Industrial Automation

With **Rust**,

Embedded Linux,
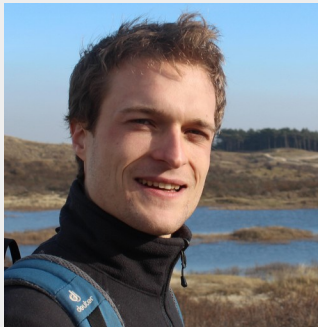
and **Open Hardware**

Who we are...

Dipl.-Ing. Markus Kohlhase

Dipl.-Inform. Uwe Klotz

M.Sc. David Ziegler
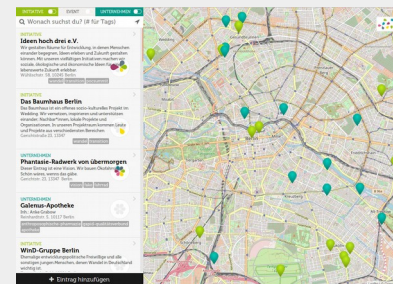

B.Sc. Enja Stein

M.Sc. Michel Sinn

M.Sc. Daniel Sprenger

What we do...

- Software Engineering
- Automation & Closed-loop Control
- Industrial 4.0
- (Web) App Development
- Product Prototyping
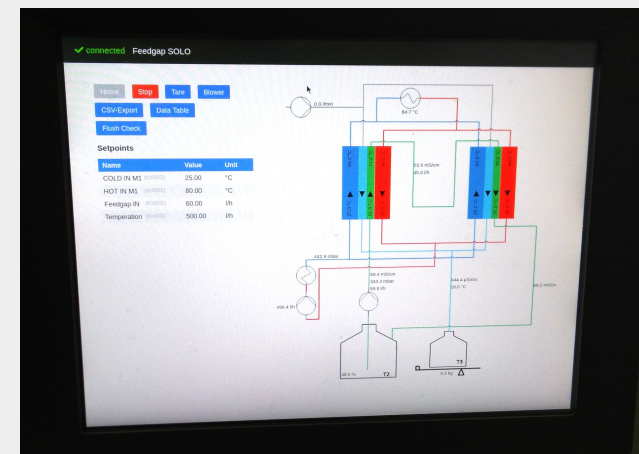- Consulting

Some of our projects...

- Water treatment plants
  - Closed-loop control
  - HMI (Web app)
- Solar power plants
- Irrigation systems
  - Product design
  - Software development
  - I/O System engineering (Partner: Relumity)
- Laboratory software
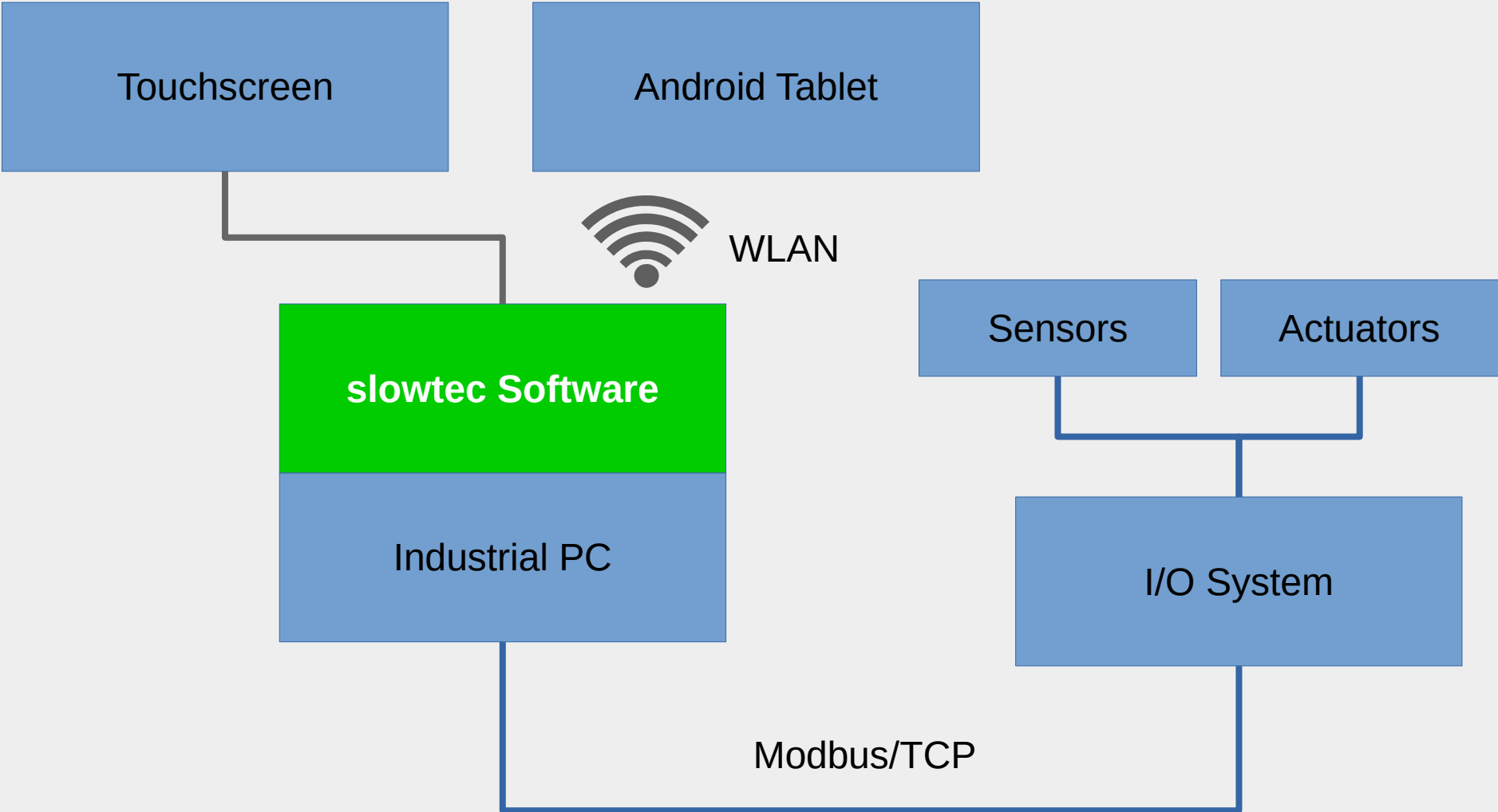- Geo. information system

An industrial use case...

- ~ 40 Sensors
- ~ 15 Actuators

Architecture

Touchscreen

Android Tablet

WLAN

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Industrial PC

Sensors

Actuators

I/O System

Modbus/TCP

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Open Hardware
(Our experiences so far)

- I/O System
  - ~~IndustrialShields~~ ← No RTD, bad materials
  - ~~Kunbus~~ ← No AO/AI in 2016

- Industrial PC
  - ~~Raspberry Pi~~ ← not reliable
  - ~~Odroid~~ ← not working with higher temperatures
  - ~~IndustrialShields~~ ← no Linux
  - Olimex ? ← no experiences so far

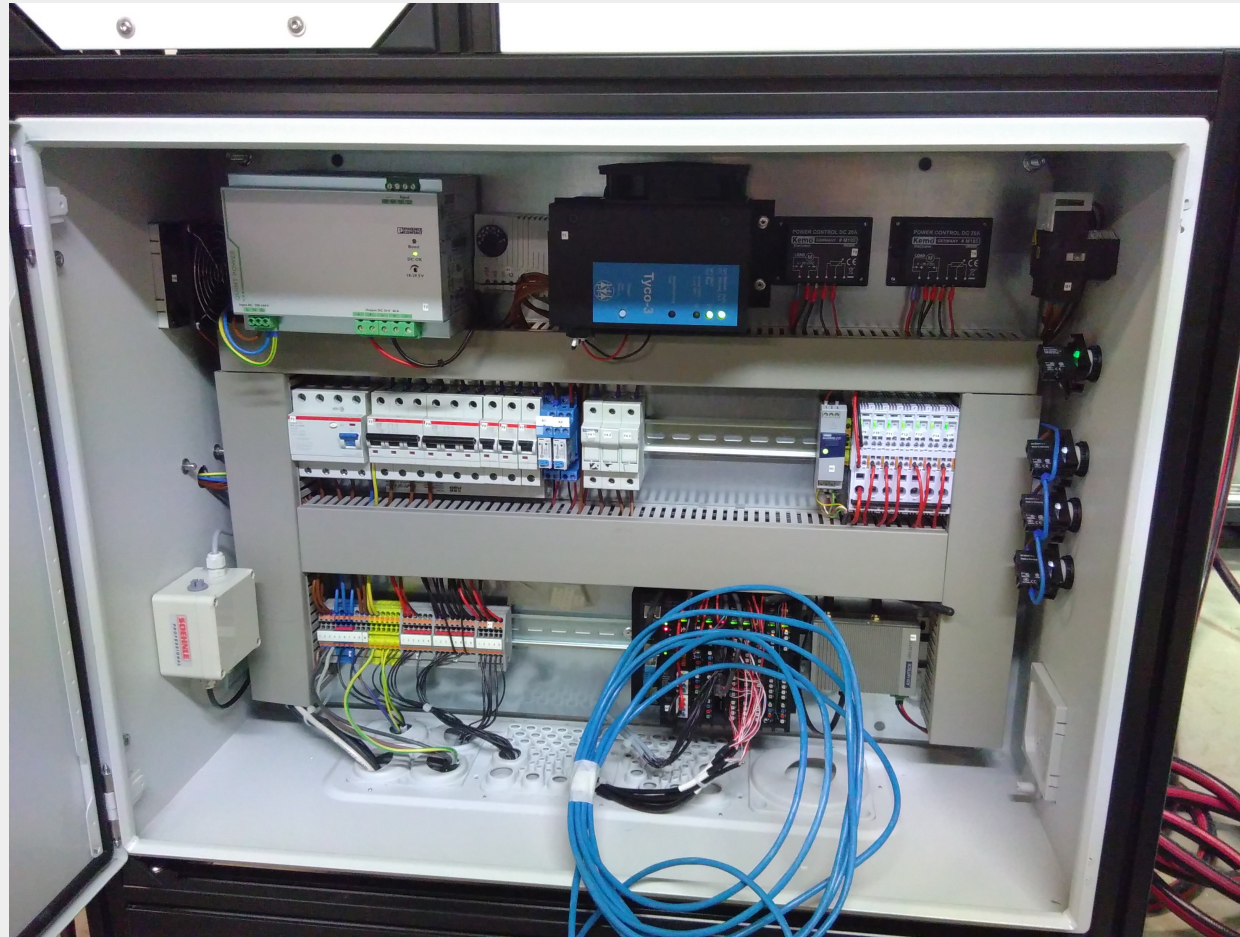# I/O System & Industrial PC
(Proprietary)

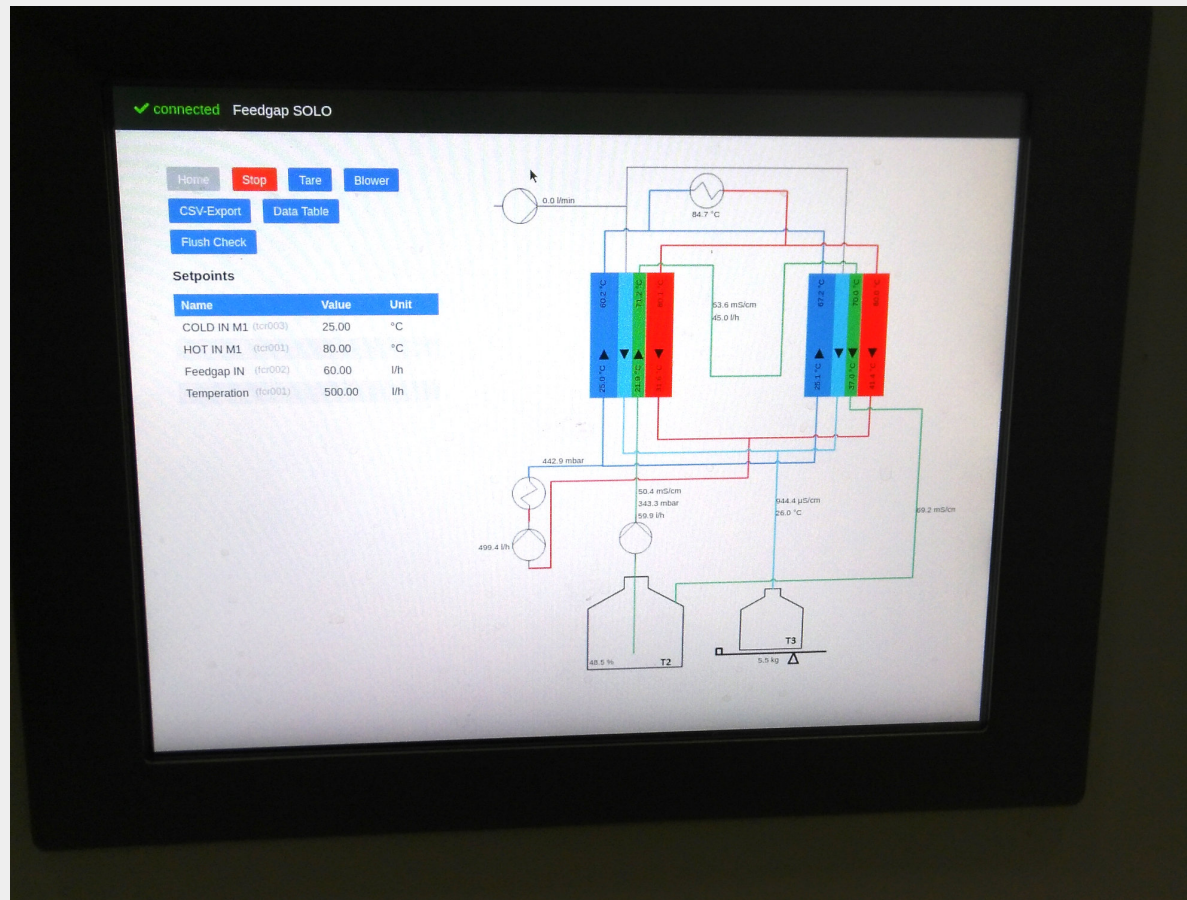# Our own open embedded industrial I/O board powered by Linux & Rust

- MIPS @ 1 GHz
- 128 MB RAM
- 32 MB Flash

Our partner: Relumity, Stuttgart

Some insights...
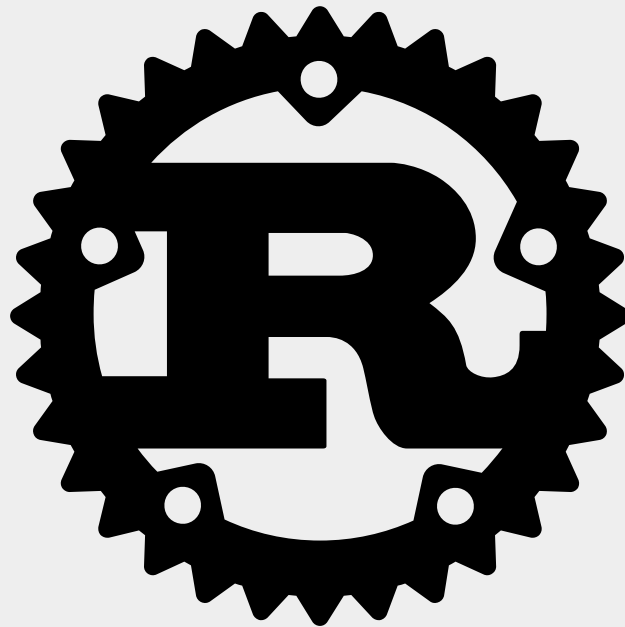
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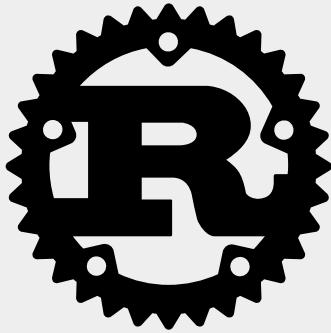
HMI (Touchscreen with WebApp)

What is NixOS?

NixOS is a Linux distribution with a unique approach to package and configuration management.
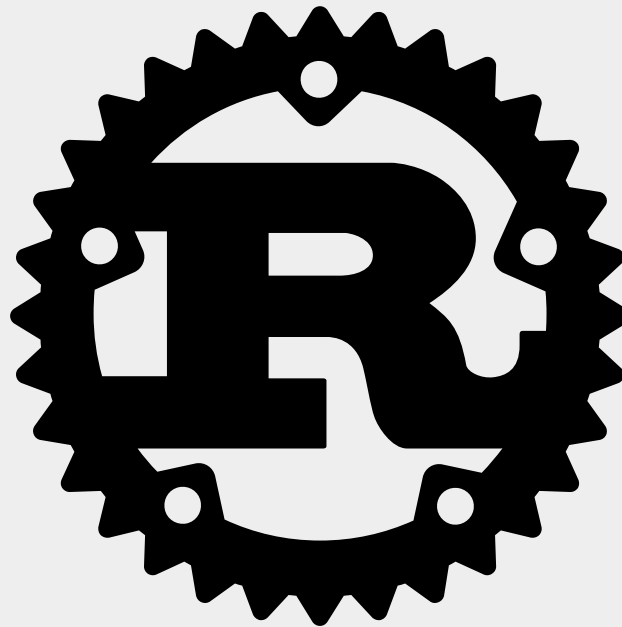It is **completely declarative**, makes upgrading systems **reliable.**

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What is Rust?

Rust is an **open source** systems programming language with a focus on **safety**.

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Why Rust?

Reliability

Why does this still happen in 2018?

Problems @ Javadoc Declaration Console

<terminated> Temp [Java Application] /Library/Java/JavaVirtualMachines/jdk1.8.0_

Exception in thread "main" java.lang.NullPointerException
        at Temp.foo(Temp.java:10)
        at Temp.main(Temp.java:5)

```
panic: runtime error: invalid memory address or nil pointer dereference
[signal SIGSEGV: segmentation violation code=0x1 addr=0x20 pc=0x40142f]
```

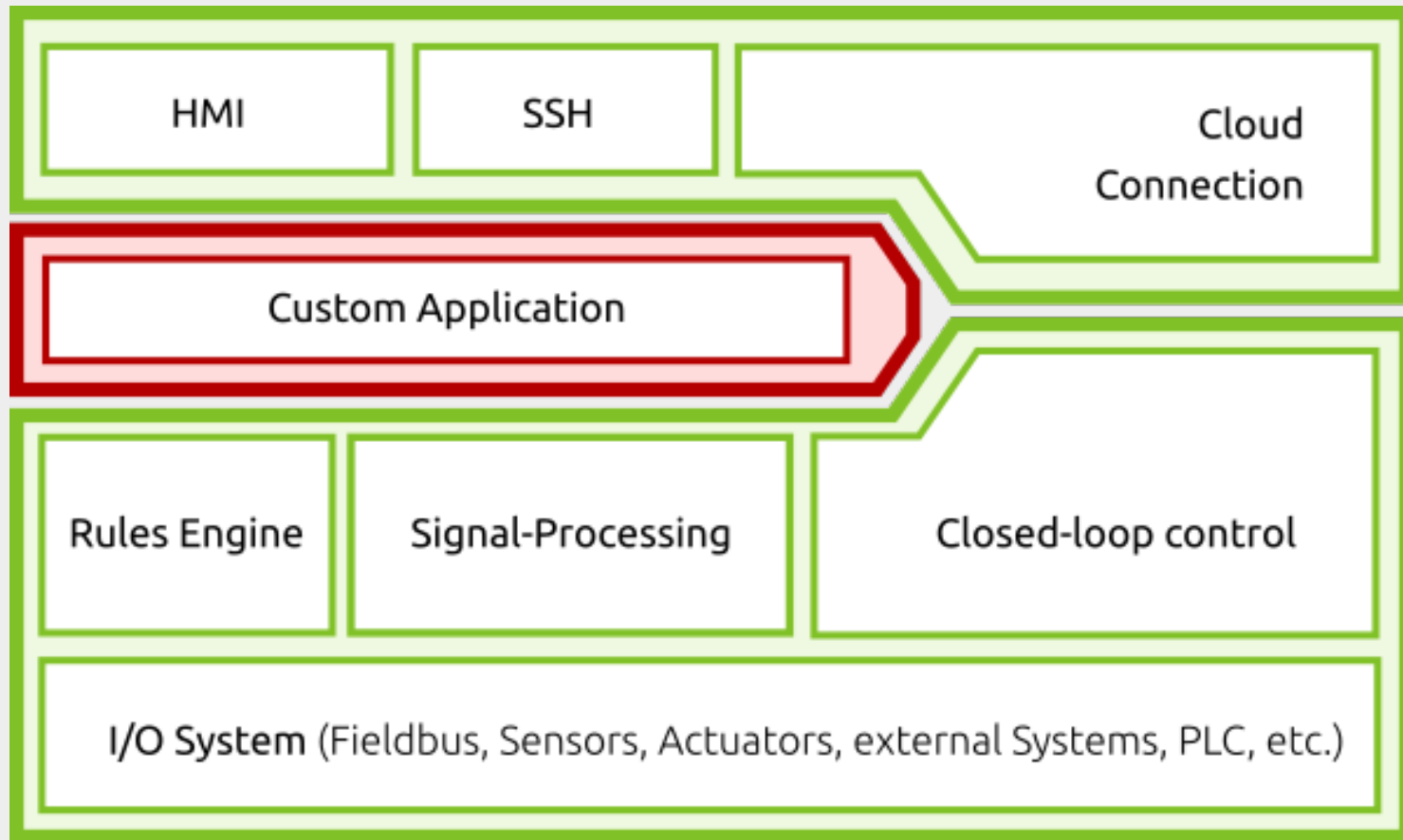*...or even worse: Undefined behavior* 🫣

Security

Languages like C can't prevent those kind of memory „leaks"
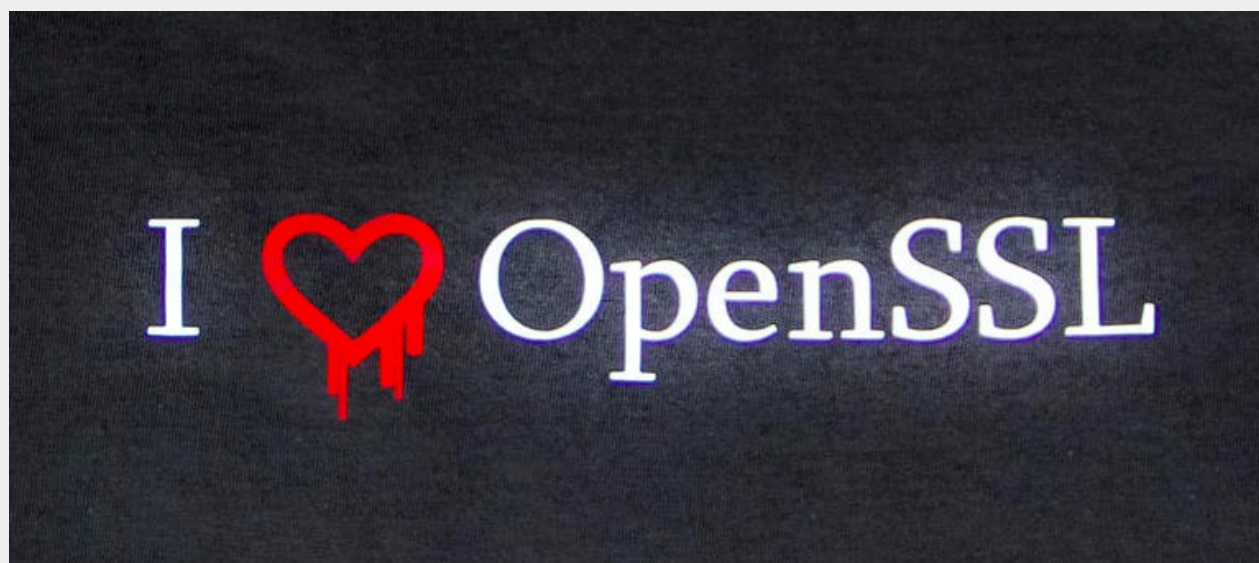
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Rust matches our requirements

- Reliability

- Security

- Predictability (hard-realtime)

- Efficiency & Performance

- Productivity

- Maintenance / Long Term Support

- Open Source

- Cross-platform / Embedded / Bare Metal

- Deployment

slowtec open industrial IoT stack

Super fast, small, efficient

- Integrated Server (HTTP, WebSocket, …)
- Embedded Web-Application
- One static linked binary
- 6 MB in total (2MB zipped)

How to build a controller without programming?

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2. Configure your sensors / actuators

```
[inputs.fcr001]
  title = "Temperation"
  unit = "l/h"
  crop = { low = 0.0 }
  [inputs.fcr001.scale]
    from = { low = 4.0, high = 20.0  }
    to   = { low = 0.0, high = 100.0 }

[outputs.p1]
  title = "Temperation pump P1"
  [outputs.p1.scale]
    from = { low = 0.0, high = 100.0 }
    to   = { low = 0.0, high = 5.0    }
```

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3. Define your controllers

```
[controllers.condensor_temp]
  input  = "tcr003"
  output = "h1"

  [controllers.condensor_temp.pid]
    p = 2.0
    i = 0.003
    d = 0.1
    i_max = 80.0
    max = 90.0
    min = 30.0

  [controllers.condensor_temp.setpoint]
    constraint = { min = 20.0, max = 45.0 }
    Default = 25.0
```

4. Run & have fun!

```
$ slowtec-iot config.toml
```

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Other features

- Rules / Actions

- State Machines

- Recording

- etc.

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Thank you!

https://www.slowtec.de

https://github.com/slowtec