A Review on Smart Driving System

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Abstract-A smart driving system provides both safety and fuel-efficient driving advice in real time in the vehicle. In spite of several technical advances made in recent years by the automotive industry, the driver's behavior still influences significantly the overall fuel consumption.As vehicle manufacturers continue to increase their emphasis on safety with advanced driver-assistance systems (ADASs) and in vehicle information system (IVIS), we propose a device that is not only already in abundance but portable enough as well to be one of the most effective multipurpose devices that are able to analyze and advise on safety conditions.

KeyWords: *Automotive Applications, Mobile Phone, Sensors, Vehicle Safety.*

I. INTRODUCTION

In the fast-paced society of today, we are focused on arriving at our destination as quickly as possible. However, with this lifestyle, we are not always aware of all the dangerous conditions that are experienced while operating an automobile. Factors such as sudden vehicle maneuvers and hazardous road conditions, which often contribute to accidents, are not always apparent to the person behind the wheel. In recent years, there has been tremendous growth in smartphones embedded with numerous sensors such as accelerometers, Global Positioning Systems (GPSs), magnetometers, multiple microphones, and even cameras [1]. The rapid development of smartphone technology, mobile computing, and GSM mobile communications to support the connected vehicle has facilitated a step change in in-vehicle information systems (IVIS). Whereas in the initial stages of IVIS deployment in-car entertainment systems and satellite navigation systems were the only systems commonly available, as the market has developed the possibilities have increased. The increasing processing power of smartphones combined with their wireless communication features has resulted in the rapid development of new applications and services hosted as smartphone "apps"[2].The manufacturers have shifted their focus of a passive approach, e.g., airbags, seat belts, and antilock brakes, to more active by adding features associated with advanced driver-assistance systems (ADASs) [3], e.g., lane departure warning system [4] and collision avoidance systems [5], [6]. In this paper, we analyze both IVIS and ADASs system features.

II. IN-VEHICLE INFORMATION SYSTEM

In vehicle information systems (IVIS) is a common feature in modern vehicles. These systems aim to help the driver by providing information, for example, about routes, traffic congestion and accidents. Because these systems can provide drivers with real-time information (and are becoming more useful).There is a growing concern that they may interfere with the primary driving task and thus compromise safety.

A. System Design Process

Figure 1 is the representation of main stages in the system design process.

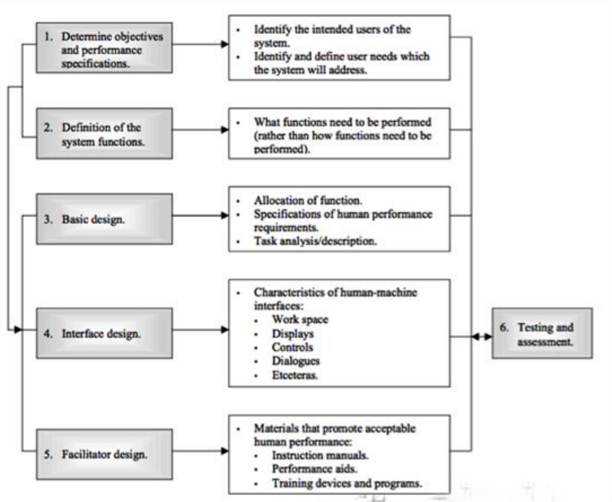
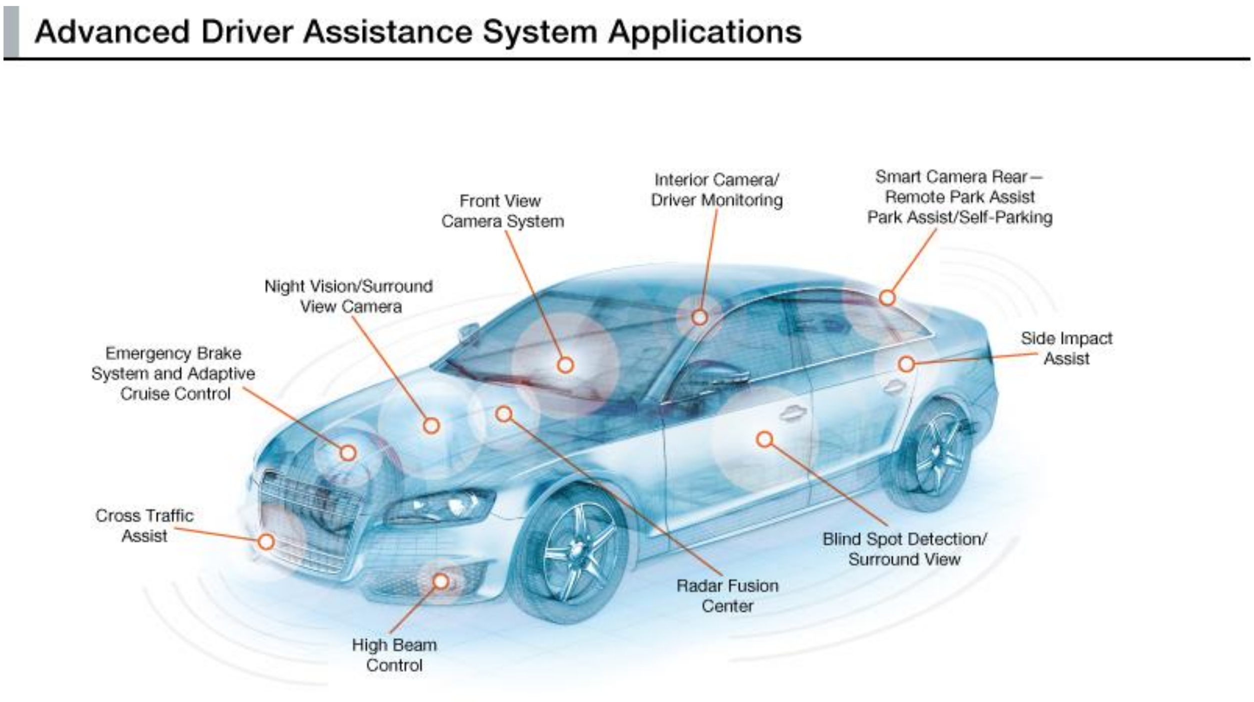


Figure 1: Stages in design process

Before a system can be designed, there must be a reason for it to exist; the objectives of a system



(considered in Stage 1) are normally formulated in very general terms (e.g. navigate the driver to destination). The performance specifications describe what the system needs to do to meet its objectives (e.g. transmitting both visual and auditory information). These should reflect the context in which the system will be used and the skills available among the users. The IVIS also needs to be compatible with the primary driving task. Stage 2 defines what functions need to be performed to meet the objectives and performance specifications formulated in Stage 1 (e.g. select destination, select route, provide directions, etc). In Stage 3 the basic design is defined. After this, more attention can be given to the human-machine interface in Stage 4. In Stage 5 attention is given to the documentation and training that is needed for the end user. Testing and assessment (Stage 6) is typically considered after this stage, but ideally should be carried out throughout the whole design process.

B. System Assessment

The system assessment is important at all stages of design, both for improved product development and to reduce potential reliability problems in the future. A formal assessment methodology or procedure should ideally be applied to ensure a continuous and consistent assessment schedule. If a new design is based on an existing system and is intended for use in the same circumstances and by a similar group of drivers, then a limited assessment by independent experts *may* be sufficient. Some examples of reliable and validated measures are provided in Table 1.

Table 1: Measure of IVIS safety and Usability performance

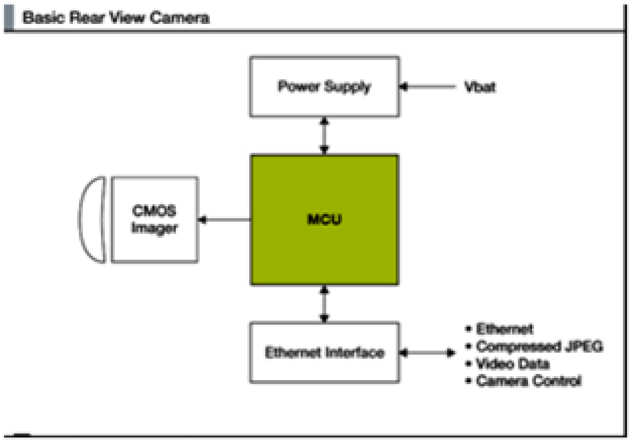
System performance	Driver and Vehicle performance
Efficiency • Number of button presses. • Number of errors. • Task success rates. • Task completion time. **Driver workload** • Subjective rating/ attitudes. (e.g. usability and usefulness ratings) • Psychophysiological measures, (e.g heat rate and heat rate variability). • Second task performance.	**Driver** • Eye movement behavior(e.g. mean and maximum glance duration,glance frequency,eyes off road time). • Situation awareness. • Reaction time to events. **Vehicle** • Lane position variance. • Unplanned lane departures. • Steering reversals. • Steering and speed entropy(i.e. unpredictable patterns). • Mean speed, speed variance. • Minimum headway and headway variance. • Minimum time to collision. • Number of critical incidents and crashes, speed on impact.

III. ADVANCED DRIVING ASSISTANCE SYSTEM (ADAS)

Advanced Driver Assistance Systems (ADAS) are systems developed to assist, complement and eventually substitute the driver in the complex process of controlling a vehicle. ADAS provide features including adaptive cruise control, blind-spot monitoring, lane-departure warning, night vision, lane-keeping assist and collision warning systems with automatic steering and braking intervention. Predictive ADAS are designed to prevent accidents by taking partial control of the car's movement. These automated safe systems are paving the way for tomorrow's fully autonomous cars.

A. Basic Rear View Camera

Rear view camera systems help drivers identify an object or a person in the back of a car and back up safely and maneuver conveniently into parking spaces. In advanced systems, a high-dynamic range (HDR) 1 MP camera is deployed using a cost-effective link with fast Ethernet and video compression over unshielded twisted pair cable. Additional system requirements include an appropriate physical layer interface and a power supply.



Target Applications

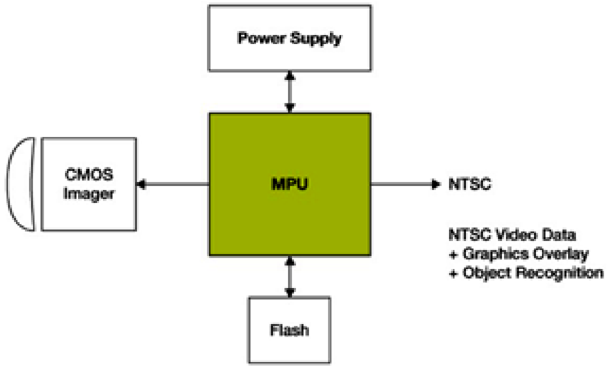
- Back-over Protection with Emergency Braking
- Blind Spot Detection
- Intersection Management
- Pedestrian Detection
- Surround View Park Assist

Block diagram for basic rear view camera is given above.

B. Smart Rear View Camera

Smart rear-view cameras analyze video content locally for object and people detection. They also support full local image processing and graphics overlay creation. The distance of objects can be measured and braking intervention can be triggered. This helps the driver to back up safely and maneuver conveniently into parking spaces. It allows a very small camera module form factor due to the high degree of integration and low power consumption. Smart rear-view cameras offer an attractive upgrade path to replace simple analog cameras using the same video interface.

Block diagram or basic rear view camera is given below.



Target Applications

- Collision Warning
- Pedestrian Detection
- Smart Rear View Camera System

C. Surround View Park Assist System

Multi-camera surround view-park assist systems capture and display onscreen the area surrounding the car from a virtual top view.

The perspective is dynamically moved depending upon the trajectory of the car, providing a 360° view around the car.
Advanced systems deploy four to five high-dynamic range (HDR) 1 MP cameras using a cost-effective link such as LVDS or fast Ethernet.

Target Applications

- Blind Spot Detection
- Intersection Management
- Parking Assistance
- Surround View Park Assist

77 GHz Radar System

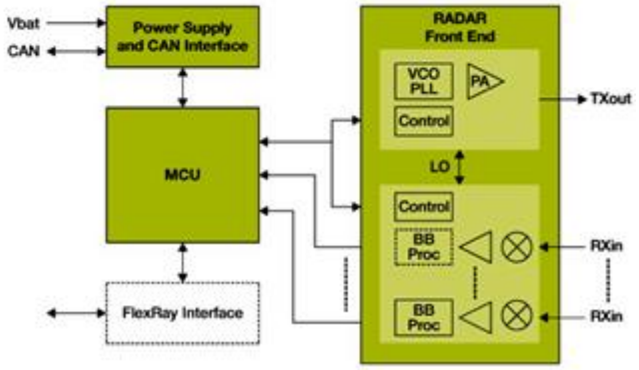
77 GHz radar systems support adaptive cruise control, pre-crash protection and collision warning systems with and without automatic steering and braking intervention.

Target Applications

- Adaptive Cruise Control (ACC)
- Blind-spot Detection (BSD)
- Emergency Braking

- Forward Collision Warning (FCW)
- Headway Alert
- Mitigation and Brake Support
- Pre-crash Detection
- Rear Collision Protection (RCP)

Block diagram for 77 GHz Radar System given below



Importance of ADASs

1. **Increased Safety:** Active and passive safety systems can help to advance the goals of reduced driving risks and zero fatalities.
2. **Greener Mobility:** Vehicles can better manage their navigation and consumption, thus reducing emissions for a smaller carbon footprint.
3. **New Mobility:** Analysts predict more car sharing and less car ownership and new technology that will enable individual profiles per driver. Additionally, the advent of autonomous vehicles could spur the growth of a more cost-effective goods distribution network.
4. **Connectivity While Moving:** As cars become more woven into the IoT, more data will be collected from them and consumers will continue to press for a connected driving experience customized just for them.

IV. OUTCOME

Advanced driver assistance systems and in-vehicle information systems are one of the fastest-growing segments in automotive electronics. ADAS technology can be based upon vision/camera systems, sensor technology, car data networks, Vehicle-to-vehicle (V2V), or Vehicle-to-Infrastructure systems. IVIS technology can provide fuel efficient driving advice to the driver.

V. FUTURE WORK

Next-generation ADAS will increasingly leverage wireless network connectivity to offer improved value by using car-to-car and car-to-infrastructure data.

CONCLUSION

Previous research has shown that IVIS can be distracting to the driver, cause an increase in workload, and also be detrimental to certain driving performance characteristics specifically when they require the driver to engage in a non-driving related secondary task. However, many IVIS have recently been developed, which aim to actually increase either safety or driving efficiency or even comfort and convenience. This paper has shown that an intelligent in-vehicle smart driving system specifically developed and designed with the drivers information requirements in mind can lead to significant improvements in driving performance in the real world on real roads with real users.

References

[1] M. Fazeen, B. Gozick, R. Dantu, M. Bhukhiya, and M. Gonzalez, “Safe driving using mobile phones,”*IEEE Trans. Intell. Transp. Syst.*, vol. 13, no. 3, pp. 1462–1468, Sep. 2012.

[2] R. Araujo, A. Igreja, R. de Castro, and R. Araujo, “Driving Coach: A smartphone application to evaluate driving efficient patterns,”in *Proc. IEEE Intell. Veh. Symp.*, Jun. 2012, pp. 1005–1010.

[3] C. Maag, D. Muhlbacher, C. Mark, and H.-P. Kruger, “Studying effects of advanced driver assistance systems (ADAS) on individual and group level using multi-driver simulation,”in *Proc. IEEE IV Symp.*, Jun. 2011, pp. 589–594.

[4] P.-Y. Hsiao, C.-W. Yeh, S.-S. Huang, and L.-C. Fu, “A portable vision- based real-time lane departure warning system: Day and night,”*IEEE Trans. Veh. Technol.*, vol. 58, no. 4, pp. 2089–2094, May 2009.

[5] A. Amditis, E. Bertolazzi, M. Bimpas, F. Biral, P. Bosetti, M. Da Lio, L. Danielsson, A. Gallione, H. Lind, A. Saroldi, and A. Sjögren, “A holistic

approach to the integration of safety applications: The insafes sub- project within the european framework programme 6 integrating project prevent,"*IEEE Trans. Intell. Transp. Syst.*, vol. 11, no. 3, pp. 554–566, Sep. 2010.

[6] P. Needham, "Collision prevention: The role of an accident data recorder (ADR),"in *Proc. Int. ADAS Conf.*, 2001, pp. 48–51, IEE Conf. Publ. No. 483.