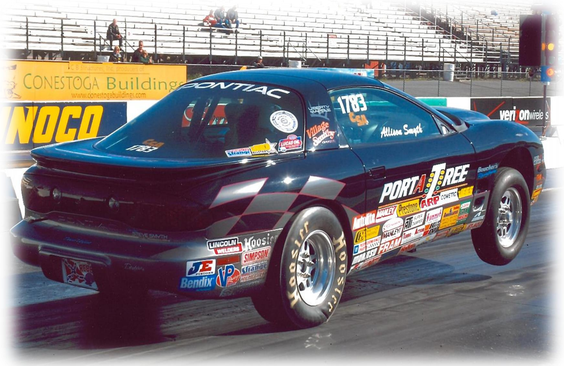

Onboard Weather Station

The Future of Race Car Performance Prediction

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Overview

Weather data including temperature, humidity, and barometric pressure are critical factors in the performance of race cars. In drag racing, cars are particularly sensitive to weather as they are designed to run for short periods of time at maximum power. Consequently, all drag racers (sportsman and professional) use weather stations to predict or tune their vehicle. Until recently it was assumed that a static weather reading before a run was sufficient to predict car performance. In 2009, the Smyth family race team found this to be false. Weather fluctuations during a race also alter car performance causing races to be lost. For this reason, the Onboard Weather Station, a weather station that can be mounted in a race vehicle, was designed, built, and tested.

Design

Two devices compose the Onboard Weather Station: the main module and the external module. The main module is placed in the driver compartment of a vehicle (Fig. 2) while the external module is placed in the engine compartment to monitor weather (Fig. 3). The main module waits for a trigger (mechanical switch or race condition) to record data at a specified sample rate. The trigger and sample rate are selectable by the user through the software created to interact with the weather station. When sampling, the device requests weather data from up to 4 external modules through the controller area network (CAN) bus. It stores the data including battery voltage, g-force, RPM, temperature, barometric pressure, and humidity on a secure digital (SD) card or in flash if the SD card is absent. The data can also be wirelessly transferred to a PC during the run. After the race, data can be downloaded to the software using the USB connection on the main module. Through this connection, new run parameters can also be sent to the weather station. The software then calculates corrected altitude (CALT) and vapor pressure to predict car performance. Fig. 3 is an operational diagram.

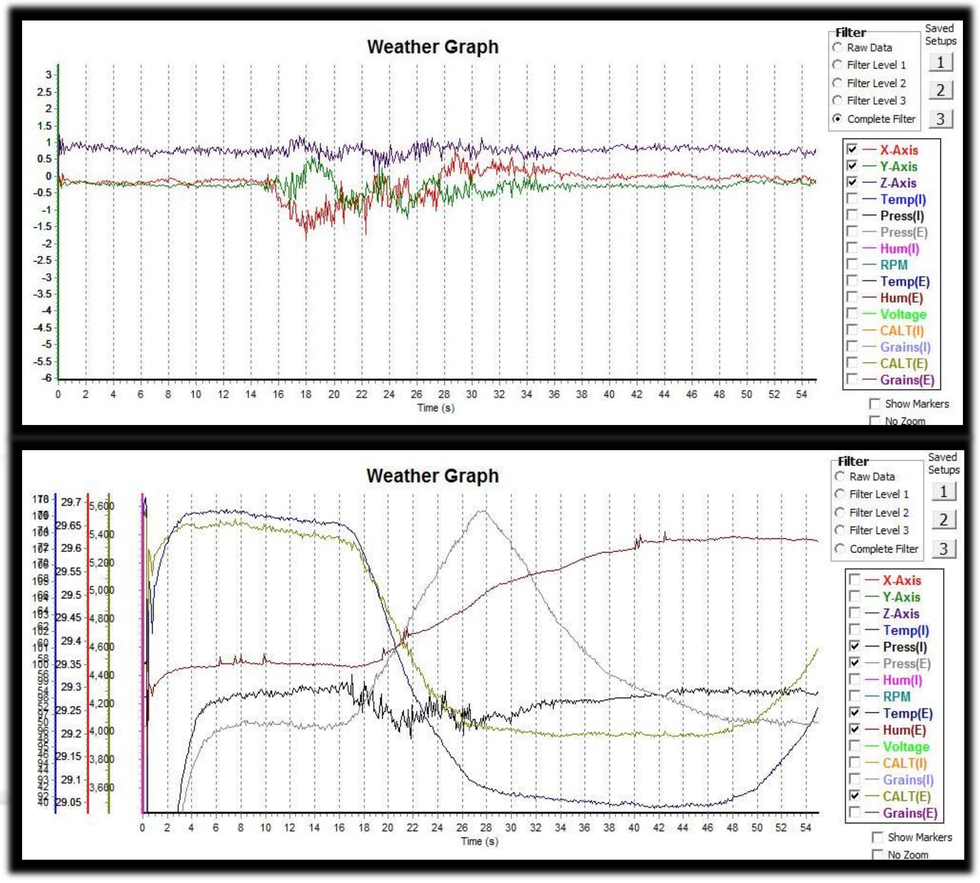

Figure 4: Accelerometer data (top) and weather (bottom) from intake of 1998 Pontiac Firebird during race. Note: Data collected by prototype weather station.

Results

The Onboard Weather Station was successfully designed and constructed. The SD card, USB, CAN bus, and sensors were tested thoroughly. Though the sensors properly collect data, calibration should be performed on a final product to improve accuracy. The system is setup to support this. The CAN bus can handle 2 external modules. Testing for 4 will occur in late May. The SD card and flash circuitry functions without fault, and the USB data connection transfers flawlessly. All sampling and storage occurs within the minimum time specification of 20ms. The created software is able to change system parameters, test weather sensor modules, and view and graph collected data (Fig. 4). The race in the figure is from 18 to 28 seconds. One can see that the static readings from the start of the run (around 10 seconds) do not adequately represent the weather during the run.

Conclusion

The goal of this project was to design and build a weather station mountable in a race vehicle to collect, log, and transmit weather data during a race. Such a device, the Onboard Weather Station, was successfully constructed and found to meet design specifications. All sub-systems have been tested and are fully operational. The device is undergoing on-car testing at the current time. Preliminary results show that a weather station of this type is able to capture changing weather conditions during a race. Therefore, the main goal for this project was accomplished.

Acknowledgments

Special thanks to Bruce Land, advisor of this Masters of Engineering Design Project and Portatree Timing Systems Inc., the official sponsor (www.portatree.com).

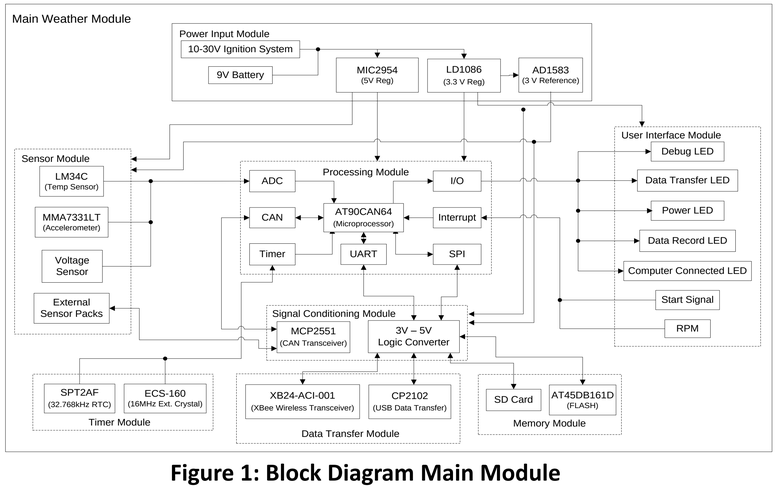

Figure 1: Block Diagram Main Module

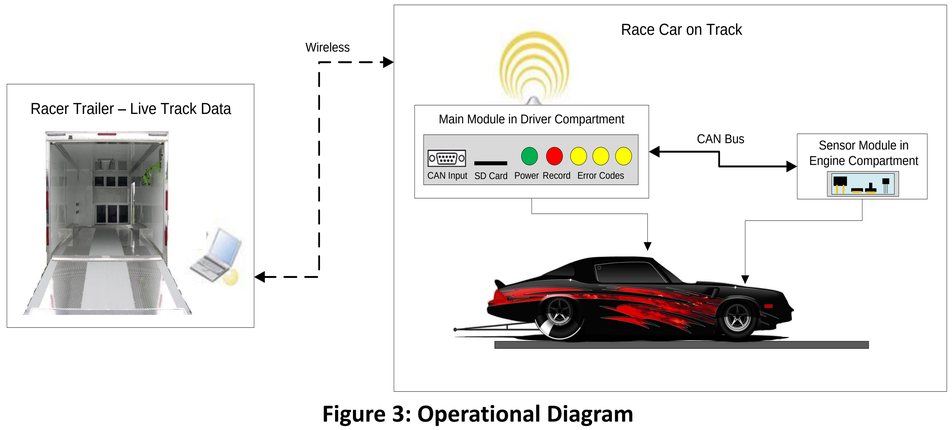

Figure 3: Operational Diagram

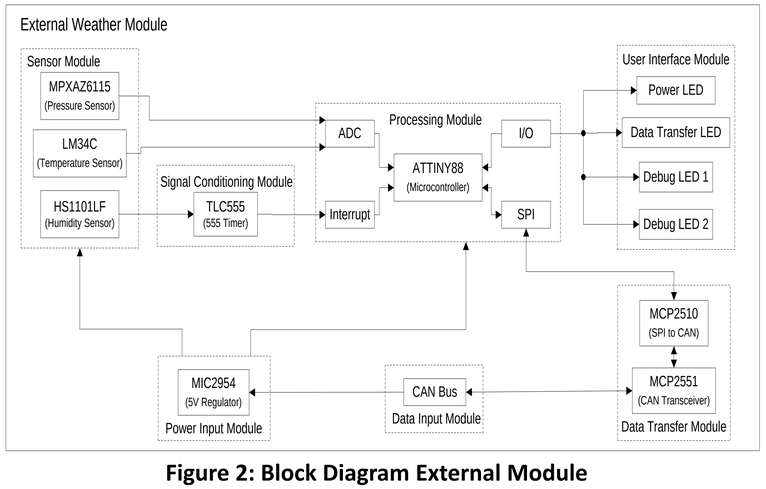

Figure 2: Block Diagram External Module