You Driving? Talk to you later

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Driver Detection System (DDS)

Design a sensing system to determine if the mobile phone user is in a vehicle as a driver or passenger.

Motivation

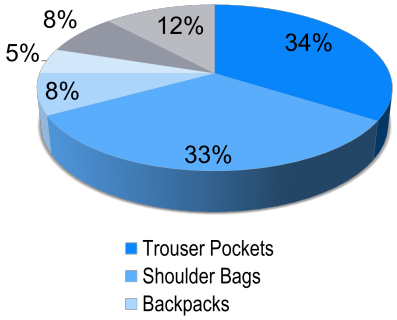
❑People spent significant time traveling in cars
- ▪US: 86 min/day
- ▪Europe: 43 min/day

❑Attention-based notification and delivery is crucial for user experience and safety

❑Potential applications:
- ▪Attention-based notifications (e.g. phone calls, text messages)
- ▪Carbon footprint logging
- ▪Reckless driving detection
- ▪Teen trainer mileage logger

Challenges

❑ Phone Locations:



❑No additional hardware sensors
- ▪Software only solution

❑Unknown phone location
- ▪System must adapt to user

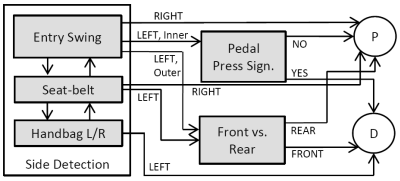
❑Unknown phone orientation
- ▪Distorts accelerometer data

❑Limited energy availability
- ▪Continuous sensing not possible

DDS Solution Design

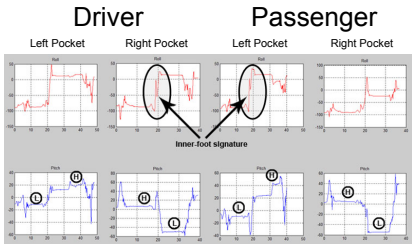
❑ Detection and comparison of multiple short-lived micro-signatures using
- ▪Accelerometer
- ▪Gyroscope
- ▪Compass
- ▪Microphone

❑ Left-vs-Right and Front-vs-Back
- ▪Driver is the Front Left user



DDS Solution Design

❑Gyroscope trace of lower-body pocket car entry signature



❑Combinations of distinct signatures allows for unique ID

Signatures

❑Left vs. Right Signatures
- ▪Car Entry (Lower Body Pocket)
  - ▪Inner foot signature caused by motion of stepping into the car.
- ▪Seat Belt (Upper Body Pocket)
  - ▪Driver's upper body rotates from left to right to buckle in seat belt. Passenger goes through the opposite motion.
- ▪Audio (Handbag)
  - ▪See Front vs. Back Audio in next column.

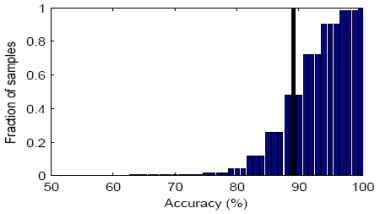
Signatures (cont'd)

❑Front vs. Back Signature
- ▪Audio Comparison
  - ▪Based on magnitude comparison of turn signal clickers.

Preliminary Results

❑Support Vector Machine Classifications of Signatures

❑Car Entry Results:



❑Summary of accuracies:

	Left Vs. Right Algorithm	Front vs. Back Algorithm
Trouser Pocket	88.99%	95.83%
Upper Body Pocket	91.08%	95.83%
Handbag	87.50%	95.83%

Power Consumption

❑Typical episode takes 155J, or 1.1% of a 1000 mAh battery.
- ▪If users walk to their car 5-10 times a day, expect a 5-15% decrease in battery life.

Ongoing Work

❑Build larger micro-signature databases with hundreds of users

❑Improving audio algorithms
- ▪Comparison requires cloud server communication

❑Reorient accelerometer
- ▪Allows for detection regardless of phone orientation