Senior Design Project Report
Energy Harvesting and Storage

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1. Introduction

Energy harvesting is otherwise known as power harvesting or energy scavenging. It is the use of ambient energy to power small electronic or electrical devices. That means solar cells on satellites, heat powered sensors buried in engines, vibration harvesting for helicopter electronics and the wind- up radio or lantern. However, there are also several more esoteric options. Energy harvesting has reached a tipping point. This is because the necessary lower power electronics and more efficient energy gathering and storage are now sufficiently affordable, reliable and longer lived for a huge number of applications to be practicable. The first solar powered watches and phones have appeared. Some new photovoltaic technologies are printed reel to reel at low cost, the resulting film working off heat as well as light. However, there are further mountains to climb from self powered wireless sensors monitoring forest fires, pollution spillages and even inside the human body and in the concrete of buildings. These applications will become commonplace one day. Even devices with maintenance-free life of hundreds of years can now be envisaged. Meanwhile, bionic man containing maintenance free, self-powered devices for his lifetime is an objective for the next few years.
In this work our goal is to create a device that will be able to harvest different kinds of energy, store it and then our goal is to use that energy stored to power different devices when electricity is needed.

1.1. Literature Review & Previous Works

There are similar products, most of them use solar panels to provide energy. [1]The Renogy E.FLEX5 is a device for the off-grid traveler. With a water-resistant and durable exterior, this panel can be taken anywhere. It uses auto-optimization charging which allows for automatic continuous charging once back in sunlight. Charge any portable USB device with this power source.

[2]The bq25570 device is specifically designed to
• Battery Charging and Protection efficiently extract microwatts (μW) to milliwatts (mW) of power generated from a variety of high output impedance DC sources like

photovoltaic (solar) or thermal electric generators (TEG) without collapsing
• Battery Good Output Flag those sources. The battery management features ensure that a rechargeable battery is not overcharged by this extracted power, with voltage boosted, or depleted beyond safe limits by a system load. In Loss of Power addition to the highly efficient boosting charger, the bq25570 integrates a highly efficient, nano- power buck converter for providing a second power rail to systems such as wireless sensor networks (WSN) which have stringent power and operational (Buck) demands. All the capabilities of bq25570 are packed into a small foot-print 20-lead 3.5-mm x 3.5-mm QFN package (RGR).
The difference between all of these devices and our idea, is that we intend to use two different kinds of energies in a single device to provide power.

1.2. Problem Statement

Cell Phones and laptops are an important part of our society today, everywhere we go we need our cellphone to take pictures or record a video.
When people go hiking or camping, there is no electricity to charge cellphones, our idea is to create a device that will provide that electricity, but another problem is the sun. What if there is no sun on a particular day?

1.3. Methodology

Our team will solve the proposed problem by using two different types of energy, solar and thermal energy.

When there is a cloudy day, solar energy harvesting is complicated, and if there is no harvest, there is no power to provide. Therefore our idea is to be able to switch between two energy harvesters and use the more convenient for specific situations.

1.4. Challenges

There are several challenges in our project but the main one is to combine two kinds of harvesters in a single device.

1.5. Marketing Requirements (MR) –

- MR.1- The device will be portable
- MR.2- The device will have storage to provide energy for 5 hours
- MR.3- The device will have dimensions of 12x12 in.
- MR.4- The device will visualize the received data so the user can see the device's performance on a daily basis.

1.7. Engineering Requirements (ER) -

- ER.1- Solar Panel Surface Material: ETFE Laminated
- ER.2- The system will use a Raspberry Pi 3 Model B+ to control the microcontroller.
- ER.3 – The device will have a Cell Efficiency of 22%
- ER.4- The device will use a switch to change the harvester used.
- ER.5- Cell Type: Monocrystalline
- ER.6- Device will have a BQ25570 thermal harvester.

References

[1]Port, R. (2017). *Renogy E.FLEX5 Portable Solar Panel with USB Port*. [online] Renogy. Available at: https://www.renogy.com/renogy-e-flex5-portable-solar-panel-with-usb-port [Accessed 27 Sep. 2017].

[2]Anon, (2017). [online] Available at: http://www.ti.com/lit/ds/slusbh2e/slusbh2e.pdf [Accessed 27 Sep. 2017].