UCF

FLORIDA SOLAR BEACH BUGGY CHALLENGE

Group 3

Cecilie Barreto, Drew Curry, and Grace Yoo

MOTIVATION

- Superimpose solar power and autonomous technologies
- Potentially provide a useful tool for future coastal research
- Reduce impact of beach vehicles on surrounding environment
- Promote interest and awareness of solar energy

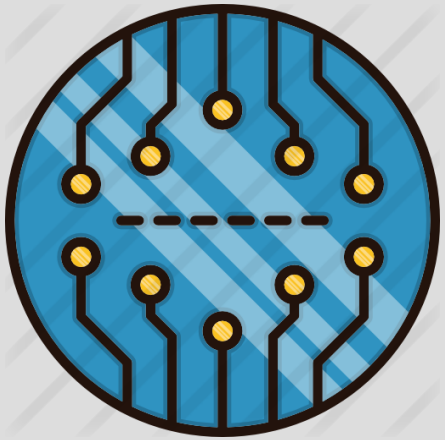
OBJECTIVES & REQUIREMENTS

- Autonomously traverse a 10 mile stretch of beach from Daytona to Ponce Inlet (and return) within 8-hour time span.
- Capable of transporting one passenger (Max payload: 120 lbs.)
- Top allowable speed → 3 mph
- Run completely on solar energy
- Do no harm to environment and beachgoers
- Detect and avoid both stationary and moving obstacles (e.g., rocks, docks, people, birds, turtles, etc.)

WORK DISTRIBUTION

Mechanical Engineering

Computer Science



Electrical & Computer Engineering

MECHANICAL TEAM

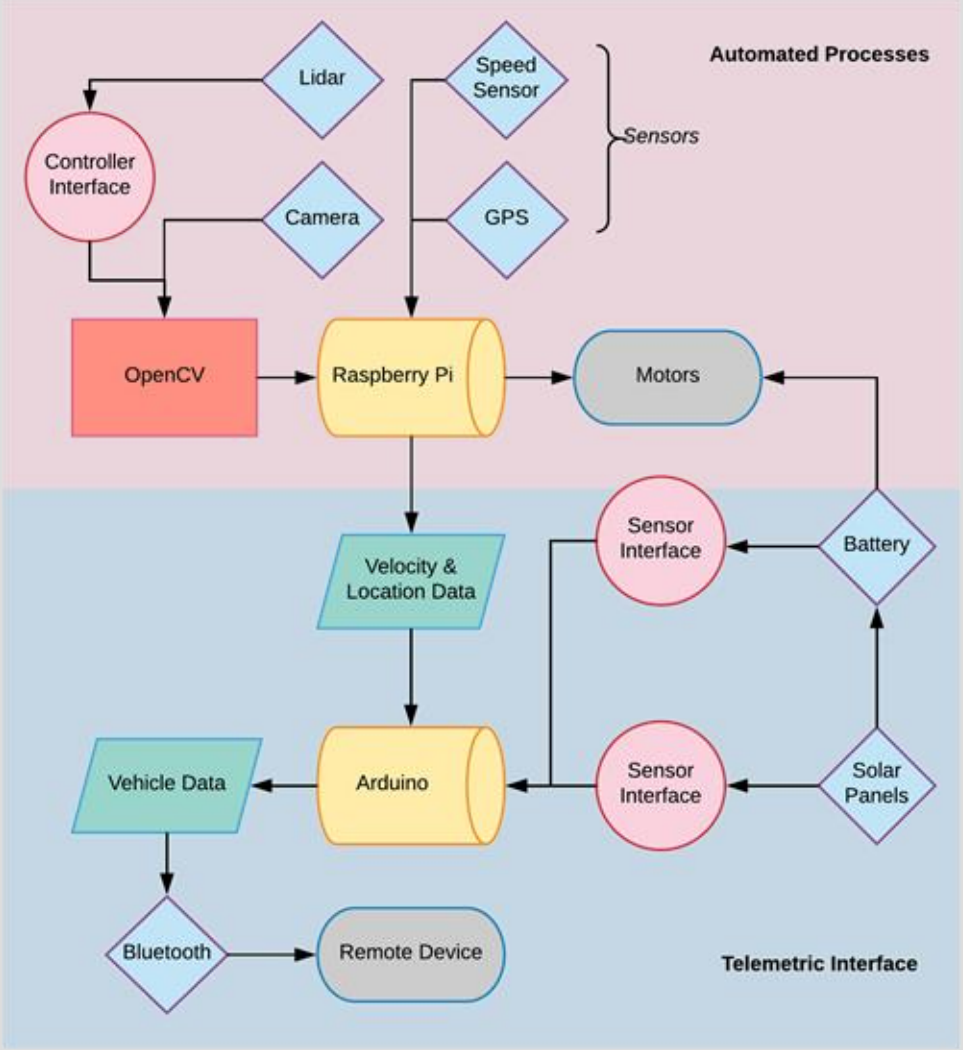
Responsibilities

- Aluminum apparatus
- Motor selection
- Wheel type/size
- Wattage calculations, maximum load required

COMPUTER SCIENCE TEAM

Responsibilities

- Navigational programming
- Decision processing
- GPS integration
- Stereo camera/image processing



WORK DISTRIBUTION

Cecilie Barreto
Computer Engineering

- Interpretation of raw sensor data
- Power management research
- Indoor/outdoor affects on sensors
- Sensor configuration
- Communication between microcontrollers
- Overall autonomous system design
- Collaborate with CS team

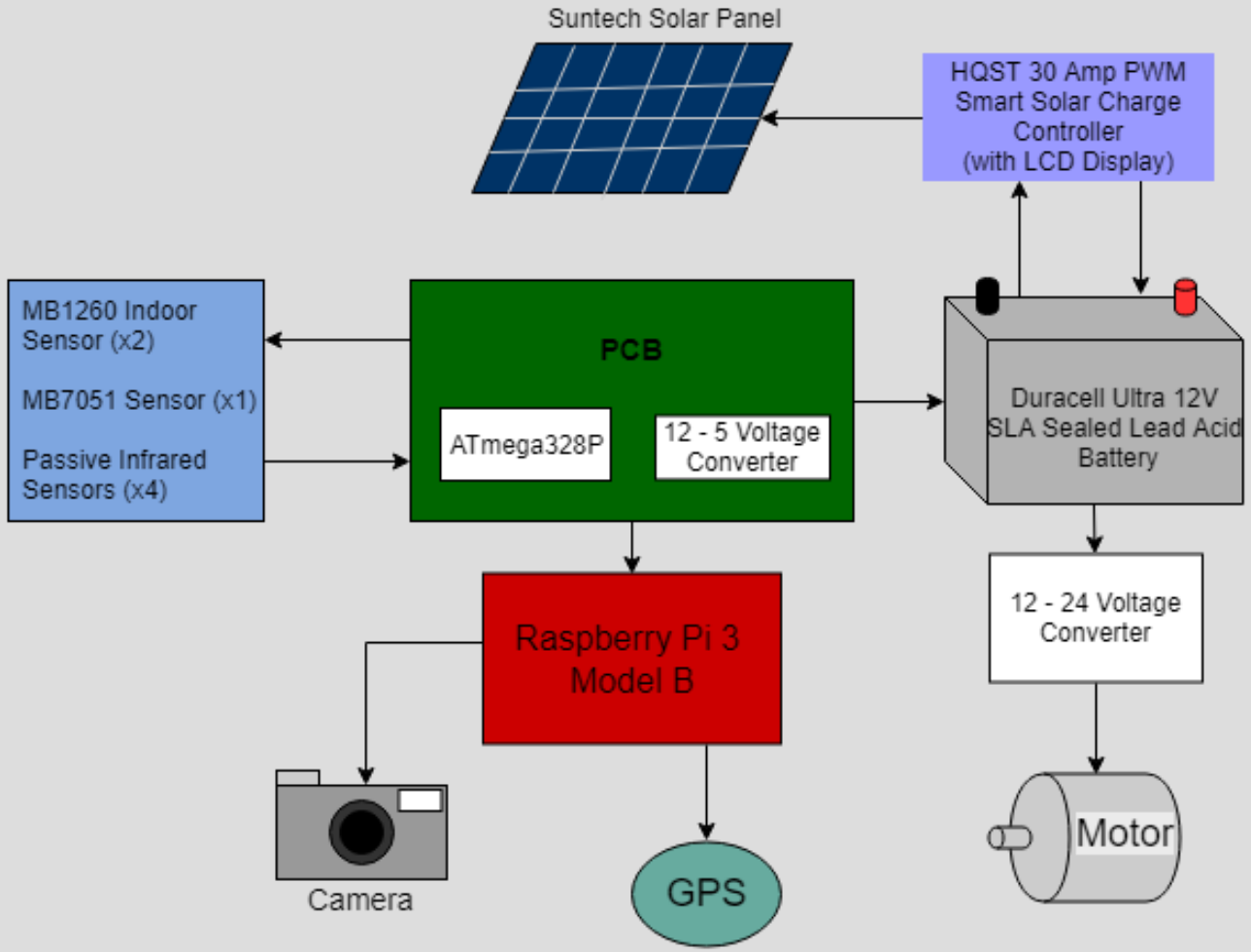
Drew Curry
Electrical Engineering

- Sensor research and selection
- Printed circuit board design
- Voltage regulator design
- Battery research and selection
- Charge controller research and selection
- Overall power distribution design
- Collaborate with ME team

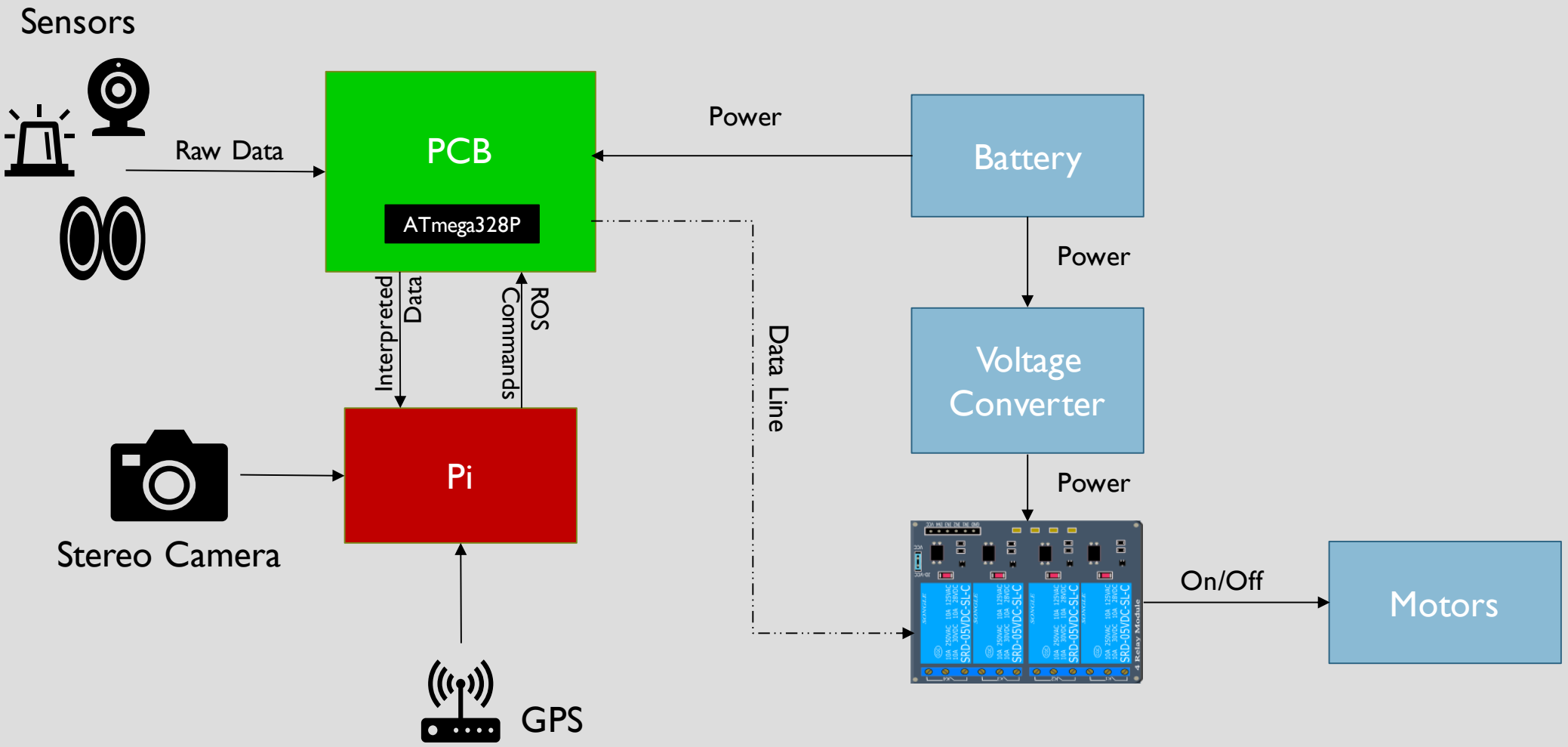
Grace Yoo
Computer Engineering

- Interpretation of raw sensor data
- Microcontroller/microchip research
- Communication between sensors and ATmega328P
- Communication between microcontrollers
- Overall autonomous system design
- Collaborate with CS team

OVERALL SYSTEM DIAGRAM



AUTONOMOUS SYSTEM DIAGRAM



SOFTWARE

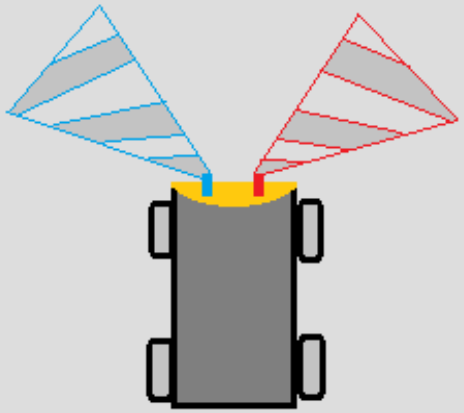
- Python
  - Raw data manipulation
  - Microcontroller communication
- Arduino IDE
  - ATmega328P
- Robot Operating System (ROS)
  - Leading robotics software in industry
  - Supporting role

SENSORS

ULTRASONIC SENSORS

MB1260 XL-MaxSonar

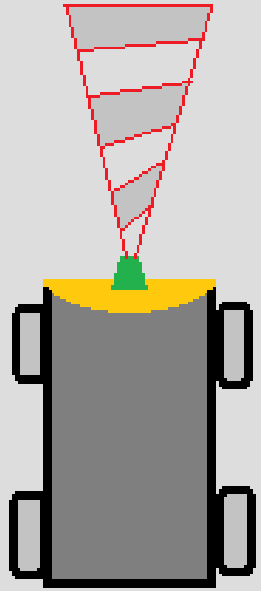
- Indoor close range ultrasonic sensor
- Used for close range proximity sensing
- Dual sensor proximity sensing
- 7m range with marginal sensing angle
- Secondary forward detection sensors



ULTRASONIC SENSORS

MB 7051 XL-MaxSonar

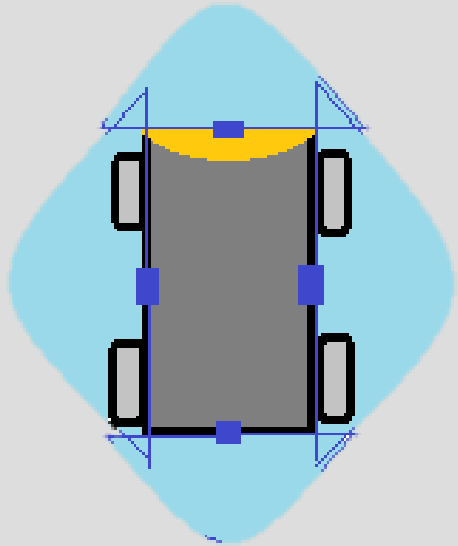
- Outdoor Long range ultrasonic sensor
- Long range precise detection in front of the vehicle
- 10m narrow angle detection
- Used for distance detection
- Most important information to gather

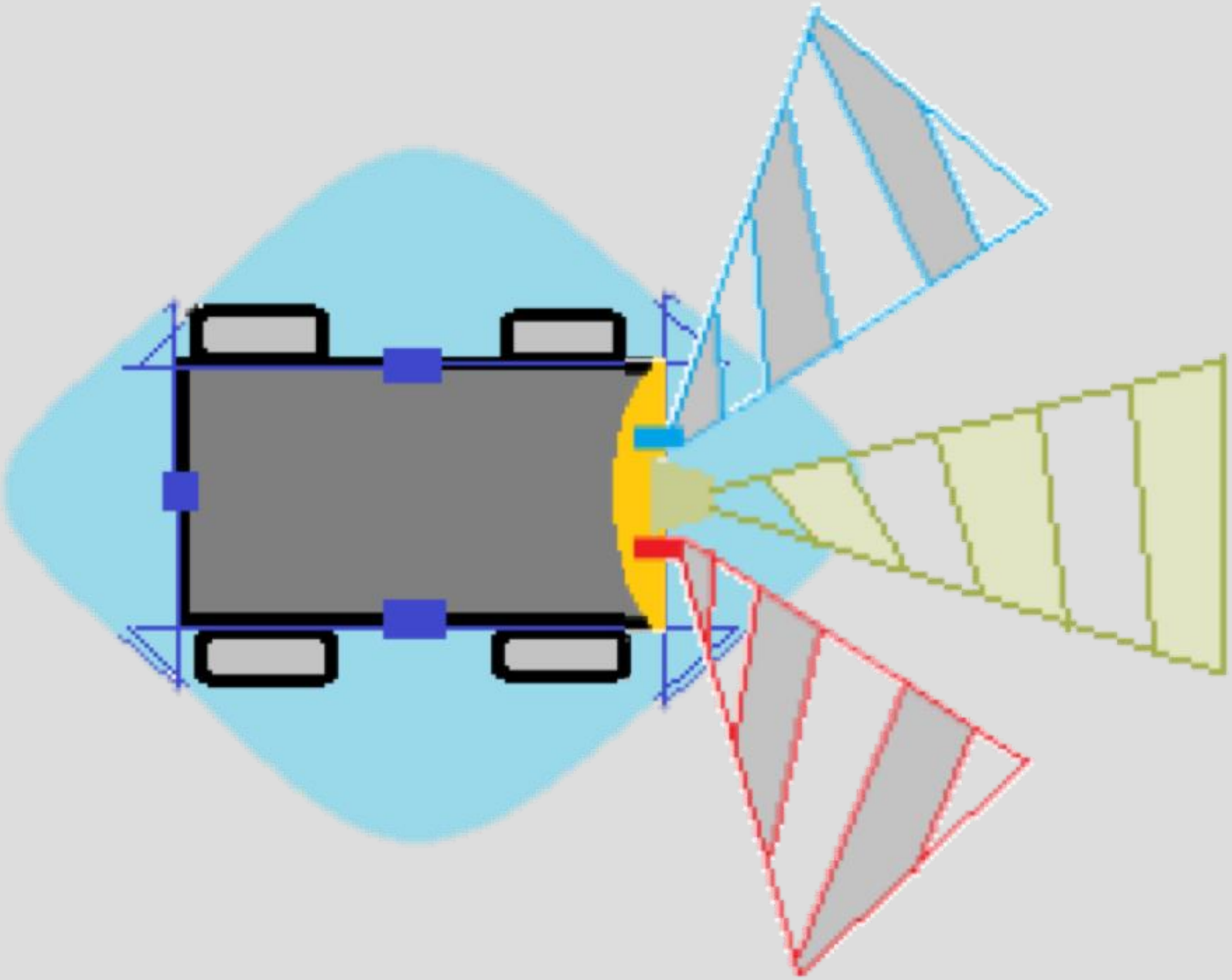


PASSIVE INFRARED SENSORS

Parallax 28032 Wide Angle PIR sensor

- Close range Infrared sensor
- Used for close range proximity sensing on the flanks of the vehicle





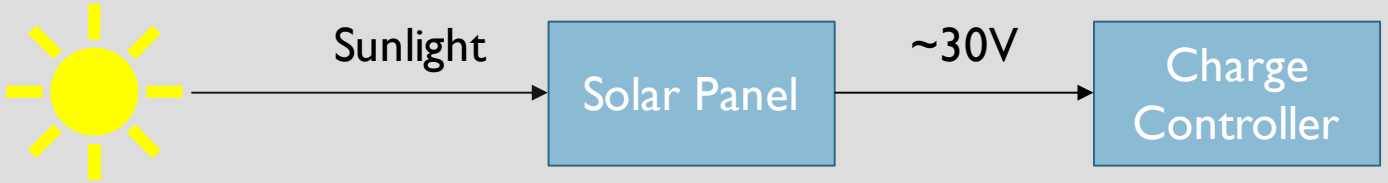
STEREO CAMERA

- Computer science scope
- Main form of object detection
- Allows images to be captured and rendered instantly in 3D

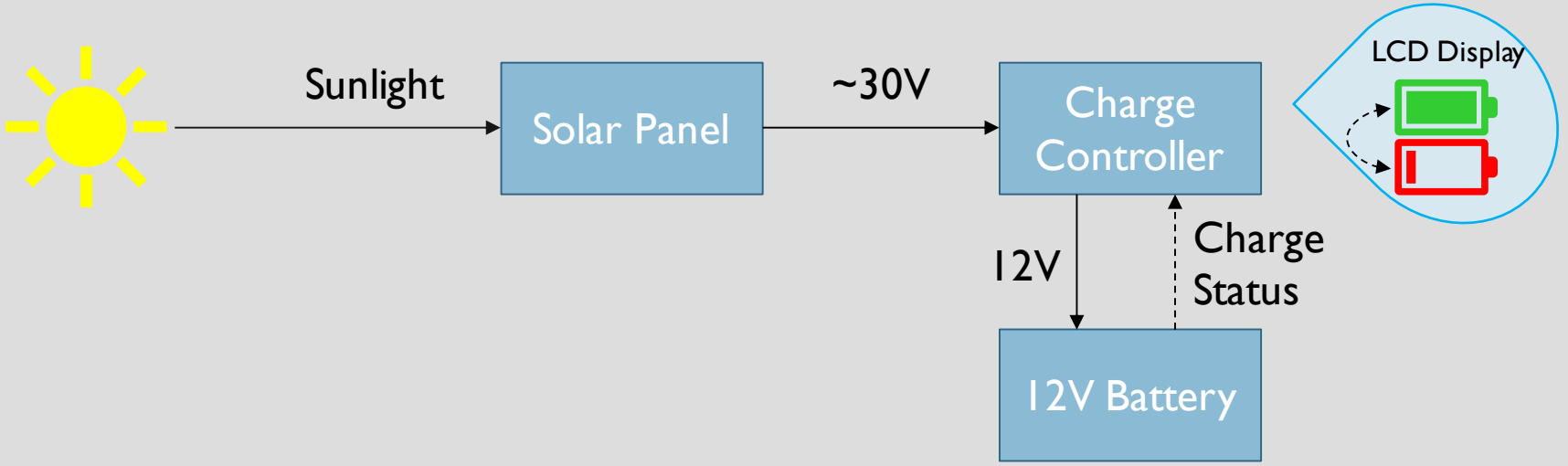
POWER SYSTEM DIAGRAM

POWER SYSTEM DIAGRAM

POWER SYSTEM DIAGRAM



POWER SYSTEM DIAGRAM



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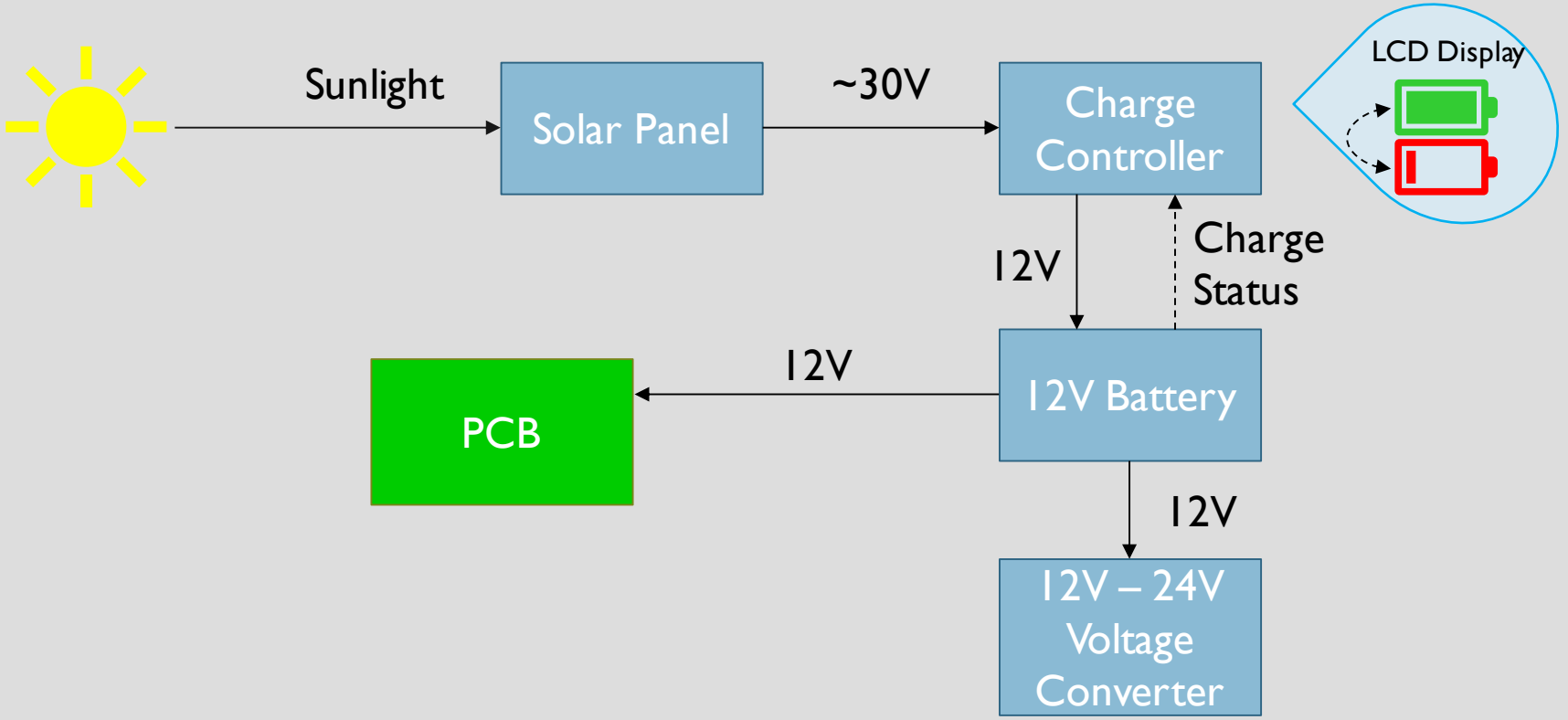
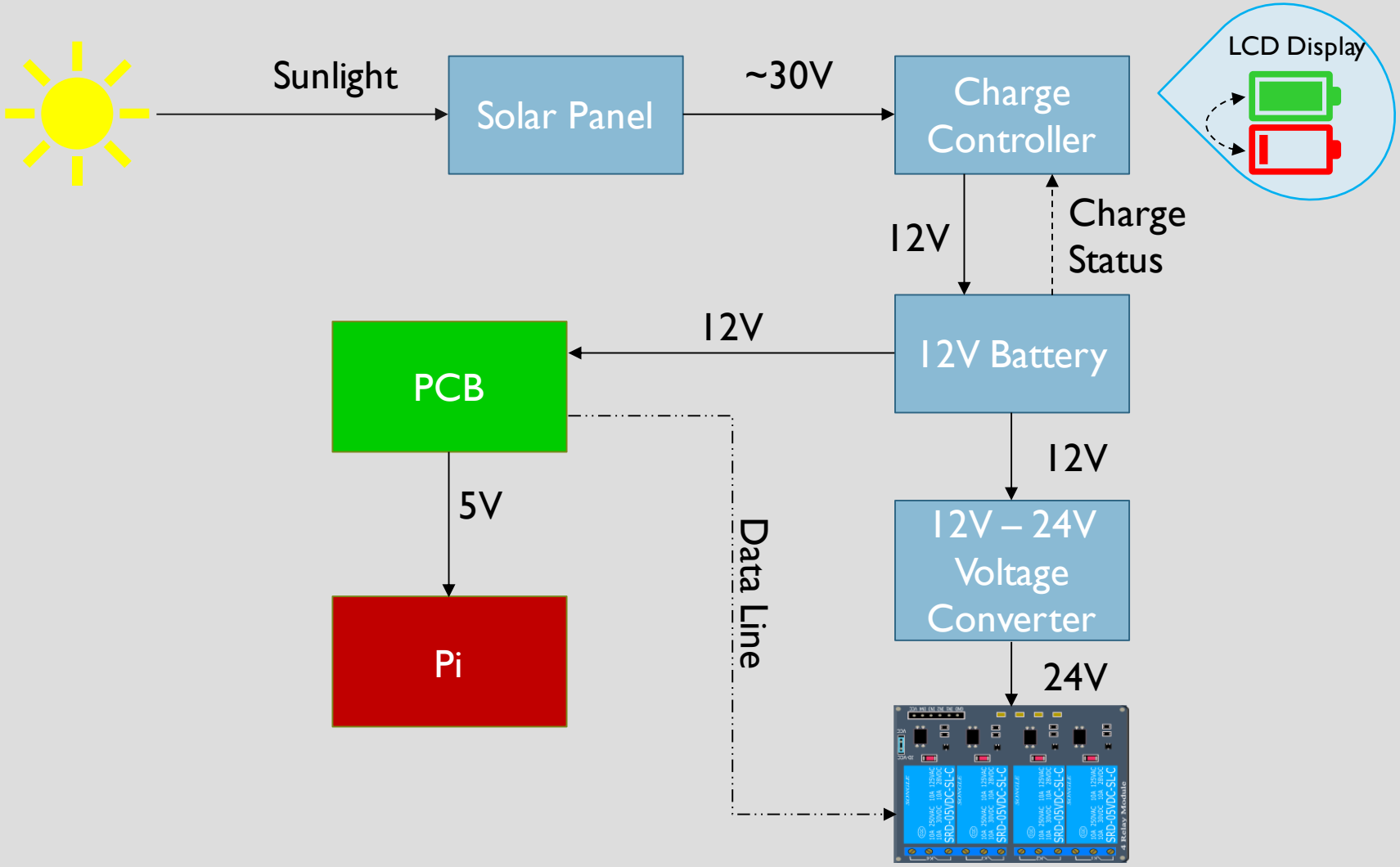
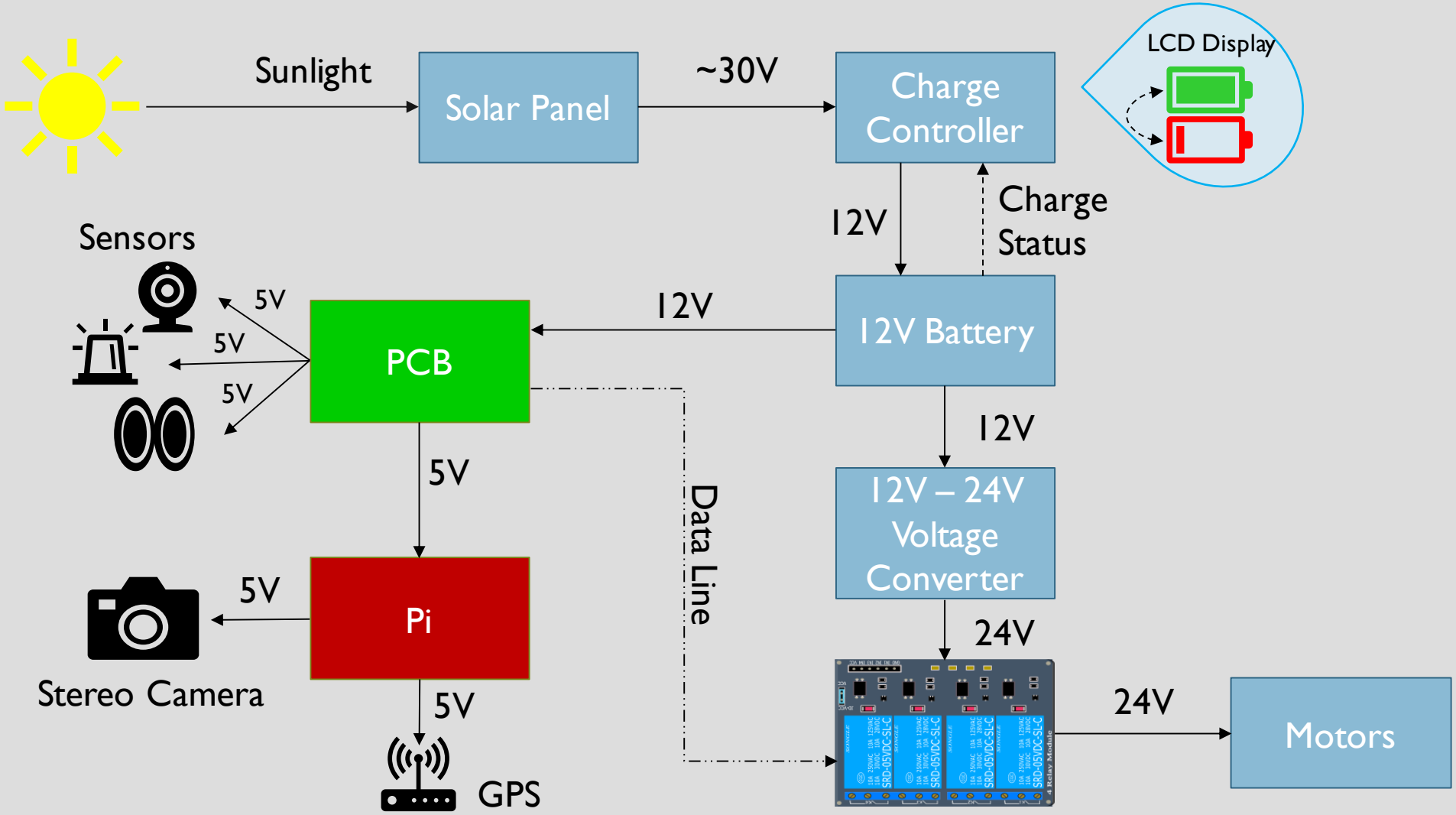


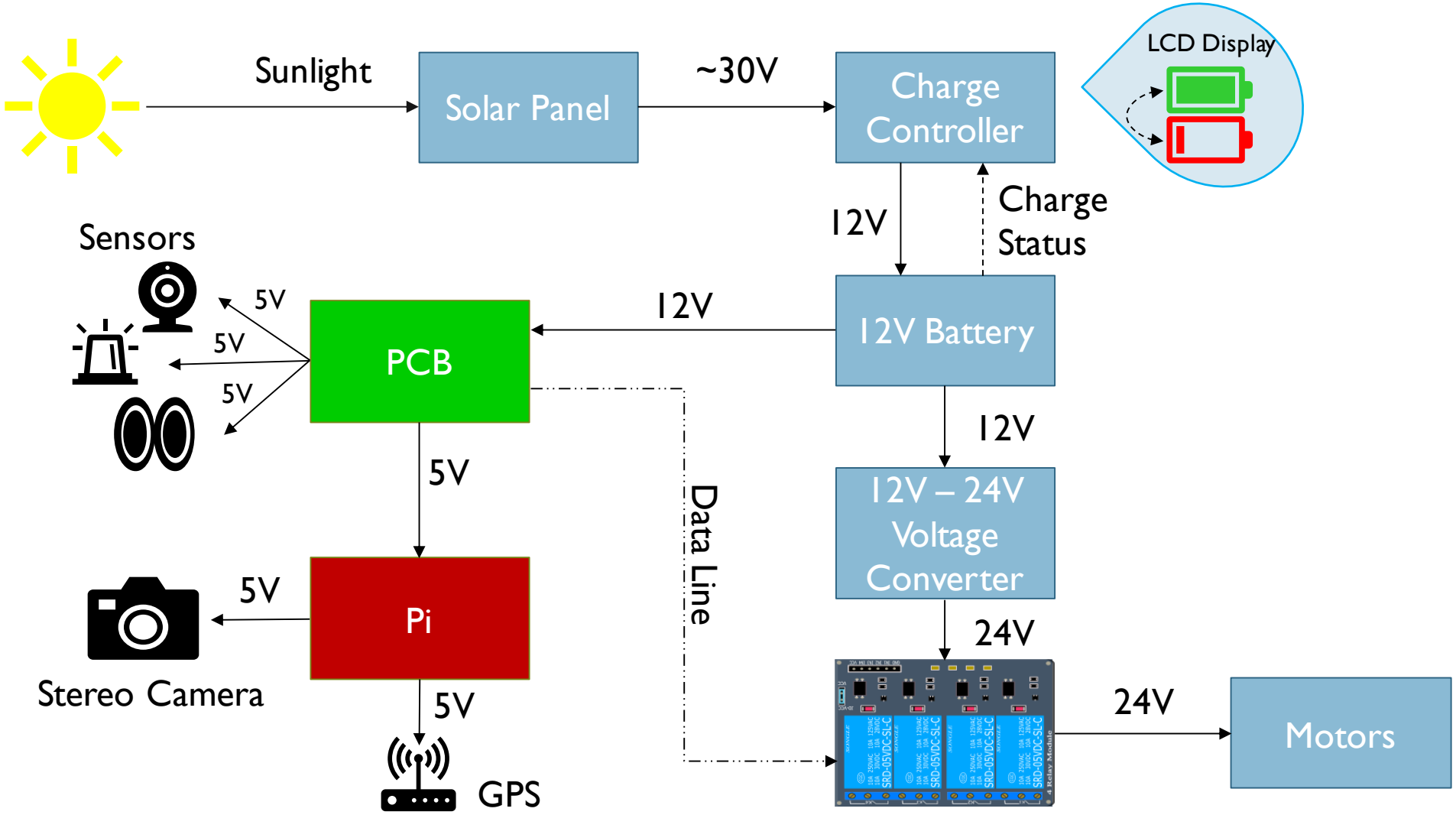
POWER SYSTEM DIAGRAM



POWER SYSTEM DIAGRAM



POWER SYSTEM DIAGRAM



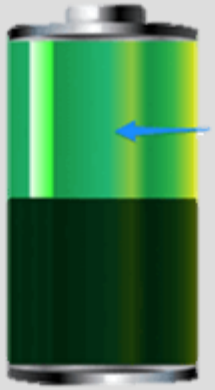
SOLAR PANEL

Suntech© Solar Panel

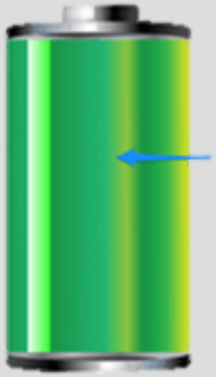
- Maximum Usage: 235W
- Maximum Current Output: 7.79 Amps
- Voltage Output: 30.16V
- System will consume wattage from panel and battery simultaneously

LEAD ACID BATTERY

Duracell Ultra 12V SLA Sealed Lead Acid 50 AH battery

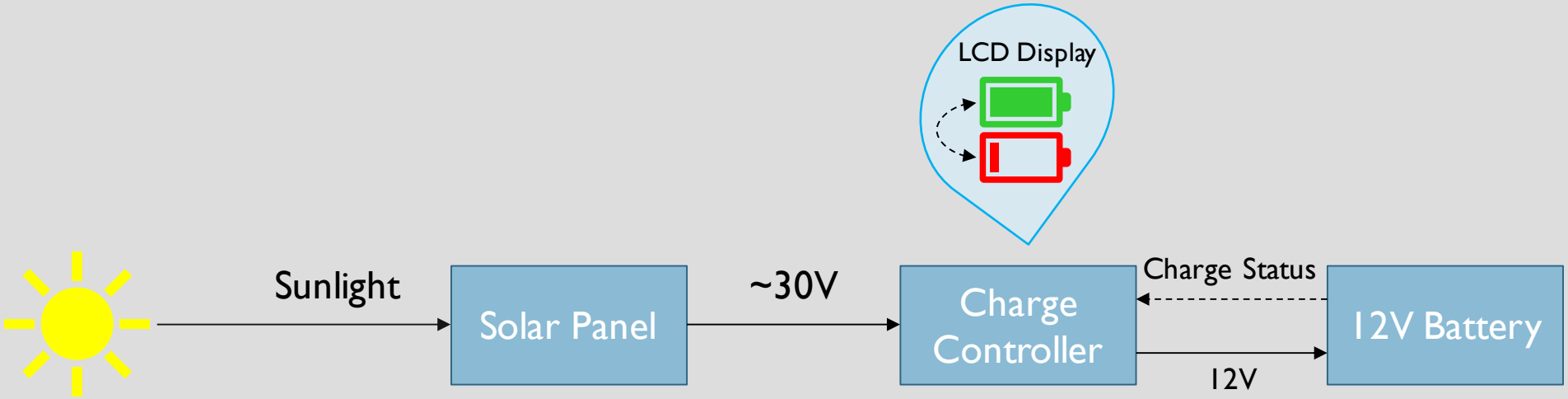


Lead-acid Rated Capacity



Lithium-ion Rated Capacity

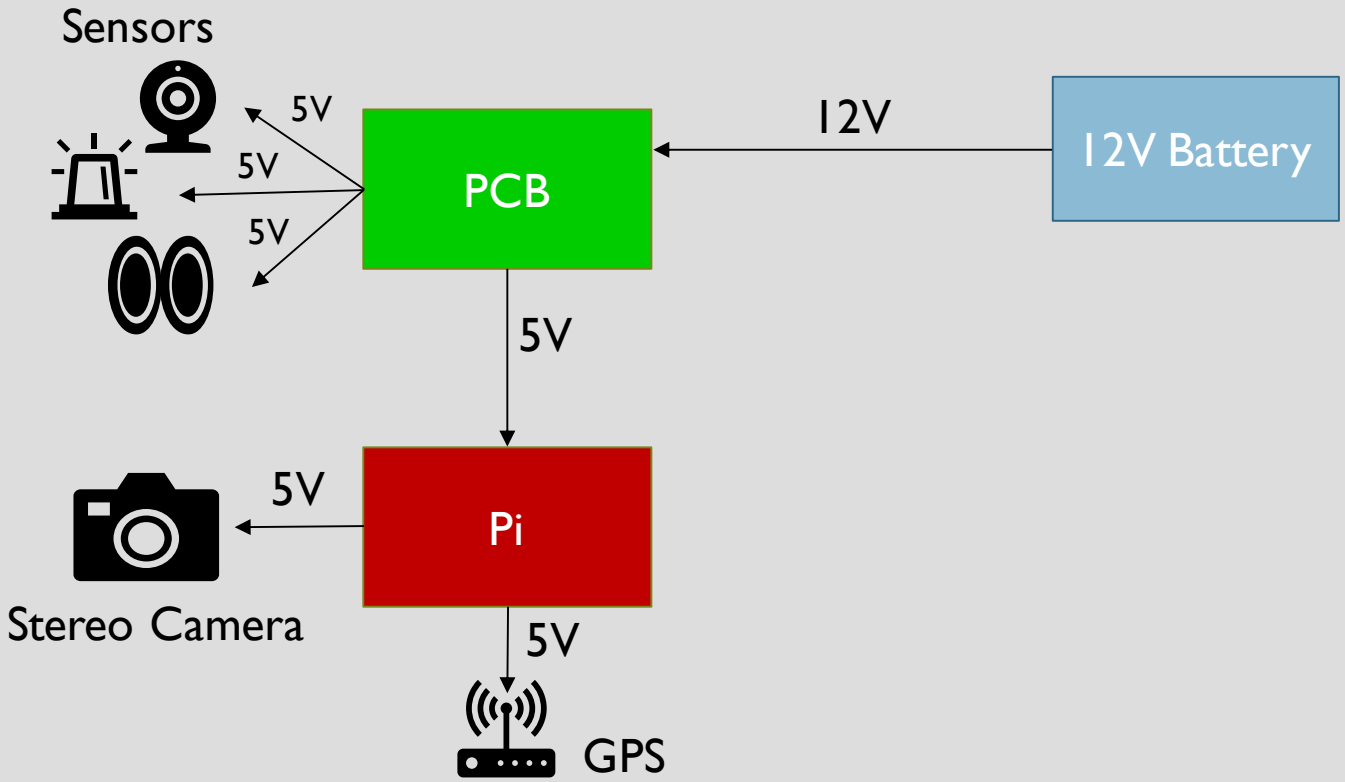
CHARGE CONTROLLER



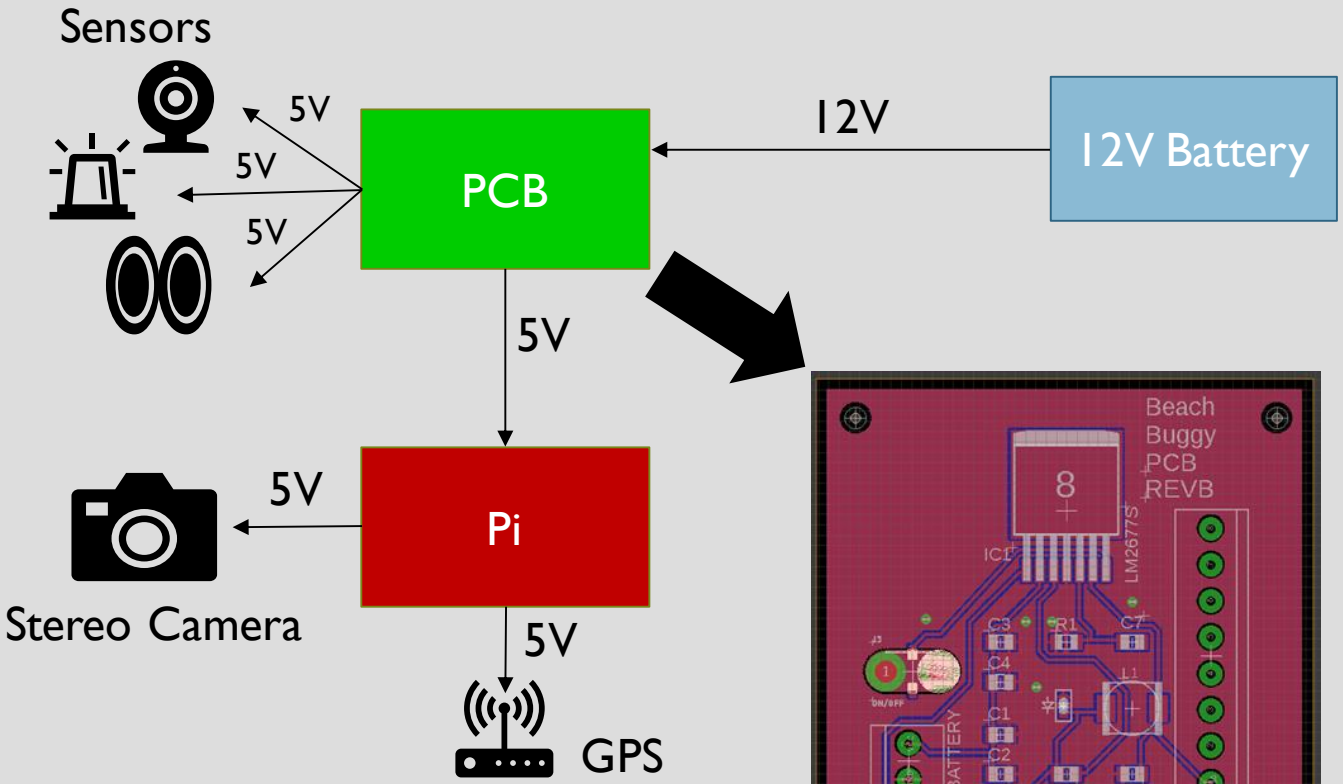
QST 30 Amp PWM Smart Solar Charge Controller

MPPT charge controllers for optimal charging

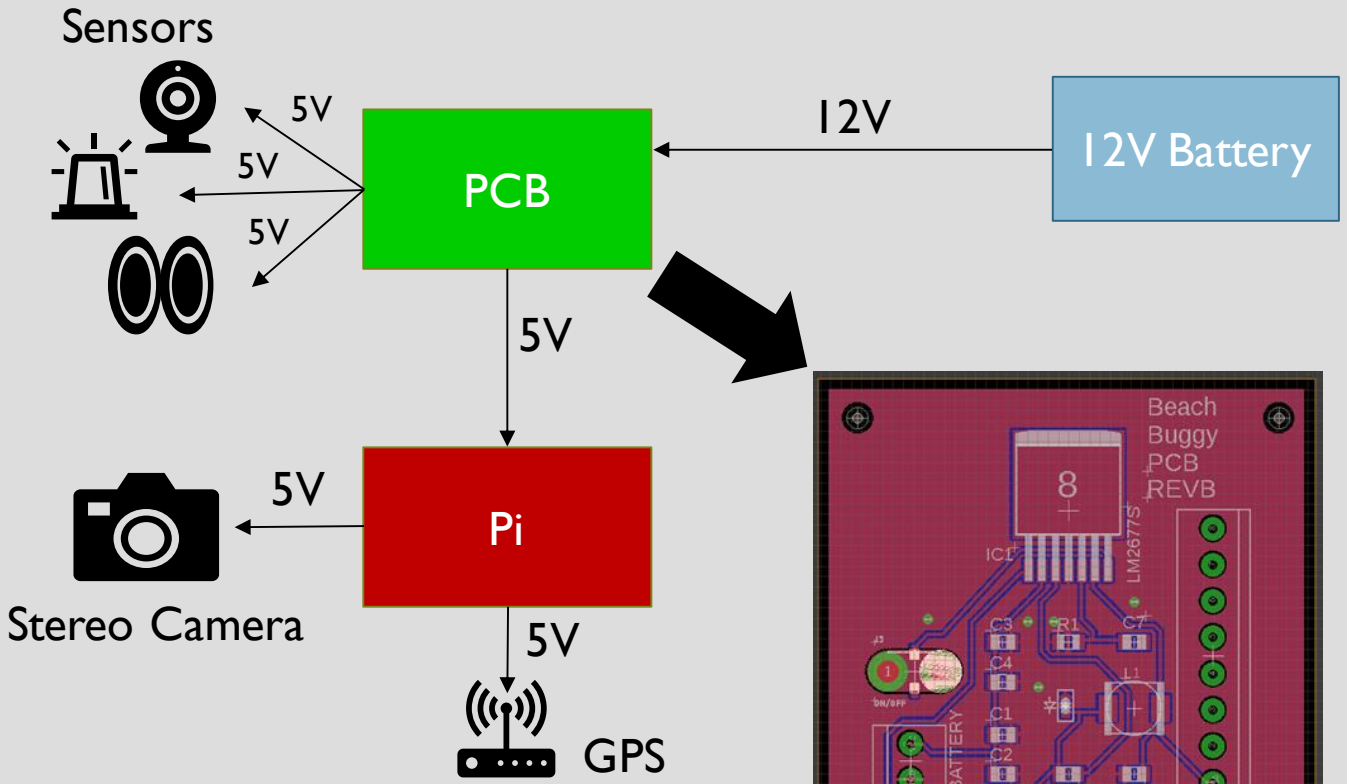
VOLTAGE REGULATOR

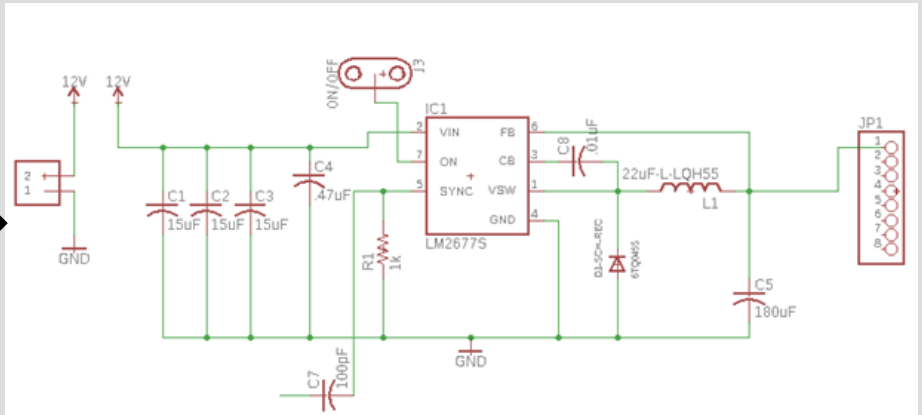


VOLTAGE REGULATOR



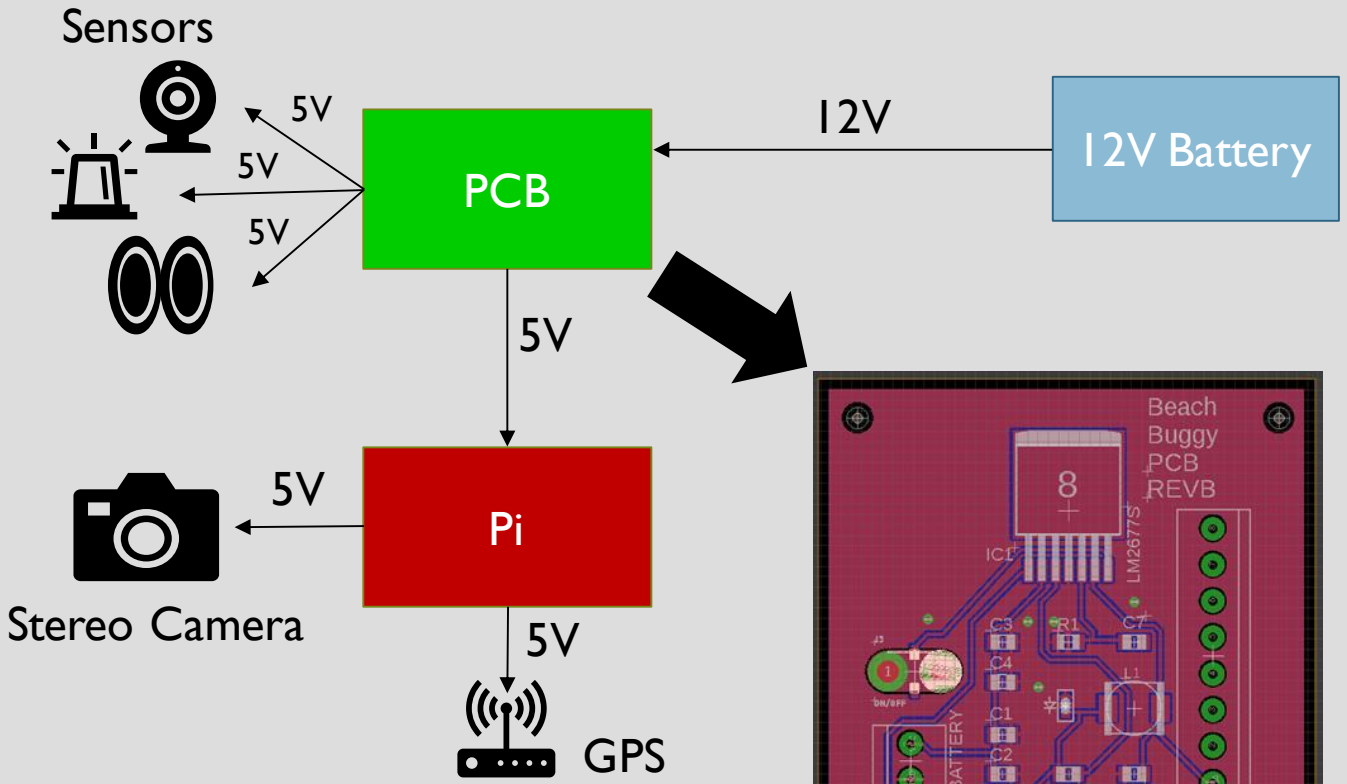
VOLTAGE REGULATOR

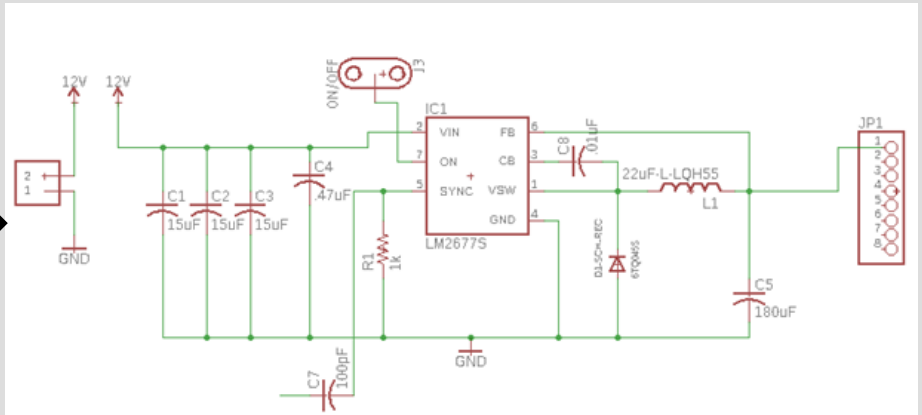




12v step down to 5v, 5A Buck Switching Regulator

VOLTAGE REGULATOR





12v step down to 5v, 5A Buck Switching Regulator

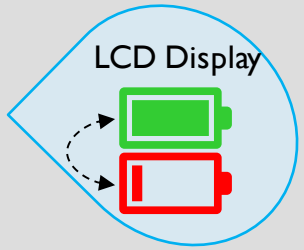
VOLTAGE REGULATOR

Sunlight

Solar Panel

~30V

Charge Controller



12V

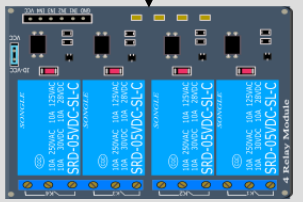
Charge Status

12V Battery

12V

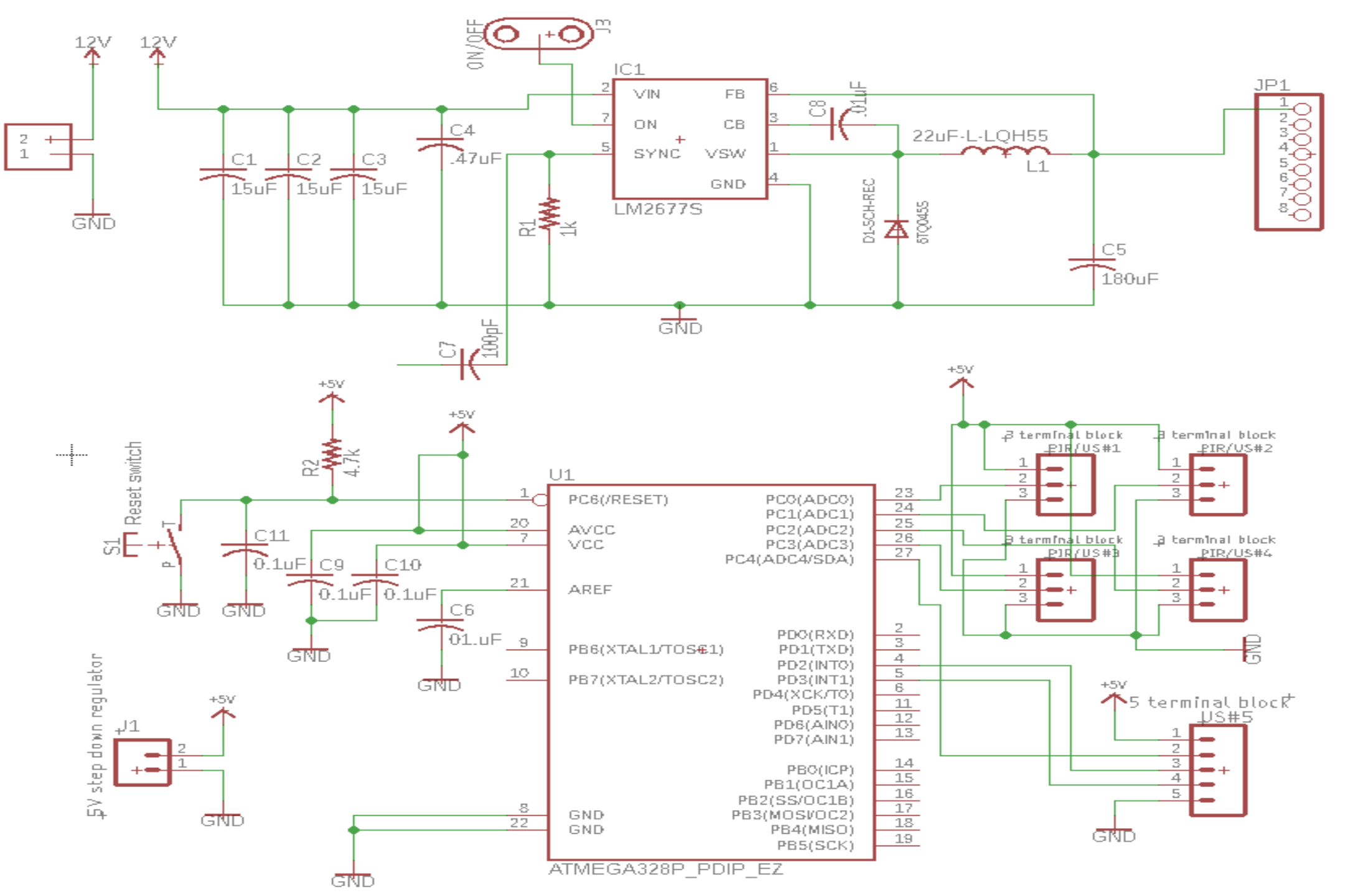
12V – 24V Voltage Converter

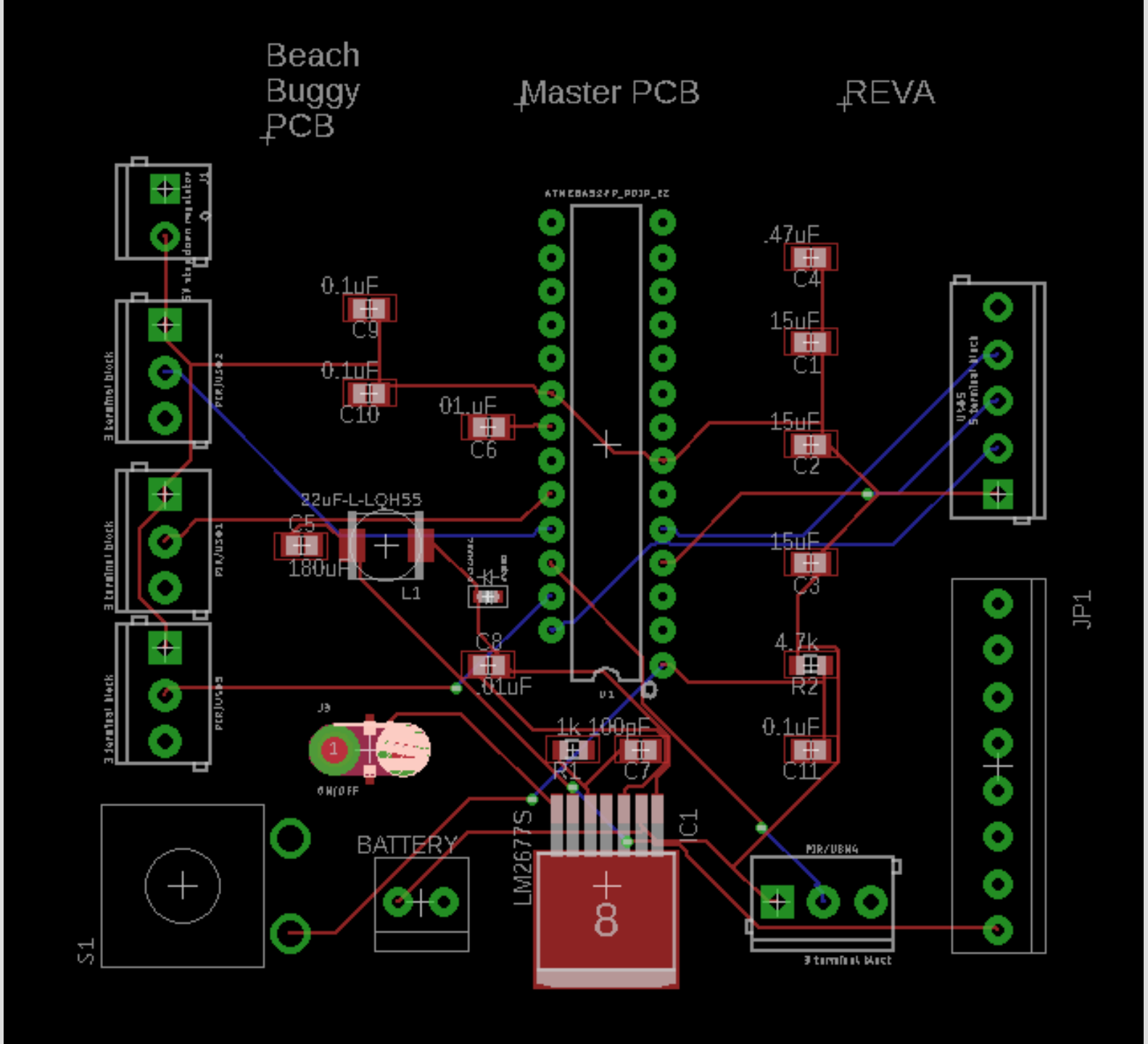
24V



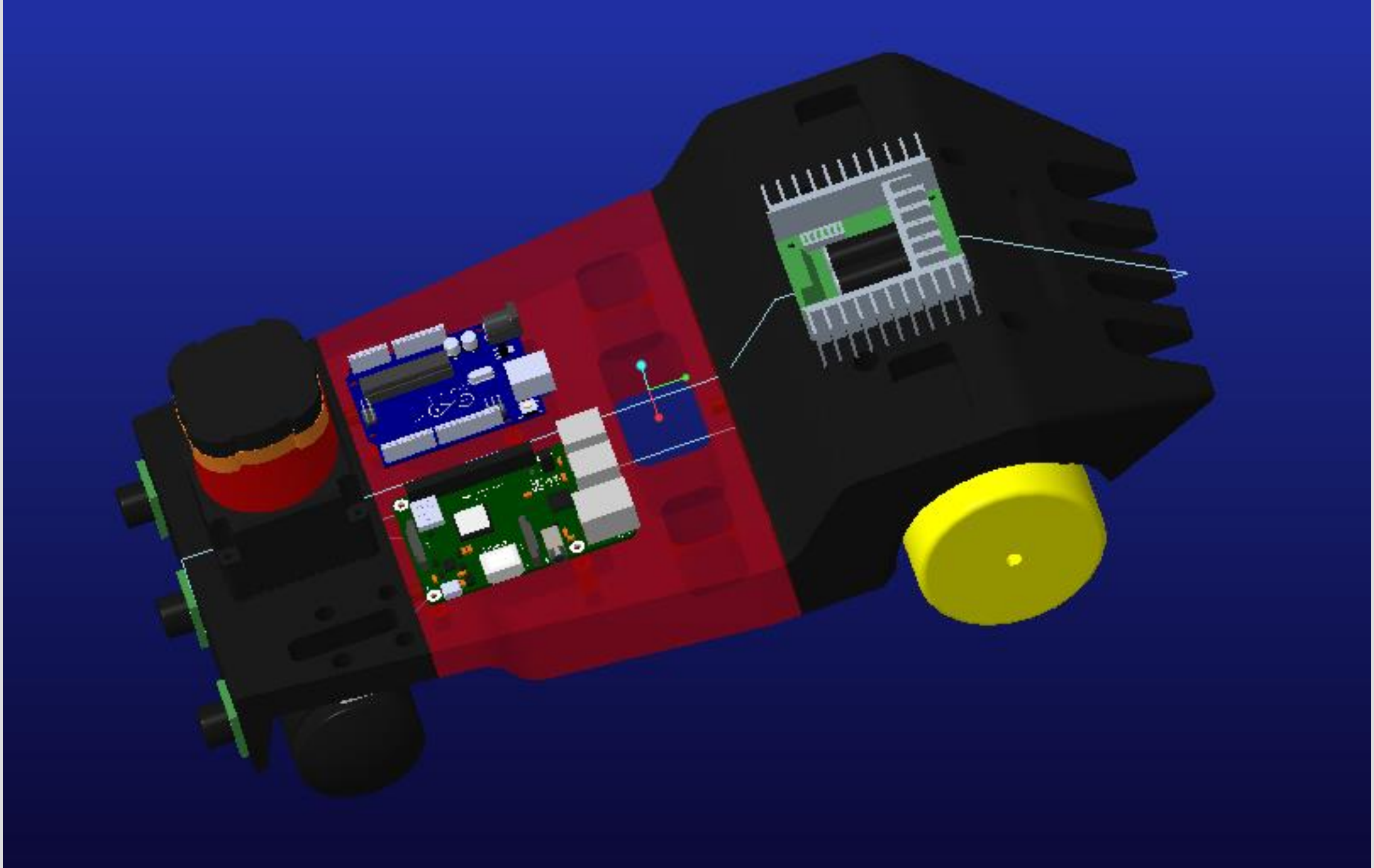
Awaking Waterproof DC/DC 12V Step Up to 24V 15A 360W Voltage Boost Converter

PRINTED CIRCUIT BOARD (PCB)


12V
12V
ON/OFF
J3
IC1
VIN
FB
ON
CB
SYNC
VSW
GND
LM2677S
C1
15uF
C2
15uF
C3
15uF
C4
.47uF
C8
.01uF
22uF-L-LQH55
L1
JP1
R1
1k
D1-SCH-REC
6TQ045S
C5
180uF
C7
100pF
GND
+5V
R2
4.7k
Reset switch
S1
C11
0.1uF
C9
0.1uF
C10
0.1uF
C6
.01uF
U1
PC6(/RESET)
AVCC
VCC
AREF
PB6(XTAL1/TOSC1)
PB7(XTAL2/TOSC2)
GND
GND
PC0(ADC0)
PC1(ADC1)
PC2(ADC2)
PC3(ADC3)
PC4(ADC4/SDA)
PD0(RXD)
PD1(TXD)
PD2(INT0)
PD3(INT1)
PD4(XCK/T0)
PD5(T1)
PD6(AIN0)
PD7(AIN1)
PB0(ICP)
PB1(OC1A)
PB2(SS/OC1B)
PB3(MOSI/OC2)
PB4(MISO)
PB5(SCK)
ATMEGA328P_PDIP_EZ
3 terminal block
PIR/US#1
3 terminal block
PIR/US#2
3 terminal block
PIR/US#3
3 terminal block
PIR/US#4
5 terminal block
US#5
J1
5V step down regulator


Beach
Buggy
PCB
Master PCB
REVA
0.1uF
C9
0.1uF
C10
01uF
C6
22uF-L-LQH55
C5
180uF
L1
C8
.01uF
.47uF
C4
15uF
C1
15uF
C2
15uF
C3
4.7k
R2
0.1uF
C11
1k
R1
100pF
C7
JP1
J3
ON/OFF
BATTERY
S1
LM2677S
C1
8
3 terminal block
3 terminal block
3 terminal block
3 terminal block

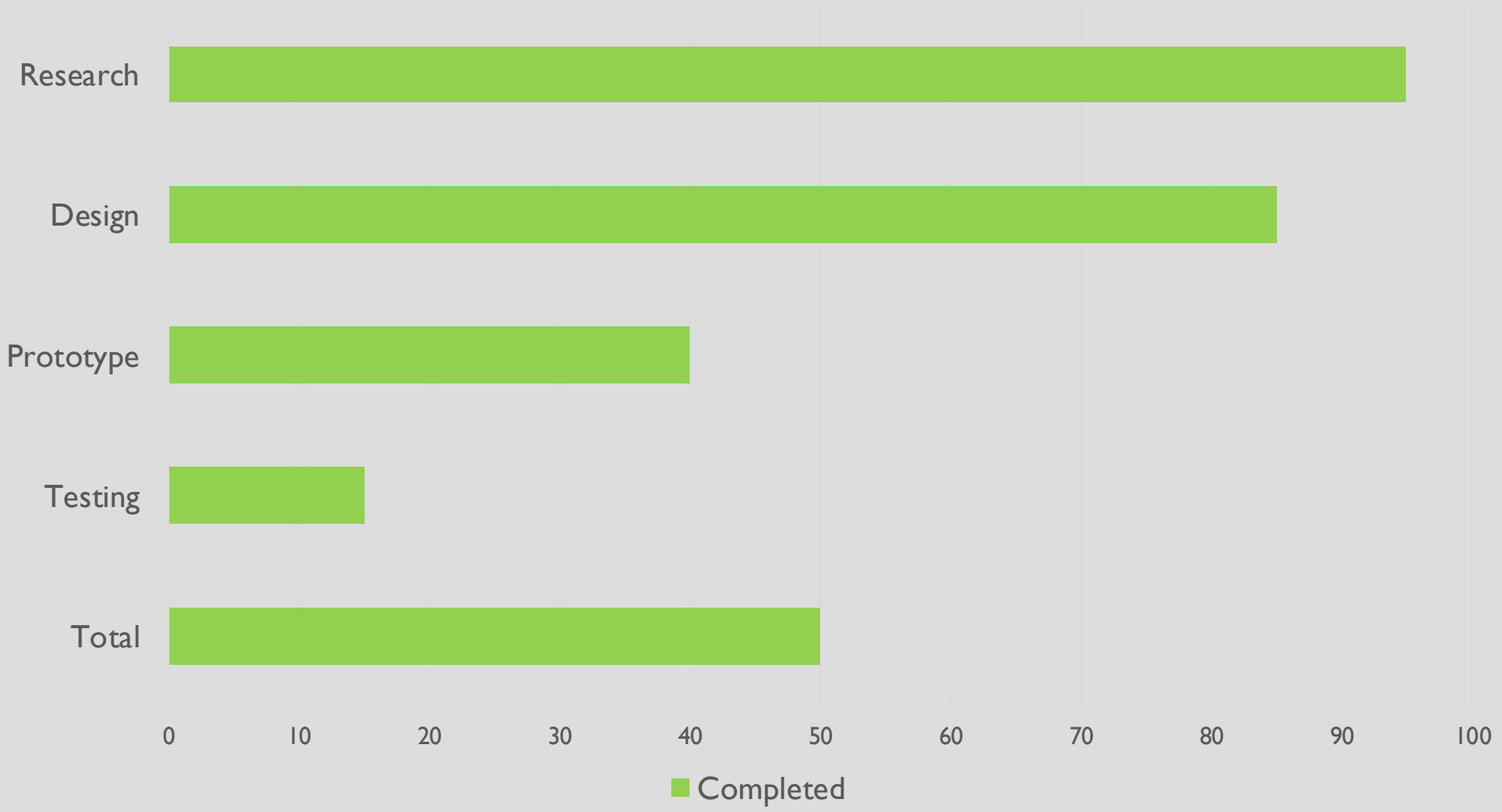
PROTOTYPE



BUDGET

	Budget Build		*Intermediate Build*		*Optimal Build*	
Frame	Steel, 90-degree plates	$500	Steel, rectangular tubing	$700	Aluminum, round tubing, 3rd party welding	$1,200
Suspension	Struts, coils	$200	Struts, coils	$200	Struts, coils	$200
Tires	Basic Tires	$60	Basic Beach Tires	$120	Premium Beach Tires	$350
Motors	2750 RPM Electric Motor	$300	2750 RPM Electric Motor	$300	2750 RPM Electric Motor	$300
Sensors	Stereo camera, 7 sensors, GPS	$300	2D LIDAR, Camera, 4 ultrasonic, GPS	$1,400	3D LIDAR, HD Camera, 4 ultrasonic, GPS	$3,000
Solar Panels	ECE Panels (Bulky)	Donated	Commercial Panels	$700	Flexible Panels	$1,000
Battery	50 Ahr Lead Acid	$100	100 Ahr Lead Acid	$250	100 Ahr Lithium Ion	$1,000
Controllers	Raspberry Pi 3, ATMega 328PCB Circuit Board	$250	Raspberry Pi 3, 2 ATMega 328PCB Circuit Board	$300	NVIDIA Jetson TX2, 2 ATMega 328PCB Circuit Board	$1,000
Total Cost		***$1,710***		***$3,970***		***$8,050***

PROGRESS


Research
Design
Prototype
Testing
Total
0
10
20
30
40
50
60
70
80
90
100
Completed

CONSTRAINTS

- Budgeting constraints:
  - ME/CS/ECE coordination
  - Indeterminate without testing
- Sensor Constraints
  - PIR reliability
  - Ultrasonic reliability
- Processing power constraints
  - ATmega328P vs Raspberry pi
- Environmental Constraints
  - Weather/Sunlight intensity
  - Terrain of beach
  - Safety

QUESTIONS?