Advanced Driver Assist System: Case Study

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***Abstract*—in this paper, Advanced Driver Assistance System (ADAS) is presented. Many injuries arise because of distracted riding and human errors. Advanced Driver Assistance System (ADAS) can help the drivers to keep away from the collision and maintain safe distance of the automobile with the aid of using giving caution signals. The device is composed of Lane Departure Warning System, Blind spot detection and warning system, Adaptive cruise control, parking zone assistance, Rear collision warning, Drowsiness and Surround view warning.**

Keywords—Advanced driver assistance system, driver safety, longitudinal control

I. Introduction

Advanced driver assist system belongs to a group of electronic technologies that assist the drivers in driving and parking. It is used for increasing the car as well as road safety towards human being. It uses sensors and cameras to detect the nearby object and the drivers defect while driving and the action is taken according to the situation. The different levels of autonomous driving depending on the features initiated in the vehicle.

ADAS is used for safety and advanced driving various technology related to it is developed. Most of the accident takes place due to the human error. ADAS is used to reduce such accident occurred due to the human error. Safety character aim to prevent accidents and technologies that alert the driver to implement safety measures and take control of the vehicle when necessary. It will detect lane departures and collisions early and precisely and gives warning to the driver. Most of the accidents takes place due to driver blind spot, signals missing so the ADAS technology is used to developed. It also works as a season change like sunny, winter, and cloudy climate. There is algorithm developed for the detection and lane changes or tracking under different climate conditions.

The longitudinal controller is divided into two parts: the inner controller, which controls brake requests and the accelerator pedal percentage, and the outer controller, which calculates the desired speed based on the speed of the lead vehicle [1]. The reverse plant model with a virtual load sensor comes after PI in the inner controller. This model makes it possible to control a car with a non-linear powertrain. An automatic transmission-equipped city bus with a diesel engine was used to evaluate the functioning of the developed controller.

To increase drivers' comfort and safety on the road, self-driving, or Advanced Driver Assistance System (ADAS) technology has been developed [1]. Autonomous cars must be able to identify possible collision hazards and take proactive action to mitigate them to ensure reliability. Since cut-in scenarios are the primary cause of traffic accidents and provide high collision hazards, proactive reaction to these situations is especially important for autonomous cars. Considering this, autonomous cars should actively slow down before nearby vehicles change lanes by detecting their intention to cut in. As a result, predictive longitudinal control and intention inference of nearby cars are needed.

Numerous studies on automating the vehicles have been conducted since 1995, when the first generation of the Adaptive Cruise Control (ACC) system was introduced on the market in Japan as an advanced driver assistance system (ADAS), with the goal of improving safety and reducing the number of people killed or injured in road accidents, which has deteriorated due to the increasing number of the vehicles on the road [2].

Nonlinear power-train dynamics have a greater impact on control behavior at low speeds than do body dynamics [1-2]. This makes it challenging to model vehicle behavior using basic models [1-2]. To be more precise, the system becomes non-linear due to the engine, torque converter, and air drag, whilst the gearbox introduces discontinuities [3]. Additionally, the performance of the controller and passenger comfort are impacted by changing parameters such road slope and dynamic mass [4-5].

The longitudinal control has been studied in the context of the advanced driver assistance systems (ADAS) concept by businesses and institutes. One of the current ADAS systems is adaptive cruise control (ACC), which uses the brake and accelerator pedals to allow the vehicle to accelerate or decelerate to maintain a safe distance from the car in front of it. Even though there are studies on ACC in the literature, most of them are intended at speeds greater than 40 km/h. For speeds under 40 km/h, only ACC systems with Stop & Go capabilities are used. The Stop & Go architecture decelerates more slowly than standard ACC and switches between deceleration and acceleration more often. More driving metrics, data analysis, and model-based studies form the basis of the Stop & Go capability. The Stop & Go pattern often has two loops: While the inner-loop manages the brake and accelerator pedal outputs, the outer-loop assures the tracking of the inter-vehicle distance.

II. Literature Review

The American company created the first commercial lane departure warning system for Mercedes Actros commercial vehicles in Europe. The technology made its debut in 2000 and is now standard equipment on many modern vehicles, trucks, and SUVs. This system was first available on North American Freightliner Trucks in 2002 [6]. By implementing advanced driver assistance systems, vehicle safety and control are increased. ADAS comprises of a suitable computing platform that analyses data gathered while driving by several sensors. To avoid a potential collision, ADAS often alerts the driver or takes autonomous action on the vehicle control system (such as automated braking). A lane departure warning system, which alerts the driver when a vehicle begins to accidentally leave a driving lane, is one of the most popular ADAS. Such a system works by processing an image that a front-view camera capture [7]. We are unable to see the cars in the blind area during lane changes, which might result in an accident. To prevent this, anytime a lane change is detected, ultrasonic sensors mounted over the back-end check for blind spots and, if any are found, alert the driver with a warning signal [8]. Wang conducted research on the FCW's through-headway performance and car-following reaction time. According to research, ADAS's subsystems can help drivers drive more safely in hazardous situations by displaying more stable speed, time interval, and lane retention rates, as well as by effectively reducing or preventing traffic accidents, if they can provide accurate information and effective intervention strategies. The ACC system is said to be able to increase traffic throughout and decrease fuel consumption in addition to giving drivers comfort and safety while they are driving [9].

III. ADAS Vehicle

India lags industrialized nations in the development of intelligent transportation systems (ITS), which are essential to guaranteeing public safety on roads and reducing traffic risks. Numerous research articles on the topics of collision avoidance, blind spot identification, overtaking of cars, driver drowsiness warning, and pedestrian safety have been published in the field of ITS. In addition to this, the absence of an ADAS on Indian roads has become a worrying problem about accidents at intersections. According to statistics, the percentage of accidents that happen near T-Junctions has significantly grown in recent years.

Based on a 2015 study by the Indian government on traffic accidents. Road accidents are more likely to occur near traffic crossroads, which are seen from the perspective of traffic in a nation as potentially dangerous sites. According to a data from the Indian government from 2015, it is estimated that 49% of all accidents happened on crossroads specifically during the year. With 94,487 accidents and 24,441 fatalities, T-Junctions had the largest number of collisions during the year 2015, accounting for 38 percent of all collisions on Junctions [1]. These figures inspired us to create a cutting-edge driver assistance system to stop accidents from happening at T-Junctions in India.

According to statistical studies, drivers' improper conduct, such as distraction, weariness, and close following, are responsible for nearly 90% of traffic accidents. Research organizations from many nations have created Advanced Driver Assistance Systems (ADAS) to assist drivers in driving safely in order to lessen the frequency of traffic accidents.

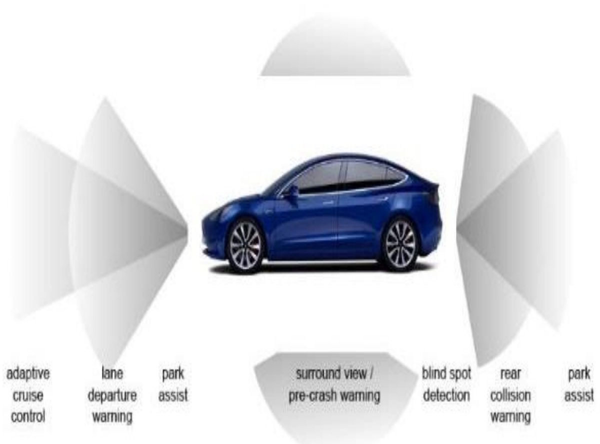

Fig 1. ADAS technology [10]

IV. ADAS Systems

A. Lane Departure Warning System

A lane departure warning system is a device that alerts a driver if their car moves out of its lane without turning on the turn signal. LDWS is a system used to warn the driver when the vehicle starts moving away from its lane. These technologies are intended to reduce accidents by tackling the primary causes of collisions such as driver error, tiredness, and interruptions. Machine vision or video processing is used by the LDWS to identify movement out of the specified lane. The video image processor is designed to mimic the human eye by recording movies which are later analyzed and examined for potentially hazardous scenarios.

LDWS is intended to assist you in avoiding accidents caused by drifting or leaving your lane. The device identifies lane markings and informs you when a tier meets one. The warning is often displayed as a glowing display and/or a beep from the appropriate side. In certain devices, a steering wheel or driver’s seat softly vibrates. In general, LDWS will not notify you if your turn signal is activated. When system detects to change the lane, but the driver does not respond on time than it will gradually steer the driver back into the lane. In some vehicles it is automatically operated when the car is started. An indicator light on this button will let you know when the device is on.

LDW systems have been proven to help reduce the risk of an accident or collision when a vehicle strikes another vehicle in an adjacent lane. These incidents may involve another vehicle traveling in the same direction as your vehicle "skidding"[11]. Or it could involve going out of your lane and hitting a car traveling in the opposite direction. Lane Departure Warning alerts you when your car is about to leave your lane and warns you to re-enter it. That's the basic idea, but there are now various versions of the technology, including technology that reacts and deviates from the edges of the lane and even keeps the car active in the center. All forms of lane departure warning use a low-cost windshield camera located near the rearview mirror that continuously monitors the road for continuous streaks. These are part of the safety circle, the three most common and useful directions where the car is in the blind spot.

The most common LDW system is a camera mounted high on the windshield, usually as part of the mirror mounting unit. It can capture a moving image of the road up to 50 meters ahead Analyze scanned images for traces of straight or dotted lines. As a driver, you have to park your car between two rows. When the car turns and approaches or reaches the beacons, the driver is warned: a visual warning and an audible warning, steering wheel or seat vibration When the turn signal is activated, the car assumes that the driver is intentionally crossing the lane and does not give a warning.

B. Blind Spot Detection

Blind Spot Detection is used to keep an eye on that area and relief from the dangerous situations. The sensor in the vehicle monitors the situations of the road behind and front of your vehicles and gives the warning to driver when the driver tries to move forward. When the sensor is detected, and driver is unable to see in the mirror and the light glows and the driver is warned. It is monitored using the sensor situated on the side mirrors of the vehicle to detect it in the opposite lanes. When it is detected, the driver is warned by means of audio, video or it may use camera and the accident are avoided.

The BSM system warns the driver when another vehicle is in their blind spot Depending on your system, this may be a light on the dashboard or the rearview mirror. BSM and Blind Spot Warning (BSW) work together to identify hazards and warn the driver with visual or audible alerts. Some warning systems even include the rumble of the seats or the steering wheel. The purpose of the blind spot monitoring and warning system is to make lane changes and merges safer According to the National Highway Traffic Safety Administration, BSW affects half a million (8.7%) blind-spot, lane-change, and merge-related crashes each year. As it stands, the technology has reduced the rate and severity of crashes, resulting in 14 lane-change crashes and 23 lane-change crashes with injuries, according to a report by the Insurance Institute for Highway Safety. Blind spot monitoring systems use radar sensors and/or ADAS rear camera sensors to monitor when a vehicle is approaching from behind and entering the vehicle's blind spot. Once detected, Blind Spot Warning (BSW) alerts the driver via indicators on (or near) the rearview mirror, steering wheel, and audible or tactile warnings. Some systems offer incremental haptic warnings and different notifications if you activate the turn signal in steering and brake system of the automobile to move it into its position to calculate the best way to steer the car into a parking space. They then use the car's steering and braking systems to guide it (and move it) into place. Some vehicles even offer remote parking assistance, that is, the ability to do so without the driver behind the wheel [12].

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C. Adaptive Cruise Control

Adaptive Cruise Control (ACC) is a system designed to help the car maintain a safe distance and not exceed the speed limit The system automatically adjusts the speed of the car so that the driver does not have to adjust. ACC works through the vehicle's built-in sensor technology, such as cameras, laser and radar equipment, to know how far the car is from another or another object on the road. For this reason, ACC is at the heart of future automotive intelligence.

These sensing technologies allow cars to detect and warn drivers of possible forward collisions. When this happens, a red light will flash and the message "Brake now!" appears on the dashboard to help the driver slow down. There may also be an audible warning we [9]. Adaptive Cruise Control is used to adjust the speed of vehicle to maintain the distance between two vehicles. The normal speed reference that the ACC System provides tracks the target speed but modifies it as a leading vehicle approach. It adjusts the vehicle speed automatically. ACC is sensed by using camera, laser, and radar which are installed in the vehicle, and it warns the driver [13]. When it is sense, the red light indicates, and driver will reduce the speed of the vehicle or the warning is giving using some audio and it will reduce the accidents. ACC has the limitation that it not fully autonomous when there is climate change like snow, rainy or winter, the system will not sense properly [14,15].

D. Parking Zone Assistance

Parking zone assistance helps the driver park the car safely Automated systems use sensors and cameras to determine the optimal way for the car to move through the parking lot. The system uses sensors and cameras that send images to an image processing device. The various inputs have been evaluated, combined and synthesized to provide a concise yet positionally correct image of the vehicle and its environment. Parking assist technology can reduce the number of accidents when parking All these assistive technologies can prevent wrong parking, parking problems and wrong parking. Each OEM has its own version of Park Assist However, most parking aids are controlled by ultrasonic sensors located on the front and rear bumpers Some systems also have ultrasonic sensors on the sides of the vehicle. These sensors emit sound waves that bounce off objects around the car. The car can then quickly calculate the distance to objects that bounce these sound waves back to the car. Most parking assistance systems use ultrasonic sensors; however, some use electromagnetic sensors behind the bumper, radar sensors in the corners of the vehicle, and/or cameras. in-car cameras to display a composite video of the vehicle's environment on the in-car display Park assist refers to automated park assist systems that use radar, camera and sensor technology and is known as an alternative term as active park assist This allows the car to do most of the work itself when parked in a parking lot or along the road [16].

Parking assist technology can prevent parking related accidents. With these help technologies in place, parking lot blinders, parking garage issues, and parallel parking in accuracies may all be avoided. When a vehicle is going to park or is in the progress of parking assistance systems employ sonar sensors, camera, or both to monitor its surrounding. The parking safety technology is classified into two types.

1. Passive Parking Assistance

During the regular parking procedure, passive devices deliver sound and tactile alerts to drivers. The driver controls the vehicle as normal when warning is given by means of brake and steering. Many systems employ a sequence of beeps that increase in frequency as you come closer to an object.

2. Active Parking Assistance

Active system is distinct. Active parking assistance control the steering, acceleration, brake and even gear positions of the car. The comfort of a vehicle refers to the level of safety provided by different types of situations and factors, including road safety. The most comfortable and luxurious cars have a high level of ride quality. A car with very good ride quality is also a comfortable car to drive. The comfort of any vehicle is also very important for automotive safety. Drivers feel more comfortable and less stressed in a comfortable car. The more comfortable and high quality the car, the more control you will have over model, parallel parking, perpendicular parking and reverse in parking are all available.

E. Rear Collision Warning

Rear Collision Warning is a special type of camera specifically designed to be installed in rear blind spots Specially designed to avoid backup conflicts The area directly behind the vehicle is known as the "kill zone" due to related accidents Rear view cameras are connected to the car's head unit display A popular option today is the spatial imaging system, which creates a synthetic but positionally accurate image of the car and its surroundings. A rear-view camera, also known as a rear-view monitor or rear-view camera, is an advanced ADAS driver assistance system. Available in many vehicles manufactured in the last two decades. In all vehicles, the rear view camera provides a low and wide angle of view behind the car when the driver is reversing to facilitate decision-making [17]. Reversing cameras offer clear benefits to drivers Improved reversing visibility makes reversing safer for people inside and outside the vehicle and allows the driver to park better, especially when parallel parking. In a Consumer Reports survey, 67% of vehicle owners said they were very satisfied. with its rear-view cameras Additionally, 38% said their systems helped prevent accidents.

Avoiding accidents is the goal. Backup cameras are designed to help drivers back up safely Two main cases are to be considered. The first situation is when you back up and hit an obstacle or another vehicle. Parking accidents are common These common fender benders require drivers to work automatically, which is inconvenient and expensive. A backup camera system consists of a backup camera mounted on the bumper or rear of the vehicle and a monitor located in the center console or in the rear-view mirror as for the camera itself, a wide-angle or fisheye lens is used. Also, the output is mirrored, so left is always left and right is always right.

When backing up, the camera turns on and provides on-screen guidance. Those parallel routes or distance lines help you find and navigate safely. These guidelines should also help drivers measure the distance between the vehicle and surrounding objects. Once the backup is complete, the backup monitor will turn off.

F. Drowsiness

Driving attention warning is a cutting-edge driver assistance system that watches for indicators of distraction or tiredness in the driver's eye and head movements. Driver attentiveness warning will notify drivers to act if a potential threat is identified. This might take the form of the motorist shifting their head to refocus their eyes, blinking their eyes more often, or pulling over until they are completely awake once again. Driver Slumped Driving Detection an ADAS technology called driver attention warning or drowsiness detection utilizes a camera pointed at the driver's face to look for symptoms of distracted driving or driver weariness. A driver monitoring system makes sure that drivers are alert while driving, reducing collisions brought on by inattentive or sleepy drivers.

Drivers are alerted to fatigue or other distractions on the road through driver drowsiness detection. There are a few techniques to tell whether a motorist is losing concentration. In one scenario, sensors can examine the driver's head movement and heart rate to see if they signify tiredness. Other systems send out motorist alerts that resemble the lane detecting warning signals. People whose employment require them to drive for extended periods of time are protected by laws. Truck drivers, for instance, are not permitted to drive after 14 hours have passed since the start of their shift. However, there are no such safety measures for the typical motorist. Studies show that lack of focus is to blame for 25% of traffic accidents, making drowsiness a key contributor to accidents [18]. It's crucial to stop sleepy drivers from operating a vehicle. One solution to deal with this problem is to be able to identify tired drivers and warn them to drive carefully and take a rest if they feel sleepy.

By detecting drowsiness, accidents caused by microsleep, tiredness, and inattentiveness can be avoided. These are several technologies and projects aimed at making driving safer and reducing the likelihood of catastrophic road traffic accidents being caused by human error. These may include automated emergency braking or a warning if something is in the driver's blind zone.

Driver drowsiness detection systems can use cameras, eye tracking sensors and other hardware to monitor visual cues, where drowsiness can be detected by yawn frequency, eye blink frequency, gaze movement, head movement and facial expression. The system also monitors driving input behavior to flag erratic steering movements, pedal use, and lane changes. Comfort and convenience are very important the car, then get in the car this reduces the impact of road disturbances on the driver ability to control a vehicle. This is an automotive safety technology that helps prevent accidents caused by drowsy drivers. Driving for long periods can lead to fatigue and drowsiness. The article aims to design an automated system to study eye blinking. The system is designed to closely control the driver's blinks. The drowsiness detection system is a vehicle safety technology that helps prevent accidents caused by drowsy drivers. Several studies have shown that about 20% of road accidents are due to drowsy drivers [19]. Developing technologies to detect or prevent drowsiness at the wheel is a major challenge for collision avoidance systems. Due to the danger of fatigue while driving, different and new methods had to be developed to counteract this effect. The article is based on the example of a system that detects drowsiness. The purpose of this article is to design an automatic system for driver safety. The system is designed in such a way that it can accurately detect driver blinking.

G. Surround view warning

The system included four cameras mounted on the front, rear and side of the vehicle, which fed images to an image processing unit The various inputs have been evaluated, combined and synthesized to provide a concise yet positionally correct image of the vehicle and its environment.

V. CONCLUSION

In this research, different systems are defined which are used in ADAS technology to reduce the accidents which are growing rapidly now a days. It uses sensors and cameras to detect nearby objects and guide the driver while driving, acting according to the situation.

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