A Review on Advanced Driver Assistant System (ADAS) Application

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Abstract: In every year, automobile manufactures spend millions in the development of new technologies to keep drivers safe and accident free while operating their vehicles. These technologies are known as Advanced Driver Assistance Systems (ADAS). There are various applications such as In this paper, various applications and their implementation, validation and testing method will be discuss which is conducted by different researchers.

***Index Terms* - Advanced driver assistance systems (ADAS), hardware-in-the-loop (HIL), Controller Area Network (CAN)**

I. Introduction

An advanced driver assistance system, or ADAS, is used to describe the growing number of safety functions designed to improve driver, passenger and pedestrian safety by reducing both the severity and overall number of vehicular accidents. ADAS include various safety features for vehicles such as autonomous emergency braking (AEB), lane departure warning (LDW), lane keep assist, adaptive lighting and night vision cameras. It is predicted that over 40% of all vehicles on the road will feature ADAS by 2020.

Advanced driver assistance systems (ADAS) are growingly used in automotive industry in last decade. ADAS can be defined as vehicle-based intelligent safety systems which could enhance road safety in terms of crash avoidance, crash severity mitigation and protection and post-crash phases. ADAS can also be defined as integrated in-vehicle or infrastructure based systems which contribute to more than one of these crash-phases. For example, intelligent cruise control and advanced braking systems have the ability to prevent the crash or mitigate the severity of a crash.

New technologies for road safety have together been known as Intelligent Transport Systems (ITS) and transport telematics advanced driver assistance or driver support technologies and, more recently, ADAS, to show increasing use of electronic and telecommunication technology in the road transport sector.

As the number of modern vehicles have advanced driver-assistance systems such as emergency braking, anti-lock brakes, lane departure warning, adaptive cruise control and blind spot warning.

There are three approaches are which are used during the development cycle: Model-In-the-Loop (MIL), Software-In-the-Loop (SIL) and Hardware-In-the-Loop (HIL). In MIL, a model of the developed system is integrated in a simulation loop with models of sensor, vehicle dynamics, actuators and traffic environment. Next step is SIL which allows to replace the tested model with a real software implementation for real-time operation validation. The last step, HIL, consists of a combination of simulated and real components in order to validate the functionality of the system on both hardware and software aspects.

The Controller Area Network (CAN) is a serial communications protocol used for networking sensors, actuators, and other nodes in real-time systems as shown fig. 1.

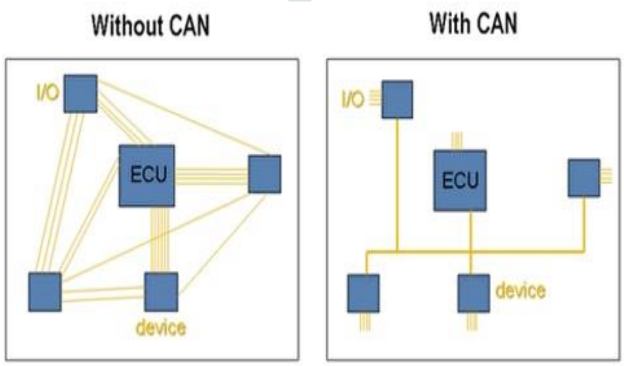

Fig 1. CAN networks significantly reduce wiring

II. LITERATURE SURVEY

Gietelink, O., De Schutter, B., Ploeg, J., & Verhaegen, M. have presented about the development of advanced driver assistance systems (ADAS) with vehicle hardware-in-the-loop simulations (HILS). In this paper, a new methodology for the designing and validating of (ADAS) is presented. Using hardware-in-the-loop (HIL) simulations, the development process, the validation phase of intelligent vehicles is done safely, cheaply. The working principle of HIL is demonstrated with the results of testing of an adaptive cruise control and a forward collision warning system. On the basis of the 'V' diagram, the position of HIL in the development process of ADASs is illustrated. [1]

W.Devapriya, C.Nelson Kennedy Babu, T.Srihari have presented about Advance Driver Assistance System (ADAS) – Speed Bump Detection. In this paper, a interestingly new method is presented to achieve speed bump detection and recognition to alert as well as to interact directly with the vehicle. Detection of speed bump is recognized using image processing concepts. This methodology is implementing effortlessly without the investment of special sensors, hardware, Smartphone and GPS. [2]

Mirko Nentwig, Marc Stamminger have presented about Hardware-in-the-Loop Testing of Computer Vision Based Driver Assistance Systems. In this paper, they have investigated the applicability of real-time generated computer graphics for mono camera lane and vehicle detection algorithms. They have also introduced a developed hardware-in-the-loop simulator along with two solutions for the synthetic input images. They have focused on the environment and camera model creation for the test to be performed. Also, demonstrate the applicability on scenarios derived from real test drives using simulator and compare the results with real scenarios. [3]

Kihong Park and Seung-Jin Heo have presented about the study on the brake-by-wire system using hardware-in-the-loop simulation. In this paper, the advantage of HILS system is discussed over actual vehicle test and pure simulation. HILS system is being widely used for designing, evaluating, and benchmarking vehicle control units. In this HILS system for the EHB (Electro-Hydraulic Brake) brake-by-wire system is also developed. This research consists of three parts: hardware, software, and interface parts. The hardware part consists a high pressure generator, four wheel cylinders, and brake tubes. The software part consists the vehicle model, the EHB control logic, and post-processing module. The interface part consists devices that are used to link the actual brake system with the virtual vehicle model. EHB control logic and VDC (Vehicle Dynamics Control) logic is tested in the HILS system. For various driving conditions test results are presented. [4]

A. Palladino, G. Fiengo, D. Lanzo have presented A portable hardware-in-the-loop (HIL) device for automotive diagnostic control systems. In this paper, a portable electronic environment system, suited for HIL simulations, is developed to test the engine control software and the diagnostic functionality on a CAN line, respectively, through non-regression and diagnostic tests. Firstly, they have compared two different software releases four-cylinder spark injection Fiat engine equipped with a variable valve timing (VVT) system and turbo-compressor. Secondly, they have performed for the same software release on two development ECUs with different processors, having different hardware characteristics. The proposed device is developed to perform the experiments as the commercial HIL simulator is unproductive in terms of time to set up the experiments and costs of the devices. Therefore, the main advantages of the HIL are the simple to use and portability. [5]

Mateus Mussi Brugnolli, Bruno Silva Pereira, Bruno Augusto Angélico, Armando Antônio Maria Laganá have presented about the Adaptive Cruise Control (ACC) with a Customized Electronic Control Unit. ACC is one of the applications of an advanced driver assistance systems (ADAS). An ACC module is produced to allow the insertion of embedded controllers, communicating with the network of the vehicle and with radar for future on-road applications. The dynamic model of the vehicle is estimated using the system identification theory, and validation of a model is performed. The control system is divided in a cascade control loop, being the outer loop controller responsible for computing the cruise speed and the inner loop for tracking such speed. The outer loop controller is performed using a switching logic between cruise control and ACC modes. The inner loop controller is designed with the control theory of Dahlin. The validation of the controllers is performed using a safe and controlled environment, with a dynamometer. [6]

Sikandar Moten, Francesco Celiberti, Marco Grottoli, Anne van der Heide, Yves Lemmens have presented about the X-in-the-loop (where X:Model, Software, Hardware, Driver/Human, etc.) driving simulation platform, developed at Siemens PLM Software, that facilitates the design, development, testing and validation of Advanced Driver Assistance System (ADAS). The simulation platform allows the virtual validation of an ADAS for different variants of vehicle, environment models, sensor models, decision making algorithms or driver behaviors. Virtual design, development and testing is used to increase confidence in the developed algorithms and technologies, provide proof-of-concept for these and ultimately increase the safety both for the test operators, road actors and infrastructure. Also, it would be feasible to test scenarios virtually which are difficult and often impossible to test in real life such as critical weather conditions, failure of components (such as camera, LIDAR, RADAR). [7]

Richard Hamilton, Hayden Seager, Kavya P. Divakarla, Ali Emadi, Saiedeh Razavi have presented about the Modeling and Simulation of an Autonomous capable Electrified Vehicle. This paper provides the major aspects associated with modeling and simulation of an autonomous-capable EV including available tools, general framework for the model, simulation setup/ test cases and results. Here the Framework provides a modular approach to simulating an autonomous-capable EV by considering various sub-models including road, infrastructure, weather, traffic, sensors and their fusion, ADAS feature set, ADAS control algorithms as well as EV control models including the powertrain, transmission, motor and battery control incorporated within the EV model itself. This paper provides the building blocks for modeling and simulation of an autonomous-capable EV and a practical demonstration through simulations. [8]

Chaudhari Priyanka Ramnath, Prof.S.Y.Kanawade has presented Advanced Driver Assistance System (ADAS). They have proposed new approach for assisting vehicle drivers through safety warning during time of serious situations. The basic principle of ADAS is to provide anti-collision automatic control system, lane change assistance, fuel level detection and adaptive light control system to provide manipulation of vehicle controls. [9]

Felipe Jiménez, José Eugenio Naranjo, José Javier Anaya, Fernando García, Aurelio Ponz, José María Armingol have presented about the Advanced Driver Assistance System for road environments to improve the safety and efficiency. In this paper the development and implementation of advanced driver assistance system (ADAS) for rural environments is proposed. The proposed system is based on advanced techniques, vehicle automation and communications between vehicles (V2V) and with the infrastructure (V2I). It allows detecting real time and classifying the obstacles, and the identification of potential risks. The designed system is to warn the driver in a risky condition and to take control of the vehicle. The system is implemented on a passenger vehicle and tested in specific scenarios on a test track with satisfactory results. [10]

III. CONCLUSION

In the Conventional ADAS technology can detect some objects, do basic classification, driver alertness from hazardous road conditions and, in some cases, slow or stop the vehicle. This level of ADAS is great for applications like forward emergency braking, blind spot monitoring, lane-keep assistance and forward collision warning.

This paper includes various means of implementation and validation of ADAS applications for security and safety of driver. Also, the system is design to warn the driver in a risky condition and to take control of the vehicle.

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