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A SURVEY ON ADVANCED DRIVING ASSISTANCE SYSTEMS FOR SAFER TRANSPORTATION

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ABSTRACT: Self-driving cars have recently become a challenging research topic, with the aim of making transportation safer and more efficient. Current advanced driving assistance systems (ADAS) allow cars to drive autonomously by following lane markings, identifying road signs and detecting pedestrians and other vehicles. Static road models including lane detection, road boundary detection and pedestrians detection to increase an detection accuracy, In addition, autonomous cars will be very beneficial in terms of sustainability. For instance, it will be possible for them to communicate with each other, plan optimal routes to avoid traffic jams or even platoon in highways in order to save energy. On the other hand, this emergent technology will also pose complex, non-technical challenges we might not even conceive yet. To begin with, new legal frameworks will need to be developed to regulate the use of autonomous vehicles.

Keywords: ADAS, Road Sign, pedestrians, boundary, Lane

I. INTRODUCTION

The field of autonomous driving has become an increasingly interesting area of research in both industry and academia during the last decades. Fully autonomous cars, which will drive completely on their own without any kind of human supervision, will have a great impact on society. First, self-driving cars will be safer, since human mistakes (drowsiness, distractions or just a not fast enough response time) will not because of traffic accidents anymore.

ADAS uses sophisticated electronics and advanced software, coupled with sensors that assist drivers in avoiding errors in judgment. Research suggests that the majority of road accidents happen due to human errors caused by distracted driving. In such a case, wouldn't accepting the assistance of technology to mitigate the imperfect driving behavior of gullible human beings make perfect sense for most drivers?

Multiple variants of modern vehicles have such systems pre-installed to help every driver in avoiding accidents, collisions or even any out-of-control driving experience. Without interfering too much, the technology is smart enough to alert the driver in time and also take control of the vehicle, only if and when the need arises. As Shown in above figure 1, The adaptive features also help automate lighting, GPS/traffic warnings; engage emergency braking, cruise control, lane-changing assistance; offer a bird's-eye view, drowsiness alerts, connect to smartphones, and reveal blind spots. Hence, implementation of ADAS components is as beneficial to the aged driver like it is for the young driver

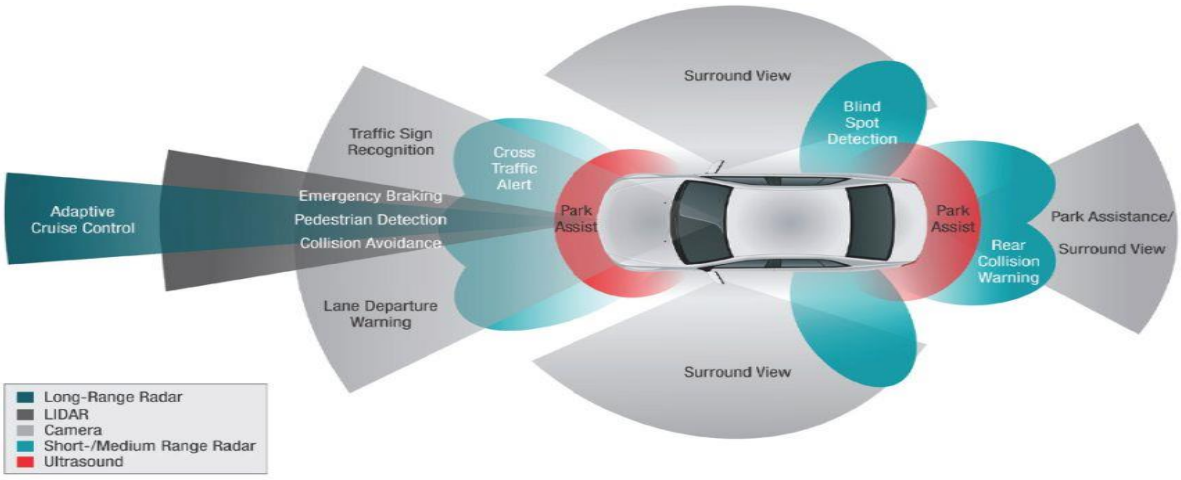

Figure 1.1: Various features of typical ADAS

Road safety for senior citizens or aged drivers is largely defined by physical vulnerability and functional limitations. In case of a crash, both these factors contribute to the relatively high mortality rate in older drivers as compared to the younger lot.

Despite their age, older drivers might have an extraordinary driving experience which comes in handy while anticipating and analyzing tricky and confusing situations. However, with age as the mental and physical capabilities of a person declines, they become vulnerable and prone to errors in judgment. ADAS warns them beforehand and accordingly helps them with extra time to think and act. This time, which might even be a fraction of a second can actually compensate for their reduced reaction time owing to age, perceptual and/or physical degeneration.

The Advanced Driver Assistance System (ADAS) provides dynamic features such as adaptive cruise control, parking assistance, blind spot detection, lane departure warning, drowsiness monitoring, tire pressure monitoring and night vision. The progresses in the automotive industry are not only limited to the development in the design or engine but also cover the safety of a vehicle, passenger as well as pedestrian.

1.1 First Sensor camera solutions for ADAS

First Sensor develops and manufactures robust digital HDR CMOS cameras for advanced driver assistance systems in cars, trucks as well as agricultural, construction and mining machines. With their large dynamic range, the cameras are ideally suited to poor light conditions and major differences in brightness. The automobile cameras provide a wide range of digital interfaces and can also be equipped with a digital signal processor (DSP) and internal memory capacities. This allows the images to be processed and evaluated directly in the camera system via software algorithms, while the images can also be merged with other sensor signals such as radar or LIDAR data. The camera then has its own "intelligence" and can forward both the images and the information obtained from the image evaluation, which considerably reduces the amount of data. All cameras made by First Sensor are subject to the quality management system ISO/TS 16949 for the automobile industry and can be adapted quickly and flexibly to custom requirements. By manufacturing all central components ourselves, we ensure the long availability of all products for series production and the aftermarket.

Figure 1.2 indicates than major causes of accidental deaths are un-natural which emphasizes the need of advanced driver assistance system.

Figure 1.3 shows percentage shares of various causes of accidental deaths during 2012 due to natural and un-natural causes. It is observed that major cause of the accidental deaths in the road accidents (35.2%). It is therefore important that road safety must be improved by providing assistance to the driver using ADASs.

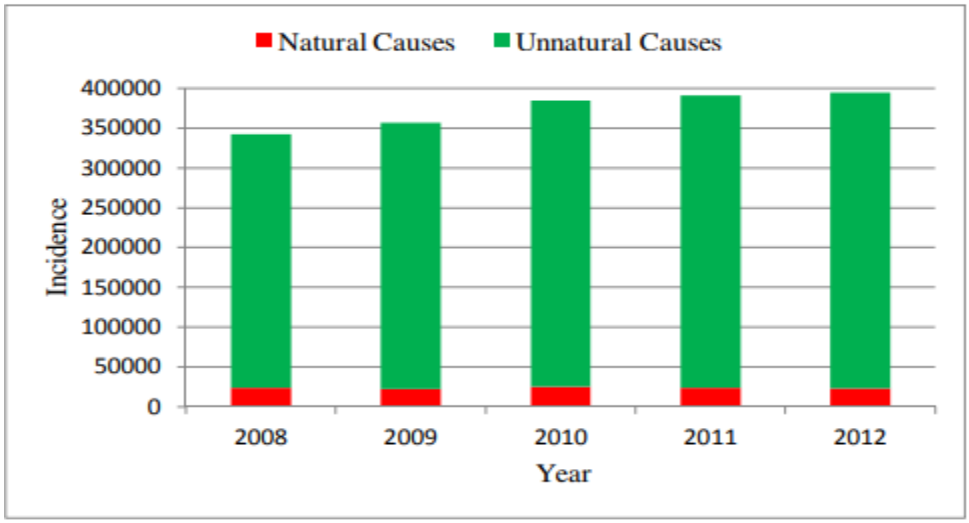

Figure 1.2: Incidence of accidental deaths by natural and un-natural causes

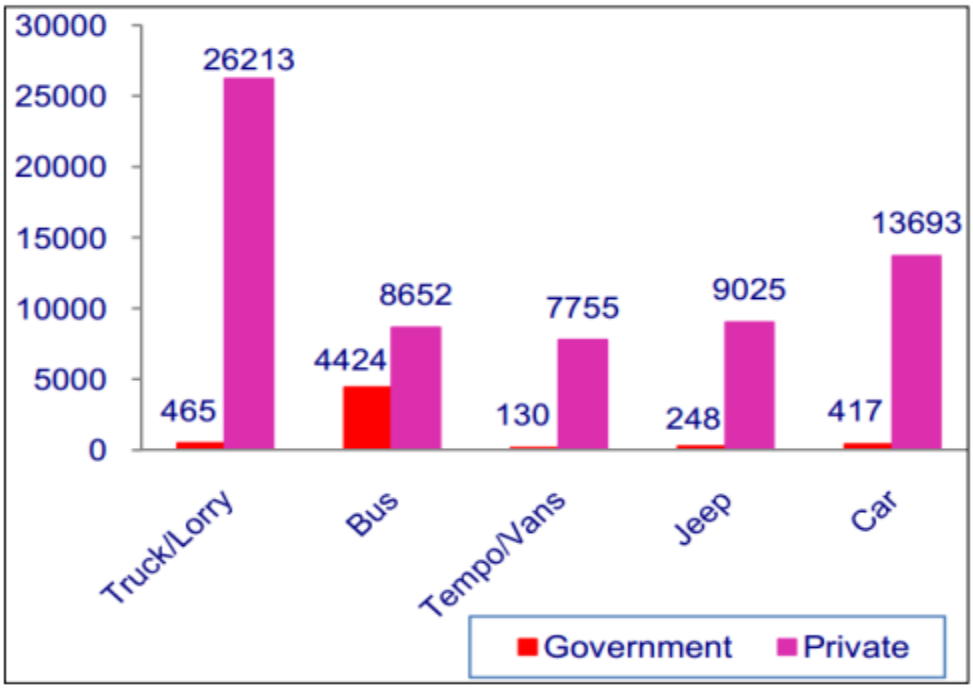

Figure 1.3: Percentage shares of various causes of accidental deaths during 2012

According to the United States National Highway Traffic Safety Administration (NHTSA), 41% of the total traffic accident fatalities are the results of the unusual lane changing or departure on the road [4].

According to [3], road accident deaths all-India percentage share is 37.4% which is higher as compared to Railways accidental deaths all-India percentage share of 7.9%. According to the U.S. Department of Transportation (USDOT), single vehicle run-off-road accidents accounts for a high proportion of all accidents on the highways. According to the latest statistics from the USDOT, over 18,000 fatalities in the U.S. alone - over 40% of all fatalities are related to unintended lane departures. It is therefore implicit the need of a lane departure warning system (LDWS) in future advanced driver assistance systems.

1.2 Overview of the Survey

Work Lane departure warning system and pedestrian detection system play an important role in the advanced driver assistance system (ADAS) informing the driver about lane departure and the presence of the pedestrians ahead of the vehicle respectively. Both the systems take the vision based approach to identify lane or pedestrian detection.

1.2.1 Pedestrian Detection System (PDS)

The pedestrian detection system is an electronic system present in a vehicle which is used to identify pedestrians in front view of the vehicle / car and provide warning to the driver avoiding fatalities. In recent years, there has been a growing interest for pedestrian detection with the help of computer vision or machine vision techniques because of the high performance algorithms as well as reduced cost of the hardware. The PDS should detect pedestrian ahead of the vehicle in various lighting conditions and should handle occlusions effectively. PDS algorithm uses object detector (in this case pedestrian) which recognizes pedestrian(s) with the help of various feature sets such as pedestrian edges, color, shape, poses, etc. A classifier is used to identify the presence of pedestrian from the object detector output. Finally, based on the classifier output, an audio-visual warning is generated and issued to the driver when the pedestrian is detected in the frontal zone of the vehicle to avoid accident.

Graphical representation of the pedestrian detection system is shown in Figure 1.4. An image captured using a camera is processed using a suitable technique to help pedestrian detection. Detection of pedestrian is carried out using different features such as edge, shape, pose, color,

etc. and corresponding candidate features are extracted. Classifier uses those features and identifies the pedestrian. An audio-visual warning is issued to the driver. Various algorithms are used for classification of pedestrians. Suitable classifier should be used so that the performance of the system should be compared with the state-of-the-art methods. The system should provides high detection rate without increasing computational cost.

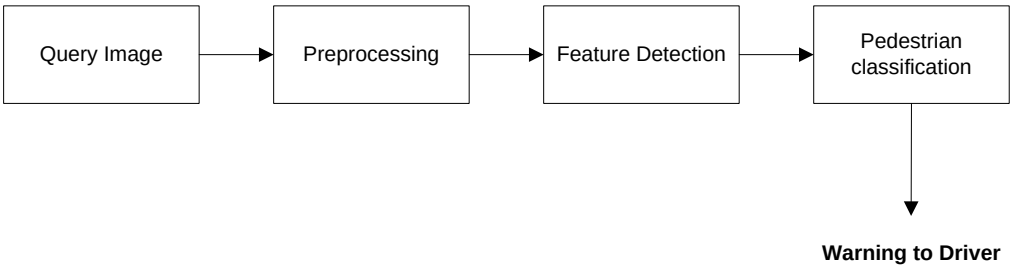

Figure 1.4: Graphical representation of pedestrian detection system

1.2.2 Lane Departure Warning System (LDWS)

A Lane Departure Warning System is an in-vehicle electronics system that continuously monitors the position of a vehicle within a lane and provides a suitable warning to the driver if the vehicle deviates or is about to deviate outside the lane. Present LDWS are forward looking, vision-based systems that use algorithms to interpret lane images to estimate vehicle state using various parameters like vehicle lateral position, lateral velocity, etc. as well as roadway alignment parameters such as lane width, road curvature, etc. LDWS warns the driver for a lane departure when the vehicle is travelling above a certain speed threshold and the vehicle's turn signal is not in use.

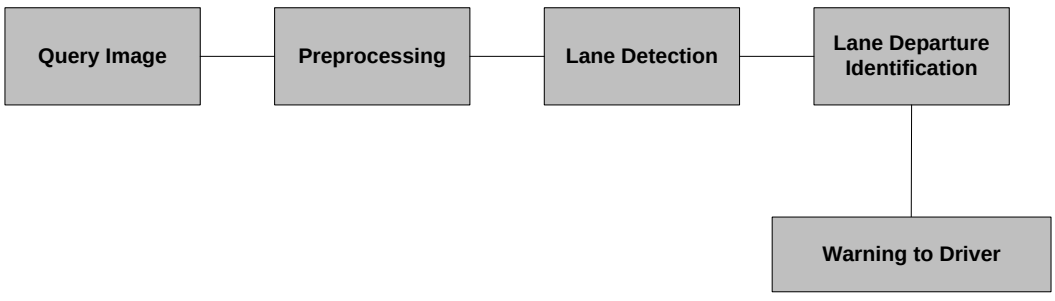

Figure 1.5 Graphical representation of lane departure warning system

Graphical representation of the lane departure warning system is shown in Figure 1.5. A lane image captured using a camera is processed using a suitable technique to help lane detection. Lane markings are identified using a lane detection algorithm and based on candidate features departure warning is issued to the driver.

Conclusion:

This survey explains the need of incorporation of multiple features of advanced driver assistance system (ADAS) in today's as well as future automobiles. And also it has been concluded that (ADAS) allow cars to drive autonomously by following lane markings, identifying road signs and detecting pedestrians and other vehicles. Static road models including lane detection, road boundary detection and pedestrian's detection to increase detection accuracy. ADAS refers to the advanced frameworks or technology that is designed to assist the drivers in arduous traffic condition. Whether it be Passenger Car or Commercial Vehicle, ADAS is widely been deployed in all classes of automobiles for better safety and occupants wellbeing.

The final goal of this project is to utilize driving to enhance the quality of life and encourage active social behavior by elderly drivers through the various aspects of the intelligent driving technologies described in this paper. The development of intelligent driving system as the main focus of this project is an important innovative technology, and continuous efforts must be made to advance and deploy this technology in the near future.

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