Building an Ecosystem of Open-Hardware E Ink Devices

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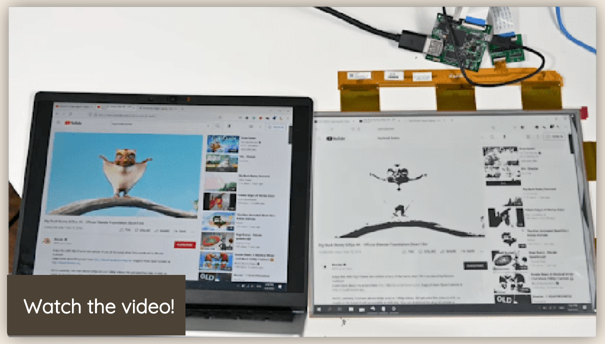
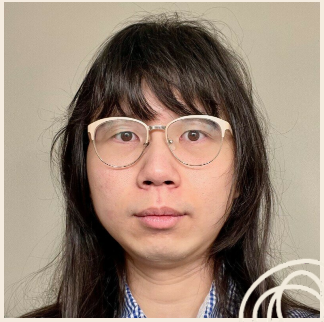
Re-imagining personal computing with a focus on creating calm, inclusive, and humane computing.



Meet the team



Wenting

Digital IC / PCB Designer

Brodie

CAD / Manufacturing

Michael

Software Architecture

Alex

Founder

Thank you to our Community and NLnet Foundation

300+

contributors

5k+

subscribers to mailing list

3k+

survey testimonials emphasize the need for healthier options

Community Survey Findings

Reading
65%

Writing
60%

Coding
51%

Focused
41%

"I lose hours and days and weeks of my life getting sucked down rabbit holes of entertainment content, and often miss deadlines or whole work sessions because my work and my play are a button away and the play buttons are so bright and colorful. It feels like my brain can't focus or rest at the end of the day while I'm staring at a bright screen for hours…"

"I have to use technology extensively for my career and I get issues on commercial screens (headaches, eye strain, overstimulation). I think e-ink is a much healthier alternative for everyone as it is a more natural and healthy way to use technology…"

"Eye strain is a real problem. Using an e-ink display for creative writing would be much more pleasant than a standard display. I'd love to see e-ink technology continue to advance and become more accessible and applicable…"

"I've been programming since 11, now 33 years old. My eyes hurt, even though wearing blue light filtering glasses, go outside regularly, etc. I have been wanting this for years…"

Desire for a Balanced Digital Life

- Reducing screen time on social media/entertainment.
- Digitally unplug and spend more time outdoors, away from screens.
- Seeking less visually stimulating digital environments.
- Reducing digital clutter and minimizing distractions.

Health and Comfort Concerns

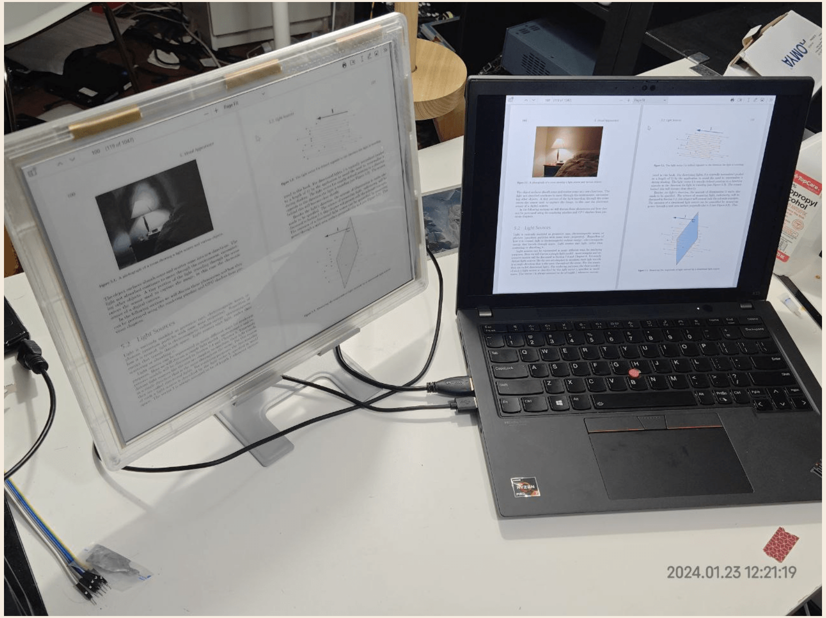
- Eye Fatigue and strain from prolonged screen exposure.
- Specific Health Issues:
  - Myopia
  - Epilepsy
  - Light sensitivity
  - Headaches
  - Migraines
  - Traumatic brain injury
  - Post-concussion syndrome

There’s a need for…

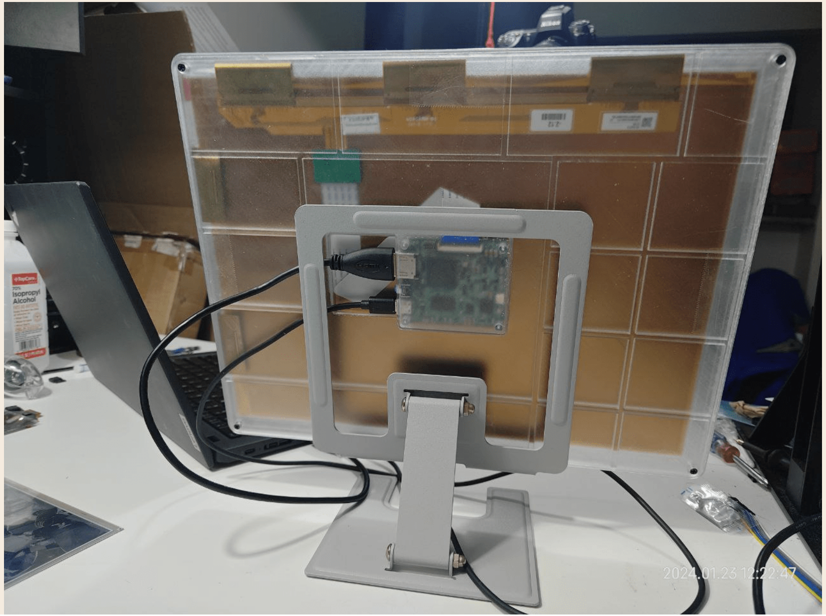
- Creating technology that satisfies our essential needs while protecting our well-being.
- Redefining the role of our digital devices to foster a healthier, balanced life.
- Creating a new class of devices, built from scratch, to embody the principles of 'humane technology' through hardware and software design.

"People who are really serious about software should make their own hardware."

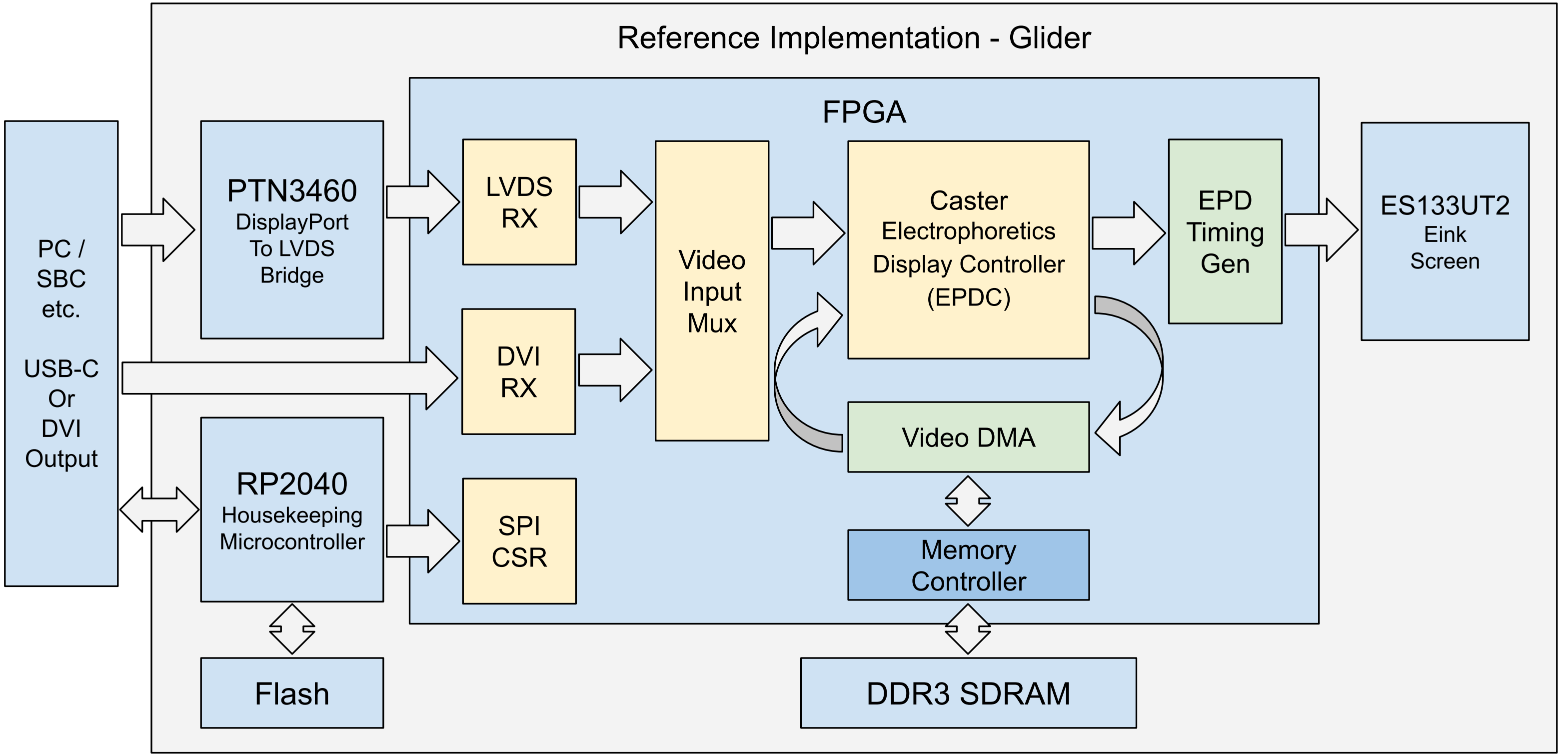
- Alan Kay



KiCad



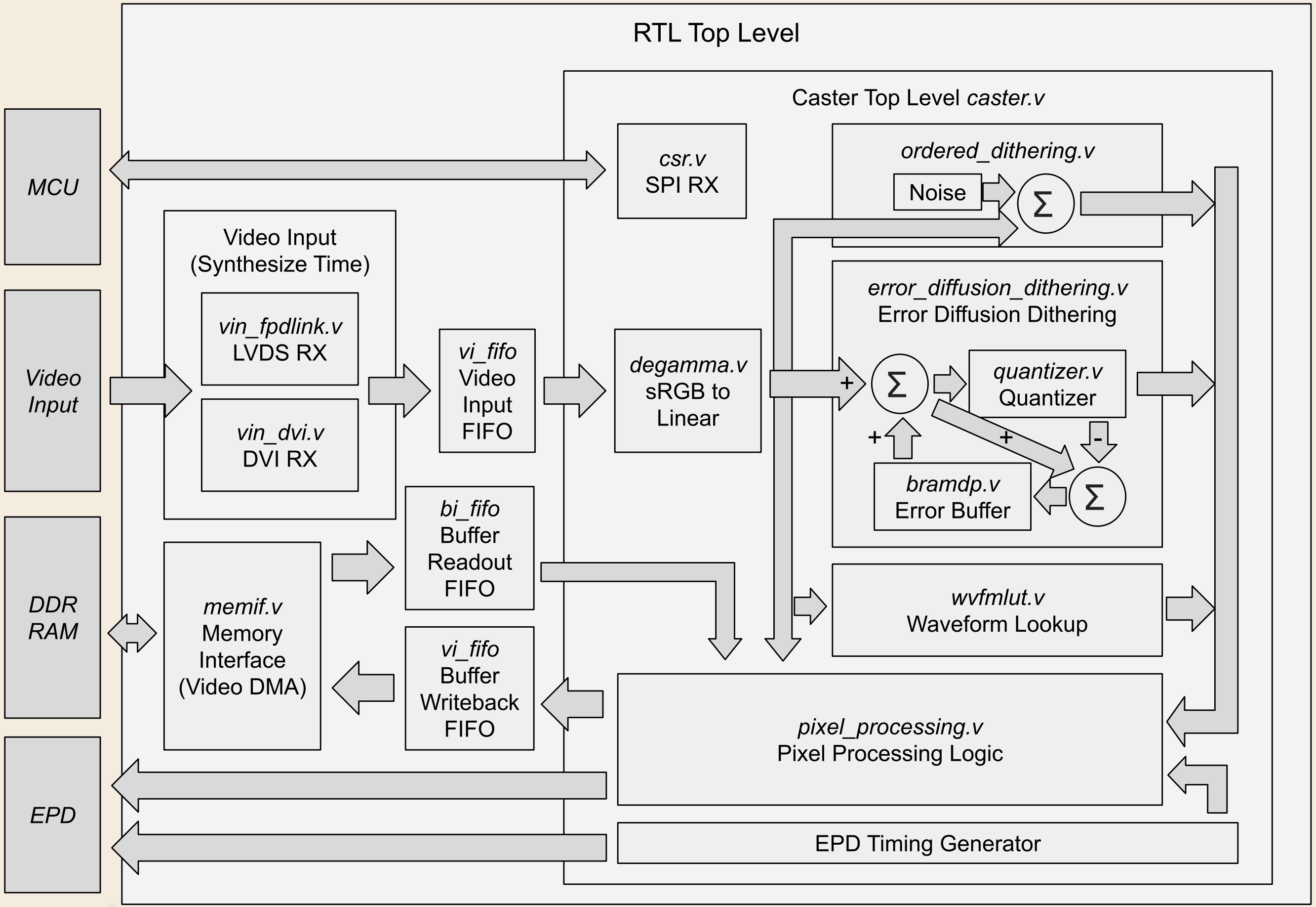
Modos Paper Monitor Block Diagram



Features

- Xilinx(R) Spartan-6 LX16 FPGA running Caster
- DDR3-800 framebuffer memory
- Type-C DisplayPort Alt-Mode video input with on-board PTN3460 DP-LVDS bridge or
- DVI (via HDMI connector) video input
- Epaper power supply with up to 1A peak current on +/-15V rail supporting large panels
- VCOM kick-back voltage measurement support
- On-board RaspberryPi(R) RP2040 microcontroller for USB communication and firmware upgrade
- Up to 133MP/s processing rate with dithering enabled, >200MP/s when disabled

Caster Block Diagram



Features

- Supports electrophoretics display panels with parallel I/F (Eink(R), SiPix and DES)
- Supports both monochrome and color-filter-array based color screen
- Extremely low processing delay of <20 us
- Supports binary, 4-level grayscale, and 16-level grayscale output modes

Features Contd.

- Latency optimized binary and 4-level grayscale driving modes
- Host software runtime controllable regional update and mode switching
- Hardware bayer dithering, blue-noise dithering, and error-diffusion dithering with no additional latency
- Supports FPD-Link (LVDS), DVI, and MIPI-DSI input

Basics

- **Pixel Arrangement and Driving**: Pixels are arranged in a 2D array and driven by Thin-Film Transistors (TFTs) at a refresh rate typically between 50Hz to 120Hz. Positive and negative voltages drive the particles to white and black states, respectively.
- **State Maintenance**: EPDs maintain their state after the electrical field is removed, requiring refresh only until pixels are fully driven.
- **Framebuffers and Driving Mechanism**: Two framebuffers determine pixel color changes. Pixels are driven based on their value (1 or 0) and a global counter is used to track the frame duration.

Basics

- **Grayscale Display**: Grayscale is achieved by partially driving pixels. The driving sequence is complex, often involving multiple switches between black and white to account for limited time control granularity and manufacturing variances. This results in a flashing refresh process and slower updates compared to binary images.

Latency Optimizations

- **Multiple Update Regions**: The Caster treats each pixel as an individual update region, allowing for immediate updates of each pixel independently. This contrasts with the basic driving method that uses a single global counter for waveform table lookup, leading to a fixed image update rate and potential delays in image processing.
- **Early Cancellation**: This method addresses the latency in updating pixels that are in the process of being redrawn. If a pixel's state changes before the completion of its current update, the update is cancelled and the pixel is immediately driven towards the new state.

Next Steps

1. Crowdfunding Campaign
2. Get Involved with Modos

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