



Eye tracking assessement & Innovative solutions in parking

Tichý Tomáš, Toman Přemysl, Mashko Alina

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Faculty of Transportation Sciences

DEPARTMENT OF TRANSPORT TELEMATICS

doc. Ing. Tomáš Tichý, Ph.D., MBA

DEPARTMENT OF VEHICLE TECHNOLOGY

Ing. Přemysl Toman

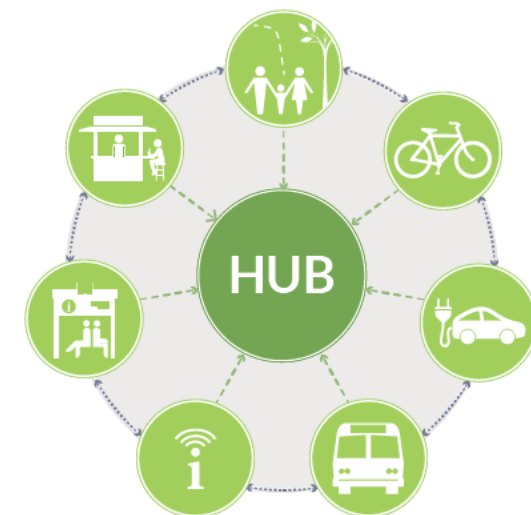
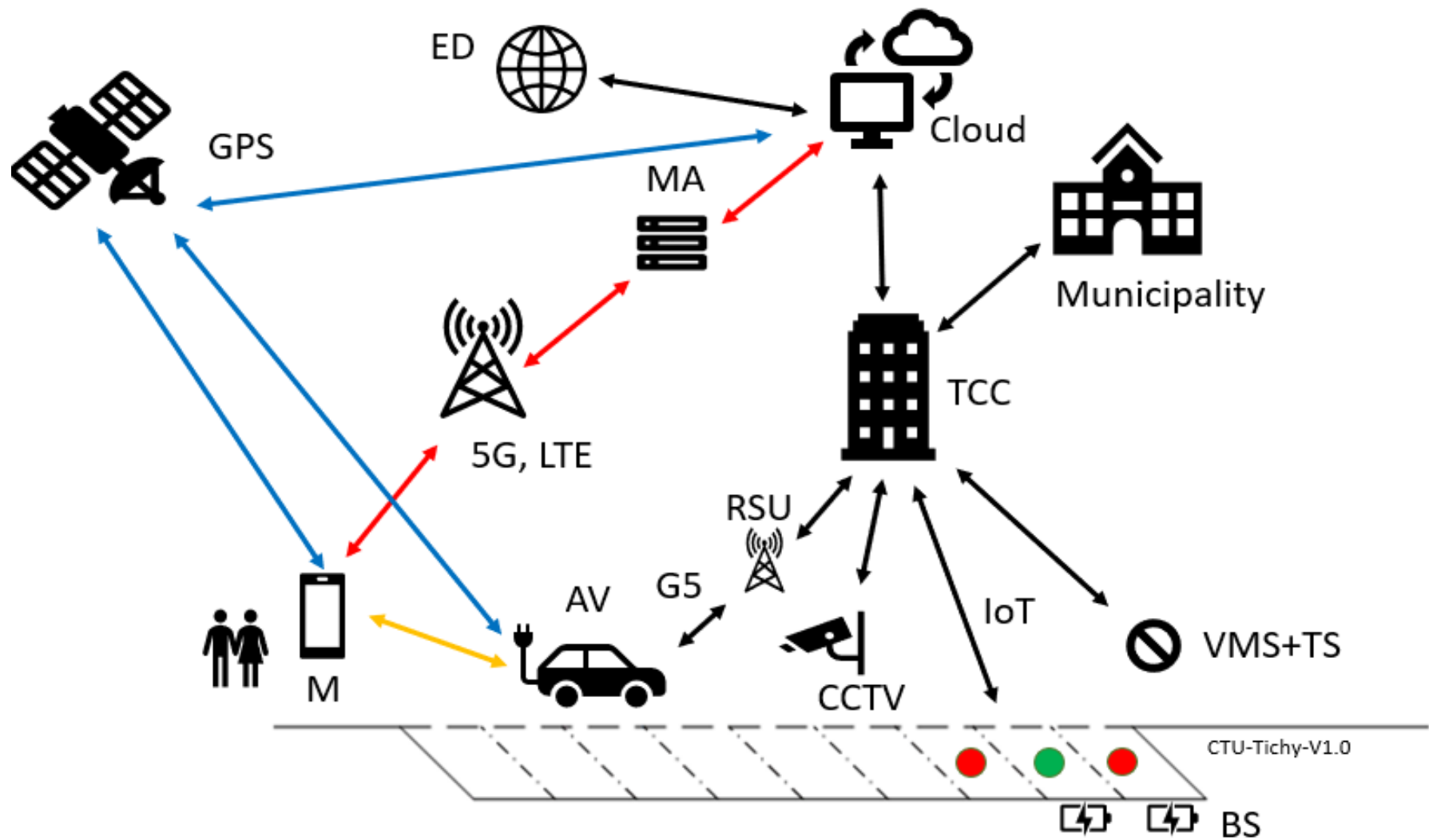
Ing. Alina Mashko



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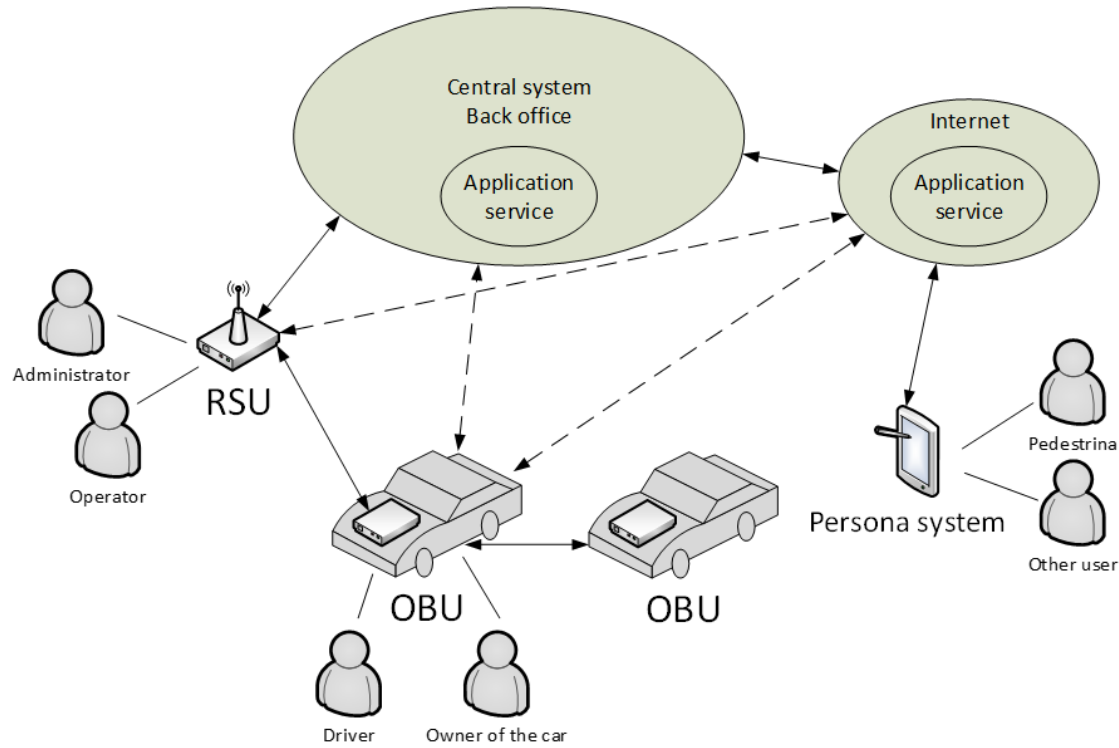


INNOVATIVE SOLUTIONS IN PARKING: VIRTUAL SYSTEM PARKING - MOBILITY HUB - TECHNICAL REQUIREMENTS



Transit stations
Minimize transfer time
Remove physical barriers
Backbone of public transport

INNOVATIVE SOLUTIONS IN PARKING: VIRTUAL SYSTEM PARKING - MOBILITY HUB - TECHNICAL REQUIREMENTS

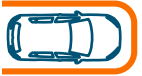
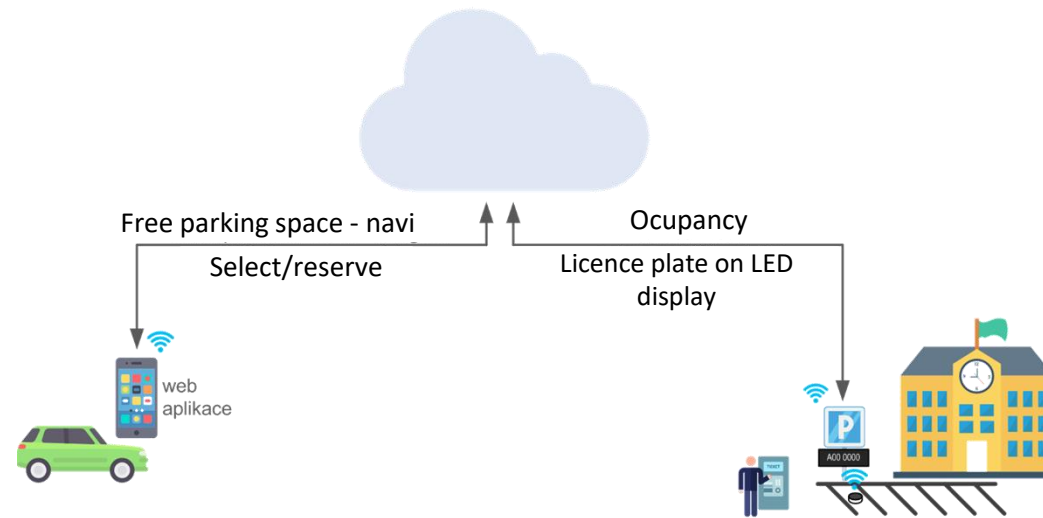


V2X Communication

Parking availability information
External information and data
Virtual places for charging
Movement of vehicles
Parking guidance

IoT technology

Virtual places for charging
Reservation of place
Parking guidance
Parking availability information

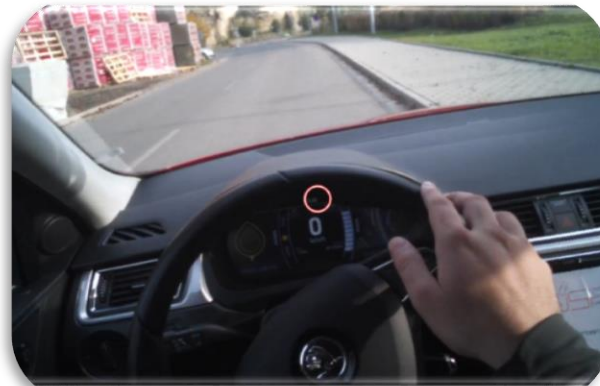


EYE TRACKING ASSESSEMENT

- First testing – demonstration
- Second testing – clinical study



Heatmaps



Live fixations



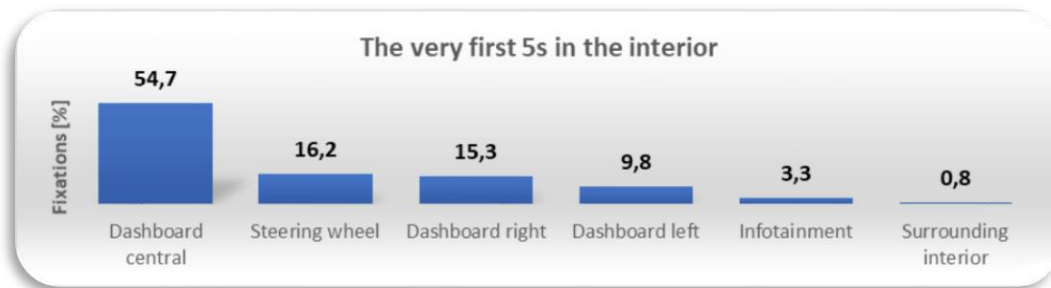
Tobii Pro Glasses 2, 50Hz, I-VT filter



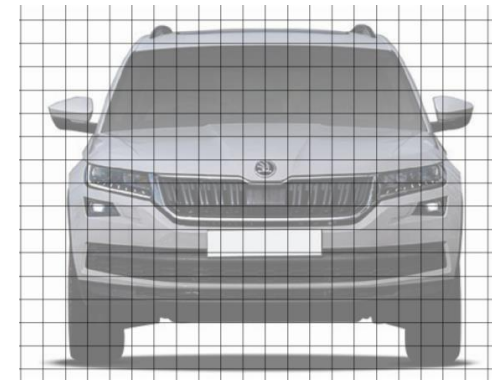
Eye-tracking

100-600ms fixations

0,6° precision



Metrics data



a) precision, distance 4m;



b) precision, distance 8m

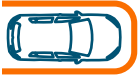
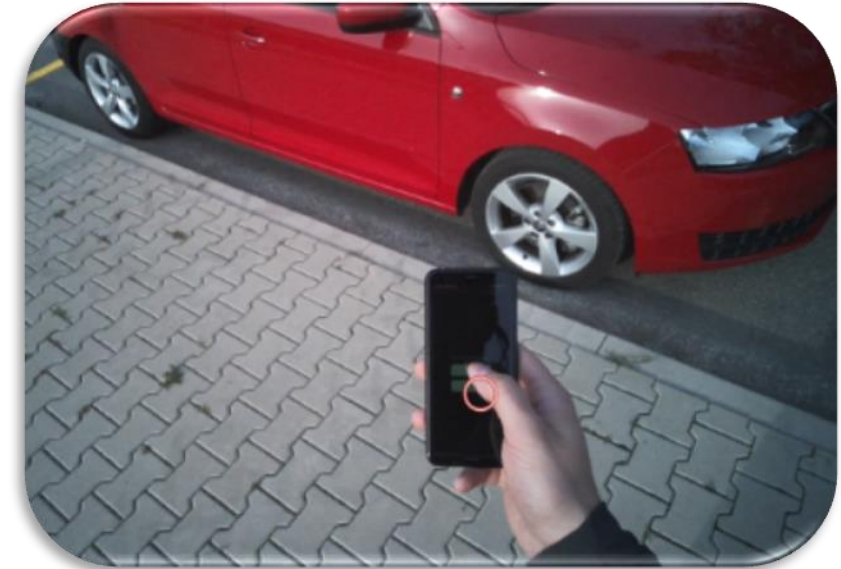
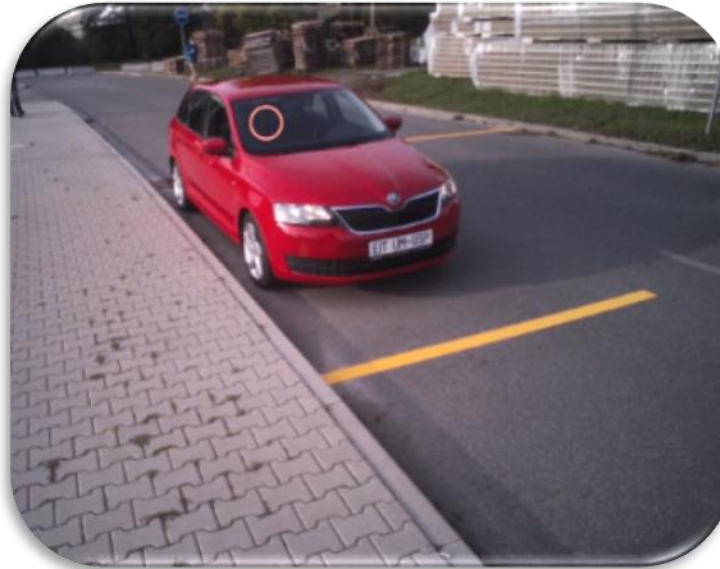
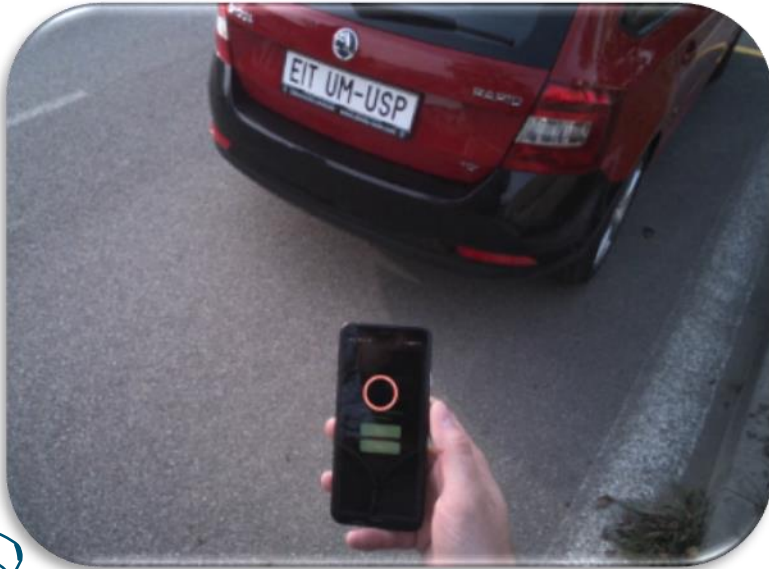


UrbanSmartPark

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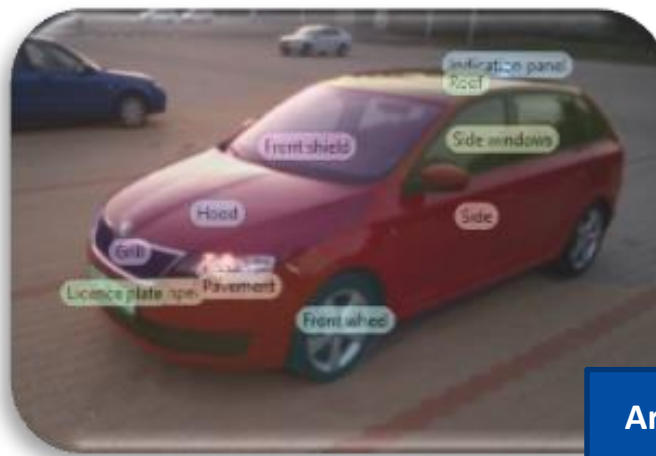
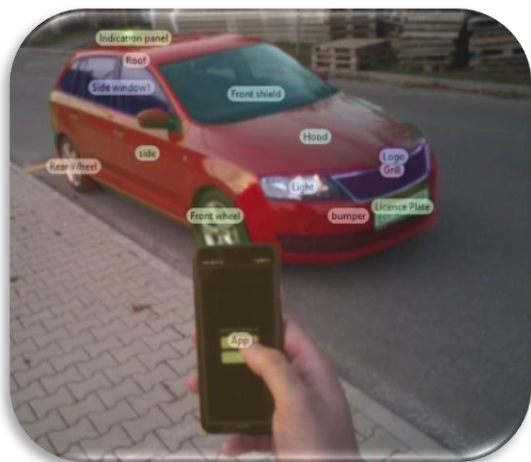
EYE TRACKING ASSESSEMENT - FIRST TESTING: DEMONSTRATION

- **Drop-off zone**
 - Subject drives to the drop-off zone
 - Driver sends the vehicle to a parking lot via mobile app
- **Pick-up zone**
 - Car arrives
 - Driver confirms arrival of vehicle via mobile app
 - Driver enters the vehicle



EYE TRACKING ASSESSEMENT - FIRST TESTING: DEMONSTRATION

- The observed scene was subdivided into Areas of Interest (AOIs)
 - Semi-front view of the vehicle
 - AOIs for pedestrian scenario



Areas
of
Interest

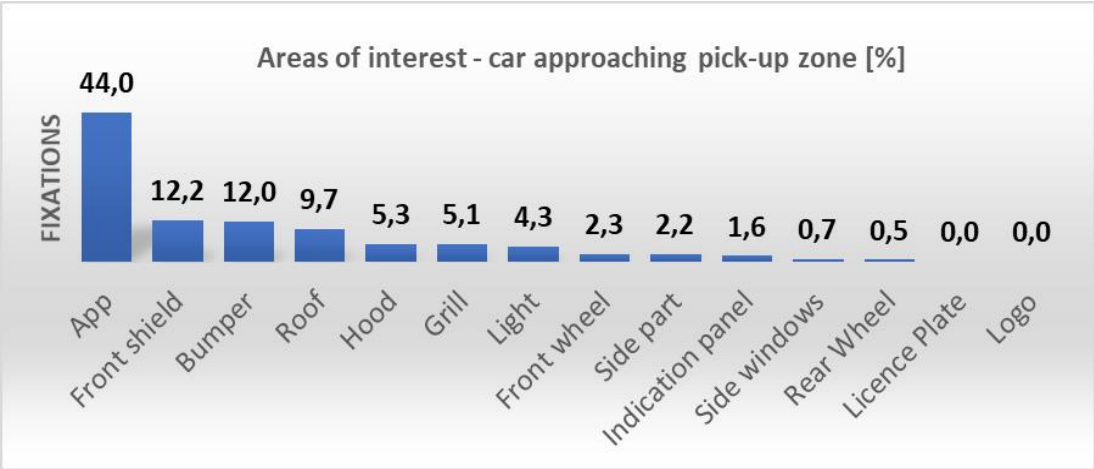
- app,
- side window,
- indication panel,
- bumper,
- hood,
- front shield,
- front wheel,
- grilles,
- license plate,
- light,
- logo,
- rear Wheel,
- roof,
- side part.
- bumper,
- front shield,
- front wheel,
- grilles,
- hood,
- indication panel,
- license plate,
- light,
- pavement,
- roof,
- car body side (side),
- side windows.

- Eye-tracking metrics and data representation
 - AOIs, Heatmaps
 - Time distribution of fixations in AOI
 - Time to first fixation – eye movement sequence

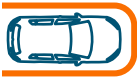
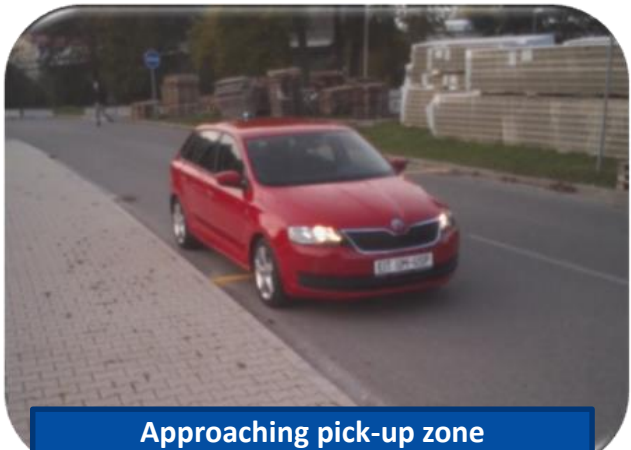
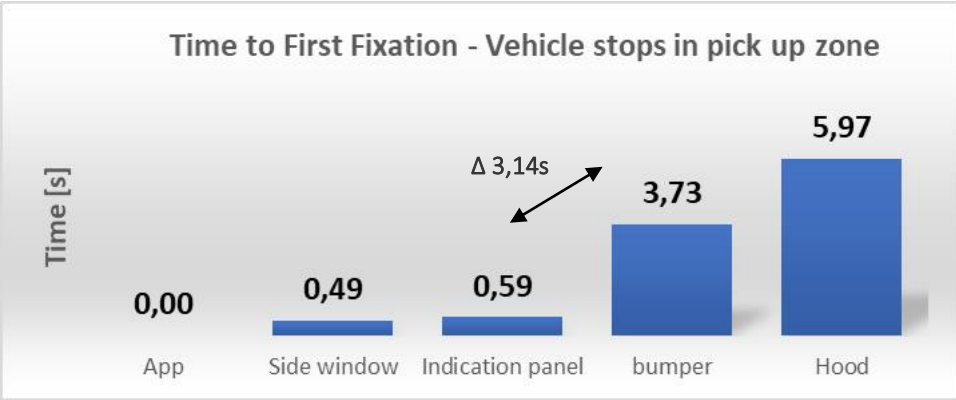


EYE TRACKING ASSESSEMENT - FIRST TESTING: DEMONSTRATION

- Vehicle approaching pick-up zone

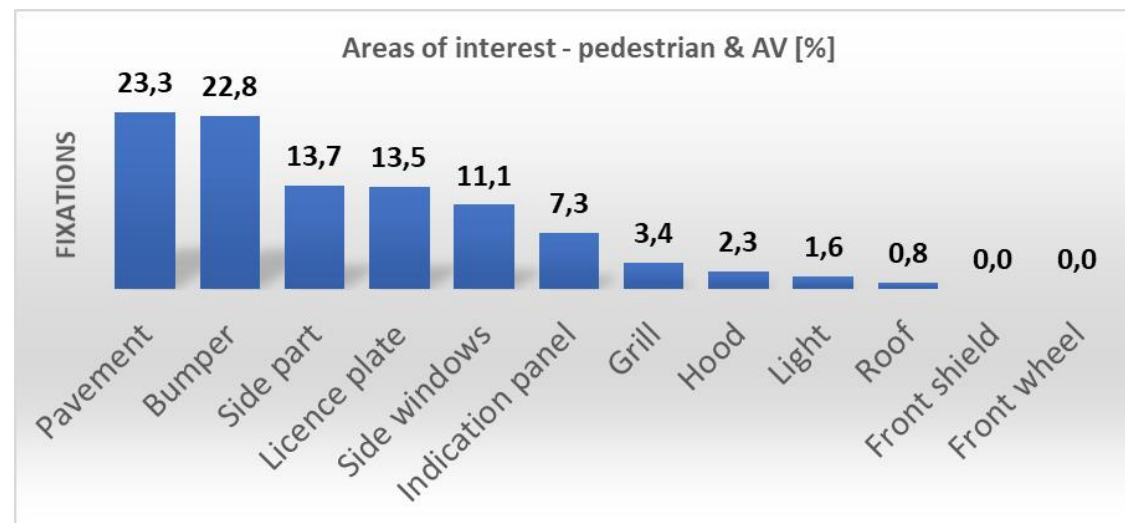


- Subject confirmed vehicle arrival with the help a button in the app and fluently continued through side windows on the indication panel where time of gaze was recorded as approx. 3 seconds.



EYE TRACKING ASSESSEMENT - FIRST TESTING: DEMONSTRATION

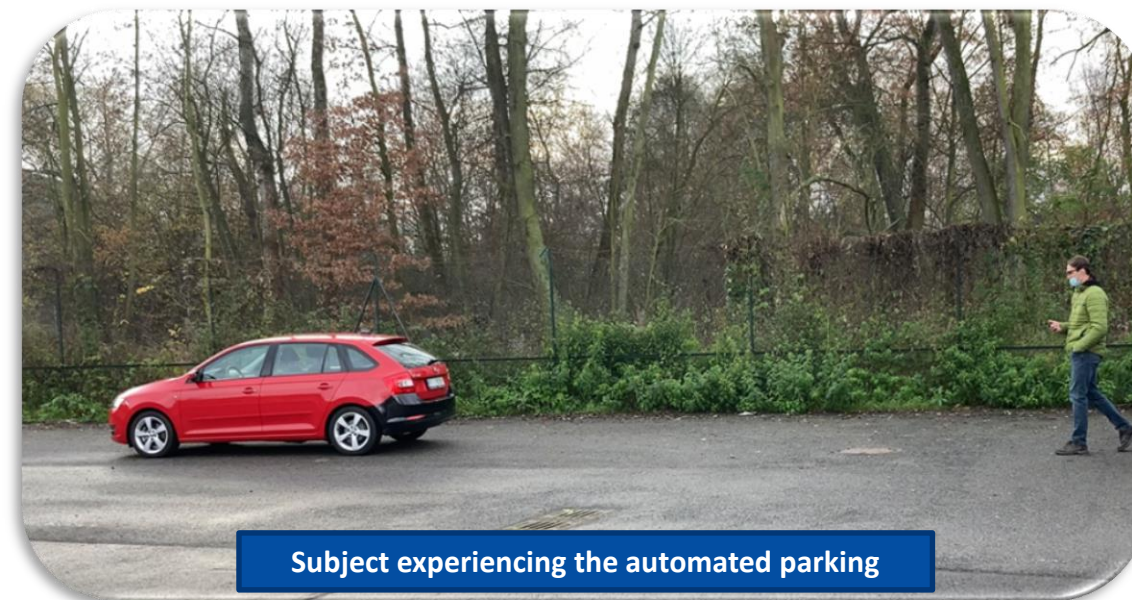
- Pedestrian & AV
- The most of the visual focus was located in the area of pavement and the vehicle bumper.
- Subject's gaze was directed downwards almost 50% of time.
- Lower part of the vehicle is suitable for showing the information about the status of the AV.
- It can be assumed that subject was able to see the indication panel.



EYE TRACKING ASSESSEMENT - SECOND TESTING: CLINICAL STUDY

Clinical study flow:

- filing in the intro questionnaire,
- eye tracking hardware and calibration,
- introduction to the concept,
- getting inside the stopped vehicle,
- sending the vehicle to the parking lot from a drop off zone,
- call the vehicle from the parking lot to the pick-up zone,
- confirm the vehicle arrival and end automated parking,
- taking off the eye tracking device,
- filling in the final questionnaire form.



Evaluation in 5 stages



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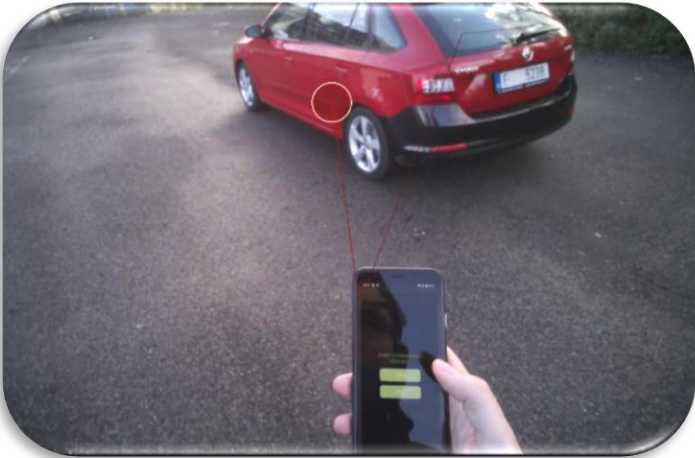
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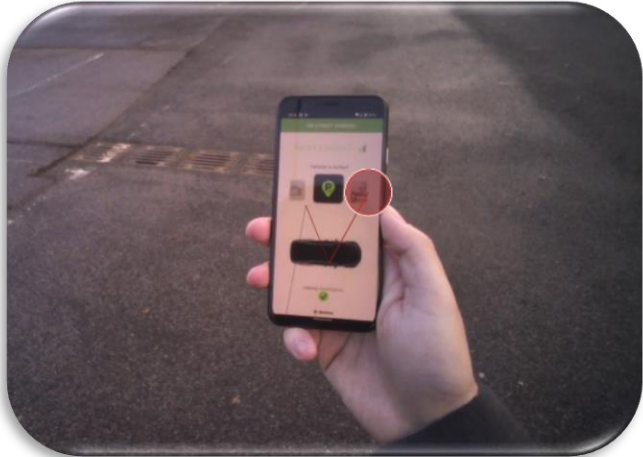
EYE TRACKING ASSESSEMENT: RESULTS&CONCLUSIONS



1. Observation of interior and in-vehicle interface of a stopped vehicle



2. Sending vehicle to a parking lot



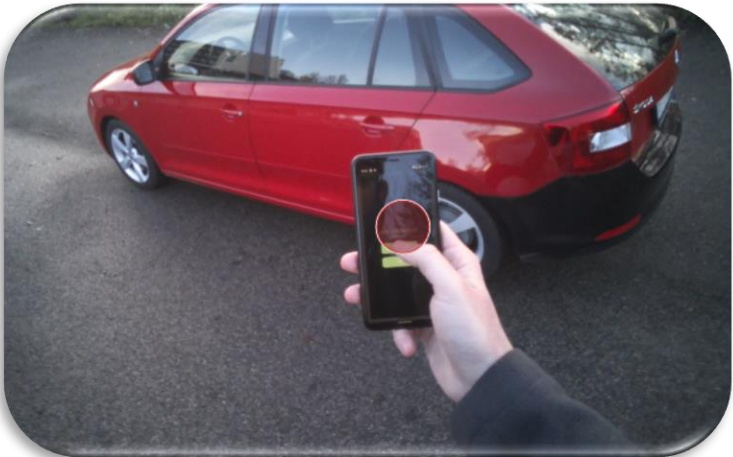
3. Calling the vehicle from the parking lot to the pick-up zone (via mobile app)



4. Car approaching pick-up zone



5. Confirmation of vehicle arrival to the pick-up zone

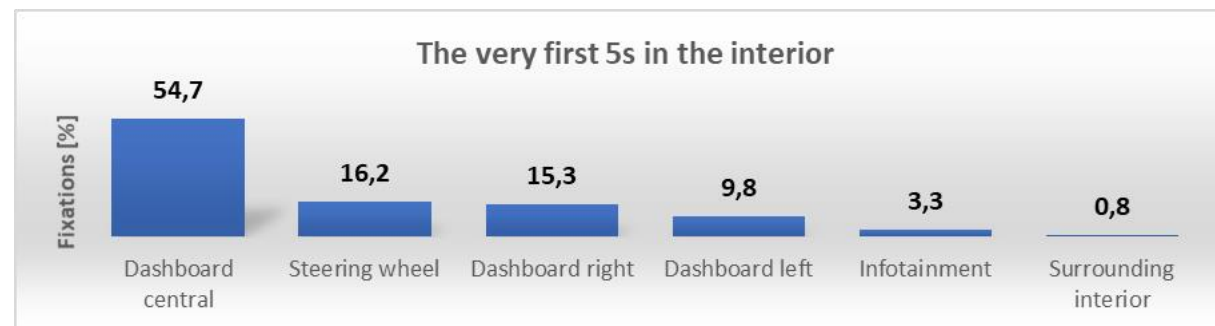


1. Observation of interior and in-vehicle interface of a stopped vehicle

- Fixation clusters are focused mainly in the middle of the gauges area.
- The results show the natural dominance of attention at the speedometer area.
- Subjects spent less time on the left or right side of the dashboard than on the steering wheel.



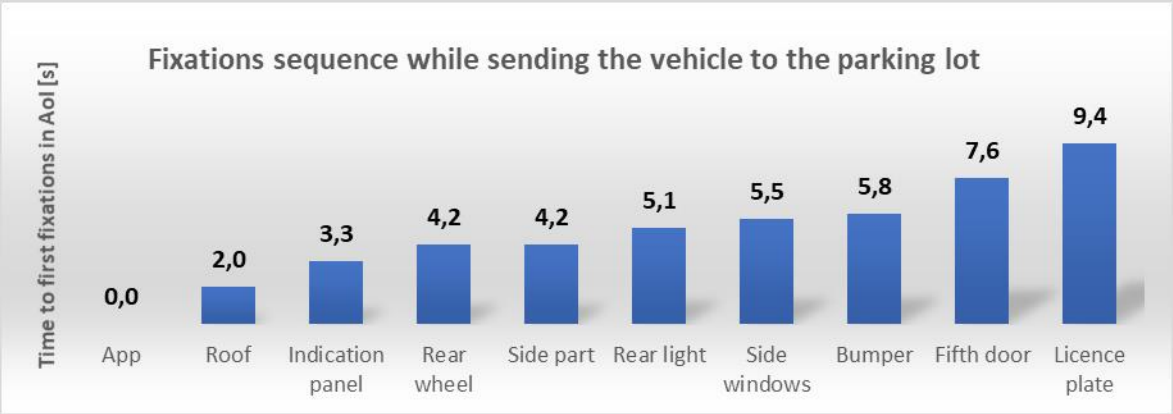
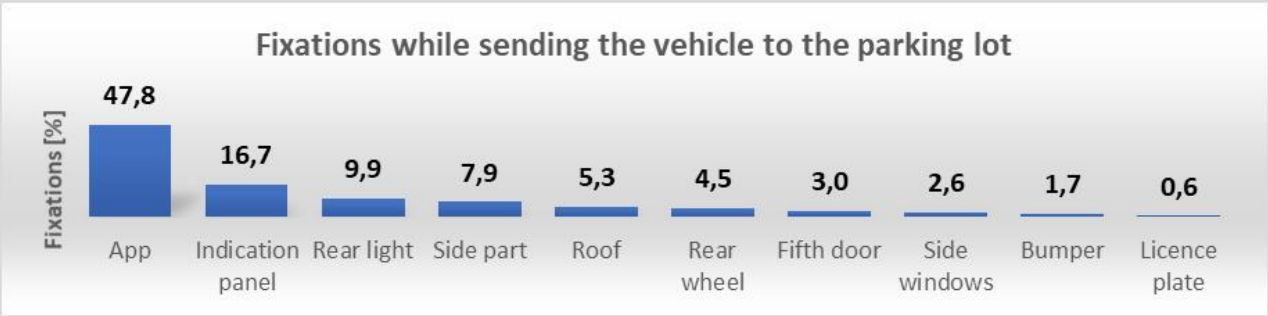
The very first 5 seconds browsing within the interior



First 5s in the interior of the AV

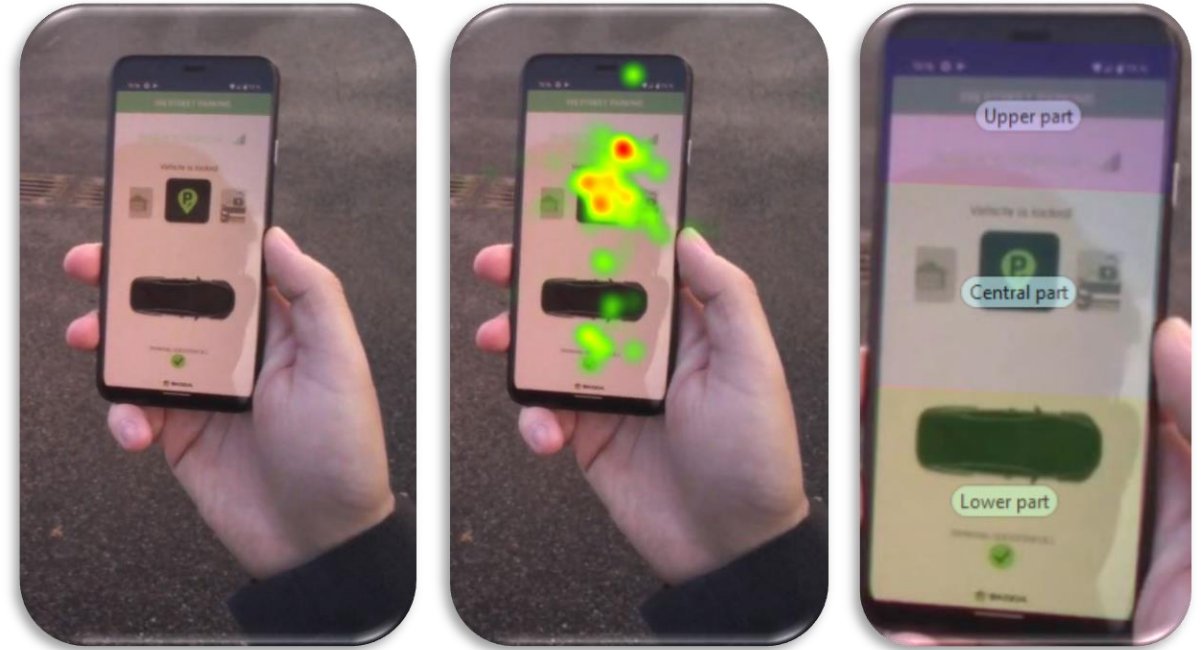
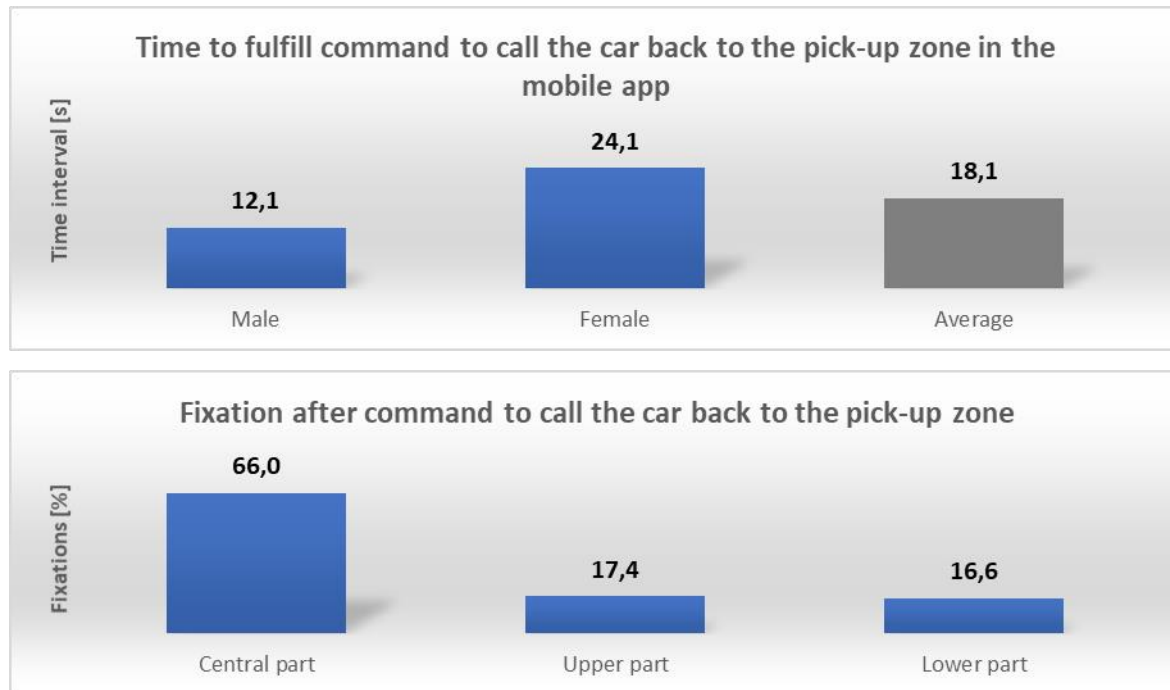
2. Sending vehicle to a parking lot

- Fixations hub is in the central part of the display where the confirmation buttons are located.
- Subjects spent 47,8% on the screen of app.
 - Longer feedback of the app after pressing the confirmation button.
- Subjects tended to verify the status of the vehicle on the indication panel.



3. Calling the vehicle from the parking lot to the pick-up zone (via mobile app)

- Subjects tend to explore more buttons (even those they expected hidden in the menu or on the screen).

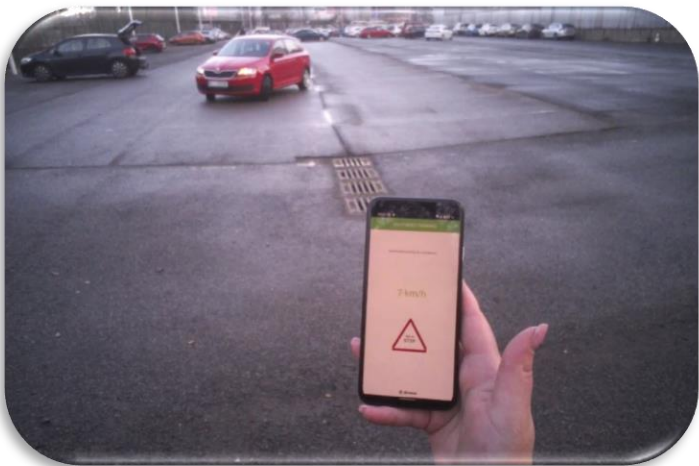


Fixation on the screen of the smartphone and defined AOI

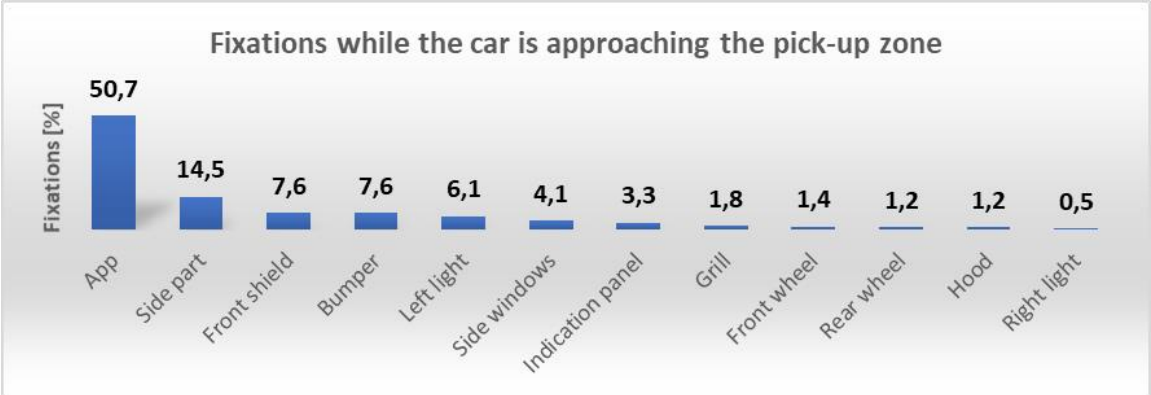
- 2/3 of glances were focused on the central area
- The lower and upper parts of the screen draw less of subjects' attention while fulfilling the task

4. Car approaching pick-up zone

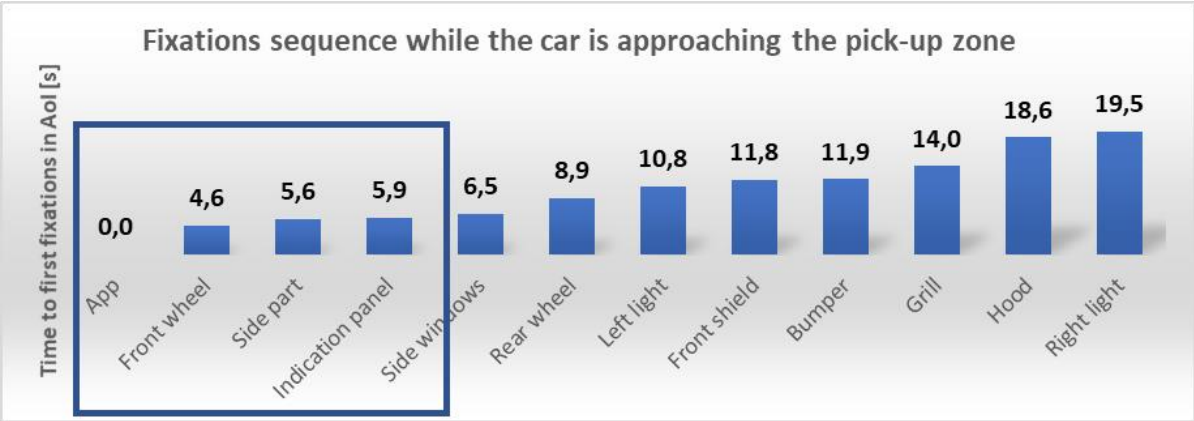
- A low level of uncertainty can be observed in subjects' visual behaviour – the need to verify what is really going to happen in the app, if everything is really alright.



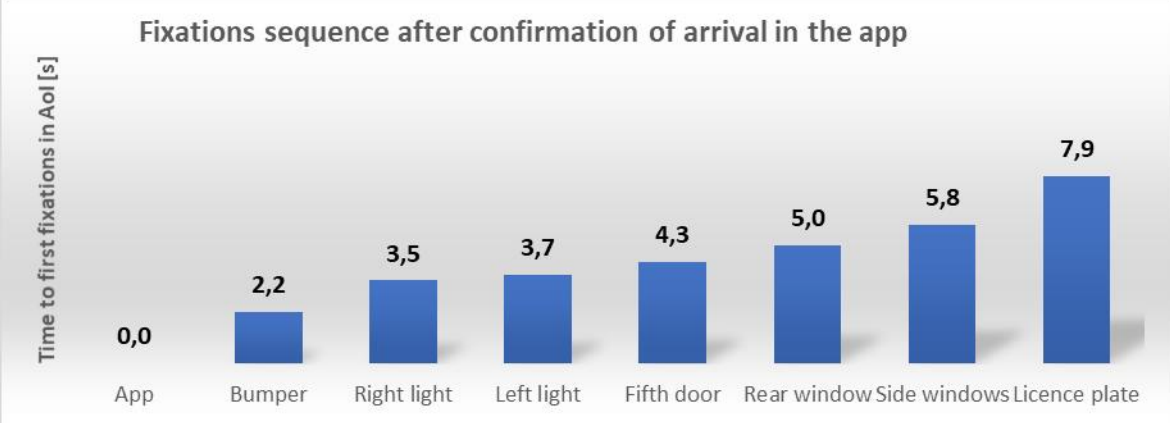
AV approaching the pick-up zone



- Trend of time delay after successful confirmation in the app (delta between App and Front wheel).



5. Confirmation of vehicle arrival to the pick-up zone



- Subjects did not tend to check the status of the indication panel.
- Almost 75% of time subjects spent on the screen of mobile app.
- Subjects tend to look on bumper and rear lights.
 - Which happens after subjects make sure that no other information ques are expected from the app.



Confirmation of the arrival and picking up the car

EYE TRACKING ASSESSEMENT: RESULTS&CONCLUSIONS

A. In-vehicle interface

- Based on the gaze focus subjects tended to look up for information in the center of the display (cluster panel).
- The redistribution of actually displayed information per its relevance (stopped vehicle) could be considered.

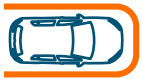
B. External interface

- Introduction to the autonomous communication of the measured vehicle was during the pilot study which has shown to be not enough to understand its messages clearly, if at all.
- This was supported by the visual attention constant shift to the information in the mobile application – a more familiar tool.

C. Mobile application

- The mobile phone app was used by the subject the most, mainly for verification of the status of the autonomous vehicle.
- The confirmations or commands for subjects' actions were missing on the app thus the interface modifications per information it delivers as well as options/further functions could be introduced after more detailed study of the user acceptance.

-
- The main communication area that was analyzed included external vehicle interface and mobile app, where a split of attention has been observed between these two interfaces.
 - During a pilot study, subjects tended to visually check the status of the autonomous parking via all means available – the external vehicle communication (indication light) and the information on the mobile app. There were significant gaze shifts between these two interfaces with an attempt to verify the correspondence of information in the application and on the vehicle.



Thank you for you attention!



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