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# Building An E-ink Laptop powered by the Sun



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Building a solar powered e-ink laptop represents a forging of nearly contradictory ideas- powering a relatively hungry device by an energy source that is not available 24hrs a day, especially indoors. That said, it represents an ambitious goal of designing a laptop according to minimalistic needs, rather than having the greatest number of transistors.

<https://forum.ei2030.org/t/e-ink-low-power-cpu-solar-power-3-sides-of-the-same-lid/82/>

In selecting a processor, a display, and a solar panel, I am beginning this project with an open mind as to the type of chip. I actually have not even settled on whether to use a microprocessor or a microcontroller. I am not an engineer, nor much of a hacker. I am more a collector and experimentalist- one that explores what is possible and whether it is practical. It's more like pre-engineering, or pre-hacking warm-up. My approach to hacking is a social endeavor- inquiring across multiple software and hardware development communities to sample the concepts and get an idea of what might be something that hasn't been tried, but is ready for a project. Approximately 8 years ago, I had this idea, but Dennard's scaling and semiconductors were still still power inefficient when even considering solar power.

<https://www.extremetech.com/computing/136043-intel-predicts-ubiquitous-almost-zero-energy-computing-by-2020>

While most people aren't focusing on energy efficiency in terms of the cost to compute individual needs, the overall landscape of power consumption in the long-view of Moore's law has opened up quite a few opportunities for self-powered devices like wearables. A quite accurate prediction by Intel's 8 years ago is discussed in the ExtremeTech article. Computing is nearly power free. But it is not zero power. Yet powering a single core processor by a solar panel seems tantalizingly close to being able to achieve in 2021. To start out, one can begin with a very simple gadget, like a microcontroller. There are already some solar powered Internet of Things,

like remote sensors with ARM M0+, but what if powering a laptop could be done on a very lightweight microcontroller? One that might have only a couple linux processes for running a word processor in static RAM and retrieving additional applications externally? Multithreading isn't prohibitive on a microcontroller, but simplifying a laptop by structuring applications by archiving them until necessary could be a way to have a fast OS, even on a microcontroller running a couple hundred mHz.

When solid state drives were first released, the drives were reserved for boot and OS files, while the applications and documents were stored on the HDD due to the cost and limited size of the SSDs. In the same way, as microcontrollers become even more power efficient with TSMC's 22nm ULL Cortex M4F processors, it really makes me wonder whether microcontrollers are like that power efficient SSD in the early days of solid state disk speed gains. Microcontrollers at being powered by batteries for days, months, and years, so why not a laptop? A few real-time operating systems have brought a few linux features to microcontrollers, like Zephyr and Riot OS.

Today's operating systems run much faster on less power, but the same could be said for microcontrollers with more RAM. So if a lightweight linux OS can fit on a microcontroller, but access external storage for less-critical applications, then power efficiency could again be reached, providing a more feasible solar laptop.

The Raspberry Pi Zero is an accessible testbed for a low power laptop, although it uses the ARMv11 45nm-90nm process. To swap it with a single core 5nm Cortex ARM v8.2 A78 would not be much more power efficient, running at 3ghz. But to have a processor underclocked until it provides no noticeable performance loss and, if possible a significant power reduction, is necessary for building a solar laptop. The latest and most powerful 64 core computer might have 15 billion transistors, but if only a few hundred million are needed to run an operating system, then less is more when it comes to designing a portable computer that must be constantly recharged.

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