

IoT Unterricht mit Open Source Hardware

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Slides auf Twitter [@tamberg](#)



MENU



SUCHE



KONTAKT

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IOT UNTERRICHT MIT OPEN SOURCE HARDWARE

Das Internet of Things (IoT) ist die Verschmelzung von Internet und physischer Welt. Das Referat gibt einen Überblick über open source IoT Hardware Plattformen und Entwicklungstools für den Informatik-Unterricht. Dazu kommen Praxisbeispiele aus dem Unterricht mit Bachelor-Studierenden.

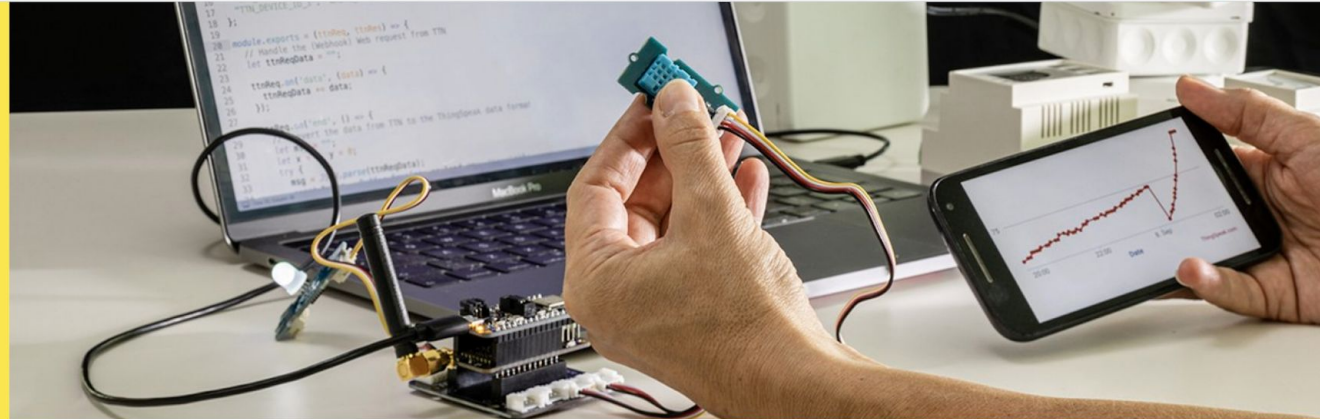
Referent

Thomas Amberg ist Dozent für IoT an der [FHNW](#) in Brugg/Windisch, Gründer von [Yaler.net](#) und Organisator der IoT Meetup Gruppe in Zürich.

Zielgruppe

➤ Lehrende an Gymnasien und Fachhochschulen, die das Thema IoT im Informatik Unterricht behandeln wollen.





Institut für Mobile und Verteilte Systeme

Wir sind ein multidisziplinäres Informatik-Institut im Themenfeld Internet of Things (IoT) mit den Schwerpunkten IT-Engineering, Fast-Data und IT-Security.

Über uns

Netzwerk und Partner

Publikationen

Hochschule für Technik

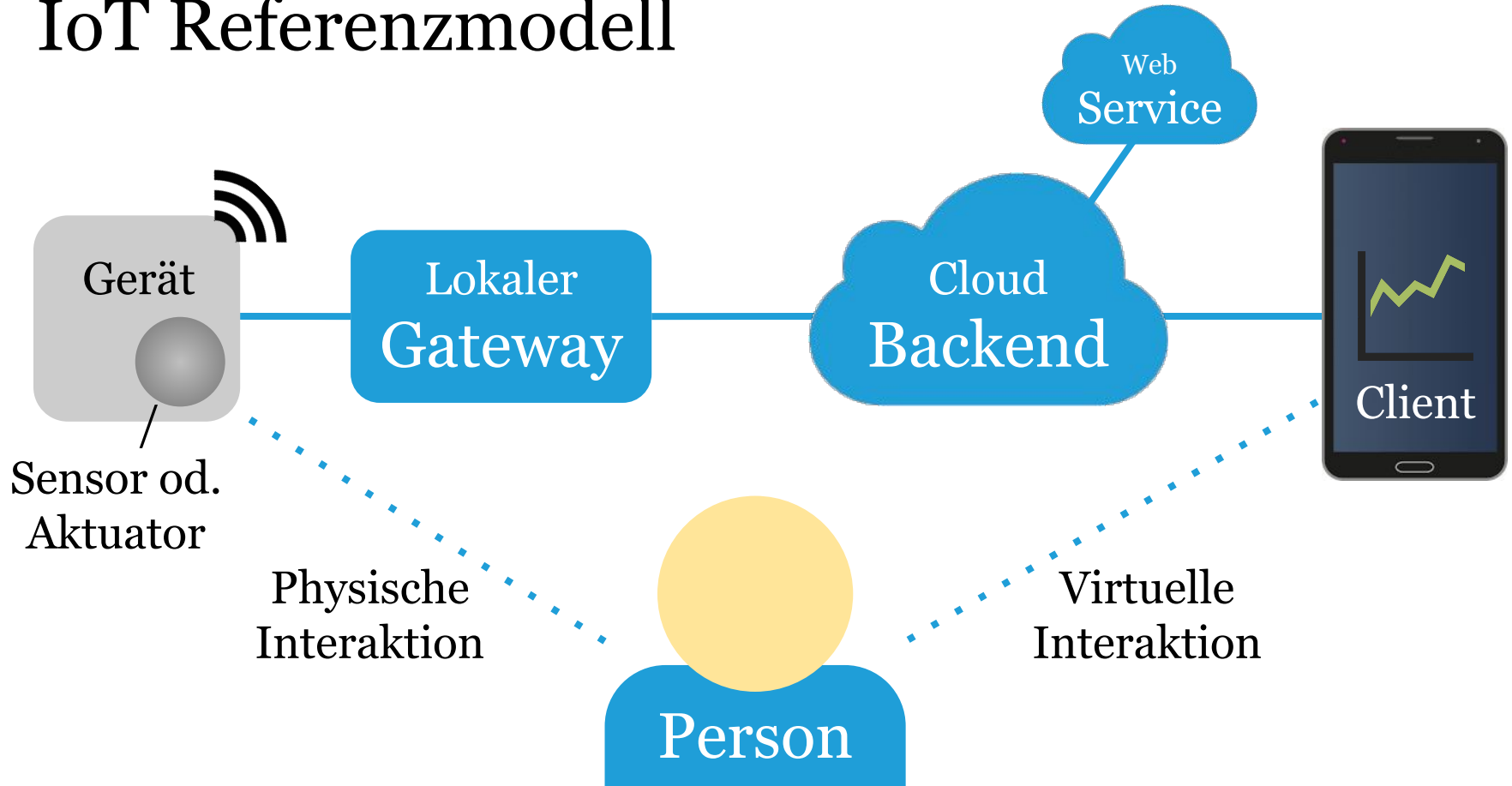
Internet of Things (IoT)

"Verschmelzung von Internet und physischer Welt."

"Internet-verbundene Computer, mit Sensoren und Aktuatoren." — [@tamberg](#)

"Physikalische Objekte mit Web API." —
[@hansamann](#)

IoT Referenzmodell



IoT Engineering Lernziele

Zentralen Aspekte eines IoT-Systems, wie Erfassung, Übertragung und Darstellung von Messdaten kennen.

Grundkonzepte betrachteter Technologien erklären.

IoT-System end-to-end entwerfen, und den Software Teil (ohne Elektronik) unter Verwendung von IoT Cloud Plattformen solide umsetzen.

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Unwatch

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★ Unstar

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Fork

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<> Code

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IoT Engineering

Slides and code examples

1. [Introduction to the Internet of Things](#)
2. [Microcontrollers, Sensors & Actuators](#)
3. [Sending Sensor Data to IoT Platforms](#)
4. [Internet Protocols, HTTP and CoAP](#)
5. [Local Connectivity with Bluetooth LE](#)
6. [Raspberry Pi as a Local IoT Gateway](#)
7. [Messaging Protocols and Data Formats](#)
8. [Long Range Connectivity with LoRaWAN](#)
9. [Dashboards and Apps for Sensor Data](#)
10. [Rule-based Integration of IoT Devices](#)
11. [Voice Control for Connected Products](#)
12. [Raspberry Pi as an IoT Edge Device](#)
13. [Assessment](#)
14. [Demo Day](#)

IoT Hardware for CS Bachelor Students

[CC BY-SA](#) thomas.amberg@fhnw.ch, 24.01.2019

Abstract

Options and thoughts around Internet of Things hardware for computer science bachelor students.

Introduction

The following options were collected during the evaluation of IoT hardware for the course *IoT Engineering* [o] at FHNW, the University of Applied Sciences and Arts Northwestern Switzerland.

IoT Hardware Auswahlkriterien

Mikrocontroller - ATmega328P, ARM Cortex M, ESP.

Connectivity - BLE, WiFi, 3/4G, LoRaWAN, NB-IoT.

Formfaktor - Uno, MKR, Feather, Wemos, M5Stack.

Elektrisch, I/O - Breadboard, Grove, Shields, USB.

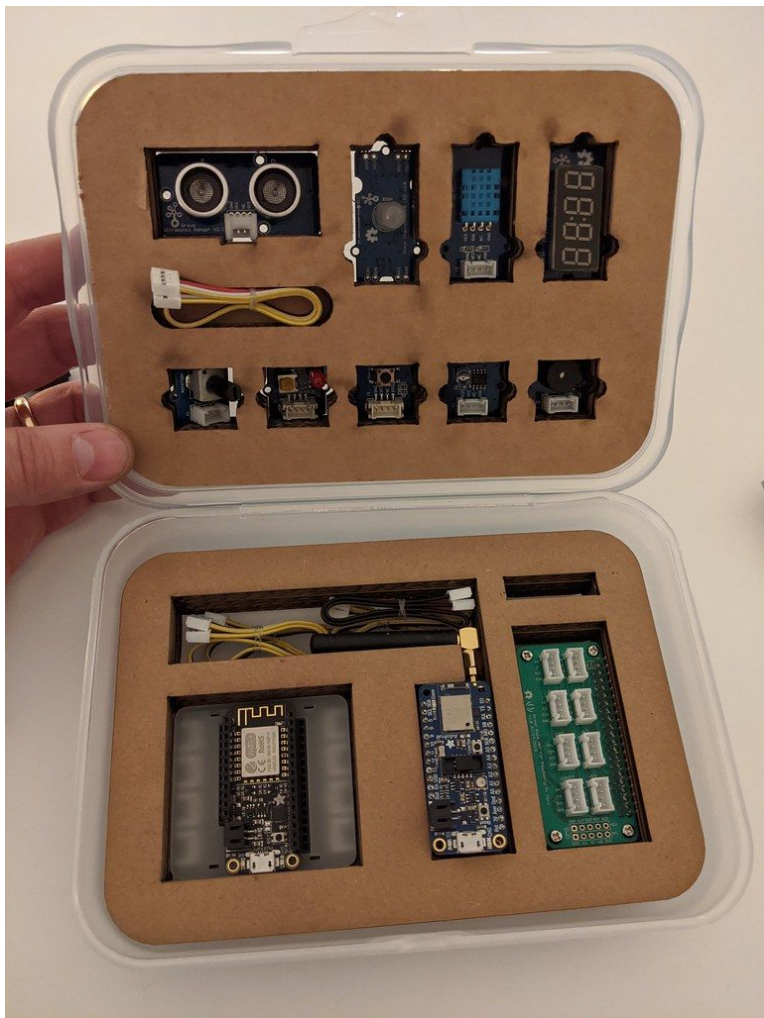
Embedded Development Ökosystem

Community - gross => Antworten im Web auffindbar.

Toolchain - einfaches Setup für Win, Mac und Linux.

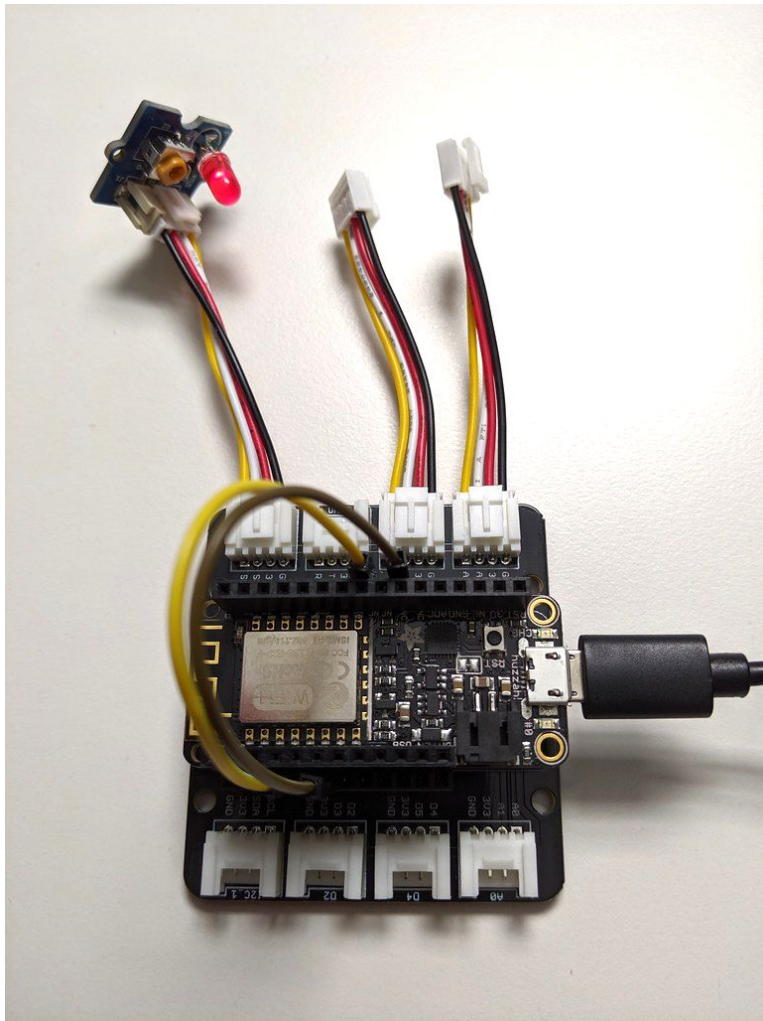
"IDE" - Arduino, CircuitPython, mBed, MakeCode.

Sprache - C (Arduino), Python, Javascript, Go.



IoT Engineering Hardware

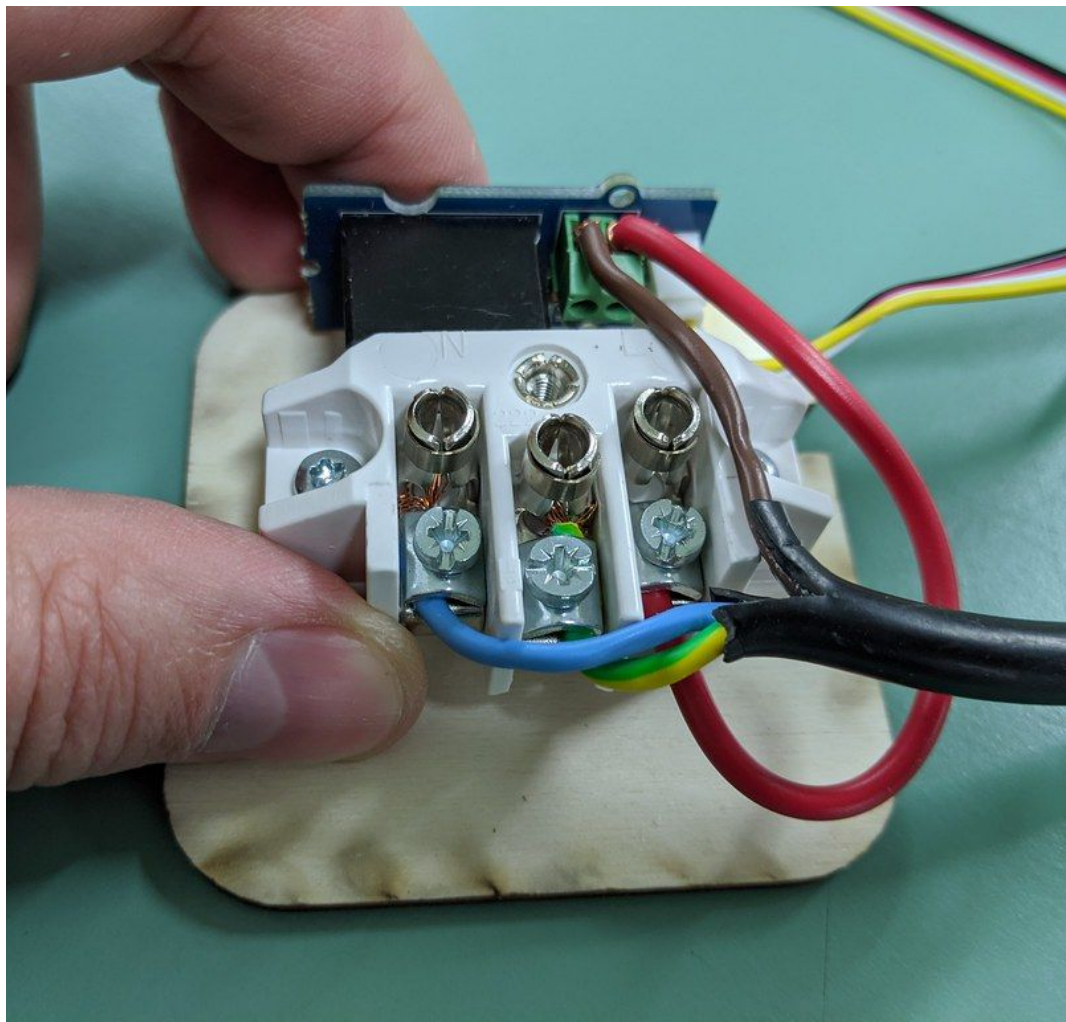
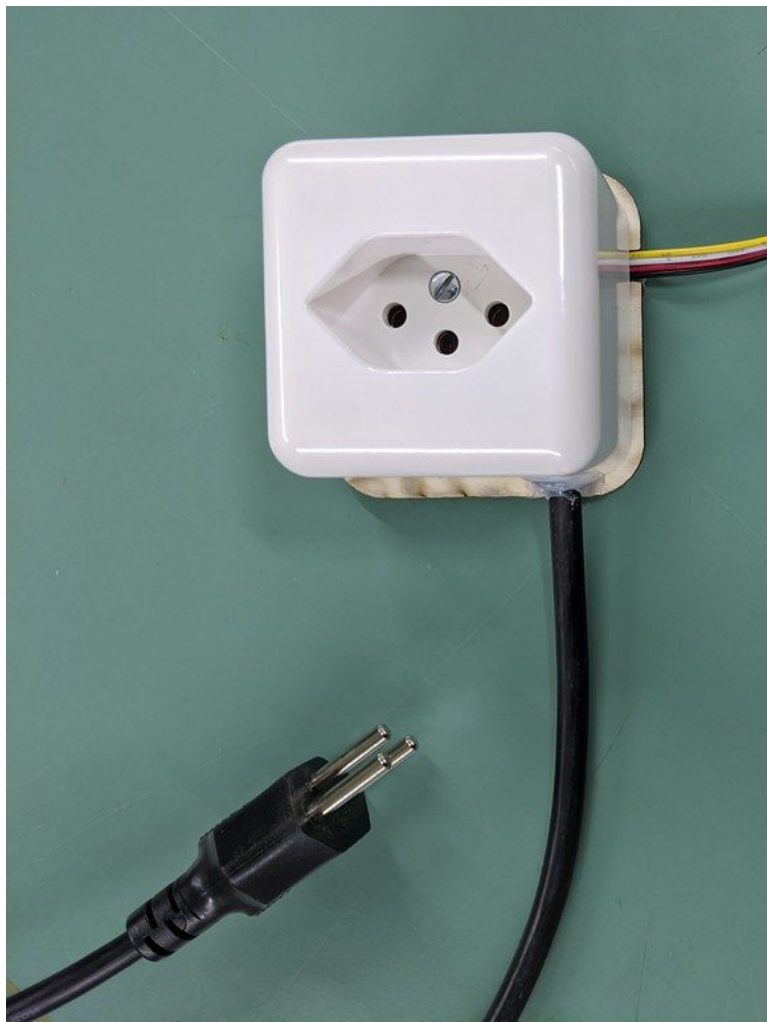
1 Feather nRF52840 Express,
1 RFM95 LoRa FeatherWing,
1 Feather Huzzah ESP8266,
1 Feather Grove Adapter,
1 Raspberry Pi Zero W,
1 Pi Grove Adapter,
5 Sensoren, 4 Aktuatoren,
2 USB, 9 Grove Kabel



Grove

Sensoren und Aktuatoren mit Grove Verkabelung, via einen Feather Grove Adapter, oder Raspberry Pi Grove Adapter.

Keine Elektronikkenntnisse erforderlich - das spart Zeit, man lernt aber auch weniger.



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Fork 5

<> Code

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Edit

New Page

Thomas Amberg edited this page on 3 Jun · 76 revisions

IoT Engineering Wiki

The Wiki contains tools and hardware setup instructions which are referenced by lessons.

Found a typo or something missing? [Submit an issue](#).

Development tools

Development environment

- [Arduino](#)
- [VS Code](#)

Pages 13

Find a Page...

[Home](#)

[Arduino](#)

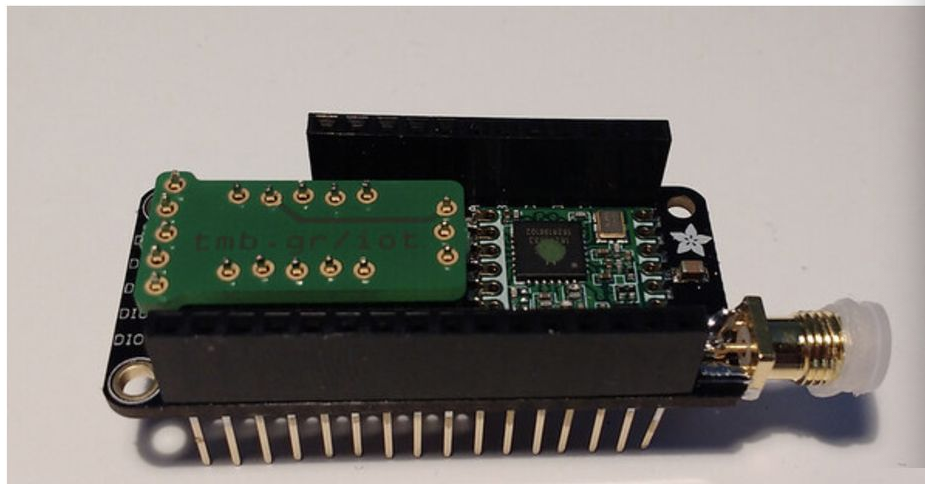
[Command Line Tools](#)

[Feather Huzzah ESP8266](#)

[Feather nRF52840 Express](#)

[FeatherWing RFM95W](#)

[Grove Actuators](#)



Feather Huzzah ESP8266

```
const lmic_pinmap lmic_pins = {  
    .nss = 2, // CS  
    .rxtx = LMIC_UNUSED_PIN,  
    .rst = 16, // RST  
    .dio = {  
        15, // DI00 = IRQ  
        0,  // DI01  
        LMIC_UNUSED_PIN  
    }  
};
```

Feather nRF52840 Express

```
const lmic_pinmap lmic_pins = {  
    .nss = 5, // CS  
    .rxtx = LMIC_UNUSED_PIN,  
    .rst = 6, // RST  
    .dio = {  
        10, // DI00 = IRQ  
        9,  // DI01  
        LMIC_UNUSED_PIN  
    }  
};
```

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⚙ Settings

Feather Huzzah ESP8266 doesn't work w/ Grove adapter #1

Edit

New issue

🔒 Closed

tamberg opened this issue on 19 Feb · 7 comments



tamberg commented on 19 Feb

Owner

+ 🗨 ...

The Feather Huzzah ESP8266 board seems to reset if used with Particle Grove adapter.

The board keeps rebooting after a short while (check the serial output).

I'm still investigating the issue, maybe a pin pulled to GND.

Assignees



No one—assign yourself

Labels



None yet

Projects



None yet

Milestone



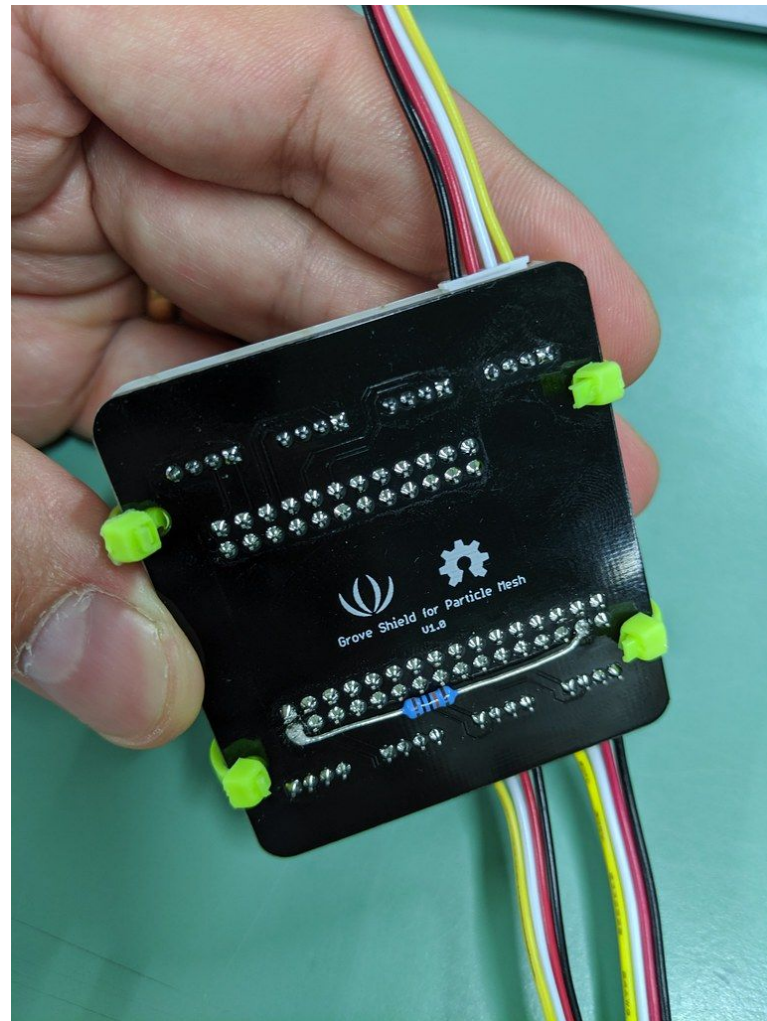
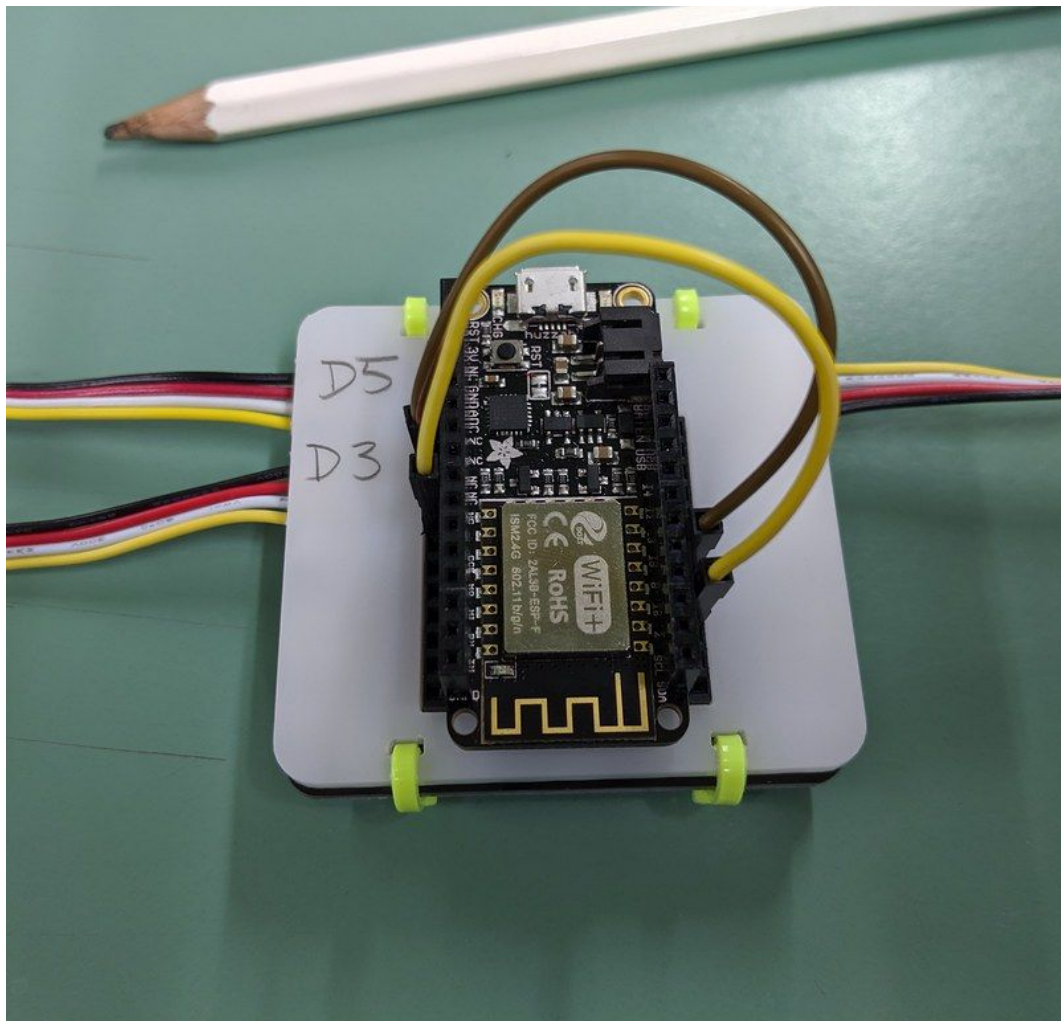
No milestone



okaerin commented on 15 May

+ 🗨 ...

According to adafruit the CH_PD pin needs to be pulled high or else the board resets. This is violated by the particle mesh board as it connects the pin to GND. It can be solved by bending the CH_PD pin



GitHub Classroom

Mapping von GitHub Nutzernamen auf Studierende.

Öffentliche GitHub Repos für Übungsaufgaben.

Private GitHub Repos für Übungsergebnisse.

Echte Kopie statt (öffentliches) Forken.

Dozentenseitige Unterstützung.



FHNW iot (4ia)

fhnw-iot-4ia

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Assignments

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Assignments

New assignment



fhnw-iot-work-00

Individual assignment

<https://classroom.github.c>

Copy invitation link



fhnw-iot-work-01

Individual assignment

<https://classroom.github.c>

Copy invitation link



fhnw-iot-work-02

Individual assignment

<https://classroom.github.c>

Copy invitation link



fhnw-iot-work-03

<https://classroom.github.c>

Copy invitation link

 **fhnw-iot-4ia / fhnw-iot-work-00**
forked from tamberg/fhnw-iot-work-00

 Unwatch ▼ 1

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IoT Engineering

Hands-on of lesson 0

For slides and example code, see [lesson 0](#)

Note: Do not work on this repository right away.

Create your personal copy by clicking this [GitHub Classroom link](#).

a) Git and GitHub, 5'

- Check the forks of this repository to find the *Classroom* link.
- Add a new text file, commit and push to submit.

GitHub Classroom

classroom.github.com/assignment-invitations/0cdaac0b2ff1940fea66637a2d710173?roster=ignore

GitHub Education

FHNW

FHNW iot (4ia)

fhnw-iot-4ia



Accept the **fhnw-iot-work-00** assignment

Accepting this assignment will give you access to the **fhnw-iot-work-00-xy** repository in the [@fhnw-iot-4ia](#) organization on GitHub.

Accept this assignment



FHNW iot (4ia)

🔗 <https://www.fhnw.ch/de/studium/module/9280188>

📖 Repositories 107

📦 Packages

👤 People 27

👥 Teams 12

📁 Projects

⚙️ Settings

fhnw-iot-work-00

Type: All ▾

Language: All ▾

Customize pins

📌 New

fhnw-iot-work-00

Forked from tamberg/fhnw-iot-work-00

🔗 2 ★ 0 ⓘ 0 🛠️ 0 Updated on 25 Feb



Top languages

● C++ ● JavaScript ● Shell ● C
● TypeScript

fhnw-iot-work-00-xy Private

fhnw-iot-work-00-xy created by GitHub Classroom

🔗 0 ★ 0 ⓘ 0 🛠️ 0 Updated on 25 Feb



People

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Search or jump to...

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Marketplace

Explore



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FHNW (iot) Meta

GitHub Classroom

- <https://classroom.github.com/classrooms>
 - <https://classroom.github.com/classrooms/42295693-fhnw-iot-4ia> (per class)
 - <https://classroom.github.com/classrooms/42295693-fhnw-iot-4ia/assignments/fhnw-iot-work-00> (assessment, per week)
 - <https://classroom.github.com/classrooms/42295693-fhnw-iot-4ia/assignments/fhnw-iot-work-01>
 - ...

GitHub Accounts

Mentoring

- Cloud-Anbindung und Bluetooth LE Gateway für Nanopartikeldetektor, a bachelor thesis at [FHNW](#), spring 2020
- Cloud-basierte Physical Security Information Management Plattform, a bachelor thesis at [FHNW](#), spring 2020
- Geo-Lokalisierung mit LoRaWAN für Werkzeug auf Baustellen, a bachelor thesis at [FHNW](#), spring 2020
- Over-the-Air Firmware Update für LTE Cat M1/NB-IoT Hardware, a bachelor project at [FHNW](#), spring 2020
- UX Prototyping für Internet-verbundene Kaffeemaschine, a bachelor project at [FHNW](#), spring 2020
- Web UI und RS-232 Adapter für Fernzugriff auf Amateurfunk-Endstufe, a bachelor project at [FHNW](#), spring 2020
- [LoRaWAN IoT Bausteine mit Java Client SDK](#), a bachelor project at [FHNW](#), autumn 2019
- [DSGVO-konforme Personenerkennung mit ML-Kamera](#), a bachelor project at [FHNW](#), autumn 2019
- [Lösung für Internet-verbundene in-store Displays](#) (w/ [source](#)), a bachelor project at [FHNW](#), autumn 2019
- [Smarte Lichtsteuerung mit ML-Kamera](#), a bachelor project at [FHNW](#), autumn 2019
- [Internet-verbundenes Nummernschild](#), a bachelor thesis at [FHNW](#), spring 2019
- [Kamera-basierter Sensor für Raumbelegung](#), a bachelor thesis at [FHNW](#), spring 2019
- [Cloud-Anbindung für Sicherheitsleitsystem](#), a bachelor project at [FHNW](#), spring 2019
- [Natürliche Interaktion mit dem Solar Manager](#) (w/ J. Luthiger), a bachelor thesis at [FHNW](#), autumn 2018
- [Porting OPC-UA Pub/Sub to the nRF52840](#) (w/ W. Weck), a bachelor project at [FHNW](#), autumn 2018
- [Web-basiertes Eigenverbrauchs-Monitoring](#) (w/ J. Luthiger), a bachelor project at [FHNW](#), autumn 2018

Presentations

- [IoT im Gebäude at Gebäude Netzwerk Initiative in Zürich](#), 14.11.2019

IoT Bricks

Bausteine mit Connectivity, Akku für ein Semester*.

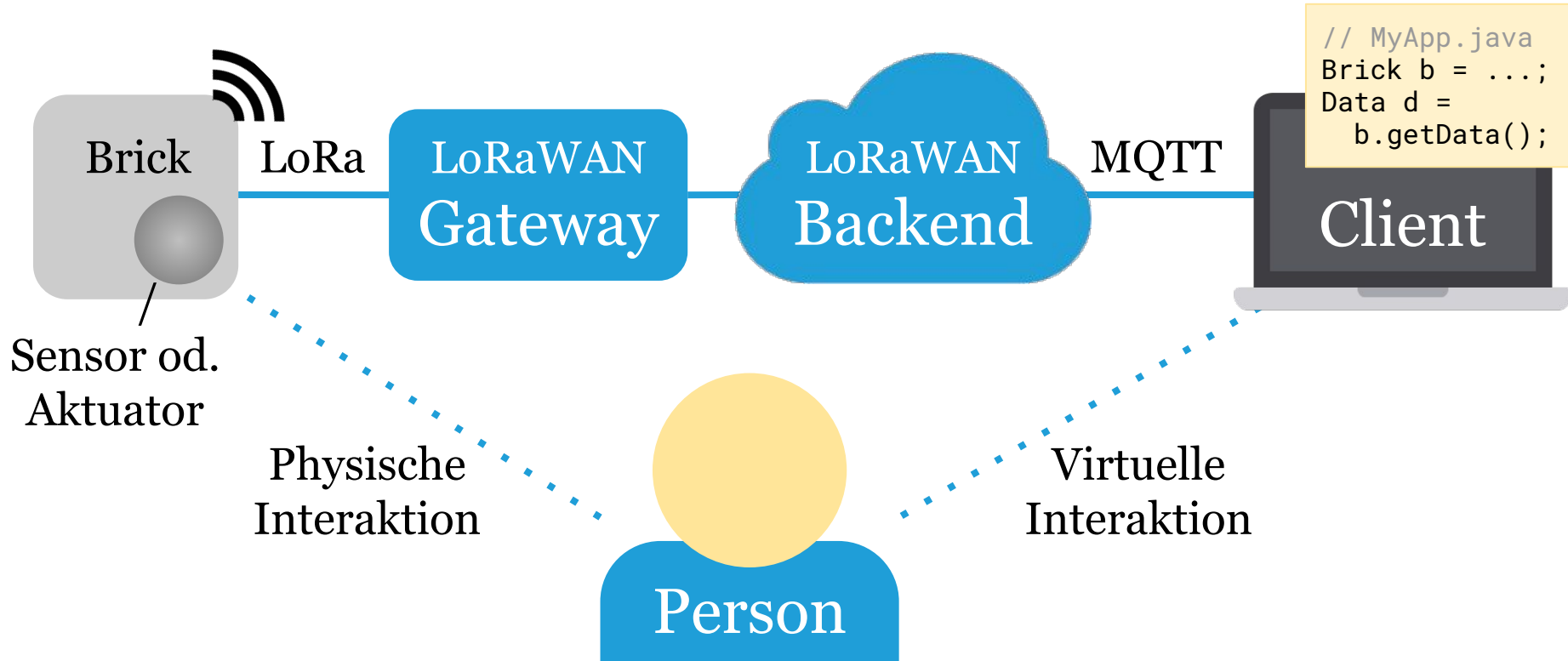
Fokus auf Anwendungsseite, no-touch Hardware.

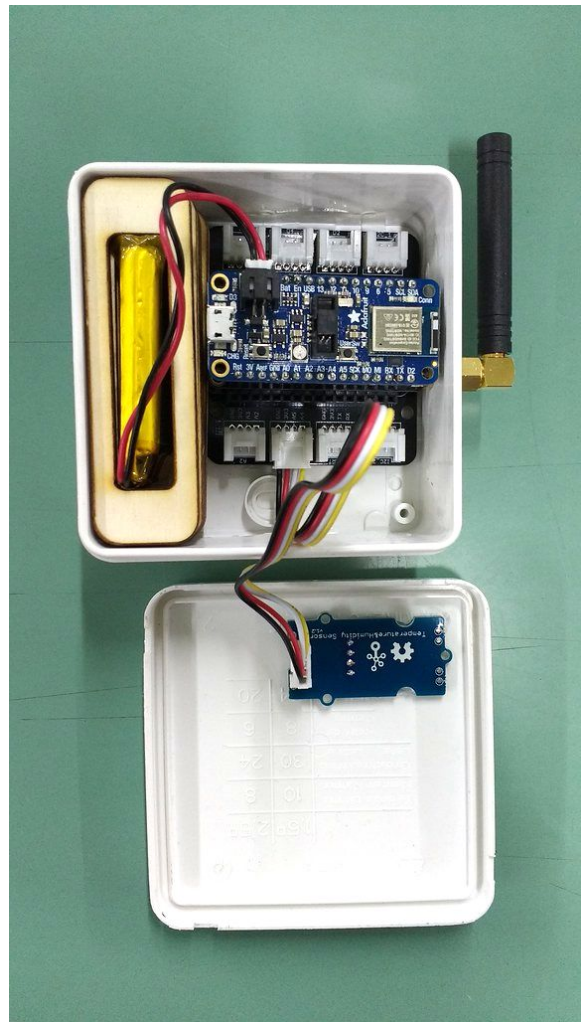
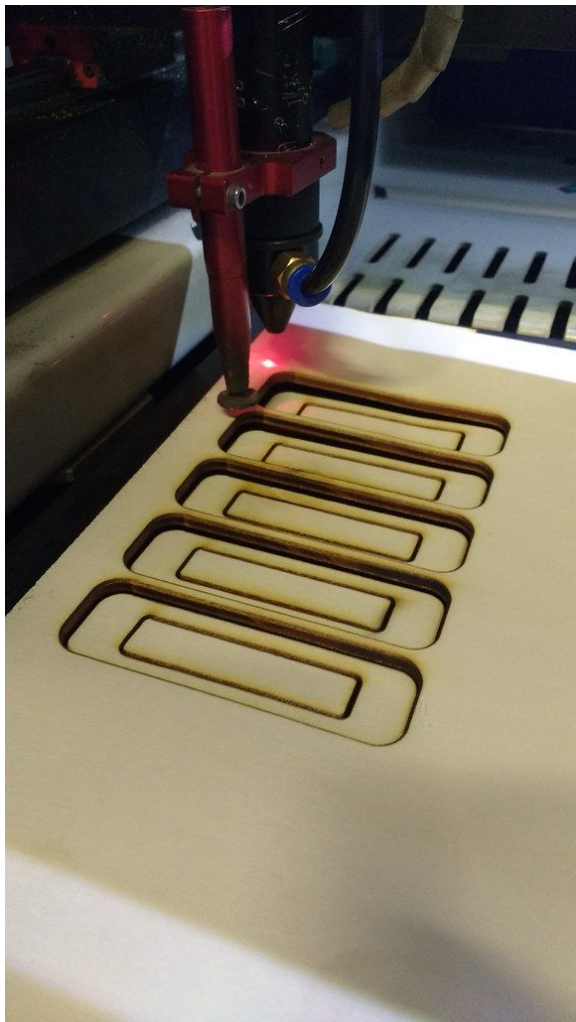
Raum-, gebäude- und stadtweites Prototyping.

Einfaches Java SDK mit Cloud Backend.

*Idealerweise.

IoT Bricks mit LoRaWAN







Open Data

Basis-URL und
Brick-ID genügt,
um an die Daten
zu gelangen.

IoT Bricks SDK

```
// http://brick.li/0000-0001 =>
```

```
String BASE_URL = "brick.li/";
```

```
String BRICK_ID = "0000-0001";
```

```
Proxy proxy = MqttProxy.fromConfig(BASE_URL);
```

```
TempBrick tempBrick = TempBrick.connect(proxy, BRICK_ID);
```

```
double temp = brick.getTemperature(); // this brick
```

```
int battery = brick.getBatteryLevel(); // all bricks
```

```
String time = brick.getTimestampIsoUtc();
```

IoT Bricks Konfiguration

```
// http://brick.li/0000-0001/config.json
{
  "brick-config": {
    "id": "0000-0001",
    "java-type": "ch.fhnw.imvs.bricks.TempBrick",
    "mqtt-host": "eu.thethings.network",
    "mqtt-user": "<app-id>",
    "mqtt-pass": "<app-access-key>",
    "mqtt-sub": "<app-id>/devices/0000-0001/up"
  }
}
```

Beispiel: Monitoring System

```
MqttProxy proxy = MqttProxy.fromConfig(BASE_URL);  
TempBrick tempBrick = TempBrick.connect(proxy, TEMP_ID);  
LedBrick ledBrick = LedBrick.connect(proxy, LED_ID);  
  
while (true) {  
    double temp = tempBrick.getTemperature();  
    Color color = temp > 23 ? Color.RED : Color.GREEN;  
    ledBrick.setColor(color);  
    proxy.waitForUpdate();  
}
```

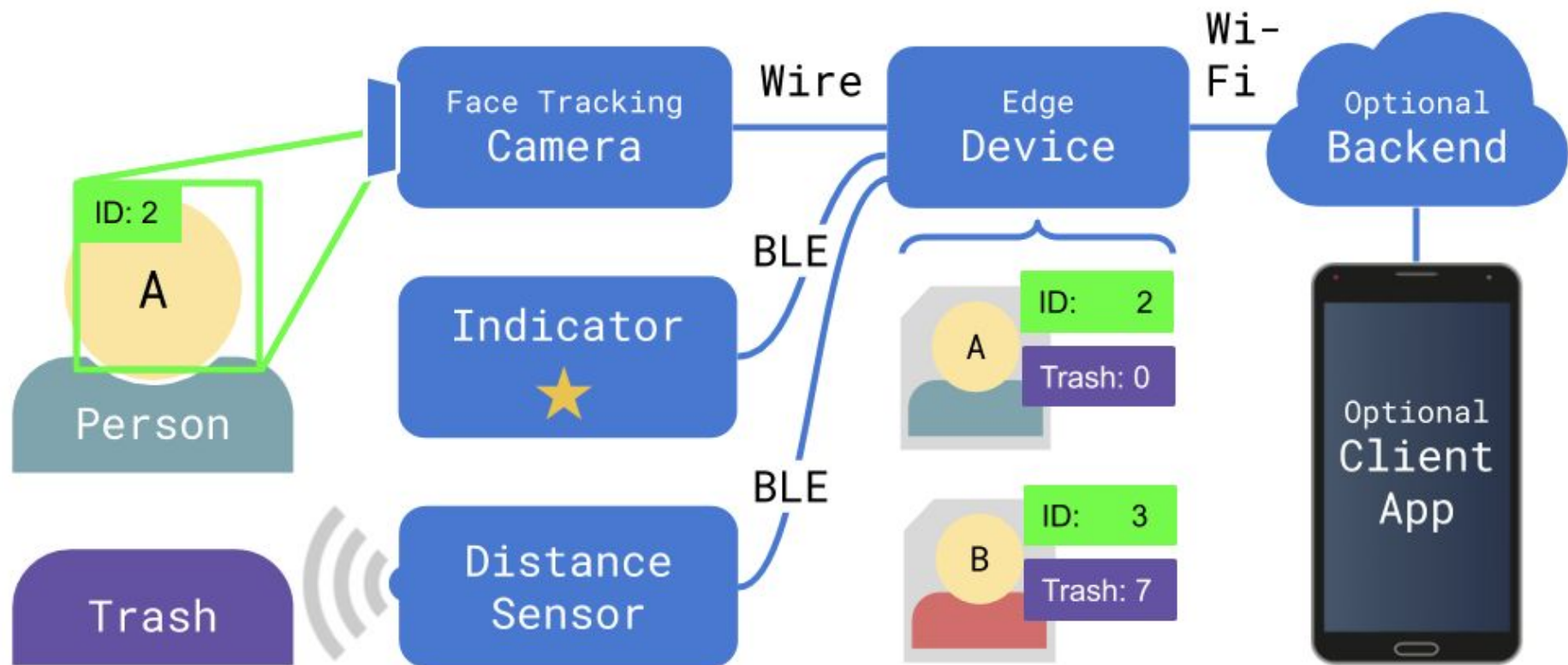
Beispiel: Türklingel

```
Proxy proxy = MqttProxy.fromConfig(BASE_URL); // slow, > 5'  
// or proxy = BtleProxy.fromConfig(BASE_URL); // fast, < 1"  
ButtonBrick btnBrick = ButtonBrick.connect(proxy, BTN_ID);  
BuzzerBrick bzsBrick = BuzzerBrick.connect(proxy, BZR_ID);  
  
while (true) {  
    boolean pressed = btnBrick.isPressed();  
    bzsBrick.setEnabled(pressed);  
    proxy.waitForUpdate();  
}
```



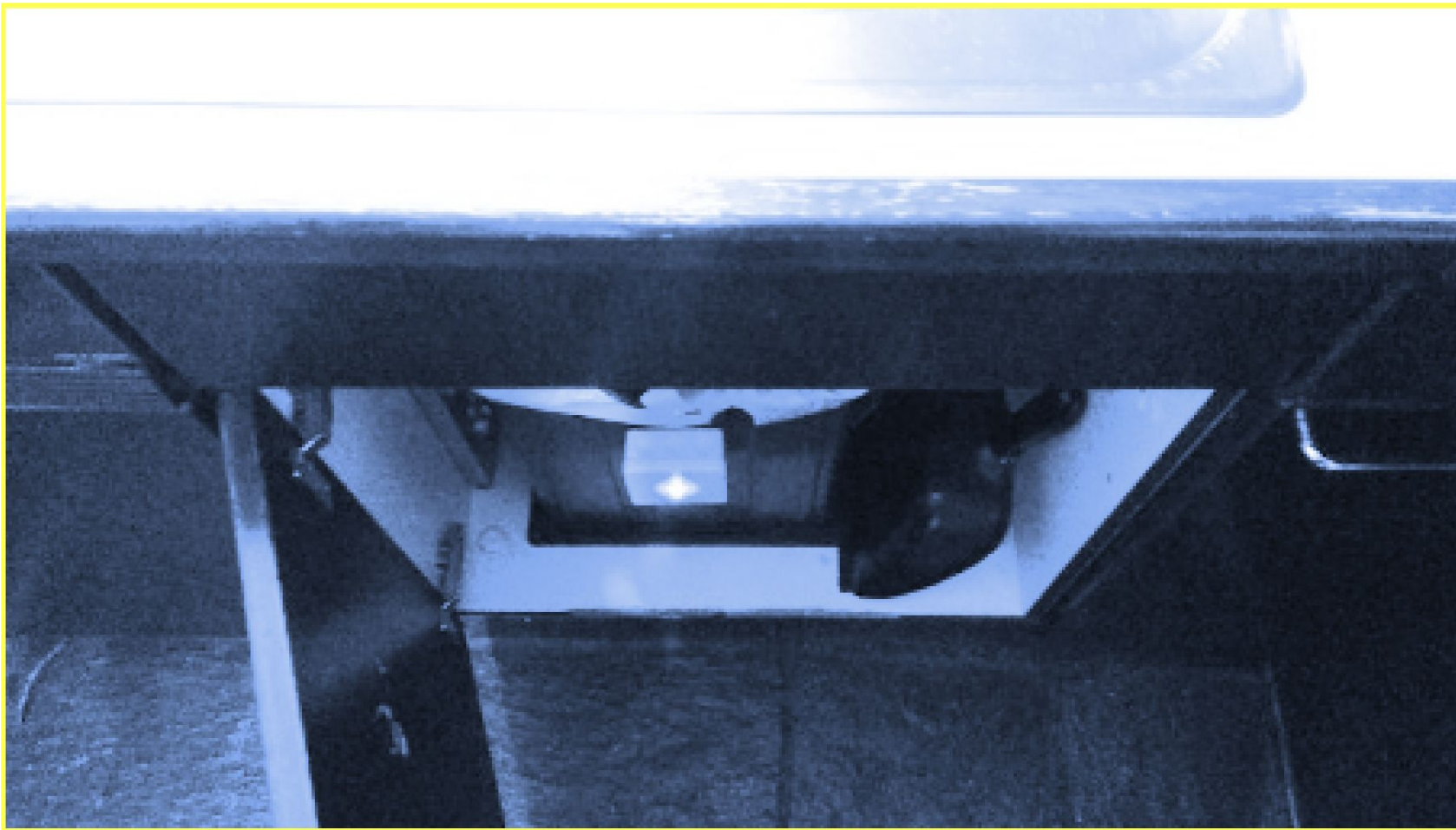
Your Turn™

AI-gestützte
Arbeitsteilung
im Haushalt.





The *Your Turn*TM camera identifies Thomas, he doesn't even notice.



When Thomas opens the trash door to get rid of the paper, the *Your Turn™* indicator is lit.



"Can't hide from the sensor, can you?"



"Done. Now it's your turn :)"



Fazit

Open Hardware - Feather, Grove - hat sich bewährt.

Open Source* erleichtert Teilen, Wiederverwendung.

Einfachheit und Robustheit eröffnen Möglichkeiten.

AI Kameras und Edge-Computing sind die Zukunft.

*Und Creative Commons, z.B. diese Slides :)

