

# Community Built E-ink Laptop Project

**Sunday, 28th March 2021, at 11 am PST**



Alexander Soto  
Boston, MA  
(aka "alexsotodev")  
Project Lead  
Core Team

I'm a community organizer, educator, software engineer, hacktivist, and agent of social change.

My interests are in exploring community-building, social justice, education, and leveraging technology to address social problems.

In the past, I've worked as a labor rights organizer, a teacher, and I'm currently an Expert In Residence at [Resilient Coders](#).

[@alexsotodev](#)

[alexsoto.dev](#)

[contact@alexsoto.dev](mailto:contact@alexsoto.dev)



Giovanni Lostumbo  
Chicago, IL  
(aka "initrd")  
Core Team

I'm an independent contractor- I provide tech support services to IT companies.

My hobby interests are in building technology (e.g. FOSS hardware & software) and making it easier to use and more accessible.

In the past, I have worked in technical support roles for IT companies in wireless networking, help desk, and hardware repair.

[@techrecount](#)

[hackaday.io/initrd](https://hackaday.io/initrd)

[Github](#)

[giovanni.lostumbo@gmail.com](mailto:giovanni.lostumbo@gmail.com)



Manuel Zeiler  
Munich, Germany  
(aka "m10r-vc")  
Core Team

Manuel is responsible for various marketing and community management activities across the whole EI2030 initiative.

He's been an early adopter and big proponent of emerging technologies including electronic paper as well as cryptocurrencies.

His work setup and station is designed around paperless eink devices. On his day job Manuel works as an Account Executive at a German publishing house.

He has also been an IT Specialist and Network Administrator with the German government and the automotive industry with a stint in New York. He has also served as Marketing Manager at various startups.

[@EI2030\\_official](#)

[ei2030](#)

[manuel@manuelzeiler.com](mailto:manuel@manuelzeiler.com)



# Resilient Coders



Our students spend 20 weeks with us, learning object-oriented programming principles, through the vehicle of full stack javascript; that's vanilla JS, React, Express, Node, and PostgreSQL.

[HIRE](#)

[DONATE](#)

# Objectives

- To generate interest in the idea of creating an e-ink laptop.
- To unite and increase our numbers.
- To iterate, test ideas, document, and show our work.
- Create a crowdsource campaign after the successful creation of a minimum viable product.
- Bring the MVP to a manufacturer and build at scale.

# Working Groups



- Led by one or two people as leads.
- Research focused or revolve around a deliverable.
- Defines a metric/cost for who the device is for.
- Working groups are time-boxed defined.
- A "template" provided for the working groups to start and self-organize.

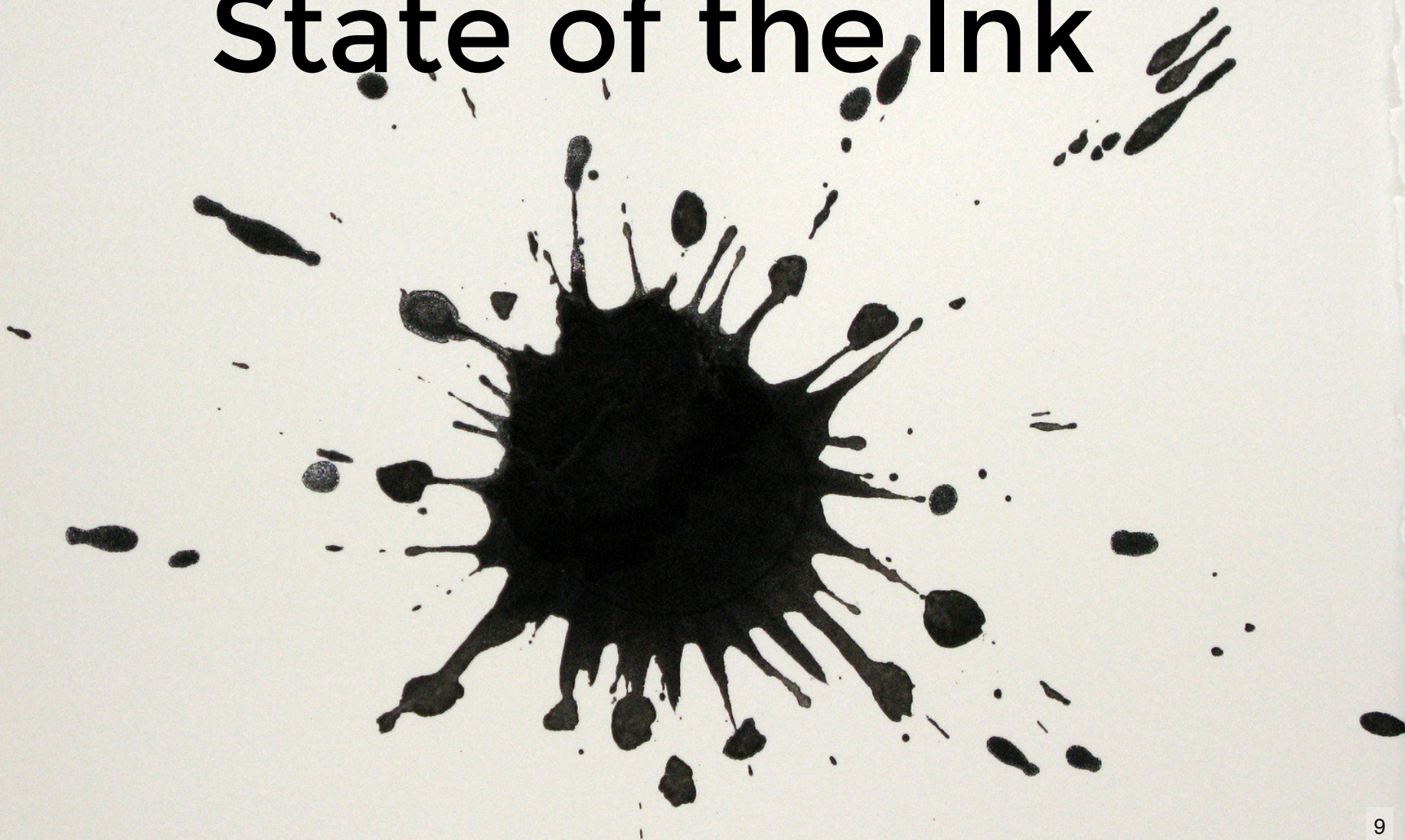
# Working Groups Contd.



- The working group documents its process in a designated website, forum, Github, a build log.
- Share resources/knowledge/material/monetary.
- Generate interest, share our work with others.
- Iterate, iterate and iterate.



# State of the Ink



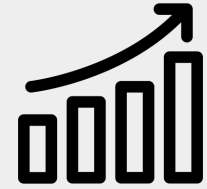
## Speaker notes

Overview of e-ink based devices and difficulties faced.

**What we have done  
so far...**



# We are growing!



- We've had **42** new members join our community!
- More people are viewing our forums, in particular the working groups.
- Continuously engaging people and communities in social media platforms, Twitter, Reddit.

Thank you for joining our community!



# We are growing!



Electroforetic Ink Working Group (EI2030) Retweeted

**Alexander Soto** @alexstodev · Mar 26  
I had a great time at this month's pi-top session, saw so many great projects and conversations! Thank you!

@GetPiTop #raspberrypi #pitop

**pi-topTEAM** @GetPiTop · Mar 25

Join us tomorrow at 5 pm GMT for our next pi-top Sessions!

We've got some new content to share, and new members of the community who have some exciting material joining the call! 🙌 Sign up now: [hubs.ly/H0JQX610](https://hubs.ly/H0JQX610)

#RaspberryPi #IoT



1 2

#2 Join our Second EI-2030 Monthly Community Call - Sunday, March 28th, 11am PST

Announcements



1 83 22h

Low-power E-Paper OS

Working Groups



1 167 8d

Proposal: ei-2030 - The Community Built E-Ink Laptop Project

Project Introduction



10 667 8d

Research: Laptop case design

Working Groups



1 67 10d

PaperTop Laptop

Working Groups



6 1.8k 11d

## Hi Pi-Top community, we are EI-2030! ✎



EI2030

3 11d

Hi Pi-Top community,

At [EI2030](#) 1, we've started a community effort to promote the use of alternative displays to blue-light emitting screens in our devices. The objective of one of our working groups, the [PaperTop](#) 4, is to explore creating an e-ink laptop using a Raspberry Pi 3B+, Pi-Top and an e-ink panel.

Another of our working groups seeks to utilize ultra low power microcontrollers & microprocessors to design solar powered laptops. We thank the invitation by the Pi-Top CTO to post on this forum as well as offering to provide technical support. We also will be attending the next monthly Pi-Top Session and look forward to sharing more of our progress! 😊

Sincerely,

EI2030 Working Groups Core Team

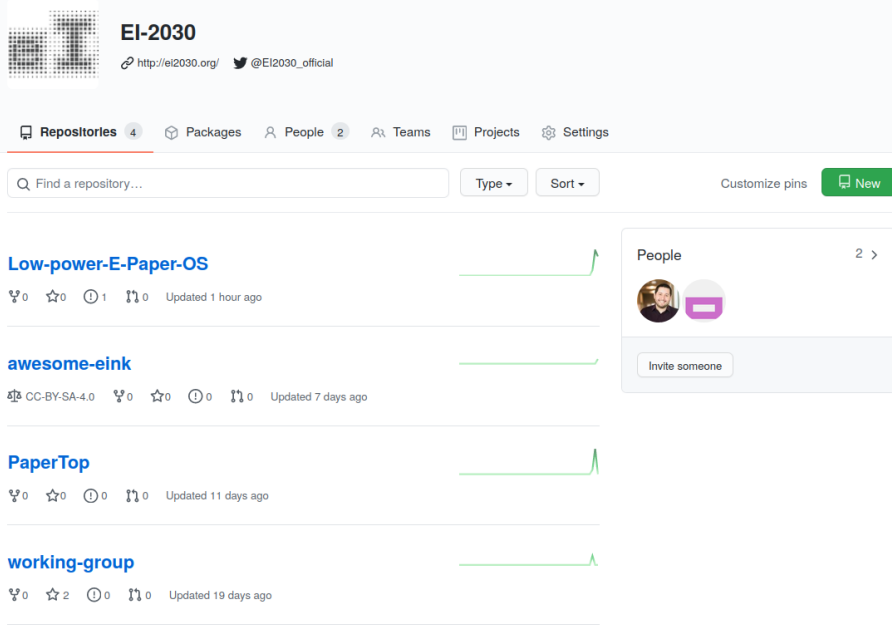
2 1 1 3 Reply

created 11d last reply 2d 21 replies 112 views 6 users 27 likes 12 links



# A structure is emerging!

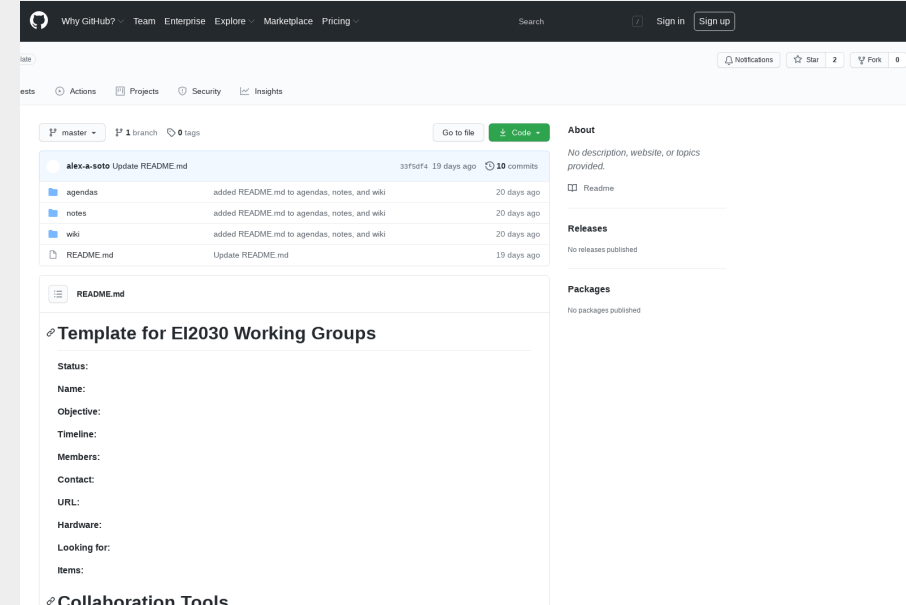
- Working Group Categories in forum.
- Templates for starting a working group.
- EI2030 Github organization.
- Github repository for each working group.
- New channels in Discord for working groups.



The screenshot shows the GitHub organization page for EI-2030. The organization name is "EI-2030" with a logo of a grid of dots. Below the name are links to the website (http://ei2030.org/) and Twitter (@EI2030\_official). The navigation bar includes "Repositories" (4), "Packages", "People" (2), "Teams", "Projects", and "Settings". A search bar is present with "Find a repository..." and filters for "Type" and "Sort". A "New" button is also visible. The main content area displays a list of repositories with their names, icons, and update times:

- Low-power-E-Paper-OS**: Updated 1 hour ago
- awesome-eink**: Updated 7 days ago
- PaperTop**: Updated 11 days ago
- working-group**: Updated 19 days ago

On the right side, there is a "People" section with two profile pictures and an "Invite someone" button.



The screenshot shows a GitHub repository page for a template. The repository name is "Template for EI2030 Working Groups". The page displays the repository structure, including a commit history table and a file tree. The commit history table shows the following entries:

Commit	Message	Author	Time
3375ef4	Update README.md	alex-a-soto	19 days ago
	added README.md to agendas, notes, and wiki		20 days ago
	added README.md to agendas, notes, and wiki		20 days ago
	added README.md to agendas, notes, and wiki		20 days ago
	Update README.md		19 days ago

The file tree shows the following files:

- agendas
- notes
- wiki
- README.md

The repository content area displays the README.md file, which contains a template for working groups. The template includes fields for:

- Status:
- Name:
- Objective:
- Timeline:
- Members:
- Contact:
- URL:
- Hardware:
- Looking for:
- Items:

Below the template, there is a section for "Collaboration Tools".

# A structure is emerging!

Working Groups ▾ all ▾ Latest Top

Topic Replies Views Activity

Low-power E-Paper OS Working Groups		1	167	8d
Research: Laptop case design Working Groups		1	67	10d
PaperTop Laptop Working Groups		6	1.8k	11d
About EI2030 Working Groups Working Groups		0	84	18d
Template: Propose for a working group Working Groups		2	56	20d

WORKING GROUPS +

- # general
- # proposals
- # join
- # papertop
- # low-power-solar
- # laptop-case-design

VOICE CHANNELS +

- general
- papertop
- low-power

## OS Options #1

alistair23 opened this issue 12 days ago · 6 comments

alistair23 commented 12 days ago · edited

I wanted to point out [Tock](#) as an OS option.

It supports the Redboard Artemis, STM32 and a range of other MCUs you listed as potential options. It includes [basic screen support](#) as well (although not e-paper).

If you are running on larger hardware (with an MMU) [xous](#) is another option. They are working heavily on screen support, although again not e-paper.

If you are able to run Linux then everyone seems to use NXP chips as they have pretty good e-paper support. For example there is work to upstream the [rM2 kernel](#) and the rM1 even ran a standard distro.

alistair23 changed the title ~~OS-Option~~ OS Options 12 days ago

hatonthehat commented 10 days ago · edited

@alistair23 Thank you for these suggestions! Sorry I didn't see this comment earlier. I am new to Github and signed up for notifications just now but I welcome these suggestions and feel free to check out our [Discord](#) as well.

The Redboard Artemis seems a great option due to its low power- the other day I made a more in-depth video on solar powering it: <https://www.youtube.com/watch?v=428cgrpPR0w> Alternatively, the [module](#) or even the [MCU](#) could be sourced without the extra power consumption of the LEDs. Their [A la carte](#) design could potentially do away with the extra components that use power, such as the red power & blue activity indicator LEDs, which could use as much as 40% less of the 5mW it is said to use (features tab).

While it uses the Apollo3, it only has 384K RAM. The Apollo3 Blue Plus has 768K RAM, and Apollo4 has nearly 4MB (3.8MB counting SRAM & MDRAM). While it doesn't have an MMU, it would be interesting to see what could run without external SPI RAM added. That said, there have been some attempts to run linux w/o MMU, such as the <https://www.crx-software.com/2019/12/03/western-digital-risc-v-linux-busybox-boot-sipeed-maix-go-board/> and it would be interesting to see how Tock could be used to run apps the way uclinux does in [limited] and low power/tickless (<https://www.electronicdesign.com/technologies/embedded-revolution/article/21795660/practical-advice-on-running-uclinux-on-cortexm3m4>) memory, since stack overflow would be a potential issue.

Reflective displays are an alternative to e-paper that some in our EI2030 are also very interested in. They have low power (such as SHARP Memory display) consumption, and perhaps xous could be used with that since it is not e-paper. Also, [memory in pixel](#) has some MbedOS support, which the Artemis Dev Kit is supposed to support fully.

There are some interesting Epaper software/drivers, such as [PaperTTY & EPDly](#), though it seems I am not sure as to the memory constraints, which is why I'd like to focus on monochrome drivers/conversion software like this [GPS e-paper display](#)

-Giovanni

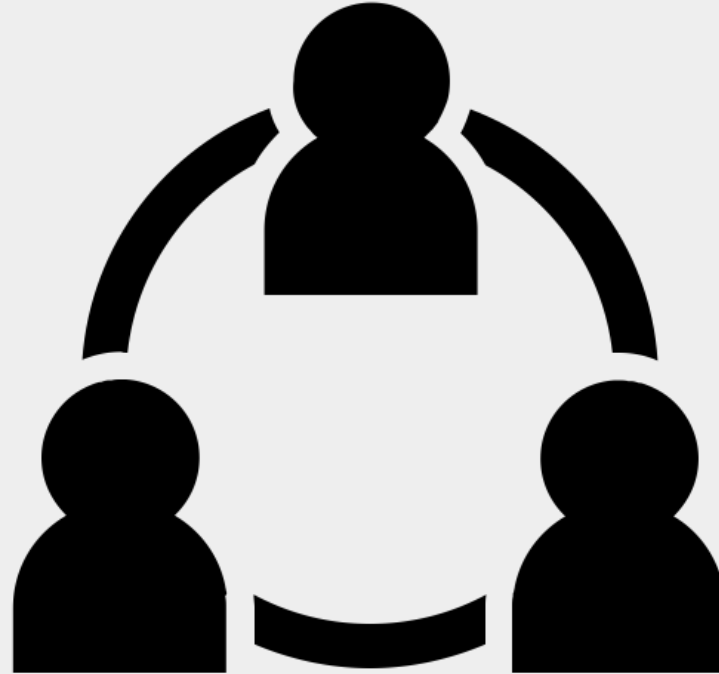
# Outreach Efforts

- Ambiq Micro
- Northwestern University
- TU Delft
- Emcraft
- Greenwaves Technologies
- PULP Platform/ ETH Zurich
- SiFive
- ARM
- Norcott.co.uk
- Samsung
- Intel
- Dreamchip.De
- Rdot Displays/Ynvisible
- Micromagic
- IMEC
- Sparkfun
- GroupGets
- Embox
- E-peas
- Epishine
- Powerfilm
- Cap-XX
- Bootlin
- Konsulko
- E-ink
- Astrohaus
- beck-elektronik
- Variscite
- Toradex
- Boundary Devices
- Pi-Top
- Slimbook
- XY Tech



# ACTIVE

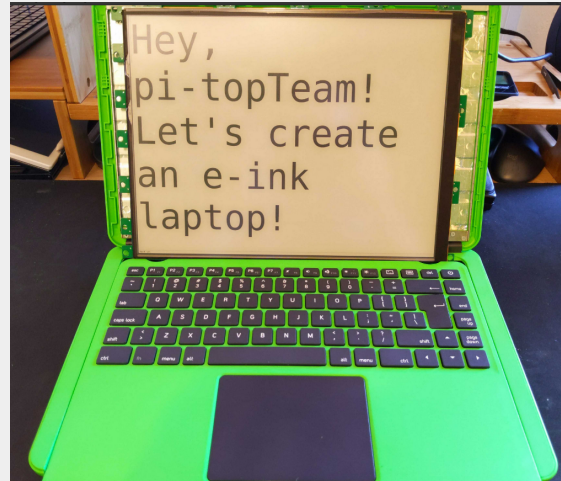
## Working Groups



## Speaker notes

- People self-organize into working groups.
- Some categories for the working groups:
- low power, high power, sub \$500, \$500-800, SBC, microcontrollers, general purpose.

# PaperTop



- PaperTop as an initial prototype for an eink laptop.
- [Working Group: PaperTop thread](#)
- Presented PaperTop at the Monthly Pi-Top Session.
- Next Steps
  - Extending the cables of the ES133TT3 panel
  - Connecting and fitting everything to the Pi-Top
  - Working with Pi-Top team to complete the prototype

# PaperTop



**D** duwudi 11d

Hi @alexsotodev, pi-top co-founder/CTO here - just wanted to say I absolutely love this project! 😊 I'd be happy to help support from a technical standpoint if you need any more details than what you can find online, but it seems you've made a pretty good start already!

It's interesting that you mention a solar-powered laptop as a possible use-case, the genesis of pi-top 1 was actually a solar-powered Raspberry Pi laptop powered by supercapacitors! An e-ink display certainly would have increased the 2 minute runtime I had with those supercaps powering an LCD panel 🌀 I posted some info on that [here over on our forum](#) 4 if you're interested 👍

We have a monthly community meeting on the last Friday of every month called pi-top Sessions, it would be great if you could attend and do a 5-minute talk on PaperTop. Also, you could post this project on our forum as I'm sure our community would love it as much as I do!

**Alexander Soto** @alexsotodev · Mar 26

I had a great time at this month's pi-top session, saw so many great projects and conversations! Thank you!

@GetPiTop #raspberrypi #pitop

**pi-topTEAM** @GetPiTop · Mar 25

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1 2

**alexstodev** 4 15d

### Introduction: PaperTop

The objective of the PaperTop is to explore creating an e-ink laptop using a Raspberry Pi 3B+, Pi-Top, and an e-ink panel. Explore what other single-board computers could be supported with the chassis. Explore what modifications to the Pi-top and what is and is not possible.

The first pi-top started as part of an IndieGoGo campaign in 2014. Since then, there have been different iterations of the pi-top. The v1 to v3 of the pi-top is of particular interest since they share a similar design. The pi-top we are using, v2, is available on eBay for about \$50-80 dollars; the one shown here was purchased for \$30.

**alexstodev** 3 12d

### Teardown of the Pi-top v3

#### Block Diagram of the Pi-top v3

#### Overview: Teardown

I performed a small teardown of the Pi-top to learn more about it and see what's possible; what follows is an overview of the process and concludes with thoughts and considerations for the next steps.

# Low Power



scrunch

13 19d

Status: Approved

Name: Low-power OS

Objective: The goal of this project is to run an OS on an ultra low-power CPU/MCU that can output terminal or a window manager to an e-paper display.

Audience: low-voltage, proof of concept

Timeline: 3/14/2021-4/13/2021

Members: @scrunch, @alexsotodev open to new members, including after project started.

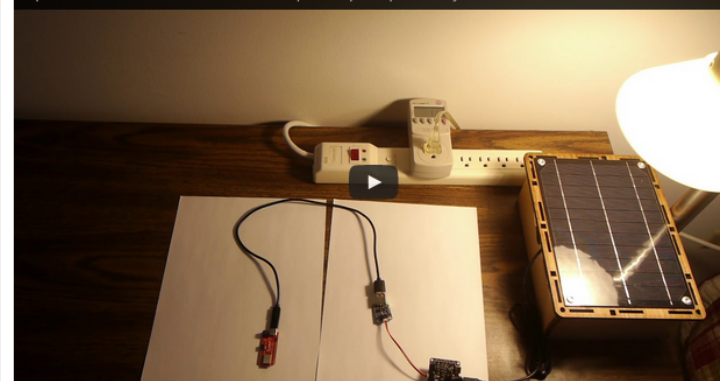
Contact: [giovanni.lostumbo@gmail.com](mailto:giovanni.lostumbo@gmail.com)

URL: Discussion ("low-power-solar" group) : <https://discord.com/invite/nnxKnxh>

<https://github.com/EI2030/Low-power-E-Paper-OS>

Hardware: [Redboard Artemis](#),

Sparkfun Redboard Artemis Nano with Ambiq Micro Apollo3 powered by 5W Solar Panel & 10.5W LED Bulb



pi-top

[pi-top.com](https://pi-top.com) KnowledgeBase

## Solar PiTop for E-Paper Display Development

pi-top [3]



Intrd

2 8d

Hi,

this is Giovanni from [EI2030.org](https://EI2030.org) !

I have posted a concept mod for the Pi-Top [v3]: I was thinking more of a cyberdeck idea since the solar powered display would need a larger panel since it would use more power. Under the keyboard fits a 5" screen, although I plan to order a different one without HDMI since the one in the photo arrived doa.

**NEW**

# Working Groups



# Laptop case design



**Name** : Research: Laptop case design

**Objective** : An ongoing group that researches the design of a laptop case to use with a non-emissive display. Group members will define, ideate, prototype, and test ideas.

**Audience** : General, modders, DIY,

**Timeline** : Ongoing

**Members** : [@alexsotodev](#), looking for members.

**Contact** : [contact@alexsoto.dev](mailto:contact@alexsoto.dev) or [Discord](#)

**Looking for** :

- Digital Fabrication
- DIY/Creatives/Modders
- Researcher
- Onshape, Fusion 360, OpenSCAD

# i.MX7/8 and Drivers



**Name** : Research: i.MX7/8 and Drivers

**Objective** : An ongoing group that researches the NXP microcontrollers i.MX7/8 with the intention to use with as a laptop with an e-ink display. Group members will research the I-MX7Dual, I-MX8ulp, EPDC, waveforms, reverse-engineering.

**Audience** : General, modders, DIY, engineers

**Timeline** : Ongoing

**Members** : [@alexsotodev](#), looking for members.

**Contact** : [contact@alexsoto.dev](mailto:contact@alexsoto.dev) or [Discord](#)

**Looking for** :

- DIY/Modders
- Researchers
- Knowledge of C, programming, embedded dev



# Porting Linux to Ambiq

## Apollo 4



- New Research Group (April 14-5/13)
- Goals
  - Porting Linux to Ambiq Apollo platform
  - Determining system requirements for apps
  - Bootloader development (Coreboot-like/Petitboot)
  - Multiboot “app as an OS” or kexec method

# Next Steps

- Continue spreading the word and bringing more folks on board.
- Further defining and bringing clarity to the project.
- Ramp-up state: formalizing tools, forum, templates
- Writing an article that summarizes the information shared here
- Building community, building relationships, building openly

[alexso.to.dev/slides](https://alexso.to.dev/slides)



**Thank you!**

