Auto-Logger

Group 13

Zachary Ross – EE

Hassan Siddiqui – EE

Justin Wright – EE

Goals & Objectives

As the war between groundbreaking electric or hybrid engines and conventional internal combustion engines wages on, the health of our planet continues to deteriorate at an accelerated rate. In an effort to turn the tables in favor of electric vehicles we have decided to create a device that will actively monitor specific transportation and characteristic drive data in order to show, plain and simple, the numerous advantages of switching from vehicles with combustion engines to those with electric or hybrid engines. In addition to providing strong supporting evidence to push the electric agenda, we can also use such a device to gather data in order to conduct research on UCF's parking infrastructure. This could include both standard parking and EV outlet parking for electric vehicles. We will be working hand-in-hand with UCF as they will be making use of the data our device collects. The final goal will be to create a device which automatically logs and uploads the desired data to a server at UCF's Florida Solar Energy Center in Cocoa Beach, Florida.

The autonomous monitoring device will collect a robust amount of data in order to address our agenda. In order to adequately express advantages of electric vehicles, data on gas combustion rates including miles driven, engine stress including RPM and radiator temperature, and oil levels will be collected. With this information we can make a strong comparison between combustion engines and electric or even hybrid engines and their impact on your wallet and the environment. To address parking infrastructure on the UCF campus our device will log data regarding the vehicle's location with an integrated GPS acquisition module, overall time spent on campus including time parked using the onboard clock on our chosen microcontroller, and even duration of time spent accessing one of the EV charge stations if implemented on electric vehicles.

Our device will incorporate custom microcontroller fabrication in an attempt to minimize housing space within the vehicle, we expect the device to be small and discreet enough to fit within the driver's legroom without notice. This microcontroller will interface directly with the vehicle through the standard OBD-II port within the cab of the vehicle. The OBD-II port protocol varies amongst manufacturers, so our device will most likely be tailored to a specific make and model to prevent errors in the data we collect. In an attempt to drastically reduce the cost of our project we plan to make use of the UCF Wi-Fi system to upload all the data we collect to the FSEC servers in Cocoa instead of charging the drivers additional fees, or including them in our own budget, for cellular data we might use.

Constraints & Standards

Constraints:

1. Available Power

   Device is limited to 12 volts set forth by the SAE J1962 port standard, mandating that pin 16 supplies 12 volts from the vehicle.

2. Vehicle age

   Because the OBD-II standard was only implemented in vehicles produced after 1996, the device can only reliably function on cars that strictly follow the standard outlined by SAE J1962

3. User error

   Take into account of user error so that damage doesn't come to the device, protective casing will need to be manufactured and a non-invasive mount will need to be designed such that the driver's ability to drive isn't impeded in any manner.

4. Size constraint

   In order to prevent interference with the driver, device size should be no larger than 10cm x 5cm with a height of 5cm.

5. Signal Strength and Participant Data Consumption

   In order to communicate with the FSEC online server, data must be sent either through the driver's phone or directly from the device itself. If UCF Wi-Fi signal reception is weak at most parking spaces, it will render direct data transfer via Wi-Fi impossible. If the device cannot detect a Wi-Fi signal before the data threshold is reached, then it must use the driver's mobile data as a conduit to relay the information to the FSEC database.

When Events Occur:

- Vehicle characteristic logging
  - Acquired while driving; recurs every 30 seconds
- GPS location logging
  - Tracks location of vehicle; recurs every 10 seconds
- Data log upload (memory dump)
  - Occurs when connection is available; recurs at least once a day
- Time logging
  - On unique event (Geolocation/Vehicle Power)

Standards:

- Wi-Fi
  - Must comply with FCC wireless transmission standards so the device doesn't cause interference with other devices or cause a safety hazard to people and animals near the transmission device.

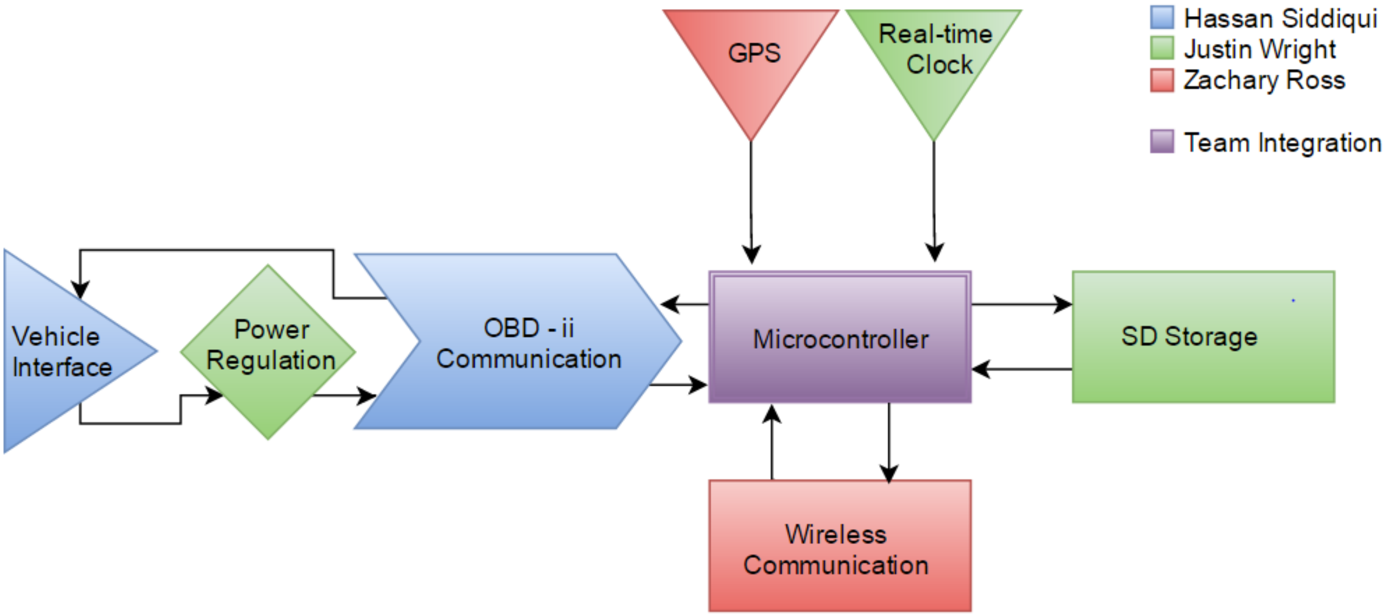
- GPS
  - National Marine Electronics Association (NMEA) protocol is the standard data format used by GPS satellites

- UART
  - This is a microchip device that translates data between parallel and serial forms. UARTs are commonly used in conjunction with communication standards such as RS-232, RS-422 or RS-485. This will be used to translate data between the OBD-II interface and the microcontroller for efficient communication.

- OBD-II PIDs
  - The standards below are data transfer and format standards to communicate with the different types of diagnostic systems on every car approved by the SAE J1962 standard built after 1996
    - CAN
    - ISO
    - PWM
    - VPW
  - SAE J1962
    - Universal Standard that mandates the pin-output of the OBD-II port. Requires a minimum amount of diagnostic information such as emission rates and fuel consumption, to provide all vehicles with a robust diagnostic system.

- Secure Digital Card (SD card)
  - Method in which the device will save acquired data to on-board memory.

Block Diagram



GPS: The receiver will be acquired but the programming and data processing will be designed

Real Time Clock: Crystal oscillator and microchip will be acquired but circuit integration and programming will be designed

Wireless Communication: Module will be acquired in order to comply with the FCC regulatory standards and testing

Microcontroller: From existing microcontroller technology, custom PCB and associated software will be designed to integrate the system into a single package.

SD storage: Circuit will be designed for integration with the microcontroller, software will be optimized for transfer speed.

OBD-II Communication: PCB will be designed in its entirety except for a number of chips that must be used in order to comply with existing OBD-II and various SAE PID communication protocols

Power Regulation: Will be designed to step down the power output from the vehicle to a level suitable for use

Vehicle interface: Provides a power source and diagnostic information supplied by the manufacturer.

Estimated Budget

Device	Quantity	Price	Total
Custom PCB	5	$20.00	$100.00
Microcontroller	1	$50.00	$50.00
Wireless Communication module	1	$12.00	$12.00
OBD-II Connector (male)	1	$4.00	$4.00
Crystal Oscillator	1	$1.50	$1.50
GPS Receiver	1	$50.00	$50.00
ELM329	1	$21.00	$21.00
ELM320	1	$14.50	$14.50
ELM322	1	$14.50	$14.50
ELM323	1	$15.50	$15.50
Voltage Regulator	3	$5.00	$15.00
Total Cost			**$298.00**

Time Table

Spring 2016 JANUARY 11, 2016 – MAY 2, 2016 (ROUGHLY 15 WEEKS)

NOTE: * denotes a project milestone

Week 1 Jan 11 - Jan 17)

- Completion of the *Independent Project Identification* Document. *
- Initial project research.

Weeks 2 - 5 (Jan 18 – Feb 14)

- Conduct research for the project to form a "body of knowledge". This research can be divided in the following manner: *
  - Real products available on the market which are relevant to the design of the AutoLogger.
  - Pertinent hardware (Microcontrollers, Communication, etc.) discovered from prior projects and products.
  - Software architecture, implementation methods, and testing procedures that relate to the AutoLogger.
- Completion of *Divide and Conquer – Initial Project Documentation*
- A transition from general project research (i.e. possible microcontrollers/modules) to more in-depth analysis (i.e. exact parts) will occur.

Week 6 - 10 (February 15 - March 20)

- Select parts and conduct extensive research, documenting all findings.*
- Each member begins to write their respective portion of the Final Documentation.

Weeks 10 - 12 (March 21 - April 10)

- Each member contributes to their respective portion of the Final Documentation, researching and collaborating when necessary.
- By the end of week 12, the Final Documentation will be written in its entirety, only subject to slight revisions thereafter.*

Week 13 - 15 (April 11 - May 2)

- All final revisions are completed during the last week.
- The Final Documentation is completed no later than May 2nd.*

Summer 2016 MAY 16, 2016 – AUGUST 1, 2016 (ROUGHLY 10 WEEKS)

Weeks 1-4 (May 16 - June 12)

- Completion of a working prototype (Communication, Data Logging, Syncing). *
- Initial testing & documentation of prototype.

Weeks 5-8 (June 13 - July 10)

- Begin designing final version of the system.
- Continued testing/troubleshooting and documentation.

Weeks 9-10 (July 11 - July 25)

- Final development and testing conducted to ensure proper functionality of the autonomous log and upload system.
- By the end of week 9, the project is declared finished as a working unit. *
- Any pertinent documents written during weeks 1-10 of Summer 2016 is now integrated into the Final Documentation*
- All required documentation is to be reviewed and finalized prior to July 25, 2016.
- The Final Presentation is constructed, revised, and delivered.*