PROJECT-TEAM
RITS

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Arbitration for Balancing Control between the Driver and ADAS Systems in an Automated Vehicle: Survey and Approach

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Abstract

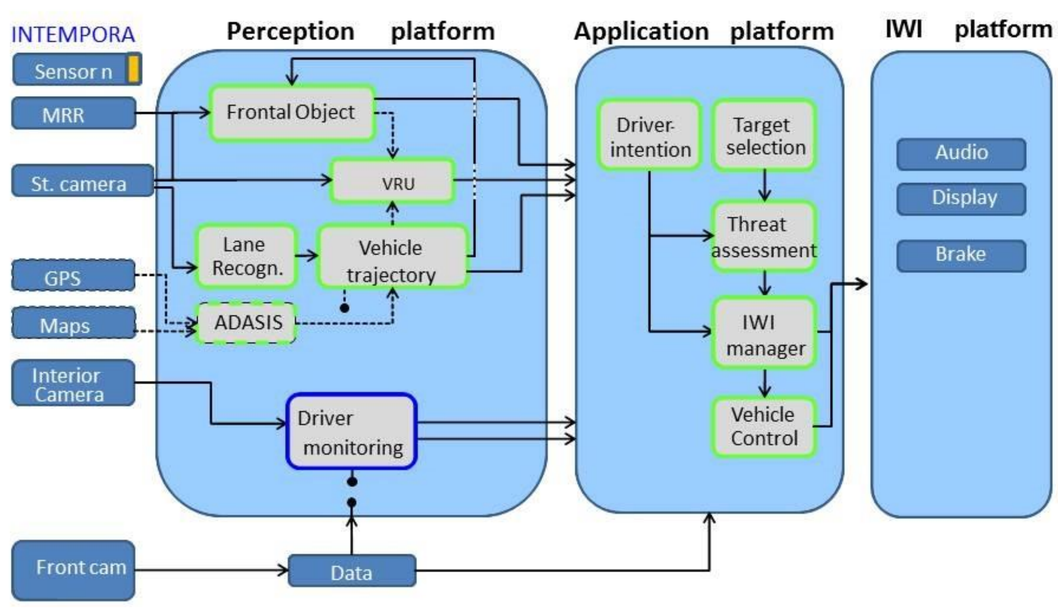
Automated functions for real scenarios have been increasing in last years in the automotive industry. Many research contributions have been done in this field. However, other problems have come to the drivers:

- *When should they (the drivers or the new automated systems) be able to take control of the vehicle?*

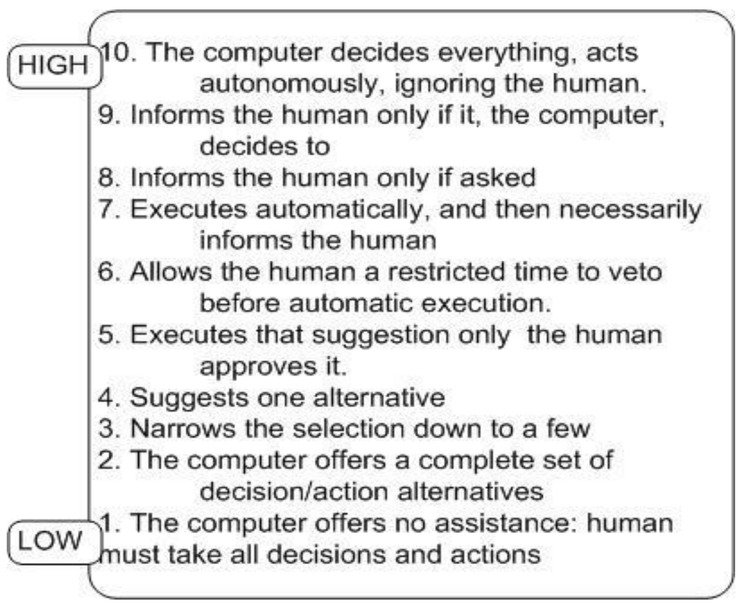
This question has not a simple answer; it depends on different conditions, such as: the environment, driver condition, vehicle capabilities, fault tolerance, among others.

In this paper a survey on arbitration and control solutions in ADAS is presented, analyzing the ADAS functions available in the market, and its relation with the different control actions

Context –DESERVE project-



Levels of automation of decision and action selection:



Key factors for vehicle control in the market

- **Legislation**: New Car Assessment Programme (Euro NCAP)
- **Cost**: customers are willing to pay more for avoidance systems (ADAS) [10]
- **Market indicator**: ADAS will have a high influence on market in few years
  Safety: Electronic systems are critical for modern automobiles [12].
- **Technology availability**:
  - *Interconnections.*
  - *Fusion.*
  - *New infrastructures*
  - *Sensor technologies*

CONTRIBUTIONS

- A survey on arbitration and on autonomy levels for co-driving.
  What if the automated vehicle (co-system) "wants" to go to the right and the driver wants to go to the left?
- An approach using controllers implementing fuzzy rules.

ARBITRATION

- Nowadays computerized vehicles cannot ensure full autonomy in all situations, i.e., co-driving is still necessary to ensure safety.
- Level of automation: a combination of tasks delegated at some level of abstraction with some authority and resources to be used to perform the task. E.g., for UAVs [Clough 02], in ITS [Pollard & Morignot 13].
  - Can be 2-dimensional [Clough 02] [Parasumaran *et al*. 00].
- Arbitration : comes from the fact that 2 decision makers must harmonize their advice on the unique path followed by the vehicle [Flemisch *et al.* 12].
  - Choosing a level of automation of the vehicle.
  - Is dynamic, to adapt to the driver's state and to the situation.
  - Is based on *ability*, *authority*, *responsibility* and *control*.

FUZZY LOGIC APPROACH FOR SHARING CONTROL OF A VEHICLE

- Decision making and intention detection concepts are usually based in the combination and evaluation of measurable parameters to infer a probability value.

RULE BASE:

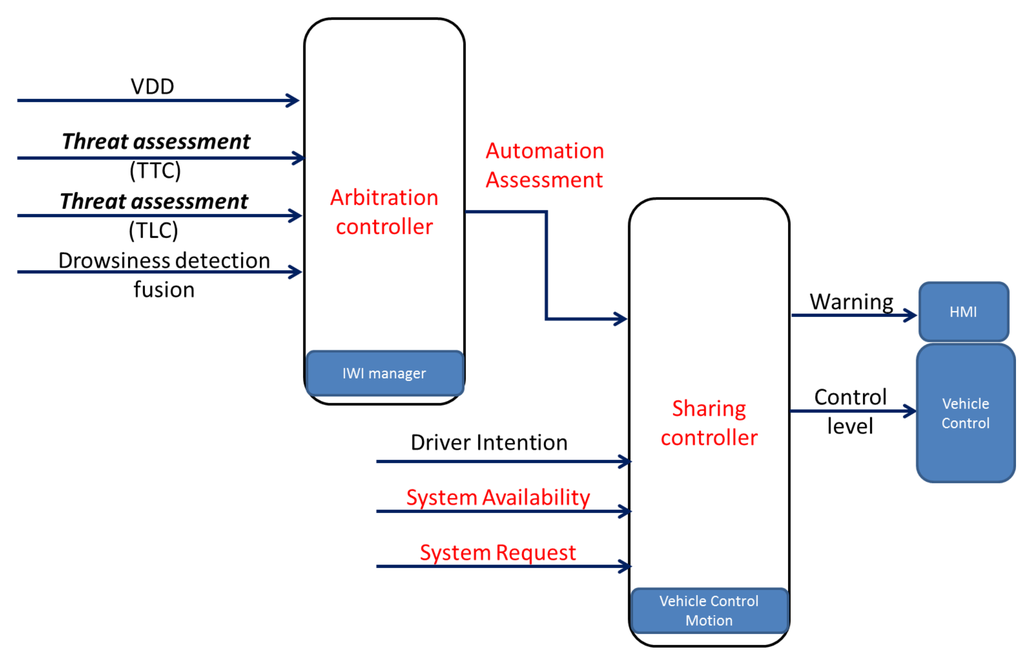
***IF** VDD level is high **AND** TTC level is low **THEN** Fully control level is **HIGH**.*

***IF** VDD level is low **AND** TTC level is high **THEN** Fully control level is **LOW**.*

***IF** Drowsiness level is high **AND** TLC is low **THEN** Fully control level is **HIGH**.*

***IF** Drowsiness level is low **AND** TLC is high **THEN** Fully control level is **LOW**.*

...



CONCLUSION & FUTURE WORK

- Federate authors on a unique spectrum of autonomy layers for ITS.
- Arbitration as solving conflicts between the driver and the co-system, based on dynamic autonomy layers of the vehicle.
- A proposed implementation in simulation using fuzzy rules.
- **Future work**: As a Human study (in a simulated vehicle), observe the behavior of drivers during long driving periods in the simulator. Topics: Adaptation of the co-system to the driver (based on driver monitoring); Initiatives of the driver (autonomy level change).

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