BMW Ultimate Embedded Vehicle-Performance Monitor

The goal of this ME218D project is to produce a first prototype of a device to monitor, record and present the driving performance characteristics of a BMW automobile to a driving enthusiast.

For technically-inclined BMW driving enthusiasts, it would be very interesting to have access to the wide range of vehicle performance sensor data, such as vehicle speed, torque, RPM, steering angle, yaw rate, brake setting, ABS system state, stability-control system state, traction-control system state, throttle position, etc., all of which are available on the vehicle's CAN bus.

It would be even more interesting to process the raw sensor data into performance curves that show vehicle performance via a graphical output.

Sample user scenarios

1. Kristin owns an M Roadster and treats herself to the occasional day on the race course with fellow driving enthusiasts. During her drives, Kristin uses her Ultimate Embedded Vehicle-Performance Monitor to store data from the various sensors in her BMW. Between laps, Kristin views the recommended and actual shift points for the just-completed drive on her PDA, based on the data which has been collected by the embedded monitoring system. Software running on Kristin's PDA allows her to compare graphs, charts and statistics for many other performance measures of her BMW with her fellow enthusiasts, in near real-time.

2. Albert enjoys taking his 5-series BMW out for drives on remote routes that require extended periods of skilled driving. After returning home, Albert moves the raw data recorded by his Ultimate Embedded Vehicle-Performance Monitor over to his home PC, via a wireless or wireline connection, or by a removeable media device. After especially interesting drives, Albert combines the recorded performance data with recorded GPS coordinates and uses software running on his PC to plot the drive data onto a map. Albert also keeps a record of the statistics for repeated trips over the same route, and uses this information to monitor both his driving skill and the performance of his BMW.

Project deliverables

Currently available devices that interface to the CAN bus are primarily intended for use by trained operators in diagnostic and repair situations, and are neither inexpensive nor "product-like" enough to be used in this role.

We would like an ME218D student team to develop a device with the following general features:

- A electrical hardware interface to the CAN bus in a BMW (e.g., a 3-series/E46)
- Firmware running on an embedded microprocessor or computing platform to monitor, acquire and record CAN bus messages for vehicle sensors of interest
- A simple, clean wireline control interface (e.g., toggle switches and LEDs) from the embedded monitor to allow the driver to start, stop and reset the taking of data, and to create marks or timestamps at moments of interest
• Non-volatile storage of any user preferences or system configuration settings
• Robust, clean mechanical packaging for all device subsystems.

Further project deliverables for user scenario #1

• An application running on a PDA of the team's choice (within reason), allowing the driver to review features of interest from a just-completed drive, with an emphasis on producing a cool display of something more than raw data. The application could, for example, process the raw sensor data to produce and display power curves, lateral acceleration plots, 0 to 60 times, recommended shift points, etc.
• A simple wireline (e.g., serial) connection between the low-level instrumentation system and the PDA

Further project deliverables for user scenario #2

• A record of the sensor data showing time-stamp and value for all sensors of interest, arranged in some open ASCII format that can be easily plotted
• A convenient way of getting acquired data from the device to a PC (e.g., a wireline download, a wireless download, a removeable MicroDrive, etc.)

We have a very strong preference for a prototype of the system (with PDA) described in user scenario #1. However, we also understand that not every ME218D project team will possess the necessary PDA programming skills. Although we very much encourage teams to consider the PDA version of this project, we also do not wish to automatically disqualify teams that are not confident of their ability to meet that part of the project goal.

Although the concept described in the first user scenario would be most interesting if the link between the embedded system and the PDA were implemented wirelessly, we expect that the available time will not be enough for this to be included in the prototype. Implementing the mapping portion of the second sample user scenario would require interfacing to the BMW GPS and navigation subsystems, which we are similarly not including in the project description.

Since we expect to build upon the results delivered by the ME218D project team, it is very important that they document all aspects of their work in a manner consistent with solid professional engineering practice. In addition, the choice of hardware or processor to use should be based on at least some evaluation of the available alternatives.

Within the spirit of the sample scenarios, the ME218D project team is always encouraged to suggest additional interesting ways to make the prototype more interesting and useful in the time available to them.

Development and testing support

This project will be supported by members of the BMW Technology Office in Palo Alto. Access to a development car in our garage will be made available for the project team during core office hours. This development car will also often be available during the early evening, depending on the schedules of the full-time BMW Technology Office staff.

When the system is sufficiently developed and debugged to be ready for road testing, the team will be able to take the car out to acquire some real data, again depending on the availability of full-time BMW Technology Office staff.