

XLAB research: Experiences on Applications for Smart Cities and Future Society

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POVZETEK

Podjetje XLAB ima močno raziskovalno skupino na področju porazdeljenih sistemov, računalništva v oblaku, varnosti, vizualizacije podatkov (medicinskih, 2D/3D GIS, senzoričnih) in procesiranja slik (3D rekonstrukcija, segmentacija, zlivanje GIS podatkov). Omenjene vsebine predstavljajo ključne kompetence, ki so potrebne za razvoj storitev za pametna mesta. Vizija podjetja XLAB je uporaba lastnega znanja in zagotavljanje varnih storitev, naprav in varne komunikacije za rešitve pametnih skupnosti in pamentnih mest.

ABSTRACT

XLAB is an R&D company with strong research background in the fields of distributed systems, cloud computing, security, information visualization (medical, 2D/3D GIS, sensors) and image processing (3D reconstruction, segmentation, GIS data fusion). Presented topics are the key competences, required for the development of smart city services. The XLAB's vision is to exploit the in-house know-how and provide secure services, devices and intercommunication for smarter society and smart cities.

1. INTRODUCTION

Our research team is recognized as one of the strongest computer science research teams outside the academic world in Slovenia. The knowledge and experiences were shaped during the contribution to the numerous European funded research and innovation projects. Our company, XLAB d.o.o., as a whole employs approximately 65 people and closely collaborates with 34 external experts, providing the whole company with access to almost 100 experts in the fields of computer science, electronics and mathematics as well as design and marketing.



Figure 1. Company logo.

Our primary expertise is in field of distributed systems followed by business and visualization software. Beside the contribution to the research projects, we work as a small incubator for ideas, where the main goal is transforming the know-how into the products and services. Small teams shape their ideas and convert them into the final product or new research and innovation opportunity. Our success in EU projects and products in figures is presented in Table 1.

Table 1. Research projects in XLAB

Type of the project	Number of past and ongoing projects
EU FP6 – FP7	19
H2020	11
National	8
LPP (Lifelong Learning)	9
Own products	10+

Working on new technologies and implementing them into various products creates a pleasant environment for gaining skills and fostering new ideas. During the past decade our team gained and improved skills in areas of cloud computing, security, IoT devices, user experience and machine to machine communication. The skills have been applied in product ideas or projects in IT, medical, energy, GIS and marine solutions. Our vision is to exploit gained in-house know-how and provide secure services, devices and intercommunication for smarter society and smart cities.

2. XLAB's role

The smart cities and smart society have clearly shaped their goals which tailor the requirements of future smart services. Smart cities strive for wise management of resources, citizen well-being, safety, efficiency and thoughtful planning for the future [1]. Achieving this fundamental goals is possible with monitoring current state of the smart city vibe, analyzing it and implementing improvements. The ongoing process lifecycle common to smart city services is presented in Figure 2.

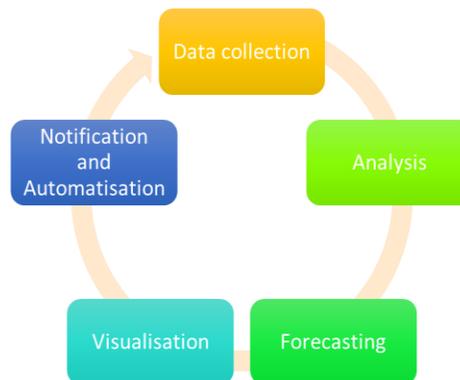


Figure 2. Stages in smart city application cycle.

The monitoring depends on data collection which relies on sensor networks based on proprietary sensors and/or universal mobile devices (e.g. mobile phones). Data from mobile devices greatly improve collection capability and allows citizen participation [2] in shaping the smart city of the future, but it introduces new challenges on citizen privacy. The privacy and secure data handling are a must-have in all stages of the process from Figure 2. Finally, from the technical aspect, the smart application has to be built, deployed and maintained. Mastering these technical skills for each smart application stage is crucial for fast and efficient smart application development and deployment.

Our core competences cover all stages of the smart application process including the crucial technical skills. Most of the stages and related issues are similar as those regarding the automatization of resource provisioning in cloud computing and overlying services, which has been deeply investigated in our research team. Shortly, our experiences in each area gained from previous and ongoing projects are presented in Table 2.

Table 2. Table of XLAB’s gained experiences that can be potentially applied in Smart City solutions

Area	Project and main XLAB’s contribution or references
Data collection	Apricot – Sensor networks Giraff+ – eHealth sensor network Sentinel – Marine sensor network eBadge – Energy sensor network
Analysis	LiaaS – Logistic optimization SPEU – Energy consumption
Forecasting	LiaaS – Logistic planning xHPA – Simulation platform MANTIS – Maintenance planning
Visualization	SPEU – Energy consumption monitoring Gaea+ – 2D and 3D GIS visualization FINESCE – Standardized visualization widgets for energy monitoring
Notification and Automatization	SPEU – Energy consumption monitoring Sentinel – Vessel monitoring system
Security	Wiser – Cyber security assessment SPECS – End-to-end encryption and secure data handling WITDOM – Privacy preserving platform
Development	DICE – Quality-driven development methodology definition CloudScale – Application scaling prediction TIMON – Service API definition MIKELANGELO – Application packing and Cloud resource management Contrail – Elastic cloud infrastructure management XtreemOS – Grid computing resource management

During our work on the FINESCE project and our FIWARE [3] product development we gained knowledge on exploiting and developing FIWARE infrastructure, which has been designed to foster the Smart City application development. We have our

internal deployment of FIWARE Lab for testing and development. Our team has skilled people able to deploy and maintain various open source solutions as, for example, OpenStack [4] (for private cloud) or CKAN [5] (for open data collection and management).

3. PROJECTS AND PRODUCTS ON THE FIELD OF SMART CITIES

Our research team contributes in research and development of Smart City solutions with participation in the projects or product development shortly described in this chapter. More information about the projects reader can find on the XLABs web site¹ or project sites. The past and current projects are:

- **Apricot** - project’s aim is to contribute a few building blocks to the grand vision of IoT interconnected devices. The final aim was to design and build an Internet of Things compliant advanced prototype that can be integrated with similar prototypes developed by other research teams worldwide.
- **CloudScale** (www.cloudscale-project.eu) – CloudScale provides an engineering approach for building scalable cloud applications and services. CloudScale supports Software as a Service (SaaS) and Platform as a Service (PaaS) providers (a) to design their software for scalability and (b) to swiftly identify and gradually solve scalability problems in existing applications. CloudScale will enable the modelling of design alternatives and the analysis of their effect on scalability and cost.
- **Contrail** (www.contrail-project.eu) – Contrail provides a full PaaS stack based on both open source solutions and the open standards, breaking you free from a specific cloud computing provider.
- **DICE** (www.wp.doc.ic.ac.uk/dice-h2020/) – The project will offer a novel UML profile and tools that will help software designers reasoning about reliability, safety and efficiency of Big Data applications. The DICE methodology will cover quality assessment, architecture enhancement, continuous testing and agile delivery, relying on principles of the emerging DevOps paradigm.
- **eBadge** (www.ebadge-fp7.eu) – eBADGE project’s overall objective is to propose an optimal pan-European Intelligent Balancing mechanism, piloted on the borders of Austria, Italy and Slovenia, that is also able to integrate Virtual Power Plant Systems that can assist in the management of the electricity Transmission and Distribution grids in an optimized, controlled and secure manner.
- **Finesce** (www.finesce.eu) – FINESCE is the smart energy use case project, the part of Future Internet Public Private Partnership Programme (FI-PPP). Its

¹ www.xlab.si/rd

objective is to contribute to the development of an open IT-infrastructure to be used to develop and offer new app-based solutions in all fields of the Future Internet related to the energy sector. The project runs a series of field trials at trial sites in 7 European countries.

- **Giraff+** (www.giraffplus.eu) – Giraff+ is a complex system for social interaction and monitoring which can monitor activities in the home using a network of sensors, both in and around the home as well as on the body. The sensors can measure e.g. blood pressure or detect e.g. whether somebody falls down.
- **LiaaS** – Through the development of selected logistical problems LiaaS project aims to build a prototype of a modern, secure, reliable, flexible and scalable-platform solution in the cloud, which will be the basis for the development of new services in the smart logistics networks using logistic infrastructure as a service – LiaaS.
- **MANTIS** – The overall concept of MANTIS is to provide a proactive maintenance service platform architecture based on Cyber Physical Systems that allows to estimate future performance, to predict and prevent imminent failures and to schedule proactive maintenance. Maintenance is no longer a necessary evil that costs what it costs, but an important function that creates additional value in the business process as well as new business models with a stronger service orientation.
- **MIKELANGELO** (www.mikelangelo-project.eu) – MIKELANGELO project targets to disrupt the core underlying technologies of Cloud computing, enabling even bigger uptake of Cloud computing, in particular, HPC in the Cloud and Big Data technologies under one umbrella.
- **TIMON** (timon-project.eu) – The main objective of TIMON project is increasing safety, sustainability, flexibility and efficiency of road transport systems by taking advantage of cooperative communication and by processing open data related to travel through a cooperative open web based platform and mobile application, developed with the purpose of delivering information and services to drivers, businesses and Vulnerable Road Users in real time.
- **SPECS** (www.specs-project.eu) – SPECS is developing an open source framework to offer Security-as-a-Service and enable user-centric negotiation of security parameters in Cloud SLAs.
- **SPEU** - The main purpose of this application is to analyze the user's energy consumption using different criteria for energy efficiency. These can be standardized, generally used or determined by the tool with the help of statistic methods of the user's average values. Such criteria would be energy efficiency of individual production departments and manufacturing or buildings energy consumption.
- **Wiser** (www.cyberwiser.eu) – delivers a cyber-risk management framework able to assess, monitor and mitigate the risks in real time, in multiple industries. WISER incorporates socio-economic impact aspects, building on current state of the art methodologies and tools, and leveraging best practices from multiple industries and international initiatives.
- **WITDOM** (www.witdom.eu) - aims at protecting the privacy and security of data outsourced to untrusted ICT providers, such as clouds. By protecting sensitive data cryptographically and by applying the privacy-by-design paradigms, WITDOM will provide a holistic framework that addresses end-to-end security for sensitive data. WITDOM's data protection methods will be tailored to the risks associated with different classes of data, so that users remain immune to the threats, vulnerabilities, and risks that may affect remote data processing.
- **xHPA** - The objective of xHPA project is to build a dynamic framework which would enable small and medium sized enterprises to perform complex computational tasks in the public or private cloud, implementation of which would otherwise only be possible with high performance computers.
- **XtreemOS** (www.xtreemos.org) – XtreemOS system installed on each participating machine should provide the Grid with what an operating system offers to a single computer: abstraction from the complex new generation grid hardware and resource sharing between different users.

Our company together with partner companies develop products that can be tailored to fulfil the requirements or used to extend the functionality of temporary smart city solutions. Most representative products are:

- **ISL Online** (www.islonline.com) is a remote desktop support and web conferencing software. Used worldwide by more than 200.000 businesses and holds 10 million remote assistance and maintenance sessions, live chats and online meetings in 30+ languages every year.
- **Sentinel** (www.sentinel.hr) is a simple yet sophisticated marine solution that provides more security to boat owners. Comprised of a network of sensors and central information hub it ensures that the boat is monitored at all times. When an issue is detected the boat owner immediately receives a specific alert via the mobile or web application.
- **Olaii Cashless** (cashless.olaii.com) is a fast and flexible cashless payment system that helps organizations and businesses manage sales accounts at their events in real time.
- **TeleTransfusion** (www.teletransfusion.com) is a solution for remote interpretation of pre-transfusion tests. The system enables experienced physician to be virtually present at any remote location and to offer a

second opinion on complicated cases. 24/7 availability of transfusion specialist results in improved clinical care and lower costs.

- **Gaea+** (<http://www.gaeaplus.eu>) is fully customizable and standards compliant 2D and 3D Geographic Information System providing emergency management system, spatial planning and analysis tools.

4. FUTURE OPPORTUNITIES AND ENROLEMENT

The Smart Cities and Smart Society paradigms require new services capable of providing rich lifestyle and obeying citizen needs, privacy and safety. Our future work anticipates possible contribution to this services, focusing on the areas of:

- Designing backend and frontend software for elastic services including suggestions for appropriate API design.
- Obtaining the data and intelligent processing of the data from large and heterogeneous sensor networks.
- Providing secure data handling and privacy preserving solutions.
- Designing hardware for vessels and extending its functionality (e.g. smart city traffic organization and optimization – sea/river traffic monitoring, drawbridges and canal lock management, etc.).
- Data visualization.
- Data fusion.
- Providing tools for remote server or client device management.
- Expanding our products with IoT devices and wearables.
- Developing tools for modeling and simulation.

To reach our goals we would like to collaborate with partners that obtain or provide:

- Large sensor networks (Energy, environmental, communicational, vehicles).
- Sensors (sensor development and related research).

- Infrastructure providers (smart network management companies, city councils, public or private organizations that possess infrastructure where sensors can be deployed, etc.).
- Domain specific knowledge.

For fluent collaboration we can provide the necessary tools for communication (ISLOnline), document sharing (koofr.net), collaboration (OwnCloud, wiki, etc.), continuous integration (Gitlab, Redmine, Jenkins, etc.), cloud deployment (OpenStack), FIWARE deployment and serve other development tools pre-arranged with the partners.

5. REFERENCES

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