

ARC

ICT for Energy

Concept maps

ICT for the AEC sector

Digital libraries

Collaborative Learning Environments

Interactive spaces

ARCHITECTURE REPRESENTATION COMPUTATION

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ARC is a multidisciplinary research group dedicated to the design, development and application of information and communication technologies (ICT) to architecture in different areas, including education, design and construction. The group was founded in 1999, and in 2009 it was officially recognized as research group by AGAUR, an education and research agency of the Catalan government. During its more than ten years of existence, ARC has carried out numerous educational and research projects whose results have been published in international journals and presented at international conferences.

RESEARCH LINES

Currently, the group has three lines of research:

Architectural Design and Building

Computer-based design and construction processes, building information modeling (BIM), building component catalogues, modular buildings and industrial construction.

Pedagogy

Environments to support collaborative learning, repositories of educational resources and learning systems.

Information spaces

Interactive interface design, information visualization, concept mapping and data mining.

2002

NETWORKING: SPACE

An abstract machine to generate spatial
hypertexts

NETWORKING SPACE is an **interactive installation** that allows users to explore the relationships between space and text. The system is designed to induce visitors' active participation by the combined actions of visual stimuli and texts. **Spaces and words are the building blocks with which spatial narratives are built in collaboration.** The installation consists of two screens: one showing spaces depicted as sequences of animation frames, and another where users interact with the selected space. Once a space is chosen, users can respond to the impressions they receive from perceiving the space by associating concepts with the animation frames. Likewise, **a user can react to the words previously associated by other users. In this way, the installation allows users to explore the spatial dimension of language and the narrative dimension of space.**

www.salleurl.edu/arc/netspace_s/



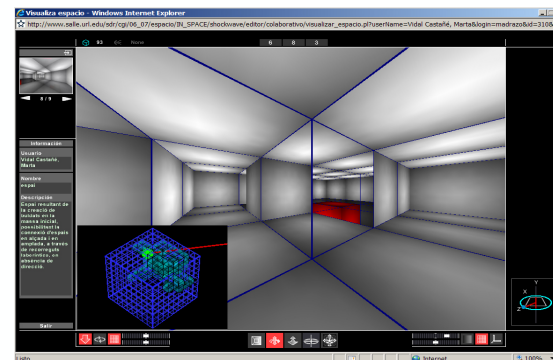
2002-2005

IN_SPACE

Giving form to space

IN-SPACE is a web-based modeling tool specifically designed to **develop the capacity to give form to space.** At the outset, the user is placed within a cubic cell at the center of a three-dimensional grid. From this starting position, **the space is modeled as the viewer moves** along one of the six axes of a Cartesian space. As the user moves, the bounding surfaces expand along the six directions. Conversely, a space can contract as the bounding surfaces moves towards the viewer. The color and lighting of surfaces can be edited, and texts and images can be attached to them. The space generated by a user can later be explored by other users following automatically-generated animation paths.

www.salleurl.edu/arc/in_space



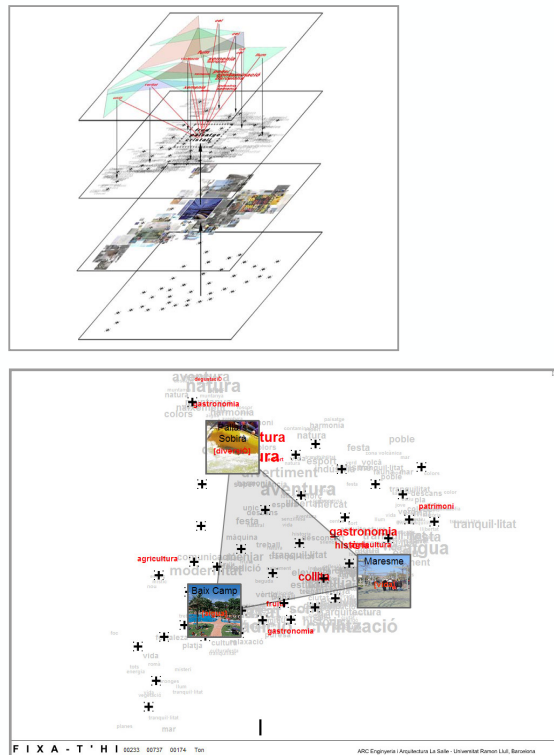
2003-2005

FIXA-T'HI

A digital territory to promote environmental education

FIXA-T'HI is a learning environment based on a representation the territory of Catalonia constructed collectively in Internet. It allows students of various levels of education to collaboratively analyze the physical and cultural environment by associating concepts and images. An "association engine" proposes associative relationships between images and concepts that students write up into short texts. The network of relations established between users and system gives rise to a digital territory **representing individual and collective perceptions of the environment: a map wich relates images and concepts, people and places.**

www.salleurl.edu/arc/fixathi/web/index.htm



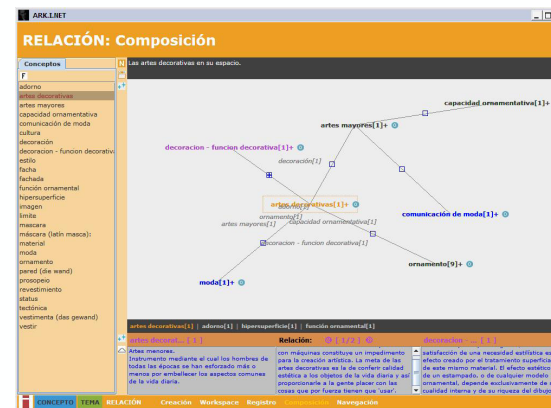
2002-2008

ARKINET

Architectural Knowledge in the Net

Web environment that allows users to collaboratively **build concept maps**. The environment is organized into three areas: concepts, themes and relationships. A concept is the basic building block, and it encompasses the multiple definitions of a word; a theme is made up of a set of concept definitions; and a relationship is a link between two concept definitions. This knowledge structure is independent of the area of study or discipline to which it can be applied. This environment can **support learning activities based on the collaborative construction of knowledge** both in virtual and blended learning settings.

www.salleurl.edu/arc/arkinet/



2010-2012

REPENER

Monitoring and improving buildings energy efficiency using repositories

The objective of this project is to design and implement a prototype for a digital repository for storing, accessing and analyzing **buildings' energy performance data to improve energy efficiency**. Users of the repository will be the technical teams accessing information that will facilitate their energy analysis of buildings, in both the design of new buildings and the maintenance and monitoring of existing ones. The repository will store different types of data, both static (geometry, technical equipment, materials) and dynamic (consumption, occupation, and climate). From their combination, simulated and real data energy patterns – i.e., **simplified models of the building and its behavior**– will be produced.

The structure of the database is flexible and adaptable to facilitate its growth and sustainability over time. The repository includes basic features to transform data into information and knowledge in specific areas, such as supporting statistical studies of the energy performance of existing buildings, formulating optimization criteria, determining reference models (benchmarking) and comparatively analyzing real and simulated scenarios.

These functionalities will be verified in different scenarios, including the design of a residential building, **predictions of consumption** in existing buildings and statistical analysis to be used in urban planning. The end result of the project is the creation of a prototype repository and an associated working methodology which can subsequently be applied on a larger scale.

REPENER is funded by the Spanish National RDI Plan 2009-2012.

2008-2011

INTUBE

Intelligent Use of Buildings' Energy Information

IntUBE is a research project coordinated by VTT Finland consisting of 12 groups, including research centers, universities and companies. The goal of IntUBE is to develop **tools for measuring and analyzing building energy profiles** based on user comfort needs. These tools will offer efficient solutions for better energy use and management within buildings over their lifecycles. **Intelligent Building Management Systems** will be developed to enable real-time monitoring of energy use and optimization. Neighborhood Management Systems will be developed to support efficient energy distribution across groups of buildings. They will support timely and optimal energy transfers from building to building based on user needs and requirements. **New Business Models** will be created to make the best use of the Management Systems developed. The results of IntUBE are expected not only to enhance the comfort levels of buildings' users but also to reduce overall energy costs through better energy efficiency. These results will be demonstrated in at least three pilot cases: publicly-subsidized housing in Spain, office buildings in Finland and a third case defined during the project.

www.intube.eu

IntUBE is co-funded by the 7th Framework Programme of the European Union 2008-2011.

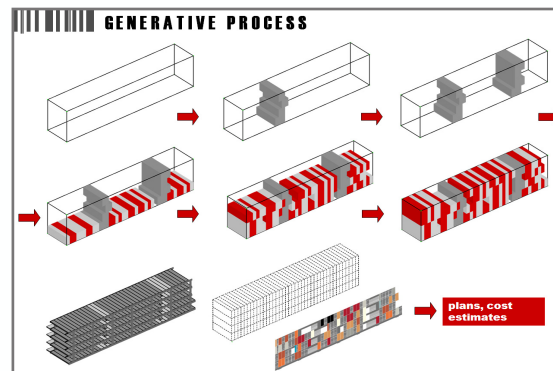
2002-2009

BAR_CODE HOUSING SYSTEM

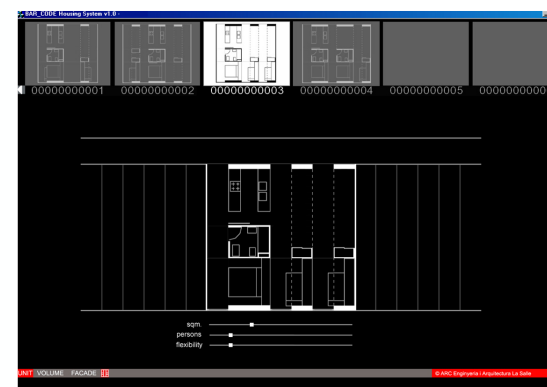
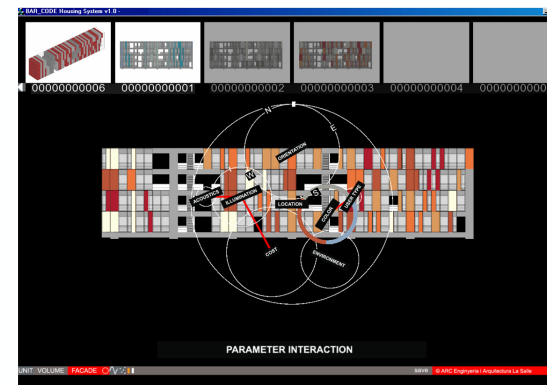
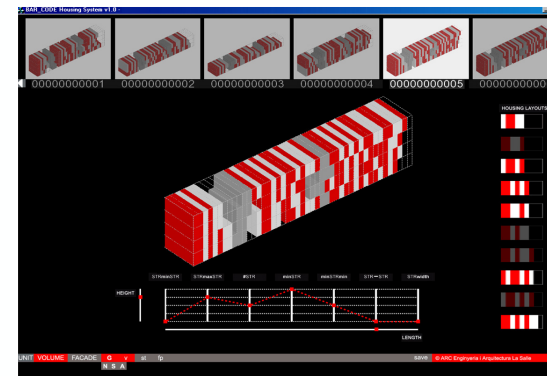
Collaborative design and construction of multifamily housing units with industrial methods

BARCODE HOUSING SYSTEM is a **system for generating multifamily housing units built with industrial methods**. Housing units are created from the aggregation of spatial bars. **A rule-based system generates all the possible space solutions**. The buildings are created by assembling housing units within a support structure. The generative process takes into account building regulations regarding distances to staircases, determines the optimal spaces for the building services and verifies that there are no conflicts between them and the structural elements. The facades are composed interactively by assigning values to parameters such as orientation, cost, color and proportion of glazed surface. Working drawings and bills of quantities of the buildings generated are automatically produced. A three-dimensional model of the building is also automatically generated and displayed in the system's web environment. Based on this prototype, **during the period 2005-2009 a new system was developed that allows different actors (residents, technicians, developers, builders, manufacturers) to collaborate throughout the phases of design, construction and use of the housing units.**

www.barcodehousing.net



BARCODE SYSTEM HOUSING was funded by the Spanish National RDI Plan 2005-2009



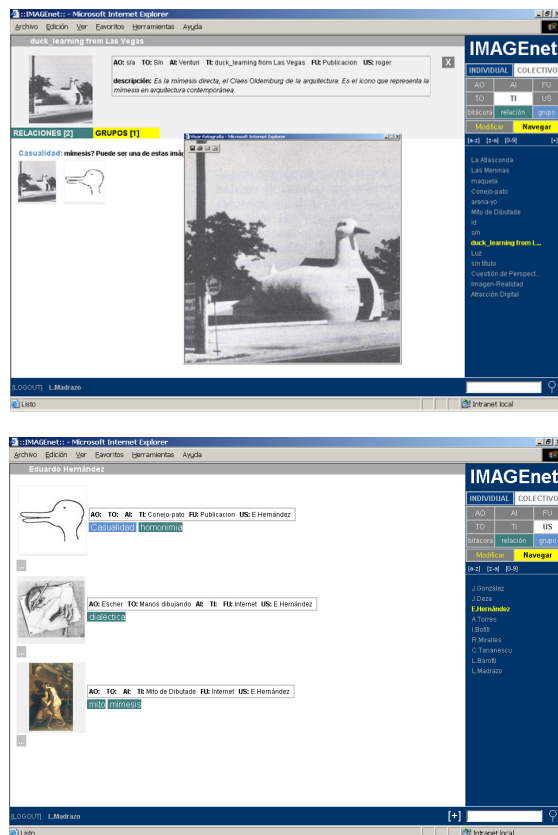
2001-2002

IMAGENET

Collaborative construction of knowledge from images

ImageNET is **a web learning environment that allows a group of users to create a library of images in order to collaboratively reflect on their meanings**. Along with images, users build a vocabulary of concepts to explain their meaning. Concepts are used to establish relationships between images. Images that share certain characteristics according to users' perceptions are organized in groups.

www.salleurl.edu/arc/imagenet.htm



2006-2008

BCN REFLEXIONES

Images of the contemporary city

This publication consists of **an interactive web environment and a book** containing the work done by students of the SDR Systems of Representation course dedicated to **analyzing the contemporary city by means of photographs and photo-montages**. A digital library contains the photographs taken, described and commented on by students. Images can be grouped in various ways according to theme or subject. In the book, the images are organized into groups and routes that the readers can trace following their own associations. Both the book and the web environment share a structure which enables the reader of the book and the Internet user to **reflect on the contemporary city based on the relationships between images and concepts**.

www.bcnreflexions.net



1999-2009

SDR:NETWORKING

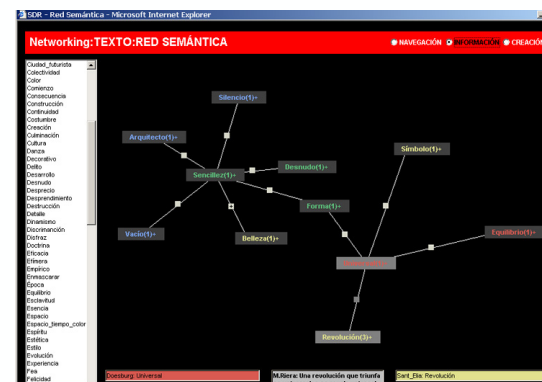
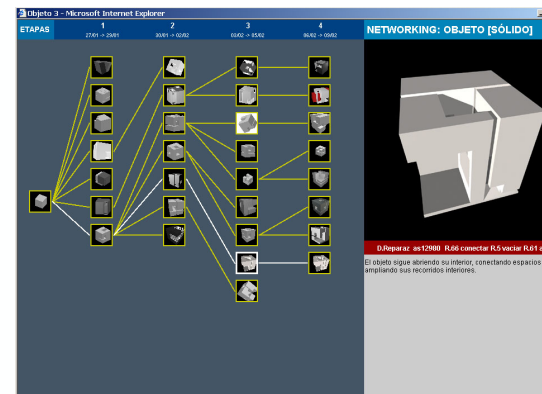
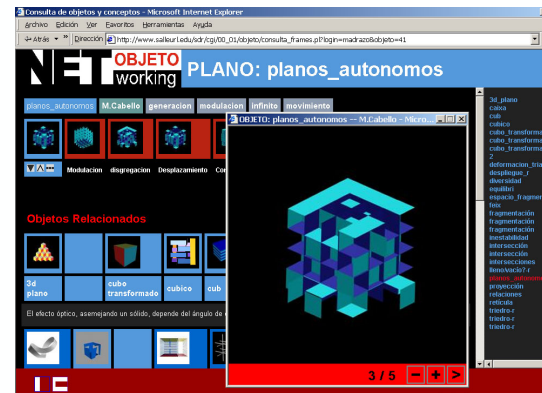
Web learning environment to promote interdisciplinary teaching and participatory education

This is a web-based collaborative learning environment which has been specifically designed for the course on **SDR Systems of Representation**. The environment is divided into six distinct areas, each dedicated to the six subjects covered by the course: Text, Figure, Image, Object, Space and Light. In the Text subject, students use **concept maps** to collaboratively analyze texts about architectural theory; in the Figure subject, they make **variations of the color compositions** created by other students; in Image, the entire class contributes to creating a digital library of photographs from which ideas are derived to create photomontages; in Space, students collaboratively construct **spatial narratives**; and in Light, spaces are transformed by changing the lighting conditions. Altogether, these environments and their associated pedagogic methodology contribute to creating an innovative collaborative and interdisciplinary learning space which arises from the integration of ICT in teaching architectural education.

www.salleurl.edu/sdr/info



In 2010, the Government of Catalonia awarded the SDR course the "Vicens Vives" distinction for excellence in university education in recognition of the use of ICT to overcome the boundaries between disciplines.



2001

ILLA MYRURGIA

Participatory analysis of the urban environment

This is a web environment that allows students of architecture and urban planning and citizens to collaborate in analyzing the urban environment through texts, images and videos. It consists of three areas: 1) a public environment where citizens, experts and non-experts can present and discuss their ideas about the city; 2) a restricted environment where students can analyze and discuss the ideas formulated by citizens and group them into thematic areas; and 3) a communication space where **students and citizens can exchange their points of view**, building collaborative lines of argument.

www.salleurl.edu/illamyurgia



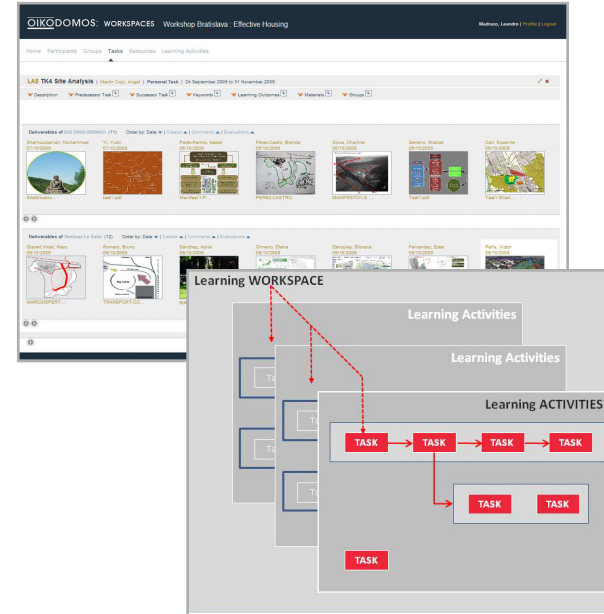
2007-2009

OIKODOMOS: Workspaces

Collaborative learning based on sequences of learning activities

This learning environment is part of the platform created for the **OIKODOMOS virtual campus**. Its objective is to provide teachers and students of participating institutions a tool to design and implement learning activities which foster the **collaborative construction of knowledge**. Learning activities are structured as sequences which together make a learning workspace. As a course progresses, the learning activities designed by teachers become connected to each other. In this way, the outputs of a learning process carried out in one school might become the input for another process taking place at a different school. Learning outcomes are evaluated using rubrics containing the specific competences that students develop in a given learning activity. Learning takes place both in courses and seminars held at each institution and in the space provided by the virtual environment (blended learning).

www.oikodomos.org



OIKODOMOS was co-funded by the European Union's Longlife Learning Programme 2007-2009 and 2010-2011.

2003-2006

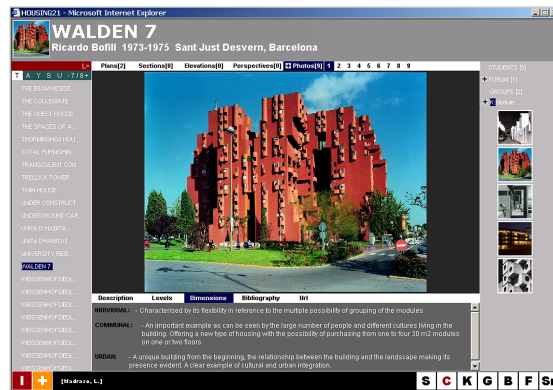
HOUSING@21.EU

Emerging forms of housing and living in 21st century

HOUSING@21.EU is an **educational platform devoted to studying housing at European level**. A **digital library** of housing case studies has been created to support collaborative learning activities. Students and teachers from five European schools of architecture have participated in the documentation and analysis of the projects. The result of this collaborative effort is **a repository containing more than 300 projects and 5,000 images** which together constitute a valuable learning resource which can be expanded over time. Also, to facilitate the joint development of architectural designs by groups of students from different schools, a learning environment has been created that allows students to collaborate throughout the **design process**, from the early conceptual stage to the presentation final.

This project has been selected as an example of best practices by the report Bildung für eine Nachhaltige Entwicklung in den EU-Bildungsprogramme, Anne Busch, Universität Lüneburg, UNESCO, 2007.

www.housing21eu.net



HOUSING@21.eu was co-funded by the Erasmus Intensive Programme 2003-2006.

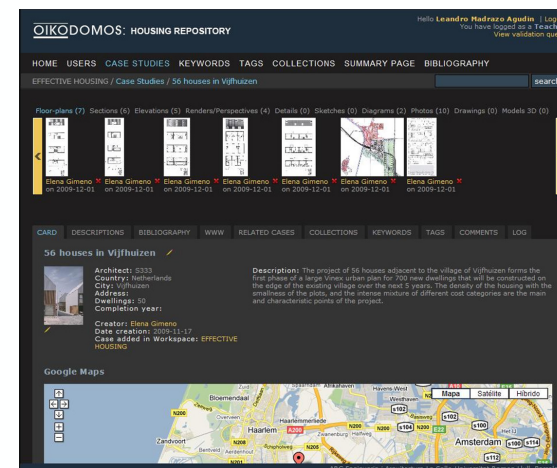
2007-2009

OIKODOMOS: Case repository

Digital repository of housing projects

This repository is part of the technological platform developed for the **virtual campus OIKODOMOS**. It is a **digital library** that contains **housing projects** documented by students of the European architecture schools participating in the program. The description of a project includes texts, images, references, links, comments, tags (folksonomies) and key concepts (ontologies). Projects with common characteristics are grouped into collections. The contents of the library can be integrated into free-form documents and merged with other external data. Students and teachers can carry out collaborative learning activities using the resources in the repository. Following a validation process to verify the quality of their contributions, their work becomes part of the repository.

www.oikodomos.org



OIKODOMOS is co-funded by the European Union's Longlife Learning Programme 2007-2009 and 2010-2011.

Partners in research projects

- Hochschule für Technik / **Stuttgart** / GERMANY
- Fraunhofer Institute for Human Factors and Technology Management / **University of Stuttgart** / GERMANY
- Hogeschool voor Wetenschap & Kunst Sint Lucas / **Brussels** / **Ghent** / BELGIUM
- Faculty of Architecture / **Slovak University of Technology** / **Bratislava** / SLOVAKIA
- Universitat Politècnica de Catalunya / **Barcelona** / SPAIN
- VTT Technical Research Centre / FINLAND
- CSTB Centre Scientifique et Technique du Bâtiment / FRANCE
- Institut d'Urbanisme / **Université Pierre Mendès** / **Grenoble** / FRANCE
- TNO Netherlands Organisation for Applied Scientific Research / THE NETHERLANDS
- University College Cork / **Department of Civil & Environmental Engineering** / IRELAND
- Università Politecnica delle Marche / **Ancona** / ITALY
- SINTEF Group / NORWAY
- Politechnika Bialostocka / POLAND
- University of Liverpool / **School of Architecture** / UNITED KINGDOM
- Centre for Construction Innovation & Research / **University of Teeside** / UNITED KINGDOM
- Università della Svizzera Italiana / **Lugano** / SWITZERLAND

