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SMART CITIES

SmartWaterGrid

A smart system to facilitate and automate real-time water leak localization down to street level

As the climate changes, the availability of water is coming under pressure, making efficient water provision ever more critical. However, undiscovered water grid leaks cause over 60 million m³ of drinking water to be lost every year in Flanders alone. This amounts to about 20% of annual consumption for some providers and represents a heavy annual cost.

While big leaks are spectacular, they are easy to localize. Moreover, they result in much smaller water loss volumes than medium and small leaks that can remain unnoticed, leading to long running times and high loss volumes. Today, state-of-the-art predictive consumption approaches exist to help locate leaks, but many providers still rely on ad hoc, often manual, methods to find smaller leaks. In addition, both state-of-the-art and ad hoc leak detection methods are restricted to detecting leaks on the level of tens of kilometers. Subsequent localization remains expensive and labor intensive.

To address this situation, the SmartWaterGrid project aimed to design a hybrid AI approach to localization. The system would take into account real-time water flow, pressure and manual valve positions using Internet of Things (IoT) sensors augmented with Geographic Information System (GIS) data, hydraulic models, expert knowledge and human feedback to accelerate and fine-tune the process of localizing leaks.

THE OUTCOMES

1. Smart monitoring solution

The project designed and developed a smart monitoring solution, SmartWaterGrid, that enables continuous improvement, driving the shift from manual measurements to near real-time analysis and proactive customer alerts. Compared to existing approaches, SmartWaterGrid reduces the number of extra sensors needed, creating a positive business case for significantly lower leakage rates while at the same time stimulating positive customer engagement. On a technical level, SmartWaterGrid has surpassed the state-of-the art in terms of data capture across the water grid and in hybrid AI modelling that involves both data-driven and model-driven approaches applied to collected sensor data.

2. Connectivity analysis

An in-depth connectivity analysis indicated that LoRaWAN technology (a low-power, wide area networking protocol) is best suited in terms of power consumption and coverage to measure elements such as the real-time position of manual shut-off valves in the water grid.

3. Demonstration of business benefits

The resulting demonstrator and strategy show how providers can decrease costs and water losses, balancing technical and business factors such as the number of sensors and prediction accuracy, and customer satisfaction. Leak localization is improved from 70 km to street level, and from weeks to a few hours.

NEXT STEPS

Following these initial outcomes, next steps include further research into sensor failures, changes in the GIS topology and other uncertainties that complicate the hybrid AI prediction. These will be investigated in combination with valve manipulation strategies and customer-side digital water meters and sensors to further improve localization of even smaller leaks. The SmartWaterGrid solution will also be transferred to other District Metered Areas (DMA) in the pipeline network. This will lead to digital twins (digital counterparts of physical systems) where operational management is combined with real-time leak localization.

FACTS

NAME	**SmartWaterGrid**
OBJECTIVE	Facilitate and automate real-time water leak localization to street level
TECHNOLOGIES USED	Hybrid AI, GNN, machine learning, logistic regression, LoRaWAN, Sigfox, NB-IoT, OCTA-Connect, Dynamics 365 Customer Service, Microsoft Power Platform, leak detection, DMA, hydraulic modelling, flow and pressure measurements, high-performance computing, MapReduce, Flask, Docker, Kubernetes, Gitlab CI/CD, scikit-learn
TYPE	imec.icon project
DURATION	01/10/2019 – 30/09/2021
PROJECT LEAD	Filip Vancoillie, De Watergroep
RESEARCH LEAD	Sofie Van Hoecke, imec - IDLab Data Science Lab - UGent
BUDGET	1,749,747 euro
PROJECT PARTNERS	De Watergroep, Aloxy, Hydroscan, Itineris
RESEARCH GROUPS	IDLab Data Science Lab and IDLab IBCN, imec research groups at Ghent University and IDLab MOSAIC, imec research group at UAntwerpen

SmartWaterGrid project partners:

aloxy · De Watergroep · HYDROSCAN smart water management · itineris excellence in utilities · Universiteit Antwerpen · GHENT UNIVERSITY

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AGENTSCHAP INNOVEREN & ONDERNEMEN · Vlaanderen is ondernemen

WHAT IS AN

IMEC.ICON PROJECT?

The imec.icon research program equals demand-driven, cooperative research. The driving force behind imec.icon projects are multidisciplinary teams of imec researchers, industry partners and/or social-profit organizations. Together, they lay the foundation of digital solutions which find their way into the product portfolios of the participating partners.

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