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State of the Art and Future Trends of Automotive Systems

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ABSTRACT: Safety related Software Codes in cars have grown from a few lines to millions of lines in modern days. This trend would continue, given all the innovations in electric/hybrid cars, autonomous cars, and connected cars. Modern cars are becoming safer, more efficient and more comfortable. The automotive industry is moving from solely the mechanical engineering domain to include system/software engineering field in its ambit; it includes the role of software as the glue to connect components and to provide functionality.
Few software-related innovations, realtime architecture, software and system engineering are increasingly being introduced. Integrated projects like Hybrid Innovations for Trucks (HIT) and FP7/OPENCOSS (Open Platform for EvolutioNary Certification Of Safety-critical Systems), with a consortium of many companies from several nations are common these days. These research projects highlight the importance of software in the automotive domain; furthermore, they are the key enablers for building up automotive software engineering expertise. Safety-Driven Development, ISO 26262, and an integrated design methodology of automotive software architectures and functional safety is a recent occurrence. Requirements Engineering for Automotive Embedded Systems present the notion of a requirement in general and these describe the types of requirements used when designing automotive software systems. This paper along with a valuable references data-base given in the paper would purportedly serve a treasure-trove of recent developments and future trends in the automotive industry. It is understood that the readers are familiar with the acronyms and jargon in the automotive industry.

KEYWORDS:
Control System, Automotive Engineering, Status Analysis, Development Trend, Industry 4.0, ADAS, automotive radar, chirp sequence modulation, compressed sensing, digital modulation, FMCW, grid map, interference, millimeter wave radar, MIMO, MMIC, OFDM, PMCW, radar networks, radar SOC, SAR, CO2 reduction; electric vehicle (EV); driver assistance systems; chassis; drive trains; electronics and mechatronic systems, fossil fuels, alternative fuels, biofuels, electric vehicles.

I. INTRODUCTION

Optimal planning of development processes for future automotive systems and for further insights is required. Software Reuse: From Cloned Variants to Managed Software Product Lines and Variability Identification and Representation for Automotive Simulink Models are the novel tool-suites to enable software reuse in different granularities point of view. Defining Architecture Framework for Automotive Systems proposes an architecture framework for the automotive systems to facilitate the architecture driven development process. The RACE Project is a particular Informatics-Driven Greenfield Approach to Future E/E-Architectures for Cars and this aims to redefine the architecture of future cars from an information processing point of view. Development of ISO 11783 is Virtual Terminal and Monitoring System for Agricultural Vehicles and it summarizes the challenges of implementing modules such as sprayer and GPS using ISOBUS and proposes a format for implementing a virtual terminal for agricultural vehicles.

Safety is one of the most important quality attribute of a vehicle that needs special attention in all the stages of the life cycle of a vehicle. Safety-Driven Development and ISO 26262 deals with some of the most important aspects of functional safety and safety management, development process, architecture design, and safety assurance. Cooperative Intelligent Transportation Systems introduces the overall system architecture and standards of European-wide Cooperative Intelligent Transportation/Transport Systems (C-ITS).

This introduces three different perspectives on C-ITS, namely, intravehicle, inter-vehicle, and nation-wide. The architecture of C-ITS solutions and C-ITS security and privacy are important. A high level automotive trend watching on the analysis of electric and autonomous driving cars and market trends in ICT and Internet disrupting the transport sector is something to be very critically observed.

II. Future Trends

Innovative features from the manufacturers are offered on higher-end cars as options. The Automobile, Automotive industry, Engineering, the future technology and trends are likely to change the landscape of automotive industry in near future. New forms of automobile technologies are: self-driving autonomous; clean Diesel; electric; hybrid; hydrogen fuel-cell. Automotive transportation may not necessarily be tied to the vehicle itself.

There may be ride-sharing apps, electric vehicle charging stations and smart connected cities. The landscape of automotive industry may see changes in the coming years: driverless cars; internet of things, IoT; telematics and block chain; crossover vehicles; shared mobility; high performance electric vehicles.

Equipment and features the public takes for granted today are electric ignition, automatic windshield wipers, power steering, airbags, cruise control and many more. The eight new car gadgets are:

- Rear-mounted radar.
- Night vision with pedestrian detection.
- Automatic high-beam control.
- Parental control.
- GPS vehicle tracking.
- Cameras.
- Driver capability.
- In-car Internet.

It is clear that manufacturers are working on removing the driver from car. This has been a drive for many years. This serves many benefits:

- Passengers can do other things while in transit.
- Computers can monitor the distance to the next car much faster than a human.
- Cars can be set at a specific speed, reducing congestion.

Vehicles can be sent to hot spots without endangering driver (drones).

The main future trends on the automotive industry are:

- Big Data and Connectivity:
- Autonomy
- Shared Mobility
- Electrification

The industries are changing incredibly fast:

- Urbanization
- Sharing economy
- Mobile technology

New mobility opportunities for the automated industry are:

The automobile industry has evolved over the decades; from four wheel drive to automatic gearbox, and has made driving safer, more efficient, and more enjoyable. The industry is still evolving.

- Services
- Vehicle concept
- Vehicle functionalities

Digital Transformation Trends in the Automotive Manufacturing & Automobile Industry are:

- IoT Automotive Mobility Solutions
- Augmented Reality in the automobile industry
- Automotive Intelligence software solution
- Automotive Business intelligence solution
- Virtual Reality for Automotive Solution

The top 10 advanced car technologies are:

- Autonomous Vehicle,
- Driver Override Systems,
- Biometric Vehicle Access,
- Comprehensive Vehicle Tracking,
- Active Window Displays,
- Remote Vehicle Shutdown,
- Active Health Monitoring,
- Four-Cylinder Supercar,
- Smart/Personalized In-Car Marketing,
- Reconfigurable Body Panels,

III. Automotive Radar: From First Efforts to Future Systems

Today, millions of sensors are produced each year, which has resulted in inexpensive and mature millimeter wave technology. The focus of research has shifted from purely hardware-oriented and device-level topics to sophisticated millimeter wave systems. This has made possible research topics such as digital modulation schemes, radar networks, radar imaging, and machine learning. Sophisticated multiple-input multiple-output (MIMO) antenna arrays and mature assembly and interconnected concepts to today's key research topics of automotive radar have resulted.

IV. Future Automotive Control System

The control system (CS) in automobile is becoming more and more dynamic. A typical dynamic CS, Electronic Stability Control (ESC) plays a key role in the field of active safety and it is the key executive layer of intelligent driving system. Vehicle state parameters are the basis of ESC control and these have a direct impact on the intervention effect of ESC related functions. The real-time and accurate estimation of state parameters becomes the key to limit the industrial application of ESC. Through analysis the functional modules can be understood. The vehicle yaw rate algorithm and the yaw steering wheel angle and speed may be analyzed by chart analysis method.

V. CONCLUSION

The innovation in automotive engineering can be summarized as follows:

- **Sophisticated consumers**
- **Intelligent vehicle**.
- **Dynamic operation**
- **Integrated business**
- **Ecosystem**
- **Alternative fuels like biofuels**

Technology trends include

- More Intelligent driver assistance systems
- Body technology by the used materials with competition between multi-materials, steel, and carbon fibers
- Improved Chassis technology
- Converted Drive trains
- Improved Electronic control

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