

■ Camera Sensor in ADAS

1■■■ What is a Camera Sensor?

A camera sensor is an electronic vision device that captures real-time images or videos of the surroundings. It acts as the “eyes” of the ADAS system, helping the vehicle recognize lanes, vehicles, pedestrians, traffic signs, and obstacles, just like a human driver.

2■■■ How It Works

- 1. Image Capture:** Continuously captures frames of the environment.
- 2. Image Processing (Computer Vision):** Processes images using CNNs (Convolutional Neural Networks) or similar algorithms.
- 3. Decision Making:** Based on processed data, ADAS decides actions like lane departure warning, automatic braking, etc.

3■■■ Types of Cameras in ADAS

| Type | Position | Function |
|------------------------|-------------------|---|
| Front Camera | Behind windshield | Detects lanes, vehicles, pedestrians, and traffic signs |
| Rear Camera | Back side of car | Assists in reversing and parking |
| Side Cameras | Side mirrors | Used for blind-spot monitoring and lane-change assist |
| Surround (360°) Camera | Around vehicle | Provides bird's-eye view for parking and maneuvering |

4■■■ Applications

Camera sensors enable functions such as Lane Departure Warning, Lane Keeping Assist, Traffic Sign Recognition, Automatic Emergency Braking, Pedestrian Detection, Driver Monitoring, and Parking Assistance.

5■■■ Technologies Used

- Image Sensors: CMOS (Complementary Metal–Oxide–Semiconductor)
- Lenses: Wide-angle for maximum field of view
- Processing Unit: Deep Learning or Computer Vision (CNN, YOLO)
- Sensor Fusion: Works with Radar and LiDAR for higher accuracy

6■■■ Challenges

| Issue | Description |
|--------------------|---|
| Poor Lighting | Low light or glare can reduce visibility |
| Weather Conditions | Fog, rain, or snow can blur camera image |
| Lens Contamination | Dust, mud, or water drops affect image clarity |
| Processing Delay | Real-time analysis requires powerful processors |

7■■■ Real-World Examples

- Tesla Autopilot – Uses cameras and AI for perception.
- Mobileye (Intel) – Supplies camera-based ADAS to major automakers.

- BMW / Mercedes-Benz – Use stereo cameras for 3D depth perception.