



## SAM 2.0 Enables Quadriplegic Race Car Driver Sam Schmidt to Drive

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By Lynn Walford

Off-the-shelf technology enables IndyCar driver Sam Schmidt to drive in the Toyota Grand Prix of Long Beach, this weekend as part of the SAM (Semi-Autonomous Motorcar) Project.

Sam Schmidt can drive, even though he was paralyzed in a racing accident in 2000. Previously, at the 2014 Indianapolis 500, he drove the first version of SAM in the qualifying trials. This year, as part of SAM 2.0, technology has been updated through the collaboration of Arrow Electronics, Freescale Semiconductor, Schmidt Peterson Motorsports, and Conquer Paralysis Now.

“The response at Indy 500 was overwhelming. Sam is a hero in racing,” said Joe Verrengia, global director of corporate social responsibility/co-director of the SAM Car project, Arrow Electronics. “Not only did the crowd cheer, all the other Indy race car drivers came out and congratulated Sam on the track.” Schmidt was able to drive at speeds of 97 mph, and 107 mph a week later.



Image: Arrow

A 2014 Corvette C7 Stingray is equipped with technology to enable Schmidt to operate the car. The SAM 2.0 Stingray is controlled by Schmidt’s head movements and breath with help from a computer system, algorithms, and a safety system.

The SAM car system was specifically designed for Schmidt with technology currently available and programmed by Arrow says Noel Marshall, applications engineer, Arrow Electronics , who noted that there are multiple processors that control actuators that “go on top” of the existing car controls. A co-driver sits in the passenger seat, who can take control of the car with a joy stick, if necessary.

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Image: Arrow

The computers don't make the driving decisions, like in a self-driving car says Verrengia. Sam Schmidt is a race car driver. His actions control the car. Schmidt, since the accident, has remained active in car racing. He is the owner of the Schmidt Peterson Motor Sports racing team.

Four sensors mounted on Schmidt's hat connect to infrared cameras mounted on the dashboard that detect his head tilt motions in order to steer the car. The windows are tinted and feature infrared screening to optimize camera performance. In SAM 2.0, enhanced cameras, programming, and networking enable more detailed recognition of his head movements. These enhancements allow him to navigate a complex road course such as the Toyota Grand Prix of Long Beach that is completed on actual streets in the city of Long Beach.



Image: Arrow

Schmidt controls a sip/puff device with an air tube in front of his mouth, blowing air into the tube accelerates the car and sipping air controls the brakes. He blows air into the tube proportional to the desired intensity of acceleration, similar to the intensity applied by a foot to a car's gas pedal. To slow down, he sips air through the same tube. The computer system's central processors collect signals from the camera and mouth control to control acceleration, braking, and steering.

A safety system is powered by algorithms to make sure commands sent to the computer system are real and defined within the car's limits. For example, if Schmidt

sneezes, the head movement will not affect the steering of the Corvette.

The communication between all systems occurring within milliseconds is accomplished based on a series of software algorithms. In SAM 2.0, the control processors have been upgraded to Freescale's Quad core technology to allow for faster data transmissions and more complex algorithm computing.



Image: Arrow

For the Long Beach Grand Prix, GPS will be used to collect data and observe Schmidt's speed while driving, says Marshal. She noted that at the Indy 500, GPS was used for pass guidance, to keep the car from drifting out of the lane.

Arrow is guiding the SAM project forward in the hopes that it will improve mobility for people with disabilities and demonstrate the power of innovation.

"You can take technology off the shelf and think about ways to get the disabled, abled. Think beyond what is out there now," said Marshal who beamed, "When I see Sam, when he presses the gas pedal, he smiles and I can tell he's having a great time. It makes me laugh, every time. He's having so much fun."

The SAM car is displayed at Arrow headquarters in Denver, Colorado and goes for visits with Schmidt to VA hospitals. The next race Schmidt will drive SAM 2.0 will be the Austin Grand Prix on October 25.

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