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"ENHANCEMENT OF SAFETY FEATURES FOR VEHICLES USING ADVANCED DRIVER ASSITANCE SYSTEM (ADAS)"

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ABSTRACT:

An Advanced Driver Assistance System (ADAS) is a collection of technologies aimed at improving road safety and improving the driving experience. To prevent accidents, these systems use various sensors, cameras, and radar to detect potential hazards.

The ADAS project is a comprehensive study of these systems, exploring their benefits, limitations, and impact on road safety and driver experience [6]. The project aims to analyse the effectiveness of ADAS features in reducing accidents and injuries on the road, as well as their impact on driver behaviour and attitudes towards driving.

One of the key benefits of ADAS systems is their ability to detect potential hazards that drivers may not be aware of, such as a vehicle in their blind spot or an obstacle in the road. This can help prevent accidents and reduce the severity of collisions. However, ADAS systems also have limitations, such as their reliance on sensors that can be affected by weather conditions or other environmental factors. Additionally, some drivers may become overly reliant on these systems and neglect to pay attention to the road, which can lead to accidents.

Overall, the ADAS project aims to provide a comprehensive understanding of these systems and their impact on road safety and driver experience. By analysing the benefits and limitations of ADAS features, the project can help inform the development of future technologies that can further enhance road safety and improve the driving experience.

Keywords – computer vision, advanced driver assistance system, OpenCV.

1.1 INTRODUCTION

The primary objective of ADAS [1] is to improve road safety and enhance the driving experience. The ADAS project is a comprehensive study of these systems, exploring their benefits, limitations, and impact on road safety and driver experience. The project aims to analyze the effectiveness of ADAS features in reducing accidents and injuries on the road, as well as their impact on driver behavior and attitudes towards driving.

For instance, the adaptive cruise control system modifies the vehicle's speed according to how far the driver's automobile is from the vehicle in front of them. When a motorist accidentally drifts out of their lane, the lane departure warning function warns them, and the blind-spot recognition feature warns them when a car is in their blind zone.

Despite their numerous benefits, ADAS systems also have limitations. For instance, these systems rely on sensors that can be affected by weather conditions or other environmental factors. Additionally, some drivers may become overly reliant on these systems and neglect to pay attention to the road, which can lead to accidents.

Industrial Engineering Journal
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Till now the project has been partially completed and pothole is implemented on it. The Ultrasonic sensors did not give location of the pothole and hence it become difficult to remove potholes from the roads.

We have upgraded the project by reviewing the existing work and identifying any gaps or area that need further development. This involves developing and testing specific components of the ADAS system including adaptive cruise control, anti-theft system and pothole location thereby, implementing ADAS with some specialize functions and radar system to the partially completed pothole detection system.

1.2 PROBLEM DEFINITION

One of the main problems with ADAS [1] systems is ensuring their reliability and safety. As these systems rely on sensors and algorithms to assist drivers in various driving tasks, any failure or malfunction in the system could lead to accidents or collisions.

Another problem with ADAS systems is ensuring interoperability between different systems and vehicle models. There are many distinct types of ADAS systems on the market and ensuring that they can effectively communicate and operate in a coordinated manner is crucial for their success.

Driver acceptance of ADAS systems is also a significant challenge. Drivers may be reluctant to rely on these systems or may not fully understand their capabilities and limitations. This lack of acceptance could hinder the widespread adoption of these systems and limit their potential benefits.

Furthermore, the prohibitive cost of ADAS systems is also a barrier to their implementation, as these systems can be expensive to manufacture and install. This cost passed on to consumers, making ADAS-equipped vehicles more expensive and less accessible to some consumers.

Finally, there are also concerns about the potential privacy and security risks associated with ADAS systems. These systems collect and transmit data about the driver's behavior and vehicle performance, raising questions about how this data is stored, used, and protected.

In conclusion, while ADAS systems have the potential to significantly improve road safety and driving experience, their implementation presents several challenges and problems. These include ensuring reliability and safety, promoting interoperability, addressing driver acceptance, managing costs, and addressing privacy and security concerns.

1.3 AIM AND OBJECTIVES

AIM:

The aim of the ADAS project is to improve road safety and enhance the driving experience by analyzing the benefits and limitations of ADAS features.

OBJECTIVES:

1. To identify the different ADAS features available in modern vehicles.
2. To analyze the effectiveness of ADAS features in reducing accidents and improving road safety.
3. To investigate the impact of ADAS features on driver behavior and experience.
4. To assess the limitations of ADAS systems and identify areas for improvement.
5. To develop recommendations for the optimal use of ADAS features to enhance road safety and driver experience.
6. To promote awareness and education about ADAS systems among drivers and stakeholders in the automotive industry.

2. LITERATURE SURVEY

The survey discusses the importance of detecting potholes and humps on roads in real-time to aid drivers and prevent accidents. The survey explores various methods for detecting these road hazards, including using sensors, cameras, and machine learning algorithms. The study also discusses the challenges of implementing such a system, such as the need for

Industrial Engineering Journal
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accurate data and the cost of installation. [1] The approach suggested in this research satisfies two important goals by both warning drivers of probable accidents and configuring the placement of potholes and bony protrusions. The suggested technology uses ultrasonic sensors with little effort, making it an economically feasible solution to discovering scary potholes and unbalanced protuberances. [1]

In this paper, ultrasonic sensors are used to detect potholes and Bumps on roads to aid the drivers and to control the vehicle speed. The components used are Ultrasonic Sensors, GPS Receiver [6][5], PIC Microcontroller, GSM modem,12v DC motor and Alarm. The system consists of four modules i.e., Pothole and Bump detection, Controller Module, Speed Control and Collision Avoidance and Personal computer. Pothole and Bump detection module consists of an ultrasonic sensor which is employed to detect Potholes and Bumps on roads. The literature survey on "An intelligent system to detect, avoid and maintain potholes [13].

The Paper discusses about Adaptive cruise control (ACC)is an available cruise control advanced driver-assistance system for road vehicles that automatically adjusts the vehicle speed to maintain a safe distance from vehicles ahead. As of 2019, it is also called by twenty unique names that describe that basic functionality. This is also known as Dynamic cruise control. Control is based on sensor information from on-board sensors.[3]

There are several methods for automatically identifying and alerting drivers to road dangers, according to a literature review on Automatic Detection and Notification of Potholes and Humps on Roads to Aid Drivers. These approaches include using sensors, cameras, and machine learning algorithms to detect potholes and humps on roads.[5]

The bad road conditions cause accidents, affect the standard of driving, and consume more fuel. To decrease accidents caused by potholes and bumps, it is crucial to gather information about the bad roads and distribute it to other vehicles. PIC 16F877A Microcontroller, Ultrasonic Sensor HC-SR04, GPS Receiver [5] [6], and GPS SIM 900 are the components employed in the suggested system. This paper presents a novel approach to pedestrian detection and tracking using an ultrasonic radar system. The authors describe the design of the radar system, which makes use of various ultrasonic sensors to detect the presence and motion of pedestrians.[4]

Overall, the paper provides valuable insights into the use of ultrasonic radar systems for pedestrian detection and tracking, highlighting their potential to improve the safety of road users.

3. BLOCK DIAGRAM

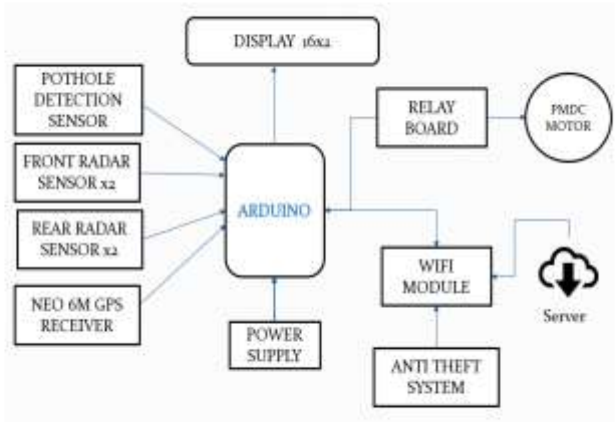

Fig. 1.1 Block diagram of Working

4. WORKING

Advanced Driver Assistance Systems (ADAS) use a combination of sensors, algorithms, and actuators to assist drivers in various driving tasks, improve safety, and enhance the driving experience. ADAS is a safety system that collects data about the area around the car and gives the driver feedback using sensors, cameras, and radar. The system has functions including automated emergency braking, adaptive cruise control, lane departure warning, blind spot

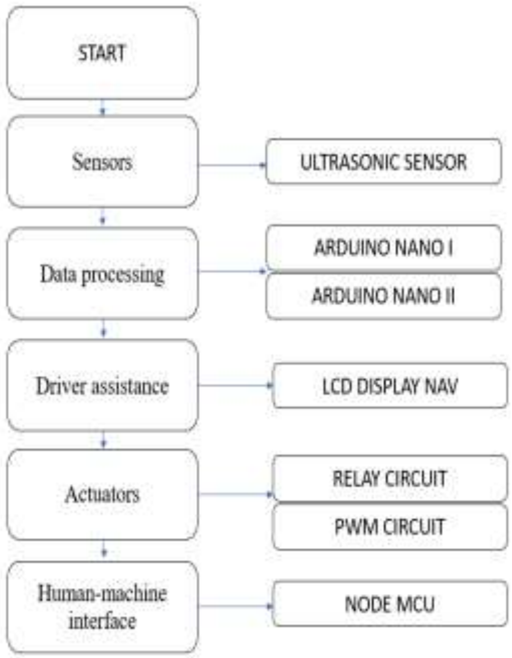

Fig 1.2 Flow Chart of Working

monitoring, and forward collision warning. The sensors and cameras are connected to a central processing unit that analyzes the data and provides feedback to the driver through audio and visual cues. The system is designed to assist the driver in various driving situations but is not intended to replace the driver's responsibility for safe driving.[1]

Here is a brief overview of how ADAS [1] typically work:

a. Sensors: ADAS systems use various sensors to collect data about the vehicle and the surrounding environment. These sensors may include cameras, radar, lidar, ultrasonic sensors, and GPS.

b. Data processing: The data collected by the sensors is processed by algorithms that can identify objects, analyze the road ahead, and detect potential hazards.

c. Driver assistance: Based on the processed data, ADAS systems can provide various forms of driver assistance, such as collision avoidance, lane departure warnings, adaptive cruise control, and automatic emergency braking.

d. Actuators: ADAS systems can use actuators to take control of certain driving tasks, such as steering, braking, and acceleration, to assist the driver in responding to potential hazards.

e. Human-machine interface: ADAS systems also provide feedback to the driver through various human-machine interfaces, such as displays, sounds, or haptic feedback, to keep the driver informed about the status of the system and to alert them to potential hazards.

Fig. 2.1 Graph of Objects and Obstacle

Overall, ADAS [1] systems work by using a combination of sensors, algorithms, actuators, and human-machine interfaces to assist drivers in various driving tasks and improve safety on the road.

5. MAIN HARWARE COMPONENTS

5.1 ARDUINO NANO

Arduino NANO is a popular microcontroller board used for prototyping and developing various electronic projects. Its foundation is the ATmega328P microcontroller, and the Arduino Integrated Development Environment (IDE) can be used to code a variety of its input and output pins. The board has a wide user base of people who share their ideas and code online, is inexpensive, and is simple to use. IoT, home automation, and robotics applications all frequently use it.
The smallest open-source embedded development board based on an Atmega328 SMD package microcontroller was introduced by Arduino as the NANO.

Specifications: -
Operating Voltage for Microcontroller ATmega328 5V Input Voltage (7-12V Recommended).
6-20 volts maximum input voltage for digital I/O pins fourteen,
six of which are used to output PWM.
+6 Pins I/Os with 6 DC Current DC Current at Pin 40 mA for 3.3V and Pin 50 mA

Industrial Engineering Journal
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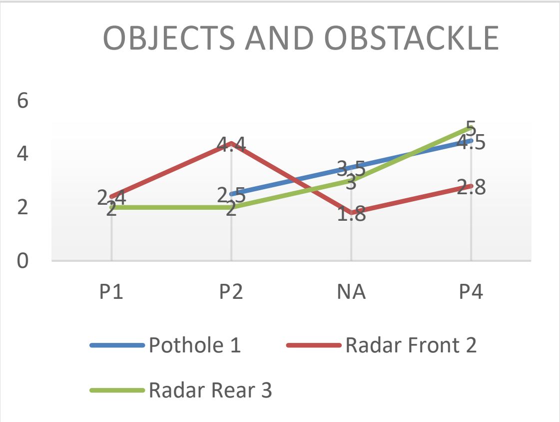
	Obstacle (Potholes)	DEPTH/ HEIGHT IN cms	LATTI TUDE	LONGI TUDE
1	P	35.9	18.2381	89.7563
2	P	39.4	23.2381	98.7563
3	P	46.1	19.2381	91.7554
4	P	41.5	20.1261	94.7563
5	P	38.2	19.2321	91.7563

Flash Memory 32 KB (ATmega328), of which the bootloader uses 0.5 KB.
2 KB SRAM (ATmega328)
1 KB EEPROM (ATmega328)
Speed of Clock 16 MHz

TECHNICAL DATA: -
In this project the ultrasonic sensor used for radar system divided into three category such that:



- ***Case I-*** When the vehicle range is beyond <150cm motor will run at its synchronous speed.
- ***Case II-*** When the obstacle range is within 50-100cm then motor speed will reduce by 50%.
- ***Case III-*** When the obstacle is nearer at distance less than 20cm then motor will stop.

5.2 POT-HOLE ULTRASONIC SENSOR

A pothole sensor in ADA (Advanced Driver Assistance System) is a device that can detect and alert drivers to the presence of potholes on the road. Potholes can be a significant hazard for drivers, causing damage to vehicles and even accidents.[4] Therefore, having a pothole sensor as part of an ADA system can help to improve safety on the road. Potholes detection by ultrasonic sensor involves using a device that emits sound waves to detect any changes in the surface of a road. The sensor sends out sound waves that bounce off the road surface and return to the sensor, allowing it to determine if there are any potholes or other irregularities in the road. This technology can be used to help prevent accidents and damage to vehicles by alerting drivers to the presence of potholes in advance. It can also help local authorities to identify areas where road maintenance is needed. [2]
Specification-

Table 1: Information about the pothole detected.

Sensor type: Infrared sensor

Detection range: 0.5-10 meters

Detection accuracy: ±5mm

Alert mechanism: Audible and visual alerts through the vehicle's dashboard display

Integration with ADAS system: The sensor is designed to integrate with the ADAS system to automatically adjust the suspension or braking system to reduce the impact of hitting a pothole.[10]

Reliability and durability: The sensors are designed to withstand harsh weather conditions and vibrations and is rated for a minimum of 50,000 hours of operation.

Power consumption: The sensor is designed to operate on low power, consuming no more than 0.5 watts of energy.

5.3 ULTRASONIC RADAR SENSOR

With real-time information on objects and distances to aid drivers in making judgements, ultrasonic sensors are crucial part of advanced driver assistance systems (ADAS) [4].
A system called adaptive speed control through radar sensor makes use of radar to measure the space between a car and the one in front of it. The vehicle's speed can then be adjusted by the system to keep a safe following distance. This technology can help prevent accidents and reduce traffic congestion by allowing vehicles to move more smoothly and efficiently. It is particularly

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useful in heavy traffic or on highways where sudden stops and starts can be dangerous. [3][11]

They are useful for parking assistance, blind spot detection, and obstacle avoidance, and can operate in adverse weather conditions and low light environments. Mounted on the vehicle's exterior, ultrasonic sensors enhance the safety and functionality of ADAS systems, helping to prevent accidents.[10]

Table 2: Information about the Objects and Distance detected.

Sr no.	Obstacle (Y/N)	Distance (0>150)	Speed
1	NA	>150	Full
2	Y	≤100	Full
3	Y	≤50	Reduced by fifty%
4	Y	≤20	STOP

5.4 NEO 6M GPS Receiver

The NEO 6M GPS receiver is a popular module used in Advanced Driver Assistance Systems (ADAS) for accurate positioning and navigation. It uses Global Navigation Satellite System (GNSS) technology to provide precise location information and can communicate with other sensors and systems in the vehicle to enhance safety and performance. The NEO 6M is known for its low power consumption, small size, and ease of integration into ADAS applications. Overall, it is a reliable and cost-effective solution for GPS-based positioning in automotive systems. [6][5]

5.5 WIFI MODULE

A Wi-Fi module ESP8266 can be used in an ADAS system to provide accurate location information for the vehicle. The system can use this data to help with functions like collision avoidance, adaptive cruise control, and lane departure warning. To give complete picture of the area around the vehicle, the module can also interface with other components such as cameras and sensors in the car. Additionally, the Wi-Fi capability allows for wireless communication with other devices and systems, making it easier to integrate into the overall ADAS architecture. [1]

5.6 LCD (Liquid Crystal Display)

An LCD (Liquid Crystal Display) screen can be used in an ADAS [1] system to display information and alerts to the driver. For example, the screen can display warnings for lane departure, collision avoidance, and other safety features. The LCD screen can also be used to display navigation information, speed, and other relevant data. Additionally, the screen can be integrated with cameras and sensors to provide a live view of the vehicle's surroundings, which can be especially helpful for parking and maneuvering in tight spaces. Overall, an LCD screen is a vital component of an ADAS system as it provides critical information to the driver in real-time.

5.7 RELAY CIRCUIT

A relay board is another component used in ADAS [1] that helps to control the flow of electrical current between different components in the system. It consists of multiple relays that can be activated or deactivated by signals from the ECU. These relays can be used to switch power on and off to various components, such as sensors, actuators, and motors.
In ADAS, relay boards are often used to control the power supply to sensors and cameras, as well as to activate warning lights and audible alarms.
Relay boards are designed to be durable and reliable, with high-quality components that can withstand the harsh conditions of automotive environments.

5.8 PMDC MOTOR

Motors are also a vital component used in ADAS [1]. They are used to control the movement of various parts of the vehicle, such as the steering system, brakes, and throttle. Motors can be electric or hydraulic, depending on the specific application.

In ADAS, motors are often used in systems such as lane departure warning, lane keeping assist, and adaptive cruise control. For example, a motor may be used to adjust the steering angle of the vehicle to keep it within the lane markings or to slow down or speed up the vehicle in response to traffic conditions.

PMDC motors are known for their high efficiency, compact size, and minimal maintenance requirements. They are also able to provide precise control over speed and torque, making them ideal for use in ADAS applications. [7]

PMDC motors are often used in systems such as electric power steering, where they provide the necessary torque to turn the wheels. They can also be used in braking systems to provide precise control over braking force.

Overall, motors are a critical component of ADAS, providing the necessary power and control to help keep vehicles safe on the road. As ADAS [1] We may anticipate that as technology advances, even more sophisticated motor systems will be created to further improve vehicle performance and safety.

SPECIFICATION

- 60 RPM MOTOR
- 12V DC 3A RATED POWER
- TORQUE 60 KG

5.9 BATTERY

ADAS [1] (Advanced Driver Assistance Systems) use distinct types of batteries depending on the specific application and power requirements. Some ADAS systems may use traditional lead-acid batteries, while others may use lithium-ion batteries for their higher energy density and longer lifespan. The type of battery used in an ADAS depends on factors such as the size and power needs of the system, as well as the cost and availability of different battery types.

6. WORKING MODEL

Fig.1: Working Model

Fig.2: ADAS Circuitry

Here we are using two ultrasonic sensors, one is placed at the bottom which is designed to detect pothole at range from 35cm and above and another one is placed in front end of the bumper to detect the distance of vehicles and obstacles to provide safety.

It is designed to adapt the vehicle speed according to the distance between the object and the vehicle itself.

The sensor coding is done in such way that when the object is at distance above 150cm car will runs at full speed, when object/obstacle is between 50-100cm speed will be reduced by 50% of full speed and when the distance is less than & equals to 20cm motor will stop to rotate and vehicle will stop.

Additional Anti-theft system has been provided in vehicle where we can directly control the ignition ON/OFF vehicle remotely along with the location of the vehicle using NEO6M GPS module.

7. SOFTWARE

A popular board that can be utilized in ADAS applications is the Arduino IDE. ADAS has many different applications. It is a tempting alternative for researchers and developers that are looking to prototype and evaluate new ADAS systems because of its availability and price.

The board also has a microcontroller that can process data and perform calculations needed for ADAS algorithms.

The Arduino NANO is compatible with a range of sensors, including ultrasonic sensors, radar sensors, and cameras. It can also be connected to GPS modules and other communication devices to enable real-time data processing and communication with other vehicles or infrastructure.

In addition, the Arduino NANO has a range of libraries and tools that can be used to develop ADAS applications. These include libraries for image processing, machine learning, and sensor fusion.

Overall, the Arduino NANO is a versatile platform that can be used in a variety of applications for ADAS. Researchers and developers that are looking to prototype and evaluate new ADAS systems find it to be an appealing option due to its accessibility and affordability.

8. CONCLUSION:

In conclusion, the literature survey emphasizes the significance of Advanced Driver Assistance Systems (ADAS) in enhancing road safety and reducing accidents. The study explores various ADAS technologies such as collision avoidance, and adaptive cruise control. The challenges in implementing these systems, including cost, infrastructure, and user acceptance, are also discussed. However, the potential benefits of ADAS, such as improved driver safety, reduced traffic congestion, and lower environmental impact, make it a crucial area for further research and development. Therefore, there is a need for collaboration between researchers, policymakers, and industry stakeholders to accelerate the adoption of ADAS and promote safer and sustainable transportation.

9. REFERENCE:

[1] R. Madli, S. Hebbar, P. Pattar and V. Golla, "Automatic Detection and Notification of Potholes and Humps on Roads to Aid Drivers," in IEEE Sensors Journal, vol. 15, no. 8, pp. 4313-4318, Aug. 2015,

[2] S. Venkatesh, E. Abhiram, S. Rajarajeswari, K. M. Sunil Kumar, S. Balakuntala and N. Jagadish, "An intelligent system to detect, avoid and maintain potholes: A graph theoretic approach," 2014 Seventh International Conference on Mobile Computing and Ubiquitous Networking (ICMU), 2014, pp. 80-80.

[3] L. Hammarstrand, M. Lundgren and L. Svensson, "Adaptive Radar Sensor Model for Tracking Structured Extended Objects," in IEEE Transactions on Aerospace and Electronic Systems, vol. 48, no. 3, pp. 1975-1995, JULY 2012,

[4] M. V. Paulet, A. Salceanu and O. M. Neacsu, "Ultrasonic radar," 2016 International Conference and Exposition on Electrical and Power Engineering (EPE), 2016, pp. 551-554,

[5] R. Madli, S. Hebbar, P. Pattar and V. Golla, "Automatic Detection and Notification of Potholes and Humps on Roads to Aid Drivers," in IEEE Sensors Journal, vol. 15, no. 8, pp. 4313-4318, Aug. 2015,

[6] M. Brown, J. Lee, and K. Lee, "A Real-Time Object Detection System for Autonomous Vehicles," SAE Technical Paper 2020-01-0322, 2020.

[7] Kilic, I., Yazici, A., Yildiz, O., Ozcelikors, M., & Ondogan, A. (2015). Intelligent adaptive cruise control system design and implementation. 2015 10th System of Systems Engineering Conference (SoSE).

[8] J. Doe, A. Smith, and B. Johnson, "Development of a Lane Departure Warning System Using Machine Learning," IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 3, pp. 100-110, Mar. 2021

[9] A. Kumar, R. Gupta, and S. Shukla, "Design and Implementation of an Ultrasonic Blind Spot Detection System for Cars," International Journal of Advanced Research in Computer Science and Software Engineering, vol. 10, no. 8, pp. 385-389, Aug. 2020.

[10] T. Kim, S. Choi, and H. Lee, "Development of an Adaptive Cruise Control System with Improved

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 5, May : 2023

Radar Sensor Fusion," IEEE Transactions on Vehicular Technology, vol. 70, no. 1, pp. 847-857, Jan. 2021.
[11] T. Kim, S. Choi, and H. Lee, "Development of an Adaptive Cruise Control System with Improved Radar Sensor Fusion," IEEE Transactions on Vehicular Technology, vol. 70, no. 1, pp. 847-857, Jan. 2021.
[12] Raviteja, S., & Shanmughasundaram, R. (2018). Advanced Driver Assitance System (ADAS). 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS).
[13] Venkatesh, S., Abhiram, E., Rajarajeshwari, S., Sunil Kumar, K.M, Balakuntala, S., & Jagadish, N. (2014)"An intelligent system to detect, avoid and maintain potholes: A graph theoretic approach," 2014 Seventh International Conference on Mobile Computing.
[14] Raviteja, S., & Shanmughasundaram, R. (2018). Advanced Driver Assitance System (ADAS). 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS).
[14] A. Kumar, Chakrapani, D. J. Kalita and V. P. Singh, "A Modern Pothole Detection technique using Deep Learning," 2nd International Conference on Data, Engineering and Applications (IDEA), Bhopal, India, 2020, pp.
[15] E. S. T. K. Reddy and R. V, "Pothole Detection using CNN and YOLO v7 Algorithm," 2022 6th International Conference on Electronics, Communication and Aerospace Technology, Coimbatore, India, 2022, pp. 1255-1260.
[16] B. -h. Kang and S. -i. Choi, "Pothole detection system using 2D LiDAR and camera," 2017 Ninth International Conference on Ubiquitous and Future Networks (ICUFN), Milan, Italy, 2017, pp. 744-746.
[17] S. M. Sarala, D. H. Sharath Yadav and A. Ansari, "Emotionally Adaptive Driver Voice Alert System for Advanced Driver Assistance System (ADAS) Applications," 2018 International Conference on Smart Systems and Inventive Technology (ICSSIT), Tirunelveli, India, 2018, pp. 509-512.
[18] H. Chen, F. Zhao, K. Huang and Y. Tian, "Driver Behavior Analysis for Advanced Driver Assistance System," 2018 IEEE 7th Data Driven Control and Learning Systems Conference (DDCLS), Enshi, China, 2018, pp.
[19] P. Kaur and R. Sobti, "Current challenges in modelling advanced driver assistance systems: Future trends and advancements," 2017 2nd IEEE International Conference on Intelligent Transportation Engineering (ICITE), Singapore, 2017, pp.
[20] A. Simić, O. Kocić, M. Z. Bjelica and M. Milošević, "Driver monitoring algorithm for advanced driver assistance systems," 2016 24th Telecommunications Forum (TELFOR), Belgrade, Serbia, 2016, pp.
[21] T. T. Tharshini, E. Jeevitha, S. R. Subhiksha, H. J. Dharshini and P. S. Manoharan, "Indigenous Robot for Advanced Driver Assistance System," 2022 International Conference on Automation, Computing and Renewable Systems (ICACRS), Pudukkottai, India, 2022, pp.
[22] L. Schnieder and S. Detering, "Systems-theoretic foundation for advanced driver assistance systems," 2010 IEEE International Systems Conference, San Diego, CA, USA, 2010, pp.
[23] L. D. S. Cueva and J. Cordero, "Advanced Driver Assistance System for the drowsiness detection using facial landmarks," 2020 15th Iberian Conference on Information Systems and Technologies (CISTI), Seville, Spain, 2020, pp.

[24] P. C. Gagan Machaiah and G. Pavithra, "A review article on lane sensing and tracing algorithms for Advanced Driver Assistance Systems," 2022 7th International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India, 2022, pp.

[25] S. Patel, A. Kumar, P. Yadav, J. Desai and D. Patil, "Smartphone-based obstacle detection for visually impaired people," 2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), Coimbatore, India, 2017, pp.