

Solar Team

Experimental Results and Discussion

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Activity Report

1 EXPERIMENTAL DESIGN

- **Research Question:** The Research question we are looking into is the reliability and efficiency of PV(Photo-voltaic) cells to power and move 1/16 scale solar car and its peripherals.
- **Data/Variables:** We have been collecting Voltage, current and subsequent power data to and from the on board battery, solar-array and motors from the solar car. This data is relevant to the project because we can quantify the cars efficiency in different testing conditions as well the effect that adding components has on the cars overall performance. The testing location is the independent variables for these tests, while the testing conditions E.g. the weather, sun angle and such are the dependant variables that will effect the voltage, current and power production and consumption of the solar car.
- **Experimental Uses:** As we are early in our testing, the data that we have begun to collect is helpful as it is reinforcing our understanding of solar cells and we can begin to quantify the work that we have been doing throughout these last two semesters. These tests and the deliberate variations that we have crafted help to illustrate the the battery systems on the car and how they aid the system in less than optimal light conditions. On top of this, we have been able to quantify shortcomings in our design, like cell shading, that arises from PV cells being connecting in series and the

overall power production limitations that cell shading has on the overall panel.

- **Bias:** We are reducing bias and error in our data by calibrating the sensor array for every test and keeping our independent variables stable.

2 RESULTS

We collected the voltage and current through the Solar panels, the Battery and the Motor. We then used this data to get the power across all three different units of our solar car. This measured power was then plotted on a chart for visual demonstration.

3 DISCUSSION

Our results from the data allowed us to see what was going on with the power in the system. The power the panels and battery were providing for the system and how much power the motor was drawing. Also depending on the sun intensity and battery level what the load was drawing. From the tests, we were able to confirm that the charge controller should be upgraded to a more custom device.

3.1 Limitations & Future Work

The solar car testing due to weather and season constraints was done inside with three large halogen lamps. The tests were sufficient to test very basic functionality of panels producing and delivering power directly to motor. During the second phase additional systems such as the micro-controller, esp (electronic speed

TIME	Panel V	Battery V	Motor V	Panel I	Battery I	Motor I	Panel P	Battery P	Motor P
17:14:15.32	7.83	6.77	6.38	4.40	2.12	4.58	34.43	14.36	29.23
17:14:10.31	7.81	6.86	6.32	4.41	0.23	7.25	34.46	1.56	45.82
17:14:05.30	7.78	6.94	6.25	4.50	0.03	7.74	35.05	0.22	48.38
17:14:00.29	8.28	5.43	7.64	4.49	1.18	6.13	37.17	6.43	46.84
17:13:55.28	7.51	7.32	6.56	4.46	0.13	7.79	33.49	0.96	51.08
17:13:50.27	8.14	5.83	7.23	4.38	0.98	6.59	35.67	5.74	47.65
17:13:45.26	7.11	7.4	5.95	3.91	1.22	8.62	27.78	9.06	51.26
17:13:40.26	8.02	6.69	6.3	4.50	0.03	7.48	36.13	0.19	47.12
17:13:35.24	7.88	7.09	6.51	4.49	0.13	7.46	35.37	0.93	48.60
17:13:30.23	7.72	6.86	6.16	4.54	0.13	7.34	35.02	0.87	45.23
17:13:25.23	8.56	8.07	2.85	4.54	0.33	6.54	38.83	2.64	18.65
17:13:20.22	8.56	8.43	0.02	4.54	2.14	4.66	38.83	18.05	0.09
17:12:50.97	7.62	7.15	6.62	4.55	2.11	7.99	34.68	15.05	52.87
17:12:45.96	8.38	5.59	7.27	4.50	0.77	6.70	37.75	4.28	48.69
17:12:40.95	7.04	7.2	5.69	4.50	0.37	7.86	31.71	2.67	44.75
17:12:35.94	8.19	6.11	7.72	4.27	1.10	6.53	35.01	6.75	50.41
17:12:30.94	7.4	6.85	5.82	4.50	0.51	8.23	33.34	3.47	47.91
17:12:25.92	8.2	5.9	7.73	4.54	1.00	6.61	37.19	5.93	51.07
17:12:20.92	7.52	6.99	6.09	4.49	0.19	7.71	33.76	1.34	46.95
17:12:15.91	8.51	8.2	2.88	4.26	2.14	4.38	36.25	17.56	12.62
17:12:10.90	8.6	8.44	0.02	4.37	2.14	4.52	37.55	18.07	0.09
17:10:03.73	8.3	8.41	0.02	4.06	2.08	4.57	33.70	17.51	0.09
17:09:56.19	8.65	8.38	0.02	4.09	2.14	4.58	35.39	17.94	0.09
17:09:48.34	7.04	7.7	6.24	4.18	2.12	4.63	29.45	16.34	28.87
17:09:43.34	8.44	5.98	7.3	4.40	0.77	6.47	37.11	4.58	47.22
17:09:38.33	8.3	6.59	4.58	4.47	0.90	8.58	37.13	5.96	39.32
17:09:33.32	8.02	6.98	6.54	4.41	0.21	7.56	35.39	1.48	49.42
17:09:28.31	7.93	6.65	6.46	4.46	0.13	7.19	35.36	0.85	46.44
17:09:23.30	8.31	6.01	7.78	4.47	1.16	6.22	37.18	7.00	48.41
17:09:18.29	7.86	7.19	6.43	4.49	0.17	7.77	35.28	1.23	49.97
17:09:13.28	8.62	8.3	2.55	4.66	2.12	4.84	40.15	17.61	12.35

Figure 1. Data

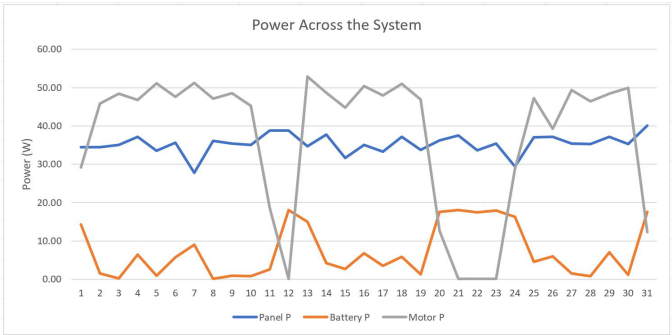


Figure 2. Power Across the System

controller), battery, and charge controller were added. Testing done indoors was not enough to produce accurate results. This resulted in having to rely on good weather to collect accurate results. After testing several times and it was very obvious that our PWM (Pulse-Width Modulation) charge controller was a great initial unit. However, not being able to be adjust some parameters was hindering our capability to fully test our power production limitations. Which leads to a conclusion that for a unique project like this one, we would need to design our own custom charge controller; It will allow us to adjust certain parameters according to our exact specifications and test the true limitations.

Future Work:

- **Custom Charge Controller:** This will allow us to control where the power goes depending on some set criteria.
- **Fix Solar Cells:** Attach the cells to a more permanent surface as well as fixing the cell shading issue by adding bypass diodes.
- **Front wheels:** Front wheels will eliminate the large resistance of the rollers and help to move in a more in a straight line.
- **Additional motor:** One motor connected to each wheel will allow the car to control the direction it moves. This allows for more complex testing conditions.

4 CONCLUSION

The objective of this project was to build and explore the possibility of utilizing PV cells as a source of power for a 1/16 scale care. Using our solar array, we managed to gather solar energy and deliver the energy to our motor that allows our car to move. Along with these initial installments, we installed a speed controller to restrict some of the power going into the motor so that we did not overwork it, added a custom made battery, as well as a charge controller to manage the power from solar panels. The progress made to this project has been incredible for it being the first year; the groups that follow will have quite a few challenges to overcome to complete and surpass the initial ideas for this system but the result will be exciting to see.