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ADAS: Should we be too Reliant for Driver Safety?

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Abstract

Advanced driver assistance systems has come a long way since its inception. It has evolved many folds and has now entered many mid-range vehicles. This article appraises certain features of ADAS as well as its' pros and cons. Emphasizing the vital parts of this system, this article also highlights the challenges ahead and way forward.

Keywords: Driver Safety; Advanced Driver Assistance Systems

Abbreviations: ADAS: Advanced Driver Assistance Systems; ECUs: Electronic Control Units; MCU: Microcontroller Units; OEMs: Original Equipment Manufacturers.

Introduction

Advanced driver assistance systems (ADAS) are contemporary technological features designed to enhance the safety of drivers during car operation. The employment of human-machine interface in the Advanced Driver Assistance Systems (ADAS) installed in automobiles has been observed to enhance drivers' responsiveness to potential traffic hazards. The features encompassed within the category include automatic braking, lane departure warning assistance, adaptive cruise control, collision mitigation warning, blind spot monitoring, traffic sign recognition, and various other functions. The objective of advanced driver assistance systems (ADAS) is to mitigate the impact of human error by incorporating risk detection systems for pedestrians and other vehicles [1-4]. These systems are designed to provide real-time warnings to the driver or even apply the brakes automatically. It is possible that forthcoming sensors will possess the capability to adapt and prioritize their focus towards the innate dependability and security of said systems. Accordingly, this concise piece dwells upon certain features of ADAS as well as its' pros and cons. Emphasizing the vital parts of this system, this article also highlights the challenges ahead and way forward.

Key Aspects of ADAS

The pace of technological advancement is a potential determinant of the adoption of advanced driver assistance systems (ADAS). Despite the significant advancements made by semiconductor companies and other stakeholders in recent times, there is considerable scope for further improvement. As an example, it is worth noting that forward-collision warning systems encounter challenges in detecting objects while a vehicle is in motion at elevated velocities. However, four of these technologies are particularly noteworthy in terms of the difficulties they pose, namely processors, sensors, software algorithms, and mapping [3-6].

Processors

The utilization of electronic control units (ECUs) and microcontroller units (MCUs) is a fundamental requirement for the majority of advanced driver assistance systems (ADAS) applications, particularly those pertaining to autonomous driving. In order to enhance the development of advanced driver assistance systems (ADAS), it is imperative to improve the performance of processors. This can be achieved through the implementation of multicore architectures and higher frequencies while simultaneously reducing power consumption requirements.

Sensors

These technological devices acquire data pertaining to their proximate surroundings, including individuals on foot and approaching vehicles. Many sensors possess a restricted measurement range and signal bandwidth, thereby posing a challenge in distinguishing between system noise and signal, such as road obstacles. Tracking moving objects under suboptimal environmental conditions, such as precipitation and fog, poses a significant challenge for sensors.

Numerous stakeholders within the industry are endeavoring to enhance the performance of individual sensors. The optimization of system performance is being pursued through the enhancement of sensor fusion, which involves the coherent amalgamation of data obtained from various sensors. Inter-sensor communication poses a significant challenge on the hardware front due to the need for high bandwidth and the development of effective measures to prevent network overloads. At present, players are engaged in the optimization of partitioning and distribution of system architecture as a means of addressing the aforementioned issue. The integration of image and non-image data poses a particularly arduous task on the software front. Several original equipment manufacturers (OEMs) and tier-one suppliers are currently collaborating with academic institutions to tackle this issue, as evidenced by Daimler's partnership with the Karlsruhe Institute of Technology and the University of Ulm.

The primary impediment to the widespread adoption of ADAS could be attributed to the restricted capabilities of contemporary sensors, coupled with their exorbitant expenses. Several enterprises are nevertheless making advancements in both areas. One instance involves the efforts of Mobil eye and several emerging companies to enhance the efficacy of camera-centric solutions, which commonly encounter challenges in identifying obstacles amidst rainfall or in scenarios characterized by restricted visibility. In the event that camera-based solutions achieve parity with RADAR and LiDAR in terms of functionality, their comparatively lower cost could potentially position them as the dominant technology in the ADAS market. Integrated systems that incorporate both lasers and cameras may gain popularity due to their cost-effectiveness compared to standalone RADAR and LiDAR technologies. The advancement holds significant value as per the analysis of professionals, who assert that the realization of semiautonomous driving hinges on the availability of an economical LiDAR system that is seamlessly incorporated with other sensory apparatus.

Software Algorithms

The topic of interest pertains to software algorithms. Algorithms operating on electronic control units (ECUs) and microcontroller units (MCUs) utilize sensor input to generate a real-time synthesis of the vehicle's surrounding environment, surpassing the processing capabilities of the sensors themselves. Subsequently, the algorithms furnish the driver with output or determine the appropriate course of action for the system to proactively intervene in vehicle control. The integration of in-car software for decision-making purposes, such as the activation of emergency brakes, is a highly intricate process that demands utmost attention to safety.

As a result of advancements in sensor fusion, the automotive industry is poised to shift from utilizing embedded software that operates on a solitary ADAS-dedicated electronic control unit (ECU) to employing software platforms that operate on centralized ECUs or MCUs. The aforementioned software platforms exhibit a heightened degree of abstraction, thereby facilitating the seamless integration of sensor-fusion algorithms with greater flexibility. Presently, industry stakeholders are prioritizing the development of algorithms that enable precise amalgamation of sensor data and expedited processing. This is because such algorithms are expected to mitigate the risk of data overload or deceleration. An additional objective is to devise algorithms that enable safer vehicular navigation and enhance the precision of forecasting all feasible human actions, including those that may be irrational, in diverse circumstances, such as when an imminent collision between two automobiles is anticipated [2,3].

Mapping

In situations where GPS connectivity is disrupted, such as when traversing through tunnels, the use of precise and comprehensive cartographic systems can serve as a preventative measure against potential mishaps. The aforementioned systems possess the capability to retain geographical and infrastructure data and are capable of updating such information as required. Additionally, they establish communication with sensors installed on the vehicle to ascertain its precise location. Original Equipment Manufacturers (OEMs) and other stakeholders in the automotive sector are actively seeking cost-effective approaches to build and sustain maps. One of the latest approaches involves the utilization of vehicles equipped with 3-D laser technology and 360-degree high-definition cameras, commonly referred to as "mapping cars." Cartographers are also utilizing information obtained from sensors that have been installed on commercial fleets, such as FedEx, in addition to GPS data that has been collected from drivers [3,4].

Pros and Cons

The incorporation of navigational alerts in automated lighting, adaptive cruise control, and collision mitigation alert systems serves to caution drivers of potential dangers such as lane deviations and vehicles in their blind spots. Automated emergency braking is activated and executes the braking action on behalf of drivers in cases where their response time to an emergency is inadequate. Furthermore, the implementation of adaptive cruise control enables Advanced Driver Assistance Systems (ADAS) to modulate a vehicle's velocity in reaction to surrounding traffic, whereas lane departure warning systems prevent unintentional lane deviation.

One contributing factor to the potential risks for both vehicle occupants and pedestrians is the excessive reliance of drivers on Advanced Driver Assistance Systems (ADAS). Furthermore, drivers have the option to deactivate their Advanced Driver Assistance Systems (ADAS) due to potential issues that may arise if the technology incorrectly interprets external stimuli. In the event that Advanced Driver Assistance Systems (ADAS) inaccurately perceive a vehicle as having passed another in close proximity, there is a possibility that the system may suddenly decrease or halt the speed of the car, thereby posing a potential safety risk. The cost of insurance and maintenance presents a hindrance to the successful implementation of ADAS. Vehicles equipped with Advanced Driver Assistance Systems (ADAS) incur notably higher repair expenses, consequently leading to an increase in insurance premiums. Moreover, the repair of automobiles equipped with ADAS necessitates the expertise of specialized personnel possessing the requisite system knowledge.

Current Status

At present, Advanced Driver Assistance Systems (ADAS) represent a pivotal element and a key marketing feature of automobiles. Advanced Driver Assistance Systems (ADAS) are a pragmatic safety feature that effectively augment the safety of vehicle occupants. The inclusion of this capability has emerged as a popular feature among Indian consumers, who now seek it in their automobiles. The MG Gloster was the inaugural mass-market Sports Utility Vehicle (SUV) in India to feature an Advanced Driver Assistance System (ADAS) Level-1 capability. Subsequently, Mahindra introduced the XUV700, which is the inaugural sport utility vehicle priced below Rs 30 lakh and equipped with Advanced Driver Assistance Systems (ADAS). To enhance their product portfolio, other manufacturers are presently integrating Advanced Driver Assistance Systems (ADAS) or some of its functionalities in their automobiles. The Advanced Driver Assistance Systems (ADAS) has achieved a significant global market penetration. The Indian market is relatively nascent with respect to the incorporation of contemporary features. In India, certain manufacturers have begun to incorporate Advanced Driver Assistance Systems (ADAS) into their vehicles, as consumer awareness of this technology increases [6,7].

Concluding Remarks

Advanced Driver Assistance Systems (ADAS) have the potential to emerge as a pivotal commercial prospect in the automotive industry, with semiconductor enterprises being favourably situated to capitalise on this opportunity. The current scenario places greater significance on the technical proficiency of suppliers, particularly in terms of offering enhanced system-level capabilities through the provision of components and solutions. This has been a long-standing priority for OEMs [5-7]. It is imperative for semiconductor enterprises to modify their conventional business practises by diversifying into software and integration competencies, as well as formulating novel approaches for collaborating with original equipment manufacturers (OEMs) and other stakeholders across the value chain. Firms that proactively engage in the ADAS market during its nascent stage have the potential to attain a competitive advantage.

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