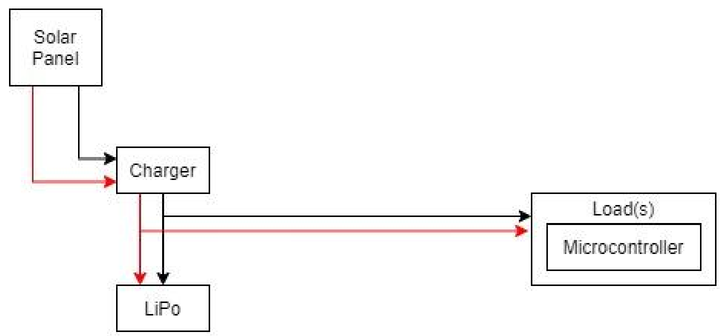
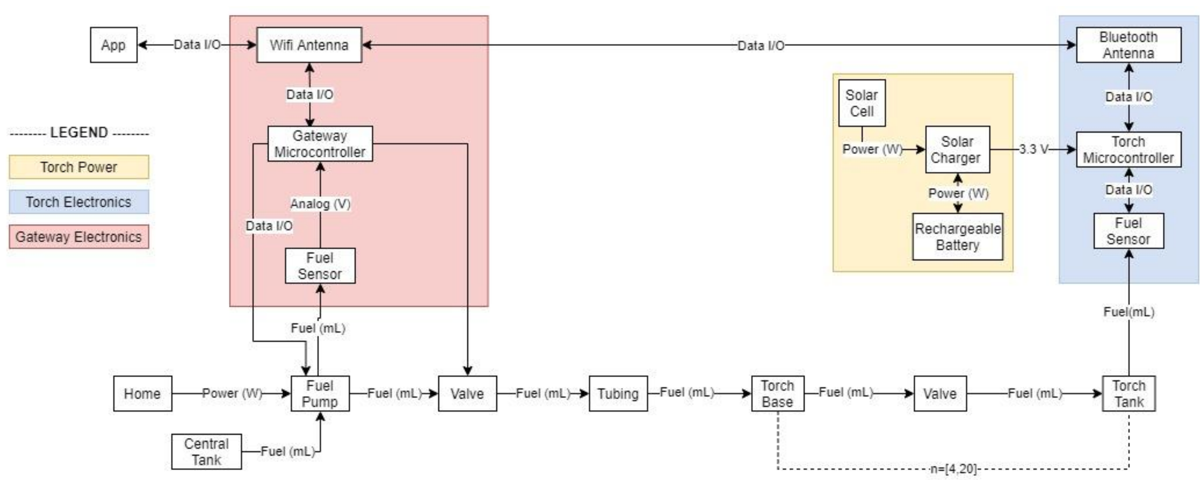
<table>
<tr><td colspan="2">Solar LiPo Charger</td></tr>
<tr><td>Objective/ Overview:</td><td>The objective of the solar subsystem is to adequately provide power to the microcontroller for the individual torch. The microcontroller will collect data from the capacitive level sensor and send it to the base station microcontroller when necessary. Also, the solar panel assembly helps eliminate a variety of risks associated with using wires such as complex consumer assembly and lost of electrical connection due wire damage in the BugTorch system.</td></tr>
<tr><td>Basic Schematic:</td><td>

The above diagram outlines the basic flow of energy with the solar subsystem in the BugTorch system. Energy is captured by UV light from the sun and transferred to a LiPo battery charger. The charger can charge a battery in the event there is not sufficient light to power the circuit on its own. As shown in the diagram below, the microcontroller needs power in order to support the individual torch and communicate with the gateway microcontroller of the BugTorch system to integrate the whole system together.</td></tr>
<tr><td colspan="2">
</td></tr>
<tr><td>Testing Methods:</td><td>Initial testing of the solar subsystem indicated that the voltage regulator needed to be removed from the circuit. The internet of the voltage regulator was to ensure a steady voltage of 3.3V would be supplied to the</td></tr>
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microcontroller based on the power generated by the solar panels. Electrical measurements were taken before and after the voltage regulator circuit during a nice sunny morning. Data was collected every hour starting at 9:30am. The results from that day are displayed below.

	VDC at			
Time of Day	LiPo Charger(V)	ESP32(V)	Solar Panel Coverage	connect to ESP32?
10/20/2021 9:30:00 AM	3.06	2.22	some shade from tree shadow	No
10/20/2021 10:30:00 AM	3.15	2.33	full sun/no coverage	No
10/20/2021 11:30:00 AM	3.28	2.46	full sun/no coverage	No
10/20/2021 12:30:00 PM	3.38	2.56	full sun	No
10/20/2021 1:30:00 AM	3.41	2.58	full sun but partly cloudy skies	No

The ESP32 microcontroller would not turn on because the voltage supplied was too low, thus justifying the removal of the regulator.

Further testing indicated that the low voltage may not have been a direct result of the voltage regulator but an issue with the charging and discharging of the battery. After integrating several of the other subsystems to construct a single torch, the torch was taken outside to test. During test set-up, we immediately saw the green LED on the LiPo charger light up signaling power was being generated from the solar panels. After several seconds the red LED turned on indicating the LiPo battery was charging. Several seconds after that, the red LED on the ESP32 was turned on. Both red LED were dim and flickers compared to when a constant voltage source was applied such as voltage from a computer when programming the ESP32. Voltage measurements were taken using a multimeter at the output pins of the LiPo charger and the input pins on the ESP32 to understand why the LEDs were flickering. At both locations, a reading of approximately 3.0V was recorded, however, the reading was very unstable. Next a reading at the solar panel input leads were taken and record to be approximately 5V which was significantly higher.

Issues/Solutions:

Reasoning for the dramatic difference described in the section above may be attributed to the battery not being able to charge simultaneously with trying to power up the ESP32. This remains an outstanding item to tackle before the individual torch can work seamlessly on its own.

With our limited knowledge in battery power the team overlooked the simple fact that a LiPO battery cannot charge and discharge at the same time which caused the microcontroller when exposed to sunlight to receive less than the expected voltage to function.

Future Areas of

To remedy these issues the team has drafted a few solutions. The easiest

Exploration:	is to search for a charger with a timing circuit that allows the battery to charge while the system is inactive but will allow proper discharge when inactive. Another solution is something similar to a car's lead acid battery and alternator but this system could end up being too complex and should be avoided. The most recent thought would be to separate a single solar panel from the charging circuit to control the enable pin on the solar charger PCB.