

# Google Self-Driving Car Project

## Monthly Report

September 2015

We met lots of our neighbors in Mountain View and Austin this month. Our prototype vehicles arrived in Austin, and we attended a number of gatherings around the city to explain our project and how our technology works. In Mountain View we held our inaugural “Open Garage” event for 800 residents of the neighborhoods closest to our Google[x] building; lots of families had a look around inside our garage and took some rides in our prototypes on the test track on our roof. This was the first time we’ve heard that our prototype looks like an [ankylosaurus](#) -- must be dinosaur season in the Mountain View school district!

### Activity Summary (all metrics are as of September 30, 2015)

#### Vehicles

- 23 Lexus RX450h SUVs – currently self-driving on public streets; 17 in Mountain View, CA, & 6 in Austin, TX
- 25 prototypes – currently self-driving on public streets; 17 in Mountain View, CA & 8 in Austin, TX

#### Miles driven since start of project in 2009

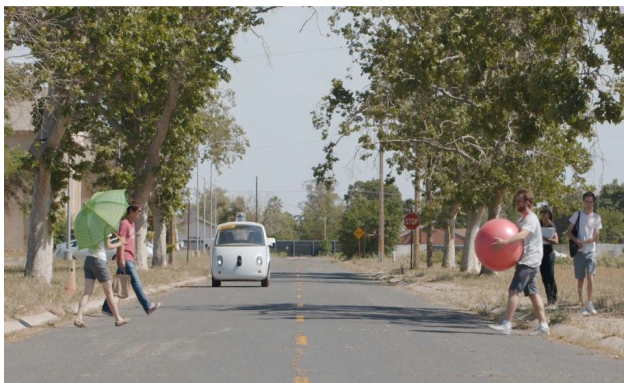
“Autonomous mode” means the software is driving the vehicle, and test drivers are not touching the manual controls. “Manual mode” means the test drivers are driving the car.

- Autonomous mode: 1,210,676 miles
- Manual mode: 911,252 miles
- We’re currently averaging 10,000-15,000 autonomous miles per week on public streets

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### Preparing for Rare & Odd Situations

Our vehicles have self-driven the equivalent of over 90 years of typical US adult human driving, and over that time, we’ve seen a lot of crazy stuff on the road. We want our cars to be capable of handling odd or rare scenarios, but even over a million miles or more of testing, we can’t expect to see everything that might be possible. So we’ve had to figure out our own methods for pushing our software’s capabilities. That’s why we created a special team to dream up rare and diabolical situations and run tests on our test track.



#### Step 1: Coming up with ideas for different situations.

We see lots of challenging things out on the roads -- both as test drivers and during our own commutes to work. We take these ideas and brainstorm some more to make them even weirder and harder. Our software benefits in two ways: we can validate that the software works as expected in extreme versions of common situations, and we can prepare for truly rare or odd occurrences.



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### Step 2: Creating a field test

Specially trained members of the team recreate each situation on our private test track, including multiple variations of each scenario—almost as if they were shooting a Hollywood movie - and we run through several variations of each test. For example, we recently tested how the car would respond to a person coming out of a “porta potty” on the side of the road. We had people pop out slowly, or spring out quickly as if from a birthday cake. We put the car in different positions, distances and speeds. If the vehicle does what we expect, great. If it does something different, our engineers can take a closer look and make adjustments to the software.

### Step 3: Building on what we’ve learned by testing some more

One of the beautiful things about our self-driving software is that it can get practice without ever leaving the garage. Using our simulator software, we can take any of the individual scenarios we practiced on our test track (as well as ones we encounter on the roads) and subtly change the variations to get *even more* practice. What if that pedestrian were taller, or shorter? If they darted out into traffic at different angles? We can very quickly get virtual practice on hundreds or thousands of variations on a single on-the-street scenario, adding to the 10,000 to 15,000 miles of real-world driving experience we gain every week.

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### What we’ve been reading

- Forbes, “[Ethics won’t be a big problem for Driverless Cars](#),” September 2015.
- The Atlantic, “[Self-Driving Cars Could Save 300,000 Lives Per Decade in America](#),” September 2015
- Wall Street Journal, “[Car Crashes Are On the Rise and Warren Buffett Blames Texting](#),” September 2015
- Associated Press, “[Meet The Man In The Front Seat Of Google's Driverless Car](#),” September 2015

This month we’re including an extended selection of articles because on Tuesday, September 29, we hosted 39 journalists at Google[x] and gave them rides in our prototypes (on a test track on the roof of the building) and our Lexus vehicles (on Mountain View streets). In Austin, 8 journalists rode around their city in a Lexus SUV. Here’s what some of them had to say about the experience:

#### The Detroit News, “[Driving in the Google Marshmallow Bumper Bot](#),” September 2015

“But the other difference is the car doesn’t feel like a car at all. It feels more like a Disneyland ride. The interior is devoid of traditional car tools. No pedals. No instrument panel. No steering wheel. The absence of the latter is transforming, actually. Rather than making me feel less safe, it is comforting not to see the pilot-less steering wheel spinning around like car is possessed. My wife won’t get in a self-parking, steering wheel-spinning Ford Focus, much less a possessed, self-driving Google Lexus.”

#### Mashable, “[The self-driving car is ready for prime time, but you still can't have one](#),” September 2015

“One woman on the team talked about how thrilled a neighbor of hers was that the cars were driving through her area — because, she said, it made all the other cars on the road behind it slow down and actually obey the speed



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limit. Ask any parent who has lost a child to an auto accident how much we need this. Once you understand the technology and its inherent safety, the driverless car practically sells itself. Some caution is warranted, of course. But if Google takes it slow and cautious, that's no help at all to the 30,000 people who are going to be killed this year by humans behind the wheel."

**Texas Tribune**, "[Google Takes Slow Ride to Testing Self-Driving Cars](#)", September 2015

"Over the next 10 minutes, the car made an unhurried loop up Burnet Road and down Shoal Creek Parkway before returning to where we started. On Kim's laptops, I watched a simulation of what the car sensors were seeing, with each moving object represented by a constantly shifting parallelogram. Yellow boxes were pedestrians. Cars were pink or green. Despite the stripped-down, Atari-esque display, knowing that millions of data points were behind each frame seemed like something out of the Jetsons."

**Los Angeles Times**, "[I failed my driving test twice. Will Google's self-driving car save me?](#)" September 2015

"For a moment, while riding in the prototype, I was excited. I could envision leaving behind worries of car ownership and thumbing my nose at everyone who'd given me a hard time for not being able to drive. Perhaps I'd whoosh past the Times building and offer editors a ride, or do wheelies outside my family home in Sydney — "Look, Mom! No hands!" And after exhausting my self-driving car fantasies, I was left with two thoughts: I hope these cars will be ready soon, and I hope they don't suck."

**Buzzfeed**, "[Google's Cute Cars And The Ugly End Of Driving.](#)" September 2015.

"Cars are giant, inefficient, planet-and-people killing death machines. Self-driving cars — especially if they are operated as fleets and you only use one when you need it, summoning it Uber-style — would mean we could have fewer vehicles per person, less traffic congestion, less pollution, far fewer vehicles produced per year (thus lowering the environmental impact of production), and best of all, safer streets. The blind, people with epilepsy, quadriplegics, and all manner of others who today have difficulty ferrying themselves around as they go through the mundanities of an average day will be liberated. Eliminating the automobile's need for a human pilot will be a positive thing for society. So go f\*\*k a tailpipe if you love cars so much. Your love for cars doesn't supersede [the lives of 1.2 million people](#) who die in automobile accidents every year. It's not more important than the energy savings we'll get from not manufacturing 60 million or so vehicles every year that spend most of their time idle. Turned off. Parked."

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### Traffic Accidents Reported to CA DMV

*None for the month of September.*

