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Google's Driverless Car Has Its Head in the Cloud

NOVEMBER 3RD, 2011   BY JOHN RENNIE   4 COMMENTS

Cruise control used to be a luxury item for car buyers. More recently, vehicles that could parallel park themselves or steer themselves through skids could inspire envy or respect. But Google's self-driving car, which has traveled over than 190,000 miles without human assistance in all kinds of traffic, over all kinds of terrain, has put these previous advances to shame.

Equipped with a Velodyne 64-beam laser imaging system on its roof, radar systems on each bumper, and a forward-looking camera, the car constructs an image of the world and of the objects moving all around it; a GPS system and inertial measurement units help it keep track of its precise location on maps in its memory. But the real key to its capabilities is its data-processing systems — only some of which are in the car. Others are part of a cloud-computing network of servers within wireless contact that Google uses to supplement the brains on board.

Building on advances pioneered under DARPA's Grand Challenge competitions of the last decade to build an autonomous vehicle, Google has leaped beyond them by applying the usual Google formula for success: collect mountains of well-structured data, analyze them with nearly limitless processing resources, and watch what comes out.

In its statements, Google emphasizes that its self-driving car (which the company calls autonomous vehicles) is still at the experimental stage, so similar vehicles are still years of development and testing away from sale to consumers. Perfecting the technology, moreover, is only the first step. Psychological, legal, and economic obstacles may be at least as formidable for postponing the era when human drivers will be obsolete.

The first and most obvious problems are that people like to drive, and they may be afraid to put their lives in the hands of a computer while on the road. Of course, people entrust their lives to computers all the time—for example, during landings of modern airliners. But they may feel more nakedly exposed to that risk inside a car, where they're used to having control.

Even when consumers want the cars, a legal framework for allowing them on the road needs to be in place. Will auto manufacturers want to produce the cars if they would become liable for serious accidents resulting from malfunctions of the self-piloting system, even if those errors involved cloud-computing glitches? Currently, Nevada is the only state where cars without human drivers would be legal, thanks to legislation that passed in June. The other 49 states might need to follow suit. (Google's early tests of its car were legal because the car always had a person behind the wheel prepared to take control in an emergency, as the cars will in Nevada, at least in the near future.)

The benefits of self-driving cars may win converts fast, however. Even relatively small numbers of self-driving cars will lessen traffic, boost travel speeds and reduce accidents for everyone—including people in conventional cars. The key is that networks of self-driving cars work better as the number of vehicles increases, because they can share information readily and reduce the computing demands on any individual car.

The distributed computing intelligence that guides the automated vehicles can coordinate all their maneuvers simultaneously: for example, make them all speed up and slow down in unison, rather than the back cars responding after the fact to the ones ahead of them. What causes highway accidents isn't high speed so much as it is discrepancies in the speeds of maneuvering vehicles. Similarly, traffic is caused less by simple congestion than by disorderly flows of cars. The intelligent cloud guiding a pack of cars on a highway could pack vehicles closer together while increasing the average travel speed.

In cities, self-driving cars could help to organize the flow of traffic to prevent gridlock, simply by preventing cars from pulling out into intersections unwisely. And even if the self-piloting cars are a minority of those on the road, they may collectively serve to shepherd other cars to drive along with them—both discouraging random speeders and compensating for them.

Self-piloting vehicles may be extremely appealing in certain niches, such as any that involve fleet vehicles. Robotic cabs and buses could be a boon in crowded cities like New York; city governments might even consider subsidizing their adoption to discourage other types of vehicles. Trucking companies could be drawn to the idea of driverless semis moving along highways almost non-stop, unhindered by a driver's need for sleep or food.

Creating this efficient cloud network of cooperative cars will undoubtedly involve its own headaches. Who will set the standards and protocols determining how the self-driving cars will communicate and respond to commands? Who will operate and maintain the computing networks supporting the cars? Will Google have a monopoly on the piloting systems for all vehicles or will competing systems arise? Will various auto makers compete on the basis of the quality of their cars' piloting systems, and if so, how well will those cars cooperate with one another?

Cars have long been quintessential symbols of American individuality and freedom, so it only makes sense that people will want to make their driving experience still better. Therein lies the irony: tomorrow's self-driving automobiles will be in a sense less autonomous than the ones we drive now. Cars won't just drive themselves; they will help to drive one another.

Top image: Velodyne's LIDAR, which creates a 3D map of the road. Courtesy Flickr user Jurvetson.

John Rennie is an editor at large for Txchnologist. He served as editor in chief of Scientific American between 1994 and 2009 and is an adjunct instructor in New York University's Science, Health and Environmental Reporting Program. His last story for Txchnologist was about the use of green fluorescent protein in medical research. John blogs at The Gleaming Retort can be found on Twitter as @tvjrennie.

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Comments

J. Doe *yesterday*

This is insanely awesome. Huge respect to the team that has created this ability and I understand the immensity of all its future applications. But I have a great fear of the number of jobs these systems will replace, as they will eventually be able to far out do their human counter part with consistent dependability. As the economy is a constant issue of discussion and well.. its certainly very fragile, do you see places for job growth in creating these industries or will the be largely over seas or themselves automated??

REPLY

Jay Mueller *yesterday*

This is a very interesting concept, and a good article. One thing I take issue with though is this:

"Of course, people entrust their lives to computers all the time—for example, during landings of modern airliners."

A human pilot is still where the buck stops. The judgement calls still rest with them as to whether the conditions are safe for landing, auto-land or no.

REPLY

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