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

- 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

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.

Preliminary Results

- Support Vector Machine Classifications of Signatures
- Car Entry Results:

<table>
<thead>
<tr>
<th>Pocket</th>
<th>Left Vs. Right Algorithm (%)</th>
<th>Front vs. Back Algorithm (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trouser Pocket</td>
<td>88.99%</td>
<td>95.83%</td>
</tr>
<tr>
<td>Upper Body Pocket</td>
<td>91.08%</td>
<td>95.83%</td>
</tr>
<tr>
<td>Handbag</td>
<td>87.50%</td>
<td>95.83%</td>
</tr>
</tbody>
</table>

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