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AUTONOMOUS CARS: THE FUTURE OF ROADWAYS

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***Abstract*— The autonomous car or the driverless car can be referred to as a robotic car in simple language. This car is capable of sensing the environment, navigating and fulfilling the human transportation capabilities without any human input. It is a big step in the advancing future technology.**

Autonomous cars sense their surroundings with cameras, radar, lidar, GPS and navigational paths. Advanced control systems interpret sensory information to keep track of their position even though the conditions change.

The advantages of autonomous cars, such as fewer traffic collisions, increased reliability, increased roadway capacity, reduced traffic congestion as well as reduction of traffic police and care insurance, are compulsive for the development of autonomous car even though we have to overcome the issues of cyber security, software reliability, liability of damage and loss of driver related jobs.

Autonomous cruise control or the Lane departure warning system and the Anti lock braking system (ABS) are the early steps. These steps though small are conclusive towards the progress in the direction of making the autonomous car. Companies such as Google, Volvo, Mercedes-Benz and Audi are the fore runners in making the autonomous car a reality.

The development and expansion of the sector in Indian conditions is also worth considering. We strongly believe that the autonomous car will be a reality soon and be a necessity of life by overcoming the current obstacles, as human life needs to be secured by safe, efficient, cost effective and comfortable means of transport.

I. INTRODUCTION

It is a known fact that even if humans have the capability to think unlike machines still they also commit errors unlike machines. A machine performs the assigned task without errors or without feeling the slightest fatigue. Similar is the case while driving automobiles. Humans tend to cause undesired errors while driving which leads to accidents, injuries, risk & damage to life and property. Thus a way to overcome these problems is having automation in the field of automobiles. Steps have been taken towards automation since the last century which have now turned out to be fruitful in the form of the AUTONOMOUS CAR.

II. A DREAM A REALITY

We have often seen in movies and read in fiction about flying cars and cars having a mind of their own. But can this become a reality we often wondered. Today in the 21st century this dream has become a reality. Such a car exists in the world today. But it wasn't a direct leap to the autonomous car. There were various intermediate steps involved in the making.

III. THE MAKING

A. Anti-Lock Brakes (ABS)

The first step towards driverless cars came in the 1980s with the invent of Anti-Lock Braking System (ABS).

When a car is braking hard and doesn't have anti lock brakes, the wheels can lock up, sending the car into an out-of-control skid. In a car without ABS the driver has to pump the brake pedal to keep the wheels from locking up. But due to ABS and the speed sensors in the wheels, the car does the pumping for you.

B. Traction and Stability Control

These systems are a step-up sophistication ladder from ABS. They use the sensors at the wheels to detect when a car might go into an out-of-control skid or roll-over. These systems can increase or decrease power to individual wheels which is often better than brakes or power being applied on all four wheels.

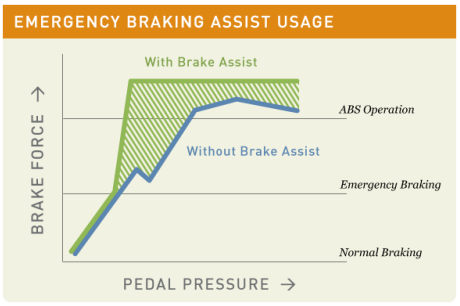
C. Emergency Brake System

Emergency brake assist (EBA) or Brake Assist (BA or BAS) is a generic term for automobile braking technology that increases braking pressure in an emergency situation. By interpreting the speed and force with which the brake pedal is pushed, the system detects if the driver is trying to execute an emergency stop, and if the brake pedal is not fully applied, the system overrides and fully applies the brakes until the Anti-lock Braking System (ABS) takes over to stop the wheels locking up.

D. Detecting traffic lights

'Actinometer' is a sensor used to detect the intensity of

radiation. If the detected intensity is of red or yellow colour, then the controller will send a command to immediately stop the vehicle. The command will act as an input to the mechanical system thereby stopping the vehicle.



E. Automated Night Vision

An automotive night vision system is a system to increase a vehicle driver's perception and seeing distance in darkness or poor weather beyond the reach of the vehicle's headlights.

Active systems use an infrared light source built into the car to illuminate the road ahead with light that is invisible to humans.

Passive systems do not use an infrared light source, instead they capture thermal radiation already emitted by the objects, using athermographic camera.

F. Intelligent Cruise Control

Cruise control are used for maintaining constant speed set by the driver and thus can be of great comfort in steady traffic conditions like highways. This can be achieved by the use of sensors or radar setup that detects the approaching vehicle and thereby reduces the speed and accelerates again to the preset value when the traffic allows.

G. Lane Support System

In order to reduce the collisions due to driving errors , distraction, talking on cell phones etc. lane support system was developed . It is a mechanism designed in such a way that the driver gets warning whenever the vehicle begins to move out of its lane.

'AutoVue'-an embedded camera based lane marking recognition and warning system, monitors the visual line markings on the road and signals the driver with an audible or tactical warning.

H. Self Parking

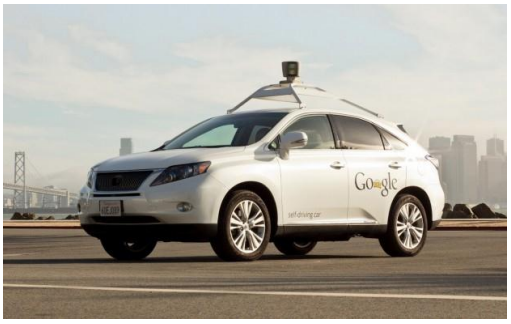
Self parking system includes sensors all around the car to guide it to the allotted parking space. The driver has to first find a position for parking and then use the in-cabin navigation screen to tell the car where to go.

A few other topics under automation include:

- Adaptive headlamps
- Advanced Automatic Collision Notification
- Blind spot monitoring
- Driver Monitoring System
- Pre-crash system
- Distance control assist

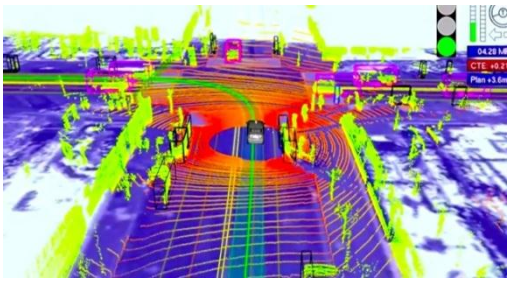
IV. THE CAR

With these various steps towards automation finally evolved the autonomous car. The autonomous car can completely drive itself without any driver input except in case of emergencies.



V. WORKING AND COMPONENTS

The above image shows how the autonomous car would see its surrounding. An autonomous car detects using techniques such as lidar, radar, sensors, cameras, GPS etc.



The heart of the system is a laser range finder mounted on the roof of the car. The device generates a 3D map of the environment. The car then combines the laser measurements with the high resolution maps, producing different types of data models that allow the car to drive it while avoiding obstacles and respecting traffic laws.

In addition to the laser, the car also has various other sensors, including four radars, mounted on the front and rear bumpers to view the front and rear traffic; a camera positioned near the rear view mirror to detect traffic lights; a GPS system; wheel encoder , that determines wheel's location and keeps the track of its movement.

The various technologies used in the components of the car are:

A. Lidar

Lidar (Light + Radar) is a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light.

Autonomous vehicles use lidar for obstacle detection and avoidance to navigate safely through environments.

B. SLAM

Simultaneous Localization and Mapping is a technique used by autonomous vehicle to build up a map within an unknown environment (without a prior knowledge) or to update a map within a known environment (with prior knowledge) while at the same time keeping track of their current location.

C. Computer Vision

It is field that includes methods for acquiring, processing, analyzing and understanding images and in general high dimensional data from the real world in order to produce numerical or symbolic information in the form of decisions. A theme in the development of this field has been to duplicate the abilities of human vision by electronically perceiving and understanding an image.

D. Sensors

1) Blind spot monitor: It is a vehicle-based sensor device that detects other vehicles located on the driver and rear side. Warnings can be visual, audible, vibrating or tactile.

2) Oxygen sensors: They are installed in the exhaust system of the vehicle, attached to the engine's exhaust manifold; the sensor measures the ratio of air-fuel mixture.

3) Air-fuel ratio monitor: An Air-fuel ratio meter monitors the air fuel ratio of an internal combustion engine. It reads the voltage output of an oxygen sensor, sometimes also called as lambda sensor, whether it is from a narrow band or wide band oxygen sensors.

Other sensors used are Video Sensors in the visual domain mounted behind the windshield, Laser Sensors mounted on the front of the vehicle, Infrared Sensors mounted either behind the windshield or under the vehicle.

E. GPS

The Global Positioning System is used to locate the position of the car using preloaded maps. GPS data is obtained from the GPS receiver through the serial port of a Personal Digital Assistant which is then sent to the PC via a wireless network card. This data is then interpreted and used by the PC to send a signal to the Remote Control via a Digital-to-Analog Converter in order to navigate a vehicle from initial to a destination point, executing a specified formation.

F. Cameras

The entire car is equipped with cameras so that it can detect its surroundings.

VI. Autonomous India

Vijay Ratnaparkhe, Managing Director, Robert Bosch Engineering said, "In around 10 years from now, we will have serial cars which will run semi autonomous in dense cities but on highways they will definitely be fully autonomous."

There are some positive as well as negative points when considering the impact of driverless cars in Indian conditions.

A. The People of India

Indians would definitely love to have the autonomous car. We surely know that Indians will not be far behind in owning or developing this car indigenously. India being a populated country, poses some challenges to the smooth running of the autonomous cars. There needs to be a fundamental change in the discipline area where we need to follow and implement the traffic and other rules stringently. It is not difficult to get this implemented as we Indians follow all the rules when we are abroad so why should it be different here. In any case we are seeing the change happening and being adapted. After all we are incredible India.

Our traffic system and infra structure will need certain improvements and that is the change which is in and around us. The benefits of the autonomous car will certainly also amuse the Indian people.

VII. Advantages

- These cars increase comfort and ease.
- These cars can be more accurate and safe.
- It saves time.
- It reduces human-induced accidents.
- It reduces driving errors.
- Due to sensors in the autonomous cars, they will be able drive closer, allowing more cars on the roads therefore shorting traffic times.

VIII. Disadvantages

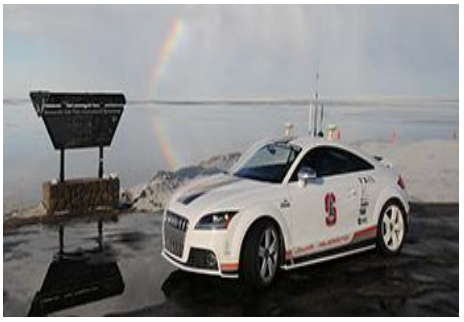
Largely the disadvantages of a autonomous cars are minimal, in fact the only drawback we thought was the over dependency on various systems for its smooth running such as the sensors, GPS, Radar etc. The very fact that the car is built by utilizing these systems necessitates its robustness and hence negates disadvantages.

The other factor being a need to change various legislations and to adapt insurance policies to suit the changing needs.

Loss of driver-related jobs.[45] Reduced demand for parking services and for accident related services assuming increased vehicle safety.

IX. Cars to Come

Audi developed the car with help from Stanford University at Volkswagen's Electronics Research Lab. The developers have taken a ride in this car and can tell you it almost certainly drives at least as well as you do and probably better.



Volvo's long been interested in autonomous technology to improve safety. It started testing autonomous cars in 2011, and hopes to have self-driving cars capable of reaching 30 mph before long. It also has unveiled the Drive Me program, which promises to have 100 autonomous cars on the roads of Gothenburg by 2017.

Mercedes- Benz became the first motor manufacturer to demonstrate the feasibility of autonomous driving both on urban and inter-urban roads.

X. CONCLUSION

The autonomous cars have become a reality and will soon be the necessity of life by overcoming the current obstacles, as human life needs to be secured by safe, efficient, cost effective and comfortable means of transport.

REFERENCES

[1] Ashley, Steven. "Smart Cars and Automated Highways." Mechanical Engineering Magazine. May 1998. (Oct. 2, 2013) http://www.memagazine.org/backissues/membersonly/may98/features/smarter/smarter.html

[2] Del-Colle, Andrew. "The 12 Most Important Questions About Self-Driving Cars." Popular Mechanics. (Oct. 8, 2013) http://www.popularmechanics.com/cars/news/industry/the-12-most-important-questions-about-self-driving-cars-16016418

[3] Fischer, Adam. "Inside Google's Quest to Popularize Self-Driving Cars." Popular Science. Sept. 19, 2013. (Oct. 2, 2013) http://www.popsci.com/cars/article/2013-09/google-self-driving-car

[4] Greene, Kate. "Stanford's New Driverless Car." Technology Review. June 15, 2007. (Oct. 2, 2013) http://www.technologyreview.com/news/408059/stanfords-new-driverless-car/

[5] Markoff, John. "At High Speed, on the Road to a Driverless Future." The New York Times. May 27, 2013. (Oct. 2, 2013) http://www.nytimes.com/2013/05/28/science/on-the-road-in-mobileyes-self-driving-car.html

[6] Tierney, John. "In the Future, Smart People Will Let Their Cars Take Control." The New York Times. Dec. 4, 2007. (Oct. 2, 2013) Audi annual report Mercedes- Benz reports

[7] Trillan, Calvin. "Park, He Said." The New York Times. Jan. 26, 2007. (Oct. 2, 2013)

[8] The New York Times, 26th January'2007.