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Autonomous VEHICLEs: A Perspective of Past and Future Trends

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ABSTRACT:

This paper provides an overview of the advancement in the automobile technology in the recent years for the society. We have come a long way from development of the manual zero automation vehicles to developing vehicles with smart systems. With technological advancement, automotive manufacturers are investing in development of smart cars, driverless processes, pre-collision technologies that deliver fuel-efficient and safe mobility solutions. Companies such as Ford, Mercedes and Tesla are front runners to build autonomous vehicles for a drastically changing consumer world

The main cause of most vehicular accidents today is driver error. Alcohol, drugs, speeding, aggressive driving,inexperience, slow reaction time and ignoring road conditions are the major factors. Hence it has become a necessity to use artificial intelligence to avoid accidents, have safer and smarter modes of transport and there will be no loss of life and property.With the rise of technological giants like TESLA and GOOGLE, the research in the field of intelligent cars has increased multifold in the past decade. We have now been able to produce cars which use intelligent systems that control the vehicle and the driver monitors the vehicle operation. With further advancement in ARTIFICIAL INTELLIGENCE it will be possible to manufacture a fully autonomous driverless smart car which can be used under all road and environmental conditions. In this paper there is an overview of the various levels of vehicle autonomy achieved through the years that have built the foundation for the cars of the future.

Keywords : AI, Vehicle, Smart Systems, Automation, Autonomous Vehicles

INTRODUCTION:

Artificial Intelligence is the future of all the technological advancements. Artificial Intelligence or AI will eradicate all the human errors and hence can be used in a variety of applications. With the increase in the number of accidents which are mainly caused by human errors over the past couple of decades it has now become a necessity to introduce AI to the field of automobile and transportation for safer and smarter ways of transportation. Hence there has been a lot of research carried out in the field of vehicular automation and then using it for the road conditions.

The use of technology can be witnessed in all applications of life, be it monitoring the household appliances to controlling space shuttles. The time spent in commutation is now treated as valuable time and hence the trend to control/reduce it using smartphones rather than manually. So it has become a necessity to use the Internet of Things (IOT) even in the automobiles. Since the launch of smartphones, consumers have been anticipating smart cars. In June 2014, Google launched its telematics software **"Android Auto"** by which the passenger can connect his smartphone to the car's dashboard which offers the driver control over GPS mapping/navigation, music playback, SMS, telephony, web search, weather and various other applications. Apple also became a part of this journey in the year 2014 with the announcement and launch of its software **"CarPlay"** which allows devices running on the iOS operating system to function with built-in display units for automotive dashboards. Car manufacturers have shown a keen interest in installing such device in their cars in order to attract customers and meet the demand.

However to develop driverless cars a lot of research has to be carried out and it is a necessity to ensure that there are no errors in the system and the Artificial Intelligence can handle all the different on-road and

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extreme environmental conditions to ensure a safe and pleasant journey for the passengers. There has been path breaking research carried out in the field of vehicle automation since the early 1950's and now the future driverless cars which seemed impossible to develop are a possibility by the end of the next decade.

In this paper, we discuss the evolution of the vehicular automation, the various technologies which build the foundation for the driverless cars. Vehicular automation traces back its history centuries before the invention of the automobile. Leonardo da Vinci designed a cart that could move without being pushed or pulled. Springs under high tension provided the power to the cart, and steering could be set in advance so the cart could move along a determined path. A distant ancestor to the car, the device is sometimes considered the world's first robot. The modern day automation is discussed below.

TEETOR CRUISE CONTROL (1945):

Cruise control takes over the throttle of a vehicle to maintain a steady speed that the driver sets. Cruise control adjusts a car's speed by adjusting the throttle position. But it does this by actuating the throttle valve by a cable connected to an actuator rather than pressing a pedal. Drivers can set the cruise control with switches marked as ON, OFF, RESUME, SET, ACCEL, and COAST. Cruise control devices also allow you to accelerate or decelerate by one mph with just the tap of a button and are designed to disengage as soon as you press the brake pedal.

It was in the year 1945 that the cruise control system was presented to the world. It was RalphTeetor, a blind man, who brought about this very first change in vehicular automation as he was fed up with his lawyer who had a tendency to slow down the vehicle while talking and speed up while listening. This irritatedTeetor and hence he decided to come up with a device to control the speed of the car automatically. After several years of thinking and researching he filed his first patent for a device which we call cruise control in 1948. (US 2519859).

The throttle was controlled by a bi-directional screw drive electric motor, the two were connected during use by an electro magnet. A 12v post would stay nearly centered between two throttle mounted electric contacts, one for turning the motor's screw for more throttle, the other for less. The floating post would "guide" the motor (and throttle and vehicle speed) with input from 1) sprung leveraged spinning weights driven from the transmission's speedometer cable, and 2) a counter-spring tension set by a cable from a dial near the steering wheel. This was commercially introduced by Chrysler in the year 1958.

STANDFORD CART (1961):

The Stanford Cart was originally constructed by Mechanical Engineering (ME) graduate student James L. Adams to support his research on the problem of controlling a remote vehicle using video information. It was basically constructed so that someone on earth could drive around the Moon using a TV camera on a vehicle and a radio control link. However Adams displayed that assumption was not right.

(Source: http://www.computerhistory.org/revolution/artificial-intelligence-robotics/13/293/1277)

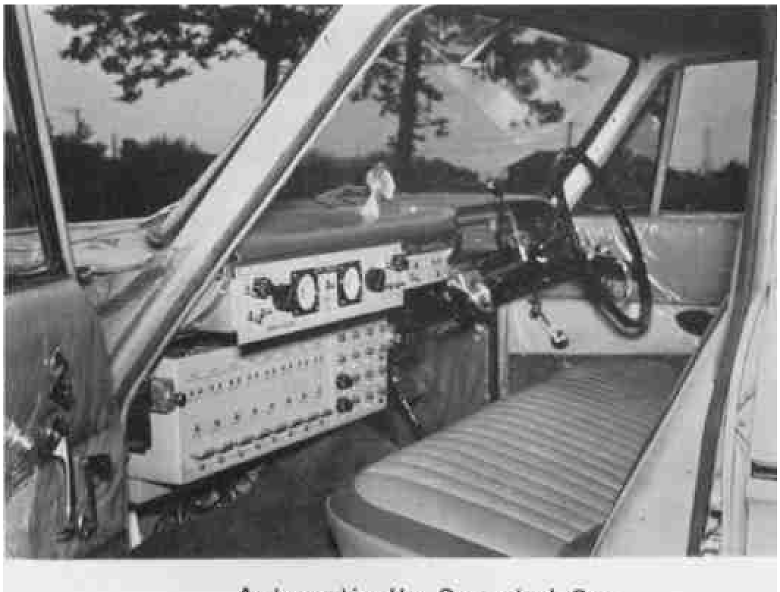
The Cart had four small bicycle wheels with electric motors powered by a car battery and carried a television camera with a fixed view in the forward direction. Tests were conducted using both 2-wheel steering, like a car, and 4-wheel steering, in which the wheels and television camera swivel together. The cart was connected by a very long cable to a control console with a television display and controls for steering and speed. A magnetic tape loop made it possible to vary the time delay of steering commands, to simulate communication delays.

Adams explored the controllability of the vehicle while avoiding obstacles with various combinations of communication delay and speed. When steering commands are delayed by communications there is a tendency for the machinist to over-steer and lose control. He also showed in his dissertation that with a communication delay corresponding to the round trip to the Moon (about 2 1/2 seconds) the vehicle could not be consistently controlled if it was traveling faster than about 0.2 mph (0.3 kph).

The most important part of this juncture was the use of onboard sensors and cameras. Even in today's technology using cameras remain a vital element in autonomous vehicles.

Tsukuba Mechanical Engineering (1977):

The first really autonomous car was developed by S. Tsugawa and his colleagues in Japan in 1977 at Tsukuba Mechanical Engineering Laboratory. This vehicle could process images of the road ahead and it could drive by itself. It carried two cameras and used analog computer technology for signal processing. It could recognize white street markings and even travel at the speed of 20 miles per hour (33 kmph). It was aided with elevated rails and was tested for dedicated circuits.



Automatically Operated Car

(Source: http://www.computerhistory.org/atchm/where-to-a-history-of-autonomous-vehicles/)

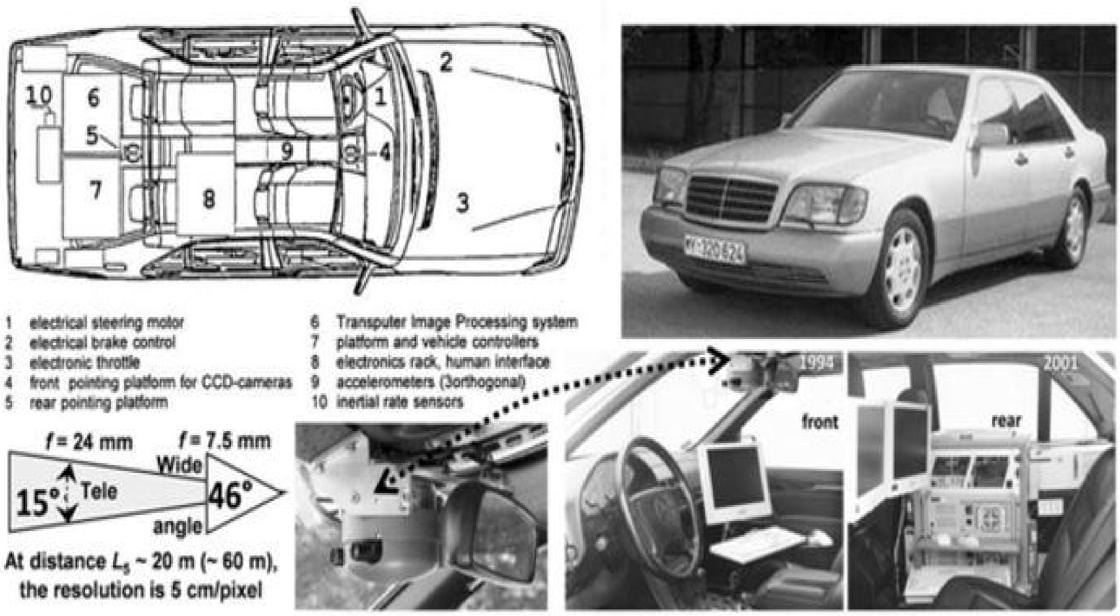
This development in the field of vehicular automation truly marked the beginning of the concept of self-driving cars. Many automobile giants then started taking efforts to build autonomous vehicles. This marked the beginning of the new era in VEHICULAR AUTOMATION.

VaMoRs (1987):

This innovation brought about by a German Engineer named ERNST DICKMANNS introduced the concept of DYNAMIC VISION. The dynamic vision allowed the imaging system to filter the external 'NOISE' and focus only on the relevant objects. It was a part of the PROMETHEUS PROJECT.

*PROMETHEUS PROJECT(**PRO**gra**M**me for a **E**uropean **T**raffic of **H**ighest **E**fficiency and **U**nprecedented **S**afety*, 1987-1995) :PROMETHEUS aims to create concepts and solutions foraroadtraffic system which is more efficient and less detrimental to the environment and guarantees an unprecedented degree of safety. The aim is to remedy the deficiencies of ourpresent road traffic system by developing new informationcontrol and management systems. Plans have been made for the use of technological developments in the fields of microelectronics and information processing as well asartificial intelligence. Thus, European Government programmes on traffic research will be supplemented andenhanced by the motorcar industry, which will engage in vehicle development and promote the sector ofmicroelectronics as the technological basis forapplications in vehicle design and transport technology, bycooperating closely with relevant research institutions.

DICKMANNS equipped a sedan MERCEDES 500 SEL with cameras on both the front and rear and 60 micro processing modules to detect objects on the road.A passenger car Mercedes 500 SEL has been equipped with vision in the framework of the EUREKA-project 'Prometheus III'. Road and object recognition is performed both in a forward as well as in the backward region; this allows an internal servo-maintained representation of the entire situation around the vehicle using the 4D approach to dynamic machine vision. The steering, throttle and brakes were controlled through computer commands based on a real-time evaluation of image sequences caught by four cameras with different focal lengths for each hemisphere. Obstacles are detected and tracked both in the forward and in the backward viewing range up to about 100 meters distance; depending on the computing power available for this purpose up to 4 or 5 objects may be tracked in parallel in each hemisphere. A fixation type viewing direction control with the capability of saccadic shifts of viewing direction for attention focussing has been developed. The overall system comprises about 60 transputers of T-222 and T-800. Beside a PC as transputer host all other processors in VaMoRs-P are transputers.



(source: https://www.lifehacker.com.au/2016/02/creator-of-the-worlds-first-self-driving-cars-ernst-dickmanns/)

During the Prometheus project Mercedes-Benz made a number of driverless prototypes that culminated with a re-engineered W140 S-Class that technically drove almost entirely by itself over 1,678 kilometers (1,043 miles) from Munich to Copenhagen in 1995.

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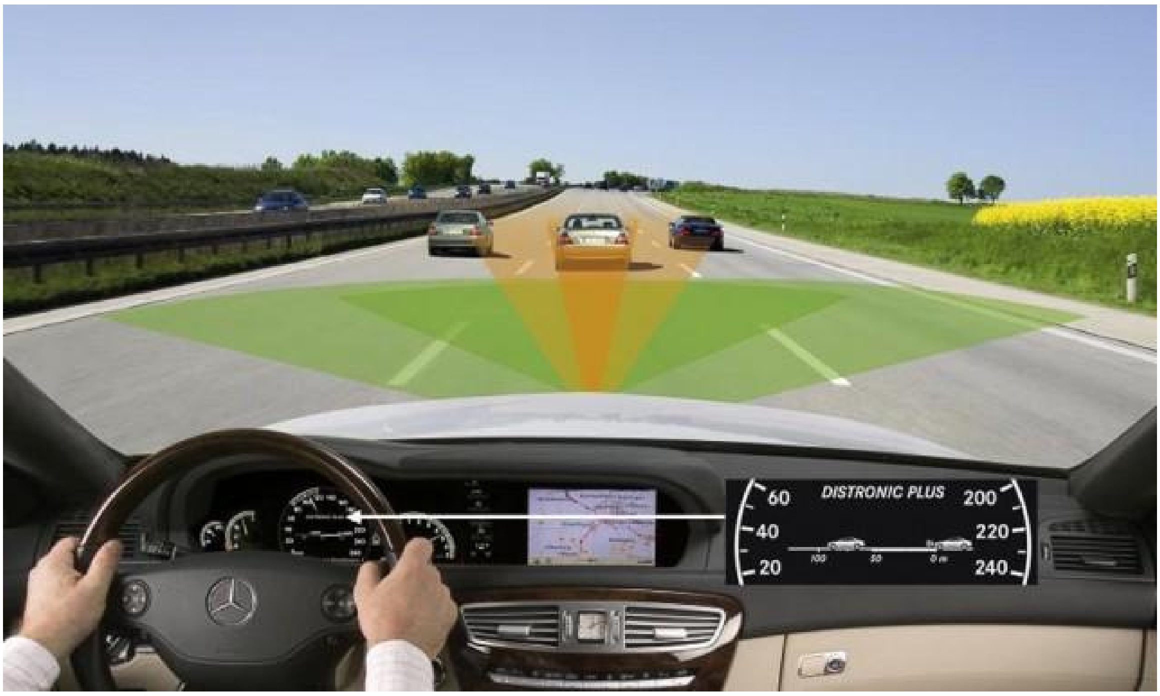
ADAPTIVE CRUISE CONTROL SYSTEMS (1992- Present):

Adaptive cruise control system speeds up the car and slows it down to maintain a present distance to the vehicle in front. The driver sets the maximum speed and a radar sensor is used to monitor the traffic ahead. The sensor then locks on to the car in its specific lane and keeps the car in lane with the car ahead of it as per the follow distance set by the driver. Adaptive Cruise Control is now almost always paired with a pre-crash system that alerts you and often begins braking. Adaptive cruise control is also called active cruise control, autonomous cruise control, intelligent cruise control, or radar cruise control. Because distance is measured by a small radar unit behind the front grille or under the bumper. Some units employ a laser as well.



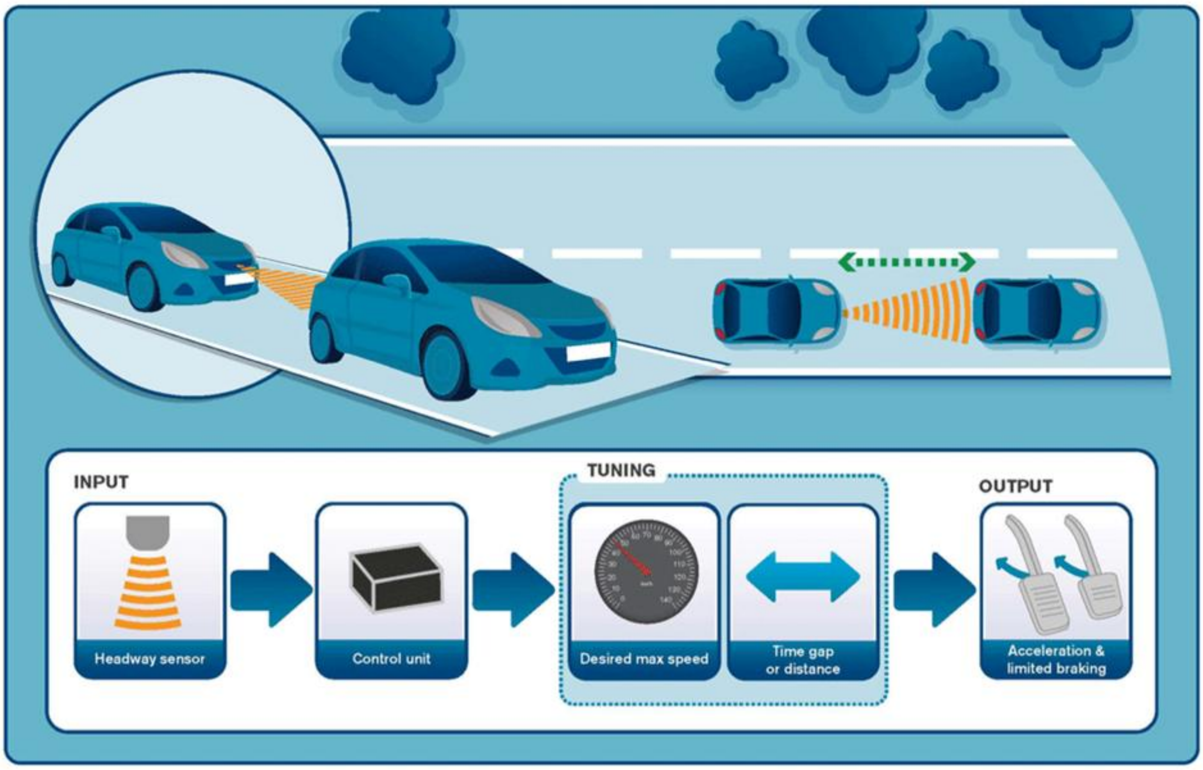
(Source: https://www.extremetech.com/extreme/157172-what-is-adaptive-cruise-control-and-how-does-it-work)

Radar based Adaptive Cruise Control was first commercially introduced by JAGUAR in the year 1999. Before it many other automobile companies introduced the concept of speed control by throttle control or downshifting of gears but not by applying the brakes. In 1992 MITSUBISHI first offered a LI-DAR (Light Detection and ranging) based distance monitoring system on the model DEBONAIR, which warned the driver about the distance of the preceding vehicle. In 1995; Mitsubishi Diamante introduced laser **Preview Distance Control**. This early system controlled speed through throttle control and downshifting, not by applying the brakes.

In 1997 Toyota offered a "laser adaptive cruise control" (lidar) system on the Japanese market Celsior. The speed was controlled through throttle control and downshifting and not by applying the brakes.

The main drawback of the ACC is that its abilities are hampered by heavy rain, fog, or snow. ACC is a crucial part of the self-driving cars of the near future. On an autonomous driving car, ACC needs to track the car in front but also cars in adjacent lens in case a lane change becomes necessary. Adaptive cruise control is typically paired with forward collision warning that functions even if you don’t have ACC engaged. When ACC is engaged, the car will typically slow under ACC braking at up to half its maximum braking potential. Even when the ACC isn’t turned ON, it’s still tracking traffic in front and intervenes with the warnings if it senses a potential accident.

ACC Adaptive Cruise Control



(Source: http://dropitanddrive.com/2016/08/02/how-does-adaptive-cruise-control-work/)

DARPA CHALLENGES (2004-2013):

The Defense Advanced Research Projects Agency (DARPA) is a part of the U.S. Department of Defense responsible for the research and development of emerging technologies for use by the U.S military. DARPA Challenges are one of the major reasons the development of the autonomous vehicles has gained momentum in the last decade. In 2004, a competition was held to challenge vehicles to self-navigate 150 miles of desert roadway for a $1 million prize. No car completed the challenge in the year but it was a pioneer event that tried to bring autonomous vehicles into the main frame. In the year 2007, the DARPA changed the challenges and the competing environment was changed to match the urban environment. The challenge of the year 2007 simulated a 60-mile long urban environment, in which four cars completed the route in the allotted six-hour time limit. The factors that made the difference were better software for road-following and collision avoidance, and improved radar and laser sensors. DARPA's "Urban Challenge" of the year 2007 was won by Carnegie Mellon University. Sensor systems became more elegant and semi-autonomous facilities began to hit the mainstream with manufacturers from Audi, Volvo, GM and Mercedes incorporating features like collision avoidance, lane recognition, and driver attention assist into their new vehicle lines

SELF DRIVING CARS TODAY:

Like many emerging technologies, autonomous vehicles have found uses in specialized applications long before reaching the general public. In the mines of northern Australia, trucks the size of a spacious house rumble over gravel roads without a human contact. Combine harvesters and other farm vehicles are

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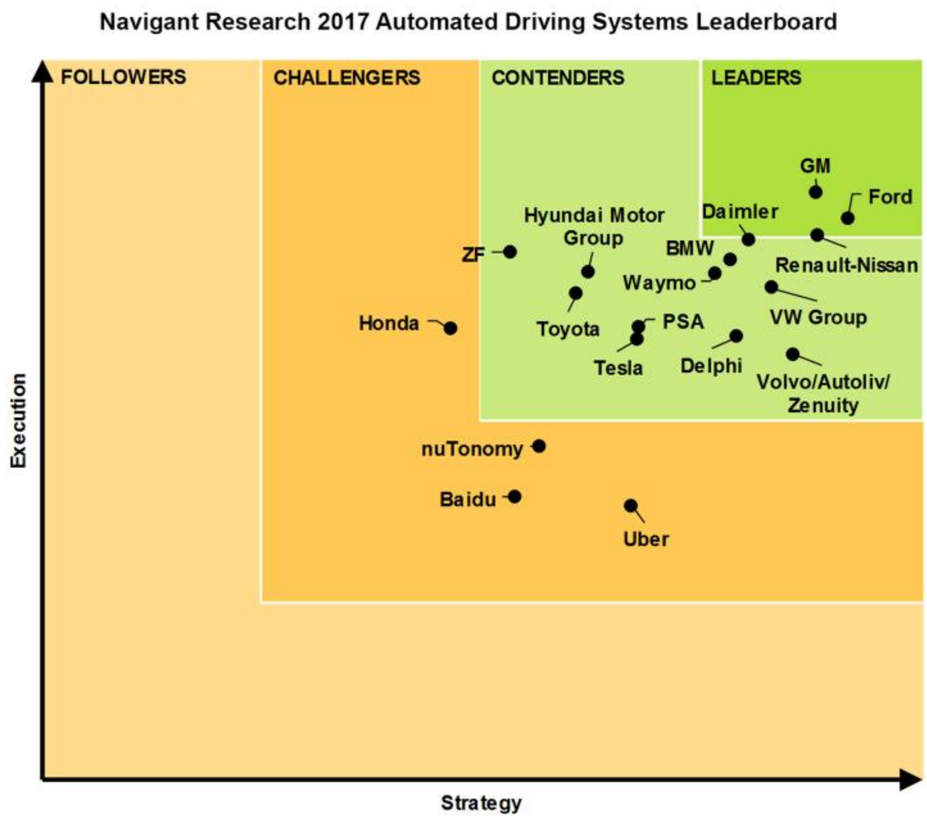
increasingly equipped with self-driving capabilities, as are specialized vehicles in warehouses, factories, storehouses and other industrial environments.

Many companies and startups alike are all working for achieving the dream of driverless cars. The front runners in the race for the car are automobile giants like General motors, BMW, Ford motors etc. Google and Uber are also amongst the front runners for the development of the self-driving cars and have successfully tested their products on a small scale level.

Volvo is aiming to make its cars "deathproof" by 2020 by rolling out semi-autonomous features in its cars, ultimately working up to fully driverless ones. Google is aiming to launch its self-driving car WAYMO by 2020. Toyota is eyeing to have a driverless car ready to go by 2020. BMW plans to introduce its self-driving cars in China in 2021. The race to build the fully autonomous vehicle has reached a new level and there have been drastic changes in the technological advancements since.



(Source: http://www.businessinsider.in/RANKED-The-18-companies-most-likely-to-get-self-driving-cars-on-the-road-first/articleshow/57996776.cms)

Conclusion:

It’s worth questioning whether human resistance will initially prevent driverless cars from gaining traction with the masses but it will surely change the transportation scenario. It might be some time before we make driverless cars a normal part of our lives.

It has been quite some time since the development for the self-driving cars technology and there is possibility that we will have self-driving cars on the roads by the end of this decade. This idea of autonomous vehicles is going to cause big ripples in the way we live our lives. It is going to change the transportation scenario and most likely will lead to safer road environments.

REFERENCES:

- Seif, H.G. and Hu, X., 2016. Autonomous Driving in the iCity—HD Maps as a Key Challenge of the Automotive Industry. Engineering, 2(2), pp.159-162.
- Abdulkhaleq, A., Lammering, D., Wagner, S., Röder, J., Balbierer, N., Ramsauer, L., Raste, T. and Boehmert, H., 2017. A Systematic Approach Based on STPA for Developing a Dependable Architecture for Fully Automated Driving Vehicles. Procedia Engineering, 179, pp.41-51.
- Gora, P. and Rüb, I., 2016. Traffic models for self-driving connected cars. Transportation Research Procedia, 14, pp.2207-2216
- Martinez, L.M. and Viegas, J.M., 2017. Assessing the impacts of deploying a shared self-driving urban mobility system: An agent-based model applied to the city of Lisbon, Portugal. International Journal of Transportation Science and Technology, 6(1), pp.13-27.
- https://www.wired.com/brandlab/2016/03/a-brief-history-of-autonomous-vehicle-technology/
- http://www.autobytel.com/car-ownership/advice/10-benefits-of-self-driving-cars-121032/
- https://en.wikipedia.org/wiki/Android_Auto
- http://www.todayifoundout.com/index.php/2014/11/blind-man-created-cruise-control/
- http://blog.americansafetycouncil.com/history-of-cruise-control/
- https://en.wikipedia.org/wiki/Ralph_Teetor
- http://web.stanford.edu/~learnest/cart.htm
- http://audiotech.com/trends-magazine/the-future-of-the-self-driving-automobile/
- http://www.mikechiafulio.com/RIDE/history.htm
- http://jalopnik.com/the-fascination-with-self-driving-cars-started-nearly-1-1782241743
- http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=981672
- http://www.eurekanetwork.org/project/id/45
- https://www.autoevolution.com/news/a-short-history-of-mercedes-benz-autonomous-driving-technology-68148.html
- http://ieeexplore.ieee.org/document/639472/
- http://www.businessinsider.in/RANKED-The-18-companies-most-likely-to-get-self-driving-cars-on-the-road-first/articleshow/57996776.cms