Monitoring an ephemeral stream with a Teensy 3.2 + audio shield to determine water level only from the noise of a stream

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CONTEXT

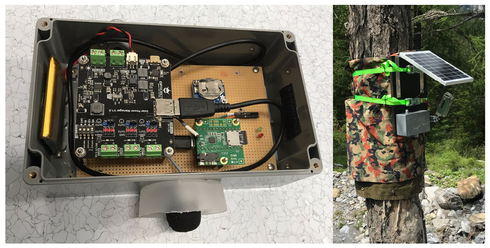
Study site: Vallon de Nant (Vaud, CH)
1497.7 meters above sea level

Intermittent and ephemeral streams (IRES) need new measuring technique

- Emerging subject of research in hydrology
- > 50% of the streams globally
- Lack of spatial and temporal data
- Current tool for water level detection = instream guage
- Harsh conditions = sensor destruction

DIY AUDIO SENSOR

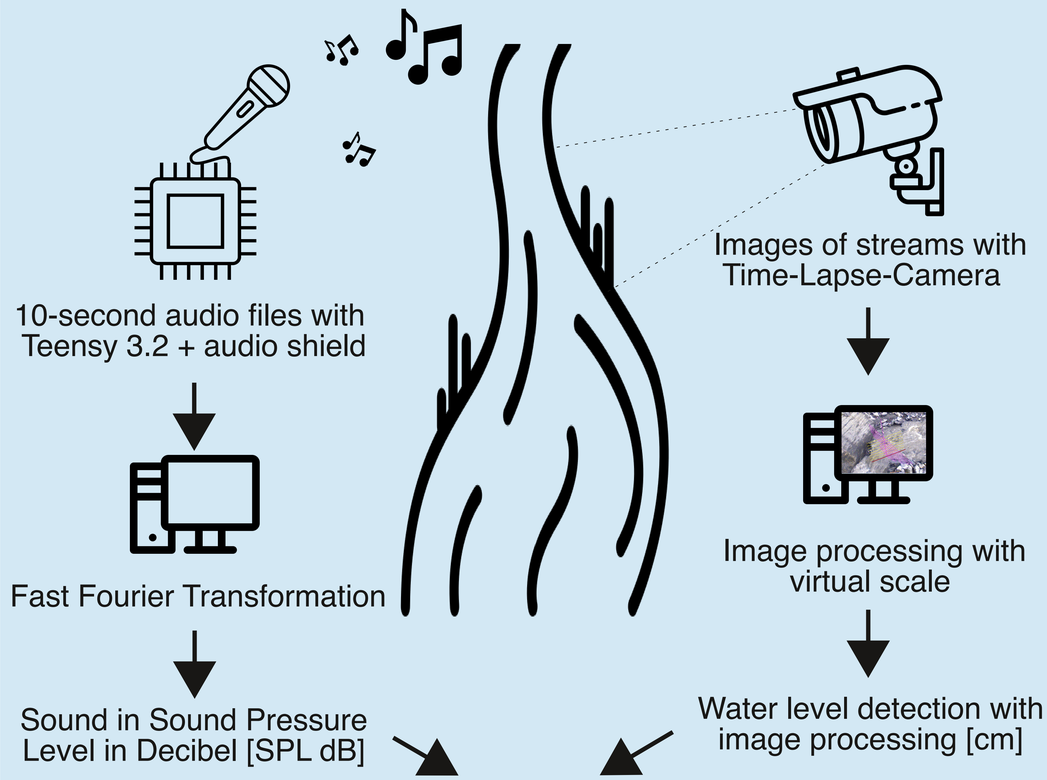
- Distance (<5m from stream)
- Calibration with images
- Monitor by day and night (24h) and powered with solar panel
- Self-made and cost-efficient
- Arduino code for Teensy 3.2 + audio shield

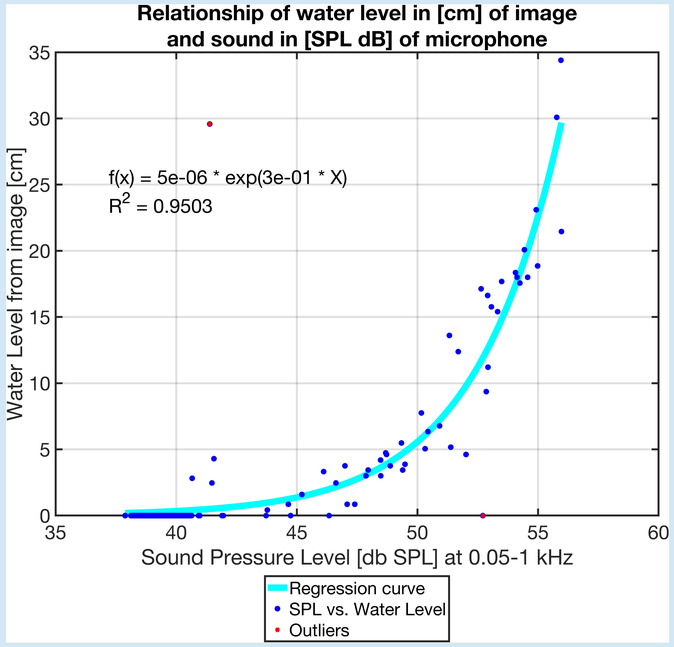


3 main components of audio sensor

1. Power supply, with voltage converter, solar panel, and lithium-polymer (LiPo) battery
2. Microcontroller with real-time clock
3. Audio shield with microphone

METHOD





RESULTS

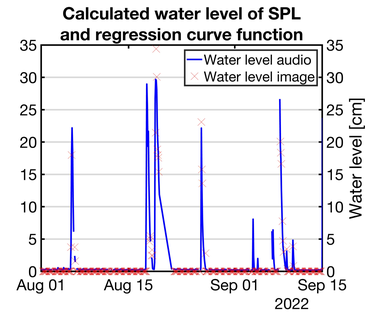
Sensor

- > 95% of the audio files were valid
- Autnomous power supply without problems for 2 months
- Cost: ≈ CHF 155.00

⚠ 2 unidentified shutdowns

Audio and image method

1. f(x) = 5e-0.06 • exp(3e-01 • x)
2. Use SPL dB values as x to get Water level in cm



Observation period: 01.08.23 - 15.09.23
7 stream flow events monitored whereas 2 happend at night
⚠ Image processing can not confirm stream flow events at night

CONCLUSION

Successful **determination of the water level** with audio files

Strong relationship between water level of images and SPL dB of audio

Requires **calibration** by another sensor

Cost-effective sensor to counteract lack of spatial and temporal data

Code **improvement required** for more stability

ACKNOWLEDGEMENT

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All codes and corresponding thesis are available on Zenodo online available