interACT – Project overview

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Project facts

• **Programme:** EU/H2020-**ART04** - *Safety and end-user acceptance aspects of road automation in the transition period*

• **Duration:** 36 months

• **Period:** May 2017 – April 2020

• **EU Funding:** 5.527.581 €

• **Coordinator:** Anna Schieben, DLR German Aerospace

• **Partners:** 8 industrial and academic partners from 4 European countries (Germany, Italy, Greece, UK)

• **US - EU twinning project:** AVIntent (NHTSA)
Question: how will AVs communicate and interact with other road users?
The challenge

Achieve a safe, highly accepted and efficient integration of Automated Vehicles in mixed traffic environment

1st Enabler
Psychological models

2nd Enabler
Intention recognition & behavioural predictions

3rd Enabler
Communication & Coordination Planning Unit & safety layer

4th Enabler
Novel HMI elements

5th Enabler
Methodology for assessing the quality of interaction
Observation of Pedestrian-Vehicle Encounters

5th Enabler
Methodology for assessing the quality of interaction

4th Enabler
Novel HMI elements

3rd Enabler
CCPU & safety layer

2nd Enabler
Intention recognition & behavioural predictions

1st Enabler
Psychological models

The challenge

Achieve a safe, highly accepted and efficient integration of Automated Vehicles in mixed traffic environment

Interaction in Urban Traffic – Insights into an Observation of Pedestrian-Vehicle Encounters
Interaction today
Key Objectives

• **Observe** human-human interactions in current complex urban environments
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• **Model the interactions** using different approaches:
  • Interaction vocabulary: *How do Traffic Participants communicate and anticipate intent*
  • Interaction sequences: *What is the general interaction process in specific use cases and scenarios and what are the cultural difference?*
  • Quantitative models: *How can interactions be mathematically formulated to allow model-in-the-loop simulations?*
Key Objectives

• Observe human-human interactions in current complex urban environments
• Model interaction using different approaches
  • Interaction vocabulary: *How do TPs communicate and anticipate intent*
  • Interaction sequences: *What is the general interaction process in specific use cases, scenarios and scenes?*
  • Quantitative models: *How can interactions be mathematically formulated to allow model in the loop simulations?*
• Develop real-time **situation and intention analysis** algorithms based on the interaction models
Key Objectives

• Observe human-human interactions in current complex urban environments

• Model interaction using different approaches
  • Interaction vocabulary: How do TPs communicate and anticipate intent
  • Interaction sequences: What is the general interaction process in specific use cases, scenarios and scenes?
  • Quantitative models: How can interactions be mathematically formulated to allow model in the loop simulations?

• Develop real-time situation and intention analysis algorithms based on the interaction models

  Observe, Model, Predict
Methodology

• 3 Countries

• 4 Use Cases
Methodology

Naturalistic observation of urban traffic

• Video

• Observation Protocols

• Questionnaires

• LiDAR
Methodology

Video:

• Birds eye view perspective of locations chosen to represent the use-cases

• Algorithmic analysis of the videos to derive positions and velocities of various traffic participants
Methodology

LiDAR:

- Stationary LiDAR giving additional information on traffic participants and increasing tracking range

- Collected data is synchronized in time enabling a holistic overview of observed interactions

WebCam
GNSS Receiver
Ibeo Lux Laser Scanner
SSD Drive
Laptop Power Bank
Raspberry Pi
WiFi Access Point
Methodology

Manual Observation:

- Observers recording individual observed interactions from the ground
- HTML based app for tablets observing pedestrian and driver behaviour, including head rotation, eye contact, etc.
- Questionnaires
Preliminary Results – Manual Observation

- Over 100 Protocols per use case and country
- Also: combined 100+ hours of videos, 20+ hours of LiDAR Data and 150+ people interviewed
Preliminary Results – Manual Observation

“Interaction Sequence” - Intersection – pedestrian goes first:

- Slows down \((50, 43, 18)\) \(/
  \) keeps pace \((48, 30, 77)\)
- Turn indicator \((83, 12, 14)\)
- Decelerates for traffic \((49, 16, 11)\)
- Looks at approaching vehicle \((43, 59, 78)\)
- Initiates Crossing \((92, 74, 95)\)
- **Waives hand \((1, 4, 2)\)
- Looks at Pedestrian \((6, 13, 18)\)
- Decelerates \((22, 26, 12)\)
  or stops* \((5, 23, 1)\)
  for pedestrian
- Passes behind pedestrian

*at times there is no complete stop but rather a continuation of the movement at a very slow pace

**in some cases there was no hand waiving and the scenario played out comparably

Percent of Observed Patterns in:
- Leeds, UK
- Munich, Germany
- Athens, Greece
Overall Findings

- The occurrence and necessity of interactions depends on the situation and a variety of other factors, such as traffic density, time of day and specific traffic conditions.

- Explicit communication (e.g. gesturing, flashing lights etc.) happens rarely - most potential interaction-demanding situations are resolved before they actually arise, mostly by adjusting kinematic motion.

- Cooperation, communication and thus interaction between human road users takes place at low speeds, usually below 20 km/h.

- At higher speeds, conflict avoidance is predominant – pedestrians use large enough inter-vehicle gaps to cross without expecting the second vehicle to adapt.

- Self reports ≠ reality: Observations did not match pedestrians’ reporting.

- Cultural Differences are complex: What is “culture”?
Overall Findings

• Human road users seem to **avoid active communication with others** by adapting their movement behavior early

• Communication is only used in **ambiguous situations** to let the other traffic participant go first, mostly **using gestures**
Some (preliminary) Conclusions

• The use of “external Human Machine Interfaces” is only relevant in ambiguous situations, when explicit communication is necessary above and beyond kinematic cues.

• BUT – Unlike manually driven vehicles, in addition to adapting their movement, perhaps Automated Vehicles could enhance acceptance, safety and traffic flow by communicating their intentions to other traffic participants earlier.

BREAKOUT SESSION #25

The Role of Human Factors in the Design of Automated Vehicle External Communications

Wednesday, July 11, 2018, 1:30 PM – 5:30 PM
Room: Yosemite C
Organizers:
  Andy Schaudt, Virginia Tech Transportation Institute
  John Shutko, Ford Motor Company
  Sheldon Russell, Virginia Tech Transportation Institute
Thank you
Any questions?

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