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# Autonomous Vehicle Vision Control (Perception System)

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**Abstract:** *Autonomous Vehicles "Fully automated vehicles without any human interactions".*
*Autonomous control software being used to fully robotic control to driving system including steering wheel, braking, blind spots, and traffic signals, etc. when route is incorrect or having any inconvenience based on the previous driving vehicle running at same route observed by autonomous driving computer system. The system will again optimize map and also facilitate to be controlled by passengers (manual driving).*

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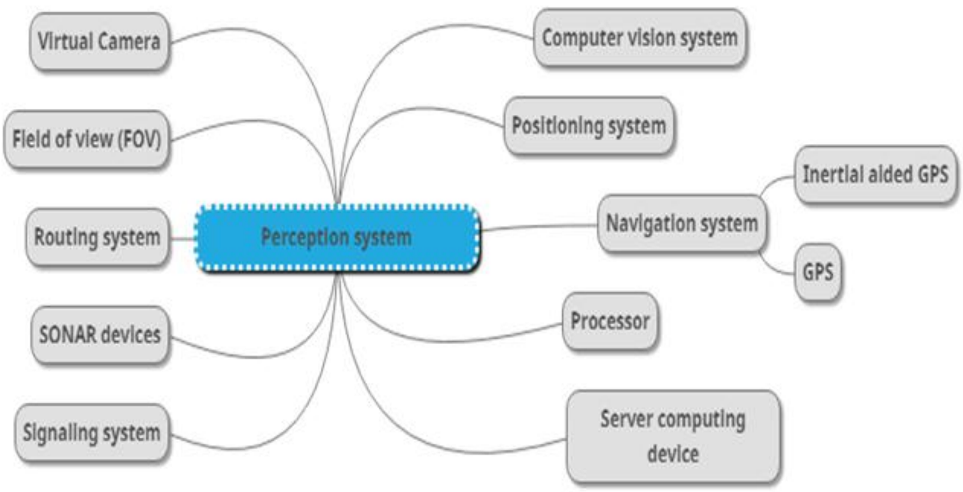
**Perception System**

- An autonomous vehicle needs sensory input devices like cameras, radar and lasers to allow the car to perceive the world around it, creating a digital map.
- To identify the vehicle environment set of system used known as perception system.
- Perception system can be divided into four categories: detection, classification, tracking, and motion estimation of the test vehicle.
- It includes –
  - Sensor fusion system
  - LIDAR and Radar System
  - Thermal imaging system

- **Components of perception system**




**Sensor Fusion Algorithm**

- Main objective of this invention to create three dimensional point clouds based on the radar measurement.
- Radio signals inform about vehicle environment, by using multiple radar reflectors system can analyze the distance between surfaces of the objects and its orientation.
- Methods and systems are provided for detecting weather conditions using vehicle onboard sensors, and modifying behavior of the vehicle accordingly.
- Behavior of autonomous vehicle based upon the detected weather conditions it may not drive under certain weather conditions such as heavy rain, wet-road, fog, direct sun light, etc.

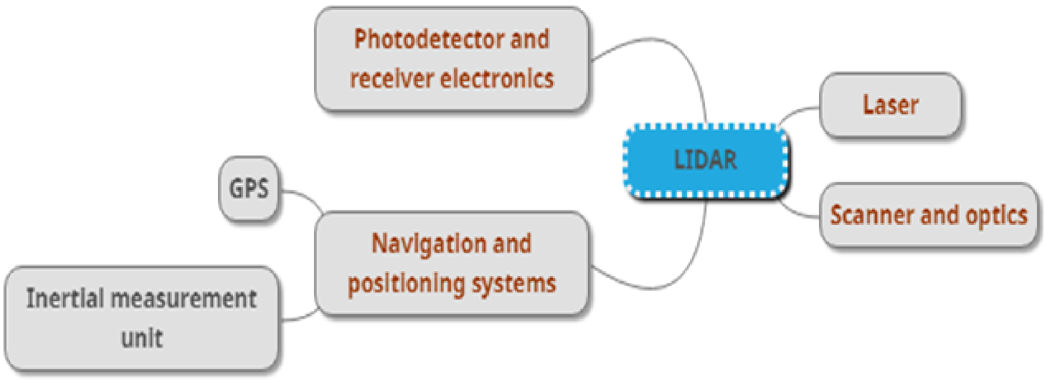
Objectives -

- ✓ Tracking of stationary and moving objects is a critical function of Autonomous driving technologies.
- ✓ Signals from several sensors, including Camera, RADAR and LIDAR (Light Detection and Ranging device based on laser) sensors are combined to estimate the position, velocity, trajectory and class of objects i.e. other vehicles and pedestrians.
- ✓ The technique used to merge information from different sensor is called sensor fusion.

**LIDAR**

- ➢ LIDAR (Light Detection and Ranging) is remote sensing method to generate precise, three-dimensional information about the shape of the object.
- ➢ A LIDAR instrument consists of a laser, a scanner, and a specialized GPS receiver.
- ➢ Continuously rotating LIDAR system sends thousands of laser pulses every second. These pulses collide with the surrounding objects and reflect back. The resulting light reflections are then used to create a 3D point cloud. An onboard computer records each laser's reflection point and translates this rapidly updating point cloud into an animated 3D representation.
- ➢ With the help of LIDAR, autonomous vehicles travel smoothly and avoid collisions by detecting the obstructions ahead.

**Main components of LIDAR –**




**RADAR**

- Radar is a detection system that uses radio waves to determine the range, angle, or velocity of objects.
- Radar device follows a simple procedure to transmit and receive the radio frequency signals for ranging and detection.

**Transmitter**

- The radar transmitter produces the short duration high-power rf pulses of energy that are into space by the antenna.

**Duplexer**

- The duplexer alternately switches the antenna between the transmitter and receiver so that only one antenna need be used. This switching is necessary because the high-power pulses of the transmitter would destroy the receiver if energy were allowed to enter the receiver.

**Receiver**

- The receivers amplify and demodulate the received RF-signals. The receiver provides video signals on the output.

**Radar Antenna**

- The Antenna transfers the transmitter energy to signals in space with the required distribution and efficiency. This process is applied in an identical way on reception.

**Indicator**

- The indicator should present to the observer a continuous, easily understandable, graphic picture of the relative position of radar targets.

**Next generation radar**

- NEXRAD (Next Generation Radar) - The radar emits a burst of energy if the energy strikes an object it will scattered in all directions the signal strength observed analyzed by the computer system.

**Thermal imaging system/ Night vision**

- A special lens focuses the infrared light emitted by all of the objects in view.
- The focused light is scanned by a phased array of infrared-detector elements. The detector elements create a very detailed temperature pattern called a **thermogram**. It only takes about one-thirtieth of a second for the detector array to obtain the temperature information to make the thermogram. This information is obtained from several thousand points in the field of view of the detector array.

Most thermal-imaging devices scan at a rate of 30 times per second. They can sense temperatures ranging from -4 degrees Fahrenheit (-20 degrees Celsius) to 3,600 F (2,000 C), and can normally detect changes in temperature of about 0.4 F (0.2 C).

There are two common types of thermal-imaging devices:

- **Un-cooled** - This is the most common type of thermal-imaging device. The infrared-detector elements are contained in a unit that operates at room temperature. This type of system is completely quiet, activates immediately and has the battery built right in.
- **Cryogenically cooled** - More expensive and more susceptible to damage from rugged use, these systems have the elements sealed inside a container that cools them to below 32 F (zero C). The advantage of such a system is the incredible resolution and sensitivity that result from cooling the elements. Cryogenically-cooled systems can "see" a difference as small as 0.2 F (0.1 C) from more than 1,000 ft (300 m) away, which is enough to tell if a person is holding a gun at that distance.

While thermal imaging is great for detecting people or working in near-absolute darkness, most night-vision equipment uses image-enhancement technology.

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