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Artificial Intelligent Sensing to Monitor Disinfection By-Products in Drinking Water

Balaram Guddanti

balaram.guddanti@wetsus.nl

Motivation

Water is life. Every living being depends on water for their survival. This caters to the need for having fresh drinking water at all times. Unfortunately, the available water can contain hazardous matter causing potentially fatal diseases. To mitigate life-threatening situations, disinfectants like chlorine are added to the potable water[1]. In certain conditions, this might lead to the production of harmful disinfection by-products (DBPs) like Trihalomethanes (THMs), Haloacetic Acids (HAAs), etc. [2][3]. Identifying and neutralizing these DBPs has become a necessity for distributing safe drinking water.

Existing solutions include time-consuming water analysis, or the use of DBP sensitive analyzers (Fig 1), which is expensive. To be more cost-effective we envision an intelligent monitoring system and sensing infrastructure to (indirectly) identify DBPs in streaming water.

However, to overcome these issues, envisioning a cost-effective sensing infrastructure and intelligent monitoring system to identify DBPs in streaming water is still lacking.

Technological challenge

The two major technological challenges in this research are:

- Designing a sensing network infrastructure:

The sensing infrastructure includes reliable sensors, low-latent data transmission units, and a micro-controller. Streaming water requires sensors that withstand water flow and can capture data at high frequencies. This ensures mapping DBPs ground truth information to the captured data.

- Developing an intelligent monitoring system:

Building an efficient and intelligent deep learning multi-column regression model that monitors the DBPs with high accuracy in streaming water.

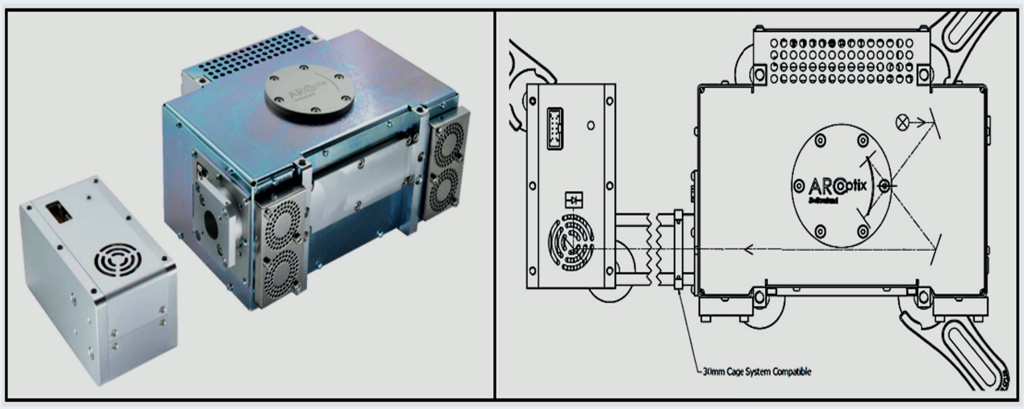

Fig 1. IR-ATR water analyzer (ARCoptix: FTIR OEM 011) - To map the DBPs ground truth information with the sensors data for building AI models.

As there are no cost-effective sensors available to measure DBPs at low concentrations, we therefore aim to build an AI model that uses data from sensors probing the conditions instead of the DBP of interest. Fig 2 shows a possible experimental setup to address the technological challenges.

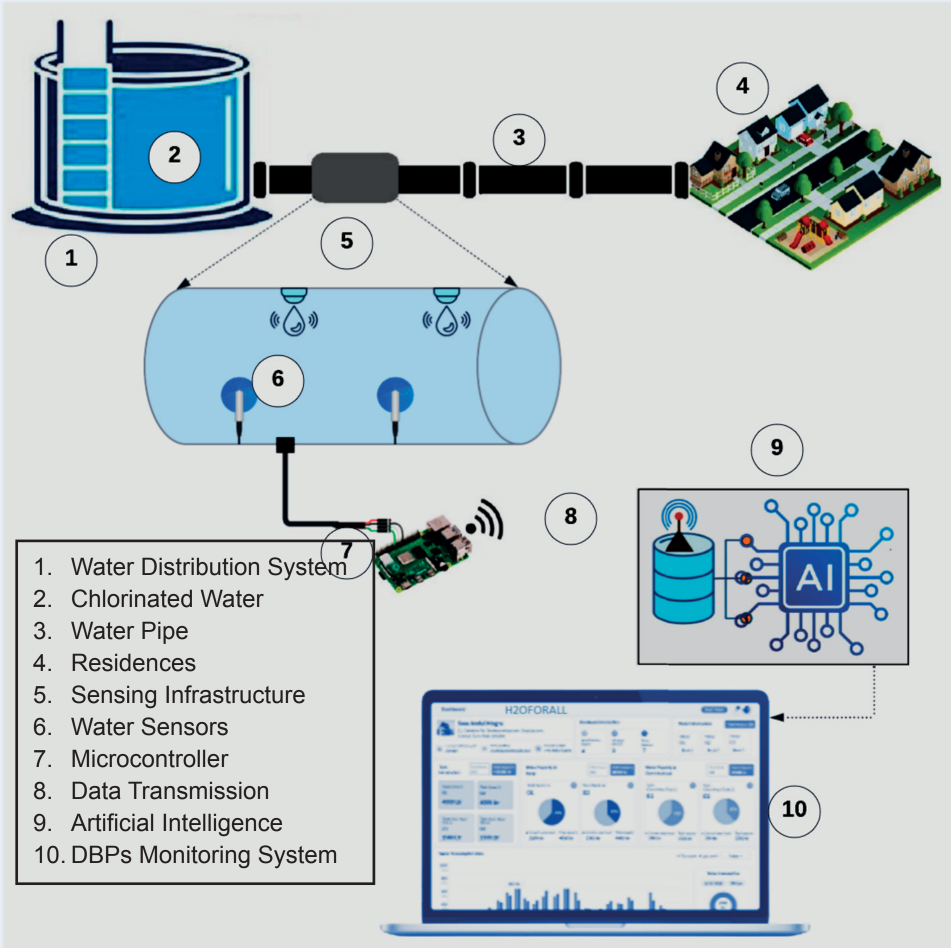

Fig 2. Expermental setup of the sensory infrastructure to monitor the DBPs in streaming water using Artificial Intelligence.

Research goals

The main goals of this research are:

1. Identifying the environmental and chemical parameters that impact the DBPs production.
2. Choosing the right water sensor modules that are reliable, durable, cost-effective, and less power-consuming.
3. Design sensing infrastructure to capture data from streaming water.
4. Building a probabilistic machine learning-based model to monitor the DBPs.

With this, we aim to develop an alternate cost-effective DBPs monitoring system that is highly scalable.

References

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This work is part of a project that has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101081963.

Balaram Guddanti, dr.ir. Martijn Wagterveld, prof.dr.ir. Andreas Kamilaris, prof.dr.ing Paul Havinga

UNIVERSITY OF TWENTE.