

## SCITECH PATENT ART SERVICES

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At least one headline, either in newspapers or news channels, is often packed with stories of self-driving vehicles. Driverless cars, as most of us know, have also sparked Hollywood's imagination for the last few decades. Nevertheless, the concept of autonomous vehicles is not entirely new. As early as 1925 itself, Houdina Radio Control demonstrated a radio-controlled driverless car, "Linrrican Wonder" on New York City streets, traveling up Broadway and down Fifth Avenue through the thick of the traffic. However, more recent years have seen significant progress towards the goal of autonomous and unmanned vehicles; these vehicles are equipped with a vast variety of technologies, including but not limited to increasingly sophisticated artificial intelligence (AI) and capabilities of robotics. These technological advancements allow society to fundamentally reconsider the vehicles available to users and the infrastructure that they are part of.

Research on autonomous vehicles in countries like the United States, Europe and Japan is now accelerating; these countries have now even begun testing prototypes of autonomous cars on public roads. The autonomous vehicle technologies are being incorporated in the vehicles, after steady research, and at a brisk pace, so as to enable these vehicles to arrive in the market quickly. While the use of autonomous vehicles provides benefits such as improved safety, reduced congestion and lower

stress for car occupants; challenges such as public's expectations regarding safety, legal responsibility and more importantly, privacy, need to be addressed.

### HISTORY OF AUTONOMOUS VEHICLES

The first known truly autonomous car — which could process images of the road ahead — was unveiled in 1977 by S. Tsugawa and his colleagues at Japan's Tsukuba Mechanical Engineering Laboratory. The first self-sufficient and truly autonomous cars appeared in the 1980s, with Carnegie Mellon University's Navlab and ALV projects in 1984, and Mercedes-Benz and Bundeswehr University Munich's Eureka Prometheus Project in 1987. However, limited research had been observed since, until 2005.

Many major automotive manufacturers; including General Motors, Ford, Mercedes Benz, Volkswagen, Audi, Nissan, Toyota, BMW and Volvo; have been testing driverless car systems. BMW in particular, has been testing driverless systems since around 2005; while in 2010, Audi sent a driverless Audi TTS to the top of Pike's Peak at close to race speeds. Available in 2013, the 2014 Mercedes S-Class has options for autonomous steering, lane keeping, acceleration/braking, parking, accident avoidance and driver fatigue detection; in both, city and

highway traffic speeds of up to 124 miles (200 km) per hour.

In April 2015, a car designed by Delphi Automotive became the first automated vehicle to complete a coast-to-coast journey across North America- it

traveled from San Francisco to New York, being under computer control for 99% of the total distance. The recent Model 3 announcement by Tesla took the industry by storm and saw Tesla collecting a whopping \$276 million in pre-orders in a matter of days.

## LEVELS OF AUTONOMOUS DRIVING

Level	Level of autonomy	Description	Existing examples, if any
0	Driver only	Vehicle is entirely under human control but may have some automated systems.	Cruise control, electronic stability control, anti-lock brakes Ex: 1972 Chevrolet Vega
1	Driver assistance	Steering and/or acceleration are automated but driver must control the other functions.	Adaptive cruise control: distance from car in front maintained. Parking assistance: steering is automated, driver controls accelerator and brakes. Ex: 1998 Mercedes S500
2	Partial autonomy	Driver does not control steering or acceleration but is expected to be attentive at all times and take back control instantaneously when required	Adaptive cruise control with lane keeping. Traffic jam assistance. Ex: 2016 Tesla Model S
3	High autonomy	Vehicles are able to operate autonomously for some portions of the journey. Reverting of control to human driver happens with some warning.	Prototype vehicles Ex: Google and Uber (expected by 2020).
4	Full autonomy	Vehicle is capable of driving unaided for the entire journey with absolutely no human intervention – potentially without a human in the car.	None.

Going from the driver performing every function and the car a few at level 1 is barely noticeable. But getting the current state of the art, high level 2, has taken decades - and gives us only a Tesla Model S that can drive itself with driver supervision, mainly on highways.

Low level 3 is the Google car, and it is still largely an experiment. Here, driver controls can theoretically be done away with, although some driver backup is preferred. On the other hand, we are just years away from seeing level 3 become widespread.

Full level 4 involves the car driving itself from point to point with zero human input. The technology required to execute this is now available, but the implementation is daunting, given the present automotive environment. Hence, it will likely be decades before level 4 arrives.

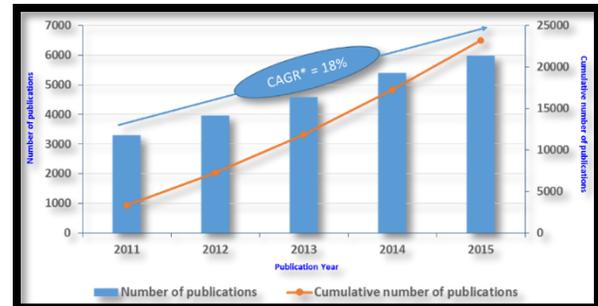
## What's happening now?

The automobile manufacturing industry is aiming for a completely autonomous car by the end of the next decade, in the wake of availability of technologies like GPS, Radar & LiDAR, IR and ultrasonic sensors, odometry, computer vision and many more, which will be used in the driverless vehicles. Automation software has been developed for autonomous vehicles, which includes software for parking assist, intelligent cruise control, lane guidance, blind-spot sensors, emergency breaking, collision avoidance and traffic jam assist. Apart from this, artificial intelligence (AI) is being integrated within the autonomous vehicles to make them more technologically advanced.

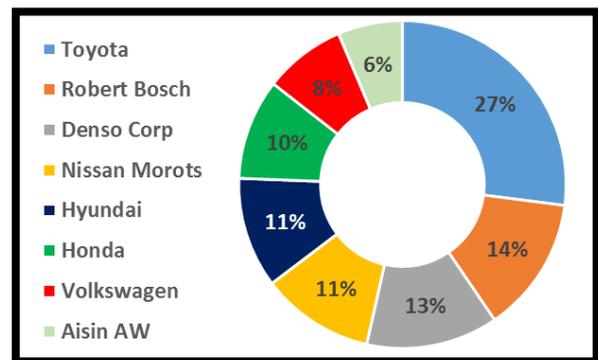
More self-driving features are incorporated in the vehicles manufactured by General Motors, Audi, BMW, Mercedes, Nissan and Tesla, with an intention to have self-driving capabilities up to 90% in their 2017 models. However, these self-driving features are mostly related to use of Advanced Driver Assist Systems (ADAS), in comparison to fully autonomous driving. On the other hand, automobile users are likely to see this transition accelerated.

## A glance at the patents:

There is much more happening in the area of patents when compared to the development of autonomous vehicles. Several companies even from outside the automotive industry are actively filing patents in the technologies that are found to be useful in autonomous vehicles. The patent filing trend in this area is increasing with a compound annual growth rate (CAGR) of 18% per year.



Toyota, Denso and Nissan are the leading automotive companies in patent filings in autonomous vehicle technologies. There are other non-automotive companies, such as Robert Bosch, who are working on technologies that can be implemented in autonomous vehicles.



## CONCLUSION

- Semi-self-driving cars are already on the road. Many have tried out Tesla equipped with Autopilot and advanced cruise-control features in a variety of cars. As a result, many experts now think that autonomous vehicles may be in the market sooner than anticipated. But fully autonomous vehicles could still take a while.
- On the other hand, the use of technologies like laser mapping systems, sensors to read terrain, V2V communication, etc., are being extensively used in autonomous vehicles. There are several companies from outside the core automotive industry that are getting involved or are already active.
- It is worth learning about the different technologies used in autonomous vehicle manufacturing and also knowing about the companies that are from outside the automotive industry.

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### REFERENCES:

1. <http://www.oecd-ilibrary.org/content/workingpaper/51lwvzdfk640-en>
2. <http://www.businessinsider.in/Self-driving-cars-arent-as-autonomous-as-you-think/articleshow/51786898.cms>
3. <http://www.geospatialworld.net/article/autonomous-cars-the-most-disruptive-innovation-ever/>
4. <http://www.mojomotors.com/blog/7-companies-to-launch-driverless-cars-by-2020/>
- 5.