Autonomous Vehicles in the Age of Information: Developing Technical Systems, Solving Ethical Dilemmas, & Enacting Legal Requirements

By Jacob Meng, Lydia Fawzy, & Rachael Bucey Leopold

What are Autonomous Vehicles?

Definition:

A vehicle capable of executing all driving functions without any driver input.

Five Levels of Automation

Level 0.

No automation. The driver is in complete control.

Level 1.

The vehicle performs one simple driving function like cruise control or anti-lock brakes

Level 2.

The vehicle controls at least two primary control functions. E.g. lane assist and adaptive cruise control

Level 3.

The vehicle drives autonomously under certain conditions but the driver is to be aware and take control if needed
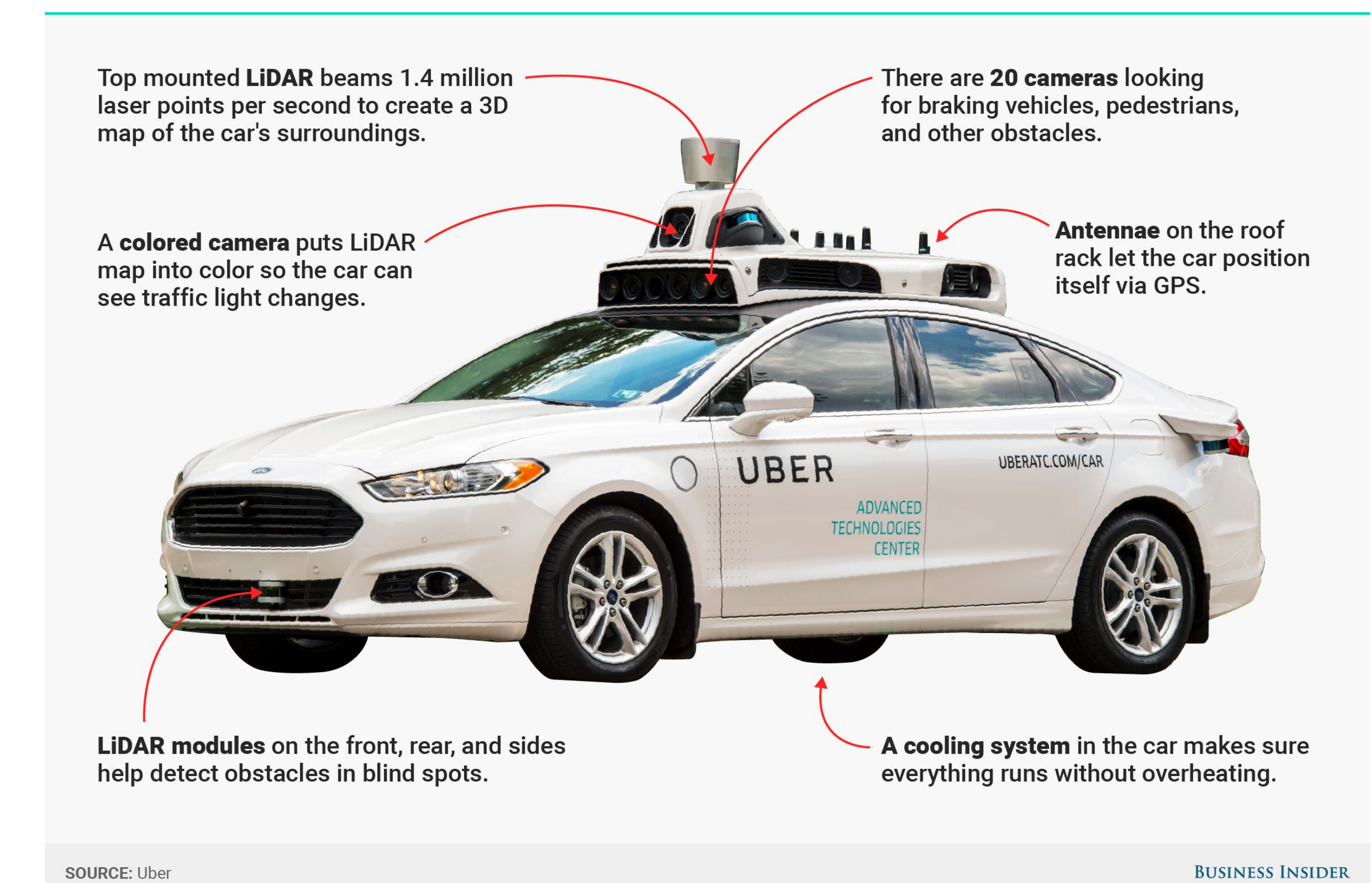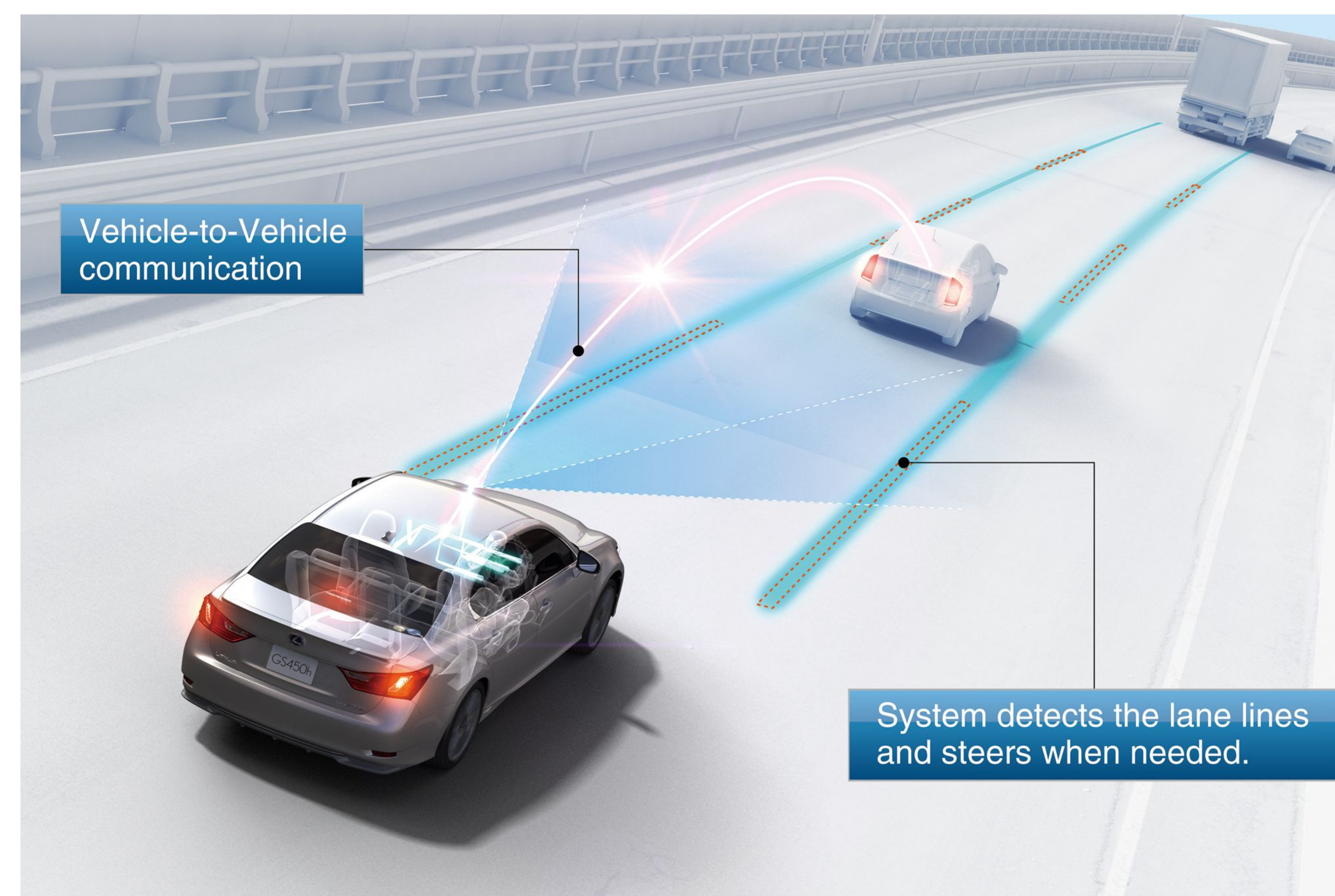
Level 4.

Full automation and responsibility. This vehicle has no use for a steering wheel or brakes

How do They Drive?

➔ Autonomous cars use GPS navigation to locate their position and create an internal map of possible routes.

➔ Sensors such as lasers and advanced cameras are utilized to ensure that the car does not experience any collisions.

➔ The images captured from these sensors construct the internal 3D map stored in the automobile's memory.

➔ This information is sent to the control system to identify what obstacles are before it. Here, distinctions are made between pedestrians, building, roadways, and other elements based on a library coded in the automobiles system. Then, actuators adjust braking and steering for avoidance.

Analyzing Ethical Dilemmas

➔ Consider a situation where an ethical decision must be made while driving, such as a truck swerving into oncoming traffic toward a self-driving car carrying passengers, with pedestrians to the right and other passengers in cars to the left.

➔ The car determines that the truck would seriously injure or kill the passengers upon collision. Should the self-driving car collide with the truck, pedestrians, or the other car?

➔ For a human-driven car, the driver was unfairly thrown into an unfathomable predicament and it is not reasonable for a human to make an ethical decision under that kind of pressure.

➔ For the self-driving car, the vehicle would have to be pre-programmed before these incidents even occur.

➔ The ethical dilemma lies in who will get to make these decisions and which lives they will choose to preserve.

Top mounted **LiDAR** beams 1.4 million laser points per second to create a 3D map of the car's surroundings.

There are **20 cameras** looking for braking vehicles, pedestrians, and other obstacles.

A colored camera puts LiDAR map into color so the car can see traffic light changes.

Antennae on the roof rack let the car position itself via GPS.

LiDAR modules on the front, rear, and sides help detect obstacles in blind spots.

A cooling system in the car makes sure everything runs without overheating.

SOURCE: Uber   BUSINESS INSIDER

Legal Requirements

➔ Ethical Programing
  ◆ A car must prioritize the vehicle occupants in a similar way to the status quo

➔ Vehicle Liability
  ◆ Insurance
    ● Insured by manufacturer or insurance companies
  ◆ Safety
    ● How safe do they have to be?
    ● Is the goal zero accidents or just a significant improvement over human piloting?

➔ Ownership
  ◆ A self-driving car might not have controls, thus a driver's license might not be needed

➔ National Security
  ◆ Autonomous vehicles would be a safe way to transport illegal items
  ◆ Kidnaping by vehicle hacking

Vehicle-to-Vehicle communication

System detects the lane lines and steers when needed.

Special Thanks to Professor Michael Gallagher

Works Cited

Belay, Nicholas. "Robot Ethics and Self-Driving cars: How Ethical Determinations in Software will Require a New Legal Framework." Journal of the Legal Profession, 2015, Accessed 27 Oct. 2016.

"10 Cars with Adaptive Cruise Control | Autobytel.com." *Autobytel | New Car Prices, Used Cars for Sale, Auto Prices, Car Pictures and Car Reviews,* Accessed 9 Apr. 2017.

"Car History 4U - History of Cruise Control in Motor Cars / Automobiles." *Car History 4U - History of the Automobile, History of the Motor Car, Car Clubs & Car Museums,*

"How Does Uber's Driverless Car Work: GRAPHIC." *Business Insider,* Accessed 9 Apr. 2017.

"U.S. Department of Transportation Releases Policy on Automated Vehicle Development." *Department of Transportation,* 3 May 2013,

Noguchi, Yuki. "Self-Driving Cars Raise Questions About Who Carries Insurance." *NPR* (2017): 1-2. Web.

Nyholm, Sven, and Jilles Smids. "The Ethics of Accident-Algorithms for Self-Driving Cars: An Applied Trolley Problem?" *Ethic Theory Moral Practice* 19 (2016): 1275-289. Web.

Rayej, Shima. "How Do Self-driving Cars Work." *Robohub.* Velocity Farm, 3 June 2014. Web. 09 Apr. 2017.