Fancy A Car Driving You Around?

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IMAGINE sitting inside your car, sipping a cup of tea and reading the morning newspaper, while your car drives you to your office...all by itself without any human interference. Driverless or self-driving cars are already here – being tested by companies round the world.

The car would have the capability to drive its passenger by automatic means through pre-set commands or self-instructional inputs. Technology pundits consider them as a paradigm shift in the human-automobile relationship. When fully operational, they are set to become the game-changer, revolutionising the way we drive and commute.

Within just a few years, these autonomous cars have become a reality, emerging out of the realms of science fiction. It is now predicted that the fully automatic or self-driving vehicles will hit the market between 2020 and 2025.

Driverless cars or self-driving vehicles are based on a very simple concept. The automobiles run either on their own with preset commands or with the partial intervention of a person sitting inside. A self-driving car, also called a driverless car or autonomous car, is a vehicle that is capable of sensing its environment and navigating without human input and hence designed to travel between destinations without a human operator or driver.

While it may seem that the technology emerged all of a sudden, the path of self-driving vehicles has taken a lot longer time than most of us think. The journey began in 1925 when Francis Houdina demonstrated the first radio-controlled car driving through the streets of Manhattan in the USA. Today, major giants round the world, including Google, Honda, General Motors and many other car manufacturers have jumped on to the bandwagon.


(Source: Wikimedia)

The Technology

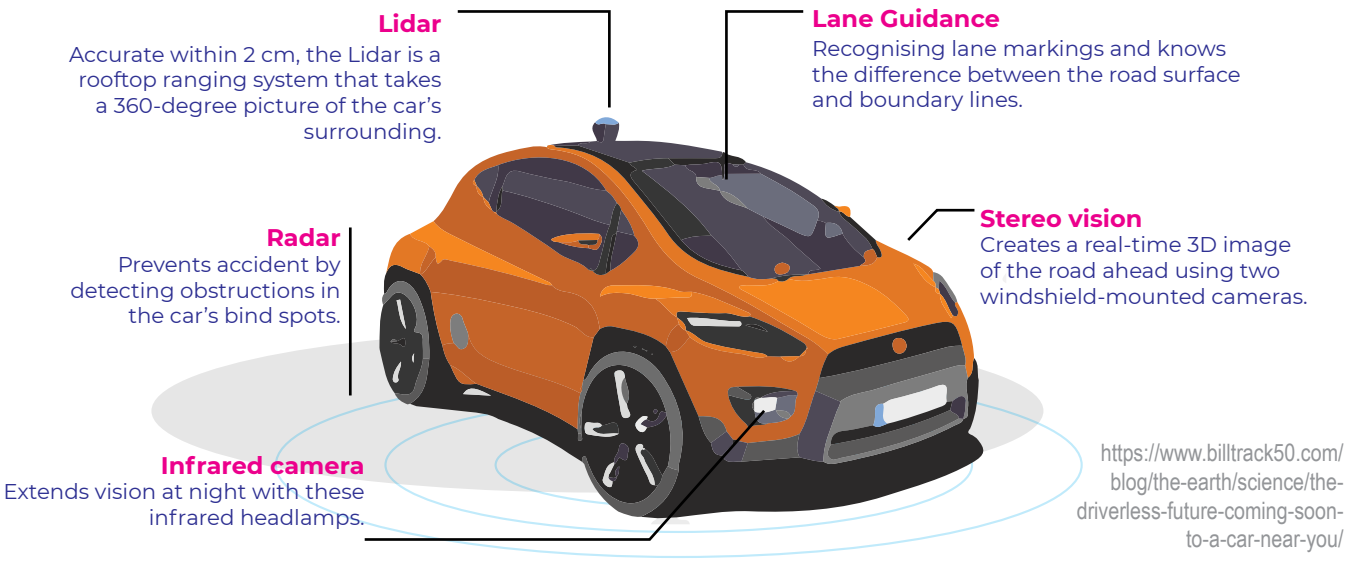
All self-driving cars typically involve the same basic principle of operation. The driver or passenger sets a destination. The car's software calculates the route and starts the car on its way. Although the basic principle is the same across the spectrum, different cars may differ in individual technologies incorporated into them.

A typical self-driving car functions in the following manner. After the driver sets the destination and the car starts, a rotating sensor mounted on the roof and other sensors attached elsewhere get activated. Sensors generally consist of technologies like Laser, Radar and camera images.

One such sensor technology used in self-driving cars is LIDAR (Light Detection and Ranging). The LIDAR system maps the objects around the car in 3D and accurately pinpoints the car's location, which helps it create a picture of the car's surroundings. Another technology used in self-driving cars is GPU (Graphics Processing Units), which interprets visual data coming from the sensors so fast, that there is no lag and response is in real time.

Sensors play an inevitable role in the functioning of self-driving cars. The cars cannot run without the sensors.

Driverless Car Features



https://www.billtrack50.com/blog/the-earth/science/the-driverless-future-coming-soon-to-a-car-near-you/

It is these sensors that give the car the sense and feel of the external surroundings. They act as the eyes of such cars.

A sensor on the left rear wheel monitors sideways movement. Radar sensor systems on the front and back calculate distances to the obstacles. Artificial intelligence software in the car is connected to all the sensors and also to Google Street View. This software consults satellite and GPS based maps (e.g., Google Maps) for advance notice of objects, landmarks and traffic signals.

This way data is fed into the car's control system, which determines the next move. The software in the car's control system, acts like a human brain and processes information coming from the sensors. The sensors are calibrated for automatic reduction of noise, so that unimportant information is ignored. It takes decisions and thus controls actions in driver-control systems by giving instant commands to steering and breaks. This process is repeated constantly in a loop multiple times per second till the car reaches its final destination. There is an override function that allows humans to take control of the vehicle at any moment during the journey.

The car's control system, which generally contains Artificial Intelligence (AI) based software, maintains an internal map of the car's environment and uses this map to decide which path is best among the few choices to reach the destination. This decision is broken into multiple commands. Finally, the commands are sent to the car's actuator which controls the car's steering, braking, etc.

So, this AI-based software, which forms a primary part of the car control system and is capable of handling fuzzy logic system, plays a key role in three main functional areas of the car – perception, planning, and control.

Types of Self-driving Cars

Society of Automotive Engineers (SAE) International, an automotive standardisation body, has given a classification for automotive vehicles. This classification, which ranges from "no automation" to "full automation", has six levels or categories (also known as key stages of the self-driving technology), based on the amount of the driver's intervention and attentiveness required, to effectually and fully drive the vehicle.

The classification or levels, also known as "SAE Autonomy Scale", is used by the auto industry as a standard for determining different levels of autonomous capabilities.

Although the technology is being fast developed by renowned automobile and some of the biggest companies of the world and governments in many countries are devising laws for the governance of these self-driving vehicles, the technology is not without its share of concerns. There are both pros and cons of this technology.

Advocates of this technology hope that:

- Driverless cars would either eliminate or decrease accidents caused by driver error and thus save thousands of lives and prevent even more number of injuries arising out of road accidents especially in countries like India and China, where thousands die every year in road related incidents.
- The greater precision of an automatic system would considerably improve traffic flow, which could ultimately increase road and highway capacity and reduce or eliminate traffic jams.
- The technology would allow car owners and commuters to do some extra work or job while travelling like reading, working or sleeping.
- This technology would ease the travel for physically disabled and old people.

Year	Breakthrough in Self-driving Cars
1925	In the USA, an inventor named Francis Houdina demonstrated a radio-controlled car, which he drove through the streets of Manhattan in the USA without anyone at the steering wheel. This radio-controlled car could start its engine, shift gear and also blow its horn.
1956	Car developed by General Motors called Firebird II equipped with receivers for detector circuits embedded in roadways.
1979	Cart developed at Stanford used video processing to navigate a cluttered room without human input.
1987	First self-driving car developed at Bundeswehr University Munich (Germany). This car used saccadic vision, probabilistic approaches and parallel computers for driving purposes.
1995	VaMP autonomous vehicle drives (almost) autonomously for 2,000 km.
2002	U.S. Department of Defense's research arm also known as DARPA announces Grand Challenge offering researchers from top research institutes of the world a $1 million prize, if they can build an autonomous vehicle that can navigate 142 miles through the Mojave Desert. The winner of this competition made it less than eight miles in several hours before the vehicle caught fire. This competition incentivised autonomous vehicle development.
2000-03	Self-parking technology emerged with Japan's Toyota's Prius hybrid offering parallel parking assistance in its cars. Later other car manufacturers followed this trend.
2009	Google's self-driving car project named 'Waymo' begins.
2013	Major automotive companies like General Motors, Ford, Mercedes Benz, BMW, and others announce that they are working on their own self-driving car technologies.
2014	Google reveals its prototype of a driverless car without any steering wheel, gas pedal and brake pedal, which in next two years drove for 2 million miles.
2016	Google's self-driving car has its first accident.
2017	Audi, a German car manufacturing company introduces A8 luxury sedan, the first car with SAE Level 3 autonomy.
2018	Nvidia announces a new self-driving car chip called Xavier that would incorporate artificial-intelligence capabilities into the operations of such vehicles.
2018	Various companies are testing their small fleets of self-driving vehicles on roads and highways.
2020	Expected release of Honda's near-fully autonomous vehicle.
2021	Scheduled release of BMW's iNEXT

Category or Level of Self-driving Vehicle	Characteristic Feature
Level Zero	No automation. Driver has full control over the vehicle. Automotive system issues only warnings and may sometimes intervene but has no sustained vehicle control.
Level 1 (or Hands On)	Limited driver control. Driver and automated system shares control over the vehicle. An example of this is Adaptive Cruise Control (ACC) where the driver controls steering, and the automated system controls speed.
Level 2 (or Hands Off)	The self-driving system takes control of the vehicle, viz., accelerating, applying brakes and operating steering. The driver only monitors the driving and intervenes only when the automated system faces any problem or fails to respond properly.
Level 3 (or Eyes Off)	The driver can safely turn attention away from the driving tasks, e.g., the driver can text or watch a movie. The vehicle can drive itself in certain situations like on divided highways. When in autonomous mode, human intervention is not needed, and the vehicle will handle situations that call for an immediate response, such as speed control, emergency braking. But the human driver should be ready to take over when the vehicle encounters any problem.
Level 4 (or Mind Off)	The attention of the driver is not required except in certain circumstances, for instance, the driver may safely go to sleep or leave the driver's seat. Human driver is needed to take over in certain situations, such as, during emergency.
Level 5 (or Steering Wheel Optional)	Fully autonomous. No human intervention is required at all under any circumstances, and the vehicle can drive itself at all times, under all circumstances. There is no manual control system in the car.

Skepticism too prevails regarding the efficiency and benefit of this technology. Skeptics of this technology raise some concerns regarding its efficiency and performance. Concerns related to self-driving cars include:

- Self-driving automobiles would leave a large number of jobs redundant and would thus pose a direct threat to driving jobs in the road transport industry.
- Safety concerns related to cyber security and loss of privacy. According to some analysts, this technology would be prone to hackers and cyber terrorists. Such concerns are due to the fact that autonomous vehicles for the first time would be directly using IT networks like Internet thus allowing access to the computer-based operations.
- In case an accident occurs where a self-driving car is directly involved, who would be held legally responsible for it. In July 2016, an American man using the Tesla Autopilot feature on a highway in Florida died when his car banged into a white truck.

Source: Google images

"Harry" the driverless vehicle is zipping around Greenwich as 10 mph

(Source: The Gateway Project)

The inside of a Tesla driverless car.

(Source: News Corp Australia)

Current Scenario

The possibility of self-driving vehicles landing on our roads looks quite bright in the near future. And the reason for this optimism is the active involvement and interest of major car manufacturing and technology companies of the world.

Some of the world's biggest companies are in the race for either manufacturing or testing self-driving automobiles on roads, to achieve market leadership in this area. Prominent among them being Audi, BMW, Ford, General Motors, Volkswagen, Volvo, Google, Apple, and Uber. The DRIVEN group consortium of British technological companies is pioneering research in self-driving or autonomous cars.

General Motors plans to develop autonomous controls in the Bolt and Super Cruise in the Cadillac CT6. Volvo also plans to launch self-driving vehicles to customers by 2021. Honda plans to release fully autonomous vehicles by 2020 and by 2021 BMW expects to release its fully self-driving car iNEXT.

Tesla, a US based company, is emerging as a world leader in self-driving car manufacturing. The company claims that all its vehicles have necessary hardware needed for full self-driving capability. It claims to have an advanced sensor coverage that includes eight surround cameras and twelve ultrasonic sensors, which provide the vehicle 360 degrees of visibility around the car up to 250 meters of range and detection of both hard and soft objects.

The US, UK, and Germany are leading the way in autonomous cars. Currently, driverless car testing is taking place in small urban areas of UK, USA, Japan and Germany. The trials are examining the effectiveness of connecting cars to each other, traffic lights and other things around on roads as well as to advanced information systems such as emergency vehicle warnings.

In the UK, the country's largest autonomous car trials have been taking place on public roads since 2017 under which companies like Jaguar Land Rover, Ford and the Tata Motors European Technical Centre (TMETC) are sharing their findings. Such trials are aimed at testing autonomous vehicle technology, using specially adapted, and GPS connected vehicles that have a capability of self-driving.

Similarly, Google's Waymo started testing trials on public roads in 2017 in USA. China too has recently allowed road tests of such autonomous vehicles, with Beijing becoming the first city to allow companies to try out the technology on its streets.

Recently the U.S. House of Representatives unanimously passed an autonomous vehicles bill titled, 'Self Drive Act 2017' signaling broad support for this emerging technology. Similarly, other European countries such as Germany, the UK, etc. have passed legislation to govern self-driving cars.

Developing countries such as China and India are yet to catch up with the developed nations in self-driving technology, although some initiatives have already been started for developing this technology.

In India, researchers and engineers working at the Indian Institutes of Technology (IITs) in Kharagpur, Kanpur, and Bombay are working on 'autonomous vehicle solutions'. In addition, a few Indian car manufacturing companies like Tata Motors and Tech Mahindra have announced their plans to develop self-driving cars for Indian roads.

But there is a lot that still needs to be done. In India, before the government takes any decision on allowing self-driving cars on the roads, there is perhaps a need to enable the public road networks for self-driving cars – the relevant infrastructure needs to be developed across the country. Manufacturers also need to ensure that self-driving cars adopt energy-efficient technologies, e-mobility options, and affordable pricing in order to provide a seamless experience for the commuters.

For the moment, let's wait and watch as the driverless car scenario unfolds in the coming years.

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