

InWaterSense: An Intelligent Wireless Sensor Network for Monitoring Surface Water Quality to a River in Kosovo

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ABSTRACT

A shift in water monitoring approach from traditional grab sampling to novel wireless sensors is gaining in popularity not only among researchers but also in the market. These latest technologies readily enable numerous advantageous monitoring arrangements like remote, continuous, real-time, and spatially-dense and broad in coverage measurements, and identification of long-term trends of parameters of interest. Thus, a WSN system is implemented in a river in Kosovo as part of the InWaterSense project to monitor its water quality parameters. It is one of the first state of the art technology demonstration systems of its kind in the domain of water monitoring in developing countries like Kosovo. Water quality datasets are transmitted at pre-programmed intervals from sensing stations deployed in the river to the server at university via the GPRS network. Data is then made available through a portal to different target groups (policy-makers, water experts, and citizens). Moreover, the InWaterSense system behaves intelligently like staying in line with water quality regulatory standards.

KEYWORDS:

Design, Intelligent Systems, Portals, Requirements, Rivers in Kosovo, Surface Water Quality Monitoring, Wireless Sensor Networks

1. INTRODUCTION

A significant driver for Wireless Sensor Network development and implementation is legislation that is being introduced worldwide which is enabled by the real-time monitoring of and sensorization of our buildings, waterways, energy consumption and environmental conditions. Table 1 provides a snap shot of some of this legislation.

As shown in Table 1 legislation exists and continues to be drawn up to address the global challenges of climate change, the health and welfare of citizens, the reduction in energy consumption in our

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Table 1. A selection of legislative drivers for WSN developments

Environmental, Water, Air Climate Change
EU Directive 2000/60/EC, EU Water Framework Directive - EU Policy and regulations on water Quality [¹]
European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003) [²]
European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I.No.272 2009) [³]
European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010):
European Communities (Good Agricultural Practice - Protection of Waters) 2010 (S.I. No. 610 of 2010) [⁴]
European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011) [⁵]
European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014) [⁶]
EU Council Directive 92/43/EEC: Birds and Habitats Directives - the conservation of natural habitats and of wild fauna and flora aims to promote the maintenance of biodiversity [⁷]
EU Directive 2006/7/EC 2006 concerning the management of bathing water quality and repealing ensuring the quality of Drinking water, bathing waters and urban waste water. [⁸]
EU Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) [⁹]
EU Directive 91/676/EEC The Nitrates Directive: concerning the protection of waters against pollution caused by nitrates from agricultural sources [¹⁰]

factories and cities and the optimisation of the use of natural resources in our society. The provision of real time data sets will help legislators monitor the impact and effectiveness of any legislation introduced on our environment and society. Real time data sets from WSN technologies in a variety of application spaces will facilitate informed decision-making around policy enforcement to meet the demands of legislation introduced by policy makers in the areas identified

Guidelines being handed down from the Water Framework Directive WFD and other government bodies worldwide in the field of water management necessitate the automation of water management systems and regular acquisition of water quality parameters. Legislation such as the WFD and other legislation (as in Table 1), will be enabled by autonomous sensor stations (sometimes in remote areas) analysing water, air and soil quality parameters, storing the data or broadcasting it reliably under different conditions to water management headquarters.

To this end, there is a requirement for next generation, highly specified sensor systems, packaged in a reliable and robust manner to provide high temporal and spatial granularity data sets associated with environmental (Oliveira et al., 2011) parameters. These systems need to incorporate the latest technologies available, and need to operate wirelessly for extended periods of time in harsh environments.

Maintaining surface waters at high quality remains a challenge even among developed countries. Water quality monitoring practices are predominantly laborious, i.e., usually manual sampling methods are applied on the sites.

In recent years, a shift in water monitoring approach, from traditional and very limited (in terms of time and space) “stream to a bottle” measurements to novel Wireless Sensor Network (WSN) systems, is gaining in popularity not just among researchers, but also in the market. These latest technologies *readily* enable numerous advantageous monitoring arrangements, like: continuous, real-time, and spatially-dense and broad in coverage measurements, remote monitoring, flexible disposition, identification of long-term trends and fluctuations of parameters of interest, and similar (Jiang et al., 2009).

Led by the abovementioned rationale, a WSN system is designed and implemented in a river in Kosovo as part of the InWaterSense project to monitor a series of its water quality parameters, and

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