Smart Sensor Buoy for early Detection of Water Pollution Agents

Motivation: About 1.5% of the area of Germany is covered with fresh, inland water, which corresponds to a total surface of 5,182 km². A considerable amount of fresh water is used for agricultural irrigation. As a direct result of this intensive usage, the quality of the used "excess" water decreases e.g. because fertilizer and other deposits of soils of the agricultural area are transmitted into the groundwater. Much more dramatic than the natural/seasonal entry of additional biomass into inland waters, is the single-point entry of large quantities of waste, fertilizers, chemicals etc. by local occasions, as accidents or illegal discharge. This local disposal of significant amounts of harmful substances and nutrients usually leads to a complete dying of the ecosystem. It is of great importance to measure, detect and localize water pollution agents at an early stage.

Measuring stations e.g. in the terms of sensor occupied buoys, are not widely used in the context of inland waters but as offshore solution. Especially regarding to an inconspicuous appearance and the level of interference of the ecosystem, previous mentioned solutions are not particularly suitable. Existing systems are based on voluminous platforms that record the data via big sensor units at the point of data acquisition and store it in different systems. Although this may create a continuous data string, in a rather low frequency of data acquisition (measured data point per hour), the created information is uncommonly available in real-time. So, appropriate reactions regarding local effect regarding specific concentrations or physical shifts can only be initiated with a big offset of time.

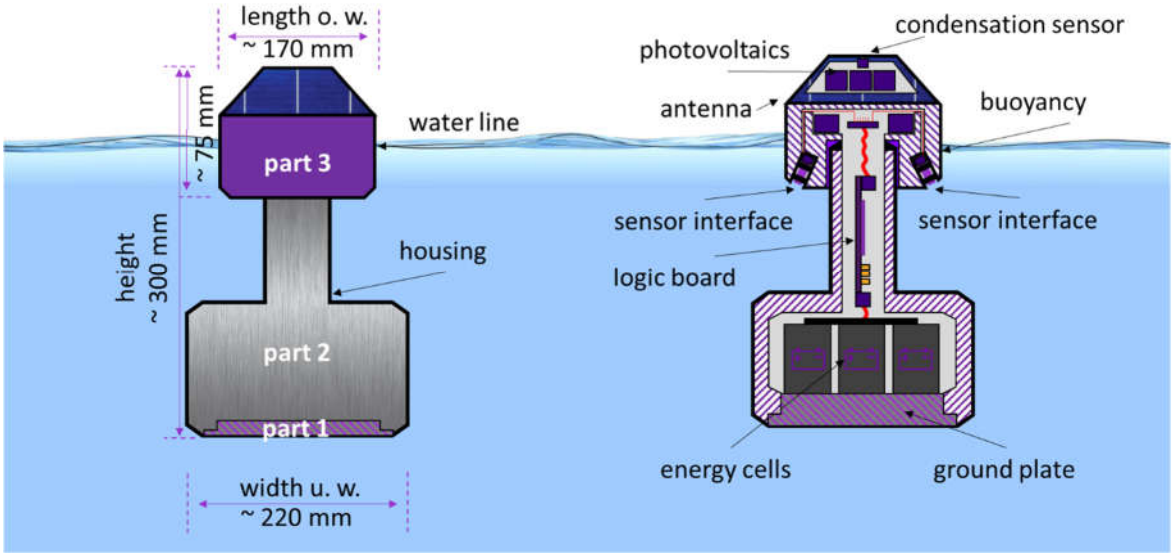

Figure 1: *scheme of one smart sensor buoy*

Development: As a result, a novel, compact sensor buoy has been developed that provides high-frequency, reliable and almost invisible monitoring by adapting analog and digital sensors, as shown in Figure 1.

The core of the innovation is not just the development of a single floating sensor buoy, but the development of a meshed network of very small-scaled smart buoys.

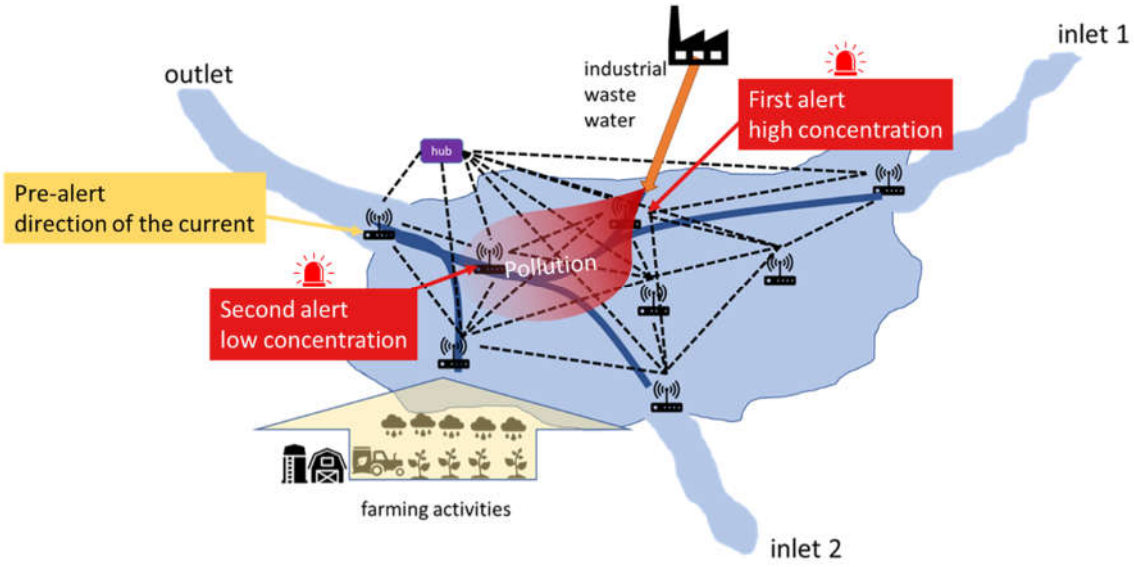

Figure 2: *scheme of a meshed buoy network with nine participants*

Every single buoy is connected wirelessly to each other, which allows them to communicate and interact, as illustrated in Figure 2. Due to this interconnection and a smart arrangement of the buoys (e.g. near to water-endangering industrial plants or agricultural area), a fast and early detection of discharges of pollutants is granted.

For this purpose, the buoys record measured data at defined intervals (up to 1 kHz) and send these to adjacent buoys or a central hub. Through smart data analysis and pre-evaluation of influencing values within the measuring units, pollutions can be detected and localized at an early stage, as well as water-polluting entry points can be identified immediately. Furthermore, the propagation of the contamination can be predicted due to modelling and simulation by data of the current and weather, so pre-alerts and guidelines for action can also be generated.