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Developing a smart integrated platform for Leakage Detection on water supply Network of Municipality of Argos, Greece

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Introduction

Non-revenue water (NRW) is the volume of water that participates in the urban water supply processes (i.e., water extraction, transport, treatment, storage, distribution, and consumption) but does not generate revenues for the water utility company (Janson 2017). NRW is divided into two main categories: water losses and unbilled consumption (Liemberger and Frauendorfer 2010). Pressure management, active leak control, speed and quality of repairs and asset management are the four strategies to reduce real losses (Kingdom et al. 2006).

Water leakages in the internal water supply networks of cities are the most common and, at the same time, the most important problem water utility companies face (Lechevallier 2014). Indicatively, the cost of leakages is estimated at 39 billion USD per year (Liemberger and Wyatt 2019), while, apart from this cost, the impact on potable water quality is also important, which monitoring is still not easy (Patelis et al. 2020). In Argos (Greece), according to the Municipal Enterprise for Water and Wastewater of Argos (DEYA.ARM), water leakage is estimated around 65%, an amount that cannot be accurately calculated, not even monitored. Trying to deal with this issue, one of the main purposes of the research project entitled "Smart integrated platform for Leakage Detection of water supply Network of Municipality of Argos" is to develop a smart monitoring system that is estimated to contribute to saving up to 1,200,000 cubic meters water per year in the internal water network of the city of Argos. This work presents the general framework of the project.

Materials and methods

The system is designed for the city of Argos, which is served by DEYA.ARM. Argos is the largest city in Argolis Prefecture with a total population of 26.361 habitants. It is one of the warmest Greek cities, with very high temperatures during summer months, when temperature often exceeds 40°C, and it often reaches 47°C during heatwaves. Winter is mild with low total precipitation depth.

According to DEYA.ARM, the water supply network of the Municipality is divided into two parts: (i) the main network that serves the city of Argos and the city's surrounding area, and (ii) local networks in other municipal areas. Regarding exploitation of local water resources, the city of Argos is supplied by the springs of Lerna and Amymone, located approximately 10 km to the South, in the coastal settlement of Mylon.

Regarding water requirements in this area, there is a seasonal fluctuation due to tourism, with an increased demand during summer months, which is difficult to be fully met. Particularly, Table 1 presents the estimated daily water needs per capita, which correspond to an annual water supply from the DEYA.ARM around 2,5 hm^3. Considering this situation and after taking into account the available data from the local system operation and water supply infrastructures, DEYA.ARM in collaboration with the Laboratory of Climatology and Atmospheric (LACAE), assessed the value of improving the water supply system operation, through setting as first priority the monitoring of quality and quantity-related parameters in combination with the development of a hydraulic model for the water supply network of Argos city.

Table 1. Daily water needs per person
(data source: River Basin Management Plans, in the frame of Water Framework Directive 2000/60/EC).

Population class	Water needs (l/cap/d)
Permanent Population	250
Tourists	400
Residents in B' residence	250
Total	**900**

Expected results and contribution

In the frame of this project, DEYA.ARM will acquire a smart integrated platform for leakage detection on the water supply network, through utilizing modern digital telemetry, remote control and management, and through procuring the sensors required to record and monitor consumption.

The implementation of the project is estimated to upgrade and modernize the operation of the existing water supply network in the city of Argos, as parts of the existing network will be restored, and also an efficient system for monitoring and detecting water leakage will be installed. This modernization of the network will prevent further consumption of valuable local resources and will also contribute to diminishing NRW (Antzoulatos et al. 2020). In addition, in the frame of the smart integrated platform development, a water leakage monitoring system will be designed based on the minimum night flow analysis.

The optimization of operation and management regarding water resources distribution will be based on the installation of remote-control systems at specific points in the city of Argos, to actively control leakage and remotely monitor several critical parameters. Through the operation of automation systems with programmable logic controllers (PLC) and Data Logger, the sensors' installation and the water parameters' monitoring parameters will further provide valuable data for the rational management of water supply infrastructures and local water resources in the area. These improvements in the overall operation of the closed water supply zone of the city of Argos are estimated to contribute to saving up to 1,2 hm^3 of fresh water per year.

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