ONU SAE Baja
Data Acquisition System

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SAE Baja Data Acquisition System

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Background

Background - SAE Baja

- First SAE Baja race held in 1976
- ONU is in its 14th year of Baja
  - Olivet Nazarene University's Walker School of Engineering

Background - Data Acquisition

- Olivet has never had a data acquisition system
  - Maximize the reliability and minimize lap time
- Other Baja teams have used systems while at the competition
  - Research on Baja forums
- Worked with ONU's Baja team
  - Highlighted main variables that need to be measured

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Problem Description

Project Scope

- To design, implement, and test data acquisition system
  - Should have multiple sensors
  - Wired to logger
- Data that needs to be logged
  - Independent wheel speed
  - CVT pulley ratio
  - Engine RPM
  - GPS location
  - Accelerometer
- Work with the Baja team
  - Make adjustments as they see fit

Constraints

- Whole logger system waterproof/mud proof
- Handle moderate vibrations
  - Data System needs to be on Baja car
- Data needs log while car is in use at all times
  - Have visible confirmation
- Self powered
- Can be removed from the car if needed
  - Car may be redesigned each year

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Design Alternatives

Design Alternatives

Distributed system

"Smart" sensors process data, central logger aggregates data.

Pros: flexible

Cons: complicated, cost

Centralized system

"Dumb" sensors, central logger processes and aggregates data.

Pros: simpler, cost

Cons: not as flexible

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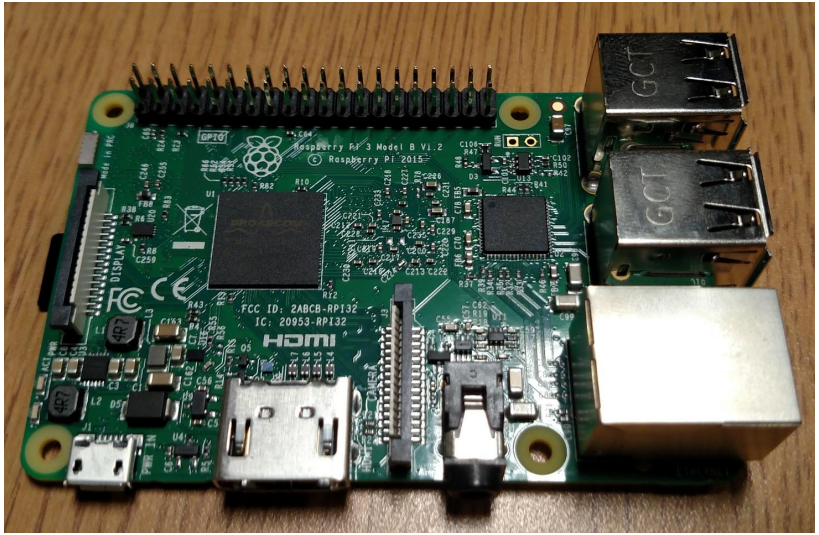
Final Design

Logger

Centralized system based on Raspberry Pi 3



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Wheel Speed Sensors

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Sensor Interface

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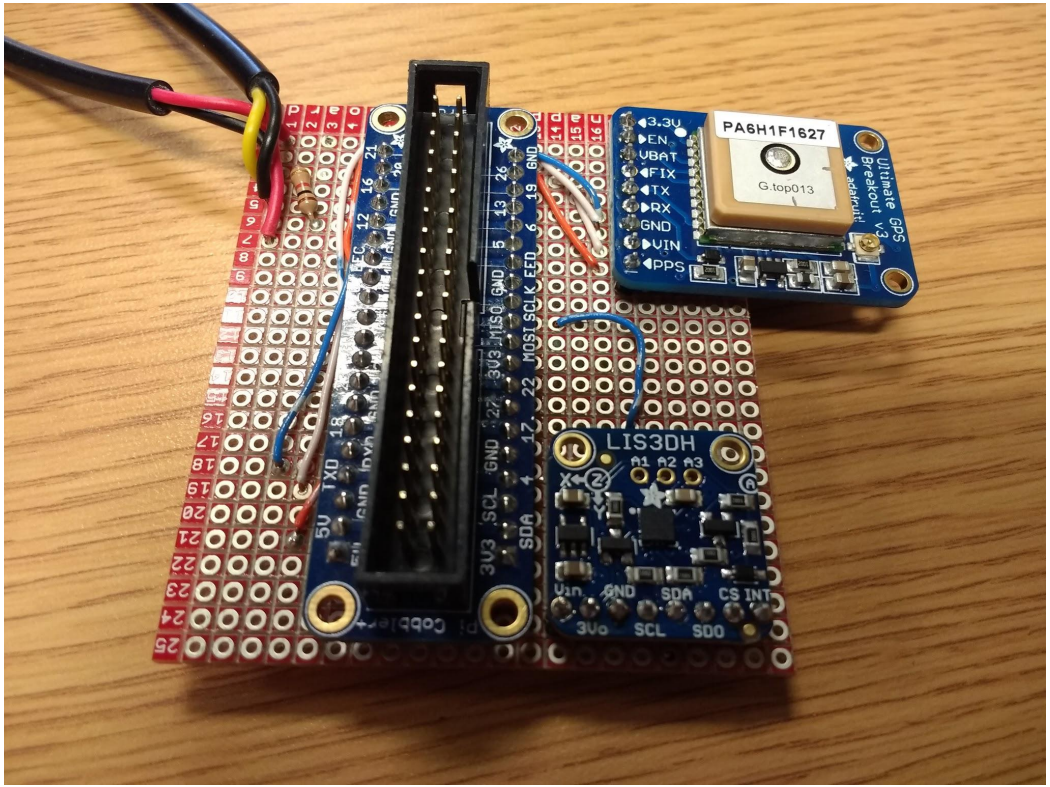
GPS Receiver/Accelerometer



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Wiring

(picture here)

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Power Supply

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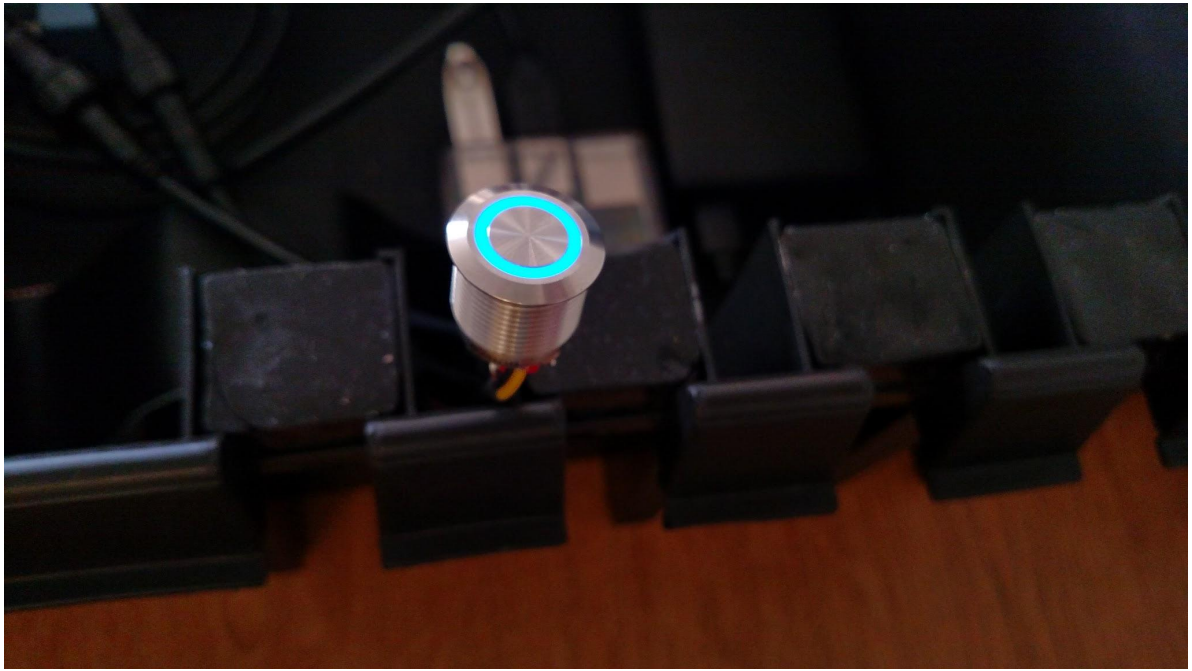
User Interface



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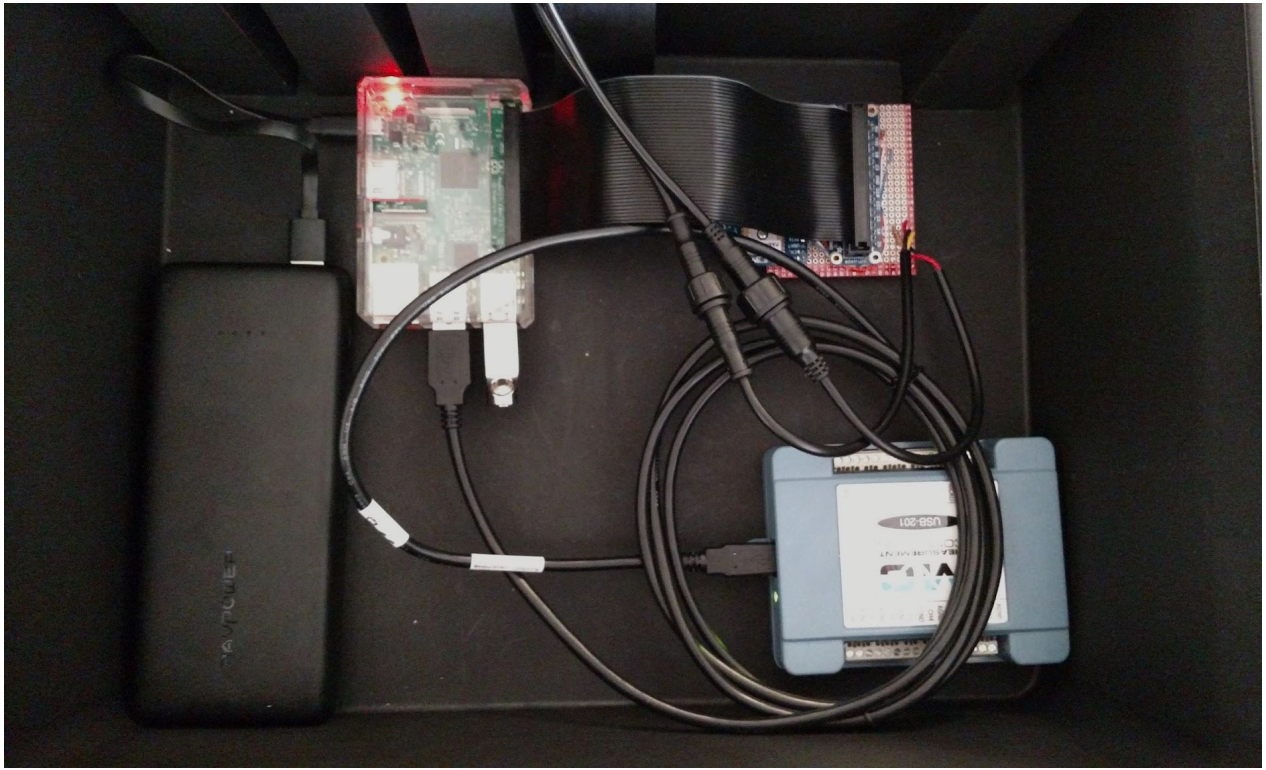
Overall System



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Logged Data

Mon Apr 17 15:22:10 2017															
Metric:	Time	Latitude	Longitude	Speed	X-Accel	Y-Accel	Z-Accel			Sensors					
Units:	HHMMSS	DD.dddddd	DDD.dddddd	m/s	m/s^2	m/s^2	m/s^2								
	152210.9	+41.155845	-87.883563	0.1	0.076633	-0.306533	9.502512	0	0	0	0	0	0	0	0
	152211	+41.155845	-87.883563	0.1	0.076633	-0.306533	9.579145	0	0	0	0	0	0	0	0
	152211.1	+41.155845	-87.883562	0.1	0.153266	-0.383166	9.502512	0	0	0	0	0	0	0	0
	152211.2	+41.155847	-87.883562	0.1	0.076633	-0.306533	9.502512	0	0	0	0	0	0	0	0
	152211.3	+41.155847	-87.883562	0.1	0.076633	-0.229899	9.655779	0	0	0	0	0	0	0	0
	152211.4	+41.155847	-87.883562	0.1	0.076633	-0.229899	9.502512	0	0	0	0	0	0	0	0

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Project Evaluation

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Work Completed

- System that collects and logs...
  - Position
  - Speed
  - Acceleration
  - Up to 8 readings from sensor interface
- Main waterproof enclosure that securely holds...
  - Logger
  - GPS/Accelerometer module
  - Sensor interface
  - Battery
- Mounting brackets with sensors for wheel speed

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Work Completed

- Battery life and digital storage space far exceed requirements
- Interface for driver to operate system
- Preliminary work for CVT ratio and engine RPM
- Installation Guide
- Operation Instructions
- Sensor Diagram

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Testing

- Enclosure durability
- Software verification and validation
- GPS accuracy
- Accelerometer accuracy
- Component Interoperability

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Work Remaining

- CVT Ratio/Engine RPM
  - software adjustments
  - mount sensors
- Wheel speed
  - software adjustments
  - mount sensors
- Wiring
  - connect sensors to logger
  - fixed with hook and loop straps to car body
- Vibration/Durability testing
- Mount main enclosure
- Complete documentation

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Possible Improvements

- Cooling technology
- Power consumption considerations
- Visualization software
- Wireless technology for logger on/off
- Additional metrics

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