Author: Maximillian Burrell

Team: Smart Park

WSUID: Z749D638

ECE595 SDP2

Smart Park Power Solution(s)

Smart Park has tested a few different power options for the product to function and operate. The ultimate solution is a long-lasting battery, that can be charged through solar panels, for energy consumption specifications required for the unit(s). Those specifications will be listed below, along with descriptions, for a better understanding of what our future goal is. I have narrowed down the required components, for our energy needs, to a few possible solutions to use a permanent means to build into the Smart Park devices.

**Advantages and general description**

* A Lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its form. This is the power solution for the Smart Park system.
  + They have one of the best rated and highest energy densities of any battery technology today.
  + Can deliver up to 3.7 volts, 3 times higher than tech such as Ni-Cd or Ni-MH batteries.
  + Can deliver large amounts of current for possible high-power applications.
  + Low maintenance and do not require scheduled cycling/checking to maintain their life expectancy
  + The lithium ions are small enough to be able to move through a micro-permeable separator between the anode and cathode.
    - Due to lithium’s small size (third only to hydrogen and helium), Li-ion batteries can have a very high voltage and charge storage per unit mass and unit volume.
* Li-ion batteries can use several different materials as electrodes. The most common combination is that of lithium cobalt oxide (cathode) and graphite (anode),
  + Most common in portable electronic devices such as cellphones and laptops.
* Other cathode materials include lithium manganese oxide (used in hybrid electric and electric automobiles) and lithium iron phosphate. Li-ion batteries typically use ether (a class of organic compounds) as an electrolyte.
* Have no memory effect, a unfavorable process where frequent partial charge/discharge cycles can cause a battery to recall a lower capacity.
  + An advantage over Ni-Cd and Ni-MH which display this affect
* They have low self-discharge rate and they do not contain toxic materials, such as cadmium, which makes them easier to dispose/recycle compared to older battery technologies.
  + Due to these advantages, Li-ion batteries have displaced Ni-Cd batteries as the market leader in portable electronic devices.

**Disadvantages**

* Li-ion batteries still have various flaws, particularly with respects to safety.
  + They tend to overheat and can be damaged at high voltages.
  + They are also subject to aging.
    - They can lose capacity and frequently fail after many years.
  + Their cost is also a factor limiting their widespread adoption in applications
    - which is around 40% higher than Ni-Cd, focusing on these issues is a key component for current research into the technology.
  + Despite the high energy density of Li-ion compared to other kinds of batteries, they are still around a hundred times less energy dense than energy solutions such as gasoline.

**Charging The Batteries**

* Mini solar panels provide a source of renewable energy; as such, they offer an alternative to energy sources that have environmental costs, such as the emission of greenhouse gases.
* Although mini solar panels might prove expensive to purchase, solar energy saves money on power bills over the long run because there is no cost for the sunlight that they use to generate power.
* Mini solar panels are versatile power sources for smaller devices that do not have robust energy needs.
  + i.e., radios, cameras, flashlights, and watches.
  + Some applications, such as in cell phones and laptops, combine mini solar panels with [batteries](https://www.walmart.com/browse/household-essentials/batteries/1115193_1076905).
    - This is what we are doing with Smart Park
* Mini solar panels absorb power from the sun that they distribute to the [batteries](https://www.walmart.com/browse/household-essentials/batteries/1115193_1076905), recharging them so that they can continue to operate the devices.
  + Mini solar panels do not generate enough power to operate devices that require a great deal of energy, such as [desktop computers](https://www.walmart.com/search/?query=desktop%20computers).
  + For many small devices, such as laptop computers, mini solar panels are not yet reliable as a sole energy source but need to work along with a battery.
  + Power interruptions are common in devices with mini solar panels because overcast days can cut off access to the sun.

**Below are Alex Chiem’s notes of what’s nominal and ideal for our product (last semester’s information):**

Basic Tech Details about the battery:

***Nominal Capacity***

* + ***Minimum: 9500mAh***
  + ***Typical: 10050mAh Standard discharge （0.2C) after Standard charge***
* ***Nominal Voltage 3.7V***
* ***Charging Cut-off Voltage 4.2V***
* ***Discharge Cut-off Voltage 2.5V***
* ***Standard Charge***
  + ***Constant Current 0.2C***
  + ***Constant Voltage 4.2V 0.01 C cut-off***
  + ***Charge Time : Approx 8.0h***
* ***Maximum Constant Charging Current 3000mA***
* ***Standard Discharge Discharge at 0.2 C to 2.5V***
* ***Maximum Continuous Discharging Current 3000mA***
* ***Operating Temperature Charge 0～45℃***
* ***Discharge –20～60℃***
* ***Storage Temperature -20～45℃ for 1Month -10～35℃ for 6Months***
* ***Storage Voltage 3.7-3.85V***

***Product Dimensions: 66.6mm x 55.3mm x 18.7mm / 2.6" x 2.2" x 0.7"***

***Product Weight: 148.0g / 5.2oz***

**Now, these are the solutions, I have narrowed down, that are within range of what we need:**

1. <https://www.alibaba.com/product-detail/43100150-rechargeable-9200mah-lithium-polymer-strong_62174539940.html?spm=a2700.9099375.35.9.YJ6Luc>
   1. Graphical user interface, table

      Description automatically generated
2. <https://www.ebay.com/itm/353373010717?chn=ps&norover=1&mkevt=1&mkrid=711-117182-37290-0&mkcid=2&itemid=353373010717&targetid=1595005180456&device=c&mktype=&googleloc=9024165&poi=&campaignid=15434774774&mkgroupid=128740808805&rlsatarget=pla-1595005180456&abcId=9300764&merchantid=459465594&gclid=Cj0KCQiA3-yQBhD3ARIsAHuHT65PkO7MalgMYm9CijvdP-8zvCXQs6L--VdkqI08vJ6WXBEndR0fdisaAq_KEALw_wcB>
   1. Text

      Description automatically generated with medium confidence
3. <https://www.aliexpress.com/item/32996520669.html?spm=a2g0o.search0302.0.0.3daf6662CEiQWD&algo_pvid=c078aae7-a42d-451e-84dc-a72ac89ed64c&algo_exp_id=c078aae7-a42d-451e-84dc-a72ac89ed64c-11>
   1. Graphical user interface, text, application

      Description automatically generated
4. <https://www.alibaba.com/product-detail/high-capacity-lithium-ion-polymer-btattery_62513205813.html>
   1. **Best Option**
   2. Table

      Description automatically generated
5. <https://www.aliexpress.com/item/1005001659178583.html?spm=a2g0o.search0302.0.0.3daf6662CEiQWD&algo_pvid=c078aae7-a42d-451e-84dc-a72ac89ed64c&algo_exp_id=c078aae7-a42d-451e-84dc-a72ac89ed64c-3>
   1. **Second Best Option**
   2. Text

      Description automatically generated

References

1. *Lithium-Ion Battery*. Clean Energy Institute. (2020, September 25). Retrieved February 27, 2022, from http://www.cei.washington.edu/education/science-of-solar/battery-technology/
2. Gresham, T. (2020, November 17). *What is a mini solar panel?* Home Guides | SF Gate. Retrieved February 27, 2022, from https://homeguides.sfgate.com/mini-solar-panel-79615.html