EXECUTIVE SUMMARY

The University of Michigan Baja Racing Team is committed to continuous improvement in design and performance at competition. The team has identified a vehicle dynamics data acquisition system with real-time feedback as a means of improving lap times. The Baja team is interested in their driver knowing certain vehicle characteristics, such as vehicle speed and roll, so that the driver can better tune his/her approach to obstacles. The team also wants to record the data for further analysis later to aid in driver training and car design. To accomplish this, the team is sponsoring this project; the focus of which is the development of a custom data acquisition system for the Baja car that features a driver oriented display as well as data recording capability.

The requirements for this project were largely dictated by the sponsor, though there are a few requirements created by the SAE Baja Competition Rules. The most important requirements are as follows: the driver must retain speed and roll information while looking at the display for no longer than 0.5 seconds, the sensors must survive the harsh competition environment (attaining an IP67 rating when possible), the driver interface must have less than 4 buttons, and the system must be able to record data for four hours continuously.

The electronic system has been designed, built, and tested. The microcontroller chosen is an Arduino Mega. The sensors include a Hall Effect sensor for output gear speed, roll will be calculated with a three-axis gyroscope and accelerometer, fuel level with a flow rate sensor, engine RPM with a custom inductive circuit around the spark plug wire, CVT temperature with IR temperature sensors, throttle position with a linear potentiometer, and brake on/off with the pre-existing hydraulic pressure sensor on the master cylinder of the brake line. Concepts for how to attach each sensor physically to the car as well as wiring them into the Arduino were generated, then a final design for each was decided upon.

Due to the project requirements, each electronic component must be attached to the car in a robust fashion, and adequately sealed from the environment to ensure consistent performance throughout competition. The concepts generated for packaging thus focused on housings that would protect the components from experiencing these harsh conditions. Commercially available packaging was looked into for benchmarking the screen and the Arduino and battery housings, because these housings are of similar shape and size to what is needed for this project. An off the shelf option was chosen for these components as a result of this research. The other components each require custom housings due to their shape and the application, so casing concepts for the other components were generated and decided upon. These final designs were put into a CAD model and manufactured. Each component that was expected to have an IP67 rating was tested to those standards through both on car testing for dust and submersion in water for waterproofness.

The system is currently working with everything connected and powered on. Further programming of the microcontroller is needed for the system to be competition ready, but every component works individually. The integrity of the housings and the wiring system have been tested by taking the car to the off-road test track and driving for 3 hours. The sensors and housings lasted through this test, which validates the goal of creating a system that is robust enough to run at a Baja competition.