Newsletter - Latina

SYnergy of integrated Sensors and Technologies for urban sEcured environMent

N.4 - February 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 **fourth issue** dedicated to the testing activities carried out in the city of **Latina, Italy.**
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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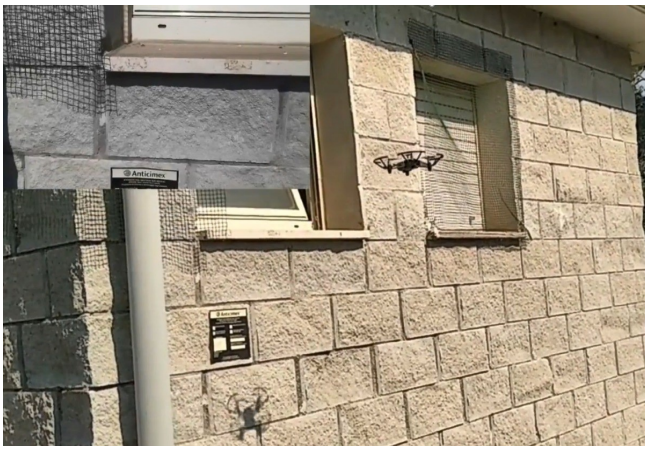
SYSTEM testing activities in Latina

Two deployment visits were in total performed in Latina during the project lifetime until October 2021 in order to test the Smart Cable Air and the Smart Cable Water in non-controlled environment. Prior to them, from August to September 2020 three onsite testing activities were carried out in preparation to the SYSTEM interim review meeting. SENSICHIPS (SCP), in cooperation with FORMIT and RESI joined the activities to prove that the Smart Cable Water can detect and classify a number of precursor chemicals in real challenging environments as defined by the Law Enforcement Agencies. The Smart Cable Air was tested in waste bins, dumpsters and on a miniaturised drone to assess its detection capabilities.



Another testing activity followed the interim review meeting in October 2020 in order for the Smart Cable Water to acquire more data for the validation of the classification algorithms.

Deployment visits were therefore carried out in June and October 2021 at a wastewater treatment plant of Acqualatina serving 7.500 equivalent inhabitants. The Smart Cable Water was installed thanks to a mechanical system provided by Acqualatina for the correct placement of the sensor in the water tank.

No special criticalities arose during the visits. The Smart Cable Air was installed in waste bins and dumpsters, as well as close to a small room simulating a flat rent by terrorists producing illicit substances. It was also mounted on a miniaturised drone. After a few minutes of calibration, the Smart Cable Air detected the target substances as expected.

Further to this, the visits aimed to test a set of rules for data fusion to correlate information between different environments besides the continuous improvement of the two abovementioned sensing technologies. Once such rules were set, data transmission to the GENESI Monitoring Centre (MC) was tested via the GSM mobile signal. The MC successfully received the data from both sensors.

The following Table provides an overview of the deployment visits held in Latina together with information about the technologies and partners contributing to its organisation and development:

Index	Timeframe	Type of Visit	Partners	Technologies
1	18.06.2021-24.06.2021	Deployment	RESI, SCP, Acqualatina, Carabinieri	SCA, SCW, MC
2	27.10.2021-28.10.2021	Deployment	RESI, SCP, Acqualatina	SCA, SCW, MC

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SYSTEM TECH FOCUS
SMART CABLES

What is the Smart Cable Water

Smart Cable Water (SCW) is a multi-sensor microsystem monitoring the presence of toxic chemicals (TICs), pollutants, hydrocarbons and organics in water. At the core of SCW there is SENSIPLUS, the Sensichips microsensor platform that can interrogate on-chip and off-chip sensors with its versatile and accurate Electrical Impedance Spectrometer (EIS) and Potentiostat. Analytics performed with EIS allow to exploit RedOx dynamics of catalytic noble metals to aid chemicals discrimination plus measurement of conductivity and permittivity spectra. The on chip Potentiostat is used for a number of different Voltammetric or Amperometric measurements and real time discrimination of pollutants. By cycling the electrodes with overvoltage, the device prevents or mitigates formation of biofilms.

What is the Smart Cable Air

Smart Cable Air (SCA) is a multi-sensor microsystem monitoring the presence of TICs, pollutants, volatile organic compounds (VOCs) and flammable gases in air. At the core of SCA there is SENSIPLUS, that can interrogate on-chip and off-chip sensors with its versatile and accurate EIS. Analytics performed with EIS allow to exploit chemisorption or ReDox dynamics of the sensitive film to aid gas discrimination. Alternate Current (AC) readout is less sensitive to drifts plus EIS allows to derive an R/C equivalent circuit of the sensor to decouple components that drift from the ones that represent the response to the gas, in support of drift mitigation algorithms. Thanks to its versatile analytical instruments and availability of on-board Interdigitated Electrodes, SCA is also an excellent experimental board for new sensitive materials. Several SCAs can be installed onto long cables for large area continuous monitoring.

Two versatile technologies

Smart Cables can be used for multiple purposes. The following are amongst the scenarios where they can operate:

1. Smart Cable Water: water quality (e.g. drinking or waste water, aquaculture); precision farming (e.g. pH; moisture); hydroponics, greenhouses; production process; food safety;
2. Smart Cable Air: indoor air quality monitors; air cleaners; ventilation control; hazards monitor.

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SYSTEM workshop for Law Enforcement Agencies

The SYSTEM project is glad to announce a **workshop** tailored for Law Enforcement Agencies (LEAs) dedicated to present its integrated system for continuous monitoring of compounds to detect hazardous substances. The workshop will be held online on **11 February 2022 from 10:00 a.m. to 12:30 p.m.** The project will be approached by three different points of view, which are at the basis of its technological set-up. After presenting the analysis and detection of home-made explosives and synthetic drugs carried out with the developed set of sensing technologies and analytical chemical methods, scenarios of data fusion will be discussed to understand how the SYSTEM Monitoring Centre can complement other existing tools used by the LEAs to identify clandestine laboratories producing illicit substances. **Registration by 09 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 LAW ENFORCEMENT AGENCIES

online, 11 February 2022
10:00 a.m. - 12:30 p.m.

Register at secretariat@systemproject.eu to join!

SYSTEM suggested readings

Greif, M, Köke, N, Pütz, M, Rößler, T, Knepper, TP, Frömel, T. Nontarget screening of production waste samples from Leuckart amphetamine synthesis using liquid chromatography – high-resolution mass spectrometry as a complementary method to GC-MS impurity profiling. Drug Test Anal. 2022; 1- 12. doi:10.1002/dta.3224

The established approaches of suspect and nontarget screening (NTS) using liquid chromatography–high-resolution mass spectrometry (LC-HRMS) are usually applied in the field of environmental and bioanalytical analysis. Herein, these approaches were employed on a forensic-toxicological application by analysing different production waste samples from controlled amphetamine synthesis via Leuckart route to evaluate the suitability of this methodology for identification of route-specific organic substances in such waste samples.

Chachuła, K., Słojewski, T.M., Nowak, R. Multisensor Data Fusion for Localization of Pollution Sources in Wastewater Networks. Sensors 2022, 22, 387. https://doi.org/10.3390/s22010387.

Illegal discharges of pollutants into sewage networks are a growing problem in large European cities. Such events often require restarting wastewater treatment plants, which cost up to a hundred thousand Euros. A system for localisation and quantification of pollutants in utility networks could discourage such behaviour and indicate a culprit if it happens. We propose an enhanced algorithm for multisensor data fusion for the detection, localisation, and quantification of pollutants in wastewater networks. The algorithm processes data from multiple heterogeneous sensors in real-time, producing current estimates of network state and alarms if one or many sensors detect pollutants. Our algorithm models the network as a directed acyclic graph, uses adaptive peak detection, estimates the amount of specific compounds, and tracks the pollutant using a Kalman filter. We performed numerical experiments for several real and artificial sewage networks, and measured the quality of discharge event reconstruction. We report the correctness and performance of our system. We also propose a method to assess the importance of specific sensor locations. The experiments show that the algorithm's success rate is equal to sensor coverage of the network. Moreover, the median distance between nodes pointed out by the fusion algorithm and nodes where the discharge was introduced equals zero when more than half of the network nodes contain sensors. The system can process around 5000 measurements per second, using 1 MiB of memory per 4600 measurements plus a constant of 97 MiB, and it can process 20 tracks per second, using 1.3 MiB of memory per 100 tracks.

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