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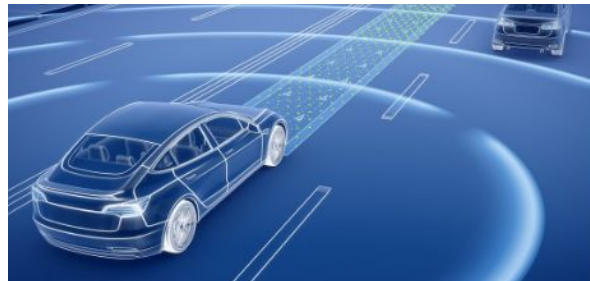
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UNIT IV: INTRODUCTION TO AUTOMATED, CONNECTED AND INTELLIGENT VEHICLES

TOPIC: **Advanced Driver Assistance Electronic Systems**



09/12/2024



19EEE309 / ELECTRICAL VEHICLE SYSTEMS / R.SATHEESH KUMAR / AP / EEE

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Advanced Driver Assistance Systems (ADAS) are electronic systems in vehicles that use a combination of sensors, cameras, radar, LiDAR, and artificial intelligence to improve vehicle safety and the driving experience. ADAS can reduce human error, prevent accidents, and assist drivers in making more informed decisions.

Introduction to ADAS

- **Definition:** ADAS refers to a group of safety and convenience features in vehicles designed to assist drivers in operating their vehicles and prevent accidents.
- **Goal:** To improve safety, reduce human error, and support driver decision-making through automation.
- **Key Features:** Vision-based systems, sensor networks, and computational algorithms to enhance vehicle control.

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Types of ADAS Features

1. **Collision Avoidance Systems:**
 - **Automatic Emergency Braking (AEB):** Detects potential collisions and automatically applies the brakes.
 - **Forward Collision Warning (FCW):** Warns the driver of an imminent collision.
2. **Lane Assistance Systems:**
 - **Lane Departure Warning (LDW):** Alerts the driver when the vehicle drifts out of its lane.
 - **Lane Keeping Assist (LKA):** Automatically steers the vehicle to keep it in its lane.
3. **Adaptive Cruise Control (ACC):**
 - Maintains a safe distance from the car ahead by adjusting the vehicle's speed automatically.
4. **Blind Spot Detection (BSD):**
 - Monitors the vehicle's blind spots and alerts the driver to nearby vehicles.
5. **Parking Assistance:**
 - **Park Assist:** Helps the driver park by controlling the vehicle's steering, brakes, and accelerator.
 - **360° Camera System:** Provides a bird's eye view of the vehicle's surroundings.
6. **Traffic Sign Recognition (TSR):**
 - Identifies road signs (e.g., speed limits, stop signs) and provides alerts to the driver.



How ADAS Works

- **Data Collection:** ADAS sensors collect real-time data from the vehicle's surroundings (e.g., cameras, radar, LiDAR, ultrasonic sensors).
- **Data Processing:** The data is sent to the central ECU, which processes the information using advanced algorithms, including machine learning and computer vision.
- **Decision Making:** Based on the processed data, the ECU decides on the necessary actions, such as braking, steering correction, or giving a warning.
- **Actuation:** The system actuates the necessary vehicle components (brakes, steering, etc.) to implement the decision.



Benefits of ADAS

- 1. Improved Safety:**
 - Reduces the risk of collisions and human errors.
 - Prevents accidents through features like AEB, ACC, and lane-keeping.
- 2. Enhanced Driver Comfort:**
 - Reduces driver fatigue with features like adaptive cruise control and park assist.
- 3. Reduced Traffic Congestion:**
 - Efficient traffic flow through systems like adaptive cruise control and automatic lane change assistance.
- 4. Increased Vehicle Lifespan:**
 - Prevents damage by helping avoid collisions and accidents.
- 5. Fuel Efficiency:**
 - Systems like adaptive cruise control optimize driving speed for better fuel efficiency.



Challenges in ADAS Implementation

1. **Sensor Limitations:**

- Cameras and radar may struggle in adverse weather conditions like heavy rain or fog.

2. **Complexity of Integration:**

- Integrating ADAS into existing vehicle systems, ensuring compatibility with sensors, ECUs, and actuators.

3. **Cost:**

- High costs of sensors and cameras, which may increase the price of vehicles.

4. **Regulatory Issues:**

- Ensuring compliance with international standards and regulations.

5. **Driver Overreliance:**

- Drivers may become overconfident, leading to reduced attention or misuse of the system.



Future of ADAS

1. **Evolution Toward Autonomous Vehicles:**

- ADAS is a stepping stone to fully autonomous vehicles, where systems like self-driving cars will take full control of driving tasks.

2. **Increased Integration with AI:**

- Improved AI and machine learning will enhance the decision-making abilities of ADAS systems, making them more predictive and adaptive.

3. **Vehicle-to-Everything (V2X) Communication:**

- ADAS will communicate with other vehicles and infrastructure (traffic lights, road signs) to improve safety and traffic management.

4. **5G Connectivity:**

- The implementation of 5G networks will enable faster, real-time communication between vehicles and cloud systems for better decision-making.

5. **Cloud-based Updates:**

- ADAS systems will receive over-the-air updates to improve performance, add features, and fix bugs.



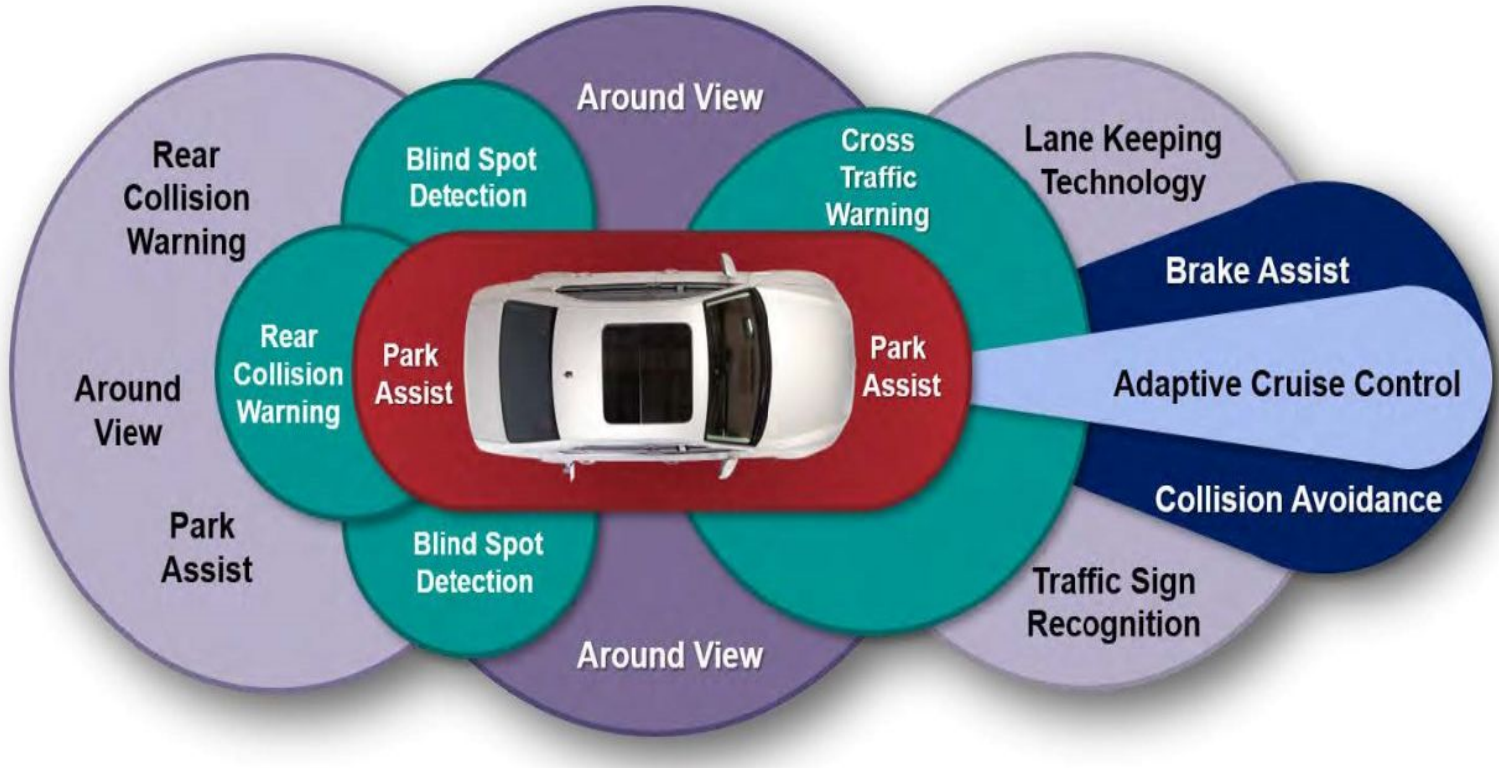
Real-World Examples of ADAS

- 1. Tesla Autopilot:**
 - Semi-autonomous driving system with features like automatic lane centering, traffic-aware cruise control, and hands-free driving.
- 2. Mercedes-Benz Drive Pilot:**
 - Level 3 autonomous driving system that allows hands-free driving in certain conditions.
- 3. Volvo Pilot Assist:**
 - Provides steering assist, adaptive cruise control, and lane-keeping in Volvo vehicles.
- 4. Toyota Safety Sense (TSS):**
 - Includes features such as Pre-Collision System, Lane Departure Alert, and Adaptive Cruise Control.



Conclusion

- ADAS is transforming the driving experience by improving safety, efficiency, and convenience.
- As technology continues to evolve, ADAS will play a critical role in the development of fully autonomous vehicles.
- While challenges like sensor limitations and regulatory issues remain, the future of ADAS looks promising with increased automation and AI integration.





...THANK YOU