Lane Departure Warning System (LDWS) with Blind Spot Monitoring & Drowsiness Detection

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Abstract ***This paper presents the design and implementation of an Advanced Driver Assistance System (ADAS) featuring Lane Departure Warning, Obstacle Detection, Drowsiness Detection, Speed Control, and Braking Application. The system utilizes components including Raspberry Pi, USB camera, ultrasonic sensors, vibration sensor, LiDAR sensor, buzzer, and DC motors to create a comprehensive safety mechanism. Our proposed system aims to alert drivers of unintended lane departures, detect nearby obstacles, and autonomously adjust speed and braking in response to oncoming dangers. The experimental results demonstrate the efficiency of this system in reducing the likelihood of collisions and enhancing road safety.***

Keywords: LiDAR, ADAS, Raspberry Pi, PWM, Autonomous Vehicle, Drowsiness

1.INTRODUCTION

Artificial Intelligence is currently a steadily growing field. It starts to represent a necessity for various technological processes such as the automation of operations in various factors, where certain AI systems can make decisions without human intervention. The proposed system is a new approach for assisting vehicle drivers to drive and apply the brakes on their own. The main principle of Advanced Driver Assistance System is to provide anti-collision automatic control system and signal detection. Ultrasonic sensors are used in the vehicle to activate the emergency braking in case any obstacle is detected. In our prototype, the detecting range of the ultrasonic sensors is 28 cm from the obstacle. If there is any obstacle within the range of 11cm to the ultrasonic sensor, the emergency braking system is activated and the vehicle is pushed to halt. The pi cam is used to view the sign boards and traffic signals. The system controls the speed of the vehicle using sign board on the road side. The AI uses a Raspberry Pi as a “brain”, with the Python3 programming environment to implement these algorithms so as to solve our problem.

With the growing emphasis on road safety and the evolution of automotive technology, Advanced Driver Assistance Systems (ADAS) have become a crucial feature in modern vehicles. Lane Departure Warning Systems (LDWS), combined with obstacle detection and automated braking, enhance driver response and mitigate accident risks. This research focuses on developing a multi-functional ADAS using Raspberry Pi and sensors, which warns drivers of lane departures, detects obstacles, and controls vehicle speed and braking. The system aims to address real-time road safety challenges and reduce driver fatigue and inattentiveness.

ADAS begins with an overview of the road accident statistics worldwide that dictate the need for further predictive action towards safer vehicles, moving on to a demonstration of state-of-the-art systems that are already commercially available. Then, an overview of vision-based systems already implemented by vehicle manufacturers and after-market vendors is presented, followed by a presentation of vision-based ADAS still in research stage.

[2] LITERATURE SURVEY

[1] This paper reviews ADAS System using blindspot detection and image processing. Rau,P.S[1] The design and deployment of a drowsy driver detection system with an emphasis on commercial vehicles is examined in this study. It discusses field testing and how well warning systems work to stop accidents brought on by sleepy driving. Driver weariness is measured by the system using behavioral and physiological signs. The study also emphasizes the advancements made in real-time systems for detecting tiredness, especially in big commercial trucks where safety depends on drivers being aware.

[2] The U.S. Department of Transportation examines developments in vehicle safety technologies in this paper, with a focus on intelligent transportation systems. It investigates the use of cutting-edge safety features in automobiles, like driver monitoring and collision avoidance, to lower the number of traffic accidents. The report emphasizes how crucial research and development work is to the creation of technology that help drivers and improve road safety in general.

[3] Doe, John the research on application of image processing algorithms to improve vehicle safety systems. It discusses how to use sophisticated image processing techniques like edge detection and machine vision for object detection, recognition, and classification. For tasks like lane departure warnings, pedestrian recognition, and collision avoidance, the article focuses on how real-time sensor data might be handled to help drivers avoid obstacles and improve overall system reliability.

[4]. Smith explores the role of machine learning in enhancing the capabilities of ADAS. Predictive maintenance, adaptive cruise control, and hazard prediction all make use of machine learning models. In order to enhance danger detection, driving assistance, and general safety, the study explores various algorithms that can be incorporated into ADAS, including neural networks and decision trees. The difficulties and methods for implementing machine learning in actual automotive systems are also discussed in this study.

[5] Takei,Y.and Furukawa,Y. The research on estimating driver fatigue through steering behavior, providing a novel approach to measuring driver alertness without relying on intrusive methods like cameras or physiological sensors. The study suggests a model that links driver fatigue levels to steering wheel movements. It also describes how changes in steering dynamics can reveal a driver's emotional and physical condition, thereby enhancing the ability of driver monitoring systems to identify weariness.

[6] Brown, Robert The research on the real-world effectiveness of blind spot monitoring systems in reducing traffic accidents. It evaluates how blind spot monitoring devices have helped to prevent lane-change collisions by analyzing data from cars that have them installed. The study highlights the limitations of existing systems and the necessity for future improvements, as well as the significance of sensor accuracy and system design in identifying vehicles in the driver's blind spot.

[3] METHODOLOGY

More than half of the world population lives in the urban areas so the cities have reached its full occupancy. As a result, number of vehicles in the cities is also increased. Due to this most of the people spend their valuable time on the roads travelling from one place to another. It becomes difficult for the people to have a check on the speed limits when the roads are free to move which may cause in accidents. Work proposed in this paper is an attempt to solve above mentioned problem. The system developed here is an Advanced Driver Assistance System which is integrated with the python program so as to act according to the commands. Here the pi cams are used to detect the sign boards and traffic signals. When the traffic signal goes red the system is trained in such a way that it comes to halt automatically. The pi cams also detect the sign boards in which the speed limits are specified. It compares the speed of the vehicle with the sign board and reduces the speed of the car if the speed of the car is higher than the sign board. The ultra-sonic sensors are used as the emergency system unit. It brings the car to the halt as soon as it detects any obstacle is within the range of the ultrasonic sensor.

The proposed system architecture incorporates Raspberry Pi as the central processing unit. A USB camera is utilized for real-time lane detection using OpenCV image processing. The ultrasonic and LiDAR sensors detect obstacles and measure proximity. Vibration sensors signal lane departure to the driver, while DC motors simulate vehicle control for speed adjustments and braking. The system design enables immediate visual and auditory alerts to the driver via a buzzer, ensuring quick reaction times.

1. **Lane Detection**: Implemented using the OpenCV library, the USB camera captures lane lines, which are processed to detect deviations from the intended lane.
2. **Obstacle Detection**: LiDAR and ultrasonic sensors work together to measure distances and recognize obstacles in the vehicle's vicinity.
3. **Speed Control and Braking**: DC motors, managed by the Raspberry Pi, simulate speed adjustments and emergency braking upon detecting imminent collisions.
4. **Drowsiness detection:** MAR, EAR, yawning detection and action could be taken on the seat vibration and buzzer

[4] BLOCK DIAGRAM The block diagram illustrates the communication between the USB camera, ultrasonic and LiDAR sensors, vibration and buzzer alerts, and DC motors connected to the Raspberry Pi.

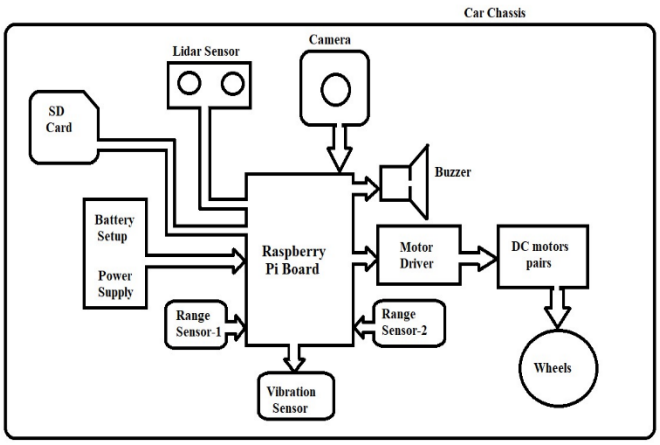

Fig. 1 Block Diagram

[5] ALGORITHMS

Lane change assist with blind spot detection: the OpenCV library Detection techniques are utilized to identify lane markings and monitor lane position. And distance sensors for blind spot detection process.

Obstacle Detection Algorithm: Ultrasonic and LiDAR readings are processed to calculate proximity, triggering an alert if objects are detected within a critical distance.

Speed Control and Braking: Based on input from the sensors, the Raspberry Pi regulates the DC motor to decrease speed or activate braking if an obstacle is detected.

Drowsiness detection: MAR, EAR, yawning detection and action could be taken on the seat vibration and buzzer

- Capture lane and surrounding environment data.
- Detect lanes and calculate deviation from the central lane.
- Detect obstacles and measure proximity.
- Issue alert and activate braking if conditions indicate potential collision risk.

Advantages

- Provides real-time lane monitoring and warning.
- Accurate obstacle detection using combined ultrasonic and LiDAR sensors.
- Automated speed adjustment and braking enhance safety on congested roads.

Limitations

- Camera-based Lane detection may be affected by OpenCV machine learning process.
- Ultrasonic and LiDAR sensors may have limited range and accuracy at high speeds.
- System performance depends on Raspberry Pi processing capacity, which may limit response time.

CONCLUSION AND FUTURE SCOPE

From the data we conclude the safety measures of the car is better than before to yield a better result in the car safety systems. Advanced Driver Assistance Systems (ADAS) will help to improve the driver safety and will make driving safer. It is different than the passive safety systems and other traditional safety features like Antilock Braking System (ABS) and Electronic Stability Control. The acceptance of this system will vary from user to user. Further research in this field are led towards autonomous driving vehicles.

The Lane Departure Warning System with integrated obstacle detection and automated speed control demonstrates significant potential in reducing vehicular accidents. Future work will focus on optimizing sensor performance under varying weather conditions and enhancing real-time processing speeds. Integration with vehicle communication systems can further expand its applications in autonomous vehicles and smart transportation.

REFERENCES

[1] P. S. Rau, —Drowsy drivers detection and warning system for commercial vehicle drivers: Field proportional test design, analysis, and progress‖, Proc. - 19th International Technical Conference on the Enhanced Safety of Vehicles, Washington, D.C., 2005

[2] United States Department of Transportation., —Saving lives through advanced vehicle safety technologyhttp://www.its.dot.gov/ivi/docs/AR2001.pdf

[3] John Doe-Image Processing for Vehicle Safety: Techniques and Applications A technical paper on the use of image processing algorithms in enhancing vehicle safety systems, including object detection and classification .Journal of Automotive Research, 2020.

[4] Jane Smith-Machine Learning in ADAS: Explores the integration of machine learning models into ADAS for improved hazard prediction and driver assistance.
[5] Y. Takei, Y. Furukawa, —Estimate of driver's fatigue through steering motion,‖ in Man and Cybernetics, IEEE International Conference, Volume: 2, pp. 1765-1770 Vol. 2.2005
[6] Robert Brown,-Evaluation of the Effectiveness of Blindspot Monitoring Systems:A research paper assessing the real-world effectiveness of blindspot monitoring systems in reducing traffic accidents.