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FNSNF

Water quality assessment sensor integration into swimming robot

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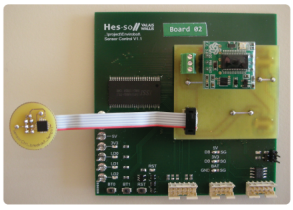
Hes·so VALAIS WALLIS

Introduction

The aim of the project is to sample and measure a set of relevant water quality parameters with physical, chemical and biological sensors, integrated into an autonomous swimming robot. This work shows the progress of the evaluation, miniaturization and integration of selected sensors. The long-term goal is to provide enough information for the navigation algorithm, so that the robot can find the source of pollution.

Evaluation

First, all sensors were evaluated in the lab to determine the mode of operation. (Turbidity, Daphnia, Bioluminescence, Sampling, Conductivity, Amperometry, pH, Dissolved oxygen, Temperature)

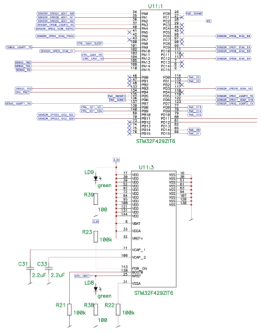


Boat tests

An intermediate step was taken to test different sensors on a remote controlled boat in real environment conditions.
Therefore a microprocessor, with a Bluetooth connection and a dedicated antenna, was set up for the sensor communication with a computer on the shore. (Turbidity, Sampling, Conductivity, Amperometry, Temperature)

Integration

Finally, sensors are integrated into the autonomous swimming robot. The core processor is connected by a CAN bus to a general-purpose sensor platform inside the different segments. These platforms perform all the calculations to obtain the water parameters and send them to the core processor to finally find a possible source of pollution. (Conductivity, Temperature)



Bioluminescence

Genetically modified bacteria are used to detect arsenic or mercury in water. A photon multiplier tube (allowing photon counting) is packed into an opaque housing, containing a 2ml vial with the bacteria. The intensity of the detected light corresponds to the concentration of heavy metal.

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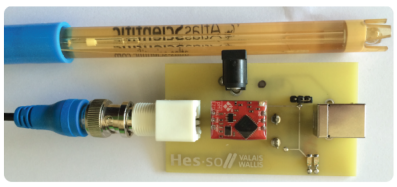
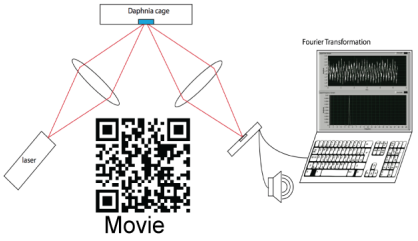


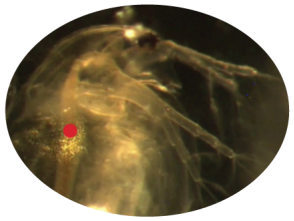
pH

Lake pH provides a means of studying various types of environmental pollution, including acid precipitation, acidic water runoff and soil leaching of chemical fertilizers.

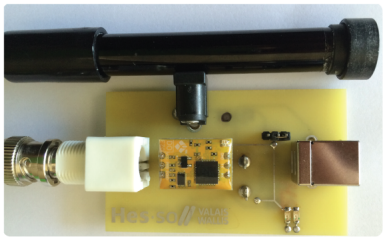
Daphnia

It is known that water pollution can affect the heart rate of Daphnia. Therefore two systems where evaluated, one based on a camera and another on laser Doppler analysis. Both systems provide a clear frequency peak at around 5Hz that correspond to the heart rate and hence could give information on water quality.





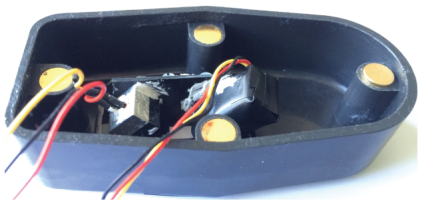
Dissolved oxygen



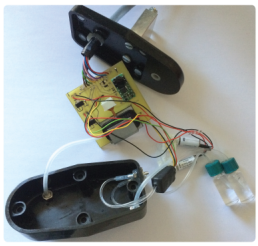
Most aquatic plant growth and marine organisms depend on the oxygen content of water for survival and so the assessment of this parameter is a useful factor in determining water quality.

Turbidity sensor

This sensor measures suspended solids, by measuring the amount of scattered light in the water.



Sampling



It is useful to obtain water samples from a lake and analyze them later in the laboratory. The system consists of a water filter, a micro pump, two valves, two liquid sensors and two 2ml reservoirs.

Conductivity and Temperature

Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate and phosphate. Significant changes in conductivity could then be an indicator for pollution. Since conductivity is also temperature dependent such a sensor is included as well.

Future work

In the near future more physical and chemical sensors already tested will be integrated into the swimming robot. Then first biological sensors that are still in the development and evaluation phase will be miniaturized and also integrated.