NTSB probe into fatal Uber crash finds software couldn't deal with jaywalkers

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We are now some distance away from the days when multiple tech startups promised a fever dream of driverless, Level 5 robotaxis at the start of the next decade. But we *are* now getting a detailed look at the outcome of their experiments on public roads before most of the industry, as well as some tech giants, collectively admit that truly driverless vehicles were not three years but three decades away, at best.

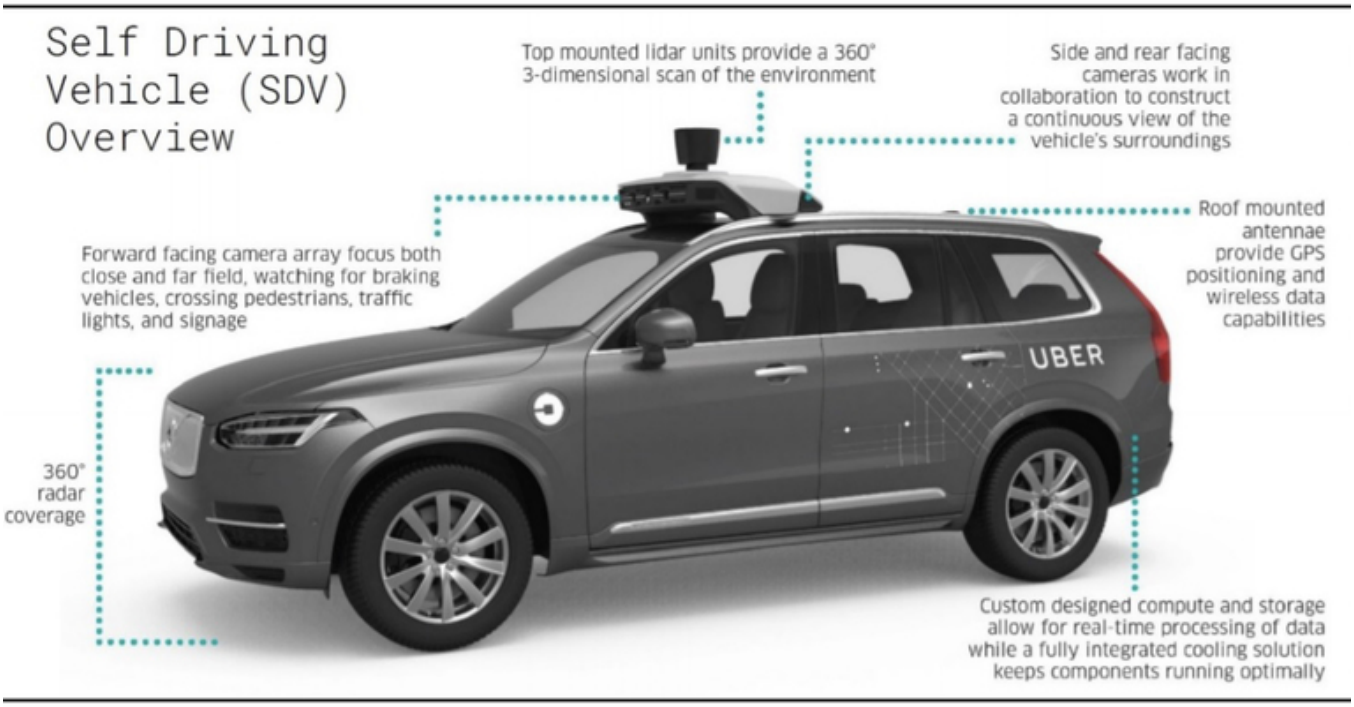
The NTSB revealed new details regarding a March 2018 crash of an Uber vehicle that killed pedestrian Elaine Herzberg, who was fatally struck by the vehicle in Tempe, Arizona, while walking her bicycle across the road. The autonomous Uber test vehicle, with one backup driver on board, was part of a testing program on public roads that has since been curtailed; the agency

earlier published a preliminary report on the crash that resulted in Herzberg's death but did not release its full report until earlier this week.

One of the more significant technical details of the crash disclosed in the agency's report is that fact that Uber's autonomous driving systems, mounted on a Volvo XC90 SUV, identified Herzberg almost six seconds before the impact but did not classify her as a pedestrian crossing the street. The report also disclosed that Volvo's own safety systems, which included a collision avoidance function, only operated while the SUV was in manual mode but not while in autonomous mode—when Uber's own systems were engaged—to prevent erratic vehicle behavior.

"According to data obtained from the self-driving system, the system first registered radar and LIDAR observations of the pedestrian about six seconds before impact, when the vehicle was traveling at 43 mph. As the vehicle and pedestrian paths converged, the self-driving system software classified the pedestrian as an unknown object, as a vehicle, and then as a bicycle with varying expectations of future travel path. At 1.3 seconds before impact, the self-driving system determined that an emergency braking maneuver was needed to mitigate a collision."

The agency's report also found that the backup driver, who was tasked with intervening if the autonomous tech failed in some way during testing but who was watching TV on her phone at the time, took action less than a second before the actual impact by moving the steering wheel. But with 1.2 seconds before impact, it was too late for the SUV to decelerate or to take evasive action.



Uber

Uber's autonomous test vehicles used a variety of radar, LIDAR and cameras to paint a picture of its environment.

"At that time, because preventing the collision would have required extreme braking or steering actions—beyond the design specifications—the ADS initiated suppression of its motion plan," the agency noted. "One second later, the vehicle was still on the collision path with the pedestrian, and preventing the collision still required an extreme avoidance maneuverer; per design, the system did not engage emergency brakes, but rather provided an auditory alert to the vehicle operator as it initiated a plan for the vehicle slowdown."

Ultimately, the NTSB report noted that the autonomous driving systems on the Uber vehicle were not able to correctly classify Herzberg as a jaywalking pedestrian due to the limitations of the system.

"Although the ADS sensed the pedestrian nearly six seconds before the impact, the system never classified her as a pedestrian—or predicted correctly her goal as a jaywalking pedestrian or a cyclist—because she was crossing the North Mill Avenue at a location without a crosswalk; the system

design did not include a consideration for jaywalking pedestrians," the agency said. "Instead, the system had initially classified her as an other object which are not assigned goals. As the ADS changed the classification of the pedestrian several times—alternating between vehicle, bicycle and an other—the system was unable to correctly predict the path of the detected object."

However, police investigators called the Herzberg crash "entirely avoidable," citing the fact that the Uber backup driver was watching a TV program on her phone during a nearly 45-minute period leading up to the crash. Uber was ultimately not charged criminally by Arizona prosecutors, settling the civil matter with Herzberg's family in the days following her death. But the NTSB report did not assign blame in the legal sense.

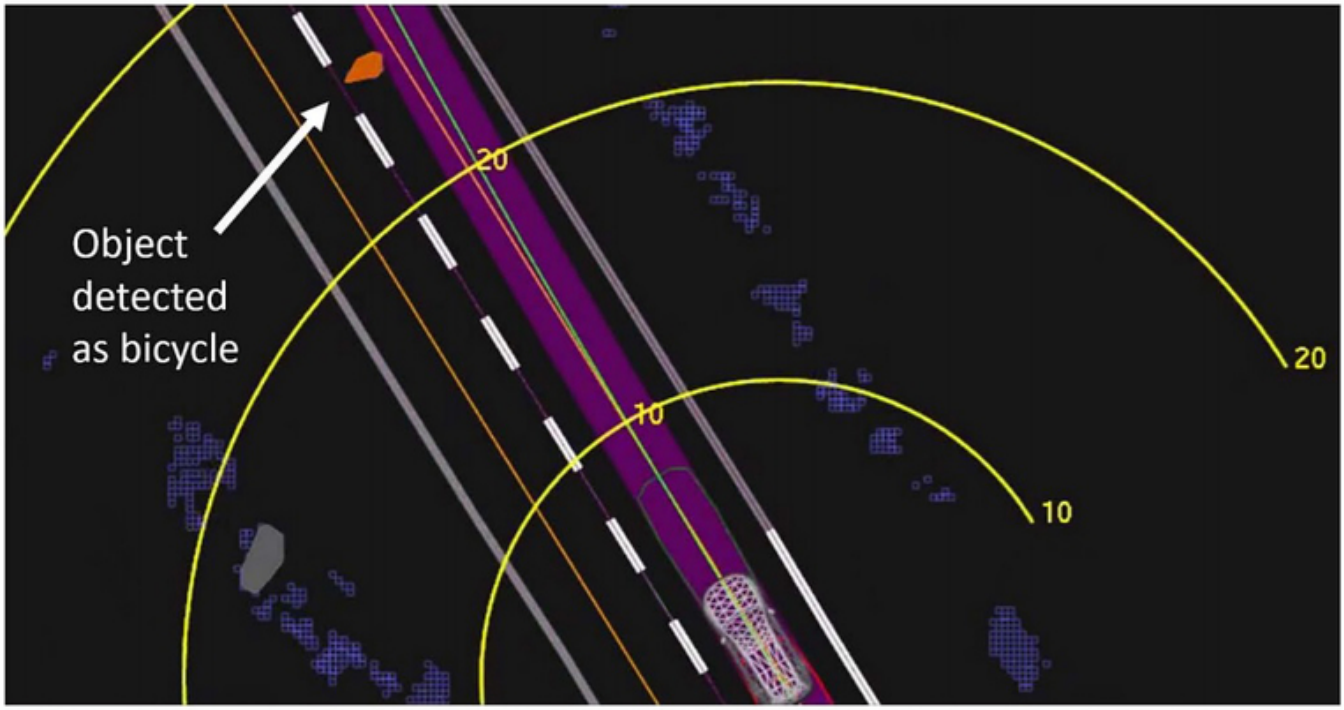
While the NTSB report shed significant light on the limitations of Uber's autonomous driving tech at the time, it also gave a snapshot of the other incidents that included impacts with objects and cars.

A total of 37 crashes and incidents involving Uber autonomous test vehicles took place between September 2016 and March 2018, not counting the one involving Herzberg, and most of them included other vehicles hitting Uber's autonomous test vehicles. The NTSB noted that there were 33 instances of other vehicles striking Uber's test vehicles, with 25 of them being rear-end crashes into Uber vehicles. In eight other instances, Uber test vehicles were side-swiped by other vehicles.

Interestingly enough, in only two other incidents noted by the NTSB the Uber vehicles were the striking ones, once again not counting the fatal Herzberg crash.

"In one incident, the ATG (Advanced Technologies Group of Uber Inc) vehicle struck a bent bicycle lane bollard that partially occupied the test vehicle’s lane of travel," the NTSB said. "In another incident, the ATG vehicle operator took control of the vehicle to avoid a rapidly approaching oncoming

vehicle that entered the ATG vehicle's lane of travel; the vehicle operator steered away and struck a parked car."



NTSB

The NTSB investigation determined that the Uber vehicle detected Herzberg almost six seconds prior to impact, but that the software could not determine what action to take until it was too late.

Overall, the report highlighted the limitations that existed in Uber's autonomous driving systems between 2016 and 2018, while also shedding light on the procedures used by Uber to attempt to prevent crashes that included its vehicles.

Of course, the number of crashes and other incidents and the determination of the party at fault cannot really be compared statistically to the overall vehicle population in the U.S. For one thing, Uber operated a small number of vehicles only in certain geographic areas with backup drivers on board, and the vehicles themselves were not operating autonomously the entirety of the time.

The report raises certain questions about the inherent capabilities of Uber's systems, and other autonomous vehicle systems in development at the time

of the fatal Herzberg crash, and the ethics of conducting this testing on public roads even with a backup driver present. To be sure, there were plenty of factors in the Herzberg crash to consider, including the fact that the backup driver was watching TV on her phone, the design of the roads, street lighting, the time of day, levels of visibility of jaywalking pedestrians, the presence of pedestrians in that area, the speed of the vehicle, the response of the autonomous driving system and the response of the human driver behind the wheel, to name a few.

But it was that particular incident, which put Uber's autonomous testing on hold, that also served as a wake-up call to the numerous startups and tech giants racing to be the first to field driverless robotaxis and other autonomous and semi-autonomous vehicles.

Aside from pointing out the complexities of actual versus controlled road environments, it highlighted the fact that fully autonomous systems are decades rather than just a few years away, and that the robotaxi future promised just a few years ago is much farther on the horizon. It also highlighted the view of some tech leaders and engineers, recently echoed by Apple co-founder Steve Wozniak, that even though 90 percent of autonomous driving functionality may have *appeared* to have been "solved" in the first few years in some limited environments such as a simple highway with clear lane markings, the remaining 10 percent of fully autonomous driving capability will take much much longer to perfect.