

Computer Vision Systems in Self Driving Cars

Haytham Alshawaf



Autonomous Vehicle Navigation and Mapping



- Localization
- Path Planning

Navigation and Mapping

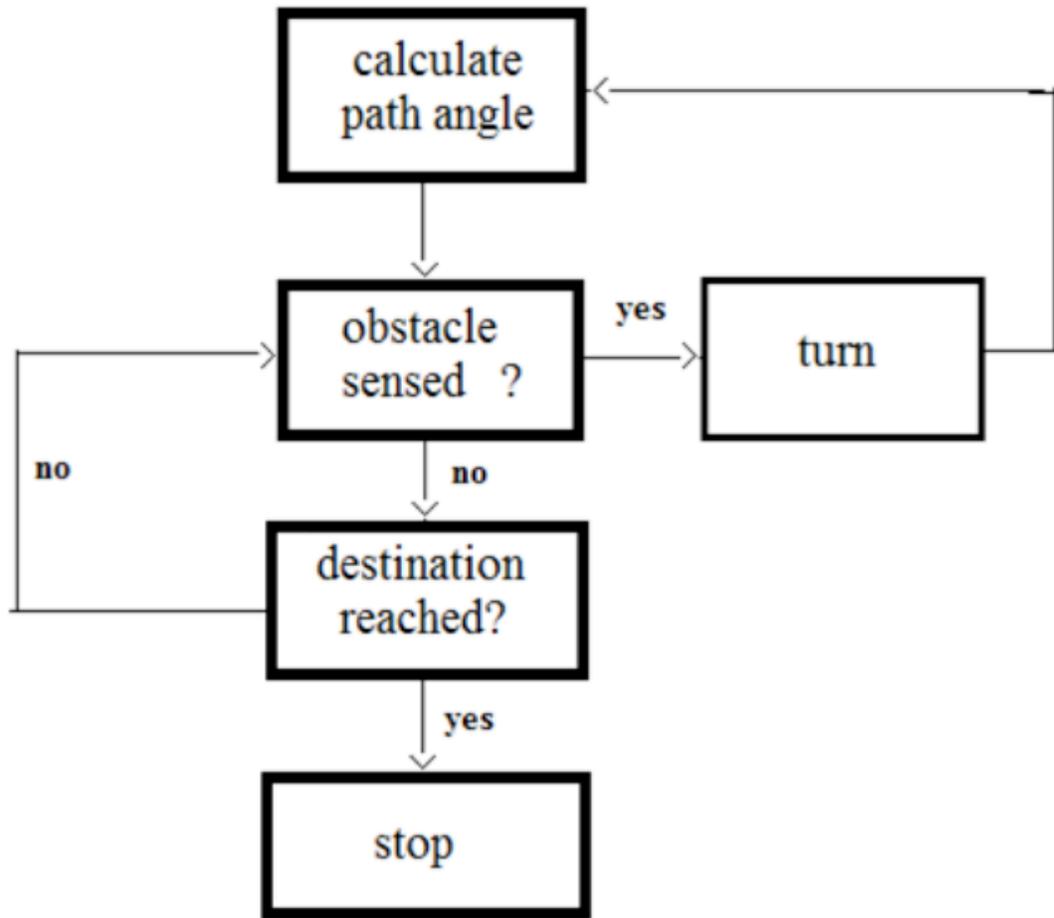


Fig.6 Navigation algorithm

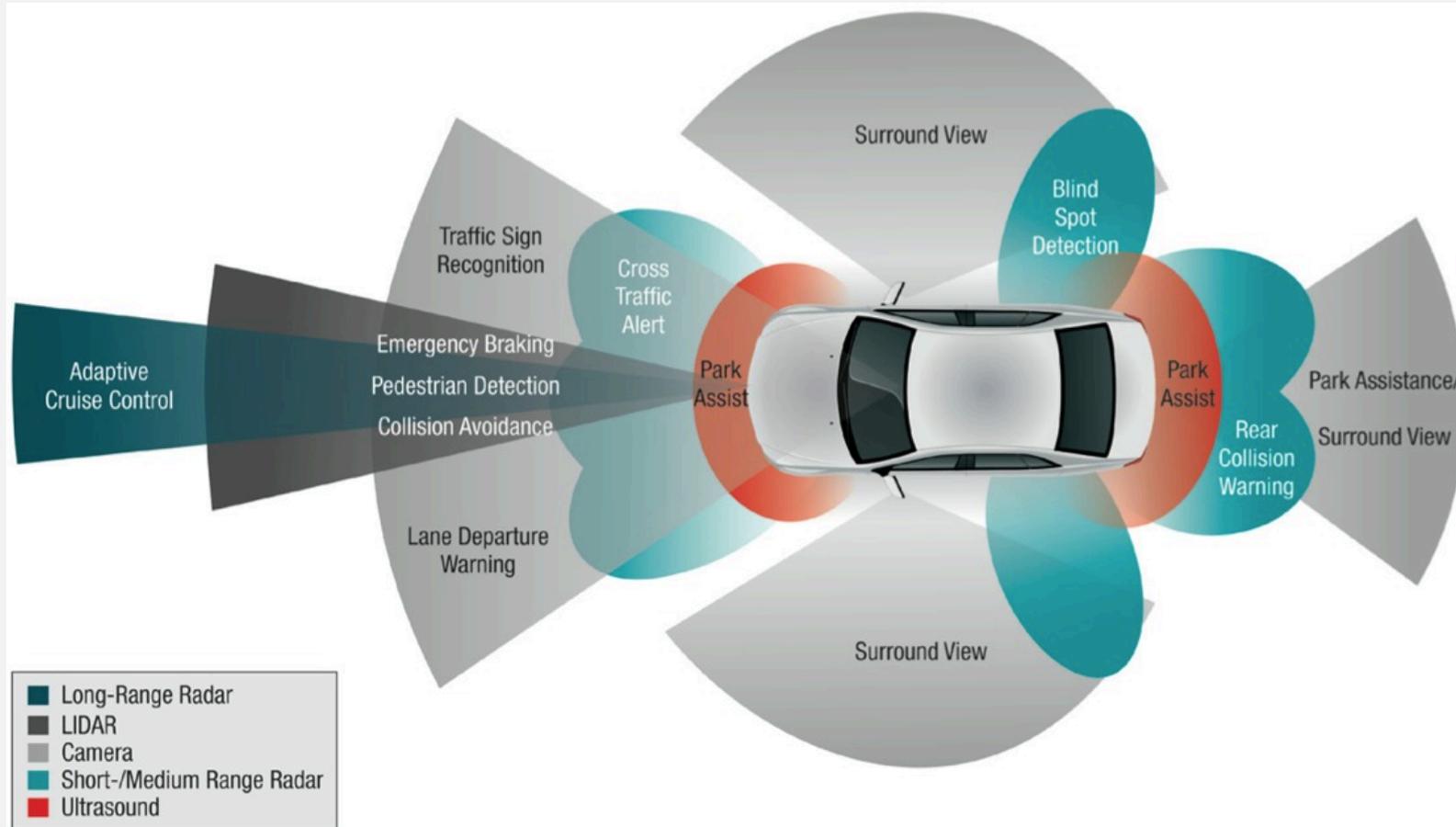
Computer Vision Systems In Driverless Cars

- Advanced Driver Assistant System
- Collision Avoidance System
- Lane departure warning system

Advanced Driver Assistant System

- ADAS systems are enhanced by supplementing cameras and Light detection and Ranging (LIDAR).
- LIDAR sends a light pulse with a set time interval between each pulse. Time over distance is calculated to measure the time of flight between the transmit and receive sensors to calculate speed and range.

Advanced Driver Assistant System



Birds-eye View Camera System

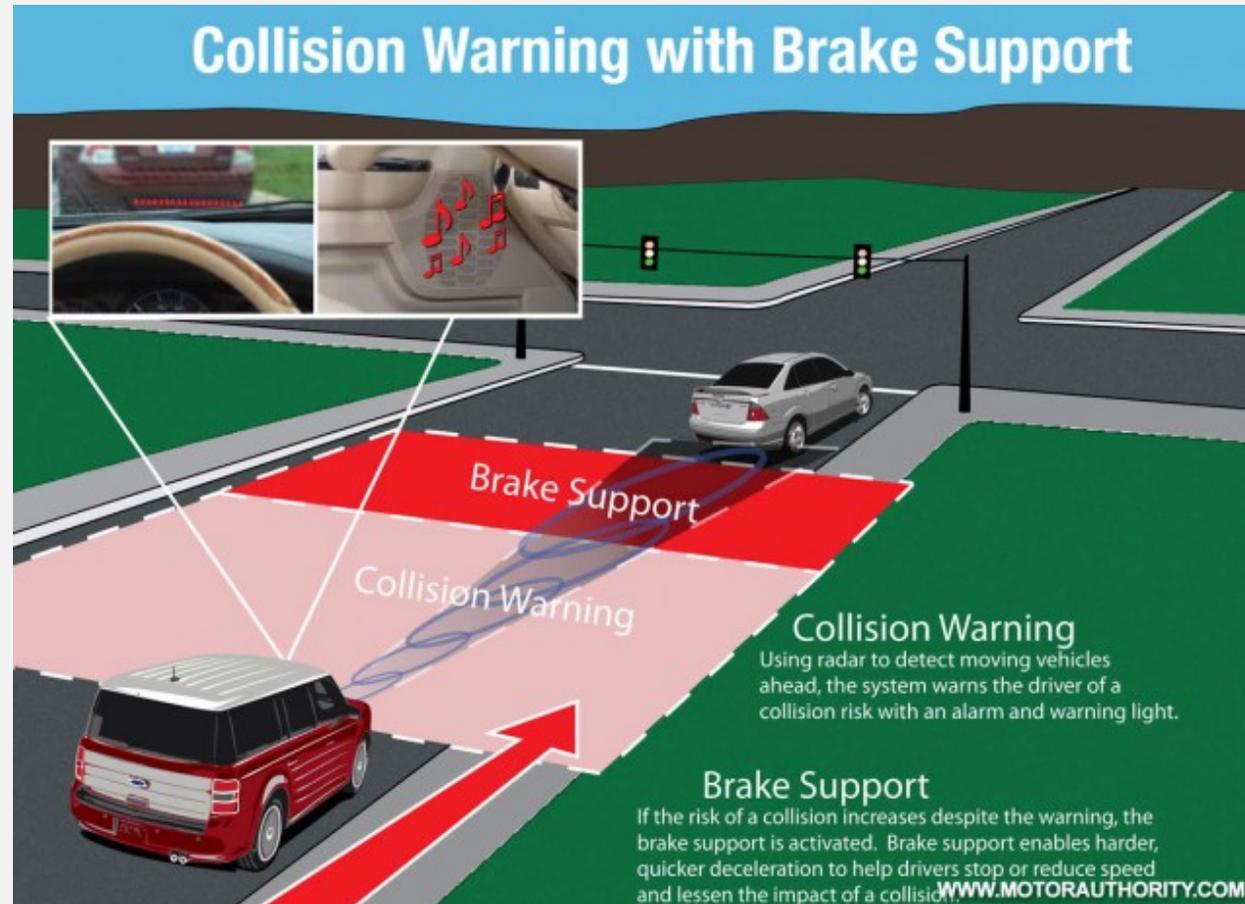
- Surround View Cameras
 - 4 Cameras
- Surround View Monitor
 - Birds Eye View
- Monitor Displays:
 - Lane Markings
 - Curbs
 - Adjacent Cars



Collision Avoidance System

- Also Known as Precrash, Collision Mitigating system.
- Uses Radar, Laser (LIDAR) and Camera for Image Recognition
- Detection causes the system to provide a warning, if the driver didn't respond it will take action by braking, steering, or both.

Collision Avoidance System



Lane Departure Warning System

Lane Departure Warning

- Systems which warn the driver if a vehicle is leaving its lane.
- Warnings:
 - Visual
 - Audible
 - Vibration

Lane Keeping System

- Systems which warn the driver, and, if no action is taken, the system will automatically take steps to ensure the vehicle stay in its lane.
 - Brakes
 - Steering

Canny Edge Detector

Lane Detection Systems use the principle of Canny Edge Detector to detect lane lines from real time camera image fed from the front end camera of the automobile.

- The Process of Canny edge detection algorithm can be broken down to 5 different steps:
- Apply Gaussian filter to smooth the image in order to remove the noise
- Find the intensity gradients of the image
- Apply non-maximum suppression to get rid of false edge detection
- Apply double threshold to determine potential edges
- Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

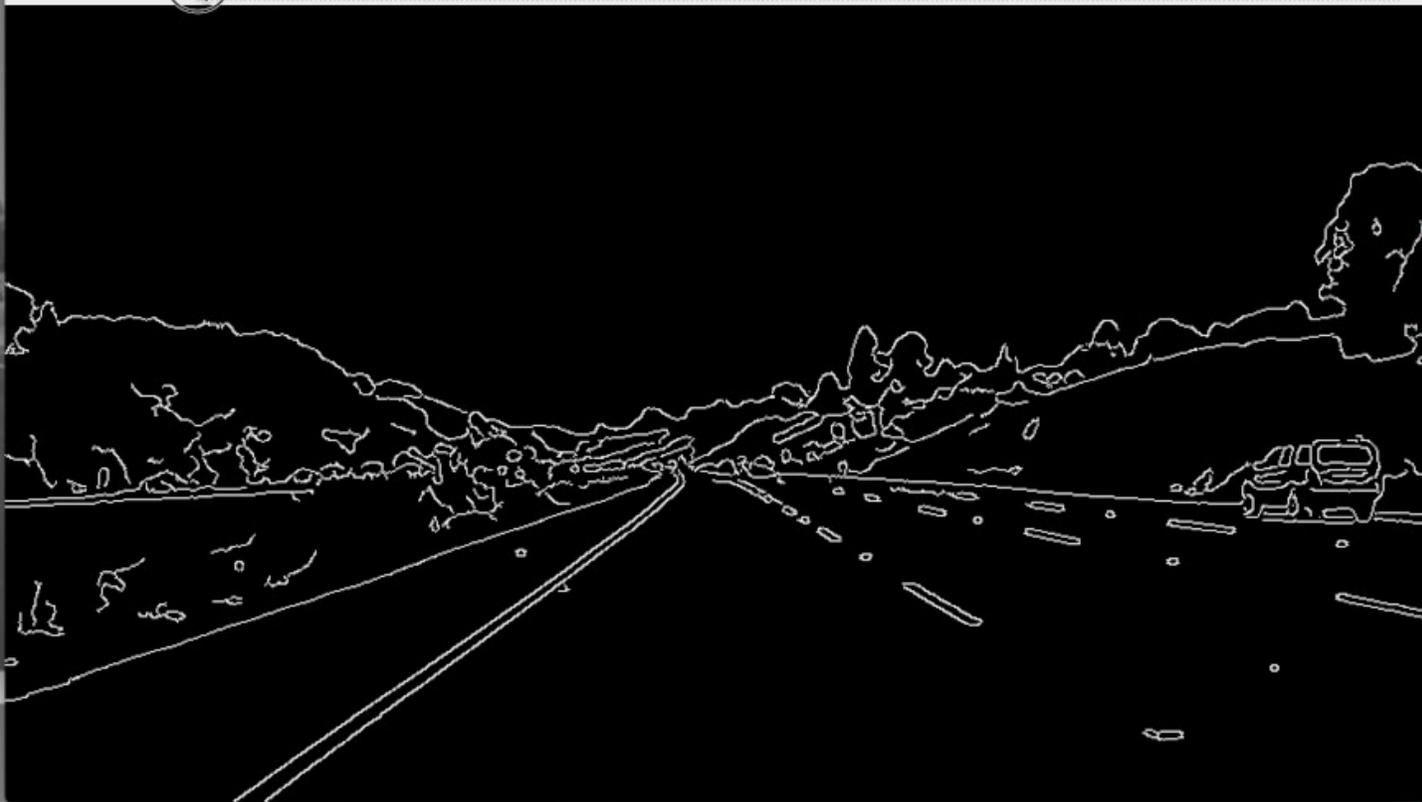


smoothed

filter_size

threshold2

threshold1



Camera Input of
the road



Camera
Calibration
+ Perspective
Transform



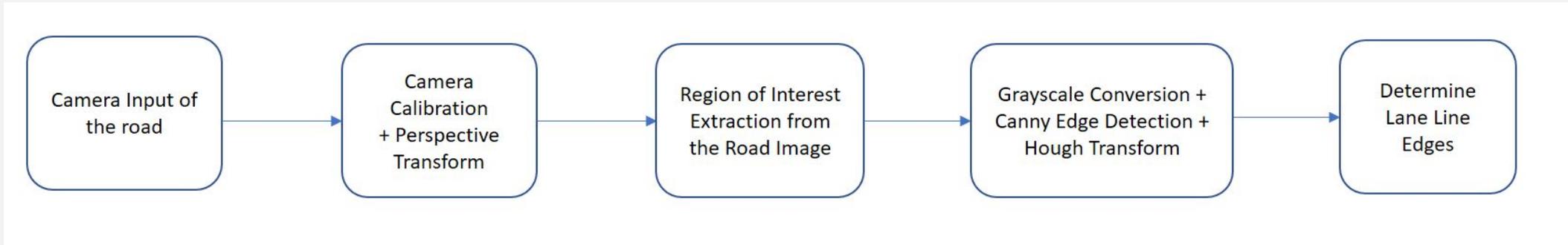
Region of Interest
Extraction from
the Road Image



Grayscale Conversion +
Canny Edge Detection +
Hough Transform

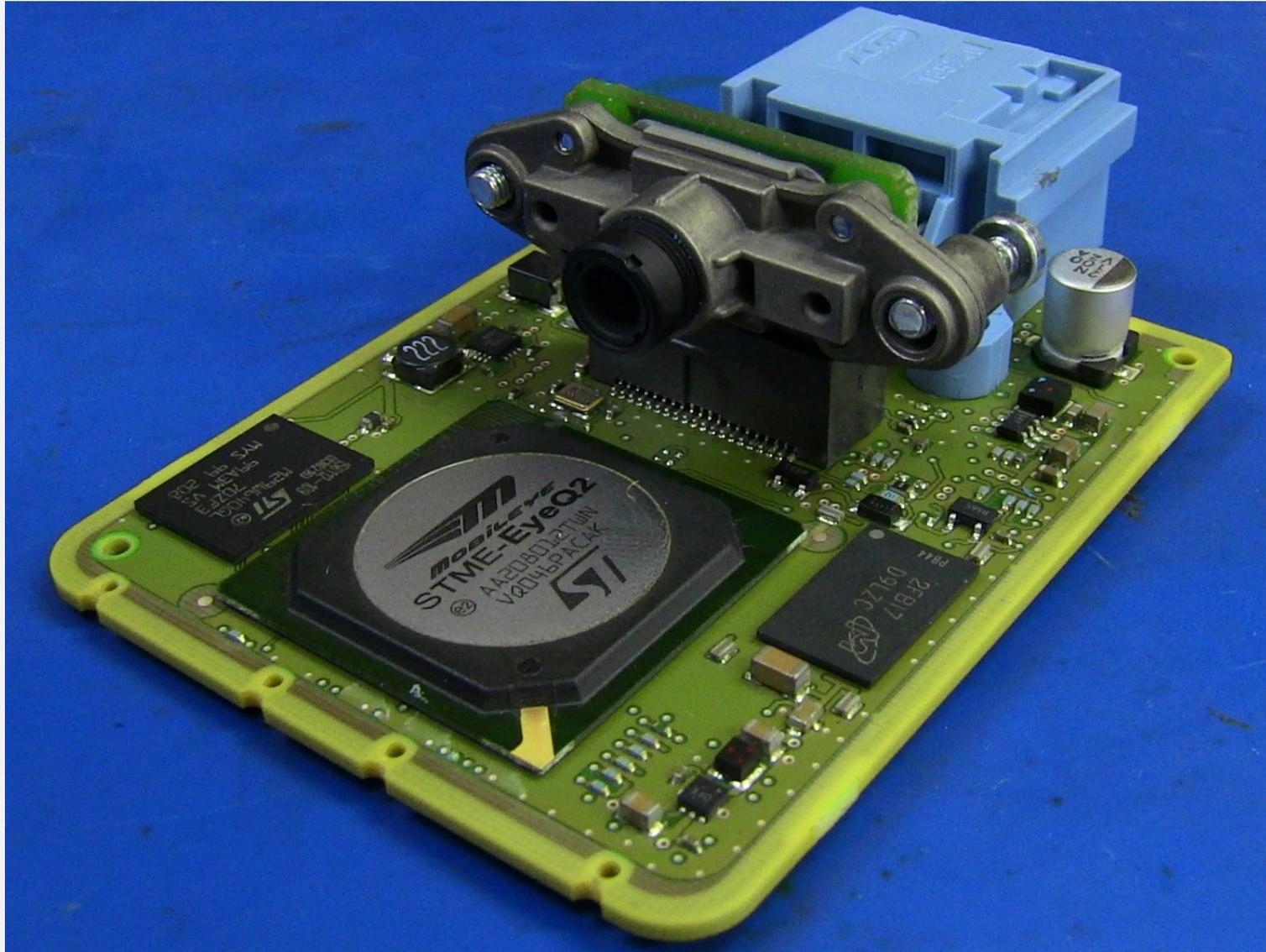


Determine
Lane Line
Edges





Lane Assist Camera of VW Golf



Hyundai Lane Guidance camera module.

Summary

- Computer vision systems in Autonomous Vehicles
 - Navigation and Mapping
 - Collision Avoidance
 - Lane Departure Warning
- Image recognition:
- Camera, GPS, Radar, and Laser (LIDAR.).