SIMEA News

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Editorial

by Angelo Cenedese

Dear Reader,

Welcome to the first volume of *SIMEA-News*, the Newsletter of the *SIMEA-Project*.

The *SIMEA-Project* is a technology transfer project funded by Regione Veneto (Italy) whose aim is to support industrial innovation and enhance scientific collaboration between industry and academia.

The focus of the project regards the use of sensor and actuator networks to monitor and control the building environment, so as to attain habitat and energy profiling and support the management of building services and resources. More details are given in the article featuring in this issue at page 2.

The partners that contribute to the project come from different fields: *RiCert* is an material analysis service and certification laboratory, *M31 Italia* is a technology company and Information Technology incubator, *SnapSystem* provides networking services for companies and public institutions, *Fornace Silma* is a manufacturing company in the field of building materials, *2x2* is a laboratory specialized in hygienic and sanitary environmental analysis. In the project, a strong collaboration with the *University of Padova* is required both at the scientific level and at the coordination level to leverage the academic knowledge for creating effective social and commercial value, and is attained through several research and consultancy contracts and the sponsorship of a PhD fellowship. Finally, the consulting company *Euris* is involved with project administration and holds the connection with the funding entity. Partners profiles are detailed at page 4 of this issue.

This Newsletter serves a twofold purpose.

- On the one side, it aims at providing a synoptic overview of the project activities and enhance coherence in a unified framework, among the partners of the *SIMEA-Project*.

- On the other, it is an effort to expand the publicity of *SIMEA* and the dissemination of its capabilities. In fact, one of the main aim of the *SIMEA* project as an ensemble and singularly of its partners is to explore new commercial avenues and opportunities.

In this spirit, the Newsletter does not aim at being

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comparable to a scientific publication but will accept contributions from the partners in order to report the progress of the project, provide both technical and commercial insights into the project activities, and complement the documentation published on the *SIMEA* website at http://automatica.dei.unipd.it/people/cenedese/research/simea.html. On the other hand, it will encourage interactions with other interested readers, from the industry, the academia, the consumers' community, to trigger unforeseen exploitation opportunities and novel research avenues.

Hopefully, you will enjoy the first Newsletter and perhaps you will be encouraged to have a closer look at the *SIMEA* activity, stimulate the project discussion, and participate in its development.

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Important Dates

- 4 January 2010: start of the project

- June 2010: Milestone Month-06

- December 2010: Workshop Month-12

- June 2011: Workshop Month-18

- December 2011: Workshop Month-24 and end of the project

Project Scope

The acronym "*SIMEA*" stands (in Italian) for "Integrated Distributed System for Environmental and Energetic Monitoring".

Environmental and Energetic Monitoring: the aim of the *SIMEA-Project* is the study, the design and the realization of a novel sensor network system and a software pack with innovative data analysis algorithms, that allow precise profiling and evaluation of the main environmental and energetic parameters in buildings.

Distributed: the nature of a sensor network is inherently that of a distributed system, and in the *SIMEA-Project* this is realized both at a geographical level, and at a logical level. Distributed algorithms will be designed, being able to perform the estimation and the prediction of the interesting quantities exploiting local interactions and neighborhood limited communications. Distributing intelligence across the network results in the twofold effect of reducing resource usage and cost, and improving system robustness.

Integrated: also, the monitoring infrastructure will be integrated and upgradable with actuator devices and multi-agent networks to maximize the system exploitation. In particular, the *SIMEA-Project* aims at the integration of the information dataflows related to the operational needs of the buildings in their specific *functional* nature (e.g. hospitals, schools, warehouses, ...) and in their generic one (for example, referred to the comfort of the users).

A smart building. Distributed sensing and acting capabilities allows monitoring and controlling the living environment.

"Pervasive, not invasive information" is the key-idea: the system should be deeply embedded in the environment and at the same time the interaction of the sensor/actor network with the environment should be transparent to the user, both in gathering information and in providing interactions through high-level personalized multimodal interfaces.

Through this paradigm, the project aims at studying a methodology to produce an energetic/operational profile of the building with a multiple objective:

- to answer to the need for energetic and environmental *certification*;

- to suggest and implement structural *modifications* to materials and buildings, so as to improve operational and comfort conditions of the occupants;

- to promote *energy awareness* and resource optimization through automatic smart control (future development of the project) and the possibility of gaining information useful for preventive/predictive maintenance.

In particular, from the point of view of a **testbed installation** and of the **prototype development**, two systems will be in focus.

A first system S1 is a mobile sensor network for the temporary and ad hoc monitoring of the environment: based on wireless technology, it is constituted by a great quantity of sensors (approximately 25 sensor points for an area of $100m^2$) of different nature. This system is employed for monitoring existing buildings so as to produce a building profile for certification or other assessment, and for preventive analysis of the building structure during the construction phase, in order to suggest optimal or suboptimal sensor placement for later continuous monitoring.

Elements of this system are:

- ZigBee modules (motes) equipped with sensors of temperature, atmospheric pressure, luminosity, and humidity;

- MiniPC's to support ZigBee communication with the motes;

- laptop to run intensive computation algorithms for building identification and profile estimation.

The other system S2 is a fixed installation, for the continuous monitoring of the environment. The site has been chosen as a hybrid commercial/industrial scenario, and is composed of a location characterized by offices and meeting rooms, and a laboratory area. The final installation of this system will be based on the indications provided by the analysis performed with the mobile S1 system, as far as the positioning of the sensor is concerned, and constrained to the environment and constructive features. The number of sensor points is in this case limited (approximately 10 sensor points for an area of $100m^2$). The objective of the installation is to obtain continuous monitoring of the parameters of interest in order to assess the energetic efficiency of the building and the quality of the environment. Furthermore, the feedback to the

occupant is provided to promote and enhance virtuous and energy-aware behaviors.

The system is mainly composed of:

- Sensor modules: temperature, atmospheric pressure, luminosity, humidity, CO, CO_2, CH_4;

- MiniPC's connected to the sensor boards via CAN bus;

- touchscreen panel, running multimodal human-machine interfaces;

- server for data logging.
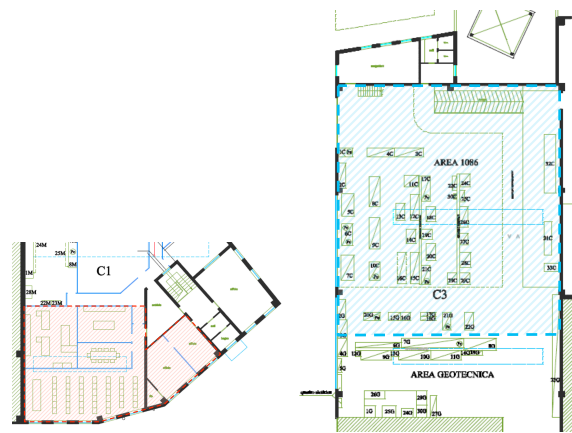
The testbed site. Mixed scenario composed of an office and meeting rooms area (on the left) and a laboratory zone (on the right).

These two systems are formally identical, beyond their specific technological incarnations, and the research leading to the implemented algorithm development takes into account important issues such as:

- scalability and complexity, with respect to algorithmic solutions and data management;

- real-time requirements and data consistency time horizons, and related operational robustness;

- preference towards standard solutions and protocols and off-the-shelf components.

The **outcome of the project** may be summarized as:

- design of novel algorithms for sensor selection and sensor set optimization;

- design of distributed cooperation and estimation algorithms in sensor networks;

- development of building identification models;

- definition of criteria for the energy assessment and certification protocols;

- definition of procedures for materials amelioration and building best practice;

- design and implementation of a mobile sensor network for ad hoc monitoring;

- design and implementation of a fixed testbed for continuous monitoring.

These outcomes are thought to be employed in residential and commercial buildings, in particular those of large dimensions, such as warehouses and malls, and in public buildings , as governative ones, schools, hospitals.

Remarkably, the features of the *SIMEA-Project* well conjugate with current trends in commercial domotics, industrial automation, and also assis-
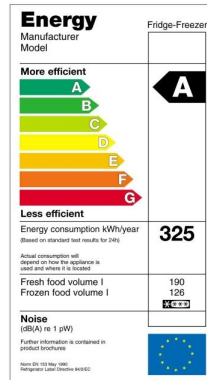
Building energy certification label.

tive domotics for the helderly and the impaired, so as to build a modular framework and infrastructure that can integrate existing systems and new concepts. Some of these regard HVAC (Heating, Ventilation and Air-Conditioning) systems, domotics control, security and safety systems, smart metering, in their double nature of monitoring sensors and controlling actuators.

In actual fact, one of the natural development of the *SIMEA-Project* concerns the control of the environment though distributed actuation systems, able to optimize the resources to attain multiobjective local management and global benefit. At a larger scale, the evolution of such systems foresees the coordination of smart buildings for ensuring energy policies at neighborhood level.

Partner Profiles

RiCert

ECAM - RiCert has been set up as a group to be a single point of reference, with strong specific expertise: ECAM offers a service technician who has experience of over 40 years in the fields of chemistry, microbiology and the environment; RiCert operates in the field of research and certification of construction materials and geotechnical engineering.

The laboratory covers over 2000 square meters and is equipped with a variety of state of the art instrumentation, such as, for example, spectrophotometer-UV-Vis, RX diffractometer, RX spectrometer, Real-Time PCR, atomic absorption flame, hot plate, to cite a few. Also, in the facility there are present acoustic rooms and a mobile laboratory.

RiCert executes tests in the following areas: ceramics, heavy-clay building products, soil/road-/rocks geotechnical areas, geological investigations, thermal and acoustic properties of building products. Offered services include the analysis of environmental materials (soil and rock from excavation, classification of waste, contaminated sites, waste water, air and atmospheric emissions), analysis in food

(including dietary and supplements) and in cosmetics, analysis of drinking water, mineral water and swimming pools, in addition to comprehensive assistance to companies undergoing certification, authorization, and CE marking in related fields.

Also, RiCert supports its customers with courses, conferences and training seminars and updates on safety, HACCP, environment, materials and technologies, new regulations.

The evolution of markets, the sensitivity of consumers and the need for optimization of production processes require that the laboratory is not only a service provider but a partner for companies that can support so qualified and professional, able to solve their problems, fast answers.

RiCert personnel is a group of people passionate about their work, willing to grow and provide qualified answers to their customers. The technical staff is composed of chemists, biologists, chemists, engineers, geologists, who have created a network of relationships with partners and qualified professionals to complete the range of services. RiCert is very active in the research and innovation fields, dedicating part of its resources to these important activities. In particular, an important rôle in the effort for research and development stands in the collaborations with several institutions and some universi-

ties, as: the University of Padova, the University of Trento, the University of Ferrara, the University of Modena and Reggio Emilia, the National Research Council. It is also in deep contact with the most important laboratories for Ceramic products in Europe (Holland, Spain, Portugal, France). Moreover, it is co-operating with the National Association of Heavy Clay products (ANDIL) for developing the most important subjects to offers the best service to the building materials companies.

In this spirit, *synergy* is RiCert motto, combined with the ability to disseminate knowledge and understanding.

More details at the website: `www.ricert.it`

M31

M31 Italia Srl is a technology transfer company and its vision is the one of becoming a recognized player in promoting and developing new technology entrepreneurship among the young generations of - primarily - Italian engineers and researchers.

M31 develops new technology enterprises with focus on Italy by applying the open innovation model: the skills and experience of its team members and its investors add value in shaping those new enterprises, helping them in launching new products and guiding them into becoming important market players.

M31 aims at becoming profitable and at creating value through commercialization of novel technologies by forming new ventures together with graduate students, inventors, entrepreneurs and other investors.

On this basis, M31 searches for, evaluates, filters and tests many new ideas, before turning only the most promising into financeable ventures by bringing together the human and financial resources necessary to develop their products and services for their commercialization.

M31 provides its start-ups a full range of resources from office space to initial/interim management, corporate and business development expertise support, marketing and sales, administrative and financial/accounting services, IT, human resources as well as legal service (corporate and IP) and QA/RA services.

The M31 Italia incubation model is based on three distinct phases: the incubation function (space and office shared services), the financing function, the management function: a true hands-on involvement. All three functions being very critical components in reducing the initial startup risks.

In March 2010 M31 Italia has received a €3M investment from TTventure. TTventure, the technology transfer arm promoted by Fondamenta Sgr, ACRI, some banking foundations and the Milan Chamber of Commerce, has taken a 24% stake in the company.

At the moment M31 entrepreneurial ecosystem consists of: CenterVue(biomedical systems and services for healthcare), Si14 (state-of-the-art embedded systems), Adaptica (adaptive optics components and systems), Zond (player in cross-platform software development that manages large scale software projects), Adant (advanced antenna systems for next generation wireless communications), Uqido (developing webservices to improve user time management).

Finally, M31 USA is a 2010 company and it is the first international outpost of M31 Italia established in Silicon Valley.

More details at the website: `www.m31.com`

Snap System

Founded in Padua in 2003 is the result of years of experience in the computer, Telecommunications and Industrial Automation of a group of professionals coming from Systems, Audio / Video Professional, Industrial and sale of hardware and software as solutions for business.

Snap System company is proposed for the national market as a supplier and consultant services for infrastructure construction of Information and Communication Technology. With a design capability and technical support, Snap System is proposed as a technology partner for the integrated solutions development in the world of global communication. The integration of computer systems, telephony, surveillance and security are the areas on which the company will focus resources in coming years.

Snap System is also able to offer immediate response in the areas of integration of hardware and software systems, IP and traditional VoIP telephone, certificated structured wiring and fiber optics.

In the wide field of action of Snap System, some solutions in the field of IT systems are for example:
- Systems SAN / NAS and direct attached storage: construction of cluster systems running Linux and Microsoft, data storage solutions with Prow Promise and 3Ware for online access to databases and archives documentary over 6TB in a single device connected to your Management Server, Switch or Network connection via SCSI, Fiber Channel or LAN.

- Document Management Solutions: software and hardware created for archiving, cataloguing, logged and search for any kind of documents, high-volume storage scanner and realization of real-time pdf, optical filing system documents with automated backup features.
- Wireless Networking: simple installation on not too complex business and WAN solutions through one or more buildings with data encryption.
- Corporate Security: firewall-based NETASQ, WatchGuard, Cisco Systems Antivirus and systems centralized Trend-Micro, APC security infrastructure supply company.

The Company is divided into three divisions: respectively technical assistance, commercial and, especially interest for this project, supervision of projects. The staff is qualified, having performed consulting services for numerous companies in various areas, network LAN / WAN, Security, Workgroup, IBM OS/400 and installations of products for professional video editing. Technical Staff consists of: technical Hw / Sw, developers, trainers, systems analysts, designers, and in particular, Snap System has a laboratory equipped for hardware product assistance.

More details at the website: `www. snapsystem. net`

Fornace Silma

Silma S.n.c. was established in 1961, developing its activity in the bricks field in

its own establishment located in S. Tomio di Malo (VI), and later in 1979 became FORNACE SILMA S.p.A.

Thanks to a careful management, the company maintains a leading position among the producers operating in the same region. Ing. Quintilio Fracasso, nephew of the founder, is joining the company as Vice President and Managing Director in 1986. The renewed energies bring the company to look for new solutions in order to not depend on property market, whose trend is rather cyclic.

After having accomplished all the necessary controls and having planned and realized the equipment, in 1988 the company starts producing a line of red clay flower pots besides its traditional products. Thanks to the positive results obtained by this product diversification, the company steps from a regional market such as the bricks market into a wider global market such as pottery, counting customers all over the world.

The company is currently owning 2 establishments located at 800 km far from each other, being able to serve the northern and southern areas. In

Malo, Silma has production of both bricks and pots, as well as administration and commercial departments for both lines. The industrial complex is totally 17.000 sq.mt. of covered area, all developed in a 70.000 sq.mt. total surface area of property. As regards bricks production, the quantity is about 300-400 quintals per day of hollow flat tiles, hollow flat blocks and wall blocks which are used in the building industry. Also, the establishment produces about 300-400 quintals per day of clay pots. The company staff is composed by 44 people, whose 35 employed in production and 9 employed in the commercial, administration and technical department.

In Calitri (AV), the industrial complex is including about 5.500 sq.mt. of covered surface area, all developed in a 21.000 sq.mt. total surface area of property. The establishment is currently not at his maximum capacity production, and 9 people are employed.

The production process of our establishment is the result of years of experience in this field, together with a careful and continuous technological research. The quality of raw material is the base element in order to obtain a finished product with high resistance and color characteristics, whose qualities are well appreciated from national and international markets.

More details at the website: `www. silma. it`

2x2

DUE X DUE LTD is a team of professionals with years of experience in the risk analysis in the chemical, biological, medical gas fields, as well as environmental quality.

It is especially qualified in bacterial contamination risk management, with specific focus on Legionella bacteria and Medical Gas and Vacuum Pipeline System Operating Management.

This management has important section integrating the General Safety Plan with any organisation or company must have and implement (Italian Law Decree 81/2008 and later amendments).

More details at the website: `www. duexdue. com`

University of Padova

Principal investigators and involved personnel are:

Angelo Cenedese is currently Assistant Professor at the Department of Management and Engineering of the University of Padova (Italy).

He received the Laurea Degree in Electronic Engineering in 1999; in 2000 he completed a postgraduate course on Plasma Physics and Engineering with the National Research Council and the University of Padova; and in 2004 he received the Ph.D. in Energy Science from the same University.

He has held several visiting positions with international institutions: the JAERI Institute, Naka, Japan (2000); the UKAEA-JET laboratory, Oxford, UK (2001-2004); General Atomics, San Diego, CA (2004); UCLA, Los Angeles, CA (2010).

He has been and he is currently involved in EU Projects on control and diagnostics of nuclear fusion devices, on methodologies for Adaptive Optics systems, on estimation and control in distributed networked systems.

His interests are in the fields of modeling, control theory and its applications, active vision, sensor and actor networks, with particular attention to environmental monitoring and control, and surveillance networks.

He is co-author of around 50 papers, and three international patent applications on the field of surveillance sensor networks are under submission.

Luca Schenato is currently Associate Professor at the Department of Information Engineering at the University of Padova.

He received the Laurea Degree in Electrical Engineering from the University of Padova in 1999, the Management of Technology Certificate from the Haas Business School at UC Berkeley, USA, in 2003, and the Ph.D. from the Electrical Engineering and Computer Science Department of UC Berkeley in 2003. In 1997 he was a visting student at the Department of Computing Science at the University of Aberdeen, UK, and in 2004 he helped a post-doctoral fellowship at the EECS Department of UC Berkeley.

From 2004 to 2007 he was the recipient of the Professorship "Returning Brains (Rientro dei Cervelli)" sponsored by the Italian Ministry of Education and he served as Adjunct Professor at the Department of Information Engineering at the University of Padova.

He won the Eli Jury Award from the EECS Department of UC Berkeley in 2006 for his "for outstanding achievement in the area of Systems, Communications, Control, or Signal Processing".

He is the author of more than 60 publications in international peer-reviewed conferences and journals.

Filippo Zanella received a Master Degree in Automation Engineering from the University of Padua in 2008 with grade 110/110 cum laude. In 2009 he collaborated to a project on the "study and implementation of algorithms for localization and adaptive video compression" at the Department of Information Engineering (DEI) of University of Padua and in 2009 - 2010 he worked for the project "WIreless SEnsor networks for city-Wide Ambient Intelligence" (WiseWai) at DEI, a three-years effort that blends scientific research and engineering together toward the definition and deployment of integrated solutions for ambient intelligence in city-wide scenarios.

Actually he is a Ph. D. Candidate in Information Engineering at DEI under the supervision of Prof. Angelo Cenedese and he is working on "coordination and distributed control for robustness and safety of multi-agent systems". His research interest fields are addressed on localization, auto-localization and tracking of multi-agents systems, distributed estimation and fault detection of distributed systems, optimization of sensors and actuators networks for environmental monitoring and management of operational environments, development of distributed control methodologies to supervise networks of interconnected heterogeneous agents, abstractions for the robustness of multi-agent networks and algorithms for intrusion detection.

In 2006 he won the Innovation Prize of IEEE Region 8 Student Contest.

Piergiorgio Cesaratto is a Mechanical Engineer, and a PhD student at Dipartimento di Fisica Tecnica (Department of Applied Physics) of Padua University.

He works on the analysis of different building solutions: in particular, concerning the building envelope he develops measurements of thermal conductance in situ, determination of air permeability of buildings by means of fan pressurization method, thermal bridges and heat balances optimization by means of simulations, as far as the heating system he studies possible optimization of coupling of convective and radiant system with different generation systems i.e. heat pump, traditional and condensing boiler.

He participated to the European Research Groups of Annex 49 and COST C24 on the low-exergy systems in buildings, and he collaborates with private agencies of heat technology and with different agencies for training of energy saving skilled technicians.

Luca Cecchinato, Ph.D., is a Post Doctoral Researcher at the University of Padova, where he also

got his master degree in Mechanical Engineering in 1998.

He teaches a course of "Energy Sustainability in Buildings" in the Faculty of Architecture of Venice University. He was engaged in several research works, mainly concerning simulation of refrigerating and HVAC equipment and CO2 refrigeration systems design.

At present he is involved in chiller controller design and HVAC supervisory system design with reference to energy saving and environment safety.

Massimiliano Scarpa works on energy and thermal systems in buildings. He is Mechanical Engineer and Ph. D. in Energetics, at Padua University. From 2003 he has been working at the Department of Applied Physics of the University of Padua.

His research activities consist in the simulation of energy systems applied to the heating and cooling of buildings. His experience covers both the use of energy simulation programs and the development and consequent implementation of thermal models of envelope elements and energy systems and plants. He collaborates in research and teaching with research groups in the Faculty of Architecture of Venice (IUAV).

He teaches classes about renewable sources and energy efficiency even for public institutions and companies.

During his Master's Thesis, he worked in EMPA (Material Science and Technology, Zuerich, CH). After the Ph. D. in Energetics, he worked at the Technical University of Denmark (Lyngby, Copenhagen, DK). He is Italian delegate in ISO TC205/WG9.

Michele Pasqualetto graduated in Energy Engineering at the University of Padua in 2009 with the Thesis: "Energy and economical aspects of heating and cooling district system based on closed loop ground source heat pump", under the supervision of prof. Michele De Carli.

From 2010 he is Ph.D. student in Applied Physics at the Department of Applied Physics (Dipartimento di Fisica Tecnica) at the same University with the project: "Monitoring system for building energy performance assessment", under the supervision of prof. Roberto Zecchin.

Giacomo Villi, Research Fellow at the Department of Applied Physics.

Euris

Please visit the website: www.eurisnet.it