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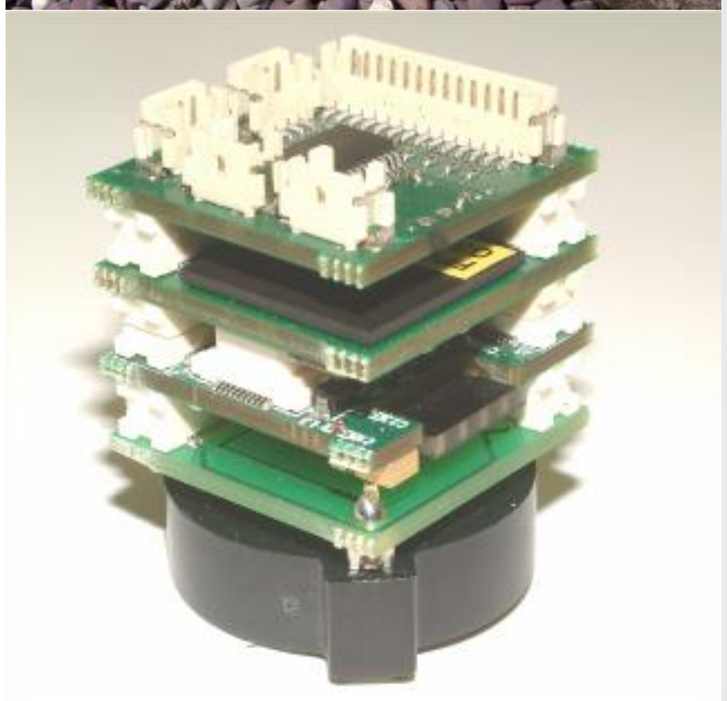

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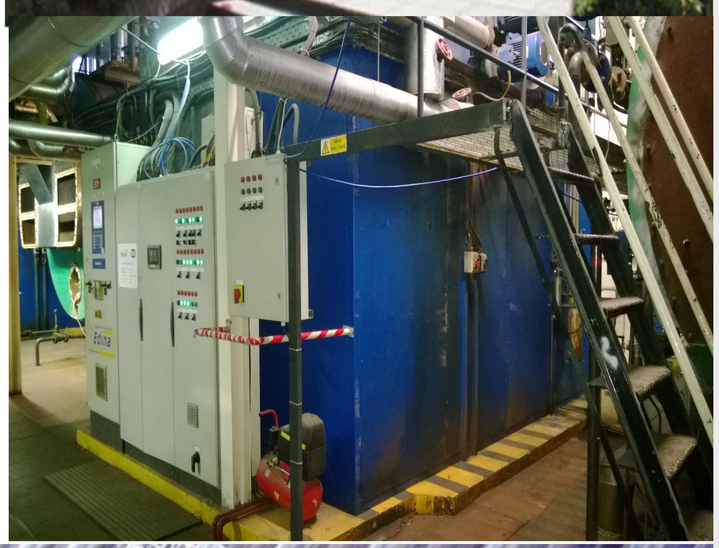

PART 1:

LIVING LABORATORIES

at

UNIVERSITY COLLEGE CORK

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Coláiste na hOllscoile Corcaigh, Éire

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Informatics Research Unit for Sustainable Engineering

LIVING LABORATORIES (1)
NETWORKS
District Heating with CHP-Generators

Steam Network

UCC operates a Steam Network on its main campus. Steam is supplied by two gas boilers and two Combined Heat and Power Plants.
The steam produced by the CHP and the gas boilers is distributed throughout the campus by means of an underground steam network. Many of the buildings on Main Campus are connected to this network.
As part of the CAMPUS21 project the performance of the steam network is analysed. We measure the gas, water and electricity consumption of plant as well as the 'output' of the plant (steam meters) and compare it to the consumption of the 8 buildings connected to the grid.

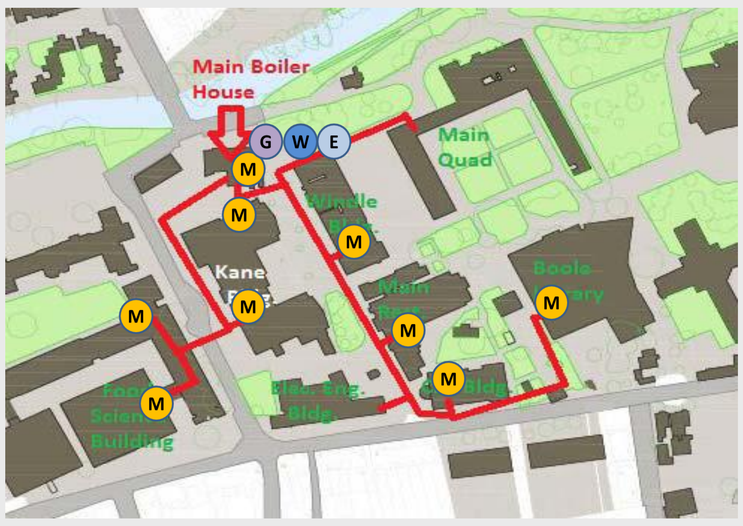

Figure 1: Schematic Steam Network

Connected Demonstration Buildings

The location of the Main Boiler House, the approximate arrangement of the steam and water mains which are in use (denoted by the red line), and the buildings connected to the Main Boiler House for heating purposes are shown on the top right figure.
The Boole Library, the CEE Building, the Food Science Building, the Campus Kitchen, the Windle Building, and the Building of the Dept of Electrical Engineering are connected to the steam distribution network which is fed from CHP steam and boiler steam. Hot water in the Boole Library is also heated by steam. The Kane Building is connected to the hot water system supplied by the CHP plant for heating purposes.

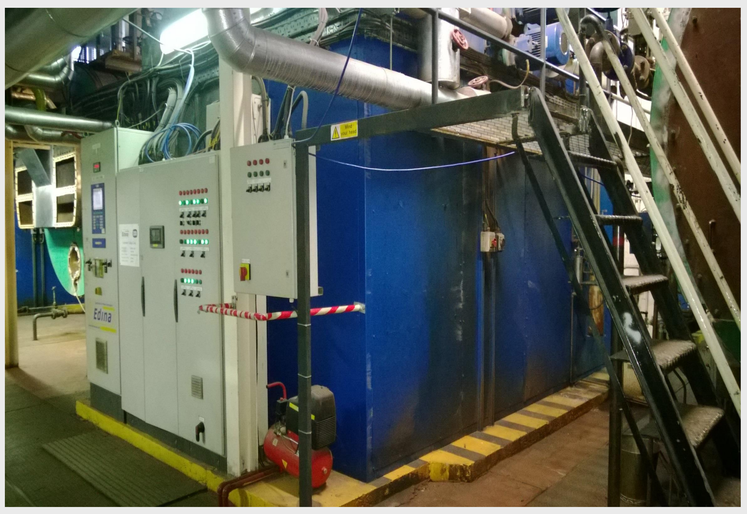

Figure 2: Combined Heat and Power Plant

Combined Heat and Power Plant

UCC operates a CHP system which generates Electricity, Steam and Hot Water. The CHP plant runs based on the demand for electrical energy on campus. The plant will attempt to meet the electrical demand and this will affect the quantity of steam produced by the plant.

The UCC CHP plant consists of 2 No. Jenbacher J320 CHP units. Each unit has an electrical output of 1006kW, a low temperature hot water (LTHW) output of 603kW and steam output of 503kW (700kg/hr @ 7bar).The CHP plant utilizes air blast coolers for heat rejection.

Figure 3: Generator Unit as part of CHP

Steam Boilers

The CHP units operate during normal daytime hours (0700hrs to 2300hrs), with the electrical load on campus determining whether one or two units operate. The peak load supplied by the plant is approximately 2.5MW with any excess requirement imported from the national grid.
2 No. steam boilers back up the CHP units; they have a combined capacity of 19,000kg/hour @ 7bar.

Figure 4: Gas-fired steam boilers

Upgrade Metering

The CHP plant and equipment at the university is currently operated by external contractors, however much of the operational data is available on a read only basis through a propriety Resource Kraft system.
As part of the CAMPUS21 Project, additional metering was added to meter some data elements of the CHP system which were not previously captured.

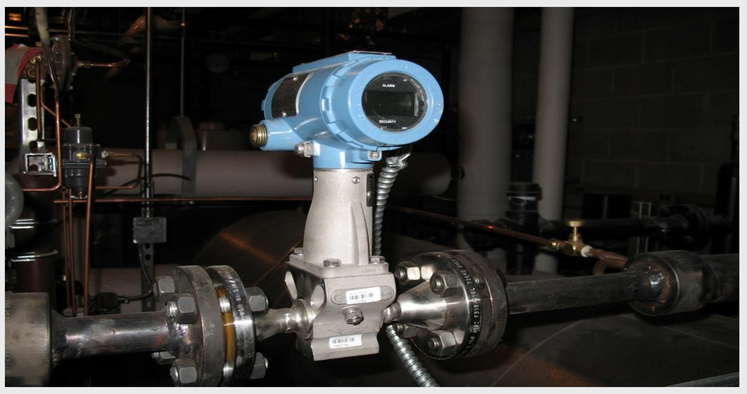

Figure 5: Steam Meter

Contact

Prof Karsten Menzel
Donal Browne, MEngSc.
IRUSE Group
University College Cork, Ireland
Western Gateway Building, room 2.12
k.menzel@ucc.ie

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

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LIVING LABORATORIES (2)
RENOVATION TECHNOLOGIES
The CEE-Building (1910)

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The Building

The Civil and Environmental Engineering Building is situated on the Main University Campus. The building was constructed in 1910 to accommodate the college's physics and chemistry laboratories. The building features high ceilings and large thermal mass. In 2009 a major renovation was undertaken including upgrading of Roof Insulation, selected windows and heating controls. Further upgrades were undertaken in 2013 as part of the CAMPUS21 project.

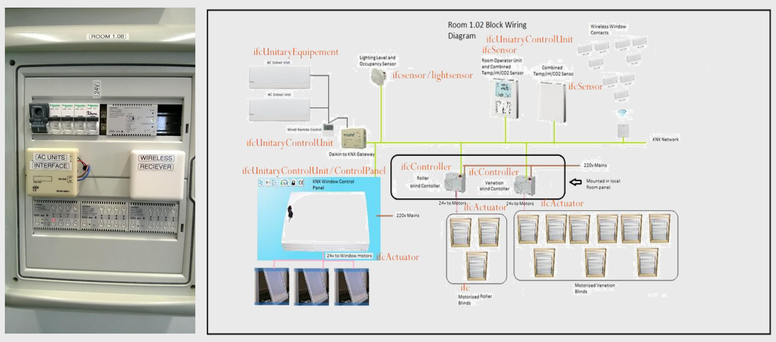
Control of Natural Lighting and Natural Ventilation

The CEE Building has blinds installed on most south, east and west facing windows. Automatic venetian and roller blinds have been installed in key teaching rooms in conjunction with lux meters.

The building is primarily ventilated by means of natural ventilation. This is controlled with a range of methods including traditional windows, manual and motorised dampers, vents & windows. Feedback is also provided from magnetic sensors.

Building Management System

The CEE Building is controlled by a Siemens BMS. It features extended wireless capabilities of integrated sensors (indoor and outdoor: motions, light fluxes, windows and doors states, environmental conditions such as temperature, humidity, CO_2) and actuation capabilities across multiple systems. Central communication network using open-standards protocols: TCP/IP, BACnet, KNX, Zigbee.



Access Control

The TDS Access Control Software Solution is built on the Oracle database. TDS Access uses AES, DES and 3DES cryptographic algorithms. Additionally RFID-based access control has the added benefit of recording in and out readings unlike 'in only' readings of the TDS system. It supports a non-intrusive occupant monitoring, no user interaction is required.

Heat Exchanger and Heating System

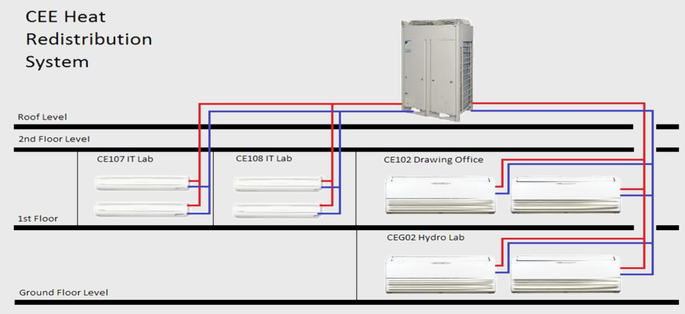
The CEE Building Heat is supplied from the UCC 2MW CHP plant through connection to the Campus Distribution System. A Siemens BMS system operates in the building which is being upgraded as part of the Campus21 project. Bypass loops were also added to the heating system in conjunction with magnetic & thermostatic valves.

Air Handling Unit and Heat Recovery

An AHU with Thermal wheel is installed to ventilate the energy intensive IT Laboratories in the CEE Building to recover heat whilst providing ventilation to these rooms. This avoids opening windows, which does provide ventilation but also excess building heat loss during winter which is undesirable for energy efficiency.
HRV provides improved climate control, while also saving energy by reducing heating (and cooling) requirements

Heat Re-Distribution

The CEE building has a heat redistribution system based on Variable Refrigerant Flow (VRF) technology. This allows excess heat from the warm IT Labs on the south of the building to be used on the cool north side of the building. This system is being optimised as part of the CAMPUS21 Project.



Contact

Prof Karsten Menzel
Donal Browne, MEngSc.
IRUSE Group, University College Cork
Ireland
k.menzel@ucc.ie

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

IRUSE

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

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LIVING LABORATORIES (3)

SUSTAINABLE DESIGN & OPERATION

The ERI-Building (2007)

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The Building

The Environmental Research Institute building is situated on the west of Cork city, on the Lee Road. The building was constructed in 2006 to accommodate laboratories from researchers in Science and Engineering.

The ERI building provides about 3000m^2 of laboratory, office and meeting space over three floors. It was built with exposed concrete, facade wood-framed windows and high-performance glazing.

Additionally, it provides a demonstration site with a combination of renewable energy sources, gas for hot water boilers and electricity from the national grid for lighting and running other electro-mechanical systems.

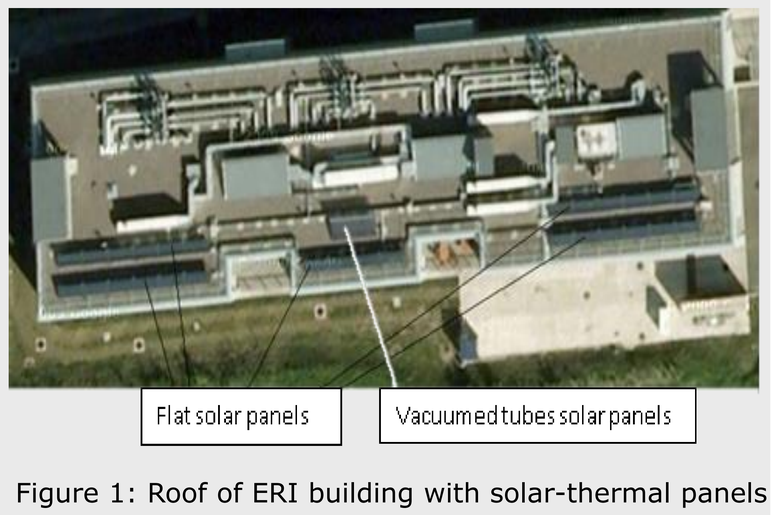

Figure 1: Roof of ERI building with solar-thermal panels

Solar Co-Generation

Sanitary hot water is primarily produced using solar collectors of different types, such as flat plate or evacuated tube types. The following types of solar panels are installed:

a) Flat solar panels – 28 panels, 2320x1070 mm (2.48 m^2) each. Total area = 69.5 m^2;

b) Vacuumed tubes solar panels – 2 panels by 30 tubes each, with dimensions: 2120x1750 mm (3.7 m^2). Single tube dimensions: L = 1750 mm, D = 65 mm.

Figure 2: Solar System components, ERI

Under Floor Heating and Geothermal Heat Pump

The Geothermal System (GTS) features an 88 kW Heat Pump supplied by an open loop aquifer. Excess heat from the solar system can be used to pre-heat the aquifer loop.

A gas fired boiler (163 kW) backs-up the renewable co-generation systems.

The Geothermal heat pump supplies the Under Floor Heating (UFH) system.

Cooling and Air Handling Units (6 heat pumps, 2,2 kW each 4 AHUs - including heat recovery section) provide the required comfort for the Laboratories and cold rooms.;

Figure 3: Boiler & GTS Systems' components, ERI

High frequency lighting with lighting controls complements the building services systems.

Figure 4: UFH system components, ERI

Building Monitoring and Control System

The ERI building is equipped with the CYLON Building Management System (BMS).
Building performance data is provided by:

- 180 wired sensors installed within the building, with 13 different types of measurements, including indoor environment and outdoor weather conditions
- along with meters
- and actuators providing sophisticated control.

All monitoring data is stored in csv-format on the BMS PC. These csv-files are uploaded into the IRUSE Data Warehouse every 24hrs, using a standard TCP/IP (IP v4) connection.

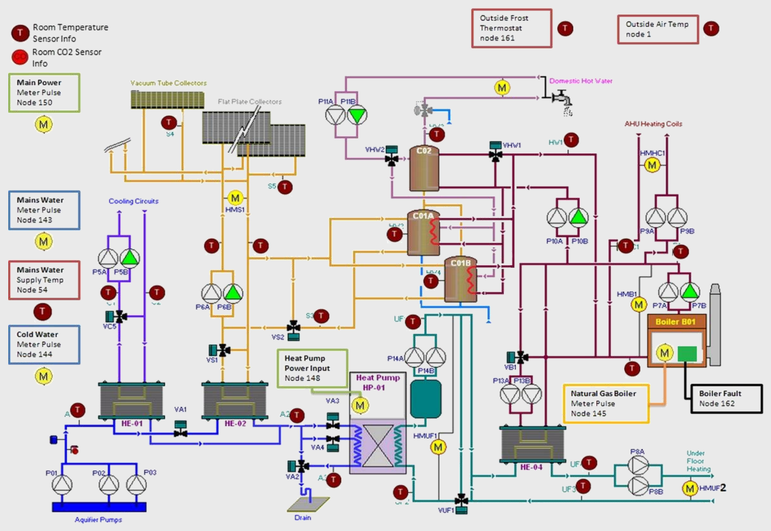

Figure 5: BMS components schematic, ERI

BACnet Compatibility

In 2013 the CYLON BMS was upgraded to be fully compatible with the BACnet standard.

The CYLON UnitronUC32 solution provides a wide choice of integration options including BACnet, Modbus, M-Bus, KNX, and OPC.

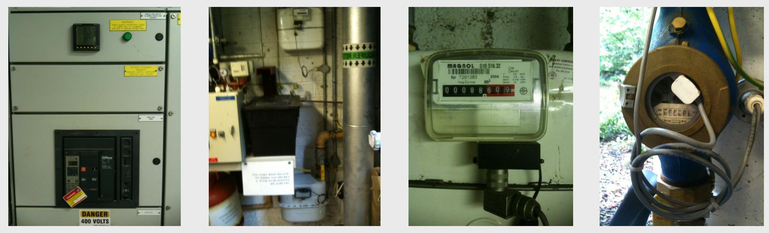

Figure 6: Electricity, 2 Gas and Water meters, ERI

Contact

Prof Karsten Menzel
Andriy Hryshchenko, MEngSc.
IRUSE Group
University College Cork, Ireland
k.menzel@ucc.ie

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

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Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

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INFRASTRUCTURE

PART 2:

DEMONSTRATORS

available in the

WESTERN GATEWAY

LABORATORIES

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Informatics Research Unit for Sustainable Engineering

Demonstrator (1)
HUMAN COMPUTER INTERACTION
Display Wall

Purpose

Demonstration activities in this area focus on "Multidimensional Information Representation". The purpose of the Display Wall is to inform visitors about recent research projects undertaken by our group. We also have information from research partners on display, to present our work in the context of joint, cross-disciplinary research.

This demonstrator focuses on information representation and has therefore limited opportunities for users to interact with the applications presented.

Technology

Uniform information representation is an analytical concept, referring to a process which allows information from several realms or disciplines to be displayed and worked with as if it came from the same discipline.

The term is also applied when taking information from a number of sources, which may have used different methodologies and metrics in their data collection, and building a single large collection of information, where some records may be more complete than others across all fields of data.

The concept is particularly important in the fields of Enterprise Information Integration (EII), where different departments of a large organization may have collected information for different purposes, with different labels and units, until one department realises that data already collected by those other departments could be re-purposed for their own needs—saving the enterprise the effort and cost of re-collecting the same information.

Multiple PC multi-monitor systems: Virtual display drivers and client-side software allows one to use multiple PCs, each with their own monitor(s), and transition from one to the other on screen edges as if they were one machine; each machine doing a different task, freeing up resources.

A different approach to multiple monitor systems involves using the monitors of networked computers to display the output of a central computer. The additional monitors can be extensions of the desktop or mirrors of the central display. The arrangement of these monitors can be configured within the properties tab in the windows display dialog box. Further, monitors and networked computers can be located wherever the network reaches.

Reference: http://en.wikipedia.org

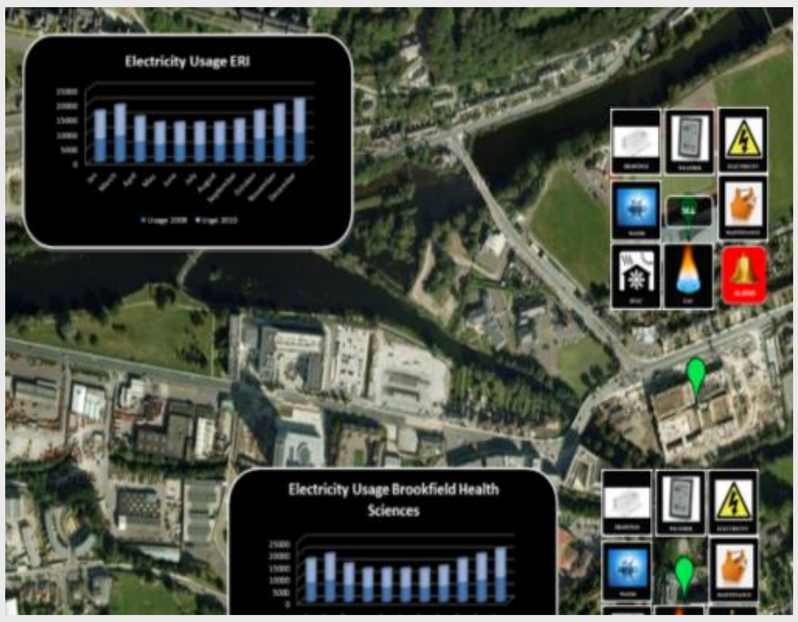
Demonstrator Specification

Demonstrator Specification:
•18 DELL PC with:
•Pentium(R) Pentium 4 (3.00GHz)
•1.00 GB-RAM, 40GB Hard Disk
•100MB-Network connection (IP v4)
to UCC Campus Computer Network
•Operating System is Windows XP (SP 2)

Demonstrator Specification:
•18 flat-screen, plasma monitors 15 inch;

Installed in a rack;
•Monitors form/build a "Display Wall" with a total of 18 monitors (see left)
•Each monitor is controlled by a dedicated PC

Demonstrator Implementation



Example Applications and Potential Usage in Industry

Currently (2013), the Display Wall is used to present the following applications:
- a broad spectrum of slide shows and movies.
- Java-applications accessing the Building Performance Data from four demonstrators and stored & managed in an Oracle Data Warehouse

Experimental Context

Potential applications in the AEC & FM-sector:

- Visualization and Simulation in small & medium-sized engineering offices.
- Simulation of alternative simulated sources in an ICT context.
- Real time comparison of numerous (up to 18) parallel simulations with easily accessible displays.

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Mr. Joe Scanlon
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

http://zuse.ucc.ie/demos

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DEMONSTRATOR (2)
HUMAN COMPUTER INTERACTION
Touch Screen using Web-Services

Purpose

This demonstrator allows visitors to test "Live, Interactive Applications" in our demonstration zone. Currently, the major emphasis is to demonstrate "Energy Management Applications". Building users and tenants are given an opportunity to retrieve data about the user comfort and the related energy consumption of systems and components.

It is our research hypothesis that an improved user awareness will stimulate a more sensitive usage and operation of building services systems. Furthermore, recent publications have shown that the availability and accessibility of "benchmarks" and comparative information stimulates energy savings.

Technology

A **Touchscreen** is an electronic visual display that can detect the presence and location of a touch within the display area.
Projected Capacitive Touch (PCT) technology permits more accurate and flexible operation, by etching the conductive layer.

An X-Y grid is formed either by etching a single layer to form a grid pattern of electrodes, or by etching two separate, perpendicular layers of conductive material with parallel lines or tracks to form the grid

The greater resolution of PCT allows operation without direct contact, (e.g. behind weather and vandal-proof glass).

There are two types of PCT: Self Capacitance and Mutual Capacitance.

Reference: http://www.wikipedia.org

Human–computer interaction (HCI) is the study, planning and design of the interaction between people (users) and computers.

Web-Services are defined by W3C as "a software system designed to support interoperable machine-to-machine interaction over a network.

It has an interface described in a machine-processable format (specifically Web Services Description Language WSDL).

Other systems interact with the web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards."

Reference: http://www.wikipedia.org

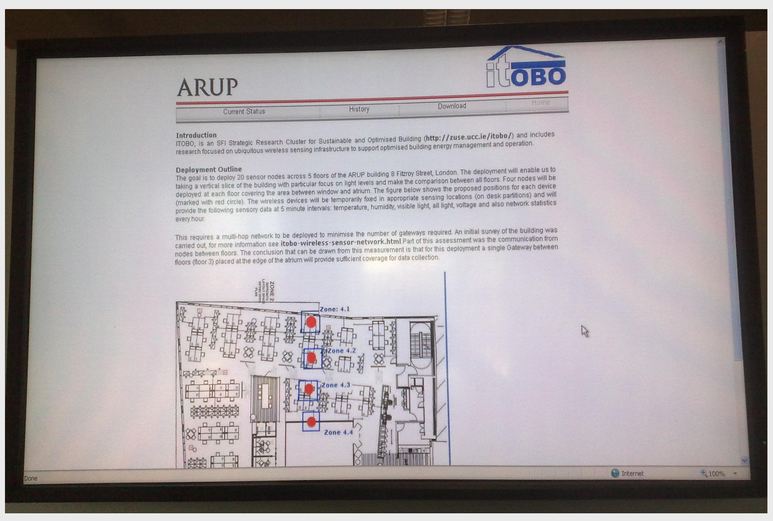
Demonstrator Specification

NEC Touch-Panel P401-PCT-V2U
NEC MultiSync 40-inch public display LCD panel with projective capacitive touch (PCT), and USB connection. Vandal resistant glass.
Brightness (cd/m2): 450, Contrast ratio: 3000

Built-In PC:
- 1.66 Core Duo or 800 MHz Celeron CPU
- Additional DVI-I output to drive a second display
- ExpressCard slot for the use of e.g. WLAN, UMTS, DVB-T
- RJ45 10/100 Mbps
- Microsoft XP, Linux (compatible)

The NEC Touch-Panel is equipped and controlled by an embedded PC. This embedded PC is connected to the UCC network.

Demonstrator Implementation

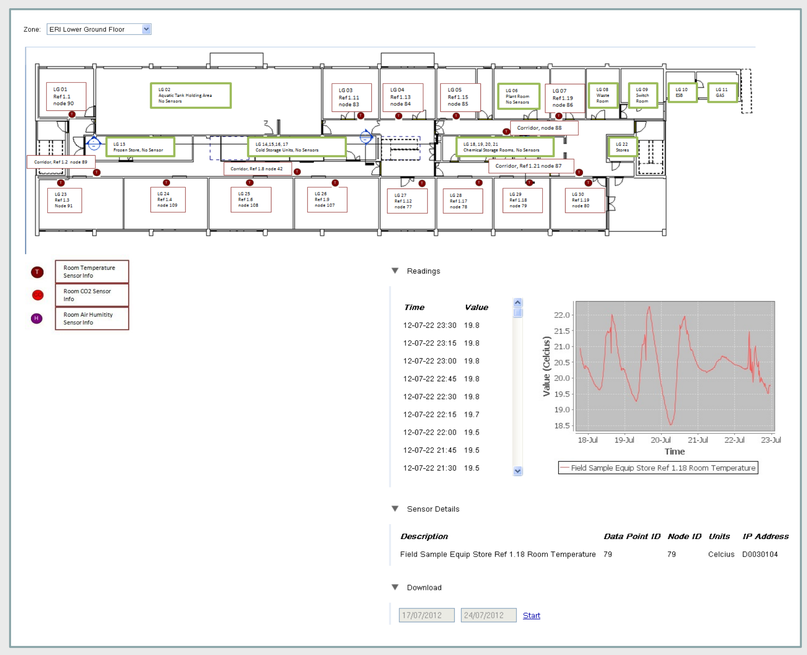


Most of the applications installed for demonstrations are web-based applications and make minimal usage of the local resources of the embedded PC.

All data processing is performed on the "back-end" Data Warehouse Server interacting with a web-server.

Example Applications

A recent demonstration scenario uses SOA-technology to present live sensor readings from ongoing experiments in six different experimental buildings in Ireland, Spain, Germany, and Greece.
The application is used to compile data from sensors and meters in these buildings to analyse the user comfort. The picture on the right presents the link between the floor plan (retrieved from BIM) and a measurement curve (retrieved from BMS)



Experimental Context

Information displayed on these demonstrators is the result of processed data collected from sensor networks installed in different buildings. This data is loaded into a data warehouse. The data warehouse is connected to engineering systems and analytical tools through SOA. Graphical user interfaces of demonstrators are used to display results of the analysis.

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Mr. Kai Mo
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

http://zuse.ucc.ie/demos

DEMONSTRATOR (3)
HUMAN COMPUTER INTERACTION
InterAc(t)Table and InterWall

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Purpose

This demonstrator addresses such questions as –

- What should a **Digital work environment** look like with technology **encouraging creativity**?
- How should IT be **embedded into Engineering Work Processes**?

Using the **Interwall** we demonstrate advanced collaboration scenarios under challenging lighting conditions. Additionally, the **InteracTable** serves as a shared meeting space for project groups. It brings those involved in a project together in an informal atmosphere and allows them to share complex information structures, such as engineering models.

Technology

A **holographic screen** is a display technology that uses coated glass media for the projection surface of a video projector. "Holographic" refers to the coating that bundles light using formed micro-lenses. The lens design and attributes match the holographic area. The whole appearance often looks rather similar to a free-space display since the image carrier appears very transparent.

The display design can use either front or rear projection. The beam widens towards the surface and then is bundled again by the lenses' arrangement on the glass. This forms a virtual point of origin so that the viewer is deceived into observing an imaginary object somewhere close to the glass as the image source. In rear projection the light passes through the glass.

Reference: http://www.wikipedia.org

Multi-touch refers to the ability to simultaneously register multiple distinct positions of input touches. In comparison **Gesture-Enhanced Single-Touch** describes the ability of a touch screen to register certain finger gestures, even though the display hardware does not have full Dual-Touch capabilities.

Pattern recognition (in machine learning) is the assignment of some sort of output value (or *label*) to a given input value, according to some specific algorithm. Pattern recognition algorithms generally aim to provide a reasonable answer for all possible inputs and perform "fuzzy" matching of inputs.

Pattern matching looks for exact matches in the input with pre-existing patterns. A common example is regular expression matching in text editors and word processors.

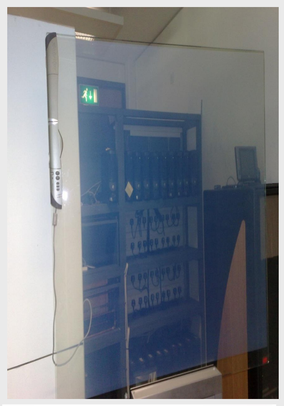
Reference: http://www.wikipedia.org

Demonstrator Specification

NEC WT 610 Projector :
100" image size at less than 26" throw
Image Size 40 inch to 100 inch
Projection Distance 64mm to 659mm
Light Output 2,000/1500 ANSI Lumens (Normal/ Eco)
Contrast Ratio 3,500 : 1

NEC WT 610 - interfaces:
Video image/sound (RCA pin); S-video (mini DIN-4pin)
DVI-i Input (DVI-I 29 pin), Computer Input (D-sub 15 pin)
Audio input (Stereo mini jack - DVI, Computer)
Monitor output (D-sub mini 15 pin),
PC control, USB Type A & Type B
PC card slot (PCMCIA Type II, CardBus)

Demonstrator Implementation

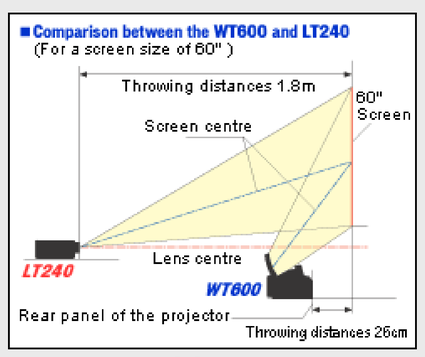


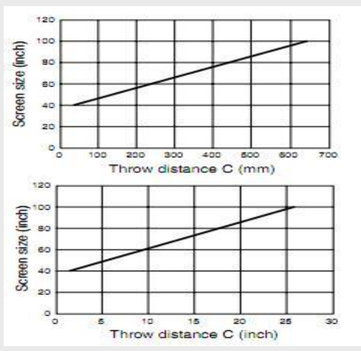
InterWall:
Presentations are projected onto a holographic glass surface.
Rear projector with mirror-projection technology delivers greatest comfort for presenters and minimises focal distances.
The InterWall only functions as a display surface when it is in use and is otherwise completely transparent.

Mimio Interactive:
Affix the mimio bar to any solid projection surface and it is instantly transformed into a high performance interactive whiteboard system.

DELL OptiPlex XE:
Purpose built design for demanding environments offers two form-factor options with the ability to mount in virtually any orientation required. Designed to run 24x7 in enclosed spaces, it is specified to operate at ambient temperatures of up to 45° C (113° F). An optional ducting kit can boost heat tolerance up to 55° C (131° F).

Mirror projection technology with aspheric mirrors achieves shortest focal distance





InteracTable:
First in a series of information devices that investigates general shapes and orientations of interaction areas. Built as a vertical rear-projection unit with a touch-sensitive display surface.

dreaMTouch-MTIR-FR01:
(Infrared Multi-Touch) for LCD monitor size 46" table and wall mounting completely redefines the principle of infrared touch and multi-touching. It offers real multi-touching by providing reliable detection of up to 32 simultaneous touch points, while delivering all the advantages of infrared touch technology without special programming efforts.
Drivers are available for Windows XP, Vista and Win 7©. Support of GNU/Linux interfaces is planned.

Touch Frames:
The electronics are in a modular construction and therefore enable quick realisation of touch frames with diagonals of up to 82". The connection to the PC is via USB.

Screen Materials:
The most varied of glass- or plastic-screens are available:
• Float glass • Tempered safety glass (TSG)
• Plastic screens of PMMA and Macrolon(r)

Example Applications

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Mr. Michal Otreba
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

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DEMONSTRATOR (4)
HUMAN COMPUTER INTERACTION
High Performance Visualization

Purpose

This demonstrator focuses on exploring the potential of High Performance Graphics. The first application under development is an "Energy Management Station". It displays energy consumption data from multiple sources with multiple granularity simultaneously on eight different monitors.

This allows Facility and Energy Managers to analyse and diagnose energy systems.
Furthermore, seamlessly displays Building Information Models (e.g. HVAC-schematics) and Building Performance Data simultaneously, providing the technical information required to support staff for diagnosis tasks.

Technology

Scientific visualization is the transformation, selection or representation of data from simulations or experiments, with an implicit or explicit geometric structure, to allow the exploration, analysis and understanding of the data.
Areas of Scientific Visualization are Flow Visualization, astrophysical visualization and chemical visualization. There are several different techniques to visualize scientific data, with isosurface reconstruction and direct volume rendering being the more common.

Information visualization (IV) concentrates on the use of computer-supported tools to explore large amounts of abstract data. Practical application of IV involves selecting, transforming and representing abstract data in a form that facilitates human interaction for exploration and understanding.

Important aspects of information visualization are dynamics of visual representation and the interactivity. Strong techniques enable the user to modify the visualization in real-time.

Product Visualization involves the viewing and manipulation of models, technical drawing and other related documentation of manufactured components. It is a key part of Product Lifecycle Management.

Technical visualization is an important aspect of product development.

Demonstrator Specification

Demonstrator Specification - PC:

CPU:	INTEL XEON W3520 **2.66GHZ 4 cores, 8MB Smart Cache**
RAM:	CORSAIR **6X2GB** DDR3
HARD DRIVE:	**500GB** 7200 SATA150 16
OS:	MS **WIN 7 PRO** 64-BIT

Demonstrator Specification – Graphics:
NVIDIA® Tesla™ C1060 (PCI Express 2.0)
based on NVIDIA Tesla T10 GPU.
Board interface:
NVIDIA® *Quadro® NVS 420*
quad-display business graphics solution.

BenQ G2020HD:
large 20"W 16:9 display,
dynamic contrast ratio of 40000:1,
response time of 5ms,
Senseye®+Photo Image Technology.

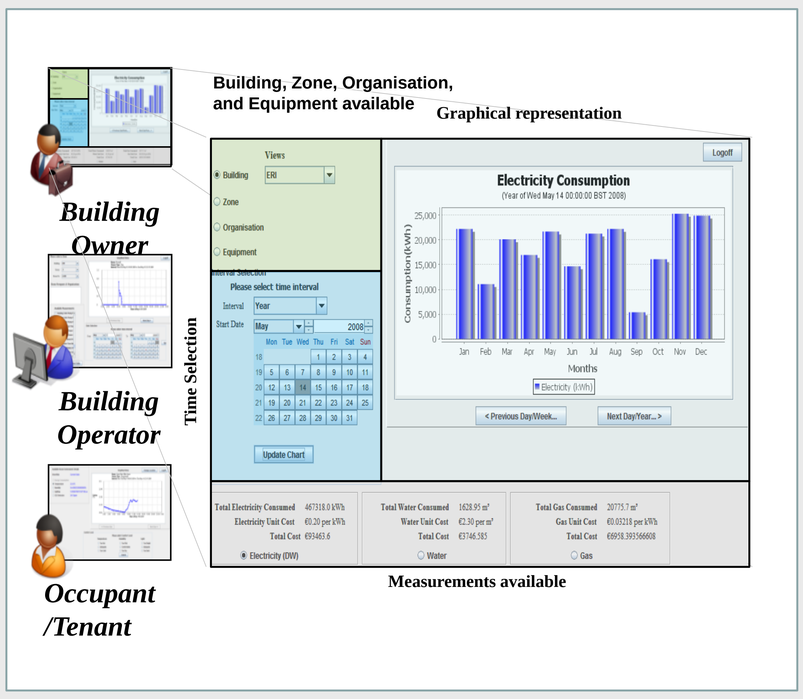
Demonstrator Implementation

Implementation:
two high-spec PCs
with one NVIDIA-Graphic-card
Each graphic card has 2 NVIDIA® *Quadro® NVS 420* quad-display business graphics solutions and therefore supports 8 monitors.

Example Applications

The application developed by a group of 5 MEngSc students focuses on the simultaneous representation of building performance data and building product data.

Potential applications in the AEC & FM-sector:
- Energy Management for Large Campuses
- High-spec graphic cards are one possible, cost-effective extension for a standard PC
- due to their moderate additional financial outlay and easy maintainability they are attractive for SME.



Experimental Context

Real time rendering can be used in many fields like 3D modeling, CFD or GIS simulations.
With the use of the high performance computers and multi display units we can prove that a simple PC with better parameters is sufficient to create fast simulations, where results and can be displayed on a separate screen simultaneously.

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Mr. Andriy Hryshchenko
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

http://zuse.ucc.ie/demos

Informatics Research Unit for Sustainable Engineering

DEMONSTRATOR (5)
AMBIENT BUILDINGS
RFID Gates and Access Control

Purpose

Demonstration activities in this area focus on exploring the different opportunities for user identification. In collaboration with groups in CIT and 4C we explore how data describing user occupation patterns and user preferences can be collected analysed and integrated with Building Management Systems.

We use RFID-technology to identify users in a certain zone. Two sets of antennas are installed at each access point to identify if users enter or leave a work zone. This experiment is coupled with the installation of swipe card readers to allow users to check in at their workplaces.

Technology

Ambient intelligence refers to electronic environments that are sensitive and responsive to the presence of people.

In an ambient intelligence world, devices work in concert to support people in carrying out their everyday life activities, tasks and rituals in an easy and a natural way using information and intelligence that is hidden in the network that connects these devices.

As these devices grow smaller, more connected and more integrated into our environment, the technology disappears into our surroundings until only the user interface remains perceivable by users.

Ambient Buildings are characterized as follows:
Adaptive:
They can change in response to users
Anticipatory:
They can anticipate desires of users
Embedded:
Networked devices are integrated into the building
Context aware:
Embedded, networked devices recognize users in their situational context
Personalized:
Building services systems can be tailored to users' needs

Radio Frequency Identification (RFID)
is a technology that uses communication via radio waves to exchange data between a reader (*interrogator*) and an electronic tag (*transponder*) attached to an object, in order to track and identify it.
There are three types of RFID tags:
Passive RFID tags, which have no power source and require an external electromagnetic field from the reader antenna to generate power and initiate a signal transmission.
Semi-Passive RFID tags, which have a battery but require reader waves for signal transmission.
Active RFID tags, which contain a battery and an RF module, and can transmit signals once a reader has been identified.

Demonstrator Specification

ALR-9800
RFID Tag Protocols: EPC Gen 2;
ISO 18000-6c (902.75-927.25 MHz);
Dense Reader Mode,
(50 Channels, Channel Spacing 500 KHz)
XScale processor, 64 MBytes RAM, 32 MB Flash

Reader protocols: Alien Reader Protocol, SNMP
LAN Protocols: DHCP, TCP/IP, NTP
Communications: RS-232, LAN TCP/IP
Antennas: 4 ports; multi-static topology; circular or linear polarization, reverse polarity TNC;

Demonstrator Implementation

Example Applications

Applications of RFID originated initially from identifying friend and foe planes in the second world war. Its application usage now ranges across industries like retail and manufacturing, medicine, supply chain management, military, access control, localization, tracking and tracing, and many more.

Experimental Context

The experimental context of using RFID in the AEC and FM sector is its ability to identify objects to which tags are attached. Many applications in the FM sector require information concerning the occupational density of buildings.

With RFID-based smart gates deployed, an office environment is monitored for its occupancy loads and hence, different parameters controlled accordingly. Four gate readers are installed in the CEE-Living Laboratory as part of the CAMPUS21 research project.

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Mr. Siyu Deng
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

http://zuse.ucc.ie/demos

DEMONSTRATOR (6)
AMBIENT BUILDINGS
eLearning

IRUSE
Informatics Research Unit for Sustainable Engineering

Purpose

This demonstration area is dedicated to post-graduate students (MEngSc and PhD) to support research-led teaching scenarios. Staff and students can explore the latest features of mobile, wireless technologies in combination with embedded, wireless presentation devices.

Currently, the space is used to support the collaboration of students in international, multi-university, remote teaching scenarios. UCC-students use the demonstrator to host their meetings for their projects in Software Engineering and IT for Energy Systems Engineering.

Technology

Collaborative work systems (CWS) are those in which conscious efforts have been made to create strategies, policies, and structures as well as to institutionalize values, behaviours, and practices that promote cooperation among different parties in an organization in order to achieve organizational goals.

A **collaborative working environment** (CWE) is the technology underpinning CWS.

A **collaborative workspace** is the implementation of a CWE. It is an inter-connected environment in which all the participants in dispersed locations can access and interact with each other just as inside a single entity.

The environment may be supported by electronic communications and groupware which enable participants to overcome space and time differentials.

Ultrasonic sensors work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively.

Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Passive Infrared sensors measure infrared (IR) light radiating from objects in its field of view. PIR sensors are often used for motion detectors.

Apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall.

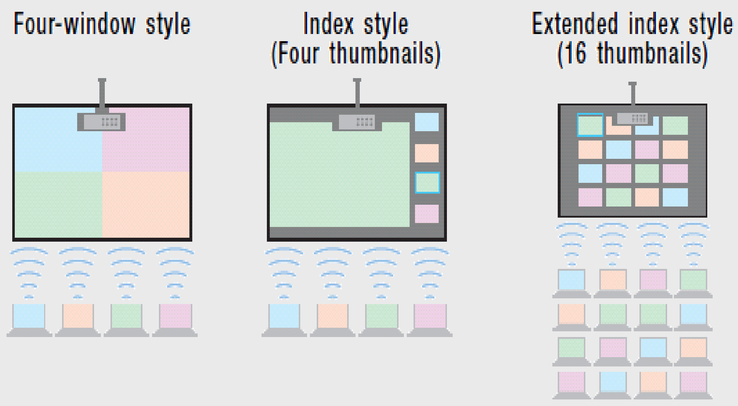
Demonstrator Specification

Mimio Interactive Xi Bar
Based on infrared and ultrasound sensor technology. Mounts vertically or horizontally to whiteboards.
Five built-in function buttons control interactive mode, tool palette, screen mark-up and presentation effects.

Panasonic FW 300 NT:
3500 ANSI Lumens, 1280 x 800 Native Resolution
16:10 Native Aspect Ratio, 600:1 Contrast Ratio
INPUTS: DVI-D, RGB D-Sub 15pin, S-Video, RCA A/V, Stereo Mini Jack
OUTPUTS: RGB D-Sub 15pin, Stereo Mini Jack
CONTROLS: RJ-45 LAN, RS-232, IR Remote Control, IEEE 802.11b/g

Demonstrator Implementation

Easy Wireless Projection from Multiple PCs
Presentation can be delivered wirelessly from a laptop in a smooth, hassle-free way. Wireless connection can be made using Wireless Manager software. When the presentation is finished, Wireless Manager restores the PC to its previous LAN settings.



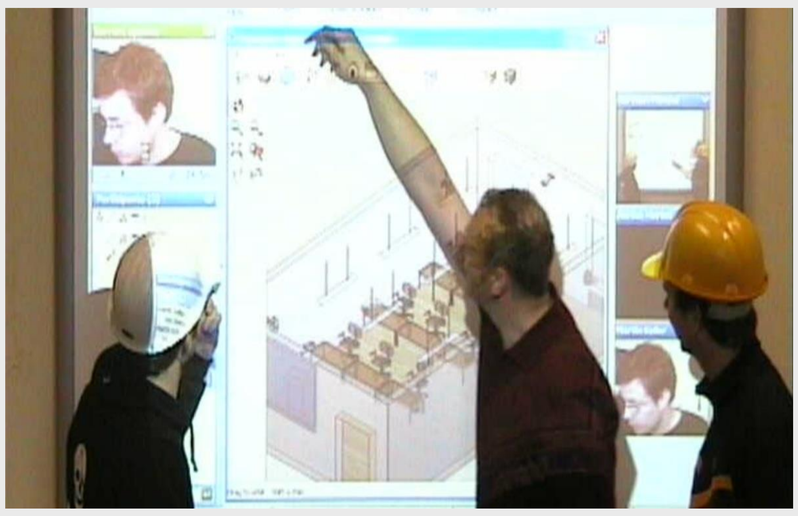
Operation Modes include:
Live mode (i.e. image projected is identical to the image seen on the PC screen) and
Multi-Live mode (wireless connection with multiple PCs)

Wireless Functions include:
Wireless Prompter (Secondary Display Transmission), Selective Area Transmission and a 16-window index style that lets you project images from up to 16 PCs at the same time.

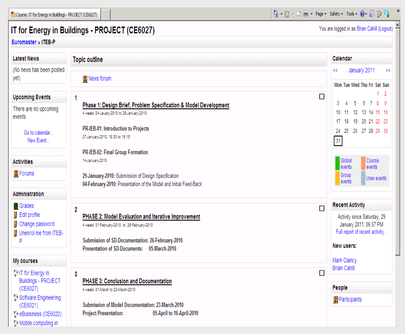
Wireless transmission is possible from one PC to a maximum of eight projectors at a time.

Projector Signal Map
The signal map (S-MAP) graphically shows the strength of wireless connection signals. This is convenient for the users to determine which projector to use when multiple wireless projectors are used in adjacent rooms.

Example Applications



Moodle
is a Course Management System (CMS), or a Virtual Learning Environment (VLE).
It is a Free web application that educators can use to create effective online learning sites.



Specification Student PCs:
- Window 7
- Intel(R) Core™ Duo U 7500 @ 3.00GHz
- 4.00GB of RAM,
- 230GB Hard Disk
- 100MB-Network connection (IP v4)

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Prof Karsten Menzel
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

http://zuse.ucc.ie/demos

IRUSE
Informatics Research Unit for Sustainable Engineering

DEMONSTRATOR (7)
UBIQUITOUS COMPUTING
Mobile Computers and RFID

Purpose

The "Mobile RFID Demonstrator" illustrates the potentials of RFID-technology to support maintenance management and inspection activities.

Applications are available in related areas, such as emergency management and fire fighter support. Our demonstration scenarios focus on the support of "routine work" in the FM sector.

Technology

Ubiquitous computing is a post-desktop model of human-computer interaction in which information processing has been thoroughly integrated into everyday objects and activities.
In the course of ordinary activities, someone "using" ubiquitous computing engages many computational devices and systems simultaneously, and may not necessarily even be aware that they are doing so.
This model is usually considered an advancement from the desktop paradigm.
More formally Ubiquitous computing is defined as "machines that fit the human environment instead of forcing humans to enter theirs."

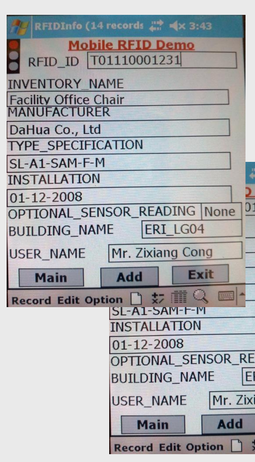
Reference: http://www.wikipedia.org

RFID combined with mobile computing and Web technologies provide a way for organizations to identify and manage their assets.
Mobile computers, with integrated RFID readers, can now deliver a complete set of tools that eliminate paperwork, give proof of identification and attendance.
Web based management tools allow organizations to monitor their assets and make management decisions from anywhere in the world.
Web based applications now mean that third parties, such as manufacturers and contractors can be granted access to update asset data, including for example, inspection history and transfer documentation online ensuring that the end user always has accurate, real-time data.

Demonstrator Specification

- Mobile RFID Reader (RF PC Handheld Reader)
- Tags (Manufacturer: TI HF passive tag)
- Visual CE professional edition
- mEnable Software (Syware Ltd.)
- Panasonic laptop(model: CF-19)
- RFID Reader (I-card 3 reader)
- Active UHF Tags (Manufacturer: Identec Solution)
- Off-the-shelf Applications

Demonstrator Implementation



Example Applications

Organizations are already using RFID tags combined with a mobile asset management solution to record and monitor the location of their assets, their current status, and whether they have been maintained.

Potential applications in the AEC & FM-sector:
- Inventory Management
- Progress monitoring for maintenance staff
- Management of inspection activities for fire-security systems and HVAC-components

Experimental Context

Renovation & Repair
Many buildings are still refurbished with limited consideration of possible improvements of building operation and maintenance (O&M) or optimized methods of system control. Building renovation and components requirement with RFID technology support excellent opportunities to reduce search times for services times for service technicians when locating and identifying fire shutters and system components like pipes, valves and fans; efficiency gains in maintenance documentation; and significant improvements of information and service qualities.

Inventory Management
Inventory management for facility items is one of the widest application areas of RFID technology and is one of the keys to an efficient and effective supply chain. This research focused on tracking inventory items with the aim of reducing equipment stock, reducing FM staff activities and resultant costs (staff hours).

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Mr. Siyu Deng
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

http://zuse.ucc.ie/demos

IRUSE
Informatics Research Unit for Sustainable Engineering

DEMONSTRATOR (8)
UBIQUITOUS COMPUTING
Concurrent Engineering

Purpose

This demonstrator is used to support easy collaboration of IRUSE-staff with their external partners from industry and academia. It integrates advanced audio, video and presentation technologies, such as sensitive room microphones, echo-cancellation software, holographic screens with rear projection and IR-based stylus.

The hardware platform is complemented by a robust, state-of-the-art software platform (Adobe Connect Pro) supporting multi-point videoconferencing and document sharing. Remote users can easily interact through audio, chat, and other "voting" and "feedback" mechanisms.

Technology

Concurrent engineering is a work methodology based on the parallelization of tasks (i.e. performing tasks concurrently). It refers to an approach used in product development in which functions of design engineering, manufacturing engineering and other functions are integrated to reduce the elapsed time required to bring a new product to the market.

This approach is intended to cause the developers to consider all elements of the product life cycle, from conception to disposal, including cost, schedule, quality and user requirements

A **video conference** is a set of interactive telecom-munication technologies which allow two or more locations to interact via two-way video and audio transmissions simultaneously. It has also been called 'visual collaboration' and is a type of groupware. Videoconferencing serves a conference rather than individuals.

Application sharing is an element of remote access, falling under the collaborative software umbrella. It enables two or more users to access a shared application from their respective computers simultaneously.

Demonstrator Specification

8.4" Modero® ViewPoint® Touch Panel
active-matrix TFT with 4 x 3 Aspect Ratio
Screen Resolution (HV): 800 x 600 pixels with Anti-glare Overlay
Built-in speakers (2) and microphone
128 MB RAM/512 MB CompactFlash Memory or more
802.11g Wi-Fi for two-way network communications
38 kHz and 455 kHz 1-way IR

Integrated Controller AMX 3100
Configurable RS-232 / RS-422 / RS-485 Serial ports
8 Relays, 8 IR / Serial ports, 8 Digital I/O ports
Communication : AxLink and Ethernet (TCP/IP)
404 MIPS processor speed, 64 MB or 256 MB RAM
2 GB CompactFlash (upgradeable to 4 GB)
1 MB Non-Volatile Memory
AMX Device Discovery enabled, JITC Compliant

Kramer 725 DS Presentation scaler switchers
4 composite inputs, 4 VGA inputs,
4 component inputs, 2 DVI inputs.
Fade-Thru-Black Switching,
Picture-in-Picture/Picture-and-Picture
Multi-Standard ProcAmp Controls,
Control (RS-232, Ethernet & IR)
HQV® Video Processing / HDTV Component Input
Computer or HDTV Output, YUV or RGB Colour Space




Sennheiser ME 34
permanently polarized condenser microphone capsule for use with Sennheiser MZH goosenecks.
This microphone capsule is suitable for a very wide range of applications including: conference, public address, studio, broadcast, video and others.

Sennheiser eW300
42 MHz bandwidth: 1680 tuneable UHF frequencies for interference-free reception . Enhanced frequency bank system with up to 16 compatible frequencies

Example Applications

Adobe Connect
This is a web conferencing platform for web meetings, eLearning, and webinars. It powers mission critical web conferencing solutions end-to-end, on virtually any device, and enables organizations to fundamentally improve productivity.

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

Staff member responsible and location:
Mr. Joe Scanlon
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

http://zuse.ucc.ie/demos

IRUSE
Informatics Research Unit for Sustainable Engineering

DEMONSTRATOR (9)
COMPUTE CLUSTER
Distributed Computing

Purpose

This demonstrator provides a test environment to staff and post-graduate students of the Chair "IT in AEC and the MEngSc Programme IT in AEC". It allows them to explore what distributed systems should be set up, configured and managed.

Furthermore, the compute cluster is used to provide an infrastructure for the computation of large-scale problems, such as visualization tasks, and the numerical analysis of complex engineering systems.

Technology

Distributed computing is a field of computer science that studies distributed systems. A distributed system consists of multiple autonomous computers that communicate through a computer network. A computer program that runs in a distributed system is called a distributed program, and distributed programming is the process of writing such programs.

A distributed system may have a common goal, such as solving a large computational problem. Alternatively, each computer may have its own user with individual needs. The purpose of the distributed system is to coordinate the use of shared resources or provide communication services to the users.

Reference: http://www.wikipedia.org

Cloud computing is location-independent computing, whereby shared servers provide resources, software, and data to computers and other devices on demand.

Cloud computing is an evolution of the adoption of virtualization, service-oriented architecture and utility computing. Details are abstracted from consumers, who no longer have control over, the infrastructure "in the cloud" that supports them.

Cloud computing describes a new supplement, consumption, and delivery model for IT services based on the Internet, and it typically involves over-the-Internet provision of dynamically scalable and often virtualized resources.

Reference: http://www.wikipedia.org

Demonstrator Specification

Demonstrator Specification:

- 18 DELL PC with:
  - Pentium(R) Pentium 4 (3.00GHz)
  - 1.00 GB-RAM, 40GB Hard Disk
  - 100MB-Network connection (IP v4) to UCC Campus Computer Network
- Operating System is Window XP (SP 2)

Demonstrator Specification:

- 18 flat-screen, plasma monitors 15 inch;

Installed in a rack;

- Monitors form/build a "Display Wall" with a total of 18 monitors
- Each monitor is controlled by a dedicated PC

Demonstrator Implementation

Distributed systems are networked computers operating with same processors. The processors in a typical distributed system run concurrently in parallel.

Distributed computing may be seen as a **loosely-coupled form of parallel computing**; each processor has its own private memory (distributed memory). Information is exchanged by passing messages between the processors.

Parallel computing may be seen as a particular tightly-coupled form of distributed computing; all processors have access to a shared memory. Shared memory can be used to exchange information between processors.

Reference: http://www.wikipedia.org

Example Applications

Potential applications in the AEC & FM-sector:

- Simulation and animation of large-scale engineering problems in small & medium-sized engineering offices.

Distributed Compute Clusters are especially attractive for SME, due to their moderate financial outlay for the initial set-up, their scalability and the easy maintainability of the cluster.

Experimental Context

Regression Analysis of Performance Data:

It is envisaged to utilise Distributed computing techniques to facilitate speedy analysis of performance data. These activities are anticipated to result in classes of performance curves which can relate the performance of a piece of equipment to the probability of failure.

Automation of Data Analysis Technique:

Likewise, distributed computing will enhance the usability of data mining techniques for maintenance scheduling. This will include scripting the technique which is currently in use and utilising this script to perform automated analysis.

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
Email: k.menzel@ucc.ie

IRUSE
Informatics Research Unit for Sustainable Engineering,
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

DEMONSTRATOR (10)
COMPUTE CLUSTER
GPU-Computing/Parallel Computing

IRUSE
Informatics Research Unit for Sustainable Engineering

Purpose

This demonstrator should allow staff and post-graduate students to explore and demonstrate the potential of high-performance graphics hardware for general purpose computing. We envisage exploring the following applications: Parallel computing for highly calculation-intensive tasks, scientific computing, (Monte Carlo simulation of light propagation) Database operations, Lattice Boltzmann methods, MATLAB acceleration using the Parallel Computing Toolbox and Distributed Computing Server, as well as 3rd party packages like Jacket, k-nearest neighbour algorithm, Computer vision, Neural networks.

Technology

GPU computing or GPGPU is the use of a GPU (graphics processing unit) for general purpose scientific and engineering computing.

The model for GPU computing is to use a CPU and GPU together in a heterogeneous co-processing computing model. The sequential part of the application runs on the CPU and the computationally-intensive part is accelerated by the GPU.

From the user's perspective, the application just runs faster because it is using the high-performance of the GPU to boost performance. The GPU has evolved over the years to have teraflops of floating point performance.

NVIDIA revolutionized the GPGPU and accelerated the computing world in 2006-2007 by introducing its new massively parallel architecture called "CUDA".

Compute Unified Device Architecture (CUDA) is a parallel computing architecture. CUDA is the computing engine in NVIDIA (GPUs) that is accessible to software developers through variants of industry standard programming languages.

Programmers use 'C for CUDA' to code algorithms for execution on the GPU. CUDA architecture shares a range of computational interfaces with two competitors –the Open Computing Language and DirectCompute

Third party wrappers are also available for Python, Perl, Fortran, Java, Ruby, Lua, MATLAB IDL, and native support exists in Mathematic.

References:
http://www.nvidia.com/object/GPU_Computing.html
and http:..www.wikipedia.org

Demonstrator Specification

Demonstrator Specification - PC:

CPU:	INTEL XEON W3520 **2.66GHZ 4 cores, 8MB Smart Cache**
RAM:	CORSAIR **6X2GB** DDR3
HARD DRIVE:	**500GB** 7200 SATA150 16
OS:	MS **WIN 7 PRO** 64-BIT

Demonstrator Specification – Graphics:
NVIDIA® Tesla™ C1060 (PCI Express 2.0) fullheight form factor computing add-in card based on NVIDIA Tesla T10 GPU.

Demonstrator Implementation

The Tesla C1060 is capable of:
933 GFLOPs/s of processing performance,
comes standard with 4 GB of GDDR3 memory.

Tesla T10 GPU spec:
Number of processor cores: 240
Processor core clock: 1.296 GHz

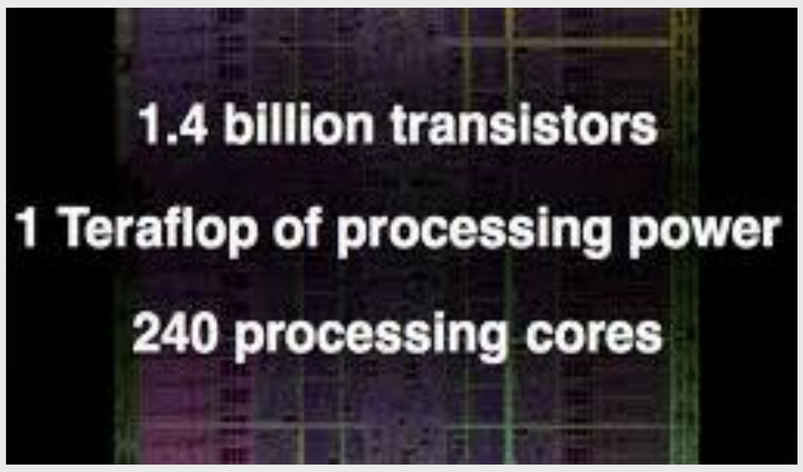
This board is targeted as high-performance computing (HPC) solution.

Board interface:
NVIDIA® *Quadro® NVS 420*
quad-display business graphics solution

Example Applications

Potential applications in the AEC & FM-sector:

- Energy Management for Large Campuses
- High-spec graphic cards are one possible, cost-effective extension for a standard PC
- due to their moderate additional financial effort and easy maintainability they are attractive for SME.



Experimental Context

The envisaged application currently developed by a group of 5 MEngSc students focuses on the simultaneous representation of building performance data and building product data.

Contact & Location

Informatics Research Unit for Sustainable Engineering
Chair IT in AEC, Prof. Karsten Menzel
University College Cork
College Road, Cork, Ireland.
Tel: 00353-21- 420 - 5402
Fax: 00353-21- 420 - 5450
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Staff member responsible and location :
Prof Karsten Menzel
Western Gateway Building
2nd floor, Room 2.12
Western Road
Cork
Ireland

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

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