Homeland Defense & Security
Information Analysis Center

Technical Inquiry 2018-4673

Developed by:
HDIAC
104 Union Valley Rd
Oak Ridge, TN 37830

HDIAC Contract Number:
FA8075-13-D-0001

Distribution A
Distribution Unlimited:
Approved for public release

This inquiry response is the result of four hours of research and analysis by HDIAC. This report is intended solely for informational purposes and is a cursory review and analysis of information available at the approved distribution level for each customer. This report is not to be construed as a comprehensive look at the topic in question. For more information on utilizing HDIAC for a more in-depth Core Analysis Task, visit www.hdiac.org.

Overview

A member of Cochise County Sheriff's Office (AZ) requested information regarding novel recharging systems or batteries with longer life expectancy. This information will support the development of a new power-supply system capable of extending the functional usage of their field cameras beyond the existing timeframe of approximately three to six months.

Findings

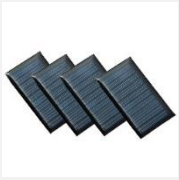
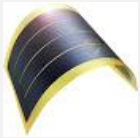
HDIAC identified several options for self-charging systems and longer-duration batteries. HDIAC found that the best approach is to exchange the current Lead-Acid batteries for Lithium-Ion (Li-Ion) batteries of a similar size and charge capacity. Several HDIAC Subject Matter Experts (SMEs) confirmed this as the best approach, and HDIAC analysts could not identify any technical reason prohibiting the integration of existing field camera systems with Li-Ion batteries.

However, because this approach would potentially require a new battery/field camera system vendor, an alternative approach is provided. For a short-term solution, HDIAC recommends the integration of a solar cell (as opposed to a solar panel) in order to increase the life of current Lead-Acid batteries by as much as 30 percent.

Solar Cells

To extend the existing Lead-Acid battery (UB1290), a solar cell energy harvester is the recommended option. These are similar to solar panels, which utilize thermal and light energy to charge a battery. However, these solar cells are extremely thin, highly pliable, and much less reflective.

A smartphone-sized solar cell fitted to the top of a UB1290 receiving 75 percent of sun light during the course of a day would lengthen a battery's life by 20-30 percent. This would push the life expectancy of each unit up to almost eight months from six months. However, larger solar cell units could achieve greater solar energy collection and, as a result, greater battery life extension. HDIAC SMEs from Missouri University of Science and Technology highly recommended this solution [1-3].

Product Image	Product Name	Cost Estimate	Description
 [4]	Micro Mini Solar Panel Cells	$8	3.6V Solar cell charger, wires to connect to battery are not included. Likely battery life extension: 15-20 percent [1, 2]
 [5]	Flexible Solar Panel Mini Thin Film Solar Cell Battery Charger	$15	2V .5W Solar Cell charger, wires to connect to a battery are not included. Likely battery life extension: 10-15 percent [1, 2]
 [6]	Flexible Solar Panel Solar Power Charger Thin Film	$35	6V 1W Solar Cell charger, wires to connect to a battery are not included. Likely battery life extension: 20-30 percent [1, 2]

These solar cells are relatively affordable and easy to install on the battery itself. Also, it is likely that vendors would be able to assist in mitigating the color and reflective traits of their solar cells to improve

Distribution A:
Distribution Unlimited: Approved for public release

concealability. The solar cell would need relatively low obstruction above it (branches, bushes) in order to collect an adequate amount of sunlight.

Radio Frequency Harvesting

This technology harvests energy from radio frequencies (RF) ranging from 3 kHz to 300 GHz (frequency of camera data transfer falls inside this range), and can harvest the energy from ambient RF or active RF. However, the amount of energy that can be harvested depends on proximity of RF source, wavelength, transmit power, and harvesting system. Because of these factors, energy collected in remote areas may be small. RF energy harvesters also require additional antennas, RF to DC converters, and DC power management circuity in order to operate. However, these additions are minor and can be easily concealed. Due to how each camera communicates with one another, a specific camera's communication could contribute to trickle-charge another camera's battery [3, 7].

Li-Ion Batteries

Should a new battery type be required, Li-Ion batteries represent the best solution. Li-Ion batteries (solid state and flow battery variations) are employed throughout government and private sectors for scenarios requiring sustained power. HDIAC SMEs highly recommend the use of Li-Ion batteries over current Lead-Acid batteries, as these batteries' life expectancy is two to three times longer. Additionally, Li-Ion batteries are available in similar dimensions to the existing UB1290s, allowing for similar concealment options. Finally, the inclusion of a solar cell charging panel into a Li-Ion battery could see the lifetime of these larger capacity batteries extended by an additional 20-30 percent [1, 2, 8, 9].

Product Image	Product Name	Cost Estimate	Details
 [10]	YTZ7S Sealed Powersports	$80	12V Li-Ion battery. Likely battery life 9-18 months [2]
 [11]	Featherweight Lithium Battery HJTZ7S-FP-IL	$75	12V Li-Ion battery. Likely battery life 9-18 months [2]
 [12]	ATZ-7-RS Re-Start	$120	13V Li-Ion battery. Likely battery life is 10-19 months [2]

Conclusion

HDIAC identified multiple options for enhancing a battery's life expectancy while maintaining concealability. These include both self-charging systems and the implementation of higher-capacity batteries. For a short-term solution, HDIAC recommends the use of a solar cell charger. A solar cell charging system is relatively concealable, and can allow for up to 30 percent battery life extension. A longer-term solution, as recommended by HDIAC SMEs, is a Li-Ion battery, due to its larger charge capacity and energy density

Distribution A:
Distribution Unlimited: Approved for public release

over a Lead-Acid battery, coupled with a solar cell panel for extended life expectancy. Again, HDIAC found no technical reason as to why a Lithium battery could not be used with current camera systems, as the physical parameters and energy output is comparable to the existing UB1290.

We request your feedback on this Inquiry: https://www.hdiac.org/new-inquiry-assessment-form/

References

1. Park, J., (2019, April 1). Alternative battery solutions [E-mail]

2. Li, J., (2019, April 1). Alternative battery solutions [E-mail]

3. Preauzek, M., Konecny, J., Borova, M., Janosova, K., Hlavica, J., Musilek, P. (2018, July 27) Energy Harvesting Sources, Storage Devices and System Topologies for Environmental Wireless Sensor Networks: Review (HDIAC-216140). Perf Org: Technical University of Ostrava.

4. Nuzamas. [NUZAMAS 5V 30mA 53X30mm Micro Mini Solar Panel Cells for Solar Power Energy] Retrieved from: https://www.amazon.com/Pieces-NUZAMAS-53X30mm-Science-Projects/dp/B06ZZCV99D/ref=sr_1_24?keywords=Thin+solar+cell&qid=1554314415&s=lawn-garden&sr=1-24

5. Nuzamas. [NUZAMAS Flexible Solar Panel Mini Thin Film Solar Cell Battery Charger] Retrieved from: https://www.amazon.com/NUZAMAS-Flexible-Battery-Charging-Projects/dp/B07D289CJG/ref=asc_df_B07D289CJG/?tag=hyprod-20&linkCode=df0&hvadid=241942867107&hvpos=1o15&hvnetw=g&hvrand=17628513344577046109&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9013403&hvtargid=pla-485893363174&psc=1

6. Jiang. [Flexible Solar Panel Solar Power Charger Thin Film] Retrieved from: https://express.google.com/u/0/product/3629349547929284610_16159287220917570094_7695788?utm_source=google_shopping&utm_medium=tu_prop&utm_content=eid-lsjeuxoegt%2Ceid-vqiqlmovzs&gtim=CISCqZr5qey02gEQ6JeaxrWm1s1bGODd0A8iA1VTRCjgiqPmBTCs29UD&utm_campaign=7695788&gclid=EAIaIQobChMI7si6kLq04QIVDZyzCh3IBQLQEAkYASABEgI0rvD_BwE

7. Lu, X., Wang, P., Niyato, D., Kim, D., Han, Z. (2014, September 5) Wireless Networks with RF Energy Harvesting: A Contemporary Survey. *Scholarly Project*, Retrieved from: https://arxiv.org/pdf/1406.6470.pdf

8. Hutcheon, A., Campbell, J. (2018, September). Energy Storage Systems and Utility Cost Savings for DoD Installations. Thesis (HDIAC-216624). Perf. Org. Naval Postgraduate School.

9. Energy Storage Association, (2019). Energy Storage Technologies. Retrieved from: http://energystorage.org/energy-storage/energy-storage-technologies

10. MMG. [YTZ7S Lithium Ion Sealed Powersports Battery 12V Powerful 150CCA] Retrieved from: https://www.amazon.com/Powersports-Powerful-Activated-Motorcycles-Scooters/dp/B00CGNCNPY/ref=asc_df_B00CGNCNPY/?tag=hyprod-20&linkCode=df0&hvadid=312195936700&hvpos=1o1&hvnetw=g&hvrand=16498623926368603017&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9013403&hvtargid=pla-571077996137&psc=1#HLCXComparisonWidget_feature_div

11. FirePower [FirePower Featherweight Lithium Battery HJTZ7S-FP-IL] Retrieved from: https://www.amazon.com/dp/B00DX891FG/ref=psdc_404722011_t1_B00CGNCNPY

12. Antigravity Batteries [Antigravity ATZ-7-RS Lithium RE-START Battery] Retrieved from: https://www.amazon.com/dp/B079V1B82Y/ref=psdc_404722011_t3_B00CGNCNPY

Distribution A:
Distribution Unlimited: Approved for public release