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'Eyes' of Google's Self-Driving Car May Bust Crooks



By Mark Hachman

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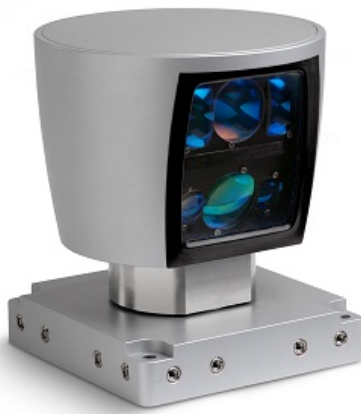
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The laser "eyes" that control Google's self-driving cars will eventually be used as the unblinking eyes of a future security camera, its creators at Velodyne say.

In an interview last week, Stuart Woods, the executive vice president of Velodyne, which manufactures the LIDAR (Light Detection And Ranging) rotating module that sits atop Google's autonomous vehicles, said that his company has started developing prototype security systems that could be trialed within the next year.

The Velodyne LIDAR HDL-64E and HDL-32E modules use an array of either 64 or 32 lasers to electronically "see" the environment, Woods said. On Google's car, the module is set inside a rotating drum. Its lasers complement Google's own mapping software and GPS data, which help orient the car on the road. The LIDAR provides additional positional data, but also identifies other cars, bicycles, pedestrians, and road hazards.

Google announced its self-driving car project [back in 2010](#) with the goal to "make driving safer, more enjoyable and more efficient." Last week, Google's self-driving car [chauffeured Morgan Hill, Calif. resident Steve Mahan, who is legally blind](#), to a local Taco Bell as part of a celebration of 200,000 miles driven. For its part, [Google and the local police said the trip was legal](#), although a CHP spokeswoman said that all drivers must hold a valid driving license.

To date, Google's cars have only had one accident, a collision blamed on another car driven by a person.

That's due in large part to Velodyne's LIDAR system, which is designed to "see" far enough away to identify oncoming vehicles from afar, but also detect small hazards close by, on the ground.



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Each 905-MHz, "eye-safe" laser is fanned out, offset enough that the coverage area reaches the ground, but also close enough to provide



centimeter resolution at distances of 80 to 100 meters, Woods said. (The 64-laser LIDAR offsets each laser by 26.8 degrees, and 40 degrees for the 32-laser unit.) On Google's car, Woods said that the turret spins at a typical 10 revolutions per second, enough to generate 1.3 million datapoints or 750 Mbytes per second across an Ethernet interface, in a standard format that allows the car's software to identify and assess potential obstacles and hazards.

"The point here is that we're generating enough of a point cloud where we can really be autonomously aware of the environment," Woods said.

What is a point cloud? The easiest way to think of it is as a form of pin art, the 1980's gadget, as the Velodyne video to the right shows. The LIDAR provides position and velocity information. But Velodyne is also developing the capability to look at the relative intensity of the reflected light, which will allow the laser to "read" objects.

Missing Plug-in

"If I had a lane marker, or tape, or street sign, basically the reflective part shows up with a higher intensity than the back part, and simply by that measurement, you get a very quick, very easy character recognition process," Woods said.

Woods said that Velodyne's LIDAR module can adjust for optically confusing conditions, such as fog or puddles. The LIDAR may also be able to pick up potholes, Woods added.

"We have mapping software folks that measure the pavement laid down, how much pavement was laid down," Woods said. "There's a whole process coming out where you can figure out if construction road maintenance put down the amount of asphalt they were under contract to do. So I'm not sure that people have measured potholes, but I believe it's entirely possible, given what I know."

Velodyne is also working to "harden" the sensors for the environment, so that the fluctuations in temperature don't affect the device's capability to generate accurate measurements, Woods said. Eventually, the goal is to produce a sensor with readings that are accurate between -10 and 60 degrees centigrade, or from 14 to 140 degrees Fahrenheit.

Security Applications

But the same technology that can identify an oncoming pedestrian could also be used to help a security guard pinpoint an intruder. Instead of being mounted on a car, the rotating drum could be mounted on a building or pole. Since it constantly spins, casting its laser out across 360 degrees, the drum wouldn't have the "blind spot" of a traditional camera.

The LIDAR itself might not be able to identify the intruder, but it could alert a security guard to pay attention to a video camera that shows the highlighted area. "The problem is that the security guy is sitting there, with too many cameras," Woods said. "There's too much information for a human to deal with."

LIDAR's next step is object identification, where the point cloud is actually interpreted to form a picture, such as a flat, square object that can be interpreted as a table, Woods said.

Editor's Note: A previous version of this story misspelled Woods' name.

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