AccelPrint: Imperfections of Accelerometers Make Smartphones Trackable

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Outline

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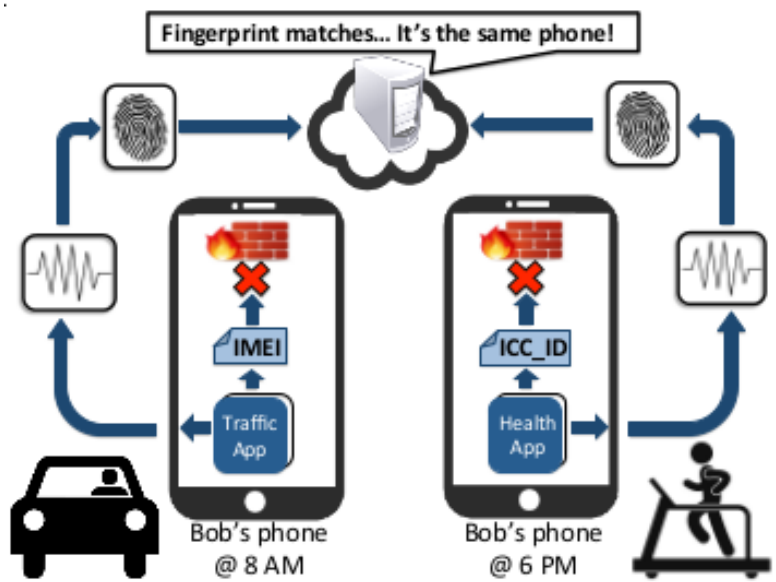
Overview …

- Accelerometers in mobile devices are unique
- The minor differences do not affect usability
- But… they are enough to fingerprint devices
- An app that collects accelerometer data can be used to track users

Outline

The Threat

- Two apps, traffic and health are supported by the same cloud backend. Device IDs are blocked
- But… Exploring a slice of sensor data, the cloud can correlate these 2 apps are from the same user



The Question

Is the fingerprint unique against millions of sensors?

The Answer

No…

- They weren't conducting research on that scale
- Nor is there theoretical proof
- sensors studied:
  - 80 stand-alone accelerometer chips
  - 25 Android phones
  - 2 Samsung Tablets

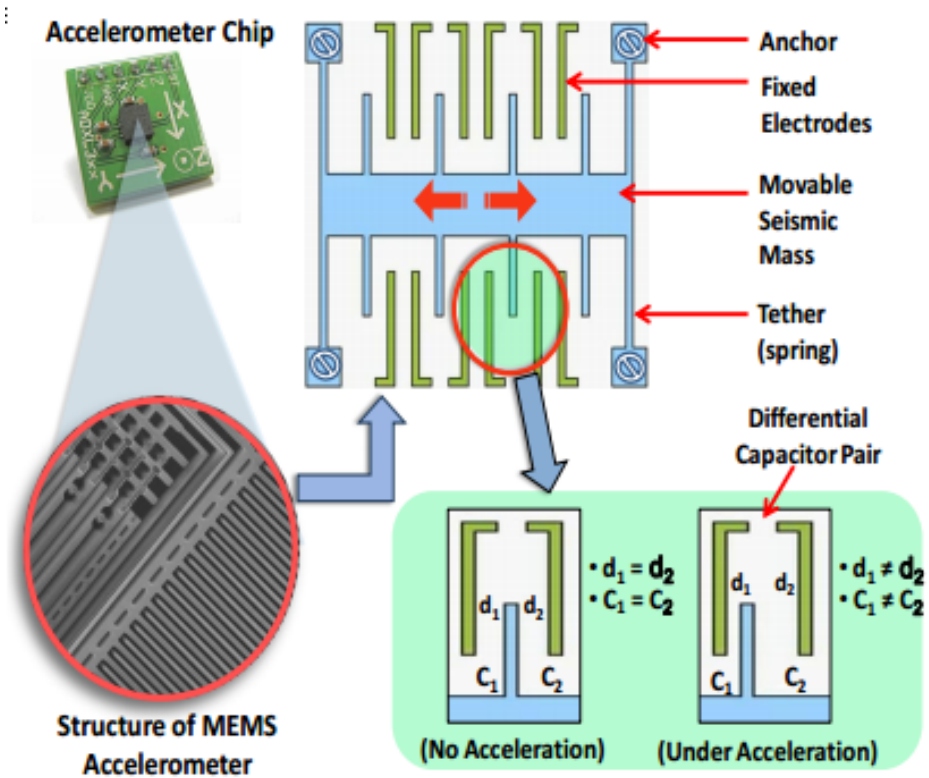
The Fingerprint

- The fingerprint is a vector of 36 features including features drawn from the time and frequency domain of accelerometer signals
- 96% Accuracy and Recall
- Robust against various settings
  - Hand held
  - Even on soft rubber

Outline

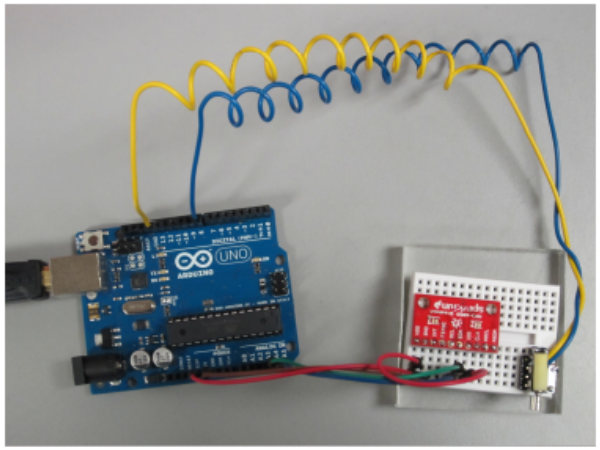
Hardware

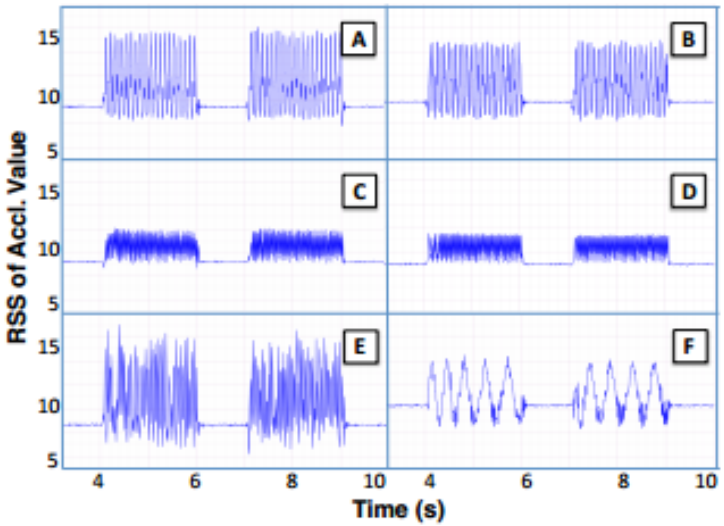
The Miro Electro Mechanical System (MEMS) for accelerometer

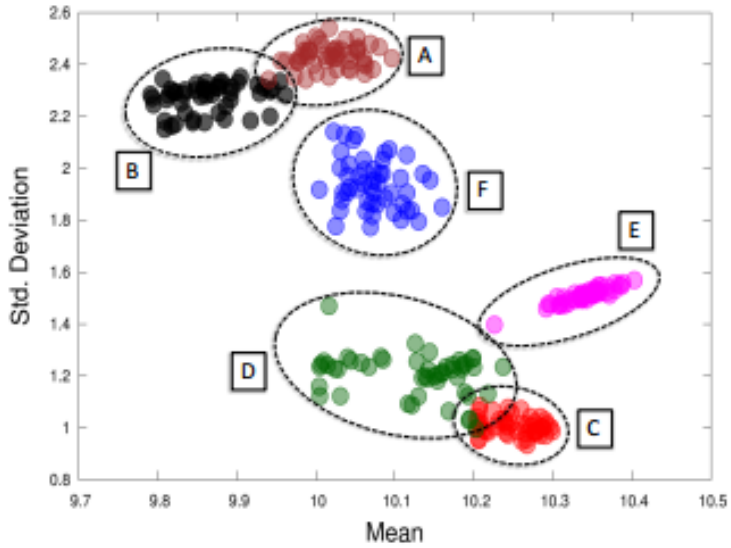


Proof of Concept

Hardware set up: Arduino with 6 censors



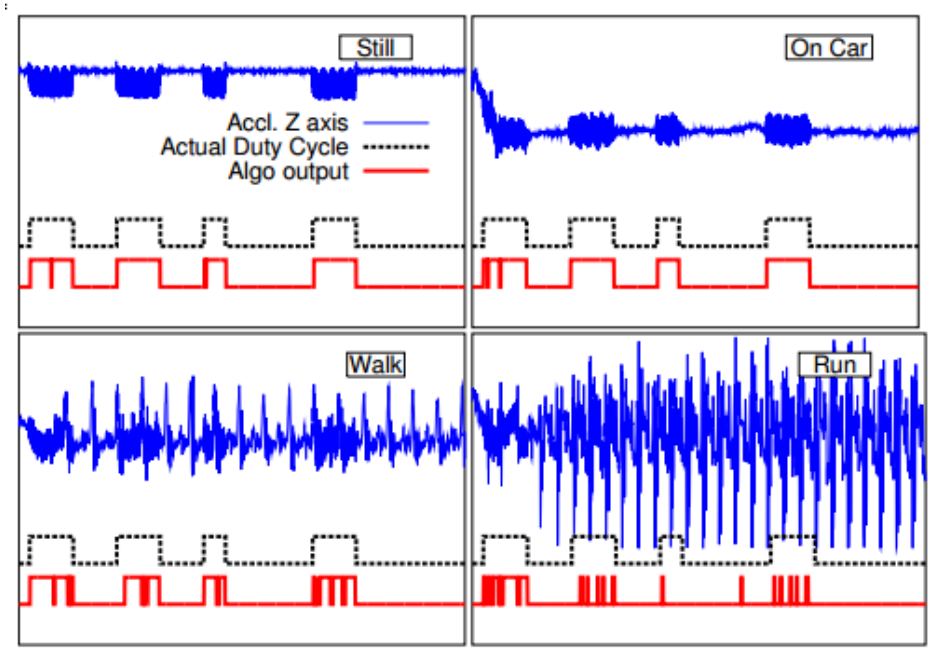




Outline

Data Collection

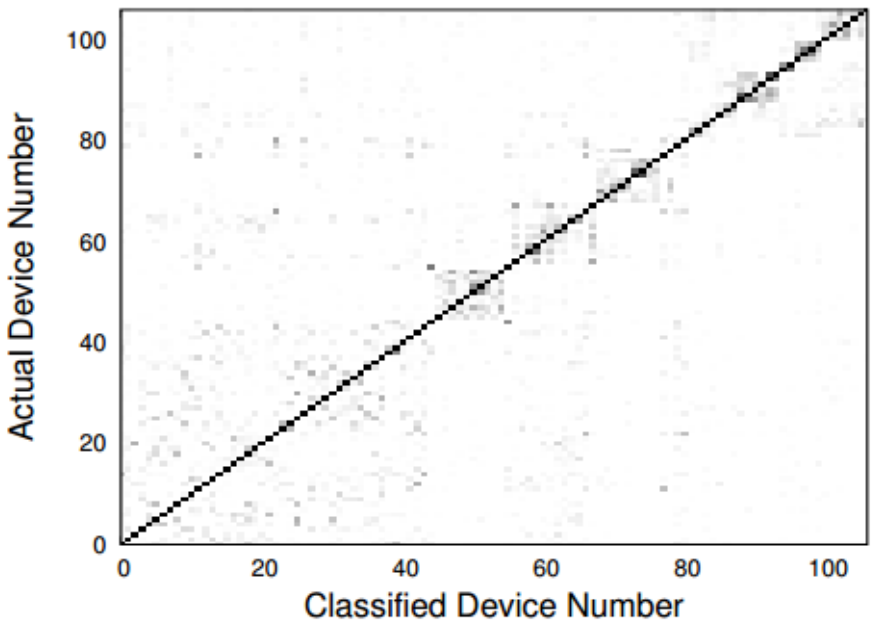
- 107 chips/smartphones/tablets
- Collect data during vibration motor is ON (consistent stimuli)
- Detecting vibration: Z-axis acceleration



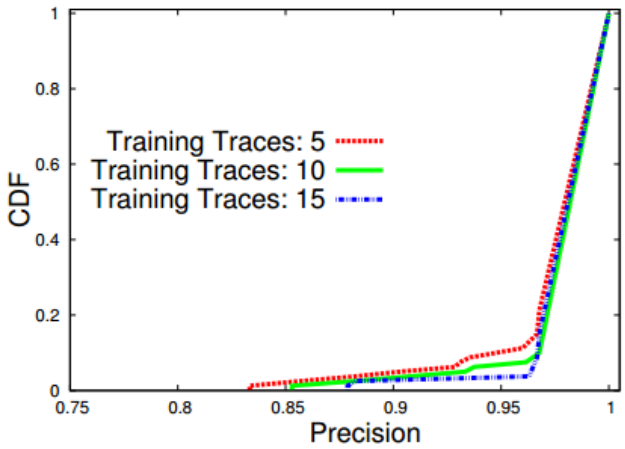
- Activate vibration motor for 2s and record (trace), sampling rate: "fastest"

Finger Print Generation and Classification

- 36 features
- Confusion matrix



How many traces do we need?



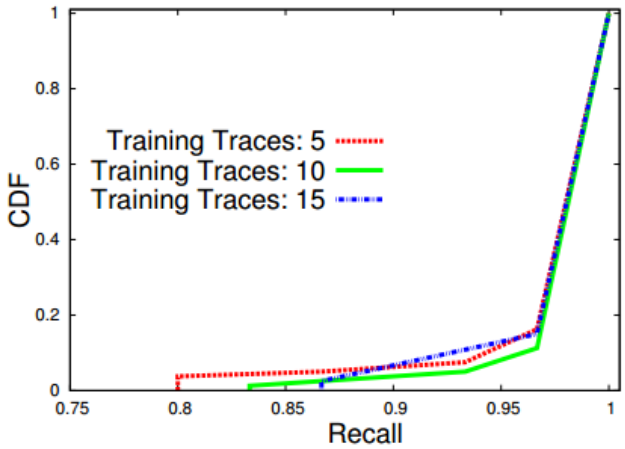
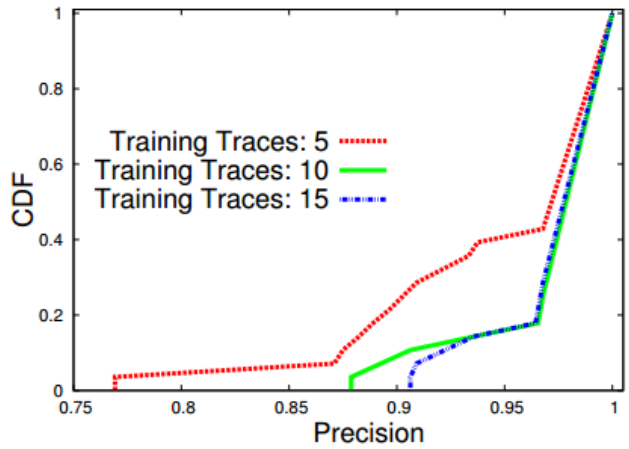


Fig. 8: Overall performance for chips: (a) precision; (b) recall.



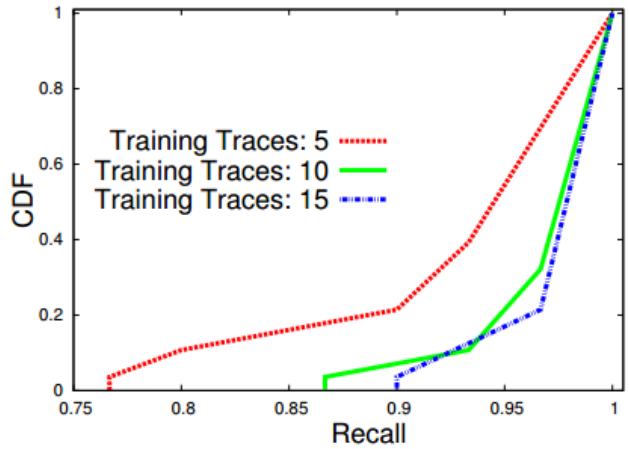


Fig. 9: Overall performance for smartphones: (a) precision; (b) recall.

(Likely) Scalability

Number of devices	Accuracy
20	0.9917
40	0.9958
60	0.9956
80	0.9908
100	0.9883
107	0.9907