The Solar Team (Physical Design)

Richard Centore, David Sagan, Usman Rehman, Noah Peretzman

Activity Report

1 Proposed Solution

As the solar team we are attempting to make an efficient solar powered car that can travel some distance on solar power alone. During the analysis phase we researched different systems that would be necessary to create an efficient car including the power production system, the power storage system, the power storage system, the powered motion system and the chassis. To solve this problem, we have propose a solution regarding a large(1/10) scale car that has solar panels capable of tracking the sun to allow for maximum solar power generation at all times of the day and year. In this first iteration of the physical design we will forgo the tracking capabilities in order properly build and test the other primary systems.

2 Physical Design

The physical design constraints consist of physical components that will satisfy the acceptance criteria in the logical design requirements.

2.1 System Architecture

When implementing the proposed solution the solar car will be built from the chassis up as all other pieces will be integrated to the chassis. The power production for the solar car will be from a sun power 50 watt solar panel. This solar panel will feed into the battery pack as well as the micro controller for monitoring the output power of the solar panel. From the battery a physical switch will be used to turn the motors on and off to allow for stationary

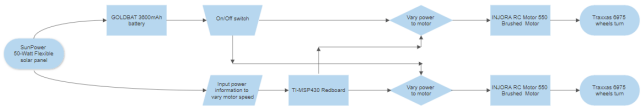

Figure 1. Solar car System Architecture Diagram.

long term charging of the solar car. After the physical switch both the micro controller and the battery will feed into a variable switch that will allow the micro controller to dictate the amount of power that can be drawn by the motors for most efficient use of the power produced by the solar panel. With the variable switch dictating the power, the motors will rotate and move the solar car via the wheels.

2.2 System Components

The physical design components of our solar car are as follows:

2.2.1 Solar Panel

The solar panel is a SunPower 50-Watt Flexible Mono-crystalline High Efficiency Solar Panel. It has a rated voltage (Vmpp) of 17.6V and a rated current (Impp) of 2.80A. The dimensions of the panel are 25.5 x 21.9 x 0.8 inches.

2.2.2 Battery

The battery is a V25 battery pack from voltaic systems, it is a voltaic battery that allows us to charge the battery at the same time as we are powering the load. The power input is rated

6v/2A which is sufficient for the solar panel to produce. The output is rated 5V/2A with 3A max which will be enough power for the motors demand.

2.2.3 Motor

The motor we selected for the car is the INJORA RC Motor 550 Brushed Waterproof Motor. This motor satisfies the torque requirements we calculated for a car of the relative size that we are building and the max efficiency falls inline with the max current the battery is able to supply. This is good as we are looking to increase efficiency the most, and we do not need to use the motors any more than when they are at peak efficiency. For this car we will use two motors that will each power a front wheel on the chassis.

2.2.4 Micro-controller

The micro-controller is a Texas Instruments Launch-Pad (MSP-EXP432P401R). This micro-controller is great for low power consumption. It offers a lot of capability with additional module add-on options.

2.2.5 Wheels

The wheels we chose Traxxas 6975 these are a 3inch tall wheel with a width of .31" this is useful for us as a thinner wheel produces less drag and will allow the motors to run more efficiently. The height of 3 inch's gives us a ride height for the solar car that will allow it go over small bumps, without compromising the stability of the car.

2.2.6 Chassis

The Chassis we chose for the solar car will simply be a sturdy board of cardboard roughly the size of the solar panel. This material and size was chosen to decrease the weight of the car but also allow for a sturdy enough chassis to support all of the desired features.

2.2.7 Switch

A physical switch will be integrated between the battery and the motors to stop the battery from powering the loads. This will allow for long term charging from the sun.

2.2.8 digital potentiometer

A digital potentiometer will be used to vary the power being supplied to the motors. The potentiometer will allow the micro controller to throttle back the motors when the solar pane is producing low power and give more when the solar panel is producing enough to sustain higher power draw.

2.3 Engineering Standards

We will be concentrating on IEEE standards. IEEE (Institute of Electrical and Electronics Engineers) is the worlds largest technical professional organization for the advancement of technology. It has over 1300 standards, that are used by engineers throughout the world. These standards help modernize our world while helping maintain a safe standard.

2.3.1 1526-2020 - IEEE Recommended Practice for Testing the Performance of Stand-Alone Photovoltaic Systems [1]

This standard is a revised version of IEEE Std 1526-2003. This standard is used as a testing mechanism to determine how a photovoltaic (PV) solar system performs under varying conditions. It uses simulated tests and real test data to determine the efficiency of a PV panel. We will use this standard to determine what PV panel would be best for our project.

2.3.2 1562-2007 - IEEE Guide for Array and Battery Sizing in Stand-Alone Photovoltaic (PV) Systems [2]

This standard was Approved on 5 December 2007. It is a standard that allows you to determine what PV panels will work best with what battery size. We will use this standard to determine what PV panel size works best with what size and type of battery. This standard will allow us to come up with an efficient design for our solar car by proportionally sizing our PV panel and the battery.

3 Ethical Concerns

The ethical concerns with using solar energy are felt more on the global level than on smaller scale. Most ethical concerns with projects have

to deal with aspects such as privacy concerns security concerns. For this project, the ethical concerns delve more into human and environmental impact.

One of the main components of solar power is a form of silicon called polysilicon, which is mainly found in the Xinjiang province in China, producing 45 percent of the worlds supply. the Xinjiang province is also where the Chinese government has been accused of genocidal acts against different ethnic groups; in addition to this, while their government has denied these claims, it has been said that the Chinese government is forcing these ethnic groups to mine polysilicon. [3] Regardless on whether that particular piece of information is true or not the reality is that unsafe working conditions exist for the people that are collecting these materials.

While solar energy is being used to relieve our dependence on fossil fuels, the gathering of materials in order to build the solar panels as well as the disposal of dead and broken solar panels can have a negative impact on the environment. A large amount of Tellurium has been discovered at the bottom of the Atlantic Ocean. Tellurium is used in the creation of some solar cells so this large deposit is a great find for the solar energy community, the fact that it is at the bottom of the ocean has cause for concern since we need to drill into the ocean floor in order to get it; this raises the chance of disrupting the ecosystem in the area of drilling as well as polluting the area from the machines. The question here becomes is it worth it to drill to the bottom of the ocean for the Tellurium at the risk of polluting the ocean? [4]

After the solar panels are already built, they have a life expectancy of about 25 to 30 years. After this amount of time, the panels need to be replaced. However, there are issues with dealing with these panels once they die or if they are damaged due to storms or other factors. The European Union has rules in place in order to have solar panels recycled but the U.S. does not have similar standards. [5] Due to this, while some places will deal with defunct solar panels properly, it is not a guarantee that panels will always be dealt with appropriately.

REFERENCES

[1] "Ieee recommended practice for testing the performance of stand-alone photovoltaic systems," *IEEE Std 1526-2020 (Revision of IEEE Std 1526-2003)*, pp. 1–32, 2021.
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[3] J. Gudmundsen, "There are ethical concerns surrounding solar energy."
[4] J. Major, "Deep sea mining could help develop mass solar energy – is it worth the risk?"
[5] V. Taylor, "The ethics of solar power are more complicated than you think."