Newsletter - Warsaw

SYnergy of integrated Sensors and Technologies for urban sEcured environMent

N.3 - January 2022

Outline:

Welcome!

We are glad to announce a new newsletter's issue of the European funded project "SYnergy of integrated Sensors and Technologies for urban sEcured environMent" (SYSTEM). This is the **third issue** dedicated to the testing activities carried out in the city of **Warsaw, Poland.**
You receive this email because your work is strictly related to the output of this project and we have thought you might be interested on our work.

SYSTEM Facts & Figures

Funding programme: Horizon 2020
Call: Fight against crime and Terrorism, SEC-10-FCT-2017
Type of action: Innovation Actions
Project Reference: 787128
Starting date: 1 September 2018
Duration: 42 months
Number of partners: 21
Total cost: € 9.087.796,60
Total EU funding: € 7.926.173,05

SYSTEM is an **Innovation Action** awarded to a consortium led by Fondazione FORMIT addressing the challenge of the topic "Integration of detection capabilities and data fusion with utility providers' network" (SEC-10-FCT-2017) included in the 2016-2017 Work Programme "Secure societies – Protecting freedom and security of Europe and its citizens" of Horizon 2020. SYSTEM started on 1 September 2018 and aims at **developing and testing a customised sensing system** for hazardous substances detection in complementary utility networks and public spaces. The proposed innovative monitoring and observing of fused data sources have been tested across urban areas in six cities (Bratislava, Idstein, Latina, Munich, Rome and Warsaw). Detection results have been gathered in real time and sent and fused in remote mode to a customised monitoring centre that will be helpful to Law Enforcement Agencies to better and faster detect suspicious illegal clandestine laboratories. To achieve these aims, a wide set of skills and capabilities has been considered key to success, determining the large partnership working on the project, made by partners cooperating with more than ten stakeholders supporting the project activities.

Who we are

The SYSTEM Consortium, composed by 21 partner organisations from Belgium, Germany, Greece, Italy, Poland and the Slovak Republic, includes four law enforcement authorities (RaCIS – Arma dei Carabinieri, Bundeskriminalamt Kriminaltechnisches Institut, Centralne Laboratorium Kryminalistyczne Policji, Ministry of Interior of the Slovak Republic), three utility network operators (Acea ATO 2 S.p.A., Acqualatina S.p.A., BVS a.s.), five scientific/academic partners (Universität der Bundeswehr München, Hochschule Fresenius GmbH, Warsaw University of Technology, Ustav Hydrologie Slovenskej Akademie Vied, Vrije University Belgium), two industrial partners (Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., RESI Informatica S.p.A.), three small and medium enterprises (Blue Technologies sp. Z o.o., SENSICHIPS Srl, T4i Engineering), two research foundations/no profit organisations (Fondazione FORMIT, ISEM – Inštitút pre medzinárodnú bezpečnosť a krízover riadenie), one association (Observatory on Security and CBRNe Defence), and one municipality (Roma Capitale).
Additional law enforcement agencies, utility network operators and municipalities have already provided their commitment to support the testing and demonstration of innovative technologies.

Discover more about us here!

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SYSTEM testing activities in Warsaw

Starting from 8 October 2020, six activities were in total held in preparation to the deployment visit held in Warsaw to test the Micromole (µMole) and the S2M subsystems. These activities were carried out by the Warsaw University of Technology (WUT), Blue Technologies sp. ZOO (BTEC) and the Polish Central Forensic Laboratory of the Police (CFLP) as SYSTEM partners in cooperation with the Sewage Water Company of Warsaw (*Miejskie Przedsiębiorstwo Wodociągów i Kanalizacji w m. st. Warszawy* - MPWiK).

The first activity was a meeting at the premises of MPWiK to draft a plan for evaluating the feasibility of different locations for carrying out the test activities in Warsaw.

Nineteen days later MPWiK, WUT and BTEC teams met at WUT premises for visual inspection of the public sewage network within the campus of WUT. Unfortunately, due to a lack of flow, pipe shape and pipe diameter, all sewage pipes within the campus were discarded for further test activities. It was therefore decided that a more suitable portion of the sewage network – given the physical constraints imposed by the µMole ring construction – could be found in another area located at the south of WUT campus.

On 9 March 2021 an onsite inspection was held by the abovementioned teams to evaluate the flow connectivity over the chosen sewage network section, which was successfully confirmed.

Three weeks later – on the night of 22 March 2021 – five manholes located in the chosen testing area were visually inspected and their dimensions were taken. The objective was to verify the pipe shape and the pipe diameter, as well as to take notes over the different possibilities for mounting the µMole and the S2M subsystems.

On 31 March 2021 a fifth meeting was held with the aim to install a flow meter over the selected testing area. The meter was necessary for estimating the filling level of the pipe during different hours of the day, as well as for estimating the flow force and the flow speed. Flow meter was deployed until 23 April 2021.

On 11 May 2021 MPWiK, WUT and BTEC teams met again at night in order to mount the gateways of the µMole subsystem to evaluate the quality of the signal of the mobile network, which could be affected by traffic and weather conditions. Three µMole gateways were thus mounted in different manholes for a period of four days, and measurements of the signal quality were collected.

Upon completion of the previously mentioned preliminary tests, on 14 May 2021 it was decided that all conditions were met to install both the µMole and the S2M subsystems.

On 18 June 2021 three µMole and one S2M subsystems were finally installed in the chosen testing area. Controlled discharge experiments were carried out in cooperation with CFLP until 24 June 2021. The S2M was activated manually 13 times during the day and then removed at night for sample extraction.

The following table provides an overview of the technologies and partners joining the deployment visit held in the city.

Index	Timeframe	Type of Visit	Partners	Technologies
1	18.06.2021-24.06.2021	Deployment	BTEC, FhG-IZM, WUT, CFLP	µMole, S2M

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SYSTEM TECH FOCUS
Micromole and S2M subsystems

What is the Micromole subsystem

The Micromole subsystem is a sensor device for online measurment of pH and electrical conductivity of sewage water. It is made of at least two devices: one Micromole ring device and one Micromole gateway.

The Micromole ring device is completely wireless and can be mounted in sewage pipe diameters ranging from DN250 up to DN1500. The ring device contains pH and conductivity (EC) sensors, battery and radio communication modules for its operation. At present, the Micromole ring device is extended as to provide online readings of wastewater flow level.

The Micromole gateway is a device forwarding the sensor measurements collected by the Micromole ring device to a selected server in the Internet using a mobile network (e.g. GSM, LTE). It is usually installed within the manhole and can forward measurements from several Micromole ring devices in its vicinity.

Where the Micromole and the S2M were installed

Three Micromole subsystems and one S2M subsystem were installed in the public sewage network of the city of Warsaw for seven days.

What is the S2M subsystem

The Sampling and Storage Module (S2M) is designed for automatised online wastewater sample collection from selected manholes located in urban areas where a clandestine laboratory is suspected to be present.

Stored wastewater samples (of some 4 ml volume) are analysed offline by an LC/MS to confirm target analytes and approximate location of the clandestine laboratory. The S2M can be installed in selected manholes under cover.

It can operate by GSM in two modes:

- Storage: it can constantly sample and store wastewater samples according to a time schedule that are thefore collected and analysed in police laboratory.
- Live: after detection of an illicit substance by any SYSTEM sensor, the S2M is activated on command to immediate sampling for cross check confirmation of the detection.

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SYSTEM workshop for municipalities

The SYSTEM project is glad to announce a **workshop** tailored for municipalities dedicated to present its integrated system for continuous monitoring of compounds to detect hazardous substances. The workshop will be held online on **08 February 2022 from 10:00 a.m. to 12:00 p.m.** After presenting SYSTEM according to the perspective of the municipality of Rome as project partner, synergies with the Smart City Programme of the municipality of Rome will be discussed. The SYSTEM project and its data fusion capabilities will follow. The event will close with a panel discussion based on three interventions made by the municipalities of Florence and Milan and the University of Perugia as invited guests sharing their experience in other projects related to smart cities. **Registration by 08 February 2022 including participants' name, surname and affiliation** is mandatory to know more about the event and get the link to join.

SYSTEM

WORKSHOP FOR MUNICIPALITIES

online, 08 February 2022
10:00 a.m. - 12:00 p.m.

Register at secretariat@systemproject.eu to join!

SYSTEM suggested readings

Solano, F. D., Krause, S., Wöllgens, C. An Internet-of-Things Enabled Smart System for Wastewater Monitoring. IEEE Access, vol. 10, 2022, pp. 4666-4685. DOI: 10.1109/ACCESS.2022.3140391.

We present and evaluate an IoT-enabled sensing and actuating system for localising illegal industrial harsh discharges of polluting wastewater in sewer networks. The special conditions of the sewer environment bring special challenges for the design of an IoT system and of its real-time algorithm for anomaly detection and localisation in wastewater networks. The proposed design fulfills these requirements by using a new IoT architecture pattern, which we generalise and name Hop-by-hop Anomaly Detection and Actuation (HADA). The distributed anomaly detection and localisation algorithm makes predictions over previous sensor measurements, while taking into account seasonality effects of wastewater and noise of the sensors. Based on simulations in a large network with three common illegal industrial wastewater pollutants, the advantages and limitations of the proposed wastewater anomaly localisation system are discussed.

Buras, M.P., Solano Donado, F. Identifying and Estimating the Location of Sources of Industrial Pollution in the Sewage Network. Sensors 2021, 21, 3426. https://doi.org/10.3390/s21103426.

Harsh pollutants that are illegally disposed in the sewer network may spread beyond the sewer network (e.g., through leakages leading to groundwater reservoirs) and may also impair the correct operation of wastewater treatment plants. Consequently, such pollutants pose serious threats to water bodies, to the natural environment and, therefore, to all life. In this article, we focus on the problem of identifying a wastewater pollutant and localising its source point in the wastewater network given a time-series of wastewater measurements collected by sensors positioned across the sewer network.

CONTACTS
Website: https://www.systemproject.eu/
Email: secretariat@systemproject.eu

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