

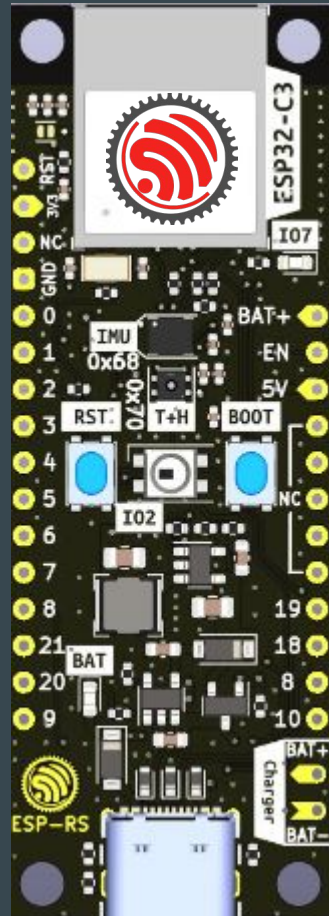


Embedded Rust on ESP32

2022-11-24

Rust Linz

Juraj Michálek - Espressif Systems



Early days of Rust support

Sep 10, 2019 - 6 min read

Rust on the ESP32

About six months ago, I made a [post on reddit](#) highlighting the launch of Espressif's llvm xtensa fork, not too long after, I had a working `rustc` toolchain capable of generating xtensa assembly. At this point I had to put this project to the side to finish my final year of university. Funnily enough I didn't stray too far, my final year project used Rust to create a ['smartwatch'](#) (I may write about this in the future, if anyone is interested).



Blog: <https://mabez.dev/blog/posts/>

EDC22 Day 1 Talk 7: Rust on Espressif chips -
https://youtu.be/qeEmJ_-6fPg

wokwi.com/rust

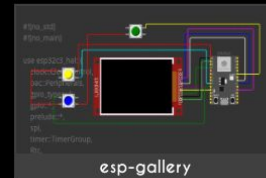
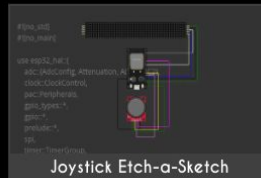
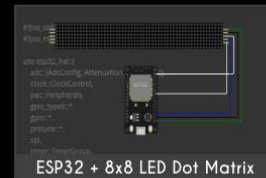
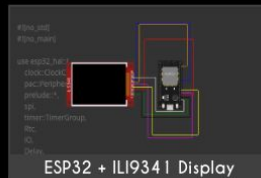
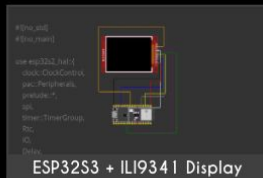
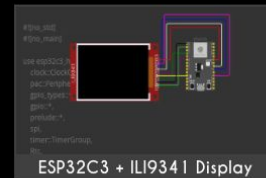
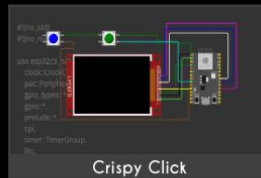
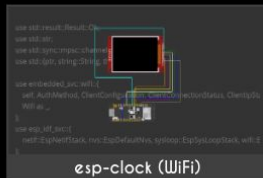
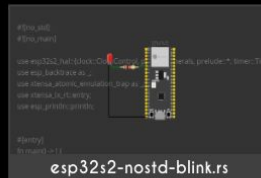
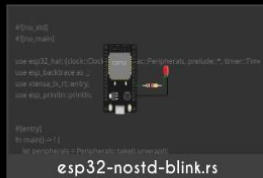
Quick start

Contribute: <https://github.com/wokwi>

EDC22 Day 1 Talk 9: Your browser is
ESP32 - Wokwi -
<https://youtu.be/TKe4MgD6O8o>

Rust project examples

+ NEW PROJECT



OSes and integration



no_std a.k.a. bare metal - <https://github.com/esp-rs/esp-hal> (minimalistic)

std based on ESP-IDF (OS based on FreeRTOS) - <https://github.com/esp-rs/esp-idf-hal> (full feature)



Zephyr - <https://zephyrproject.org/> (as app, possible to separate core for security apps)

- EDC22 Day 1 Talk 10: Applications of Asymmetric Multiprocessing with ESP32 Devices - including Rust on one core - <https://youtu.be/oble9ObAqxM>



NuttX - <https://nuttx.apache.org/> (as app, Linux-like OS, separate core for sec. apps)

SVD files: <https://github.com/espressif/svd>

Peripheral Access Crates (PACs): <https://github.com/esp-rs/esp-pacs>

Many chips, many boards - quick help

<https://products.espressif.com/>



ESP32-S3

 Product Brief

 Docs & Certs

 DevKits

ESP32-S3 is a low-power MCU-based SoC that supports 2.4 GHz Wi-Fi and Bluetooth® Low Energy (Bluetooth LE).

ESP32-S3 has a complete Wi-Fi subsystem and a Bluetooth LE subsystem, State-of-the-art power and RF performance. S3 provides a rich set of peripheral interfaces, and supports ultra-low-power applications. Different security features allow the device to meet stringent security requirements.

Features:

- **Core:** Xtensa® single-dual 32-bit LX7 CPU, frequency up to 240MHz
- **Memories:**

Block Diagram:



List: 203 items

 IC/Module

 Development Board

 Comparison

 Export

☐	Index	Name	MPN	Marketing Status	Type	Wi-Fi
☐	1	ESP32-S3	ESP32-S3	Mass Production	SoC	IEEE 802.11 b/g/n; 2.4 ...
☐	2	ESP32-S3	ESP32-S3R2	Mass Production	SoC	IEEE 802.11 b/g/n; 2.4 ...
☐	3	ESP32-S3	ESP32-S3R8	Mass Production	SoC	IEEE 802.11 b/g/n; 2.4 ...
☐	4	ESP32-S3	ESP32-S3R...	Mass Production	SoC	IEEE 802.11 b/g/n; 2.4 ...
☐	5	ESP32-S3	ESP32-S3F...	Mass Production	SoC	IEEE 802.11 b/g/n; 2.4 ...

Development options

- Local
 - bootstrap whole env with “espup install” - <https://github.com/esp-rs/espup#installation> (written in Rust)
 - bootstrap with sh/pwsh (older method) - <https://github.com/esp-rs/rust-build#download-installer>
- Local in container
 - Podman, Docker, Lima
 - with VS Code Remote Container extension
- Cloud in GitPod.io or CodeSpaces
 - EDC22 Day 2 Talk 11 Just Few dot files in Repo or Paradigm Shift to Cloud-based Embedded Development - <https://youtu.be/WAwfRyOy7N8>
- Wokwi.com

Create new project

Bare metal:

```
cargo generate https://github.com/esp-rs/esp-template
```

STD with ESP-IDF:

```
cargo generate --vcs none --git https://github.com/esp-rs/esp-idf-template cargo
```

Build, flash, monitor

```
cargo espflash --release --monitor
```

-note: always flash with release due to size and other limitations

Examples:

- <https://github.com/esp-rs/awesome-esp-rust>
- <https://github.com/georgik/esp32-buddy-rs>
- <https://github.com/playfulFence?tab=repositories>
- <https://github.com/sambenko/esp32s3-box-examples>

Explore no_std

Supported peripherals: <https://github.com/esp-rs/esp-hal/issues/19>

```
git clone git@github.com:esp-rs/esp-hal.git --depth 1
```

```
cd esp-hal/esp32c3-hal/
```

```
cargo espflash --release --example hello_rgb --monitor --features "smartled"
```

Embedded Graphics (e.g. ESP32-S3-BOX)



ESP32-Sooky-Maze (PoC):

<https://github.com/georgik/esp32-spooky-maze-game>

Simple bare metal branch: main

WASM | ESP32-S3 Xtensa targets: feature/multiplatform

Big advantage of Rust:

shared business logic over multiple platforms!

<https://github.com/espressif/esp-box>

Explore STD + ESP-IDF

```
cargo generate --vcs none --git https://github.com/esp-rs/esp-idf-template cargo
```

Embuild: <https://github.com/esp-rs/embuild>

- Rust build system integrating with ESP-IDF
- Big thanks to [N3xed](#), [ivmarkov](#) and whole open source community

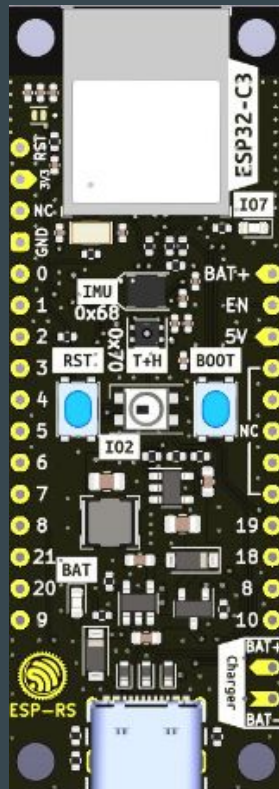
Designing Open Hardware - esp-rust-board

KiCad templates

<https://github.com/esp-rs/esp-rust-board>

ESP32-C3-DevKit-RUST-1 (available at Mouser, AliExpress)

<https://www.espressif.com/en/products/devkits>



ESP-RS organisation <https://github.com/esp-rs>



esp-rs

Libraries, crates and examples for using Rust on Espressif SoC's

Rust ESP32 Community meeting

Regular meeting every two weeks

<https://github.com/esp-rs/rust/discussions/>

Training Embedded for ESP32-C3 by Ferrous Systems

Training: <https://ferrous-systems.com/training/#package-espressif-beginner-training>

Material: <https://espressif-trainings.ferrous-systems.com/>

GitHub: <https://github.com/ferrous-systems/espressif-trainings/>

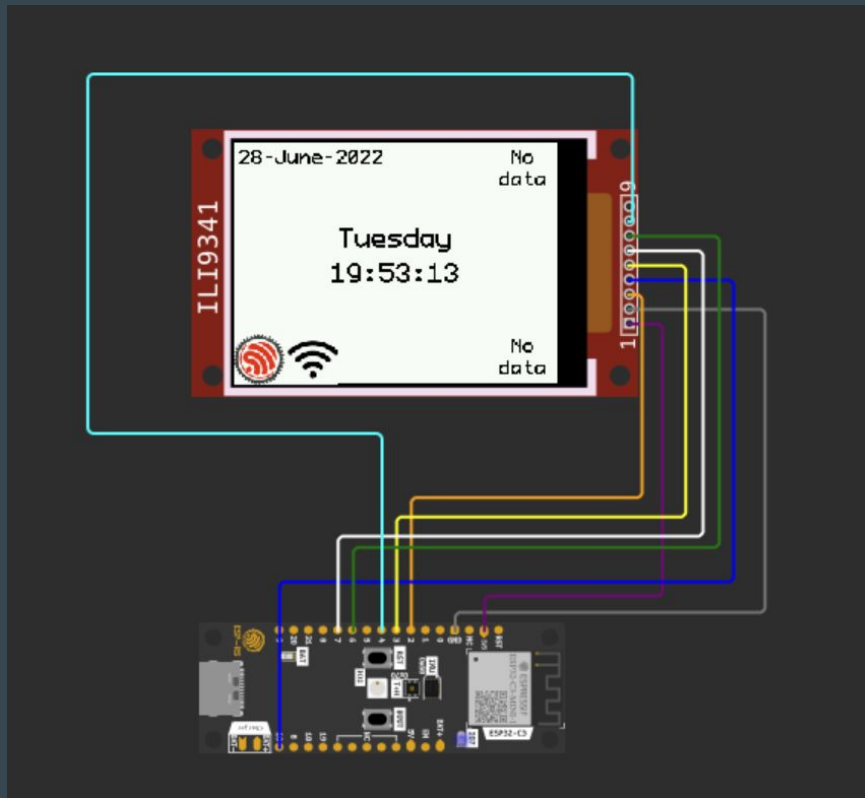


ferrous systems

GitPod.io + Wokwi.com



Open in Gitpod



<https://github.com/playfulFence/esp-clock#dev-containers>

Some links

The Rust on ESP Book - <https://esp-rs.github.io/book/>

Awesome ESP Rust - <https://github.com/esp-rs/awesome-esp-rust>

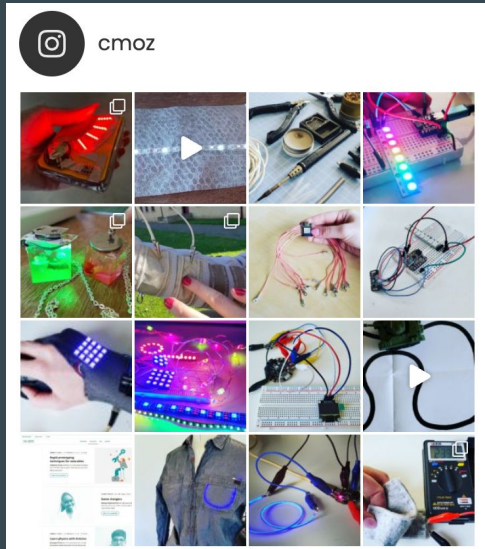
- submit your project :-)

**Some Inspiration
(not necessary in Rust)**

Wearables

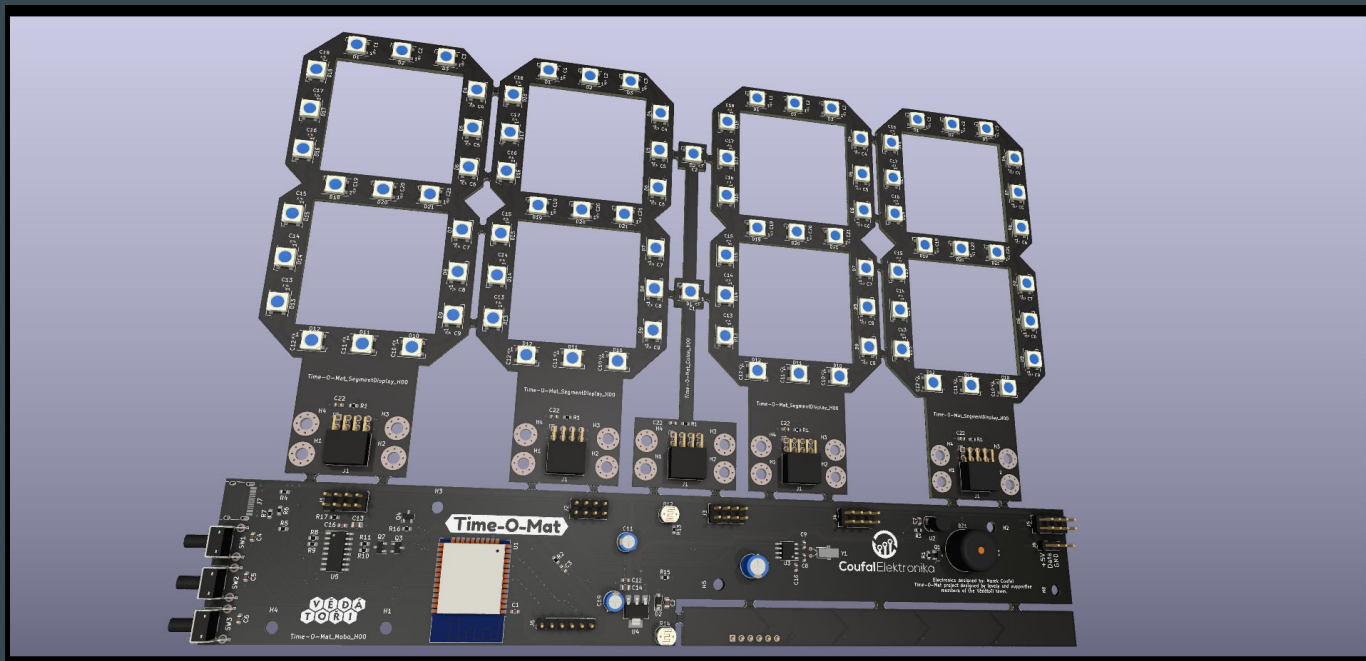
The Ultimate Guide to Informed Wearable Technology

- book: <https://packt.link/01VBv>



Time-O-Mat - built at summer camp

<https://github.com/vedatori/Time-O-Mat>



Grafana



<https://grafana.com/blog/2020/06/17/how-to-monitor-a-sourdough-starter-with-grafana/>

<https://github.com/grafana/diy-iot> - Arduino now. We're not Rust yet :)

Visit us in Brno

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Czechia, Europe



See you in Linz in 2023. We're planning ESP32 Rust Workshop ;-)