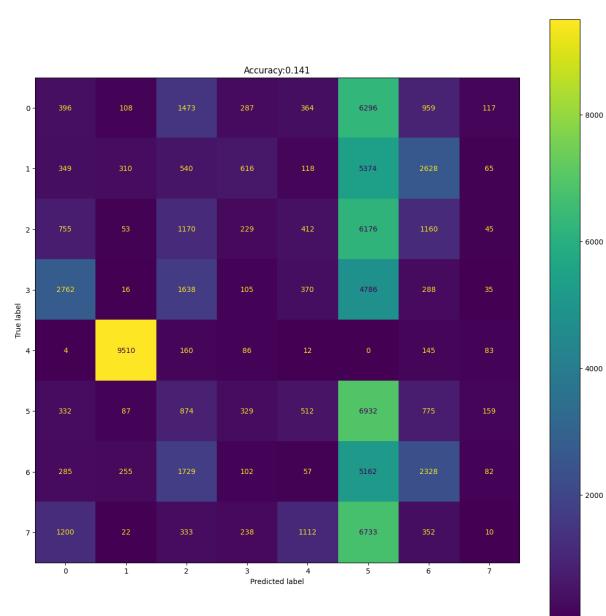


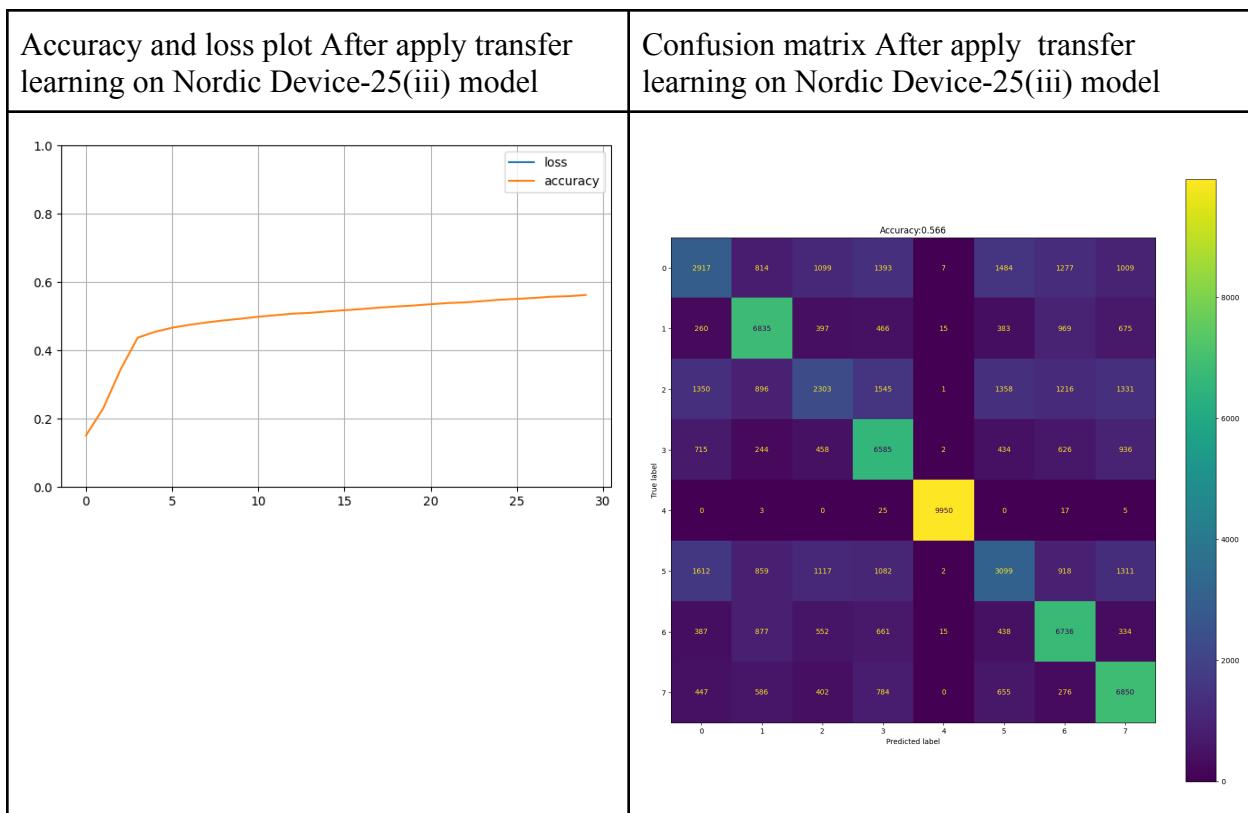
Confusion matrix After apply transfer learning on Nordic Device-25(ii) model



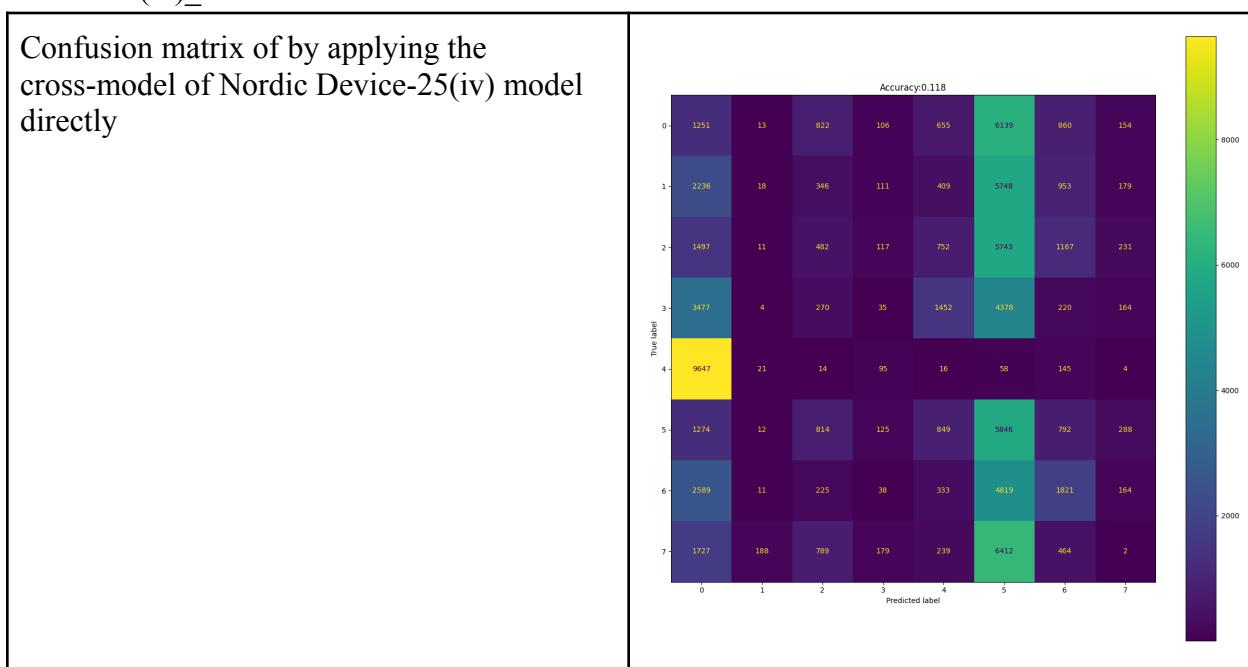
Device-25(iii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly

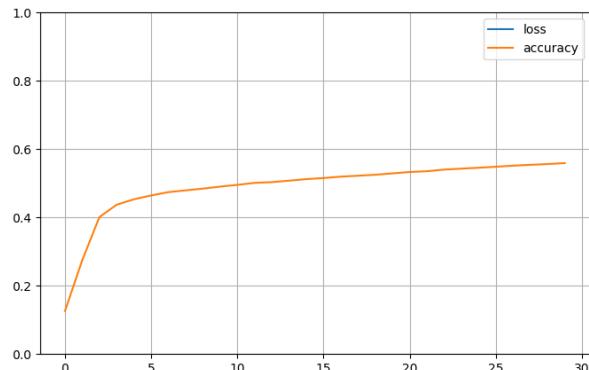




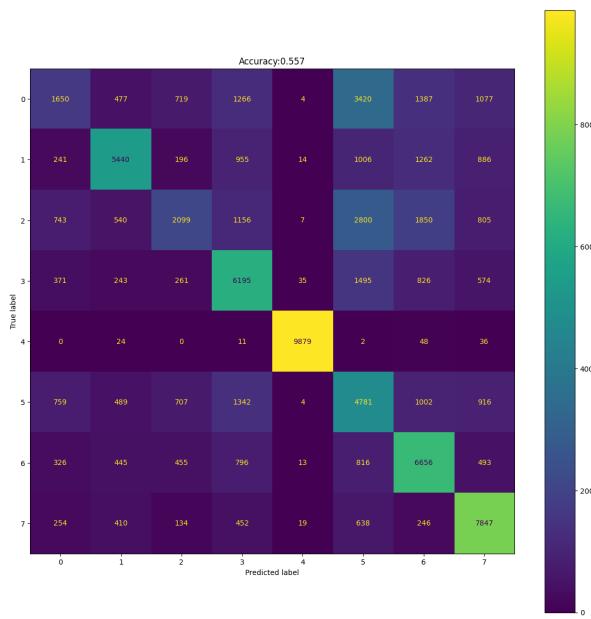
Device-25(iv)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iv) model

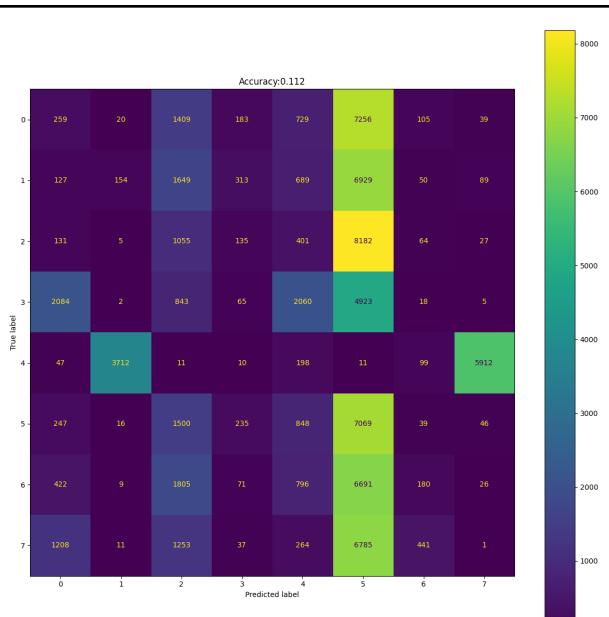


Confusion matrix After apply transfer learning on Nordic Device-25(iv) model

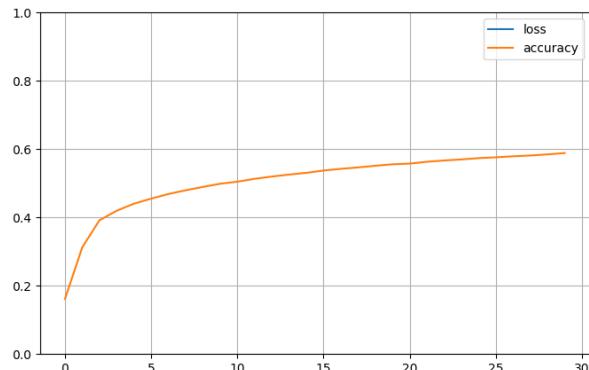


Device-25(v)_model.h5

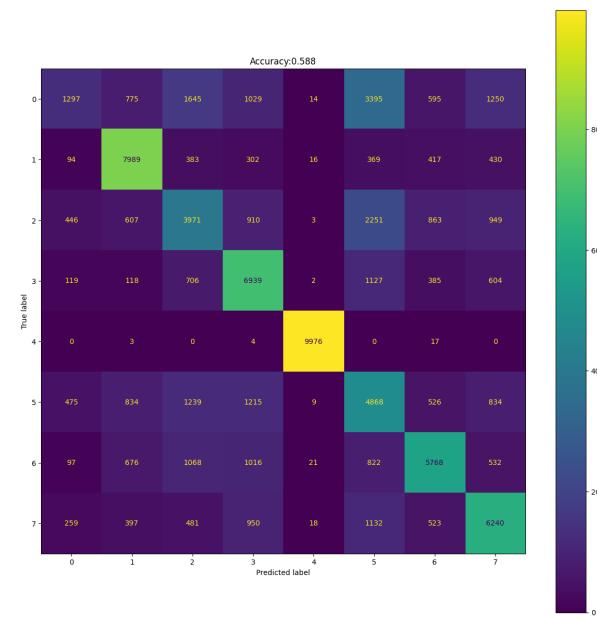
Confusion matrix of by applying the cross-model of Nordic Device-25(v) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(v) model

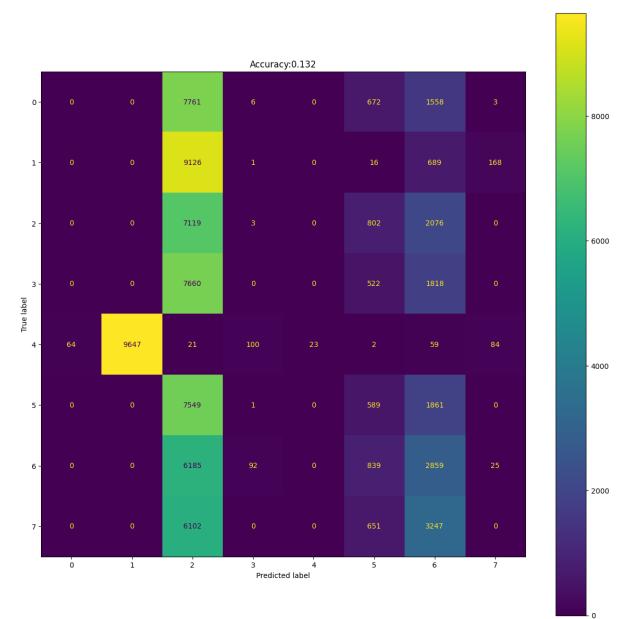


Confusion matrix After apply transfer learning on Nordic Device-25(v) model

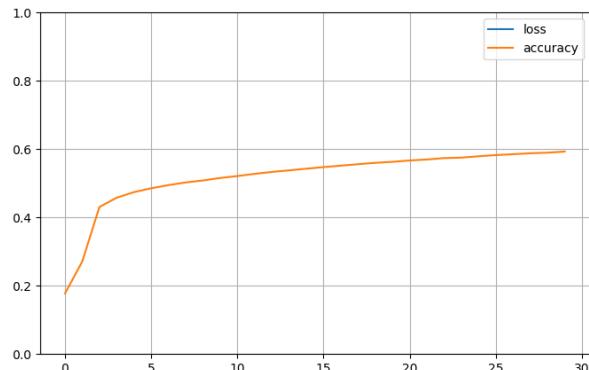


Device-30(i)_model.h5

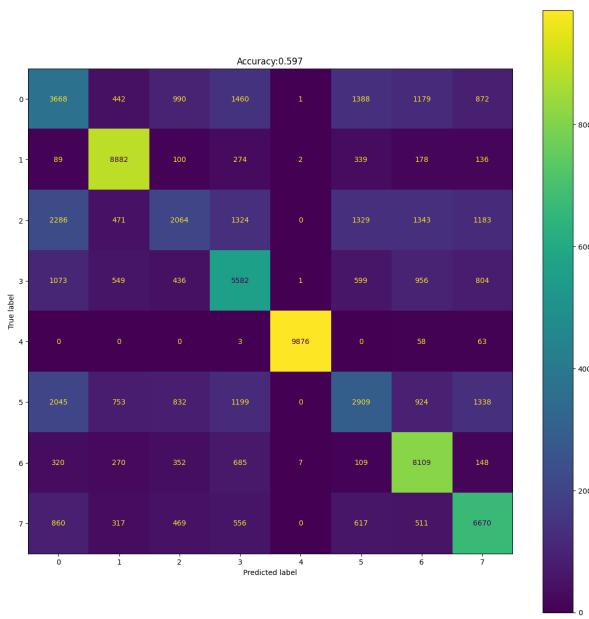
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

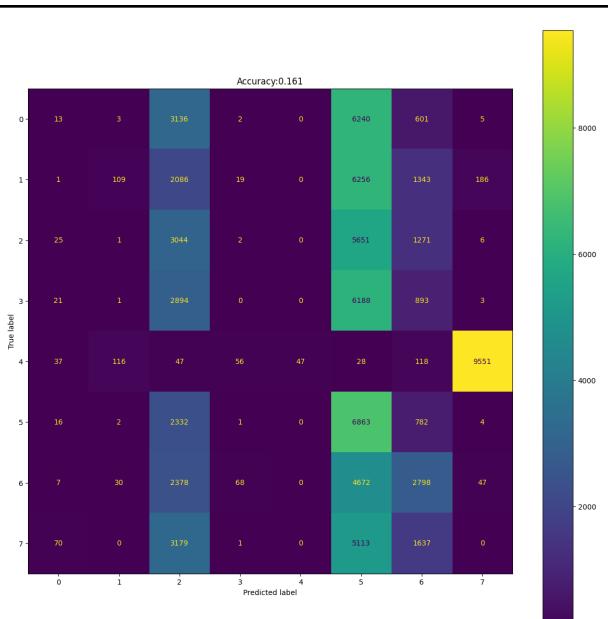


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

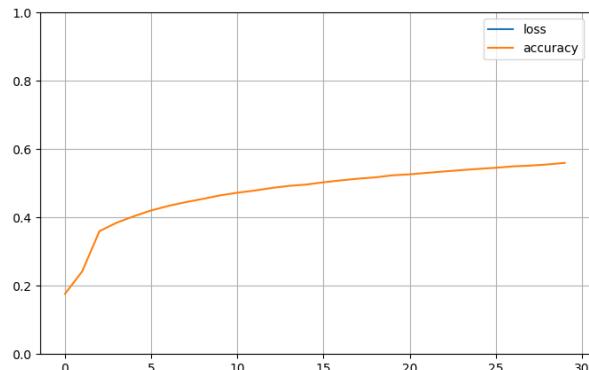


Device-30(ii)_model.h5

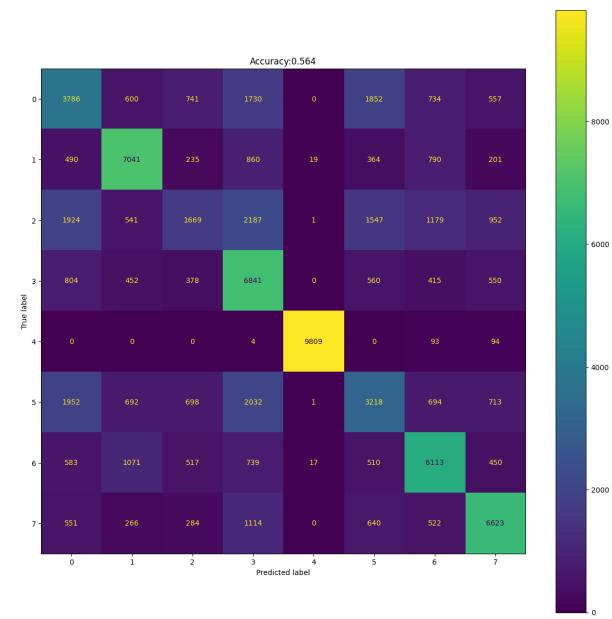
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

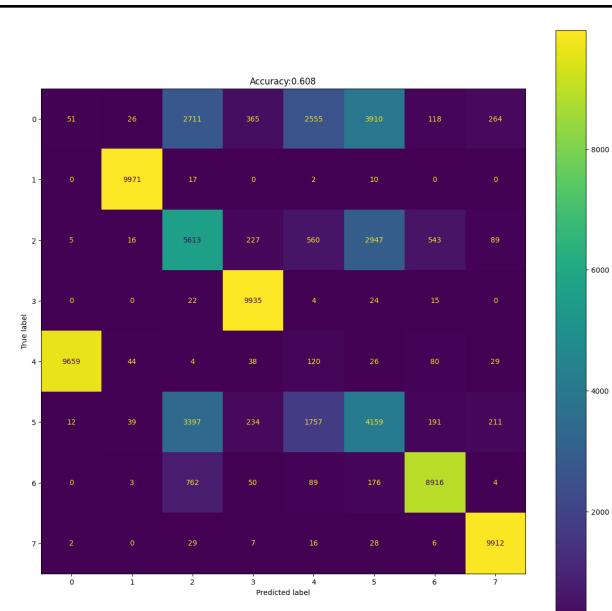


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

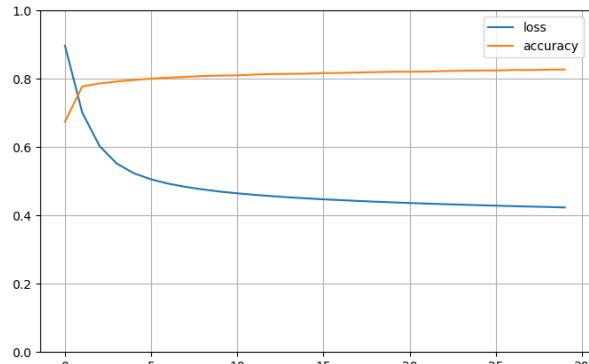


Device-30(iii)_model.h5

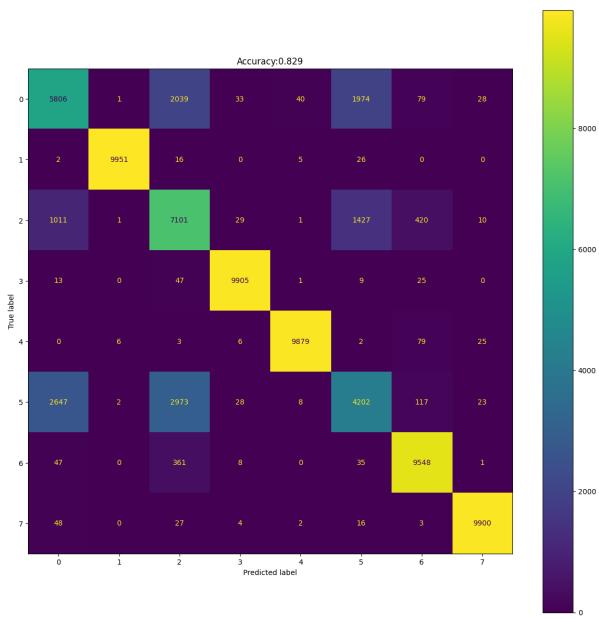
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model

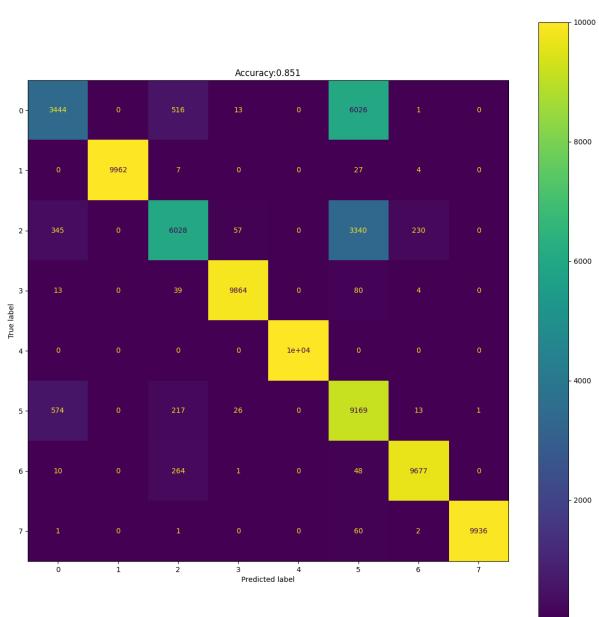


Confusion matrix After apply transfer learning on Nordic Device-30(iii) model

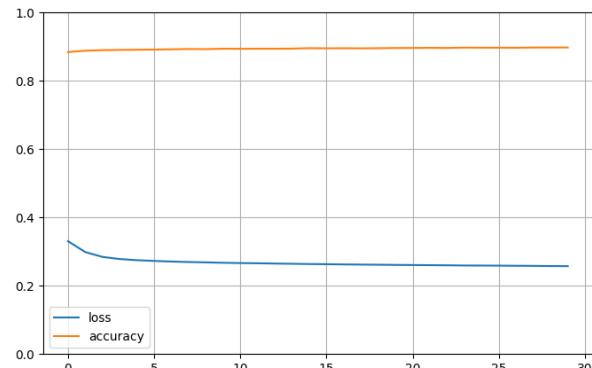


Device-30(iv)_model.h5

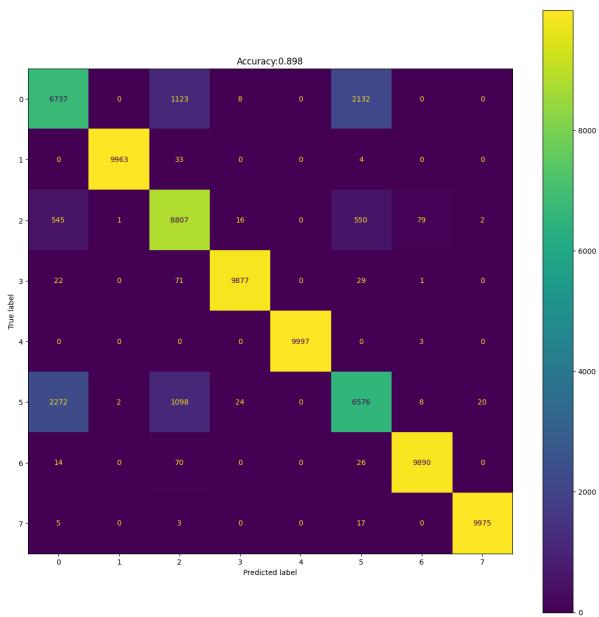
Confusion matrix of by applying the cross-model of Nordic Device-30(iv) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iv) model



Confusion matrix After apply transfer learning on Nordic Device-30(iv) model



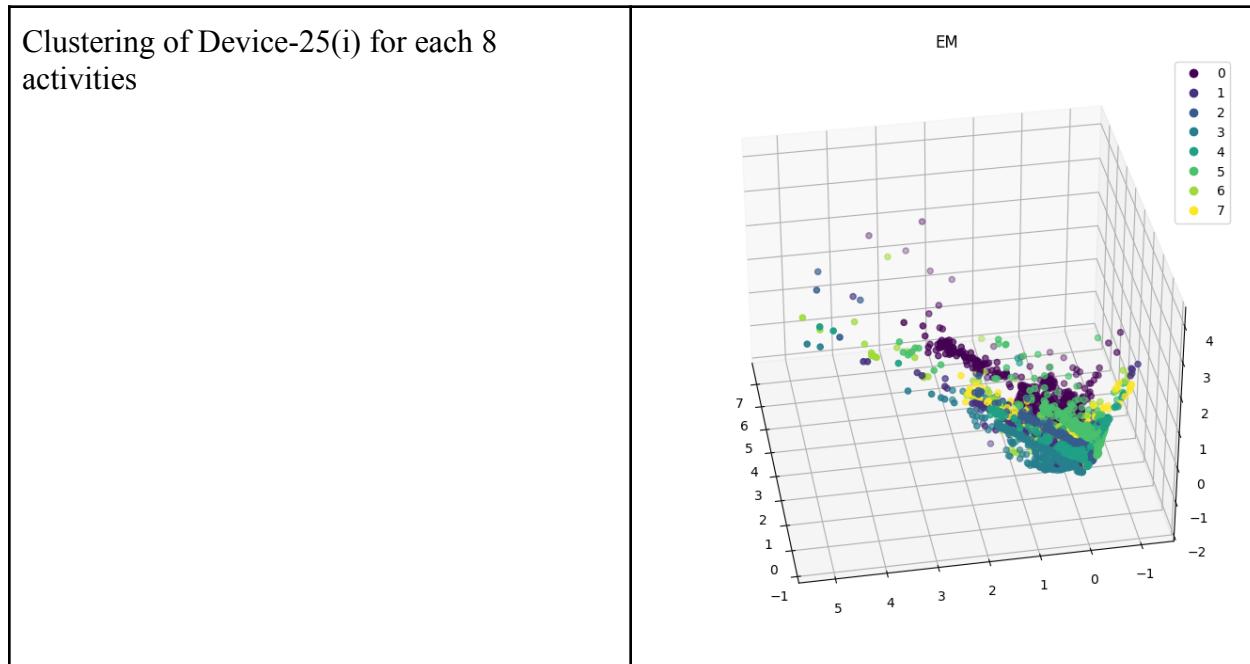
EXPERIMENT: 3

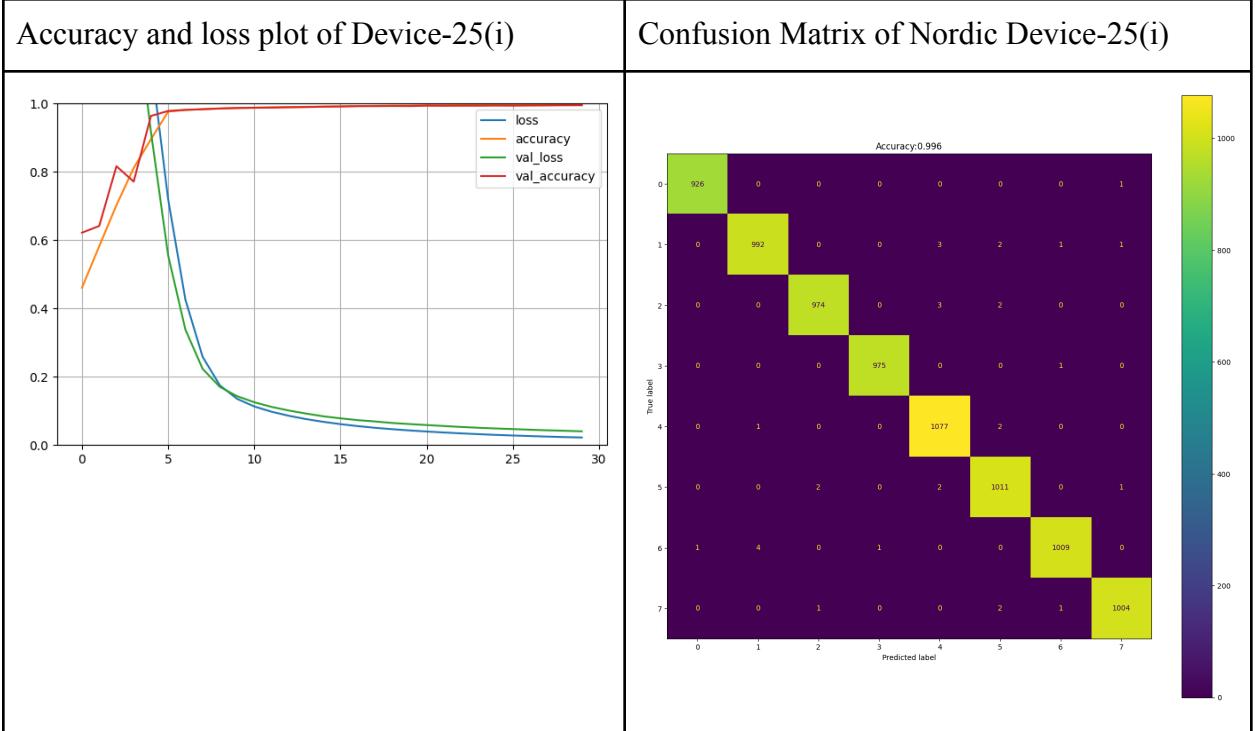
Three nordic (identical devices) were selected to analyze the experiment. The devices are named Device-25 and Device-30 and the EM traces are collected at the frequency of 2.4GHz.

Results Comparison three semiconductors

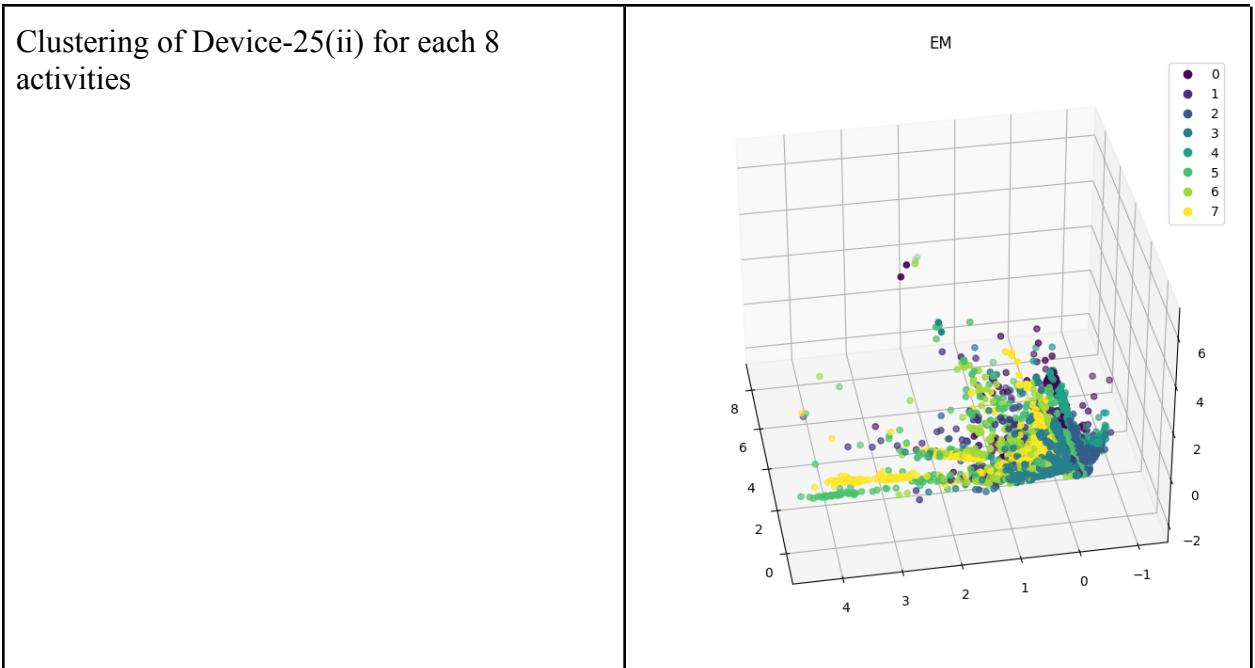
| Smartphone Name | Device-25 (i) | Device-25(i i) | Device-25(i ii) | Device-30(i) | Device-30(ii) | Device-30(iii) |
|---------------------------------|---------------|----------------|-----------------|---------------|----------------|-----------------|
| Training Accuracy at 30th epoch | 0.9950 | 0.9962 | 0.9958 | 0.9925 | 0.9947 | 0.9932 |
| Learning Time | 11m 41.7s | 11m 27.1s | 11m 22.6s | 9m 41.8s | 9m 28.2s | 12m 0.3s |
| Testing Accuracy | 0.9960 | 0.9967 | 0.9955 | 0.9929 | 0.9955 | 0.9951 |

Nordic Device-25(i)

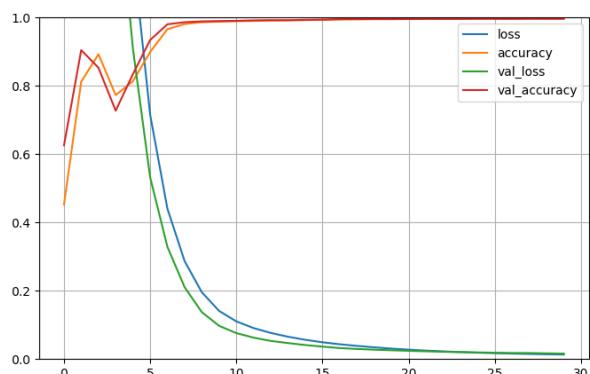




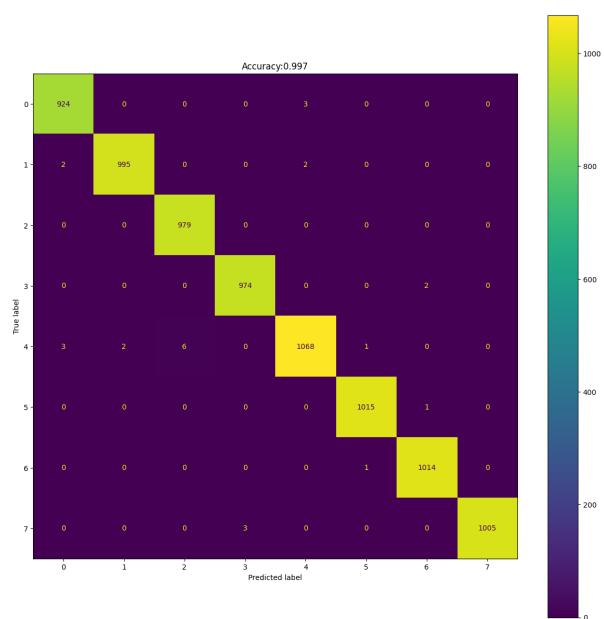
Nordic Device-25(ii)



Accuracy and loss plot of Device-25(ii)

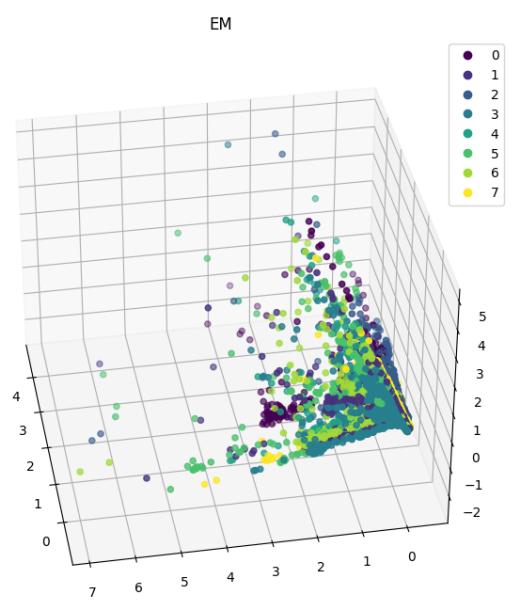


Confusion Matrix of Nordic Device-25(ii)

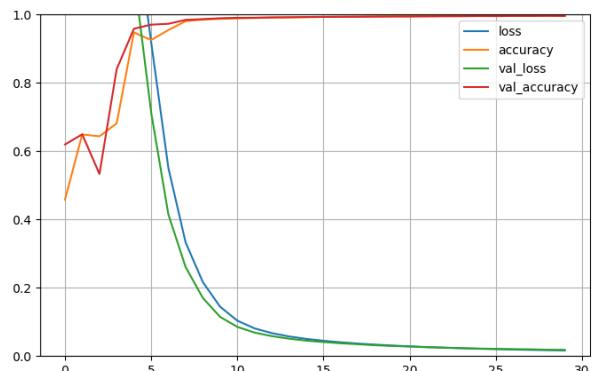


Nordic Device-25(iii)

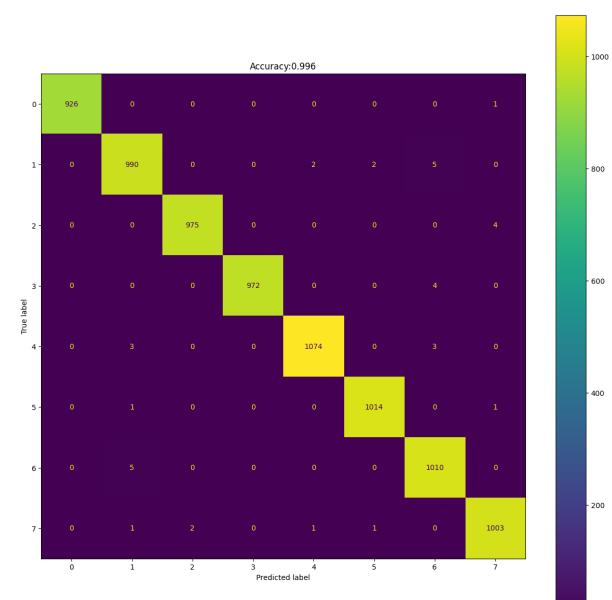
Clustering of Device-25(iii) for each 8 activities



Accuracy and loss plot of Device-25(iii)

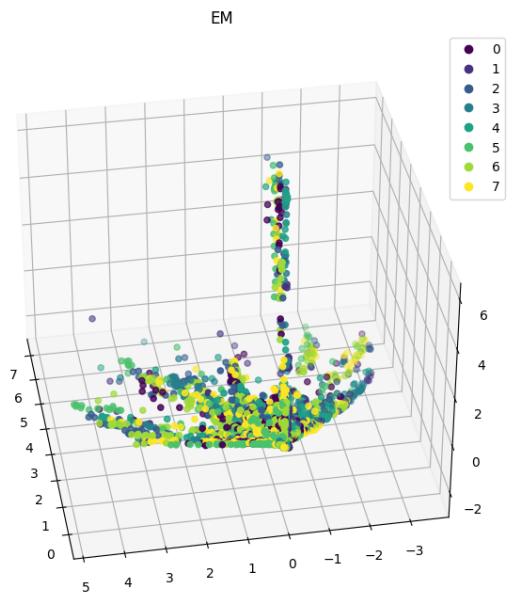


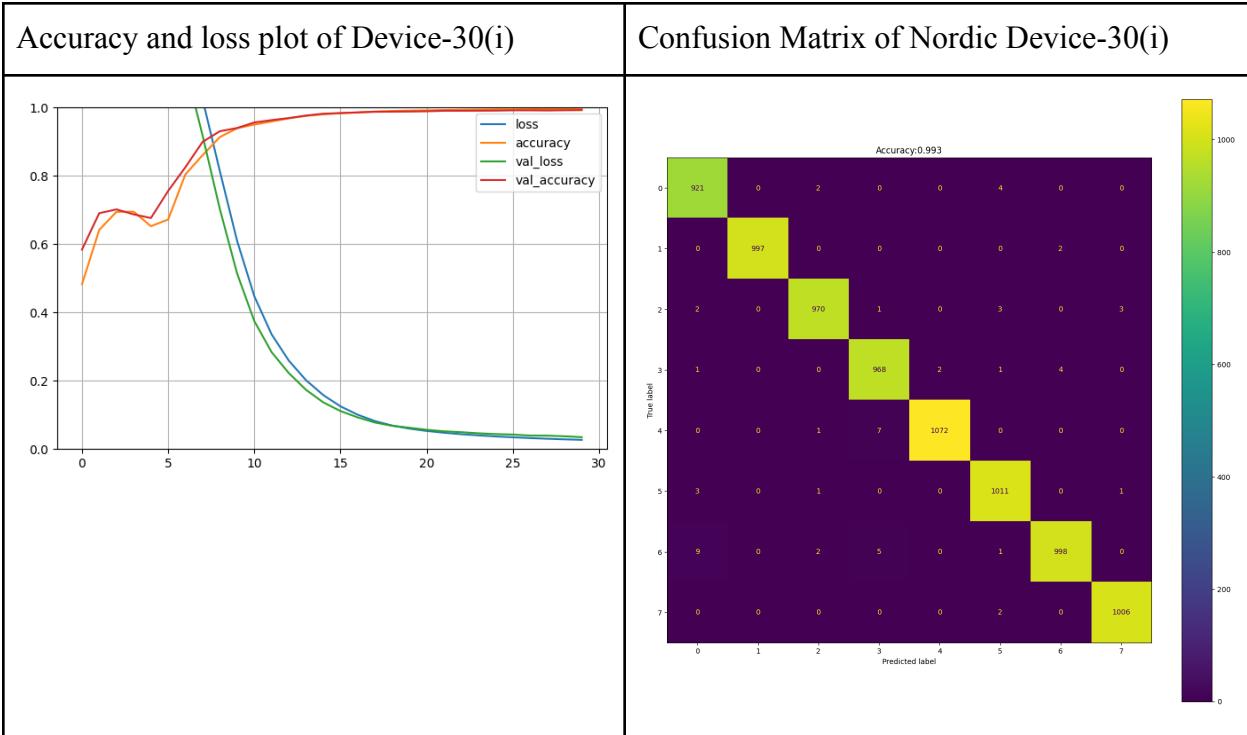
Confusion Matrix of Nordic Device-25(iii)



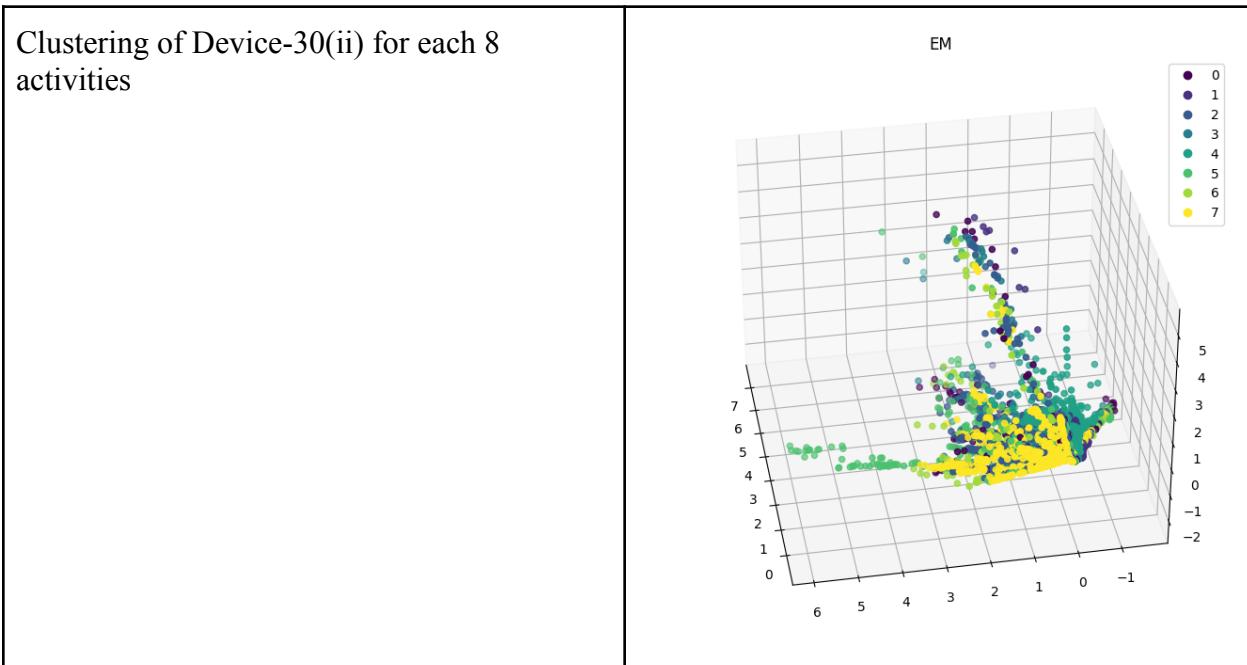
Nordic Device-30(i)

Clustering of Device-30(i) for each 8 activities

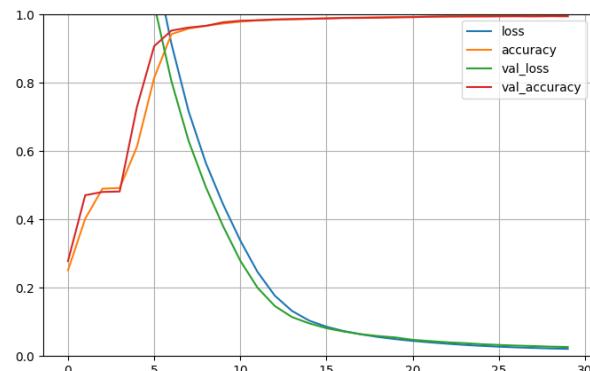




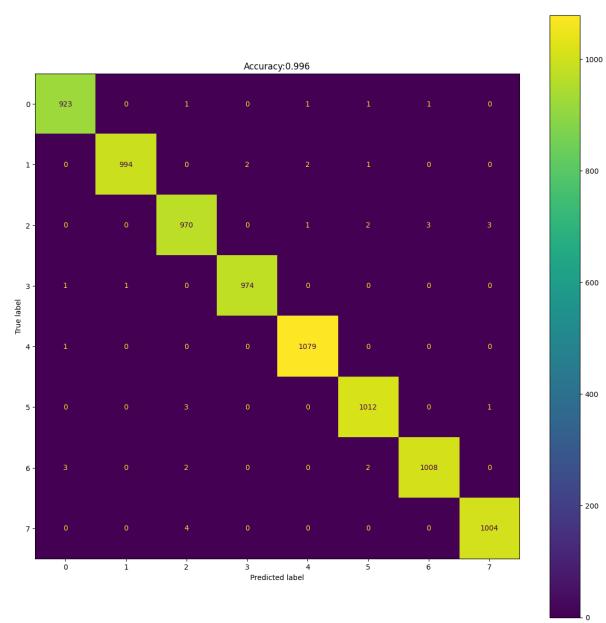
Nordic Device-30(ii)



Accuracy and loss plot of Device-30(ii)

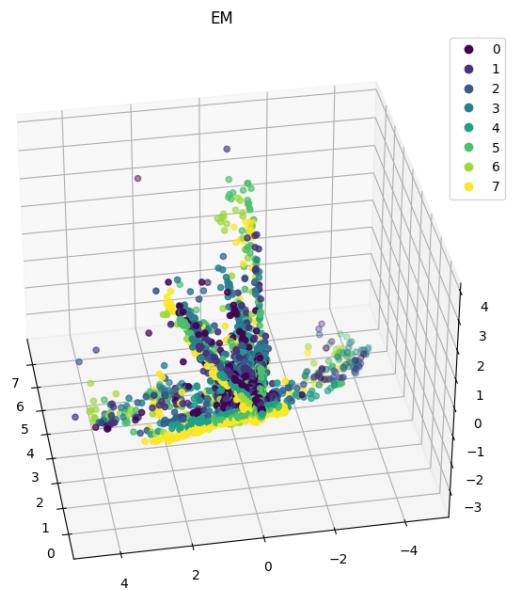


Confusion Matrix of Nordic Device-30(ii)

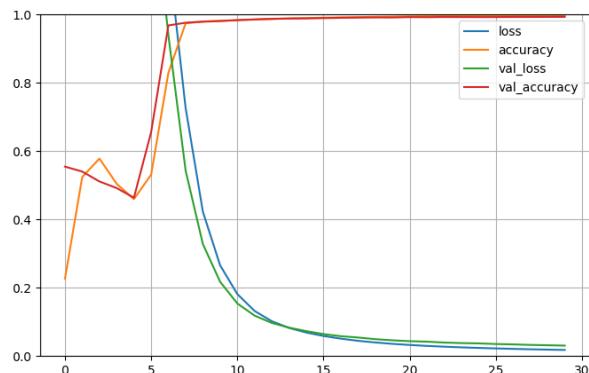


Nordic Device-30(iii)

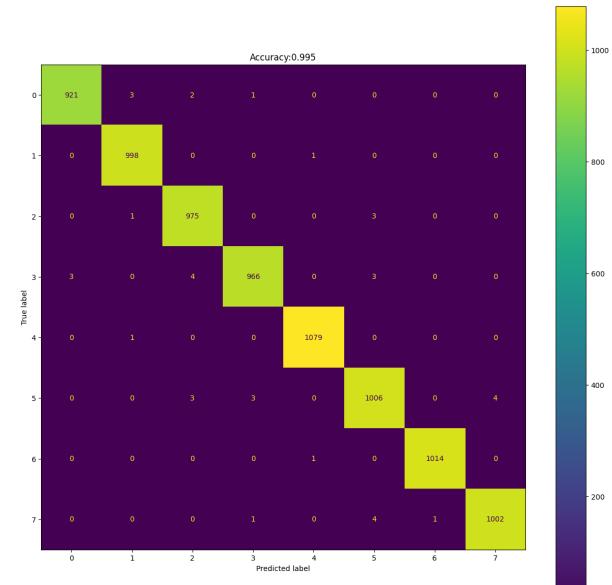
Clustering of Device-30(iii) for each 8 activities



Accuracy and loss plot of Device-30(iii)



Confusion Matrix of Nordic Device-30(iii)



EXPERIMENT: 4

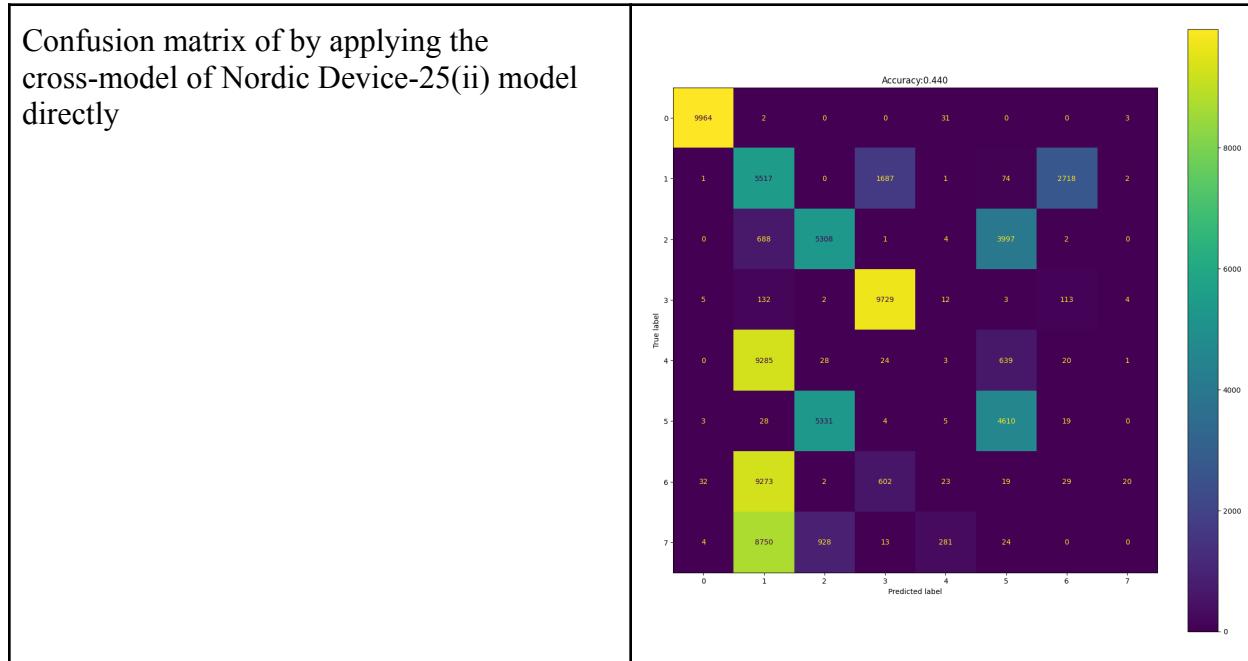
Cross-model applications by directly applying other dataset models and applying transfer learning in between the dataset of Nordic Device-25 and Device-30 at 2.4GHz clock frequency.

Nordic Semiconductor

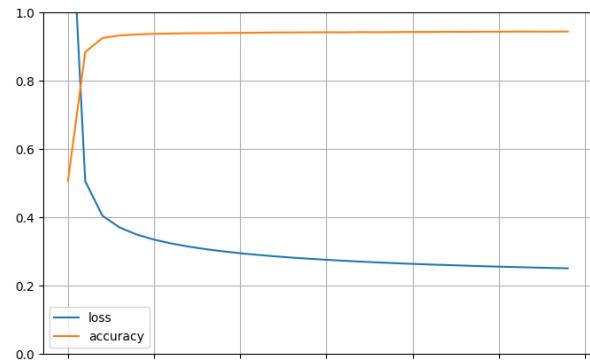
Nordic Device-25(i) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(ii)_model.h5 | 0.4395 | 0.9444 | 5m 49.1s | 0.9445 |
| Device-25(iii)_model.h5 | 0.2107 | 0.9565 | 5m 27.9s | 0.9571 |
| Device-30(i)_model.h5 | 0.2009 | 0.8996 | 6m 6.4s | 0.9004 |
| Device-30(ii)_model.h5 | 0.0043 | 0.9613 | 6m 6.6s | 0.9617 |
| Device-30(iii)_model.h5 | 0.1231 | 0.9256 | 6m 7.7s | 0.9245 |

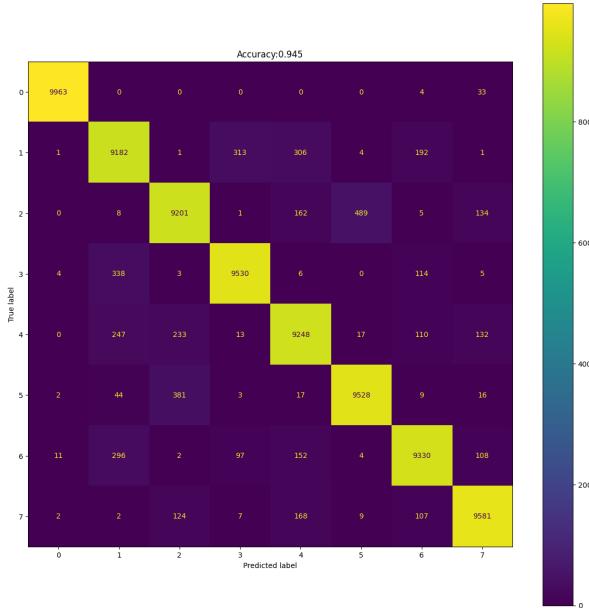
Device-25(ii)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

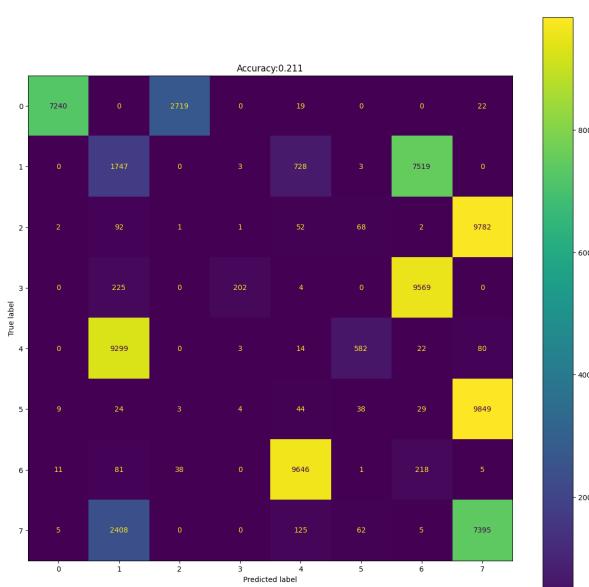


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

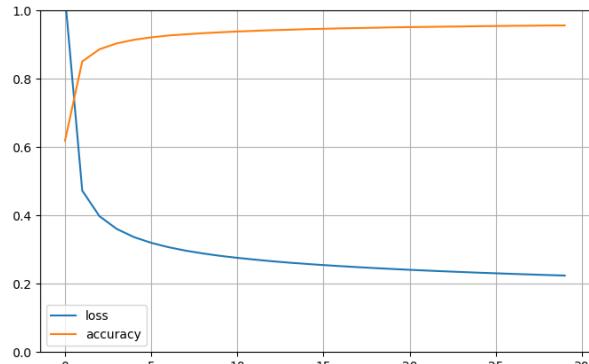


Device-25(iii)_model.h5

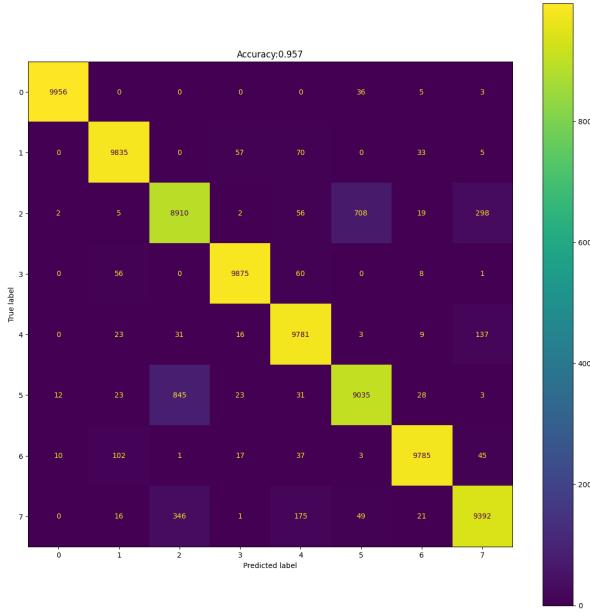
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

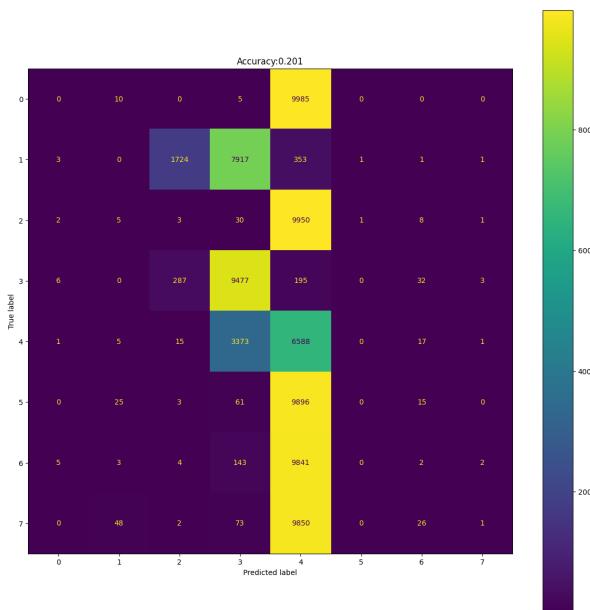


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

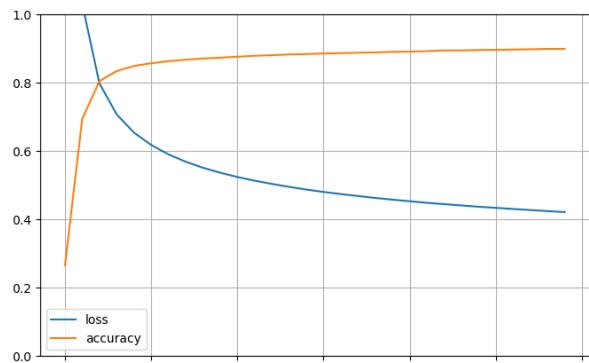


Device-30(i)_model.h5

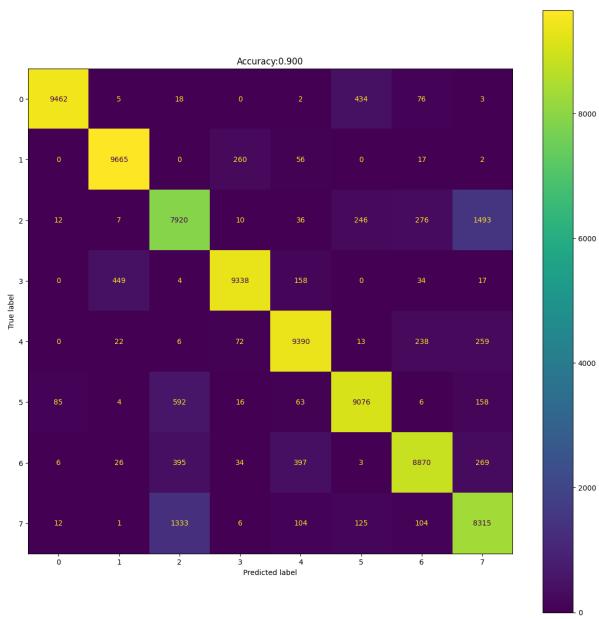
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

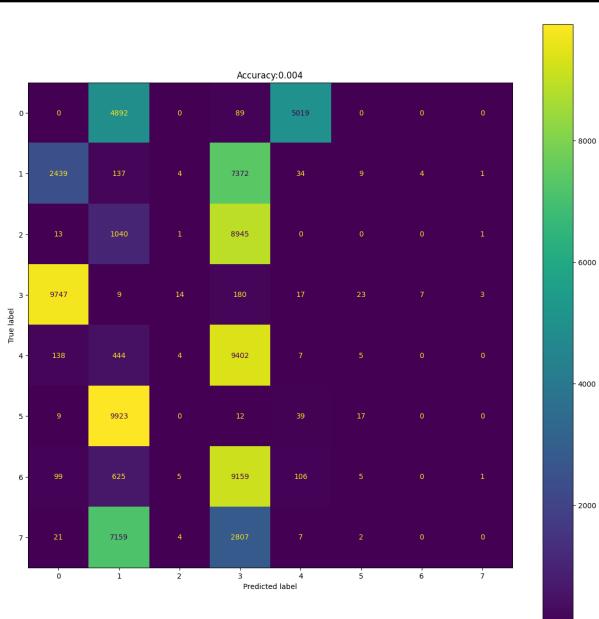


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

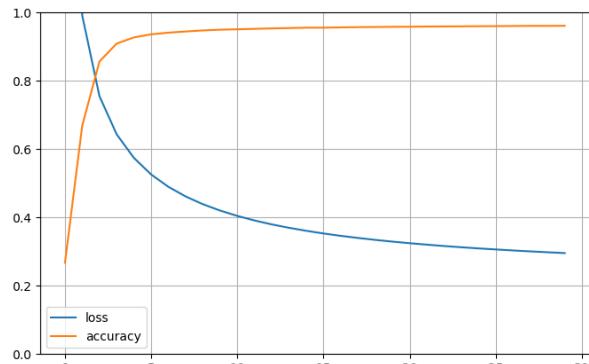


Device-30(ii)_model.h5

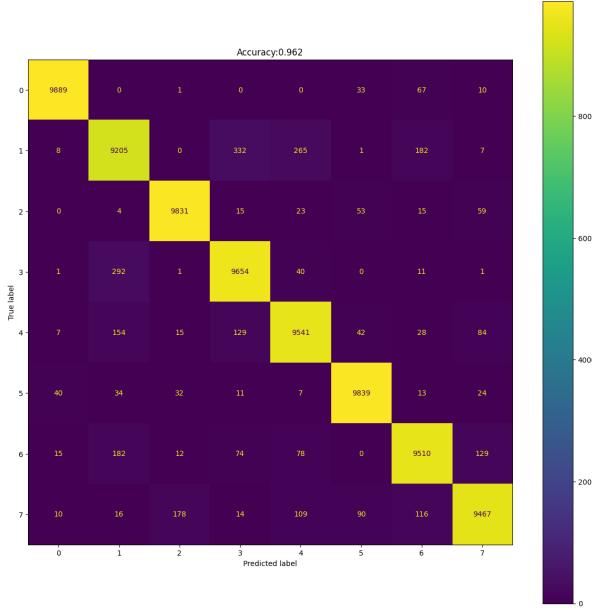
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

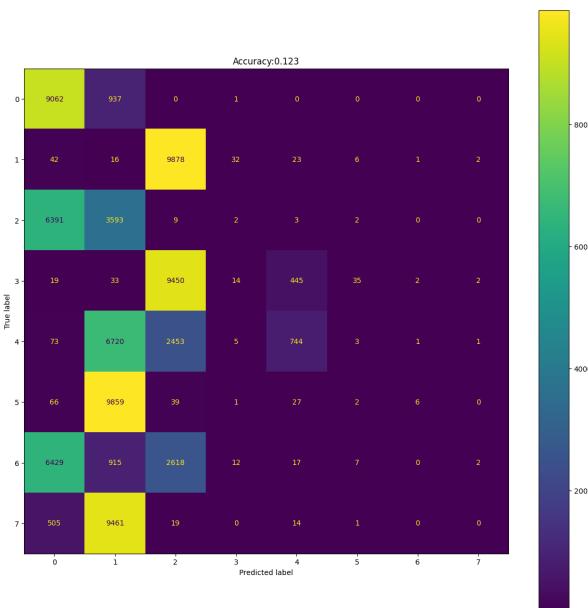


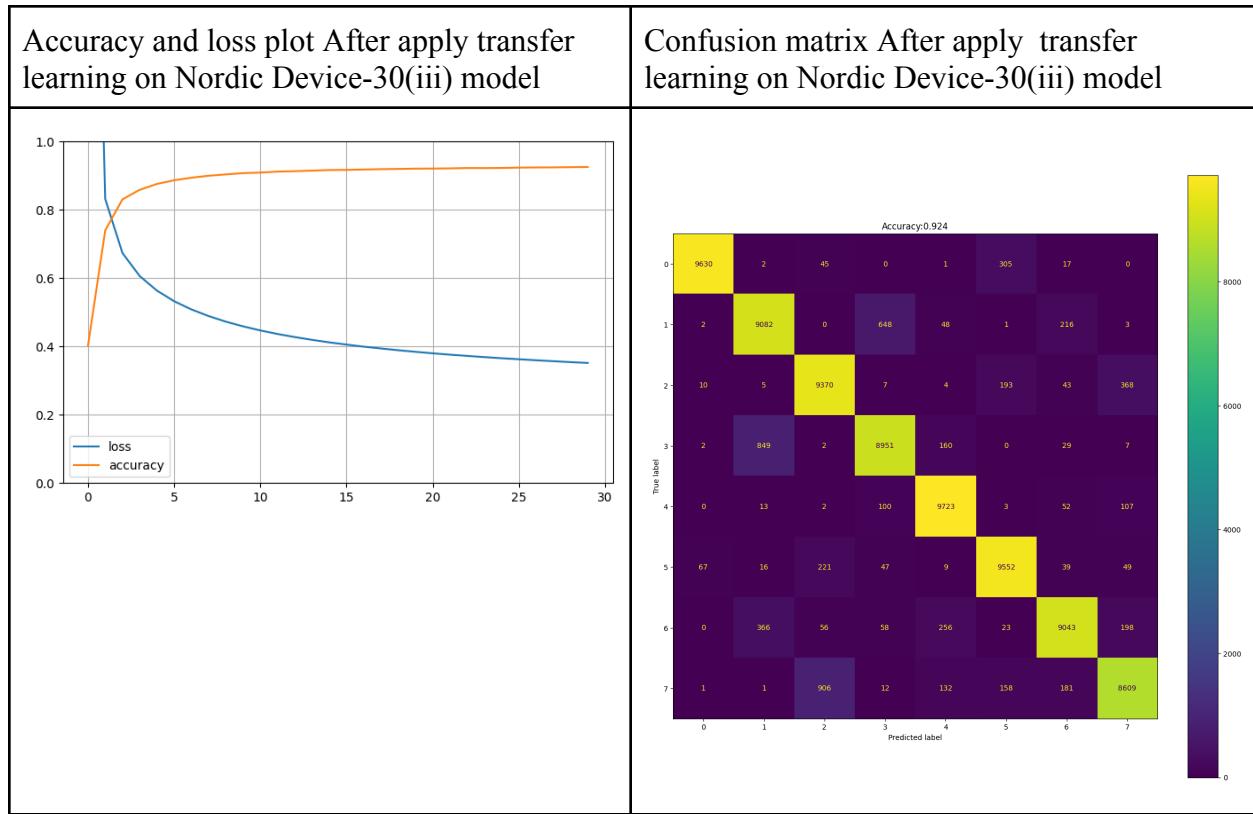
Confusion matrix After apply transfer learning on Nordic Device-30(ii) model



Device-30(iii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



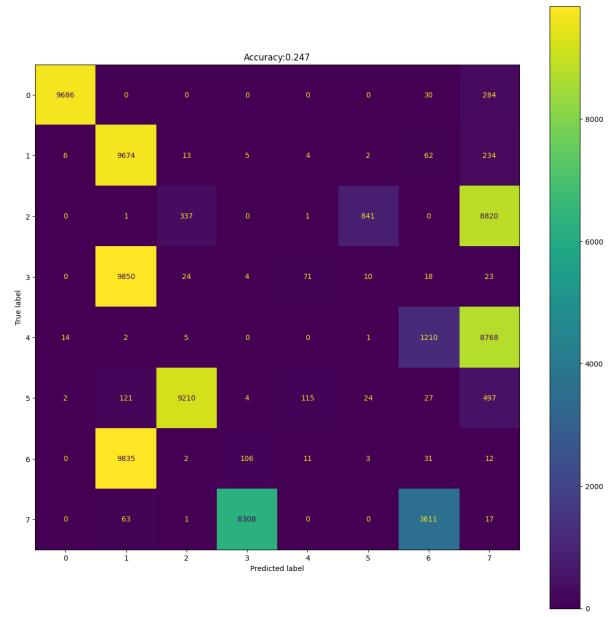


Nordic Device-25(ii) dataset

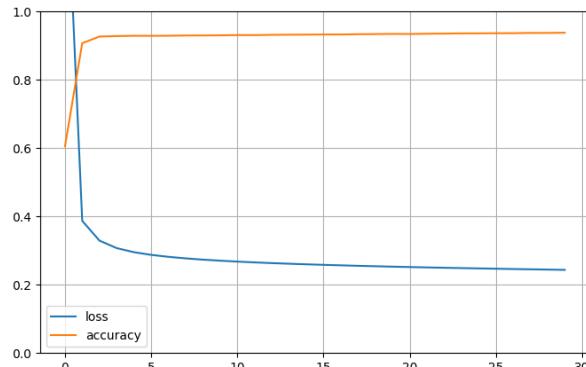
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.2472 | 0.9381 | 6m 8.5s | 0.9389 |
| Device-25(iii)_model.h5 | 0.3146 | 0.9619 | 5m 42.5s | 0.9621 |
| Device-30(i)_model.h5 | 0.2439 | 0.7736 | 5m 7.6s | 0.7728 |
| Device-30(ii)_model.h5 | 0.0447 | 0.9349 | 6m 0.6s | 0.9355 |
| Device-30(iii)_model.h5 | 0.0988 | 0.8959 | 5m 58.4s | 0.8946 |

Device-25(i)_model.h5

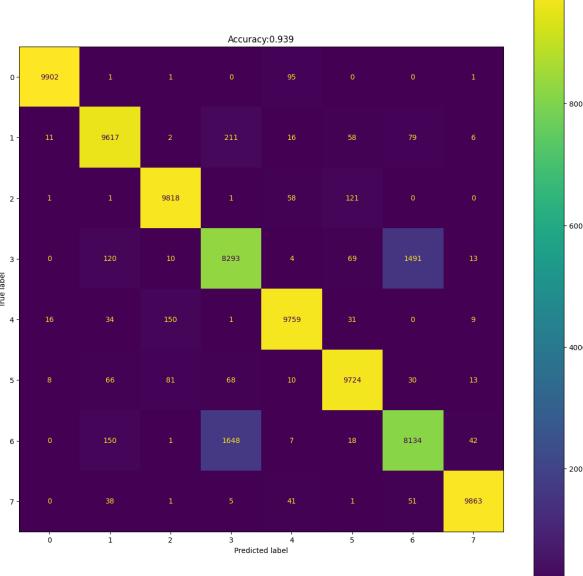
Confusion matrix of by applying the cross-model of Nordic Device-25(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

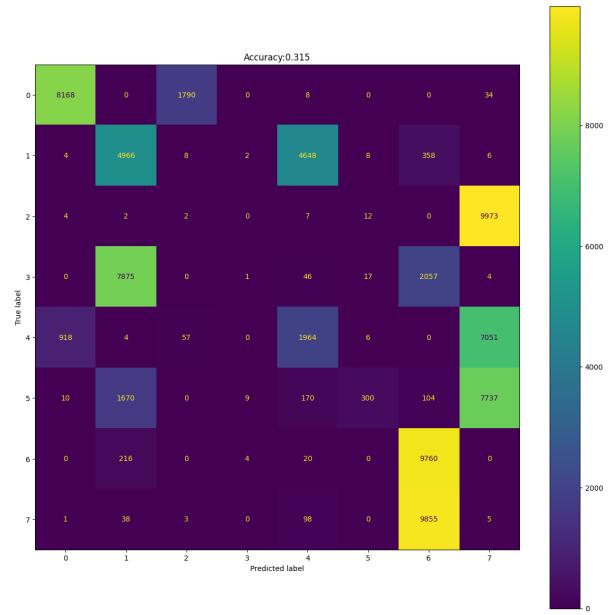


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

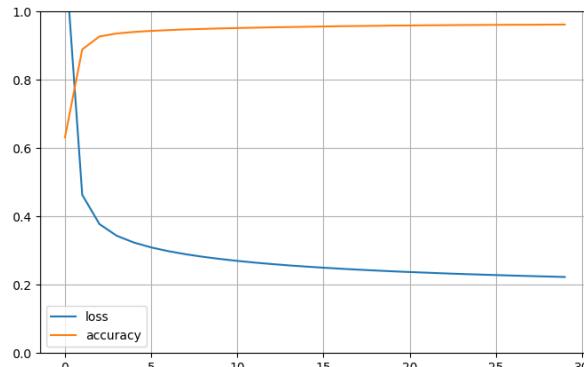


Device-25(iii)_model.h5

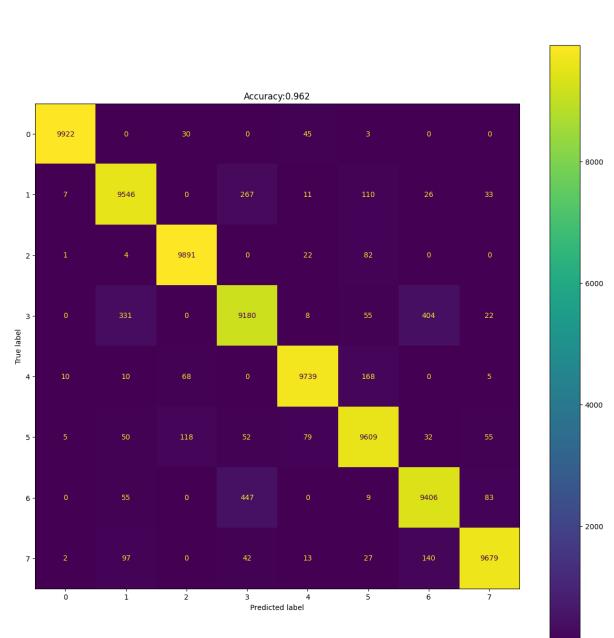
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

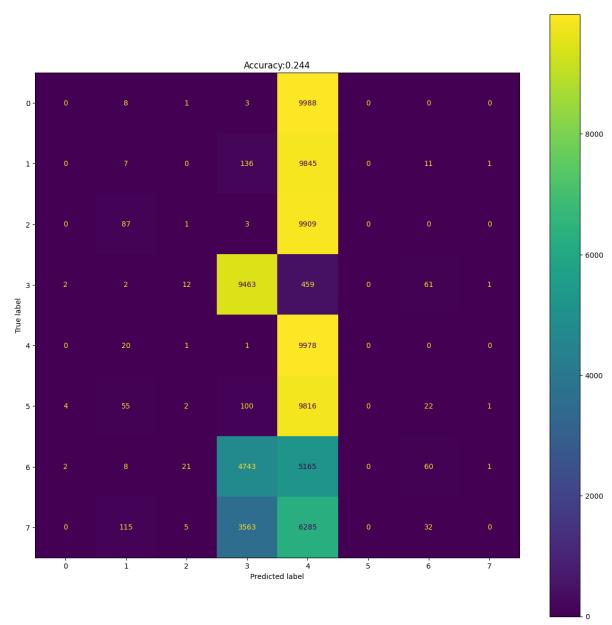


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

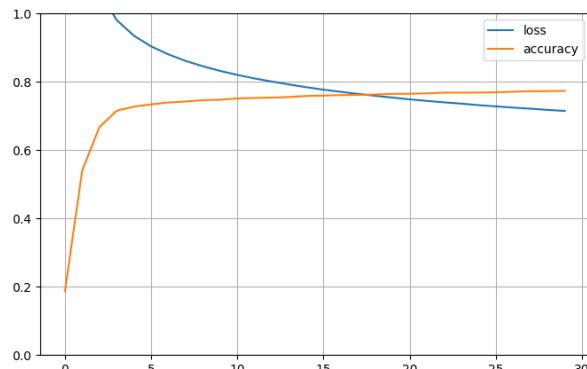


Device-30(i)_model.h5

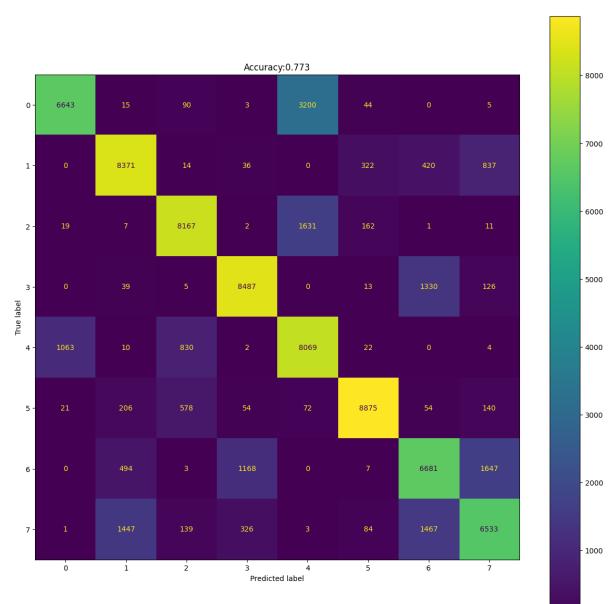
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

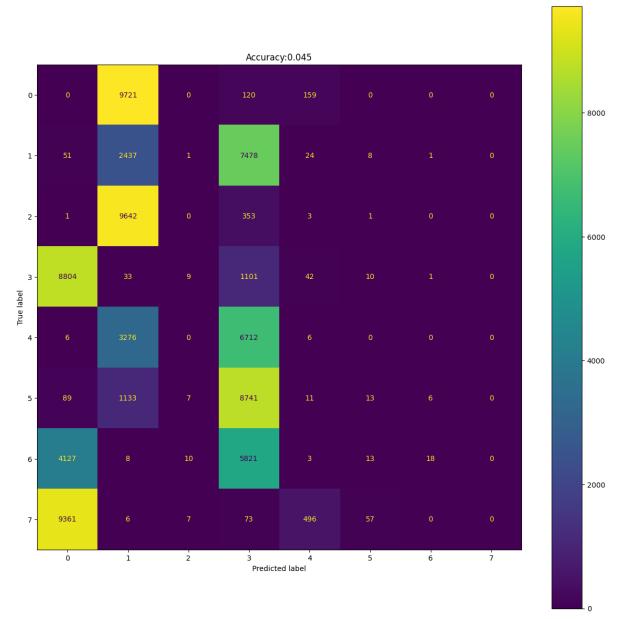


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

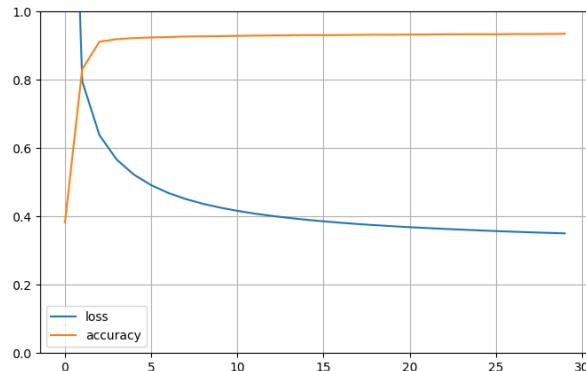


Device-30(ii)_model.h5

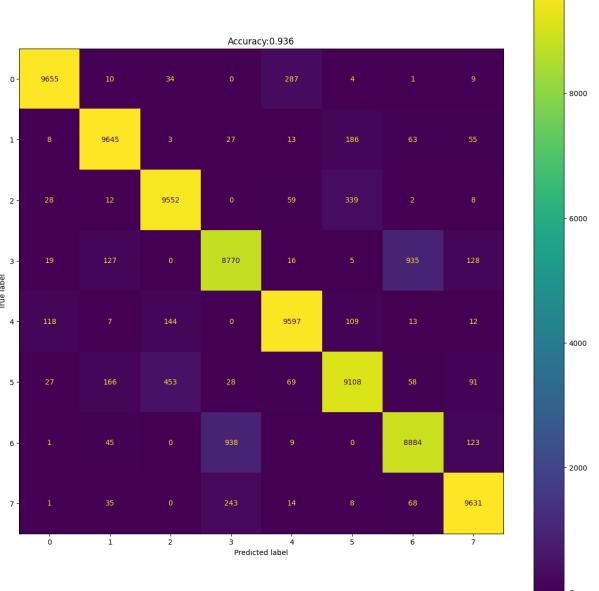
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

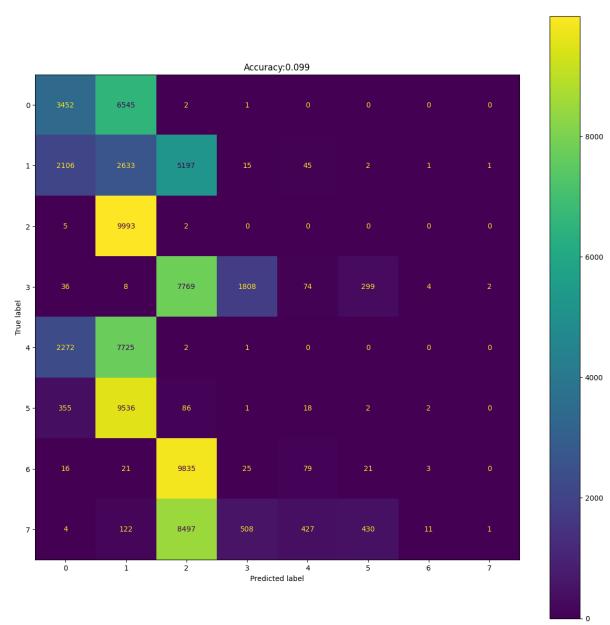


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

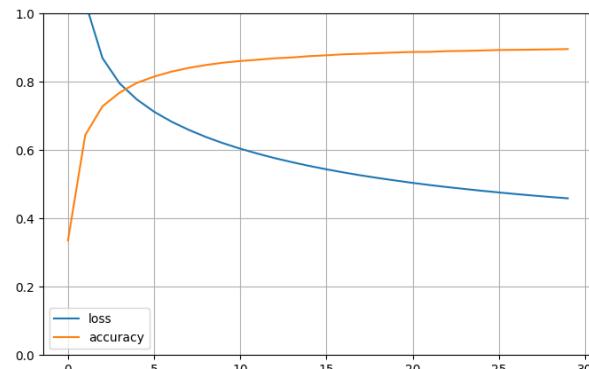


Device-30(iii)_model.h5

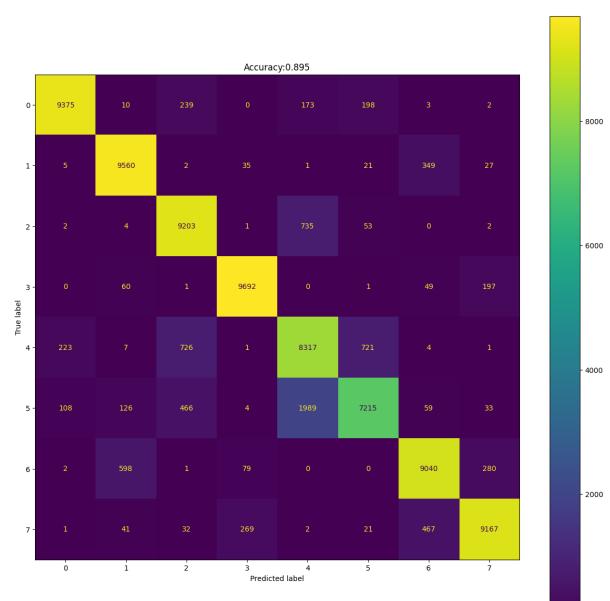
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model



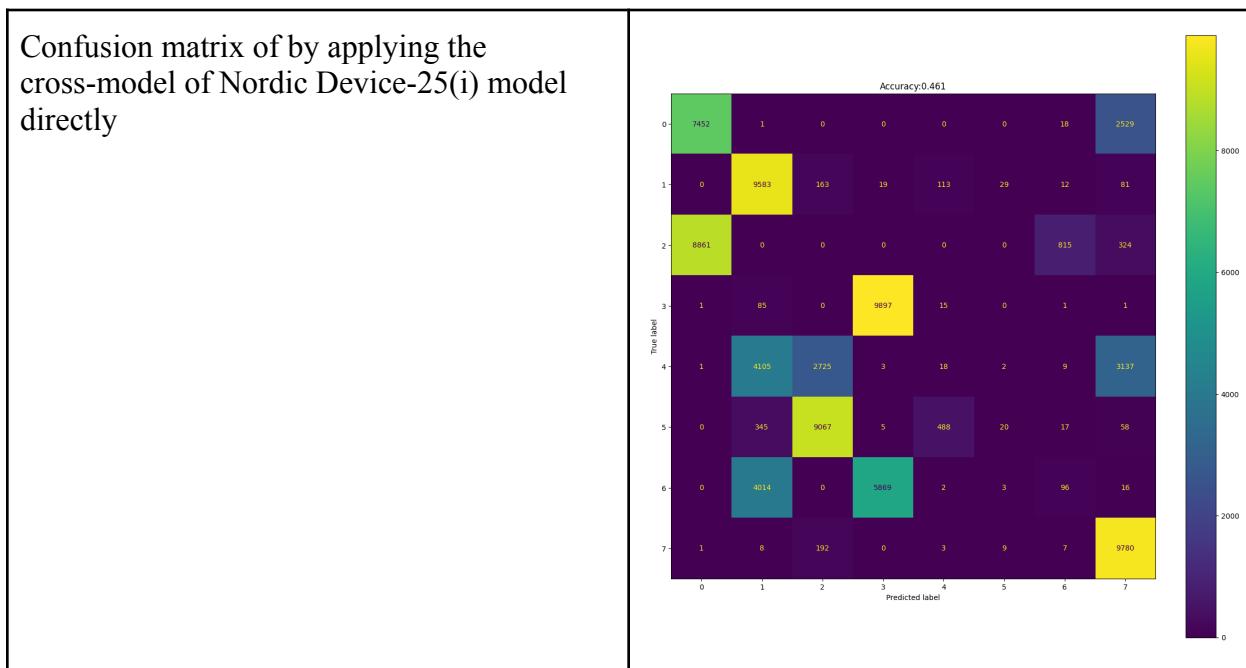
Confusion matrix After apply transfer learning on Nordic Device-30(iii) model



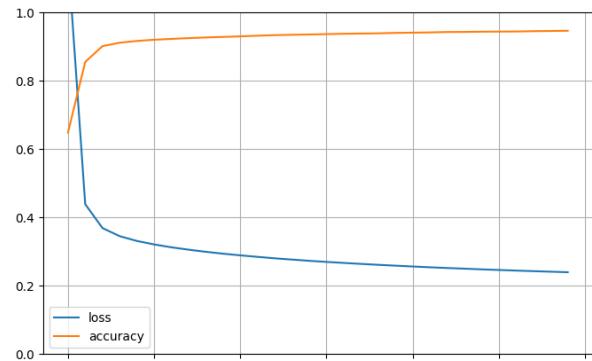
Nordic Device-25(iii) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.4606 | 0.9467 | 5m 33.4s | 0.9470 |
| Device-25(ii)_model.h5 | 0.5052 | 0.9373 | 6m 25.9s | 0.9372 |
| Device-30(i)_model.h5 | 0.1296 | 0.8126 | 6m 21.7s | 0.8132 |
| Device-30(ii)_model.h5 | 0.0025 | 0.9390 | 5m 58.4s | 0.9406 |
| Device-30(iii)_model.h5 | 0.1090 | 0.9200 | 6m 16.6s | 0.9204 |

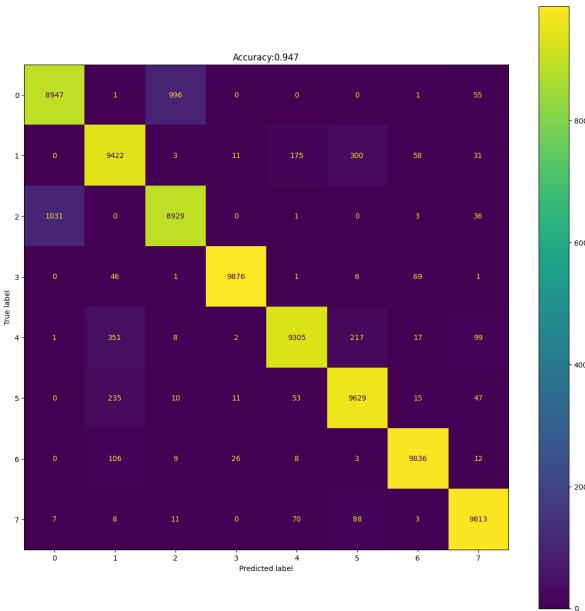
Device-25(i)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

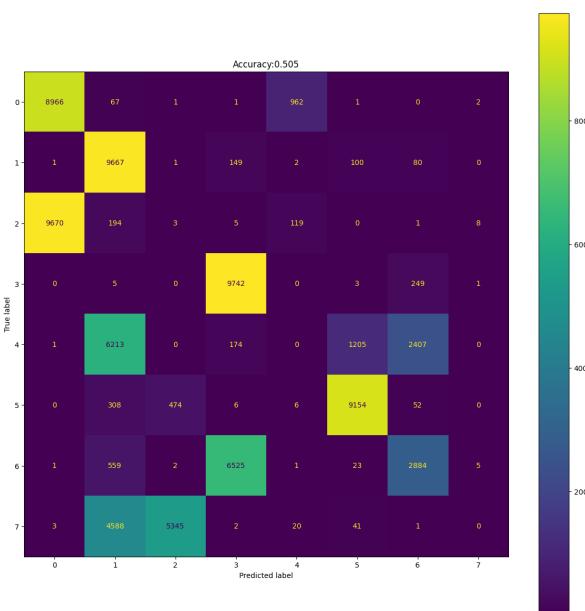


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

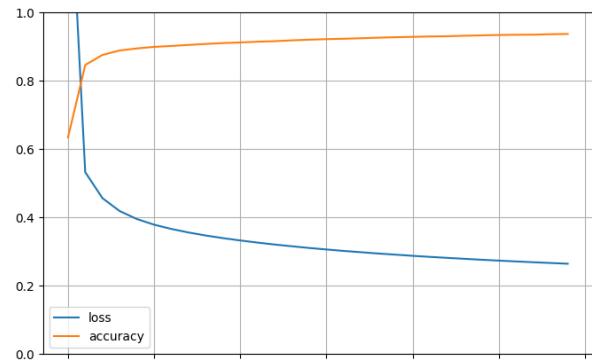


Device-25(ii)_model.h5

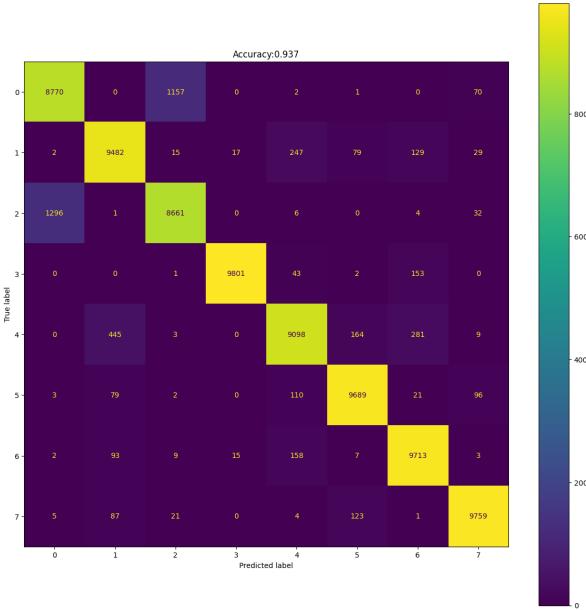
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

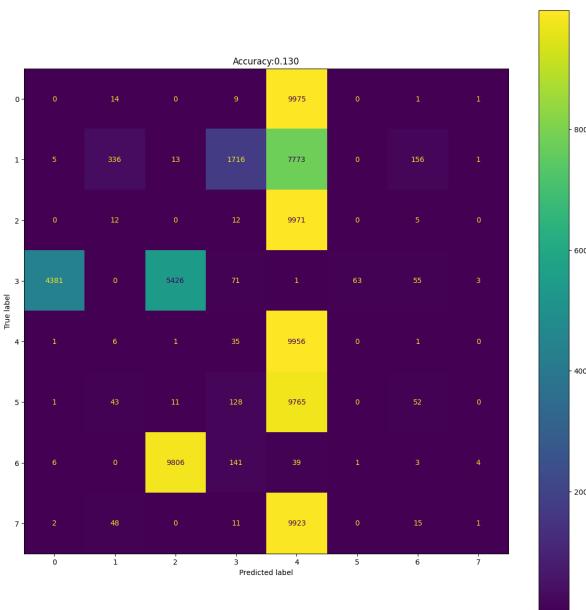


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

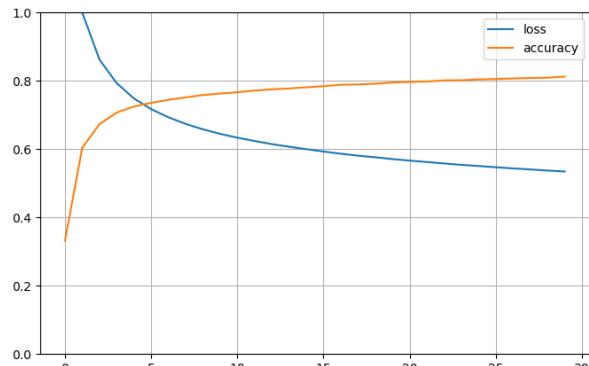


Device-30(i)_model.h5

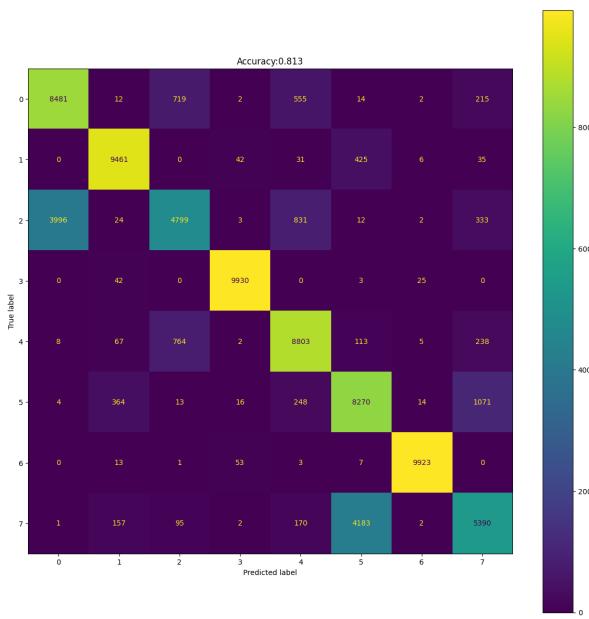
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

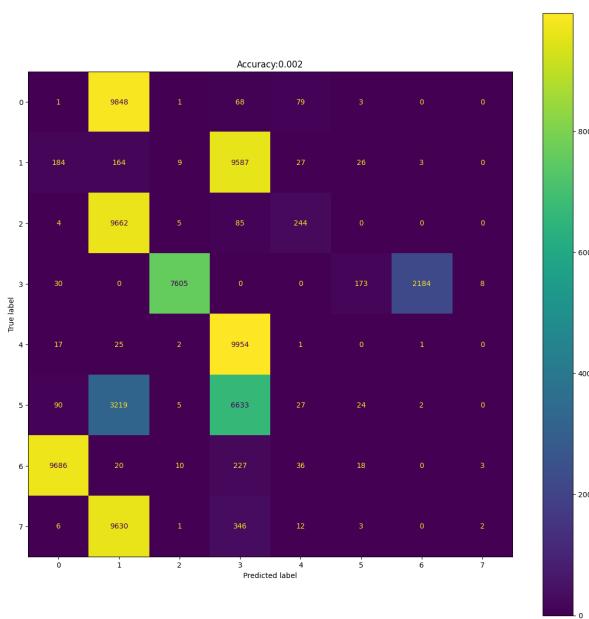


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

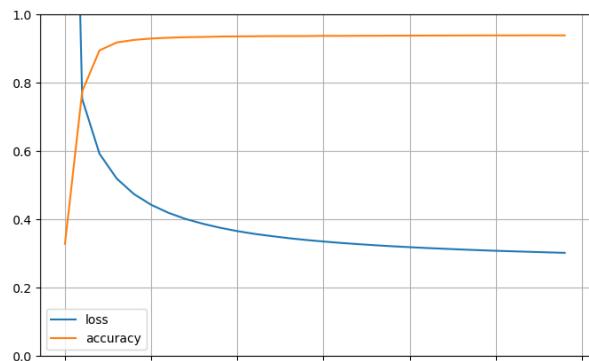


Device-30(ii)_model.h5

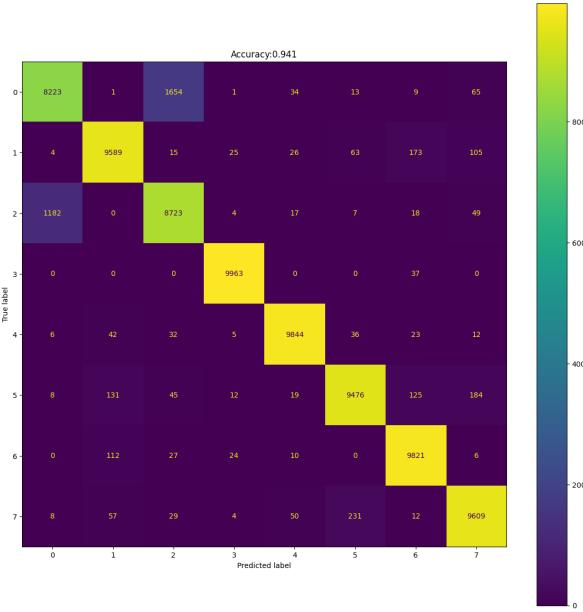
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

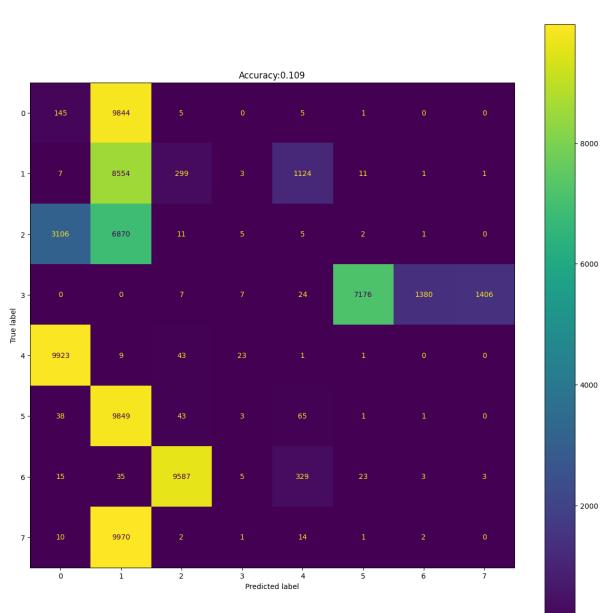


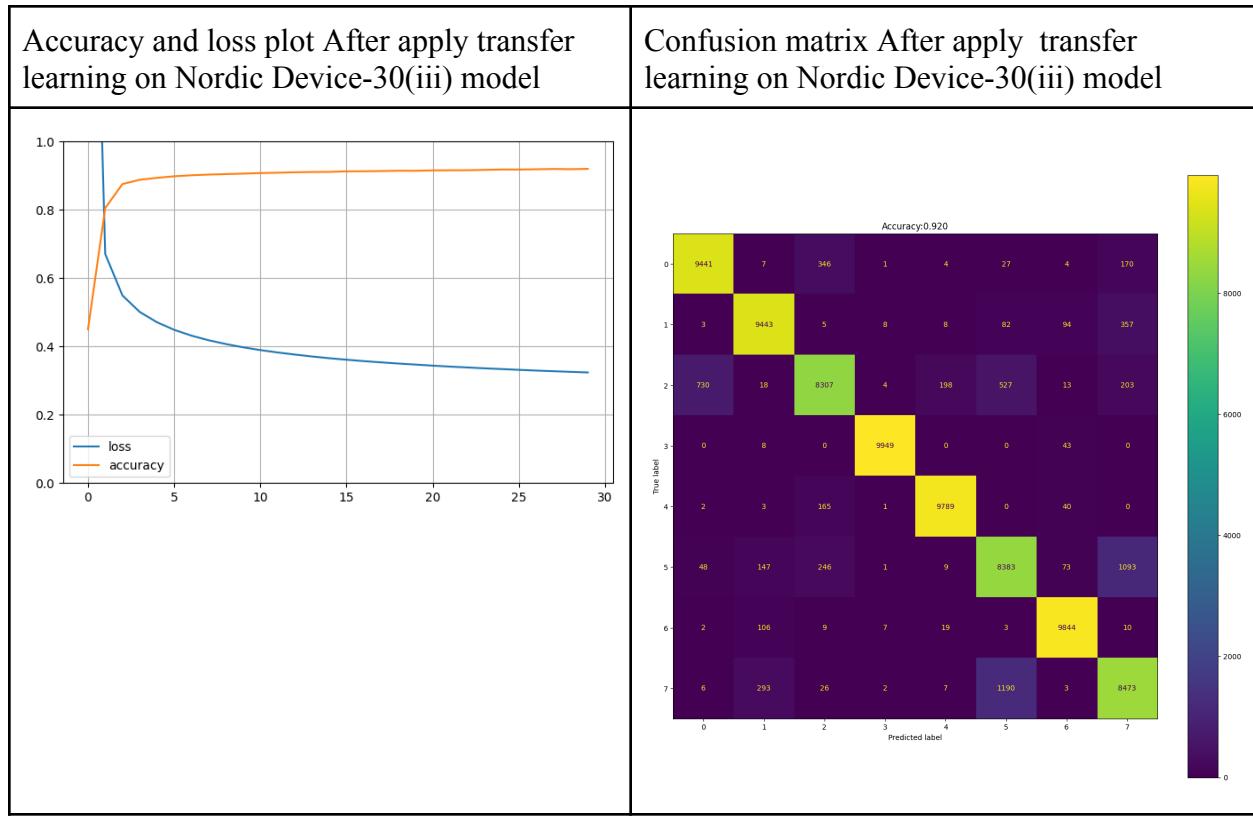
Confusion matrix After apply transfer learning on Nordic Device-30(ii) model



Device-30(iii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



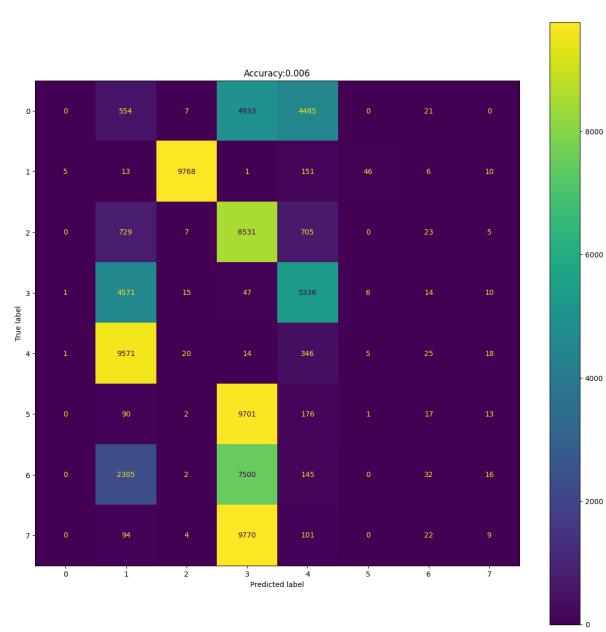


Nordic Device-30(i) dataset

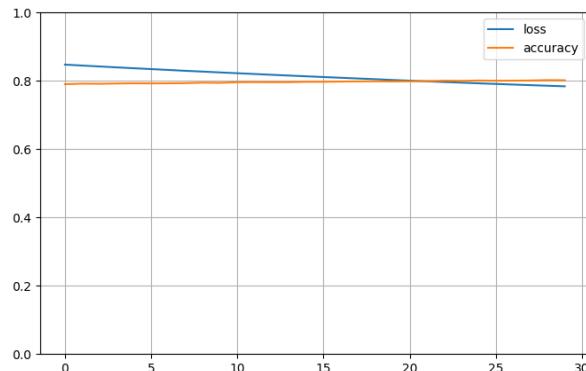
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.0057 | 0.8018 | 4m 47.5s | 0.8075 |
| Device-25(ii)_model.h5 | 0.2587 | 0.7483 | 5m 12.4s | 0.7536 |
| Device-25(iii)_model.h5 | 0.0214 | 0.8777 | 5m 8.1s | 0.8890 |
| Device-30(ii)_model.h5 | 0.1263 | 0.8667 | 5m 20.9s | 0.8664 |
| Device-30(iii)_model.h5 | 0.3965 | 0.8460 | 5m 18.6s | 0.8494 |

Device-25(i)_model.h5

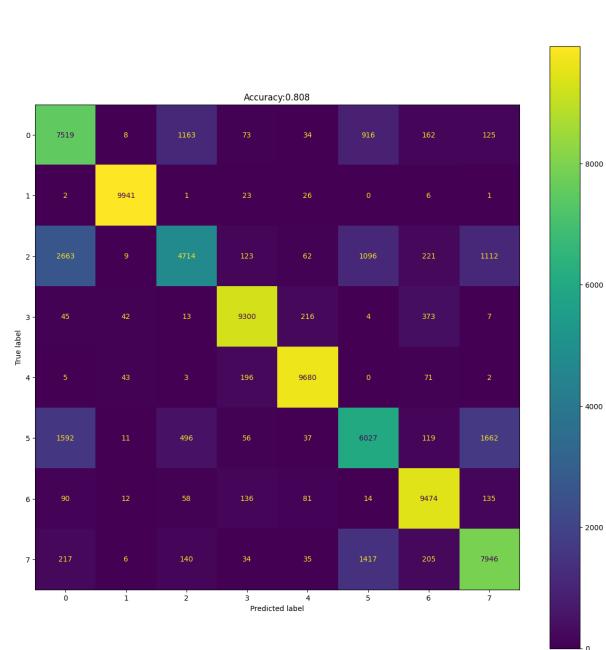
Confusion matrix of by applying the cross-model of Nordic Device-25(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

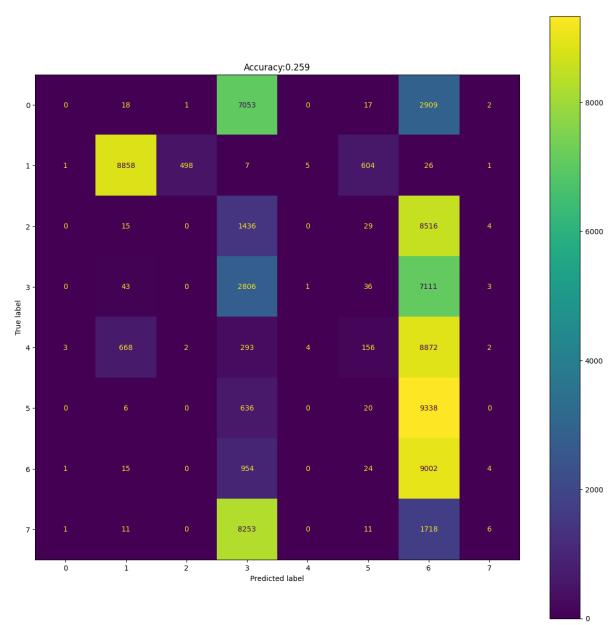


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

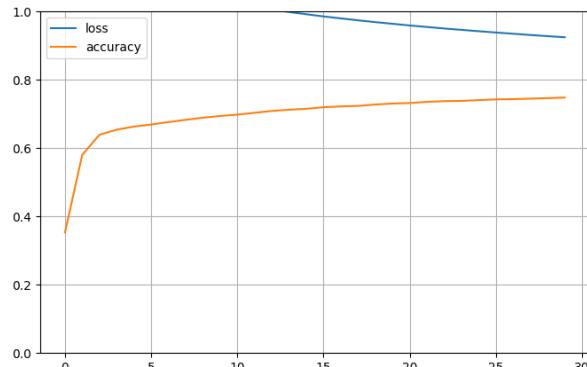


Device-25(ii)_model.h5

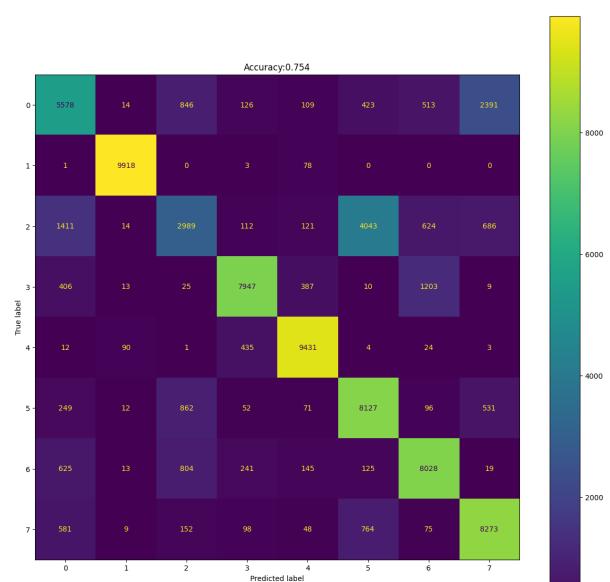
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

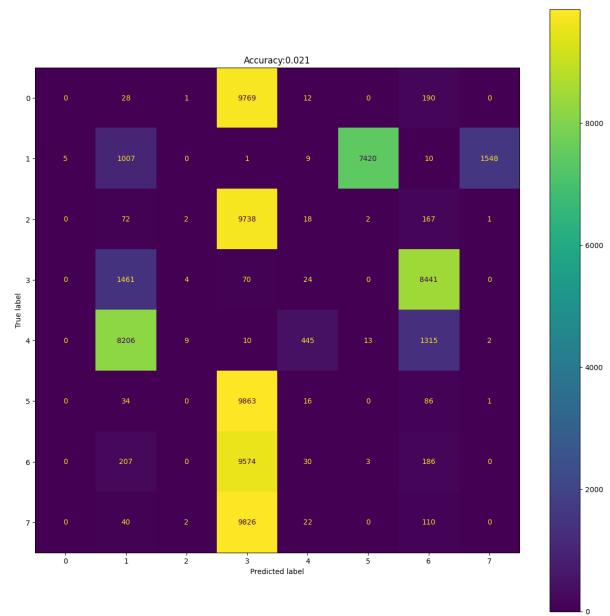


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

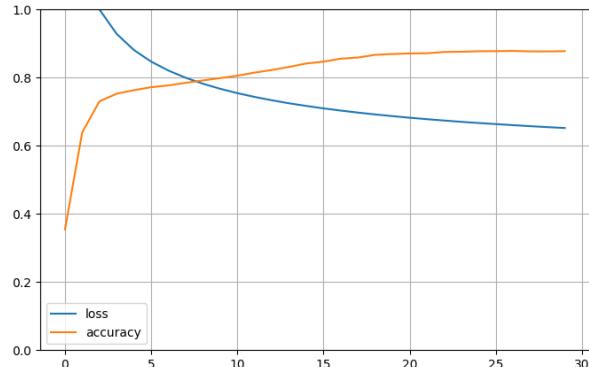


Device-25(iii)_model.h5

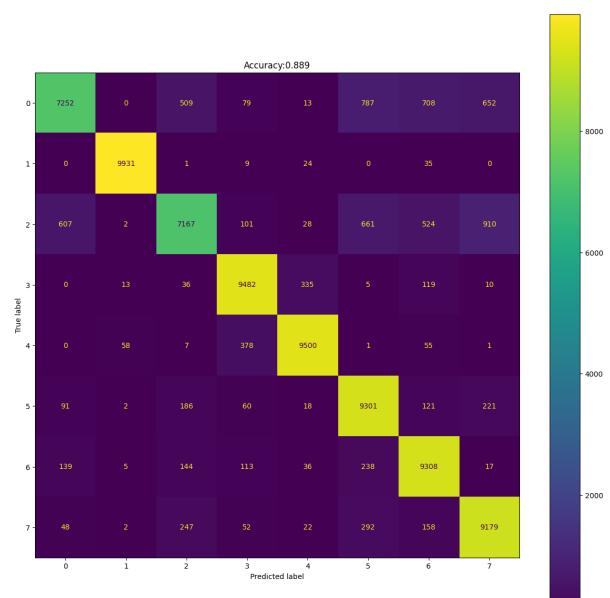
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

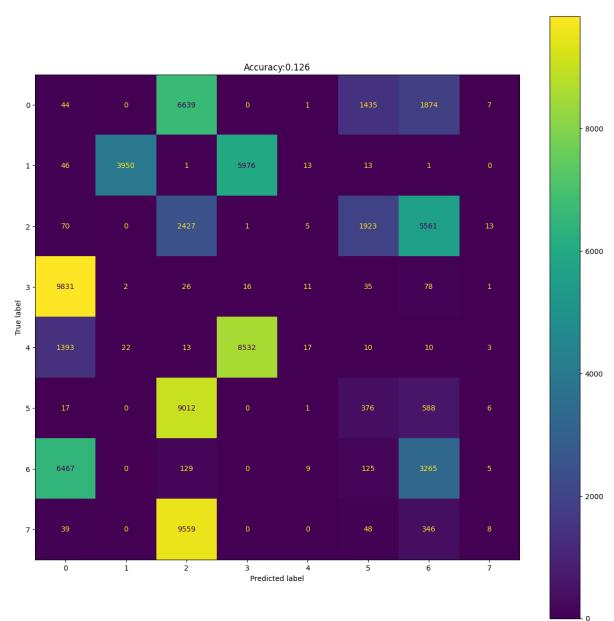


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

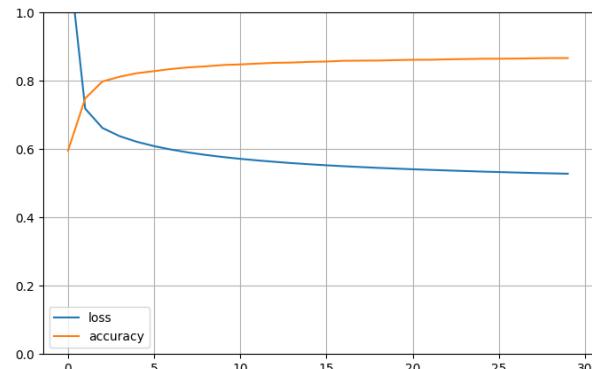


Device-30(ii)_model.h5

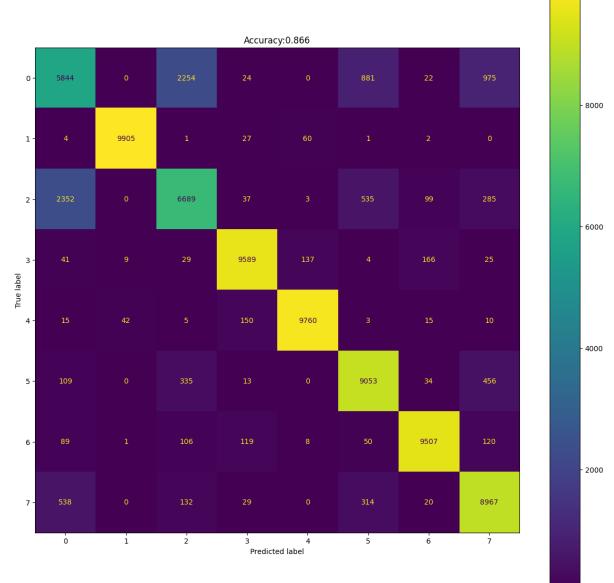
Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model

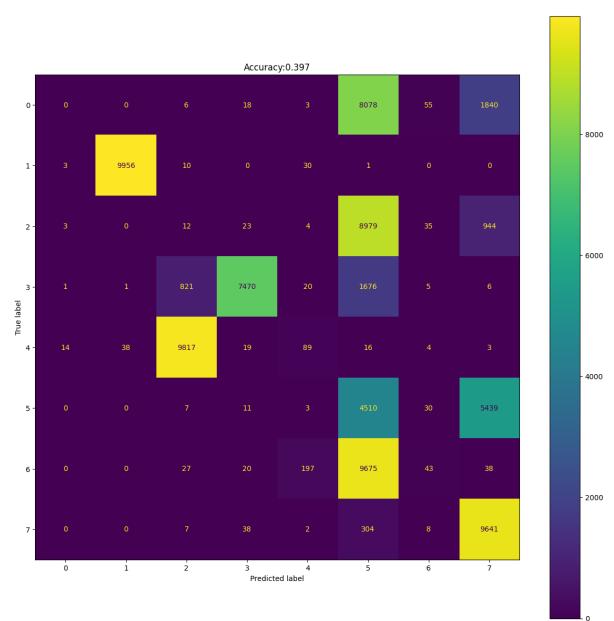


Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

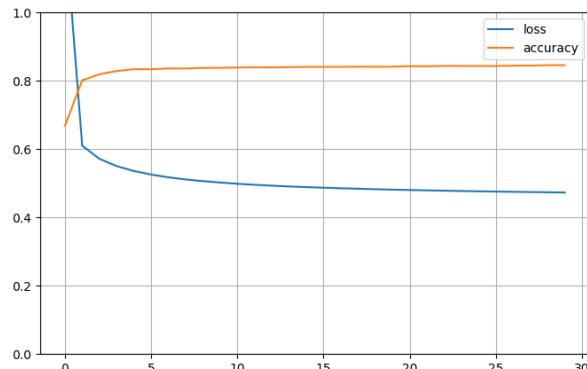


Device-30(iii)_model.h5

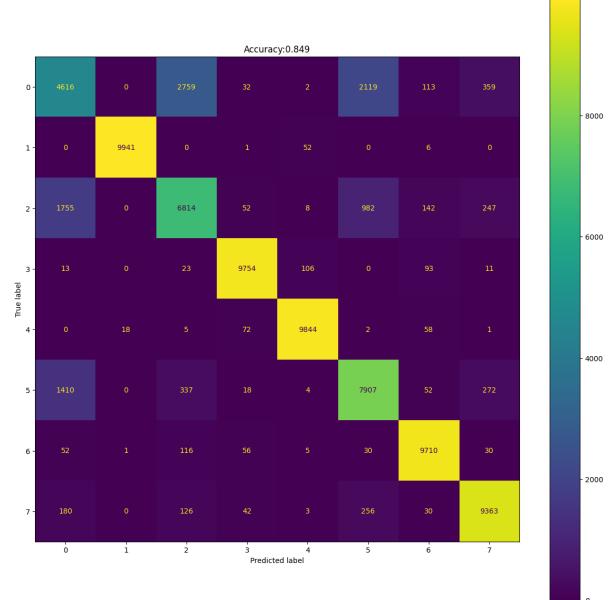
Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(iii) model



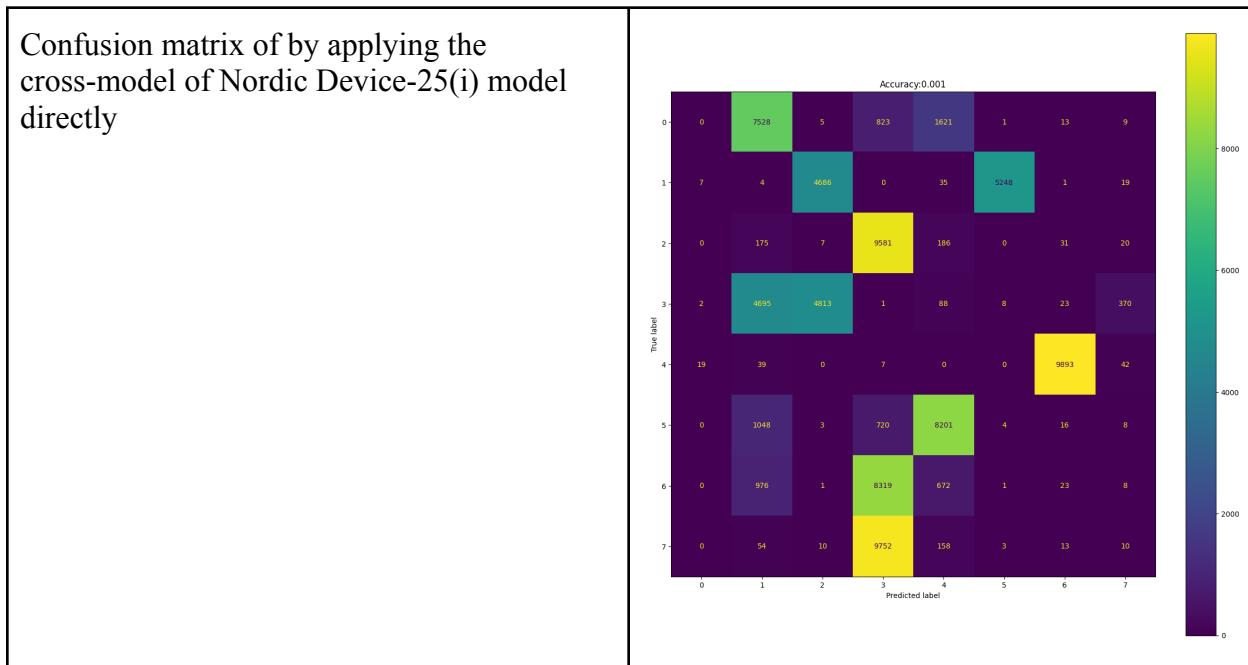
Confusion matrix After apply transfer learning on Nordic Device-30(iii) model



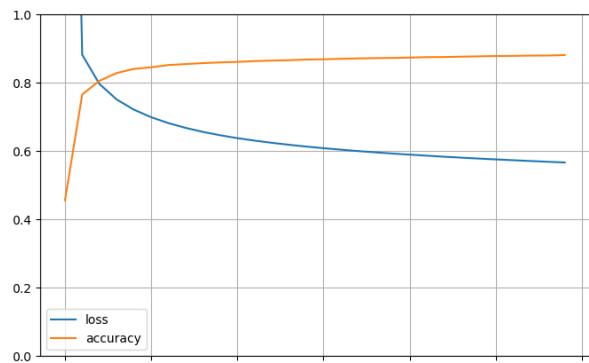
Nordic Device-30(ii) dataset

| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.0006 | 0.8812 | 4m 52.8s | 0.8795 |
| Device-25(ii)_model.h5 | 0.1681 | 0.8928 | 4m 54.4s | 0.8958 |
| Device-25(iii)_model.h5 | 0.1432 | 0.9111 | 4m 51.2s | 0.9127 |
| Device-30(i)_model.h5 | 0.1727 | 0.9184 | 4m 54.3s | 0.9189 |
| Device-30(iii)_model.h5 | 0.3727 | 0.9355 | 4m 41.4s | 0.9363 |

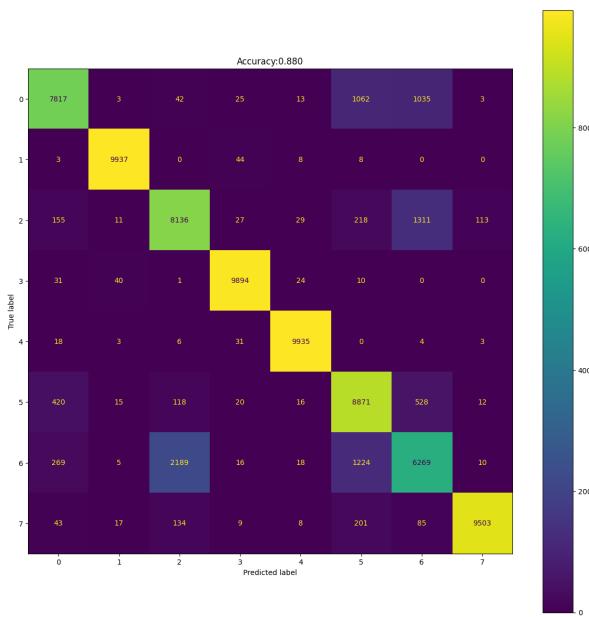
Device-25(i)_model.h5



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

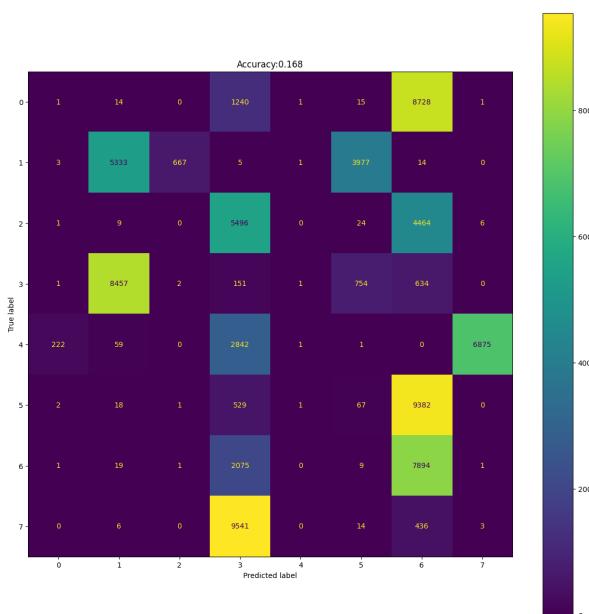


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

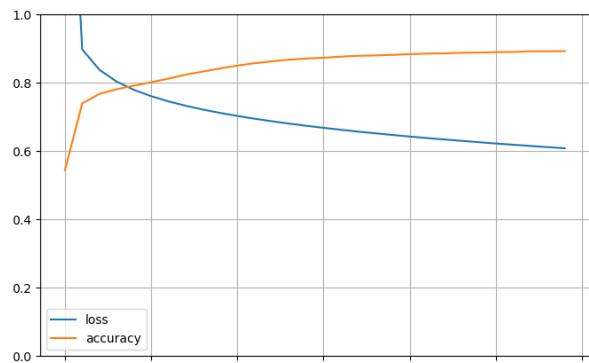


Device-25(ii)_model.h5

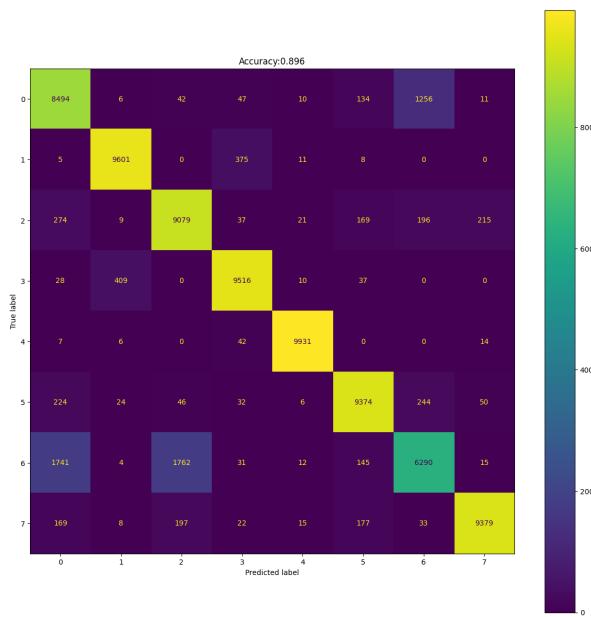
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

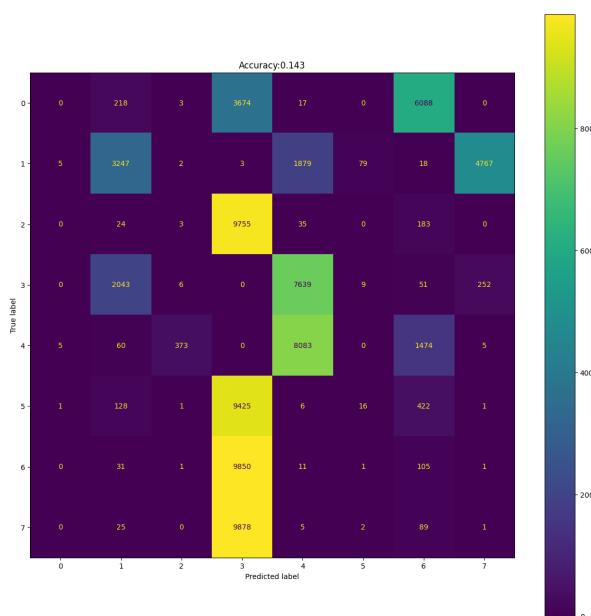


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

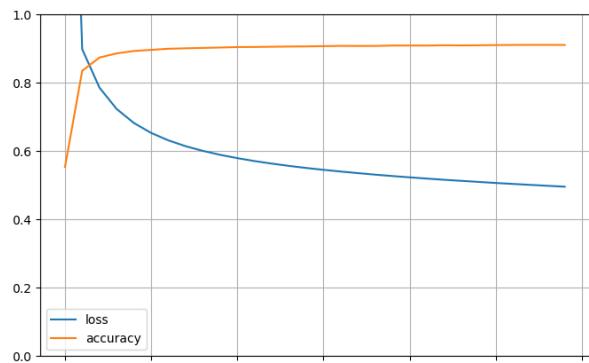


Device-25(iii)_model.h5

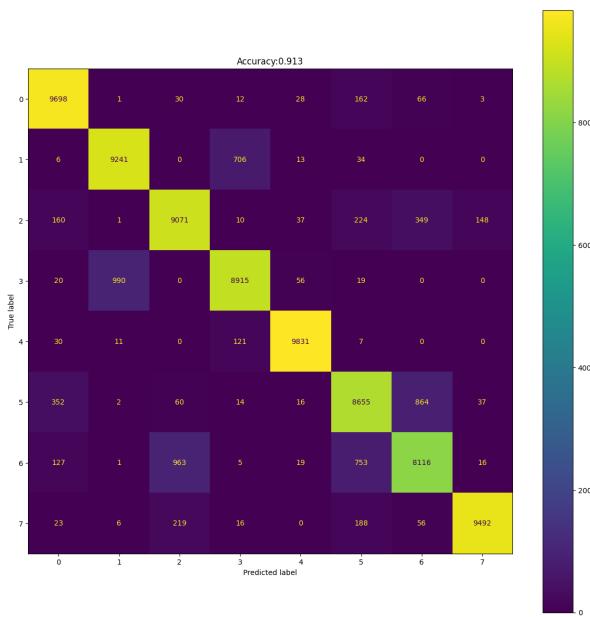
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

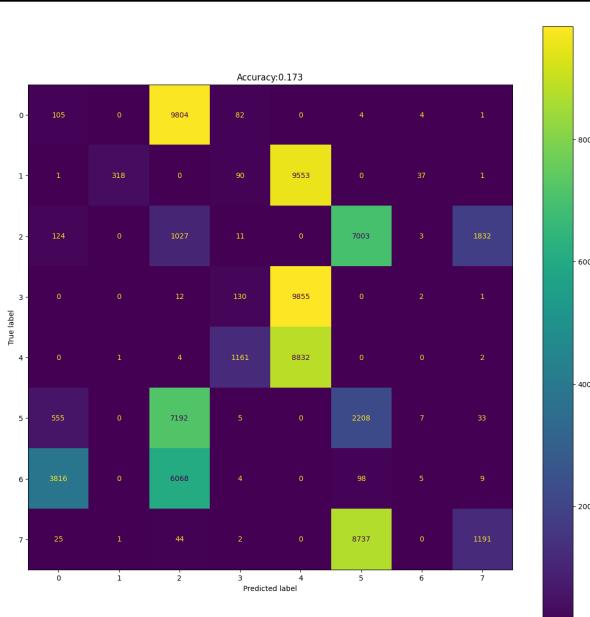


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

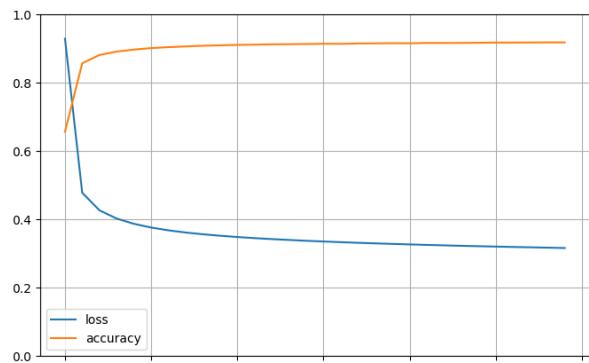


Device-30(i)_model.h5

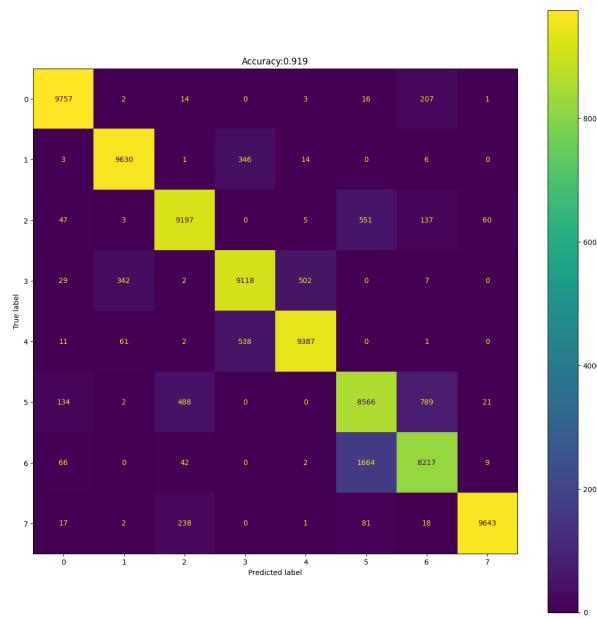
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

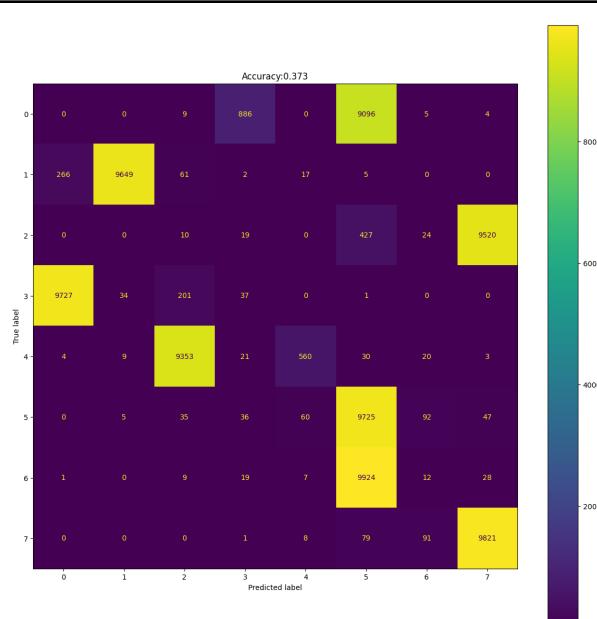


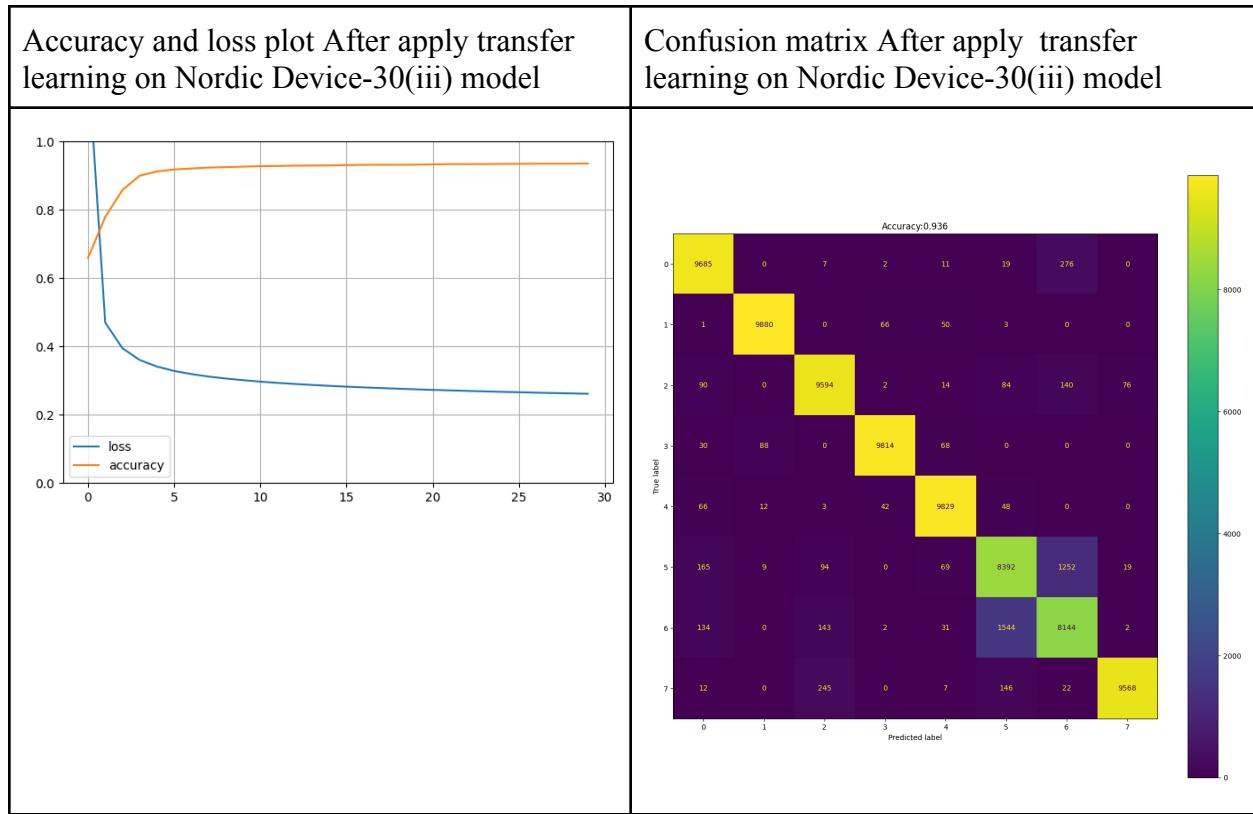
Confusion matrix After apply transfer learning on Nordic Device-30(i) model



Device-30(iii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(iii) model directly



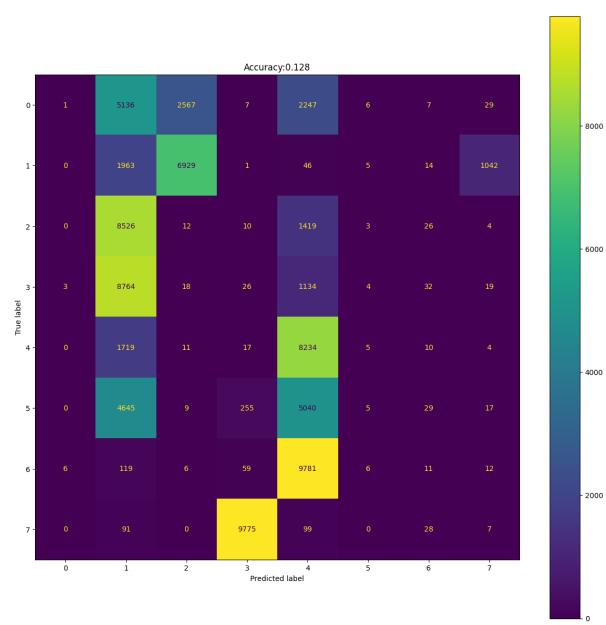


Nordic Device-30(iii) dataset

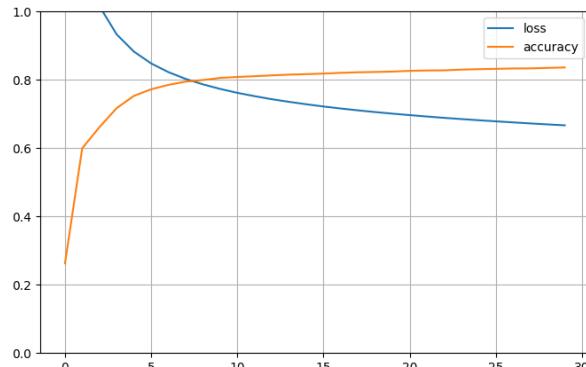
| Model Name | Cross-Model Accuracy (without training) | Transfer Learning | | |
|-------------------------|---|---------------------------------|---------------|------------------|
| | | Training Accuracy at 30th epoch | Learning Time | Testing Accuracy |
| Device-25(i)_model.h5 | 0.1282 | 0.8363 | 4m 50.3s | 0.8351 |
| Device-25(ii)_model.h5 | 0.0679 | 0.9056 | 5m 8.9s | 0.9056 |
| Device-25(iii)_model.h5 | 0.1118 | 0.9086 | 4m 47.8s | 0.9079 |
| Device-30(i)_model.h5 | 0.1684 | 0.9061 | 5m 2.5s | 0.9064 |
| Device-30(ii)_model.h5 | 0.0712 | 0.9440 | 5m 1.1s | 0.9445 |

Device-25(i)_model.h5

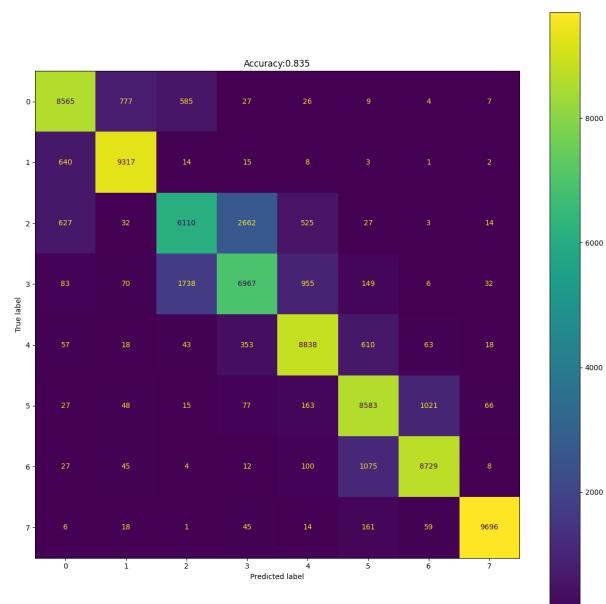
Confusion matrix of by applying the cross-model of Nordic Device-25(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(i) model

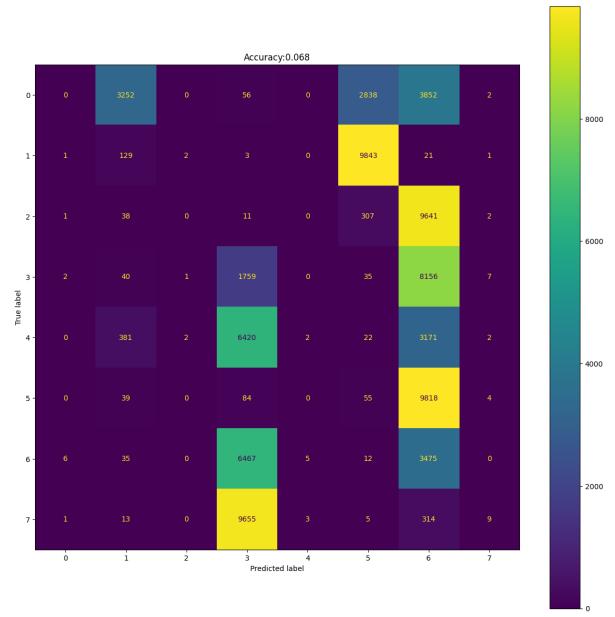


Confusion matrix After apply transfer learning on Nordic Device-25(i) model

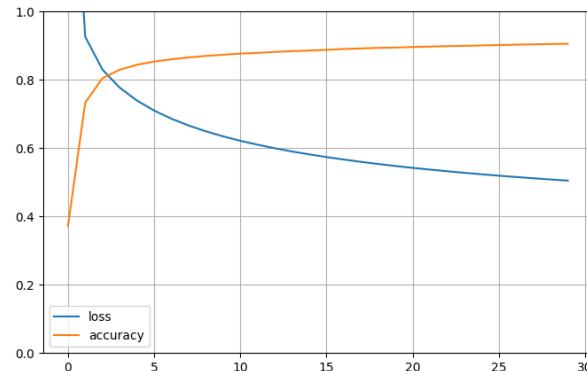


Device-25(ii)_model.h5

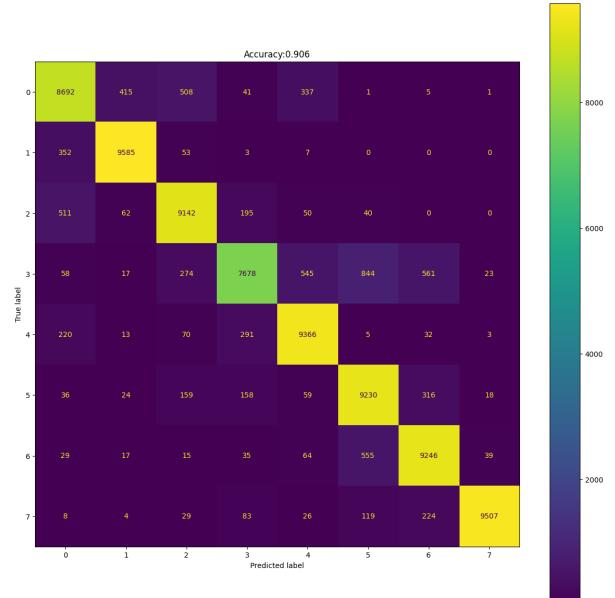
Confusion matrix of by applying the cross-model of Nordic Device-25(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(ii) model

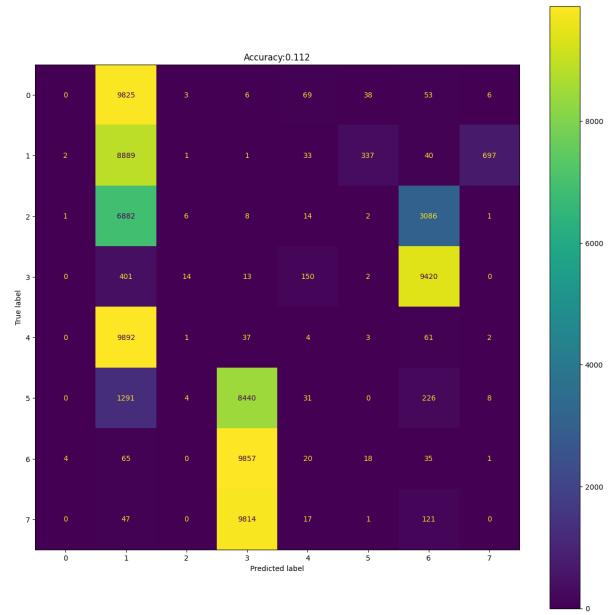


Confusion matrix After apply transfer learning on Nordic Device-25(ii) model

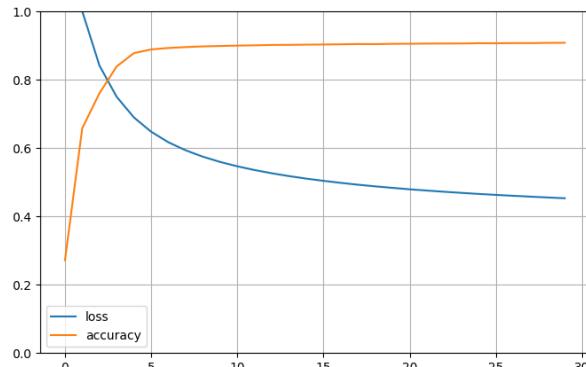


Device-25(iii)_model.h5

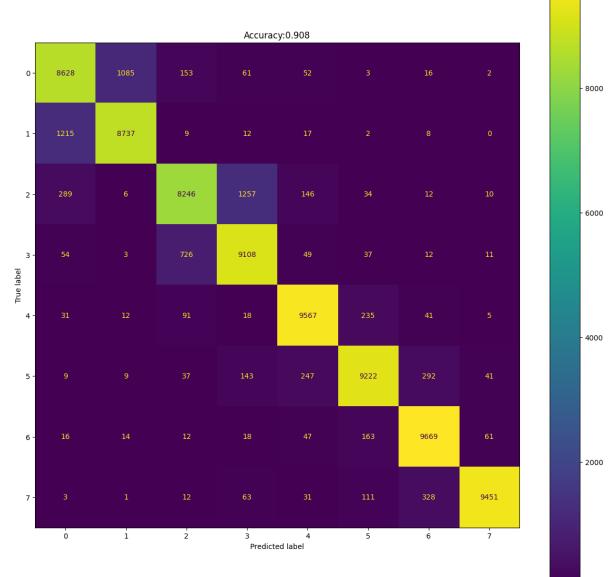
Confusion matrix of by applying the cross-model of Nordic Device-25(iii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-25(iii) model

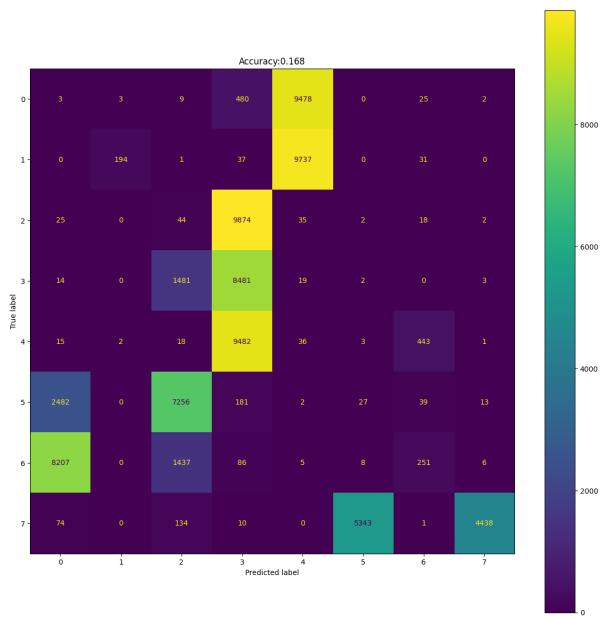


Confusion matrix After apply transfer learning on Nordic Device-25(iii) model

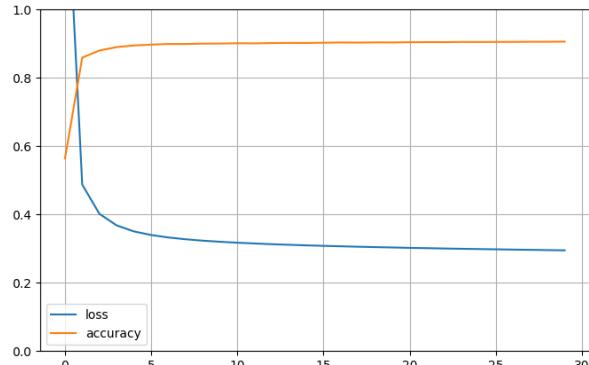


Device-30(i)_model.h5

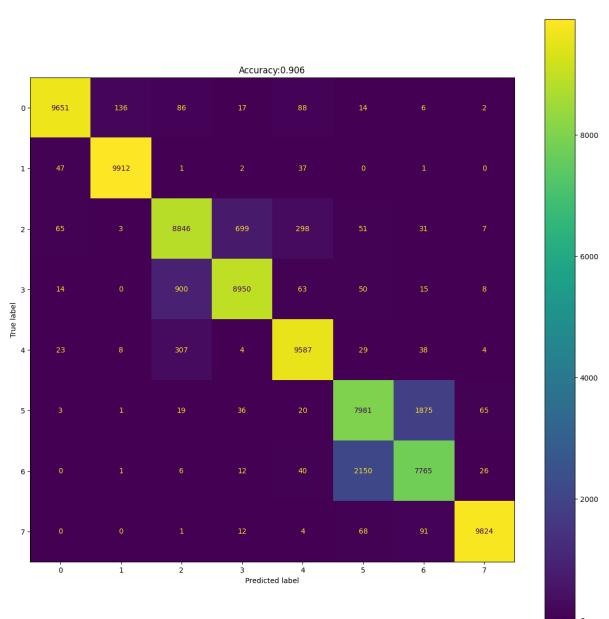
Confusion matrix of by applying the cross-model of Nordic Device-30(i) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(i) model

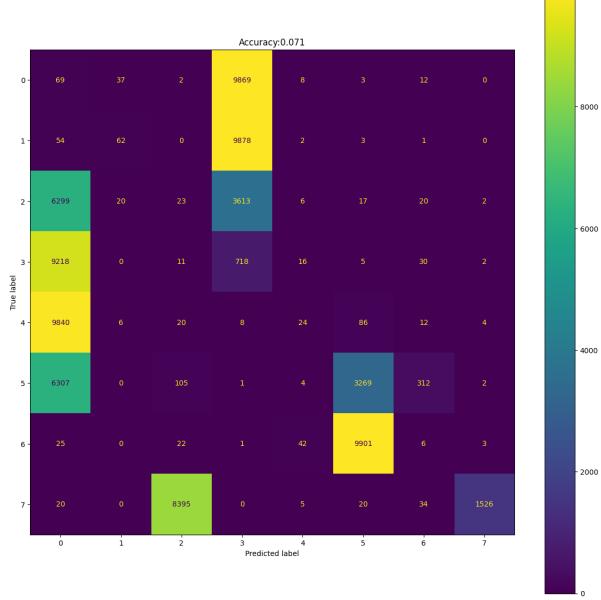


Confusion matrix After apply transfer learning on Nordic Device-30(i) model

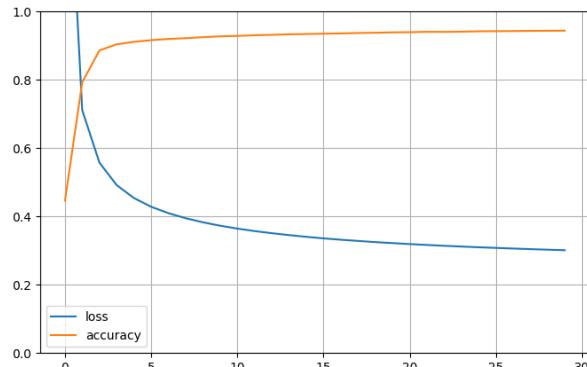


Device-30(ii)_model.h5

Confusion matrix of by applying the cross-model of Nordic Device-30(ii) model directly



Accuracy and loss plot After apply transfer learning on Nordic Device-30(ii) model



Confusion matrix After apply transfer learning on Nordic Device-30(ii) model

