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Challenges in infotainment system development for autonomous vehicles

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Introduction

The complexity and the performance of the In-Vehicle-Infotainment (IVI) systems are continuously increasing. The new road vehicles continuously implement more and more automated driving related features. The goal of the technology development in the automotive industry is to produce fully autonomous cars, that can drive everywhere in all conditions. Until reaching that advanced state, the technology will have to get over several maturity level. Due to the nature of the automotive business and the technical complexity of the autonomously driving cars and the related critical infrastructures, the continuous development is impossible without properly analyzing the whole context.

Building blocks of the IVI system

A general sketch of a premium passenger car can be seen in Fig 1. Not all these system blocks can be found in each passenger car. Some blocks are new developments, and some have already undergone major changes.

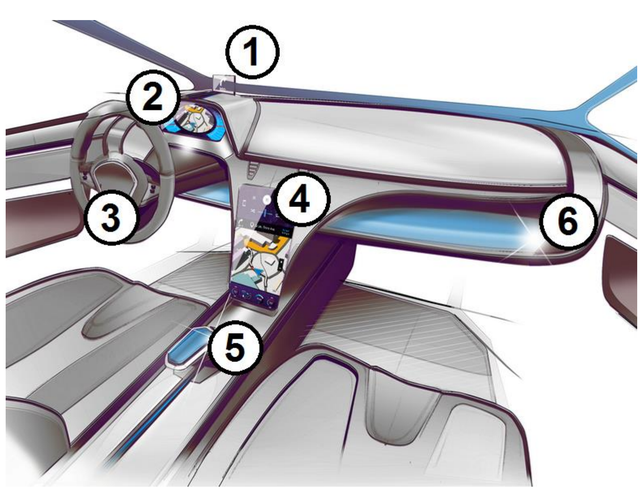

Fig. 1. *Passenger car In-Vehicle-Infotainment system*

1. *Head up display*
2. *Instrument cluster*
3. *Steering wheel controls*
4. *Head unit*
5. *Control panel*
6. *Microphone and speakers*

The main function of the IVI is still providing a Human Machine Interface (HMI) in the vehicle. The development of an HMI is a complex, interdisciplinary challenge. As in other vehicle domains, in the IVI domain, the electronics and the software were the most innovative technological areas in the last decades.

Challenging aspects of the development

Production Volume

The number of the produced cars is by order of magnitudes higher than that of other safety critical systems, e.g., power plants or airplanes. Any critical problem resulting in a recall of a car type can cost a lot for the OEM.

Supply Chain

The supply chain extends around the globe and is very complex. The responsibility sharing between the parties is based on actual contracts, but the players must comply with the global quality standard IATF16949 by International Automotive Task Force.

Technical Complexity

A new premium car has over 100 million Lines of Code (LoC) As a comparison a Boeing 787 has 3 million or less LoC. Such level of complexity raises specific requirements on the architectural design (at the system, software, and hardware level), on the component interface specification, on the related integration test specification as well as on the actual integration process.

Vehicle Lifecycle

IVI systems have an increasingly stronger customer requirement to be able to add new system features after the production.

Cultural Differences

Since the UI is always an essential part of the vehicle level safety concepts, the developers must consider the target market cultural background. Developers working for global markets must develop competence to deal with this aspect, which is time-demanding for the organization.

Functional Safety

The society and the authorities want to see a continuously decreasing trend in the number of car accidents. The inappropriately low level of safety can result in a recall with financial, legal as well as reputational consequences. ISO issued the functional safety standards for road vehicles ISO26262 in 2011.

Personalization

Mobile users are used to their phone's personal settings and want to keep using the familiar UI while driving or travelling in a car. Therefore, the IVI UI has to be able to dynamically adjust to the driver's and the passengers' device settings. The trend of carsharing strengthens the requirements on personalization.

Information Security

Future autonomous cars will continuously monitor the environment and send information to the cloud where High Definition (HD) maps will be created and maintained. The HD maps will be an integrated part of the traffic and logistics infrastructure, which is considered as critical infrastructure.

Newcomers in Business

With the integration of System on Chip (SoC), quality displays, and high-performance Graphics Processing Units (GPU), global, originally nonautomotive OS providers, e.g., Google and Apple, and several smaller software component developers appeared in the market.

Level of Driving Automation

In order to provide a common terminology for the industry, the Society of Automotive Engineers (SAE) International issued the J3016 standard.

Conclusion

IVI system developers must work in a very complex and interdisciplinary environment. The safety criticality of IVI system increases as the technology advances towards Level 5 driving automation. Development of autonomous vehicle connections to critical infrastructures require special focus on information security. Therefore, the autonomous road vehicle IVI system development processes must comply with automotive functional safety and information security standards too. Accordingly, IVI system developers will have to consider functional safety and information security aspects parallel form the early concept phase.