CS BITS & BYTES
National Science Foundation

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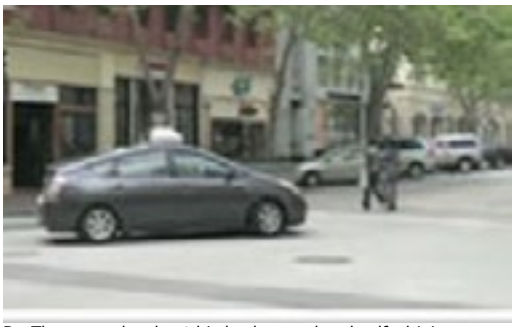
Self Driving Cars

Do you think K.I.T.T., the Batmobile, Herbie, Lightning McQueen, and other self-driving cars are only for fantasy movies? Think again. A fleet of self-driving Toyota Prius cars owned by Google has now logged more than 190,000 miles (more than three-quarters of the distance to the moon!) driving in city traffic, busy highways, and mountainous roads with only occasional human intervention.

Self-driving cars use precision sensors, like laser range finders, to see 360 degrees of the world. Unlike people, the cars never get tired or distracted. If everyone used them, it could greatly reduce traffic accidents, saving tens of thousands of lives each year; make driving more accessible for persons with disabilities and the elderly; and even reduce traffic jams and congestion by allowing cars to safely drive closer to each other.

MUST SEE!

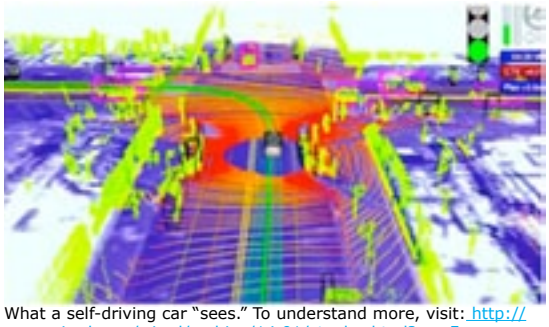


Dr. Thrun speaks about his background and self- driving cars: http://www.ted.com/talks/lang/en/sebastian_thrun_google_s_driverless_car.html

Autonomous ground vehicles navigate on their own with no human driver or remote control. In 2004, DARPA (the Defense Advanced Research Projects Agency) sponsored a Grand Challenge—a contest to build autonomous ground vehicles that could race each other through the Mojave Desert. No entries made it to the finish line the first year, but the very next year Stanley, built by a team from Stanford University, won the race and the team took home a prize of $2 million.

In 2007, DARPA created the Urban Challenge, shifting the playing field from the desert to city streets. Vehicles now had to contend with traffic, merging, passing, parking, intersections, and pedestrians in a mock city. Six cars crossed the finish line. Judged on speed as well as adherence to California traffic laws, Carnegie Mellon's car, BOSS, took home the $2 million prize.

Maneuvering a self-driving car in traffic is a significant challenge for computing and engineering. It is not easy to build a self-driving car and there is much more development work that must be done before they will be available in showrooms near you. The National Science Foundation supports research to enable technology for self-driving cars to effectively monitor and act in complex, dynamic environments. The car needs to sense its environment. Often, it does this with roof-mounted laser rangefinders, radars, cameras, and a GPS (Global Positioning System) receiver.



What a self-driving car "sees." To understand more, visit: http://www.wired.com/wired/archive/14.01/stanley.html?pg=5.

The Google fleet of cars use very detailed maps as the basis of their model of the world. Each car needs to be able to update that model with objects it detects, and smart algorithms enable the car to quickly distinguish stationary objects, like a telephone pole, from potentially moving objects, like a person. The cars must react in real-time and quickly handle unexpected events. They must be able to reason with uncertain or missing data, and they must be able to adapt to unpredictable events: roads can contain uncooperative or antagonistic vehicles as well as quirky pedestrians.

Image of Professor Sebastian Thrun.

Who thinks of this stuff? Sebastian Thrun is a Google Fellow and a Research Professor at Stanford University. He is a pioneer in using statistical techniques to model complex environments. He led the Stanford Racing Team that developed Stanley and he currently guides the Google project. In Fall 2011, Professor Thrun taught Introduction to Artificial Intelligence (ai-class.org) with Peter Norvig at Stanford. As part of an effort to make sure that high quality computer science education was available to the public, Professor Thrun made this class available online for free for anyone to enroll. Over 160,000 people signed up and over 23,000 completed the class.

Links:

Learn and watch about Stanley at: http://www.pbs.org/wgbh/nova/darpa/team.html.

Find out more about BOSS at: http://www.tartanracing.org/.

Want to participate in a Challenge? Find one at: http://www.challenge.gov!

Activities:

Students can realize how to maneuver a car in a complex environment by participating in this simple activity.

1. Break students into pairs and have them go to: http://www.y8.com/games/Traffic_Jam.
2. Each pair should play the game two or three times to learn how to get a car out of the parking lot.
3. Once the game is understood, one of the students should look at a new traffic jam and write down the steps to get out of the lot.
4. Their partner then should follow the steps to see if they can get out of the parking lot.
5. Have students trade roles and repeat steps 3 and 4.
6. If time allows, have students repeat and aim for the lowest number of steps possible.

Class Discussion: Ask students one of the following questions:

* Who is legally responsible for a self-driving car?
* Can minors now travel in self-driving cars without an adult?

Nevada is the first state that is preparing to allow self-driving cars. In June of 2011, the state passed a bill requiring the Department of Motor Vehicles to draw up rules for self-driving cars by March 1, 2012. More can be found in this article from PC Magazine (http://www.pcmag.com/article2/0,2817,2387526,00.asp).

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