

# IoT and ML Infrastructure for Urban Biodiversity Monitoring

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# Mitwelten – Medienökologische Infrastrukturen für Biodiversität

Interdisziplinäres Designforschungsprojekt (SNF, 2020-2024)

Wie können mediale Designinterventionen auf Grundlage des Internets der Dinge ökologisch und kulturell zur Förderung von Biodiversität in lokalen Ökosystemen beitragen?

Zur Beantwortung dieser Leitfrage wird in drei Fallstudien in Mensch-Umwelt-Aushandlungsprozessen medientechnologische Infrastruktur gestaltet und installiert: in der Kulturlandschaft der Merian Gärten bei Basel, im Dreispitzareal Basel und in der Reinacher Heide, einem Naturschutzgebiet in der Agglomeration Basels.



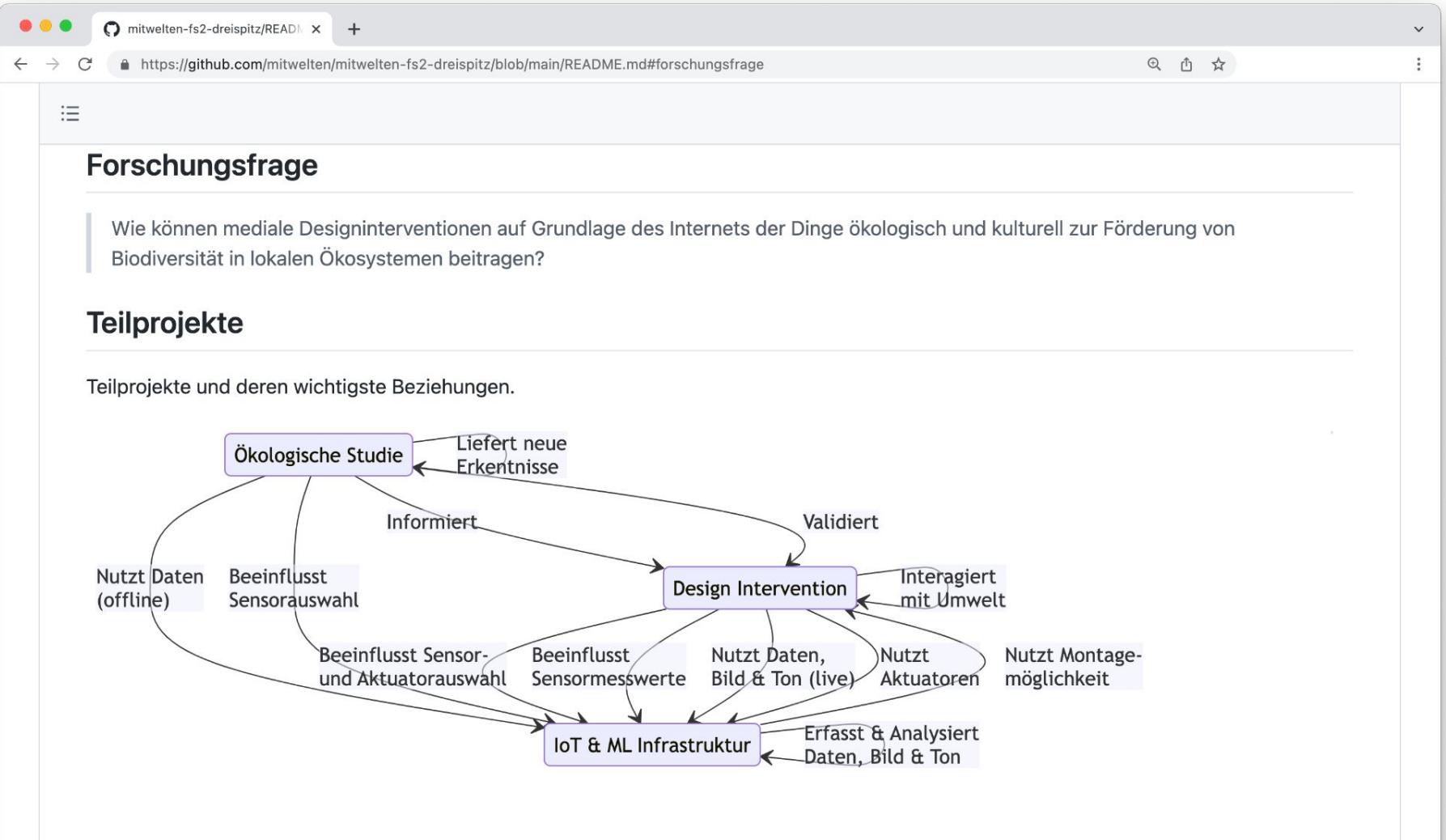
FS1: [Merian Gärten](#), Basel



FS2: [Dreispitzareal](#), Basel



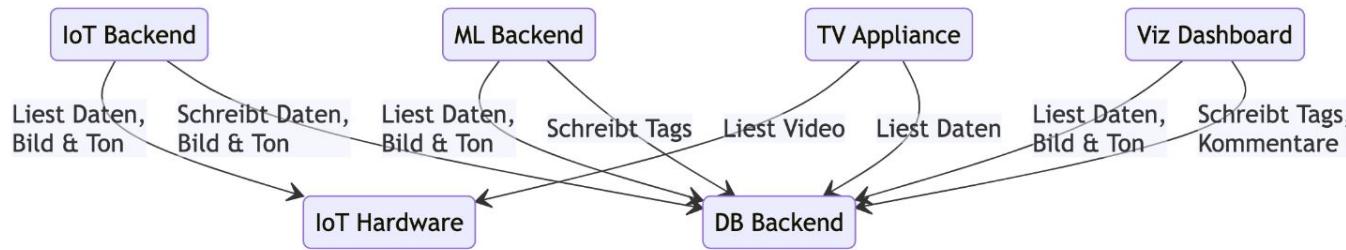
FS3: [Reinacher Heide](#), BL





## IoT & ML Infrastruktur

Hardware und Software, inkl. Betrieb.



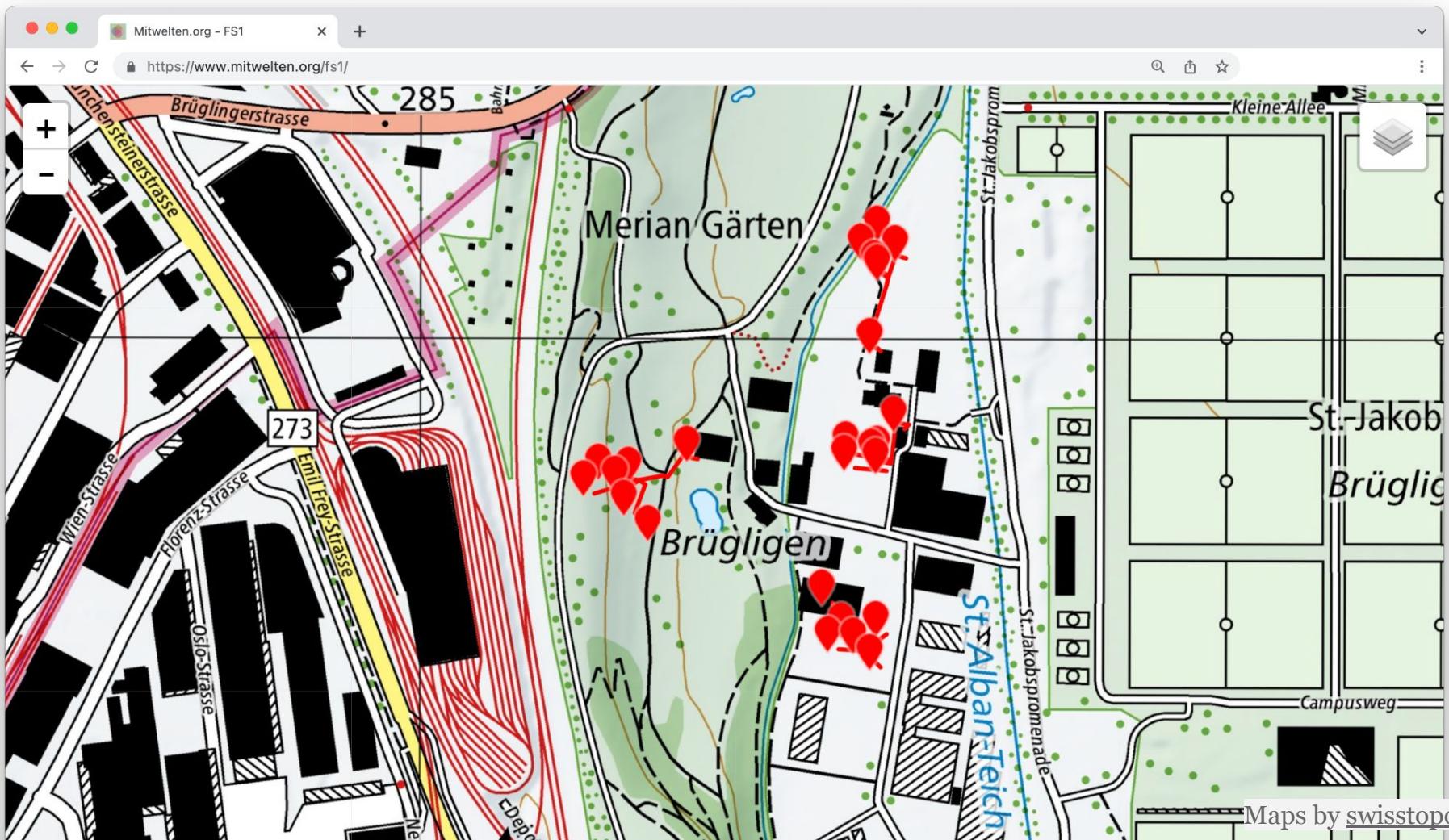
## Team

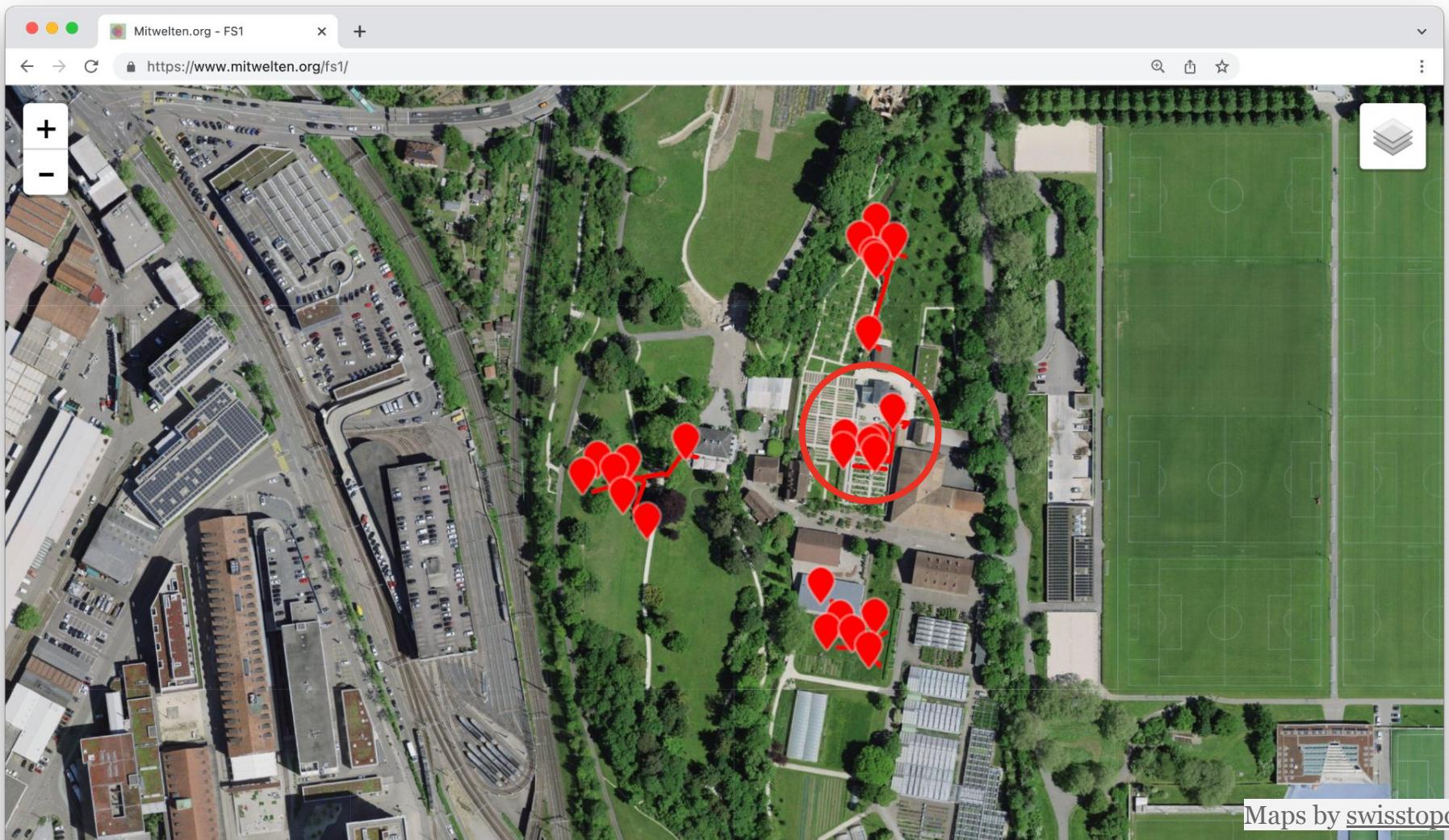
- Thomas (IMVS)
- Cedric (IXDM)
- Simon (IMVS)
- Timeo (IMVS)

## Hardware

- PoE Access Point ([Repo](#), [Tasks](#))
- PoE Pi Cam ([Repo](#), [Tasks](#))

The map and the terrain





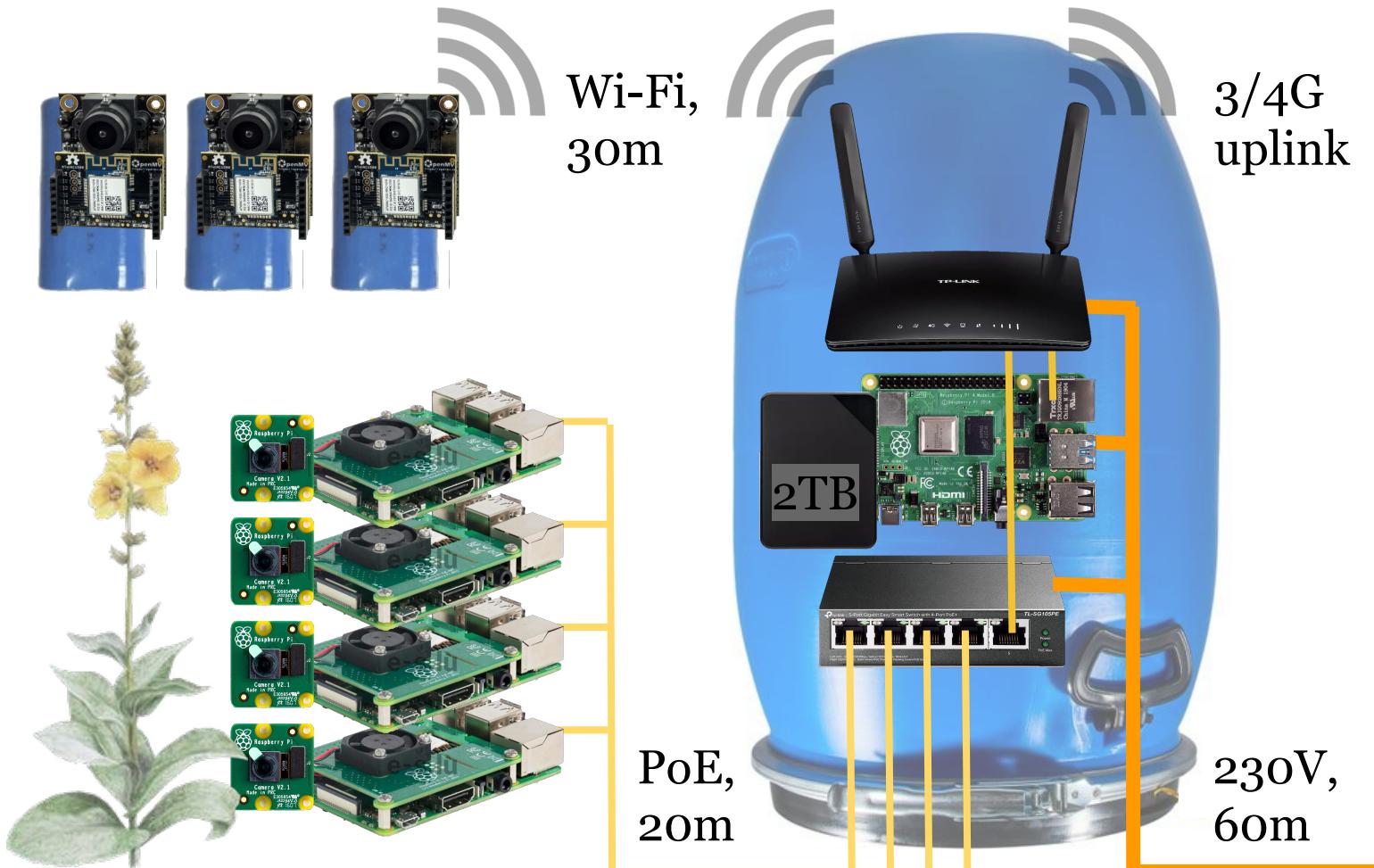
Maps by swisstopo



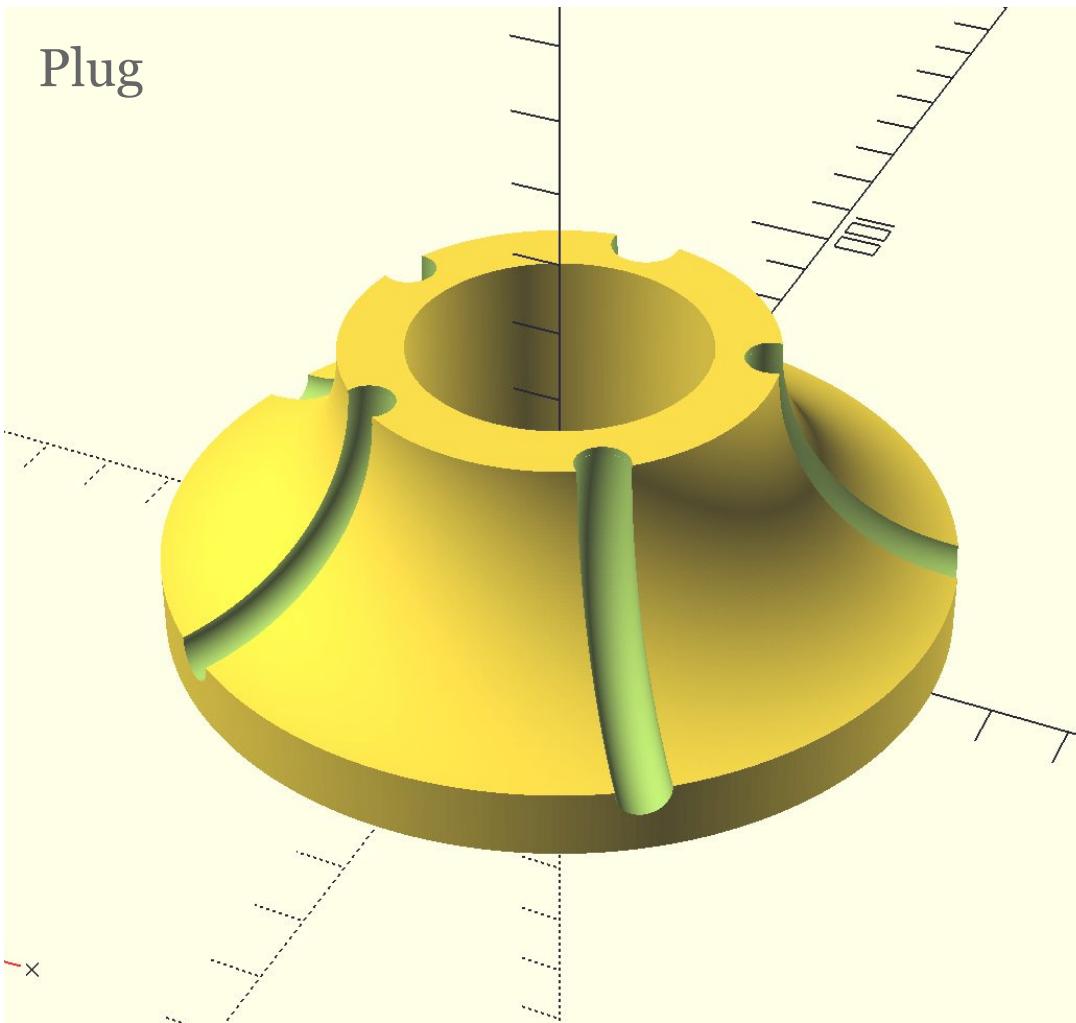


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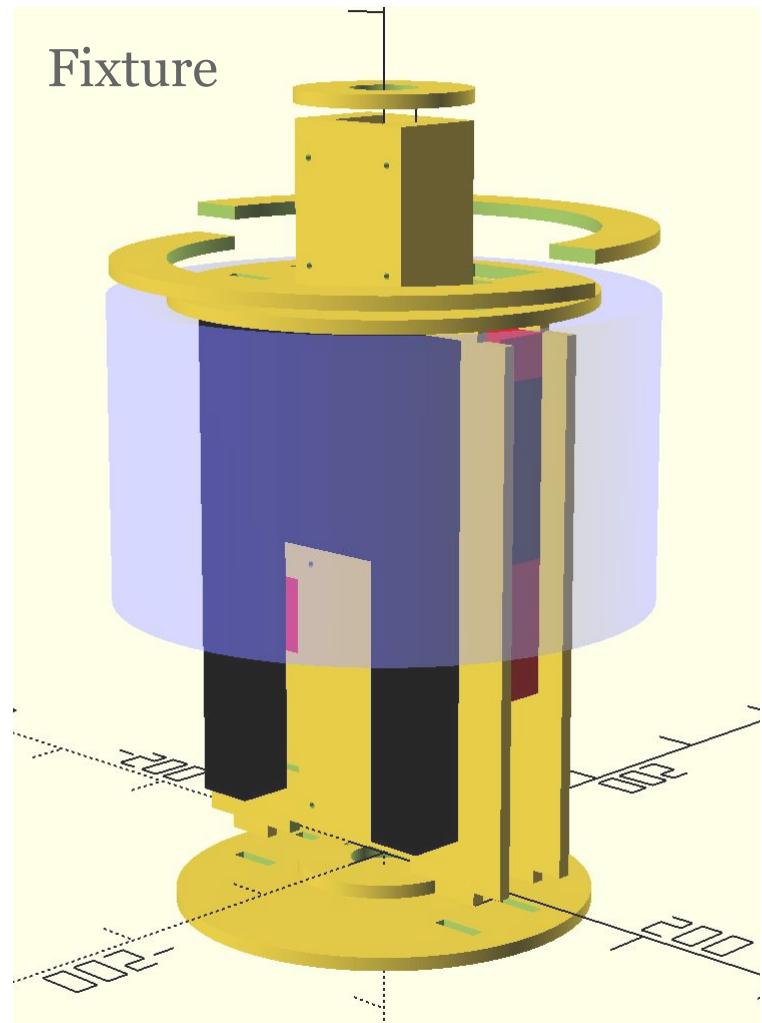
Low-end high tech

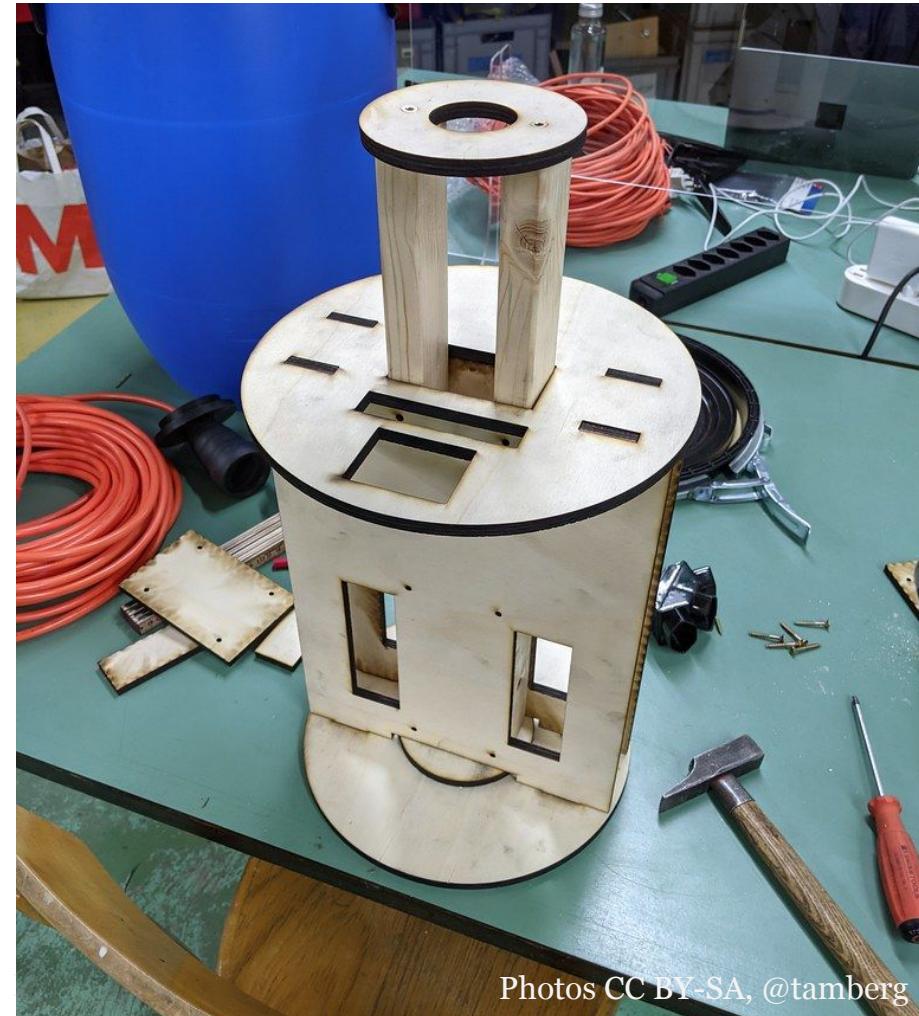
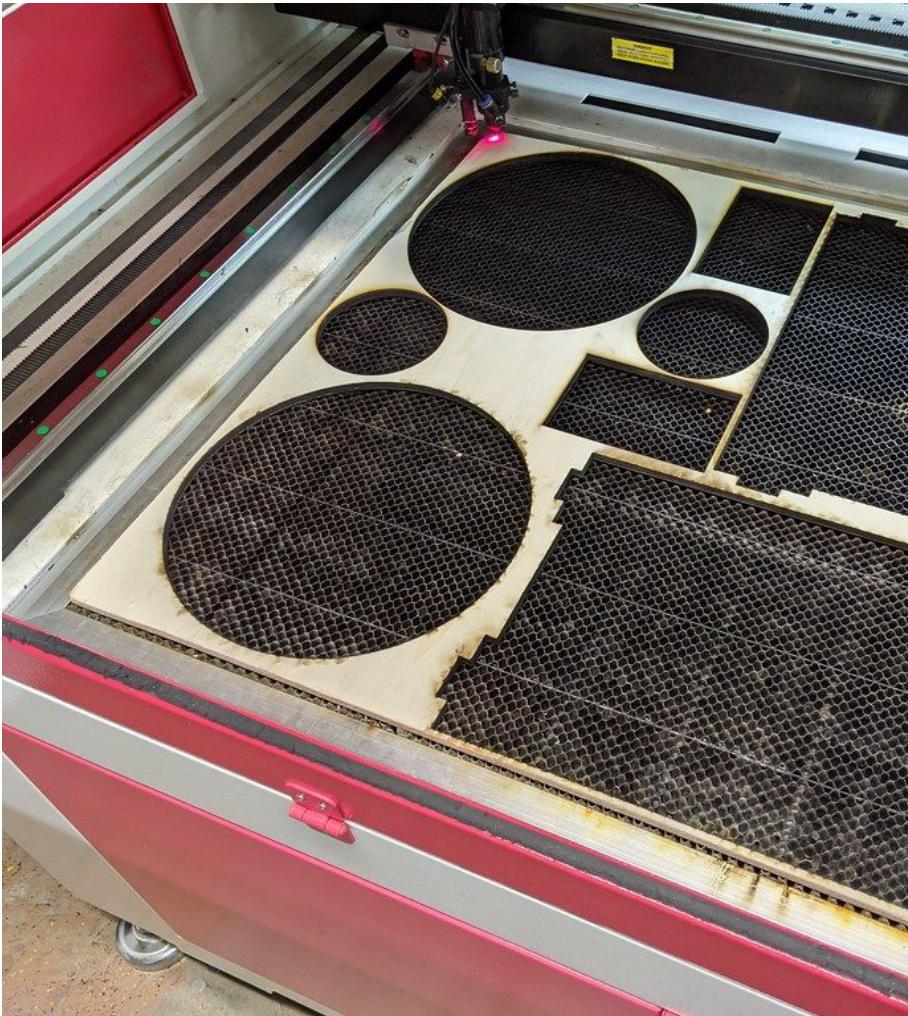


Plug

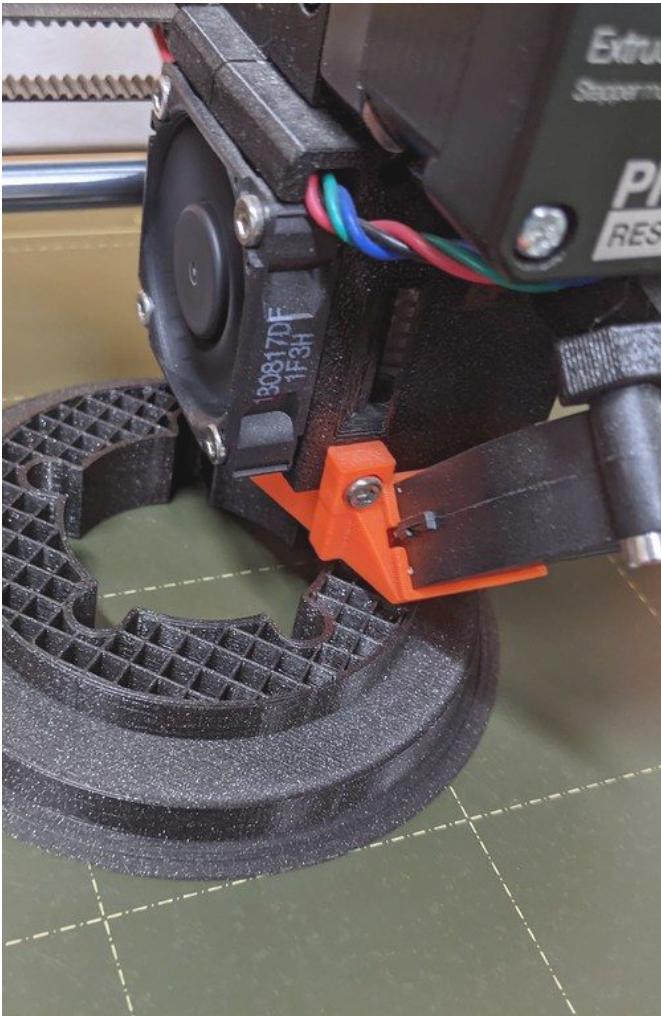


Fixture

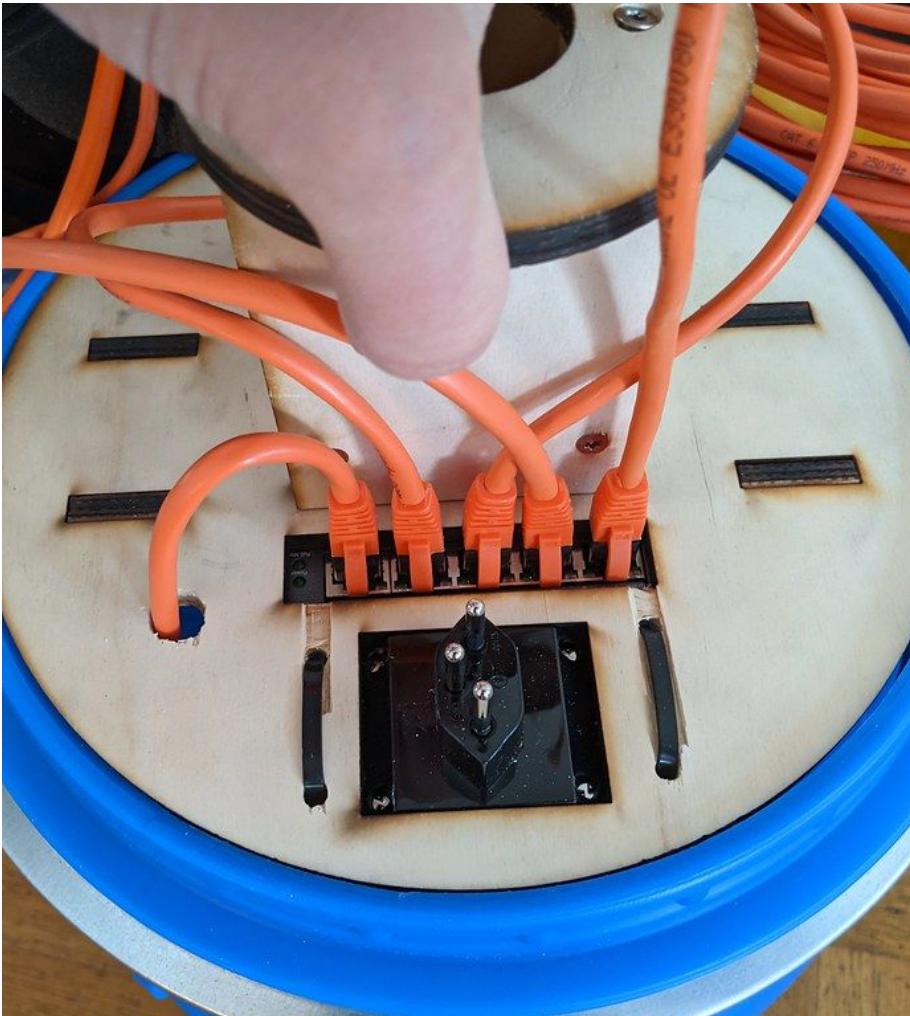




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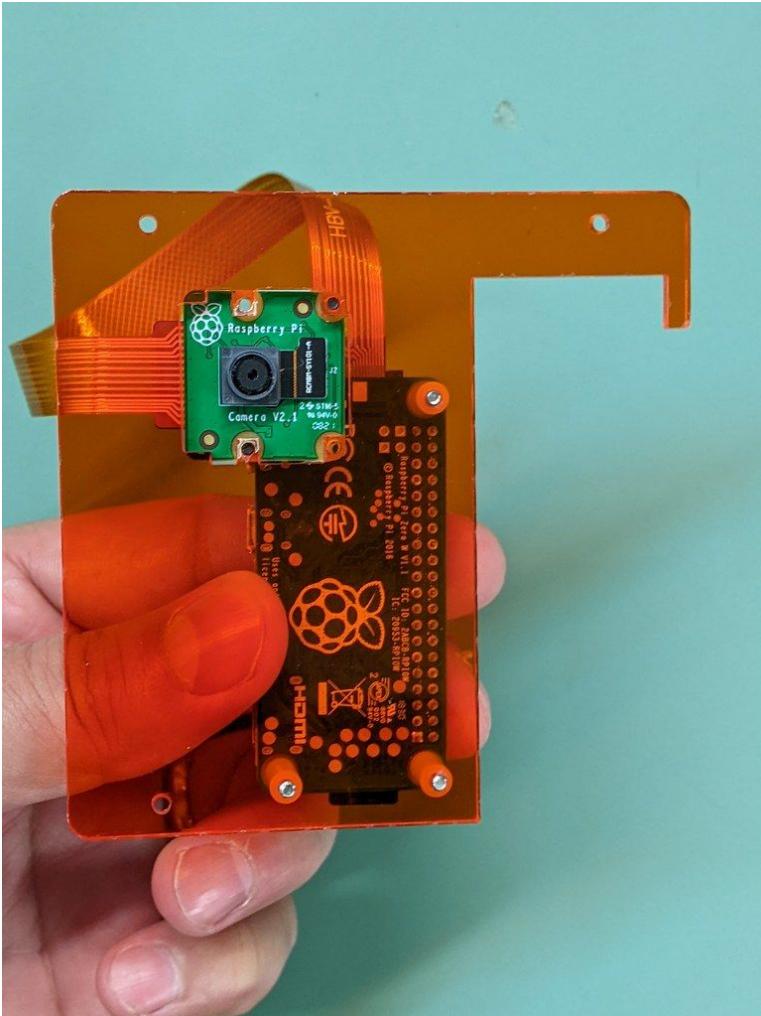


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Keep it simple, iterate



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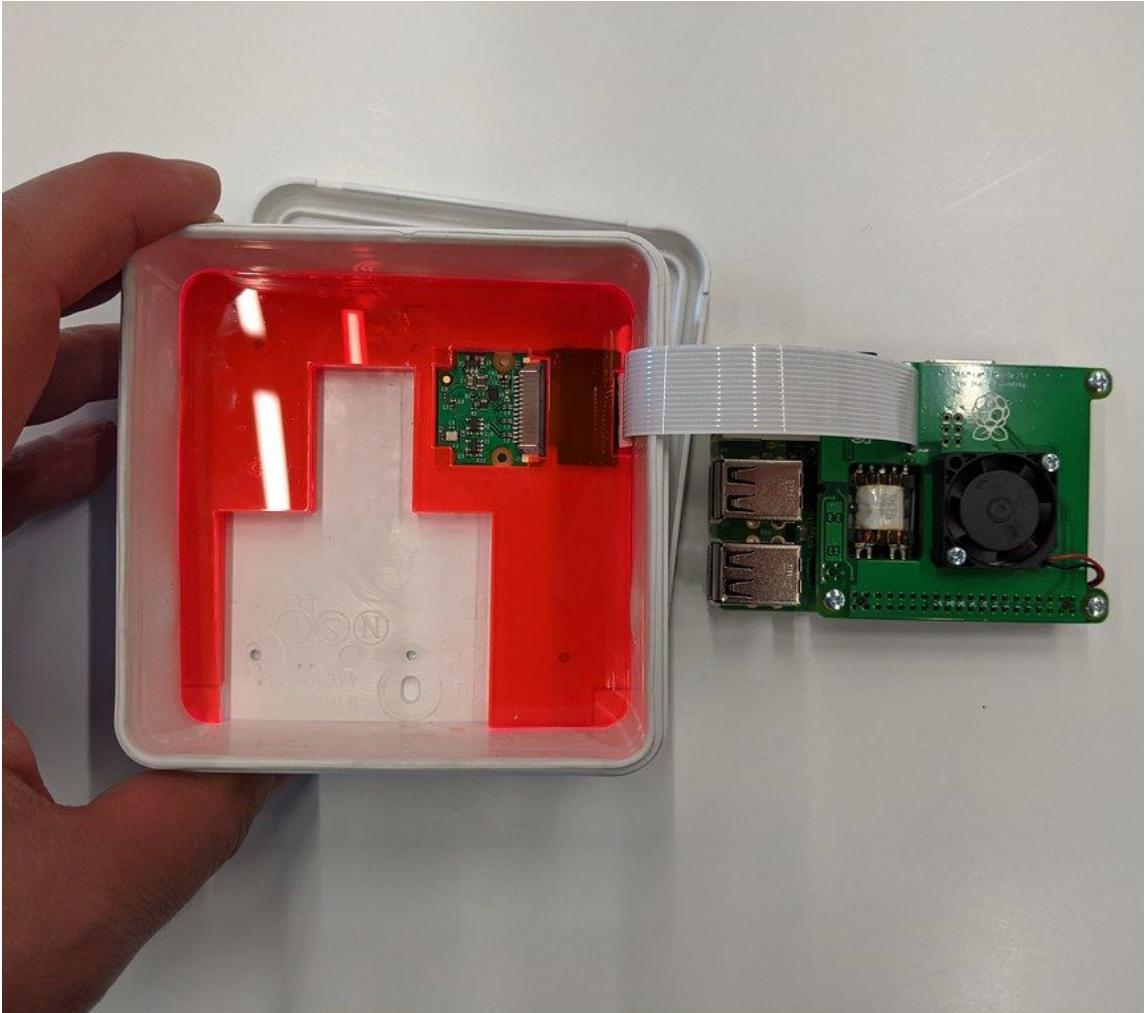


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Do it yourself / with others



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Analysing ~1.5 M photos with ML



## Projektdokumentation P8

## Timeo Wullsleger

The screenshot shows a web-based image exploration tool. At the top, there's a header bar with a back/forward button, a search bar, and other navigation icons. Below the header, the title "Projektdokumentation P8" and "Timeo Wullsleger" are displayed. The main area has a dark background with several interactive elements:

- Left sidebar:** Includes a "Base directory = E/Originals/" label, a "Images to show:" section with a radio button for "All Images" (selected), and a "Node ID" dropdown menu.
- Center:** Displays the image ID "ID: 0344-6782 Date: 2021-06-21 08:00:02". Below the image, there's a timeline from 8 to 18.
- Right sidebar:** Contains classification results:
  - Marked as Flower (green)
  - Flowers visible (green)
  - No Flowers visible (red, checked)
  - Not sure (grey)It also includes buttons for "Open Image in new Tab" (blue) and "Annotate" (yellow).
- Bottom right:** Navigation buttons for "Load", "Random", "Jump back", "Jump forward", "Previous", and "Next".

Abbildung 52 User Interface Image Exploration Tool

Knapp 2700 Bilder wurden mit dem Tool klassifiziert. Zeitabschnitte, die für das Projekt brauchbar sind, können ausgewählt und für weitere Bearbeitung ausgewählt. Die Klassifizierung ist im Detail nicht detailliert beschrieben.

## Projektdokumentation P8

Timeo Wullsleger

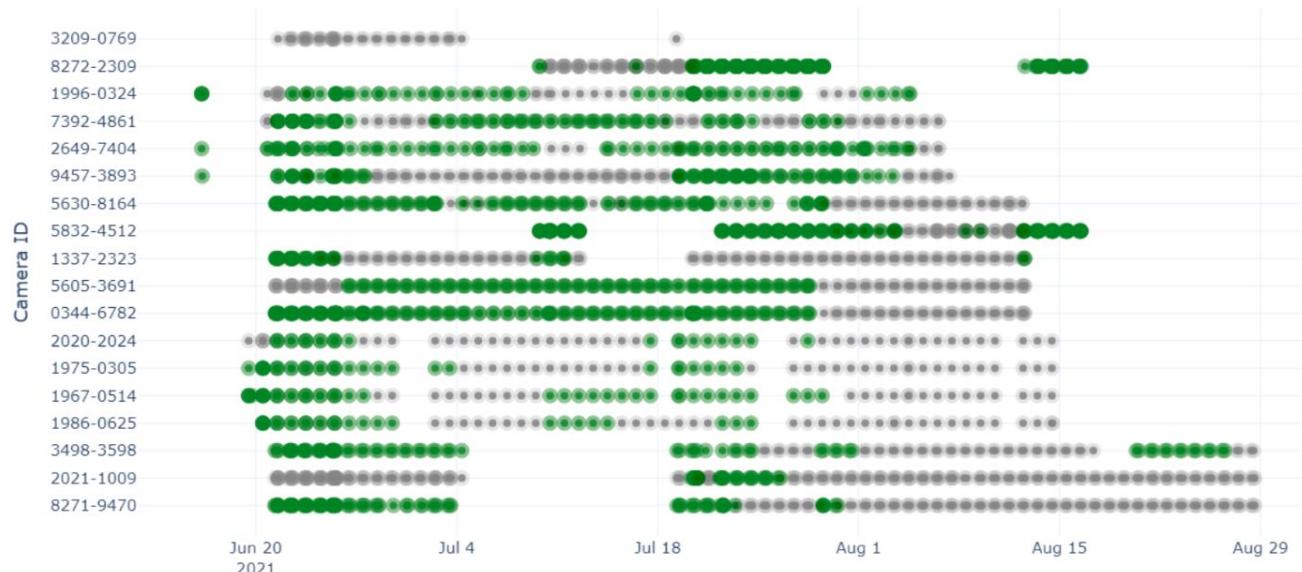


Abbildung 54 Bilder mit Blumen nach Kamera und Aufnahmedatum

### 3.2 Annotieren der Bilder

## Projektdokumentation P8

Timeo Wullsleger

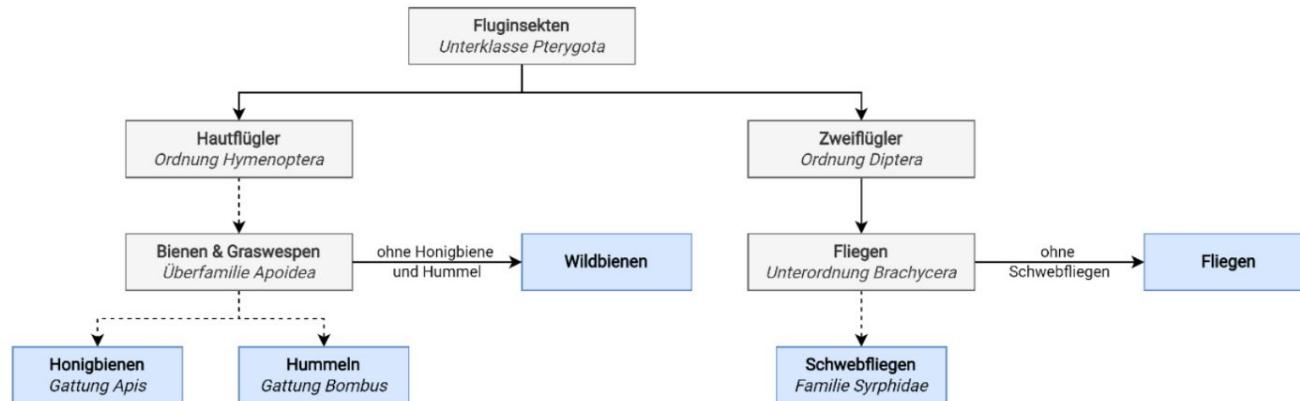


Abbildung 64 Pollinator Dataset: Taxonomie der Bestäuber [43]

Abbildung 65 zeigt die Aufteilung der Bestäuber im Datenset nach Art. Die Größen der Klassen sind nicht gleichmäßig. Wildbienen und Honigbienen verfügen über sehr ähnliche optische Merkmale, was eine Unterscheidung schwierig macht. Schwebfliegen, Fliegen und Hummeln sind optisch besser voneinander unterscheidbar, womit die geringere Anzahl Vorkommnisse das Modell nicht schwerwiegend beeinträchtigt.



## Projektdokumentation P8

## Timeo Wullsleger

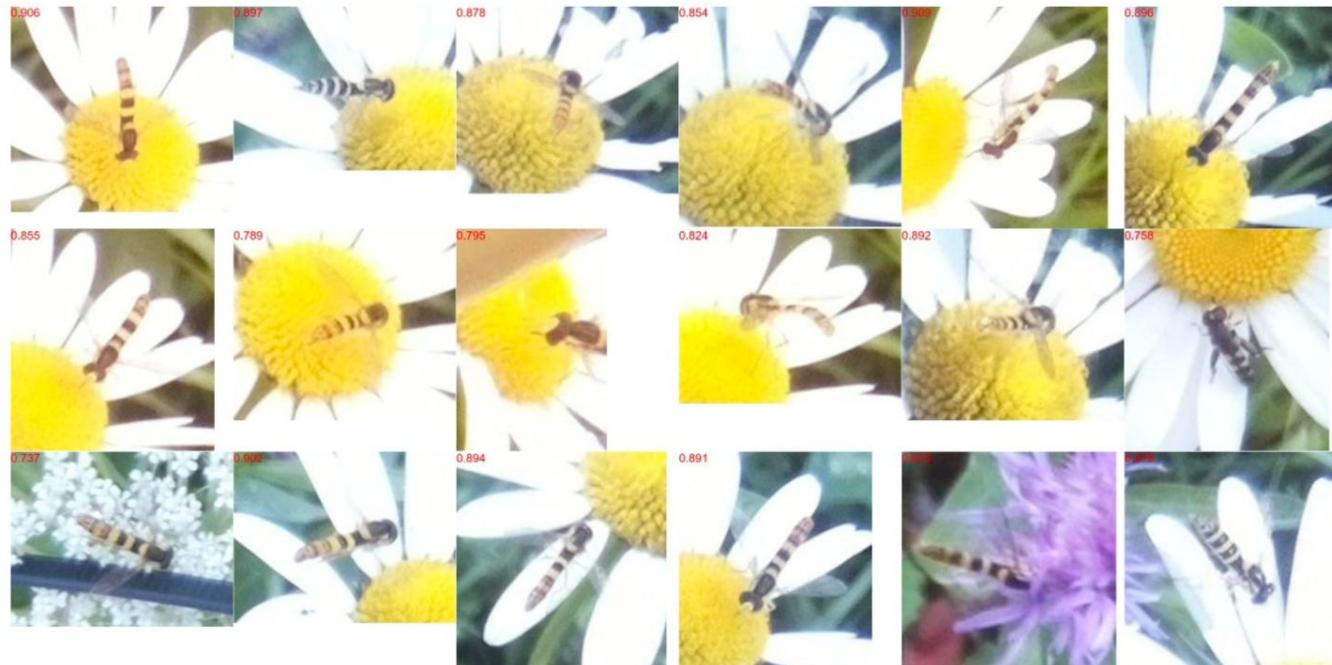


Abbildung 96 Mosaik aus Resultaten der Klasse Schwebfliege

Mit dem report\_generator Tool [38] kann aus den Resultaten ein Report im PDF Format gene-



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Standing on the shoulders of giants

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 martonmiklos - new branch renamed, ... Latest commit 559d91e on Nov 10, 2010 History

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339 lines (281 sloc) | 17.6 KB Raw Blame

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9          Preamble
10
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 **Borda** Add pre-commit CI actions (#4982) ... ✓

Latest commit ed887b5 on Oct 28, 2021 [History](#)

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 **torkelo** Re-license Grafana to AGPLv3 (#33184) ... ✓

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mitwelten/mitwelten-iot-hardw x +

https://github.com/mitwelten/mitwelten-iot-hardware-poc#mitweltenorg-iot-hardware-proof-of-concept

README.md

# Mitwelten.org IoT Hardware Proof of Concept

Work in progress. Questions? Contact [mitwelten.technik@fhnw.ch](mailto:mitwelten.technik@fhnw.ch)

- [AudioMoth Audio Logging Microphone](#)
- [AudioMoth Audio Logging Microphone with LiPo Battery](#)
- [LiPo/Li-Ion Charging Station](#)
- [LoRaWAN Gateway with 3G Uplink](#)
- [LoRaWAN Sensor Nodes](#)
- [LoRaWAN Sensor Nodes with Solar Power](#)
- [OpenMV Bug Tracking Camera](#)
- [OpenMV Photo Logging Camera](#)
- [OpenMV Photo Logging Camera with PIR](#)
- [OpenMV Video Streaming Camera](#)
- [Raspberry Pi Streaming Camera](#)
- [Raspberry Pi Streaming Camera with PoE](#)
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- [Raspberry Pi Streaming Camera with Solar Power](#)
- [Raspberry Pi Streaming Endoscope](#)
- [Wi-Fi and PoE Access Point with 4G Uplink](#)

Contributors 3

 **tamberg** Thomas Amberg

 **WullT**

 **simsta1**

Languages



Language	Usage (%)
G-code	99.9%
nesC	0.1%
OpenSCAD	0.0%
C++	0.0%
Python	0.0%
C	0.0%

# Tools for deployment and operations

Maps of Switzerland - Swiss C X +

https://map.geo.admin.ch/?lang=en&topic=ech&bgLayer=ch.swisstopo.swissimage&layers=ch.swisstopo.zeitreihen,ch.bfs.gebaeude\_wohnungs\_re...

Back / Finish drawing

Marker

Text

Line

Measure

Map saved.

Delete Export Share

Your drawing is automatically saved for one year. By using this service, you agree to the [terms of service](#).

Close menu

Background

## Draw & Measure

334.75° / 20.01 m

230V

PiCam

PiCam

PiCam

AP

PiCam

Maps by swisstopo

## Menu

Mitwelten: Nodes Deployment Manager

## Deployments

## Add Deployment

## Nodes

### Add Node

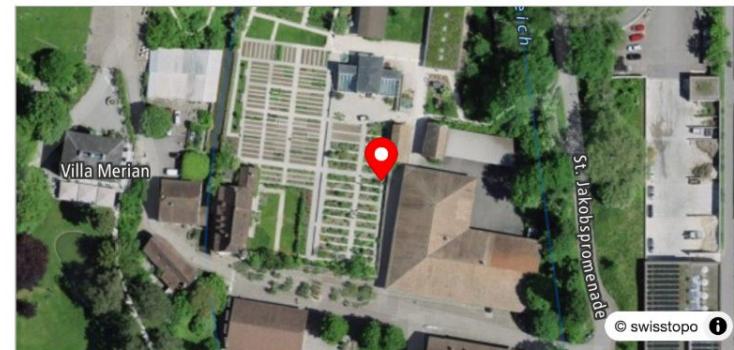
[Log Out](#)

## Deployments

	8776-8942	A
	1975-0305	O
	1967-0514	O
	1337-2323	O
	5605-3691	O
	5630-8164	O
	8632-4498	A
	1996-0324	O
	7392-4861	O
	9457-3893	O
	1986-0625	O
	3498-	-

## Deployment of Node 5605-3691

Node ID	5605-3691
Deployment Period	01.03.2021 - 31.10.2021
Description (Location)	(kml-import)



## Node Details

Type	Optical	Platform	PiCam
Connectivity	RJ45	Power	PoE
Hardware Version	v0.0.0	Firmware Version	v0.0.0

[Edit Deployment](#)

Close

ms per page: 10

1 - 99 of 9

Developed by C. Spindler

Bot developed by C. Spindler

yaler/YalerTunnel2 x +

https://github.com/yaler/YalerTunnel2

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yaler / YalerTunnel2 Public Edit Pins Unwatch 3 Fork 0 Starred 1

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marcfrei Added tag v2.3.2 for changeset a5a92b20de78 6c818b3 on Jan 14, 2020 9 commits

test	YalerTunnel v2.3.0	4 years ago
tls	YalerTunnel v2.3.1	3 years ago
udns	YalerTunnel v2.3.0	4 years ago
LICENSE.txt	YalerTunnel v2.3.1	3 years ago
Makefile	YalerTunnel v2.3.0	4 years ago
README.txt	YalerTunnel v2.3.1	3 years ago
http_reader.c	YalerTunnel v2.3.1	3 years ago
http_reader.h	YalerTunnel v2.3.1	3 years ago

About No description, website, or topics provided.

Readme BSD-2-Clause license 1 star 3 watching 0 forks

Releases 4 tags Create a new release

Disclosure: I'm a founder

Student projects, bachelor and master



Qv Thushyanthan Saravani & Mithusan Sivakumar

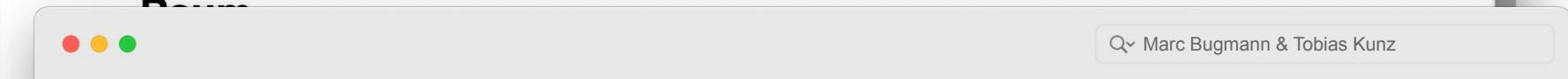


Fachhochschule  
Nordwestschweiz

App  
Web

Design  
UX

## 21HS\_IMVS02: Visualisierung von Biodiversität im Urbanen Raum



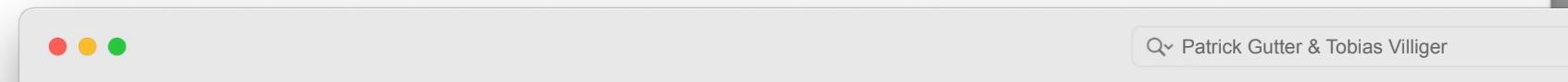
Qv Marc Bugmann & Tobias Kunz



Fachhochschule  
Nordwestschweiz

App  
Web

## 22FS\_IMVS30: MJPEG Multiplexer Web Service



Qv Patrick Gutter & Tobias Villiger



Fachhochschule  
Nordwestschweiz

App  
Web

Design  
UX

## 22FS\_IMVS31: Interaktive Darstellung von Biodiversität im Urbanen Raum



Qv Simon Matile (in progress)



Fachhochschule  
Nordwestschweiz

App  
Web

Design  
UX

## 22HS\_IMVS35: Audio-Visueller Media Player für Biodiversität im Urbanen Raum



Qv (to be done)



Fachhochschule  
Nordwestschweiz

App  
Web

Design  
UX

## 23FS\_IMVS???: Data Storytelling für Biodiversität im Urbanen Raum



Qv (to be done)



Fachhochschule  
Nordwestschweiz

CG  
IP

ML  
Alg

## 23FS\_IMVS???: ML-Kamera für Biodiversität im Urbanen Raum

Mitwelten Dashboard

<https://viz.mitwelten.org/?env=true&fs1=true&from=1604999861000&optical=true&audio=true&pax=true>

3340-2993

Humidity

Moisture

Teilen Exportieren

Brügglingen

St. Jakobs-Promenade

Orangerie

Café Merian

Mühlemuseum

Brüglingerhof

Unterbrüglingen

Lehmhaus

Lärchenstelli

Floren

St. Jakobs-Promenade

NACH DATUM EINGRENZEN

Startdatum 10.11.2020 Enddatum 10.11.2022

FILTERN NACH SENSORTYP

- PAX-Sensoren
- Umwelt-Sensoren
- Audio-Sensoren
- Kameras

FORSCHUNGSAREALE

- Merian Gärten (FS1)
- Dreispitz Areal (FS2)

NACH KATEGORIEN FILTERN

Developed by IP5/6 teams

Filtrern nach Kategorien

Mitwelten – Medienökologische Infrastrukturen für Biodiversität

The dashboard displays environmental data and sensor locations. On the left, two line graphs show 'Humidity' and 'Moisture' levels over time from September 26 to November 21. The 'Humidity' graph shows a sharp drop from 100% to 60% in early October, while 'Moisture' shows a steady increase from 380 to 400. Below the graphs are sharing and export options. The central part of the dashboard is a map of Brügglingen, showing various research areas like 'Merian Gärten (FS1)' and 'Dreispitz Areal (FS2)'. Numerous circular icons representing different sensors (PAX, Umwelt, Audio, and Camera) are placed on the map at specific locations. A green button labeled '>>' is located in the top right corner of the map area.



Qv Timeo Wullschleger



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## Projektdokumentation P7

Data Acquisition for Urban Biodiversity Monitoring



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## Projektdokumentation P8

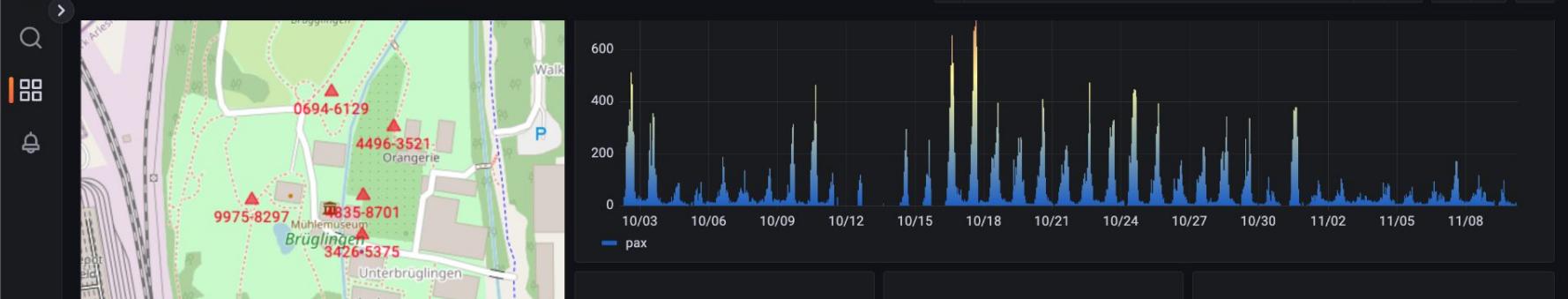
Automated Analysis for Urban Biodiversity Monitoring

PaxCounter - Grafana

https://status.mitwelten.org/d/QHW8H7OVk/paxcounter?orgId=1

General / PaxCounter

2021-10-02 06:54:49 to 2021-11-10 06:28:25



Selected Nodes				
nodeid	start	end	records	description
3426-5375	2021-09-22 ...	2021-12-01 ...	4335	(user-added)
4835-8701	2021-10-01 ...	2021-12-01 ...	1279	(user-added)
4496-3521	2021-10-01 ...	2021-12-01 ...	2903	(user-added)
0694-6129	2021-09-22 ...	2021-10-13 ...	788	(user-added)
9975-8297	2021-10-01 ...	2021-12-01 ...	2568	(user-added)

Developed by T. Wullsleger



Thank you. More? [Mitwelten.org](https://Mitwelten.org)