

Smart Steering Wheel

Cyber-Physical Systems (Fall 2012)

Final Presentation

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Objective

- Constant need to improve car safety
- Driver stress is potential cause of accidents
- Need to quantify driver stress
- Does it relate to changes in environment?
- Measuring human body is always challenging

Overview of operation

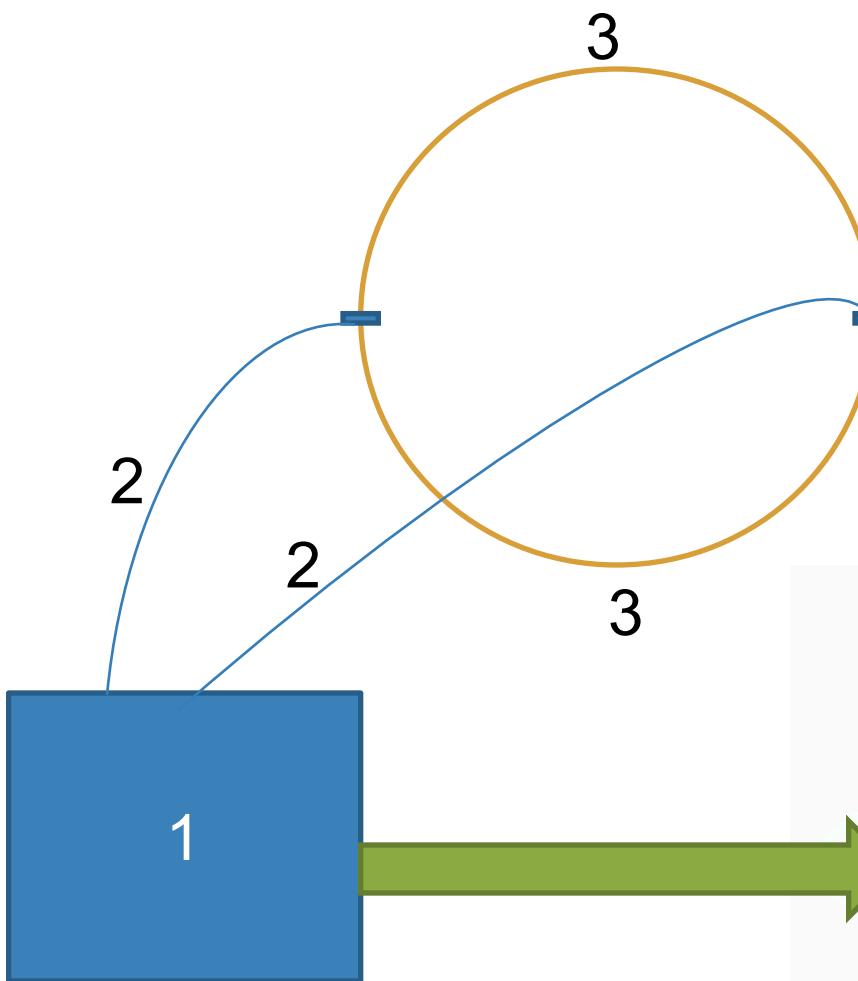
- Steering wheel cover
- Arduino boards
- Sensors
- Test, save the data
- Perform Analysis

Concept Diagram



The Central Unit consists of the processing unit which is connected to all the pressure sensors and other sensors such as accelerometer and GPS. Also contains a battery pack.

System Design



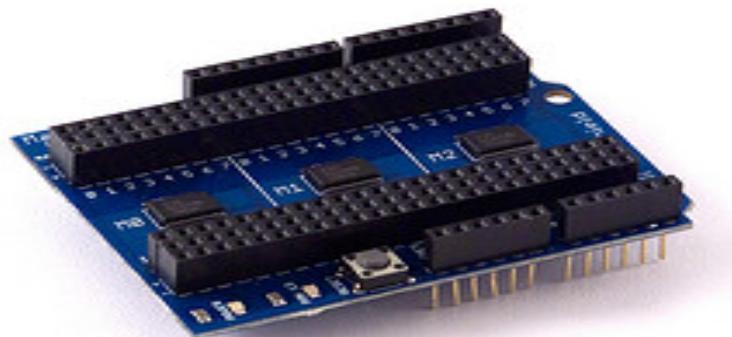
1: The Central Unit.
Contains 2 Arduino Boards, Breadboard, mux Shield, GPS, Accelerometer.

2: Input wires from pressure sensors to Central Unit.

3: Steering Wheel mounted pressure sensors.

Data is Written to a file on a laptop connected in a serial fashion.

HARDWARE COMPONENTS 1/2



MULTIPLEXER SHIELD

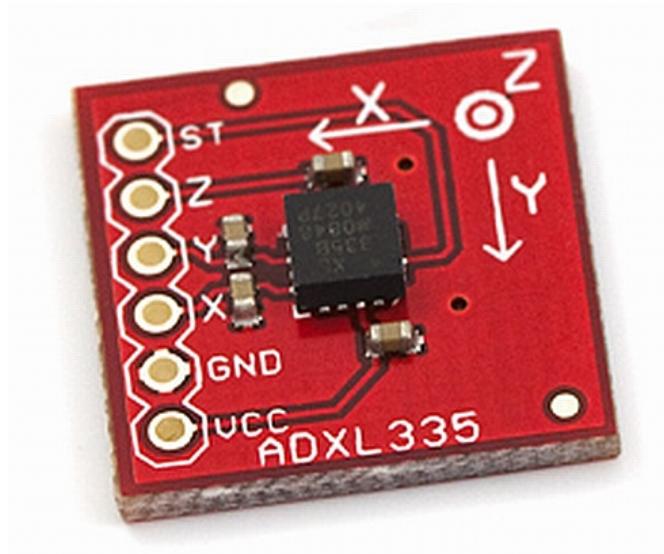
- 48 analog inputs/digital inputs
- Vcc and Ground header strips
- Reset button
- PIN 13 LED and Power LED
- Stackable headers



PRESSURE SENSORS

- Size: 1/2" (12.5mm) diameter active area by 0.02" thick
- Resistance range: Infinite/open circuit, 100KΩ (light pressure) to 200Ω
- Force range: 0 to 20 lb. (0 to 100 Nwtns)
- Power supply: Any! Uses less than 1mA of current

HARDWARE COMPONENTS 2/2

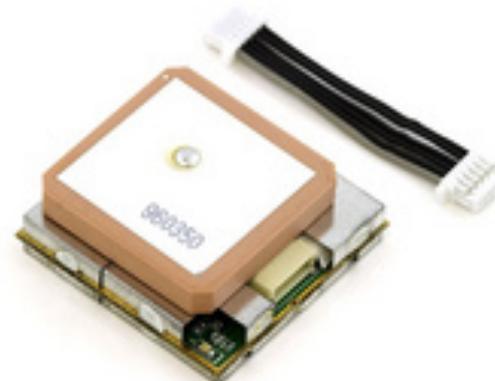


ACCELEROMETER

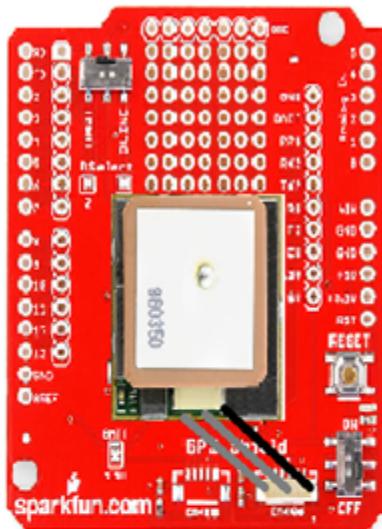
- 3-axis sensing
- 4 mm × 4 mm × 1.45 mm LFCSP
- Low power : 350 µA (typical)
- Single-supply operation: 1.8 V to 3.6 V
- 10,000 g shock survival
- Temperature stability -40 deg C to 85 deg C

GPS MODULE

- 20-Channel Receiver
- Extremely high sensitivity : -159dBm
- 10m Positional Accuracy / 5m with WAAS
- Hot Start : 1s
- Warm Start : 38s
- Cold Start : 42s
- 70mA at 4.5-6.5V



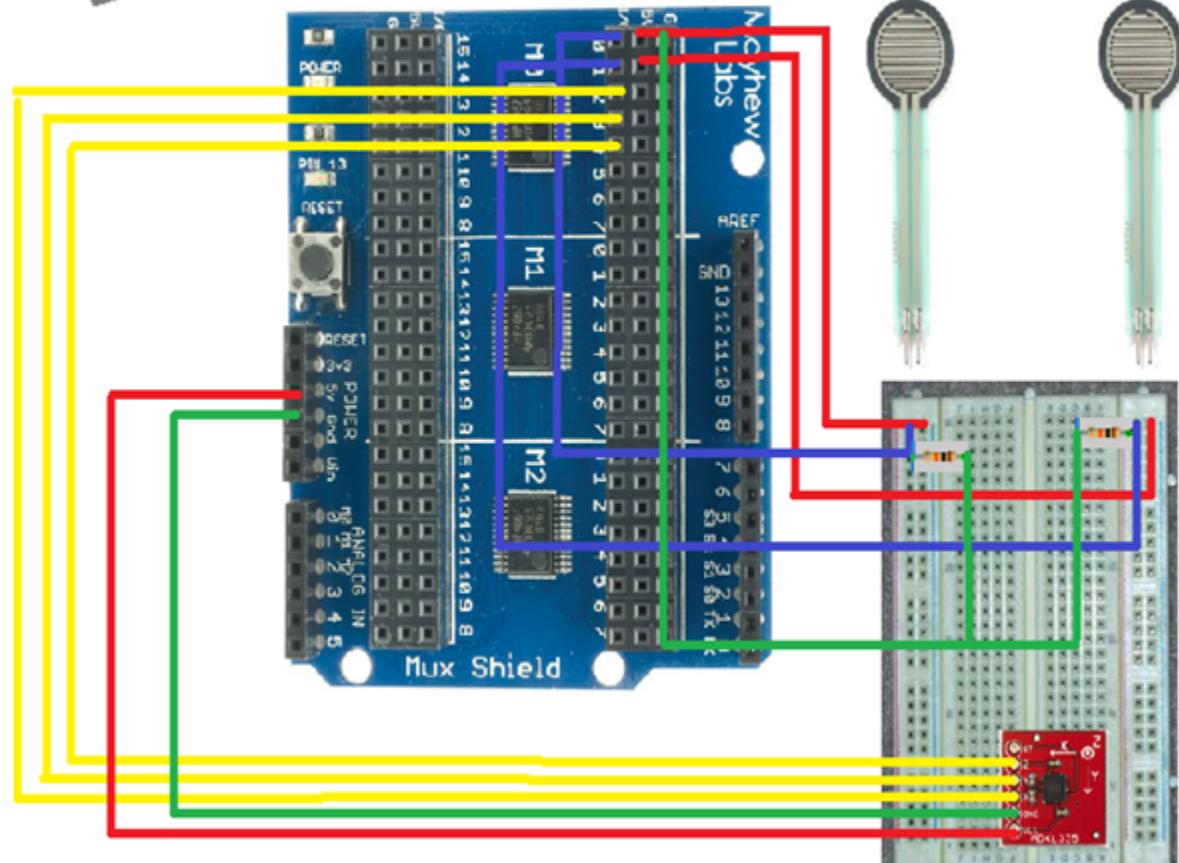
Circuit Diagram 1/2



GPS MODULE

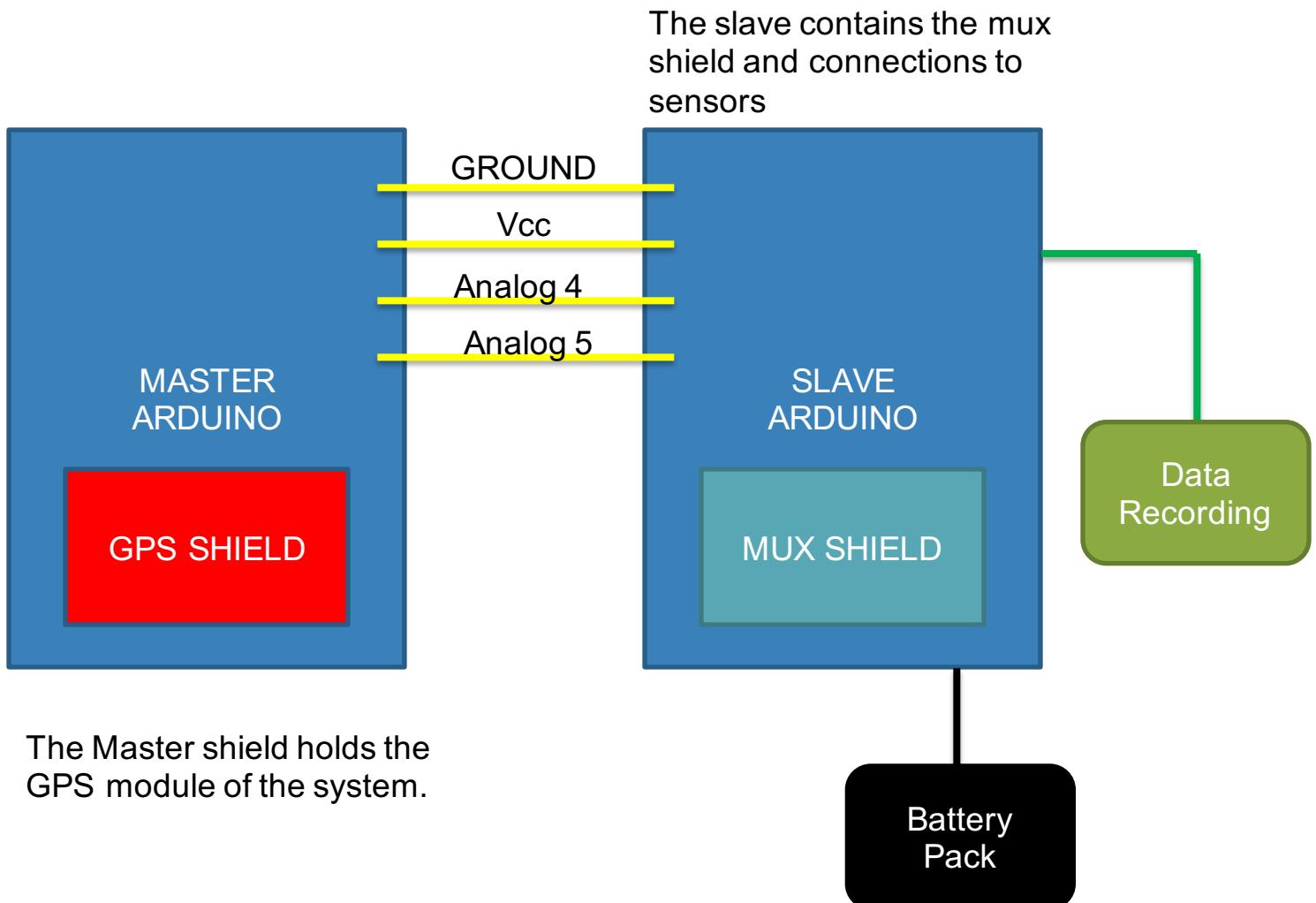


STACK ON TOP OF MUX SHIELD



BREADBOARD

Circuit Diagram 2/2



Data Recording

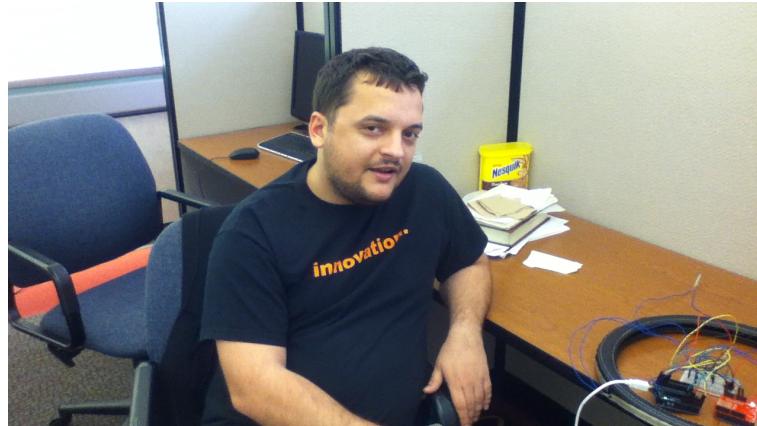
- Data from sensors written to a file on the laptop
- Process files to get information

Interesting Challenges Faced

- Common Input Pins
- GPS encoding and decoding
- Individual Component Soldering

Video Demos

- On the desk (1:10)



- Real testing (2:40)



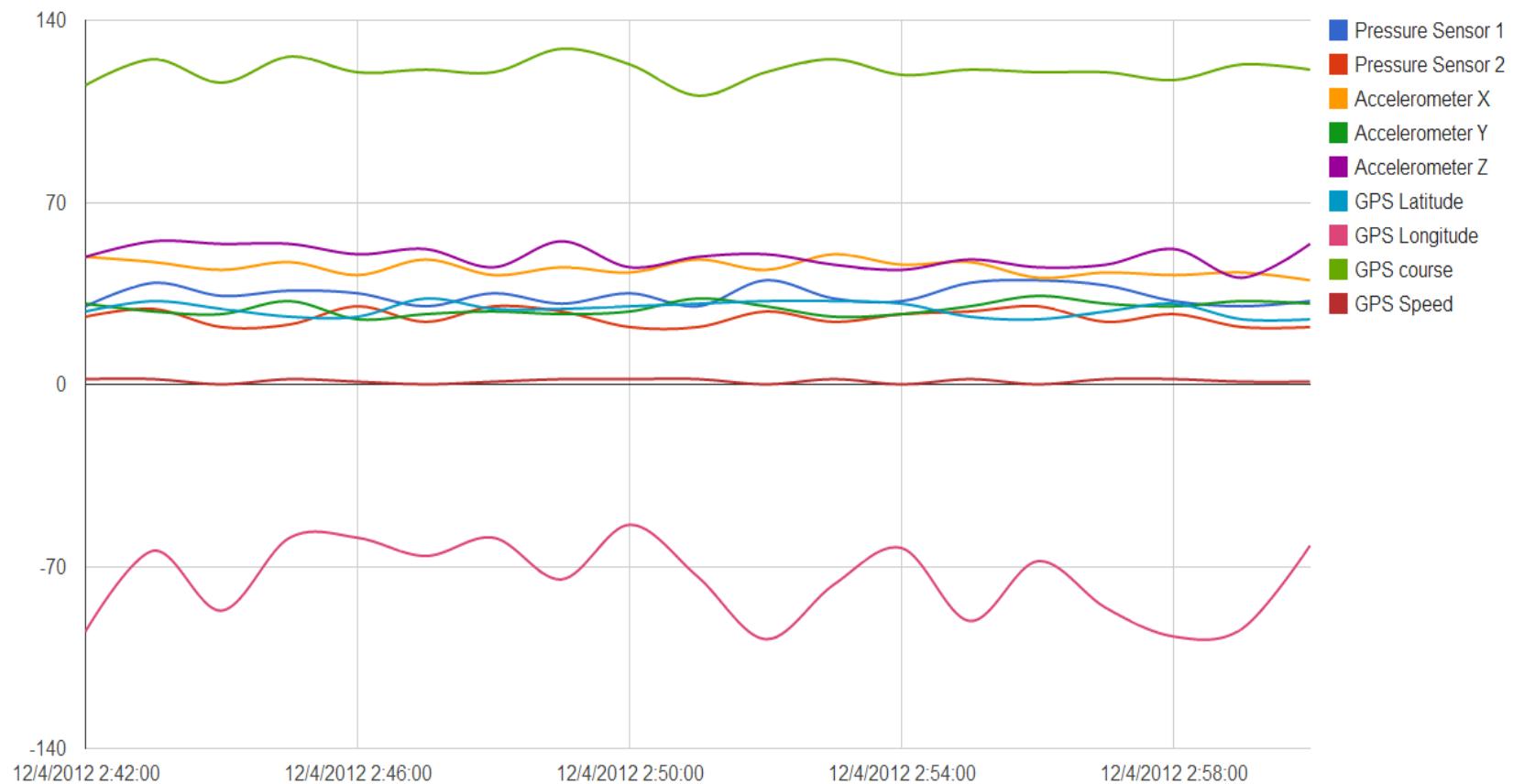
Results 1/3

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COM12 Send
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894, 962, 30.04, 27.31, 48.23, 29.72, -95.34, 1000.00, -1.00, 4.20,
894, 963, 30.19, 27.31, 48.41,
-----
Pressure(2) | Accerometer(X,Y,Z) | GPS (5)

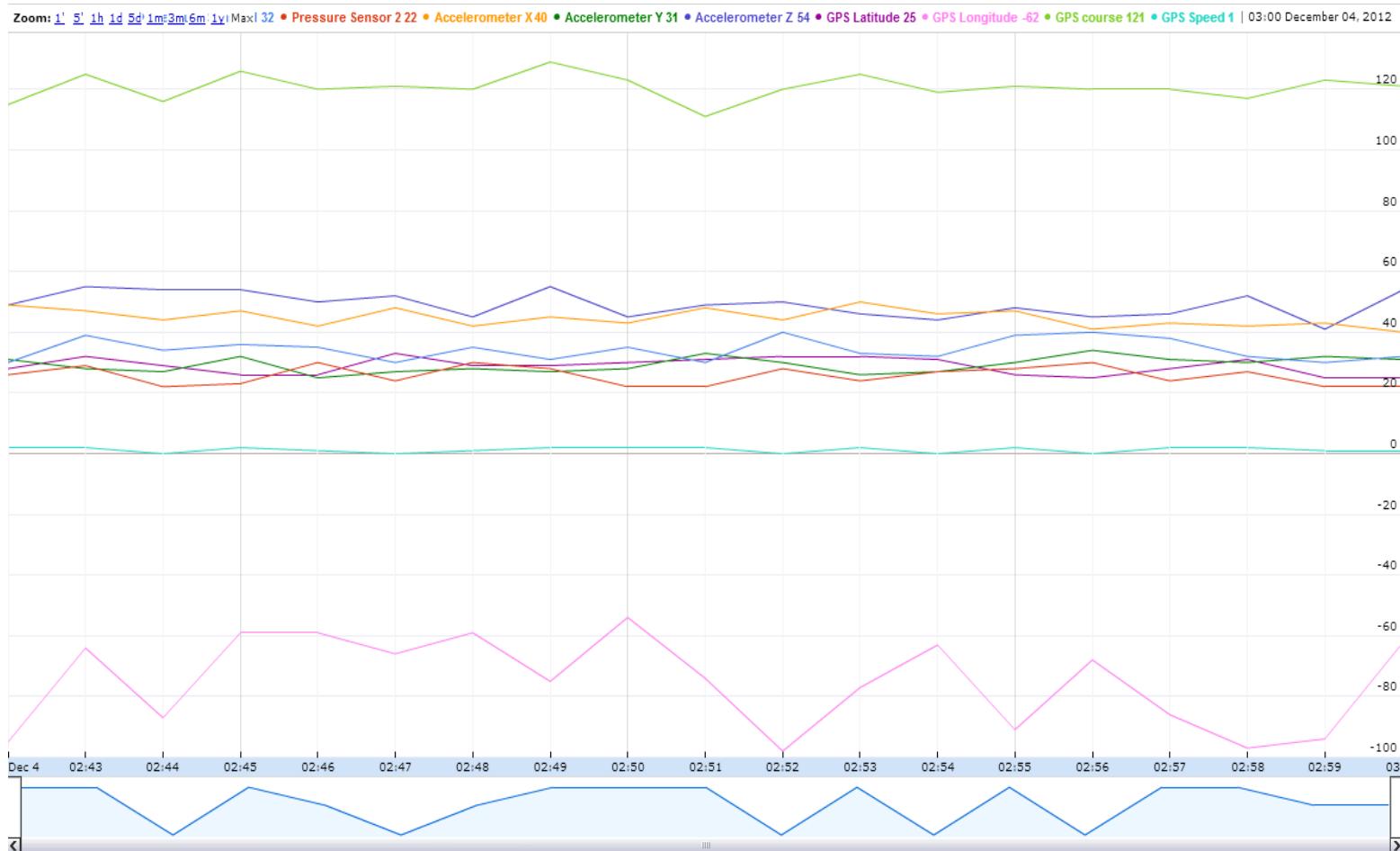
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894, 963, 30.19, 27.47, 48.21, 894, 963, 30.19, 27.47, 48.21, 29.72, -95.34, 1000.00, -1.00, 6.50,
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894, 962, 30.10, 27.23, 48.41, 894, 963, 30.19, 27.31, 48.41, 29.72, -95.34, 1000.00, -1.00, 6.60,
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894, 963, 30.19, 27.31, 48.41, 894, 963, 30.04, 27.31, 48.23, 29.72, -95.34, 1000.00, -1.00, 10.40,
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Pressure(2) | Accerometer(X,Y,Z) | GPS (5)

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893, 963, 30.19, 27.31, 48.41, 29.72, -95.34, 1000.00, -1.00, 15.80,
893, 964, 30.10, 27.23, 48.41, 893, 964, 30.19, 27.31, 48.41, 29.72, -95.34, 1000.00, -1.00, 17.60,
904, 967, 30.10, 27.23, 48.41, 29.72, -95.34, 1000.00, -1.00, 17.80,
878, 960, 30.19, 27.31, 48.41, 880, 960, 30.19, 27.31, 48.41, 29.72, -95.34, 1000.00, -1.00, 21.10,
-----
 Autoscroll  
```

Results 2/3



Results 3/3



Bill of Materials

Name	URL	Cost	Quantity	Total	Comment
MUX Shield	https://www.sparkfun.com/products/9832	\$ 25.00	1	\$ 25.00	Received
GPS Shiled	https://www.sparkfun.com/products/10710	\$ 14.95	1	\$ 14.95	Received
Circular FSR (0.2")	https://www.sparkfun.com/products/9673	\$ 5.95	5	\$ 29.75	Received
FSR (24")	https://www.sparkfun.com/products/9674	\$ 17.95	2	\$ 35.90	Received
Male To Female	https://www.sparkfun.com/products/9885	\$ 4.50	2	\$ 9.00	Received
Male to Male	https://www.sparkfun.com/products/9887	\$ 4.50	2	\$ 9.00	Received
Female to Female	https://www.sparkfun.com/products/9889	\$ 4.50	2	\$ 9.00	Received
Accelerometer for Arduino	https://www.sparkfun.com/products/9269	\$ 25.00	1	\$ 25.00	Received
Wheel Cover	none	\$ -	1	\$ -	Received
20 Channel EM-406A SiRF III Receiver with Antenna	https://www.sparkfun.com/products/465	\$59.95	1	\$ 59.95	Received
Connector Horizontal SMD for EB-85A	https://www.sparkfun.com/products/8297	\$ 1.95	2	\$ 3.90	Received
Connector Vertical SMD for EM408	https://www.sparkfun.com/products/8288	\$ 1.95	2	\$ 3.90	Received
Data Logging Shield for Arduino	http://www.makershed.com/Data_logging_shield	\$ 19.50	1	\$ 19.50	need to order
Battery Holder - 4xAA to Barrel Jack Connector	https://www.sparkfun.com/products/9835	\$ 2.49	1	\$ 2.49	need to order
One Wire Digital Temperature Sensor - DS18B20	https://www.sparkfun.com/products/245	\$ 4.25	15	\$ 63.75	need to order
Flash Memory - microSD 1GB	https://www.sparkfun.com/products/8163	\$ 9.95	1	\$ 9.95	need to order
Jumper Wires Premium 12" M/F Pack of 10	https://www.sparkfun.com/products/9885	\$ 4.50	10	\$ 45.00	need to order

Thank you!

