TEAM 1
NOBI
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BACKGROUND

Low Humidity levels cause forest to become kindle

High temperatures cause drought conditions

Volcanoes can occasionally cause wildfires

Lightning Strikes produce sparks that can light a forest

90% of wildfires are caused by humans

Winds supply fire with oxygen and spread it

5,700
STRUCTURES LOST
Property Damage, Homes, Companies, and more

100,000
PEOPLE DISPLACED
Forced to evacuate and leave their homes and belongings behind

65 Billion
DOLLARS DAMAGE
California will be left recovering for years

PROBLEM STATEMENT

How to prevent and fight the outbreak of wildfires?

63% **PROJECTED INCREASE** in average cost of fire suppression in the span of 10 years

Health

Money

Homes

Lives

Environment

MARKET RESEARCH

The cost of wildfires on human life, property damage, and federal dollars is increasing at an alarming rate.

THE GOVERMENT

The government is looking for solutions and ways to fend off and mitigate wildfires.

AGENCIES

There are current challenges to fight wildfires by the Environmental Protection Agency

Customer Requirements

According to the market research, the government and other private entities are looking for:

Implicitly
- tamper-proof
- long-range comm
- low-power consumption

Self-Sustainable

Low Maintenance

Accurate

Durable

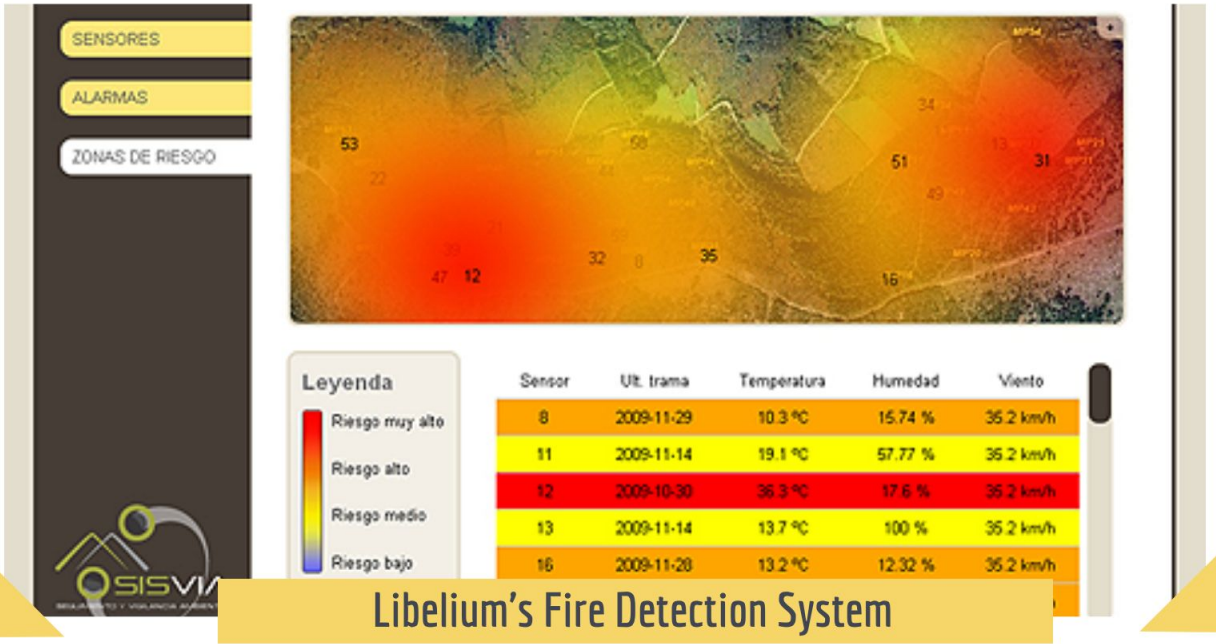
Easy to use

COMPETITION

Comparison between: Quality, Convenience, and Price

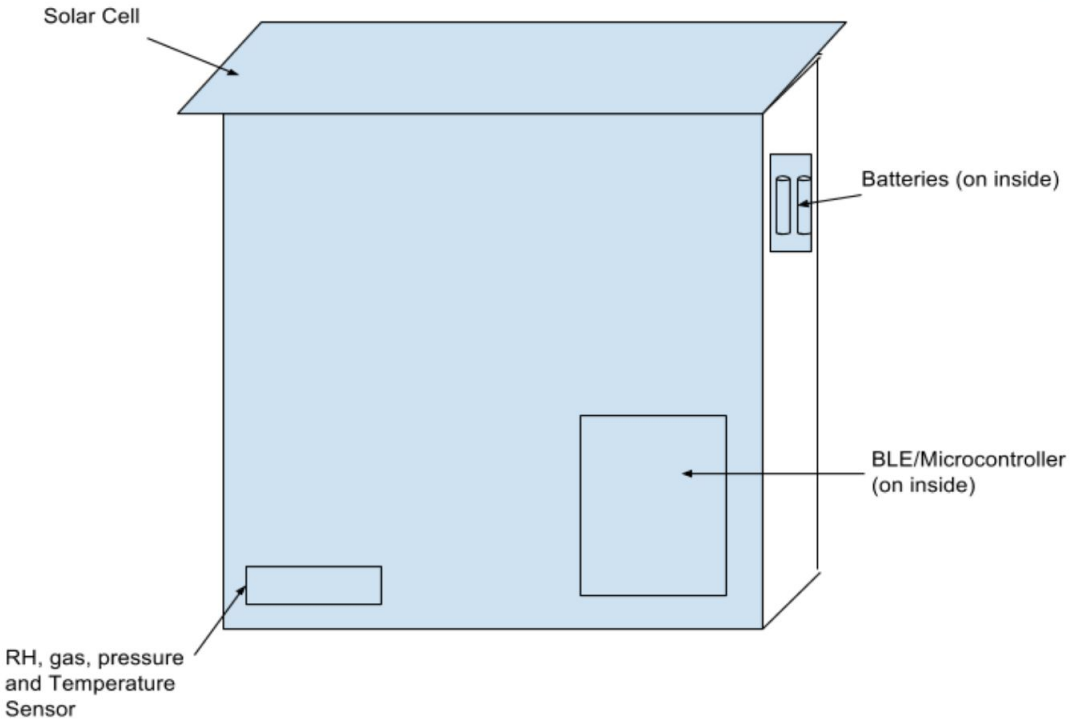
Vigilys' FireAlert MK I

Insight Robotic's Wildfire Detection System



Libelium's Fire Detection System

Nobi: Version 2.0

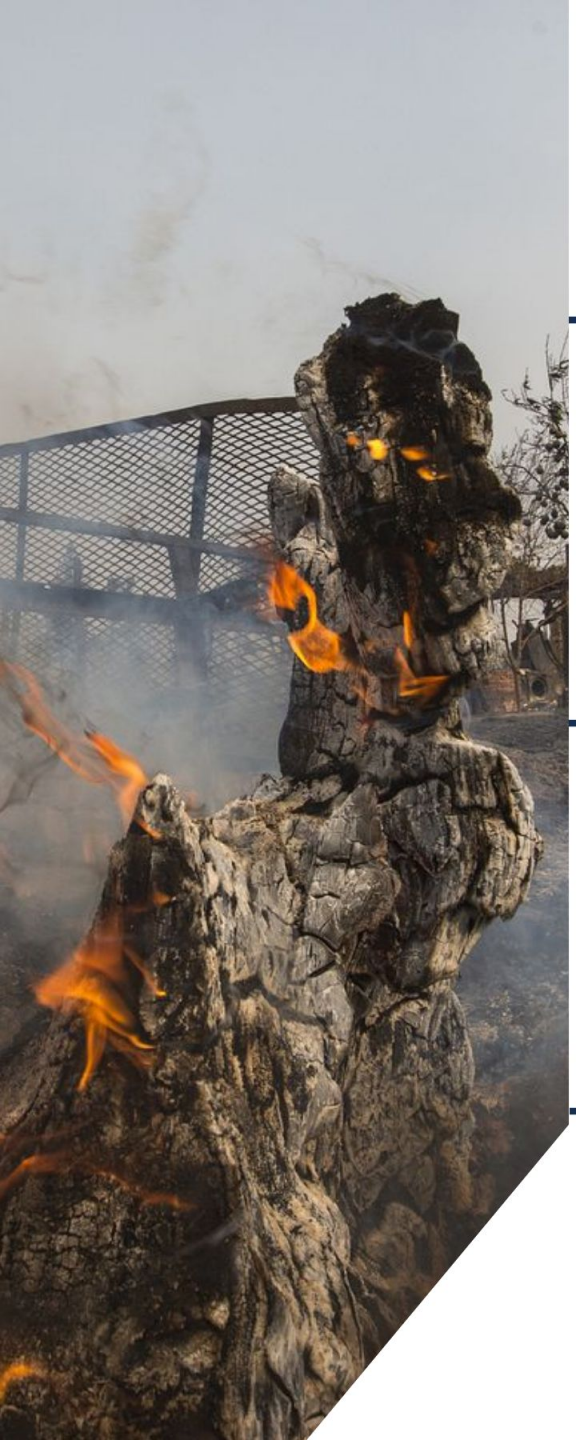


Micro-controller and BLE

Sensor

Temp, Humidity, Gas, Pressure

Solar-Powered



PRODUCT SPECIFICATIONS

Sensors

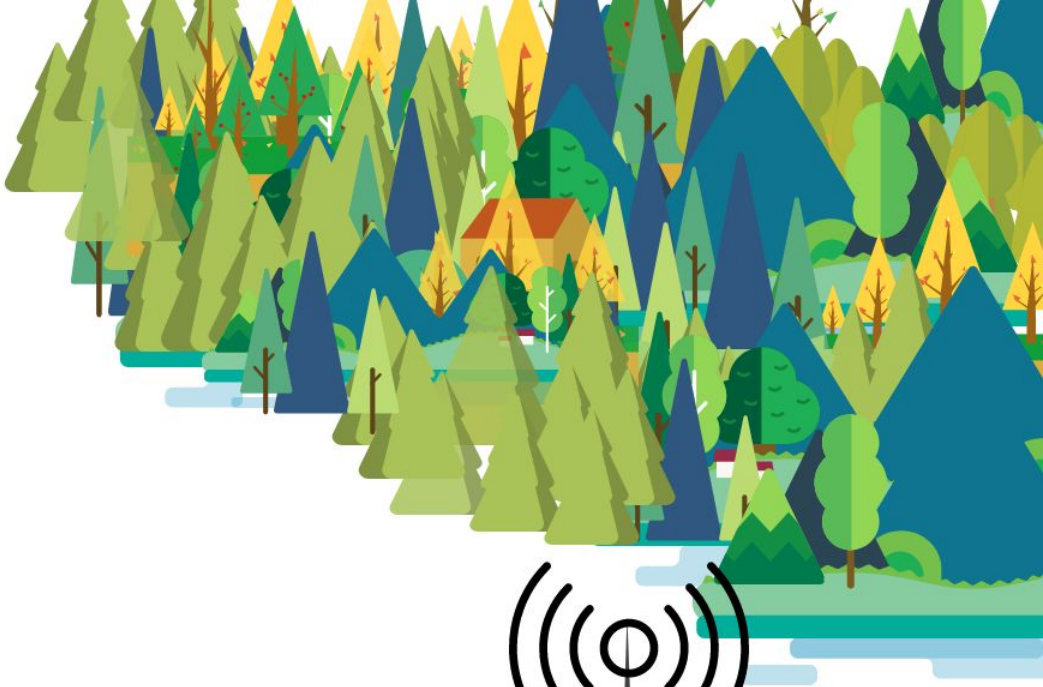
- Gases - Carbon Monoxide
- Temperature
- Humidity

Wireless Communication

- BLE
- Provides wide range
- Low power-consumption

Solar Panel & Battery

NOBI TOWER

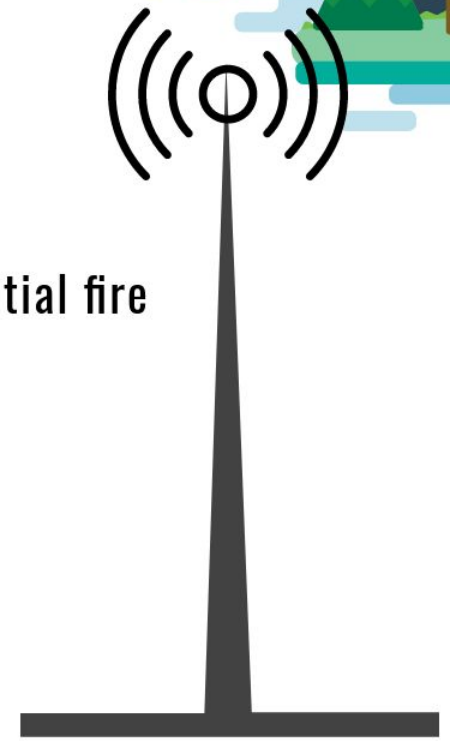


PROS:

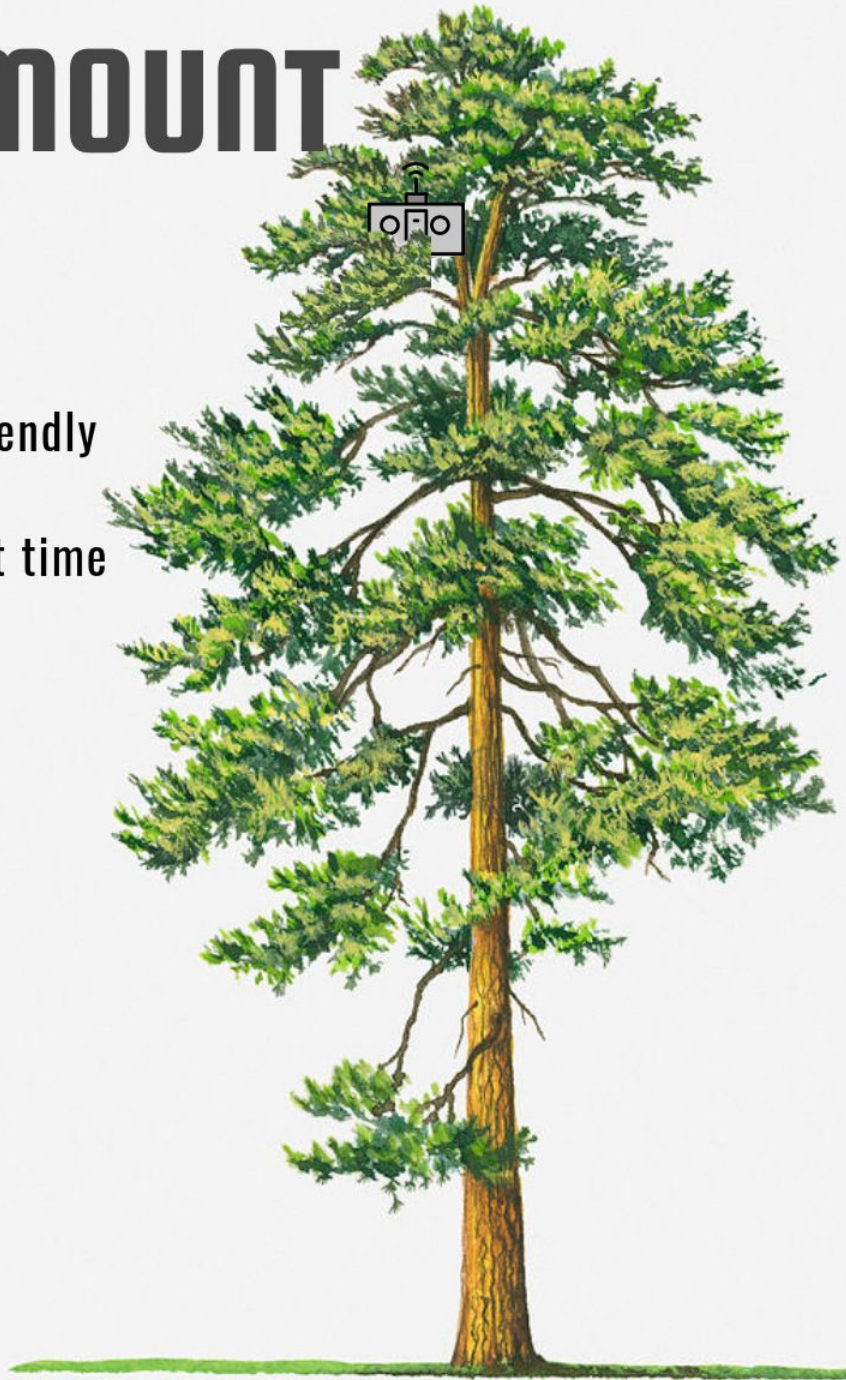
Solar panel won't be shaded
Land doesn't need to be cleared
Durable

CONS:

Expensive
Tower needs to be installed
Probably won't detect the initial fire



NOBI MOUNT



PROS:

Environmentally friendly
Less expensive
Quicker installment time

CONS:

Solar panel adjustment needed
Professional installment needed

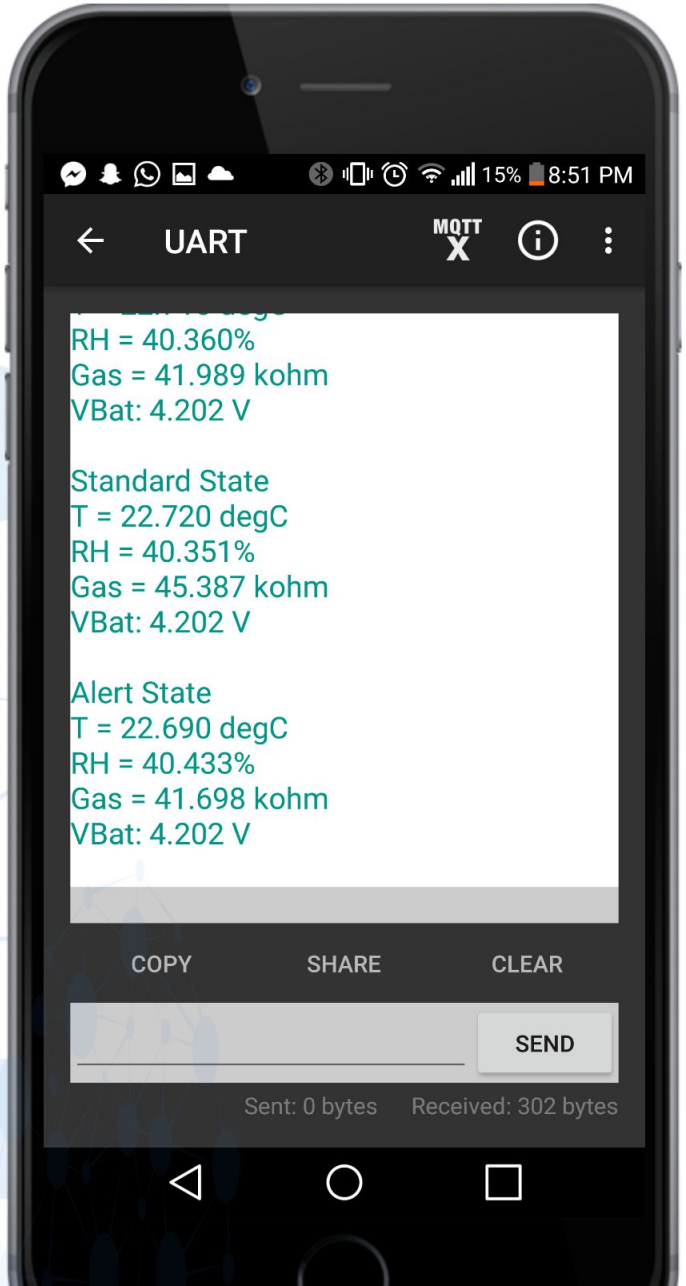
PROTOTYPE TESTING

Sensor Testing

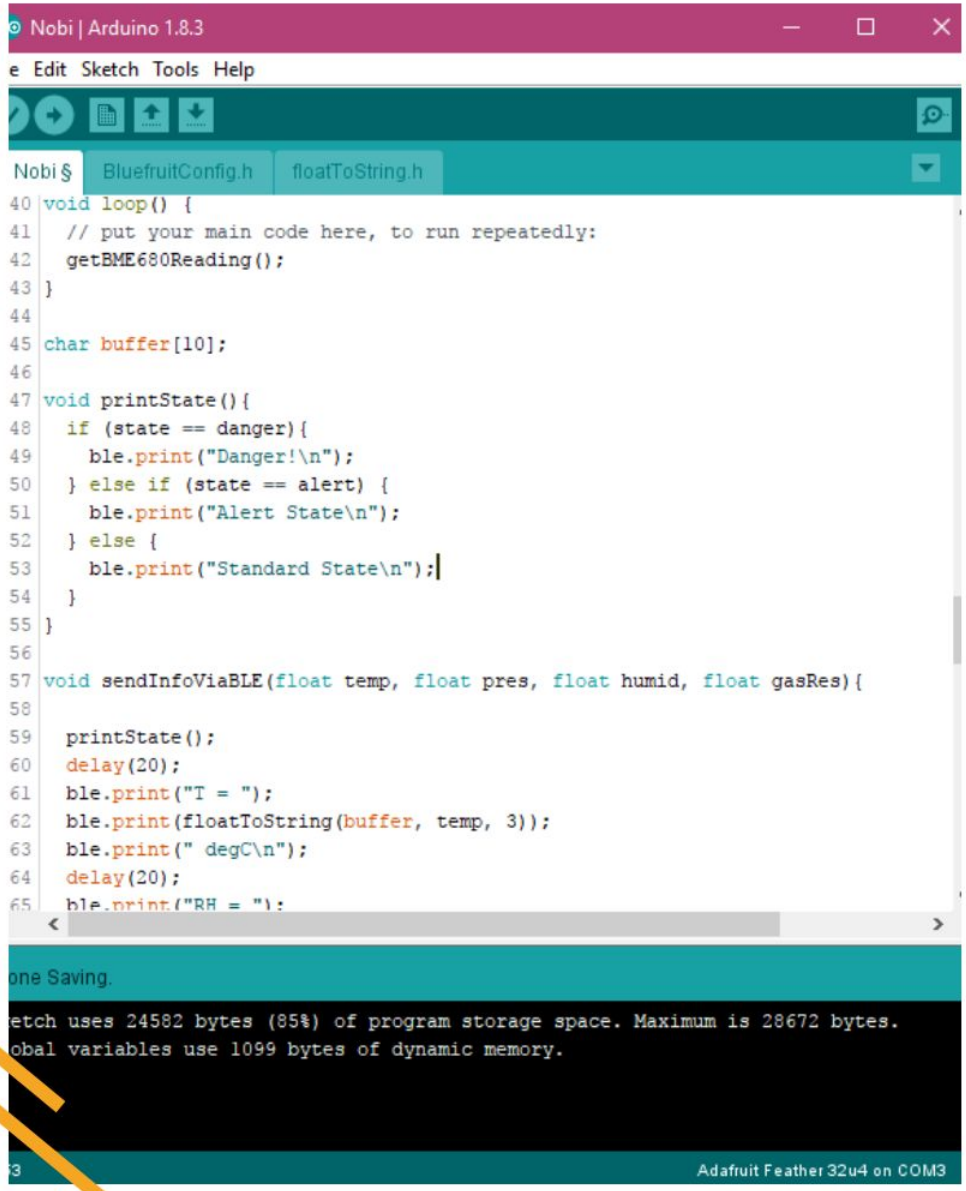
- Temperature by using heat/cold sources
- Humidity by steam
- Gas by creating smoke

State Testing

- Dangerous gas levels predetermined based on gas range PR
- Alert state when gas levels are too high



System Integration

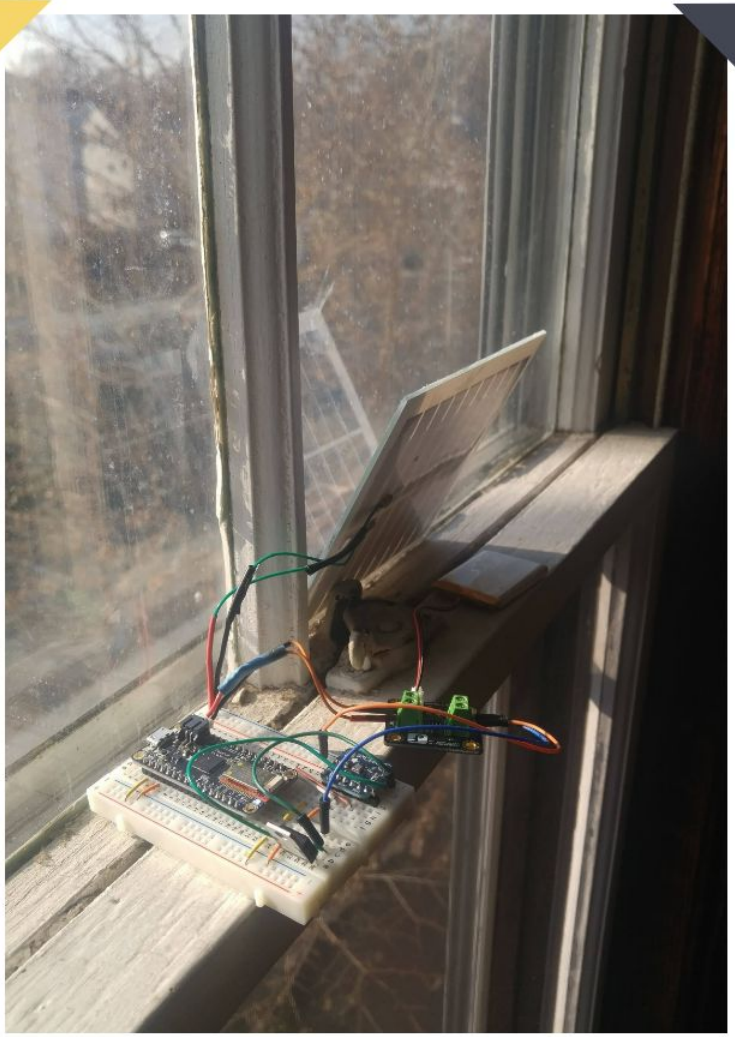


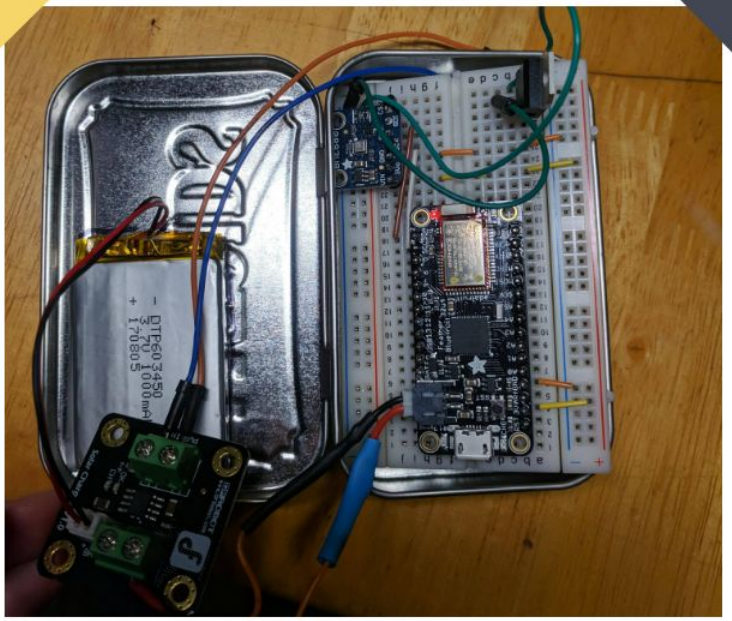
Software

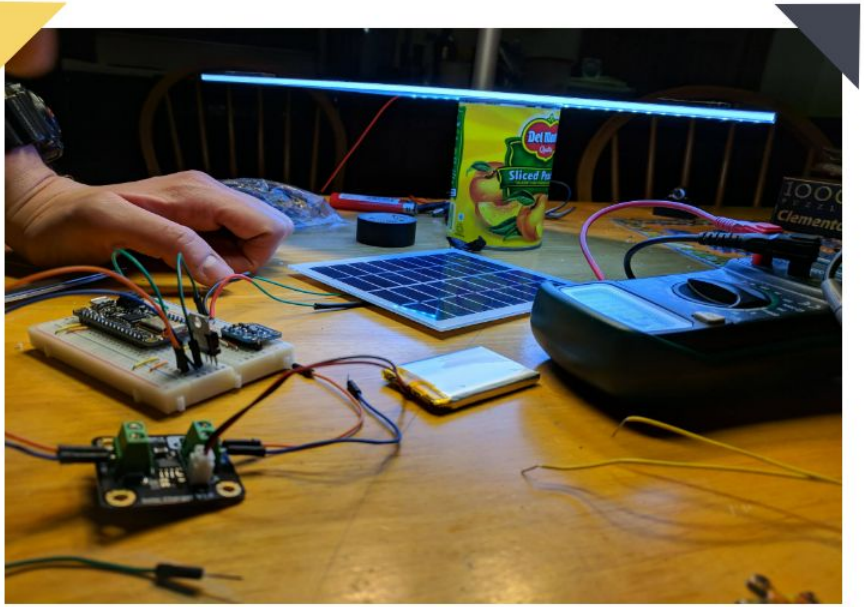
- Programmed with Arduino IDE
- Used libraries provided for development boards

System Integration

Hardware







FIXED COSTS

- $3,000 - Rent
- $1,000 - Utilities
- $2,000 - Insurance
- $30,000 - Development Costs
- $20,000 - Salary Expense

Total: $61,000

UNIT COST

- $7.90 - Solar Panel
- $1.46 - ATmega328p
- $2.05 - nRF51822 BLE
- $7.40 - BME 680
- $9.95 - Li-Ion Battery
- $1.00 - Voltage Regulator & Charge Controller
- $10.00 - GPS Tracker

Total: $32.36

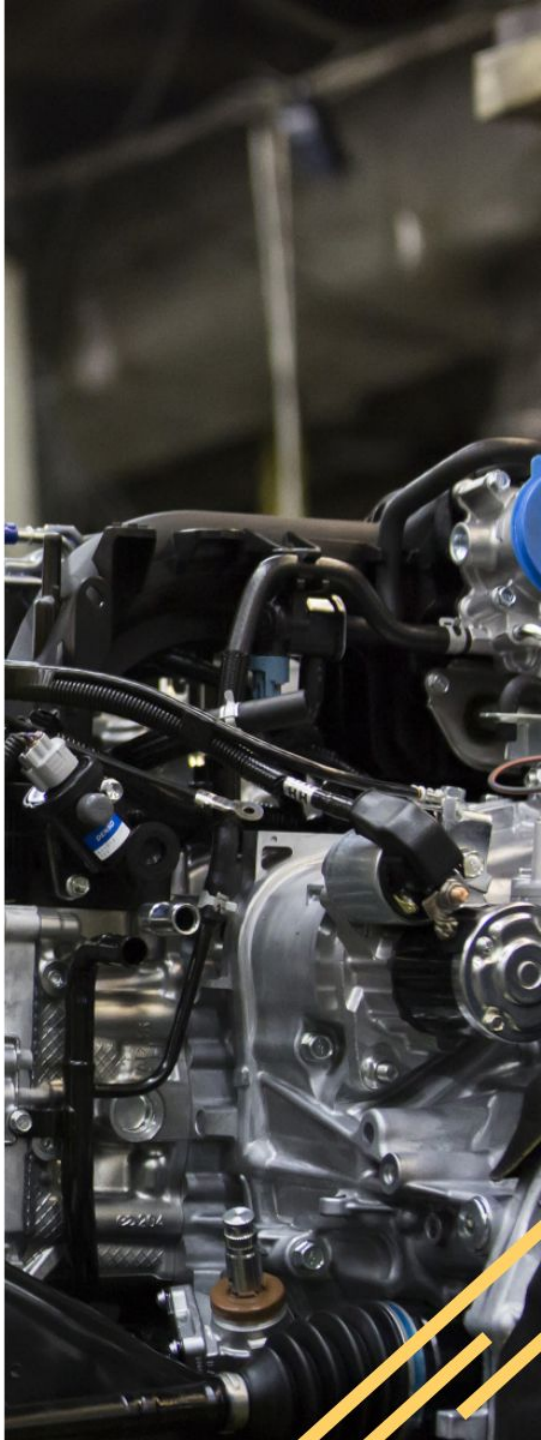
REVENUE

Cost per Unit = $40
60% profit wanted

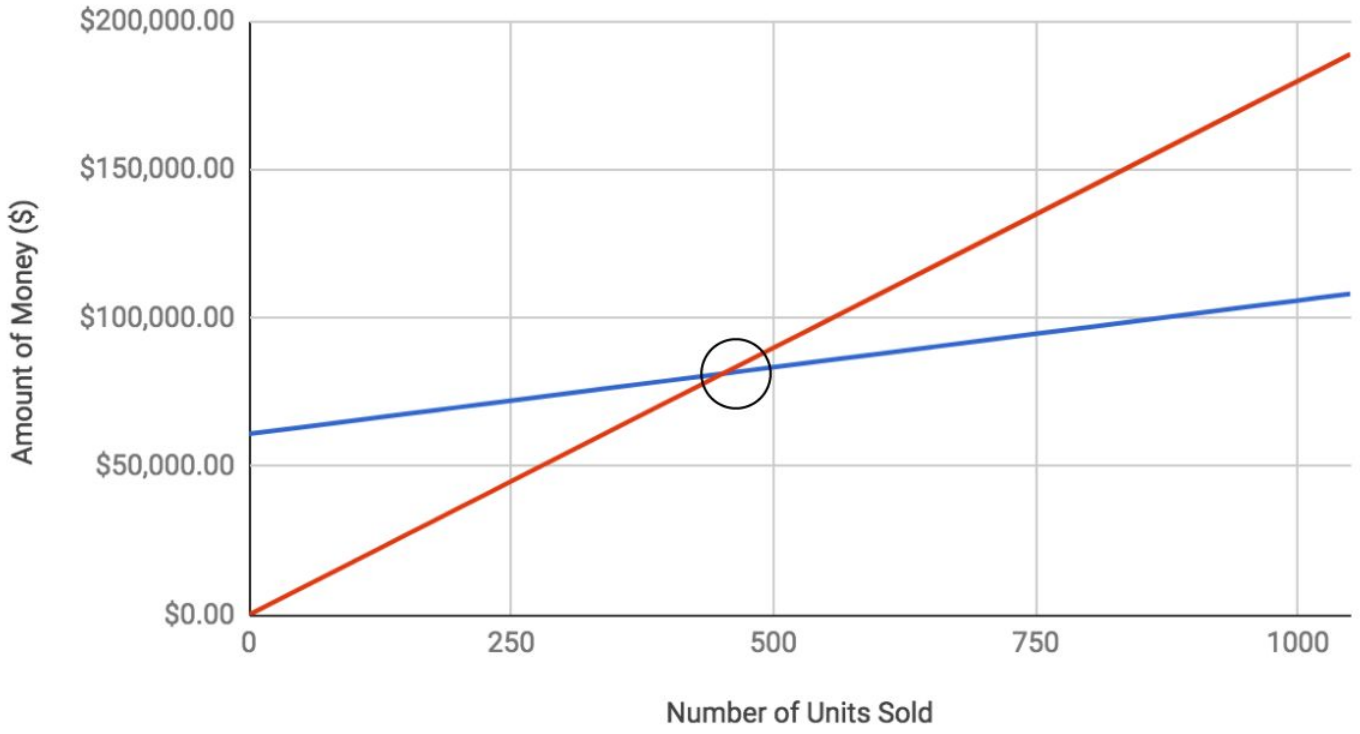
Distributers
65% profit
$66

Retailers
65% profit
$110

Customers
$180



BREAK-EVEN ANALYSIS



FORMULA:

Fixed Cost + Unit Cost*N = N*Unit Price

61,000 + 40N = 180N

N = 436 C = $78,440 R = $78,480

ROI Calculation

Assuming an N = 10,000

(Revenue - Total Cost)/Total Cost = ROI

(1,800,000 - 461,000)/461,000 = 290.46%

Initial Investment

180,000

Summary

Expenses

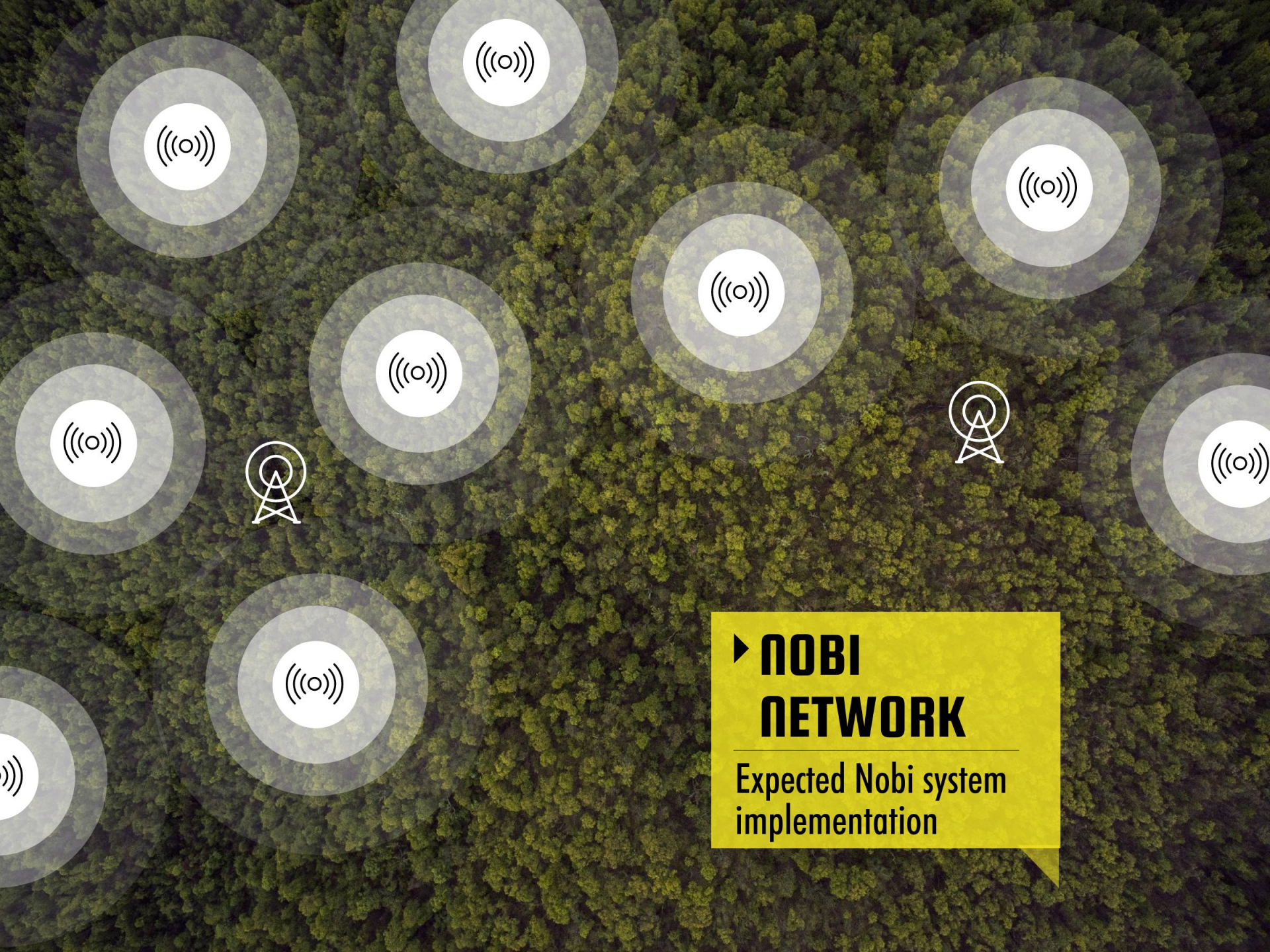
FC: $61,000
UC: $40

Break-even Analysis

N = 436
C = $78,440
R = $78,480

Challenges #3

Assuming an N of 10,000
ROI = 290.46%

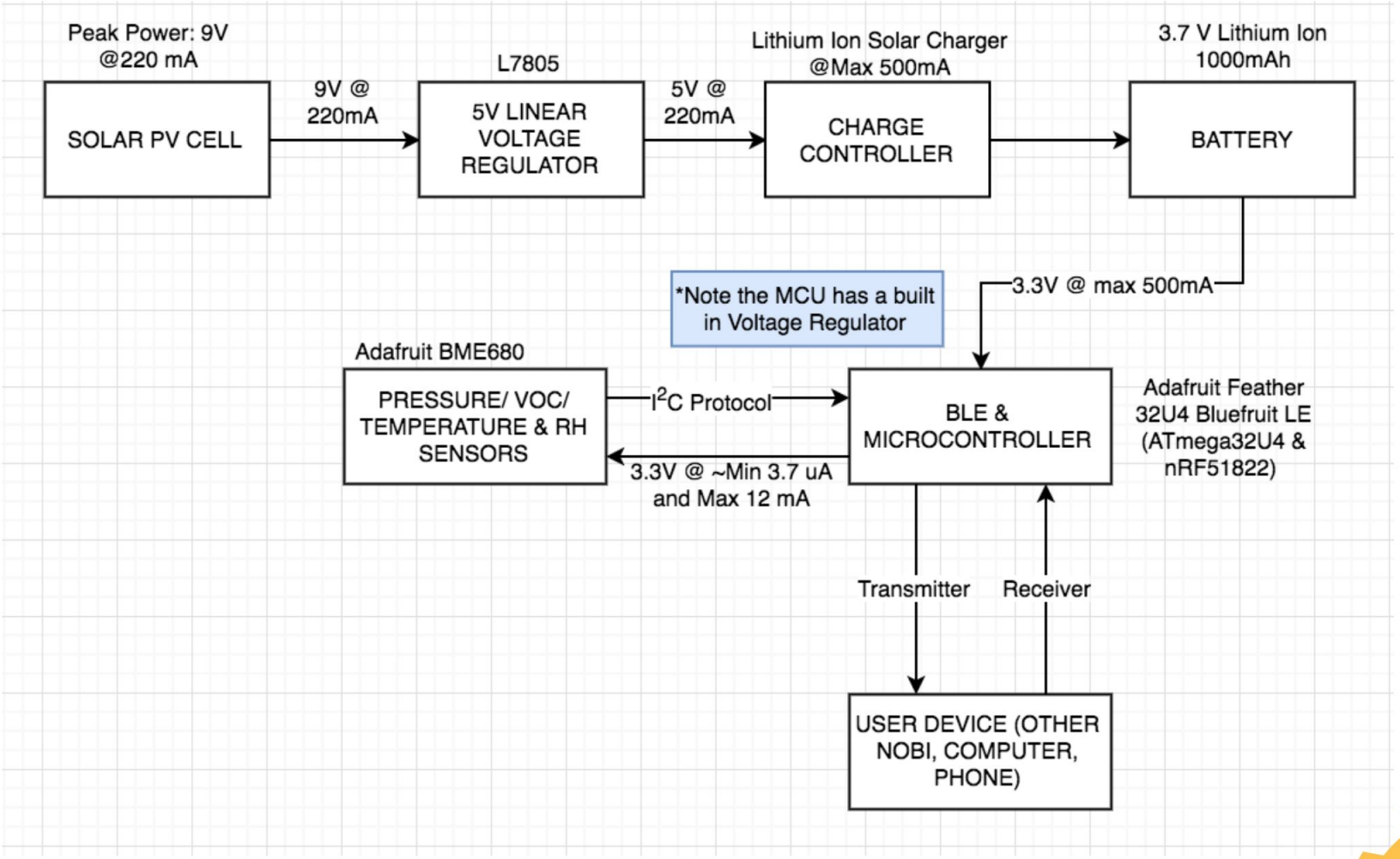

NOBI
NETWORK
Expected Nobi system
implementation

THANK YOU!

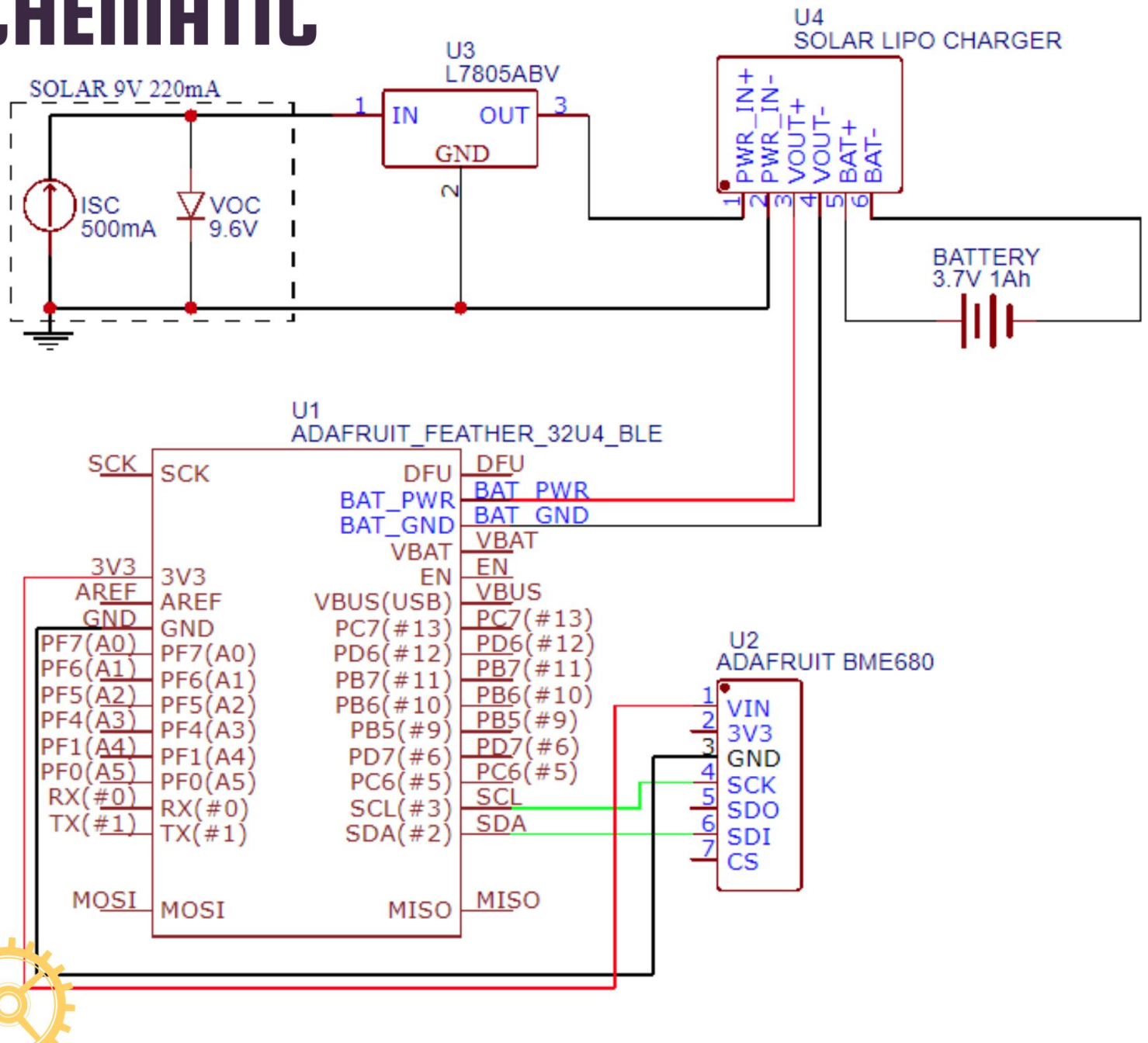
Resources

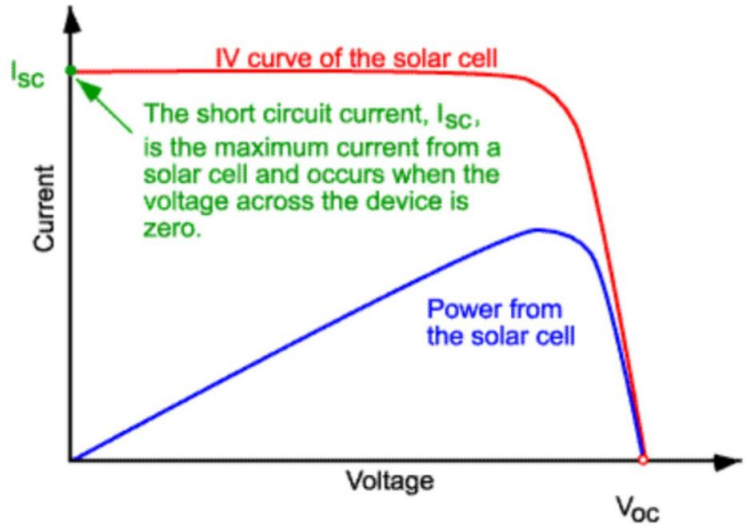
The sources are all included in our HW 1-4
Picture references are included at the very end
For more info please contact ece2799team1@wpi.edu

OVERALL BLOCK DIAGRAM



SCHEMATIC


SOLAR 9V 220mA
ISC
500mA
VOC
9.6V
U3
L7805ABV
IN
OUT
GND
U4
SOLAR LIPO CHARGER
PWR_IN+
PWR_IN-
VOUT+
VOUT-
BAT+
BAT-
BATTERY
3.7V 1Ah
U1
ADAFRUIT_FEATHER_32U4_BLE
SCK
3V3
AREF
GND
PF7(A0)
PF6(A1)
PF5(A2)
PF4(A3)
PF1(A4)
PF0(A5)
RX(#0)
TX(#1)
MOSI
DFU
BAT_PWR
BAT_GND
VBAT
EN
VBUS(USB)
PC7(#13)
PD6(#12)
PB7(#11)
PB6(#10)
PB5(#9)
PD7(#6)
PC6(#5)
SCL(#3)
SDA(#2)
MISO
U2
ADAFRUIT BME680
VIN
3V3
GND
SCK
SDO
SDI
CS



☒ SOLAR PANEL

Converts sunlight to DC energy
Collects 9V and 220 mA

Short Circuit Current = 500mA
Open Circuit Voltage = 9.6V
Max Power = 1.8W

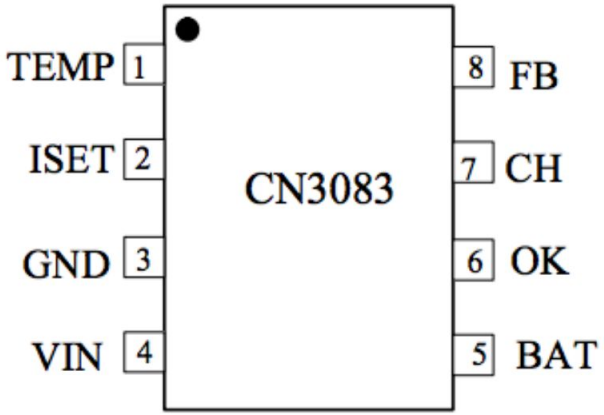
☐ Lithium Ion Battery

Specially made for harvesting solar energy

Output Voltage = 3.7V
Output Charge = 1000 mAh

Ideally 4.54 hours to fully charge

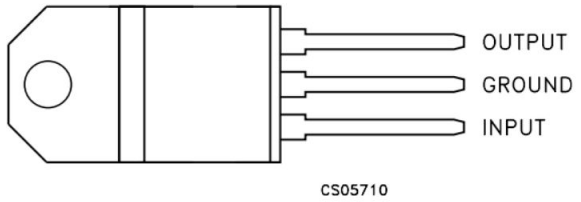
LITHIUM ION SOLAR CHARGER



8-bit CN3083

Regulation Voltage: 4.2V
Input Supply Voltage: 4.4 - 6.0V
Operating Current: 440 - 950uA
Average Operating Current: 650 uA

VOLTAGE REGULATOR



TO-220

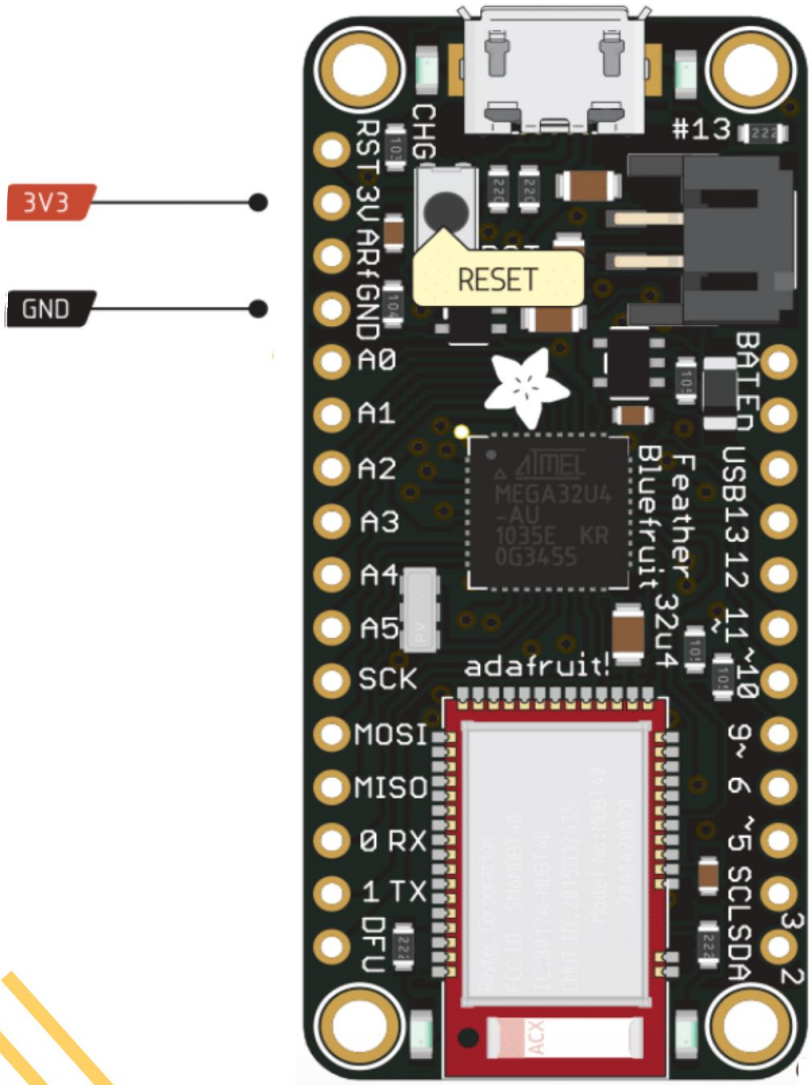
9V to 5.0V with 2% regulation

~2V linear drop-out
At least 7V required to use
Output voltage: 4.9 - 5.1V
Operating current: 6mA

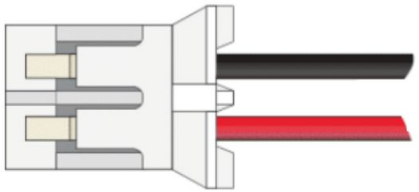
MICROCONTROLLER/BLE

Adafruit 32u4 Bluefruit LE

Power Supply: 3 - 5V
Max Current Draw: 6mA
Communication: I2C Protocol



Lipoly Battery



BLE Module control

25	PD4	ICP1		ADC8	
1	PE6	INT6	AIN0		
28	PB4	PCINT4		ADC11	

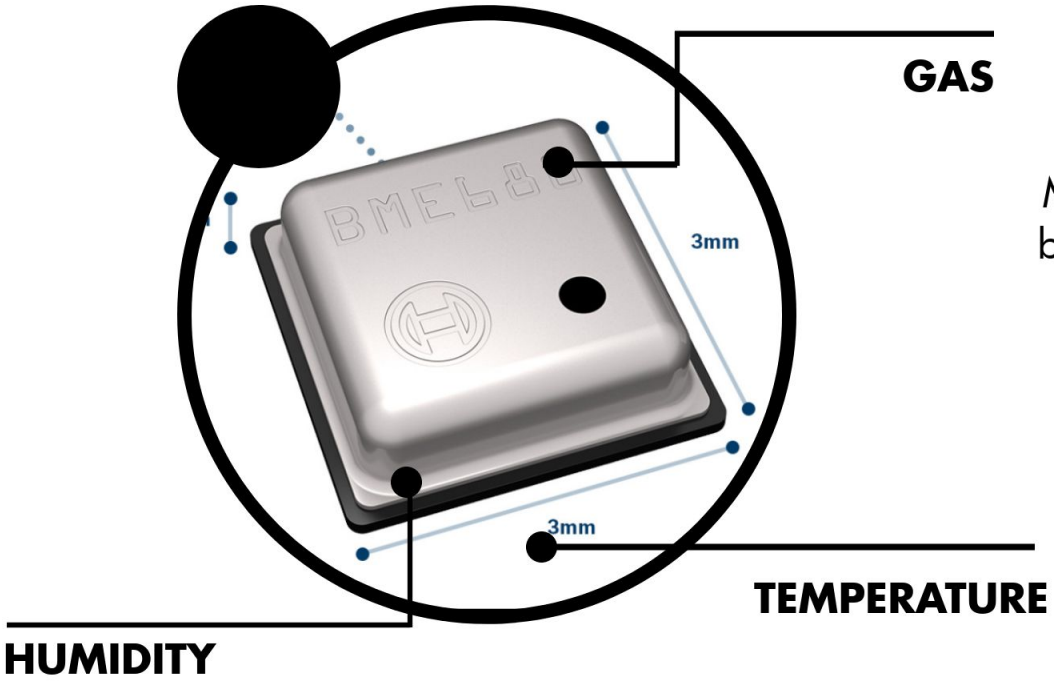
4	RST	
7	IRQ	
8	CS	

Used by the BLE radio module too!

18	PD0		OC0B	INT0	SCL
19	PD1			INT1	SDA

3
2

BME 680 SENSOR

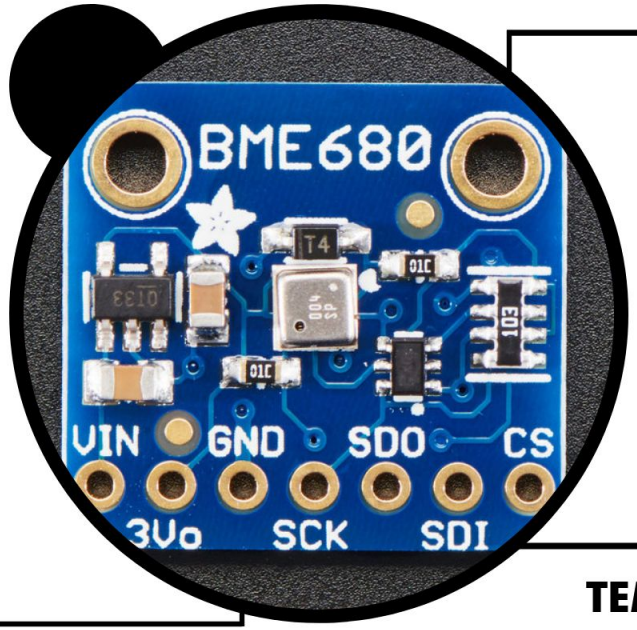


Bosch Sensortec

Measures relative humidity, VOC, barometric pressure and altitude, and ambient temperature

Input Voltage: 3 - 5V
Drawn current: 1mA
Uses I2C Protocol
Forced Mode: T - P - H ---- G
16 ADC Count

BME 680 SENSOR



GAS

TEMPERATURE

HUMIDITY

Bosch Sensortec

Measures relative humidity, VOC, barometric pressure and altitude, and ambient temperature

Input Voltage: 3 - 5V
Drawn current: 1mA
Uses I2C Protocol
Forced Mode: T - P - H ---- G
16 ADC Count

BREAK-EVEN ANALYSIS CHART

Number of Items	Fixed Cost	Total Variable Cost	Total Production Cost	Total Revenues
0	$61,000.00	0	$61,000.00	$0.00
50	$61,000.00	2250	$63,250.00	$9,000.00
100	$61,000.00	4500	$65,500.00	$18,000.00
150	$61,000.00	6750	$67,750.00	$27,000.00
200	$61,000.00	9000	$70,000.00	$36,000.00
250	$61,000.00	11250	$72,250.00	$45,000.00
300	$61,000.00	13500	$74,500.00	$54,000.00
350	$61,000.00	15750	$76,750.00	$63,000.00
400	$61,000.00	18000	$79,000.00	$72,000.00
450	$61,000.00	20250	$81,250.00	$81,000.00
500	$61,000.00	22500	$83,500.00	$90,000.00
550	$61,000.00	24750	$85,750.00	$99,000.00
600	$61,000.00	27000	$88,000.00	$108,000.00
650	$61,000.00	29250	$90,250.00	$117,000.00
700	$61,000.00	31500	$92,500.00	$126,000.00
750	$61,000.00	33750	$94,750.00	$135,000.00
800	$61,000.00	36000	$97,000.00	$144,000.00
850	$61,000.00	38250	$99,250.00	$153,000.00
900	$61,000.00	40500	$101,500.00	$162,000.00
1000	$61,000.00	45000	$106,000.00	$180,000.00
1050	$61,000.00	47250	$108,250.00	$189,000.00