How Safe Are Auto Electronics?

Product Design & Development

Toyota's crisis of quality has put a spotlight on all that can go wrong with auto electronics, from buggy software to electrical interference.

DETROIT (AP) -- Investigations into whatever is lurking behind Toyota's crisis of quality have put a spotlight on all that can go wrong with auto electronics -- the growing number of wires, sensors and computer chips that have profoundly changed the automobile in the last decade.

Though no smoking circuit has been found so far, a picture is emerging that shows the automobile industry's technology is racing ahead of quality-control testing and regulators. It's troubling not only for Toyota owners but for drivers of any modern car that's basically a computer on wheels.

Toyota insists that electronics played no role in the unintended acceleration that has sparked its massive recalls, and no one has been able to disprove it.

Lawyers, regulators, engineers and politicians aren't so sure.

The auto industry has been moving at Pentium speed since the late 1990s to replace mechanical cables and other devices with computers to control everything from brakes to throttles to power steering. Automakers say electronics have made vehicles safer with devices such as air bags and antilock brakes. It's also made cars more fuel efficient, cleaner and, usually, more reliable.

Still, things can go wrong and diagnosing problems is complicated.

Glitches can include buggy software, circuitry that's randomly influenced by electrical interference and shorts caused by microscopic "whiskers" that sprout from solder. It can be one or more of these problems, as well as environmental factors -- a blast from a heater vent or moisture from the road -- that can cause a failure. Age also can be a factor.

"You're looking for a needle in a haystack," said Raj Rajkumar, an electrical and computer engineering professor at Carnegie Mellon University in Pittsburgh. "Those are very hard to reproduce. The problem happens and you go back and check and it's not there. The normal tendency is to blame it on the driver and go on."

And that's what Toyota did initially.

Drivers complained their vehicles accelerated out of control -- without stepping on the gas. But complaints were largely dismissed by Toyota, its dealers and

government regulators, who blamed mechanical problems or drivers stepping on the wrong pedal.

Toyota, which until recently had a reputation for being high-quality and cutting-edge, began replacing mechanical accelerators with electrical ones starting with the Camry in 2002. Since the 2007 model year, all its cars have been equipped with the high-tech throttle.

An analysis of complaints by the auto safety research firm Quality Control Systems, found that the number of Toyota "speed control" complaints received by the National Highway Traffic Safety Administration tripled since the electronic throttles were introduced. NHTSA says 34 people have died because of sudden acceleration crashes in Toyotas since 2000.

But the issue didn't get much attention from Toyota until an off-duty California Highway Patrol officer and three members of his family were killed when their loaner Lexus sped out of control and crashed into traffic near San Diego. The Aug. 28 crash received widespread media coverage.

Just over a month later, on Oct. 5, the automaker recalled 3.8 million Lexus and Toyota models in the U.S. because of floor mats. In January, it recalled 2.3 million because of sticky accelerators. It later added more than a million to the floor mat recall, and also said some cars might be covered by both. So far, more than 8 million vehicles have been recalled worldwide to replace floor mats or fix pedals that get stuck because of condensation.

Toyota's denial that electronics played a role in the problems has been repeatedly challenged. Questions linger, including why, according to a congressional analysis, 70 percent of Toyota speed control complaints involve vehicles not covered by the floor mat or sticky pedal recall.

Jim Lentz, president of Toyota Motor Sales USA Inc., was asked at a congressional hearing this week if he could say with certainty that the fixes now being undertaken would completely eliminate unintended acceleration problems. Lentz replied: "Not totally."

The company's quick dismissal of electronic flaws and inability to fully explain the uncontrolled acceleration have generated many theories over what else might be in play. Flaws in electronics are well known to engineers who expect them and design around them. Some electronics experts have challenged the auto industry's testing and backup systems.

The theories came up during this week's congressional hearings, and Toyota repeated that it has found no evidence that electronics are at fault. But Toyota wasn't alone in the hotseat. NHTSA, the nation's auto safety watchdog, was attacked for not investigating complaints more thoroughly and earlier.

"Carmakers have entered the electronics era, but NHTSA seems stuck in a mechanical mindset," said House Energy and Commerce Committee Chairman

Henry Waxman, D-Calif. "We need to make sure the federal safety agency has the tools and resources it needs to ensure the safety of the electronic controls and on-board computers that run today's automobiles."

Even if regulators get the resources, they have their work cut out for them. Diagnosing electronic glitches is far more complicated in today's high-tech cars.

Michel Mardiguian, an engineer and consultant near Paris who specializes in tracking down electronic problems for automakers, recounts one such mystery involving a European automaker. On a cold day in 2005, one of the company's employees started a preproduction model in his driveway and began wiping the dashboard with a cloth. Suddenly, the air bag blasted into his face.

The manufacturer suspected electronics and called in Mardiguian. He worked with engineers, hitting the air bag sensor with multiple electronic signals, using a Taser-like device to create static electricity and turning the heater on just like the driver did. (Mardiguian declined to identify the automaker.) Four days of extensive testing passed, but the problem couldn't be reproduced.

Finally, someone on the assembly line noticed an errant wire that was causing a short on some of the cars. Still, engineers couldn't make the air bag deploy. But when they hit the air bag sensor with static electricity and directed the heater vent at it, it popped.

"Electromagnetic interference leaves no trace," Mardiguian says. "It goes away just as it came."

Could that be behind Toyota's problem? Toyota says it's not.

Mardiguian disagrees.

"An automaker who declares bluntly that uncontrolled acceleration cannot be caused by electromagnetic interference because they have fully tested their vehicle is a liar, or naive," he said.

Nearly all automakers have big, sophisticated labs that test their products for electronic glitches. Chrysler Group LLC, for instance, says it goes far beyond what cars will encounter in the real world and beyond standards set by the European Union or Japan.

Toyota currently has eight such labs, each half the size of a gymnasium, where the automaker blasts each car and component with electromagnetic energy.

Even so, is the testing sufficient? Some experts say automakers' labs don't have the time to replicate real-life conditions that vary with temperature, moisture and age of equipment.

Last year, Ford Motor Co. engineers found that signals from two wires in the Ford Fusion and Mercury Milan hybrids caused the brake control computer to misbehave.

The waves hit a sensor, sending a signal to the computer that it didn't recognize, so it switched off the hybrid's electric brakes and went to the backup hydraulic brakes, according to a Ford service bulletin.

"In the real world, there's all sorts of different things that can happen," said Keith Armstrong, a British electronic engineer and consultant who advises companies on electromagnetic interference.

Even if problems do crop up, backup technology should prevent the original glitch from turning into a catastrophic crash.

Airplanes, for example, are heavily shielded from electromagnetic signals and have as many as four independent systems that control devices such as flaps and the rudder. If one fails, another takes over.

Cars also have backup systems. Automakers say they prevent malfunctions and note that reports of problems are few given the number of vehicles on the road.

Most German automakers, Nissan Motor Co. and Chrysler, for example, have programmed their cars to cut engine power whenever the gas pedal and brake pedal are hit at the same time. If the throttle is stuck, for whatever reason, this "smart pedal" software gives control to the brake and prevents an accident.

Toyota has a system that kills the throttle when a computer gets unusual signals from gas-pedal sensors. It's also started deploying "smart pedal" software in some models and pledges to add the feature to all of its new vehicles by the end of next year.

Toyota maintains its backup systems are sufficient -- and all performed as expected in testing.

"We've designed our electronic throttle system with multiple fail-safe mechanisms, to shut off or reduce engine power in the event of a system failure. We've done extensive testing of this system and we've never found a malfunction that's caused unintended acceleration," Toyota's Lentz said.

Still, just because no one has found an electronic flaw doesn't mean there are none.

Clarence Ditlow, who leads the Center for Auto Safety, a consumer group, knows of a case of unintended acceleration in which a car had no floor mats, no sticking gas pedal and the driver clearly was pressing the right pedal because the brakes were scorched from heat.

"What else is there other than electronics?" he asked.

Associated Press Writers Ken Thomas in Washington, Jordan Robertson in San Francisco, Harry R. Weber in Atlanta and Dan Strumpf in New York contributed to this report.

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