Recognize Keystrokes on Touch Screen Using Smartphone Sensors

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Goal

- ❑ Present an attack that recognizes what's the user's input on an Android smartphone's touch screen by only using the sensors data, which can be collected easily without any permissions.
- ❑ Show that sensor data should be considered as a kind of user privacy as well. Hope this attack can arouse vendors' attention to importance of data privacy.

Motivations and Objectives

- ❑ Motivations
  - Many APPs have access to sensor data nowadays.
  - High risk of data privacy leakage
- ❑ Objectives
  - Implement an APP disguised as a health&fitness APP to collect sensor data at the background
  - Train and use the CNN model to analyze the sensor data to infer the user's input
  - Arouse the public's attention to the serious of data privacy

Research Challenges

- ❑ The movements between two touches are small and quick.
- ❑ The sampling rate might be limited because background APP has lower priority.
- ❑ Too much useless sensor data, hard to find out whether it is a touch on the screen or not.
- ❑ How to choose the features to train the CNN model

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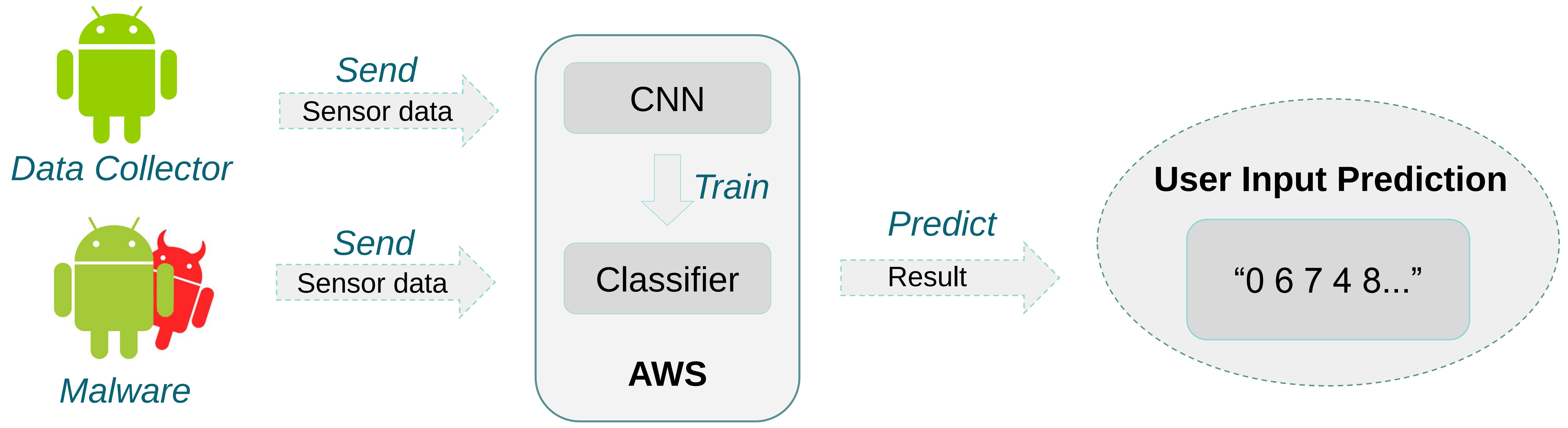
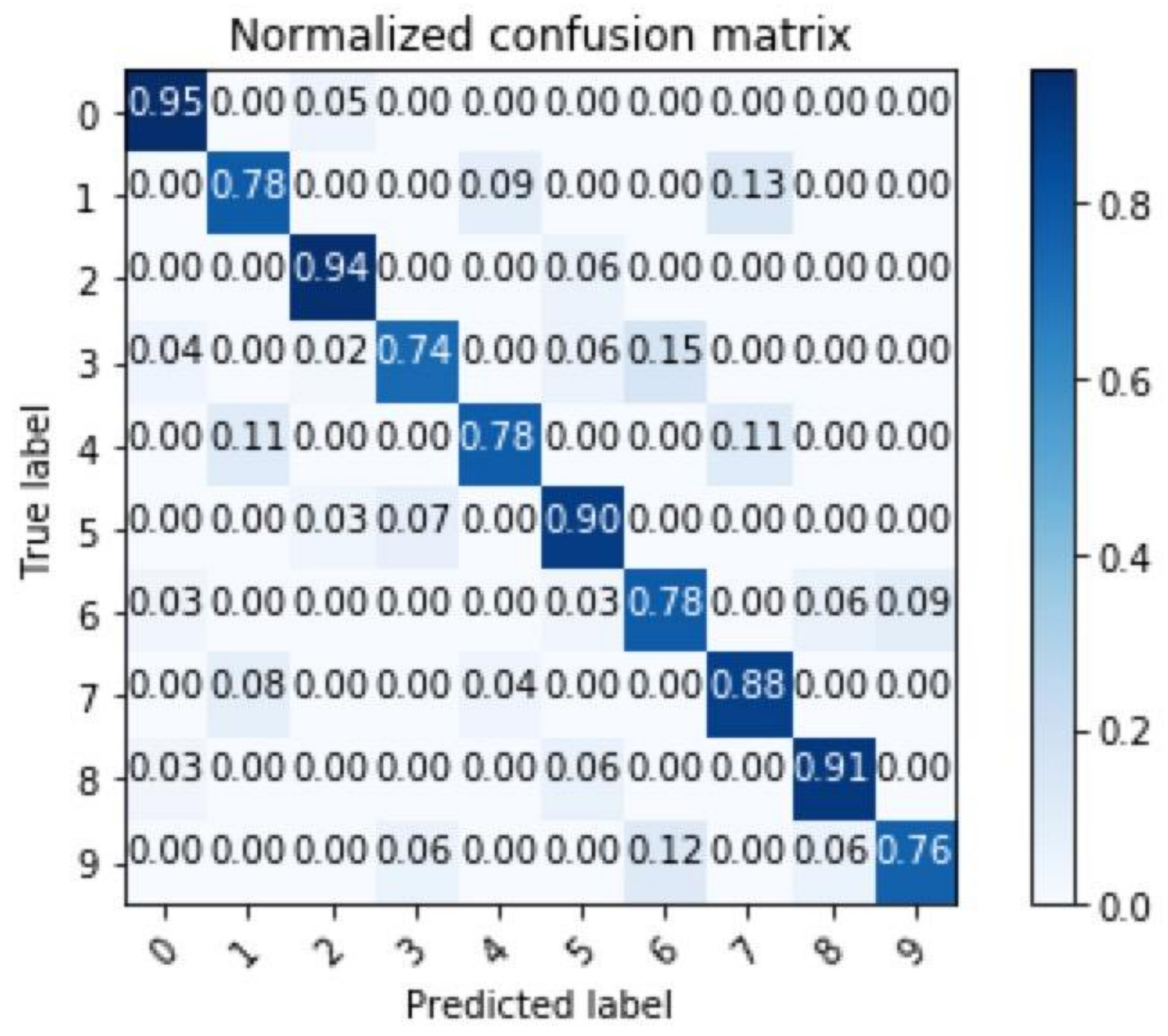
Methodology

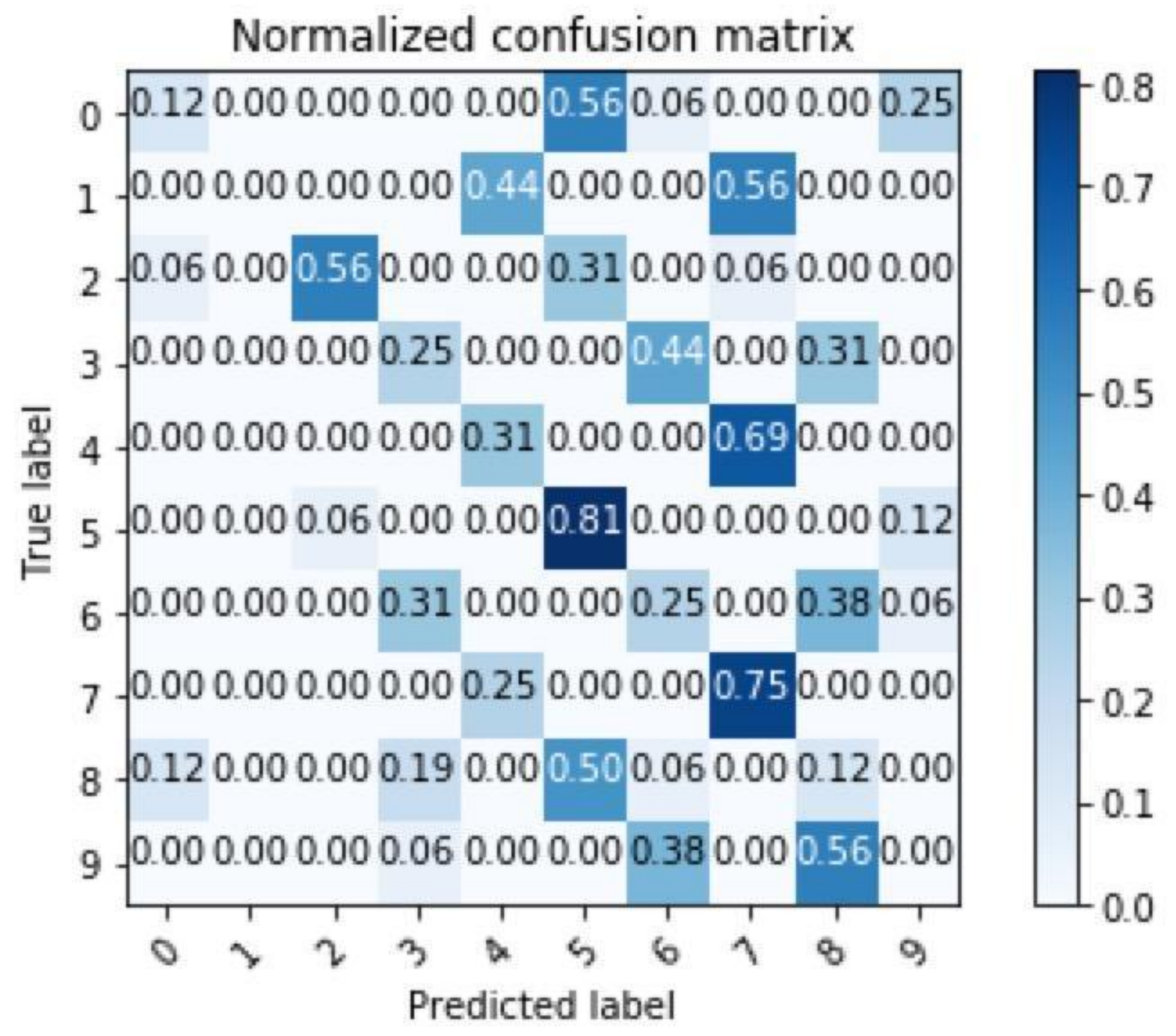


- ❑ Write an APP to collect the training data
- ❑ Machine learning based on TensorFlow
- ❑ CNN architecture: Input->Conv->Conv->Pool->Conv->Conv->Pool->Fully Connected->Fully Connected->Fully Connected->Output->Argmax or Softmax
- ❑ Final model deployed on APP and AWS server

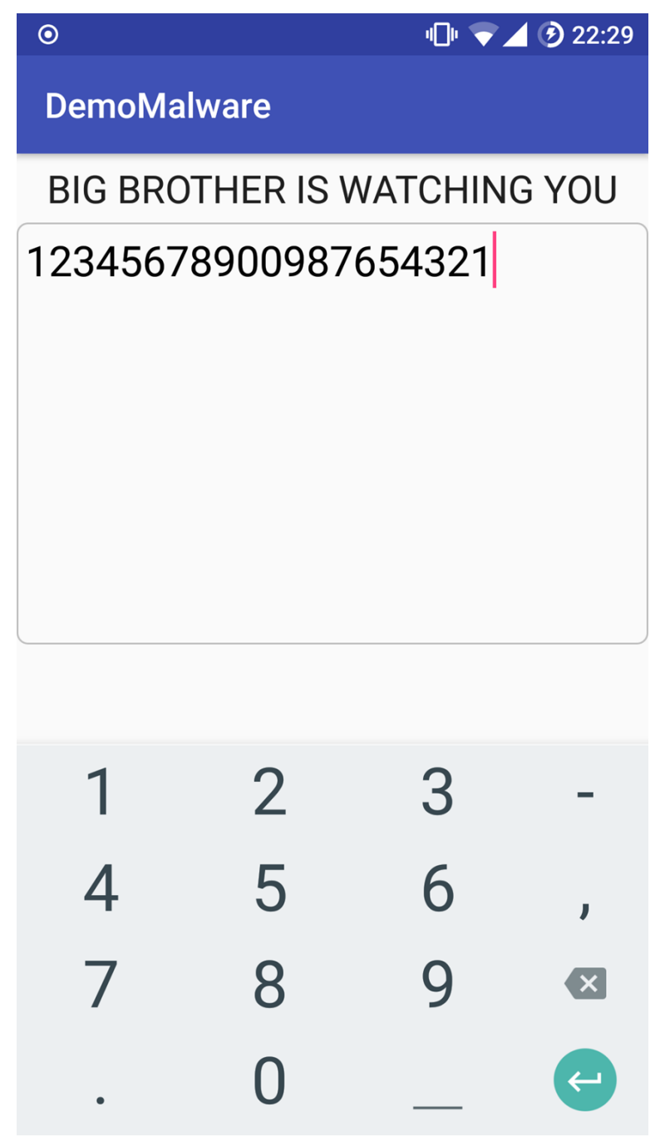
Results



Normalized confusion matrix (cross-valid data)



Normalized confusion matrix (with real data)



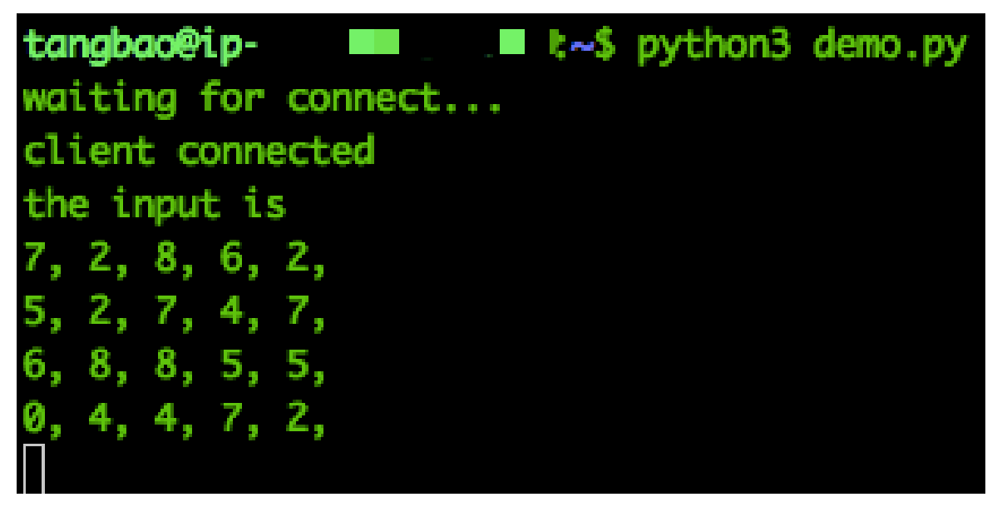
22:29

DemoMalware

BIG BROTHER IS WATCHING YOU

12345678900987654321

Malware Demo



```
tangbao@ip-[redacted]~$ python3 demo.py
waiting for connect...
client connected
the input is
7, 2, 8, 6, 2,
5, 2, 7, 4, 7,
6, 8, 8, 5, 5,
0, 4, 4, 7, 2,
```

Prediction result from remote server

The second figure indicates that we can infer user's input from the sensor data. Although the accuracy is only 60%, the result shows a considerable correlation to the real input. We successfully prove that the sensor data should be considered as a kind of user privacy, which is a more important thing.

References

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[2]Al-Haiqi, A., Ismail, M. & Nordin, R. On the Best Sensor for Keystrokes Inference Attack on Android. Procedia Technology 11, 989–995 (2013).