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## solar-powered raspberry pi with fast e-ink refresh display

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solarlaptop  
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**Posts:** 2

**Joined:** Wed Oct 31, 2012 3:25 pm

### solar-powered raspberry pi with fast e-ink refresh display

Wed Oct 31, 2012 5:03 pm

Hi, I'm looking to assemble a prototype for a modular, but clean-designed solar laptop. About a year ago I researched online for the latest advancements on components available to purchase and wrote about it here:

[https://orjoules.wordpress.com/2011/10/ ... ar-laptop/](https://orjoules.wordpress.com/2011/10/...ar-laptop/) (<https://orjoules.wordpress.com/2011/10/04/theoretically-assembling-a-solar-laptop/>)

I decided to wait about a year before looking into it again to see if more recent advancements have been encouraging, and they are.

From what I've gathered, solar panels have already been made to power the Raspberry pi, using a 4watt panel with a 12V, 1.3amp charger here: <http://raspberrypi-projects.com/category/powering/solar/> (<http://raspberrypi-projects.com/category/powering/solar/>)  
<http://www.instructables.com/id/Solar-Powered-Raspberry-Pi/> (<http://www.instructables.com/id/Solar-Powered-Raspberry-Pi/>)  
An HDMI to LVDS adapter has been made by Chalkboard Electronics which allows connection to various LCD screens.  
[http://www.chalk-elec.com/?page\\_id=1280](http://www.chalk-elec.com/?page_id=1280) ([http://www.chalk-elec.com/?page\\_id=1280](http://www.chalk-elec.com/?page_id=1280))  
Low-powered E-ink/like displays, among dual-mode ones (B&W & Color), such as Pixel Qi, have kits that connect to LVDS, such as by TinCanTools: <http://tincantools.com/product.php?productid=16164&cat=256&page=1> (<http://tincantools.com/product.php?productid=16164&cat=256&page=1>)  
5W solar panels by Bootstrap solar, could be mounted on the backpanel of an e-ink screen, and use a mirror, like a fresnel concentrator (can be found in one of of Apple's patent applications)  
<http://www.bootstrapsolar.com/collections/related/products/5w-solar-panel> (<http://www.bootstrapsolar.com/collections/related/products/5w-solar-panel>)

So far the materials are quite costly (especially the low-powered display, although an e-ink display by Pearl would be interesting), and I'm seeing some costs/availabilities have improved since last year.

The costs so far:

Raspberry Pi: \$25

HDMI to LVDS adapter: \$35 from Chalkboard Electronics

Pixel Qi LCD to LVDS DIY kit: \$299 from TinCanTools; works with Pandaboard, not sure about R-pi

5W Solar Panel: \$31 from Bootstrap Solar

12V 7Ah Lithium Iron Phosphate Battery with BMS: \$139 from K2 Energy K2B12V7EB (I'm picking this slightly oversized battery because LifePO4 batteries are superior to Lithium polymers and they will last 5-10 years like a good battery should. It can be used with future SoCs anyways. Plus, it's just a prototype, but a coordinated design could allow a flatter, more compact one as are in laptops: [http://www.amazon.com/K2-K2B12V7EB-Lithium-Phosphate-Battery/dp/B0056BXE6A/ref=pd\\_sim\\_sbs\\_auto\\_6](http://www.amazon.com/K2-K2B12V7EB-Lithium-Phosphate-Battery/dp/B0056BXE6A/ref=pd_sim_sbs_auto_6) ([http://www.amazon.com/K2-K2B12V7EB-Lithium-Phosphate-Battery/dp/B0056BXE6A/ref=pd\\_sim\\_sbs\\_auto\\_6](http://www.amazon.com/K2-K2B12V7EB-Lithium-Phosphate-Battery/dp/B0056BXE6A/ref=pd_sim_sbs_auto_6)) (the battery would need to power both the SoC plus the LVDS adapter, which outputs to the screen, so I don't know if it needs two 6V outputs or one 12V, etc, from a controller)

Lastly, a USB keyboard with a built-in touchpad for clicking and scrolling (wherever one can find one) \$30-40.

Total cost for a solar laptop: \$569, excluding charge controller, which Bootstrap solar sells (may have other alternatives. some solar panels have them built in when using less than a number of Amps)

I recall one forum post that said there is an LVDS adapter being worked on that works specifically for the Pixel Qi to the Rasp Pi. I will post that soon when I find it.

Lastly, the goal of this design is not just to make a solar laptop that can be run after a long enough wait in the sun, but one that can make use of the lowest power SoCs (the 5V 3.5w on the Rasp Pi is good, 2 watts for a Pixel Qi is great, but together it's 5.5 watts, which benefits from a battery that's 10Ah at minimum for all-day computing (9hrs+)). Thus, we're still not quite at instant-on power-up the way amorphous silicon can charge a 4-function calculator, but that comparison is not too far from being reached. For example, within the past year, Intel demonstrated a Claremont processor that charged a Pentium x86 processor running at Near-threshold voltage, using just 2 milliwatts.

<http://semiaccurate.com/2011/09/28/intel-solar-cell-cpu-demo-was-really-impressive/> (<http://semiaccurate.com/2011/09/28/intel-solar-cell-cpu-demo-was-really-impressive/>)

In practice, they may run at 300 milliwatts (active) to be of mainstream attractiveness. But also, more recently, ARM announced their highest efficiency ARMv8 A53 and A57 64-bit processors for use in servers, which use 500milliwatts on idle and 2 watts on load, which is great for future Raspberry Pis. 😊 My interest is assembling a solar laptop that can run ideally all motherboard, display, and i/o devices under an relatively affordable battery and solar panel kit, as the solar components

aren't the most expensive anymore. While I like how the Amazon Kindle Fire HD uses a color screen, it's moved away from the low-powered efficiency and long lasting ability of the e-ink, and in that sense, the Pixel Qi is still the best display in that class. The only other displays I've seen is by CPT, an older transfective display. [http://liliputing.com/2010/06/cpt-trans ... money.html](http://liliputing.com/2010/06/cpt-trans-money.html) (<http://liliputing.com/2010/06/cpt-transfective-display-could-give-pixel-qi-a-run-for-its-money.html>) and E Ink's Triton [http://www.eink.com/display\\_products\\_triton.html](http://www.eink.com/display_products_triton.html) ([http://www.eink.com/display\\_products\\_triton.html](http://www.eink.com/display_products_triton.html)) However, a B&W solar using a newer Pearl e-ink display with fast refresh could be attractive for those interested in solar netbooks under \$300 (excluding the One-Laptop-Per-Child XO-3, which sells for \$200-\$400, thus comparable), if it has LVDS inputs and is compatible with pins and electrical. They sell for about \$60 on Ebay: [http://www.ebay.com/sch/Computer-Compon ... \\_nkw=e-ink](http://www.ebay.com/sch/Computer-Compon..._nkw=e-ink) ([http://www.ebay.com/sch/Computer-Components-Parts-/175673/i.html?\\_fspt=1&\\_sop=12&\\_sac=1&\\_mPrRngCbx=1&\\_nkw=e-ink](http://www.ebay.com/sch/Computer-Components-Parts-/175673/i.html?_fspt=1&_sop=12&_sac=1&_mPrRngCbx=1&_nkw=e-ink))

o\_nv\_d\_o

**Posts:** 29

**Joined:** Sun Oct 14, 2012 10:12 pm

Re: solar-powered raspberry pi with fast e-ink refresh displ

Mon Nov 12, 2012 10:19 am

It is a good initiative. Keep up the good work.

Regarding the charge controller or other electronics, they can be custom designed to reduced the cost. RPi can also help acting as the main controller aided by external electronics.

In this way, one can log the charging and discharging process of the battery.

In your post, you have not specified the voltage of the battery. It will keep the RPi plus other peripherals running for 9+ hours if its voltage is around 5 V. If the voltage is higher, you can get more time using switching regulators to step the voltage down for RPi and other peripherals.

Thus:

Time = (Battery Voltage \* Battery Ah rating) / [ (5 V \* 1 A) + (x1 V \* y1 A) + ... ] \* Combined Efficiency of Switching Regulators

1 A is for RPi (just to be on the safe side) though 0.7 A should suffice if its USB load is minimal.

Combined Efficiency of Switching Regulators: Around 80% or higher

x1: Voltage needed by peripheral 1

y1: Current need by peripheral 1

If RPi and other peripherals can be put into idle mode when not in use, battery life can be extended.

It is good if target price is 100\$ to come up with something like:

<http://one.laptop.org/> (<http://one.laptop.org/>)

Good vision. 😊

solarlaptop

**Posts:** 2

**Joined:** Wed Oct 31, 2012 3:25 pm

## Re: solar-powered raspberry pi with fast e-ink refresh displ

Thu Nov 15, 2012 9:29 pm

o\_nvd\_o,

Thanks. Yes, I am unsure of the voltage of the battery's output, though the K2 Energy is listed as 12V with battery management system (it's also sold without it). I wrote a little more on this page: [http://elinux.org/RaspberryPi\\_Laptop](http://elinux.org/RaspberryPi_Laptop) ([http://elinux.org/RaspberryPi\\_Laptop](http://elinux.org/RaspberryPi_Laptop))

This H.264 video demo of Big Buck Bunny using Pearl E-ink is quite nice: <https://www.youtube.com/watch?v=24srQXX81Oc> (<https://www.youtube.com/watch?v=24srQXX81Oc>) There are other videos that are equally impressive. I'm curious what the energy consumption is compared to static page display.

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