SAE Baja
Data Acquisition System

Team E#5

Milestone #1
Needs Analysis and Requirements Specifications

September 26th, 2014

http://www.eng.fsu.edu/~willidew/baja

The Design Team

Project Manager - Christopher Riker (CpE)
- Ensure deadlines are met
- Maintains communication between team members
- Actively monitors and encourages project progress

Data Coordinator - Tyler Dudley (EE)
- Keeps meeting minutes
- Maintains an organized report archive
- Collects and organizes data from the DAQ prototype

Financial Manager - Dewey Williams (CpE)
- Keeps inventory of project parts
- Maintains project budget ledger
- Requests parts from ECE department
- Writes and delivers sponsorship requests

DAQ Leader - Hebe Perez (CpE)
- Acts as an ambassador between the DAQ team and the Baja team
- Assists financial manager with sponsorship requests
- Coordinates project tasks

Christopher Riker

Code of Conduct

Meeting Times:
Sundays at 1 PM
Sundays at 2 PM with SAE volunteers
Meetings with Project Advisor Tuesdays at 2PM

Document Transfer
Google Drive
Blackboard Group File Exchange

Communication
GroupMe/E-mail

Christopher Riker

Introduction/Background

- The SAE International Baja series is held annually in April/May.
- Teams from around the world compete to complete the most laps in a 4-hour period.
- Each team is supplied with a 10 Hp Briggs & Stratton engine that cannot be modified.
  - Focus is placed on the design reliability and the creativity and feasibility of the accessory subsystems.
- The FAMU-FSU Baja team finished 75th in Rochester, NY in 2013 and 46th in Illinois in 2014.
- The DAQ will be designed to assist the team as much as possible to improve their status even further in the 2015 competition.

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Statement of Needs

- The Baja team hopes to make more efficient and effective changes to the vehicle before and during a race.
  - The team currently makes calculated guesses to determine when to make changes
- The Baja team wants the DAQ to provide them with the following during the race:
  - Fuel level
  - Tire pressure
  - Speed
  - Acceleration
  - Speed
  - Vibrations (to improve driver comfort)

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3 Why are the subsystems listed by 3?
Hebe Perez,

Marketing Requirements

- ***Customer Needs***
  - Measurements of:
    - Speed
    - Fuel
    - Acceleration
    - Vibration
    - Tire pressure
  - Mirrored indicator lights for low fuel and tire pressure
    - Displayed to both driver and pit
- ***Customer Wants***
  - Speedometer and fuel gauge
  - Driver-to-pit communication

Hebe Perez

Prioritization Analysis

	Aesthetics	Cost	High Performance	Ease of Use	Modularity	Geom. mean	Norm. Mean
Aesthetics	1	1/7	1/9	1/9	1/7	**0.296**	**0.044**
Cost	7	1	1	3	1/5	**1.332**	**0.200**
High Performance	9	1	1	3	3	**2.408**	**0.361**
Ease of Use	9	1/3	1/3	1	1	**1.000**	**0.150**
Modularity	7	5	1/3	1	1	**1.635**	**0.245**

Hebe Perez

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Prioritization Analysis

- Ranking in Order of Importance:
  1) High performance
  2) Modularity
  3) Cost
  4) Ease of Use
  5) Aesthetics
- High performance - the system must provide the team with data in real-time
- Modularity - Will make the system easily repairable
- Ease of use - should require little to no setup on race day. “Plug and play”
- Cost - the system should be developed within the given budget in addition to any outside sponsorships
- Aesthetics - the look of the system does not matter much, as it will be mounted on a dirty car

Hebe Perez

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Ranking of Needs

Needs	Secondary Power Source
	Sense & display peed & fuel level to driver
	Record sensor data to removable media
	Sense tire pressure and report to driver
	Wirelessly mirror warnings/data to pit
	Measure vehicle acceleration
	Measure vibration to improve ergonomics
Wants	Driver-to-pit voice communication
	Suspension travel measurement
	Tachometer
	Camera

Hebe Perez

Slide 9

4 unnecessary
Chris Riker,

Slide 10

1 Dont need this
Hebe Perez,

Preliminary Solution Concepts

- *Speed measurement*
  - Hall Effect sensor with magnet mounted to a wheel
- *Fuel measurement*
  - Float, tentative depending on whether or not the fuel tank can be modified
- *Acceleration*
  - Accelerometer mounted somewhere near the center of the vehicle
- *Tire pressure monitoring*
  - Similar approach to production automobiles
  - Pressure sensor in the valve stem that sends an IR signal to a sensor mounted on the body
    - one for each wheel
- *Communication*
  - Radio module
    - potentially one for voice comm. and one for data transmission depending on throughput

Hebe Perez

Requirements Specifications

Tyler Dudley

Functional Requirements

Req. ID	Requirement Description
REQF-001	The system must accurately measure and report the speed of the vehicle.
REQF-002	The system must accurately measure and report the fuel level of the vehicle.
REQF-003	The system must accurately measure and report the linear acceleration of the vehicle.
REQF-004	The system must measure and report the intensity (frequency and amplitude) of vibrations in the vehicle.
REQF-005	The system must accurately measure and report the tire pressure of the vehicle.
REQF-006	The system must accurately measure and report the suspension travel.
REQF-007	The system must alert both the driver of the vehicle and the pit crew if the fuel or tire pressure is below a certain threshold.
REQF-008	The driver must be able to communicate with the pit crew wirelessly with reasonable sound quality.
REQF-009	The system must display the speed and fuel level to the driver in an easy-to-read display.
REQF-010	The data collected by the DAQ must be stored in an SD card for later use.

Tyler Dudley

Non-Functional Requirements

Req. ID	Requirement Description
REQN-001	The system must be designed and implemented within an initial budget of $600, with the possibility of obtaining more funds through sponsorships.
REQN-002	The system must be completed before the Auburn, AL Baja competition on April 9th, 2014.
REQN-003	The system must include its own power source - the Baja vehicle's battery may not be used.
REQN-004	The system must be easy to use for both the driver and the pit crew.
REQN-005	The system must be easily repaired (i.e. modular) so that the entire system need not be taken apart in the event of part failure.
REQN-006	The system must maintain a high level of performance.

Tyler Dudley

Constraints

Req. ID	Requirement Description
CONS-001	The system must be completed within an initial budget of $600
CONS-002	The system must be completed before the baja competition on April 9th, 2014
CONS-003	The system must be designed to withstand external temps of 100 degrees celsius
CONS-004	The vehicle's engine cannot be modified in any way.
CONS-005	The data transmission range must be 3 miles urban.
CONS-006	The system cannot add a significant amount of weight to the system.

Tyler Dudley

Operating Environment

Req. ID	Requirement Description
OE-001	The vehicle will be operated in an outdoor environment. The system should be durable and resistant to outdoor particles such as dust and dirt.
OE-002	The system will be subject to high temperatures and UV radiation from the sun, as well as ambient engine heat.
OE-003	The system will be subject to large amounts of shock and vibration.
OE-004	The communication system may be subject to RF interference.
OE-005	The system may be subject to rain and other weather conditions.

Tyler Dudley

Environmental and Safety Requirements

Req. ID	Requirement Description
EHS-001	Special care will be taken in choosing the system's power source. It must be recyclable with minimal environmental impact, and it must last for a large number of recharge cycles.
EHS-002	To ensure the safety of the Baja driver and other drivers on the track, the system must not interfere with or undermine any essential systems of the vehicle.
EHS-003	The system must be attached to the vehicle securely to prevent creating a hazard for other drivers.
EHS-004	As the Baja may be subjected to rain or other water sources, it is important that the DAQ be resistant to water, and that systems are in place so that the Baja is safe to operate and repair when wet.

Tyler Dudley

Usability Requirements

Req. ID	Requirement Description
REQU-001	The system must be easy to use by both the driver and the pit crew to allow them to focus on the competition
REQU-002	The system must not require a significant amount of setup work to run.

Tyler Dudley

Reliability

Req. ID	Requirement Description
REQR-001	The system must remain functional for the entirety of the race, which lasts 4 hours.
REQR-002	The components of the system must be easy to replace or repair in the event of failure.
REQR-003	The system must remain securely mounted to the vehicle at all times during the competition.

Tyler Dudley

Preliminary Test Plan

Hebe Perez

Requirements Test Plan

Req. ID	Requirement Description
REQT-001	Compare hall effect count with manual count
REQT-002	Accelerometer tumble test
REQT-003	Visual confirmation of display
REQT-004	Use the sensor to detect a premeasured amount of fuel
REQT-005	Sensor output will be compared with a standard tire pressure gage
REQT-006	Manually trigger a notification event and verify if the system reacted appropriately
REQT-007	Send data to the SD card and review SD card data
REQT-008	Audio Confirmation of voice communication
REQT-009	Compare sensor travel distance measurement to a manually measured value

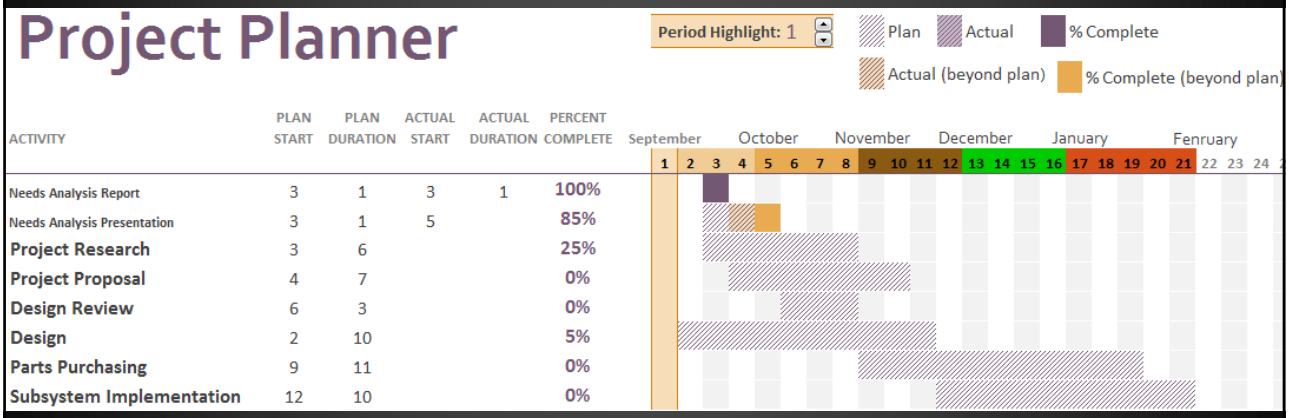
Hebe Perez

Constraints Test Plan

Req. ID	Requirement Description
CONST-001	The financial manager will keep an up-to-date ledger of expenses and remaining funds so that the project does not go over budget. This information will be made available to the DAQ team as well as the faculty advisors.
CONST-002	Any parts which may be placed near the engine will be chosen so that the external heat does not exceed the device's safe operating range.
CONST-003	Communication systems will be tested at distances exceeding 3 miles in an urban environment to verify complete and reliable data transmission.
CONST-004	The system will be weighed regularly to ensure unnecessary weight is not added to the vehicle.

Hebe Perez

Preliminary Project Schedule



ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Needs Analysis Report	3	1	3	1	100%
Needs Analysis Presentation	3	1	5		85%
Project Research	3	6			25%
Project Proposal	4	7			0%
Design Review	6	3			0%
Design	2	10			5%
Parts Purchasing	9	11			0%
Subsystem Implementation	12	10			0%

Christopher Riker

Conclusion

- System to be completed on April 9th, 2015
- Will provide Baja team members with useful data
- Will also provide the Baja team with more points in the design portion of the Baja competition
- May lead to more intricate electronic systems in future competitions

Christopher Riker