START 10-3-2021 @ 13:25

Answer the 2 assigned questions (3 & 4)

3) What is the amount of power consumed by our sensors in accordance with time? Arduino, magnetometer, and time of flight sensor. (Assuming these are by hour)

***NOTE: 1,000,000uA = 1,000 mA = 1A (These are based on using 3.7v)***

a) At sleep:

aa1) Arduino: 104 uA

aa2) ToF Sensor:

aaa1) Hardware: 3 – 7 uA, Typical: 5 uA

aaa2) Software: 4 – 9 uA, Typical: 6 uA (Uses 2.8v)

aa3) Magnetometer: 3 uA

aa4) Approx. Total: 114 uA (0.114 mA)

b) At usage:

b1) Arduino Components

bb1) Security Chip: 5mA

bb2) Micro Processor: (On page 988 for DETAILS) 3.4 – 5.73 mA

bb3) LoRa Module: (On Page 6 for DETAILS)

bbb1) Receiving: 21 – 25 mA

bbb2) Sending (no boost): 34 – 47 mA

bbb3) Sending (boosting): 106 – 128 mA

b2) Approx. Total Receiving: 36 mA

b3) Approx. Total Sending: 58 mA (No Boost)

b4) Approx. Total Sending : 139 mA (Boosting)

b5) ToF Sensor: 19 mA

b6) Magnetometer: 2.6 mA (At Peak)

b7) Send/Receive (Norm/Boost): 83 mA/164 mA

c) Scenarios:

c1) Sending:

cc1) No Boost (On for 24 hours): 58 mA x 24 hrs = 1392 mAh

cc2) Boosting (On for 24 hours): 139 mA x 24 hrs = 3336 mAh

cc3) No Boost, All Sensors (24hours): 1392 + 456 +62.4 = 1910.4 mAh

cc4) Boost, All Sensors (24 Hours): 3336 + 456 + 62.4 = 3854.4 mAh

c2) Receiving:

cd1) Receiving (On for 24 Hours): 36 mA x 24 hrs = 864 mAh

c3) Sleeping:

ce1) Sleep (for 24 Hours): 114 uA x 24 hrs = 2736 uA (2.7 mA)

c4) Combinations:

cf1) Send/Recieve (On for 24 Hours):

ccc1) No Boost: 1392 mAh + 864 mAh = 2256 mAh

ccc2) Boosting: 3336 mAh + 864 mAh = 4200 mAh

ccc3) No Boost, All Sensors: 2256 + 456 + 62.4 = 2774.4 mAh

ccc4) Boosting, All Sensors: 4200 + 456 + 62.4 = 4718.4 mAh

c5) ToF Sensor (For 24 hours): 19mA x 24 hrs = 456 mAh

c6) Magnetometer (For 24 Hours): 2.6 mA x 24 hrs = 62.4 mAh

d) Battery Life Cycles:

d1) For 1 Full Discharge Cycle:

dd1) Sleeping : 10050/2.7 = 3722.22 (3723 days)

dd2) No Boost, All Sensors: 10050/2774.4 = 3.622 (4 days)

dd3) Boosting, All Sensors: 10050/4718.4 = 2.129 (2 days)

d2) Battery life until it hits below 80% charge capacity:

de1) Sleeping: 3723 x 300 = 1116900 days (3060 years)

de2) No Boost, All Sensors: 4 x 300 = 1200 days (3.2 years)

de3) Boosting, All Sensors: 2 x 300 = 600 days (1.64 years)

4) How do we plan to power our sensors (battery, solar panel, longevity of charge)?

***Just a quick note about battery properties:***

***The standard rating for batteries is at room temperature 25 degrees C (about 77 F).***

***At approximately -22 degrees F (-30 C), battery Ah capacity drops to 50%.***

***At freezing, capacity is reduced by 20%.***

***Capacity is increased at higher temperatures – at 122 degrees F, battery capacity would be about 12% higher.***

a) Possible Solar Panel: 60mm x 30mm (2.3 in x 1.2 in) can do up to 50 mA. If for some reason, the panel gets hit with direct sun for long periods, this could be a feasible idea in recharging the battery. In an ideal situation on a ~2.6” x 2.4” package, it COULD charge up to 100 mA. With the low amount of power consumption during its sleep, this is beneficial. It’s hard to make a case for otherwise. It was mentioned this could be used as another form of vehicle detection, but we haven’t spoken about this at length.

b) Most likely use batteries. We may need to package in a way the hardware could ‘warm up’ the batteries to mitigate the power losses from temperature. Currently looking at a 10050 mAh Li-Ion Battery ($29.95). If this battery is sufficiently large, then it could last for quite some time.

Basic Tech Details about the battery:

***Nominal Capacity***

* + ***Minimum: 9500mAh***
  + ***Typical: 10050mAh Standard discharge （0.2C) after Standard charge***
* ***Nominal Voltage 3.7V***
* ***Charging Cut-off Voltage 4.2V***
* ***Discharge Cut-off Voltage 2.5V***
* ***Standard Charge***
  + ***Constant Current 0.2C***
  + ***Constant Voltage 4.2V 0.01 C cut-off***
  + ***Charge Time : Approx 8.0h***
* ***Maximum Constant Charging Current 3000mA***
* ***Standard Discharge Discharge at 0.2 C to 2.5V***
* ***Maximum Continuous Discharging Current 3000mA***
* ***Operating Temperature Charge 0～45℃***
* ***Discharge –20～60℃***
* ***Storage Temperature -20～45℃ for 1Month -10～35℃ for 6Months***
* ***Storage Voltage 3.7-3.85V***

***Product Dimensions: 66.6mm x 55.3mm x 18.7mm / 2.6" x 2.2" x 0.7"***

***Product Weight: 148.0g / 5.2oz***

***Cycle life > 300 (It will take this many cycles until it gets lower than 80% charge capacity)***

Going through the other questions:

1) We’ll be using an Arduino MKR WAN 1310, magnetometer, and a ToF Sensor. We want to detect a vehicle and send the status (detect/no detect) with the LoRa WAN system. The power consumption is the main reason for the particular Arduino, while the sensors is for the detection.

2) It will send out some unique ID to differentiate from the other modules, and the status of the parking spot.

3 & 4 Are at the top

5) Tech Specs:

5a) Arduino:

5aa) Temp Range: Not listed

5ab) Detection Range: N/A

5ac) Transmission Range: N/A

5ad) Signal Speed: N/A

5b) Magnetometer: (Starts on Page 3)

5c) Time of Flight: (Starts on Page 22)

6) LoRa Specs:

Looks to be a 101 page document.

7) Problem Mitigation:

7a) We may need to calibrate each sensor based on location (zero out sensors during install/reinstall), add conditions (when it’s reading oddities check the module?) The rest is probably more in depth than the time I gave myself.

8) Future Scope:

8a) This may be excessive to consider since it’s assuming we have a clear idea on where we want to take this and our method of monetizing this to stay ‘alive’ or create it in some way so it can also be managed by the user(s). This also makes an assumption that the entire or majority of the team wants to go this route as well.

8b) The possibility of being an EXCLUSIVE University parking lot solution could initially help with cash flow for the short/mid term, as long as the system is within the University’s price expectation. A long term solution could be using this for current pay parking lot/spots or small lots that gets high traffic (like Chic-Fil-A??). The long term monetization would be turning this into a full one stop solution (hardware and software) and continually updating the hardware to create an incentive for updating it on a regular basis.

STOP 16:04