Household Waste Tracking System
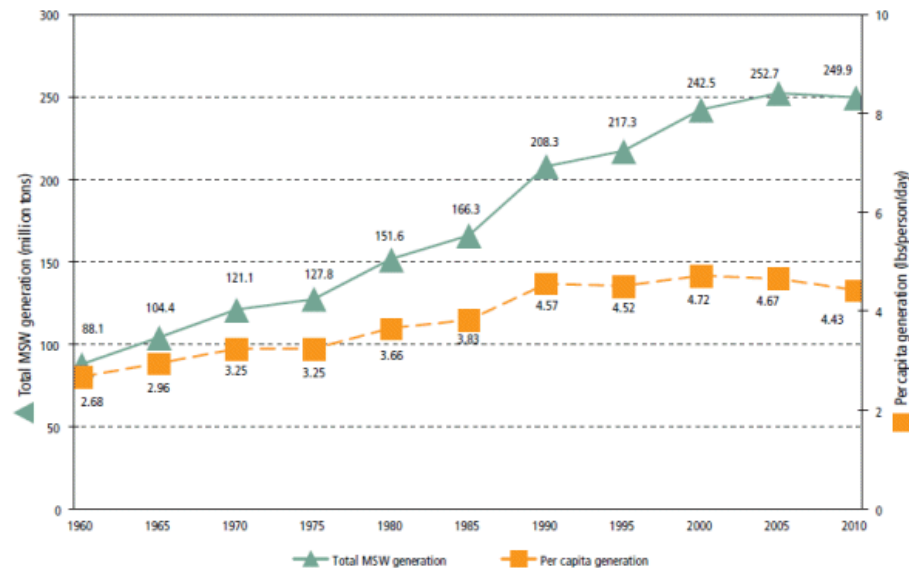
Senior Capstone Design
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The Issue

- America has a waste problem
- In 2012: 251 million tons of landfill trash Generated
- Personal Waste is around 4.43 lbs. per day

http://www.epa.gov/waste/nonhaz/municipal/

Solution

- Generate "Big" & personal waste data
- Create economic incentive for sustainability
- Create a culture of accountability

System Proposal

- Catalogue personal waste production

Main Functions of the system

- Measure weight of the waste
- Identify the producer & Location of the waste
- Catalogue that data
- Present that data to customers, Trash companies, and local governments

Customer Identification

CAN WEIGHT

Location

MICROCONTROLLER /MEMORRY

TAG AND WEIGHT TABLE

Risks/System requirements

- Waste measurement
-Load Cell/Load Cell interface
- Customer Identification
-RFID/GPS
- Location
-GPS/GPRS
- Data Storage/Transmission
-Flash Storage/GSM

Required Load Cell Tolerance

- Av. Monthly household bill: $12-20

https://wasterecycling.org/images/documents/resources/Research-Bulletin-Service-At-A-Bargain.pdf

- Av. Daily individual waste: 4.4 lb/day

http://www.epa.gov/waste/nonhaz/municipal/

- Av. People of per household: 2.58

http://quickfacts.census.gov/qfd/states/00000.html

Minimum Resolution Required

$$\frac{\$20}{1\ household\ month} \times \frac{1\ household}{2.68\ Persons} \times \frac{1\ month}{30\ days} \times \frac{1\ Person}{4.41\ lb\ day} = \frac{\$0.056407}{lb.}$$

$$\$0.01 \times \frac{lb.}{\$0.056407} = 0.177282\ lb.$$

$$0.177282\ lb. = 80.413763\ grams$$

Theoretical Load Cell Resolution

- A/D converter: 24 bit
- Max Load Cell Voltage: 0.5 V
- Load Cell response: 3333.33 kg/V

$$24 \ bit = 16777216 \ div.$$

$$\frac{0.5 \ V}{16777216 \ div.} = 29.802 \times 10^{-9} \frac{V}{div.}$$

$$29.802 \times 10^{-9} \frac{V}{div.} * \frac{3333.33 \ kg}{V} = 99.34 \times 10^{-6} \frac{kg}{div.} = 0.9934 \frac{g}{div.}$$

```
                                 Poll Can          Record          Dump
                                    ID              Full           Trash
                                                   Weight

                                  Can              GPS            Record
                                Detected         Location         Empty
                                                 Recorded         Weight

                   Send                                          Assign Net
                 Weight to        Poll For                      Weight to ID
                    Web            GSM
                 Interface

                                 Record To
                                SD for later
                                  Record
```
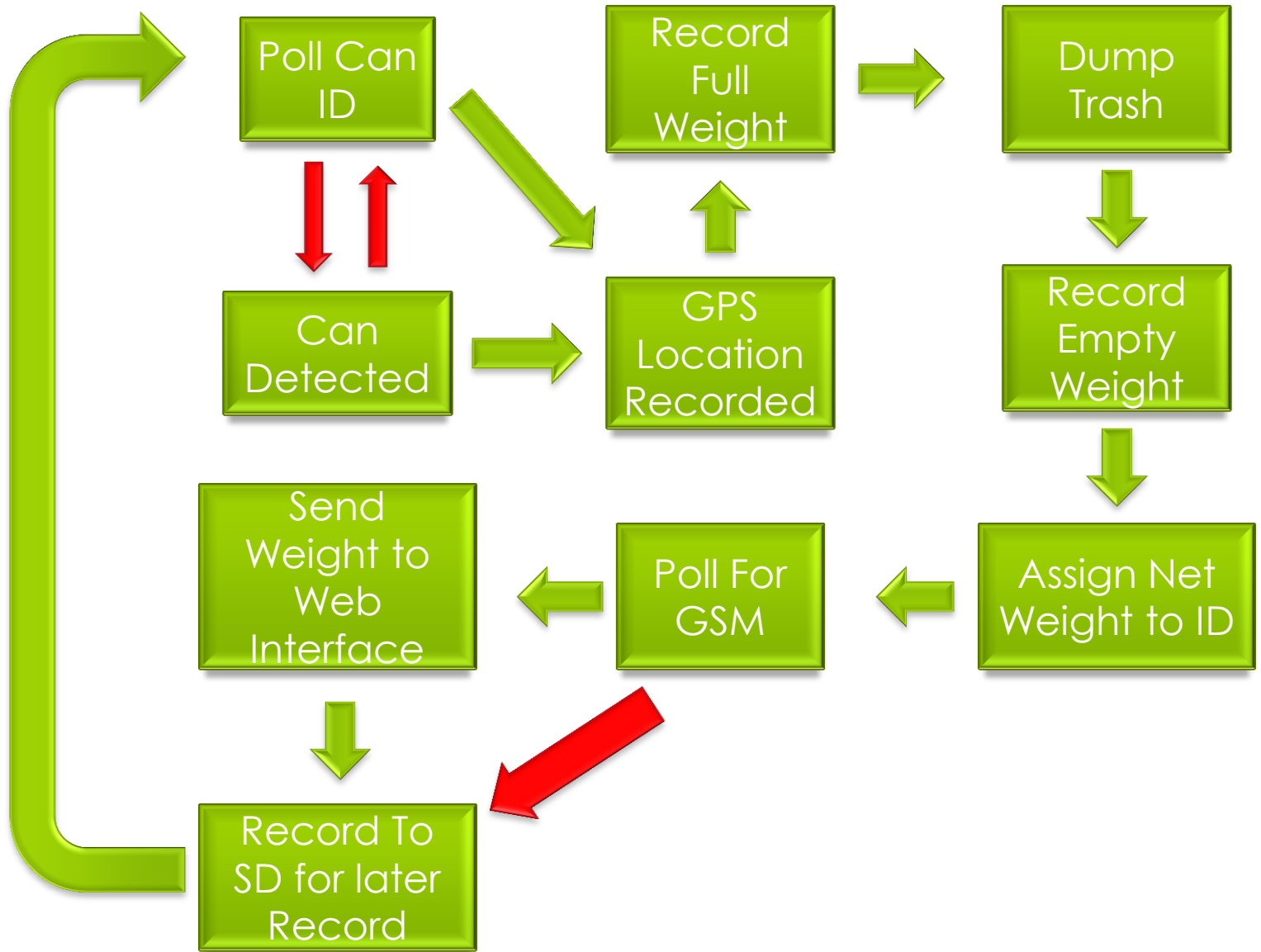
Web Interface Overview

Dweet

- Stores Variables through Http "Post"
- Variables retrieved through Http "get"
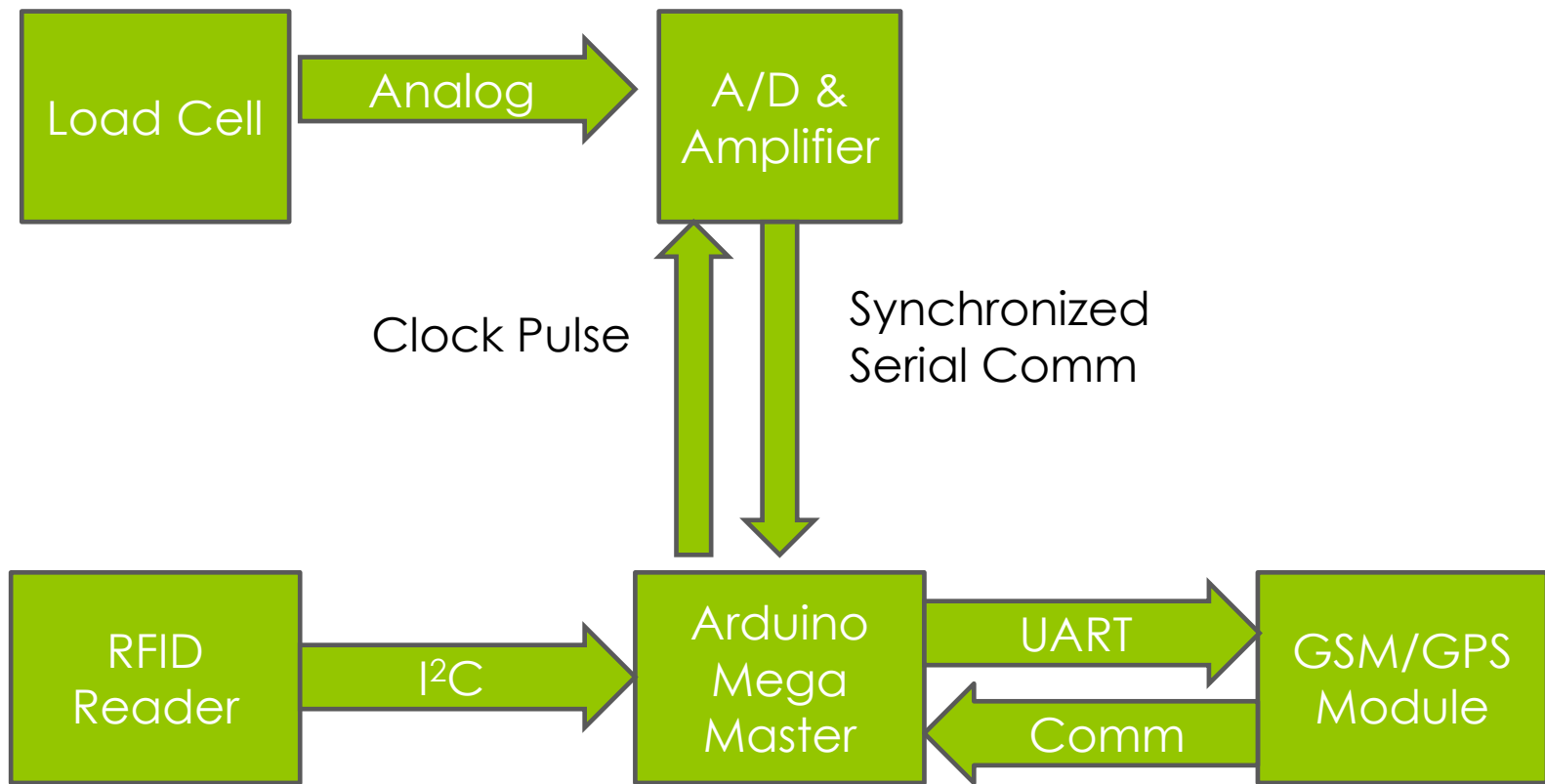- Variables identified by "thing" and key

Dweet Payload:

{"this":"succeeded","by":"dweeting","the":"dweet","with":{"thing":"000004","created":"2016-03-05T03:01:05.117Z","content":{"Weight":26},"transaction":"202aeac4-c3a9-4993-88ba-686bea350cd9"}}
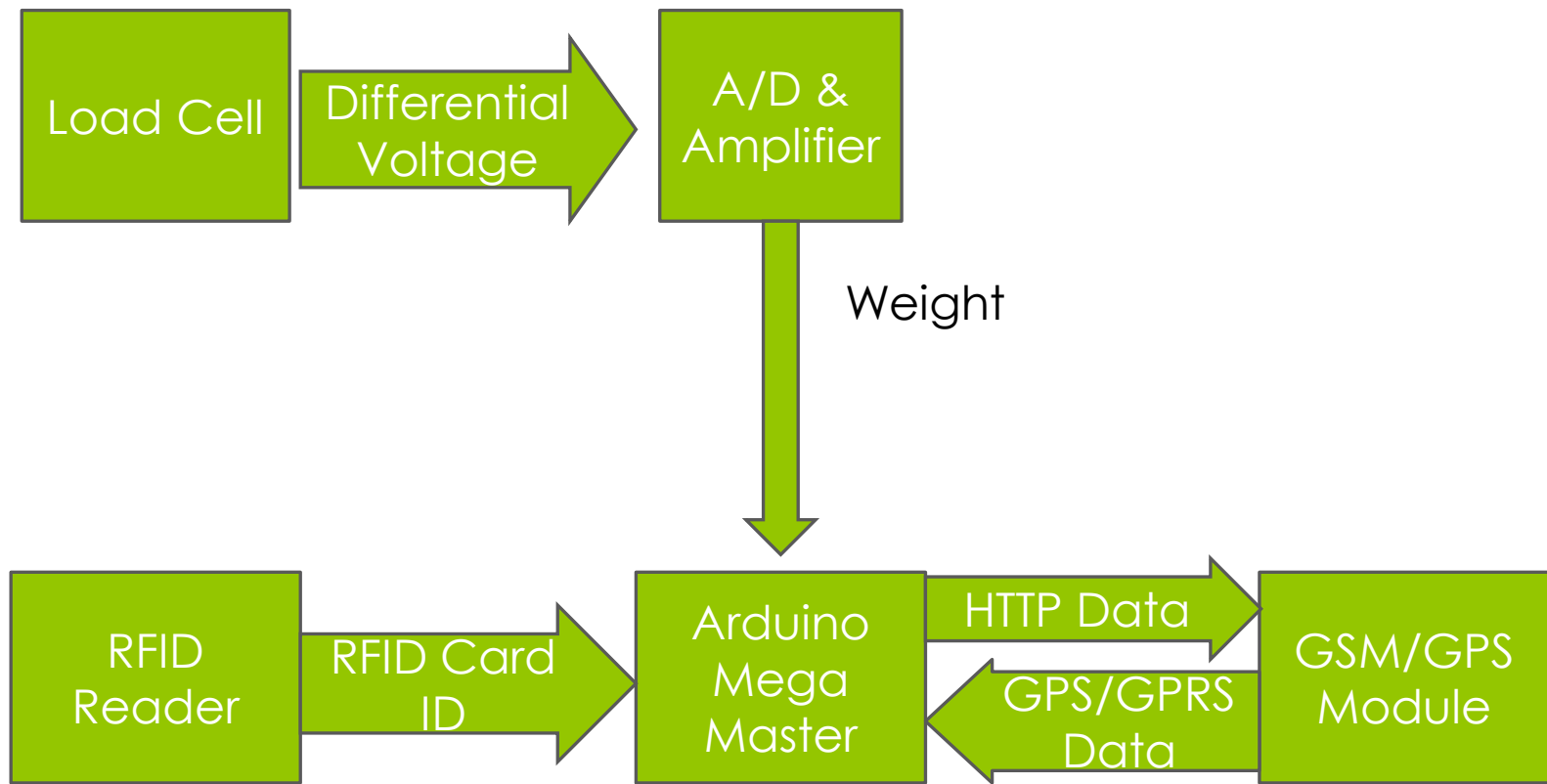
Freeboard.io

- Updates based on variables from Dweet using "get" commands
- Can display values, strings, locations, etc.

Device Connection

Devices Information

Device Build
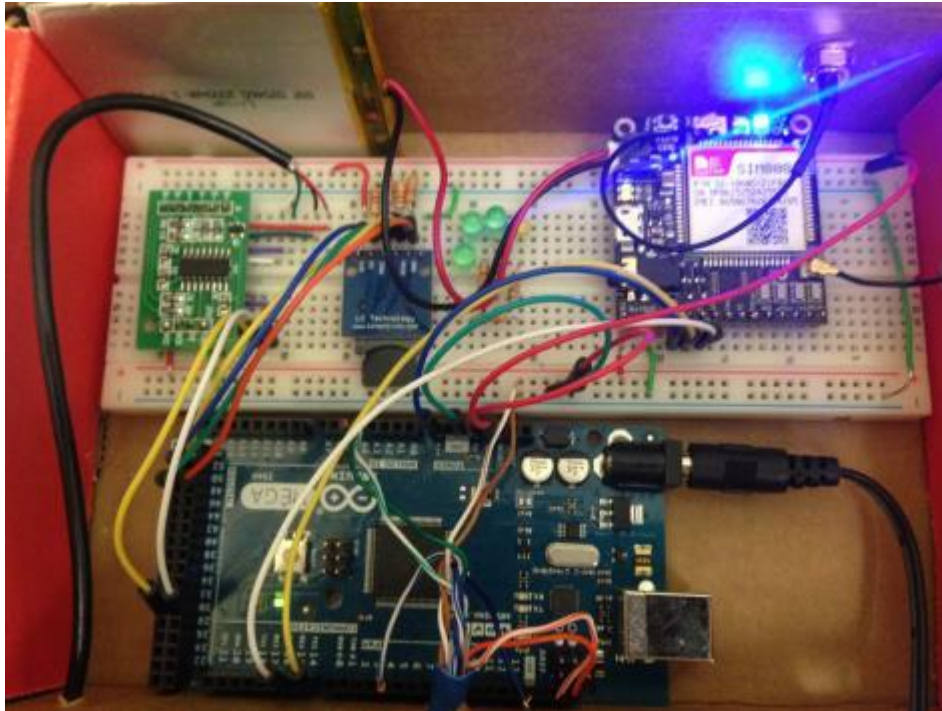
Test Device
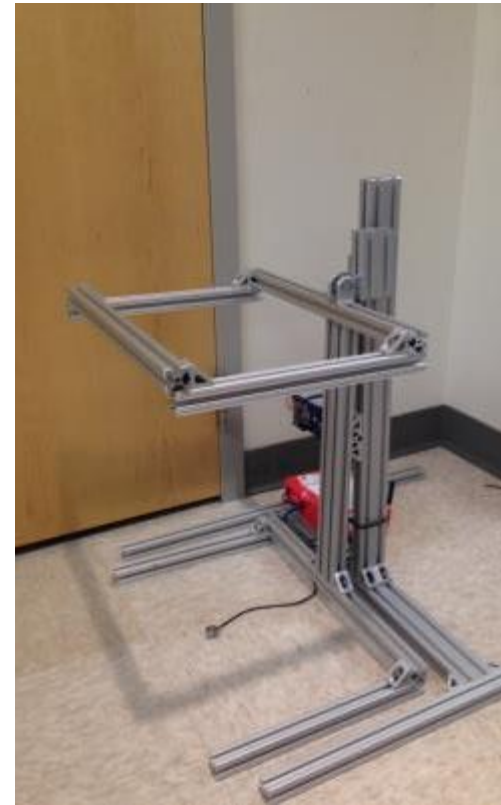
Freeboard.io Display
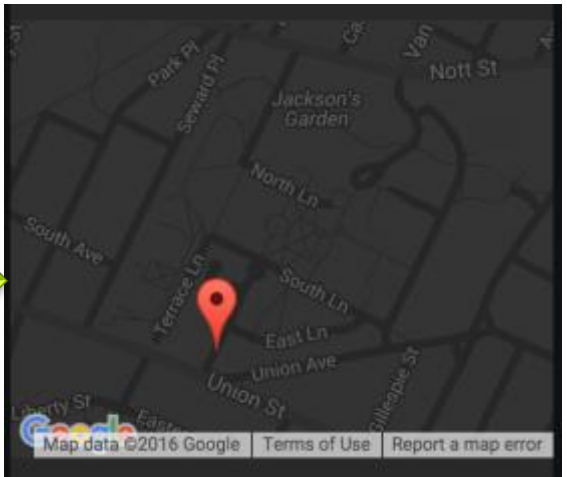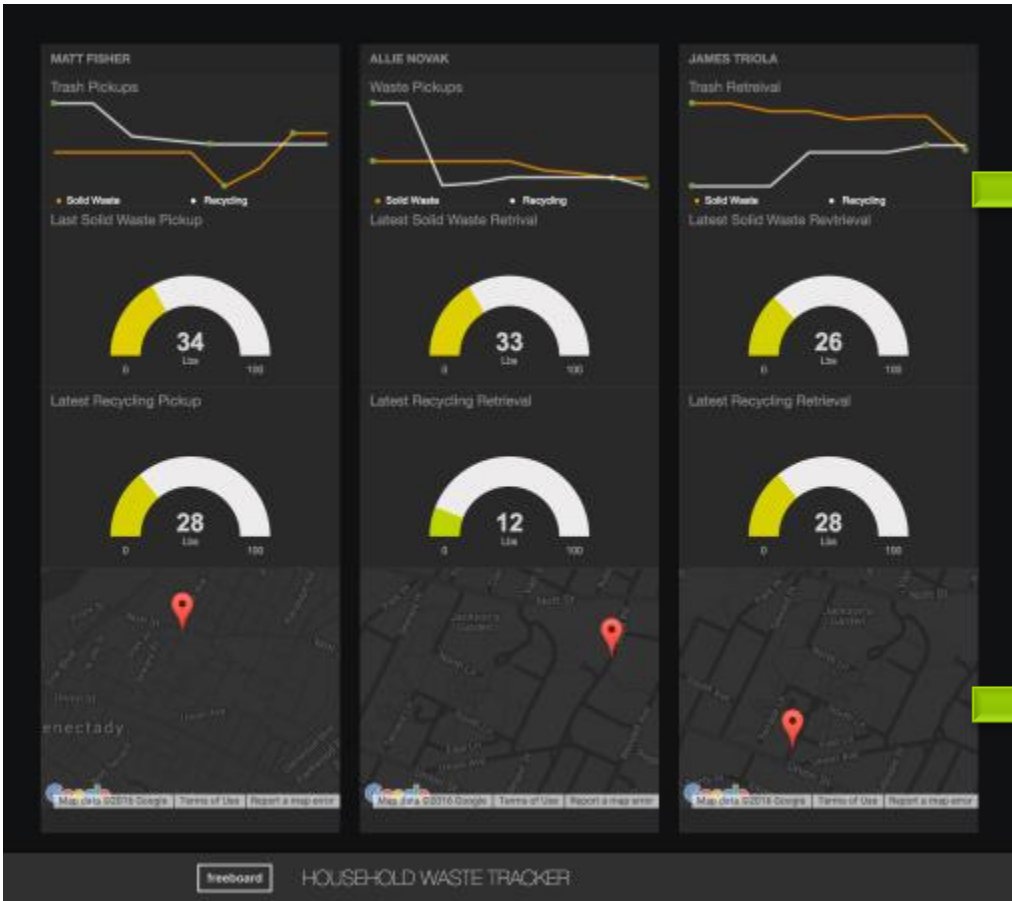
Equipment Testing

- RFID Distance
- Load Cell Accuracy
- GPRS Location Testing
- GPS Location Testing
- Cellular connectivity
- Overall function

GPS Location Testing

,42.817493,-73.927833,
nmddHHMMSS),latitude,lc
32.700,1.35,5.3,1,,1.6

,42.817518,-73.927842,
nmddHHMMSS),latitude,lc
32.400,0.06,164.9,1,,1

,42.817518,-73.927842,
nmddHHMMSS),latitude,lc
32.400,0.02,358.5,1,,1

,42.817518,-73.927842,
nmddHHMMSS),latitude,l

Gps Location

Actual Location

GPRS Location Testing


```
GSMLoc lat:42.815082
GSMLoc long:-73.927261
            ---> AT+CGNSINF
            <--- +CGNSINF:
Waiting for FONA GPS 3D fi
Checking for Cell network.
            ---> AT+CREG?
            <--- +CREG: 0,1
            ---> AT+CIPGSML
            <--- +CIPGSMLOC
GSMLoc lat:42.815082
GSMLoc long:-73.927261
            ---> AT+CGNSINF
            <--- +CGNSINF:
Waiting for FONA GPS 3D fi
Checking for Cell network.
            ---> AT+CREG?
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            ---> AT+CREG?
            <--- +CREG: 0,1
            ---> AT+CIPGSML
            <--- +CIPGSMLOC
GSMLoc lat:42.815082
GSMLoc long:-73.927261
```

Actual Location

Gprs Location

Load Cell Testing

```
Reading: 200 g calibration_factor: -76.00
Reading: 200 g calibration_factor: -76.00
Reading: 199 g calibration_factor: -76.00
Reading: 200 g calibration_factor: -76.00
Reading: 200 g calibration_factor: -76.00
Reading: 200 g calibration_factor: -76.00
Reading: 200 g calibration_factor: -76.00
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Reading: 199 g calibration_factor: -76.00
Reading: 198 g calibration_factor: -76.00
Reading: 198 g calibration_factor: -76.00
Reading: 199 g calibration_factor: -76.00
Reading: 197 g calibration_factor: -76.00
Reading: 198 g calibration_factor: -76.00
Reading: 198 g calibration_factor: -76.00
```

RFID Testing

Infront	
Trial	Distance (cm)
1	9.1
2	9.2
3	9.1
4	9.2
5	9.5
average	9.22

Infront (5cm displacement left)	
Trial	Distance (cm)
1	7.25
2	7.4
3	7.5
4	7.3
5	7.4
average	7.37

Expenses

Item	Quantity Needed	Price Per Unit	Total Estimated Price
Micro Controller	1	$45.95	$45.95
GPS/GSM sheild	1	$49.97	$49.97
GPS Antena	1	$3.95	$3.95
GSM Antena	1	$7.95	$7.95
GSM Antena Conector	1	$4.95	$4.95
GSM Battery Pack	1	$12.95	$12.95
Battery Pack Charger	1	$7.95	$7.95
50 Kg Load Cell	1	$56.95	$56.95
Load Cell amp	1	$4.81	$4.81
Micro Controller Power Supply	1	$3.95	$3.95
SD read/Write board	1	$1.97	$1.97
RFID Reader	1	$39.95	$39.95
RFID Chips	4	$2.50	$10.00
Arduino Headers	2	$1.50	$3.00
SD Card	1	$0.49	$0.49
Cell Contract/SIM card	1	$15.00	$15.00
		Total:	$269.79

Questions/Comments?

Future Work

- Web Server & Database Development
- Retrofitting and testing in real world environment