MODALES Mobile App

Ramiro CAMINO, PhD

ramiro.camino@list.lu R&T Associate Luxembourg Institute of Science and Technology (LIST)

INTRODUCTION: THE MODALES VISION

To reduce air pollution from all types of road vehicles (but especially older vehicles) by encouraging adoption of lowemission driving behaviour and proper maintenance choice

MODALES advances the understanding of the co-variability between user behaviour and vehicle emissions from powertrain, brakes and tyres, in order to modify user behaviour, via training and awareness

Retrofits

6. Diesel-saving technologies for cars & vans 7. NOxBUSTER for buses and trucks 8. Diesel particulate filter servicing

training 2. Guidelines for regular maintenance 3. Use of adaptive cruise control & navigation to avoid congestion 4. Increased awareness of emissions 5 Real time indication of emission (app)

Exhaust emission

CO2, CO, HC, NOX, PM, PN



emission control systems

10. Enhanced OBD functionality as an anti-tampering measure

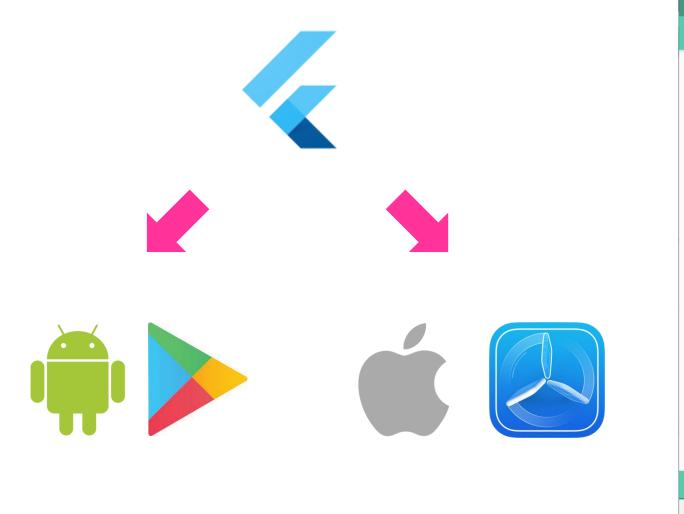
Periodic inspections

11. Enhanced inspection procedure to trap tampering 12. Roadside emissions testing



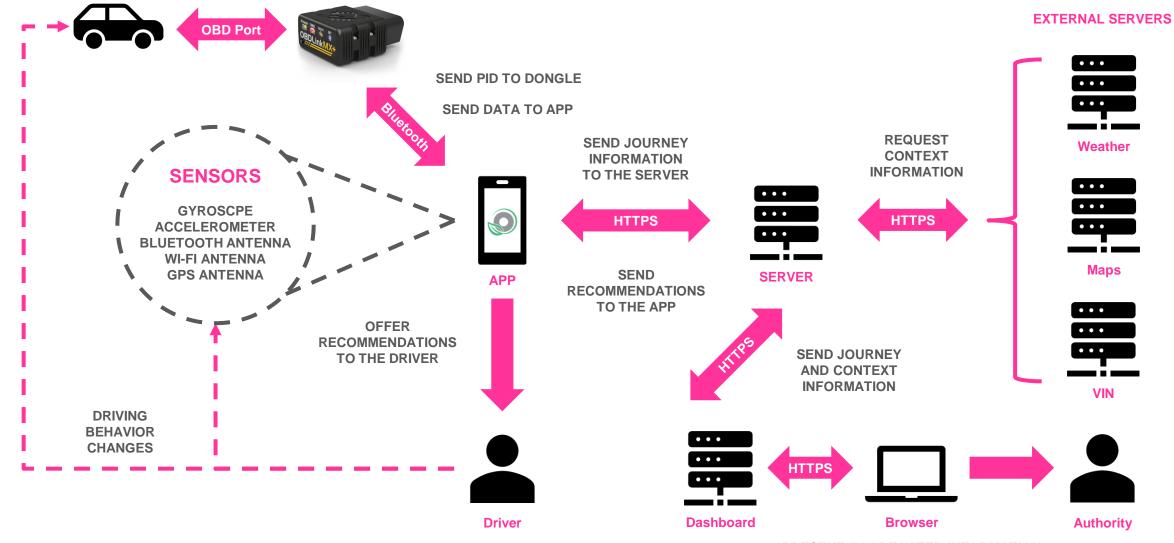


Simple user interface



| 🏺 SM-A505FN | - 🗆 X | 🏺 SM-A505FN | - 🗆 X |
|---|--------------|---|----------------|
| 12:30 E 🌡 🛅 | * * © © di B | 12:31 E 🛎 🖬 | \$¥\$ Q € € B |
| MODALES | | MODALES | |
| OBDLink MX+ 77350 OBD Dongle (Connected) | \odot | OBDLink MX+ 77350 OBD Dongle (Connected) | \$ |
| Default Vehicle Vehicle | 0 | Default Vehicle Vehicle | \$ |
| | | | |
| | ۵. | <u> </u> | \$ |
| III O | < | III O | < |

Architecture overview



PRESENT AGGREGATED INFORMATION

On-Board Diagnosis (OBD)

More reliable:

- Absolute barometric pressure
- Absolute throttle position
- Accelerator pedal position
- Air flow rate
- Ambient air temperature
- Catalyst temperature
- Engine coolant temperature
- Engine fuel rate
- Engine speed
- Vehicle speed

Less reliable:

- Intake air temperature
- NOx sensor



Context Information

Weather:

- humidity
- temperature
- total snow
- visibility
- wind speed

Traffic:

- historical average speed
- historical free flow speed
- historical jam factor
- historical traversability
- real-time confidence
- real-time traffic speed

Road:

- average roughness category
- curvature
- distance to intersection
- functional class
- has end of no overtaking sign
- has no overtaking sign
- has pedestrian crossing sign
- has stop sign
- has traffic signal
- has yield sign
- heading
- intersection category
- international roughness index

- is bridge
- is intersection
- is long haul
- is ramp
- is roundabout
- is tunnel
- is urban
- lane category
- radius
- road type
- slope
- speed category
- speed limit
- speed limit trucks

Research Challenges

- Learn useful driving indicators from raw data in real time.
- Design a user interface for the journey without compromising safety.
- Build a recommender system.
- Handle different connectivity scenarios.
- Ensure privacy policies.
- Analyse behaviour changes.

Conclusion

- We solved many challenges.
- Started with a data collection campaign in Luxembourg and discovered new challenges.
- Continued with an iterative process, adding more trial sites and new components.
- For the future: we have more campaigns planned on several trial sites, the recommendation system under development, and a lot of exciting data exploration to do!



Smart and Sustainable Mobility for all.



EUROPEAN CONGRESS TOULOUSE 30 May - 1 June 2022

Thank you