Gasoline Economy Management - G.E.M.
A Senior Design Project Proposal

Group 8
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1 Introduction

In 2013 the U.S. consumed over 134 billion gallons of gasoline. On that scale even slight improvements in efficiency can save millions of dollars and prevent tons of CO_2 from entering the atmosphere. Automobile manufacturers are constantly striving to develop more efficient engines in order to meet the needs of consumers as well as regulatory requirements. Unfortunately purchasing a new vehicle in order to realize better fuel economy isn't always viable or practical. In fact purchasing a new vehicle in order to receive an incremental increase in efficiency is actually a bad idea. Usually the efficiency gains won't pay for themselves except over an exceptionally long period of time. In order to make progress in this realm what we need is a simple, low-cost solution that is available to every driver.

What we are proposing is a small, low-cost device that connects to the diagnostic port on a vehicle and provides feedback to the driver to help them make more efficient driving decisions. We will accomplish this by recording driving data such as speed, acceleration, braking, and other metrics. Then we can take this data, analyze it, and provide information to the driver about how they can adjust their driving habits in order to be more fuel efficient. The information will be transmitted to an Android application via bluetooth LE. The information will be processed by the app and then displayed for the user to view through a very simple interface.

2 Specifications and Requirements

2.1 Hardware

1. The device shall connect to the OBDII port
2. The device shall be powered by the OBDII port
    2.1. The device shall power itself off automatically when the vehicle is turned off
    2.2. The device shall power itself on automatically when the vehicle is turned on
    2.3. The device shall have a status light that reflects the power state
3. The device shall support OBDII protocols legislated by law
    3.1. ISO 15765-4 (CAN)
    3.2. ISO 14230-4 (Keyword Protocol 2000)
    3.3. ISO 9141-2 (Asian, European, Chrysler vehicles)
    3.4. SAE J1850 VPW (GM vehicles)
    3.5. SAE J1850 PWM (Ford vehicles)
4. The device shall have an accelerometer
    4.1. The accelerometer will record starts
    4.2. The accelerometer will record stops
    4.3. The accelerometer will record acceleration data
5. The device shall transmit data via Bluetooth
    5.1. The device shall support the Bluetooth Low Energy stack
6. The device shall be able to store recorded data
    6.1. The device shall store data when unable to connect to transmit data
    6.2. The device shall transmit stored data upon finding a valid receiver

2.2 Software

1. The device shall connect to an Android device with Bluetooth LE
    1.1. The Android device shall run on API level 18 (Android 4.3) or greater
    1.2. The Android device shall automatically connect to receivers in a 10 meter range
2. The system software shall store up to 5 vehicle profiles
3. The system software shall identify the currently connected vehicle using the Vehicle Identification Number (VIN)
4. The system software shall display data in real-time with at most a 2 second delay
    4.1. The system software shall display the average MPG up to 200
    4.2. The system software shall display the average MPG within $\pm 10\%$
    4.3. The system software shall display the speed of the vehicle within $\pm 5\%$
    4.4. The system software shall suggest driving patterns to optimize fuel economy
5. The system software shall store up to 6 months of data
    5.1. The data shall be stored on a native database
    5.2. The total application size including stored data shall not exceed 2 GB
    5.3. The system software shall continue to collect data running as a background application
6. The system software shall support all displays, ranging from HDPI to XXHDPI

3 Block Diagrams

3.1 Hardware

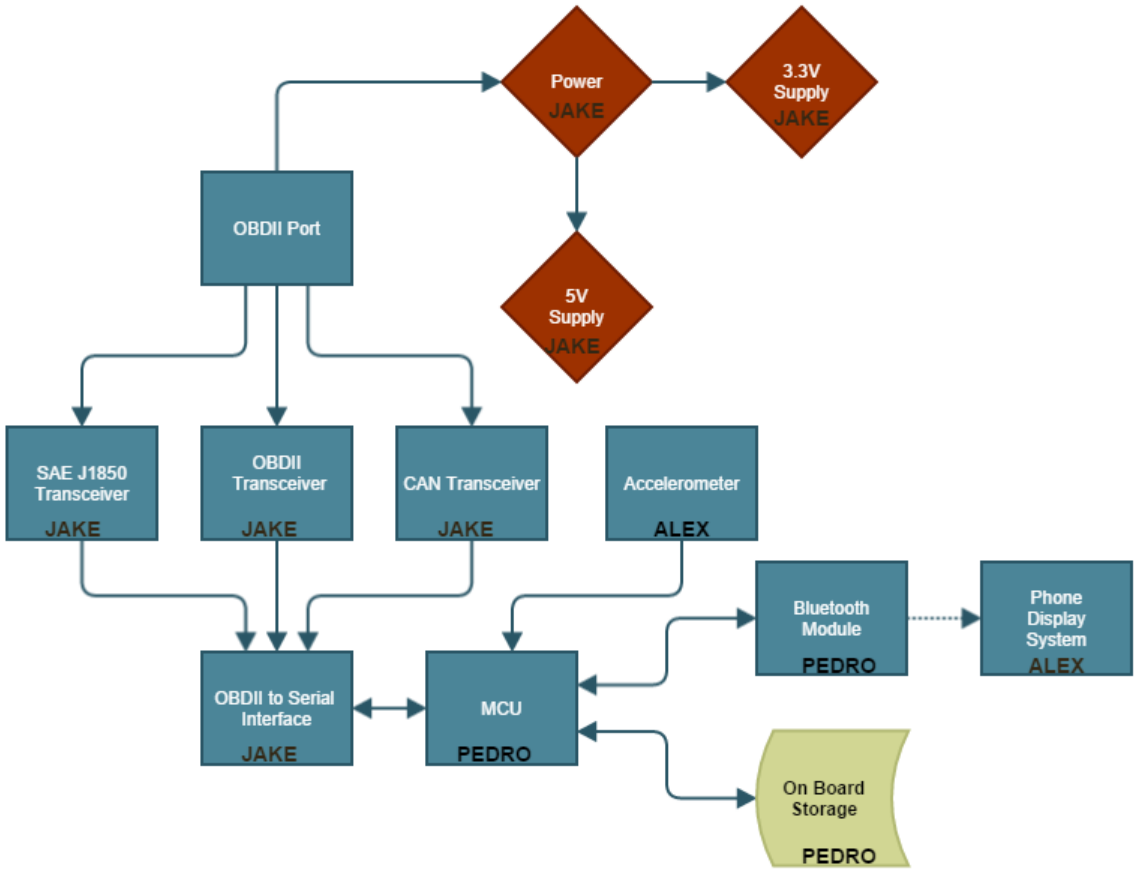

Figure 1: Hardware Block Diagram

3.2 Software

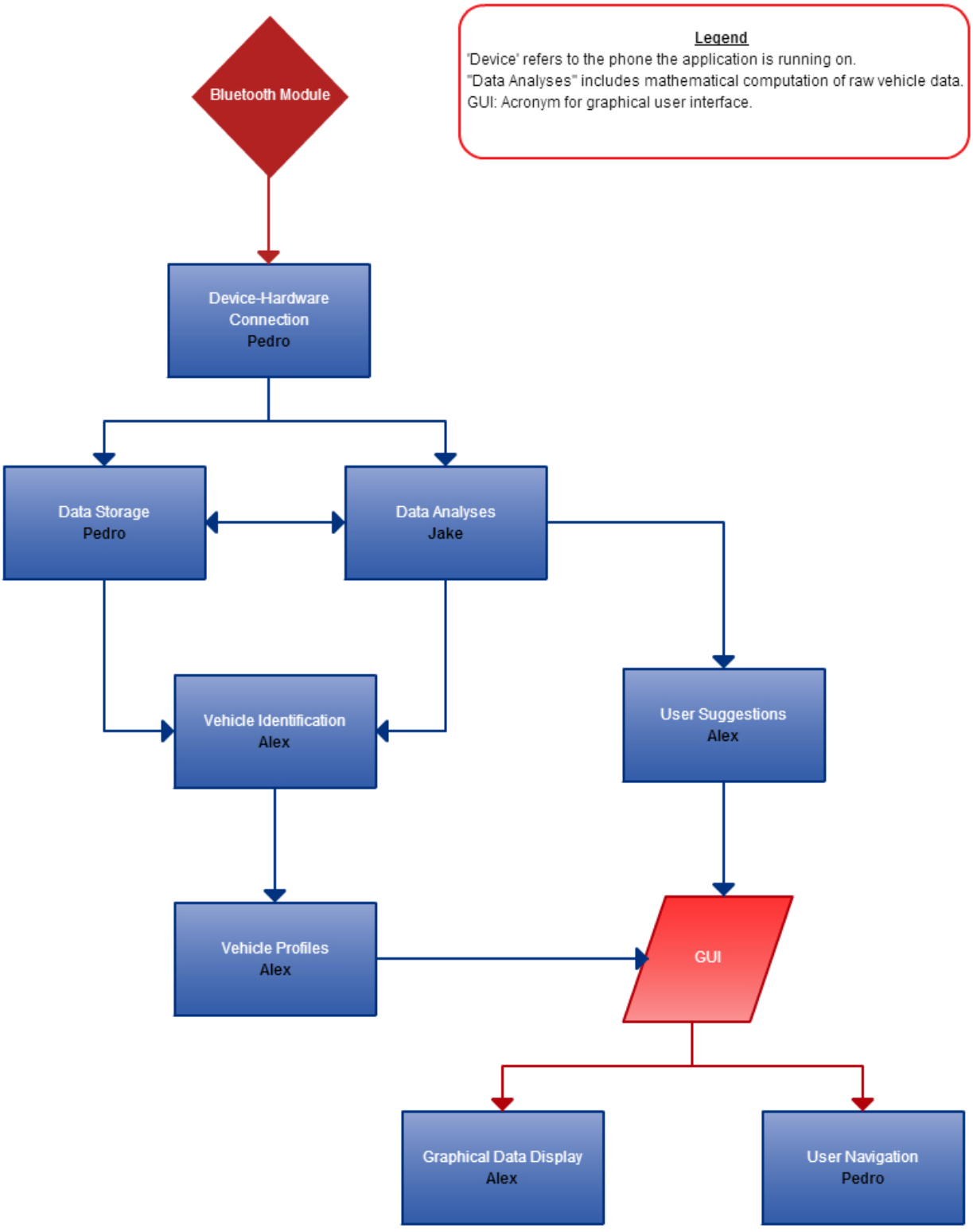

Figure 2: Software Block Diagram

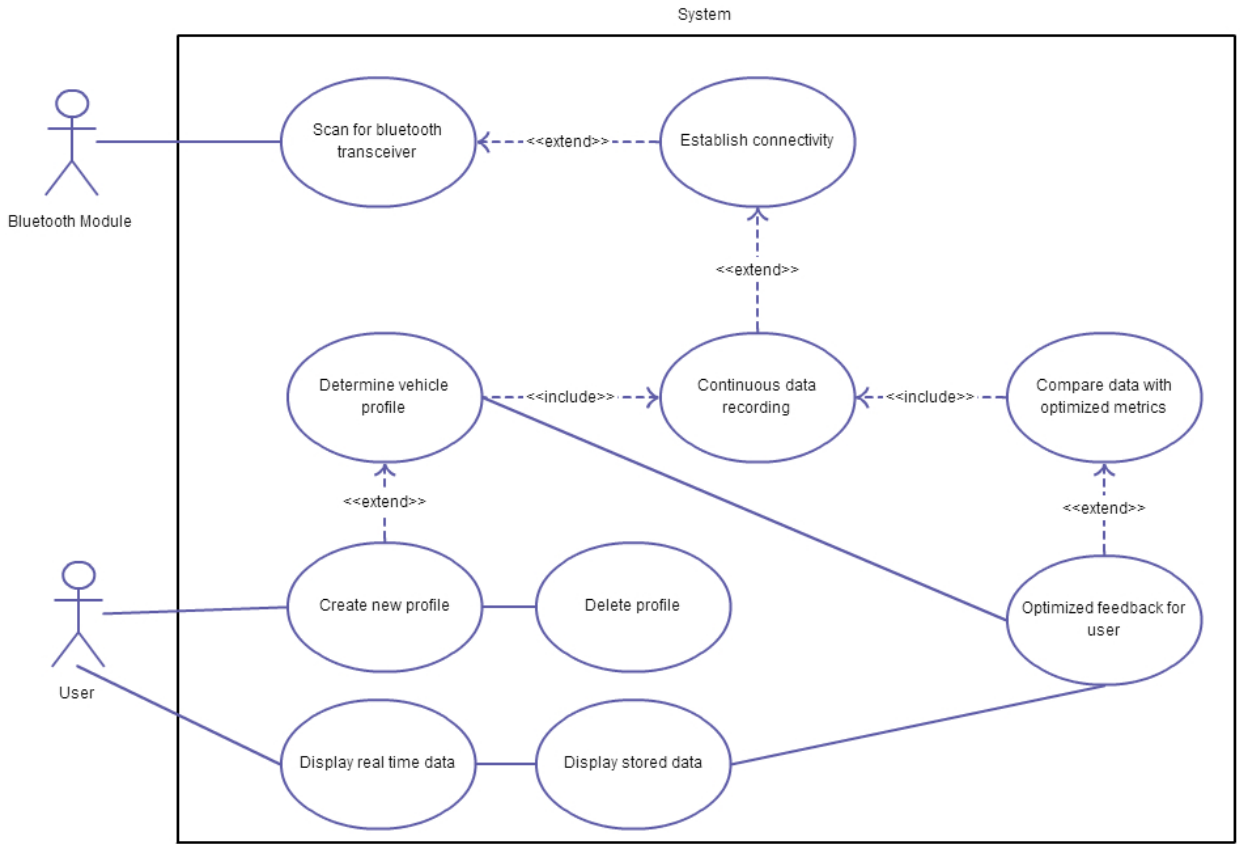

Figure 3: Use Case Diagram

4 Budget and Financing

Our goal is to find a funding partner. As our project is centered around energy efficiency we believe that Duke Energy would make an excellent partner. In addition we also have a tentative agreement with Aptas Technologies, a local start-up, to provide a small amount of funding. Should we be unable to raise external funding, funding will be split evenly among the design team.

Item	**Cost**	**Source**
OBDII Testbench	179.00	`http://freematics.com/`
PCB's	200.00	`http://oshpark.com/`
Components[1]	200.00	None
Test Android Device	350.00	Google Nexus 5[2]
Total	929.00	

Table 1: Project Budget

[1] IC's, MCU's, etc.

5 Milestones & Timeline

Our goal is to have the project design and review complete by the end of Senior Design I and to order parts and PCB's in order to have them ready by the beginning of Senior Design II. As this is a complicated system testing will be crucial to make sure that we stay on track. In order to facilitate testing we will have quick builds with long testing periods in between. Ideally we are seeking to have three 3 week long sprints between each revision. If we follow this schedule we will be able to deal with problems before they become serious.

[2]Possible team member donation

Schedule

ID	Task Name	Duration	Start	Finish
1	**Senior Design I**	**61 days**	**Mon 9/8/14**	**Mon 12/1/14**
2	**Research**	**20 days**	**Mon 9/8/14**	**Fri 10/3/14**
3	Bluetooth System	20 days	Mon 9/8/14	Fri 10/3/14
4	Storage System	20 days	Mon 9/8/14	Fri 10/3/14
5	MCU	20 days	Mon 9/8/14	Fri 10/3/14
6	Accelerometer	20 days	Mon 9/8/14	Fri 10/3/14
7	ODBII to Serial Interface	20 days	Mon 9/8/14	Fri 10/3/14
8	Transceivers	20 days	Mon 9/8/14	Fri 10/3/14
9	Power System	20 days	Mon 9/8/14	Fri 10/3/14
10	Android BLE	20 days	Mon 9/8/14	Fri 10/3/14
11	Android UI	20 days	Mon 9/8/14	Fri 10/3/14
12	**Research Complete**	**0 days**	**Fri 10/3/14**	**Fri 10/3/14**
13	20 Pages Written (Each)	0 days	Fri 10/3/14	Fri 10/3/14
14	**Design**	**35 days**	**Mon 10/6/14**	**Fri 11/21/14**
15	Bluetooth System	35 days	Mon 10/6/14	Fri 11/21/14
16	Storage System	35 days	Mon 10/6/14	Fri 11/21/14
17	MCU	35 days	Mon 10/6/14	Fri 11/21/14
18	Accelerometer	35 days	Mon 10/6/14	Fri 11/21/14
19	ODBII to Serial Interface	35 days	Mon 10/6/14	Fri 11/21/14
20	Transceivers	35 days	Mon 10/6/14	Fri 11/21/14
21	Power System	35 days	Mon 10/6/14	Fri 11/21/14
22	Android BLE	35 days	Mon 10/6/14	Fri 11/21/14
23	Android UI	35 days	Mon 10/6/14	Fri 11/21/14
24	**Design Complete**	**6 days**	**Fri 11/21/14**	**Mon 12/1/14**
25	30 Pages Written (Each)	0 days	Fri 11/21/14	Fri 11/21/14
26	Pre Holiday Document Review	3 days	Mon 11/24/14	Wed 11/26/14
27	Documention Complete	0 days	Wed 11/26/14	Wed 11/26/14
28	Turn In Senior Design I Documenta	0 days	Mon 12/1/14	Mon 12/1/14
29	Order Parts/PCB's	0 days	Mon 12/1/14	Mon 12/1/14
30	Spring Semester Begins	0 days	Mon 1/12/15	Mon 1/12/15
31	**Senior Design II**	**76 days**	**Mon 1/12/15**	**Mon 4/27/15**
32	Review Hardware	2 days	Mon 1/12/15	Tue 1/13/15
33	Review Documentation	2 days	Mon 1/12/15	Tue 1/13/15
34	Firmware Rev. 1	14 days	Wed 1/14/15	Mon 2/2/15
35	**Hardware Rev. 1**	**23 days**	**Wed 1/14/15**	**Fri 2/13/15**
36	Build	7 days	Wed 1/14/15	Thu 1/22/15
37	Test	14 days	Fri 1/23/15	Wed 2/11/15
38	Respin Board if Needed	16 days	Fri 1/23/15	Fri 2/13/15
39	Firmware Rev. 2	14 days	Mon 1/12/15	Thu 1/29/15
40	**Hardware Rev. 2**	**23 days**	**Mon 2/16/15**	**Wed 3/18/15**
41	Build	7 days	Mon 2/16/15	Tue 2/24/15
42	Test	14 days	Wed 2/25/15	Mon 3/16/15
43	Respin Board if Needed	16 days	Wed 2/25/15	Wed 3/18/15
44	Firmware Final	14 days	Mon 1/12/15	Thu 1/29/15
45	**Hardware Final**	**20 days**	**Thu 3/19/15**	**Wed 4/15/15**
46	Build	5 days	Thu 3/19/15	Wed 3/25/15
47	Test	15 days	Thu 3/26/15	Wed 4/15/15

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Figure 4: Schedule Page 1

Schedule

ID	Task Name	Duration	Start	Finish
48	Phone Software Alpha	21 days	Wed 1/14/15	Wed 2/11/15
49	Alpha Integration Testing	3 days	Thu 2/12/15	Mon 2/16/15
50	Phone Software Beta	21 days	Tue 2/17/15	Tue 3/17/15
51	Beta Integration Testing	3 days	Wed 3/18/15	Fri 3/20/15
52	Phone Software Final	21 days	Thu 3/19/15	Thu 4/16/15
53	Final Integration Testing	3 days	Fri 4/17/15	Tue 4/21/15
54	Rev 1 Complete	0 days	Mon 2/16/15	Mon 2/16/15
55	Rev 2 Complete	0 days	Fri 3/20/15	Fri 3/20/15
56	Final Complete	0 days	Tue 4/21/15	Tue 4/21/15
57	Final Documention	7 days	Fri 4/17/15	Mon 4/27/15
58	Final Presentation	5 days	Fri 4/17/15	Thu 4/23/15
59	Print Documentation	0 days	Mon 4/27/15	Mon 4/27/15

Figure 5: Schedule Page 2