metadata

* **Article Title** – Soft Buildings.
* **Author Name** – Mike Phillips. Director of i-DAT [The Institute of Digital Art and Technology], University of Plymouth. mike.phillips@plymouth.ac.uk

* **Abstract**s – Buildings are solid, monolithic, static structures of steel, stone and glass. Buildings are at their most dynamic during the phases of construction and ossify from the point of completion. They occupy a different timescale to the rest of us, unlike the Mayfly that enacts its lifespan in the space of a day, or our three score and ten, buildings emerge from a long gestation to face the elements for periods that can span a thousand years. Or they used to - increasingly the contemporary built environment ebbs and flows, generating a dynamically changing landscape as buildings are designed, constructed and demolished in the time it used to take to construct a model. This state of flux is enhanced by the addition of surveillance systems, telematic communication networks and environmental monitoring and control technologies. All these factors provide a new tangible dimensionality to contemporary architecture.

Arch-OS is an 'Operating System' that harnesses these new architectural, technological and social dimensions. Arch-OS, 'software for buildings', has been developed to manifest the social, technological and environmental life of a building and provide a living laboratory for cultivating transdisciplinary knowledge. Arch-OS buildings will be permanently in a state of flux. By feeding on the diverse forms of dynamic data that are generated by a building, its environment and its occupants, Arch-OS transforms the architects drawings, the brick, steel, glass and fiber-optic infrastructure into a living breathing environment. Arch-OS provides users of buildings with a spatial and temporal consciousness, essentially re-programming human activity through a heightened social, architectural awareness. Arch-OS combines a rich mix of the physical and virtual into a new dynamic architecture, an 'intelligent' entity, that interacts, responds and anticipates: Arch-OS is a nervous system for multidimensional buildings.

'Soft Buildings' explores some of the 'dimensions' made manifest by Arch-OS. Specifically the generation of new kinds of space, a new kind of model, generated by a soft building.

* **Keywords** – **Architecture, Intelligent, Operating System, Model, Inhabitants**.

* **Author biography** – Mike Phillips is the director of i-DAT [The Institute of Digital Art and Technology] at the University of Plymouth. Phillips initiated and coordinated the BSc (Hons) MediaLab Arts Programme [1992] and the On-Line MSc Digital Futures programme (2000) and is now overseeing the development i-DAT. Private and public sector grant funded R&D orbits digital architectures, transmedia publishing and generative media, projects and other work can be found on the i-DAT web site at: http://www.i-dat.org.

* **Author institutional affiliation** – i-DAT [Institute of Digital Art and Technology], University of Plymouth,

* **Author addresses** – Mike Phillips: Director of i-DAT
Institute of Digital Art and Technology
School of Computing, Communications and Electronics,
University of Plymouth, Drake Circus, Plymouth, PL4 8AA, Devon, UK.
tel: ++44-01752-232549 / fax: ++44-01752-232540 /
eml: mphillips@plymouth.ac.uk / www: http://www.i-dat.org
http://www.arch-os.com

Arch-OS v1.1:
Arch-OS is an 'Operating System' for 'Cybrid' architectures. Cybrids, a term coined by Peter Anders [1], are "native to the increasingly mixed reality in which we now live. They integrate

physical and cyberspaces within new entities comprising elements both material and virtual. In so doing they marry the affordances of digital media – among them virtual reality, telepresence and on-line environments – with the grounding stability of matter. In cybrids physical and virtual domains become interdependent: actions in material and virtual spaces mutually affect one another." Arch-OS, 'software for buildings', has been developed to manifest the social, technological and environmental life of a building and provide artists, engineers and scientists with a unique environment for developing transdisciplinary research and production. Arch-OS has been integrated into the fabric of the University of Plymouth's Portland Square building, which houses the Head Quarters of the Institute of Digital Art and Technology, which is also the hub of the Planetary Collegium. Arch-OS has also been commissioned for installation into the three new buildings of the Peninsula Medical School, distributed across the South West of England. The PMS is a unique 21st Century model for the education of medics in a diverse rural peninsula. Arch-OS extends the social and learning communities of these individual and distributed spaces by providing a dynamic networked collective public space.

Figure 1: Arch-OS control centre, i-DAT SoftLab Portland Square.

Arch-OS combines a rich mix of the physical and virtual into a new dynamic architecture. Arch-OS uses embedded technologies to capture audio-visual and raw digital data through a variety of sources which include: the 'Building Management System (BMS) (which has approximately 2000 sensors in the Portland Square development); digital networks; social interactions; ambient noise levels; environmental changes. This vibrant data is then manipulated and replayed through audio-visual projection systems and broadcast through streaming Internet and FM radio.

By making the invisible and temporal aspects of a building tangible Arch-OS creates a rich and dynamic set of opportunities for research, educational and cultural activities, as well as providing a unique and innovative work environment. The Arch-OS takes the notion of 'smart' architecture to a new level of sophistication. A Cybrid is a 'intelligent' entity, it interacts, responds and anticipates, and Arch-OS is its nervous system.

Arch-OS Systems:
There are **3** system levels to the Arch-OS building:
[A] Interface: the construction of the internal media networks and data collection devices. The interface (between the physical and the virtual) consists of a dedicated network that transports data from a range of sensors (intelligent cameras that monitor the 'flocking' of people, microphones to monitor ambient sounds, BMS information, network traffic data, lift location and movement) to the 'Core'.

[B] Core: the processing and manipulation of the dynamic data generated by the 'interface'. The Core computer systems incorporate a range of interactive multimedia applications (video and audio processors, neural networks, generative media, dynamic visualisation and simulation software) that generate a dynamic 3D sonic model of the building and its activities. This model allows artists, scientists and engineers to manipulate and control the buildings media output which can be broadcast within and between each structure, and out over the internet. The core enables the sensing and monitoring of social, spatial and technological interactions such as:
• the movement of people and spaces occupancy can be translated into metaphorical representations such as flocks of birds, and many forms of natural phenomena: clouds, waves, buildings being constructed, viruses forming and collapsing.
• Temperature can be read and again translated into images and forms, and particularly into lighting systems that modify colour and ambience.
• Exploring 'Lift Zoning', we are able to develop interesting programming techniques that will make the lifts more intelligent, able to learn user habits and needs and provide a far more intelligent service to the standard dumb lift.

[C] Projects: the projects enabled by the Arch-OS system are the audio-visual manifestation of the dynamic data processed by the Core. The Projects component of Arch-OS are a curated ongoing programme of cultural events, musical performances, installations and exhibitions which take advantage of the unique digital opportunities presented by the building. The institute of Digital Art and Technology (i-DAT) is housed in the centre block of the Portland Square development and will develop, exploit and curate the Arch-OS Core systems to display and disseminate digital works produced by transdisciplinary practitioners.

Figure 2: Arch-OS audio system simulation (from animations by Phil Webster).

Soft Buildings:
The Arch-OS system is essentially an Operating System for Architecture, one ability of this OS is to unite and control existing software applications running within a building. It is easy to forget the level of code that exists within most buildings; code controls the lifts, heating, ventilation, alarms, security systems and door locks. Arch-OS provides a common interface that establishes a coherent language that makes all levels of a buildings software infrastructure accessible. One output of this common language is the ability to map all the data sets within a building.

A key aspect of this language is that it is translated into the domain of the buildings occupants through their interaction with the projects that it enables. In doing so the building has the ability to enter into a direct dialogue with its inhabitants. It senses their presence and makes its awareness known. It creates a critical relationship between the space, the architecture and the inhabitants. Through this relationship inhabitants re-programme the building and the building re-programmes the behaviour of the occupants. This dynamic social interaction provides a backdrop to the following exploration of the space of a soft building, but at all times the glue that binds the physical space of the building to the mental state of the inhabitants is code.

Core Model:
The Core Model (developed by Adam Montandon) represents the combined activities of the code at work within the Arch-OS system. The Core Model is available as a live 3D model of this code and can be downloaded as a screen saver or as an online 3D model. Every computer in the Portland Square building has the option of using the Core Model screensaver. This generates a dynamic recursive environment within the building. Sitting in the building the inhabitants can see a live, real-time 3D representation of the building, the space they occupy, on their screen. They can even pinpoint the data that is being generated by their viewing of the Core Model over their local network. The Core Model has many characteristics of 'Liquid Architecture'. It has a high level of virtuality about it, but this model is a tangible and dynamic real-time inhabited space. Its existence is dependant on the occupants of the building and the digital fall-out from their interactions with it.

Figure 3: Arch-OS and Core Model.

Model Architecture:
A key aspect of the Core Model is its relationship with other architectural models. I once had the pleasure of teaching a postgraduate architecture student whose application of digital technologies allowed him to make complex acoustic online architectures. When presenting these online generative VRML models for assessment by architecture staff, the student was informed that 'digital' models were not 'real' models, and therefore could not be assessed. Somehow the tradition of architecture has fooled itself into suspending its own disbelief about the nature of the model. For some reason models of card and wood had a greater reality than those of bits and bytes. The Core Model takes the architectural model several stages along the scale of unreality. It is a dynamically generated software model that cannot exist without the data feed that spawns it. It has a symbiotic relationship with the building that hosts it. It occupies no physical space (apart from, maybe, the 2 dimensions of the screens that display it) and it is distributed throughout the building and across the internet to whoever logs on to view it. It also has the potential to be a combined model of several buildings. Being a networked environment Arch-OS can unite several

buildings at the same time. As such it can operate as a composite model. A multidimensional space that occupies no space at all.

Arch-OS Core Vision data as composed by George Grinsted:
"Source ID: vis_atria_a
Value: [6, 7, 7, 20, 10, 8, 12, 4, 2, 6, 8, 8, 12, 15, 2, 6, 9, 4, 6, 7, 6, 4, 2, 1, 11, 2, 5, 3, 4, 1, 2, 7, 7, 5, 3, 4, 5, 5, 5, 10, 5, 3, 12, 5, 4, 8, 11, 7, 7, 9, 4, 11, 6, 6, 9, 5, 7, 3, 0, 1, 5, 8, 5, 10, 6, 3, 4, 10, 1, 13, 14, 6, 3, 7, 14, 6, 0, 8, 6, 3, 18, 2, 7, 5, 6, 8, 9, 7, 3, 5, 8, 10, 9, 2, 11, 5, 3, 8, 2, 8]
Last Recorded: 14:56:43 13/04/2004
Source ID: vis_atria_b
Value: [49, 42, 41, 40, 42, 43, 45, 51, 47, 45, 45, 41, 37, 45, 45, 45, 41, 49, 37, 43, 42, 43, 45, 48, 45, 49, 41, 44, 43, 48, 43, 48, 43, 45, 43, 41, 48, 48, 45, 45, 42, 44, 38, 40, 44, 50, 49, 45, 45, 47, 47, 45, 44, 37, 43, 44, 45, 42, 44, 49, 43, 47, 45, 42, 49, 45, 42, 43, 43, 51, 45, 50, 44, 43, 45, 45, 45, 45, 42, 47, 45, 42, 47, 47, 43, 43, 42, 51, 54, 48, 44, 50, 42, 48, 38, 44, 47, 49, 50, 56]
Last Recorded: 12:50:59 07/08/2004
Source ID: vis_atria_c
Value: [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
Last Recorded: 03:13:34 01/09/2004
Source ID: vis_lobby_a
Value: [38, 27, 41, 36, 26, 29, 26, 30, 25, 11, 1, 4, 33, 25, 40, 14, 33, 27, 21, 7, 33, 23, 36, 30, 22, 30, 22, 32, 28, 22, 39, 12, 7, 0, 28, 51, 36, 30, 29, 14, 0, 4, 44, 30, 32, 90, 57, 15, 0, 0, 60, 20, 0, 10, 19, 2, 26, 28, 25, 23, 92, 36, 27, 23, 47, 86, 58, 30, 27, 81, 61, 0, 3, 29, 94, 93, 4, 12, 23, 56, 45, 0, 9, 64, 40, 5, 44, 40, 51, 97, 21, 14, 37, 22, 44, 10, 43, 0, 2, 0, 0, 0, 0, 67, 40, 33, 1, 0, 0, 0, 0, 0, 29, 55, 45, 23, 7, 39, 27, 45, 26, 23, 11, 3, 29, 16, 20, 7, 0, 0, 0, 0, 0, 14, 37, 37, 0, 0, 0, 0, 0, 0, 0, 18, 22, 16, 29, 52, 21, 34, 22, 28, 46, 47, 36, 18, 28, 43, 23, 12, 15, 25, 19, 4, 29, 23, 2, 0, 16, 2, 11, 18, 1, 16, 41, 34, 29, 38, 28, 30, 26, 50, 34, 38, 25, 45, 39, 37, 29, 12, 3, 20, 40, 23, 15, 28, 16, 21, 11, 11, 0, 11, 21, 14, 46, 18, 32, 16, 41, 28, 23, 20, 18, 19, 29, 14, 22, 22, 19, 14, 32, 16, 22, ..."

Model Inhabitants:
The interaction between individual inhabitants operating as part of a networked composite model requires them to develop a new understanding of their social space. They are no longer a person in a room separated from other inhabitants by walls doors and windows, they are participants in a larger space which requires a shared social responsibility. This is as much a psychological space as it is a physical or technological one. The interaction of individuals within such a system generates a 'social' space, which, according to Harré (1985), is the 'space' where understanding and knowledge are exchanged, and learning takes place. The core model occupies such a space, it exists as much in the minds of the inhabitants as it does in code or on screen. This spatial consciousness is enhanced by the buildings feedback on ecological and temporal activities. Arch-OS and the Core Model here become a conduit for complex human interaction at a level not normally experienced in the built environment.

The Arch-OS Vision Tool, developed by Dr Guido Bugmann for Arch-OS, provides dynamic data on crowd motion in public spaces. The information is acquired by four CCD cameras overlooking the space in Portland Square and is made available to any computer in the Arch-OS system. The composite video signals of each camera are pre-amplified, before being sent to the Vision Tool. The Vision Tool acquires live images with a frame grabber card and processes them using a dedicated motion detection and tracking software (10 x 10 matrix). Motion information is stored every 40 ms as a data matrix using a double buffer scheme. The Vision Tool's web server allows it to access the most up-to-date data in the form of a binary stream produced by a server-side CGI program.

Figure 4: Arch-OS Vision Tool, ceiling in Atria A Portland Square.

The perception of the self within the complexity of the Arch-OS Core Model is problematic. The body exists within a fractured space-time architecture: sitting in a room and viewing the larger space of the networked building as a real-time 3D model can be both disorientating and exhilarating. The viewer is both within the model and removed from it. When this model of interaction is layered across several networked buildings utilising Arch-OS, the problems created by asynchronous activity increase dramatically. Geographical distances dissolve into the Core Model and social interactions, conversations and gazes are extended over longer periods of time, or compressed into a fraction of their normal length. Arch-OS effectively shares rooms in the same way that files are shared over a network. Arch-OS can model and control the implosion of space and time, the shrinking of distances and the multiplicity of moments that occur within a building or geographically separate buildings.

Figure 5: The boot up sequence of the Portland Square Arch-OS, at the buildings opening ceremony performed by Lord Owen, July 15 2003

The View From Here...
The shrinking of space through this complex layering of technological spaces generates new social space. For instance, the flat 'screen-space' of a video conference presents rectangular 'portals' to the other participants, and a feedback 'portal' showing, in real-time, the place of origin. The 'portal' opening on the other screen shows similar views, but at the point of reception the delay and strobe indicates that a space between has been crossed. However, this space may not be geographical, it may be generated by technological inadequacies or the processor lag for Arch-OS. This 'space between' is a conceptual and temporal space. The Core Model fractures the single point of view offered by the computer or TV screen, already a greatly reduced Renaissance perspective. By providing a dynamic telematic data landscape it is possible to extend the Albertian window, offering a high tech Baroque vista.

"The eye itself has not, of course, remained in the monocular, fixed construction defined by Renaissance theories of perspective. The hegemonic eye has conquered new ground for visual perception and expression. The paintings of Bosch and Bruegel, for instance, already invite a participatory eye to travel across the scenes of multiple events. The seventeenth-century Dutch paintings of bourgeois life present casual scenes and objects of everyday use which expand beyond the boundaries of the Albertian window. Baroque paintings open up the viewer's vision with hazy edges, soft focus and multiple perspectives, presenting a distinct, tactile invitation, enticing the body to travel through the illusory space."
(Pallasmaa J, 1996)

People in Soft Buildings require a new nomenclature. They are no longer an 'audience', such a definition is too passive. They are not just inhabitants, a term that negates participation. Telematic activity, as Sermon (1997) says, "is nothing without the presence and interactions of the participants who create their own television programme by becoming the voyeurs of their own spectacle." It is at the crossroads of these interactions between the participants and the space of an Arch-OS enhanced building that the new space and place emerge. This place, like the inhabitants that construct it, needs a new nomenclature. They are both audience and performers, and the place they occupy has form, time and simultaneous location. It lacks volume, and is constructed in synchronous and asynchronous time by the interaction of its inhabitants.

Soft Buildings may not be as monolithic as the stone temples of the past, but they do exist at a more human-centric scale, both in terms of spatial and temporal experience. They are, after all, generated by the people that live and work in them. Arch-OS provides a new 'model' for architecture and a new 'model' for social participation: a model that is simultaneously virtual and real.

Notes on Arch-OS Development.

The Arch-OS project is managed by the Institute of Digital Art and Technology and produced in collaboration with the Architects and Engineers: Feilden Clegg Bradley Architects, Buro Happold, Nightingale Associates, Hoare Lea, DrMM (Derijke Marsh Morgan), Signwave/CASM.

Arch-OS: is a collective of individuals working from the School of Computing at the University of Plymouth. Mike Phillips (Director of i-DAT) represents the Arch-OS development team that consists of: Birgitte Aga (web mistress), P. Anders (cybrid architect), Martin Beck (Intelligent Systems/Genetic Data), G. Bugmann (Autonomous Robotics), George Grinsted (Sys Op), Eduardo Reck Miranda (Generative Audio), Adam Montandon (Data Architect), and Chris Speed (Tele-Social navigation/Spaceman). Previous collaborative projects include: 'Psalms' Autonomous Wheelchair for Donald Rodney, the STI Project (The Search for Terrestrial Intelligence), Arch-OS is managed by i-DAT [http://www.i-dat.org].

References
(1) Anders P. 1999, The Cybrid Condition; Implementing Hybrids of Electronic and physical Space. Reframing Consciousness. Intellect, pp237
Harré, R. et al. 1985. Motives and Mechanisms: an Introduction to the Psychology of Action. London. Methuen & Co Ltd. pp72
Pallasmaa J, 1996, The Eyes of the Skin, Polemics, Academy Group Ltd, pp23
Sermon P. 1997, From Telematic Man to Heaven 194.94.211.200, Conference Proceedings Consciousness Reframed 1997, CAiiA, University of Wales College, Newport