Low-cost remotely sensed environmental monitoring stations

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Goals of the study

- Building an automated low-cost on-line river water level monitoring device to be used in Multi-Scale Urban Flood ForecastINg (MUFFIN) `http://www.muffin-project.eu/`

System design

The monitoring stations are deployed in an urban area measuring river water level, as shown in Figure 6.

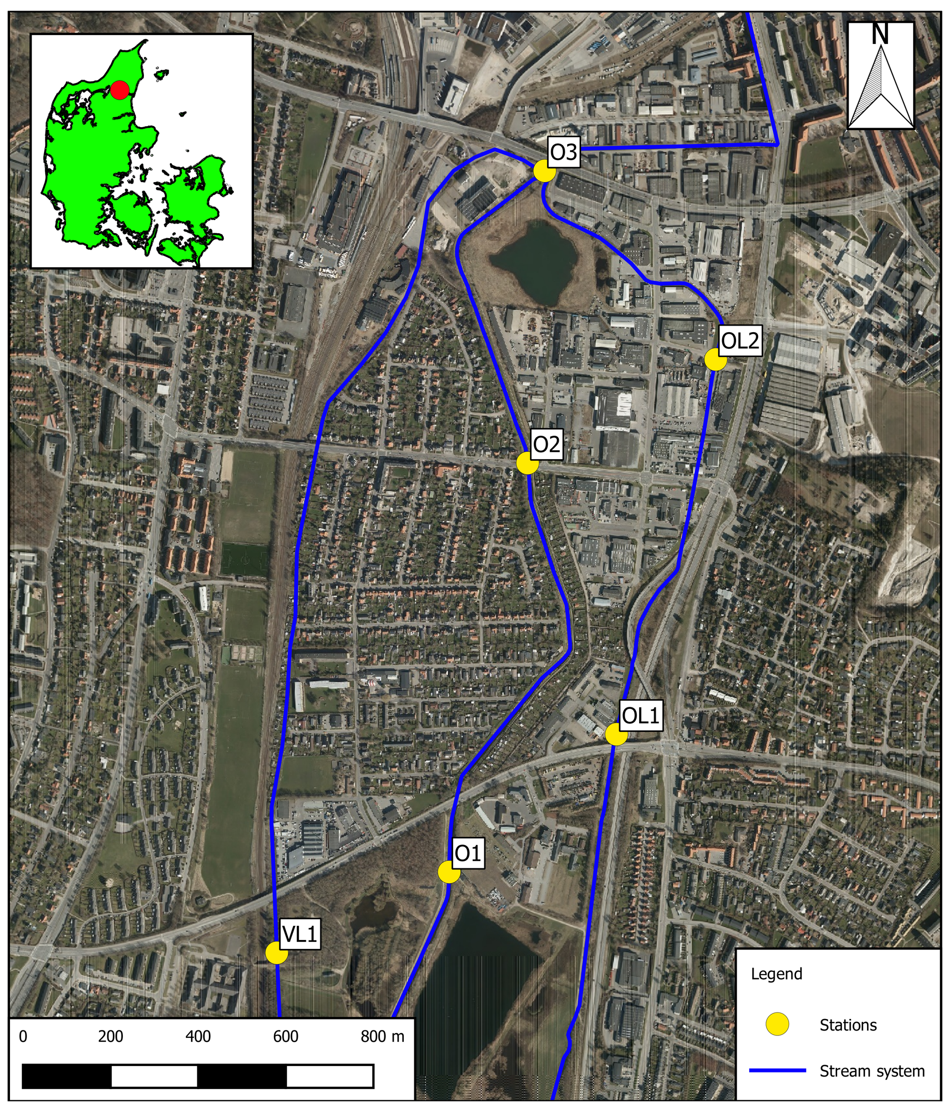

Fig. 1: Overview of monitoring stations.

- Total cost of approximately 280 EUR for:
  - Microcontroller unit (MCU)
  - Ultrasonic sensor
  - Cellular network device
  - Solar panel
  - Li-Po battery
  - μSD card

The structural framework of a monitoring station is illustrated in Figure 2.

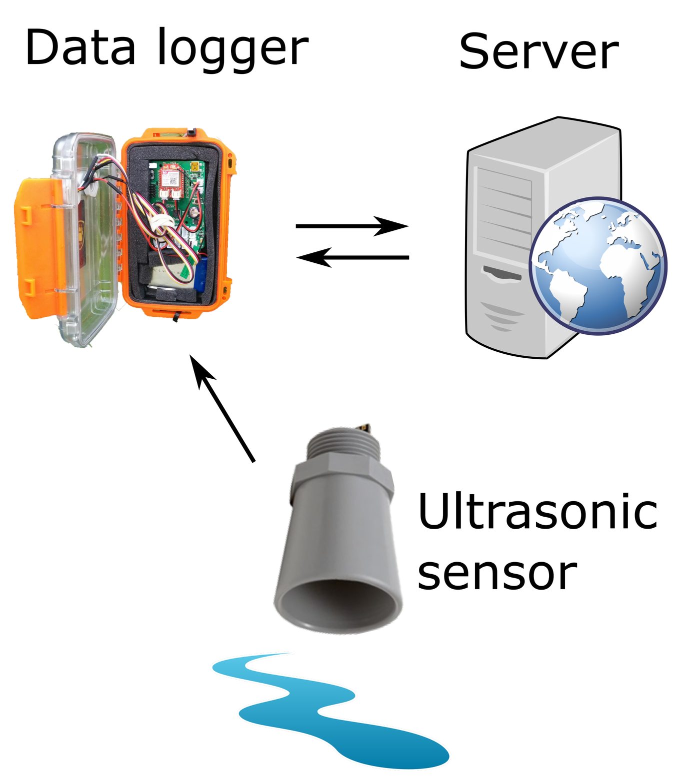

Fig. 2: Structural framework.

Station VL1 is illustrated in Figure 3.

Fig. 3: Monitoring station VL1.

Features

- Solar and battery powered
- 14 days of battery life time with no available sun light (Uploading data every hour)
- Situation dependent upload frequency
- Server side warning system to detect equipment malfunction
- Automatic resets of the device in case of breakdown

Operational design

Operational routine of the monitoring stations and server side operations are sketched in Figure 4 and 5.

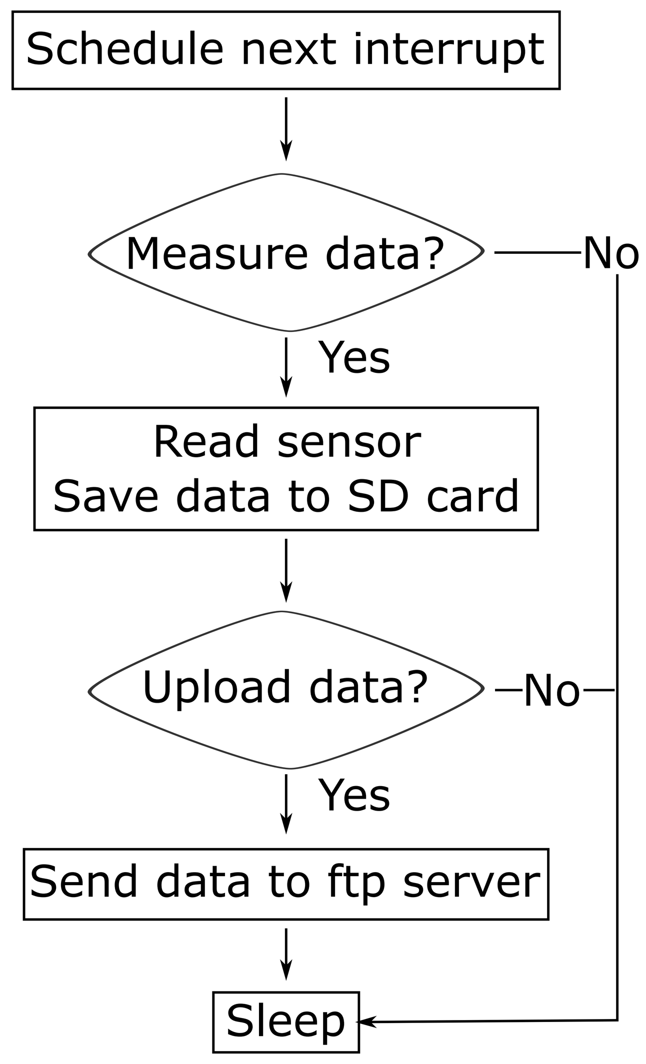

Fig. 4: Monitoring station routine.

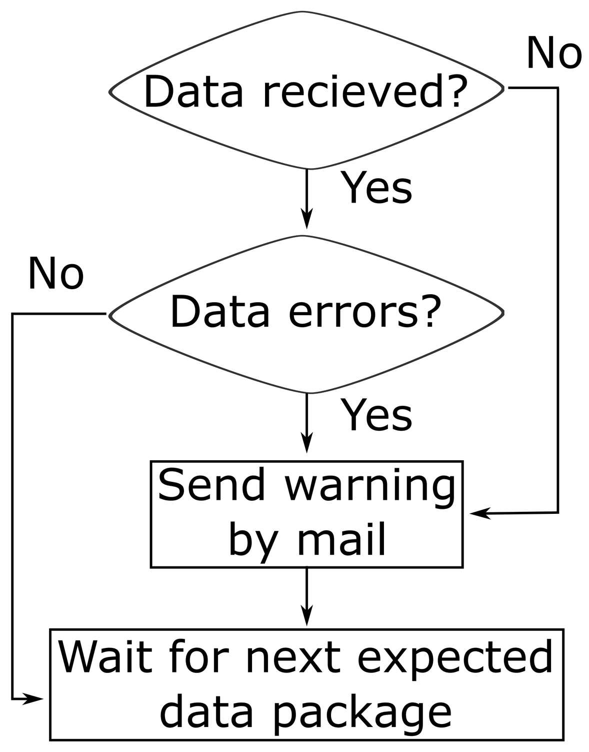

Fig. 5: Server side operations.

Design recommendations

Remote data access

- Quad-band cellular network devices are recommended

Hardware design

- Use specialized low-powered MCU's such as SODAQ MBILI or Mayfly [1, 2]
- Choose the battery capacity based on no solar radiation for a 2 weeks period
- Determine solar panel requirements from local solar radiation levels and conditions at each specific site

Network design

- Server side automatic warning and system reset functions greatly improves the autonomy of the monitoring system

Results

- Sampling from every 30 seconds and up to whatever desired interval
- Supports upload frequencies up to once every 10 minutes (3 days continuous life time)
- Low maintenance: removal of spiders, etc.

Routine	Current draw [mA]	Time [s]
Upload	321	30
Measure data	51	5
Sleep mode	0.673	565

Table 1: Power consumption.

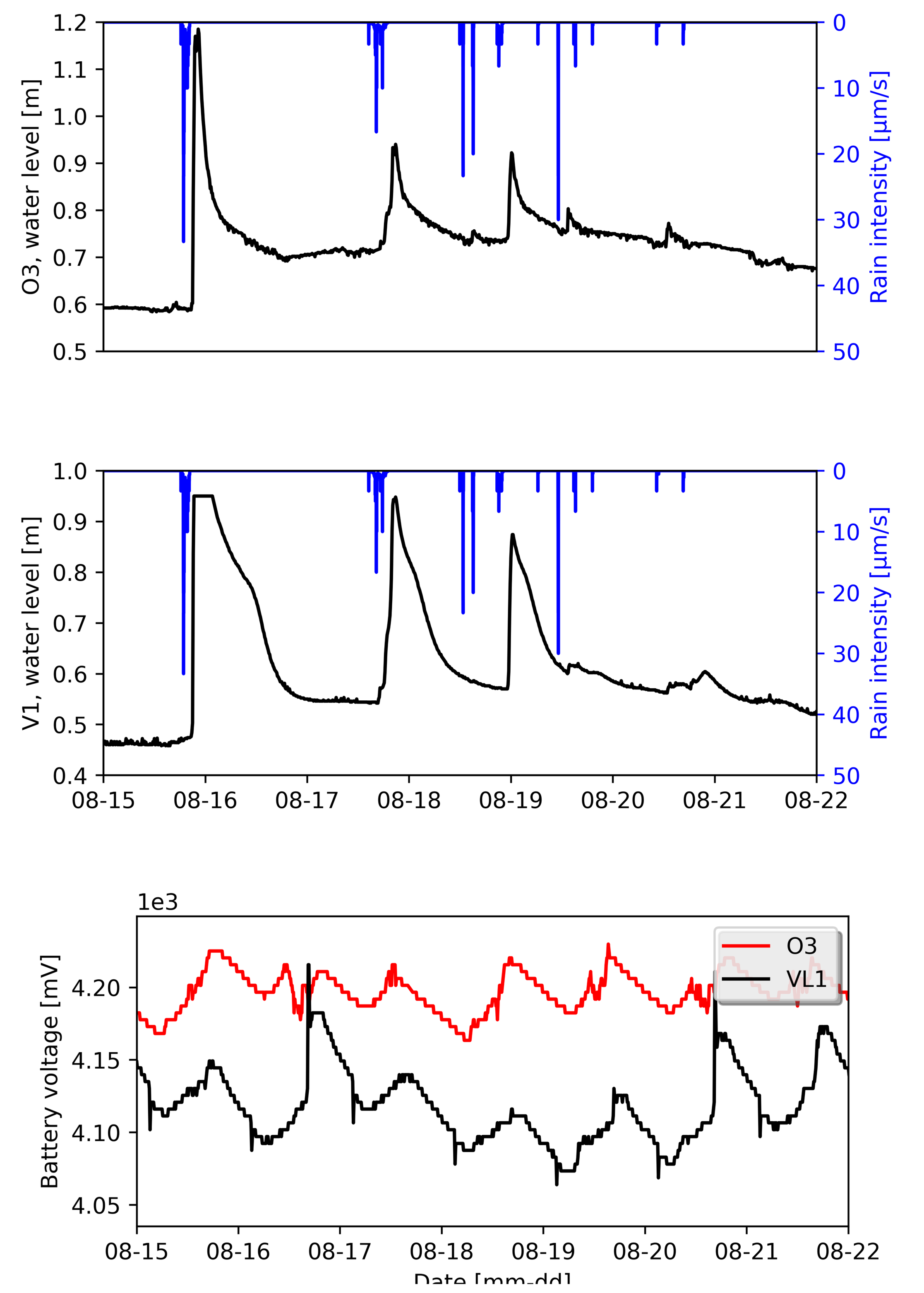

Fig. 6: Measured river water level and battery voltage.

Conclusion

- Monitoring stations performs well during the test period
- The cost is very low
- Warning systems to detect false observations are key to get reliable measurements
- Keep server side track of monitoring system
- Situation based upload frequencies extends the life time significantly

Acknowledgments

The authors would like to acknowledge to the ERA-NET Cofund Water Works 2014 (project MUFFIN) for the funding of this research and fellow colleagues at Aalborg University for their input

References

[1] SODAQ, 2017 `https://shop.sodaq.com/en/sodaq-mbili.html`

[2] EnviroDIY, 2017 `https://envirodiy.org/mayfly/`