All about Junior (10/26/2007)

The body

Make and model: 2006 Volkswagen Passat wagon
Engine: 4-cylinder turbo diesel injection
Transmission: Six-speed direct-shift gearbox
Engine cubic capacity: 1968cc
Fuel Consumption: City: 25.5 mpg (9.2l/100km), Highway: 42.7 mpg (5.5l/100km), Combined: 34.6 mpg (6.8l/100km)
Power: 140 hp (103kW) at 4000rpm
Torque: 236 lb ft (320Nm) at 1800-2500 rpm
Top speed: 126miles/h (203km/h), Acceleration: 0-100km/h: 10.1sec
Engine provides power through a high-current prototype alternator and a battery-backed, electronically-controlled power system.

The senses

Cutting-edge sensors and custom AI software enable Junior to determine its position and perceive its surroundings, day or night, even in adverse GPS conditions.

Position: Position and orientation are estimated by an Applanix POS LV 420 system that provides real-time integration of multiple dual-frequency GPS receivers, a high-performance inertial measurement unit, wheel odometry, and Omnistar's satellite-based Virtual Base Station service. Real-time accuracy is ~50cm and 1/50th of a degree.

Localization: Junior's position and the path on the road are both optimized in real-time with the help of several active sensors. Two side-facing SICK Lidars along with a forward-facing RIEGL LMS-Q120 Lidar, allow Junior to find lane markings from brightness differences in the ground and improve position estimation to within 5cm.

Perception: For object detection and tracking, a Velodyne HD Lidar looks in every direction 10 times a second, combining 64 individual lasers into millions of 3D points at up to 65m range. Five BOSCH radar sensors point straight and to each side to track up to 32 obstacles simultaneously over a range of 200m. Two IBEO ALASCA XT Lidars in the front and two SICK LD-LRS Lidars in the rear handle ranges up to 100m. These sensors allow for continuous, high-accuracy coverage of the environment.

The brains

Hardware: Rackmount servers with two Intel quad-core processors process sensor data up to 20 times a second and run Junior's artificial intelligence software.

Software: Junior's intelligence comes from a suite of integrated, custom-coded modules, including a planner (making decisions, choosing paths), a mapper (transforming sensor data into environment models), a localizer (refining GPS position and road map structure from lane markings), and a controller (turning decisions into driving).