EGN4952L – Capstone II
Fall 2019

# SOLAR CAR ELECTRONICS

FORMULA SUN/AMERICAN SOLAR CHALLENGE

# TEAM

## CURTIS DUVALL, TEAM LEADER

Curtis is a senior studying Electrical and Computer Engineering. He has been focusing on team coordination and regulatory adherence in this project. Curtis plans on obtaining an engineering job at the completion of his degree.

## RONDA EASLEY, SYSTEMS INTEGRATION

Ronda is a senior studying Electrical Engineering. She has been focusing on research and budget implementation thus far in the project. Ronda will be attending graduate school at UWF after completion of her bachelor degree.

## RAYMOND FLEMING, SR ENERGY SYS COORD

Raymond is a senior studying Computer Engineering. He has been researching the drive and energy storage systems for the project. Raymond will be moving into an engineering role after completion of his degree.

## JULIAN THAYER, LEAD PROGRAMMER

Julian is a senior studying computer engineering. He has a background in robotics, machining, carpentry, and welding. Julian is responsible for programming duties for the controllers and sensors. He plans to work in industry after graduation.

**Team Member Introductions**

# PROJECT SUMMARY

## OVERVIEW

This senior design project is comprised of designing and implementing the electrical components of a solar race car while adhering to Formula Sun Grand Prix (FSGP) race guidelines. The electronic system of the car includes the rechargeable battery array, the motors and motor controllers, as well as following the ASC regulations for vehicle lighting requirements. These components will be implemented on the University of West Florida's solar race car.


## REQUIREMENTS

- A battery system to hold the energy gathered from the solar panels and will power the motor of the car.
- Motor controllers programmed to accurately control the speed of the vehicle.
- A safety system to display overvoltage or overcurrent conditions for the driver.
- Operational headlights, turn signals, hazard blinkers and a horn.
- Documentation of all parts utilized.

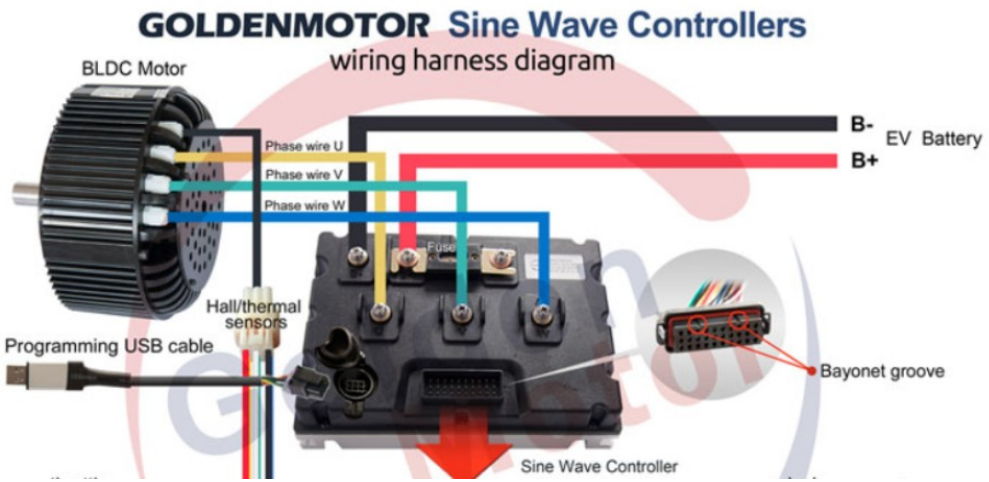
# PROJECT DELIVERABLES – BATTERIES

- Rechargeable battery array is made up of 12 Turnigy LiPo battery modules connected in series to provide 48V to the motors. The battery array is expandable to meet any future needs for the vehicle and is completely enclosed in a non-conductive box to be placed into the vehicle. The enclosure is air cooled by 2 fans and also contains a lead-acid 12V car battery to power the auxiliary equipment.



# PROJECT DELIVERABLES – MOTORS AND CONTROLLERS

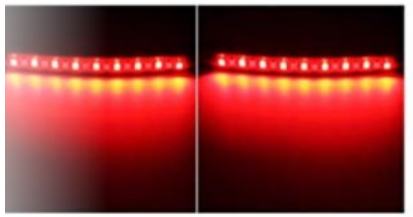
- The motors selected for the project are dual 3-phase Golden Motors rated at 3kW at 48V to provide 3000rpm at a rated torque of 10 Nm. These motors were selected based on their high efficiency rating, their price, and their size. Motors for this project needed to be compact and as lightweight as possible. The controllers are Golden Motor sine wave controllers programmed through computer interface.

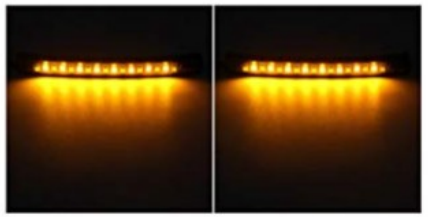

Julian Thayer

# PROJECT DELIVERABLES – SAFETY MONITOR & LIGHTING

- A commercial hall sensor was utilized to display current, voltage and battery discharge levels. The lighting requirements included headlights, front, side, and rear turn/hazard signals and 2 rear brake lights. A 130dB horn was also added to fulfill safety requirements set forth by FSGP guidelines. These components are all powered by the 12V lead acid battery and each component is properly fused. All connections are labeled for easy placement into the solar vehicle.

Red LED Light



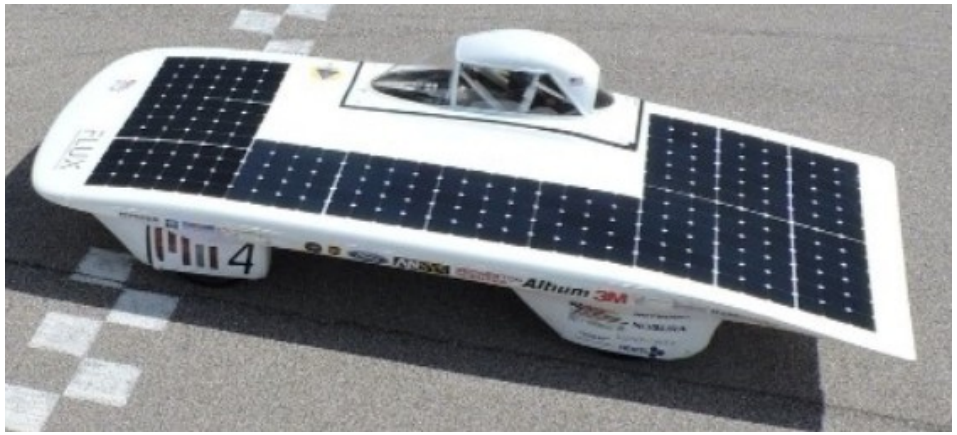
Yellow LED Light

# PROJECT DELIVERABLES – DOCUMENTATION

- The final component of the project was full documentation of each part used as well as a maintenance guide to using the components. This was completed in the form of a book containing data sheets for each component as well as product information which can be used for reordering if any component should need to be replaced later. Guides were added for the use and maintenance of LiPo batteries as well as a wiring diagram for the whole project. This documentation will be passed forward to the solar car team in both an electronic version and a printed copy.

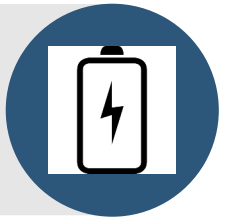
# PROJECT DELIVERABLES – MIT DONATION

- While researching solar cars, our team was able to connect to other teams and race officials which allowed us to vie for the donation of a retired solar car body and solar array from MIT. MIT interviewed 8 teams across the country and ultimately selected UWF to receive the donation. Our team then coordinated shipment and receipt of this vehicle on behalf of the school. This vehicle can be used in future years to advance the success of the solar car team.



# COMPONENTS AND TESTING

## BATTERY AND MOTORS



•For testing purposes, the batteries were charged using a standard hobby charger.

•Current and voltage levels for the batteries were displayed on the chargers and confirmed in the lab with a multimeter.

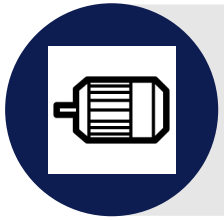
•While utilizing the batteries to test the motors, the commercial hall sensor was used to ensure no overvoltage or overcurrent situations occurred.

•Motor testing was done at no-load conditions as the vehicle is not yet ready to accept the motors.

•Each LED strip was measured in the lab using a multimeter to verify current draw.

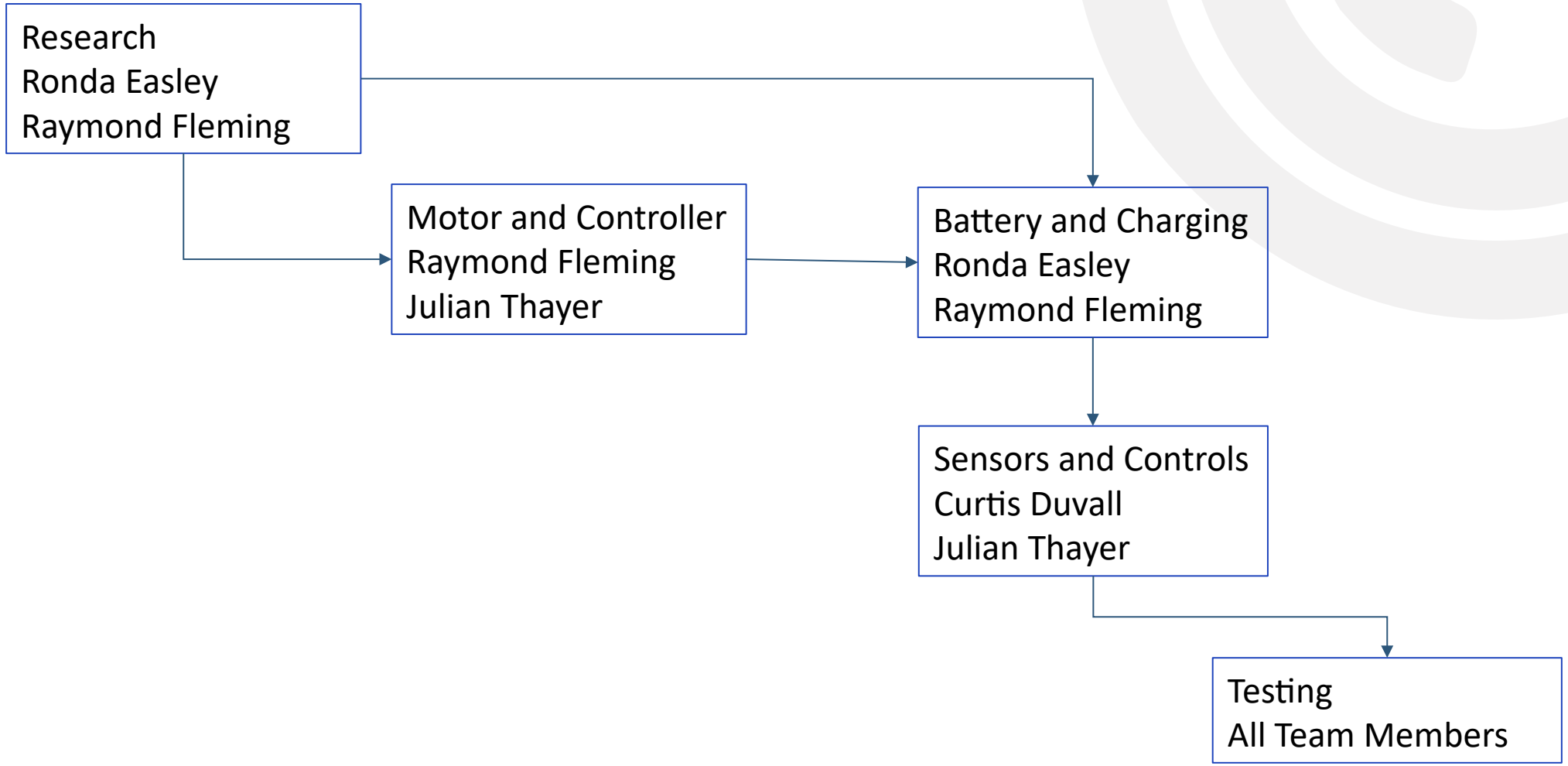
•Circuits with 555 timers were initially used to control the blinker sequences but were changed to commercial relays during testing. This is the method being used by other solar racing teams.

•During testing, the horn was found to have a higher current draw than noted on the materials sheet. This was verified with a multimeter and was fused accordingly.



## LIGHTING AND HORN

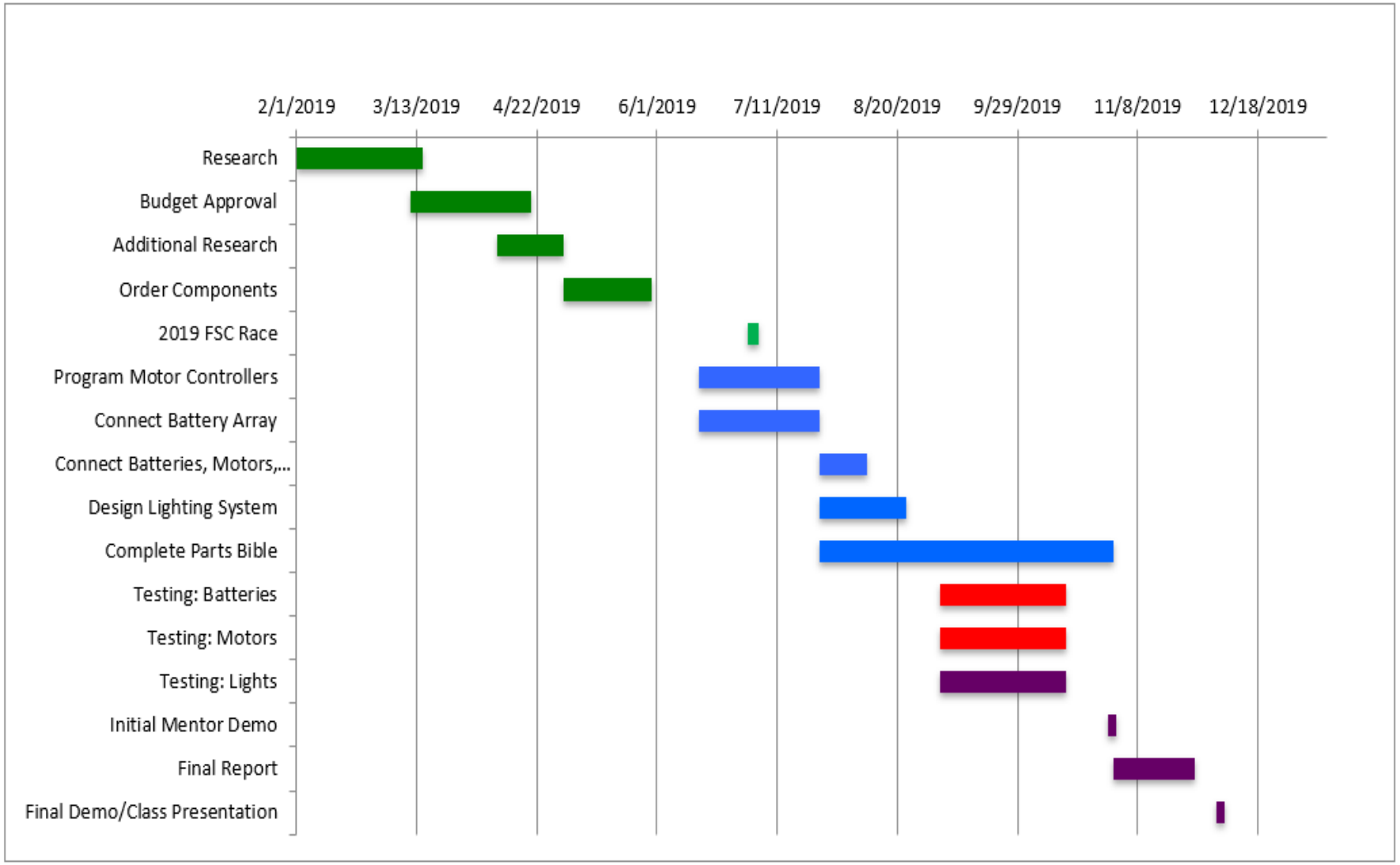
# SYSTEM BLOCK DIAGRAM



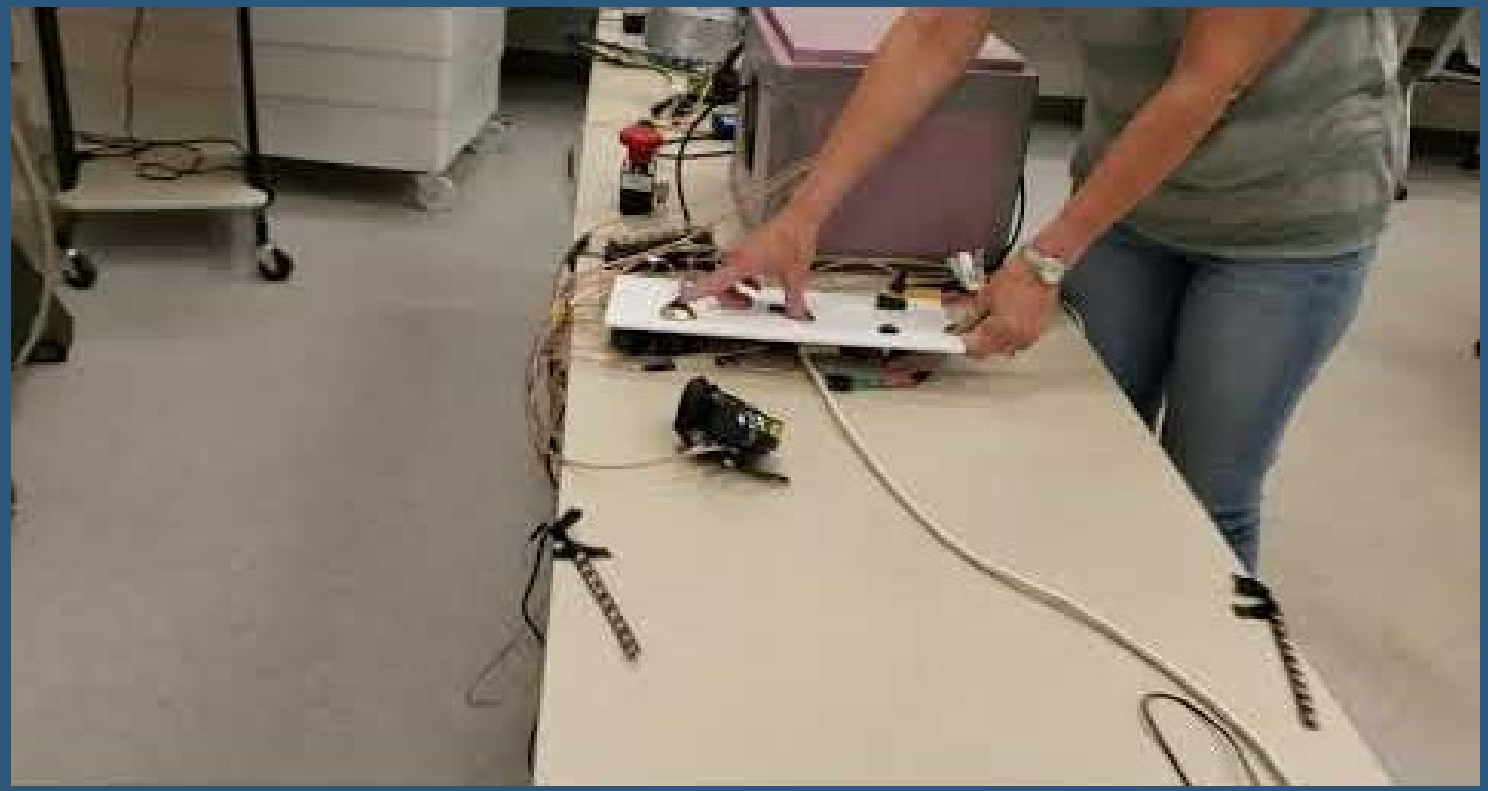
# BUDGET

| Item | Initial Budget | Actual Expense | Description |
|---|---|---|---|
| Primary Batteries | $594.00 | $918.23 | 12 Turnigy Heavy Duty 5000mAh 6S2P and battery charger |
| Motors | $178.65 | $766.00 | 2 Golden Motors HPM3000B 48V/3kW |
| Motor Controllers | $269.00 | $795.00 | 2 Golden Motors VEC200 Controllers and harnesses |
| Battery Protection Components | $189.85 | $183.00 | Battery Protection Box, Cooling, Emergency Shut-Off, Current and Voltage Sensor |
| Signals | $178.65 | $172.65 | Headlights, Turn Signals, Brake Lights, Switches, Connectors |
| Wire | $164.80 | $114.20 | 4/0 Gauge Welding Wire |
| Drive Components | $74.80 | $79.00 | Golden Motors throttle |
| Auxiliary Battery | $30.00 | $39.90 | 12V 18Ah Sealed Lead Acid Battery |
| **TOTAL** | **$1679.10** | **$3067.98** | |

# GANTT CHART


2/1/2019
3/13/2019
4/22/2019
6/1/2019
7/11/2019
8/20/2019
9/29/2019
11/8/2019
12/18/2019
Research
Budget Approval
Additional Research
Order Components
2019 FSC Race
Program Motor Controllers
Connect Battery Array
Connect Batteries, Motors,...
Design Lighting System
Complete Parts Bible
Testing: Batteries
Testing: Motors
Testing: Lights
Initial Mentor Demo
Final Report
Final Demo/Class Presentation

# VIDEO OF COMPLETED PROJECT



All Team Members

# QUESTIONS



All Team Members

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# THANK YOU

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