ENSC 440W/305W

PROJECT GROUP B

Monday December 14th, 2015

Solarity by SUNLINK

THE TEAM

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OUTLINE
AT A GLANCE

OVERVIEW

BACKGROUND

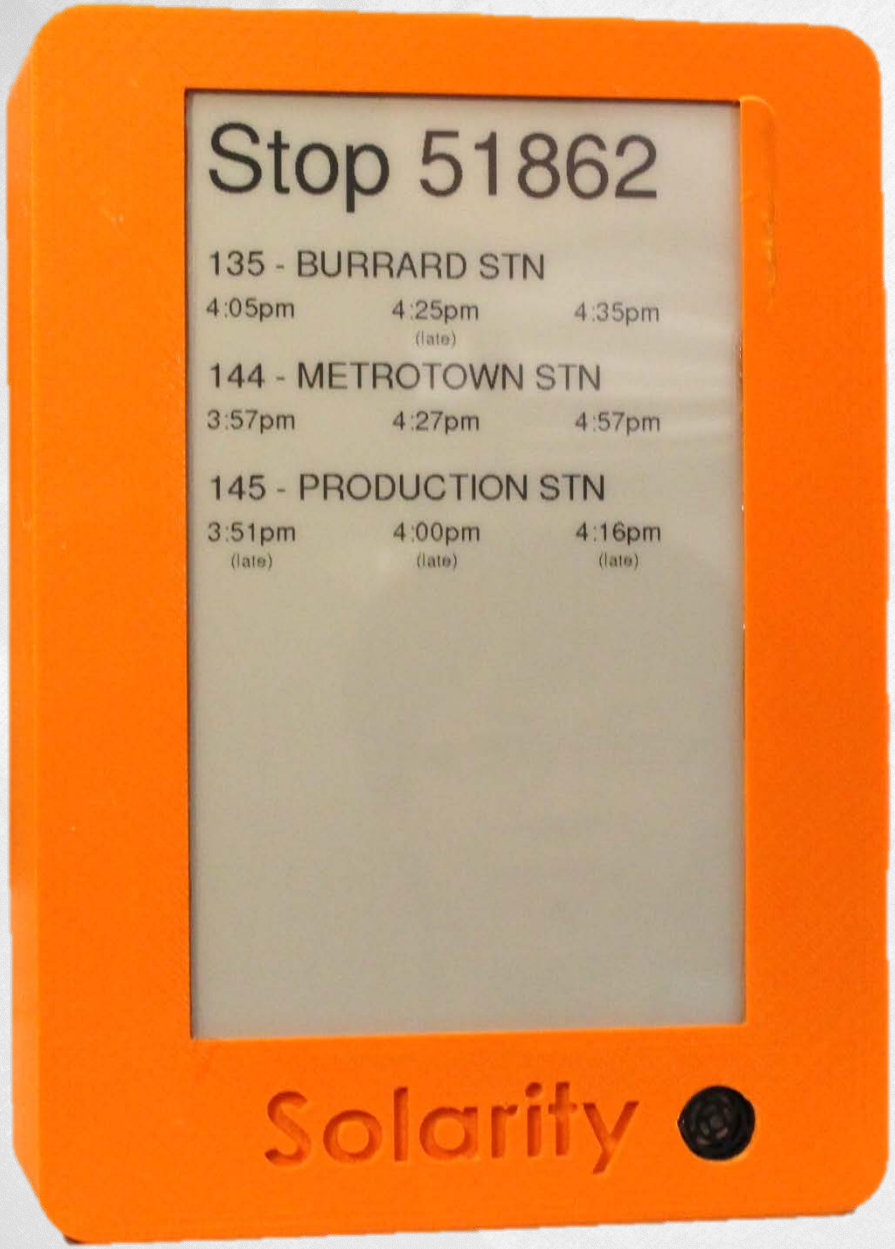
- 418,000 people take transit a day (2014)
- Traffic and unexpected circumstances lead to late buses
- How can we make it easier for them?

MOTIVATION

- We are regular Transit Users
- Translink App does not accommodate everyone
- Improve current paper schedules

OUR GOAL

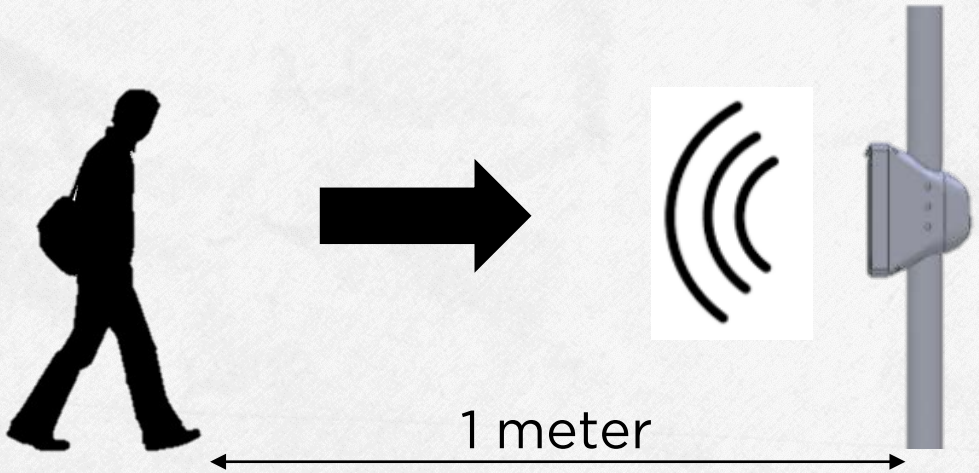
- To build a device that provides real-time info to transit users
- Have a cost-effective solution
- Power with solar energy to minimize costs and be powered wirelessly



“SELF SUSTAINING REAL-TIME BUS DISPLAY”

SOLARITY INTERACTIONS

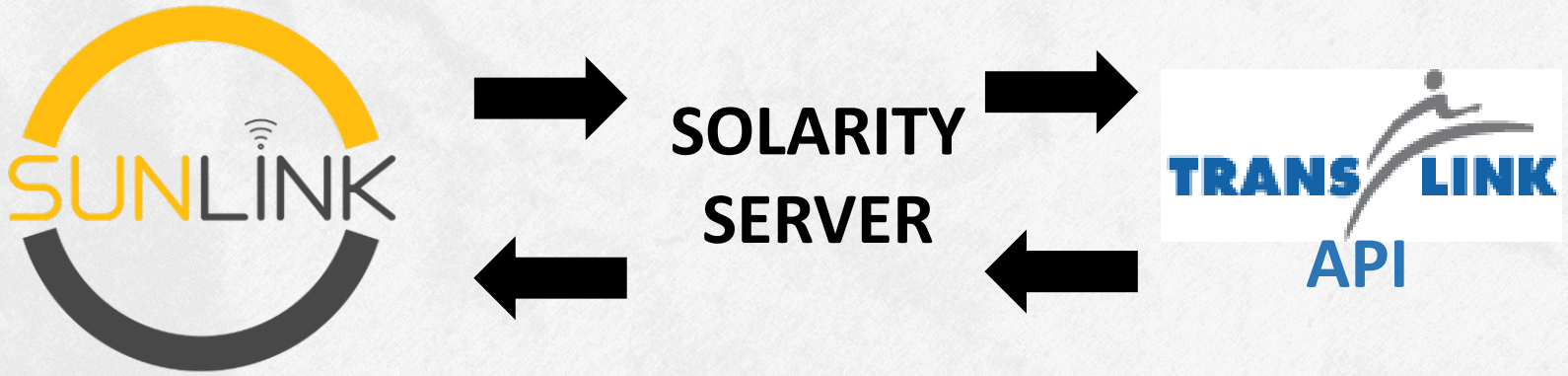
Preliminary Step: User arrives at transit stop which is equipped with Solarity device.



- Proximity sensor detects nearby transit user

SOLARITY INTERACTIONS CONT'D

Step 2: Solarity System sends request to server



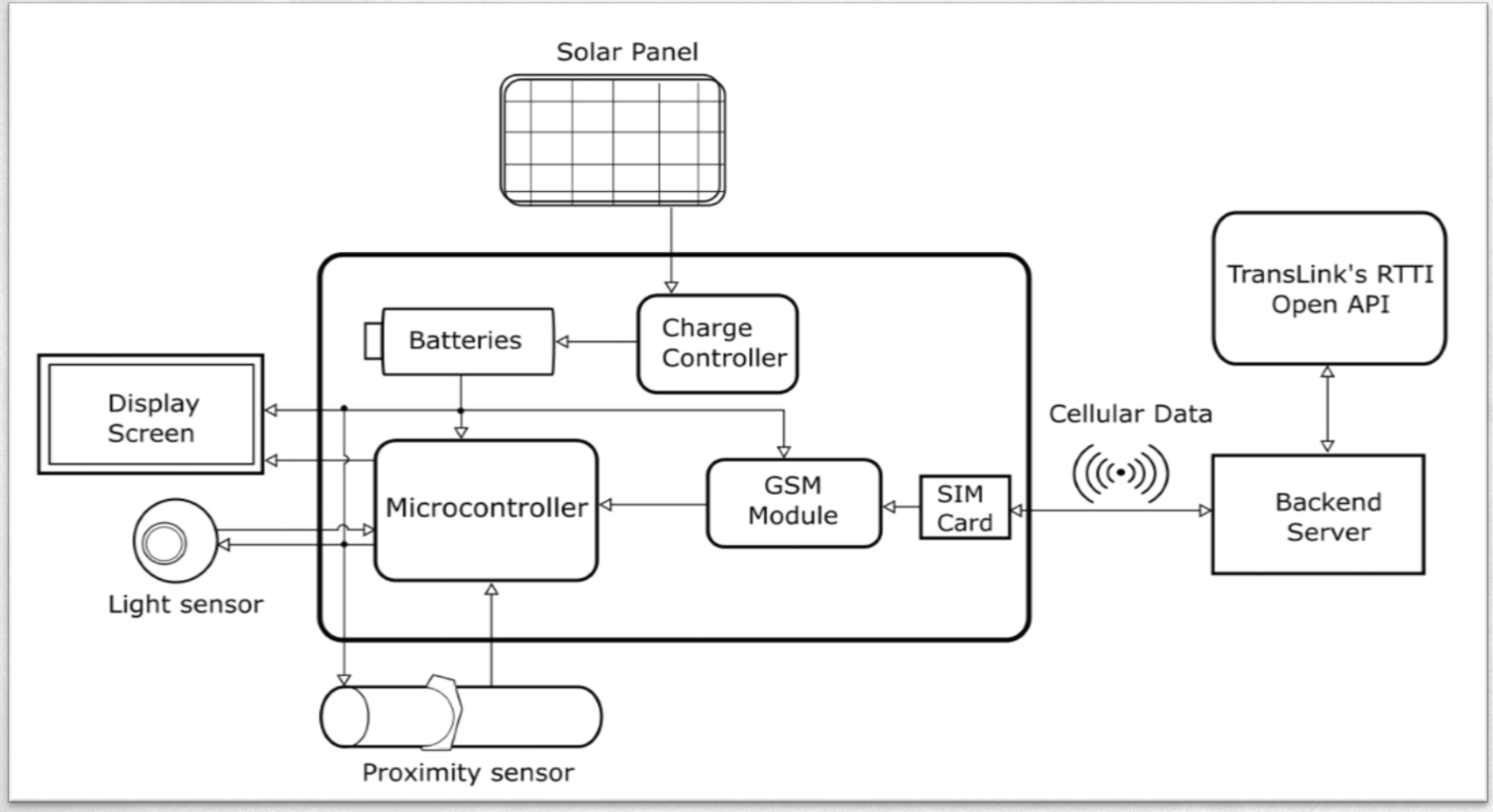
- Retrieves data from Translink open API
- Data contains bus times for particular stop

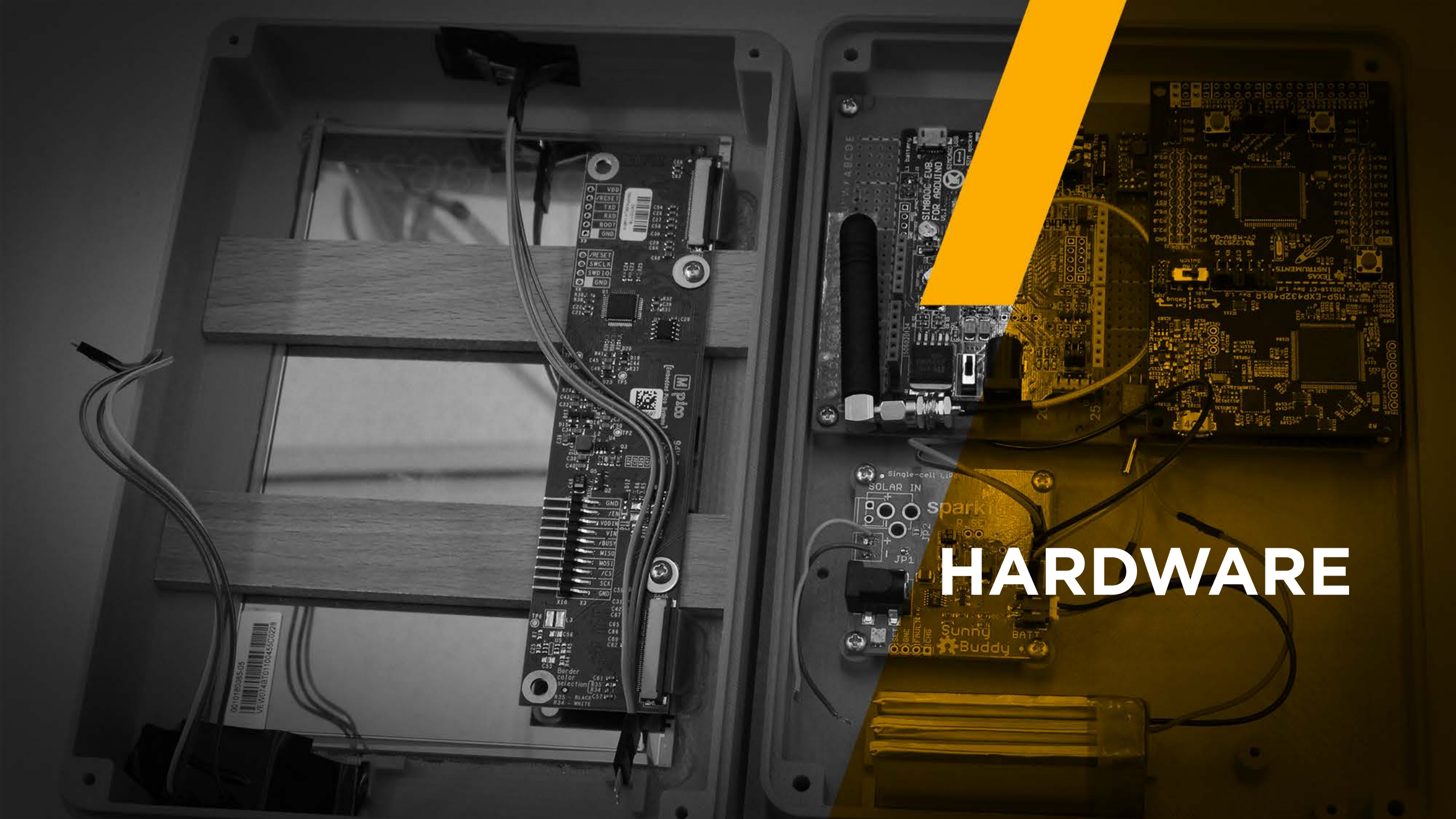
SOLARITY INTERACTIONS CONT'D

Step 3:

- The Display will refresh with updated transit times.
- Users can make their decisions based on real-time info

SYSTEM OVERVIEW

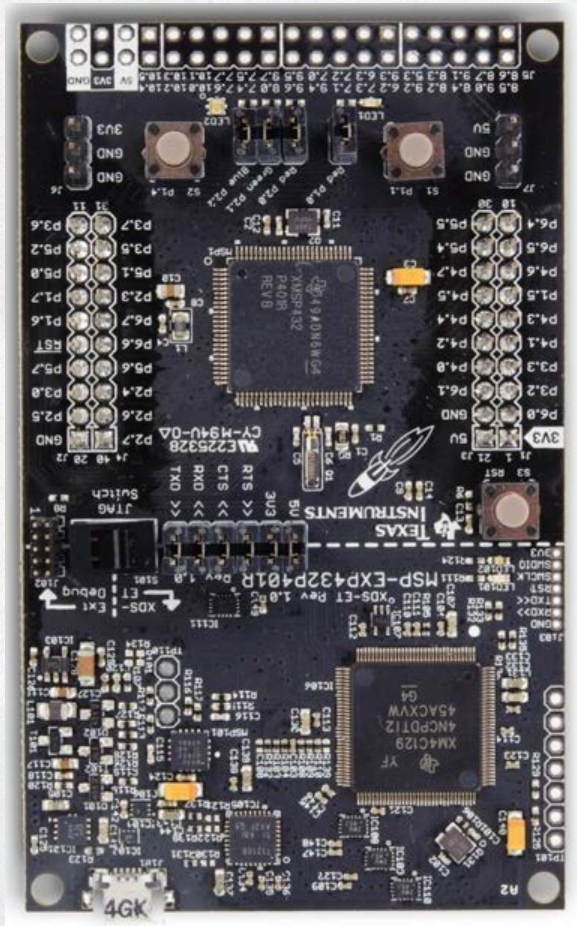




HARDWARE

MICROCONTROLLER – MSP432

- MSP432P401R
- Ultra-Low Power Operating Modes
- Inexpensive
- Serial SPI/UART communication



DISPLAY – MPICO 7.4"

PERVASIVE DISPLAY

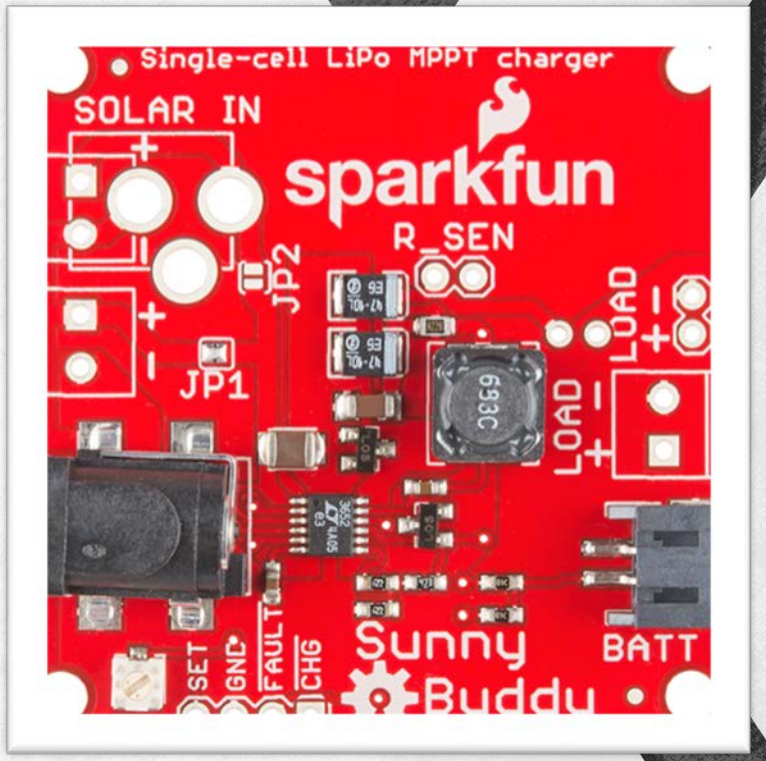
- E-INK
- Bistable: retains image when not powered
- Consumes power only when updating

PROXIMITY SENSOR

- LV-MaxSonar-EZ0
- Ultrasonic sensor
- Better for outdoor conditions
- Low power (2mA)
- Wide and sensitive beam pattern

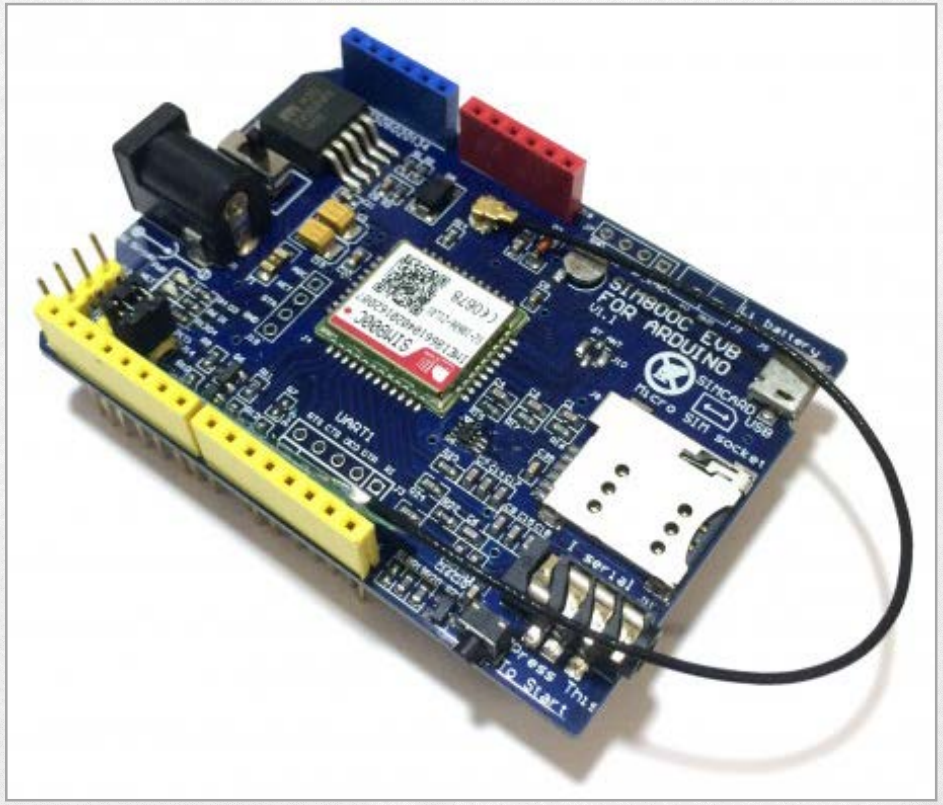
CHARGE CONTROLLER

- Sunny Buddy – MPPT Solar Charger
- Maximum Power Point Tracking (MPPT)
- Switching mode operation
- Maximum charge current of 1A



GSM MODULE– SIM800c

- Compact
- Supports 2G/3G networks



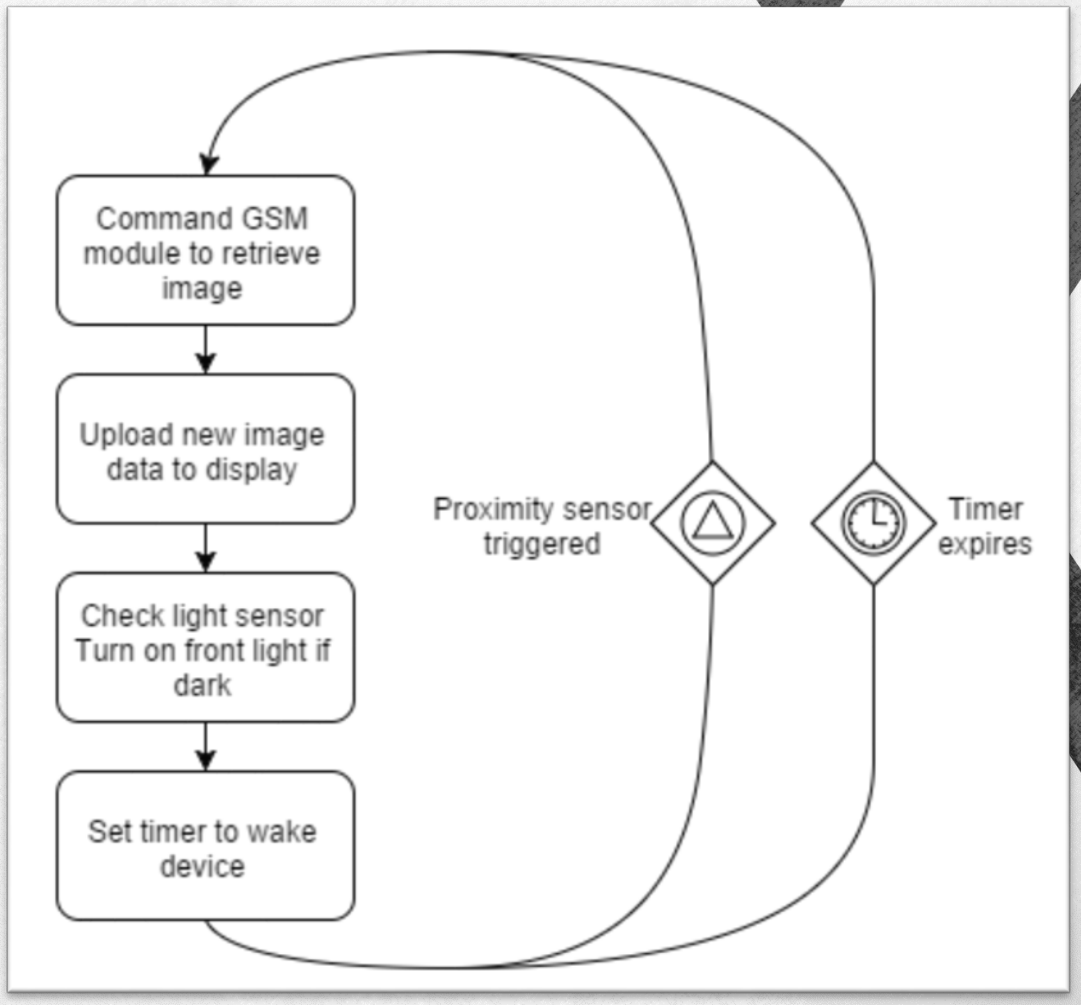
POWER

- Total power: 5.1 Wh/day
- Lowest monthly solar energy in Vancouver is 810Wh/m^2/day [6]
- 30cm * 20cm is approximate required size


SOFTWARE

MICROCONTROLLER

- Microcontroller interfaces all the modules
  - Light, ultrasonic sensors
  - GSM module
  - Display

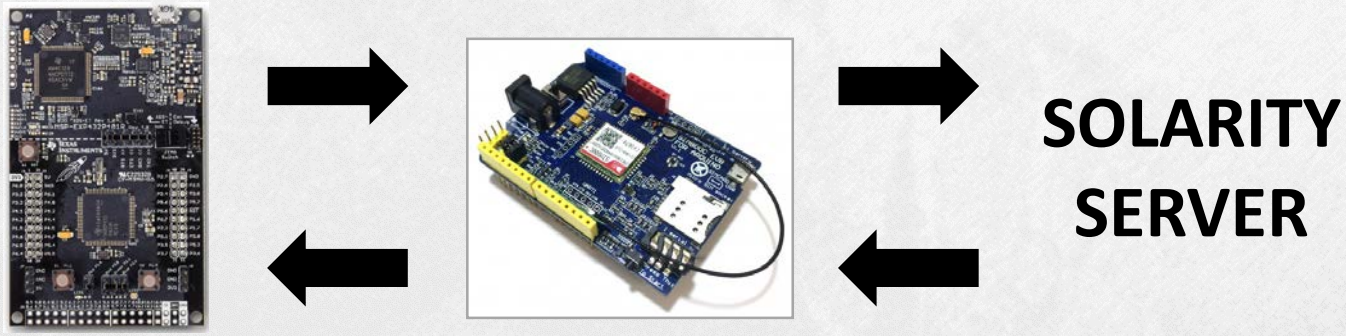


DISPLAY

- Interfaces with microcontroller through 3-pin SPI connection
- 2.5MHz SPI Clock
- Upload image data 250 bytes at a time

GSM MODULE– SIM800c

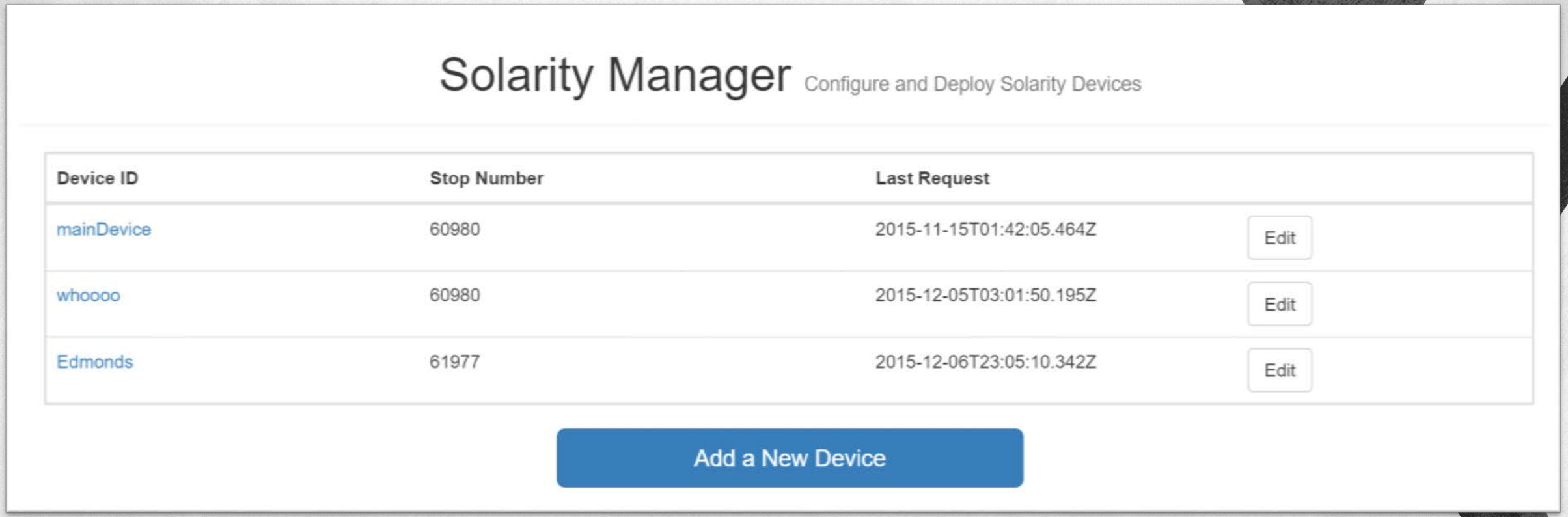
- AT commands are transmitted from microcontroller to GSM, they will:
  - Set up network connection
  - Connect to Solarity server
  - Request data from server
  - Read data from server
  - Transmit data to the microcontroller



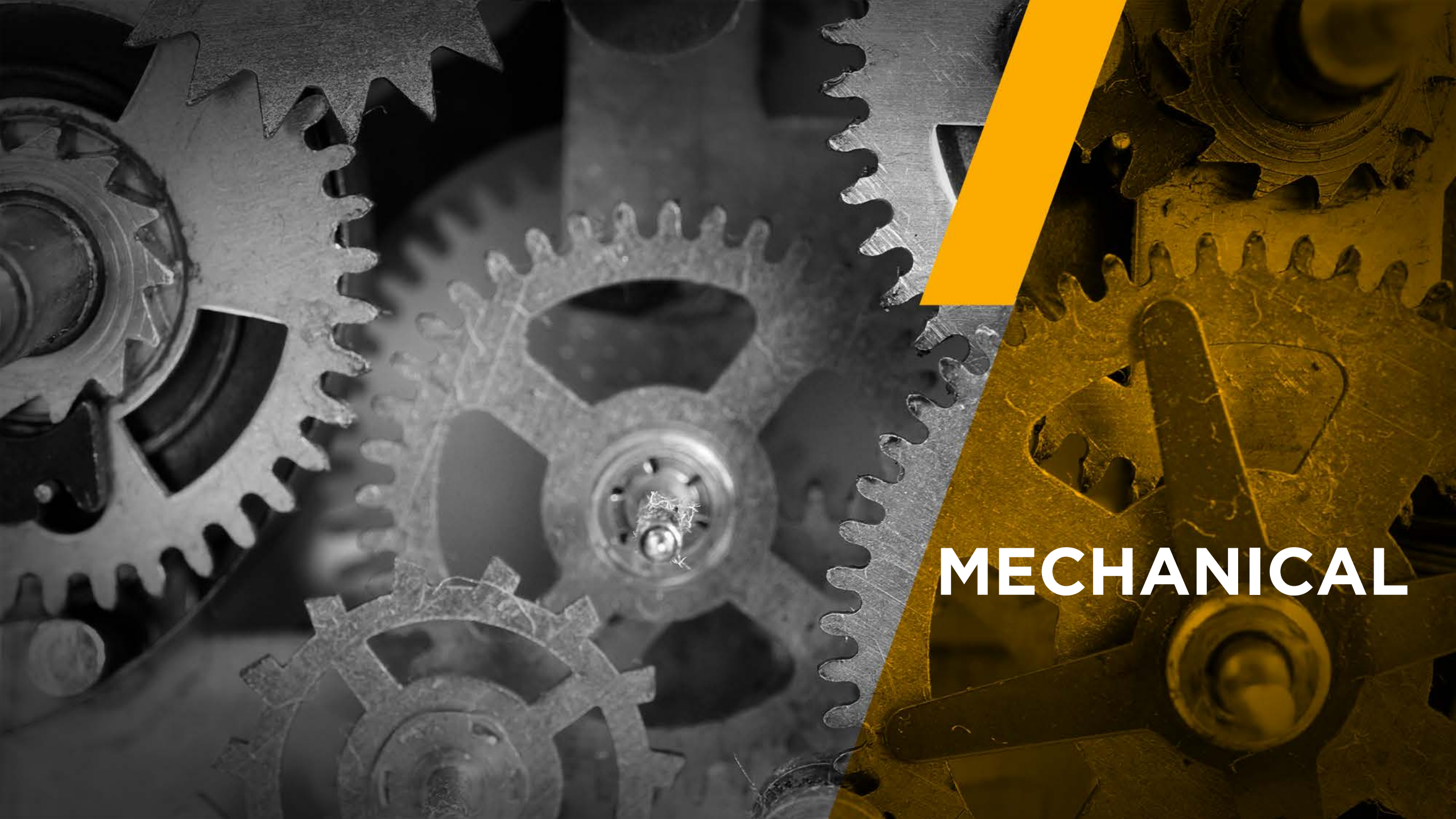
SERVER – IMAGE API

- Generates image based on live bus times from TransLink API
- Retrieves stop number for device from database
- Early and late busses are indicated

SERVER – MANAGER



- Web-based configuration
- Device IDs are preassigned and unique to each Solarity device

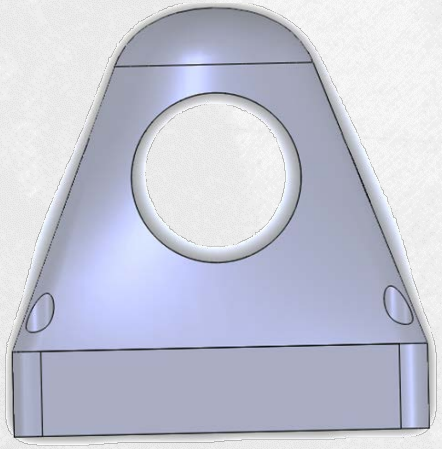

MECHANICAL

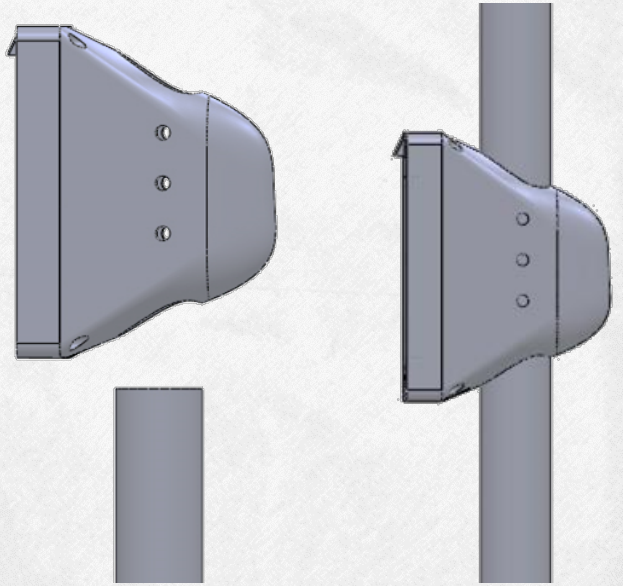
ENCLOSURE

- Three main risks
  - Theft
  - Vandalism
  - Weather

Theft Protection

- Only one way to remove device
- Secured with custom security screws
- Screw caps to hide screw head bit

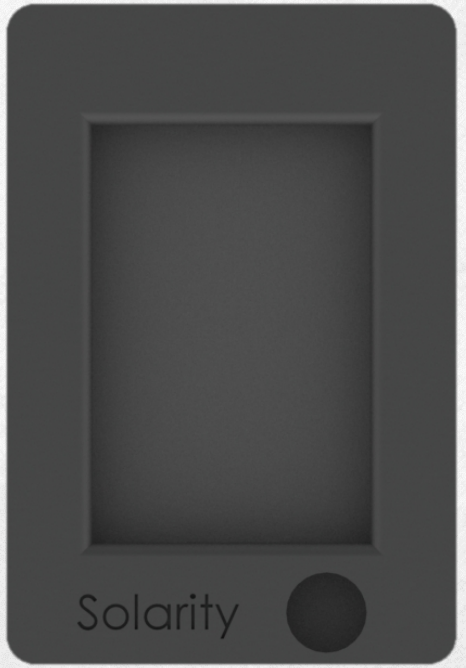




Vandalism & Weather Protection

- Kydex® Thermoplastic Sheet
  - Excellent impact resistance
  - Low water absorption index
  - Outstanding formability

- Polycarbonate
  - Outstanding toughness
  - Good optical clarity
  - Strong and stiff
  - Easy to fabricate



BUSINESS ASPECTS

BUSINESS MODEL

- Solarity is intended to remove some of the stress involved in transit travel
- Simple as walking up to stop and receiving valuable travel information
- Our target market is not the end user, rather the transit provider
- Point of presence for transit provider

MARKET ANALYSIS

-SINCE WE LIVE IN BC, TRANSLINK IS OUR PRIMARY TARGET

- Why would TransLink want Solarity?
  - Improve user satisfaction
  - Increase ridership [3] [4] [5]
  - Advertising

MARKET ANALYSIS

-COMPETITION

Some Popular Mobile Applications:

The Transit App

iOS 4.5/5.0

Android 4/5

Radar for Metro Vancouver Buses

iOS

5/5

BusLink

Android

4.5/5

Live Transit

Android

4/5

MARKET ANALYSIS

-WHY SOLARITY

- Wider customer base – tourists, elderly
- No personal info or location required (Privacy)
  - One less outlet to share personal data
- Ability to display any information
- Users associate device as part of TransLink unlike third-party apps
- Ads can be “annoying” when on seen on cellphones

BUDGET & FINANCING

Components	Estimation Price	Actual Price
Microcontroller	$20	$17.73
GSM Module	$75	$80.44
Display	$175	$166.66
Solar Panel	$175	$0 (Had access to one)
Battery and charging circuit	$50	$50.40
Cable and Miscellaneous Electronics	$50	$182.97
Housing	$75	$120.00
Contingency (25%)	$155	$43.84
Total	**$775**	**$662.04**

PROJECT TIMELINE


TIME TO
REFLECT

LESSONS LEARNED

- Integration takes a long time
- Debugging software requires lots of time
- Parts sometimes break or don’t work

FUTURE IMPROVEMENTS

- Bigger screen during production
- Advertising (increase revenue)
- Additional optimization for better efficiency

ACKNOWLEDGEMENTS

- Dr. Andrew Rawicz
- Steve Whitmore
- the TA's
- Rob Church & Jeff Vogstad (from TransLink)
- Fred Heep
- Gary Shum
- Ken Kaarvik

CONCLUSION

- Sunlink's Solarity provides an energy and cost effective solution for the betterment of transit
- Aim to draw more people away from driving to take public transit by enhancing the experience
- Our schedule and budget were followed closely, and the prototype meets most of our project functional requirements.


QUESTIONS


DEMO

Thank you!

Have a great day

REFERENCES

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- [4] Brakewood, C., Macfarlane, G. S., & Watkins, K. (2015). The impact of real-time information on bus ridership in New York City. Transportation Research Part C: Emerging Technologies, 53, 59-75.
- [5] Metro Focus (2012). Comparing Urban Bus Tracking Systems and Ridership http://www.thirteen.org/metrofocus/2012/03/does-knowing-count-comparing-urban-bus-tracking-systems-and-ridership/

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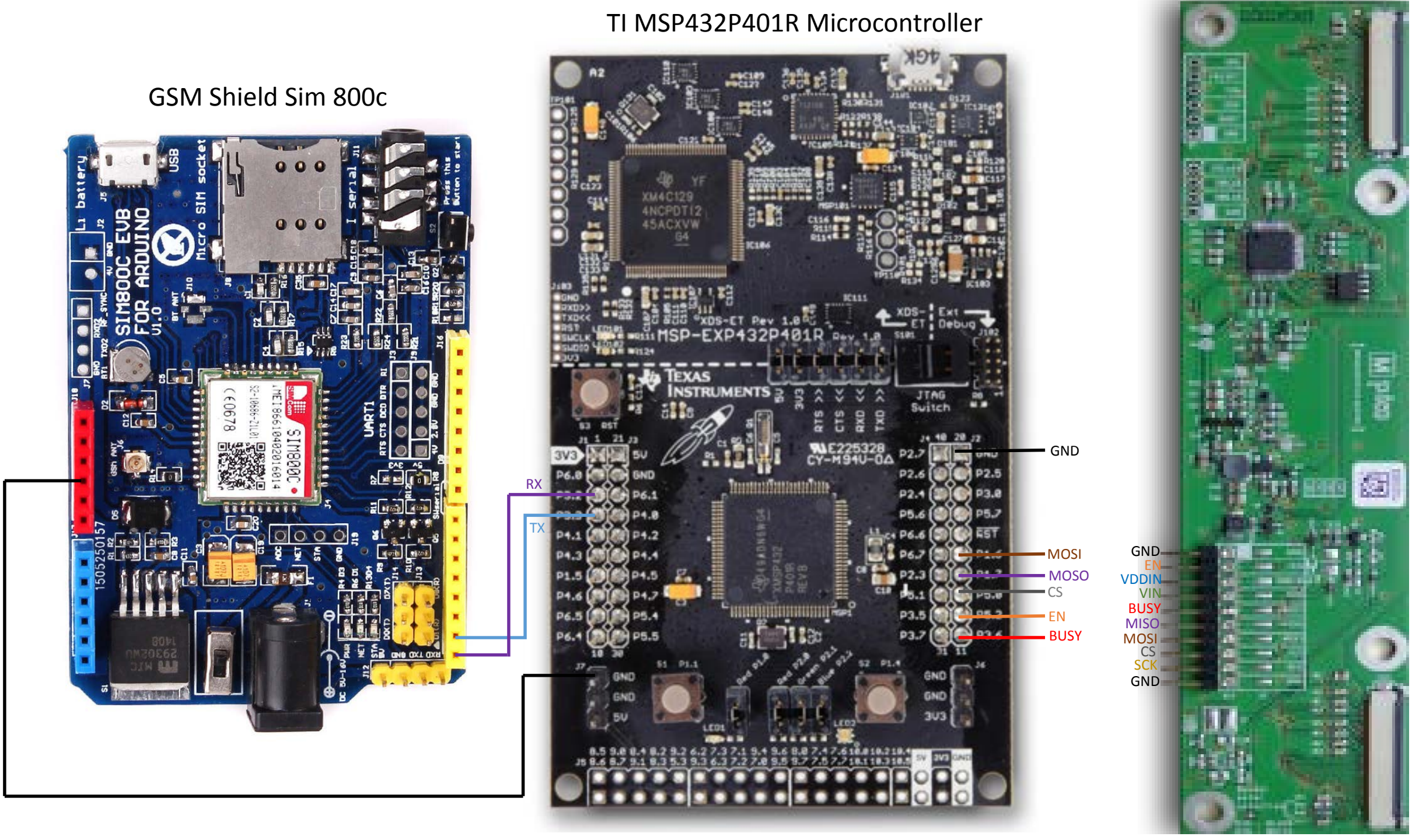
GSM Shield Sim 800c

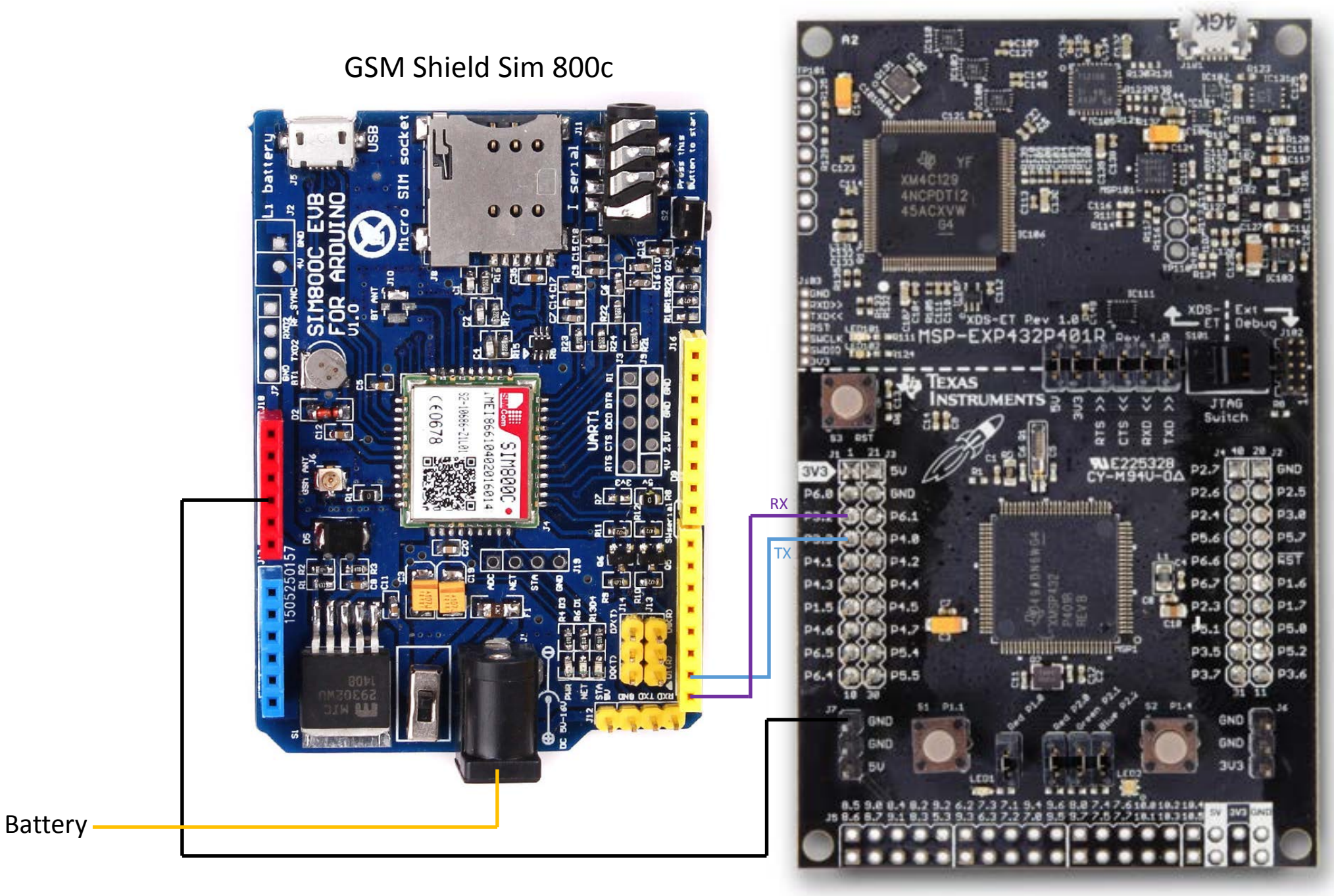
TI MSP432P401R Microcontroller

MPico Pervasive Display



GSM Shield Sim 800c

TI MSP MSP432P401R Microcontroller



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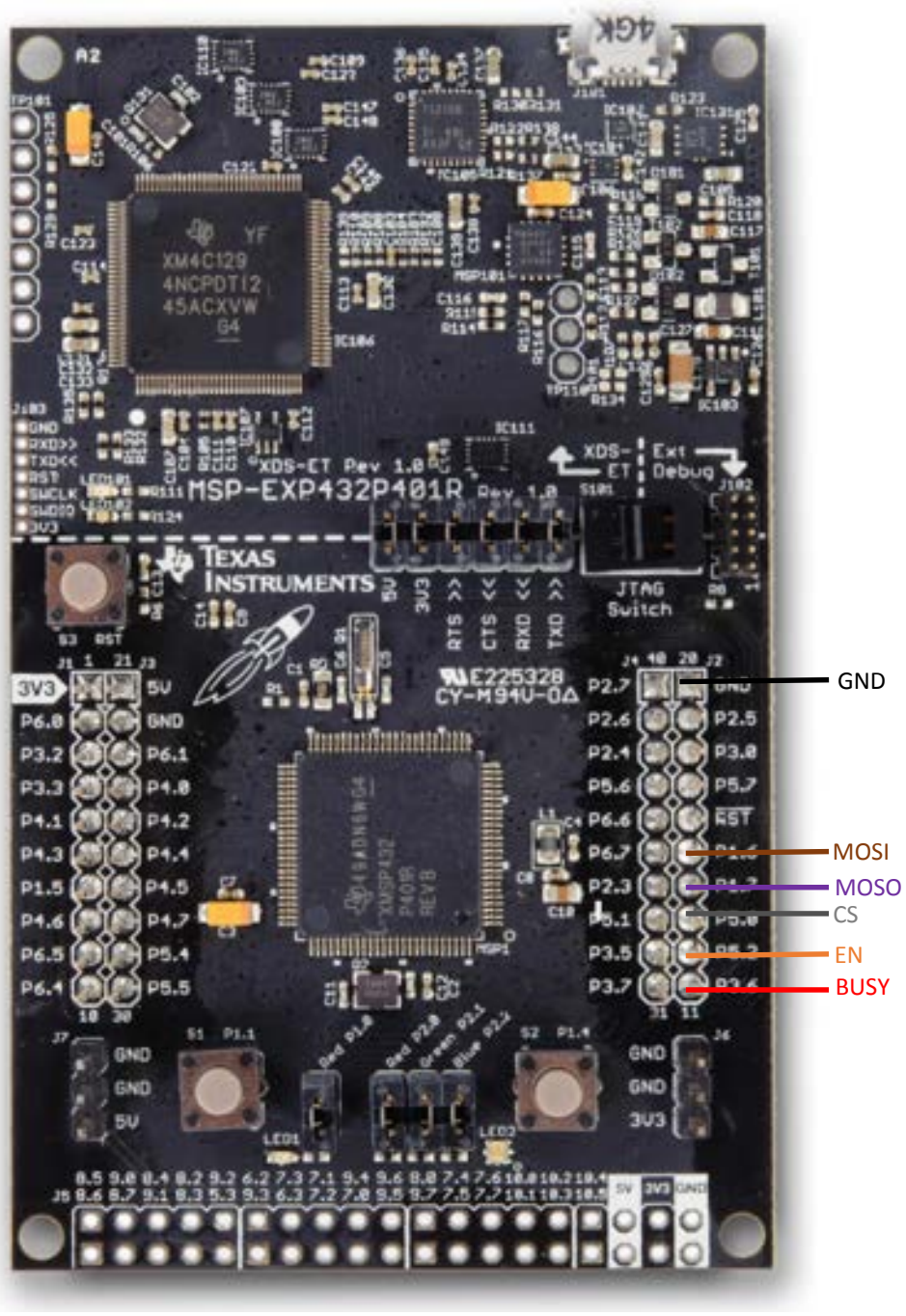
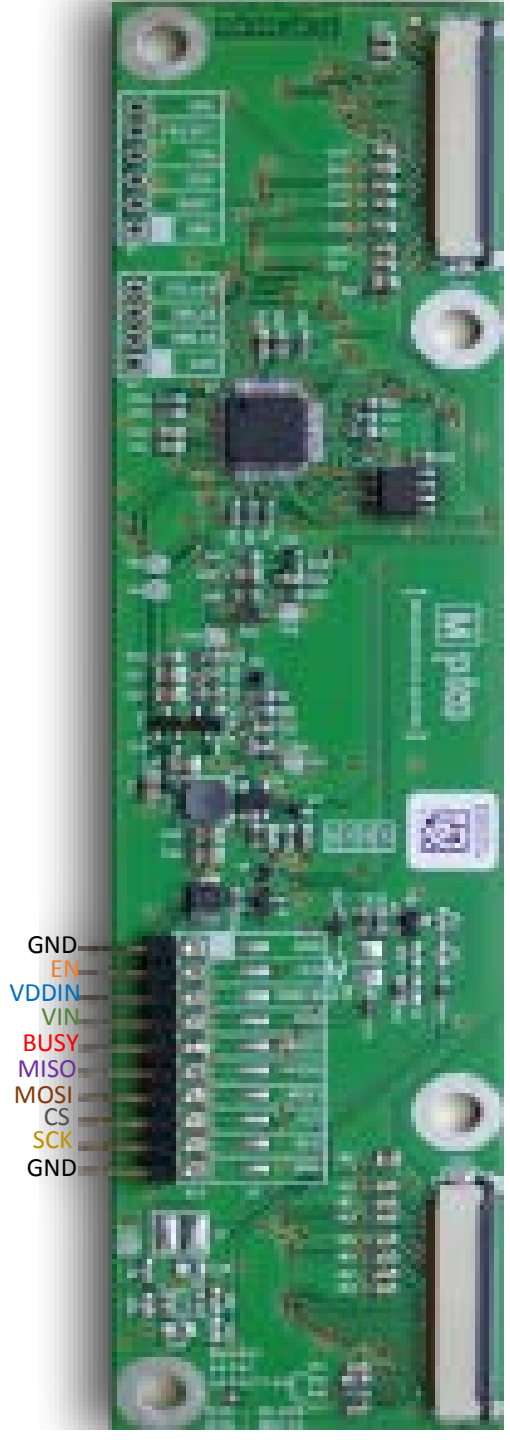
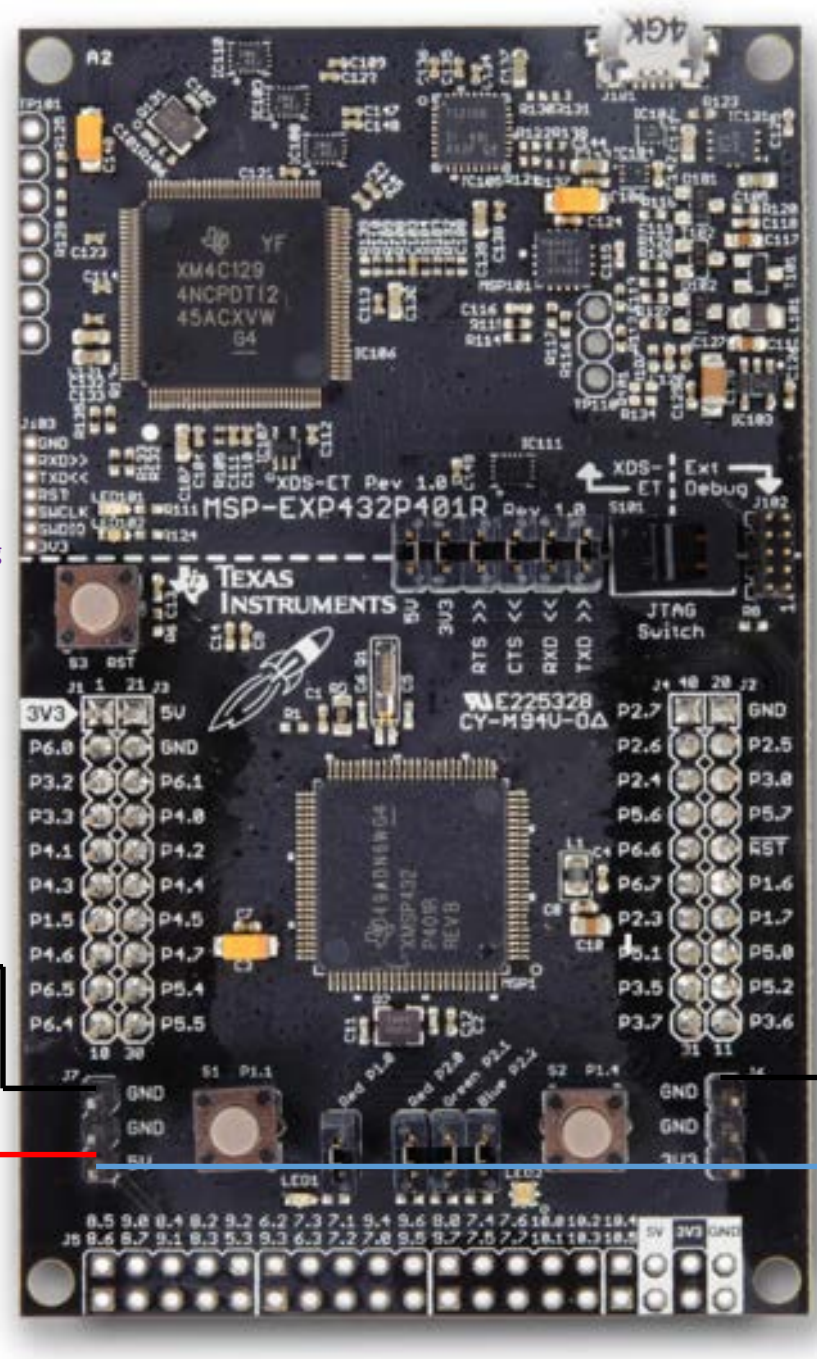




MPico Pervasive Display

TI MSP MSP432P401R Microcontroller

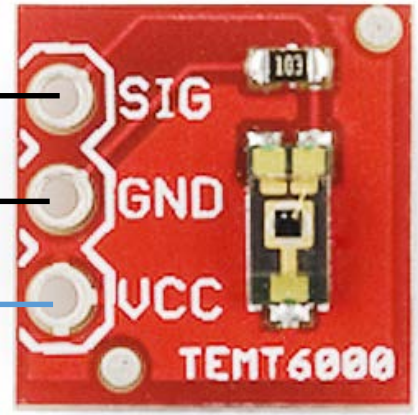


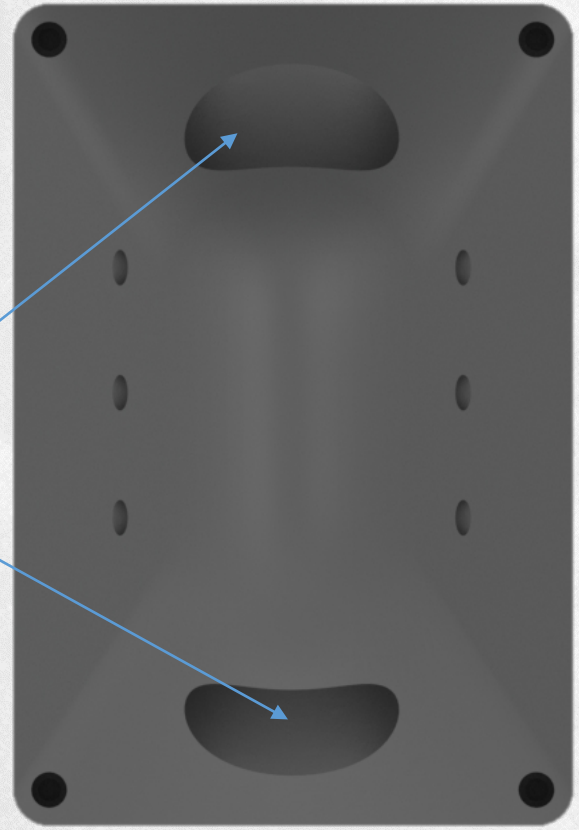
To Analog pin

SparkFun Ambient Light Sensor

LV-MaxSonar-EZ0 Proximity Sensor

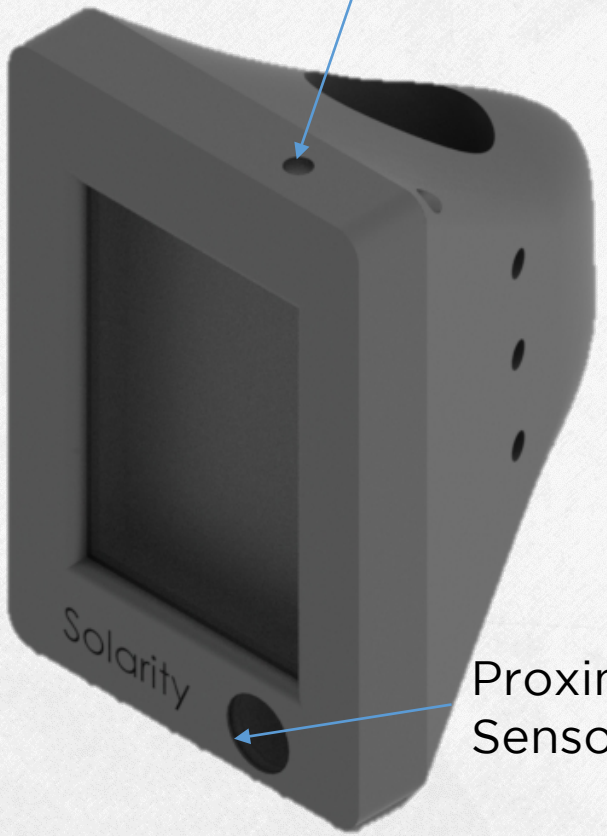
To Analog pin



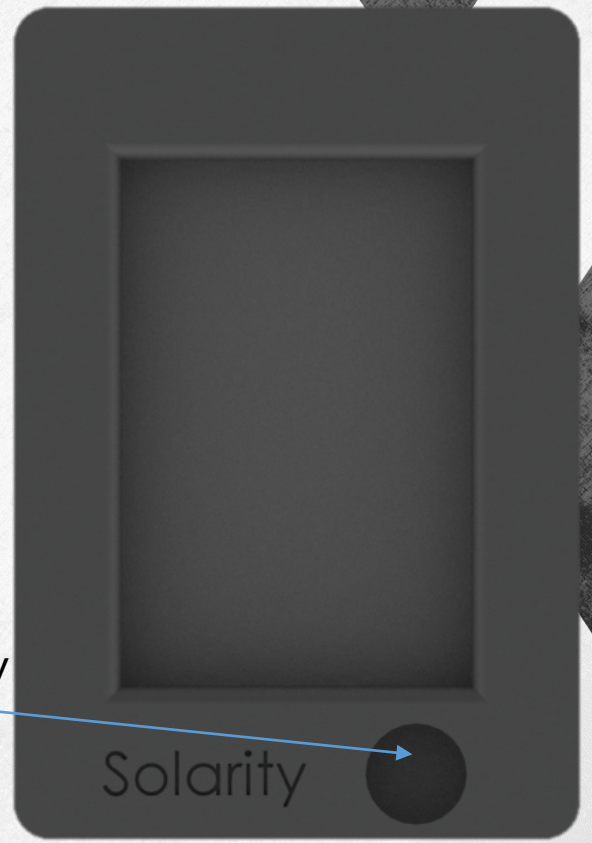


Pole Mount

Back View



Perspective View



Front View