



# PEDAL Bike



Group 32

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# Motivation



- No outlet to charge a device when away from home
- An increasing need to use renewable energy
- Wanting to charge or keep a device charged while on a bike ride
- Wanting to stay safe and connected while on a long trip
- Especially useful for trail bikers and delivery services

# Goals and Objectives



- Two different sources to generate renewable energy
  - A generator on the wheel to create energy through pedaling
  - A solar panel that allows for daytime charging and storage
- An LED system setup to keep the rider safe at night
  - Photoresistor control or manual switch to turn on lights at night
- Affordable when compared to similar products

## Advanced goals

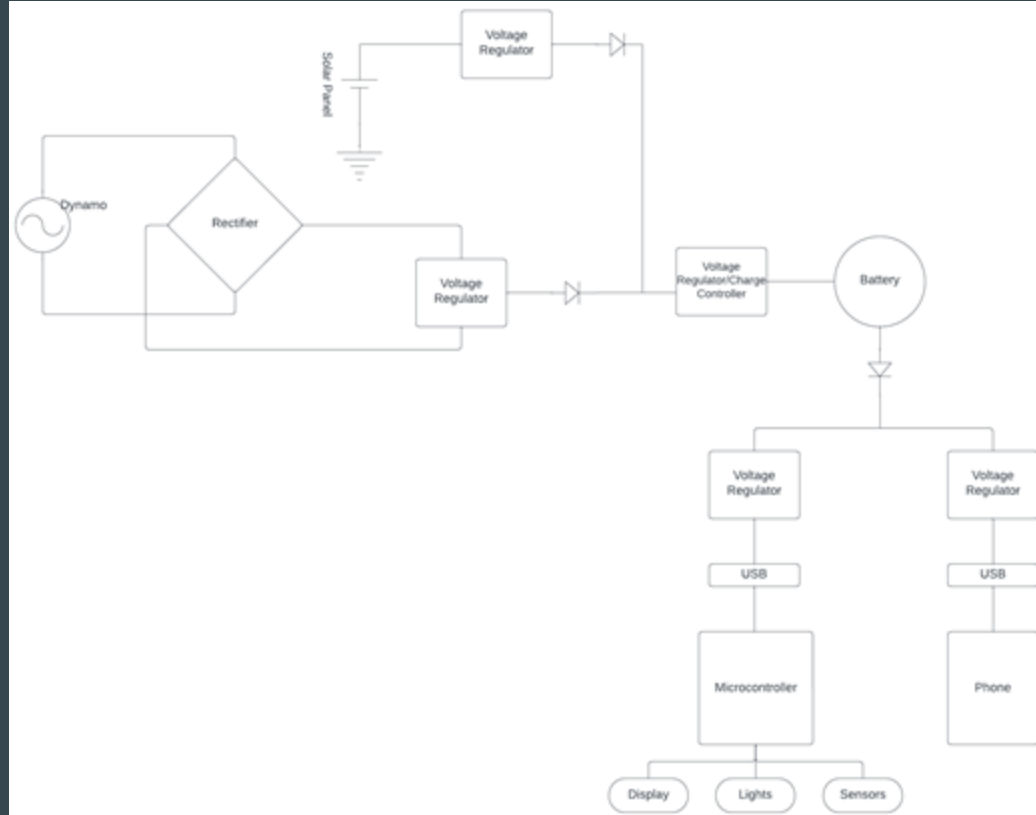
- Automatic light sensing headlights
- Fast charging

# Specifications



| Parameter                      | Specification |
|--------------------------------|---------------|
| Portable / Lightweight         | < 5Lbs        |
| Low cost                       | < \$250       |
| Output to phone                | $\geq 5W$     |
| Water resistance               | IP34          |
| Voltage regulator efficiencies | $> 80\%$      |

# Overall Block diagram

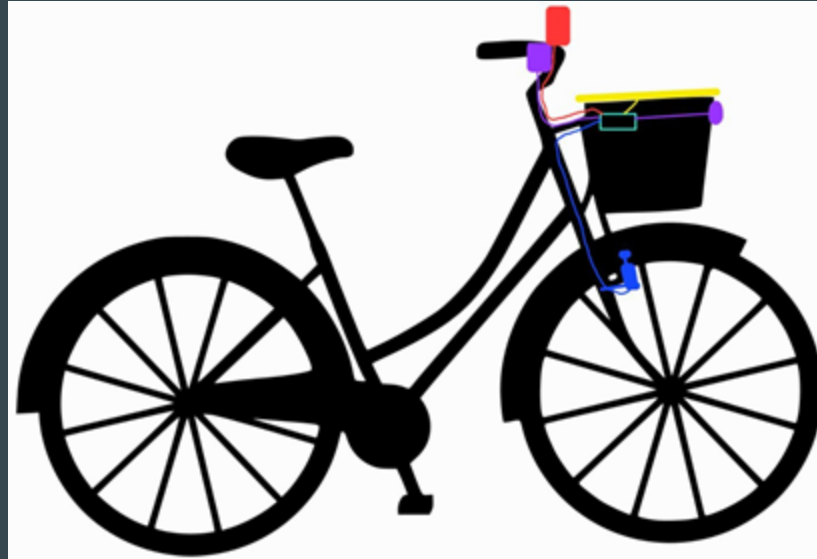


# Power Generation



Two sources of renewable power generation

- Mechanical sidewall generator attached to bicycle wheel
- Solar panel for more continuous power generation



# Mechanical generator types

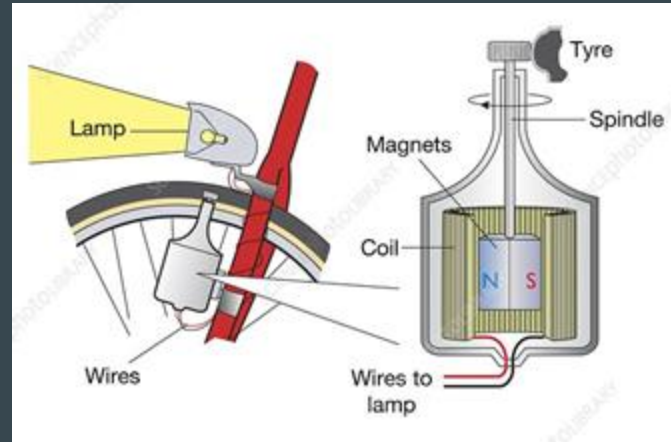


|              | Sidewall                          | Hub                           | Rim                               | Wheel mounted                            | Chain                    | Bottom bracket                     |
|--------------|-----------------------------------|-------------------------------|-----------------------------------|--|--------------------------|------------------------------------|
| Price        | \$15-\$30                         | \$60-\$200                    | >\$100                            | >\$100                                   | \$30-\$60                | -                                  |
| Installation | Friction against side of the tire | Replaces the hub of the wheel | Friction against rim of the wheel | Clasps onto the spokes or around the hub | Around the bicycle chain | Friction against tread of the tire |

# Sidewall Generator



- Configurations of 12 Volt / 6 Watt / 0.5 Amps and 6 Volt / 3 Watt / 0.5 Amps
  - We chose a 12V / 6W / 0.5A generator
- Low cost and low weight

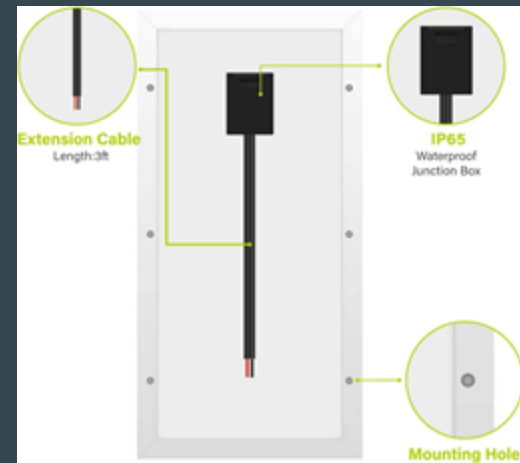
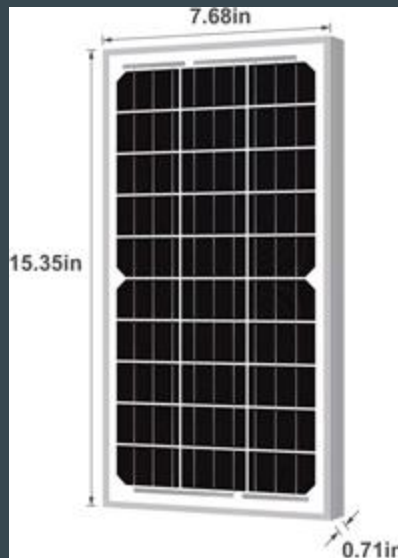




# Solar Panel



- Monocrystalline
- Conversion rate: 21-23%
- Dimension: 15.35\*7.68\*0.71 inches
- Weight: 2.0lbs
- Max Power Output(W): 10W
- Voltage MPP  $V_{mp}(V)$ : 17.37V
- Current MPP  $I_{mp}(A)$ : 0.69A
- Water resistant: IP65



# Voltage Regulation



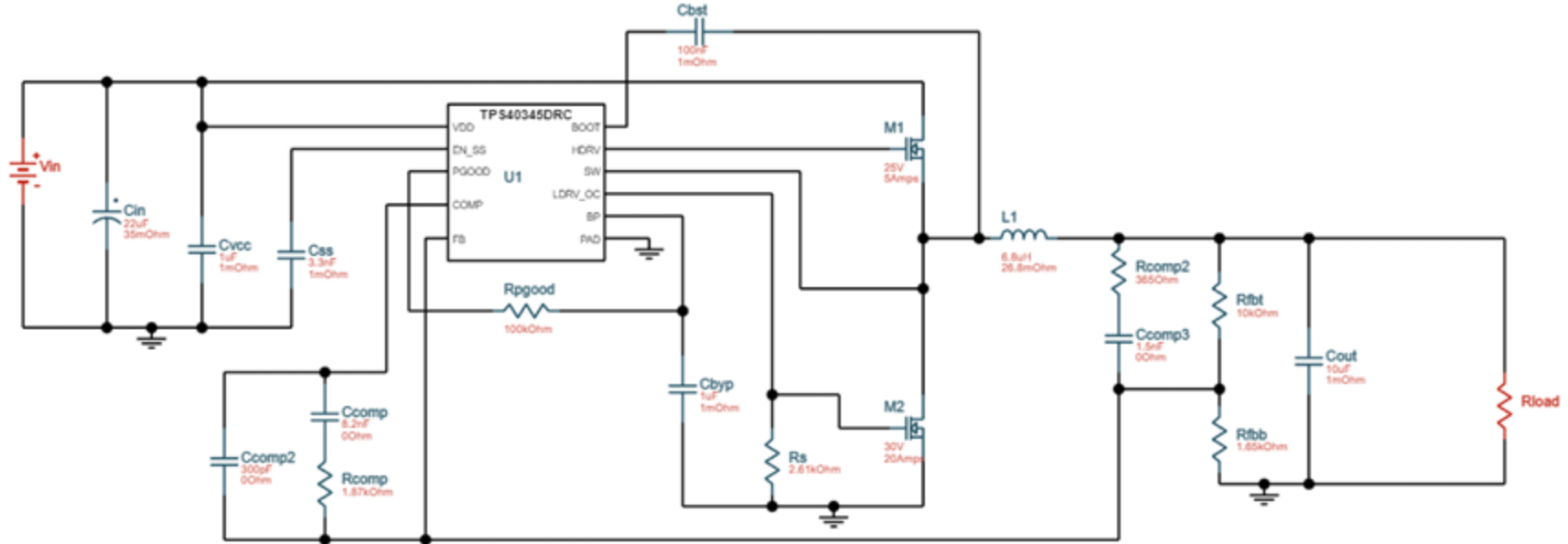
- Used Webench to help design voltage regulators throughout our system
  - Footprint:  $<300\text{mm}^2$
  - Price:  $<\$3$
  - Schematic export available
  - Efficiency  $>80\%$
- From power sources to battery charger
  - Input: DC 5 V - 20 V
  - Output: 4.2 V at 3 A
- From battery to microcontroller
  - Input: DC 2.3 V - 5.5 V
  - Output: 3.6 V at 0.5 A
- From battery to phone
  - Input: DC 2.5 V - 5.5 V
  - Output: 3.3 V at 2 A

# Voltage Regulator: TPS40345DRCR

RC



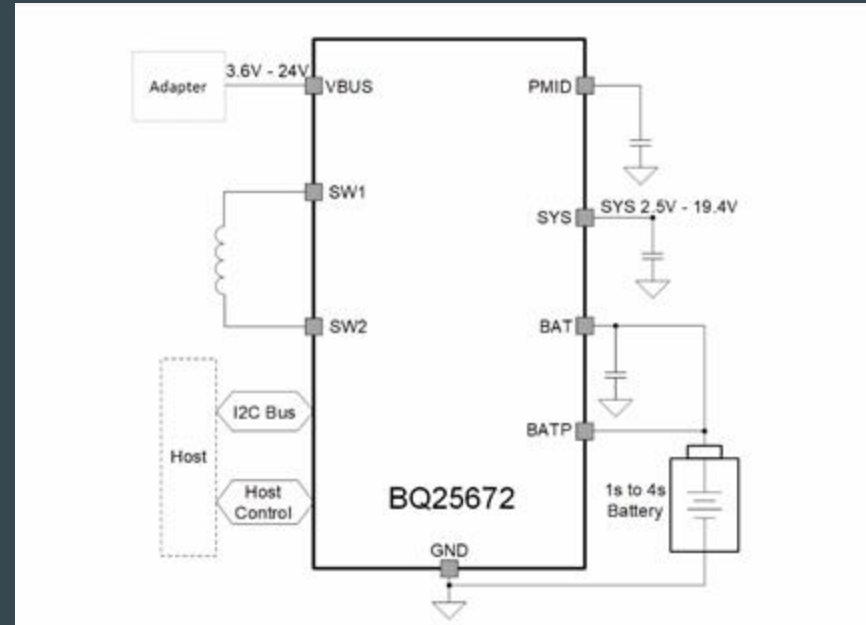
Generator/solar to charger: Efficiency: 94%, BOM Cost: \$2.83, Footprint: 230 mm<sup>2</sup>



# Charger - BQ25672RQMR



- Supports 1-4 cell batteries with a wide range of inputs
  - 3.6V to 24V and an absolute max of 30V
- Supports switching between sources
- Highly accurate
- Compatibility with photovoltaic panels
- Incredibly efficient
- Auto charging
- Several built-in safety features
  - Thermal regulation
  - Over Voltage Protection
  - Displays statuses



# Power storage

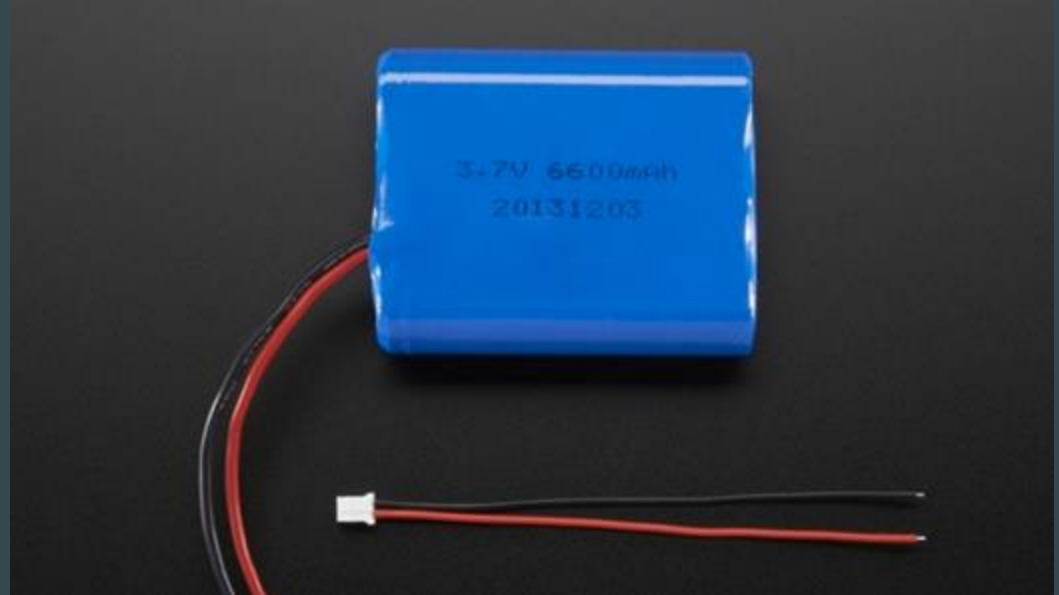


| Battery | Lithium-Ion         | Lead acid         |
|---------|---------------------|-------------------|
| Voltage | 3.7V                | 6V                |
| Ah      | 6600Ah              | 4500Ah            |
| Size    | 2.2 x 2.7 x 0.72 in | 2.8 x 1.91 x 4 in |
| Weight  | 0.31 lb             | 1.7 lb            |

# Battery - ICR18650



- Lithium ion rechargeable
- 3.7V and 6600mAh
- 2-pin JST connector



# Voltage regulator

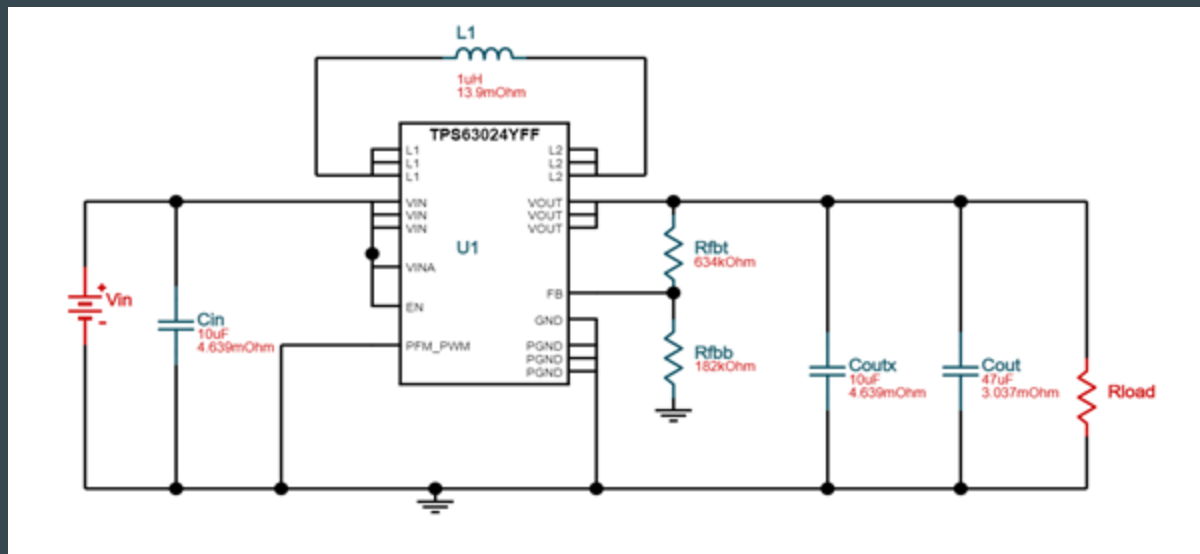


From battery to microcontroller Input: DC 2.3 V - 5.5 V Output: 3.6 V at 0.5 A

Efficiency: 93.8%

BOM Cost: \$1.46

Footprint: 106 mm<sup>2</sup>



# Voltage regulator

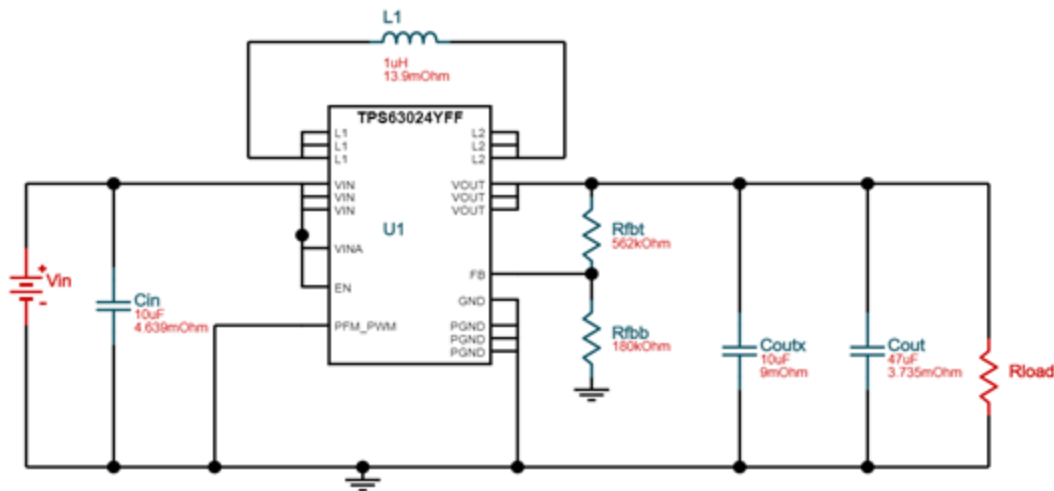


From battery to phone: Input: DC 2.5 V - 5.5 V Output: 3.3 V at 2 A,

Efficiency: 83.4%

BOM Cost: \$1.36

Footprint: 102 mm<sup>2</sup>





# Fast charging



- Need min. 18W
- Step-up voltage regulator



# Microcontroller



- With the MSP430FR6989 TI LaunchPad, several components will connect to the board, which will then connect to the PCB through a USB connection
  - LCD Display
  - Lights
  - Sensors
- Connecting these components allows for several features to show up on the display



# Sensors

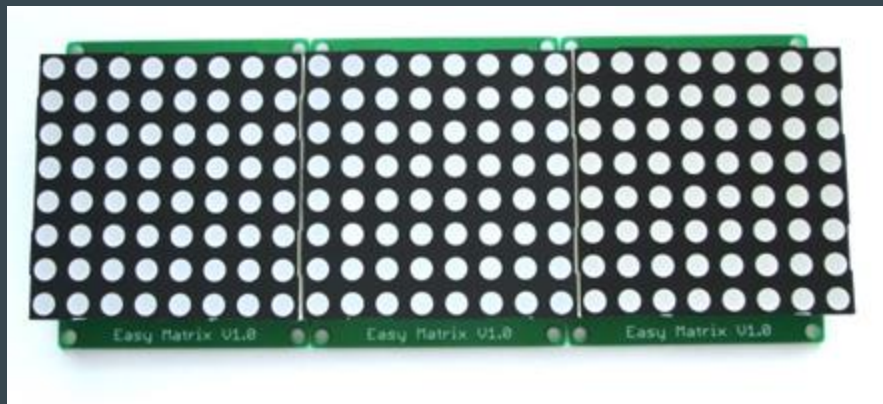


|                        |                       |         |
|------------------------|-----------------------|---------|
| <b>NEO-6M</b>          | GPS/Speed             | \$10.50 |
| <b>PCF8523</b>         | Date/Time             | \$4.95  |
| <b>Sensirion SHT40</b> | Temperature/Humidity  | \$5.95  |
| <b>INA169</b>          | Voltage/Current/Power | \$9.95  |

# Lights



- USB vs LEDS
- Stretch goal: automatic light sensing lights

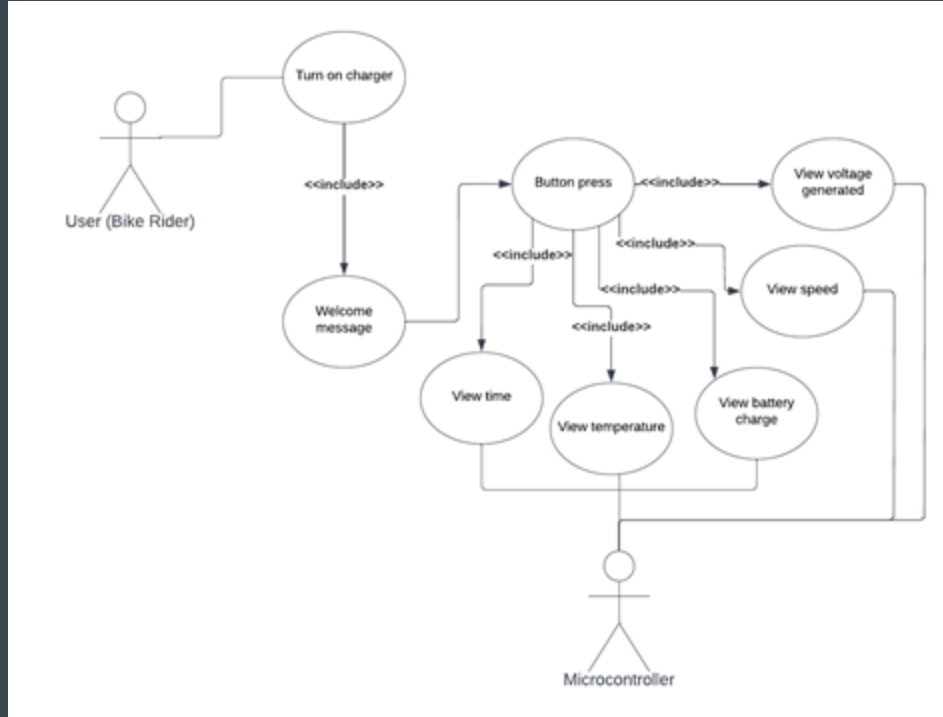


# Display



| LCD1602                | AMC2004HR-B-W6WFDW | ILI9341         |
|------------------------|--------------------|-----------------|
| \$9.99 (already owned) | \$11.18            | \$16.99         |
| 5V                     | 5V                 | 5V              |
| 64.5 by 16 mm          | 46 by 18.4 mm      | 36.7 by 48.9 mm |
| I2C                    | Parallel           | SPI             |

# Software Block diagram





# Administrative Content

# Work Distribution



|           | Research | Software design | Power generation | Power storage | Parts acquisition / Physical construction | Testing |
|-----------|----------|-----------------|------------------|---------------|---|---------|
| Roxanna   | ✓        |                 | ✓                | ✓             | ✓   | ✓       |
| Elizabeth | ✓        | ✓               |                  |               | ✓   | ✓       |
| Dexter    | ✓        |                 | ✓                | ✓             | ✓   | ✓       |
| Melvin    | ✓        |                 | ✓                | ✓             |   | ✓       |

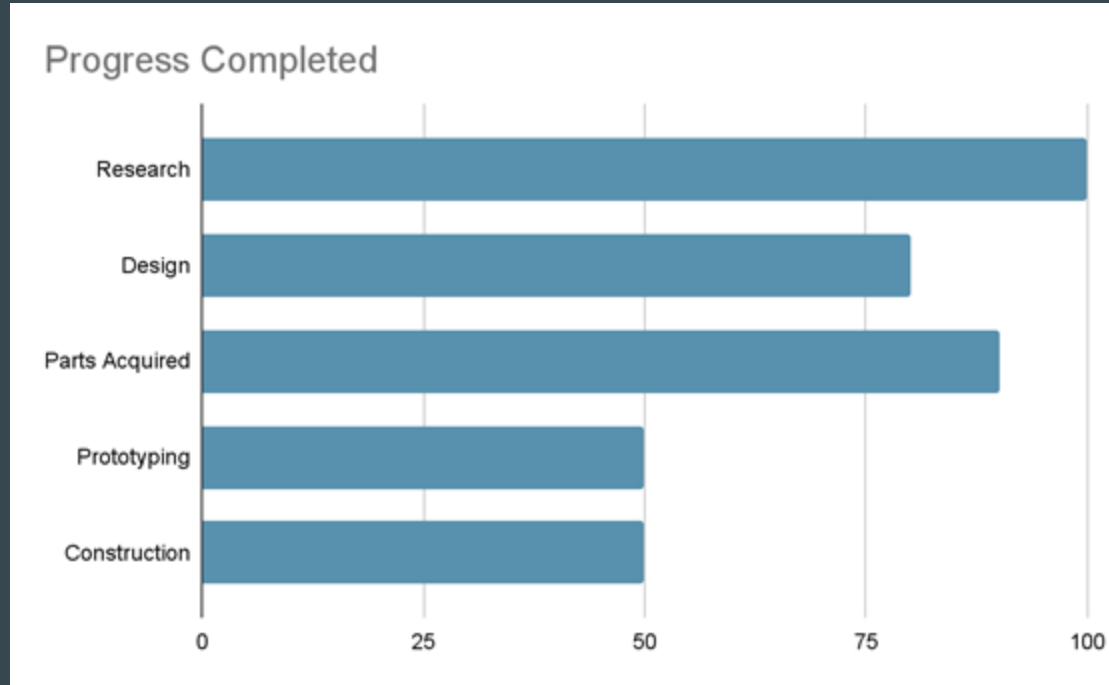


# Budget: Money Spent



| Item                                  | Quantity | Cost/item | shipping+tax | total    |
|---------------------------------------|----------|-----------|--------------|----------|
| bikes                                 | 1        | \$25.00   | \$0.00       | \$25.00  |
| generator                             | 1        | \$8.99    | \$8.80       | \$17.79  |
| sensors (clock, temperature, voltage) | 1        | \$30.00   |              | \$30.00  |
| GPS module                            | 1        | \$10.50   | \$11.00      | \$21.50  |
| solar panels                          | 1        | \$26.50   | \$2          | \$28.50  |
| TI parts (voltage regulators)         | 1        | 18        | 13.17        | \$31.17  |
| lithium-ion battery                   | 1        | 24.5      | 8.58         | \$33.08  |
| total                                 |          |           |              | \$187.04 |

# Progress



# Issues



- Fast charging will require larger battery
- Getting a bike
  - Fixing the bike acquired
- Shipping issues
- Parts were out of stock during SD1
- Attaching the Sidewall Generator

# Questions?

