CAReful

Mobile and Social Sensing Systems

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Overview

- Introduction
- Sensors
- Application
- Conclusions



Introduction

Among the wrong driving behaviours, the most frequent are the distraction, the lack of respect for precedence and too high speed. The three groups together make up 40.2% of cases (60,981).

Istat – Incidenti stradali [Published in July 2021]

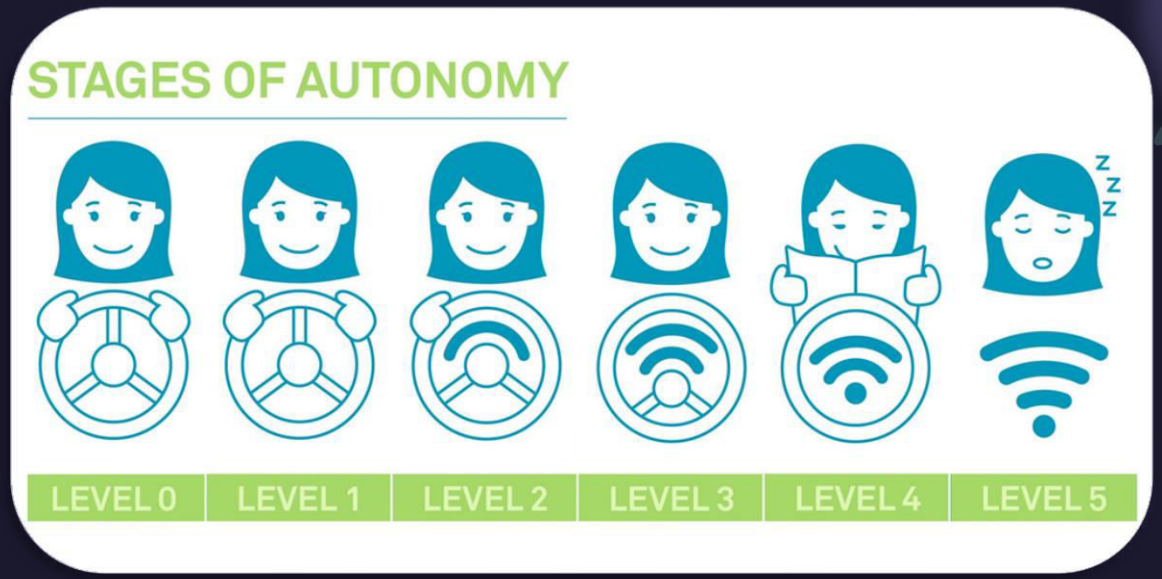
Distractions

Despite the increasing automation of driving vehicles, we are so far from the full automation. So, the driver has to perform all the main tasks of driving with full attention.

Any non-driving activity is a potential distraction and increases the risk of crashing, in particular at high speed or curvy roads.

Examples of distractions are:

- Usage of the smartphone
- Looking away from the road
- Drowsiness
- Too much noise



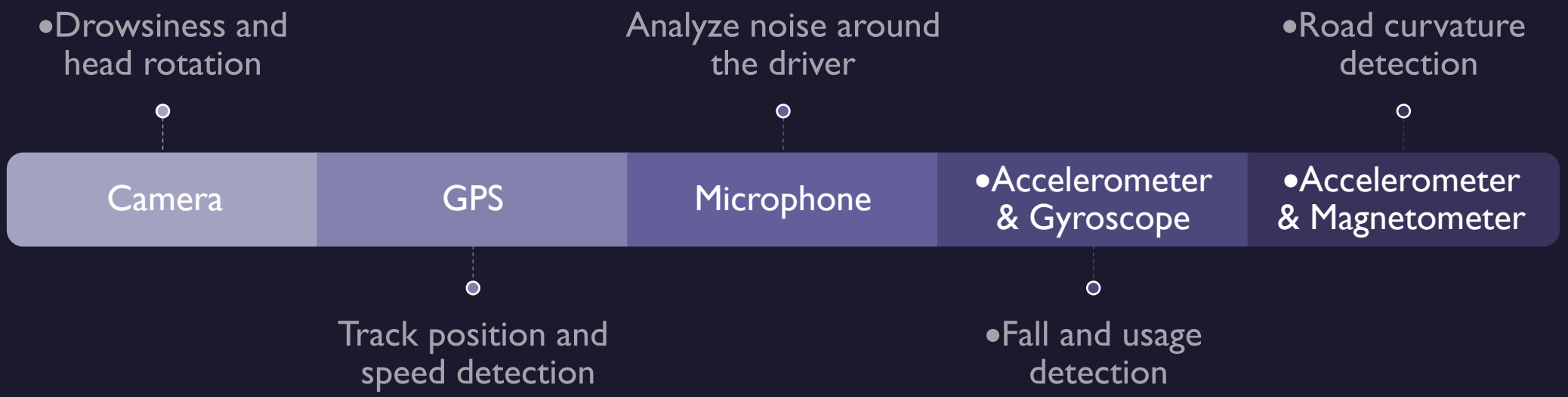
Idea

Our idea is a simple application able to detect the different distractions while driving.
When you start a new trip, you have just simply to place the phone in front of you and the application performs by its own.

Various uses can be designed for the application:

- personal use to test your attention while driving
- monitor the attention of a bus driver in a company
- an insurance company to categorize drivers

Exploited sensors



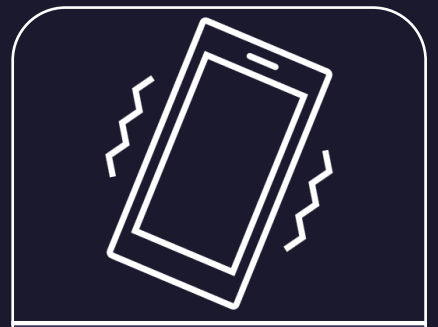
Sensors

Sensors

Camera

Accelerometer & Magnetometer

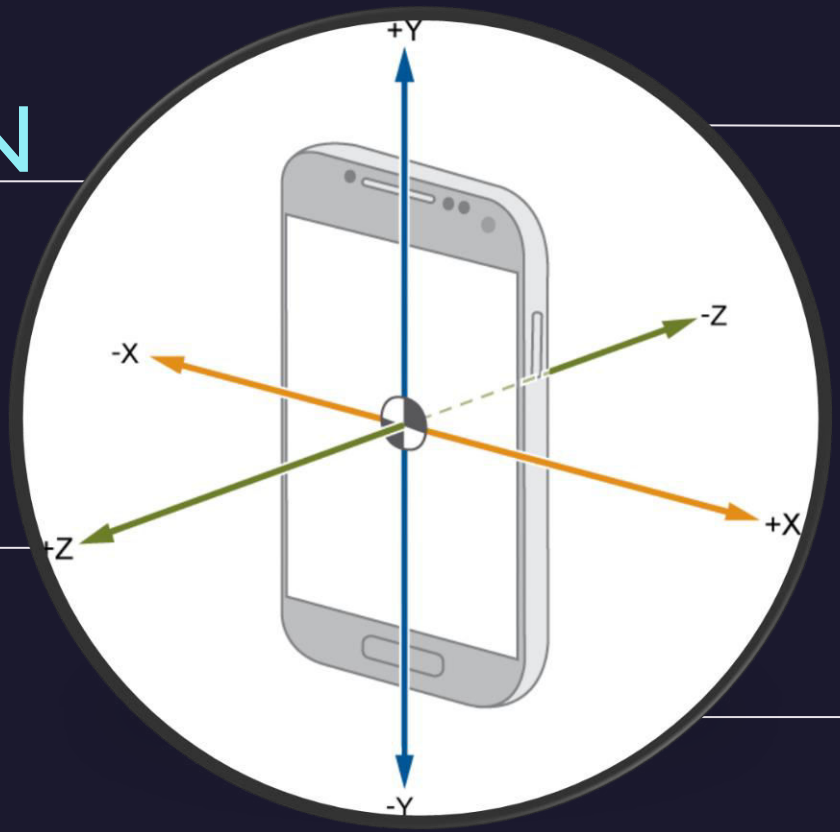
Microphone



Accelerometer & Gyroscope

GPS

USAGE DETECTION



MAGNITUDE

$$m = \sqrt{x^2 + y^2 + z^2}$$

THRESHOLDS

lowThreshold = 5.0
highThreshold = 18.0
gyroThreshold = 1.9

FALL DETECTION

arraySize = 8
samplingPeriod = 200 ms

Accelerometer & Magnetometer

RISK INDEX

$sum < 10 \rightarrow 1$

$10 \leq sum < 60 \rightarrow 2$

$sum \geq 60 \rightarrow 3$

SAMPLING PERIOD

~200 ms

AZIMUT

$-\pi, +\pi$

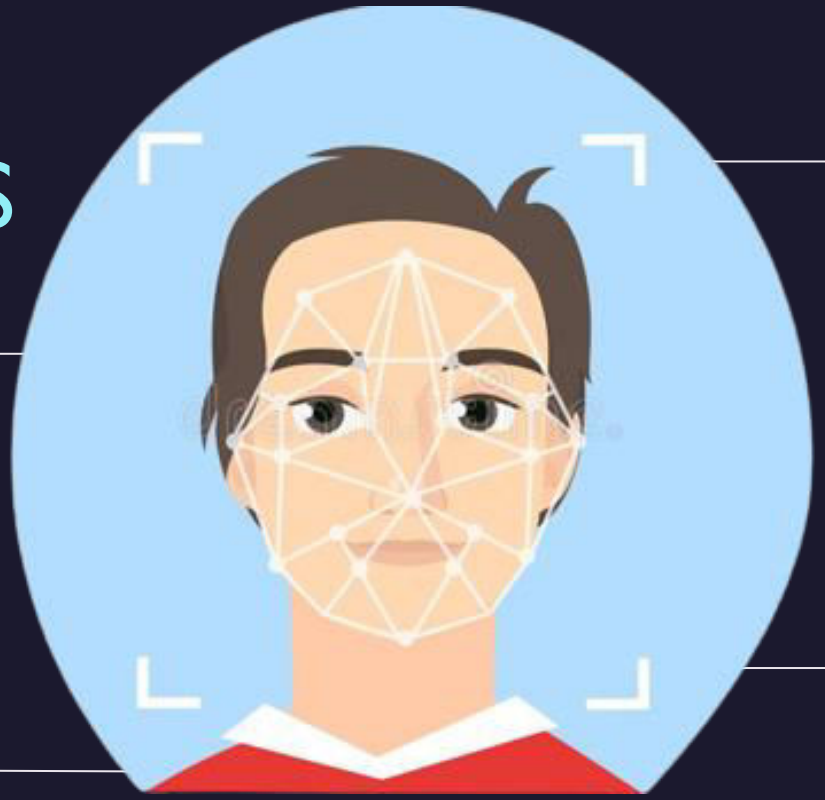
arraySize = 300

ROAD CURVATURE

Camera

DROWSINESS DETECTION

2 s



THRESHOLD

P(left and right eye open) < 0,5

HEAD ORIENTATION

≥40° | 4 s

ML KIT

Face detection API

Microphone

TIME THRESHOLD

5 s

DECIBEL DETECTION

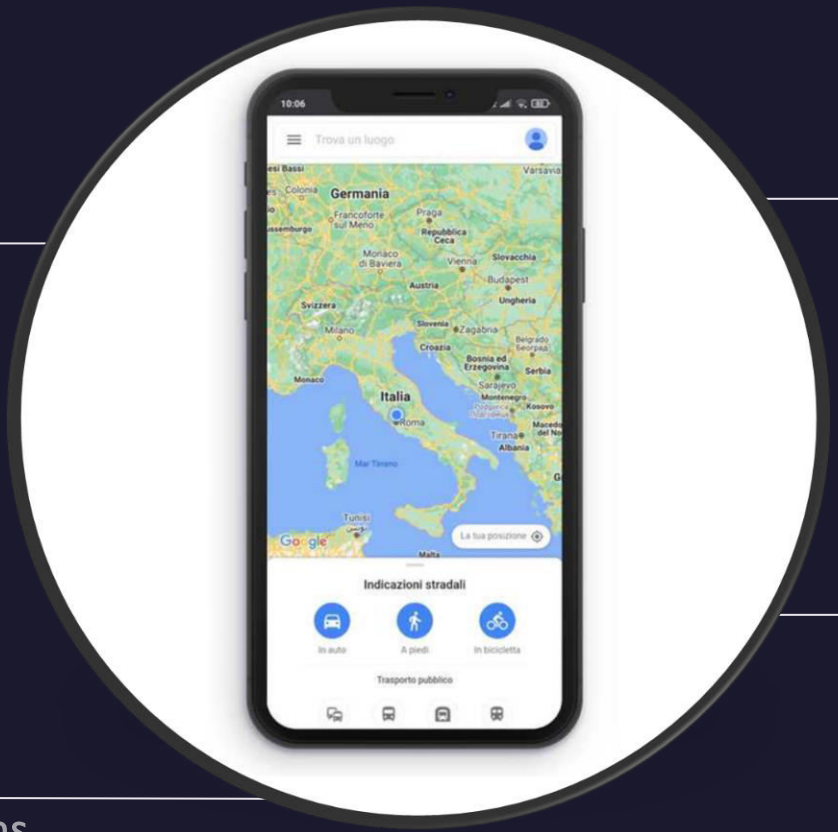
NOISE DETECTION

≥150.0 dB

GPS

ROAD MAP

Google Maps API



AVERAGE SPEED

4 ranges

5 sec

SAMPLING PERIOD

TRIP INFO

Departure and arrival locations

Distraction Weights

	Role	Range	Description
Road curvature	Multiplier	1 - 3	Difficulty of the road
Car speed	Multiplier	1 - 4	Speed of the car
Drowsiness detection	Adder/Counter	0 - 30	How many times eyes are closed
Head Turned detection	Adder/Counter	0 - 12	How many times head is turned
Usage detection	Adder/Counter	0 - 1	How many times the phone is used
Fall detection	Adder/Counter	0 - 293	How many times the phone fall
Noise detection	Adder/Counter	0 - 12	How many times there is noise in the car

AttentionLevel Formula*

$$disattention = \left(\frac{speed}{4} + \frac{curvature}{3}\right) * \left(\frac{head}{12} + \frac{drowsiness}{30} + usage + \frac{noise}{12} + \frac{fall}{5}\right)$$

$$disattentionLevel_i = \alpha \ * disattention + (1 - \alpha) * disattentionLevel_{i-1}$$

$$attentionLevel = 10 \ - disattentionLevel$$

Attention level

*computed every 1 min

Application

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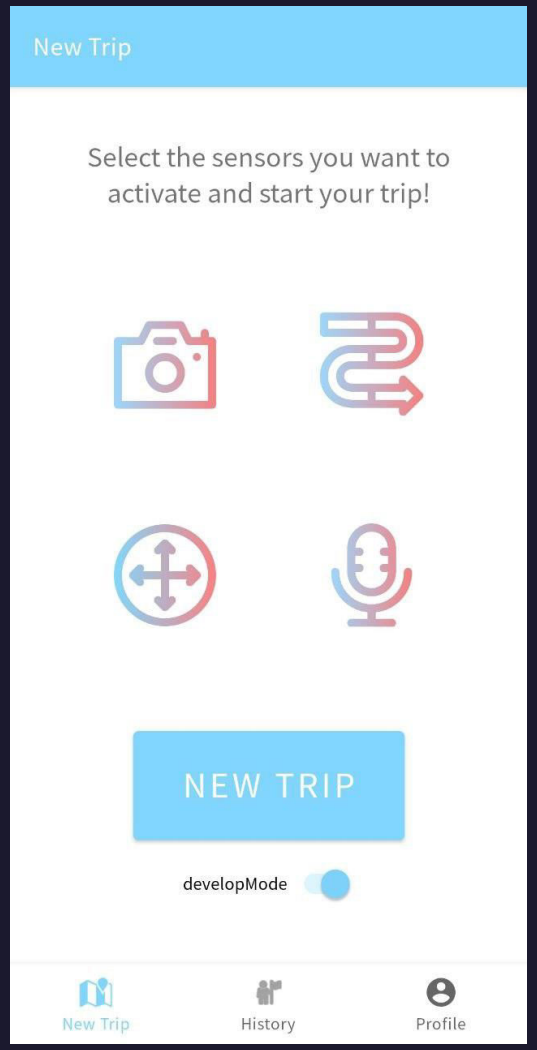
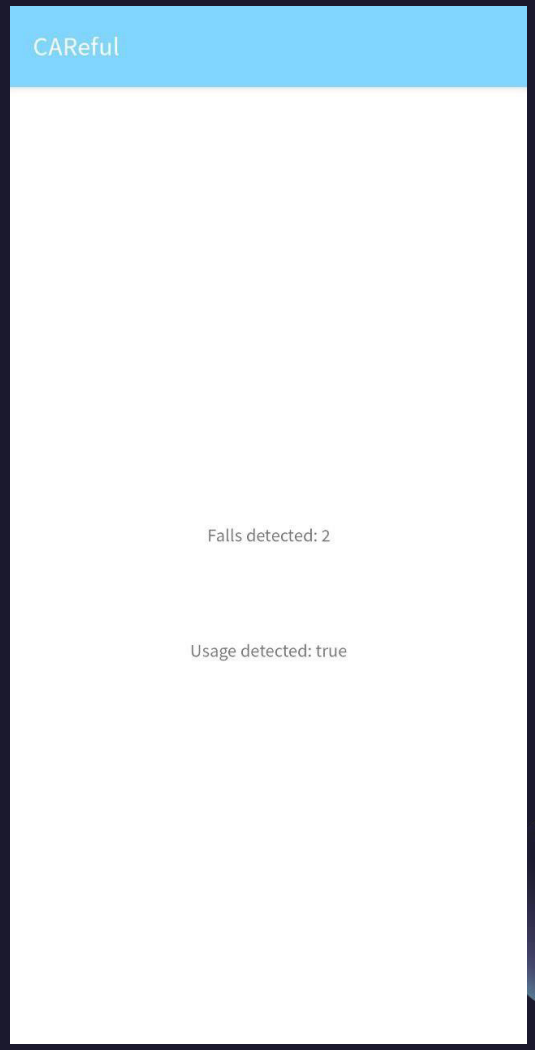
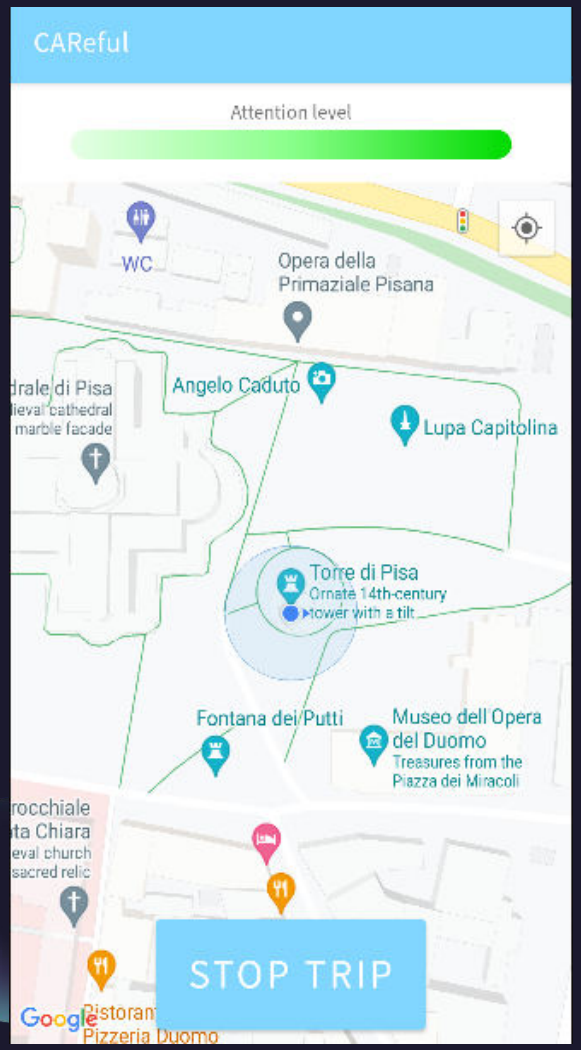
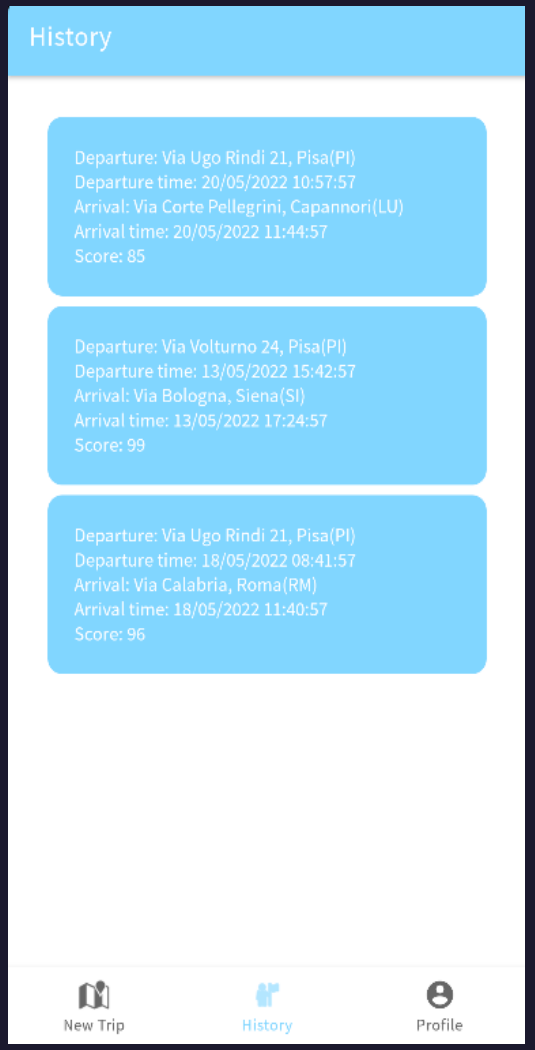

New Trip
Select the sensors you want to activate and start your trip!
NEW TRIP
developMode
New Trip
History
Profile

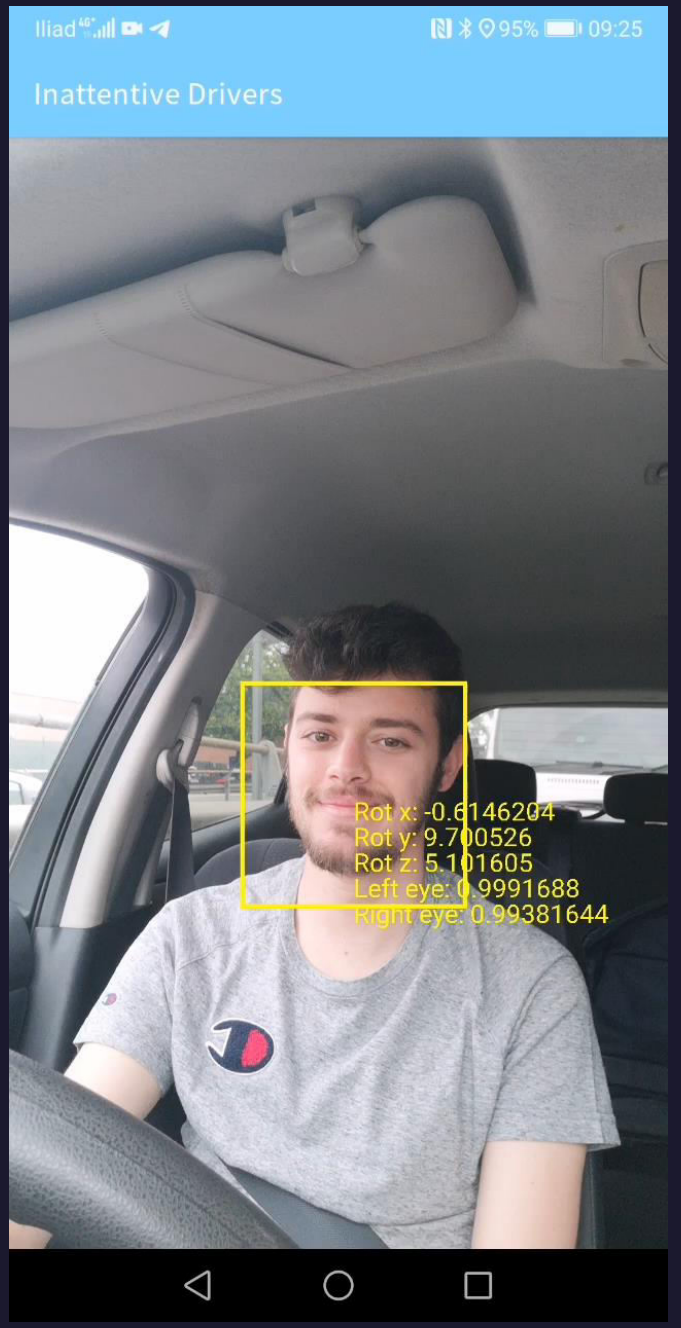

CAReful
Falls detected: 2
Usage detected: true


CAReful
Attention level
WC
Opera della Primaziale Pisana
Angelo Caduto
Lupa Capitolina
Torre di Pisa
Ornate 14th-century
Fontana dei Putti
Museo dell Opera del Duomo
Treasures from the Piazza dei Miracoli
STOP TRIP
Google


History
Departure: Via Ugo Rindi 21, Pisa(PI)
Departure time: 20/05/2022 10:57:57
Arrival: Via Corte Pellegrini, Capannori(LU)
Arrival time: 20/05/2022 11:44:57
Score: 85
Departure: Via Volturno 24, Pisa(PI)
Departure time: 13/05/2022 15:42:57
Arrival: Via Bologna, Siena(SI)
Arrival time: 13/05/2022 17:24:57
Score: 99
Departure: Via Ugo Rindi 21, Pisa(PI)
Departure time: 18/05/2022 08:41:57
Arrival: Via Calabria, Roma(RM)
Arrival time: 18/05/2022 11:40:57
Score: 96
New Trip
History
Profile

Video

Camera - Develop mode example



Privacy

- Real-time evaluation of sensors' information
- No sensitive data are stored (e.g. microphone/video recordings)
- Trip details stored:
  - departure and arrival location
  - departure and arrival time
  - score.
- Local SQLite db is used

Limits of the application

- Does not detect the eyes if you wear sunglasses, but it works with eyeglasses
- Requires precise positioning of the phone
- Some threshold values may not be correct under particular conditions

Future improvements

- Detect if the driver has something in his hands and what it has (food, drink, cigarettes)
- Detect and classify noises, understanding if they are speeches, music or other.

Thanks for the attention

Questions are welcome!