Automated leak detection system for the improvement of water network management
About R2M Solution

**What:** Innovation, Technology Transfer, and Consulting Company

- We stimulate research ideas
- We bring clients to research programs
- We focus research projects toward exploitation
- We consult to bring research results to market

**Competitive Advantages:**

- Focus on exploitation
- Multi-disciplinarity
- High risk tolerance
- Energy that comes with a young growing company

We are involved in the topic area via our participation in

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**R2M Solution**

- Innovation Energy Services & Sustainability Engineering
- ICT & Automation

- Founded in: 2012
- Company staff: 24
- Funding raised: 65 M€
- Running research projects: 14
- Organizations partnered with: 523
- Jobs created 2014-16: 13
Type of project: Collaborative project

Project start date: February 2014

Duration: 36 months

Call: FP7-ICT-2013-11

Effort: 416 PM

Budget: €4.287M

Max EC contribution: €2.905M

Grant No.: 619660

Consortium: 9 partners

Countries: 4

SMEs: 4

Pilots: 4
WATERNOMICS will provide **personalized** and **actionable** information on water consumption and water availability to individual households, companies and cities in an intuitive & effective manner at relevant time-scales for decision making.

- Combining information from various sources & domains to offer **contextual water information services**
- Making water usage information **accessible** across devices & locations
- Supporting **personalised interaction** with water information services
- Enabling **sharing** of water information services across communities of users
- Demonstrating generic water information services **can be used in a variety of environments**
- Enabling open (collaborative) business models and **flexible pricing mechanisms**
## Pilot sites

<table>
<thead>
<tr>
<th>Target Users</th>
<th>Corporate Water Consumers Leisure and Business Travellers</th>
<th>Domestic Water Consumers and Utility Providers</th>
<th>Mixed/Public Water Consumers - University</th>
<th>Mixed/Public Water Consumers - School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Linate Airport, Milan, Italy</td>
<td>Domestic Houses, Thermi, Greece</td>
<td>Engineering Building, NUI Galway, Ireland</td>
<td>Coláiste Na Coiribe, Galway, Ireland</td>
</tr>
<tr>
<td>Key Statistics</td>
<td>Corporate Water Consumers Leisure and Business Travellers</td>
<td>Domestic Water Consumers and Utility Providers</td>
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<td>Mixed/Public Water Consumers - School</td>
</tr>
<tr>
<td>Corporate Water Consumers Leisure and Business Travellers</td>
<td>no water remote monitoring system in place</td>
<td>15 km from Thessaloniki covering an area of 38.34 ha with 70,000 people</td>
<td>Opened in 2011 Designed as a living laboratory; 14,000 sqm on four floors occupied by 1,000 students and 100 staff;</td>
<td>Opened in October 2015 M21; 500 students and 40 staff;</td>
</tr>
<tr>
<td>Domestic Water Consumers and Utility Providers</td>
<td>10 Km of drinking water network</td>
<td>Different water usages and different family types</td>
<td>11 existing water meters &amp; BMS system in place</td>
<td>7 water meters and building control system planned in original construction contract</td>
</tr>
<tr>
<td>Utilities Management, Maintenance Staff, Environmental Managers</td>
<td>5 New USF Meters &amp; 47 commercial meters (flow/pressure/energy/ground water level) proposed by WATERNOMICS</td>
<td>Typical cross section of the domestic environment Adults young adults and children</td>
<td>8 New USF Meters and 3 inline meters proposed by WATERNOMICS</td>
<td>14 New inline water meters and site view screen proposed by WATERNOMICS</td>
</tr>
<tr>
<td>MESSERVEY – 3rd Int’l Electronic Conference on Sensors &amp; Applications</td>
<td></td>
<td></td>
<td>Building/Utilities Manager, Staff Students Researchers</td>
<td>Building Manager, Staff, Students, Teachers</td>
</tr>
</tbody>
</table>
Linate Pilot objectives

- Advanced monitoring system of the water cycle
- Quantification and localization of losses
- Pressure management to save water and energy

- 10 Km of water network
- 52 meters installed (flow/pressure/volume/Energy/ground water level)
- Data transmission system enabled via GSM
Linate water network optimization

Using the Epanet Hydraulic model in the operational phase:

- To detect abnormalities
- “What If” scenarios (pressure/leakages/energy)
ADWICE (Anomaly Detection With fast Incremental ClustEring) as a clustering-based anomaly detector

The approach consists of modeling the normality as a set of clusters that summarize the normal behavior (identified during training). Once ADWICE is trained, it can be used for online detection of anomalies or faults.
Test conducted

Model Based FDD:
- ADWICE (Anomaly Detection With fast Incremental ClustEring)

Scenario without leakages

Leakage Scenario n. 1

Leakage Scenario n. 2

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15/11/2016
Preliminary results

• **Results**
  • False Positive Rate: **4.9 %**
  • Detection Rate: **60 %** (average value) [min. 0.33 – max. 0.93]
  • Accuracy: **80 %** (average value) [min. 0.66 – max. 0.94]

Main next step is to retrain the algorithm and apply it to real time measurements.
What do we expect?

Expected results based on data collected in the field

13%  16%  20%

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Conclusions

• Water management considering water as a resource is a challenge
• Finding innovative ways to address ageing water infrastructure is a challenge
• To facilitate decision makers and stakeholders at all levels into taking action to address these challenges, a model-based FDD can serve as a powerful enabler
• This paper has presented such a FDD method
• We’re always available to talk about solving water problems.
• Much of the work is available online and we are happy to be contacted directly.

More info about WATERNOMICS:
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