

Driverless Cars: Coming to Your Street Sooner Than You Think



In just one generation of drivers, the experience of driving a car has evolved dramatically. A typical economy-class car now includes such *standard* features as automatic transmission, power windows, and cruise control. Higher-end models offer intelligent transportation systems, such as enhanced cruise control and self-parking technology. According to *Businessweek*,¹ the demand for such intelligent transportation systems has grown into a \$48 billion

industry in the U.S.

But while all of those improvements make driving easier than ever, they are designed with *human* drivers in mind. By the end of this decade, that will begin to change, and we'll witness the biggest change in personal transportation since the Model T replaced the carriage horse. Thanks to the rapid acceleration of technological progress, cars will begin



All of the major automotive firms are actively involved in the development of driverless vehicles. This is an example of a driverless research vehicle being tested by General Motors.

to drive themselves.

At *Trends*, we've been following the progress of this technology for more than a decade. We're now pleased to report that all of the necessary trends — in demographics, psychology, and technology — are finally converging to make driverless cars a reality:

- First, demographic trends support the need for autonomous vehicles. The aging of the population is increasing the demand for cars that will enable drivers with weakened eyesight and slower reflexes to remain both mobile and independent. At the other end of the age spectrum, young people are increasingly reluctant to drive. According to the *National Household Travel Survey*, the number of vehicle miles traveled by Americans aged 16 to 34 dropped 23 percent during the past decade.²
- Second, consumers of all ages are increasingly becoming prepared psychologically to cede control of the steering wheel. Self-parking technology, crash-avoidance systems, and telematics have

made consumers comfortable with intelligent transportation systems.

- Third, the key supporting technologies of a driverless car system are now in place. The “Internet of things” and improved GPS technology have paved the way for vehicles that know exactly where they are and can report their status to other vehicles around them. Enormous geographic databases such as Google Maps and its “StreetView” feature enable vehicles to recognize landmarks and synchronize them with GPS data. The relentless advance of Moore’s law has made the necessary computing power available at very low cost. Wireless communication infrastructure has made instant access to databases and sensor networks shared between multiple vehicles a cost-effective reality.

With all of these forces in favor of the new paradigm, the automobile manufacturers are fast-tracking the development of their autonomous car programs. Among the companies that are known to be working on driverless cars are Ford, Volkswagen, BMW,

Google's Driverless Car Uses a Wide Range of Sensors

VIDEO CAMERA

Mounted near the rear-view mirror, the camera detects traffic lights and any moving objects.

LIDAR

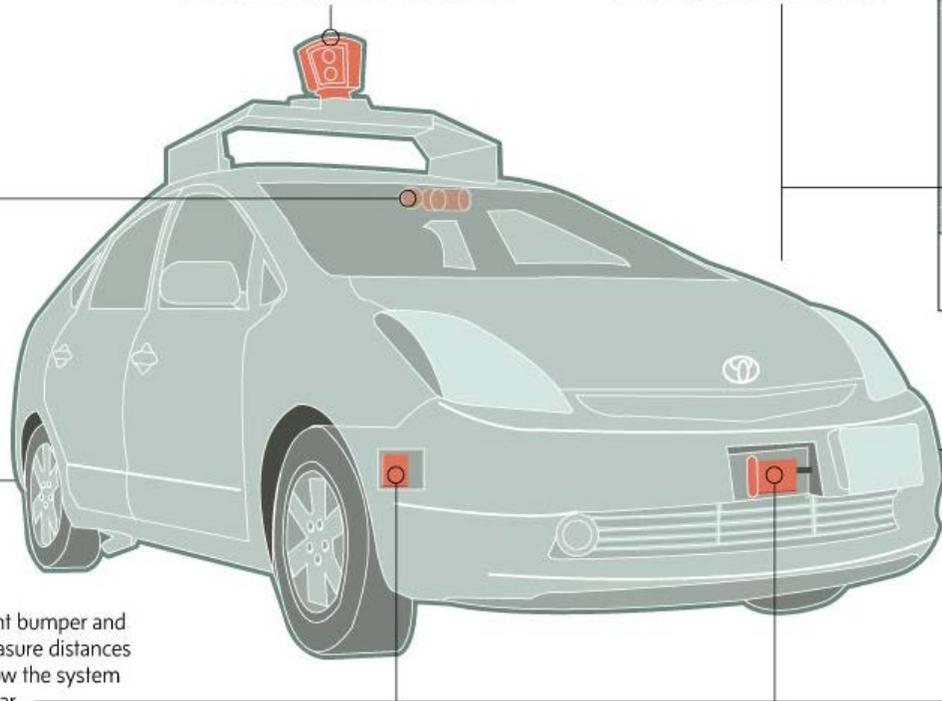
A rotating sensor on the roof scans the area in a radius of 60 metres for creation of a dynamic, three-dimensional map of the environment.

POSITION ESTIMATOR

A sensor mounted on the left rear wheel measures lateral movements and determines the car's position on the map.

DISTANCE SENSORS

Four radars, three in the front bumper and one in the rear bumper, measure distances to various obstacles and allow the system to reduce the speed of the car.



CARRIE COCKBURN/THE GLOBE AND MAIL || SOURCES: GOOGLE; ARTICLESBASE.COM; WHEELS.CA

Mercedes-Benz, Volvo, Cadillac, and Audi.

While the driverless car systems vary in design, they typically include GPS, cameras, lasers, and radar to identify the car's position on the road, the location of obstacles and pedestrians, and its distance from other vehicles, as well as laser-fast processors to combine all the data and enable the car to react in real time, according to *Businessweek*.³

The early results are promising: BMW's engineers have programmed a 3 Series vehicle to drive itself safely around a speedway at 75 miles per hour with human passengers, slowing to 40 miles per hour at a treacherous S-curve. Google has modified a Prius with a roof-mounted lidar that slowly revolves to scan its surroundings; the Prius has already driven itself 300,000 miles in normal traffic in California.

Moreover, the new technology has already passed an important legal hurdle. California and Nevada have

passed laws that will allow consumers to operate driverless cars on state roads after safety standards are set for their use.⁴ Each car would have to be tested to ensure that it met those standards, and owners of such cars would have to apply for a special permit to use them.

Ultimately, an autonomous car will drive itself for every mile of every trip, but when the cars first hit the market, humans will drive the car until it reaches designated highway lanes for driverless cars, where the "autopilot" system will take control. Google recently received a patent for a system that will enable a car to make the transition to self-driving when it reaches a "landing strip" on the road.

According to *FoxNews.com*,⁵ the strip will be similar to a QR code that will be located on an overhead sign or painted onto the asphalt to mark the beginning of a "self-driving zone." When sensors mounted on the car identify the code, the system



Today's vehicles are designed to permit human drivers to function comfortably and safely. However, those constraints will disappear once everyone is a passenger. Vehicles optimized for entertainment, work, and relaxation, could look far different from anything we've known.

will locate itself with GPS and then use Google Maps data and landmarks to navigate through the zone.

Autonomous cars should deliver at least six benefits, including:

1. **Safety:** According to the World Health Organization, more than 1.2 million people throughout the world are killed in car crashes every year. Another 50 million people are injured in accidents. The National Highway Traffic Safety Administration blames human error for at least 60 percent of traffic fatalities. As Tom Jacobs of the Nevada Department of Motor Vehicles, who took a test-drive in Google's Prius, told *BBC News Magazine*,⁶ "When the car is on self-driving mode, it doesn't speed, it doesn't cut you off, [and] it doesn't tailgate."

2. **Time savings:** Self-driving cars that can keep track of each other using sensors could maintain the speed limit with a minimum of distance between them. Vehicles would be automatically rerouted to less-traveled roads — and traffic congestion could be eliminated.
3. **Convenience:** A car could be left at the entrance to a parking garage, where it would park itself. Or to avoid the expense of parking at a convention center or airport, it could simply drive itself back to the owner's driveway.
4. **Efficiency:** Since the typical car is idle for 96 percent of the time, allowing cars to drive themselves would maximize their usage. For example, a car could return home after dropping the owner at work, eliminating the need for a second car to take the children to school.

5. **Cost savings:** According to *Businessweek*,⁷ if projections about the world's population growth hold true and if trends in car ownership continue, the number of cars on the road will multiply from 850 million today to 7.7 billion in 2050. Those cars will burn 375 million barrels of oil per day, quintuple the global production in 2008, according to MIT professor John Sterman. While the *Trends* editors believe the projected number of automobiles is exaggerated and that oil will not be fueling most vehicles four decades from now, there is no question that the growing middle class in China and other developing countries will increase the demand for cars, just as there can be no argument that America's highway infrastructure has reached its limits. Rather than building new highways or widening existing ones, our current roads could handle two or three times as many cars if "robotic precision" were used to allow cars to drive closer together, according to engineer Sebastian Thrun, who heads Google's Driverless Cars program.
6. **Productivity:** When autonomous cars become the norm, people will become even more productive. Initially, a licensed driver will still need to sit behind the wheel in case the system fails. But the *Trends* editors expect that, by the mid-2020s, traveling in one's own car will become just as passive an experience as taking a train. Automobile interiors will be redesigned so that seats can swivel sideways to face other passengers instead of facing forward, and desk surfaces will be built into the cabin walls or will fold out from the sides of the seats. Millions of drivers who once needed to remain focused on the road will be free to devote their full attention to their work as they commute to their offices or homes. This increase in productivity will make a positive impact on the economy, just as the adoption of personal computing, e-mail, and the Internet led to productivity gains that increased the nation's GDP.

In addition to all of these benefits, we foresee the following developments emerging from this trend:

First, the emergence of autonomous vehicles poses a critical threat to the profitability of the insurance and advertising industries. Because human error is blamed for 60 percent of traffic fatalities and 99 percent of car accidents, proponents of driverless cars believe that roads will be much safer without human drivers. In fact, preventing fatal traffic accidents is what motivated Google engineer Sebastian Thrun to develop autonomous cars after a friend died in a car crash. If the cars succeed in eliminating wrecks, will car owners still need collision insurance? There's a lot riding on the answer to that question. According to the U.S. Census Bureau's *2012 Statistical Abstract*, auto insurance is a \$180 billion business in the U.S. Because the market is highly competitive, auto insurance companies spend a lot on advertising: According to *The Wall Street Journal*,⁸ Geico alone spent just under \$1 billion in marketing in 2011, while State Farm and Allstate weren't far behind. All of that revenue could be at risk if private automobile insurance becomes obsolete.

Second, expect the car manufacturers to lobby vigorously for laws that absolve them of liability if an autonomous car crashes. A case could be made that if the car is driving itself, the manufacturer should be liable for any mishaps. That issue concerns the car makers; the Alliance of Automobile Manufacturers opposed California's bill to allow driverless cars on the state's roads because it did not address the issue of liability.⁹ It's too early to predict how this issue will be resolved, but one possibility in the short term might be a relatively small liability surcharge that would be bundled into the sale of the vehicle so the cost would be passed on to the consumer. However, once the technology becomes virtually fool-proof and highway accidents become as rare as plane crashes and train wrecks, this issue should become less relevant.

Third, despite the overall improvements in safety that autonomous cars will bring to individual passengers, our increased reliance on the kinds of technology needed for driverless automobiles will make us increasingly vulnerable as a nation. Among the potential threats that must be addressed are electromagnetic pulse weapons that could be launched by terrorists or

foreign powers, as well as natural disasters such as solar storms.

Fourth, another issue that must be resolved is the matter of privacy. Some critics contend that Google's driverless system will track users' every movement and store data on their habits and destinations.¹⁰ The nonprofit privacy organization called Consumer Watchdog sent a letter to California's lawmakers urging them to prohibit Google's cars from collecting data for marketing or other purposes. In a press release, Consumer Watchdog warned, "Now

that Google is taking to the freeways, we must prevent inappropriate collection and storage of data about our personal movements and environment before we allow Google's robots to take to the roads and report back to the Googleplex." At issue is whether people will tolerate the trade-off between giving up some privacy in exchange for convenience — and, as the popularity of Google's search engine can attest, it is a bargain that hundreds of millions of people have been willing to make.



November 2012 Trend #5 Resource List:

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<http://www.uspirg.org/reports/usp/transportation-and-new-generation>
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4. *SILICON VALLEY MERCURY NEWS*, August 30, 2012, "California Accelerates Toward Driverless Highway of the Future," by Mike Rosenberg. © Copyright 2012 by the San Jose Mercury News. All rights reserved.
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9. *SILICON VALLEY MERCURY NEWS*, September 25, 2012, "Google's Sergey Brin Joins California Gov. Jerry Brown to Sign New Driverless Car Law," by Mike Rosenberg. © Copyright 2012 by the San Jose Mercury News. All rights reserved.
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