Newsletter - Idstein

SYnergy of integrated Sensors and Technologies for urban sEcured environMent

N.1 - December 2021

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 **first issue** dedicated to the testing activities carried out in the city of **Idstein, Germany.**
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!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 787128.

SYSTEM testing activities in Idstein

Niklas Köke, M.Sc. - HOCHSCHULE FRESENIUS GEM. GMBH (Germany)

The first deployment visits were already performed before the project officially started (e.g. with Sciex to assemble the LC-MS instrument and with the WWTP operators in Idstein-Beuerbach). Starting at the beginning of September 2018, 12 deployment and demonstration visits were in total performed during the entire project time until November 2021. The performed deployment and demonstration visits comprised different activities, including organisation and planning of the installation of sensors, installation of sensors as well as several testing activities. The first experiments carried out with sensors developed/built for the wastewater scenario were performed in the laboratory with beaker experiments. Afterwards, sensors were tested in an artificial sewer network (ASN), which was built only for the SYSTEM project. Once sensors successfully passed tests in the controlled environment of the ASN, they were thus installed in a real sewage system. Tests in a non-controlled environment were therefore performed. In addition to sensors tested in the wastewater scenario, sensors working in the solid waste and air sce-

narios were tested using a waste truck or drone, respectively. All sensors, regardless the scenario where they were used, were successfully installed during the visits carried out in both controlled and non-controlled environment. Sensors operated up to one or two weeks without any maintenance, such as the LC-MS or microMole, respectively. Data gathered by sensors, such as the LC-MS, the microMole and the T4i ARMA were sent to the GENESI Monitoring Centre (MC), which collected them all and enabled data fusion. As backup options, passive sampling and sampling of wastewater using a commercial sampler were implemented. The sampler enabled sampling of wastewater in non-controlled environment and could be started the MC. All sensors, data communi-

cation and data fusion have been successfully tested in the different scenarios in Idstein-Beuerbach.

A list of deployment and demonstration visits including reference to partners and technologies joining is shown in the Table below:

Index	Timeframe	Type of Visit	Partners	Technologies
1	04.09.2018-05.09.2018	Deployment	HSF, BKA, UNIBWM, FhG-IZM	None
2	21.10.2019-25.10.2019	Deployment and Demonstration	FORMIT, HSF, BKA, FhG-IZM, WUT, UNIBWM, ICH-SAS, SCP, Carabinieri, Acqua Latina	LC-MS, µMole, SCW, SCA, passive sampling, portable GC-MS
3	02.12.2019-06.12.2019	Deployment and Demonstration	FORMIT, HSF, BKA, FhG-IZM, WUT, BTEC, CFLP, UNIBWM, ISEMI, VUB	LC-MS, µMole, S2M, SKAM, passive sampling
4	03.02.2020-07.02.2020	Deployment and Demonstration (including PMB)	FORMIT, HSF, RESI, T4i, SCP, FhG-IZM, BKA, WUT, BTEC, UNIBWM, CFLP, ISEMI, ROMA, OSDIFE, VUB, ACEA, IH-SAS, BVS	LC-MS, µMole, S2M, SCW, SCA, T4i Dover, SKAM, passive sampling, portable GC-MS
5	09.03.2020-10.03.2020	Demonstration	HSF, BKA	LC-MS, passive sampling, portable GC-MS
6	13.07.2020-17.07.2020	Demonstration	HSF, BKA, FhG-IZM, WUT, UNIBWM	LC-MS, µMole, passive sampling, Ori sampler including M-log, portable GC-MS
7	24.08.2020-28.08.2020	Demonstration	HSF, BKA, FhG-IZM, WUT, UNIBWM	LC-MS, µMole, passive sampling, Ori sampler including M-log, portable GC-MS
8	07.09.2020-11.09.2020	Demonstration and Midterm-Review	HSF, BKA, FhG-IZM, WUT, UNIBWM	LC-MS, µMole, passive sampling, Ori sampler including M-log, portable GC-MS
9	26.07.2021-30.07.2021	Demonstration	HSF, BKA, FhG-IZM, WUT, BTEC, UNIBWM, UniRoma/FORMIT, RESI	LC-MS, µMole, passive sampling, Ori sampler including M-log, MC
10	08.11.2021-12.11.2021	Demonstration	HSF, BKA, FhG-IZM, WUT, CFLP, UniRoma/FORMIT, RESI	LC-MS, µMole, passive sampling, SCW, SCA, MC
11	15.11.2021-19.11.2021	Demonstration	HSF, BKA, FhG-IZM, WUT, RESI	LC-MS, µMole, MC
12	22.11.2021-26.11.2021	Demonstration	HSF, BKA, FhG-IZM, WUT, RESI, UNIBWM, T4i	LC-MS, µMole, passive sampling, MC, Ori sampler, T4i ARMA and Dyna

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 787128.

SYSTEM TECH FOCUS
Liquid Chromatography/Mass Spectrometry (LC-MS)

What is the LC-MS

The LC/MS is a system for the analysis of wastewater in the sewer network.

The instrument has a very high selectivity and robustness and is used to acquire real-time data of the target substances through the sampling of the wastewater.

The sampling procedure comprises three phases: wastewater is pumped from the sewage into a tank. Water is then filtered through a membrane and finally transferred in the autosampler for analysis.

The LC-MS adapted by HSF

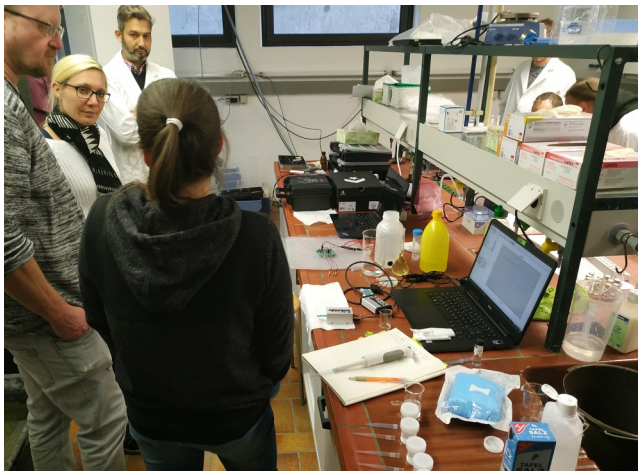
Within the SYSTEM project, Hochschule Fresenius GmbH, in cooperation with Bundeskriminalamt Kriminaltechnisches Institut and the supporting partner Sciex, adapted a commercial LC-MS system by assembling an adjusted sampler.

Originally designed to be used in a clean and conditioned laboratory, the LC-MS commercial system has been therefore modified to ensure a proper and reliable functioning during the on-site deployment and demonstration visits carried out throughout the project lifetime.

Where the LC-MS was installed

The LC-MS was installed in Idstein-Beuerbach and tested during the deployment and demonstration visits carried out in the wastewater scenario.

Thanks to the cooperation of the SYSTEM supporting partner KBV which hosted the activities in its WWTP, tests were carried out by collecting and analysing the wastewater and sending in real-time data to the GENESI Monitoring Centre (MC) which enabled data fusion as expected by the project.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 787128.

Participation in an Arte documentary

The European public service channel Arte asked the SYSTEM project about the participation in a documentary about treasures of wastewater. Since the SYSTEM project is in the final stage of its lifetime, the knowledge about wastewater analysis gained during the project can be perfectly presented to a broader audience that not only consist of experts. For this purpose, project partners Hochschule Fresenius gem. GmbH and the Bundeskriminalamt Kriminaltechnisches Institut participated in the documentary on behalf of the SYSTEM project explaining how wastewater analysis can be used to get information about criminal acts. Furthermore, Hochschule Fresenius gem. GmbH analysed two wastewater treatment plant influent samples collected in wastewater treatment plants in Berlin and Paris for residues of pharmaceuticals, illicit drugs, pesticides and industrial chemicals. A simple comparison of the results of both samples should show what information can be collected and what information cannot be collected by wastewater analysis.

SYSTEM suggested readings

Velísková, Yvetta & Sokac, M.. (2019). Dispersion Process in Sewer Pipes with Sediments and Deposits. IOP Conference Series: Earth and Environmental Science. 362. 012107. 10.1088/1755-1315/362/1/012107.

This paper describes the dispersion process in sewer pipes, which is from the hydraulic point of view a prismatic stream channel with relatively constant roughness of streambed. In such hydraulic conditions should the effect of "dead zones" not occur, but this effect was observed during the field experiments.

Hehet, P., Köke, N., Knepper, T. P., Pütz, M. Biotransformation of synthetic cannabinoids and selected human metabolites in sewage water. Poster presented at: XI Symposium of GTFCh (Society of Toxicological and Forensic Chemistry); 11-13 April 2019; Mosbach, Germany.

New psychoactive substances (NPS) were selected as target analytes for the biotransformation study part of the ongoing EU-project "SYSTEM".

C. Bourelly et al., "A Preliminary Solution for Anomaly Detection in Water Quality Monitoring," *2020 IEEE International Conference on Smart Computing (SMARTCOMP)*, Bologna, Italy, 2020, pp. 410-415, doi: 10.1109/SMARTCOMP50058.2020.00086.

In smart city framework, the water monitoring through an efficient, low–cost, low–power and IoT–oriented sensor technology is a crucial aspect to allow, with limited resources, the analysis of contaminants eventually affecting wastewater. In this sense, common interfering substances, as detergents, cannot be classified as dangerous contaminants and should be neglected in the classification. We developed an anomaly detection system based on one-class classifiers, able to discriminate between a recognized set of substances and an interfering source. In this way, the proposed detection system is able to provide detailed information about the water status and distinguish between harmless detergents and dangerous contaminants.

CONTACTS

Website: https://www.systemproject.eu/

Email: secretariat@systemproject.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 787128.