Case Study: University of Nebraska–Lincoln

Using CAN to Develop the Future of Agricultural Machinery

The University of Nebraska–Lincoln (UNL) is renowned for its agriculture and natural resources program, long a home to groundbreaking research in agricultural sciences and landscape management. It's no surprise, then, that the tractor plays an important role for the school, both in the curriculum and in research.

Agricultural machinery is on a parallel track with the automotive industry regarding the use of computers and electronics. Modern-day tractors utilize the controller area network (CAN) bus to facilitate communication between various MCUs and for sensor data acquisition. The ISO 11783 protocol defines the communication standard for the tractor communication network. This is based on SAE J1939, a communication standard for off-road machinery.

Assistant Professor of Advanced Machinery Systems, Santosh K. Pitla, Ph.D., relies on the Kvaser Leaf Light HS v2 and two-channel USB devices, such as the Kvaser Memorator Pro HS/LS and the Kvaser USBcan Pro 2xHS v2, to develop automated solutions to pressing agricultural issues.

Dr. Pitla is working on two projects that require communicating with and developing for the CAN bus to improve efficiencies in large-scale farming situations.

Building an Autonomous Agricultural Vehicle Platform

Project 1 is developing CAN-based autonomous agricultural vehicle platforms. Industrial farming runs on efficiency, and this is driving a desire for driverless tractors and the ability to have one person operating multiple machines.

This project builds on an existing autonomous vehicle platform (AVP) to create a field-usable 40-horsepower robotic vehicle – nicknamed the “Flex-Ro” – which is variable in height and width to navigate through fields of crops in different row spacing and at different stages of growth.

A Kvaser Leaf Light HS v2 establishes the connectivity between high-level software and the distributed

CAN controllers on the autonomous platform. The high-level software, which incorporates Kvaser's built-in libraries, was developed in Visual Basic .NET. It allows researchers to read and write messages to and from the CAN bus, and to generate control points that distributed embedded controller networks need to achieve.

Messages are sent to the drive motor to determine speed and to the steering actuator to change the direction of the vehicle. The Flex-Ro is equipped with front and rear infrared (IR) sensors to detect obstacles. When one of the sensors is triggered by an obstacle in the vehicle's path, a flag is raised and a CAN message is sent to stop the vehicle.

CAN data gathered from field tests will help to create a more robust distributed control architecture that can be used as the basis for developing more complex automated agricultural machinery.

Using CAN Data Analysis to Determine More Accurate Tractor Power Consumption

"UNL's agricultural robotics research program will greatly benefit from its association with Kvaser..."

Project 2 aims to determine more precise load demands for tractors performing various field operations. Based on the task, the terrain, the implements used, the time of year and the operator, the load demands on a tractor can vary widely. Load demand projections for various field operations (and using various implements) are currently available, but the range of variation can be as much as +/- 50%. By collecting and analyzing CAN bus data gathered in the field in varying conditions, this project will create a better understanding of actual tractor power consumption in different working states to create more accurate estimations of average load conditions.

The Kvaser USBcan Pro 2xHS v2, a two-channel USB device, is ideal for collecting CAN bus data from tractors in the field. The device is connected to the tractor's ISOBUS communication port that is located inside the tractor cab so it is protected from the elements and not exposed to dust and rain in the field. The USBcan Pro 2xHS v2 uses an SD card for storage, so months of field data can be collected and stored directly on the device.

The typical tractor has a two-channel ISO diagnostic port. Channel 1 provides engine performance data such as fuel use, engine speed and torque, while Channel 2 provides data regarding the implement in use, such as sprayer-nozzle status and planter-row-unit status. Gathering and decoding this data from both CAN channels during different field operations in different terrains and conditions as well as using various implements will allow for true tractor and implement performance to be assessed, weighted and averaged, leading to improved fuel consumption estimates and more efficient tractor and implement matching.

Universities Using Kvaser Devices

Dr. Pitla is thrilled to be using Kvaser CAN interfaces to complete these research projects. "UNL's agricultural robotics research program will greatly benefit from its association with Kvaser," he said. "Excellent developer support, software libraries, resource and documentation for their products make them attractive to university research programs."

Kvaser is a longtime supporter of university research involving the CAN bus. We are proud to be a resource to the next generation of CAN innovators. To learn more about our university sponsorships, visit www.kvaser.com/about-us/university-sponsorships.

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