OBI Capstone 2015 Weekly Reports and Tasks

Sponsor: Intel Open Bike Initiative

Faculty Advisor: Professor Malgorzata Chrzanowska-Jeske

Team members:

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12/1/2014

Initial meeting with sponsor (Brad, Kevin, Robert, Pedro and Dr. Jeske).

Winter Break:

12/23/2014 Group meeting. Discussed proposal ideas.
Robert: Wrote preliminary proposal.

Week of 1/4

Preliminary proposal submitted to sponsor 8 Jan. 2015.

Week of 1/11

1/11 Group meeting.
Robert will be group leader for this month.

1/13 Robert: Created this document. Uploaded preliminary proposal to google drive.

This Weeks Tasks/Issues To Solve	
Everyone	Research air quality sensors.
Robert	Construct and test inductive power using magnets mounted to a bicycle wheel.
Ali	Research Android app development.
Meng	Research I2C bus (interface for air quality sensors).
Pedro	Analyze current prototype of air quality sensors.

Week of 1/18

Group meeting 1/18.

Report	
Everyone	We have not heard back from the sponsor on the proposal. Pedro will contact them tomorrow.
Robert	Power generation using magnets mounted to the wheel is not promising. The prototype generated less than a millivolt across a 1K resistor. Using stronger magnets and more wire would increase the power but would also increase the cost. We would in effect be building a dynamo which is already done more efficiently in the hub.
Ali	Began getting familiar with Android Studio and wrote a simple Hello World app.
Meng	Revised ECE372 project about I2C bus and interfacing, focusing on data packets organization and transfer, baud rate, etc.
Pedro	After analyzing the current prototype of the air quality sensors, it seems like the ideal situation would be to implement the sensors to the current OBI board instead of building separate module and implement it since it would possibly increase the size of the current enclosure and cost of the overall system. The deciding factor would come once we obtain an actual system from the sponsor for further study and analysis.

This Weeks Tasks/Issues To Solve	
Everyone	Research air quality sensors.
Robert	● Research volatile organic compound (VOC), NO_X, SO_2 air quality sensors. ○ Acceptable levels ○ Cost ○ Sensitivity
Ali	● Research carbon monoxide (CO) air quality sensor. ○ Various options ○ Acceptable levels ○ Pros and Cons

	○ Other important information ● Continue Android research and begin analyzing the Portland ACE application for Android.
Meng	● Research particulate matter (PM) air quality sensors. ○ Health effects ○ Environmental effects (Visibility impairment, environmental damage, aesthetic damage) ○ Categories and differences ○ Sensitivity
Pedro	● Research temperature and humidity sensors. ● Communicate with sponsors and adviser to obtain current prototype and meeting schedules.

Week of 1/25

Group Meeting 1/25

Report	
Everyone	News from the sponsors gave us the OKAY to continue.
Robert	A cost effective alternative to the dynamo hub and rim dynamo is the bottle dynamo. They are available from $7 to $30, produce as much power as the hub dynamo and require no modifications to the bicycle other than being attached. They do place a higher power demand on the rider when in use but have no power drain when not being used. The rider would be responsible for engaging the bottle dynamo when it is needed. The EPA lists 6 primary outdoor air pollutants. They are: ozone, carbon monoxide, particulate matter, nitrogen oxides, sulfur dioxide and lead. Volatile organic compounds are listed in a separate category and are primarily an indoor pollutant. Sensors for ozone, SO_2 and NO_X are expensive, starting at approximately $50 and, for ozone, going to well over $300. While these are potentially significant pollutants in an urban environment, it is not economically feasible to equip a fleet of bicycles with these sensors.

Ali

Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes.
CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

Symptoms: headache, dizziness, weakness, and clumsiness, nausea and vomiting, quick irregular heartbeat, chest pain, hearing loss, blurry vision, disorientation or confusion, and seizures.

Level of CO	Health Effects, and Other Information
0 PPM	Normal, fresh air.
9 PPM	Maximum recommended indoor CO level (ASHRAE).
10-24 PPM	Possible health effects with long-term exposure.
25 PPM	Max TWA Exposure for 8 hour work-day (ACGIH). **Pocket CO TWA warning sounds each hour.**
50 PPM	Maximum permissible exposure in workplace (OSHA). **First Pocket CO ALARM starts (optional, every 20 seconds).**
100 PPM	Slight headache after 1-2 hours.
125 PPM	**Second Pocket CO ALARM starts (every 10 seconds).**
200 PPM	Dizziness, naseau, fagitue, headache after 2-3 hours of exposure.
400 PPM	Headache and nausea after 1-2 hours of exposure. Life threatening in 3 hours. **Third Pocket CO ALARM starts (every 5 seconds).**
800 PPM	Headache, nausea, and dizziness after 45 minutes; collapse and unconsciousness after 1 hour of exposure. Death within 2-3 hours.
1000 PPM	Loss of consciousness after 1 hour of exposure.
1600 PPM	Headache, nausea, and dizziness after 20 minutes of exposure. Death within 1-2 hours.
3200 PPM	Headache, nausea, and dizziness after 5-10 minutes; collapse and unconsciousness after 30 minutes of exposure. Death within 1 hour.
6400 PPM	Death within 30 minutes.
12,800 PPM	Immediate physiological effects, unconsciousness. Death within 1-3 minutes of exposure.

Sensor (CO):
https://www.sparkfun.com/products/9403
$7.25
20-2000 ppm range
high sensitivity and fast response time
analog resistance output
5V power + load resistance output to ADC

	Sensitive to temperature and humidity - may need to account for both Datasheet: https://www.sparkfun.com/datasheets/Sensors/Biometric/MQ-7.pdf Sensor (Heart Rate): Pulse Sensor (plug and play open source arduino based sensor). https://www.sparkfun.com/products/11574?gclid=CLnR74_JsMMCFUZbfgodZ3AAjw
Meng	ECE372 Project 2 (Zeus board I2C calendar interfacing) revisited. Details on particulate matter (PM): ***Particle pollution*** - especially fine particles - contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing. People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure. However, even if you are healthy, you may experience temporary symptoms from exposure to elevated levels of particle pollution. ***Environmental effects:*** ● Visibility impairment: Fine particles (PM2.5) are the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas. ● Environmental damage: Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include: making lakes and streams acidic; changing the nutrient balance in coastal waters and large river basins; depleting the nutrients in soil; damaging sensitive forests and farm crops; and affecting the diversity of ecosystems. ● Aesthetic damage: Particle pollution can stain and damage stone and other materials, including culturally important objects such as statues and monuments. ***Categories:*** PM 2.5, PM 10, etc. Depending on diameter.

	Sensitivity: dust sensor, for instance: ● Sharp optical dust sensor GP2Y1010AU0F (I2C): https://www.sparkfun.com/products/9689 ● Grove dust sensor: http://www.seeedstudio.com/depot/Grove-Dust-Sensor-p-1050.html Arduino coding reference: http://www.seeedstudio.com/wiki/Grove_-_Dust_Sensor Sensors might need calibration to do accurate measurements
Pedro	Throughout a very extensive list of possible temperature and humidity sensors, I was able to narrow them down to the best two sensors in terms of cost, interface, and accuracy. These sensors are great for some basic data logging and are made of two parts, a capacitive humidity sensor and a thermistor. There is also a very basic chip inside that does some analog to digital conversion and spits out a digital signal with the temperature and humidity. The digital signal is fairly easy to read using any microcontroller. There are two versions of the DHT sensor, they look a bit similar and have the same pinout, but have different characteristics. The specs are presented as follows. **DHT11** ● Ultra low cost ● 3 to 5V power and I/O ● 2.5mA max current use during conversion (while requesting data) ● Good for 20-80% humidity readings with 5% accuracy ● Good for 0-50°C temperature readings ±2°C accuracy ● No more than 1 Hz sampling rate (once every second) ● Body size 15.5mm x 12mm x 5.5mm ● 4 pins with 0.1" spacing **DHT22** ● Low cost ● 3 to 5V power and I/O ● 2.5mA max current use during conversion (while requesting data) ● Good for 0-100% humidity readings with 2-5% accuracy ● Good for -40 to 125°C temperature readings ±0.5°C accuracy ● No more than 0.5 Hz sampling rate (once every 2 seconds) ● Body size 15.1mm x 25mm x 7.7mm ● 4 pins with 0.1" spacing

	• References:
	  ○ http://www.adafruit.com/product/386
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	Kevin Bross (Intel) has given us the go ahead to start design of possible ideas in order to perform integration later on as the project develops. We will not be given an actual prototype at the moment since the current board is wrestling with some power/inrush issues (i.e. ~1.5A inrush on a part to provide 2.5mA).

This Weeks Tasks/Issues To Solve	
Everyone	--
Robert	Order air quality sensors on Monday 1/26.
Ali	Rent a locker in the engineering building for group use and bring Arduino Uno.
Meng	Check Alex Bigazzi's air design as a in terms of interfacing.
Pedro	Set up a shared spreadsheet in the google drive folder to track expenses.

Week of 2/1

Group Meeting 2/1
Pedro will be the leader for this month.

Report	
Everyone	--
Robert	Air quality sensors ordered and delivered.
Ali	Locker number 155 was rented in corridor 80-03 for group use. All materials will be kept in there so that we can all have access to them at any time. We will leave a sheet in the locker where we will write down what materials we are using and where we will be (on campus) in case someone else needs them. The Arduino Uno is in the locker along with delivered parts from Sparkfun.

Meng	Arduino Uno denotes I2C as TWI. Uno uses A4 as SDA and A5 as SCL. There are both 7- and 8-bit versions of I2C addresses. 7 bits identify the device, and the eighth bit determines if it's being written to or read from. The Wire library uses 7 bit addresses throughout. If you have a datasheet or sample code that uses 8 bit address, you'll want to drop the low bit (i.e. shift the value one bit to the right), yielding an address between 0 and 127.
Pedro	Bill of materials (BOM) spreadsheet was created and shared to the group in order to maintain records of expenses throughout the project. The main idea is to have a separate spreadsheet each time an order is placed which will contain important information such as part numbers, spent costs, quantities acquired, and who placed the order. Upon completion of the project, a final BOM will be produced, if needed by the sponsor, to generate the overall funding of the project. As an additional reference, John McArthur was recommended as a contact for possible funding procedures.

This Weeks Tasks/Issues To Solve	
Everyone	Submit official proposal.
Robert	● Write formal proposal. ● Begin Temp / Humidity sensor coding.
Ali	● Start a Github repository for group. ● Begin CO sensor coding. ● Look for ZH series 6 pin 1.5mm JST connectors.
Meng	● Start PM sensor coding (material preparation)
Pedro	● Begin Pulse Sensor code.

Week of 2/8

Group meeting 2/8

Report	
Everyone	The official proposal has been sent to the project adviser for further review and submission to the sponsors. The proposal encloses the project’s scope and methodical steps towards the proposed goal.

Robert	Began work on temp/humidity sensor. Reviewed and edited the official proposal.
Ali	Drafted the official proposal to be submitted to sponsors. The draft was reviewed by the group, finalized and submitted to our advisor for a final review. Wrote Arduino code for CO sensor. The sensor requires a heater voltage which switches between 5V at 150 mA for approximately 60s and 1.4V for 90s. These voltage ratings are outside of the Arduinos capability. If they cannot be adjusted (requires further research) it may be necessary to figure out how to regulate the voltage levels using the Arduino Uno. Will likely require a voltage regulator and relay to accomplish that circuit. A GitHub repository was created to give everyone access to each individual block of code as the project progresses. https://github.com/alaviali/OBI
Meng	Arduino Uno denotes I2C as TWI. Uno uses A4 as SDA and A5 as SCL. There are both 7- and 8-bit versions of I2C addresses. 7 bits identify the device, and the eighth bit determines if it's being written to or read from. The Wire library uses 7 bit addresses throughout. If you have a datasheet or sample code that uses 8 bit address, you'll want to drop the low bit (i.e. shift the value one bit to the right), yielding an address between 0 and 127.
Pedro	The code is under testing and review. The initial run included a verification of the code and possible adjustments towards the arduino pro (currently used under the existing prototype). Since the board used for testing the proper performance for the sensor is the arduino uno, there might be some adjustments in the timers, and interrupts callouts (software) in order to integrate the code to the arduino pro. In addition, extra insulation via hot glue will need to be performed on the back of the pulse sensor (recommended by developers) in order to avoid short circuits due to sweat from the fingers or earlobe (depending sensor placement).

This Weeks Tasks/Issues To Solve	
Everyone	Submit official proposal.

Robert	• Continue Temp / Humidity sensor coding.
Ali	• Finish CO sensor coding • Figure out CO sensor circuit • Look for ZH series 6 pin 1.5mm JST connectors
Meng	• Continue PM sensor coding (material preparation)
Pedro	• Continue Pulse Sensor code.

Week of 2/15

Group Meeting 2/15

Meeting with project supervisor prof. Jeske 2/16

- Add deliverable section in proposal; and ask sponsor about fund approval process (What data format does the OBI team need? Raw or processed?)
- Finish the weekly report on working process for different sensors
- Rearrange and add research section in proposal
- Start to work on project schedule in order to finish project in mid-May
- Send group report every week in word format (containing works done and challenges)

Report	
Everyone	In the process of designing and organizing the circuitry, we encountered a design problem. Our initial thought was to design a "sensor hub", meaning that we intended to combine various sensors with a multiplexer, and then have the multiplexer integrated to the Arduino Pro that's already on OBI team's board using I2C interface. This design is based on the fact that the sensors and multiplexer input/output are digital and ready to process. However the CO sensor outputs an analog; so before sending it to multiplexer an additional ADC is required to convert the analog signal to digital. Then we discussed the possibility of feeding the analog signal directly to the Arduino Pro, but it's unknown that if we'll be granted for any extra pin use. This implementation would also limit the units expandability and would require that the CO sensor circuit uses an alternative method to switch between the high and low voltage other than the relay. A new solution would be to put our own microcontroller in the

	"sensor hub", so that the multiplexer and ADC can be eliminated. This will have a lot more freedom due to the availability of other pins. The comparison between two designs is as follows: **Without on-board microcontroller:** ● Pro: less programming ● Con: Coordinating communication with the host system is more difficult. **With on-board microcontroller:** ● Pro: ○ Microcontroller can be set up as I2C slave device, facilitating communication with I2C host. ○ Data preprocessing can be done on-board, transforming data from various sensors to a unified format. ○ ADC, timer interrupts and other functions of a microcontroller simplify communication with sensors. ○ Flexibility to add more sensors or change the existing ones without having to modify the host interface. ● Con: more programming.
Robert	● Temp / humidity sensor programming in progress.
Ali	● CO sensor circuit design completed. ● The CO sensor requires two different voltage levels for correct operation. The sensor must be at 5V for approximately 60s and requires ~150mA of current. It must then switch to approximately 1.4V for approximately 90s. The Arduino Uno is unable to provide this amount of power. Thus, the circuit will require a power source and an adjustable voltage regulator capable of outputting the above, and a relay to adjust between the two desired voltages. Coding for the sensor is almost complete.
Meng	● Purchased 2nd Arduino board, expected to arrive on 2/21. ● Continuing dust sensor coding.
Pedro	● Pulse sensor coding completed and working.

This Weeks Tasks/Issues To Solve	
Everyone	Continue working on sensors and send proposal to sponsors.
Robert	● Continue work on sensor.sharp

Ali	● Continue work on sensor. ● Order voltage regulator and relay. ● send proposal to sponsors.
Meng	● Continue work on sensor. ● Begin work on project schedule.
Pedro	● Continue work on sensor. ● Edit Bill of Materials.

Week of 2/22

Group Meeting 2/22

Report	
Everyone	Awaiting response from sponsors.
Robert	● Temp / humidity sensor programming in progress.
Ali	● Completed final proposal and sent to sponsors on 2/18. ● Purchased voltage regulator and relay for CO sensor circuit. Parts were expected to arrive on 2/21 but were delayed until 2/23. ● CO sensor circuit design and code completed. Waiting for the last of parts to begin testing.
Meng	● Dust sensor programming in progress ● 2nd Arduino ordered, arrived on 2/21 ● Started working on project schedule ● Sharp dust sensor put on hold momentarily because connector unavailable
Pedro	● Pulse Sensor programmed and working on Arduino Uno successfully. ● Bill of materials for extra parts added. ● Overview of scope of the project adjusted.

This Weeks Tasks/Issues To Solve	
Everyone	Finish work on sensors to begin integration.

Robert	● Finish coding and testing temp / humidity sensor.
Ali	● Assemble, test, and finalize CO circuit. ● Begin work on integrating sensor into final design. ● Begin work on ADC code for CO sensor output.
Meng	● Get Grove dust sensor working ● Come up with a comprehensive way to calibrate and test the dust sensor ● Finish project schedule by the end of the week
Pedro	● Update bill of materials for extra parts. ● I2C programming for Pulse Sensor. ● Send weekly report to Adviser.

Week of 3/1

Group Meeting 3/2 with project supervisor Prof Jeske

Ali will be group leader for this month.

Report	
Everyone	Response received from sponsors. Some modifications/specifications were outlined for the design: ● RS232 Tx/Rx interface (no longer I2C). ● turning 3.3V power on when we want it to collect data and off otherwise. ● provide timestamping of the data. Will want to have an RTC (real-time clock) in the system to maintain clock even when power is off (this is usually doing with a coin cell, such as a CR2032 cell). ● should develop code for their local sensor and the upstream (main) box ● main box will set the time in the downstream box; this will synchronize time events between the upstream and downstream sensors. ● set the sensing rate. Though I would expect 5 seconds/cycle would be fairly common, they should support sampling between 1 and 300 seconds between cycles (1 Hz down to ~0.003333 Hz).

	● collect up to ~100 sensor readings and store them locally (in the front box). ● Report number of sensor records stored locally. This will return a number from 0 to 100 to indicate how many records have been stored locally. ● Read sensor record. After this is sent and acknowledged, that sensor record should be deleted locally. ● Clear all sensor records. ● have some sort of application that reads this spreadsheet and presents data to the researcher reviewing the data. ● design their board with an RJ-45 as the connection to the main box, using the pinout in the attached thread with UW. ● provide 2-pin terminal blocks or a 2-pin header to pass through the V_AC_x lines. This is what we would connect to the dynamo. However, their board should not otherwise use these lines. ● provide a second 2-pin terminal block or 2-pin header for V5X_USB and GND; we may want to hang off a small USB cable for this.
Robert	● Temperature - humidity sensor coding finished. Unit tested and appears to be working fine.
Ali	● Parts arrived and CO sensor circuit assembled and tested. Circuit appears to be working fine. The unit uses a lot of power and the sponsors have highlighted that we will only have 3.3V available to us. It will be necessary to figure out an alternative method to deliver power, likely through a battery. ● CO sensor test plan is to light a candle next to the sensor, and place an upside down cup over the two to deprive the candle of air. View the sensor readings to ensure they are detecting CO.
Meng	● Grove dust sensor coding finished, verified working under 3.3 V power (3 minutes pre-heat time) ● Grove sensor test plan: ○ Need a smoker to test ○ According to manufacturer the sensor has already been calibrated ○ Refer to datasheet plot to verify relative concentration of smoke ● Project schedule finished ● Sharp dust sensor still on hold because of lack of connector

Pedro	● Bill of Materials for additional parts uploaded to the projects drive. ● Pulse sensor fully functioning for 3.3V as specs required. ● Weekly report to Adviser was sent as requested.

This Weeks Tasks/Issues To Solve	
Everyone	● Finish evaluation form, turn in as hard copy to Prof Jeske's mailbox by the end of term. ● Begin making presentation for meeting on week of 3/9.
Robert	● Commit code to GitHub. ● Adjust proposal based on sponsors feedback.
Ali	● Contact Brad and set up a meeting for week of 3/9 (Ideally Monday or Thursday morning). ● Review adjusted proposal and send to Brad. ● Adjust weekly report and send to Prof. Jeske. ● Draw CO circuit schematic in Eagle and upload to google drive.
Meng	● Adjust project schedule according to Brad's email, send to Prof Jeske by Tuesday. ● Start to merge everyone's code on GitHub.
Pedro	● Start preliminary circuit and layout for sensor's box. ● Commit pulse sensor code to GitHub.

Week of 3/8

Group Meeting 3/8

Report	
Everyone	Made design choices based on modifications. Design is nearing completion.
Robert	Modified proposal based on sponsor feedback. Temp / humidity code checked in to github repository.
Ali	● Added boost converter to CO sensor circuit to step-up 3.3V to 5V. ● CO sensor circuit completed in Eagle and uploaded.

	● Sent adjusted proposal to Brad and set up meeting for 3/12. ● Began powerpoint for proposal presentation to be completed by 3/11 to present on 3/12. ● Report for week of 3/1 sent to Prof. Jeske. ● Connector for Sharp dust sensor ordered and on the way. Unfortunately coming from China with slow shipping (no other options were found).
Meng	Project schedule finished and adjusted according to Brad's email. Code merging in progress.
Pedro	● Preliminary board layout was discussed with the group and the schematic has been started to present to sponsors on 3/12. ○ A complete schematic cannot be delivered just yet since as group we need to address some questions/concerns with the sponsor for optimal solution. ○ The main skeleton of the schematic (microcontroller, sensors, etc.) is completed. ○ Pinouts for sensor will be selected accordingly with orientation and design of the overall circuit. ● The Pulse sensor code was uploaded to the project's repository for code integration.

This Weeks Tasks/Issues To Solve	
Everyone	● Work on presentation for 3/12. ● Submit evaluations.
Robert	Work on eagle schematic, ATmega, crystal, programming interface, etc. Work on real time clock circuit.
Ali	● Complete powerpoint presentation by 3/11 to present on 3/12. ● Send weekly report for week of 3/8 and project schedule to Prof.Jeske. ● Order necessary parts after design confirmation with sponsor.
Meng	Continue to merge team code in coordination to Thursday's meeting, make adjustments accordingly. Leave out enough space for the awaiting Sharp dust sensor.
Pedro	● Design final schematic and layout of the PCB.

	● Deliver pulse sensor for full circuit design.

Meeting with sponsor 3/12/15
Brad, Barrett and Professor Jeske were present as well as all 4 term members. Details can be found in the meeting minutes. Brad gave each of us an Intel Edison development board and asked us to consider using that as our development platform.

Week of 3/15

Group Meeting 3/15

Report	
Everyone	Met with sponsors and gave proposal presentation. Sponsors addressed some of our questions and concerns, and gave us Edison development boards and asked us to look into feasibility of shifting focus from Arduino to Edison, as well as preparing 3 prototype units for testing.
Robert	A suitable RTC is the MCP7940N. It is a 8 pin DIP and communicates using I2C. Preliminary schematic done including ATMEGA, crystals for microcontroller and RTC, and supporting circuitry.
Ali	● Completed powerpoint presentation and presented to sponsors. ● Sent report and project schedule to prof. Jeske.
Meng	Merging and re-writing code according to meeting with sponsor.
Pedro	Making progress with final Schematic

This Weeks Tasks/Issues To Solve	
Everyone	● Research feasibility of shifting focus from Arduino to Edison boards. ● Finals!
Robert	● Find out how to access RTC on Edison Arduino breakout board.
Ali	● Find out if Edison board will provide necessary current for CO sensor.

	● Test MQ-7 Arduino code with Edison board.
Meng	Change code according to Intel Edison specifications
Pedro	Continue work on schematic.

Week of 3/22

Group Meeting 3/22

Report	
Everyone	● Done with finals! ● Decided Edison boards were not feasible for transitioning to at this point since we couldn't get any sensors to function on one. ● Made decision to run entire circuit on 5V, thus needing to use a boost converter with enough output power on input of the 3.3V power line. ● Figured out memory needed for record storage. Need to add additional memory to circuit. Adding 256K SRAM chip.
Robert	● RTC is accessible using linux commands on Edison board. ● Unable to get temp sensor working with Edison board. ● Spring break. ● Updated Boost converter on Schematic
Ali	● MQ7 circuit must be adjusted to account for the constant 5V and no battery use. ● Since a constant 5V will be provided, decided to just use a voltage divider to pull down to 1.4 for measuring phase but later realized that the resistance in the sensor itself will make this impossible.
Meng	● Received Sharp dust sensor connector ● Sharp dust sensor programmed and working
Pedro	● First draft of the schematic was submitted to the group. ● Further analysis regarding memory expansion, voltage booster, and real time clock circuit will be assessed in the following meeting.

This Weeks Tasks/Issues To Solve

Everyone	● Finish hardware design and schematic.
Robert	● Continue work on schematic
Ali	● Finalize MQ7 design. ● Update schematic to reflect design. ● Possibly need to find SPDT switch. ● Must find suitable voltage regulator. ● Help complete schematic. ● Begin work on Wiki.
Meng	● Re-write existing code to accommodate 2-mode mechanism ● Help team verify schematic design from software point of view
Pedro	● Analysis regarding memory expansion, voltage booster, and real time clock circuit. ● Submit second draft of the schematic.

Week of 3/29

Group Meeting 3/29

Report	
Everyone	● Finalized hardware design schematic. ● Picked out all parts. ● New SRAM memory unit picked out having 1Mbit instead of 256K solving all our memory troubles. ● Decided we will be meeting twice a week from now on to speed up progress. Once on Wednesdays and again Sundays.
Robert	● Finalized design of transistor switch for CO sensor power using 2 PMOS, 1 NPN and a Schottky diode. ● Started digikey cart selecting components and verifying that they will have correct footprints on the PCB. ● Added MQ7 switch to schematic
Ali	● Added a new voltage regulator (LM317) for 1.4 V ● After some debating and deciding between using an SPDT switch or relays, robert designed a very efficient and effective

	transistor switching circuit to switch between the 5V and 1.4V lines which we decided to implement. ● Made significant progress on Wiki. ● Some help with hardware design and schematic. ● Got in touch with Barrett (sponsor) regarding progress. Updating him after each meeting. Sent him the finalized schematic.
Meng	● Grove dust sensor 2-mode programming done ● Sharp dust sensor 2-mode programming done ● Code committed to GitHub, refer to “programming worklog” for more details
Pedro	● Hardware design and schematic. ● Added micro USB. ● Added additional test points schematic.

This Weeks Tasks/Issues To Solve	
Everyone	● Order all parts. ● Begin breadboarding circuit as soon as all parts arrive. ● Meet with Barrett to discuss program
Robert	● Complete and submit digikey order. ● Order additional sensors from Sparkfun.
Ali	● Update group schedule and send to Barrett. ● Continue work on Wiki. ● Work with Meng to create state machine outline of program. ● Purchase CO sensor with PPM readout to calibrate the MQ7. ● Arrange phone/skype meeting with Barrett regarding system model and programming
Meng	● According to Barrett’s response, rework code to interrupt only mode ● Rewrite code for rest of the sensors to adapt to interrupt-only mechanism ● Start to program memory expansion and serial connection
Pedro	● PCB Layout. ● Revision of entire schematic and design.

Week of 4/5

Group Meeting 4/5
Over the phone meeting with Barrett Hafner 4/5
Meng will be group leader for this month

Report	
Everyone	● All parts ordered ● Met with Barrett over the phone on 4/5 to discuss system model and address some programming issues.
Robert	● Digikey order placed and received. Sparkfun order placed, will arrive 4/8/15. Newegg order placed, parts coming from China. ● Continued work on schematic.
Ali	● Updated group schedule and sent to Barrett ● Arranged phone meeting for 4/5 with Barrett ● Added more information to project wiki ● Purchased CO sensor with PPM readout for calibration of MQ7
Meng	● Rewrote Arduino code for Grove, Sharp and MQ7 CO sensor based on new requirements ● Sampling rate verification
Pedro	● Schematic fully completed for first test run.

This Weeks Tasks/Issues To Solve	
Everyone	● Breadboard circuit as soon as all parts arrive. ● Continue system modeling ● Finish PCB layout and send to OSH Park
Robert	● Prototype discrete transistor power switch for CO sensor power supply.

	● Prototype DC-DC switching regulator (LT1302) to confirm functionality, sufficient current output. ● Prototype RTC after Sparkfun order arrives.
Ali	● Work with Meng to create state machine outline of program ● Continue work on Wiki ● Help breadboard circuit
Meng	● Rewrite Arduino code for temperature & humidity sensor and pulse sensor ● Incremental test of all sensors, verify sampling rate ● Data packet with checksum implementation ● Serial transmission programming
Pedro	● Start PCB Layout. ● Determine possible size of the board. ● Assist in discrete components prototyping.

Week of 4/12

Group Meeting 4/8 with Professor Jeske

Report	
Everyone	● Having issues with power on the boost converter
Robert	● RTC minimally tested with Arduino, it works well. ● Unable to to get boost converter to work as specified on data sheet. Schematic and board modified to use alternate power source.
Ali	● Helped with testing boost converter ● completed state machine for communication program ● helped with schematic modification ● Researched battery packs for power
Meng	● Pulse sensor working, data very unreliable ● Merged sensor code without pulse sensor
Pedro	● Schematic fully finished and approved by team. ● Preliminary layout was discussed and improved. ● Complete layout was delivered and ready for fabrication.

This Weeks Tasks/Issues To Solve	
Everyone	● Send out board to OSH Park by Wed, 4/15 ● Evaluate demo hardware to be used for demo
Robert	● Board layout completed. Ordered 4/15. ● Work on integrated sensor code with Meng. Minimize delays while interrupts are off. Integrate RTC into serial output. Test memory expansion for record storage.
Ali	● Work on finding ways to 5V keep battery pack powered on ● Continue work on test plan ● Continue work on system block diagram
Meng	● Explore new way to keep sensors running at different speeds ● Incremental test of all sensors ● RTC integration with all sensors
Pedro	● Optimize layout. ● Help debugging voltage booster.

Week of 4/19

Report	
Everyone	● Working on figuring out power solution ● Barrett emailed us saying we may need to make dummy back box on breadboard for testing since their system won't be complete by the time ours is, we told him we can make 2 front boxes instead of 4 and repurpose the other 2 sets of parts to be the dummy back box.
Robert	● Completed the board layout and sent order to OSH Park on 4/15 ● Researched methods of keeping USB power packs powered on with low current ● Tested multiple USB power packs with Ali and got no desirable results, decided to eliminate them as an option for battery ● Began looking into alternative batteries

Ali	● Updated wiki with schematic, layout, state machine, and others. ● Figure out how to keep battery pack powered on but realized battery pack loses voltage at the cost of current very early, cannot be used, must find alternative battery power. ● purchased USB power pack which did not work as we wanted, took it apart and looking into the possibility of using the battery
Meng	● Merged code with all sensors done. ● Incremental sensor test done (without RTC or memory expansion)
Pedro	● Layout was changed due to power concerns. Running USB connection instead of voltage booster. ● PCB sent to fabrication expecting delivery on 5 business days.

This Weeks Tasks/Issues To Solve	
Everyone	● Continue brainstorming and finalize power solutions
Robert	● Finalize battery solution ● Begin soldering parts to PCB once it arrives ● Test regulators for 5V
Ali	● Continue work on wiki ● Determine battery alternative for powering box ● If there is time, work on test plan and block diagram ● Email Barrett about dummy back box and tell him we would like to pursue that route
Meng	● Memory expansion programming ● Serial transmission programming
Pedro	● Research on power delivery by USB.

Week of 4/26

Report

Everyone	● Power issues solved. We'll be using 7.2V Ni-MH with 3300 mAh battery packs and linear regulators to regulate them down to 5V. ● PCB arrived
Robert	● 5V will be supplied through the TP_5V pin on the board. A daughter board has been prototyped using a linear voltage regulator (LM317, LM7805, or equivalent) to step down the 7.2V battery voltage. ● Power to the regulator and hence the board will be turned on from the 3.3 volt line from the back box. This signal is brought out as a pin on the board. Switching was prototyped using a p-channel mosfet with low on resistance (150 mOhms). It can also be effected using a relay. A suitable relay has been added to the digikey cart. ● Found a flaw in the design, obvious after examining the timing diagram for the memory expansion chip. The CS line must be brought low prior to a memory operation. Keeping the signal continuously at ground does not work. This will require modification of the boards.
Ali	● Purchased two 7.2V Ni-MH battery packs and tested them with 5V linear regulators. They worked perfectly so we'll be using these for our systems. ● Emailed Barrett about making two front boxes and two dummy back boxes which he agreed to. ● Researched relays suitable for using as a switch, so when the 3.3V line from the back box is detected, connect power to our box. ● Some work on test plan.
Meng	● Memory expansion design modified, tested with Grove sensor and timer interrupt ● Worked out data formatting for memory expansion, and packet formatting for serial data transmission
Pedro	● Soldered first prototype board. CO connector is tricky to solder since leads have to be bent a certain way in order to fit the solder pad. A more productive method for soldering without compromising the leads will be developed.

This Weeks Tasks/Issues To Solve	
Everyone	● Work on tests.

	● Work on board modifications
Robert	● Work with group on incremental testing of first board. ● Work with Ali on test plan.
Ali	● Finish test plan and upload to wiki ● Send Dr. Jeske a copy of reduced project schedule ● Set up meeting time with Barrett
Meng	● Go deeper into memory expansion implementation, try different ways to program data types or function types, so the program works with multiple data types (int8, uint8, unsigned long, uint16, char, etc.) ● Program and test memory expansion with all other sensors ● Program and test memory expansion with RTC ● Serial transmission programming ● Help with test plan
Pedro	● Research possible board modifications. ● Test first prototype.

Week of 5/3

Report	
Everyone	● First board almost complete ● Modifications so far done on board ● Met and discussed some points with Barrett. Also demo'd the board collecting sensor data to him. ● Decided to remove year from captured data. ● Overall dummy back-board design complete
Robert	● Did incremental tests on each part of board with success. ● Modified boards for memory unit by scraping off the ground plane from chip select line and adding a mod wire to an available arduino pin.
Ali	● Wasn't able to finish test plan ● Talked about overall enclosure ideas and how air will flow through it. ● Sent Dr. Jeske a reduced version on schedule

	● Meeting set up with Barrett for Sunday 5/3 which went very well. ● Helped determine issue with CO sensor not switching. Pins in code needed to be modified.
Meng	● Finished new functions to parse different data types through serial communication ● Sensor error checking code
Pedro	● Soldered second board. Some footprints were backwards which weren't consistent with the actual part gotten from DigiKey. ● New board includes such modifications as well as final modifications for proper performance of the final prototype.

This Weeks Tasks/Issues To Solve	
Everyone	● Complete enclosure design idea ● If time, work on test plan ● Finish first and possibly second board (memory and RTC) ● Determine possibility of getting some data for hackathon on May 16th.
Robert	● Work on programming. ● Begin working on dummy stub back box
Ali	● Work on test plan if there is time, priority right now is collecting some actual data in time for the hackathon on the 16th. ● Work on board and help finish first one ● Help finish second board ● Work on enclosure and possibly cut one
Meng	● Merge front box code
Pedro	● Solder additional shield boards for dummy back box including RJ-45 serial communication port.

Week of 5/10

Report	
Everyone	● Boards are done. ● SD shields received from Barrett

	● Both boards completed ● Completed enclosure design idea
Robert	● Received SD card shields from Barrett. Working on stub back box. There are difficult memory corruption issues when combining code.
Ali	● Enclosure is decided to have three holes on the left and right side with the back mostly open for any incoming or outgoing connections. Sensors will be connected to the sides or top of the box with the exception of the CO sensor which is on board. ● Finished soldering the second board ● Made one daughter board for regulating power from battery.
Meng	● Front box code merging.
Pedro	● Shield boards for dummy box fully soldered. No issues were encountered while assembling the shield boards.

This Weeks Tasks/Issues To Solve	
Everyone	● Get some data for hackathon by wednesday ● Begin documentations and poster ● Finish programming
Robert	● Code dummy back box to implement GPS, SD card storage and serial communication with front box.
Ali	● Make second daughter board for power regulation. ● Begin work on documentation ● Help with any programming
Meng	● Help Robert with software design changes
Pedro	● Review code for data communication between boxes.

Week of 5/17

Report	
Everyone	● The working, but not fully tested, front box does not meet the original specification. We will continue testing and collecting data with the working system and will also develop a second

	system that can meet the project specification, i.e. serial communication with a back box. This will require moving GPS to the front box and having the SD card in the back box. ● System was demo'd at hackathon with great feedback. ● Decision made to have one standalone board with memory and GPS in front box and no serial communication, and one board without memory and serial communication but GPS will have to stay in front box.
Robert	● Discovered that software serial and memory will not work together. This is true for both the SD card and memory chip which use the same SPI interface. ● Moved GPS and SD card to front box and rewrote the code for this new configuration. Was able to get the system working as a stand-alone front box. Collected 8 hours of stationary data with GPS coordinates, date and time, and data from all sensors except pulse.
Ali	● Completed second daughter board. ● Spend a large amount of time trying to figure out a code to convert CO voltage output to PPM with no luck. It seems we will have to have the CO data represented as a relative increase/decrease of CO levels. In order to get actual PPM data we would need to have a vacuum box with controlled temperature, humidity, and CO levels to calibrate the sensor. ● Helped robert with trying to figure out communication/storage issues between the front and back box. ● Presented the box at the global smart cities hackathon with some sample data robert managed to successfully collect. The presentation got great feedback and they are considering sending me to DC to present the board at the Global Smart Cities event on June 1st.
Meng	● Attended Global Smart Cities Hackathon in beaverton with Ali.
Pedro	● I wasn't able to attend this week's meeting due to a seminar I had to attend on the East Coast.

This Weeks Tasks/Issues To Solve	
Everyone	● Work on documentation: ○ Finish test plan

	○ Make poster outline ○ Begin report and user manual ○ Work on wiki ● Finish enclosures ● Run test on boards and collect data
Robert	● Begin final report. ● Conduct road tests with the standalone front box system.
Ali	● Work on poster ● Work on getting presentation ready for Global Smart Cities event on June 1st. ● Work on test plan with Meng. ● Update wiki. ● Work on getting one enclosure for the standalone system.
Meng	● Work on testplan, poster and help with other documentations
Pedro	● Work on “Assembly” portion of the final report. ● Work on “Schematic” portion of the final report. ● Help on additional documentation required for final presentation.

Week of 5/24

Report	
Everyone	● Box is complete ○ Box is not to specification which is fine by sponsor and advisor. Since the sponsor back box cannot be completed we cannot have the necessary specs done. ○ The microcontroller is not able to both store and send data simultaneously. For this reason we had to make the choice to either store data or send it. Since the back box is not done, our decision was to store data instead to have a full, self contained, working box. ● Enclosure is complete and everything is assembled ● Poster is complete and printed ● Test plan is almost complete ● Showed completed project to Prof. Jeske and set up presentation date for Thursday June 4th

Robert	● Collected and processed data for several bike rides. ● Used Makercase and Inkscape to design enclosure. ● Packaged and minimally tested a second system in the new enclosure. ● Minor modifications to program.
Ali	● Helped assemble completed box in enclosure ● Completed poster and had it printed ● Helped test completed box ● Worked on presentation for global smart cities event in June 1st
Meng	● Helped Robert adjusting sensor programming ● Testplan 85% done ● Helped Ali creating poster
Pedro	● Assistance with processed data for bike ride. ● Assistance with preliminary design of enclosure.

This Weeks Tasks/Issues To Solve	
Everyone	● Prepare for presentation on June 4th ● Finish test plan ● Create presentation slides ● Update Wiki ● Complete report
Robert	● Start final report
Ali	● Update Wiki ● Create slides for presentation ● Help with report
Meng	● Finish Testplan ● Create presentation slides
Pedro	● Update Schematic ● Create presentation slides ● Help with final report

Week of 5/31

Report

Everyone	● Preparing for presentation on Thursday ● Helping with report and other final steps for completion of project
Robert	● Found an error is Sharp dust sensor code, fixed. ● Submitted final version of standalone front box code to github. ● Working on Final Report. ● Conducted CO test (candles) and PM tests (incense), collected data.
Ali	● Preparing to present project for global cities tech challenge ● Progress on slides for oral presentation ● Updating wiki
Meng	● Testplan
Pedro	● Schematic is being revised along with final design. ● Layout to changes accordingly with schematic.

This Weeks Tasks/Issues To Solve	
Everyone	● Continue preparing to present ● Continue completion of documentation
Robert	● Work on presentation slides. ● Continue working on Final Report.
Ali	● Complete presentation slides ● Complete Wiki ● Help with report
Meng	● Complete presentation slides
Pedro	● Complete Schematic/Layout Slides ● Prepare for final presentation