Deploying Rust UIs to the Terminal
(and to your pocket)

Orhun Parmaksız

RustChinaConf 2025& Rust Global China

Orhun Parmaksız

🇹🇷 Creator based in **Ankara, Türkiye**

🦀 *Open source, Rust and terminals!*

🐭 **Ratatui**, **Ratzilla**, **git-cliff** ...

📦 **Arch Linux** (btw)

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https://github.com/orhun
https://youtube.com/@orhundev

Imagine a rat.

rat wants to download MP3

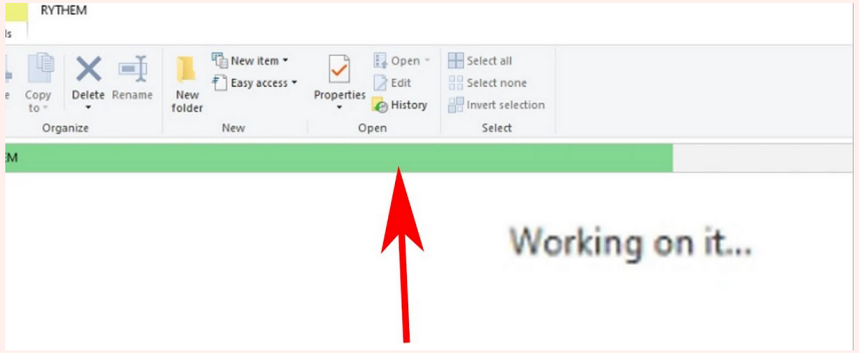
rat goes to ytmp3downloader.cc

PresenterMedia
neural lookup
Both religion and the occult derive much of their power from simultaneously
shifting boundaries of the self, and especially the ultimate borderland of dea
shadows, doubles, and dark reflections that haunt human
YOU FEEL UNCO
OR SCARED
Fax
@pitaa_k PPPPPPPPPP
and lunch I filed we in al
planning sent
the
22 4610 51 6046 5 7

Imagine a rat.

rat wants to find the cheese.txt

rat uses file search



www.youtube.com › watch

How to Fix File Explorer Green Loading Bar Very Slow or ...

IMPORTANT NOTE: ITEM 12 WAS ADDED AFTER THIS VIDEO WAS PUBLISHED AND I THINK IT IS THE BEST FIRST CHOICE AT THIS TIME…

YouTube · LiveWindowsTraining-DougBetts · Jan 8, 2025

www.youtube.com › watch

Follow-Up on How to Fix File Explorer Green Loading Bar ...

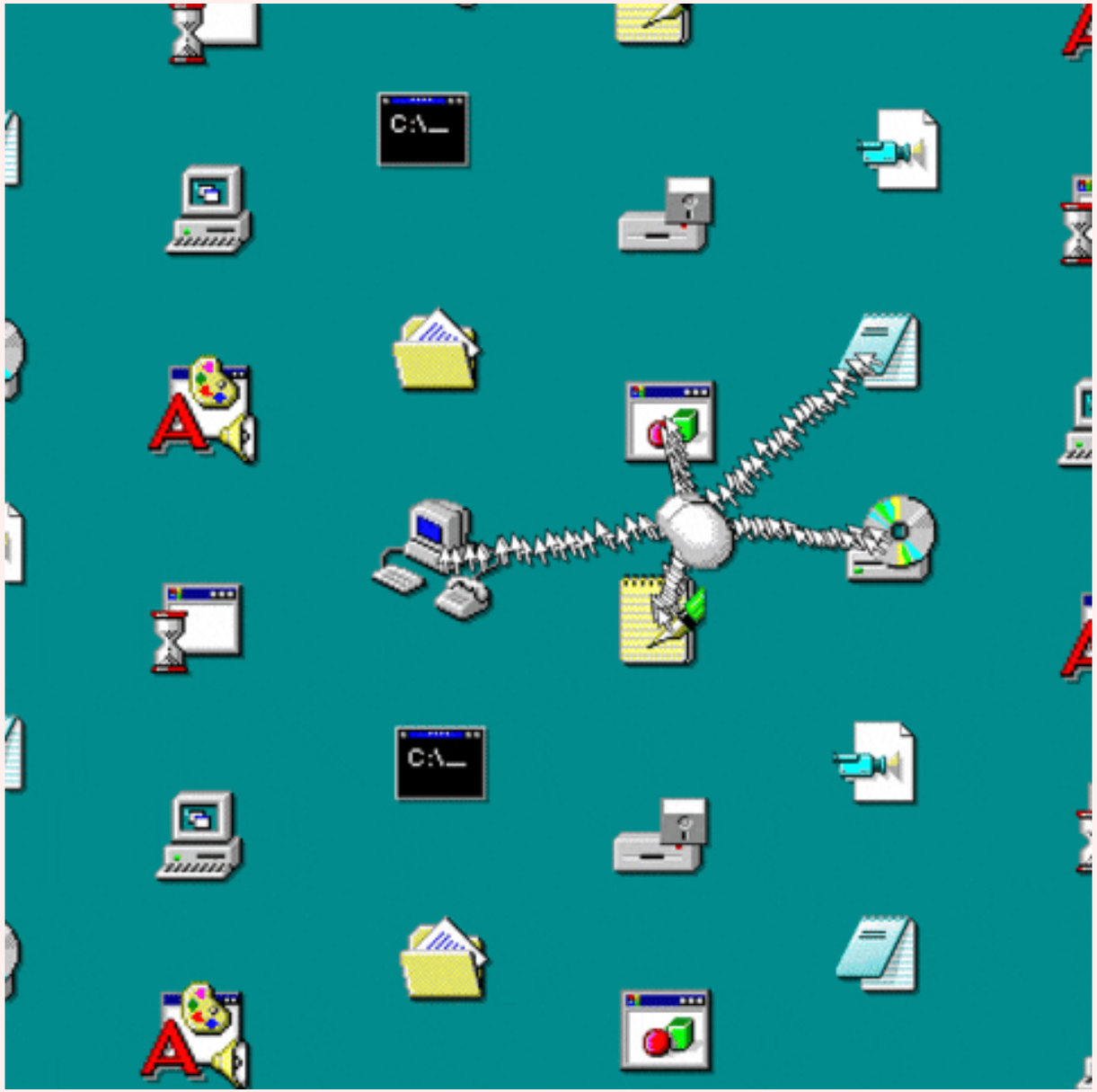
IMPORTANT NOTE: ITEM 12 WAS ADDED AFTER THIS VIDEO WAS PUBLISHED AND I THINK IT IS THE BEST FIRST CHOICE AT THIS TIME…

YouTube · LiveWindowsTraining-DougBetts · Jan 9, 2025

Imagine a rat.

rat wants to monitor network traffic

rat runs a GUI tool


C:_
C:_

rat explodes.

Solution?

The terminal.

```
$ yt-dlp -f bestaudio --extract-audio --audio-format mp3
```

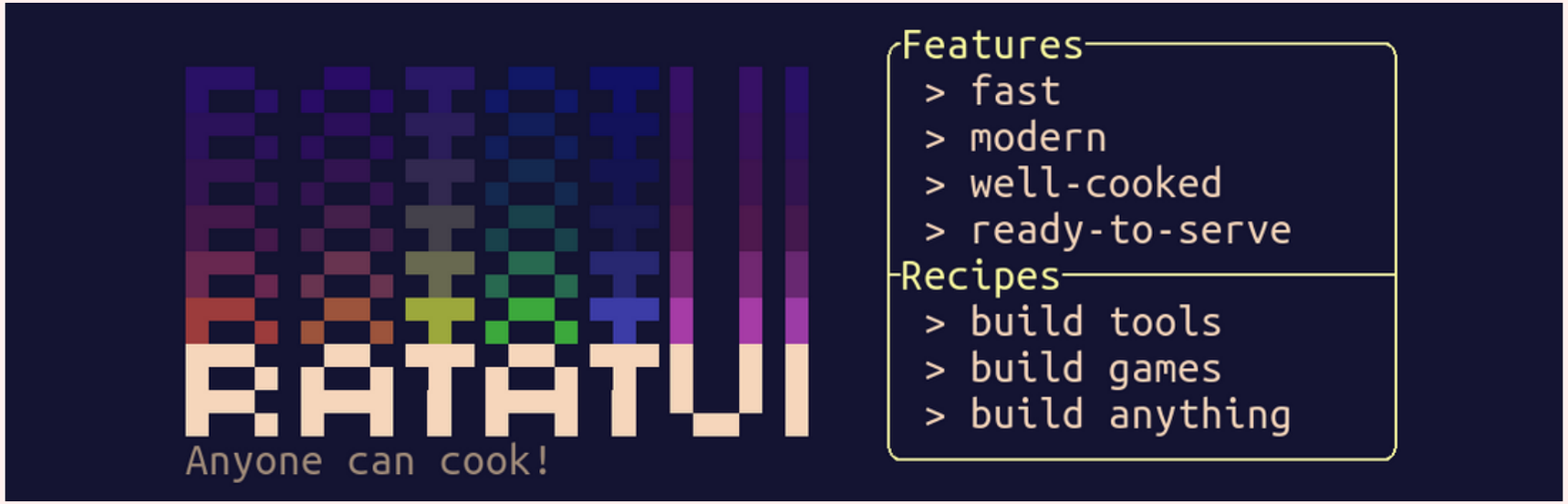
```
ig 'fn main' /home/orhun/gh/
```

——————————— [finished] ———————————

```
sudo oryx -i wlp3s0
```

——————————— [finished with error] ———————————

```
failed to run snippet: error running process:
thread 'main' panicked at oryx-tui/src/interface.rs:261:26:
called `Option::unwrap()` on a `None` value
note: run with `RUST_BACKTRACE=1` environment variable to display a backtrace
```



https://ratatui.rs

> Ratatui is a Rust library for cooking up terminal user interfaces (TUIs).

- Been around since 2023 (fork of tui-rs)
- 250+ contributors, hundreds of apps, 8M+ crate downloads
- tokio-console, yazi, dioxus-cli, atuin, gitui & more
- Used by Netflix, OpenAI, OVHcloud & many more

```
                                                  [ Swagger Petstore - OpenAPI 3.0 • 1.0.17 ]
APIs                                   [ALL]      Update an existing pet
→ PUT     /pet                                    PUT    https://petstore3.swagger.io/api/v3/pet
  POST    /pet
  GET     /pet/findBySta                          Request
  GET     /pet/findByTag                           Body
  GET     /pet/{petId}                            → 1   application/json:
  POST    /pet/{petId}                              2     $ref: '#/components/schemas/Pet'
  DELETE  /pet/{petId}                              3   application/x-www-form-urlencoded:
  POST    /pet/{petId}/u                            4     $ref: '#/components/schemas/Pet'
  GET     /store/invento                            5   application/xml:
  POST    /store/order
  GET     /store/order/{                          Responses
  DELETE  /store/order/{                           200 [application/json] | 200 [application/xml]
                       1 of 20                    → 1   properties:
Tags                                                2     category:
→ [ALL]                                             3       $ref: '#/components/schemas/Category'
  pet                                               4     id:
  store                                             5       example: 10
                       1 of 4                     [ Pet ]
[l/h → next/prev pane] [j/k → next/prev item] [1-9 → select tab] [g/b → go/back definitions] [q → quit]
```

https://github.com/zaghaghi/openapi-tui

```
localhost   Topics

Topics                                  Records
[ ] __consumer_offsets                  Timestamp                    Topic   Offset        Key   Value
[ ] _schemas
[ ] adventure-logs
[ ] adventure-photos
[ ] alien-encounters
[ ] anime-releases
[ ] art-exhibitions
[ ] astronomy-updates
[ ] baking-contests
[ ] circus-acts
[ ] comedy-sketches
[ ] comic-book-releases
[ ] concert-announcements
[ ] cooking-challenges
[ ] cosplay-contests
[ ] craft-ideas
[ ] creative-writing
[ ] dance-battles
[ ] diy-projects
[ ] dragon-sightings
[ ] enchanted-forest

Search
from end - 10

[ENTER]:Consume topic   [CTRL + P]:Show details   [CTRL + O]:Hide topics   [CTRL + H]:Help   [TAB]:Next panel   [E
```

https://github.com/MAIF/yozefu

Show me!

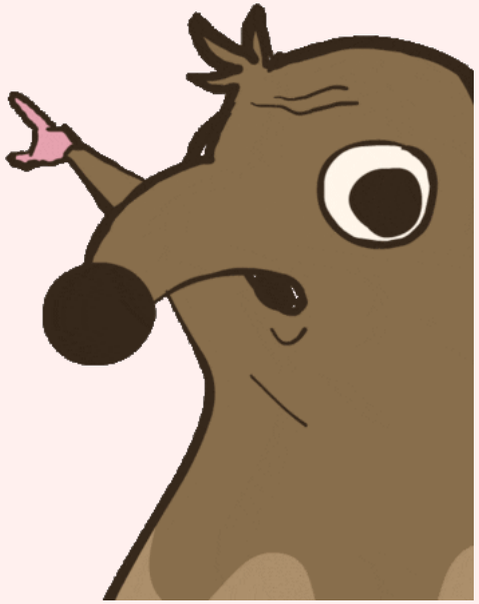
Easy.

```rust
fn main() -> std::io::Result<()> {
    ratatui::run(|terminal| {
        loop {
            terminal.draw(|frame|
                frame.render_widget("rat", frame.area())
            )?;

            if crossterm::event::read()?.is_key_press() {
                break Ok(());
            }
        }
    })
}
```

Or cheesy? idk tbh

Template	Description
Hello World	A "Hello, World!" example.
Simple	A simple example.
Simple Async	A simple async example.
Event Driven	An event-driven TUI application.
Event Driven Async	An async event-driven TUI application.
Component	A component-based TUI application.

```
cargo generate ratatui/templates
```



Architecture (>=v0.30)

Widgets

- BarChart
- Calendar
- Canvas
- Chart
- Sparkline
- Table
- impl Widget
- ...

Backends

- Crossterm
- Termion
- Termwiz
- impl Backend

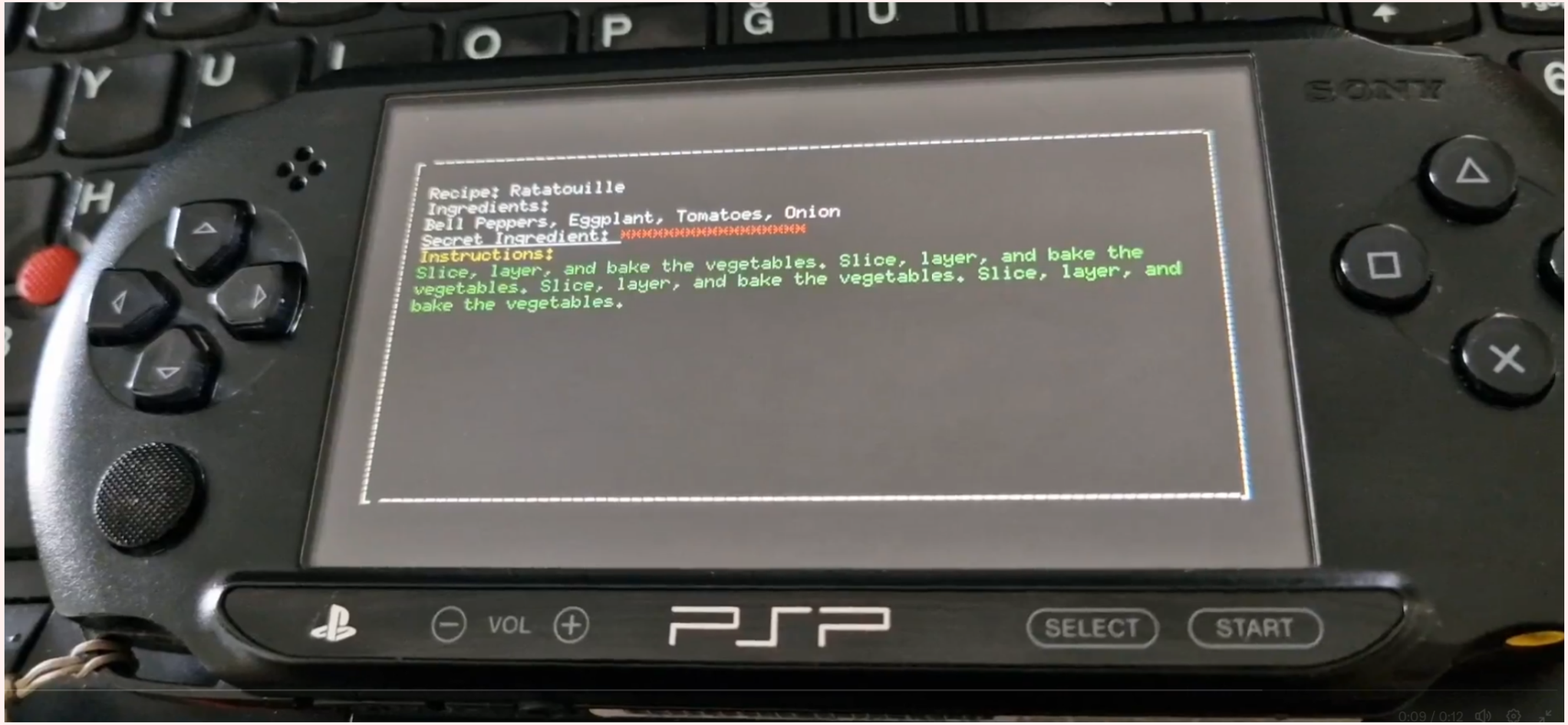
Components

```
ratatui
├── ratatui-core
├── ratatui-widgets
├── ratatui-crossterm
├── ratatui-termion
├── ratatui-termwiz
└── ratatui-macros
```

So why shall we stop here?

Ratatui on Suzuki Baleno

https://github.com/thatdevsherry/suzui-rs



Ratatui on PSP
https://github.com/overdrivenpotato/rust-psp/pull/190

Radioforestrion RPG by j-g00da (WIP)

We call this:

ratatuify

To rebuild or redesign something using the Rust library Ratatui, often transforming a GUI into an interactive terminal UI that's more performant and way more fancy.

No wonder why your GUI runs so slow. Hold my cheese, let me ratatuify it.

by ratshaker August 09, 2025

FLAG

https://www.urbandictionary.com/define.php?term=ratatuify

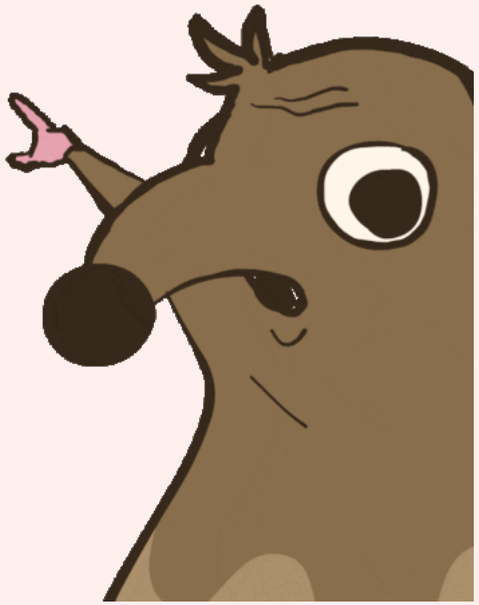
But how is it possible? 🤔

impl Backend

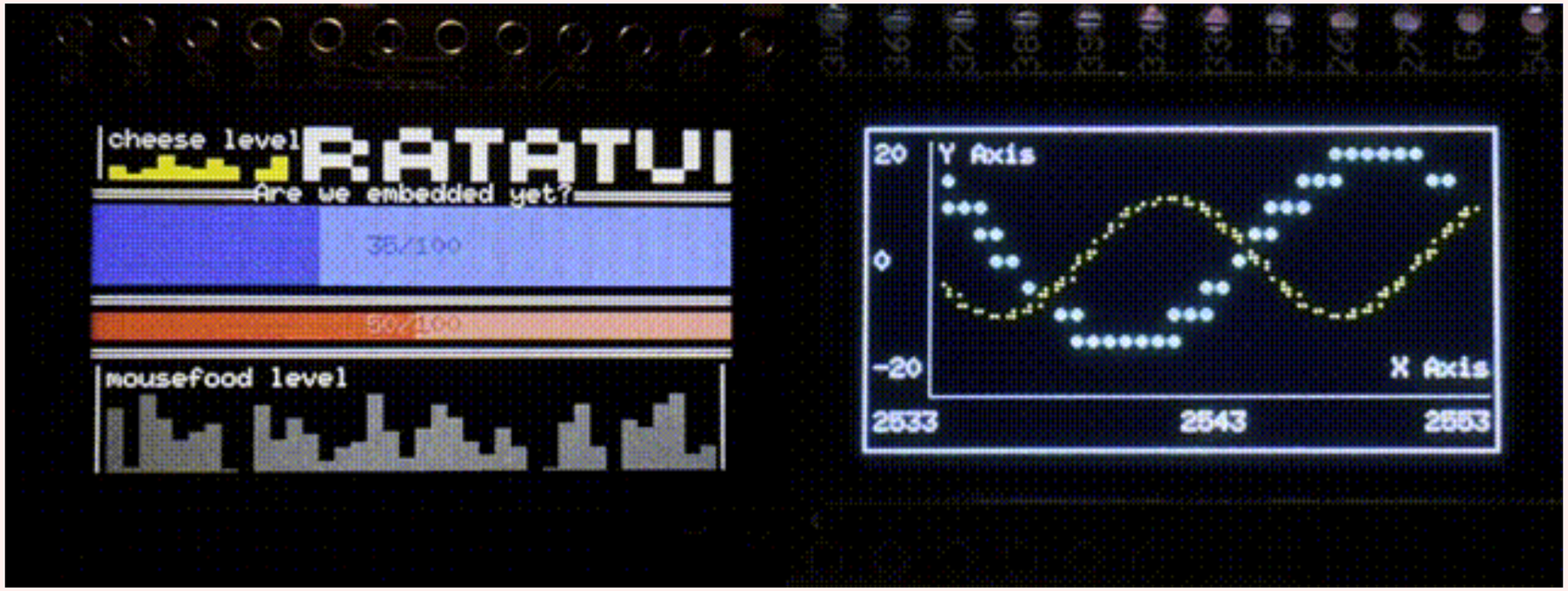
```rust
pub trait Backend {
    fn draw<'a, I>(&mut self, content: I) -> Result<()>
       where I: Iterator<Item = (u16, u16, &'a Cell)>;
    fn hide_cursor(&mut self) -> Result<()>;
    fn show_cursor(&mut self) -> Result<()>;
    fn get_cursor_position(&mut self) -> Result<Position>;
    fn set_cursor_position<P: Into<Position>>(
        &mut self,
        position: P,
    ) -> Result<()>;
    fn clear(&mut self) -> Result<()>;
    fn size(&self) -> Result<Size>;
    fn window_size(&mut self) -> Result<WindowSize>;
    fn flush(&mut self) -> Result<()>;
    // ...
}
```

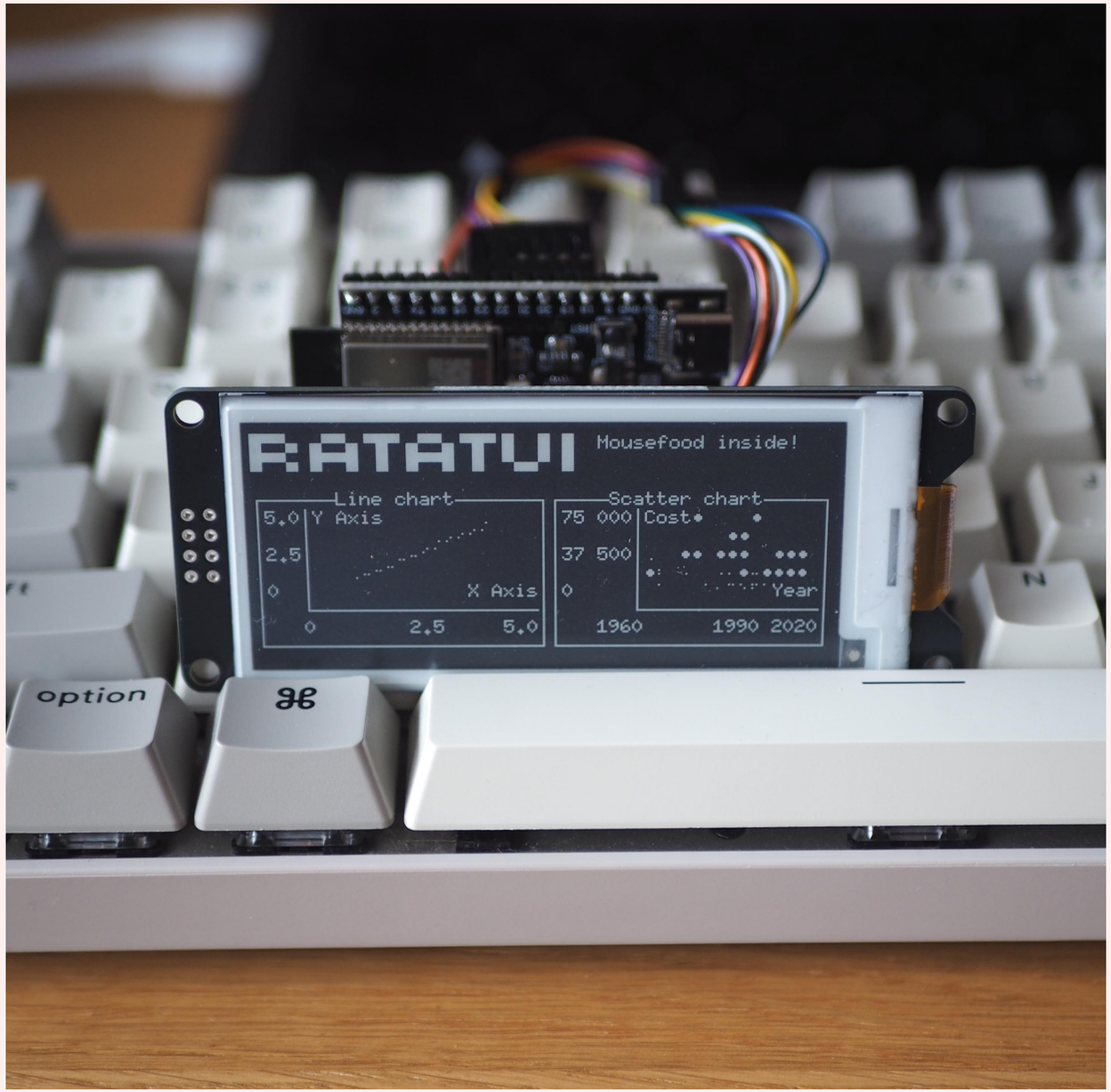
Custom Backends

Repository	Description
reubeno/ratatui-uefi	UEFI
j-g00da/mousefood	embedded-graphics backend
Jesterhearts/ratatui-wgpu	GPU-accelerated rendering to a buffer
gold-silver-copper/egui_ratatui	EGUI widget
gold-silver-copper/soft_ratatui	Pure software rendering to arbitrary buffer
cxreiff/bevy_ratatui_camera	Render Bevy app to the terminal
orhun/ratzilla	Web



Today we will talk about:

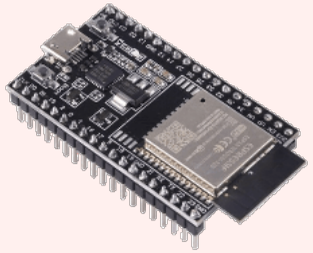



RATATUI
Mousefood inside!
Line chart
5.0
Y Axis
2.5
0
X Axis
0
2.5
5.0
Scatter chart
75 000
Cost
37 500
0
Year
1960
1990
2020
option
⌘

Know your hardware!

ESP32 by Espressif Systems

- Dual-core 32-bit MCU up to 240 MHz with Wi-Fi + Bluetooth
- 520 KB SRAM, supports external flash/PSRAM
- Rich I/O: ADC, DAC, SPI, I²C, UART, PWM, touch sensors



Frameworks

esp-hal

- Bare metal (#![no_std])
- Development funded by Espressif

esp-idf-hal

- With std support!
- Community effort
- Requires a custom toolchain

Toolchain

```
cargo install espup
espup install
```

```
cargo install espflash
```

.cargo/config.toml:

```toml
[build]
target = "xtensa-esp32-espidf"

[target.xtensa-esp32-espidf]
linker = "ldproxy"
runner = "espflash flash --monitor"
rustflags = [ "--cfg",  "espidf_time64"]
```

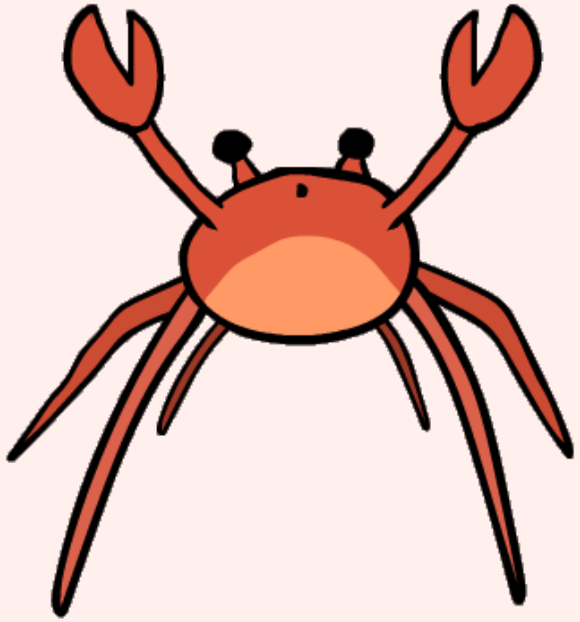
```
esp-generate
```

```
──────────── [finished with error] ────────────

failed to run snippet: error running process:  [?25l [38;5;10m? [39m Select your target
chip:
 [38;5;14m> [39m  [38;5;14mesp32 [39m
  esp32c2
  esp32c3
  esp32c6
  esp32h2
  esp32s2
  esp32s3
 [38;5;14m[ [39m [38;5;14m↑↓ to move, enter to select, type to
filter [39m [38;5;14m] [39m
target chip: q  [K25l [27D [38;5;10m? [39m Select your
 [38;5;14m[ [39m [38;5;14m↑↓ to move, enter to select, type to filter [39m [38;5;14m] [39m [K
 [2K
 [2K
 [2K
 [2K
 [2K
 [2K
 [2K

                         [38;5;10m? [39m Select your target chip: qq  [K



 [1A [29C [?25h [2B [29D [?25hError: Operation was interrupted by the user
```

https://github.com/esp-rs/esp-generate

Built with **Ratatui**! 🐭

Soooo, *crab?*



YES!!!!

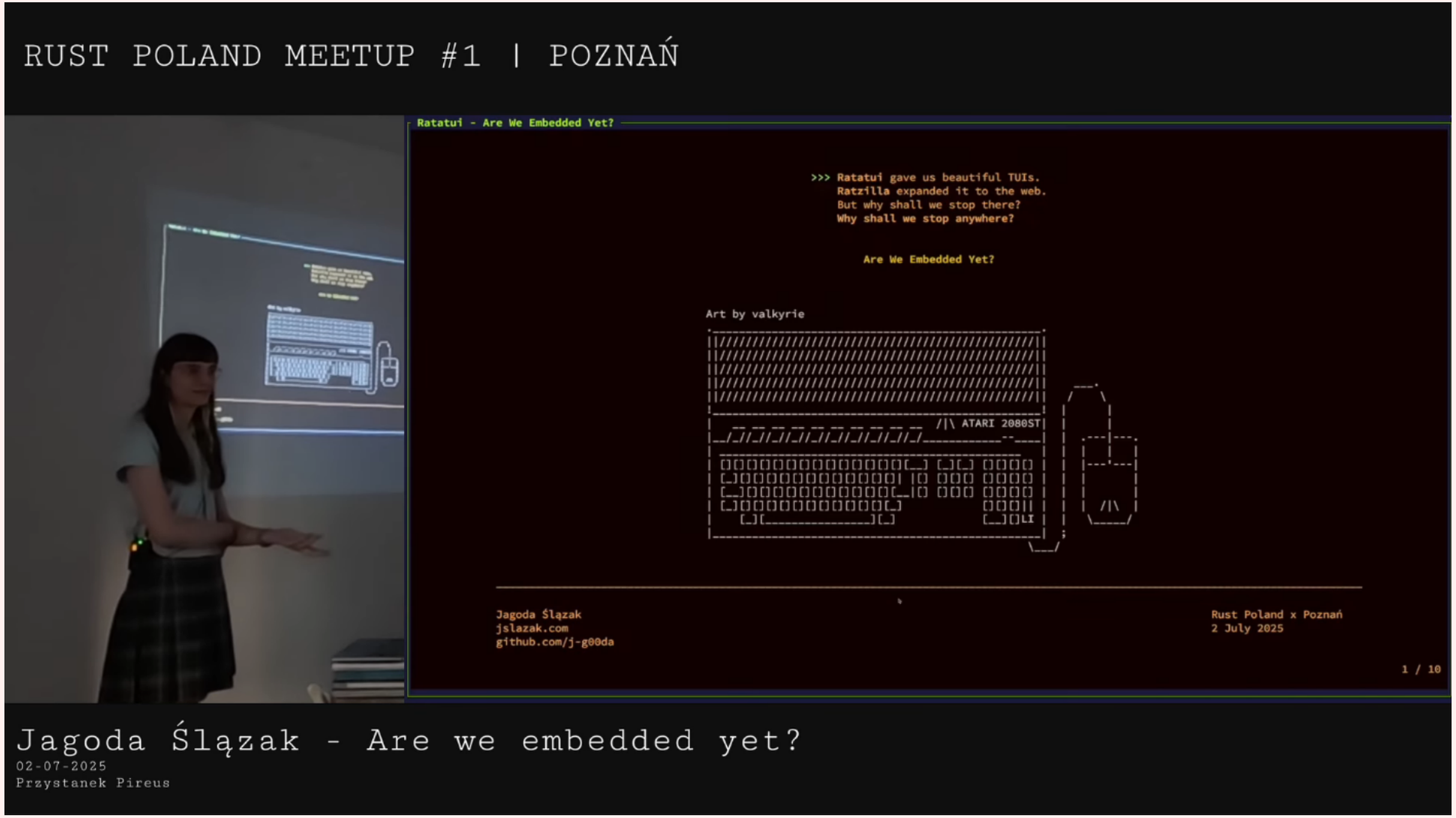
What about rat?

▒▒▒ Ratatui + embedded-graphics = **Mousefood**

- Built on embedded-graphics
- Custom bitmap font support

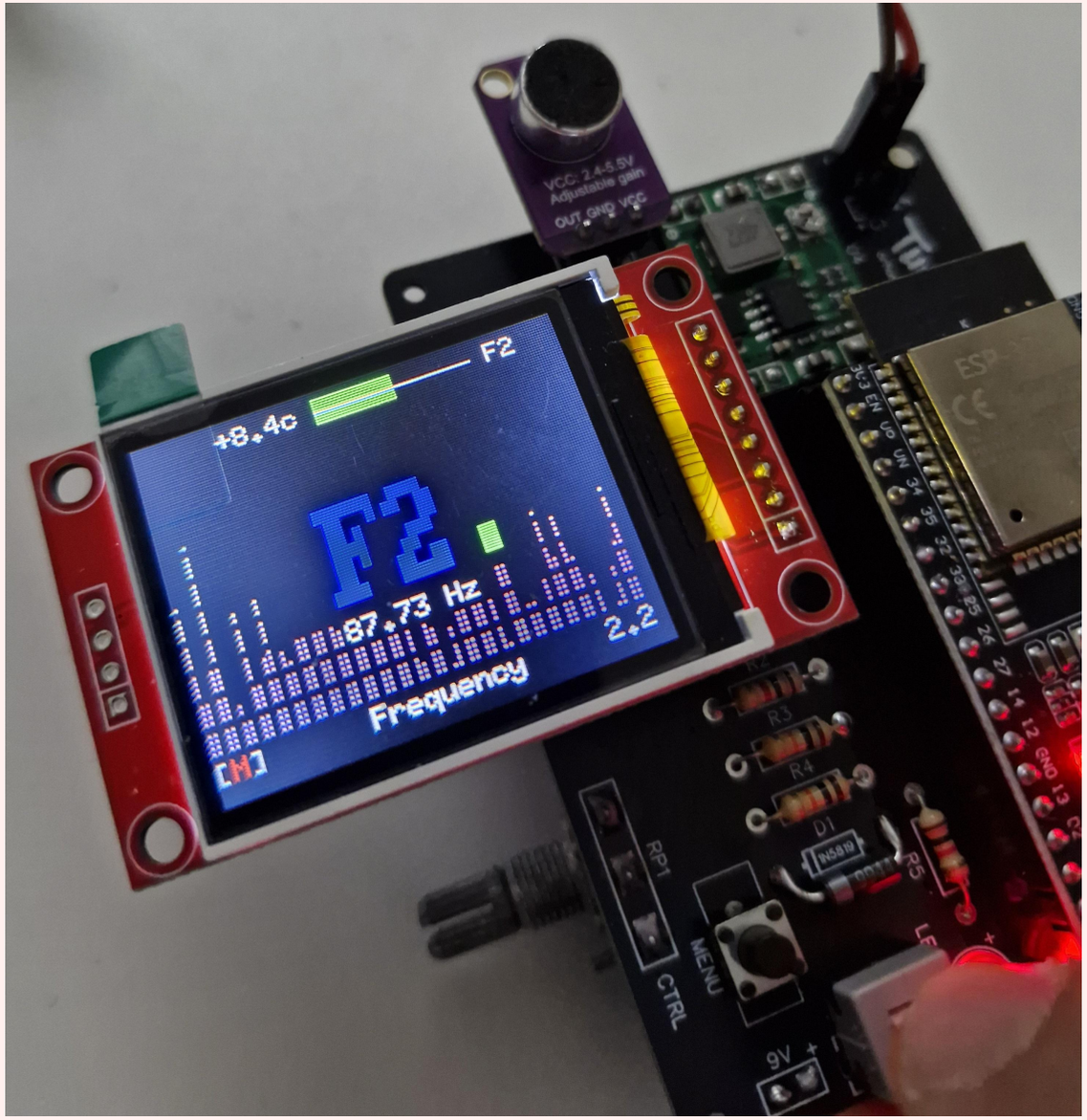
```rust
// Any embedded_graphics DrawTarget
let mut display = MyDrawTarget::new();

let backend = EmbeddedBackend::new(&mut display, EmbeddedBackendConfig::default());
let mut terminal = Terminal::new(backend)?;

loop {
    terminal.draw(...)?;
}
```

https://github.com/j-g00da/mousefood



https://youtu.be/QPjojOuhbe8
Ratatui is now no_std!

Demo time!



Powered by Rust, Ratatui and 9 volt battery!

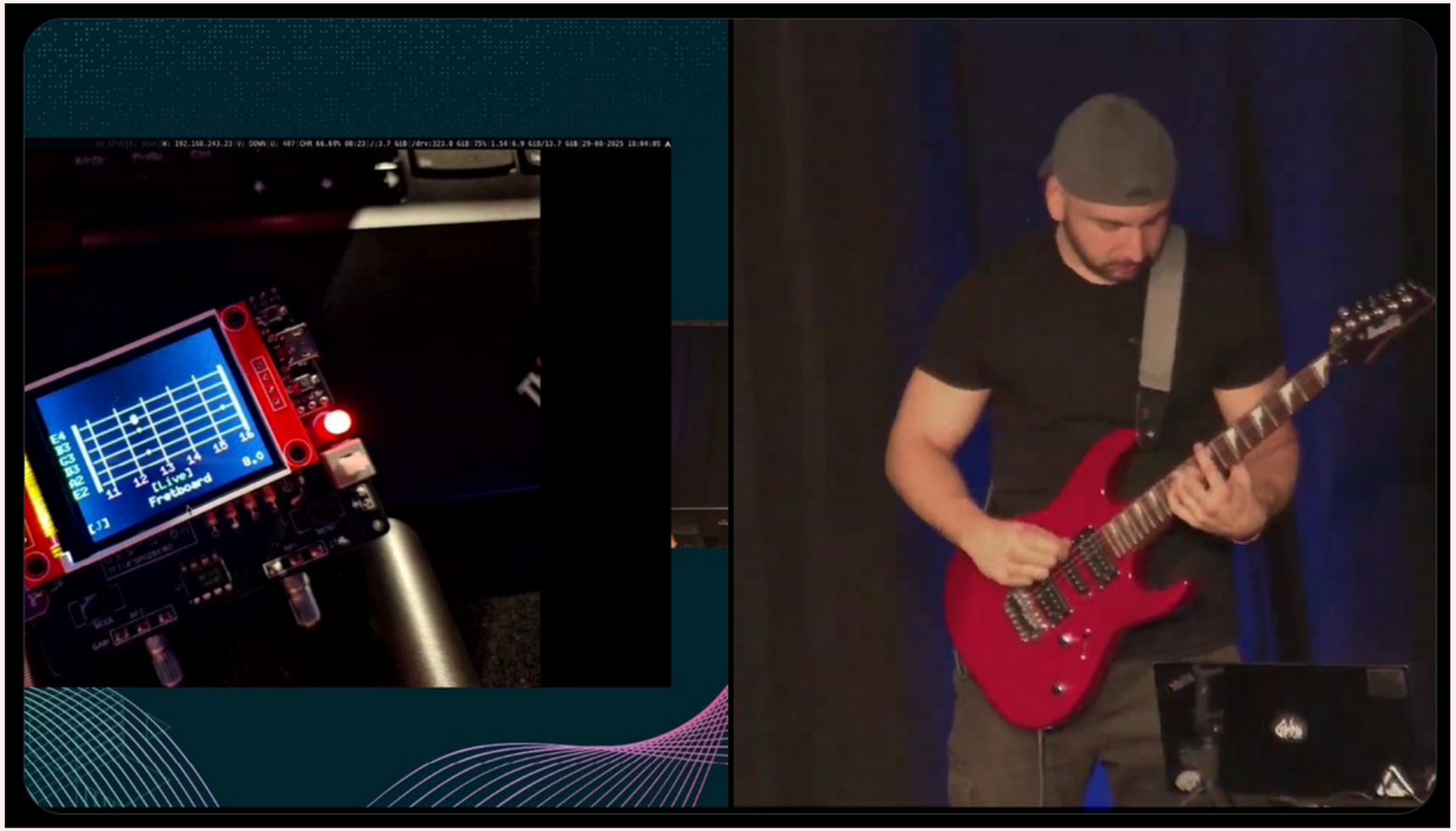
TUITARRR

"A portable and terminal-based guitar training tool"

```
mpv /home/orhun/downloads/tuitar-final.mp4
```

——————————— [finished] ———————————

```
● Video  --vid=1  --vlang=eng  (h264 1920x1080 30 fps) [default]
● Audio  --aid=1  --alang=eng  (aac 2ch 44100 Hz 318 kbps)
[default]
File tags:
 Title: tuitarrr-reencod
```



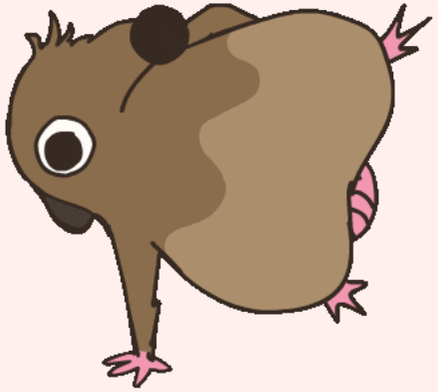
https://www.youtube.com/live/es48dmNWMVQ

Live demo at Rust Forge!

impl Widget

```rust
pub struct Fretboard {
    tuning: Vec<Note>,
    style: Style,
}
```

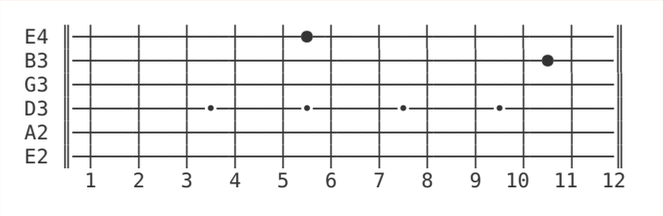
```rust
pub struct FretboardState {
    notes: Vec<Note>
}
```



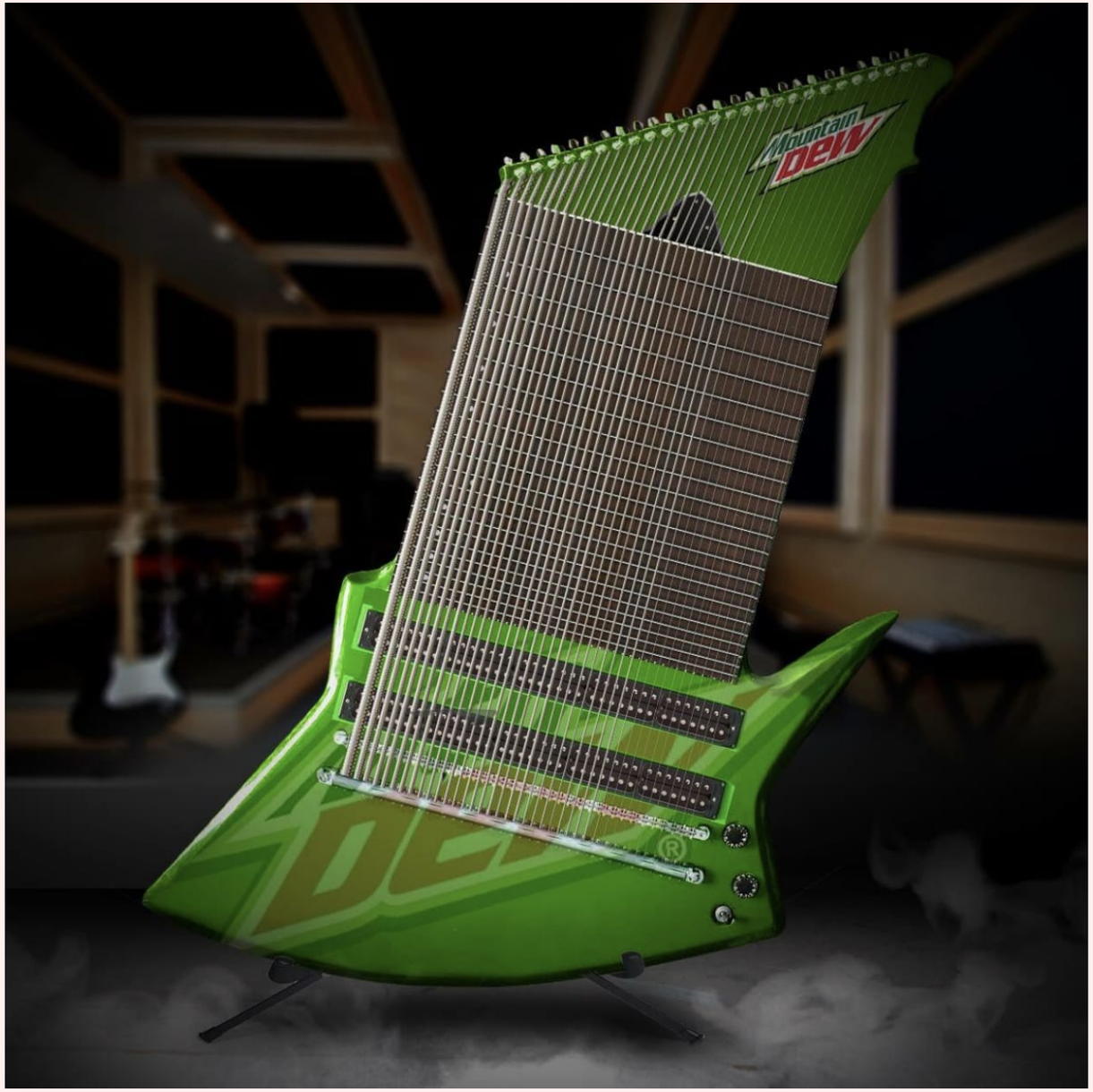
```rust
impl StatefulWidget for &Fretboard {
    type State = FretboardState;

    fn render(
        self,
        area: Rect,
        buf: &mut Buffer,
        state: &mut Self::State,
    ) {
        for s in self.tuning.iter() {
            // ...
            buf.set_line(
                area.x,
                area.y + i as u16,
                &Line::from(spans),
                area.width,
            );
        }
    }
}
```

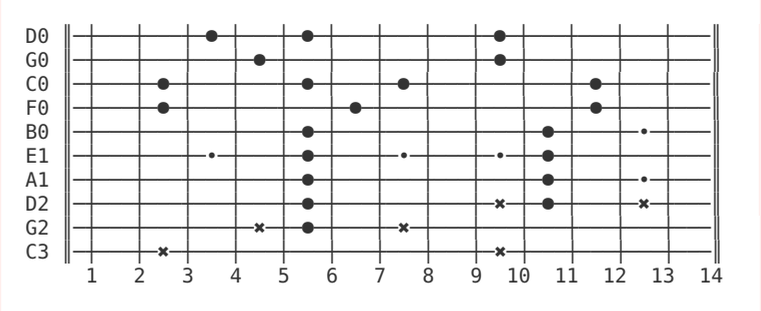
Introducing ratatui-fretboard widget 🎉

```rust
let fretboard = Fretboard::default();
let mut state = FretboardState::default();
state.set_active_note(Note::A(4));
frame.render_stateful_widget(fretboard, area, &mut state);
```

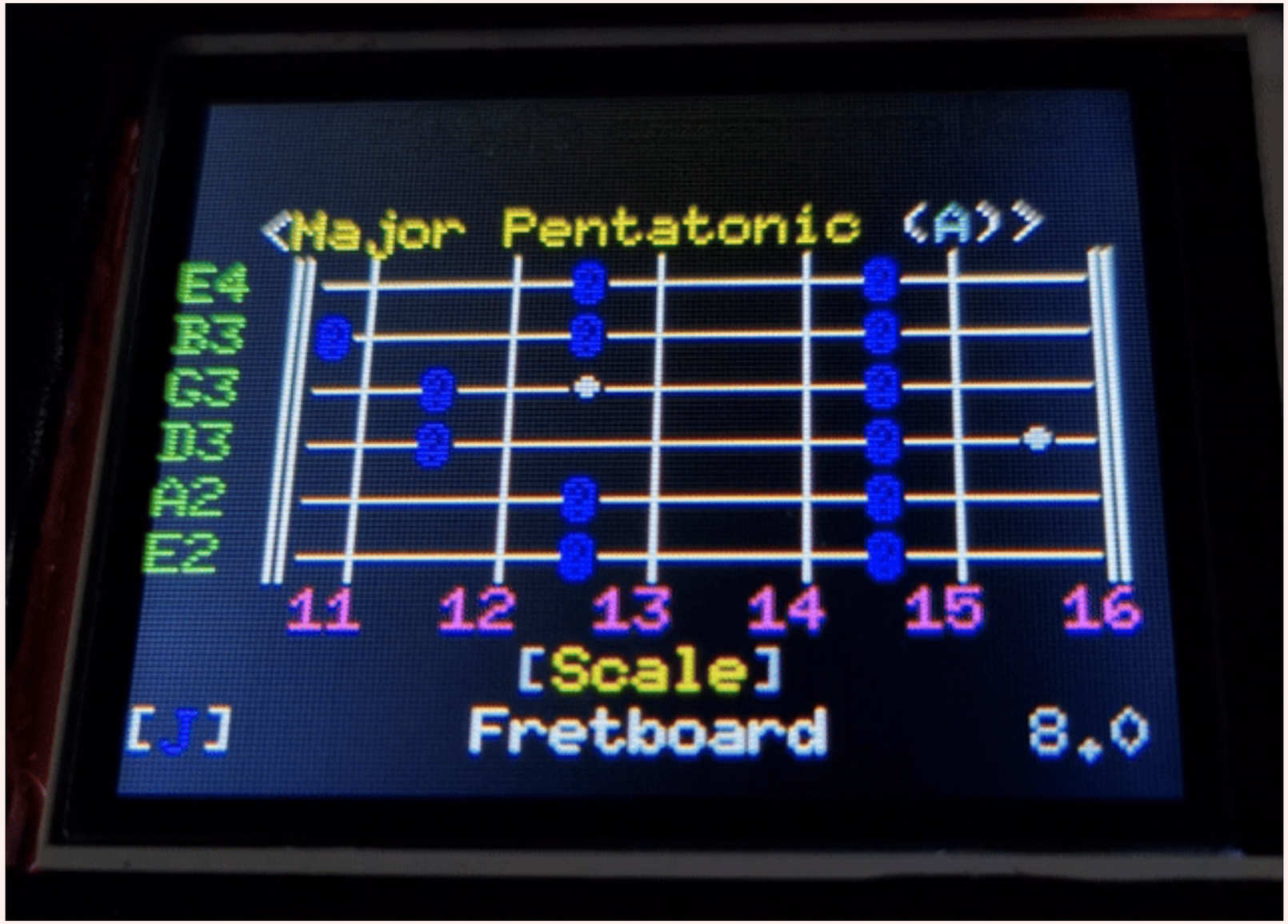


String names, frets, colors and everything else is customizable.


Mountain Dew


D0
G0
C0
F0
B0
E1
A1
D2
G2
C3
1 2 3 4 5 6 7 8 9 10 11 12 13 14

-17.5c
D4
E4
B3
G3
D3
A2
E2
11
12
13
14
15
16
[Live]
[J]
Fretboard
8.1


<Major Pentatonic (A)>
E4
B3
G3
D3
A2
E2
11
12
13
14
15
16
[Scale]
[J]
Fretboard
8.0

+5.7c
D#4
43%
Points: 2
E4
B3
G3
D3
A2
E2
11
12
13
14
15
16
[Random]
[J]
Fretboard
7.7

+12.3c
A3
<Unscripted Violence>
E4
B3
G3
D3
A2
E2
11
12
13
14
15
16
[Song]
[J]
Fretboard
7.7

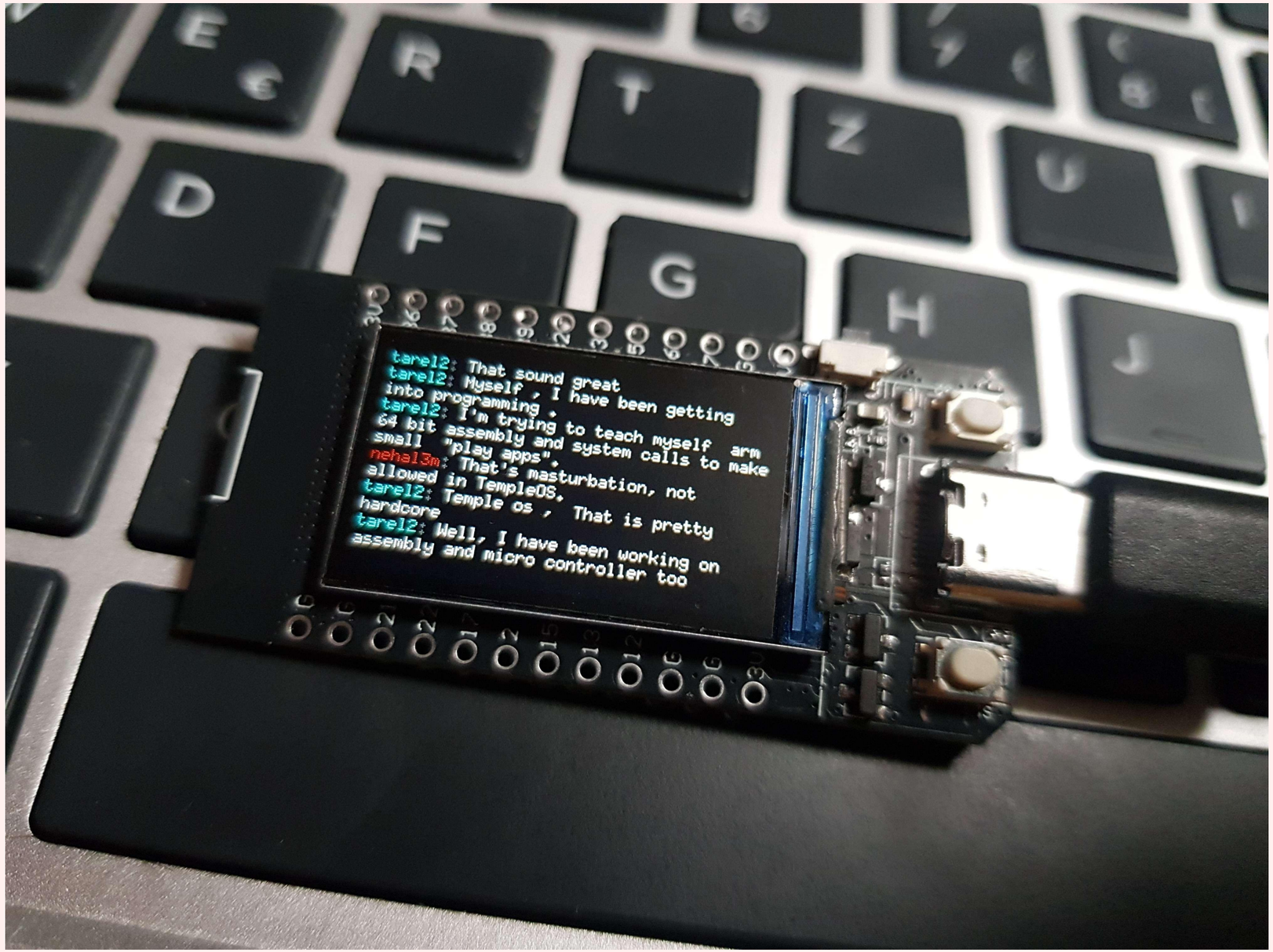
```
tuitar
```

[finished]

https://github.com/orhun/tuitar

Want more?

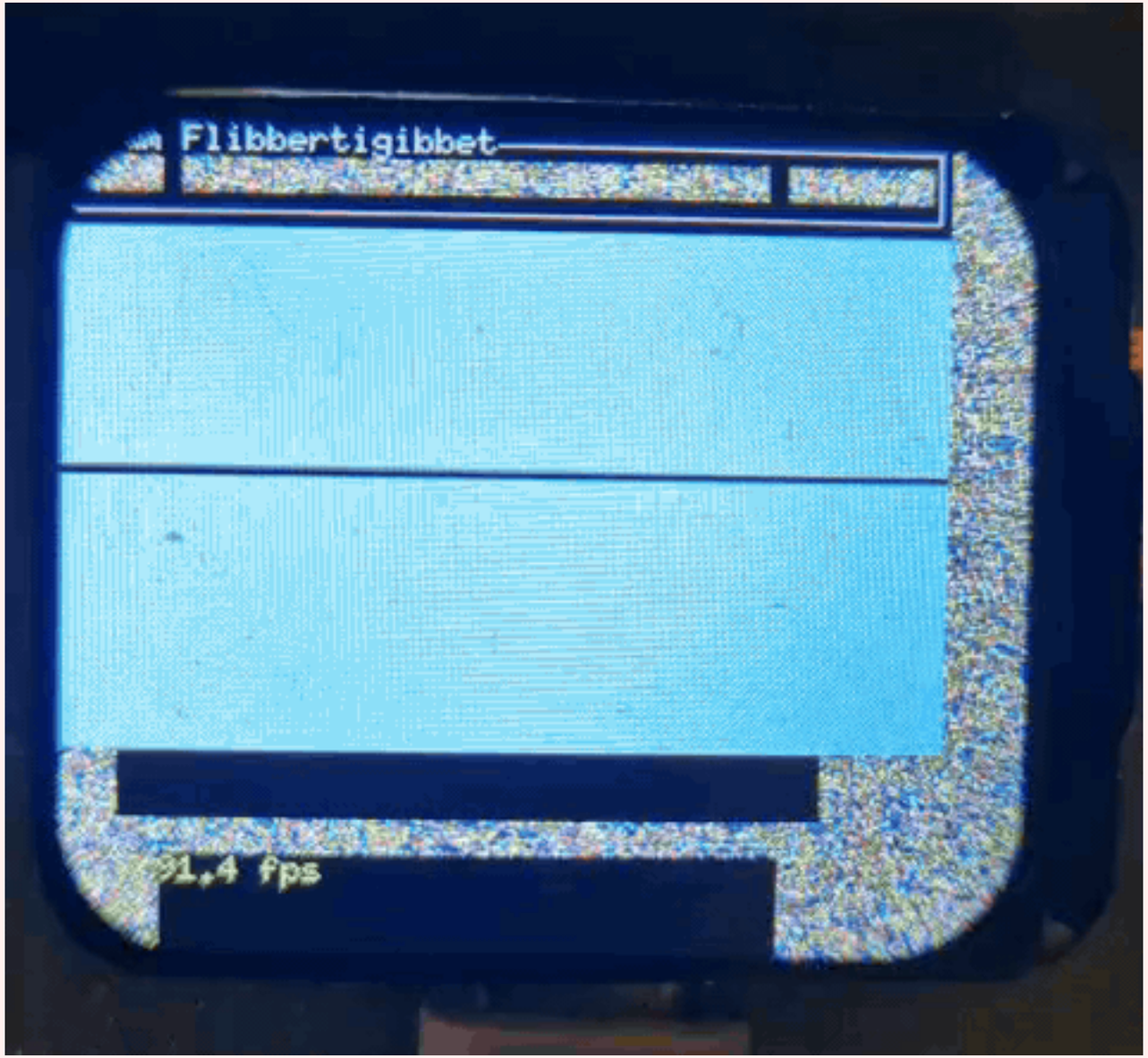
Talk is cheap, show me the cheese.



https://github.com/intuis/mnyaoo32

ILI9341 Cap Touch
PhoneOS
15:14
Wokwi-GUEST
WiFi settings
1

ILI9341 Cap Touch
WiFi settings
00:01
Not connected
← Go back
Wokwi-GUEST
Connect
a z e r t y u i o p
q s d f g h j k l m
Maj w x c v b n ' DEL
?123 , . ENTER
1



via https://github.com/junkdog/tachyonfx

i'm afraid
you've
ratted
your last
tatouille
sir

▒▒▒ Bigger screen == bigger problems

```
memory allocation of 153600 bytes failed
...
ili9341::graphics_core::<impl embedded_graphics_core::draw_target::DrawTarget for ili9341::Ili9341>::fill_contiguous
```

- ST7735: 160 × 128 ≈ 20 KB of pixel data.
- ILI9341: 240 × 320 ≈ 150 KB of pixel data.

```rust
esp_alloc::heap_allocator!(size: 160 * 1024);
```

```
CONFIG_ESP_MAIN_TASK_STACK_SIZE=16384
```

```
iver/gptimer.h`                                                    [27/30]
I (530) main_task: Started on CPU0
I (540) main_task: Calling app_main()
memory allocation of 8 bytes failed

abort() was called at PC 0x401229c6 on core 0
0x401229c6 - std::sys::pal::unix::abort_internal
    at ??:??


Backtrace: 0x400834a6:0x3ffdeb70 0x40086c55:0x3ffdeb90 0x4008cf66:0x3ff
debb0 0x401229c6:0x3ffdec20 0x4012de66:0x3ffdec40 0x401227e1:0x3ffdec60
 0x401227ee:0x3ffdec80 0x400dd796:0x3ffdeca0 0x40136d2e:0x3ffdecc0 0x40
1272c0:0x3ffdece0 0x4011c515:0x3ffded00 0x400dd783:0x3ffded30 0x400e0b9
7:0x3ffded60 0x4015c74f:0x3ffded80
0x400834a6 - panic_abort
    at ??:??
0x40086c55 - esp_system_abort
    at ??:??
0x4008cf66 - abort
    at ??:??
0x401229c6 - std::sys::pal::unix::ab
    at ??:??
0x4012de66 - std::process::abort
    at ??:??
0x401227e1 - std::alloc::rust_oom
    at ??:??
0x401227ee - __rg_oom
    at ??:??
0x400dd796 - __rust_alloc_error_handler
```

Build hell

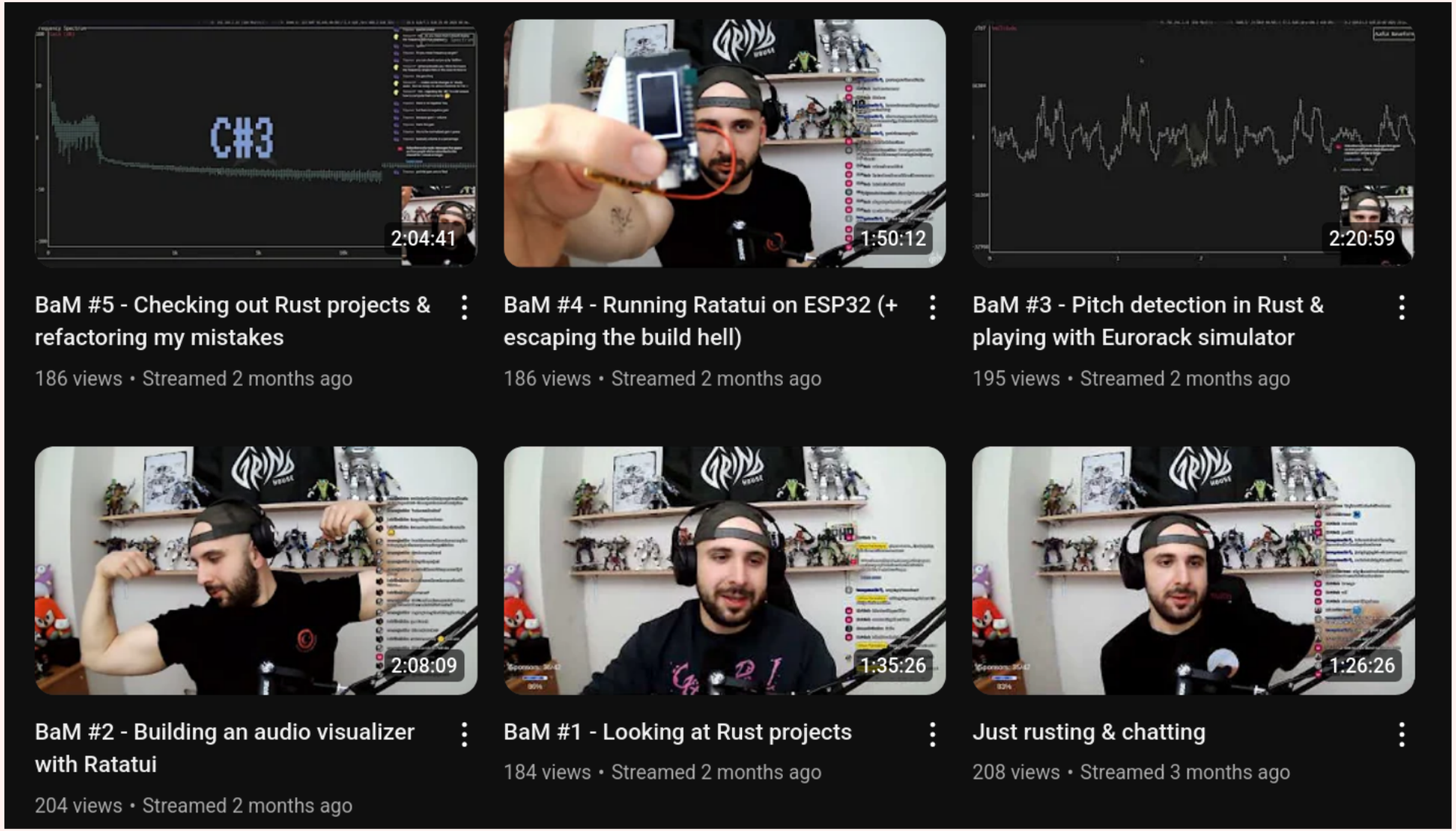
Random panics / loadprohibited / semaphore asserts with opt-level > 1

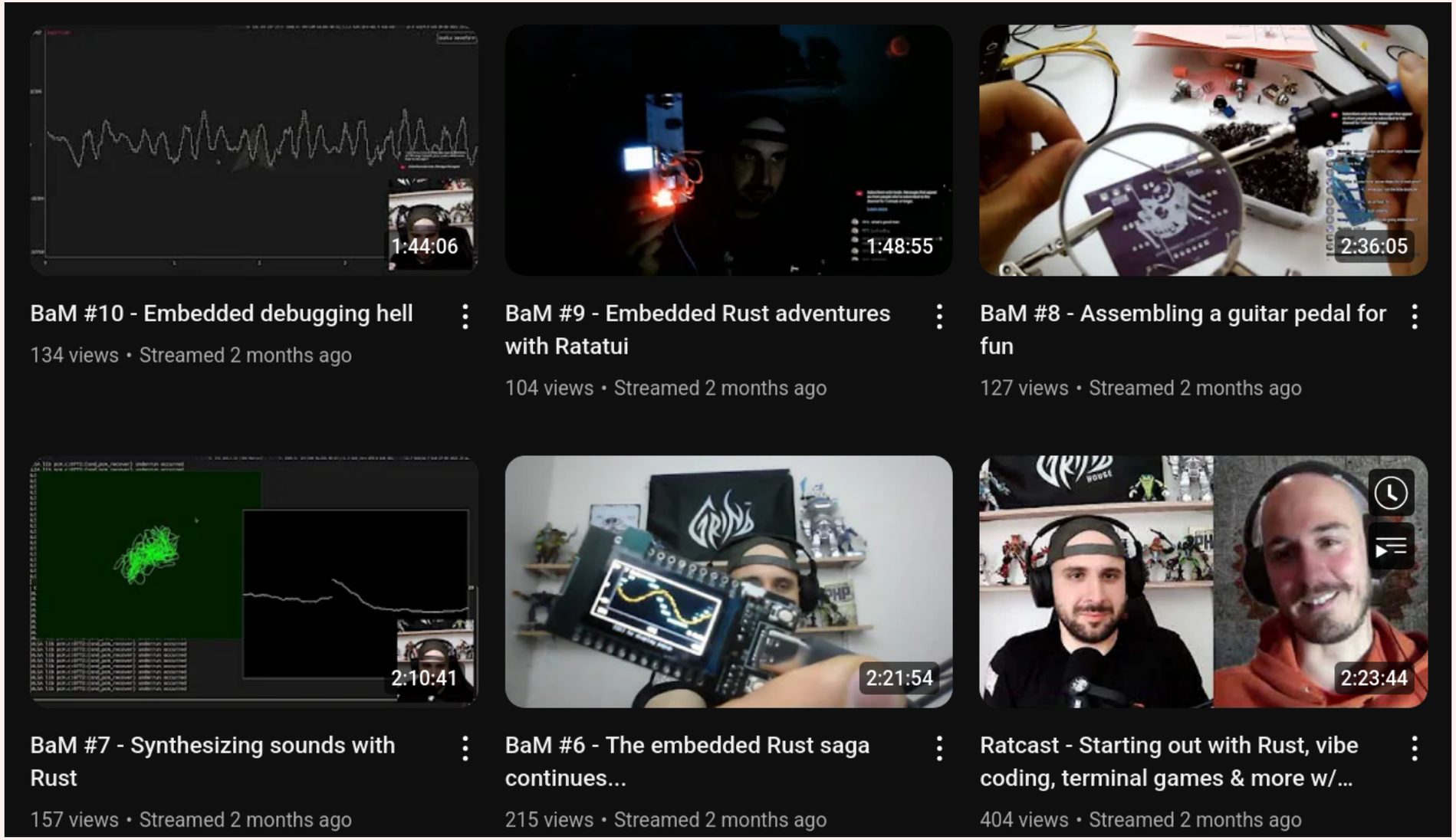
```toml
[profile.release]
opt-level = 3

[profile.release.package."firmware"]
opt-level = 1

[profile.dev]
debug = true
opt-level = "z"
```

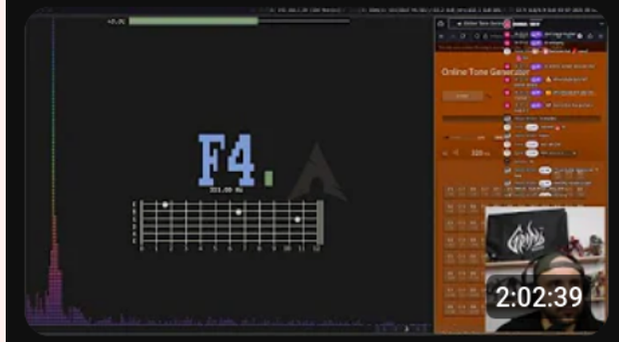
Caused by LLVM optimizations + Xtensa backend bugs + undefined behavior (allocation, alignment, lifetimes, etc.)

i.e. pain

btw you can watch me suffer




1:44:06
BaM #10 - Embedded debugging hell
134 views • Streamed 2 months ago
1:48:55
BaM #9 - Embedded Rust adventures with Ratatui
104 views • Streamed 2 months ago
2:36:05
BaM #8 - Assembling a guitar pedal for fun
127 views • Streamed 2 months ago
2:10:41
BaM #7 - Synthesizing sounds with Rust
157 views • Streamed 2 months ago
2:21:54
BaM #6 - The embedded Rust saga continues...
215 views • Streamed 2 months ago
2:23:44
Ratcast - Starting out with Rust, vibe coding, terminal games & more w/...
404 views • Streamed 2 months ago



BaM #15 - Guitar tab visualization widget for Ratatui

114 views • Streamed 1 month ago

BaM #14 - Improving the pitch detection of the tuner

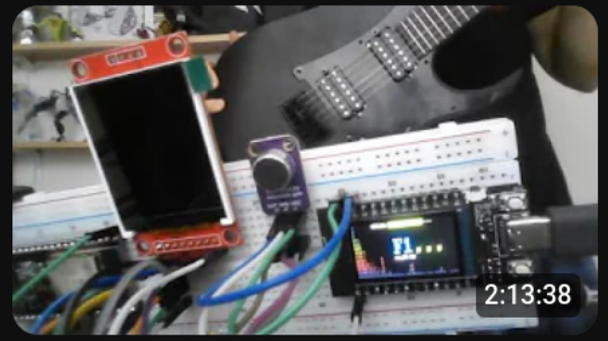
100 views • Streamed 1 month ago

BaM #13 - Doing a recap & refactoring Rust

83 views • Streamed 1 month ago

Mauritius Beach Stream

228 views • Streamed 1 month ago

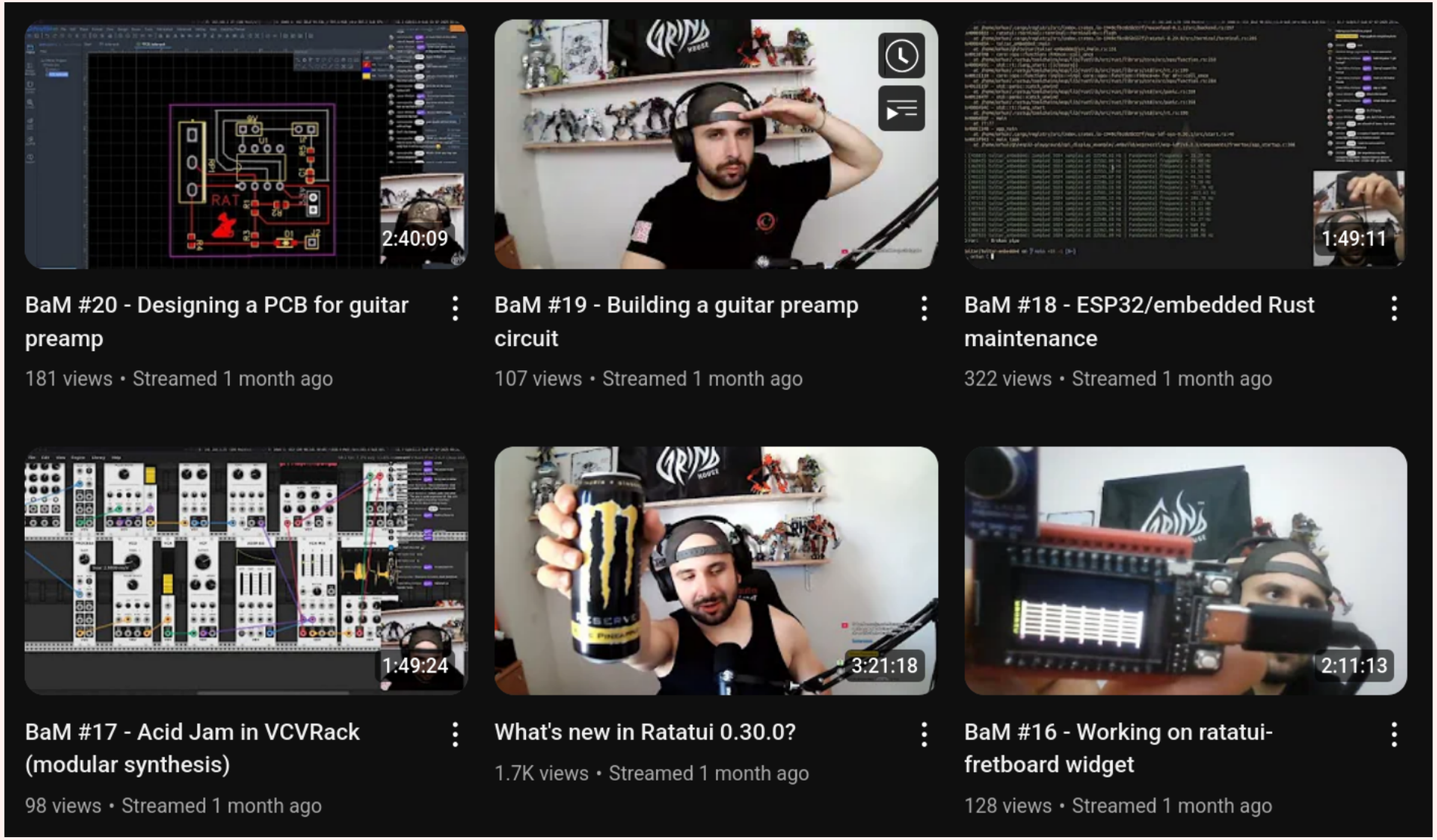


BaM #12 - Guitar tuner embedded UI with Ratatui

265 views • Streamed 2 months ago

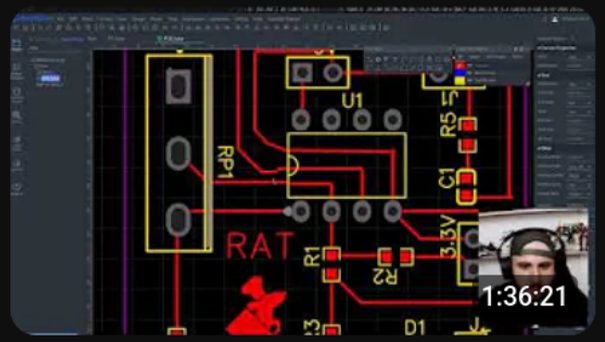
BaM #11 - Doing embedded Rust chores

248 views • Streamed 2 months ago


2:40:09
BaM #20 - Designing a PCB for guitar preamp
181 views • Streamed 1 month ago
BaM #19 - Building a guitar preamp circuit
107 views • Streamed 1 month ago
1:49:11
BaM #18 - ESP32/embedded Rust maintenance
322 views • Streamed 1 month ago
1:49:24
BaM #17 - Acid Jam in VCVRack (modular synthesis)
98 views • Streamed 1 month ago
3:21:18
What's new in Ratatui 0.30.0?
1.7K views • Streamed 1 month ago
2:11:13
BaM #16 - Working on ratatui-fretboard widget
128 views • Streamed 1 month ago

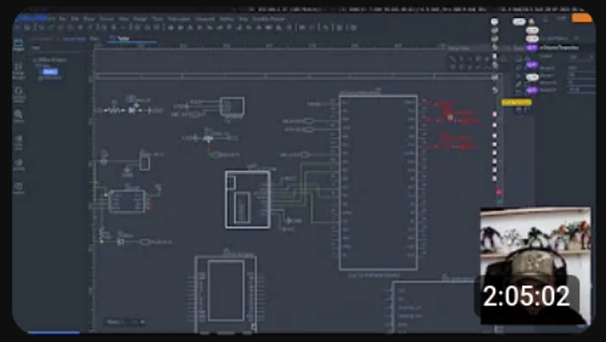
BaM #26 - Refactoring/reorganizing/ rethinking Rust

281 views • Streamed 2 weeks ago



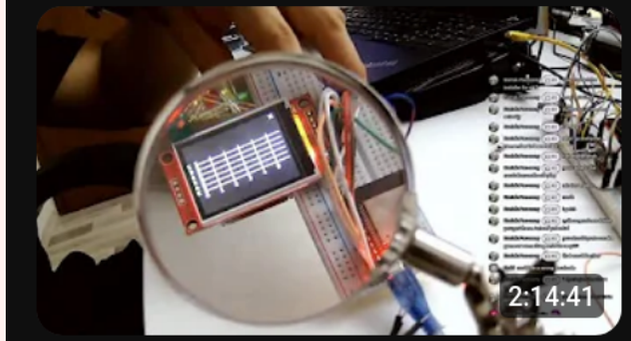
BaM #25 - Designing the final PCB

77 views • Streamed 3 weeks ago



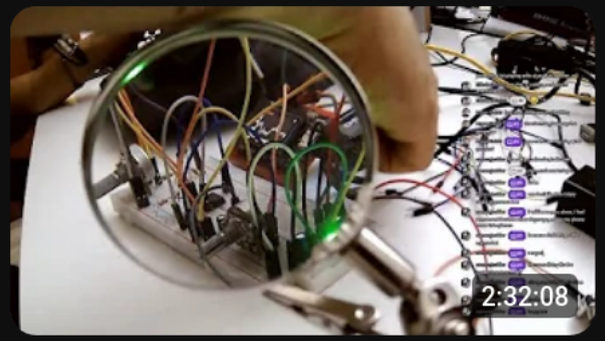
BaM #24 - Updating schematics for the guitar tuner

106 views • Streamed 3 weeks ago



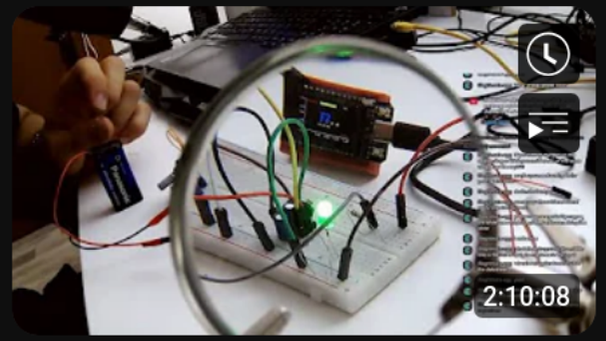
BaM #23 - ESP32 goes wroom & TFT display for Ratatui

149 views • Streamed 3 weeks ago



BaM #22 - Rotary encoder, analog reads and TUI updates

115 views • Streamed 4 weeks ago



BaM #21 - Voltage regulation, fancy switch and PCB updates

161 views • Streamed 4 weeks ago

BaM #31 - Improving ratatui-fretboard & tracking mode

90 views • Streamed 3 days ago

BaM #30 - Rust firmware updates

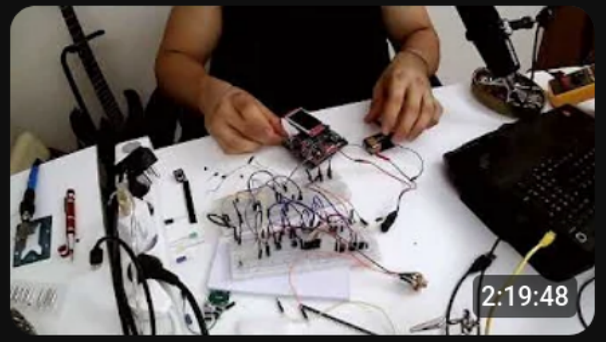
196 views • Streamed 5 days ago

Alright RustRover, impress me. (Best IDE for Rust??)

701 views • Streamed 6 days ago

BaM #29 - Improving the Rust embedded firmware yay

267 views • Streamed 7 days ago

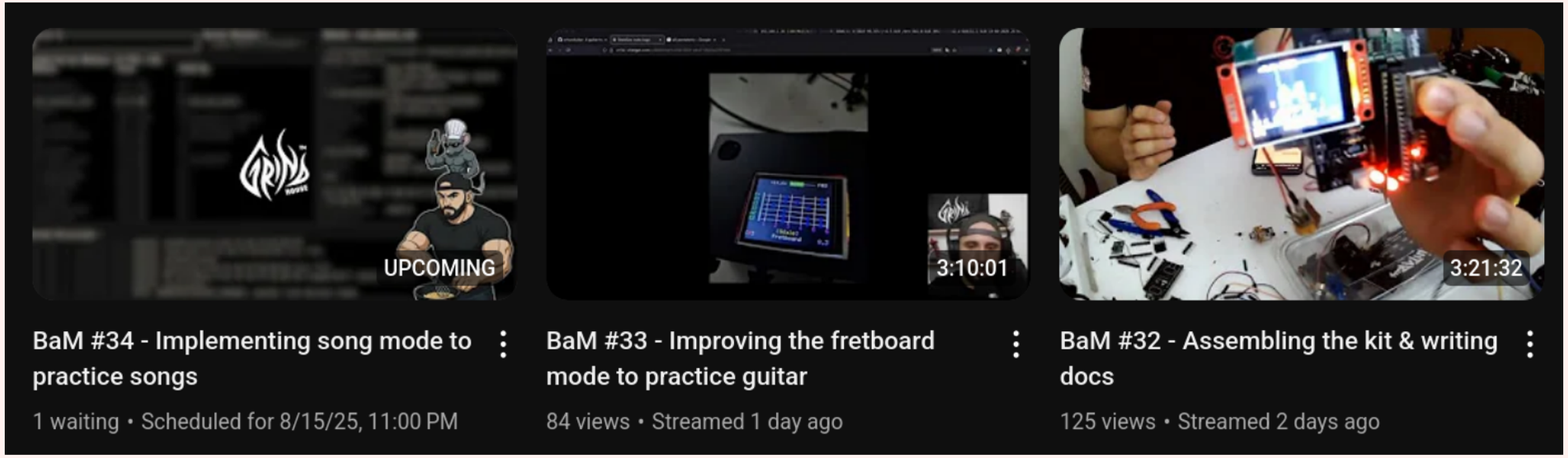


BaM #28 - Assembling the tuitar PCB

127 views • Streamed 10 days ago

BaM #27 - Rewriting my Rust code in better Rust

195 views • Streamed 2 weeks ago



https://www.youtube.com/@orhundev

Important note!

Thank you!

https://github.com/orhun
https://github.com/orhun/tuitar

✨ Slides: https://github.com/orhun/rustchinaconf-2025-talk
P.S. I don't have a rat under my hat!