Next Generation Smart Water Grids

Over the next 25 years, fresh water demand will be 40% higher than the available supply. In most of the water utilities, the water management is not properly addressed in terms of real time monitoring of the grid. Therefore, a smart water grid was developed comprising both: hardware (sensor quality meter and data transmission systems) and software (data management systems) components.

Main Project Team	
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Indicators	
Funding	29k €
Journal Papers	3
Book Chapters	1
Concluded MSc	4

Two Main Publications

N. D. Oliveira Oliveira, D. Duarte, C. Ferreira Ferreira, P. Silva, R.n. Nogueira, L. Bilro, Development And Characterization Of A Sediment Concentration Low Cost Optical Sensor, "25Th International Conference On Plastic Optical Fibers Pof 2016", Birmingham, United Kingdom, Vol. 0, Pp. 0 - 0, September, 2016,

João Rodrigues, João Paulo Barraca, And André Zúquete. Data Security Mechanisms For Iot Platforms. In "Proc. 8Th Informatics Symposium (Inforum 2016)", Volume. Sep 2016.

PROJECT WEBPAGE URL
DASHBOARD - http://swat.atnog.org/instances/segadaes/

Fig. 1 sWAT dashboard - Home page

Fig. 2 Water Quality Sensor installed at Segadães (Águeda) water supply network – pipe point oNE. up right: turbidity measurements between 31st MAy and 6th June, 2017.

GENERAL MOTIVATION AND OBJECTIVES

Fresh water shortages will be tomorrow's next big problem. In most of the water utilities, the water management is not properly addressed in terms of real time monitoring of the grid. This status is starting to change as water distribution companies are increasingly moving to Smart Water Grids (SWG). However, to date the approach for water grid management does not integrate inline water quality information. On the other side in-line turbidimeters that exist in the market (LaMotte, Conflab, Thermoscientific, Optek, SFI, Bamo, Siemens, etc...) are costly and can only provide limited water quality assessment.

sWAT project addressed these today's impairments targeting the following objectives:

- Development of a novel low cost water quality sensor capable of in line and real time monitoring;
- Development of new data acquisition and processing techniques in order to develop a network of water sensors;
- Development of a water sensor M2M network;

CHALLENGE

Monitoring relevant parameters in situ, with independent sensors, offers a valuable solution for assessing the quality of water. However, solutions based on isolated sensors do not meet current requirements in terms of operation and management overheads, the determination of the actual water quality, long time monitoring of a complex distribution grid, the inclusion of multiple stakeholders, or simply prompt reaction to violation of key performance indicators. Therefore, the sensing devices must be seen under the light of smart objects, which act in a coordinated manner, and provide observations to key components. Only by having data from multiple sensors it is possible to properly orchestrate corrective measures, or develop scalable solutions that are useful to actually solve real world problems. This area includes the sub-areas of Internet of Things (IoT), data mining, and decision support systems.

The team of Optical Communication and Photonics Group was focused on the i) development of the water quality sensors for monitoring turbidity, Total Suspended Sediments (TSS) and color, ii) the design and development of the best configuration to be integrated in water supply pipelines and iii) the development of data processing techniques.

The team of Advanced Telecommunications and Networks Group has led tasks related to the integration of the devices in a Smart M2M environment, the creation of a framework with a dynamic service execution environment and the development of tools for creating BPEL workflows and solutions for analysis of structured information.

WORK DESCRIPTION AND ACHIEVEMENTS

Four industrial prototypes for water quality assessment were designed and developed. Two different mechanical enclosures were assembled considering either pipe or reservoir measurement points (see cover figure). Artificially-created solutions were used in order to calibrate all the devices. This calibration data was used by the developed Expectation-Maximization (EM) Clustering Algorithm in order to obtain the different parameters (turbidity, TSS and color) from the signal output given by the multiwavelength based sensors.

Regarding to the computational platform, local and central information aggregation elements were implemented. M2M and Big data protocols were used in accordance with ETSI M2M standard and a dashboard for data analysis and visualization of the project pilot was implemented (see figure 1).

DEMONSTRATOR:

After revision and optimization, the full water quality platform was installed at the water supply network in Segadães Parish. Two scenarios were tested: spring water and water hole collection point. In both scenarios, two sensors were installed: one in the water line (figure2) and another in water reservoir after filtering system (see cover figure). The use of LoRa technology allowed data communication at long distances (~ 3 km between two points in line of sight).

Results showed that a low cost optical sensor based water quality monitoring platform was successfully developed and is fully operational.