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Introduction

This volume is the proceedings of the i3 annual conference, held in Siena, Italy 20th - 22nd October 1999. i3 is a research and innovation community that seeks new ways to enhance communication and information exchange among people in their everyday lives. i3 stands for *Intelligent Information Interfaces*. Launched in 1997, i3 consisted initially of thirteen collaborative research projects, and a network of excellence (i3net). In 1998 a new cluster of projects to do with experimental school environments was established, bringing the size of the research programme to some seventy million euros ($60m) of funded research. The i3 programme includes 300 researchers and more than 100 organisations encompassing corporate and university research laboratories, end-user organisations, public institutions and real communities in fifteen European countries.

A vital part of i3's research activities is the dissemination and cross-fertilization of ideas. A 'members only' conference in Nyborg, Denmark in June 1998 was followed by a series of workshops, known as the Spring Days, in Sitges, Spain in March 1999. The co-ordinating group of the i3net felt that an effective way to build upon these events was to have an open conference to act both as a showcase for i3 products and ideas and as an effective way of building and enlarging the i3 community. 'Community of the Future' was chosen as the overarching theme for the conference with the focus on new visions of information technology products for everyday life.

Originally scheduled to take place in Edinburgh, Scotland, the conference was envisaged as a radical departure from the usual academic style. It was to be styled as a 'research theatre' populated by thematic presentations, live performances, a 'piazza experience' and an underground cafe. Live interpretations or performances involving researchers, users and designers would sit side by side with poetic, philosophical and creative interpretations. Models and working demonstrations of prototypes and commercial products would be in the piazza dealing with artefacts for use at home, artefacts in public spaces and a young at heart interactive play space. Controversial and provocative topics were to be debated in the underground cafe. Rising costs forced the organising committee to review the style and scale of the conference and move it to Siena, Italy.

This volume represents the published account of this conference. The conference attracted a wide range of philosophical, practical, technical and reflective presentations. 24 talks were given besides the invited speakers contributions. These ran alongside four workshops, six performances two panels and a large exhibition of work from the 26 i3 projects. The result is an eclectic collection of ideas, concepts, technical specifications of future products, novel design approaches and descriptions of the i3 projects.

Not surprisingly the contributions in this volume reflect the i3 themes associated with the ways that information technology is transforming everyday activities, whether in travel, education, entertainment, health care or social interaction. From play and learning in childhood, through new forms of work as adults, to self-help in old age, new forms of communication and community are emerging. i3 develops scenarios, pilots and products for these developments bringing together an understanding of people and communities, new forms of interaction and the deployment of novel technological solutions.

i3 projects are currently grouped in three clusters: Connected Community, Inhabited Information Spaces, Experimental School Environments:

Connected Community explores the situated use of information by communities of ordinary people, future services and technologies to enhance social interaction, devices to help children and adults stay in contact.

Inhabited Information Spaces projects examine new ways to embody information, and to support virtual communities, new ways of managing access to online resources, new forms of interactive television, new forms of community participation.

Experimental School Environments investigates learning environments of the future for four to eight-year-old children - and their teachers and parents -, visualisation of ecological processes, or sound and gesture interfaces.

i3 fosters continuous innovation among a critical mass of creative people and communities working together in novel ways. Inspired by a human-oriented vision of the potential of information technology, i3 involves researchers from many different backgrounds and perspectives in a unique partnership. They include interactive system and technology developers; interaction and product designers outlining new concepts; interactive media artists developing new media forms; human and social scientists achieving new insight into the relationship between users and technology.

One of the many changes that have come about as a result of the changes in information and communication technologies is that it is no longer very useful to think about a person interacting with a computer. Increasingly, designers have to consider how networks of information artefacts, people and artificial agents can engage in meaningful and effective activities. People undertake co-operative activities, situated within a socio-cultural environment mediated by information processing devices. Designers have to be aware of non-cognitive and non-engineering approaches to the development of human-computer systems and to see design itself as a human activity. Many contributions to this volume reflect this idea and seek to understand communities better through detailed socio-cultural analysis.

The development of personal and mobile computing systems and the use of systems for collaborative work again have a huge impact on what it means to interact. For example, novel interfaces are required to facilitate collaborative work amongst individuals who may be mobile or co-located. Requirements analysis and prototype evaluation is made more difficult as the ways in which the new technologies impact work and community are slowly understood. These concerns are also reflected as we move people, or representations of people, into the virtual worlds offered by virtual reality systems.

Systems that employ some form of intelligent interface technology (IIT) present their own design, social and ethical issues. On the one hand IIT can contribute to the usability of systems by adapting and tailoring information to meet the different needs of different users. On the other hand there is the need for IIT systems to explain and present their reasoning and to allow users to collaborate with, and assist the technology when the limits of its 'intelligence' is reached. Combining IIT with the increasing ubiquity of mobile computing and communication between people through computers leads to alternative perspectives on interaction; we can view the user inside an information space. This in turn leads us to consider the issue of how users can navigate their way through information spaces. A number of papers reflect the paradigm of social navigation of information space.

These proceedings capture the ideas of one community, i3, as the millennium comes to an end. Few real answers are provided in these contributions: instead different agendas are presented, questions are posed and important issues are raised. There is no doubt that there are genuine insights presented in these contributions. There is real innovation in the products and processes that are described. There is a real sense that by involving communities and individuals, and studying the impact of technologies on early learning, working lives and activities of the elderly, better products will result. The products described in this volume are there to support the diverse activities of people within their social contexts; the community of the future.

Acknowledgements

Many people have contributed to the 1999 i3 annual conference and the risk of acknowledging some is that others get overlooked. With apologies to those who fall into this category, it would be inappropriate not to mention the work and vision of Raghu Kolli and other members of the original conference organisers, particularly Alessandra Agostini. Manfred Tscheligi, Thomas Rist, Lars Heide, Marilyn Panayi, Richard Millwood, Alberto Bianchi contributed tirelessly to the organisation of the conference and along with Niels Ole Bernsen and Jakub Wejchert produced the final programme.

David Benyon
Duncan Smith

October 1999

Workshops

LocalNets

International Workshop on Community-based Interactive Systems

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The claim that communication technology can adversely affect interaction within a close community in favour of promoting interaction with a global web-based virtual community is a widely-supported opinion. In this context, a research strategy is currently being devoted to technology-based schemes, specifically designed to enhance social cohesion in local communities. A principal issue here is the nature of the interaction between a member of the community and some representation of that community's locus and history. It is the purpose of this international workshop to present current research on local communities, to assess the outcomes of such research and to identify issues for future investigation.

The focus of the workshop is Community-based Interactive Systems (CIS). Interactions in a CIS context are based on devices/appliances (whether portable, mobile, or fixed) with software capabilities that can support lay people in performing their social activities and potentially enhance community spirit. Such capabilities allow the device to act intelligently in support of one or more users, further facilitating the interoperability between devices through a network. In this context, the interoperability supported by a CIS is by default:

- ubiquitous - to allow people to interact in a location-independent manner with different devices and different contexts;
- intelligent - to mediate/personalise interactions with lay people seen either as individuals or groups;
- networked - to support the richness and complexity of social interactions.

The approach taken is that technology is not an end in itself, but instead is a way of serving, empowering, and assisting people in their role as members of a local neighbourhood. Technologies that motivate a CIS approach are multi-disciplinary in nature: some examples are human-computer interaction for lay users, information management using multi-agent systems, and network computing exemplified by developments in distributed systems. The focus of the CIS approach is primarily on the convergence of these different technologies, especially where a specific technology in isolation may ignore either the challenge of the interface intelligence, or the network elements of the users' experience.

Physicality and Tangibility in Interaction

Towards New Paradigms for Interaction Beyond the Desktop

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All forms of human expression involve physical action of the body. Although we can make sense of the virtual, we are grounded in the physical. We physically interact with other people, our pets, and objects in our environment. Physical interaction, the dance and rhythm of life, is central to our existence. The nature and quality of this dance affects our wellbeing and helps shape our understanding and concept of the world. It helps to define who we are and our relationship to the rest of the world.

Humans possess a wide range of natural abilities and skills from everyday life that are fundamentally motor-sensory in nature. Only a few of these skills and abilities have either been adequately modelled or harnessed in terms of human-computer interaction.

The nature of our environment heavily influences how we interact with it. A rich and stimulating physical environment affords rich stimulating interaction. As we move away from the desktop metaphor, the physical constraints that normally apply to interaction with computers are removed. This relates both to the embodiment of the technology and our physical actions. Putting computer technology "out there" beyond the desktop presents both new challenges and opportunities. There is a need to develop a vision and understanding that enable us to combine the real and the virtual into a coherent whole.

What are the best ways to make use of the real to support the virtual and visa-versa? Clearly, by building the virtual into the real, the real is enhanced, but conversely, by drawing upon the physical, there is the opportunity to make the virtual more tangible and intuitive, and lower the overall cognitive load associated with each task.

With the prospect of advanced technology embedded into everyday objects and the environment, new ways of thinking are needed which provide fresh perspectives on the very concept and nature of human-computer interaction. This workshop provides a focus for such discussion by providing a forum for researchers, practitioners, theorists, and other visionary thinkers to discuss the philosophical, scientific, technical, design and humanistic aspects of physicality and tangibility as they relate to interaction with computers of the present and the future.

Towards a New Generation of Interfaces

IWAI - International Workshop on Affect in Interactions

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Summary

Although emotions were for a long time considered undesirable for rational behaviour, there is now evidence from Neuroscience and Psychology that place emotions as an important factor in problem-solving capabilities and intelligence in general (Damasio, Descartes' Error, 1994). As a result, organisations now use emotional intelligence (Goleman, Emotional Intelligence, 1997) tests as an evaluation procedure, and a strong new field is emerging in computer science: Affective Computing, i.e. "computing that relates to, arises from or deliberately influences emotions" (Picard, Affective Computing, 1997). As Humans interact directly with computers, it is critical for this interaction to be empowered with affective components that enrich it and make it more adequate for each individual user, but also provide "machine intelligence" with otherwise impossible capabilities.

Based on these recent findings, this workshop will form a discussion forum for researchers and practitioners who are considering the affective dimension of human/computer interactions.

The workshop is particularly aimed at fostering interaction between multidisciplinary researchers, practitioners and industry within the affective computing and intelligent software agents communities. It will provide an opportunity for investigators to demonstrate new work; report on state-of-the-art accomplishments; discuss and debate new ideas; and/or new research results, which apply to these areas.

Workshop Theme

Based on recent scientific evidence of the importance of emotions in human intelligence, and on new applications of emotions in human-computer interactions, this workshop will delve into the impact of "affective computing" on the communities of the next decade.

Considering the human element as crucial in designing and implementing interactive intelligent information interfaces for everyday computer system activities, the workshop will be organised to evolve around three main themes:

- Affective computing, including affectiveware, affective models and the application of affective autonomous agents in different embodiments and environments for new generation interaction
- The role of personality in the interaction between humans and machines
- The examination of the practical and ethical issues of deploying affect in application interfaces

This workshop will form a discussion forum for multidisciplinary researchers, practitioners, and industry that are considering the affective dimension of human-computer interactions.

Topic Areas

The general topic areas of the workshop are: Affective Computing, Autonomous Agents, Human Computer Interaction, Intelligent Interfaces, Intelligent Virtual Environments, Interface Agents, Synthetic Emotions, Synthetic Personalities.

Invited Talks

In the workshop we will have four outstanding invited speakers presenting their views on topics such as personality based synthetic characters, emotion theories and emotion expression.

Barbara Hayes-Roth

Characters with Feelings

In most of our everyday lives, we interact with the world through a very special interface: other people. In their role as interface, people provide high functionality and ease of use. But more than that, people are affective creatures who care about and respond to our feelings and also manifest feelings of their own. These affective qualities of our human interactions bring colour and warmth to everyday life. By contrast, today's Web is a cold and mechanical world offering low functionality, difficulties in use, and no affective connection. I will talk about a new kind of interface for the Web: interactive characters. Like people, characters provide high functionality and ease of use. Also like people characters can be affective creatures who respond to our feelings and manifest their own.

Cristiano Castelfranchi

Affective Appraisal Vs Cognitive Evaluation in Social Emotions and Interactions

Something important is usually missed by current computational models and uses of emotions. On the one hand, human emotions are complex and rich mental states, not simple reactive mechanisms. I will propose some examples of such a necessary "cognitive anatomy" (in terms of beliefs and goals) of complex social emotions (for ex. shame) and of the "meaning" of its expression related to that mental state. On the other hand, emotions are felt; and we do not have a model about what it means to "feel" something, about the unavoidable role of a "body" in this, and the necessary function of the feeling component in the emotional process. In this structural and functional analysis of emotions I will also discuss the relationships between emotion and motivation, and between emotion and personality, that in my view are currently quite mixed up. In this perspective, it becomes especially important to make the distinction between a true "cognitive evaluation" and a merely intuitive and implicit affective appraisal. I will apply this distinction specifically to a theory of "trust". I will wonder about the importance of affective appraisal vs. explicit evaluations in Affective Computing and HC and computer-mediated interactions. Are these cognitive complex emotions (implying explicit evaluations), and are these felt and embodied emotions (implying intuitive appraisals) useful? and why?

Thomas Wehrle & Susanne Kaiser

Emotion and Facial Expression

Facial expression is usually synthesized or predicted on the basis of a given emotion. The prototypical expressions for basic emotions (happiness, sadness, surprise, disgust, anger, and fear) postulated by discrete emotion psychologists are rather consistently produced and interpreted among different cultures, and can be used as icons to represent emotions.

But these facial expressions are actually rarely observable in everyday affective episodes, because of the complexity and multi-functional nature of facial expression and high inter-individual variance. We would like to sketch the different functions of facial expression, and present an alternative way to predict, synthesize and understand facial behavior. We will present an experimental setting which allows us to collect behavioral data in human-computer interactions, and present some case studies as well as a computational model for facial expression on the basis of appraisal theory.

Sponsorship

This workshop is sponsored by the EC i3 network (www.i3net.org/) and the EC Agent Link network (www.AgentLink.org/).

Support may eventually be given to some members of the Agent Link to present at the workshop.

Towards Global Comunities

A vision from community networking

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Workshop Theme

"Towards Global Communities" is a workshop which aims to develop new visions of the Community or communities of the Future, combining the following approaches:

- The Community Networking international experience. This will be the main stream.
- The Internet2 international initiatives.
- The Community Knowledge Engineering and Management emerging area.

The underlying hypothesis is that a community of the future can be some complex combination of different aspects:

- a networked community.
- a global community.
- a knowledge community, and many other aspects that we haven't even yet dreamt of.

There is a good possibility for starting an international research project or a network of projects on this Community of the Future, or Global Communities, that could combine at least these three aspects as a kind of first global research project of the Digital Era. Other international projects like the Global Change or Human Genome paved the way years ago. The workshop will cover:

- Goals and outcomes.
- Thinking together about such an international research project on the Community of the Future (cf. Annex 3).
- Establishing the different theoretical and applied fields that such a common project could have.
- Developing some task force, after the end of the workshop, for working in such a project blueprint.
- Studying how this project could be presented to the different national or international agencies.

Presentations

- **Fiorella di Cindio**
  An overview of the international Community Networking experiences.(cf. Annex 1)
- **Claude Henry**
  European CN Case Studies (cf. Annex 2)
- **Artur Serra**
  The Internet 2 international Projects and their impact in communities.
- **Ramon Sanguesa.**
  Exploring Community Knowledge Engineering and Management.

Annexes

Annex 1: An overview of the international Community Networking experiences.

The community networking movement is a new social force in the global information society. The first freenets started in Cleveland, Ottawa, and other cities. They are now spreading through different countries and continents (the US, Canada, Australia, Europe, Japan, Latin America, Russia...) A first meeting with representatives from these countries took place in Barcelona in July 1998.

New national organizations like Telecommunities Canada, the American Association for Community Networking, and the European Association for Community Networking are organized expressions of this movement. Other community organizations like Internet community centres or the Community Technology Centres Network are part of the same movement.

Annex 2: European CNs cases studies

In Europe, the movement of community networking started its organization with two conferences, first in Milan (ECN'97) and then Barcelona in July '98 (ECN'98). Both were partially funded by an European research project under the TAP program in FP4, called EPITELIO. We will present two case studies:

- La Rete Civica di Milano (RCM).
- Ravalnet (Barcelona).

In cases we will see the use of computer networks by the citizens and how this process creates a new kind of social organization. In the first case, the RCM' s motto, "You are the network", (La Rete siete voi) stresses the leadership of the citizenship in ruling their own affairs in the information society. In the second case, Ravalnet, a group of young people in the most marginal district of Barcelona, uses the technology for fighting social exclusion and rebuilding social links.

Annex 3: A Global Communities Project: a convergent Information Society Technologies initiative.

Global Communities could be envisioned as a Next Generation of community networks project. This is a possible scenario for a "Community of the Future". This vision could be a long-term EU project inside the FP5-IST combining the strength of three potential promoters:

- The i3 Consortium (gathering the best of computer science research in Europe)
- The Internet 2 European projects and organizations (the advanced Internet and telecom. projects at the EU)
- The EACN consortium (the pioneer group of social researchers and practitioners, which has experimented in telematics applications for communities).

With the GC project, the EU could lead a global research initiative for a humane and inclusive Information Society.

Interactive Lectures and Performances

Social Navigation: a series of distractions

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Social navigation is in some ways a powerful concept precisely because it touches on the banal, everyday ways in which we utilise information from the environment and from others. We navigate in the real world by asking people directions, looking at where they go, following crowds. We navigate socially, judging from a room full of people what kind of social event this is, whether a party, funeral or lecture. We take cues from the different 'trails' left by people in different ways, following footprints in the snow, for example. If we are lost, the well-trodden path is the one which is followed. In terms of information similar 'navigation' takes place. We find out how to find and place knowledge from others, we talk over and assess the import of information in a social way, we judge a lot from the information's source. Social navigation is so banal we often don't notice it. It is perhaps only in its absence that we might realise its power.

At the conference a Venice-based theatre group will create a number of small situations and events, based on various aspects of social navigation. Hopefully they will be inspiring, challenging and (you never know) even enlightening. Let us just say that we will take our cues from Dada and Situationism (though one could say that Situationism's heart always belonged to Dada). The exact nature of the happenings will not be divulged at this moment — it would spoil the fun after all...

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CARESS

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Ever dreamed of playing on the stage? Are you a budding composer? CARESS will show you how to make your dreams reality as the team lead this interactive demonstration of Soundbeam and sensor technology. Using wearable and shareable interfaces to explore movement, gesture and sound, audience members are invited to contribute to the creation of a new composition in celebration of the i3 gathering in Siena.

Siena Improvisation by Critical

A Live Performance of Electroacoustic Music

Sten-Olof Hellström
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Critical is a two-person ensemble who perform electroacoustic and computer-generated music. Critical use novel interactive technology to improvise music and control complex sound synthesis live. Critical also perform with interactive video and virtual reality. Throughout their work, Critical are concerned with how results from human-computer interaction research (and related fields) can be deployed to support musicians cooperating in real-time performance. The members of Critical are associated with the eRENA (Electronic Arenas) i3 Inhabited Information Spaces project.

At Siena, Critical will demonstrate the use of interactive technology and concepts for the organisation of artistic performance with new technology that is being developed in the eRENA project as prototype tools for supporting on-line cultural events in the 'community of the future'. It is hoped that there will be an opportunity after performance for audience members to discuss the work in more depth, while also trying out the interactive technologies hands-on.

Sensor Technology

Critical will be exploring the use of sensor technology to realise a 20-minute improvisation. For example, one performer will be interacting with an 'extended Theremin', whereby two antennae responding to the movements of the performer's hands are used to control complex sound synthesis methods. The other performer will be using proximity sensors, amongst other devices, to interact with computer-based models of virtual physical instruments. In this way, the performers intend to explore the range of gestures appropriate to interaction with electronic sound.

Improvisation and Algorithmic Interaction

Although the members of Critical also work as composers, their performance work strongly emphasises improvisation. Improvisation sets rigorous challenges for interactive technology, software and hardware. As a duo, Critical 'expand' their sound through the extensive use of real-time algorithmic performance software. That is, in addition to directly manipulating synthesis systems, methods of delegating some aspects of the realisation or structuring of the music to computing technology are also explored.

Cooperative Technology

A performance by Critical involves a local network being established between the performers and the exchange of control data and sound. For example, one performer may manipulate the sounds produced by the other or transform data from their sensors. Critical explore ways of technically supporting the interplay between performers to realise a form of music in which technology has an active role as part of a cooperating ensemble.

Performance as Navigation of Virtual Soundscapes

Critical experiment with notions of music composition and performance inspired by research in Virtual Reality. The emphasis on spatial metaphors and the notion of navigation enable one to conceive of musical structures based less around traditional notions of narrative than in terms of trajectories through space where each locale has a characteristic sound and means of interaction with it.

Sonifying Collective Processes

As part of their work in the i3 eRENA project, the members of Critical have been experimenting with ways of rendering collectivities as sound. Imagine a crowd forming in a large scale virtual environment, perhaps attending an on-line cultural event or participating in some future entertainment. What sound would they make? How would their sound change with their activity, their identity, their mutual purpose? Critical's

performance will present some of their 'soundings' of crowds from the community of the future.

Interaction at the Edge of Complexity

Contemporary technology presents us with dilemmas, many concerned with the degree of personal and collective control we have over complex processes, of which we can't possibly 'directly manipulate' every detail. Do we forfeit control and trust others (including our software agents)? Or do we nostalgically prefer a simple life where we can keep 'hands on'? Critical experiment with the boundary between these two possibilities, that is, with the dilemma of control itself. Critical wilfully design interactive musical systems which can spiral out of control and head for chaotic noise. The performance challenge is to find the edge of complexity, where the music can be steered but will never lose its surprise.

Nomad Technology

The Siena Improvisation will be realised with modest hardware: two laptop computers, two synthesisers, some sensor-embedded devices, and not much else. We wish to demonstrate the richness and complexity that is possible with modest means as a contrast to the extremes that many contemporary music and cultural spectacles seem to require.

Critical is Sten-Olof Hellström and John Bowers, both of the Centre for User-Oriented IT-Design (CID), Royal Institute of Technology (KTH), Stockholm, Sweden. The support of Clavia Digital Musical Instruments, Stockholm, Sweden is gratefully acknowledged. Sten-Olof Hellström is also affiliated to the Department of Music, City University, London, UK. John Bowers is also affiliated to the School of Music, University of East Anglia, Norwich, UK.

The Box of Stories

Today's Stories

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The Concept

The spider went to the god of the Horizon and begged for the BOX OF STORIES. After all, the box of stories is filled with all of the stories of all of nature's creatures: own it and you rule the world.

It cost the spider everything – including his own mother and his own son! But then he had to be given that box. The spider got everyone's stories, even yours and mine.

Then the whole planet screeched, and stopped. And all of the beings of the sea and the land and the air screamed with such force that the box burst open. And all of the stories of the world were sent into the sky and blown to every corner of the Earth.

It cost the spider everything – including his own mother and his own son! But then he had to be given that box. The spider got everyone's stories, even yours and mine.

Then the whole planet screeched, and stopped. And all of the beings of the sea and the land and the air screamed with such force that the box burst open. And all of the stories of the world were sent into the sky and blown to every corner of the Earth.

So that no one creature could ever own them.

Ownership of stories - of one's own story - lies at the heart of this project. THE BOX OF STORIES will also provide opportunities for important and profound lessons. Pandora's box sent sorrows out into the world. Stories send happy endings, too and Truths.

Installation Description

The BOX OF STORIES will be a playground installation available for families throughout breaks at the Conference. The BOX OF STORIES site will consist of an intriguing box four cubic meters in dimension. This box-shaped structure will bolster a central notion of the project – that of containment. Within this larger box, at the entrance to the installation, there will be a box 1.5 cubic meters in size, filled with scraps of paper on which short sentences will be written or images drawn. Visitors to the box will use these as messages: triggering them subjectively, they will begin to create a scenario in concert with other participants who will also have drawn a story hint from the box.

Along one wall of the installation itself there will be a bank of TV monitors. Television is, of course, the quintessential modern Box of Stories. Within the box, and among the boxes, people – especially children - will make tele-visual tales that they - rather than any media 'spider' - will own.

Each storyteller will be issued with wearable video-camera equipment – the KidsCam. Three budding filmmakers at a time will develop the collaborative stories created within the box.

Starlab personnel will make sure that the region is safe, organized and attractive, but they will be discreet, so that the storytelling process itself will be unsupervised.

At a given signal from a member of the Starlab team all three cameras will begin running simultaneously. The participants will encounter each other, and improvise with each other, while at the same time recording the exchange.

Then the footage will be viewed. Generally speaking, structured material, and self-conscious playacting will not actually be as interesting – even to the participants - as the spontaneous and real-life incidents: overcoming shyness, getting to know each other, dropping concentration – in short: moments that are true and human.

The viewing process will be greatly enlivened by 'fast-forwarding' through the more predictable sequences and, of course, using slow motion for the 'charged' moments, highlighting them and stretching them for amusement and also, tangentially, for instruction.

Rationale and Reflection

While nothing will interfere with the atmosphere of play, and while the KidsCams with their magical videos are above all toys, THE BOX OF STORIES will be a place of learning as well as a place of wonder. Most childhood activities involve the simultaneous pursuit of pleasure and research. During the viewing process participants will examine a number of aspects and issues that have been raised during the first phases of the Today's Stories project, including aspects of learning and privacy.

Who are tomorrow's citizens of the world?

They may or may not be budding film-makers or TV directors, paparazzi, market research experts or private detectives. A linear narrative will be compiled from all the recorded material. The Box of stories will be a step towards the development of communities of the Deep Future, and the building up of rich sediments of experiments in living. It will also provide excitement, delight and simple, glorious fun.

The final step in the sharing of this box of stories will be the broadcasting of these video tales via the Internet and onto those other story-boxes, computers around the globe.

Acknowledgements

We'd like to acknowledge the children, staff and parents of Nr. Broby Skole, Nr. Borby, Denmark, the KidSearchers' and their parents at the Natural Interactive System Laboratory, Denmark, and children, staff and parents at participating schools in Israel.

Building Blocks for Constructing Social Narratives

A framework for augmenting physical space with distributed intelligence

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As technology disappears into the very fabrics of our lives it will play a significant role in our changing perception of what constitutes reality. It is prophesized that we will be able to send email from our toasters and automatically order milk from our self-monitoring refrigerators. However, as the phenomenon of information technology matures, will uses of technologies that challenge conventional boundaries, encourage dynamic learning, and leave everlasting imprints of lessons learned emerge?

Concept

How often have you been in a public space and yet felt hauntingly alone? Have you wondered who those people are standing near you, why they stare or ignore, if they have any similarities to you, are they thinking the exact same questions?

I am particularly interested in harvesting the unspoken narratives, poems, and possibilities that exist as strangers occupy a common physical space. This will be done by integrating individual human islands of closed narrative systems into a transformative spatial structure, thus, creating a responsive, continuous and wholly innovative approach to the concept of immersive interactive environments. The primary activity of this research and creative development involves learning through knowledge navigation that exploits the social context of a physical environment. The knowledge gained by participants and the space itself is cycled back into the fabric of the physical environment for subsequent participants to continue building. This creates a persistent memory incased in the physical structure and a collective discovery for participants.

The framework for augmenting physical space with distributed intelligence encourages fluidity among its components creating a cyclic environment that adapts to its users inquiry and methods of learning. This concept is based on constructivist views of the nature of learning and knowledge. The constructivist philosophy states that attaining knowledge is a recursive process of constant reorganization and building of facts and ideas. It is the combination of an individual's knowledge base and a social process situated by the learner's experiential wealth and interaction with the world.

Knowledge navigation proposes to establish a framework for inclusive immersion mediated through a minimum of evasive technology. This places both the observer and the observed in a seamless environment that continuously regenerates its knowledge base to its visitors and physical structure.

There are two main areas of research and creative project(s) development for this body of work. The first is the development of minimal evasive technology carried on the body that serves as a node identifier to map the individual participant into a system wide graph of the physical space. The system will use various techniques of artificial intelligence and advanced search capabilities to link the participants to each other and other installation devices in the shared space.

The second area of development involves the creative engineering of ART-I-TRONICS TM, the union of art, artifact and mechatronics. ART-I-TRONICS TM seeks to unite electronic art with smart product design by developing theories and practices that foster the transcendence of vertically-bound market driven vision of smart appliances and screen-centric experiments in hyperArt. "the book of ruins and desire," an ART-I-TRONIC TM sculpture I created in 1996 is an example of this type of work.

(www2.sva.edu/~pamelaj/html/artitronics.html)

Interactive Lecture

Connect the Dots: a human constructed non-monotonic graph, a low-tech experiment for a high tech idea

Participants:
Nodes: Audience
Arcs: moderator(s)
(one English speaking, one Italian speaking)
Heuristics: ("x,y,z) {P(x) Ÿ P(y) Ÿ P(z) … (($v) P(x,y,z))}
{x/ individual}
{y/ chance encounters}
{z/ public space}
{v/ narratives}

What am I to it?
What am I to you?
What am I to them?
What am I to I?

thoughts as I watched an ant crawl up my pant leg one sunny afternoon in California while a perky suburban family of four invaded my "private" space to take snapshots

(please note… I would be really surprised if the above predicate calculus is sound, complete, and resolvable, but I love the symbolic representation)

The intention of this interactive lecture is to provide a fun social learning environment that tests the hypothesis that an augmented environment can be designed that challenges self-developed individual conceptual frameworks by creating cognitive dissonance between a visitor's internalized theory and external surroundings. The lecture will serve as an introduction to the project and an opportunity to collect conceptual data to be used for the development of the interactive system. The interactive lecture will serve as a platform for investigating the construction of social narratives without the aid of computer technology.
There are three basic requirements for a constructing social narratives: 1. many people milling about in a common space for a common purpose, 2. people who are for the most part strangers to each other, 3. environments where distributed intelligence from individuals can enhance the experiential quality of the environment and its occupants.

Lecture Scenario

* Individual audience members will be human nodes in a controlled real-time graph of narratives created from chance encounters.

* Audience members will be given a "focus" device, something cheap and disposable that will enable them to indicate their node position in the audience knowledge/narrative tree. The branching structure of the narrative/knowledge tree will be determined by the audience members' random seating arrangements.

* The moderator(s) will ask questions which prompt audience members to indicate their positions in the space as it relates to the questions. For example, if the moderator would ask "who has red hair?" those audience members with the focus device and red hair will project the focus device onto the ceiling.

* Based upon these ceiling constellations, the moderator(s) and audience members will vocally construct a guided narrative among the paths between the nodes.

From user participation to user seduction in the design of innovative user-centered systems

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Many approaches have been proposed and used to design computer-based systems. Nevertheless, generally the outcomes are not satisfactory from various perspectives (e.g. user satisfaction, technology innovation, etc.). After analyzing the strengths and weaknesses of some of these approaches we propose in our presentation a new 'seductive' way designing innovative user-centered systems based on the integration of the CSCW and industrial design cultures.

Seductive design is the integration of two well-known design approaches (rooted respectively in industrial design and in CSCW competencies) and their evolution. It originated as the merging of the two approaches we described, but their interaction transformed them, drawing new values out of their integration.

For us, integrating the two approaches means letting users and their ethnographers, technologists and designers communicate with each other. It does not mean canceling their differences. The user understanding process, the technology innovation process and the scenario creation process remain. Therefore, in seductive design, three distinct autonomous processes develop their cycles in parallel, intertwining and intersecting frequently to compare results and fine-tune the process. In this way each of the three cycles is constantly enriched by the other during joint design sessions. The frequency and quantity of these joint design sessions are generally high in order to avoid, on the one hand, misunderstandings and/or conflicts or, on the other, a situation where one cycle takes a lead in the whole process, reducing the other to silence.

The process characterizing seductive design may, therefore, be graphically represented as a three-dimensional spiral converging towards a common point where the distances among the three lines disappear.

The invention of a new approach to the design of human-centered systems can have two different objectives. It can overcome (some of) the limits which existing approaches exhibit with respect to user orientation and/or technological innovation; or it can be conceived to design new types of systems that are innovative not only from the technological point of view but also, and mainly, from the point of view of the services they deliver to their users, and of the place they occupy in the user work-space. Seductive design belongs to the second category. It inherits from CSCW an orientation to the design and development of user-centered systems supporting the (collaborative) practice of their users and not their tasks. By adhering to the industrial design lesson, it proposes to develop the system from the new interaction patterns it offers to its users and not to give user-friendly interfaces to the new functionalities of the system.

Therefore, developing seductive design is, necessarily, work in progress: only applying it in the design of new user-centered systems can both the features characterizing the latter, and the ways in which its two main cycles intertwine and both of them are permeated by an innovative image of the technology, be evaluated and tuned.

Dilemmas encountered in consumer research into communication needs

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KPN Research supports the development and introduction of new products and services by KPN Telecom, market leader in telecommunications in the Netherlands. Our project called fusi@home (fusion of products and services in a domestic context) was set up to develop new products and services for households with double incomes and children. We investigated the way in which family members communicate with one another in daily life, and then we developed concepts for new services and products and proposed them to consumers.

In this 'interactive lecture' we shall examine a number of dilemmas we encountered in researching the 'real needs' of consumers and developing concepts for 'real solutions'. The dilemmas will be illustrated by role-playing sessions during which we shall put questions to the audience. Time will also be reserved for discussion.

1. Needs research interviews

During the initial round of consumer research, six households were interviewed so we could form a picture of their communication behaviour in everyday life. The interviews were conducted with both partners together so that they could supplement and correct each other's remarks.

Role-playing

- Researcher: Can you describe a typical day for your family? How do you arrange your work, look after your partner, children and household, and spend your free time?
- Respondent: I work four days a week. My wife and I have divided the household tasks. In the evening and on weekends we do things together as a family, etc.
- (more text during the interactive lecture) …

During the interview there is more detailed questioning on some subjects. Some statements are not clear, so the researcher has to listen very carefully.

- Researcher: Do you have any contact with your children during the day?
- Respondent A: I occasionally phone them when they come home from school.
- Respondent B: But sometimes you are so busy at work that you don't get round to phoning. And anyway, they also ring you.
- …(more text during the interactive lecture)

Dilemma: The interviews deal with existing behaviour, and the researcher must deduce latent needs based on this behaviour. Sometimes the description of behaviour is inaccurate or the described behaviour is not really relevant.

Questions to the audience: How can you deduce needs from behaviour? How can one identify real needs? What are the pros and cons of interviewing more than one person at a time?

How we dealt with the dilemma…

Role-playing

- Researcher: Do you have any contact with your children during the day?
- Respondent: I occasionally phone them when they come home from school.
- Researcher: Do you have any other contact with them?

- Respondent: No...
- Researcher: A different sort of contact perhaps?
- Respondent: No, well actually yes I do. I leave notes for them every morning. But that's not the kind of contact you lot from KPN are interested in.
- Researcher: Yes, we're interested in that sort of contact as well.
- Respondent: We write a lot of these notes, twice a day in fact. And my son often leaves a note when he goes out.
- … (more text during the interactive lecture) …

Dilemma: Respondents associate communication with using a telephone ("You are researchers from KPN"). But the researchers are interested in communication and information through all sorts of media. Respondents also have a tendency to think 'modern' and positive.

Questions to the audience: Do you tell respondents from which company you come? Or do you 'disguise' the company?

How we dealt with the dilemma…

2. Teamwork in the design process

We formulated the conclusions from the needs research interviews as opportunities, and chose one opportunity as a basis for concept development. This opportunity was formulated as a problem in everyday life, as a business opportunity for KPN and as a stimulating HCY ("How Can You…") for researchers/developers: "How can parents and children have contact during the day?"

Role-playing

- Researcher A: I have an idea, a device a child could use to send a drawing to his parents, who would be able to look at it while still at work.
- Researcher B: Yes, a nice idea, and the child could also take a photo and send it the same way.
- Researcher A: But how would that fit into their everyday life?
- Researcher B: Wait a minute, what did the respondent say; oh yes: "But sometimes you are so busy at work that you don't get round to phoning. And anyway, they also ring you."
- Researcher A: Children should be able to operate the device, so it would have to be easy to use. And parents should be able to view the picture when it suits them to prevent too much work disruption.
- Researcher B: But that could lead to a situation where the parent does not come home on time, and looks at the drawing at work instead. Hardly an ideal solution for parents and children who want to have contact during the day…
- … (more text during the interactive lecture) …

Dilemma: When a researcher takes decisions and creates solutions without consulting consumers, there is a risk they will not meet consumers' needs.

Questions to the audience: When must a researcher discuss decisions and solutions with consumers and ask their 'approval'? What are the pros and cons of getting back to the consumer again and again?

How we dealt with the dilemma…

Dilemma: When a new communication product or service is introduced, it will promote either normal (real

life) communication or virtual communication, which seems less desirable.

Questions to the audience: In the family context, should we try to promote real life or virtual life? Do new communication products and services influence people's lives?

How we dealt with the dilemma…

3. Concept-testing interview

During the second round of consumer research, eight households were interviewed. We chose to interview new respondents and not go back to the previously interviewed households. The interviews consisted of two parts:

1 discussion of the respondent's behaviour with regard to 'contact between parents and children during the day';

2 discussion of solutions (concepts) that the researchers have developed and that correspond to the behaviour described by the respondent.

Role-playing

- Researcher: Do you have any contact with your children during the day?
- Respondent: No, I work in a shop the whole day, so I can't phone whenever I want.
- Researcher: But do you ever contact them during the day?
- Respondent: Yes, occasionally we phone during our break. It's not really a problem.
- … (more text during the interactive lecture) …

Role-playing

- Researcher: Just now, we were talking about contact with your children during the day. Look, this is what the people from KPN have thought up. It allows your child to tell you that he or she will be coming home from school a bit earlier than normal. You can read the message without your work being interrupted.
- Respondent: Oh yes, that would be really handy.
- … (more text during the interactive lecture) …

Dilemma: Sometimes what a respondent says about a solution ("really handy") conflicts with the needs that the researcher deduces from the respondent's behaviour.

Questions to the audience: Does anyone recognise this conflict? And how did you solve it?

How we dealt with the dilemma…

Dilemma: The example situation in which the researcher offered a solution (concept) had a marked effect on the respondent's perception, reaction and appreciation.

Questions to the audience: Should you present a solution in isolation, or should you place it in an example situation? And if so, how would you do that?

How we dealt with the dilemma…

"Tracing Father"

A futuristic detective story about accessing private location-based annotations

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What might a full-blown location-aware infrastructure that has been annotated by people for years be used for? This scenario in the form of a mini-novel was written to fill the need in the i3 ESPRIT project HIPS for a scenario emphasising the community communication aspect. In the story, the personal trace of a man long dead is unravelled by his son with a somewhat surprising result.

"On my 40th birthday, I received an auto-generated email from the Public Trace Archive informing me that my father's traces had been released to me according to his last will. He would have been 70 years of age had he lived now, and I was frequently missing him. It is strange how memories of the past seem to grow in significance as one gets older, and I have often wanted to ask him the reasons for doing as he had done.

I was standing in the living room as I switched on my tracer. And sure enough: There in my personal address list his name was now present, and I selected it as a hotspot filter, thereby reducing the number of visible hotspots in my surroundings dramatically. On my location-map with my self-spot nicely put in the centre, I now could see some new hotspots, especially if I zoomed out to see the map with the house and the surrounding estate in bird's perspective.

At the entrance a new hotspot was marked with a "1", indicating that this was the starting-point of a suggested tour. I walked over to it and dragged my self-spot over it in order to tell the system my change of location, as the house had not yet been fully connected with indoor location-sensors.

Immediately, I was very moved by hearing my father's long-lost voice speaking out:

> *"So, dear son, you are finally here, and well, I hope! At this moment I must surely have been dead for a long time, which sounds rather odd as I can assure you I am as alive as ever from my point on the time-line. But through this nice tracer invention I am able to talk privately to you, bridging the mortal gap somehow, so please take a little walk with me? I have something to show you. Let's first stroll down to the pond!"*

I noticed that the timestamp was five months before he died – he must have had his premonitions, I guess. The tracer now indicated the path I could use to get to the pond, but since it made a detour avoiding a hedge that had long been gone, and as I knew the place well, I walked straight to the bench - his favourite one under the large oak. That hotspot was number two. Arriving, I sat down, as he himself had so often done according to the gardener, and the tracer having located me let me hear my father whisper in my ear:

> *"Yes, this is indeed a lovely place. I hope you will keep it like it is to me, just be careful not digging too deep into the ground over here, or the pond will dry out leaving you with nothing much to look at. I nearly did that myself some twenty years ago..."*

I heard him scribbling something on the screen, and looked at the tracer but was too late. I replayed the message and saw his familiar curly handwriting circling an area to my far left where I had planned to build a garage – I would have to reconsider that one now. It was like being accompanied by a dear ghost, and I decided that I would share these hotspots with my own daughter, so I granted her access to them too.

> *"I remember you as a good little boy, and I hope that you have grown up to be as good a man too, hopefully better than me. You'll be 40 when this information is handed to you, provided the system does not screw up or somebody doesn't delete the dang thing by accident - and provided you live that long - oh dear! Anyhow: I have chosen to tell you this, as you are now as old as I was on the day of my terrible discovery. Now join me to the wablinth!"* , *he said, as he obviously rose from the bench breathing heavily.*

The what?! I had to use the next-spot button to find out that his last word must have been "labyrinth" cause that's where it was: In the big labyrinth in the old garden, and in one of the smaller dead-ends, too. What on earth did he go there for? It actually took me quite a while to find my way, since I hadn't been there much since I was a child, when I have faint memories of running and screaming with my father at my heels trying to scare me like some friendly troll coming round the corners. As I entered the old hotspot, he told me:

> *"You see, I came here frequently – mostly to relax in turbulent times, but also to – I don't know exactly how to put this…You see, I always enjoyed watching your mother in the kitchen through this hole in the hedge. She was so beautiful when in her own thoughts and doings. But the day this young man suddenly showed up all this changed. The sadness I felt when they embraced each other and her stolen looks out the window. They obviously knew each other well, and my heart froze. When I returned hours later she did not mention anything. Nothing! And she pretended not to understand a bit, as I grew more and more cold to her in the following days."*

The next spot was just outside the front gate:

> *"Finally, the day he arrived with his car full of suitcases and parked right here in order to take you both away on my 40th birthday, it was just too much. I saw him sneaking up to the house from my hiding point, but I refused to watch you all leave, so I just decided to leave instead. I slipped out the back and that was my life, son. Cowardly, you might say. You won't find any hotspots telling you about my roamings around the country – suffice to say that my life was poor and miserable until I by accident found out that she had died and that I had inherited a greater sum of money and the house. Nobody knew of your whereabouts. I guess you are abroad somewhere and might return some day as well. The thought of you hearing this comforts me somehow. You see, I made the big mistake of letting my own pride block my love for both of you. Sorry, son, I hope you'll forgive me some day. Now I just wish you the best!"*

Here the recording abruptly stopped while a torrent of thoughts ripped through me: Oh, you silly old man! So that's why you left without a trace for all those years! But it still didn't make sense: I know that mother never left the place! After having played the traces again and again, I tried to use the tracer to get some more information. My father's spots revealed little of value, but searching the area of the house for hotspots from my father's 40th birthday, I found one that was entered by a Japanese tourist and shared to be public. It contained an audio link in Japanese and a photo of Mr Chang and his family lined up at the gate smiling impeccably in these strange but beautiful surroundings. In the background I could clearly see a white Austin. I immediately recognised it by its registration plate as being the one of my elder half-brother who surprisingly revealed himself to me three years ago in Australia, as mother never dared to mention her unknown extramarital first-born son to anyone…"

Paper Presentations

KidStory

Evaluating Children's Collaborative Story Creation

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Introduction

One of the main aims of the KidStory project is to develop technologies that support children's collaborative story creation. During the first year of the project researchers have spent over 50 sessions working with over 100 children in real school settings in the UK and Sweden. The work in schools supported a number of evaluation goals; primarily – usability of technology and the impact of the technology on children's collaborative behaviour and creative story telling.

This paper focuses on children's collaborative behaviour and the next section provides a brief overview of research in the area of collaboration and computers. Schools activities will then be discussed, followed by preliminary first year results. Finally we will discuss the implications of our findings and give some ideas for evaluation in the second and third years of the project.

Collaboration and Computers

For a situation to count as "collaborative learning" two components are necessary. Firstly, children must share a common goal or task focus; and secondly, they must be actively engaged in solving the problem, constructing some shared understanding or artefact. Reviews of both psychological and educational investigations of peer collaboration have repeatedly demonstrated that working in pairs and small groups can have beneficial effects on learning and development, particularly in early years and primary education (Wood & O'Malley, 1996; Rogoff, 1990; Topping, 1992)

It has been suggested that learning environments supported by technology offer an opportunity for optimal collaboration (Barfurth, 1995). This is because there can be a shared goal where working with others will genuinely lead to an improved solution. However, for the situation to offer optimal opportunities for collaboration the design of the computer system, computer software, tasks and the groups of children must be taken into account. There have been limited investigations into how the modification of some of the standard input features of a computer may effect collaboration. Light, Foot and Colbourn (1987) modified the input of a standard computer so that two pupils had to enter information at the same time to succeed. A kind of dual key control was used. It was found that this enforcement of collaboration improved individual cognitive development. Crook states:

" Research of this kind – relating structural features of computer tasks to the social organisations they support – is all too scarce"(p. 125, Crook, 1994).

The settings within which computer supported collaborative learning takes place may also greatly influence what is learnt. Many studies have related the size and composition of groups of children with the behaviours experienced or learning gains made. O'Malley, (1992) provides a review of these factors with respect to computer-supported collaborative learning (CSCL). However, few researchers have looked at peer collaboration and creativity where goals are less clearly defined and measures are more difficult to derive (Morgan, 1998).

Activities in Schools

In the first year of the KidStory project researchers spent a considerable amount of time in schools in order to familiarise the children with the technologies (described below) and allow them to become confident and competent users. KidStory is currently developing two technologies: KidPad and Klump. KidPad is a 2D zooming drawing tool. The Klump is a 3D clay-like spherical undulating object. Both technologies enable children to co-operatively create stories. Researchers were able to observe and evaluate the children's use of technologies and worked with them as design partners to feedback design ideas for technical development. The school activities included working in pairs, small groups (4-6) and large class size groups

(25-30) to create a story using project technology.

In the first year the evaluation was of an exploratory nature, and informal observation notes and video recordings were taken of a large number of children using the technologies. Contextual inquiry charts were created which consisted of one researcher observation of quotes and another researcher observation of actions linked by timings. Measures of skills that have been correlated with ability to collaborate, such as communication and planning, have also been taken. A three year project gives us the opportunity for a longitudinal study of these factors.

Results

This section will focus on a small sample of the results from the first year of the project. Two examples of informal observation of collaboration are shown in tables 1 and 2. In this case the children's goal was to create a shared narrative using KidStory technologies.

The passage below came from two 7-year-olds (D and E) from Stockholm, who were collaboratively creating a story on KidPad. In the collaborative creation of stories the children must build up a common understanding of the shared narrative (Crook, 1994). This passage demonstrates the incorporation of the idea that the characters are monsters. D's contribution to the story (that they are monsters) is at first ignored. D persists with this idea until it is accepted by E who announces "It's going to be a monster."

Quotes	**Activities**
D: You can draw yourself and then I draw myself. Not too big! Further down. Who is that?	D: gives the mouse to the other child
E: I don't know. with eye	E: chooses a red crayon, draws a face
D: The man can be here.	and mouth, draws a body
E: A monster am I, aren't I?	
D: I'm going to be…	D: takes the mouse
E: Yes there. The camera, we'll see.	E: points at the screen at the symbol save
D: I'm very big. Look at the shoe! E: Chewing monster!	D: draws a giant with the blue crayon
D: It's going to be a monster.	They talk about giants and monsters
E: What hands!	

Table 1: Creation of a shared narrative

The passage in table 2 gives an example of a less collaborative session at the computer. This is from another set of 7-year-olds (Al and Ab) from Stockholm using KidPad. Unlike the example above there are no examples of an idea from one child being accepted by another child. Although Ab controls the mouse for most of the session, he is not willing to share his ideas with Al. Al seems frustrated that he does not have control of the mouse. His ideas are being ignored and Ab will not explain what he is drawing – there is no shared understanding of the narrative. When Al takes over the drawing he deletes the entire screen: "I erased the whole thing, it's better that way." Ab grabs the mouse back and continues to draw. One indication of collaborative behaviour is the statement from Al who states: "It's your story too, so think." He shows awareness of a shared goal and an attempt to get Ab to help them work towards it.

Time	Quotes	Activities	Researcher commenents
10.09	Al: What are you drawing, Ab?	Ab: tries the tools, wants the blue crayon	
	Al: Shall I help you draw the man?	AL: gives advice	
	Ab: Now I'm getting the red!		
	Al: Ab, what are you doing? Ab: I want to have the blue!	AL: laughs, gives advice, is critical	
		Ab: draws a blue man, looks away	
	Al: Abdi, bring that here!	Al: is hanging on his arms, points	
	Al: Go here! Al: Click on the yellow! [Al giggles.] Ab: What are you laughing at!? How stupid you are! Al: Get with the hand! Al: But draw, Ab! Ab: I'm drawing poop! He, he. Al: Do what you want, I don't care! Al: What's that – tall – leg? Al: C'mon, stop it, that's no fun! Ab: I'm going to draw… Ab: Wait, I'm doing it wrong! Al: What are you going to do now? Erase that blob! Ab, shape up! Erase that big one! Al: May I help you now? Al: Oh, there, there! Al: Abdi, what are you doing? [Researcher explains that they have to switch.]	Ab: erases, tries to erase only some details	By constantly giving Ab orders and questioning what he is doing Al tries to get involved in what drawing on the screen. He wants to help to create a shared narrative.
	Al: I erased the whole thing, it's better that way.	Al: takes the mouse, erases the lot	As he has not been involved in the previous drawing and has no understanding of it he gets rid of it.
10.12	Al: Ab, I want to use any pen I like! Al: Ab…! Al: Oh, that's a better man!	Ab: takes the mouse again, draws with blue crayon, erases	
		Al: takes the mouse Ab: takes the mouse from Al Al: leans back, looks at the others	
		Ab: draws with the blue	

Time	Quotes	Activities	Researcher comments
	Al: Do this! Ab: No…	Al: shows Ab, is bored Ab: draws, erases	
10.13	Al: But draw all the way down! [Points.]	Al: hits his head, is leaning over the table	
	Ab: A man! I can't draw that well on the computer.	Ab: expresses difficulties, draws very concentrated	
	Al: I hope you can draw better on paper! Al: Eyes, nose and a mouth and ears! Triangular ears? Well, what's that?	Al: critical of Ab's drawing	
10.14		Al: takes the mouse	
	Al: Ab, do you know what you're doing? Al: You removed that star! Al: Again, again! Ab: Where are you? Ab: I want to erase.	Ab: takes it back, erases, picks up the magic wand, sounds a bit worried	
	Al: No, that doesn't work, we haven't made a single story…!	Al: is upset over the little time there is left for him	
	Al: Abdi, can I do it? [Researcher forces Ab to give the mouse to Al.]	Ab: doesn't want to leave mouse leave the mouse	
10.16	Al: It's your story too, so think!	Al: draws a face	Al tries to get Ab to collaborate – he is aware of the common goal – to create a story together
	Ab: Are you going to draw a red eye? Al: Cut it out, Ab! Al: Yes, but I can't draw that way, the way that I like.	Ab: pushes Al	
	Al: Here… Almost like yours! [He's drawn a man with hair that looks like Ab's.] Ab: No way!	Al: draws a man	
		Ab: stamps his feet, talks to the adults	Ab frustrated as he does not have control – does not want to be any
involved more.			
		Al: keeps on drawing Ab: does something else Al: keeps on drawing	

Table 2: Two children work on KidPad with the instruction to create a story together

It can be seen from the example in table 2 that there is dominance of control of the mouse and difficulty creating a shared reality. This may be due to a number of factors and there is a body of literature linking collaboration with issues such as gender and ability.

To gain an overall idea of the scale of problems children experienced when sharing an input device to use the KidStory technologies, a frequency of codes has been collated (see table 3).

Frequencies from observation notes	YEAR 1
Struggling for Control of the Input Device	98
Sharing Control of Input the Device	26

Table 3: Summary of input device control reflected in Contextual Inquiry charts, Year 1

It can be seen that in a large number of instances children experienced problems when sharing one input device, in this case a mouse.

Although these frequencies give us an indication of the scale of the problem, we cannot rely on them for context. We can see who controls the mouse, but who contributes the ideas is perhaps more crucial in the creation of a shared narrative. Cole (1995) looked at mouse control and active and passive contribution towards shared tasks. She found that the child in control of the mouse was not necessarily the dominant partner in terms of idea contribution. However, children's creative input may be limited by the use of a single input device. For instance, in Sweden it was observed that during group story telling sessions the child with the mouse could not keep up with the ideas generated by the rest of the group. The rest of the group therefore lost momentum and concentration with the story creation. This may indicate a need for new forms of input device.

Planned Further Investigation

In order to enable shoulder-to-shoulder collaboration the KidStory team have developed a platform for multiple input devices, allowing two or more children to interact with the computer at the same time. Over the next phase of the project we will evaluate the impact of this new form of sharing. We will be carrying out more detailed investigation comparing the use of one, two and four mice on children's collaborative story creation.

A detailed coding system is under development which will capture verbal and non-verbal behaviour from video recordings. In parallel, the children's actions on the computer will be tracked and the two may be combined to produce a richer picture of the collaborative behaviour.

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POGO

Pedagogical issues in designing narrative technology

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1. What is POGO?

Children talk and tell stories to communicate, express themselves and construct models of the world they live in. This is a pervasive attitude which they express in many different ways: through drawing, gestures, use of the voice, rhymes, creation of artefacts and games. Stories are a means to explore, experience and represent the external world, and the more the stories emotionally engage children, the more they stimulate learning and child development.

POGO is an EU i3 Experimental School Environment project which addresses story-building as a key concept to drive technology development, through the construction of a real and virtual environment where children create, explore and develop language and social skills. POGO aims to support children in the creation of stories.

In POGO we aim to develop an environment which creates new modalities of narration exploiting the theoretical framework of cultural psychology. The POGO environment is consistent with some of the pedagogical objectives identified by two of the leading figures in Cultural Psychology: Vygotsky and Bruner. The design process involves psychologists, designers, technologists and users (children, teachers and educational experts). It is based on a parallel and iterative process where activities involving users are concurrently combined with an open concept and content generation phase and flexible technological implementation. This parallel and iterative process on the one hand allows good communication and cooperation among all the people involved in the project in different roles, and, on the other hand, grounds the concept development in the current narrative practice.

2. Narrative and artefacts

Narrative is considered by Bruner (1990) as a primitive function of human psychology, lying at the heart of human thought. The representation of experience in narratives provides a frame which enables humans to interpret their experiences and one another. For Bruner, narrative is a fundamental aspect of meaning construction. If it were not for such narrativised framing "we would be lost in a murk of chaotic experience and probably would not have survived as a species in any case" (p.56).

Narrative as a primitive function becomes a higher psychological function when it undergoes transformations according to the mediational role of cultural artefacts (Vygotsky, 1978). Writing, printing and broadcasting have all evolved the narrative process (Ong, 1986). None of these new artefacts has dramatically changed the previous one: writing and printing have been de facto currency of information and culture, and they will remain so for the foreseeable future even though broadcasting has become the dominant media in many social contexts. But computing, the most recent communication artefact, has a property that no communication artefact has had before: it can change the previous ones. Almost all printing is now controlled by computers, and so are many aspect of broadcasting; at the same time writing, drawing and painting are increasingly mediated by computing. Indeed computing is merging all the previous media, preserving their particular properties yet also producing new ones through their merging.

It might be an exaggeration to compare the way writing has transformed human cognition and culture with the transformation that may occur due to the effect of computing on narrative. But it is quite safe to say that computing technology, and the merging of communication artefacts it produces, will have implications for human cognition and culture that extend well beyond the horizon of our current understanding. In POGO we aim to develop an environment which mediates a new modality of narration through computing technology according to well-specified pedagogical objectives.

3. POGO's pedagogical objectives

The development of the POGO environment is driven by a set of pedagogical objectives derived from the theoretical framework of Cultural-Historical Psychology and, more specifically, from the original work of Vygotsky and Bruner. These objectives are related to the fundamental characteristics of the individual's ontogenetic development.

The first set of objectives POGO proposes are rooted in the relations Vygotsky (1972) identified between reality and imagination, which are at the basis of the creative process. He claims that the notions of reality and imagination are not as separate as they appear to be in every day life. In order to understand the psychological mechanisms of imagination and creative thinking Vygotsky argues that the creative activity of imagination directly depends on the richness and variety of previous experiences of an individual because fantasy's constructions are composed of the material supplied by experience. Fantasy is not antithetic to memory of real events: it is supported by it and disposes traces of events in new forms. This constitutes the first relation between fantasy and reality.

The second relation is more complex. It does not consist of a relation between the elements of fantastic construction and reality, but between the ready product of fantasy and any complex phenomenon of reality. This form of relation is only possible thanks to social experience. For instance, the French revolution, which is a real historical event, can be known only through social experience and interactions with others.

These two relations are the core of the first pedagogical objective: the POGO environment should (1) expand as much as possible the sensorial experience of children within each type of relationship: the imaginary relationship between the real elements (first relation), and real relationships between unexperienced elements (second relation); and (2) allow comparison and experimentation among both relationships, stressing the social origin of the second relationship.

The third kind of relation is the one of emotion. In this relation Vygotsky distinguishes two different aspects: the law of the common emotional sign and the law of reality of imagination. In the first law, the author claims that fantasy's images supply an inner language to our feeling. Our feeling selects elements which are isolated from reality, and it combines them together in a relationship which is internally conditioned by our mood, instead of by the external relationship or the logic of images in themselves (social semiotics).

On the other hand, in the second law Vygotsky states that every form of creative imagination includes affective elements. This means that each construction of fantasy influences our feelings, so even if it's not a construction, which corresponds to reality, the feeling evoked by it is effective and really lived.

This emotional relation is the central issue of the second pedagogical objective: the POGO environment should support children in developing emotional knowledge (e.g. empathy) through the law of the common emotional sign and the law of reality of imagination.

The law of reality of emotion is a bridge toward the fourth relation between reality and imagination. A construction of fantasy may constitute something effectively new, something which has never existed before in the experience of a man, and which does not correspond to any existing object/concept. Yet once this crystallised image of imagination is externally embodied, once it is concretised, once it has become a thing among other things, it really starts to exist in the world, and to act on other things. This is true for physical objects (devices, machines...) as well as for ideas and emotions.

The POGO environment should sustain children to complete the circle of creative imagination that starts from sensorial knowledge of reality and goes back to reality through the active modification of the environment produced by the embodiment of the imagination. The process of embodiment concerns not just the material/technical aspects but also the emotional/experiential ones (e.g. metaphor). To complete the circle allows children to deliberately produce social experiences.

The fourth pedagogical objective adopted in POGO comes from the notion of intersubjectivity and the role of cooperation in the development of metacognitive consciousness put forward by Bruner. For Bruner (1996), intersubjectivity is the way humans come to know each other's minds. Human beings have a kind of innate readiness for intersubjectivity that manifests itself in children's pre-linguistic phase of development

and evolves through social experience. Intersubjectivity becomes in Bruner's pedagogical framework both the object and the instrument, at the same time an epistemological and a methodological issue. Stories are always expressions of a point of view, a possible interpretation of reality. Through collaboration children can negotiate these interpretations with others in order "to achieve not unanimity but more consciousness". Meaning construction is an activity of negotiation that starts in early childhood and characterises the whole of human life (1990). Even if he doesn't attribute a conscious intentionality to the pre-linguistic child, Bruner (1990) considers our early ability to have meaningful exchanges with other people as a "primitive form of folk psychology", "a set of predispositions to construct the social world in a particular way and to act upon our construals"(p. 72). Bruner relates intersubjectivity to our interpretative activity. We do not use analytical tools to describe our own and other people's minds; our mental activity is a "mystery", not accessible to introspection. Nevertheless people, both in the scientific community and in everyday life, have theories of mind that influence their behaviour in the world.

While educational programs devote a great attention at the scientific paradigm, the interpretative one is often neglected. One of Bruner's most important pedagogical claims is to devote more attention, more time, more effort to the development of children's narrative competence through collaboration.

It is important for the POGO environment to support the child building his fantasy and world model and the elaboration of the understanding process through discussion and co-operation. The POGO environment should sustain and enhance this discussion between children and between children and adults and should keep to support co-operative mechanisms and reflection.

4. POGO's design concepts and their assessment through POGO's pedagogical objectives

In the POGO design process, in parallel with the definition of the pedagogical objectives, there is an open concept and content generation phase. One of the design partners of the project, Domus Academy, inspired partly by user observations, produced 14 new ideas of narrative environment described in a draft document (Domus Academy, 1999). These design concepts represent different ways by which enabling technologies can create new narrative process and mediate the development of child communication. In the next stage of the design process, the different participants of the project (researchers, users, designers and technologists) were asked to evaluate these design concepts. This evaluation has been performed firstly by filtering the concepts through the defined pedagogical objectives, and secondly through the comments of the teachers. The driving question was how these concepts allow to achieve the defined objectives. The gathered comments are structured in different sections: the first section is directly related to the objectives and responds to the question stated above, the second section groups general comments and finally the third section represents the teachers' comments. We will exemplify these parts of the process (concept generation and evaluation) by describing shortly two concepts and their respective evaluations.

Concept 1 "TheatReality"

The design theme of the concept "TheatReality"(named after the combination of the words theatre and reality), is related to how to 'visualise' the emotional aspects of story narration by emphasising the elements of expression of the characters and how to integrate in the performance the reactions of the audience. The concepts outline has been described as an environment that emphasises the physical (i.e. voice) and behavioural characteristics (i.e. expression) of children performing or telling story. The narrator can choose, modulate and emphasise his/her emotions during the narration by adding visual and aural effects to his/her performance. The voice can be altered and transformed into music. Facial expressions can be modified and highlighted and gestures can be exaggerated for a more effective communication. The same can be applied to virtual characters that can be used to convey emotional aspects of interpersonal communication. The public, both real and virtual, intervenes expressing consensus by way of enhanced reactions. The combination of the choices of the different actors participating to the building of the stories, both the narrator and the public, determines the appearance and behaviour of the POGO world.

Consistency with pedagogical objectives

"Theatreality" appears to be coherent with the first objective because it is based on rich and various visual

and auditory experience. This concept is also coherent with the objective of developing a language of emotions through "images". Indeed, after a free and chaotic exploration of the possibilities offered by the instrument, children could use these possibilities to better express their emotions and build new meanings through an "augmented" dramatisation. The third objective should be more emphasised. Children have to be able to understand clearly the effects that the changes they introduce produce on the public. It should be clarified. How does the public interact?

As a general comment we can say that this concept is positive but it has to provide stronger and more accentuated moments of socialisation. For instance, more actors could collaborate. It would be also useful to explore some elements belonging to the children's socio-cultural context (i.e. Sicilian voice, or French one). When thinking aloud about this concept, we imagined the following situation: a child wants to obtain an angry face, so he pushes the button "angry face" and his own face is projected on a screen, but it's not his normal face. In fact it has been transformed into an angry one. Children should not simply ask POGO to transform his face from a normal one to an angry one. POGO must invite kids to learn how to change their appearance. Moreover, POGO may suggest the way different cultures represent an angry face (Chinese, European, African, etc.)

Teacher's remarks

The proposal about voice is interesting. In fact not only can the voice be altered but it can be transformed in music too. We think that this opportunity is really amazing. Moreover we like very much the possibility to exaggerate movements and to alter facial expressions. Indeed, the more children can modify themselves, the more they can identify with the embodied characters and the more their capacities to develop stories may be stimulated and augmented.

Besides, we don't like the idea that the public's reactions could be altered or emphasised. To observe a bigger reaction could be a stimulation for some children, but it could be a negative input for others (shyer and more insecure ones) who could be inhibited by strong reactions.

When we think about the POGO World we imagine a room inside of which children may have many educational opportunities. The POGO World could offer the possibility of projecting scenaries on three sides of a room. These scenaries would be big enough to make children feel themselves inside the projected environment (a wood, or something else). We think it would be better to use scenes drawn by children, so that they would be inside the wood exactly as they imagined it. This way the child feels completely plunged in the scene and in the story. This active immersion in the story allows a bigger comprehension of the story. The more the child feels immersed in it, the more he will be able to create and invent new events. Indeed, if he feels to be in a wood or in the bottom of an ocean, he will be automatically stimulated by particular inputs and go on in with the story.

Having the possibility of projecting the drawings made by children or taken from books is also useful because it takes less time than preparing them in big posters. Preparing hand made scenes takes so much time that often children have the opportunity of making a good dramatisation only once a year. We think that dramatisation is of fundamental importance in education. But preparing scenes takes too much time, and the long period that passes before the final product is finished, leads one to lose the immediateness of the moment! The POGO World should allow children to make dramatisations more frequently.

Concept 2 "Redrum"

A second concept, "Redrum", named after the movie *The Shining*, was designed on a quite different theme: how can a virtual partner guide the narrator in the discovery of the story world? How to support children's curiosity in informal ways? The concept outline is the following: a virtual partner introduces and guides children into a story. The child can create or find a virtual friend, which has its own identity and a personal story. The "ghost friend" can help the child solve problems, but at the same time it never stops browsing through the possible story-world. The "ghost friend" identity is affected by its experience and by the interaction with the narrator and with other characters. "Ghost friends" learn from each other and grow along with the child that has to take care of them.

Consistency with pedagogical objectives

This concept does not seem to meet the first objective related to the expansion of sensorial experience. Indeed, there aren't any particularly stimulating sensorial activities. Moreover with such a concept the child cannot explore properly the distinction between the real and the virtual. For the same reasons, we think that this concept doesn't support the second objective. To allow children to verify the effects of their own action on the social world, the activities proposed in "Redrum" are not appropriate as they are totally individual, so we don't think that it can meet this third pedagogical objective either. We don't think it is possible for a child to develop "one's mind theory", due to some interactions between himself and a "virtual friend". We believe that in the educational development of a child, the activity proposed in this concept may become something ambiguous and dangerous; moreover we don't think the metaphors used (Tamagotchi) are particularly stimulating and interesting.

Teacher's remarks

Teachers commented that if the virtual friend is already pre-determined, if it already has its own story, it is something too cold and not appropriate. But if, on the other hand, the child can create the virtual friend as (s)he wants (a person or an animal, big or small…), this friend can become a part of him or her — which would not be something strange, given by the external world. If it comes from his or her inner world, the child will probably build a story made of things and events coming from his or her unconscious that (s)he won't be able to externalise without the support of the virtual friend. The concept might be interesting and might help us to keep out emotional things. Children would build another ego, with another name and another form, that could be used to project their inner feelings. The virtual friend becomes a kind of inner mirror. But it can be used only at an individual level, only by children who have got problems and who are not able to express their feelings.

The two design concepts sketched above and the associated summarised comments provide a simple but representative example of the cooperative strategy adopted to design the POGO world. The same process was carried out for the evaluation of the design concept with respect to the enabling technologies. In an iterative process all the participants in the POGO project get in contact and cooperate with each other in the design process.

5. Conclusions

POGO's challenge is to design innovative technologies for children that should be attractive, long-lasting, and that also offer sound pedagogical learning opportunities. The proposed design process has so far enabled communication and cooperation between members of the multi-disciplinary design team. In particular it has allowed fruitful participation of the stakeholders in the two phases involved, namely pedagogical objective definition and early concept design.

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The design of online learning communities

Research at the Center for Technology in Learning, SRI International

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At SRI International's Center for Technology in Learning, much of our work has focused on the development and deployment of collaborative educational technologies for researchers (e.g., the Center for Innovative Learning Technologies' Knowledge Network), teachers (e.g. the TAPPEDIN teacher professional development online community), nonschool practitioners, and students (e.g., GLOBE and the new Streets project).

The construction of online learning communities is complex, requiring multiple design methodologies. We present design approaches, which address several fundamental issues in online communities: community support, collaborative infrastructure, shared representations, and assessment and research methodologies. SRI uses a multidisciplinary teaming approach (as reflected by the presenters' backgrounds in computer science, artificial intelligence, developmental psychology, educational measurement, graphic design and art, and cognition) and endeavours to use participatory design methods where possible. In addition, we make extensive use of the design experiment paradigm, which combines iterative refinement and field testing with empirical, quasi-experimental research.

The Center for Technology in Learning is a department of SRI International, a nonprofit research institute in Menlo Park California. Recently, much of the Center's work has focused on the development and deployment of collaborative educational technologies for researchers (e.g., the Center for Innovative Learning Technologies' Knowledge Network, kn.cilt.org), teachers (e.g. the TAPPEDIN teacher professional development online community, tappedin.sri.com), nonschool practitioners, and students (e.g., GLOBE, www.globe.gov and the new vStreets project).

The construction of online learning communities is complex, requiring approaches from cognitive science, education and educational reform, computer-human interaction, aesthetics and humanities, and organizational behavior. Through our experiences building learning communities online, we have developed design approaches which address several fundamental issues in online communities: community support, collaborative infrastructure, shared representations, assessment and research methodologies. In this session we describe our design approach and describe some of the research projects that have helped inform our design process. SRI uses a multidisciplinary teaming approach (as reflected by the panel presenters' backgrounds in computer science, artificial intelligence, developmental psychology, educational measurement, graphic design and art, and cognitive science) and endeavors to use participatory design methods where possible. In addition, we make extensive use of the design experiment paradigm, (Brown, 1992; Collins, 1992) which combines iterative refinement and field testing with empirical, quasi-experimental research.

Collaborative infrastructure and very low threshold interfaces: The CILT Knowledge Network

Christopher M. Hoadley

The CILT Knowledge Network is a set of databases of information about, by, and for the learning technology research community. CILT (the Center for Innovative Learning Technologies) is a multi-institutional project charged with increasing collaboration and cumulativity in learning technology research, including researchers, teachers, and industry partners. After several attempts to directly support collaboration through shared workspaces or discussion tools, CILTKN was reconceived as a collaboration infrastructure rather than a collaboration workspace, providing contact information, bibliographic information, course syllabi, and other data which aims to support users in uncovering other individuals and their role in the field. I describe how field research and design experiments led to this novel, and ultimately successful approach.

ChemSense: Electron Clouds Orbiting the Giant Hairball: Designing Visualizations as Expressions of Students' Understanding in Chemistry

Elaine B. Coleman

ChemSense (chemsense.sri.com/), a research and development project funded by the National Science Foundation is a chemistry learning environment to promote representational competence and epistemological thinking in high school and undergraduate chemistry. For science education it is especially important that students learn to develop models and explanations of natural phenomena, as well as relating particular models and explanations to domain theories. In ChemSense, students learn chemistry ideas by creating representations of chemical concepts to communicate and collaborate with others. Accordingly, we are designing a learning environment that help students investigate complex chemical systems by making the underlying chemistry more visible to students, and making students' underlying thinking more visible and open to inspection in their collaboration. We hypothesise that the act of "representational expression" (e.g., the design and use of visualisations) will advance students' understanding of chemistry. In ChemSense, we are proceeding with iterative design of the representations, and are conducting field research on students' current use of representations with and without the aid of software.

Marshalling people and organisations in support of an online community

Mark Schlager

TAPPED IN is a platform-independent, Web-based, real-time environment in which we have created a scalable, sustainable online community for teacher professional development (currently supporting dozens of professional development organisations and over 5000 teachers). One central finding in TAPPED IN is that fostering a scaleable and sustainable community initially requires the participation of many organisations representing a variety of approaches and perspectives, and the active participation of designated leaders. Our research is investigating the implementation process and community building using a combination of qualitative and quantitative methods. Organisations that collaborate using TAPPED IN enable their affiliated teachers to gain access to expertise, ideas, and resources that no single organisation could provide by itself. By having a larger community that surrounds the many organisations in TAPPED IN, our members (teachers and other education professionals) will be able to easily find different resources to suit their needs through the course of their career. We have found that enthusiasm and presence of leaders are important, but how much and in what form seems to be the important question, not so much who. Leaders are needed to stir the pot, adjust the heat, and add new spices to taste. Currently, designated leaders are not needed on a day-to-day or even week-to-week basis. Will we ever be able to walk away and have it stand on its own?

Evaluating Learning Communities

Barbara Means & Bill Penuel

Assessing the development and success of learning communities poses challenges for evaluators, as communities are constantly forming, transforming, and turning over people, technologies, processes, and practices. The challenge for researcher-evaluators is to form partnerships with learning communities that help guide program design and community development, document the evolution of communities, and measure the kinds of learning that takes place. At SRI, we have developed research frameworks and conducted evaluations of innovative technology-supported learning communities in schools and in the workplace. For example, we have assessed the success of distributed learning communities created through the GLOBE (www.globe.gov) program and the Virtual High School project (www.concord.edu) for students in K-12 settings. SRI has also developed a conceptual framework for understanding how the cognitive science of learning applies to the construction of communities of practice in the workplace. Key themes that have emerged from our research include: (1) the need to integrate program design, ongoing "formative" assessment, and summative evaluation; (2) the significance of cross-disciplinary collaboration as a challenge and opportunity for learning; (3) the key role technology plays in transforming relationships among learners and opening up new learning opportunities for communities.

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The environment as interface

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The more hand-held computing and nomadic systems become popular and significantly address the market, the more the design of applications based on such systems need new metaphors and interaction paradigms to fit user needs in new contexts of use. On the one hand emerging technologies like Personal Digital Assistants (PDA) offer new opportunities of use, on the other hand the applications that they can support require new methodologies and design approaches to be successful.

This paper describes metaphors and design strategies used to develop a hand-held location-aware electronic guide for museums and exhibitions. In particular we describe a design approach based on the visiting strategies and space affordances. The work reports some of the results achieved within HIPS, a three-year project funded by the European Commission within the i3 Programme.

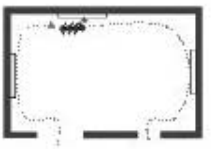
1. The environment as interface

HIPS is a personal assistant that guides the tourist in the exploration of the physical environment, providing contextual and personalised information by detecting the user position within the physical space. The presentation of information is dynamically generated, adaptive and integrated with maps and spatial directions (Broadbent and Marti, 1997). Information is mainly provided through earphones; a visual interface supports the recognition of items, map display and information browsing. From a hardware point of view, the HIPS system consists of a Personal Digital Assistant (PDA), the visitor's guide, communicating with a server machine via a radio link. For localisation, the PDA forms part of an Infrared (IR) sensing system.

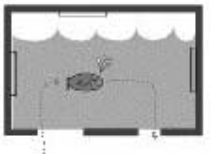
The visitor's movements and his/her orientation in the space (traced by means of the IR sensing system) are used as the system input: the museum space is, indeed, the interface of the system, and the physical movement is the main interaction means to access information. These data are thus used to personalise the information and to enrich the visitor experience.

2. Physical movements and visiting strategies

User behaviour in artistic environments has received attention by ethnographic studies. In particular, Veron and Levasseur (1983) conducted a field study on visitor's behaviour in artistic exhibitions. The study identifies four categories of visitors based on their paths, movements, and observation about the time spent in exhibition contexts. The visitor classification proposed by Veron and Levasseur suggests how to isolate significant variables linked to physical movements and how to relate the physical movements to the browsing of information spaces:

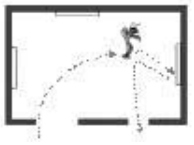


The ant visitor: "ant" visitors are those who follow the path proposed by the curator, taking a lot of time to observe all (or almost all) artworks. They stop frequently and the overall visit is long in time. Ant visitors usually move close to walls and artworks, avoiding empty spaces. They need to be guided by a powerful rationale and this is the reason why they usually follow the path proposed by the exhibition curator.



The fish visitor: the "fish" visitor moves preferably in the centre of the room, performing a "slipping" visit of the exhibition. Fish visitors usually cross empty spaces (e.g. the centre of the room), and have a "peripheral" vision of the contents of the room. Fish do not look at details of artwork but prefer a more "holistic" observation. Even if the fish make just a few or no stops, most of the artworks are seen, but only for a short time. The visit is shorter than the ant one.

The butterfly visitor: the "butterfly" performs a sort of "pendulum" visit. They frequently change the direction of visit, moving from the right to the left wall without following the proposed path. Empty spaces are usually avoided. The butterfly sees almost all the artworks, stopping frequently. Times of visit vary for each artwork. The visit is mostly guided by the "affordance" of the elements in the physical space. The duration of the visit is intermediate between the ant and the fish. It can be defined as a "semi-long" visit.



The grasshopper visitor: the "grasshoppers" see only artworks they are interested in, without following the proposed path. The visit is mostly guided by personal interests and pre-existing knowledge about the contents of the exhibition. The grasshopper crosses empty spaces, stops rarely, and the times spent to observe single selected artworks are quite long. However the entire visit is quite short.

Table 1: Veron and Levasseur Classification

This classification was originally proposed for exhibitions, that is, physical spaces purposefully designed as exhibition spaces. The physical space in the HIPS experimental site is not purposefully designed as an exhibition space: it consists of a series of existing rooms in a historical building, and the exhibits are frescoes, permanently part of the wall. Consequently, some variables considered extremely significant for the Veron and Levasseur study, such as the concept of proposed path, are not so useful in the HIPS scenario.

To verify that the Veron and Levasseur classification can be adapted to the HIPS context, observations and video-recording analysis were carried out in two museums in Siena. This study revealed that, considering all possible uninterrupted sequences of artworks observation as a "proposed path, all visitors could be easily categorised within Veron and Levasseur's framework.

Following this theoretical approach, we set up an experimental condition (Marti, Rizzo, Petroni, Tozzi, Diligenti, 1999). Some audio files containing information about four artworks in the Sala del Mappamondo, chosen with respect for their position and their relevance, were sampled. Considered artworks were: "La Maestà" and "Il Guidoriccio"(by Simone Martini); "Beato Bernardo Tolomei" (by Sodoma), and "S. Caterina" (by il Vecchietta). The descriptions were segmented in macronodes, small blocks of information dynamically combined to form an audio presentation. Each of them was labelled with one of four possible topics, generalist, historical, anecdotal, and artistic. The macronodes were then organised in a hypertext structure, setting links between them on the basis of logical relationships, which constitute the clusters of objects. The starting hypothesis was that different types of user (ants, butteries…) need different durations for the presentations, and so different depths in the hypertext structure. For instance: short descriptions are probably suitable for fishes, whereas longer ones are more suitable for ants. The audio presentation needs also to be adapted to the user preferences about the topics.

Two descriptions related to two different artworks were presented to five subjects belonging to the same user type (e.g. an ant preferring artistic information): one of them was generated taking into account both the user movement strategy and topics preferences, the other was generated providing a wrong visiting style model. The experimental hypothesis was that the provision of a presentation that is not adapted to user movement strategies should produce a strong increase of user explicit actions in term of request for more or less information. These reactions can be interpreted as breakdowns in the interaction, at the level of clusters of objects.

The results show interesting behavioural differences between those users who were assigned a path matching their visiting style versus those who were not: the degree of information skipping and of explicit requests for more information significantly increases if the spatial user-model is altered. Table 2 shows the reaction of two users (A and B) to the presentation of two audio paths: it is clear that in both cases the number of requests for more information increase when the spatial user model is altered. This confirms our hypotheses of correspondence between visiting strategies and information contents.**User**

	Real User-model	Tested User-model	Path (id number of activated nodes) & User reactions									Artwork
User A	Ant	Fish	0 more	4	8	13 more	14 more	19	23 more			Maestà
	Ant	Ant	0	4	8	9	13	14	10 more	11		Guido
User B	Ant	Fish	0	4 more	8 more	9	13 more	10	11			Guido
	Ant	Ant	0	4	8	13	14	15	17	19	23	Maestà

Table 2: User Behaviour under matched/unmatched visiting styles.

Starting from these results we implemented a "visiting style module" on the server system that, using a fuzzy logic approach and a bayesian algorithm, is able to update time by time the user classification, assigning a probabilistic value to the user belonging to one of the four types. Since the system continuously and dynamically computes these values, HIPS can personalise moment by moment the information delivered. Even if visiting strategies provided seem to fit the requirement of a "natural design" they are not sufficient to exploit the idea of the environment as interface. This concept is discussed below.

3. Real and perceived affordances

In a famous work on ecology of perception, Gibson (1979) discusses the notion of affordances of objects that link perception and action. Affordance refers to the perceived and actual properties of a thing, primarily those functional properties that determine just how the thing could possibly be used. Less technically, a doorknob is for turning, a wagon handle is for pulling. Research examining the concept of affordances is critical if we are to build a flexible design orientation for nomadic systems in cultural settings. The tool that supports the visit should not only intrude on the activity but, and most critically, should be part of the activity itself. In this way the cognition can flow from the external environment to the interior world of interests and emotions. The tool should be assimilated by the user as a means toward the achievement of situated, cultural and emotional objectives.

Don Norman elaborated Gibson's insights on affordances into what he calls a "psychology of everyday things". He offers many examples to show how affordances of objects deeply and often unnecessarily restrict their accessibility to the ordinary human. The point is that better design of artefacts would make it easier to accomplish a certain function. One would like to be able just to look and see what to do and then do it, without instruction, without manuals, without complex deductions. Such "efficiency" of action is reached when the artefact becomes part of the activity, a sort of invisible aspect of our experiential world.

4. The affordances of cultural settings

The physical layout and the contents of a museum or an exhibition encourage the exploration of the environment and the meeting with the artworks. Visitors move in the space because they are driven both by intentional motivations (personal interests and preferences) and visiting strategies but also by the properties of the environment. In the latter sense, the movements of the visitor mostly depend on natural and contextual affordances of the space. We will call real or natural affordances those properties that are "intrinsically" connected to a particular setting like the width of the artworks, their position, their artistic importance, or by architectural elements like access points to a room, arches and steps. Other properties of the space depend on the context of a visit: the number of people in front of an artwork, light conditions, individual or group visit. We will call these properties contextual affordances.

From observations and field studies, we collected a large set of data about how affordances affect visitors' strategies. In the following we provide three examples that illustrate how the properties of the physical space influence the visitors' interests and preferences. The examples in particular refer to data collected in the Museo Civico in Siena, the experimental site of HIPS:

- Light Conditions: At different times of the day, especially during winter, the natural or artificial light plays a significant role in affording the visiting strategies. For example the Sala del Mappamondo contains, on opposite walls of the room, two famous and big frescos: the Maestà and the Guidoriccio. During the morning people mostly go to see the Maestà that is well lit by the natural daylight and they almost ignore the famous Guidoriccio at the opposite side. In the afternoon, when the artificial light brightens the Guidoriccio, people spend much more time in front of this beautiful fresco and pay less attention to the Maestà.

- Steps: On the north-east wall of the same room, there are two large windows. At the bottom there are three steps used to open and close the windows. When sitting on the steps is not forbidden by a belt, people usually sit down and look at the frescos on the front wall, read the guide book and speak to each other. However, the frescos are almost always ignored if the steps are blocked by the belt.

- Labels and maps: When a map panel of the room is moved from one wall to another one, people start the visit from the fresco that is just in front of the panel, even if it is not important, and even if there is no information related to it.

These simple examples make clear that the visiting strategies are strongly conditioned by both natural and contextual affordances. Obviously this kind of information cannot be detected by the system, nor be used to make universal inferences about user interests. Our belief is that we can exploit the concept in the design process to augment the physical affordances of artworks by means of an auditory information space. For this purpose, we are designing audio descriptions containing references to important items that are usually ignored in the context of particular visits (e.g. those in bad light conditions). These descriptions will be selected at the right time (e.g. when the system realises that the user missed an important artwork). If the user reacts positively moving to the mentioned artwork and listening to the description, then the system will continue to provide information, otherwise it will just mention the artwork without further elaboration.

5. Conclusions

The application domain described in the paper raises challenging issues about the concepts of interface and interaction. People mainly interact with a rich and stimulating environment like a museum for pleasure. Their activity is not structured; they move in the physical space following their interests and preferences and exploiting the real and perceived affordance of the environment.

Our aim in designing a system to support such an unstructured and emotion-driven activity is to augment the physical space with an information space providing a seamless boundary between the two. The notion of visiting strategy and space affordances can be a step toward a “natural design” of nomadic applications.

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Mixed collaborative and content filtering

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Information filters

With the increasing availability of information in electronic form, it becomes more important to have automatic methods to filter information. The amount of research in automatic mediation of access to networked information has exploded in recent years. The success of many new information services that provide end users with access to diverse information sources is crucially dependent on the availability of effective filtering technology.

Information Filters (IF) are essentially mediators between information sources and their users. In most cases, both the information sources and the information users possess no mutual knowledge that can guide them in finding the information most relevant for the users' momentary and long-term needs. Filters, which are positioned logically as "third parties" to the communication between users and information sources, should possess both the knowledge and the functionality to examine the information in the sources and to forward the information "they judge" as relevant to individual users.

So far two main approaches have been proposed, content-based filtering and collaborative filtering. While content-based filtering has for many years targeted a single user and his or her information needs, collaborative filtering has emerged recently, and makes use of the evaluations of other users. Both approaches can be problematic in settings with a transient user population, and therefore the system has to rely on little information to predict what is interesting for a certain user. This is especially true when people external to established communities, like inhabitants of a town, wish to be helped in finding items of relevance in usually very large set of data. In the Campiello system, for example, we need to assist not only local inhabitants but also people who are planning a visit to the town and would like to know what they can learn from experience of other people.

Content filtering

A content-based filtering system is defined as one in which filtering is made for a user based solely on a user profile built by analyzing the content of information items that a user has rated in the past. In content-based filtering, each user is assumed to operate independently. The objective is to automate the process of examining documents by computing comparisons between the representation of the user's information need and the representation of the documents. This automated process is successful when it produces results similar to those produced by human comparison of the documents themselves with the actual information need. The process of information filtering begins with people (the users of the filtering system) who have relatively stable, long-term, or periodic goals or desires. Groups, as well as individuals can be characterized by such goals. These then lead to regular information interests that may change slowly over time, as conditions, goals and knowledge change. Such information interests lead people to engage in relatively passive forms of information-seeking behavior. This is accomplished by representation of the information interests as profiles or queries that can be put to the filtering system. Such profiles have generally been constructed as good specifications of the information interests. Content-based filtering attempts to find information items of interest to their user, often using some scoring function to evaluate features of the information item and returning items with the highest scores. Content-based filtering techniques recommend items based on correlations between the content of the items and the user's preferences.

Collaborative filtering

Collaborative filtering is based on the premise that people looking for information should be able to make use of what others have already found and evaluated. Collaborative filtering systems assist and augment this natural social process. So, collaborative filtering systems are built on the assumption that a good way to find interesting content is to find other people who have similar interests, and then recommend items that those similar users like. In a typical collaborative filtering system people provide recommendations as inputs, which the system then aggregates and directs to appropriate recipients. In some cases the primary transformation is in the aggregation; in others the system's value lies in its ability to make good matches

between the recommenders and those seeking recommendations.

Collaborative filtering systems work by including people in the filtering system and it is expected that people are better at evaluating documents than a computer. People can effortlessly evaluate features of an information item that could be important to other people, but would be difficult to detect automatically. Rather than compute the similarity between users' profiles and information items, the similarity among users is computed. Typically, for each user a set of "nearest neighbour" users is found with whose past ratings there is the strongest correlation. Scores for unseen items are predicted based on a combination of the scores known from the nearest neighbors. A proposed definition of collaborative filtering given by Resnick is the following:

> *Guiding people's choices of what to read, what to look at, what to watch, what to listen to (the filtering part); and doing that guidance based on information gathered from some other people (the collaborative part).*

Limitations addressed by the Campiello approach

Both content and collaborative filtering have their own drawbacks when considered in isolation. Typically the content-based approach suffers from over-specialization, while the collaborative approach typically suffers from lack of enough overlapping among users feedback (ratings, comments, etc.) at the start of the system (cold-start problem). We call these algorithmic problems.

Additionally both approaches address only one of the mathematical models used to learn and predict interesting items, while one of the biggest problems of the filtering systems is to be able to obtain the user feedback required by the algorithms to work effectively. We call these ergonomic problems.

The Campiello system addresses both the algorithmic problems and the ergonomic problems. The algorithmic aspects are addressed by proposing a mixed-content and collaborative approach, exploiting the strengths of both. In particular in Campiello the collaborative approach is used because circulate and enrich information on the basis of people experiences. However it is coupled with the content filtering to solve the algorithm problems that it presents when:

- there is not enough feedback in the system;

- the interaction is from a transient user.

To address the ergonomic problems in Campiello we have designed a number of personal user functionalities that can be turned in to public recommendations with little effort. We aim in this way at providing incentives to produce the recommendations and share the experiences.

In this presentation we describe the Campiello Information Filter, which comprises an information model and an algorithm for content and collaborative IF. How the ergonomic problems are not addressed in the framework of this presentation.

The information model

Three elements are part of the information model: a representation of the content, a representation of the user (user profile) and a representation of the user actions (traces) to be exploited by the filtering system.

The Content

A context is a hierarchical classification scheme that can be used to group-related items. Each context has a title in one or more languages and one or more descriptions in one or more languages. Contexts can also have context specific information associated with any items related to them allowing the knowledge base to be extended. Contexts are organized hierarchically from more general to more specific ones (e.g. Accomodation is divided in Hotels, Hostels, Rent Rooms etc.). This hierarchical organization is stored in the IsSubContext relationship type.

An item represents a concrete or abstract entity about which information can be collected. Items can be buildings, museum exhibits, cultural events, associations or any "thing" about which people might wish to collect information. Items have a title in one or more languages and one or more descriptions in one or more languages. Items are classified into any number of contexts – for example an Italian restaurant might be classified under:

- restaurants/Italian – it's a restaurant!
- architecture – the building containing the restaurant might be of architectural significance
- cuisine/italian/venice – the restaurant might service particular examples of local cuisine.

Moreover items can be organized in an aggregation hierarchy given by the IsPart relationship type.

Finally keywords are used to describe Items. For each Context, a set of relevant keywords are defined using the ContextKeyword relationship type. An Item is associated with the Keywords describing it through ItemKeyword relationship type

User Profile

A Person is a user of the Campiello system. He is associated with one or more Contexts (groups of people with similar interests). This association is done through Interests relationship type.

The information associated with user (called user profile hereinafter) is composed of a number of structures:

- A set of standard attributes describing the user such as his name, age, description, nationality. (demographic information)
- The user's interests. This is essentially a combination of a list of Contexts of interest using specific keywords in the frame of each Context, using the structure < PersonID, ContexID, KeywordID, Weight>.

  An example of part of a user profile is the following:

George	Sports	Ronaldo	0.6
George	Sports	Jordan	0.5
George	Music	Rock	0.8
George	Music	Zazz	0.8

- The "history" of the user, namely the complete set of his traces i.e. what he has done during his interaction with the system
- The travel diary containing explicitly memorized and organized traces is also part of the user profile.

The user actions

As people interact with the system they leave traces of these interactions which are then used to find correlations between users and as implicit indications of a user's preferences and interests. Traces can be both implicit and explicit. Implicit traces are generated by actions such as requesting information on an item, sending a message to another user, or a record of a visit to a particular place. Explicit traces are generated when a person explicitly wants to communicate information to the system and other people. Examples of explicit traces include the rating of an item (a score awarded on a linear numeric scale indicating like-dislike) and comments (a text or hand-written comment indicating the users opinion and intended to be communicated to other users).

The filtering algorithm

The proposed filtering algorithm computes the scores both using the collaborative filtering and the content filtering. The resulting score is then obtained by the combination of the two as suggested in [Pazzani, 1999]. Moreover, in order to have a wider application of the collaborative filtering, correlation among users is done not only on the basis of the historical agreement among couples of users, but also taking into account the personal (dynamic) interests.

The algorithm works by computing a set of correlation among users and among items, that are described in the following part of this section.

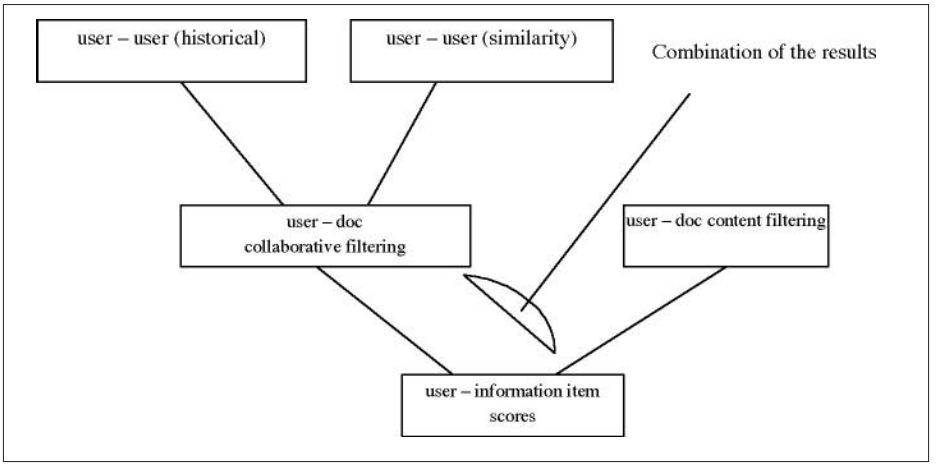

Figure 1: Using multiple techniques to relate information items to users.

Correlation

This module is responsible for correlating users to users and information items to users. This module consists of various sub-modules which implement different algorithms for achieving this.

User-user historical correlation

Historical correlation is done by statistically measuring the similarity of peoples' evaluations with the Pearson algorithm [Resnick et al., 1994]. To work it requires that users have rated items in common. Typically this collaborative filtering algorithm set a threshold of common rated items above which to rely on statistical correlation of user evaluations.

User-user interest correlation

Computing similarity using interest similarity is, on the other side, always possible in Campiello. This happens because people choose a set of contexts at registration time in order to describe themselves and the profile dynamically changes on the base of the feedback describing at each time the current interest in a certain context. Therefore the classical historical correlation has been coupled with a correlation measure that describes "the common interests and the historical agreement measure". These lists of weighted keywords are then be used to calculate the similarity between two user profiles using the weighted Jaccard algorithm [Grefenstette, 1994].

User-item collaborative filtering

This part of the algorithm is based on the collaborative filtering algorithm used e.g. in GroupLens [Resnick et al., 1994], which is based on the assumption that is users have agreed in the past then they are

likely to agree in the (near) future. However, the GroupLens version of the algorithm operates by finding users that have rated a number of items in common and using those ratings to compute a correlation between the two users; this approach is only useful if two users have rated several of the same information items. In a setting where there are typically many new users (the people planning a visit to a town), the experiences of other people can be poorly circulated unless the correlation concept is expanded. We propose to extend it by taking into account not only the commonly rated documents, but also similarity of interests.

User-item content filtering

Information Retrieval classical techniques are used in this module. The words appearing in the item description are first tokenized [Grefenstette & Tapanainen, 1994] and looked-up in a morphological lexicon and the most probably part of speech tag for each sentence is calculated [Schiller, 1996]. This is used to produce a normalised form of each word (i.e. convert all nouns to singular masculine, all verbs to infinitives). As this process occurs, duplicate words are discarded and a count of the number of occurrences of each word is kept to enable the calculation of weights based on word frequency. Finally, a list of stop words [Salton, 1971] for the source language is used to discard frequent words that are no use in classifying the text such as conjunctions and prepositions (for example: and, the, a & but). As a result of this process each item has associated with them a list of keywords with associated frequencies. Keywords are first given weights inversely proportional to their frequency in the corpus so that less frequent words, which are therefore probably better discriminators, have a higher weight. These lists of weighted keywords are then be used to calculate the similarity between an item and the user profile of the user (the list of weighted keyword associated to the context(s) where the item appears) using the weighted Jaccard algorithm [Grefenstette, 1994].

User profile update

The User profiling agent manages updates to the user's profile and it deals with the representation of a user both with explicitly entered data and with dynamic modification of it, according to the behavior, i.e. when high ratings are given to items. In fact each new rating has an impact both on the calculation of the historical correlation with other users and on the interest representation, because information retrieval techniques are used to dynamically modify the keyword interest representation, as suggested in [Babalanovic et al., 1997]

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Lessons in social interaction within shared virtual environments

Tales from the Distributed Legible City

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Virtual Environments (VEs) are inextricably embedded in Human/Computer Interaction; key issues revolve around the psychology of interaction and perception, together with the socially oriented study of task, engagement and collaborative working. Because of this central role of the participant, the design of VEs that involve a significant degree of novel invention requires the open minded and explicit study of participants at very early stages of the project. This is in contrast to the traditional scheme of an initial "requirements capture" with real user engagement appearing late in the project evolution. We present one such study in detail. The VE application is that of a multi-user distributed art-work aiming to engage geographically dispersed users with each other and the environment. The open-ended nature of an interactive art-work almost demands this tight relationship between user evaluation and design engineering. In the paper, we evaluate the role of situated user evaluations in the evolution of the work and comment upon the wider ramifications of the approach to design.

Virtual environments (VEs) appear to offer many novel things: the potential, using immersive technology, to engage the human perceptual and kinaesthetic faculties in ways impossible using other techniques; the prospect of rehearsing tasks in the virtual world such that skills may be transferred to the real world; or the opportunity for richer engagement with applications and other users. However, constructing anything but the most trivial VE is a technically challenging task, and until recently much of the effort in the field has appropriately been directed towards demonstrating the basic feasibility of VEs as a mechanism for Human/Computer Interaction. It is only really of late that enabling technologies such as processors, graphics engines, networks, and software infrastructures have matured to the point where high level issues such as usability may realistically be examined. Though there are many important challenges in underlying VR technology yet to be tackled, they are, broadly speaking, understood. What can be done in a VE, and what paradigms are appropriate to do it, is however a much more open-ended question.

For many VE applications, a particular purpose or requirement drives their design and evaluation. For example, if the task to hand is to familiarise the user with the structure of an offshore oil-platform, then the form of the resulting VE is well specified, and the kind of evaluation possible is clearly delineated. The 'requirement' that lead to the construction of the environment considered here is considerably less well defined, and yet is fundamental to many shared virtual environments: to enable or even encourage social interaction in the virtual world. In this paper we describe the design, implementation, study and evolution of The Distributed Legible City (DLC), a shared virtual environment based on a multi-media art installation. We consider the technical challenges faced during its implementation, and examine the issues associated with the indeterminate nature of the requirements. We comment upon expectations and intentions of designers and results of the piece as revealed by studies of it in use by the general public during two European exhibitions.

The DLC was constructed in the context of the eSCAPE project, which aims to investigate the paradigms and technologies appropriate for the construction of large-scale virtual environments (or 'electronic landscapes') suitable for access by the general public. The research programme brings together engineers, social scientists and artists in an attempt to address these problems in a concerted manner. The final aim is to construct and inform the future construction of shared virtual environments that, whilst being visualisations of electronic information, are inhabitable and engaging social places in their own right. One of the approaches being taken to build such an environment is based on a 'cityscape' metaphor (being the concrete or physical end of a spectrum to which a 'virtual planetarium' is the 'abstract' end). On the premise that city-like structures are commonly understood and contain many features for aiding navigation (maps, signposts, information kiosks), a number of techniques for generating 'virtual cityscapes' have been investigated within the project. The DLC is the first of these aimed specifically at examining social interaction in a city-like environment.

The traditional engineering phase of 'requirements analysis' is difficult to apply to the development of such an environment. Whilst the low level technical needs (interactive frame rates, low device lag etc.) are ostensibly the same as for any other VE, the 'purpose' of the environment (to enable 'social interaction'), and what features it should have to support this are considerably less clear. Nevertheless, three broad statements can be made:

1. Social interaction requires some means of communication between users. In its least technically challenging form this implies some kind of textual dialogue. However a conversation held by typing at a keyboard does not fit well with the metaphor of being 'in' a three dimensional virtual environment, and in any case the social situations arising from text-based worlds are already the subject to much study. It was therefore decided that providing an audio link between users was a more appropriate form of communication.

2. There must be some representation of the other users to engage with. Existing 'avatars' range from 'blockies' to more complex geometric models. An appropriate avatar is 'context sensitive', and depends on the application of the environment.

3. There must be some reason to interact in the environment, i.e. 'something to do'. In previous Collaborative VE trials, we have observed that without a 'purpose', there is little communication beyond exchanging greetings ("Hello", "How are you?", "Now what can we do?").

The technical challenges arising from the distribution of audio across a network are well understood, and our particular approach to solving this problem and the 'usability' issues it provokes will be described in later sections. There are a number of 'traditional' approaches to giving purpose to an environment. Games populate their environment with bloodthirsty creatures that form an incentive to keep moving while more serious research environments pose problems or present tasks that are to be performed within the VE. While both approaches have much to commend them, the former limits the possibilities for relaxed social interaction, while in the latter, communication concerning technical difficulties connected with the manipulation of objects in networked VEs often overshadows 'genuine' social interaction (this is not to denigrate the value of studying such communication, which often provides valuable insights).

The approach taken here is to avoid the problems of manipulative or interactive tasks (which require that a number of problems be addressed before the failings of the technology itself are not the main topic of conversation) by constructing an environment that is ostensibly uncomplicated in its structure, and yet contains enough 'of interest' to stimulate and support social engagement.

The DLC is based on 'The Legible City', a 1990 multi-media art installation conceived by Jeffrey Shaw (Shaw, 1998), in which a single cyclist, seated upon on a modified touring bike is able to travel around three virtual cityscapes by pedalling and steering the bike. The piece is situated inside a darkened square room, with the bike mounted facing a large back-projected screen. The screen displays the cyclist's view that reveals not buildings and street clutter, but instead solid coloured letters forming sentences appropriate to that location. Thus the tourist is able to cycle around Manhattan, Karlsruhe or Amsterdam taking in routes that reveal commentaries about the respective city or are fragments from texts associated with that area. Mounted on the handlebars of the bike is a Liquid Crystal Display that shows a 'you are here' map and a large button that, when pressed, transports the cyclist between the three locations.

On a subtle level, then, there is actually much 'to do' in the original Legible City (for example, a tour of much of Manhattan is possible following the musings of a 'taxi driver'). The intention in extending this piece to be a multi-user environment was that the subtle and somewhat esoteric content of the environment would be a 'talking point' worthy of social interaction. We examine later in this paper the results of user's interaction with one another and the structure of the Legible City.

The first incarnation of the Distributed Legible City was build using the MAVERIK (Cook, 1998) and Deva (Pettifer, 1999) VR systems, and consists of a number of 'stations' (three were constructed for the exhibitions considered here) connected via networking technology. Each station was fitted with a 21-inch monitor mounted in front of a modified exercise bike. The cyclist was provided with an audio headset with headphones and a boom microphone, via which to communicate with the other users. A button mounted on the handlebar of the exercise cycle activated an overview map that was superimposed upon the current city's view.

The user's 'body' was represented to the other inhabitants of the environment by an animated cycling avatar, the pedalling and steering motion of which was coupled with the actual pedalling and steering of the user's exercise bike.

In this initial form, the DLC was exhibited at the 1998 Information Society Technologies conference (IST'98) in a large auditorium in Vienna. During part of the exhibition, a demonstrator was present to explain the use of the piece, during the remainder of the conference the users were left to their own devices. Use of the DLC, both with and without demonstrator, was subject to ethnographic study, the results of which are presented here.

Although meeting low-level requirements (high graphical update, low device lag) admirably, the studies revealed a number of 'usability' problems with the DLC's initial format.

1. Engaging with the environment (or understanding the purpose of the installation). Though this was not a problem when the demonstrator was present (the piece would invariable be introduced as an 'artwork' that 'you can ride through', 'meet people' and 'to talk to'), users coming afresh to the exercise bike were unsure of what to do. A design decision to modulate the volume of the audio link according to the distance between the cyclists meant that only cyclists close together could hear each other. The original intention was that this would encourage users to find one another in order to hold a conversation. In practice, users would don the headset, pedal around a little saying "Hello, hello" and then on hearing no response, would exit the piece.

2. Navigating the virtual space and locating other users. Learning to competently use the overview map was a troubled affair. In the first instance the action of 'pulling the map up' by pressing the cycle's handlebar button usually required instruction on the part of the demonstrator. There was a similar requirement for instruction on the part of the demonstrator in terms of interpreting the meaning of the map's features. Although users orientated to the map on the basis of a common 'background expectancy' that the map was a map of the DLC, nevertheless the demonstrator had to render its features intelligible (thus 'these are the cities'; 'this dot is you'; 'that dot the other' etc.).

3. Achieving conversational orientation. Those users able to locate one another in the environment found it important to orientate themselves to be 'face to face' before engaging in any meaningful conversation. Achieving such orientation was however rendered difficult by the nature of the bike as an input device (a 'wide turning circle', the inability to 'cycle backwards' and the inability to 'just pick it up and turn it around') coupled with the fact that the viewpoint/display device was fixed in front (i.e. 'over the shoulder' conversation was not possible). The effort involved in achieving face-to-face conversation was often followed by a perfunctory exchange, before the users exited the piece.

In our presentation we recall the design decisions leading up to the construction of the DLC in the context of ambiguous end-user 'requirements', and examine the relationship between designers 'expectations' and the user's observed responses. We then describe how the results of the initial evaluation of the DLC were taken into consideration in the construction of a second version of the DLC, exhibited at the launch of the Eurpean Union's Fifth Framework Programme at the Messe Essen conference hall in February, 1999.

Figure 1: a cyclist using the first version of the Distributed Legible City

Figure 2: Various scenes from the DLC

The situated evaluation of the DLC highlighted several significant human-machine and human-human interactional problems and occasioned the making of number of technical changes to the installation in order to address them.

1. In the light of the observable difficulties experienced by users in attempting to locate one another, the overview map was dropped in favour of a 'tour guide'. This took the form of an animated, flying bird that positioned itself so as to appear to be flying in the direction of the closest other user whilst maintaining 'line-of-sight' contact with its 'owner'.

2. The most significant of these changes in terms of the architecture involved the use of a Head Mounted Display (HMD) on each station to ease the problem of achieving conversational orientation. In this revised immersive DLC, each station was fitted with a HMD and position sensor, enabling the system to determine the position and orientation of the cyclist's head and to render an appropriate viewpoint. Associating the viewpoint with the position of the cyclist's head movement, rather than directly with the orientation of the virtual cycle gives the user the freedom to look in a direction other than that in which they are cycling, enabling them to easily look over their shoulder or to one side without the need to re-orient the cycle. The animation of the virtual cyclist was modified such that the head orientation reflected that of their user.

We discuss the outcome of the modifications to the DLC, based on further ethnographic study, and examine the process of designing shared virtual environments for social interaction based on situated evaluation. We comment on the economics of the forms of interaction used in the DLC, and discuss the use and abuse of the city metaphor as a means of engaging interest and enabling understanding of the environment.

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Raindance

Making Visible the Community of the Internet

The current manifestation of the Internet is a direct result of how CyberSpace was colonised in an aggressive and economic manner. As a consequence of this the nature of much of the content of the Internet is inappropriate to the properties of its landscape, structure and community. This paper dismantles the visions of Cyberspace and illustrates through referencing Cognitive Mapping in real space the need to re-learn what Cyberspace is really like in order to construct new applications that will offer new interactive processes and opportunities for the internet user and their community.

The author references a piece of software entitled "Raindance" that was designed for cyberspace and that works to optimise the potential of the Internet as a true network. The project specifically addresses the communities of users that remain invisible from each other in current cyberspace and uses their visibility to enable an alternative way of navigating through websites.

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Introduction

'Raindance'[1] won a British Telecom Interactive Networking prize in April 1999 for its innovative use of the data that passes through servers as visitors to web sites log on and log off. Primarily, it is a data visualisation tool that illustrates how many people are visiting sites on a server. However, it also represents the current shift in emphasis of a new wave of software which is located between the server and the client that uses information from both parties to inform their interactive relationship. As the broadcast model for the Internet begins to diminish and the traditional "inert" web site is being transformed into becoming "intelligent"and responsive, Raindance questions the landscape that is cyberspace and offers a vision much more like our high street where the activities of the community inform our decisions of where to travel.

Visions of Cyberspace

The difference that the emerging culture of network applications (of which Raindance is only one), from the typical tools and representations that make up the Internet is the image that it creates of the "placeí we call "Cyberspace". Coined by William Gibson in his novel "Neuromancer", the term has been adopted to describe the "spaces" and "places" generated as communication occurs via the world wide web of networks and connected computers. In his original vision, cyberspace was the area in which a virtual journey was taken in getting to information that was organised on a hard disk somewhere. If this journey is now possible through the transference of information via telephone cables instead of the streets, roads, air routes and paths that connect up the actual world, then cyberspace is generated as we order the process of choosing one telecommunication pathway from another in order to retrieve our desired information across the web of connected networks.

Although we never leave our seat the linear procession of directions that we make becomes akin to travelling as we reach landmarks during the process. Gibson's cyberspace becomes a time/space because it is travelled through, there is no time to dwell as the next objective to overcome is always upon us.

As the Internet evolved from being a delivery system for communications to a place where communications could take place, chat systems began emerging. As people stayed online to talk to each other, the experience of travelling transformed into a familiar space that began to contain residues of past conversations and triggered memories of familiarity. Space was becoming place, and time became less important as the currency of interaction and exchange demanded a space for reflection.

From these space/time experiences, metaphoric places began emerging such as ThePalace[2] and the bar The Black Sun that Neal Stephenson uses as a social space in his Metaverse, the metaphorical universe that provides the alternative dimension for the adventures of Hiro-Protaganist in Snowcrash. The Metaverse is a literal representation of life on Earth; a space / world made up of places. Lifestyles that are defined by

activities are carried out in the same way as they are in actuality, forming not a cyberspace but a series of connected cyberplaces. Time slows down and participants engage with an alternative life that allows them to gain a new status as the economy of the space defines refreshing opportunities for places. Such a literal translation appears very slow and heavy for a subject matter that is typically agile and elusive, full of imagined impossibilities that the virtual reality work of Marcos Novak3 and the navigationable processes in Char Davies'[4] work realises. However, it identifies and manifests something that is omitted from the travelling time-led worlds of Gibson's people and community.

The Reality of Cyberspace

Defining the time delays and architectures between telephone calls, the places where websites are housed and the scale of networks as an environment or space is a proposition that occurred without the need to define a community. The inhabitants of cyberspace for Gibson were the bits and bytes of data that presented threats to the hero as he navigated around them as best he could with his mortal and analogue reflexes. Such was the apparent conquering of the new digital frontier that it was done, not for people, but as an act of dominance, with speed its primary weapon. Once it had been secured and mapped as a space for use and colonisation, places began emerging as visitors were sold space that they could call their "home". Although this seems an extreme and crude interpretation of how we begin to think about cyber / virtual / digital space it seems to fit with the current landscape of the internet in which the biggest homes are actually corporate websites that sell small spaces to small groups and individuals. The primary manifestation of a website is not one that is entirely interactive either, unsurprisingly the common webspace uses technologies that mirror print publishing forms (software development titles such as PageMill[5] and HomePage[6]) that operate to tell and sell us things with communication and dialogue kept to a minimum.

The apparently automatic form of exploration and the most dominant to emerge seems to have colonised cyberspace in a manner is absolutely capitalist, rewarding and effective for enabling a proportion of the environment to work and support a system, but ironically in the long term perhaps unsuitable for the nature of the landscape. It is slowly emerging through a growing number of new wave applications that the nature of cyberspace is not best suited for storing inert html pages that are located on hard disks solely for retrieval purposes. That in fact the extra-ordinary speed that information can travel to and from the simultaneously connected computers presents an environment whose properties are unlike actuality and therefore demand an alternative way of relating to the space (if it can be still called that).

The Problem with Being Human

Our experience of the world has a hierarchy that includes a linearity. This is simply a result of the streaming nature of the way we interact with actuality, where we call home or work, and how we connect and organise our lifestyles. Cognitive maps enable us to navigate and travel through spatial environments and find security in them however unusual they may be. Downs describes them as "a person's" organised representation of some part of the spatial environments (Downs,1977, p.6), the maps may be informed by visual diagrams, stories and experiences that represent your understanding of a place. Work on the distortions found in Cognitive Maps that lead to us getting lost or badly describing the relations between spaces and places reveals that many problems are due to hierarchical organisation. Whilst the non-linear complexity of experience in the present is clearly understood by ourselves as we perform extraordinary tasks such as playing sport, language encourages us to build maps that have some kind of hierarchy, perhaps because language is often imparted in a linear form. Stevens and Coupe (1978, p.422-437) find examples where subjects of a series of questions locate places badly because they reference a categorisation of the world from maps and consequently stored the relative locations of counties, followed by storing cities by the county that contains them. As a result of this many cities despite being West of another may be described North if the county that they were in was largely North of another. These distortions Tversky finds useful in identifying that spatial information is hierarchically organised because hierarchical organisation is characteristic of memory for linguistic material, from words to text, so that it suggests a common basis for spatial and linguistic memory. (Tversky, 1992,p.132)

The Possibilities for Cyberspace if we Pretend we're Not Human

The properties that bind our cognitive maps of actual space are relative to the nature of the places we visit, our understanding of the scale of trees as opposed to houses, cars to sheep, lamp-posts to bollards all provide a relativity to space and our understanding of its parameters. The speed that we can travel at has massively transformed the constraints of horizons and thus our worlds. It is fair to say then with a cognitive process for mapping and exploring that may well be linear and hierarchical, and with the constraints of being a 5 foot 8 inch organism able to run at 15mph and control an automobile at 100mph; that any direct movement to an environment where all things are connected with such speed that there may as well be no distance to speak of between them, in which routes are indirect and irrelevant, where records and artefacts do not degrade and there is no necessary hierarchy of experience, is likely to result in a few misconceptions.

Judging from the dramatic difference that new forms of web based applications are from the old, it appears that we are finally becoming acclimatised to the virtual environment of cyberspace. Assuming also that the initiatives of domination and mapping are never friendly or in the immediate interests of the community, it is also likely then that we can expect the new generation of software to ignore the publishing and broadcast models and begin using the nature of the network to enable communication.

Software such as Lotus Notes7, OpenTxt8, SETI Home Project9 and Raindance all address and acknowledge the presence of a community of users and attempt to distribute the actions, procedures and results across the network.

Raindance

The purpose of "Raindance" is simply to enable a virtual community of viewers to become more aware of itself by picturing the current activities of the whole system. If cyberspace was like real space, when we arrived in a particular street or homepage we would be able to base our decisions on where to go within that space according to the visible traffic of other visitors. Some spaces like bars maybe very busy whilst others like specialist shops maybe quite quiet.

Presently, most online services in cyberspace present a hierarchical list of possible places to visit on their server and there is no mention of other people visiting the site, making surfing a lonely and server biased experience. 'Raindance' is a simple illustration of how the traffic of users can be used to inform an interface to a website and enable visitors to 'see' their community.

In its current form Raindance is quite basic and it has no context from which to inform its graphics, so it simply uses circles whose size correspond to how many visitors are "hitting" that part of the web site. Upon arriving at the Raindance interface the user is presented with a host of circles all apparently fluctuating in diameter and size (Fig1). Upon clicking and holding down the mouse button whilst the pointer is inside one of the circles, the user is shown a menu in the form of a list which describes what the circle represents, how many visitors it is taking at the moment, and gives an opportunity to visit or to tag the link. Clicking on another circle will reveal the same type of information but if the circle is of a different size then a different number of visitors will be revealed.

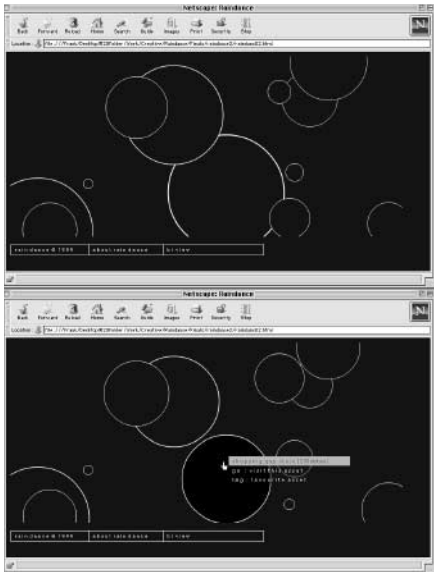

Fig 1. Raindance Interface

Although it is a very simple concept, Raindance reveals a great deal of information in an extremely clear manner. For users it provides a clue as the popularity of websites which might impair their download but might also suggest their interest value, and it certainly gives users a view of cyberspace as though it were populated by a community.

Notes

1. Raindance; Developed by Richard Hackett, Noemi Sadowska, Chris Speed.

Please visit caiia-star.soc.plym.ac.uk/projects/raindance to see Raindance but you will need the Macromedia Shockwave plugin. www.macromedia.com

2. The Palace, chat room with graphic user interface describing environments and users; www.thepalace.com

3. Marcos Novak; virtual reality architect, worked with four dimensional geometry in cyberspace see "Liquid Architecture".

4. Char Davies; virtual reality artist, uses breath aparatus similar to diving to navigate through virtual reality environments. Works include Osmose, and Ephemere.

5. PageMill; Web page manufacturing software by Adobe Systems.

6. HomePage; Web page manufacturing software by Claris.

7. Lotus Notes; Simple document editing system distributed across network enabling individuals to amend a shared document and share diaries. Manufactured by Lotus Systems.

8. openTxt; Sophisticated document editing system with voting and editing features enabling individuals to alter and amend a text document across the internet. Developed by Adrian Ward. www.signwave.co.uk

9. SETI Home Project; Distributed number crunching software released by Search for Extra Terrestrial Intelligence program designed to run on home computers which email back the results when processed. setiathome.ssl.berkeley.edu

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The Image Makers:
Visual Communication and the Family

Two teenage boys are playing hooky. As they hang out around the downtown mall, a girl catches their eye. They take aim, click the shutter, and send the picture to their more diligent classmates at school. Maybe they paste a message on it: "something to get you through maths class."

Grandmother lives some way off. The children are not able to visit often, and she sees her grandchildren even less. She could phone but prefers to send a picture message. A picture of the garden, reprocessed into a digital water-colour, appears directly on her daughter's screen. "My latest painting, darlings," she writes.

How real is visual messaging? After one year of design-research into the communicative behaviour of the family, the Maypole team narrowed its focus on the area of visual communication and the family. We assumed that image-based communication might support or enliven interaction among family members.

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The Maypole team developed wireless prototypes of digital cameras that allow the users to send images to one another at the press of a button. We gave them to 11 test subjects in four families—without telling them what they were supposed to do with the devices. After an initial familiarisation period, family members began sending pictures to one another. At first, the users snapped mostly inanimate objects just to get the hang of the controls. Gradually they started sending messages to one another—faces, visual jokes, and images that expressed emotions and moods. The users had a lot of fun using the prototype and used the prototype mainly for emotional communications rather than casual exhanges. Chit-chat in the form of pictures. It worked!

The results we saw gave us the feeling that we had opened up a fascinating area of communication that needed to be explored further. Therefore we selected a number of sociologists, psychologists and business specialists, and asked them to give their perspectives on the area of visual communication and the family. As each perspective discussed the subjects in a different context, the stories deepened our understanding about the area of visual communication and the family—offering starting points for the design of communication technology for non-work related purposes along the way. To give an impression of the variety of outlooks, some extracts are selected below.

The minutiae of everyday life

People spend a surprisingly large proportion of their time socialising; as psychologist Robin Dunbar says: "about two-thirds of our conversational exchanges are social chit-chat." Dunbar, author of Grooming, Gossip and the Evolution of Language, takes a long look at human behaviour and argues that it's the tittle tattle of everyday life makes the world go round. We asked what kind of future he can picture for visual communications technology aimed at family-level socialising.

Dunbar believes that the modern family will respond warmly to new inventions that boost emotional communication in images. "On the one hand," he says, "family members communicate with one another much more intensively than in the past. On the other, they are becoming increasingly dispersed across different towns or even different countries."

"Words are a poor way of expressing emotions. That is why so few people are capable of writing convincingly about their feelings. Visual images can stir up the emotions. It's clear that people react very emotionally to realistic images. Faces have a way of grabbing your attention." When asked if we really need a new gizmo in addition to the computer, Dunbar responds: "Of course you could mail an image like that, but you'd also have to write: 'Dear Grandma, little Johnny has done a drawing for you, please click on the attachment.' It'd be quite a different matter if the drawing were to appear suddenly on Grandma's screen more or less as a surprise."

Media Hermits?

"The child's bedroom has turned into a multifunctional space where the child can watch TV, play computer games, do homework on a PC and entertain friends," says Sonia Livingstone. Together with Moira Boivill, she recently published a hefty report called Young People New Media, which took a close look at the emerging bedroom culture. Are the media ruining childhood?

"The activities of children and teenagers are not radically affected by the new media, in Livingstone's opinion. "They pick up on them quickly but the media do not make any significant difference to their daily life." However, she does have some reservations about the growth of the bedroom culture. She brands it "living together separately." "In your bedroom you are no longer part of the family hierarchy but you are in a peer culture mode. You can watch MTV, phone your friends, and listen to your favourite CDs. The bedroom furnishings and the posters on the wall are a statement of your identity."

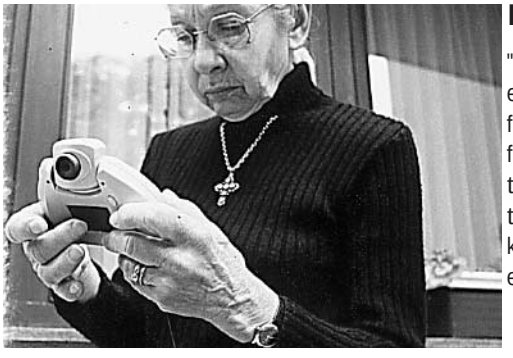
Livingstone does not expect young people to have much need for sending one another images. "I am sure parents would generally like to have more time for communicating with their children. Children, on the other hand, pull away from that. They are afraid they will find it boring. Youngsters mainly use media as a kind of identity display."

'Reading' family snapshots

Sociologist Luc Pauwels has a special interest in 'visual methodology' and talks about the roles of photography in the family. "Photos have always marked and celebrated important moments in life: marriage, birthdays, first communion. Happy moments. Family snapshots tend to idealise the family; they are meant to suggest outsiders that this particular family is a happy, successful and well-integrated one.

A photo album sheds light on the social and moral values of the family. The importance of at least some of those life-events has declined. We take pictures more often, and young people tend to take pictures of their peer group rather than of their relatives. Teenagers use pictures to create their own identity. Even so, the fundamental rules of photography have barely changed.

Now that we are able to enhance our pictures, you might think that objectivity and truthfulness were about to disappear. But photographic truth has never been anything but artificial. Photos are always a manipulation of reality. A certain amount of manipulation takes place before every shot when the photographer decides what and who to include in the picture. Digital manipulation is just a different take on that, which can be applied afterwards."



Do children drive the media market?

"As teenagers left home for college and discovered e-mail there, many urged their parents to join on this fun way to communicate. Arguably, no single company fuelled that trend. At the same time, WebTV greeted the market with a nice message saying, if you want to have e-mail so that you can correspond with your kids and see what 'the Internet' is all about, here's an easy-to-use, low cost way to do it."

Here lies an interesting implication for marketers to families. "In the United States, 40 percent of all purchases are made by or influenced by children. This leads to the question, at whom should we target the marketing? If a product will be used by all members of the family, do you try to capture the teen audience, knowing they will persuade their parents to bring it home?

In any event, companies will need to acknowledge a major shift in media habits between baby boomers and their children, says Carolyn Ramsey-Catan, manager of Business strategy Development at Philips Research in Briarcliff, United States.

Image telephony by ordinary folks

"Virtually 100 percent of Finnish young people aged 14 to 21 have mobile phones. What's more, research shows that half of their use is for SMS calls, short messages of up to 160 characters that can be types on the keypad. They use them for dating, birthday, swapping jokes and even sending useful information. The average Finnish teenager swaps about a hundred SMS messages monthly and the volume is growing." Seppo Kari, manager of wireless imaging a Finnish telecom giant Nokia looks to the future of telephony. "Conversations" of this kind will expand enormously when image communication is added, particularly for informal communication between family members. "So far," says Seppo Kari, "wireless imaging applications have mainly been conceived with professional users in mind—work-related stuff. But we can think of several other ways of using image telephony, ways that have nothing to do with work."

Polaroid's plan for a bright future

Polaroid's invention of instant photography was a classic example of technology-led success. Today, Polaroid has to find new ways to take, view, display, manipulate, exchange , or store images—as single actions, or as part of a seamless process. And those new ways must be valuable to users, otherwise they won't help the company stay in business.

To increase an understanding of the why as well as the how of consumer behaviour with images, Polaroid teamed up with E-lab, and experience research and design firm in Chicago. E-lab created what John Cain, president of E-lab, calls an "opportunity map" for Polaroid. By breaking down the photographic process into smaller distinct moments or experiences, the map helps the company's marketing and product development teams search for ways to make each experience easier, or more meaningful. It is significant, that in this project, know-how is given as much emphasis as know-what. The long-term benefit to Polaroid will be its increased capability to improve the rapid uptake of ideas.

These texts are extracted from The Digital Hug: families keeping in touch, the final publication of the Maypole project. It will appear as the November/December special issue of interactions—the ACM's (Association for Computing Machinery) bi-monthly on interaction design..

The Maypole project was a collaborative enterprise of Nokia Research Center and the Usability Group at the Helsinki University of Technology in Finland, IDEO Europe in the United Kingdom, the Center for Usability Research and Engineering in Austria, and Meru Research and the Netherlands Design Institute in The Netherlands. Maypole was supported by the European Commission as part of the Intelligent Information Interfaces (i3) Research Program.

User Modeling and Adaptivity in Nomadic Information Systems

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1 Introduction

Mobile and wearable computing and wireless multimedia communication enable new forms of user-adaptive applications that are becoming popular. Users of nomadic information systems either have connected devices with them all the time or can use existing stationary devices to access a nomadic system personalized to their needs. Adaptive nomadic information systems support both settings, i.e., they can be accessed at any time, from any devices and can adapt information to the user and his/her current context. This class of applications brings up new challenges for user modeling and adaptivity of which some issues will be discussed in this paper.

We will discuss some extensions of adaptive methods from adaptive hypermedia [1, 2] for nomadic applications in respect to the information available for user modeling, the application features that can be adapted, and the goals of the adaptations. Prototypical implementations of adaptive methods for nomadic information systems will be shown with the system hippie [3], which is an exhibition guide realized at GMD[1]. Currently hippie supports one art exhibition (Art at Schloss Birlinghoven) and one fair (Parts of hall 26 at CeBIT 99).

2 User Modeling in Nomadic information systems

Adaptive hypermedia systems mostly adapt the information selection and presentation to the user's goals, preferences, knowledge, and interests. In most cases the user model acquisition is driven by monitoring the activities of users in the information space or by an analysis of their connection and device characteristics. Additionally nomadic information systems can make use of localisation technologies (GPS, DGPS, Infrared, and digital compass) to adapt to a richer context model of the user's current situation. Beside an identification of the user's current position these technologies allow for user tracking in the physical space and his/her movements within.

The hippie system models the user's preferences, knowledge, interests, and movements in physical space. The user preferences are acquired by explicit user dialogs where the user can set language, select auto-started or manually controlled presentations, configure the interface and others. The user knowledge model is built by monitoring the user's interaction with the user interface. Positive evidence for gaining knowledge about exhibition objects comes from listening or watching presentations. Negative evidence comes from skipping or stopping presentations.

The interests of the user are the most difficult part to model, especially because they are highly dynamic. On the one hand we are assuming an underlying relatively stable interest trait structure of a visitor, on the other hand we take into account the current situation and a multiplicity of environmental factors that have an impact on the actual activation (the state) of the interest structure. In the hippie system we currently use different approaches to model the user's interest trait and state.

2.1 - Learning with domain taxonomies

With a rule based approach the system learns from all interactions of a visitor with the information system. Based on several taxonomies of the domain objects and information types about these objects the system tries to identify preferred types of objects of users (the user is interested in paintings), preferred type of information about types of objects (for paintings the user prefers the artist information), and preferred instantiations of object characteristics (the user prefers a painting when Vincent Van Gogh is the artist). Example: In the object taxonomy the class artwork has the subclasses painting, sculpture, and installation. Each of these three classes inherits common attributes from artwork and has additional specialised attributes. Depending on the information requests from a user the system computes a value for the user's interest in a class, i.e., if a user requests significantly more information about paintings than about the other classes the system infers that the user is currently interested in paintings.

2.2 Keywords for implicit user categories

With a keyword based approach we try to identify clusters of objects that are not represented by the object taxonomy. In this approach we try to identify similarity between objects that are not captured by the categorization in the domain taxonomies, i.e., for describing exhibits on a fair not all exhibits can be easily classified into a category—especially research projects often contribute to several research areas and questions. For solving this problem the system allows the author of an exhibition database to specify keywords with each instance he/she creates. In a taxonomy of domain interests these keywords are associated with an interest field. Every instance that is presented to the user triggers these interest fields by way of the associated keywords. Comparing the values of the interest fields allows estimations about the user's preferred interest fields and the user's interest for an object depending on the associated keywords. For future work we will expand this with a semantic analysis of the text information associated with domain objects in the sense of [4].

2.3 Interests of population

With a collaborative filtering approach we take into account the previous routes of other visitors and object characteristics explored by them. With this approach we are able to identify points of main interest and commonly used paths through physical space and information space. With the main points of interest and routes for the visitor population the system can propose tours and object information to the individuals. The visitor can be perceived as a typical member of the visitor population (the beaten path paradigm). Or the visitor can be regarded as an individual characterised by a significant deviation from the standard tour (the eccentric paradigm).

Especially the interest model can be refined by data of the movement model. In the movement model we store the whole track of the user within the physical environment of the exhibition. In our current hippie system we mainly use IR emitters and receivers and electronic compass to identify the current user position. With the current user position and the information about the exhibits in this area we are able to identify the artwork context a user prefers, e.g., if a user spends a lot of time in rooms/areas with sculptures the system triggers an update of the interest model for sculpture interest. If the user passes of certain type of object without stopping this behavior can give negative evidence for user interest in this type of object.

3 Adaptive methods in nomadic information systems

Beside the forms of adaptations already known from adaptive hypermedia [1], nomadic information systems can adapt to the current user environment and the support functions commonly needed in these environments. Furthermore the system can keep track of activities distributed over time and space, e.g., the preparation of an exhibition visit from home, the execution in the museum, and the evaluation of the visit from home again.

In the hippie system we currently apply several types of adaptive methods:

- Adaptive navigation support: We support the navigation of the users in information space and in physical space. Adaptive annotation gives the users feedback about the objects they have already visited and those which are currently close to their physical position. A special tour module allows the users to prepare own tours or select predefined tours from a menu. If a user selects a tour the navigation support in the information space is given with a "next" button to jump directly to the next object, navigation support in the physical space is given with a "map" button that displays a map with the user's current position and the next tour object with a "target" annotation.

- Adaptive maps: Adaptive maps contain the user's current position and annotate exhibits in the exhibition to support user's navigation in physical space.

- Adaptive presentation: Object presentations are adapted by the user's preference, knowledge, interests and movement model. In the preferences model the users can specify if they want to have an auto-start presentation or if they want to control the presentation manually. The knowledge of a user has an impact on the information selected about this object and tries to reduce information

redundancy. If a user selects a presentation about a painting and has already seen a painting from the same painter the system will just mention the name of the artist and will not present the artist details again to this user. The user interest model is used to adapt the information selection and sequencing to users. The selection of available information about an object is adapted to the user's interest in certain information types about the class of the object.

- Adaptive recommendations: Depending on the objects a user selects by navigation in the information or in the physical space the system learns about the interests of the learner. The interest model is used to generate adaptive tour recommendations. These tours can consist of objects from the same type or of objects that have the same value for a certain characteristic, e.g., they are of the same painter or belong to the same genre (an example can be seen in figure 1). Furthermore the system alerts the user if an object of interest is in his/her closer physical area, these can be hotspot objects defined by the user or objects of interest computed from the system.

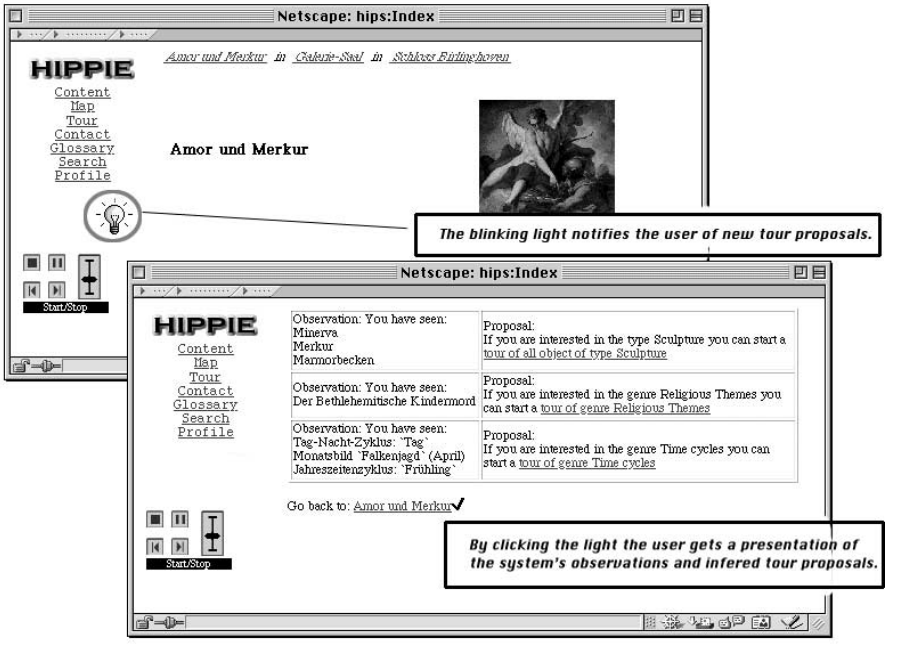

Figure1: An example for an adaptive tour proposal

- Adaptive interface: On the one hand the user interface can be adapted by the user, on the other hand the user interface is dependent on the context of a user who accesses the system. Different presentations and functionality support the user by default. When accessing the system from a desktop the main output modality will be visual (video, graphics, text) when accessing the system with a mobile device with position recognition the main output modalities will be audio (speech, audio alerts). Furthermore with a mobile device the interface will be optimized for controlling audio streams while in the desktop interface the system will be optimized for browsing data.

By the combination of features described above hippie makes use of Weiser's vision, called calm technology by ubiquitous computing [5]. (The equipment used in the museum and the information and communication interface is designed to let the visitor walk in the physical space of the museum getting access to a contextualised information space tailored to the individual needs and the current environment. Contextualised information presentation takes into account more than just the user's location (for contextualisation see [6]). A contextualised information space is defined by an information repository adapted to the location, the user and the task. In the case of a museum visit as an instance of self defined activities the task can be replaced by the visitors interest.

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Footnotes

1. The prototype Hippie was developed by GMD in the context of the project "Hyperinteraction within Physical spaces" (HIPS), an EU-supported LTR project in ESPRIT i3. The partners of the consortium are University of Siena (co-ordinating partner), University of Edinburgh, University College Dublin, ITC, SINTEF and GMD, CB&J, and Alcatel.

UNIVERSAL CANVAS

Internet Collaboration System with 'Interactive Image Control' and its Experiments in Distance Learning

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This paper describes an internet collaboration system, "UNIVERSAL CANVAS", which supports awareness by 'interactive image control': and a number of experiments in distance learning exchanging language and cross-cultural communication between Japanese and French students using UNIVERSAL CANVAS. It also explains how the unique features of UNIVERSAL CANVAS could facilitate the effective use of shared Web pages in a multiparty environment from the viewpoints of location, numbers of people, and method of the lecture.

'Interactive image control 'supports awareness without any special facilities and makes UNIVERSAL CANVAS work smoothly even in narrow band networks. It consists of 'Clear Window image control' and 'Abstract image control' technology. 'Clear Window image control ' can function as 'near-gaze awareness' by using other participant's live image as a background image of her drawing and allow participants to collaborate 'as if they are operating with a glass plate between each other'. 'Abstract image control ' sends non-linguistic information such as gestures and emotions.

1 Introduction

In recent years, the term Computer-Supported Collaborative Learning (CSCL) has been used in educational fields much more frequently than the term Computer Supported Cooperative Working (CSCW). Parallel to the development of internet technology, human communication is becoming increasingly important, and the expectations for group work learning have increased globally.

Social interactions are very important in the development of human communication through collaborative distance learning. However, verbal expression by itself does not convey all a human being wants to express. Non-verbal cues such as facial expressions, gestures, , behaviour, eye contact, and gaze awareness are particularly important for the development and improvement of social interactions for cooperative working.

To convey the non-verbal cues, collaboration systems need special machines or high-speed networks. So, I have developed a practical internet collaboration system which can support efficient communication, which can occur anywhere, anytime and by any one, but not a high level of communication in terms of expression of non-verbal cues. In other words, UNIVERSAL CANVAS does not support non-verbal cues precisely and strictly. However, UNIVERSAL CANVAS does support non-verbal cues roughly (rough awareness).

This paper presents:

1. UNIVERSAL CANVAS - its features and functions
2. The experiments of collaborative distance learning lectures which were conducted through UNIVERSAL CANVAS to exchange language and cross-cultural communication lessons between Japanese and French students.
3. A new method of interactive distance learning through which knowledge can be exchanged between individuals in different parts of the world. In the experiments, participants learned about each other's language by means of the most effective way of learning a foreign language namely to study it with a person who uses this foreign language, as a mother language. More than thirty thousand people from all over the world have used UNIVERSAL CANVAS so far. To indicate its importance and value, it should be mentioned that UNIVERSAL CANVAS has been recognized by the Java software site "Gamelan" (www.developer.com/).

2 UNIVERSAL CANVAS Internet Collaboration System

UNIVERSAL CANVAS is a practical, integrated collaboration system with enough 'flexibility' to enable participants to deal with a variety of working conditions and to exchange ideas.

Figure1: UNIVERSAL CANVAS

2.1 Problems with the present collaboration systems

Collaboration systems have problems: they cannot be used in ordinary and general conditions. For instance, TeamWorkstation, the MERMAID, and PMTCall have the following problems:

- They can be used only in a limited environment.
- They can only be used with a high-speed network such as B-ISDN for live images to consider other participants.

The other collaboration systems, such as Clearboard, MAJIC and MAX, which have a Seamless shared board, all have the following problem: to recognize what each participant is doing (participant awareness), and especially to recognize where each participant is looking (gaze awareness), the system needs special expensive machines and related tools such as polarized light plate and half mirrors. For these reasons, it does not have a practical use for ordinary conditions. With the expansion of Internet use, therefore, internet-based collaboration systems with practical use even with a narrow band network are highly necessary.

2.2 The features of UNIVERSAL CANVAS

The following are features of UNIVERSAL CANVAS:

1. Participants' awareness and recognition of member's spatial position by using still images,
2. Participants' gaze awareness and circumstantial judgement through video camera,
3. A practical system implemented by using Java Applet on World Wide Web,
4. An efficient presentation by cooperation of Java Applet with a World Wide Web browser,
5. Further cross-cultural communication by implementing a digital art museum. So that, all participants can develop the sense of togetherness and unity.

2.3 Practical System

To solve the problems referred to in 2.1, the system is implemented as an ordinary, general-conditions and internet-based system.

A platform-disoriented system implemented by the Java program is required for use anytime, anywhere and by anyone.

An integrated system designed for both real time and non-real time systems.

2.4 Efficient Awareness Supports

This system does not provide a high level of awareness, but it provides 'efficient' awareness by interactive image control on the small window, called 'Private Window', which can consider each participant's behavior and conditions without any special equipment or high speed network.

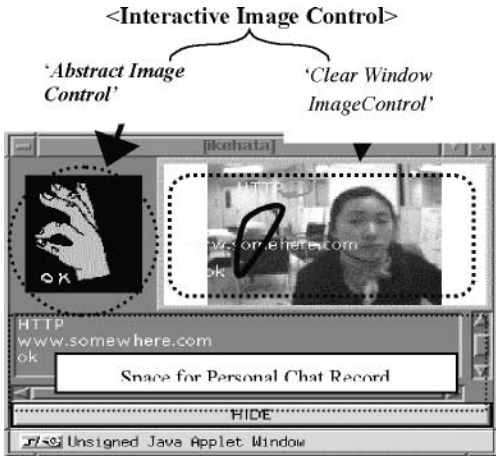

Figure 2: 'Private Window'

2.4.1'PrivateWindow'

The 'Private Window' functions as follows:

Interactive Image Control

-Near-gaze awareness and circumstantial judgement by video camera

-Awareness of simple communication, such as gestures, emotions and conditions

-Each participant's behaviour of operations and chatting record

-Recognition of participation and leaving the room

2.4.2 Interactive image control

Interactive image control is characterized by two attributes: 'Clear Window' image control and 'Abstract' image control

a. 'ClearWindow' image control:

'ClearWindow' image control has a 'gaze awareness' function. A participant's image from video camera server indicates it as a background image of his/her operation (drawing) which turns over on both sides. So, many people collaborate by looking at each other's face and operation, as if they operate by putting a glass plate between each other.

b. 'Abstract' image control

'Abstract' image control sends non-linguistic information, such as a gesture or a conditions image. The image is changed automatically and intentionally. It can make the other participants visually recognize their decision-making and their conditions.

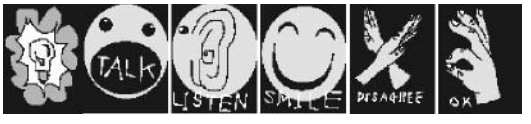

Figure3: An example of abstract images

3 How the experiments were carried out and completed

In the distance learning system, students both teach and learn: they teach other students and learn from other students. For instance, French students teach French language and culture and they learn Japanese language and culture. Different ideas and extensive information are exchanged. Students using this system could become more interested in other cultures and learn or improve their foreign language. Our goal is to find out

1. The type of distance interactive learning lectures that are suitable for World Wide Web
2. Whether or not the internet collaboration system, UNIVERSAL CANVAs is practical and useful for the purpose of distance learning.

This paper suggests a new method of the distance learning lecture through which each participant can collaborate and study interactively with others, 'A person to person exchange Lecture'.

The present methods of international distance learning are between two separated classrooms connected via the internet. However, in this way of distance learning, collaboration is only between two classrooms. It means communication is not of a private person-to-person type, but between a group of classrooms in each country. As a result of this, there is less chance of personal interactive communication.

The experiments are about learning each others language through one of the most effective ways of learning a foreign language, namely by studying that language with someone for whom it is his/her first language.

In this study, the experiments have been analyzed from three points of view:

1. Location
2. Methods of the lecture
3. Number of the participants

In terms of the lectures, there are two methods of lecturing in this study:

a. "an elaborately prepared lecture": a method where each person lectures as a teacher with editorial digital textbook, and the rest of the participants are students.

b. "A free-talk lecture": a method where everyone can ask and answer questions and discuss freely. They can become both a teacher and a student.

Each one-hour experiment is done 18 times in the course of 1 month. Each experiment is carried out by both the elaborately prepared lecture and the free-talk lecture. The participants' common language will be English.

Numbers / Location	Same room	Different Building at ECN	France and Japan
Each 1 French and 1 Japanese	March 1	March 1	March 2
Each 2 French and 2 Japanese	March 4, 10	March 5	March 10
Each 3 French and 3 Japanese	March 11	March 15	March 16

Figure 4: The schedule of the experiment

3.1 Time schedule

For the elaborately prepared lecture, each participant has to give a ten-minute presentation. For the free-talk lecture, each person could participate in a 40 minute question and answer session. Each participant took a five-minute examination at the beginning and at the end of each lecture.

4 Research findings

The results of each lecture have been assessed through:

1. the results of the questionnaires
2. analysis of each type of experiment
3. analysis of formation of collaborative groupwork.

The results of the questionnaires are evaluated by calculating an average of all scores and comments. The result of the examination is evaluated based on the students' knowledge improvement.

4.1 Evaluation of scores in questionnaire

Scores of the questionnaire are evaluated on the basis of the average scores for 19 questions. One can conclude that almost all of the questions have good response:

40 % of the participants like the FreeTalk Lecture method

30 % of the participants like both Elaborately Prepared Lecture and Free Talk Lecture methods

30 % of the participants like the Elaborately Prepared Lecture method.

4.2 Analysis of each experiment based on the results of the examination

The experiment is analyzed on the basis of exam results

Figure 5: The distance learning experiment using UNIVERSAL CANVAS

4.2.1 Location and the numbers of participants

All students scored greater than 90 % in all examinations. In the experiments carried out at ECN and at different buildings of ECN in France and in Japan (which had no functions of interactive image control) students scored worst compared to the one with interactive image control. This means that interactive image control of UNIVERSAL CANVAS supports an efficient awareness and helps students' collaborative learning. Based on the participants' comments and the examinations results, only 4 participants could get the best distance learning group-work and collaboration through using Universal Canvas.

4.2.2Methods of the lecture

When the results of the examination for Elaborately Prepared Lecture and Free Talk Lecture were compared, the results for the former were better than the results for the latter. However, 57% of participants were more interested in the contents of the Free-Talk lecture compared to the elaborately prepared lecture.

The reason for this is that the Free-Talk Lecture method needs more collaboration. The more participants tried to collaborate, the more they became interested in the lecture.

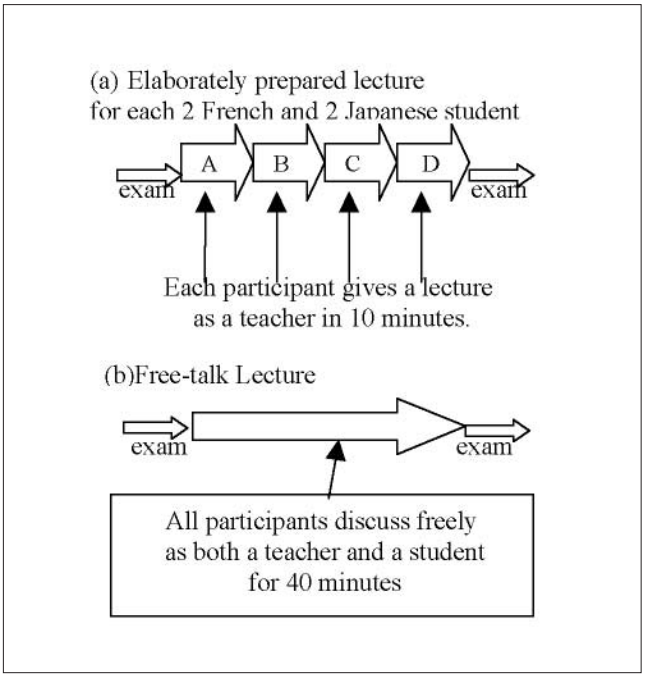

Figure 6: Two kinds of methods of a lecture

5 Interpretation

The experiments of Distance Learning using UNIVERSAL CANVAS showed that:

1. Location

   Based on the examinations and questionnaires, location differences did not hinder a group-work/study and collaboration in Distance Learning through UNVERSAL CANVAS, because of the interactive image control.

2. Numbers of people

   Although it worked best with only 2 Japanese and 2 French students, it is possible for more than 5 people to use UNIVERSAL CANVAS for the collaborative distance learning lecture.

3. Method of the lecture

   Both the Elaborately prepared lecture and Free Talk lecture are good for interactive and cooperative group-work studying. The Elaborately prepared lecture is easier to understand. The Free Talk lecture is more complicated and more difficult to understand but more interesting if participants can collaborate.

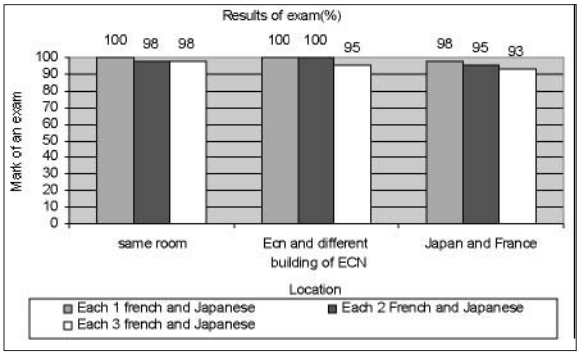

Figure 7: The result of the exams for each experiment

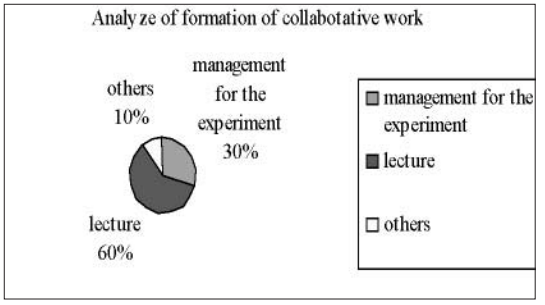

Figure 8: Analysis of formation of collaborative work

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Designing Memory Communities - Taking the Past into the Future

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Communicating shared memories is one of the cornerstones for forming communities. Commemoration can be seen as a means of building and communicating collective memory within a community. Interactive digital systems serve as a unique commemoration media in that they allow for both the transmission of content and serve as a channel of communication between members of a defined community.

By reviewing existing systems and online sites, I will highlight the design elements they incorporate for the purpose of commemoration and the communication of the community's shared memories.

I will then propose design guidelines for Memory Communities — media based commemoration systems designed to collate, preserve and relate the shared past in a meaningful way. These systems enable modes of communication for present community members and establish new modes of expression and interaction to ensure the continuation and future of the community.

Semiotic relativity in human-machine-human interaction - can we bridge the gap?

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When dealing with human-machine-human interaction we are confronted with a hybrid system of a combination of language and visual communication. The WWW and virtual worlds give us, for the very first time, a realistic chance to interact with people from very different cultures without help from professional translators. Interaction can take place via very different communication channels, which can be combined. Nevertheless, users still seem to cling to their culture and community as far as navigation on the WWW is concerned. We seem to miss the opportunity to come to a better understanding of other cultures and people, be it only on the European level.

When using signs, symbols, icons, emoticons, and colours (i.e., when creating new sites), we rely on the mutual intelligibility of the output. Yet, every user brings along with him the " semiotic landscape " (Kress, 1996 :15) he has grown up with, as well as the semiotic practices which are strongly coloured by affective factors. We speak of connected communities, but we forget that every community has its " semiotic unity " (McHoul, 1996 : 48) which might be unintelligible to other communities. In the same way as Sapir and Whorf considered language to act as a shaper of ideas, we deduce that the semiotic practices of each culture and community influence the cognition as well as the world view of every user. Research in this area would give way to a theory of semiotic relativity, in the sense of linguistic relativity. We use this thought experiment to explore what it means to be member of a certain community, that is to say to be 'prisoner' of that community's semiotic practices and frames.

The question that arises when analysing semiotic communication via the WWW is the following : apart from the purely descriptive work of analysis of the WWW as an ever-evolving semiotic space, how can we enhance mutual intelligibility when creating sites or virtual worlds? We are investigating up to what point signs, as opposed to natural language, can act as a substitute and ersatz of natural language: we consider the computer and the WWW as a sign-processing system and " self-organizing system " (Andersen, 1996) in that it can have internal states which allow the processing of signs.

Until recently, linguistics and semiotics have been trapped in the dilemma of a purely descriptive analysis. The speed of information flow on the WWW, as well as its large distribution, offers for the first time the creative possibility for every WWW user to be part of the creation of a new semiotic space: A completely new generation of meaning structures triggered by sign expressions make their way via the WWW every day and this will force us to revisit the intelligibility, actionability and historicity of semiotic systems, their meaning structures and their relationship to the experience of the world.

The theoretical objective of our research work is twofold: firstly, we want to gain new insights in the human inference processes via multi-channel communication and interaction; secondly, we want to use these insights in order to develop a creative space of symbolic and pictographic and iconic communication within the virtual world of AMUSEMENT. Every day, hundreds of people from different countries meet in AMUSEMENT and will experience what is actually communicated by means of images, symbols, icons and visual design. Yet, instead of simply experiencing the visual, they will not only be able to positively create meaning, but also negatively experience the limitations of meaning via visual aids.

This does not mean that natural language cannot be a vital part of interaction within this space. Nevertheless, we believe that 'meaning-in-use' can be experienced to a large extent via non-linguistic signs, in the Hallian sense of a 'silent language'. It will be very interesting to see how far we can go without the interference of natural language.

Within the framework of AMUSEMENT, we investigate which parts of information conveyance are being taken over (and to what extent) by other meaning structures. Presently, we are witnessing a changing role of distribution between language and icons on the WWW, where visual aids are more capable of communicating feelings, emotions or affection. Interestingly enough, we have noticed a wide range of cognitive divergences due to language differences between English speaking, French speaking or German speaking users. Thus, analysis must not only be community-based, but language-orientated, in that language apparently influences perception of space and time. Thus, we noticed an interesting divergence concerning

spatial and temporal cognition of the information space between Anglo-Saxon users and French users. This accounted also for cognitive differences between Anglo-Saxon users and German users, to a smaller extent, however. These findings will impose a theoretical basis for a combination of linguistic relativity and semiotic relativity

The outcome of our investigations will hopefully help to connect communities by enhancing mutual understanding via new channels of communication, information conveyance and positive recognition of cognitive differences between different users and communities within the WWW and virtual spaces.

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Community Participation in a Dialogue of Values and Ethics of Information Technologies

This paper examines the intersection of information technologies, power, people and bodies. Information technologies bring about positive changes, but they are also embedded in what Michel Foucault called power networks. Information technologies have inherited influences from prior historical, cultural and social structures. They are, at present, positioned to create greater efficiency, productivity, and profitability, instead of promoting more humanistic goals. I believe a dialogue of values and ethics is needed both within the information technology industry as well as in the communities that technologies are deployed in. There is a need for awareness and consciousness about the systems that are being built and the uses to which they are being implemented. Public participation is necessary to assure that we create the kinds of societies and cultures we desire.

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Technocratic Paradigm

With the advent of the information economy, it has been argued that a paradigm shift has occurred, however much of the present value system was inherited by a prior technocratic paradigm. Technologies do not arise in a vacuum, but have been products of a military-industrial complex, in which academia also participates. The consumer applications to which technologies are implemented often reflect this value system. Inherited are the values of constantly improving efficiency and productivity, with the ultimate goal of increasing corporate or individual profit.

Leo Marx traces the historical development of the Enlightenment notion that science and technology are instruments of progress, transformation and liberation from the period of the American Revolution to the present day. In the eighteenth century, U.S. founding fathers Thomas Jefferson, Ben Franklin and John Adams believed that science and technology were tools that would assist in the liberation of Americans. During this period, science and technology were attached to the ideals and goals of social and political freedom. In the spirit of this idealism, Franklin denied himself a patent on the design of his Franklin stove because he felt that inventions should be given freely and generously to others. [1]

By the mid-nineteenth century, however, the "technocratic concept of progress" was already taking root. That is, science and technology were increasingly separated from the goals of social and political liberation. As the U.S. became industrialized, the industrial elite promoted technological innovation to serve their own ends. Innovations were no longer shared with others, as Franklin had hoped, but benefited individual entrepreneurs, such as Andrew Carnegie, Thomas Edison and Frederick Winslow Taylor. Marx notes, "The dissociation of technological and material advancement from the larger political vision of progress was an intermediate stage in the eventual impoverishment of that radical eighteenth-century worldview. This subtle change prepared the way for the emergence, later in the century, of a thoroughly technocratic idea of progress. It was 'technocratic' in that it valued improvements in power, efficiency and rationality as ends in themselves." [2]

Frederick Taylor adopted the technocratic view in developing the notion of scientific management, or Taylorism, which fostered the idea that human movements could be measured, analyzed and controlled by techniques analogous to the principles applied to physical objects. Later Henry Ford applied Taylor's technocratic notions to the standardization of process and product in the twentieth-century workplace. Ford extended Taylorism by transferring skills from workers to specialized machines on an assembly line. The pace of work was controlled mechanically, as work was brought to the labourer. [3] These and other practices were called "Fordism."

Information technologies have incorporated facets of Taylorism into work performed by white-collar workers. Franco de Benetti, the managing director of the office equipment company, Olivetti, states, "The Taylorisation of the first factories… enabled the labour force to be controlled and was the necessary pre-requisite to the subsequent mechanization and automation of the productive process. In this way Taylorised industries were able to win competition over the putting-out system… Information technology is basically a technology of coordination and control of the labour force, the white-collar workers, which Taylorian organisation does not cover."[4]

Reflecting the basic values of Taylorism, information technologies create even greater efficiencies for both white collar and manual labour. Let me offer an example from the current discourse of wearable computers, an instance of a human-machine interface technology, which displays this set of values.

Wearable Computers

Wearable computers are being promoted for their ability to save time, making workers more efficient and productive (Figure 1). For instance, Xybernaut, a leading wearable computer company, remarks, "Studies in the use of electronic technical manuals have shown that large amounts of time are lost when a technician has to turn his hands and attention from the work at hand to access information needed to complete a task even when this information is stored on a desktop or laptop computer… Field tests with body-worn computing have demonstrated that large increases in productivity can come from the added mobility necessary to view a schematic while simultaneously reading and recording instrument data. The user's hands and body are free to perform other tasks, while his voice accesses and inputs computer data." [5]

While one cannot contest the labour-saving aspects of wearable computers, there is a distinct possibility that some of our technology choices are leading to an increasingly less skilled pool of employment opportunities. Xybernaut cites that at one Army demonstration, a janitor (unskilled in the task) was asked to fix an M1A1 Abrams tank's turbine engine using a wearable computer with an expert system. He was able, in only seven minutes, to diagnose and repair a problem that usually takes six hours for a trained individual with manuals.[6] Expert systems allow less skilled individuals to use the data without the actual physical presence of a knowledge expert. Are we moving to an era where surrogate bodies and unskilled labour will become the standard?

What is more, the knowledge worker may also be undermined. The project leader for Intelligent Fault Locator software developed by the U.S. Army, Dave Stall, said, "We went out and collected expertise among soldiers, engineers, manufacturers, consultants, or anyone else who had this knowledge. This was integrated into an expert system shell in such a manner that it could be retrieved quickly and easily. This now augments the electronic technical manuals."[7] Are we creating an era where information workers' special knowledge is captured and stored for reuse, rendering them less valued as well?

Steve Mann, one of the pioneers of wearable computing, has even developed an "underwearable" computer. It is Mann's vision that wearables will become as essential as clothing, to be worn constantly in public settings. He promotes a feedback loop he calls "humanistic intelligence" whereby the computer and the human being have a constant bond. The wearable becomes "a true extension of mind and body, and no longer feels like a separate entity. In fact, the user will often adapt to the apparatus to such a degree, that when taking it off, its absence will feel uncomfortable (figure 2)."[8] As computers and digital devices become smaller and more powerful, they are becoming increasingly ubiquitous in our lives. Just how integrated do we want to become?

We ought to ask about the purpose of new technologies rather than pushing forward with every labour-saving innovation. These technologies may lead to a decrease in the need for skilled labour, a reduction in the level of autonomy of that labour, and a continuing increase in the pace of work. The key question is not whether technology means progress but progress toward what end and for whom.[9] Rather than technology bringing the utopian dream of liberation or freedom for labourers, it supports the existing paradigmatic goals of higher productivity, greater efficiency and profit. These value systems when considered with respect to bodies and labour beg the questions: How far are we willing to integrate bodies and digital devices? Just how digital do we want to become? And whose bodies matter?

Figure 1: Xybernaut wearable computer

Figure 2: Steve Mann and Underwearable computer[22]

Values and Ethics: A Call for Dialogue

I believe a discussion of values and ethics is needed both within the information technology industry as well as in the communities that they are deployed in. There is a need for awareness and consciousness about the systems that are being built and the uses to which they are being implemented. Community participation is necessary to assure that we create the kinds of societies and cultures we desire.

I have identified four levels of active participation for change. They are resistance, local value influence, technological democratization and global context.

As Foucault contended, where there is power, there is also resistance, and the possibility for rupture of an existing power network. Within a given power network, a multiplicity of points of resistance and a plurality of expressions of resistance are available.[10] Individuals or groups may instigate resistance. Group activity can be manifested in demonstrations, protests, letter writing campaigns, petitions and the like. Resistance can be spontaneous or strategically planned, violent or peaceful, compromising or stubborn. Acts of resistance serve to create rifts and fractures within a society. Resistance is the lowest level of change. However, resistance is often the starting point from which larger social movements depart.

One key aspect of resistance is that one is reacting to a situation. Resistance is often a strategy used after a given situation or, in this case, technology, has already arrived. One example of resistance with respect to wearable computers might be a union arguing against their implementation or requesting that additional studies be conducted to test their effects on the physical body.

The resistance strategy is usually not proactive, but reactive. While resistance can be effective, it may be more difficult to create change after a technology's release. This is, in part, because a company or industry has already invested in research, development, sales and marketing. Thus they become active opponents of resistance.

Acting within one's local environment is the next level of change. That is, rather than merely resist, one actively influences a local situation by applying the community's values to a given technology during its implementation. An application of new technology becomes more effective if it reflects the values of a particular culture and situation. Bonnie Nardi and Vicki O'Day discuss several case studies where individuals and teams applied their own values to a new technology. They call the local environments, information ecologies.[11] They use "ecology" as a metaphor because it allows for local differences, and captures interrelationships among the social, economic and political contexts in which technology is utilized.[12] The definition of an information ecology is "a system of people, practices, values, and technologies in a particular local environment. In information ecologies, the spotlight is not on technology, but on human activities that are served by technology."[13]

Local value influence is about active engagement and participation of individuals within their information ecologies. As differentiated from resistance, individuals are seen shaping the way technologies are utilized. For example, one California school implemented computers and email. Parents, teachers and school administrators discussed the appropriate uses of email for their school community. A question came up as to whether or not to use email to distribute the weekly newsletter. One of the main functions of the newsletter is to share information with not just parents, but also children. The current newsletter often ends up on the refrigerator door for all to see. After it was noted that email is (at present) in the parents' names and not the children's names, the observation was made that children would not longer be viewing the newsletter in a public space. The school decided that one of the values and principles it deemed important was the building of relationships through personal interactions. Thus, they decided to continue distribution of the newsletter in paper format.[14] They valued the interaction it causes over the efficiency of the email distribution system.

Nardi and O'Day give practical advice for influencing one's local environment: work from core values, they suggest considering issues from the heart, not just the head and hands; pay attention, deliberately evaluate whether a technology or practice has merit; and ask strategic, open-ended questions about use.[15]

Another level of change within a larger context is to push for technological democratization. Richard Sclove aptly notes that progressive political strategies must contend with technologies' role in shaping fundamental social and political relations. "Contemporary technologies contribute indirectly to diverse social ills, and in particular conspire in subtle ways to significantly hinder participatory democratic decision making."[16] Some of the social problems Sclove observes include: increasing disparities in wealth, loosening of community bonds, decreased political engagement and experiential divorce from nature.

Sclove promotes design criteria for creating democratic technologies. The first criterion promotes technological practices that encourage "democratic community." Sclove borrows Benjamin Barber's term "strong democracy." Strong democracy entails a procedural standard of involving citizens, for empowering the people to determine their society's basic structure, including technological design and practice. Historic examples are the New England town meetings, the confederation of self-governing Swiss villages and cantons, and the tradition of trial by jury. Technologies would be designed and used to seek a balance among communitarian, cooperative, individualized and inter-community interests. Technologies that establish authoritarian social relationships would be avoided. People within a community would determine what these interests are and how to utilize a given technology.

Second, Sclove recommends that technologies be used toward "democratic work." Technological practices that affirm flexible work schedules and self-actualizing practices would be selected while those that promote debilitating or autonomy-impairing practices would be avoided. The technologies exist to take advantage of the notion of flexible work hours, controlled by the knowledge workers themselves, yet many companies remain locked in the old paradigm. Employers have yet to move toward allowing employees to work from home on a large scale, even though fax machines, Internet access, cellular phones, pagers and notebooks abound to make this a reality. Instead, technologies are used to demand more productivity and efficiency from employees.

Third, technological practices that help enable disadvantaged individuals and other groups to participate fully in social and political life would be embraced, while technologies that support illegitimately hierarchical power relations between groups, organizations, or polities would be shunned.[17] In the present economic mode, technologies are not primarily designed to assist disadvantaged groups. If women and minorities were included in technology design, the results would likely be quite different.

Fourth, the distribution of technologies that have potentially adverse social or environmental consequences would be avoided. However, technological practices that promote relative local economic self-reliance and autonomy would be embraced. Technologies that are compatible with globally aware, egalitarian political decentralization would be accepted. Fifth, technologies that are ecologically destructive of human health and survival are to be evaded in order to pursue ecological sustainability. Technologies that are globally pluralistic and locally flexible are to be pursued.

Last, but most importantly, technologies and technological practices need to be created with participatory design. Sclove promotes the coupling of technology institutions with greater popular involvement. Over

150 blind users, for example, tested the Kurzweil Reading Machine. These testers made over 100 recommendations to improve the product, many of which were incorporated into the final version. Another example is "science shops." Dutch university staff and students support networks of "science shops" through which citizen groups receive free assistance in learning to address social issues that have technical components. One success of these science shops was the cleanup of polluting metal-working plants.[18]

Rather than reacting to technologies after they have been developed, more proactive participation is necessary. Sclove eloquently states, "The opportunity to participate in RD&D [research, design and development] is a matter of moral right—essential to individual moral autonomy, to human dignity, to democratic self-governance, and to generating technologies more compatible with democracy."[19]

Finally, I challenge individuals to "play a bigger game" within a global context. A wonderful example of a successful approach toward building agreement about values within a larger context is Karl-Henrik Robert's Natural Step process. Robert, a leading cancer researcher in Sweden, was tired of the constant arguing and lack of agreement about what could be done to protect the environment. He decided to see if he could obtain agreement amongst 50 scientists in Sweden. They worked at the systemic level and were able to draft a consensus report, after 20 revisions. Then the King of Sweden endorsed the report after which millions of copies were distributed to every household and school. Participation widened, Swedish television promoted it and artists and celebrities helped raise awareness. The dialogues of the report resulted in Electrolux, the world's largest household appliance manufacturer, abandoning CFCs. Instead they use a compound that does not harm the ozone layer in their refrigerators and freezers.[20] One individual was able to ultimately engage his entire nation in building a common set of values. Margaret Mead's remark rings true, "Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has." [21]

Examining technology from a position which values the environment and human life, perhaps we will arrive at different decisions with respect to technology, than the present ones. I surmise that we would apply technologies and tools toward the amelioration of the human condition, the creation of more leisure time, and an increased interpersonal connection with others.

Footnotes

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20 Gail Bernice Holland, A Call for Connection (Novato, CA: New World Library, 1998), 120-121.

21 Mead as quoted in Nardi and O'Day, 75.

22 An embodiment of Dr. Steve Mann's "Wearable Computer" and Reality Mediator invention. The eyeglasses modify (augment, diminish, or alter) the visual perception of reality. This "Mediated Reality" is controlled by the computers attached to the vestlike structure that is worn underneath ordinary clothing (outer clothing removed here to show the apparatus of the invention). This image originally appeared as Fig. 5 in the lead article of Proceedings of the IEEE, Vol. 86, No. 11, November 1998, cover + pages 2123-2151. Title: Humanistic Intelligence: WearComp as a new framework and application for intelligent signal processing. Author: Dr. Steve Mann, University of Toronto. URL: www.wearcomp.org/hi/index.html.

New Communication Structures for Third System Groups

The C3E Project

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Introduction

In the following paper we give an overview of the C3E (CyberCinema - the Third System and Employment) project. In this project a network of public spaces for entertainment, education and debate throughout Europe, primarily located in rural regions, in urban neighborhoods in crisis will be created.

The aim of the C3E is to use technologies developed for electronic cinema applications (Cyber Cinema) as a communication and learning tool in two contexts. First, the major use, in the context of the 'Third System and Employment' pilot action programme is to assist in strengthening local Third System structures, and appropriate affiliated regional development and policy making bodies and institutions, and thereby facilitate the creation of employment in the Third System. Second, in a minor sense, in the context of already ongoing Local Agenda 21 consultation processes, the aim is to assist the local sustainability debates and to strengthen the link to the Third System and employment spheres.

Project description

The provision of a technological and human resource infrastructure is one thing, however, it is quite another to develop CyberCinema as a resource for the community in order to develop the local level of the Third System. This project, carried out in the action-research mode, aims to both demonstrate and develop the, as yet, unrealised and only partly imagined potential of CyberCinema in the public sphere. The focus of the project is to explore ways in which CyberCinema can be successfully inserted into a range of Third System projects, most of them already established and known in the 'Third System and Employment' pilot action and other programmes.

Seven sites will be selected for the implementation of basic audio-visual group conferencing facilities that form the core of the CyberCinema technology. The exact nature of the Third System projects cannot be pre-judged as it is dependent upon the final selection of sites, and the 'content' that is relevant to those projects. At present the following sites are candidates for the C3E project:

MAIN SITE	MAIN THEME	EVENT
	Social Exclusion and the World of Work	
Amsterdam: De Balie Centre	Social and Cultural Barriers	Various programs to help refugees and to establish, by means of Internet and radio stations, links between the refugees and their home countries, and refugees from one country who ended up in different places
Athens:	Social and Cultural Barriers	Various programs to fight xenophobia in schools and in other institutions
Dublin:	Economic Barriers	"Carers" - care for the elderly and the sick

MAIN SITE	MAIN THEME:	EVENT
Marseille: Friche Belle du Mai	Economic Barriers	Community employment schemes, such as job exchange on local "free" radio station
Potsdam: Jewish Community	Social and Cultural Barriers	Schemes to commercialise community skills, i.e. musical skills
Speeke: Credit Union	Economic Barriers	Operation of credit union ("peoples' bank")

Conceptual Framework

The Third System has specific communication needs in the context of the knowledge society. The Third System is an intermediary system positioned between the economic, political and cultural systems. Its role has changed in the transition from the industrial to the knowledge society. In the industrial society the gap between the economy, politics and culture was bridged by corporate negotiation systems and not-for-profit, or voluntary, organisations. In the emerging knowledge society this bridging function is not simply an added extra but is a core function. Recently, leading sociologists, such as Manuel Castells, have characterised this transition to the knowledge society as the 'rise of the network society'.

The intermediate networks that comprise the Third System perform a variety of activities: consultation and negotiation, implementation, and the creation and realisation of knowledge. Typically, social actors discuss and create solutions and proposals at the local level. By contrast, democratic legitimation and legal frameworks are established at the national level, and the establishment of economic frameworks occurs at the trans-national level. Some functions, usually the most innovative and risky ones, have been, historically, locally provided within the Third System, commonly by Not-For-Profit organisations (for example: health care, rehabilitation, education, environment, mobility, housing, nutrition, or refuse recycling). In the industrial society some of these functions were taken over by the state. In the knowledge society more innovation and experimentation will be required to create the most appropriate intermediate organisations in our economies and societies. Third System agencies will thus become very important.

CyberCinema installations will be used to meet six communication needs arising in the context of the Third System project networks operating in each selected locale. The six communication functions in the multi-level, multi-field network are:

- narration;
- archiving;
- demonstration;
- deliberation;
- negotiation; and
- legitimation.

Together, these six components constitute the enactment of a multi-level public sphere for the Third System. This six-fold interaction will be networked across the case study areas and will constitute a learning resource in and of itself. Individuals and collectives will be able to participate in the narration, archiving, demonstration, deliberation, negotiation and legitimation of the following: best practice, introduction to both specific and generic knowledge, skill acquisition, as well as important social network processes such as debate and alliance formation.

It will be an explicit objective to focus on a variety of socially excluded groups in the population whether exclusion is due to social, cultural, economic, or spatial disadvantage. The project will not only offer a practical demonstration and realisation of the public sphere dimension of CyberCinema, and the added

value of this communications form to these groups, but it will also evaluate the nature and scale of employment generated by the establishment of CyberCinema facilities both within and beyond the Third System in indirect and direct forms.

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Today's Stories

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Research frameworks are being developed that involve very young children in the process of development of future technologies. Children, their teachers and parents from schools in Israel and Denmark are coming together with researchers, educationalists, psychologists, designers and technologists to develop a wearable technology for educational use- the KidsCam. This example of a hyper-camera will facilitate and support the development of social, communicative and emotional skills in the context of the everyday activities of children. It is envisioned that such digital technology will become embedded in educational culture and create opportunities for shared reflection on early life experiences. Integral to the work is the development of an ethically theorized and ethically led practical framework to consider the issues that surround the development and deployment of new technology by and for children. These will include issues of appropriateness, need and value. A series of interactive presentations will be used to illustrate both the work in progress and the vision of the project.

1 Introduction - Pedagogy and Interaction Technology Perspectives

1.1 Framing The Scene

The Today's Stories project is evolving a wearable technology facilitated approach to learning for young children (4 to 8 years old) that is aimed at supporting the development of social, communicative and emotional skills of children in the context of their everyday activities. The facilitating role of technology will be complemented by the discovery of novel forms of educational interaction and the development of new media that often follows new technologies. Wearable technology will allow children to learn from reflecting on their actions and learn from other children's perspectives on their own actions. The technologies will facilitate capture and document such "reflective experiments in living". Children will build up their own but interrelated digital portfolio of their day's interesting events. A community memory of a group of children will be co-created and evolve through a didactic process of dialogue and reflection, leading to understanding. Children, teachers, parents, educationalists, developers, researchers and designers are focusing on the co-exploration of technology development in the context of a model of knowledge sharing. At the Israeli site a future-oriented educational framework, The Autonomy Oriented Education paradigm is geared towards the development of autonomy, morality and belonging in children [5]. In Denmark researchers are working both in local schools and focus groups to set up 'Communities of Enquiry'.

These children form groups of 'KidSearchers'', that are contributing to the development of this future technology. These interactive research paradigms have arisen from previous work by Roy et al [6] and Panayi and Roy [7] and are being developed within a Danish cultural context. The conditions for acceptance and success of deploying such technology in a social, cultural and ethical context are being investigated [8]. It is envisioned that these interactive digital artifacts will enhance and also contribute to cross-cultural understanding and critical technology awareness.

1.2 Aims and Content – Future Education

Key questions that may guide our thinking in terms of the nature of education in the future could be framed in terms of technological context and distance learning.

Three different directions in which the implementation of technology and distance learning can be developed in the future will be presented:

- Technocratic
- Fundamentalist
- Humanistic

In terms of Humanistic pedagogy for education in the future, examples of didactics that are being developed by the Center for Futurism in Education will be reviewed in the context of emerging technologies being developed in the Today's Stories project [Yael & Ronni ref].

2 KidsCam - A Deployment Scenario

The technology embodiment is currently envisioned as a KidsCam, a 'wearable' device to be worn by children that audio-visually captures events in the child's daily life, and relays them to a collective memory of interrelated episodes. KidsCam is a hyper-camera, i.e. an ad-hoc network of communicating cameras that record a hyper-video document of interleaved episodes from different perspectives. The KidsCam is designed to have image and audio processing capabilities operating over a wireless local area network. The network will connect the wearable computers to a server with two modes of operation for the KidsCam: 1) on-demand operation controlled by the children and 2) autonomous mode where the camera notices interesting events occurring and triggers the recording of cameras that share the same view.

Wearable cameras have been proposed by Starner et al [1], Healy et al [2] and Mann [3]. In [2] Healy describes a camera called the Startle Cam, which is triggered upon the detection of the "startle response" indicated by the wearer's skin conductivity. Techniques suggested in [2] and [6] for gathering information about the physiological states of the wearer using physiological signals, may be of interest to Today's Stories in later stages of development. Mann proposed in a recent paper [4] the possibility of automatic generation of photo albums. These techniques may be of interest to Today's Stories in optically determining which cameras may be sharing the same visual view given that an interesting event is happening or about to happen.

Today's Stories differs from previous work by specifically targeting the ease of pedagogical implementation of new technologies in learning environments. The children will be wearing the hyper-camera during school-time. Usability issues are being explored and the interplay between functionality, novelty and intrusion is an example of elements of the interaction being traced. The recognition algorithm will have two functions: 1) detection of interesting events occurring and 2) determining which children are sharing the same view given one particular interesting event. Machine vision techniques such as optical image flow are to be investigated to calculate distances between children as a feature for "interest value" of events. Image flow calculations can be aided by inertial data, received from accelerometers and gyroscopes as described in [9]. In [10] Davis and Bobick present a temporal template approach to represent and recognize actions such as aerobic exercises. Starlab already has a prototype of a camera that is able to gather inertial information about the camera motion, called the Metacam.

It is envisaged that temporal templates could be created, from different visual points of visual view. These representations of actions from each child's perspective could be used to infer specific information of interest in the visual field. Joint audio and video analysis of events may result in more robust decisions about the 'interest value' of events. Coupling the KidsCam with biosensors is also a promising way of improving the 'interest value' criterion. Feedback from children, during the authoring stage, could also be used to improve the recognition algorithm.

3 Artifacts for Reflection -'Composer', 'Memory Boxes' and 'DigiComs'.

3.1 'The Composer'

'The Diary Composer' is a multi-media environment under development that will allow children to form their ongoing portfolio out of the different sequences that capture events from various perspectives. Digital events will be augmented with voice, graphics and sound effects. A suite of annotation features will include stylized faces to express various emotions and special sound effects to highlight for example surprise or fear. A survey of state of the art multimedia editing and authoring packages and their current use in educational settings is being carried out and incorporated into Roadmaps that will support the technology development [11]. A novel feature that is proposed with the 'composer' is the option for children to interact with the scene and objects at different levels of abstraction thus creating rich artifacts for reflection.

Several types of abstraction and metaphor are being explored. Features currently under development include video filing system, video navigation, browseable timeline i.e. temporal event ordering. For example the child will be able, by browsing in the diary's pages to choose a month, a week or a day and select video files they wish to view. At that point, they will be able to narrow their selection to one video file by clicking on e.g. the first snapshot of a video taken the previous day's morning being optionally tagged by a graphic or text sub-title, where the children's videos and notes will be automatically arranged. In

this way, the Diary Composer will support organization of files, according to the date of their creation, that will be transparent to the child. In navigation mode the children will be able to navigate inside each video and pause, playback at any moment, entering a frozen frame mode, associate sounds and images with the situation shown in the frozen-video window. After a video part is fully processed by the child and augmented with sounds and graphics, it will be stored in its enriched format. The next time the child loads and edits the same video instance, all the graphics and sounds previously added will have been linked with the video playback.

3.2 Memory Boxes

The issue of how to deal with the amount of information that one captures in any given digital record has been raised during system development discussions. In order to explore this issue the concept of a 'digital information continuum' has been proposed. Memory Boxes, are being constructed as a means of capturing a 'constrained record' or 'digital memory'. A Memory Box can be used to collect memories of objects, places or people (i.e. information item) which have been marked by special Memory Tags. By opening the little box in the presence of objects, places or people, a memory of them is stored into the box. Technically, a memory could be a pointer to a multi-media document that is associated with the information item - but not necessarily a representation of it. By opening the box next to a computer screen its content is visualized. By opening boxes near to each other their contents are mixed. And by shaking, a box it is emptied. With the boxes, the only 'recording' of the event will be in the collection of e.g. three pointers, 'memories' of two children and an object. This leaves the initiative to explain what it recollects about the event and in what way it experienced it, completely with the child, and thus stimulates an alternative basis for reflection.

The 'Memory boxes' are currently being used with children to explore a number of notions of representation, relationship and interaction e.g. containment, information capture and exchange, proximity, intimacy, privacy, space and time. Digital portfolios are being created for individual and collective using existing technologies e.g. cameras, video cameras and digital toys and the new technologies as they come on stream. This project provides the opportunity to explore how new technologies become embedded in educational culture, Panayi and Roy [12]. Prototypes and mock-ups of the Memory Boxes and the KidsCam will be made available during the exhibition.

3.3 DigiComs

A series of videos and CD-roms are being developed for the children, teachers, parents and researcher to 'reflect' on the progress of the project and for presentation at academic meetings, exhibitions, teaching purposes and dissemination to press and media.

Key elements in the design of the series include the collaborative nature of the research with children as key people in the process and the involvement of the schools as communities. The creativeness of the children is highly valued in the context of both technology development and their comments in relation to technology in society and how it may affect them in the future. These videos aim to illustrate the atmosphere at the Danish and Israeli schools and the Natural Interactive Systems Laboratory sites. Footage includes activities of the children and teachers, and researchers involved in the project, e.g. video clips of the 'everyday' activities at school and their 'Stories', and photographic stills. At the Danish site the 'Today's Stories' work has involved working on storyboards and making the characters and props for simple 'video theatre narratives' (black backdrop), and some reflective discussion work about what the children have been doing as an illustration of the 'Community of Enquiry'. A group of children also work on storytelling using traditional and digital media. Examples of the short 'video theatre narratives' will be shown. Early examples of children's design work will also be included. The video includes some short 'video comments' from the teachers. Extracts from the 'Digital Interactive Community Memory' (DigiComs), will be presented.

4 Interactive Drama Experience

An interactive experience is being designed that will use age and theme appropriate props and presentational media to give a complex, varied and polyphonic representation of the project and its development. As a conceptual form of interactive theatre, we shall use and adapt techniques from 'Boal's'

Forum Theatre. An innovative form of theatre which is extremely flexible and effective at facilitating audience participation and 'live' involvement in examining societal issues and personal perspectives [13] [14]. This work has been used by members of the consortium in the development of interactive media [15]. It offers a linking substrate to explore several of the education and cultural issues that have been raised in relation to the development of future technology that could support children's learning. Among the issues are the development of living, innovative education that follows the paradigm of Autonomy Oriented Education (AOE) mode. A forum will also be created that both demonstrates and examines ethical values and standpoints, "as lived out" in practice, e.g. in new, living partnerships, through involvement, empowerment, hegemonic de-stabilization. Finally, interactive theatre offers an accessible medium, which can be recognized by many other ESE projects, several of which also operate with the concept of (learner) empowerment.

5 The Box of Stories – Installation

5.1 The Concept

The spider went to the god of the Horizon and begged for the BOX OF STORIES. After all, the box of stories is filled with all of the stories of all of nature's creatures: own it and you rule the world.

It cost the spider everything – including his own mother and his own son! But then he had to be given that box. The spider got everyone's stories, even yours and mine.

Then the whole planet screeched, and stopped. And all of the beings of the sea and the land and the air screamed with such force that the box burst open. And all of the stories of the world were sent into the sky and blown to every corner of the Earth.

So that no one creature could ever own them.

Ownership of stories - of one's own story - lies at the heart of this project. THE BOX OF STORIES will also provide opportunities for important and profound lessons. Pandora's box sent sorrows out into the world. Stories send happy endings, too and Truths.

5.2 Installation Description

The BOX OF STORIES will be a playground installation available for families throughout breaks from the Conference. The BOX OF STORIES site will consist of an intriguing box 4 cubic meters in dimension. This box-shaped structure will bolster a central notion of the project – that of containment. Within this larger box, at the entrance to the installation, there will be a box 1.5 cubic meters in size, filled with scraps of paper on which short sentences will be written or images drawn. Visitors to the box will use these as messages triggering them subjectively. Thus prompted, they will begin to create a scenario in concert with other participants who will also have drawn a story hint from the box.

Along one wall of the installation itself there will be a bank of TV monitors. Television is, of course, the quintessential modern Box of Stories. Within the box, and among the boxes, people – especially children - will make tele-visual tales that they – rather than any media 'spider' - will own.

Each storyteller will be issued with wearable video-camera equipment – the KidsCam. Three budding filmmakers at a time will develop the collaborative stories created within the box.

Starlab personnel will make sure that the region is safe, organized and attractive, but they will be discreet, so that the storytelling process itself will be unsupervised.

At a given signal from a member of the Starlab team all three cameras will begin running simultaneously. The participants will encounter each other, and improvise with each other, while at the same time recording the exchange. Then the footage will be viewed. Generally speaking, structured material, and self-conscious playacting will not actually be as interesting – even to the participants - as the spontaneous and real-life incidents: overcoming shyness, getting to know each other, dropping concentration – in short: moments that are true and human.

The viewing process will be greatly enlivened by 'fast-forwarding' through the more predictable sequences and, of course, using slow motion for the 'charged' moments, highlighting them and stretching them for amusement and also, tangentially, for instruction.

5.3 Rationale and Reflection

While nothing will interfere with the atmosphere of play, and while the KidsCams with their magical videos are above all toys, THE BOX OF STORIES will be a place of learning as well as a place of wonder. Most childhood activities involve the simultaneous pursuit of pleasure and research. During the viewing process participants will examine a number of aspects and issues that have been raised during the first phases of the Today's Stories project.

Aspects of Learning

It is said that lessons are learned when experiences are:

- captured
- contained
- re-embodied
- reflected uponIt is said that episodes from life are best understood when appreciated from a number of different points of view:

It is said that episodes from life are best understood when appreciated from a number of different points of view:

- Subjective impressions vs. objective evidence.
- Memory - essential in storytelling - is confirmed or contradicted.
- Histories, however fragmented, are best understood when they are inter-related.

It is said through the analysis of experience and through our own stories we learn to:

- Empathize
- Identify
- Resolve conflicts
- Become peacemakers.

It is said that analyzing experiences is supposed to require a level – or a number of levels - of abstraction:

To this end the Kidscam wearers will (be filmed and film each other) while they are watching the videos

Issues of Privacy

Even though the children involved will know their actions are being recorded, the less intrusive the camera equipment is, the better the video results will be. Inevitably, however, this raises questions of privacy, a vexed one in this day and age, when celebrities:

- Do anything to get on television.
- Sell the stories of their lives
- Complain when cameras and journalists get too close
- Complain that they feel 'owned'

It is also known that the incidence of video surveillance and secret recording is increasing in the everyday lives of people in different - and often worrying - ways in modern societies everywhere on earth.

Fresh insights will be provided with regard to privacy as children use the Kidscam:

- Children have their bottoms wiped, their tears mopped, their nakedness witnessed many times a day. And yet children have a very keen sense of what is private, what is secret, and what parts of their lives - and their own stories – are theirs to own.
- Children have an instinctive ability to distinguish between 'care' and 'invasion'
- In some cases children need to be told what grown-ups think about privacy, to see whether it accords with their own views, their own assessments, and their own notions of what may be revealed or hidden. Thus a child can really want to know: 'Is a foot a private part'?

Thus this exercise will offer some instruction, given instinctively by the children as to:

- The need for privacy
- The extent to which the need for privacy is learned
- The extent to which privacy is an issue with this equipment and activity
- The moral issue of privacy
- How children view privacy altogether

For tomorrow's citizens of the world - who may or may not be budding film-makers or TV directors, members of the paparazzi, market research experts or private detectives - a linear narrative will be compiled from all the recorded material. The Box of stories will be a step towards the development of communities of the Deep Future, and the building up of rich sediments of experiments in living. It will also provide excitement, delight and simple, glorious fun.

The final step in the sharing of this box of stories, will be the broadcasting of these video tales via the Internet and onto those other story-boxes, computers around the globe.

6 Concluding Comments

The innovative character of the project lies in the potential of how a child would use such a wearable technology. In the pedagogic context such technology could be described as the 'paper and pen' of the future and as a starting point for introducing advanced learning skills. Within future creative learning arena the control and accessibility of the means for manipulation of your digital records gives rises to greater opportunities for reflection, discussion and re-embodiment of ideas, events and interactions. The ability to transform your digital records could give rise to the creation of a new media for reflective learning. These new media would have the potential of supporting the development of understanding of inter-personal relationships and interactions for very young children.

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The Rain Curtain

A permeable boundary between real and virtual worlds

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The eRENA project is developing technologies to establish novel relationships between physical and virtual worlds that might be used to support new forms of performance, art and entertainment. One approach involves the creation of mixed reality boundaries that join together physical and virtual spaces so that the occupants of each can see into the other [Benford98].

A simple example of a mixed reality boundary is provided by a recent poetry performance that was staged as part of the development process. A poet was immersed in a virtual world, appearing as an avatar, and performed to an audience in a physical theatre. The audience saw a projected view of the virtual world as if it were a stage. At the same time, the poet saw a video image of the audience that was embedded as a dynamic texture map within the virtual world in such a position that it appeared top be looking back out of the virtual stage. The result was the creation of a transparent window between the two spaces that, coupled with a live audio connection, enabled the poet to successfully work with the audience, persuading them to stand up, chant and join in the performance. Figure 1 shows a view from the physical theatre as the poet (their avatar can be seen in the centre of the image) addresses one of the audience members.

More recently, we have proposed that different kinds of mixed reality boundary might be created with a range of properties [Koleva99]. Inspired by real world boundaries such as walls, curtains, windows and doors, that offer different degrees of solidity, visibility and audibility, our properties are grouped into three categories. Permeability properties describe the extent to which a boundary allows different kinds of information to pass across it and also whether it transforms this information on the way. Situation properties concern the spatial relationship that the boundary establishes between the connected spaces. Finally, dynamic properties describe temporal aspects of the boundary such as its lifetime and configurability.

Figure 1: A virtual poet addresses a physical audience member through a mixed reality boundary

A particularly interesting property of a mixed reality boundary is its solidity – the extent to which it allows participants on one side to project themselves into the other or even to traverse from one to the other. In its most extreme interpretation, traversing a mixed reality boundary would involve completely crossing the boundary, either materialising in or dematerialising from physical space. Unfortunately, materialisation and dematerialisation are only possible in the realms of science fiction. However, in eRENA, we have been experimenting with new forms of projection surface for use in performance, art and entertainment that increase the illusion of traversal, both to those crossing the boundary and those watching. This has involved collaborating with the performance company Blast Theory who have been working with a technology called the rain curtain.

The rain curtain is a fine vertical spray of water into which images may be projected. The resulting "screen" has a number of intruiging properties. First, it is not solid. Participants and objects can pass through it, appearing to emerge from or pass into the image. It also offers variable degrees of transparency, depending upon lighting conditions, and produces an image and sound that is aesthetically pleasing. The eRENA project has been working with Blast Theory to create a public demonstration of this technology, a performance called Desert Rain that involves six members of the public experiencing a collaborative virtual environment through six rain curtains. Both performers and participants pass through the rain curtain at different points as they journey through the shared virtual world. Figure 2 shows an image of a virtual world projected into a rain curtain (the image is subject to additional blurring due to the use of long exposure times in the photography).

Figure 2: An image of a virtualworld projected into the rain curtain

Figure 3 shows an early example of the rain curtain in use at a preliminary public demonstration that was staged at the ZKM in Karlsruhe in January 1999. The figure shows some participants watching a performer emerge through an image of a virtual world projected onto a rain curtain.

Figure 3: a participant watches a performer emerge through the rain curtain

Figure 4 shows the physical infrastructure of the rain curtain, including the plumbing, spray nozzles and water capture pool.

Figure 4: the physical infrastructure for the rain curtain

The eRENA project is currently working to create dry versions of the rain curtain. These will be non-solid projection surfaces that do not involve water and so may be suitable for use in a wider variety of settings. By combining these with the use of mobile robots to create remote physical proxies of virtual participants, we intend to create public interfaces between the real and the virtual that support some level of physical traversal.

The presentation will cover concepts of mixed reality boundaries, their properties, the rain curtain and progress with dry equivalents, supported by video material. By coincidence, Desert Rain will have its public premiere in Nottingham in the same week as the i3 conference in Siena, before going on to tour various locations across Europe. We hope to be able to show some footage of its public opening.

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Improving Human-Computer Interaction through Paper Interfaces

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Introduction

Paper has a number of clearly defined advantages over computers [12,14]: these include being cheap, portable and pleasant to read (high-definition); ubiquitous (paper can be found nearly anywhere); permanent (in the sense of 'frozen' since data cannot be altered much once printed); collaborative (easy to exchange and annotate and support multi-user input); and not requiring power, but simply a pen to operate, using skills that have been developed over time (thus there is no need to acquire new skills).

For these reasons, much research has been done on trying to merge work with paper and work with computers, making the transition from one to another as seamless as possible. This leads to a new notion of paper interfaces, or Paper User Interface (PUI), as opposed to Graphical User Interface (GUI), where paper becomes the medium to interact with the computer. But first, we give a definition of paper interfaces:

> *A Paper User Interface is a system that allows users to interact with a computer using a traditional piece of paper and a pen.*

There are two co-existing approaches in the Human-Computer Interaction field. The first one tries to make computers more like paper. Examples are PCs becoming portable, PDAs (Personal Digital Assistant) and the electronic paper technology [3]. The second approach augments paper with computing technology, without changing the physical nature of paper. The latter approach is the one in which we are interested and that is covered in this definition. By specifying traditional paper, we exclude electronic paper, and all electronic devices similar to paper. However, the traditional paper can be pre-printed with special tags, or can be augmented with different objects (stickers/tags) in order to be processed by the computer, but this doesn"t affect the physical nature of the paper.

Such paper interfaces can be an interesting support for community sharing, since much data is still kept on paper and people are in general more comfortable with paper than computers. Moreover, older people that form the memory of the community will most probably be more willing to use paper than computers to share their knowledge.

In the following sections we will first give a taxonomy of existing applications, and finally briefly describe Campiello, an example of a paper-based application ,and how it supports community sharing.

Taxonomy of Paper Interfaces

There are two dimensions that we believe are important when designing paper interfaces. One of the most important characteristics of paper is being portable, so it seems reasonable to implement support for mobility. The other dimension, to make it useful as an interactive medium, is support for interaction. Mobility can be defined as the number of access points to the system. A system implementing poor mobility will only allow access in an office environment, whereas a more 'mobile' system will allow interactions while travelling (through fax for instance). The other dimension, interaction, is quantified by the number of operations a user can perform with paper. A low interaction system will only allow the paper to be identified and thus generate simple operations such as showing the digital version of the paper, whereas a richer interaction will allow users to input and modify data in the computer and to interact with other users.

In the following section, the dimensions of mobility and interaction will provide us with a framework that we will refer to when describing the systems, which are classified according to the context of use: private/public and outside the office. However, some systems are more difficult to classify because they are closer to infrastructure than applications. We made an attempt to fit them in the framework of mobility/interaction by extrapolating the potential for paper based applications.

Private office context

Electronic tags [16] (infrastructure) aim to bridge the gap between the physical and the computer world, by using RFID tags that can be attached to physical objects. When waving the object next to a tag reader, an application on the computer can react to it and perform various tasks. RFID are very small devices that can be attached to any object (paper, books, videotape, etc). For instance, attaching a tag to a business card allows the display of the user's home page. Mobility support is fairly poor in the example shown, but we could imagine spreading the technology to many places since it is a cheap and almost invisible system. With regard to interaction, the possibilities are limited but the authors suggest a way to combine operations; for instance, waving a paper can invoke the digital version, and then waving a French to English dictionary can generate the translation of the paper from French to English. However, free text input for instance cannot be envisaged and thus the technology imposes limits on the interaction.

Digital Desk [17,11] (infrastructure) uses video image processing techniques and projection in an office environment to seamlessly integrate the physical and the computer world. OCR techniques were used to cut and paste data from paper to electronic documents and special paper tags were used to select a piece of data in the physical world. Digital Desk supports low mobility and medium interaction, as in InfoWall, it is more focused on the exchange of information between media.

Paper Link [1] (infrastructure) augments paper with electronic features. It uses a highlighter pen augmented with a camera, along with simple computer vision to allow a user to make marks on paper which can have associations in an electronic world and to 'pick up' printed material for use as electronic input. They describe use of a bookmark that contains a list of possible commands that can be extended by simply writing new commands. Paper Link is designed for an office environment and thus supports low mobility, however the bookmark example shows a potential for high interaction.

Video Mosaic [9]: Paper video storyboards are used as a framework to experiment linking the digital to the computer world. With Video Mosaic, elements of a paper video storyboard are used as input to an on-line video editing system, thus taking advantage of the best aspects of each. Two versions have been developed; one for Unix and one for Macintosh. The Unix version uses only video analysis whereas the Macintosh uses also barcodes and a barcode reader to link the two worlds. This system supports low mobility, but a good set of interactions (playing a storyboard, capturing hand-written annotation, printing out a sequence of storyboard elements).

Public office context

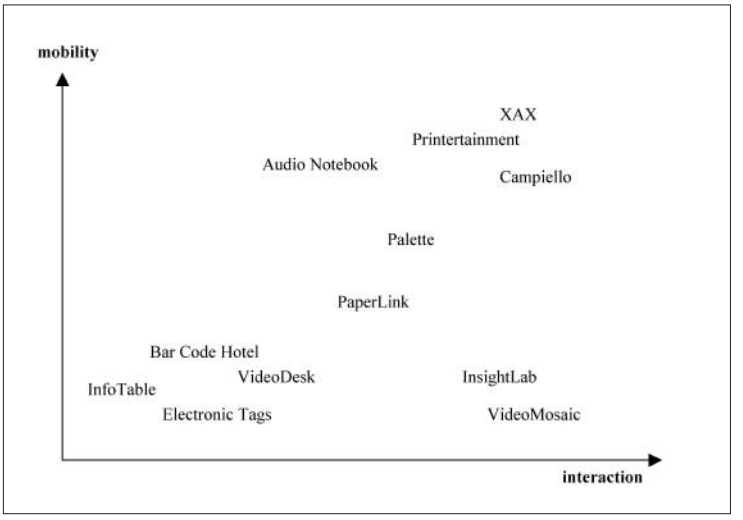
InfoTable [13] (infrastructure) supports the interchange of digital information among portable computers, table, wall display and other physical objects. Special 2D tags are used which allow detection of the ID of objects as well as their position and orientation. The system does not focus on paper interfaces, but mostly on data exchange, however it makes use of a different type of identification based on 2D tags, which can be used for paper. This system is dedicated to an office environment thus with poor mobility, and limited interaction through paper.

Bar Code Hotel [5] is an interactive art exhibit for multiple participants. By covering an entire room with printed bar code symbols, an environment is created in which every surface becomes a responsive membrane, making up an immersive interface that can be used simultaneously by a number of people to control and respond to a projected real-time computer-generated stereoscopic three-dimensional world. Paper interaction is not the focus of the project; paper is considered an object among others. Mobility is low since the system is confined to a room, and interaction is low when it comes to paper.

Insight Lab [8] is an immersive environment designed to support teams who create design requirements. It consists of software tools to manage multimedia data, numerous display devices and writing surfaces, and the use of barcodes to link paper, displays and data. Paper interaction is supported though the use of a barcode reader, a custom-designed barcode command slate, and barcode-enabled paper forms which are called "Linked Sticky Notes" and "Linked Data Reports". The Barcode Command Slate is a sheet of paper filled with barcodes and the associated commands. For instance, to view a video, one could scan the "view media for" barcode and scan the barcode of a video which plays the video on the computer. This system supports low mobility (restricted to a room) and high interaction.

Palette [10] is a digital appliance designed for intuitive control of electronic slide shows. Palette cards are encoded with slide information permitting presentation by simply sliding a card under a Palette code reader. A presenter may compose a talk by selecting cards from one or more sets of previous talks. Here we have an average mobility support since users are not restricted to their office, and are not tied to a specific position in the room. Palette also supports much interaction, the paper controls the order of the slides, and allows operations such as mixing slides from different shows that are actually more difficult to realize on the computer. For changing slides at the last minute, the authors suggest having a few empty slides ready, so that adding slides to the PC presentation can still be done, but this is still a workaround for a lack of interaction possibility.

Printertainment [6] suggests the concept of interactive cover sheets, the use of cover sheets output from printer jobs as a means of interaction (asynchronous). It uses glyphs and Xerox's Document Application Environment (DAE) to process the paper. A number of applications have been implemented: Xamagotchi, "virtual printer pet" (i.e. tamagochi), where people could check boxes on the cover sheets to take care of the virtual pet. MadLibs, a form fill-in party game that uses input of nouns, verbs, adjectives and produces an amusing story; Cover Notes, a group communication tool where people get a cover sheet with a set of randomly picked hand-written comments, and can add more comments. From the mobility point of view, the application can be used at any printer connected to the system in the building, so it's more mobile than systems restricted to offices. And interaction is quite powerful especially from the example of Cover Notes.



Outside the office context

XAX [7] (infrastructure) provides a framework for supporting applications which use paper interfaces. It consists of a server, a form editor, and a client-server interface. Forms are made up of glyphs to be identified, and checkboxes and comment boxes to input information or issue commands. XAX supports high mobility since data can be input from fax, and high interaction through the use of the generic forms (similar to dialog boxes).

Intelligent paper [4] (infrastructure) is a proposal for bridging the gap between the physical world and the digital world. Intelligent paper pages are standard sheets of paper entirely covered with printed marks, invisible to the human eye, but visible to a special pointer device. The marks convey two types of information: unique page identification plus position relative to the page frame. An example of application would be to point to different locations on a map of Paris, and having the computer show information about each location. This is a proposal and therefore has not been implemented but is still an interesting concept although difficult to classify in the mobility/interaction framework.

Audio Notebook [15] allows a user to capture and access an audio recording of a lecture in conjunction with notes written on paper. The audio is synchronized with the user's handwritten notes and page turns. The paper notebook is placed on top of a digitizing tablet, and the user takes notes using a cordless digitizing

pen with an ink cartridge. Playback is triggered by the location and pressure of the pen, and page detection is done through a specialized detector. The user can also navigate in time by dragging an audio scrollbar. The system is very mobile and supports a number of interactions, such as scrolling the audio, playing the audio each time a page is turned, and recording, but is limited in the framework of audio applications. The system is not designed for a generic communication between paper and computer.

Campiello [2] aims at supporting the dynamical exchange of information between local community and foreign visitors. The Paper interface provides a means for the user to request information as well as to add new information to the system. As in Printertainment, checkboxes, comment boxes, glyphs and a scanner/printer are used to communicate with the system. Thus Campiello supports high mobility and high interaction.

This overview shows that a large number of systems already exist, and that the field has been continuously growing since the Digital Desk. However it is not well structured, and each system seems to tackle a specific issue. In fact, a clear specification of paper interaction hasn't yet emerged from all these projects, and although this field is promising, it is still too young to say whether the paper interface will become common in the office environment.

Community sharing: the Campiello project

This overview provided general knowledge of paper interfaces, but didn't provide details. In this last section we will give a more detailed description of the Campiello system as an example of a paper based application. The Campiello project aims to develop and support the exchange of information within local communities and between those communities and visitors. It makes use of new interfaces such as a paper interface and a large screen display, and the traditional web interface. What is important is the focus on "warm data", which are data that are added to the system by the community itself, as opposed to "cold data" which are typically found in tourist's books. This warm data is what defines Campiello as a community shared knowledge base. It also contains the living memory of the community in the sense that users of the system continuously update it with knowledge about not only current and future events, but also about the past of the community.

The paper interface was chosen as an interaction tool for the various advantages previously stated, and especially for the fact that it is mobile and doesn't require acquiring new skills to interact with computers. Moreover, the paper interface allows the input of hand-written data, which contains richer information than typed text, thus making the interaction more "human" and enhancing the sense of community. However, a simple means of interaction was needed for the paper interface. The users should be able to navigate in the data and be able to comment, rate it and be identified. We used a very generic interaction scheme similar to dialog boxes in current computer interfaces. It is based on checkboxes and comment boxes as the basic means of interaction. The interactive paper made of text, picture, checkboxes and comment boxes is called the active Newscard. The current set of possible operations with checkboxes is used to insert ratings and to print more information, whereas comment boxes allow one to add comments, and to identify oneself. Identity is provided by having a squared comment box on the upper right corner of the Newscard, in which users can stick their identification tag, provided by the Campiello system. This tag contains a picture and a glyph, which allows mapping of the action done under the user's identity. The system is based on Xerox's DAE, thus access is provided by scanner or fax.

Campiello is an ongoing project, and the paper interface is currently evolving to include newspaper formats and interactive maps. Newspapers can provide a personalized view of the local news and can be interactive through the use of detachable Newscards. Interactive maps allow information to be requested through pointing directly on a map.

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Tracking users' movements in an artistic physical space

HIPS studies new technologies and interaction modalities that allow people to navigate both a physical space and a related information space at the same time. In this paper we briefly describe the steps from detecting a set of infrared sensors to the building of an internal representation of the visitor behaviour and discuss how this knowledge is employed to build a personalised presentation. In HIPS the Physical Organisation Knowledge Base generalises the notion of space relying on a notion of naive geometry rather the usual Cartesian geometry. A Visiting Style Module estimates the degree of compatibility between the user's movement patterns and four categories. Hence the Presentation Composer builds a new presentation selecting from an existing repository of audio files using knowledge about the visitor's area/orientation in the Physical Organisation Knowledge Base, while information about the Visiting Style is exploited to collect specific information to be delivered to the user.

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Setting up the context.

The HIPS project's main research activities are new interaction paradigms for navigating artistic physical spaces (eg museums, art exhibitions or even towns). The system is meant to provide the visitor with personalised information about relevant artworks nearby. The information is mainly audio in order to let the user enjoy the artworks rather than interacting with the tool. The visual channel is employed too, in order to help the visitor recognise details of artworks and to orient themselves with a (personalised) map.

Fig. 1: User interaction episodes

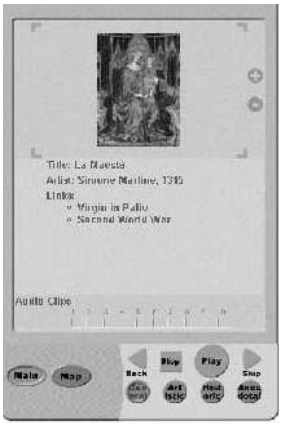

Fig.2: PDA interface (see [7])

A prototype has been demonstrated in the Museo Civico in Siena. The basic hardware infrastructure has been tested using a Pen Tablet PC connected to an IEEE802.11 compliant wireless network after integration with an IR based position recovery module. The transparency of the wireless connection for the user, together with the absence of relevant delays in the production of information, are encouraging the implementation of even more sophisticated prototypes. The implementation of the components dynamically models a User Model and assembles the presentations to be delivered (Presentation Planner). The User Model includes the Visiting Style model, which infers the visitor movement preferences.

In this scenario, tracking the users position in the physical space is not only a matter of sensing: users move in the space in order to get information. In this sense, movement resembles a communicative act. As for all communicative actions, knowledge come into play.

In the following we briefly describe the steps from detecting a set of sensors to the building of an internal representation of the visitor behaviour, and how this knowledge is employed to build a personalised presentation. More details of the HIPS project can be found in [1]. For a discussion of the module which builds the presentation, see [4] and for a discussion on sensor position see [6].

From sensor codes to position ...

20 IR emitters have been installed in the museum room. Taking into account the most relevant positions to appreciate the artworks, a grid of 24 positions, with 8 orientations each, was created. During the learning phase, 192 log files were made, lasting 3 minutes each, recording the absolute time during which a set of different codes were detected. We also created 20 arrays of 192 elements (one for each transmitter), containing the percentage of time in which the code was detected. This was the collection of the learnt probabilities of viewing a single IR in each position with a give orientation of the user. Every time the software module is interrogated, a computation is performed using the collection of arrays associated with the received sensors. The position with the highest likelihood is assumed to be the actual position. The system can thereby track the movement of a user, according to the discrete grid of positions and orientations.

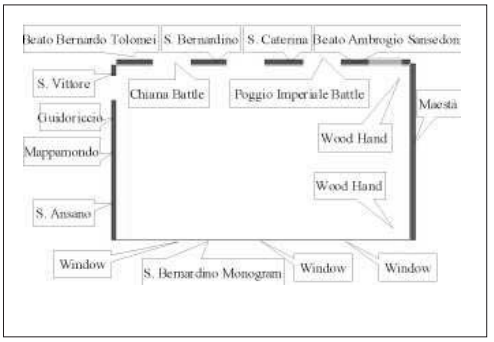

Fig. 3: Artworks in the Sala del Mappamondo

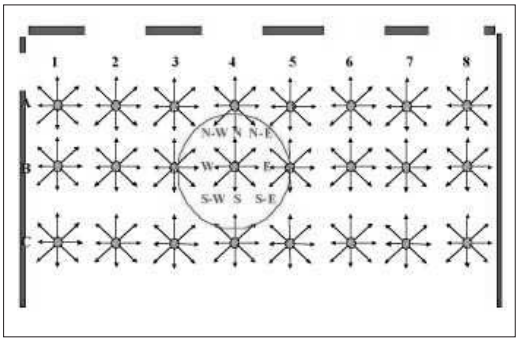

Fig. 4: Positions and Orientations (arrows)

... to the knowledge of space ...

The representation of space described above is useful for drawing maps, but when the task is to describe a painting it is better to employ a different representation. In HIPS the Physical Organisation Knowledge Base (POKB) generalises the notion of space by relying on a notion of naive geometry rather than the usual Cartesian geometry. Moreover, we tried to abstract away from the particular localisation system used (currently overlapping infrared areas, but the use of GPS is planned for the outdoor prototype).

The basic notion of the POKB is the area. An area is a closed region of space identified by a name and a type (e.g. a room, a floor, etc.). An area can contain other areas; an area that does not include any other areas is called a primitive area.

Usually, an area contains one or more exhibit. An exhibit is identified by a name and by its containing area. Each exhibit belongs to exactly one primitive area.

In order to abstract away from the particular localisation system, we define the orientation of a visitor at a given time by the set of exhibits in his/her line of sight. The POKB encompasses a mapping function that maps each location code coming from the current localisation system (e.g., M-A-3, East) to an orientation in the sense above. Thus, at each time stamp, the position of a visitor is determined by a pair <area, orientation>.

Figure 5 illustrates the mapping of the location codes to the position pairs for the Sala del Mappamondo. The green dots represent the possible set of sensor codes. The red squares are areas and the green labels signify the orientation for each sensor code. For example, for the sensor codes <A,3,east> the position in the POKB is <guidoriccio, maesta>, which indicates that the visitor is in the "Guidoriccio" area, but is oriented toward the opposite side, looking at the "Maestà".

The POKB also contains other information about the exhibits, such as title, author, date, etc., that are passed to the User Interface to be displayed on the screen. Other information relevant for other modules, such as the minimum and maximum average time spent by visitors in front of each exhibit, used to compute the visiting style, are stored here.

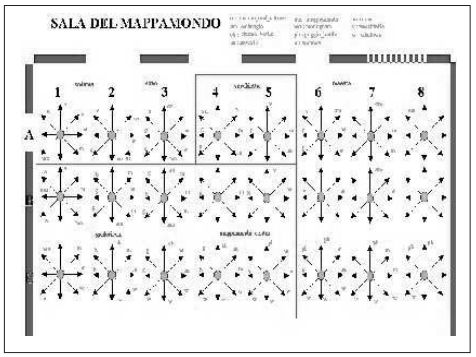

Fig. 5: Mapping Sensor Codes to POKB Positions.

... to understanding user movements ...

According to the ethnographic studies of Veron & Lauvassier [5], visitors of museums can be classified into four categories. The ant visitors move slowly and closely to the artworks, observing almost all objects with a sort of sequentiality; ants follow the directions given by the curators and stands a lot in front of artworks. The fish visitors tend to move with different speeds in the middle of the space, with a lateral view of the artworks. The butterfly visitors see almost all of the objects, but without the sequentiality of ants. Lastly, the grasshopper visitors tends to cross the space quickly, jumping towards the objects which attract their attention confidently, and standing there for quite a long time. More information about the Visiting Style model from a Human-Computer Interaction point of view can be found in [2]. In the following we describe the current Visiting Style Module (VSM).

The module estimates the degree of compatibility between the user's movement patterns and the four categories. Whenever the location/orientation value changes in the POKB, the VSM computes the probability that the visitor belongs to each category (for example, at a given time stamp, a visitor can be FISH 20%, ANT 30%, BUTTERFLY 50%, GRASSHOPPER 10%).

In order to compute the array of percentages, three main conditions have been taken into consideration: time, the number of artworks already seen, the time spent on each artwork and the sequentiality condition. The last two conditions are briefly discussed below.

Time condition: each artwork in the POKB has been assigned an estimation of the maximum and minimum time considered necessary to "appreciate" the artwork. This estimation depends on the artwork size, on its placement in the physical space and on its importance and affordance with respect to the other artworks. In the future, we plan to use the system logs to compute the time condition.

Sequentiality: this is the degree to which the visitor visits the artworks sequentially. We have divided the three sequentiality styles:

- Cyclic sequentiality (clockwise and anticlockwise): the visitor moves strictly clockwise or anti-clockwise.
- Pseudo-sequentiality (clockwise and anticlockwise): the visitor who is generally cyclic in their motion, but performs at least one change of direction in their visit. Pseudo-sequentiality is computed differently depending on whether the user has seen all the artworks or not. If the user has not seen all the artworks, this condition is computed as cyclic sequentiality, but allowing for jumping a few artworks. If the user has seen all the artworks, this condition is computed like the Cyclic sequentiality, but allowing for one discontinuity in the direction (changing direction), e.g., 1-2-3-5-4 or 2-5-4-3-1 and so on.
- Non-sequentiality: the visitor does not meet the above conditions.

Judgements of sequentiality do not depend on where the user started his navigation, but rather on the motion from the starting point.

... and producing effective presentations.

The Presentation Composer is a rule-based system whose goal is to build a new presentation selecting from an existing repository of audio files. The HIPS prototype employs a formalism (the MacroNode formalism, see [4]) for annotating a set of existing repositories of data (texts, audio messages, images) for a presentation planner, both to reason on the deep semantic structure of the ongoing presentation and to adjust its surface form.

In the current implementation, there are about twenty rules divided into two clusters. The knowledge about the visitor's area/orientation in the POKB is used primariy by the rules of the first cluster that select the starting information in the data repository. Information about the Visiting Style is exploited primarily by the rules in the second cluster, that traverse the repository to collect other material. Thus, for example, a visitor classified up to 80% as an ant who stands in front of the Maestà gets detailed description of that artworks, while a visitor classified mainly as a fish in the same position gets, for example, a description with less detail but with more comparisons toother relevant artworks.

Example: 80% ant in front of the Maestà

> This is the great fresco La Maesta`, depicted by Simone Martini in 1315. La Maesta` was the first decoration piece of Palazzo Pubblico, therefore it acquired through the centuries a particular value for Sienese population. It's not surprising that the very first decoration of Palazzo Pubblico (the site of political power) was a religious artwork. Only four years before, in fact, the 'Fabbrica del Duomo' the other civic power of Siena influenced by the bishop, commissioned the famous 'Maestà' to Duccio di Boninsegna. The traditional spirit of competition between the two great 'factories' of the city demanded an adequate reply

Example: 90% fish in front of the Maestà

> In front of you, you can admire the great fresco La Maesta`, the fresco is located in the main part of the hall, the central point that gave the orientation of the Sala del Mappamondo. On the contrary the Guidoriccio fresco, on the opposite side of the wall, was a sort of great 'poster', glorifying the power of the Siena Republic. It was a sort of historical documentation more than an artwork to be judged for its artistic value

Table 1. Two examples of the information output related to different movement classifications

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Linking between real and virtual spaces

eMUSE – electronic Multi User Stage Environment

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Objectives

This paper is concerned with developing the concept of the Mixed Reality stage as a networked layering of physical space and virtual environments for interaction and communication of multiple users enabled through intuitive free body interfaces. The goal is the creation of interface environments which enable participants in both shared and remote physical spaces to communicate through their natural senses: hearing, seeing, speaking, gesturing, touching and moving around. Relating the concept of the stage to the idea of digital information space comprises investigation of interactive storytelling and the design of non-linear narratives.

The Mixed Reality stage

The term Mixed Reality is commonly used to refer to environments which combine real and virtual objects with visual representation of real and virtual space. The underlying paradigm is that of an information space merging components of physical and digital information. The metaphor we use for the Mixed Reality stage is that of a room furnished or filled with data. The 'room' stands for the physical interaction space but the furniture of data is virtual and stands for the information space. It is spatially organised information in which data is revealed through user's movements in the combined real/virtual space, and through interaction with other users. In this concept the virtual space is realised as an interactive field of sounds which are triggered by user's movement and emitted into the physical space (Fig.1). If sound is understood as data of information space, this illustrates the realisation of the basic idea of using digital data for filling the physical space.

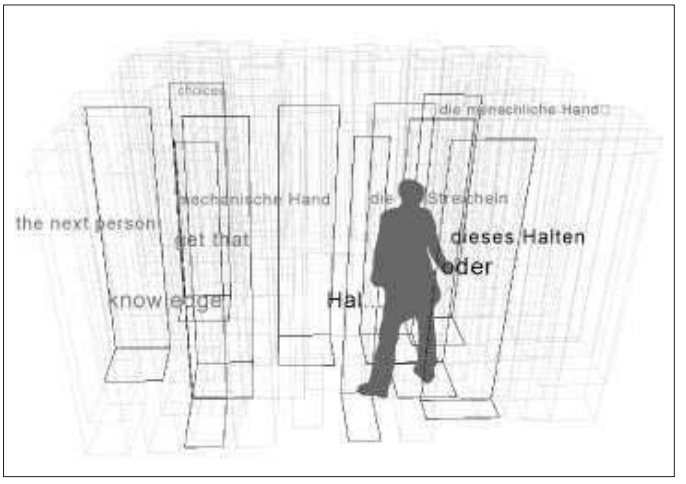


Fig.1: Movement reveals data from virtual space as if it were in physical space

eMUSE: realisation of the electronic Multi User Stage Environment

eMUSE is built as a modular system providing independent levels of implementation for rendering and displaying the virtual environment, for supporting multiple users in shared physical and virtual space and for supporting attachment of non-standard, free body interfaces. The system consists of three main parts: the external user interface driver, the multi user support driver and a VRML browser (Fig. 2). The external user interface driver allows attachment of arbitrary input devices for controlling navigation in the VRML scene. It reads data from input device drivers, transforms it into appropriate VRML co-ordinates for controlling viewpoint and movement of avatars, and passes these data to the multi-user driver over a socket connection. The multi-user driver takes care of updating the user's local VRML scene accordingly. It

runs a JAVA applet inside the Web browser by using the external authoring interface (EAI) to communicate with the VRML browser. Changes are propagated directly between the multi-user drivers supporting individual users, through TCP/IP peer-to-peer connections. The modular structure of eMUSE enables the use of any VRML browser as the rendering machine, provided it supports the external authoring interface. Therefore the eMUSE system itself can be understood as an interface and communication control environment.

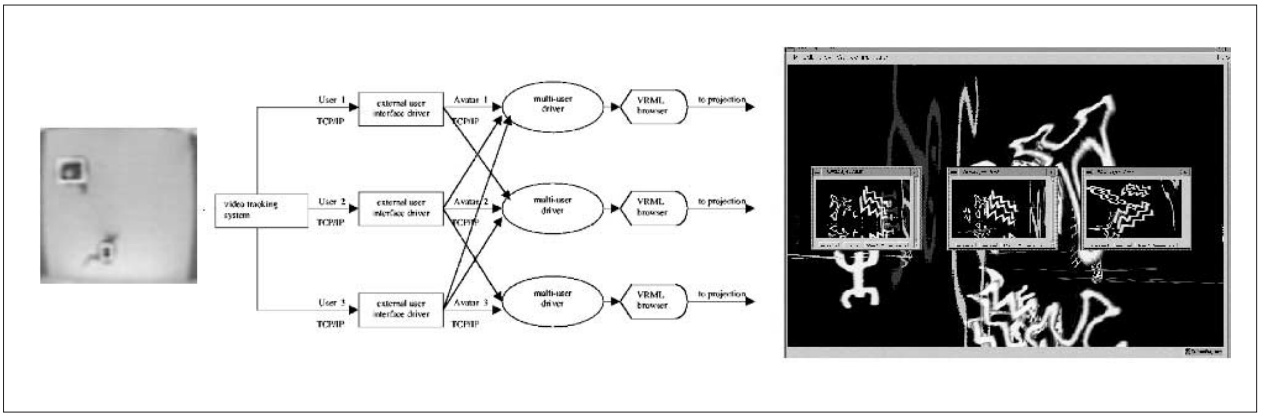
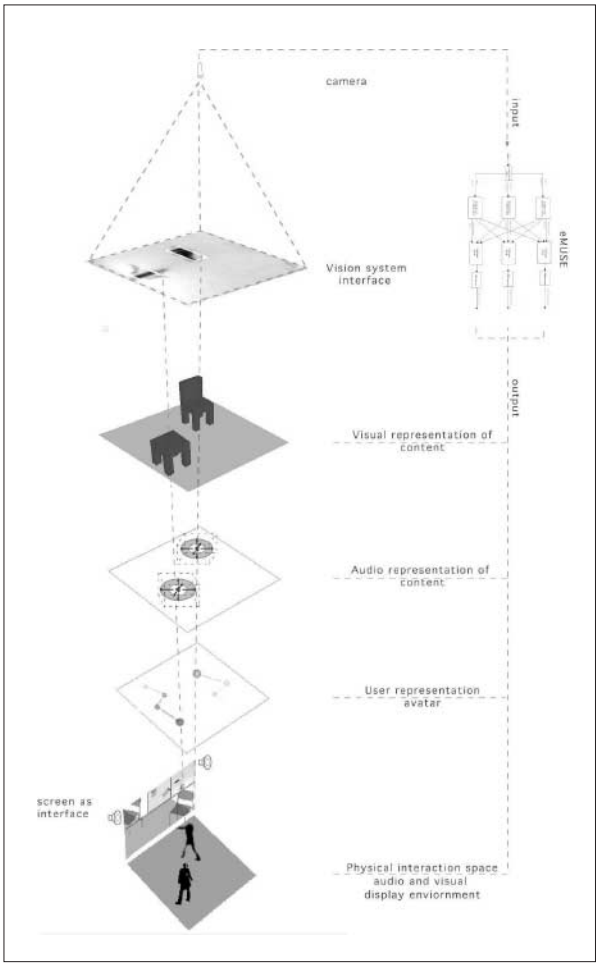


Fig. 2: The basic structure of eMUSE



The eMUSE interface environment

In order to realise the concept of the Mixed Reality stage, the whole system – the medial staging of action and movement – needs to be understood as the interface environment; not only as the connecting of man and machine, but as an action oriented situation in which the users become involved. This concept of "the situation as interface" (to the situation) acknowledges and introduces the distinction between two different levels of an interface:

- connecting the users with each other through the situation created by the Mixed Reality environment,
- technical devices needed for realisation of an unobtrusive underlying computer system.

In order to achieve this, different levels of perception and presentation need to be layered and related in a coherent structure where individual layers are carefully constructed, scaled and suitably mapped to support and complement each other (Fig.3). The Mixed Reality interface environment functions through the interplay of the following elements:

Fig. 3: Layers of the Mixed Reality stage

1. the Vision System interface

2. the Virtual Environment containing

- the visual representation of content
- the audio representation of content
- the representation of the user – the avatar

3. the physical interaction space

The Vision System interface

The tracking data provided by the vision system is used to control the position and the appearance of the avatars, and to control individual viewpoints in the virtual space (VRML scene). The position co-ordinates of the user are mapped onto the co-ordinates of the virtual environment allowing navigation in virtual space. Position and movement of the users as picked up by the system can also be observed in the tracking window visualising the tracking process (Fig.4). The speed and size of the tracking box is influenced by movement and gestures of the user which in turn determines the speed and size of the corresponding avatar.

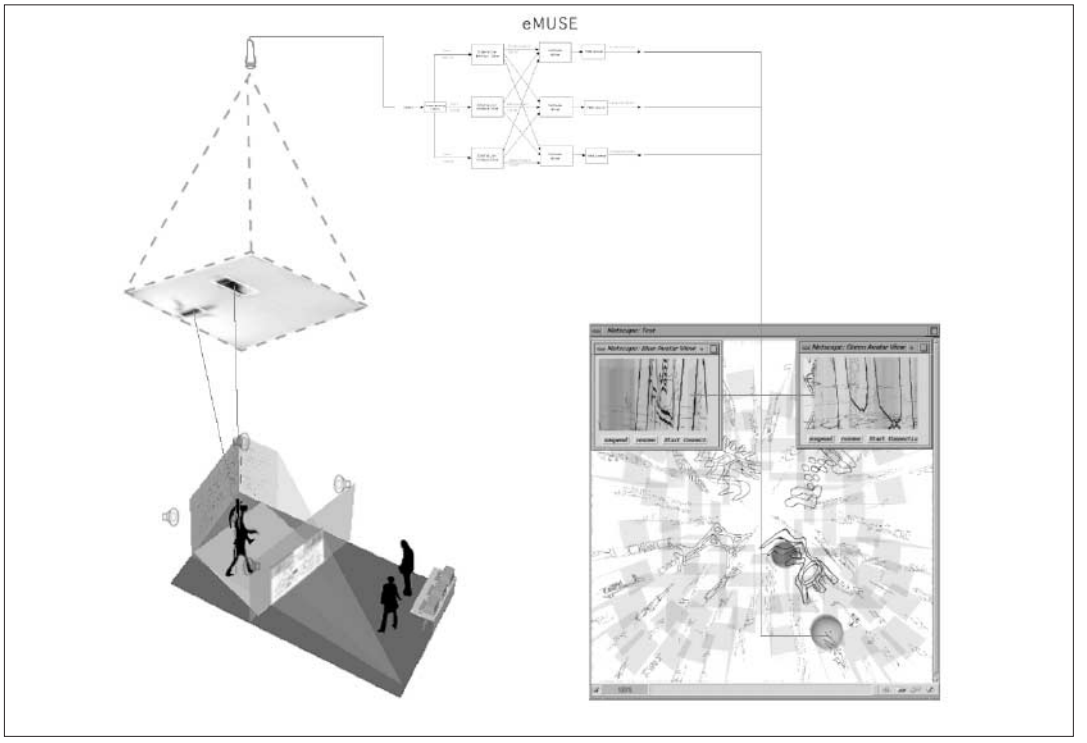


Fig.4: Vision System controlling avatars and viewpoints of two users

The virtual environment: staging the " Murmuring Fields"

The virtual environment – "Murmuring Fields"- is primarily an acoustic architecture, a field of sounds. The visual elements of the virtual environment serve as placeholders for the sound-objects and as an orientation aid for the users. A user's movement in physical space controls the creation of the corresponding avatar in virtual space (Fig.5). By crossing the boundaries of the proximity sensors the avatar triggers sound simultaneously emitted in the real space. These sounds inspire further movement and lead to a mutual play of the participants in producing sound patterns together. Participants are connected with each other in a dynamic circuit. They communicate through their avatars and determine thereby the action space as well. The avatar becomes an interface and a medium of communication.

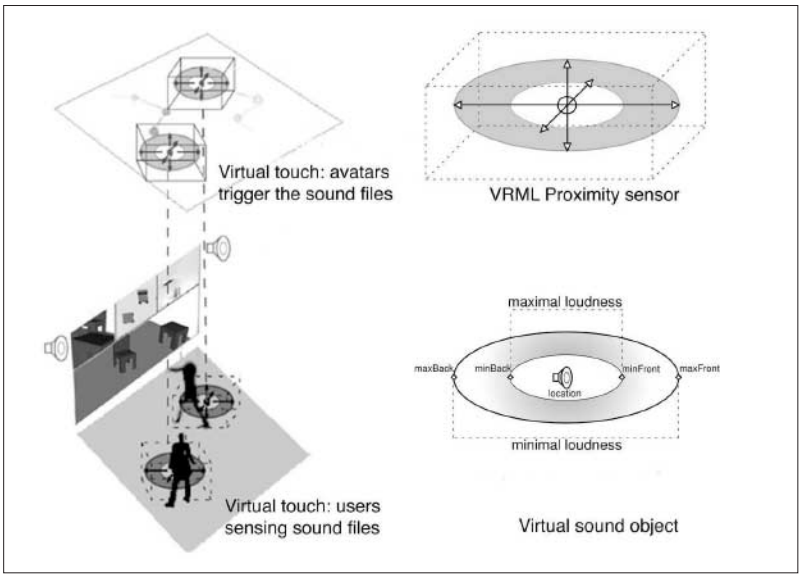


Fig. 5: Proximity sensors on sound objects in virtual space triggered through movement in physical space

Physical interaction space

Unlike in systems where navigation in virtual space is achieved by direct manipulation of some physical device, the Mixed Reality stage cannot be navigated without the existence of an appropriate physical space. Without being able to move in the physical space one is unable to move in the virtual space. Confronting the theory of dematerialization, the physical space and the body becomes an essential part of the Mixed Reality interface environment. As a user becomes immersed in the play of image, sound and movement, his/her awareness of being in space, and of interaction with others, becomes increasingly a bodily one. As a result, participants are connected through their bodily sense of each other. The interactive audio-visual virtual environment transforms individual motion into an experience of behaviour dynamics.

Conclusion: eMUSE strategy of development

With eMUSE we have built an instrument for the Mixed Reality stage, for theatrical play in and with networked space. This is no stage to be observed, but a stage to be entered by one. Invitations to numerous festivals, in theatre and Internet, enable us to learn how to play this instrument together with accidental visitors as well as with invited performers, in a public rehearsal space. Fig. 6 depicts the conceptually planned presentation of the "Murmuring Fields". The image of the virtual stage (floor projection) overlays the real stage and facilitates orientation in the information space. The sound system emits the sounds triggered by users movement. The video-tracking system surveys the entire interaction space while two projection surfaces display individual viewpoints of the participants. Presence in virtual space is mediated through the trace-avatars (coloured traces of movement) corresponding to the movement of individual participants. This provides a similar kind of presence for both participants in the shared physical space and remote participants across Internet using different interface channels.

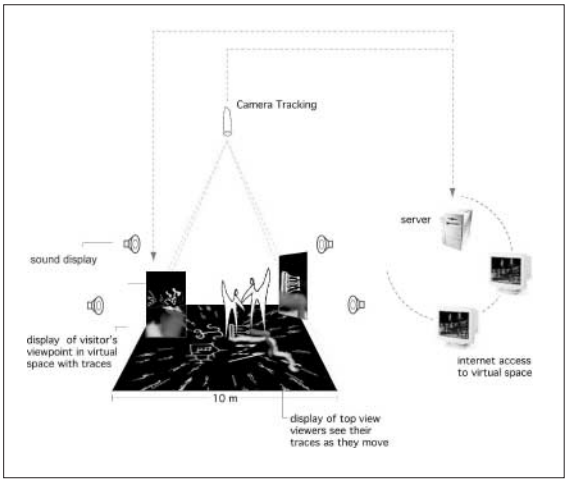


Fig.6: Basic set-up of the Mixed Reality stage featuring "Murmuring Fields" environment

The innovative approach is the combination of the new developed VRML based multi user system, the intuitive interface environment and the focus on interactive experience in different theatrical and everyday settings. The goal is to provide a platform for Mixed Reality stages through the interdisciplinery exchange of performing art, technology, danceand extended cinema.

Cloning, Morphing, then Tracking Real Emotions

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We describe the full pipeline from cloning a real person and morphing several cloned people, to the real-time emotion tracking of a person in front of a video camera. As telecommunication is a rising area for virtual reality, there has been the introduction of new standard MPEG-4 for practical and low bandwidth communication in real-time. We focus on the cloning, morphing and tracking methods developed for very efficient and robust communication and visualization, which can be used for a local system or remote system with standard parameters. The advantage in having a 360o view of a virtual clone (rather than just video streams) is a 3D viewing of a virtual emotional face from any angle in any kind of environment. Our system has a big potential for the analysis and understanding of real emotion, and for creating an emotion database. The input for cloning is just two pictures of a person (front and side views) and the individualized 3D face is created by modifying a predefined generic model with detected features on the two photos. The generic model contains function information for animation and shape, so that any face produced from it inherits the functional structure for facial animation. Once several people are virtually cloned, we use a rapid 3D-morphing system, which enables a user to control the shape and skin color in a very intuitive way. It is an integration of 3D shape and 2D skin information. Then any face, (either her/his clone or any other created face from 3D-morphing system), will be used for the visualization of emotion tracking system. With a very simple initialization, the system tracks features like eyes, eyebrows, and a mouth shape on the participant's face. The system successfully tracks any kind of face in real-time, independent of skin color, with or without beard, or glasses.

Introduction

Our method focuses on an easy and intuitive method of creating faces. animating them, and tracking their true facial expressions in a virtual world. We have designed a virtual cloning system that starts from photo data and one generic model; the next step is to generate new populations out of cloned face data using a 3D-morphing system, which uses shape and image morphing, but eliminates many computationally intensive steps. Profiting from 3D-face structure, our real-time facial feature tracking system allows us to generate and visualize real expressions on either a given clone or any virtual face in a database.

Approaches to the realistic reconstruction of individuals, some of them with a view to animation, have included the use of a laser scanner [1], a stereoscopic camera[3], an active light stripper [2], or a video stream [4] to reconstruct heads and natural expressions. Modeling has also been done from picture data [5], by detecting features, modifying a given generic model and then mapping texture onto it. Not all of these, however, combine sophisticated and reliable shape deformation methods with seamless, high-resolution texture generation and mapping.

Techniques for generating virtual populations have been investigated by DeCarlo et al. [6]. However, we are more interested in intuitively controlling the creation of virtual people using a 3D-morphing system. The main 2D-morphing methods [7][8] have been little exploited in terms of combining them with 3D-shape morphing. Nevertheless, this seems to be a natural approach with better results and less effort. Furthermore, with face cloning methods, many user interactions can be avoided.

In the research field of multimodal interfaces, the recognition of facial expressions is a very complex and interesting subject, and there have been numerous research efforts. Cosatto et al. [9] used a sample-based method which requires a sample for each person. Kouadi et al. [10] used a database and some face markers effectively to process it in real-time. However, the use of markers is not always practical and it is much more attractive to recognize features without them. Pandzic et al. [11] used an algorithm based on edge extraction in real-time, without markers. The presented face tracking method is inspired from this method. The output is converted to MPEG-4 based FAP points [12][13]. These feature points are sent to a real-time player that deforms and displays a synthetic 3D animated clone face or morphed face. Figure 1 shows the whole system of making clones and then tracking the face in real-time.

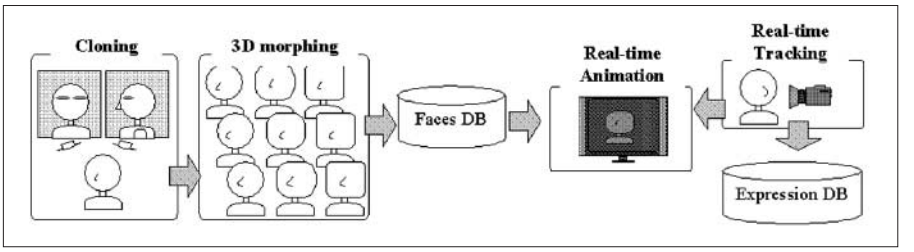


Figure 1: System Overview

Cloning

2D photos offer clues to the 3D shape of an object. It is not feasible, however, to consider 3D-points densely distributed on the head. In most cases, we know the location of only a few visible features such as eyes, lips and silhouettes, the key characteristics for recognizing people; these are detected in a semi-automatic way using the structured snake method with some anchor functionality for a subset of feature points. Figure 2(a) depicts an orthogonal pair of normalized images, showing the detected features. The two 2D sets of position coordinates, from front and side views, i.e., the (x, y) and the (z, y) planes, are combined to give a single set of 3D points. The problem is how to deform a generic model, which has more than a thousand points, to make an individualized smooth surface. One solution is to use 3D feature points as a set of control points for a deformation. Then the deformation of a surface can be seen as an interpolation of the displacements of the control points. In the Dirichlet-based FFD approach, any point of the surface is expressed relative to a subset of the control points set with the Sibson coordinate system. Therefore DFFD [14] is used here to get new geometrical coordinates for a modification of the generic head on which are situated the newly detected feature points. The correct shapes of the eyes and teeth are assured through translation and scaling appropriate to the new head. As shown in Figure 2(b), the result is quite respectable when we consider the input data (pictures from only two views). To improve the realism, we make use of automatic texture mapping together with texture generation.

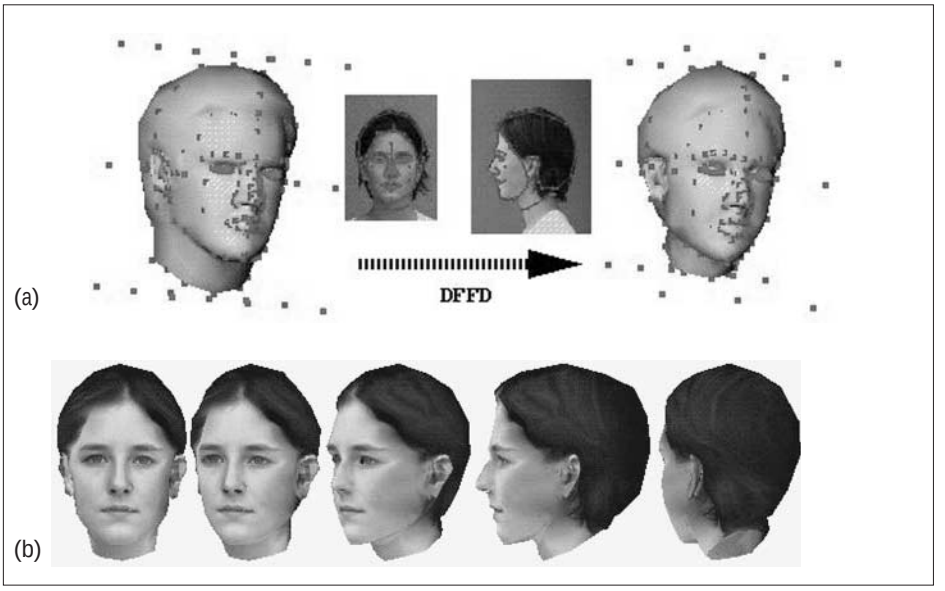
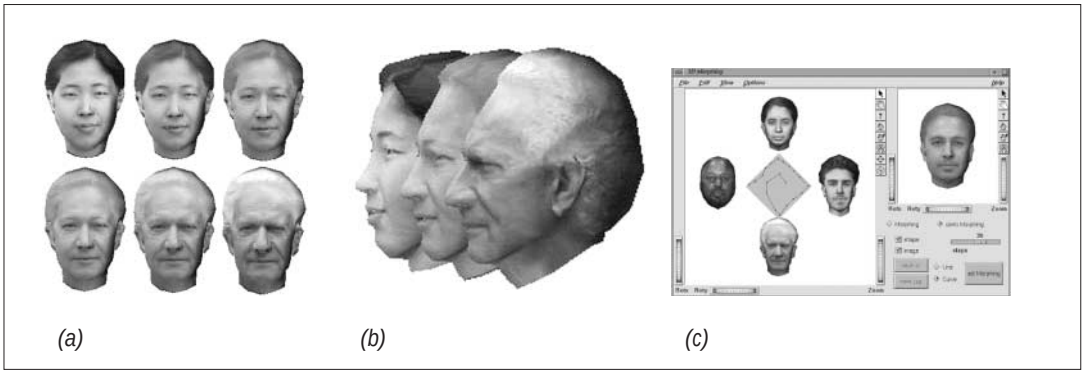


Figure 2: (a) Modification of a generic head according to feature points detected on pictures. Points on a 3D head are control points for DFFD. (b) Snapshots of a reconstructed head in several views.

Texture mapping serves not only to disguise the roughness of shape matching determined by a few feature points, but also to imbue the face with more realistic complexion and tint. If the texture mapping is not correct, the accurate shape is useless in practice. We therefore use information from the set of feature points detected to generate texture fully automatically, based on the two views. The main criterion is to obtain the highest resolution possible for most detailed portions. We first connect two pictures along predefined feature lines using geometrical deformations and, to avoid visible boundary effects, a multi-resolution technique. We then obtain appropriate texture coordinates for every point on the head using the same image transformation. Figure 2(b) shows several views of the head reconstructed.

3D morphing System

Morphing technology has seen a great deal of development, either in only 2D or 3D. In this paper, we vary aspects of both 2D and 3D representations in creating new virtual faces, showing how easily and quickly the smooth morphing can be achieved. When we morph one person into another in 3D, we must deal with alteration in both shape and texture. Since every face created through the methods described here shares the same topology, it is relatively easy to vary head shapes in 3D just using a simple linear interpolation of 3D coordinates. Then we utilize 3D information to facilitate 2D morphing among texture images following triangle by triangle the entire 3D head. The resulting head manifests very smooth images without any gaps in the textured parts. This approach for two persons can be very easily extended to several people. Figure 3(a)(b) illustrates 3D morphing between two persons. The interface in Figure 3(c) shows 3D morphing among several people. It has two windows, the left one for controlling weights among several input faces and the upper right one containing the resulting new face. Since only a barycentric calculation for texture image pixels is required, the calculation is very fast, which makes it possible to see real-time 3D morphing. There is also an option to have the shape and image variation separately to enable more various creations of new faces.



(a) *(b)* *(c)*

Figure 3: (a) morphing between two persons (b) in another view (c) A dynamic system for creation of new population from several people in intuitive way.

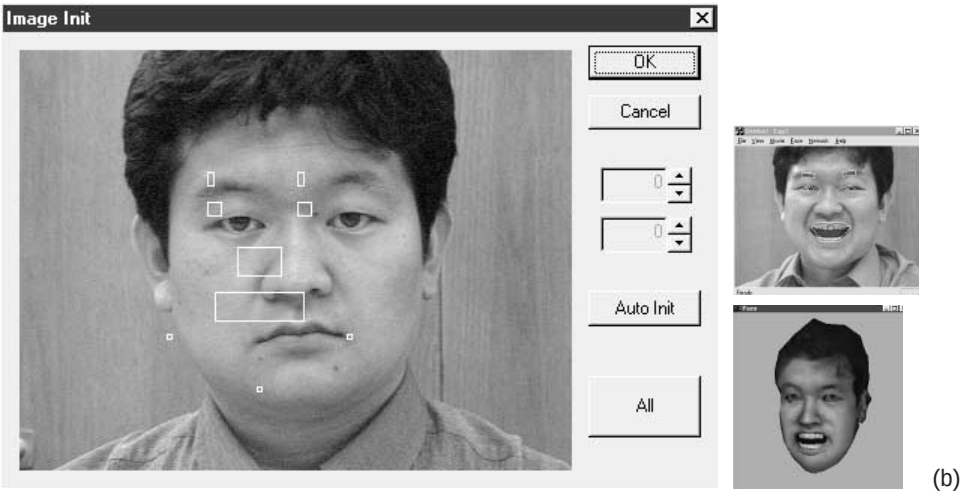
Facial Feature Tracking System

The motivation of the facial feature tracking system is to move the clone in a virtual environment. The system includes a head-mounted video camera and a computer that tracks features. A person puts on the head-mounted camera, and initializes the system first. After the initialization, the system tracks the person's features in real-time. In detail, MPEG-4 Facial Animation Parameters (FAPs) are extracted from a real-time video stream, and they are sent to the virtual environment. These FAPs can be used either to animate the cloned face or to compute the high-level emotions transmitted to the actor. The FAPs take up a very small bandwidth when animating in real-time.

Tracking facial features is a key issue in face analysis. To obtain a real-time tracking, many problems have to be resolved. One important problem lies in the variety of the appearances of individuals, such as skin colour, eye color, beards, glasses, etc. The facial features are sometimes not separated by sharp edges, or edges appear at unusual places. This diversity increases the difficulty for the recognition of faces and the tracking of the facial features.

In this application, the facial features and their associated information are set during an initialization phase that will solve the main problem in facial feature differences between people. Figure 4(a) shows this initialization. The way to initialize one's face is very easy. The user only moves some feature boxes, like pupil boxes, a mouth box etc, to proper regions. Once the user sets the feature positions, the information around the features, the edge information, and the face color information are extracted automatically. Various parameters used during feature tracking are then generated automatically. Those parameters, gathered during the initialization phase for every face, contain all the relevant information for tracking the face position and its corresponding facial features without any markers.

The tracking process is separated into two parts: 1) mouth tracking and 2) eye tracking. The edge and the gray level data around the mouth and the eyes are the main data used during tracking. These data are combined with proper weights, and the best movement from the previous shape is chosenas the next shape. Then the shape that is extracted by the image recognition is converted into MPEG-4 based FAPs. It is attractive to obtain an output compatible with the latest standard. This way, the stream of output values can be used with any clone, avatar or even comic character without any reprogramming. Figure 4(b)(c) shows some results. The actor's face movement is used for another one's cloned face movement.



(a) (b)

(c)

Figure 4: (a) Initialization (b) Feature tracking with his own clone (c) with another virtual face

FAPs are created from the movement of features. Therefore, the neutral face that is used for the initialization is considered as having no movement. We use the difference between the initial points and tracked points to make these FAPs. For example, a mouth width was 100 dots and the edge moved 10 dots, movement is shown as 1024*10/100, so that the size of the mouth edge movement was 102. This value does not change when the cloned face is changed to another person. The recognition method for facial expressions in our system does not use any special markers or make-up. It does not need training and only a simple initialization of the system allows it to adapt to a new person immediately. Extracted data is transformed into MPEG-4 FAPs that can be used easily for any compatible facial animation system and transmitted to web pages all over the world.

Conclusions

We presented our system covering topics from cloning and creating virtual humans, to representation of facial expressions with real-time feature tracking. Just two photographs of a few persons are needed to produce not only virtual clones, but also a large number of photo-realistic virtual faces using rapid 3D-morphing method. In addition, through facial tracking methods we have created an expression database based on parameters. These three methods are well connected to meet the rising needs of network communication, which requires realistic-looking, "moving" humans, with low bandwidth. This approach has the potential to be extended for both human face shapes and expression analysis.

Acknowledgments

The authors would like to thank Laurent Moccozet, Pierre Beylot, Christian Zanardi and Marc Escher. We are grateful to Chris Joslin for proof reading this document. This project is funded by an European project eRENA and Swiss National Research Foundation.

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SONIC WORLD

Music in the Online World

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Graphical based online worlds that more or less replaced their text based predecessors will soon be enriched through the use of sound and video. The emerging possibilities of such multimedia based online spaces were the starting point for this project. SONIC WORLD is a prototype that is being developed to explore ways in which online communities can have collaborative music performances. It is aimed to support an ambitious and creative experience for amateur musicians that are interested in making music together as a form of active entertainment in their leisure time. In SONIC WORLD participants will be able to meet in various virtual spaces, where they can interact through computer interfaces with "instruments" that are represented as abstract graphical shapes. They will be able to create their own spaces and define the musical properties and characteristics of them.

Introduction

Making music together is an important community forming process. In the physical world, music is an important subject for every culture and region. So far communities within the virtual realm were entirely silent, based on the communication through text and graphics. The increase of computer power and bandwidth lets one start to imagine how a music experience for an online group would be like. What instruments would be attractive to use? How would the people interact with each other?

SONIC WORLD is a project that is aimed to design a space where users can explore, interact together, participate in music sessions and share an active musical experience. We imagine it as a playground for online participants, to support forms of cultural experience through musical performance, coupled to a new form of artistic and social interaction. We want to increase the form of creative expressiveness, resulting in an immersive interactive experience.

The form of expressiveness will not be bound to instruments that need to be learned before hand but to musical interfaces that are controlled through simple but meaningful gestures on a higher level, which go beyond just triggering samples with a click of the mouse. In this way we hope that this online space is as inviting to amateurs as to those that haven't played an instrument before, and that they will all like to spend time within that space.

At this point of development we keep the definition of user to which this project is aimed quite open. We think that the space and its musical output should cover various musical styles in order to support young people and kids as well as adults. The possibility for visitors to create their own space with certain musical preferences supports that openness. This is also the reason that we look to different interfaces, to allow the users to move away from screens on a desk, and use either a networked TV, Web Pad or Game Console in the home.

Also the amount of people that can play in a particular space can vary. Therefore it is important for us to design the interaction in that way that it is fun to be explored alone as well as by a bigger group of people.

We imagine several different situations that SONIC WORLD is used in. It can range from a music session in an office to a more intimate musical experience with a close friend, who might live far away.

Background

Online worlds can be traced back to the early Multiuser Dungeons or Domains (MUDs) built on university mainframes in the late '70s. These early MUDs were simple text-based games, where a route and the surroundings were described to the visitor. People slayed monsters and teamed up with various players from around the globe.

With continued development in computer technology, visual elements were introduced to these newly

emerging online worlds. Graphical worlds promised to give a face to the people who meet, whether it be a fanciful avatar or true-life depiction. Besides the two-dimensional worlds, 3D worlds came more and more into focus. With a first-person view, 3D worlds created in Virtual Reality Modelling Language (VRML) hold promise in distance learning, meetings, conferences and even gaming. But it's still early in the development of these richer online spaces. As these worlds become more prevalent, communities will move away from text-based chat to graphical, audio and video chat since voice and video are the logical evolution [2]. They won't replace text entirely, but they will augment it.

SONIC WORLD

What will the music making process be like for the end-user?

Rowe [1] distinguishes two ways in which music can be made with an interactive computer based system. Both of them can be found within SONIC WORLD. One is the "Construction Approach" comparable to composing or arranging, and the other is the "Direct Manipulation Approach" comparable to playing an instrument.

The constructive process uses predetermined event collections or stored music fragments as a form of building blocks that can be arranged and manipulated by the user according to parameters like tempo, form or melody line. In this case interaction and listening to the result happens mostly consecutively, but it can be also a parallel process with several users. The tasks of the users can be seen to be somewhere between those of a composer and a DJ.

In the direct manipulative process, gestures applied to the graphical instruments drive the musical output in real-time and the role of the user is that of an musician. This performance-driven approach does not have a stored representation of music that can be expected. Parameters used here involve perceptual measures such as density or regularity of the incoming information.

In Figure 1 a graphical presentation of the architecture and current implementation of the used components is shown. On the client side the user interacts with the graphical elements on screen. The resulting information is sent via Midi to the server, where the synthesised sound is generated in real-time and sent back as an audio signal. All the participants that stay in the same space will have the same visual and acoustic experience. They can not only hear but also see the activity of the other participants, since the interaction with the instruments also changes the shape of the instrument-graphic itself. The software being used is Macromedia Director™ for the client Application and Max™ and Super Collider™ [6] for the music synthesis server.

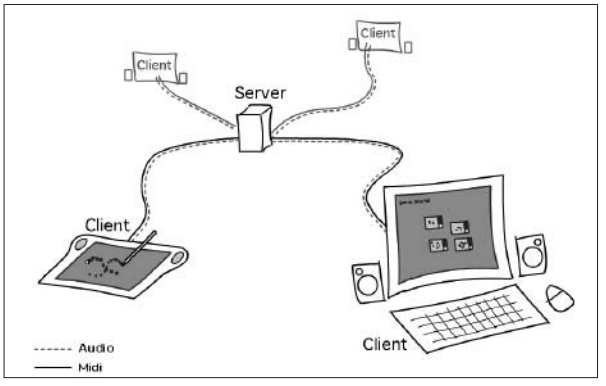

Figure 1: SONIC WORLD system layout

Figure 2 shows the starting screen of SONIC WORLD that a user is presented with upon logging into the virtual world. It contains all the possible spaces a user can choose to go to. The names on the right side of each space icon displays the name of the people who are currently within that space.

SPACE: Each space has a theme and a defined musical characteristics. The sound properties are not only defined through size and reflectiveness of the space, but also by musical characteristics.

Some of them can be rhythmical and loud, others calming and smooth, and some might also have an ambient soundscape that is continuously being played in the background.

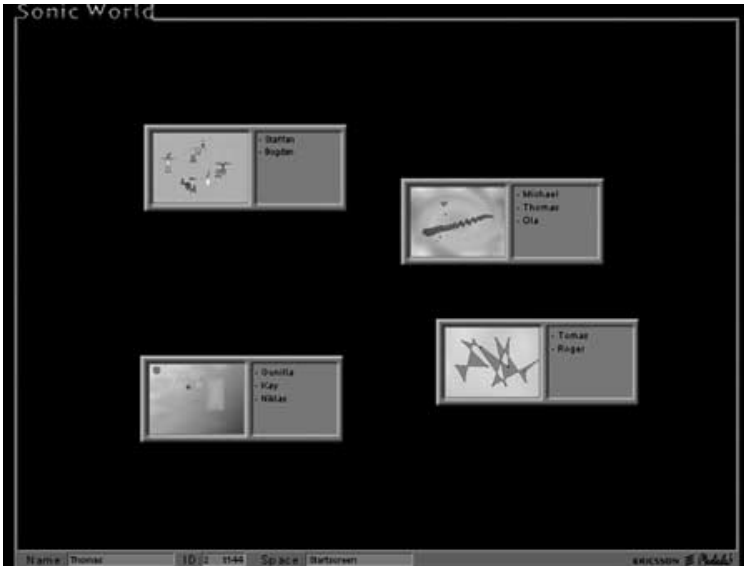

Figure 2: Starting Screen of SONIC WORLD

INSTRUMENT: Within each space the user finds special instruments that can be manipulated in various ways to produce the sound, and zones that transform the output of them. Figure 4 shows one of these spaces where the blue rectangle represents a zone and the different sized circles are instruments.

Some of them require a constant input from the user to perform the musical transformations, where others react on a higher level and thus supports a constructive approach. In the space "ElasticWaltz" (see Fig. 4) both approaches were implemented. The users can put together a collage of various waltz themes by dragging objects that represent a particular theme onto the sequence line. They also can manipulate the shape of the sequence, which transforms the resulting sound in real-time.

ZONE: Certain areas change and transform the musical behaviour of the instruments according to the position within the zone. Zones were designed to allow bigger variations to the musical expression.

INSTRUMENT CONTROLS: The characteristics of an instrument can be edited through the instrument controls. This control allows one to change the voice samples of a voice sample instrument, for example.

Further work

After establishing the prototype we will test it with several different user groups, to get information about the feel and usability directly from the users. Parallel to that the system software will be expanded allowing users to be able to expand the SONIC WORLD by themselves. Users will then be able to create their own spaces with specially defined properties and instruments.

The prototype will run on a local network due to bandwidth constraints of wider networks. As soon as the network speed allows, the system will be expanded to a geographically wider range. We will make more advanced clients which move beyond the two-dimensional image and into structured video and 3d graphics, like Chat Worlds, designed and implemented here at the Ericsson Media lab [5]. In this context it will be useful to explore what gains can be made with MPEG4 and especially the structured audio part [4]. In order to get a better granularity in networked sound control and interaction than MIDI currently provides, we intend to explore the Open Sound Control (OSC), which will provide the glue for maintaining efficiency between several real-time synthesizers in a networked environment [3].

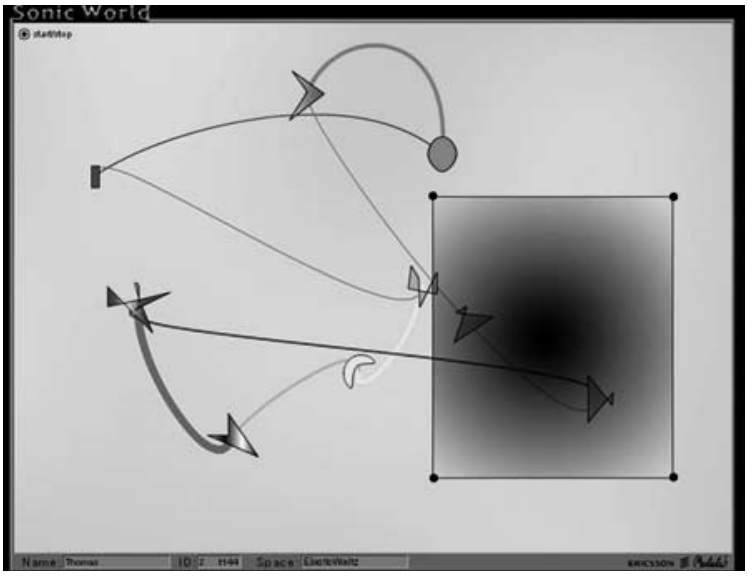

Figure 3: Instruments and one Zone

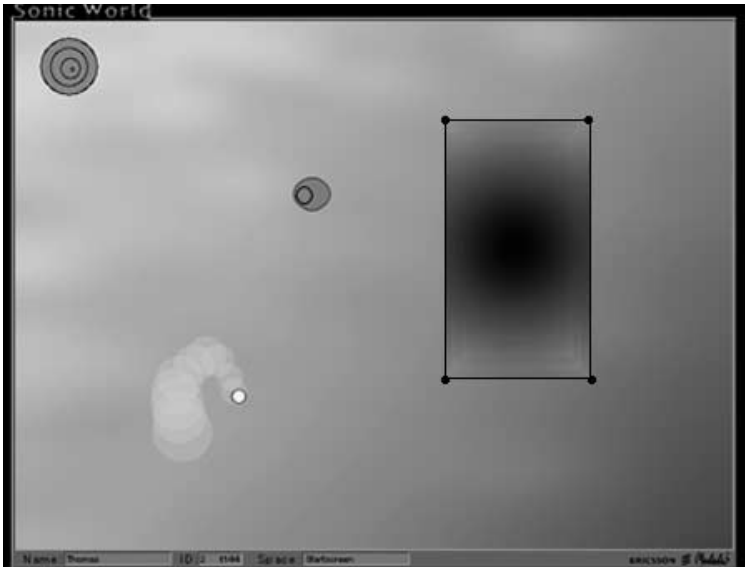

Figure 4: Space "ElasticWaltz"

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The role of memory in a community

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This study aims at understanding the role of memory in a community, and the forms of communication that allow for the sharing and transmission of memory. Our approach is socio-cultural, and our basic assumption for the connected community schema, in line with the LIME Project, is that a community needs memory to exist, and that connected community involves communication and shared information. The objectives of the research are to understand better the role and importance of memory in community, thereby giving direction to critical reflection and theoretical elaboration of concepts. With this aim, we are investigating the synergy between community memory and communications. This process will lead to the exploration of a new paradigm for social interaction and networked media.

How to make use of Communication Technology in ways that make sense to people

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Is starting out from the point of the user - or rather the user's behaviour, desires and frustrations - a good idea? Can meaningful applications for Information and Communication Technology be found by using people as a starting point?

Presence's key finding: older citizens wish to remain (or become) active participants in society, more specifically in their local communities. The ideas in the book focus on ways to help them achieve that goal.

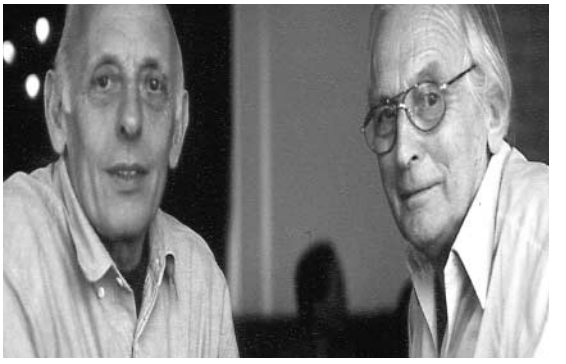
Throughout the project, older people acted both as design catalysts as well as commentators on evolving solutions. As subjects in the innovation process - rather than passive objects - they helped the team focus, and consistently served as "reality checkers". They also helped to clarify the communication throughout the project. Many of the eventual solutions can be applied to other types of users, but the three test groups formed the heart of this project.

The Presence team learned from older people in three very different cultures. This was not an exhaustive process, but we began to realise that there are many different ways of being old, even within Europe. In working with our older collaborators, we learned that you can both ask and offer, and that you need a good balance between the two if you want to arrive at creative and original solutions. All the partners learned from each other that there are many ways of tackling problems, none of which is objectively "the best".

The team started by making a generalised assumption about "active older people", yet "our" older people never ceased to amaze us with their sheer energy and assertiveness. It was refreshing and illuminating to work with real people, to see real examples; a postcard, a photo, a meeting with someone you've spent two years getting to know. The test group participants also helped immensely in bridging the natural divide between disciplines within Presence. A real person is something that everyone understands, regardless of their academic or professional training.

Older people

In the summer of 1997, the Presence team set out to challenge stereotypes of older people as predominantly frail, needy and disabled, by focusing on the opportunities presented by ageing; specifically, on new ways that information and communication technology could be used by people in their homes and communities, in the context of changing lifestyles and social relations.



Presence was a bringing together of different groups, each with its own way of working. On the one hand there were the community co-ordinators (Telenor, Human Factors Solutions, the Netherlands Design Institute, Innovative Devices & Engineering for Automation, and Scuola Superiore Sant' Anna) and their supporting partner (Design for Ageing Network), who typify the user-driven approach to design: engaging in dialogue with the communities, profiling them, and extracting and interpreting feedback from the test groups. On the other hand, there were the design centres (the Royal College of Art/Computer Related Design and the Domus Academy), whose approach was more visionary or inspirational. The Netherlands Design Institute was responsible for the management and communication of the project.

Inspirational Research

By having chosen to ground the research in real communities, the inherent problem of user-centred research was immediately thrust to the fore: how could the designers avoid becoming little more than facilitators of the test groups' wishes, or simply asking the test groups to rubber-stamp the designers' visions and ideas? The team felt that the research should initially focus on a more impressionistic understanding of each test group, thereby fleshing out the factual picture with more "inspirational" data from the test communities about their actual lives. Only in this way would it be possible to get away from the stereotypical views of older people as "needy".

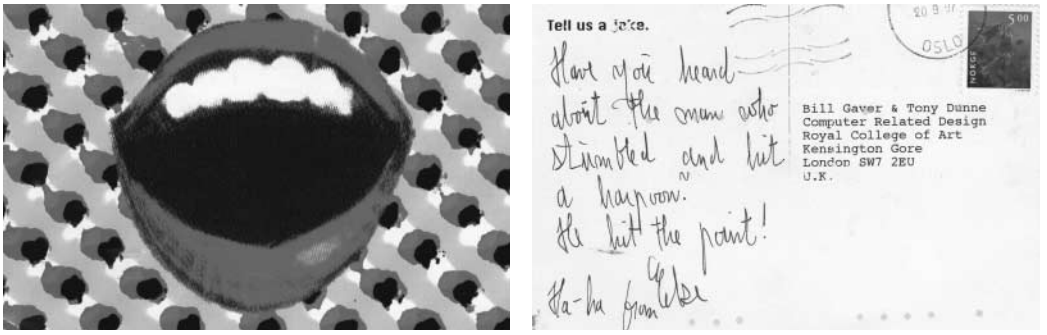


Figure 2: The Cultural Probes: A returned postcard from the Oslo test-community

Figure 3: The Cultural Probes. A personal answer from a test-community member to the question: Tell us something about yourself.

One of the novel approaches decided upon was to create packages of materials dubbed "Cultural Probes" - custom-designed packets of materials such as maps, postcards, photo albums, disposable cameras, and other material which the test group participants were encouraged to fill out and return to individual Presence partners. The name was chosen to suggest that they be dispatched into an alien environment, returning hints and signs that would have to be interpreted from afar. Each package was designed to be aesthetically pleasing, stimulating, and fun to complete. This attention to detail certainly helped avoid the syndrome of "professional design doctors coming in to study the locals". The probes were distributed to each test site and in the following weeks 120 maps, 200 postcards, 500 photos and 25 albums and media diaries trickled in from the participants. They were not analysed in a rigorous, quantitative way, but instead were scoured for patterns and exceptions. The aim was to concentrate on aesthetic control, the cultural implications of the design, and ways to open up new spaces to design. That is not to say that scientific theories were not a source of inspiration, but so were more informal analyses, chance observations, the popular press, and other equally "unscientific" sources.

Projected Realities

What came to be known as the Projected Realities system uses a range of electronic technologies to give an Amsterdam area with a bad reputation, "the Bijlmer", a new interface, or a new facade. The system has four main components: an input scanner, a mains radio, Sloganbenches and an Imagebank. Together they enable a kind of "legal graffiti" which allows older residents to express their attitudes and opinions about the area to fellow inhabitants and passing commuters. The Projected Realities system is a design for a public communication system that is genuinely owned and inhabited by local residents. The system could run over longer periods of time, with the elders co-ordinating how local inhabitants could introduce new slogans and images. The local government could hereby enable the citizens of the Bijlmer to converse amongst themselves, beyond any divisions of culture, ethnicity, and age.

Figure 4: A Sloganbench in the Bijlmer area

Figure 5: Testing the Sloganboards in the Bijlmer, in preparation of the Projected Realities system

An Imagebank – an eye-level construction containing five video monitors and a computer which disseminated images collected by the local elders – was placed along a major road passing the Bijlmer. As the images changed to reflect the activity in the Sloganbenches, they provided a glimpse into the Bijlmer beyond that offered by the somewhat intimidating buildings themselves.

Images and slogans were collected from the elders a week or two before the devices were installed, and again during the trial week. A third component of the system automatically telephoned volunteer inhabitants to assess their attitudes, asking people to select an image from a pre-distributed booklet as a way of indexing their emotions.

The system amalgamates people's attitudes from the individual to the collective. The results from the telephone surveys are entered into the computer, which selects what slogans are to be shown on the nearby Sloganbenches. The attitudes reflected by current slogans will in turn drive the selection of the images to be shown on the Imagebank. Thus the displayed pictures and words are not chosen by any single group, but instead reflect the input of all the participants.

A lot of positive feedback was received from the Bijlmer community during the trial run, with local TV and radio picking up on the system and helping generate further debate and discussion. The Presence team also came in contact with the creators of a new museum of immigrant culture slated for the Bijlmer, and the chance remains that Projected Realities could become part of a wider effort to collect and display images of the community.

Emotional Communication

The team combined the four concepts into a suite called the "Emotional Communicator"; two of these concepts have already been prototyped and tested. The Emotional Communicator could take the form of an all-in-one product, such as a software application for the upcoming generation of mobile phones, linked to a digital camera, or be a suite of integrated but separate devices. (At the time of publication, the Presence partners are still actively working on and testing each avenue of development).

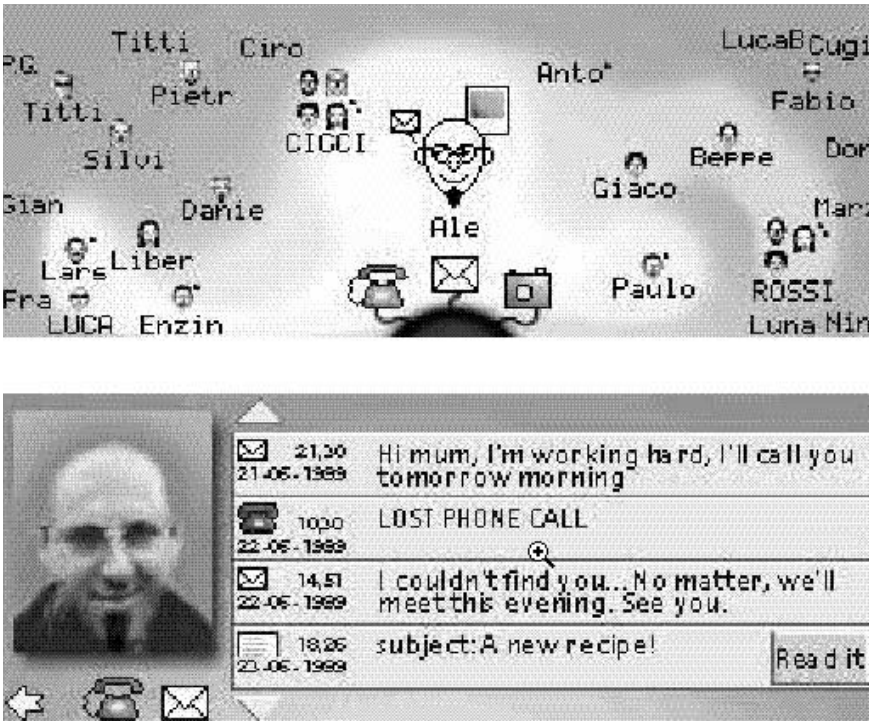


Figure 6: The Emotional Agenda

The basic idea of the Emotional Agenda is to provide older people with "traces" of their communication with loved ones. It is a personalised visual interface that allows the user to access the mobile phone's communication features using icons which represent their family and friends. By clicking and zooming in, the user can choose different communication modes and access information about each individual. The Agenda also displays more emotional information; though the user initially decides on each icon's position and representation, the Agenda itself later adjusts these arrangements according to the user's communication patterns. In effect, it's a touch-screen-driven, adaptive visual diary of these patterns.

The Chain of Angels service is a smart facilitator that fosters communication among older people in the same community and creates a shared environment for older people to "meet". The preliminary prototype was a database-driven, automatic telephone system which easily allows older people to stay in contact with each other and lend a hand with small problems. Subscribers are called every day at a fixed time to make sure the other is all right, to enhance social contact, and to organise care. It's based on the traditional "phone circle", where a volunteer makes a daily check on a small group of older people. With the Chain of Angels, however, the computer mediates the calls. If a problem comes up, the subscriber can input a request for help, which the system then matches to the skills and availability of other subscribers, who are finally contacted about whether they can help. Other services can be added: Free Call, for example, allows users to make one free call a day, and Public Arena is a bulletin board where older people can broadcast public messages either by local radio or by phone.

Nonnogotchi (Italian for "grandpa gotchi", based on the Tamagotchi toy) is a system designed to strengthen inter-generational communication by simultaneously enhancing children's awareness of their grandparent's lives and stimulating them towards new interests and activities. The system uses two devices, one for the child and one for the grandparent. Messaging can be asymmetrical, i.e. the child suggests something to do

and the grandparent reacts (this is the system that was prototyped and tested). It can also be symmetrical, where both participants exchange and assess suggestions for activities. Initially, the child creates the grandparent's profile from the Nonnogotchi's option menu according to four basic parameters: sociability, well-being, activity, and entertainment. The child's goal is to stimulate and improve the grandparent's profile by sending an activity suggestion. The acceptance, postponement or refusal of this suggestion then changes the grandparent's icon on the child's Nonnogotchi.

More and more families live apart, and younger members are often too busy to maintain regular contact with their elders. Send a Picture lets these older members see what the younger relatives are up to, and what kind of mood they're in. The team came up with two versions of Send a Picture. The first is a system that transfers pictures from a small portable camera to a home TV set or dedicated digital picture frame, thereby providing older people with "meaningful traces" of a youngster's activities. The pictures taken from the camera are automatically transferred to the older person's TV, where they can either be viewed, annotated, or even edited to create a "shared memory". The second version of Send a Picture is more deliberate (pictures are not taken automatically) and enables a pictorial conversation. When an image is sent, the receiver is prompted to reply by taking another picture and sending it back.

What next?

What are the Presence results? There are prototypes, and the possible products and services they might lead to. And there are research methods such as the Cultural Probes, and an overview of these in the Methods Lab. There are insights into older people's extremely varied lifestyles and communities. We developed a host of design ideas and concepts. But the most important thing we learned is how important it is to use the lives of real people as a starting point. Real users, and real designers - the dialogue between them has delivered interesting results.

So what are Presence's more general lessons? For starters, designers can do more than simply listen to users; they can also interact creatively, making proposals and debating them as well, provided they take advantage of the users' reactions. Designs need not be based exclusively on dry demographic analyses or abstractions of large-scale user research. Designers can also invoke other influences, for example literature and fine art. Research is more than mere statistical analysis and focus groups. Research can also be used as a source of inspiration, which allows it to become deeper and more detailed. Working with a small group of users then becomes a strength rather than a statistical weakness.

It's also possible to teach ordinary people how to think along with designers, and vice versa, and how to co-create coherent visions of the future. Without this learning process, users' ideas about the future tend to be less interesting.

Motivated test users are prepared to invest a lot of time and provide a considerable amount of information - even very personal details. Their motivation can be greatly enhanced by making it clear from the outset that they are to be taken seriously, and not simply investigated from afar. Creating a dialogue instead of isolated questions also helps, as do the careful design and presentation of all test materials. Working with real users facilitates the interaction between various team disciplines. And finally, Information and Communication Technology doesn't need to be complicated; there are simple and appropriate ways of putting it to use.

Paradoxically, even if you don't begin with a purely technical or commercial goal, interesting ideas still emerge that can later lead to new uses of technology and new commercial propositions.

We would be most grateful if you could share your thoughts about these issues with others on our website, located at www.presenceweb.org.

BSCW: A Collaborative Environment on the World Wide Web

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In recent years the World Wide Web (WWW) has achieved a widespread use in commerce and industry as well as for educational purposes. Though originally the WWW was intended primarily for the distribution of information, it can be used successfully for enabling and supporting cooperative work. In this paper, we present the BSCW system (Basic Support for Cooperative Work). It uses the World Wide Web as a platform for communication and offers a number of functions for supporting collaboration. The basic idea is to provide the cooperation partners with a shared workspace. Users perform their cooperation activities via this workspace by means of the standard WWW browsers. Furthermore, the system offers additional functions such as information about events and processes occurring in a workspace. The system is meanwhile being used on hundreds of servers both in the education area and in business applications around the world.

1. The WWW as a platform for shared workspaces

Even today, the platform-independent cooperation in geographically distributed projects is often a difficult problem. So far the Internet has provided support for this problem only to a limited extent [1,3]. With the BSCW system, the German National Research Center for Information Technology (GMD) in Sankt Augustin has developed a WEB-based platform for cooperation support which extends the possibilities of the World Wide Web considerably. The use of the WWW offers several advantages in parallel. The WWW is platform independent because WWW browsers are available for all standard operating systems such as the different Windows and Unix variants and Macintosh OS. The handling of the WWW browsers is easy to learn and obviously fulfils the basic user requirements as is shown by the widespread use of WWW technology - even for users without thorough computer knowledge [6,8]. Furthermore, many organizations, including schools, have already installed WWW servers and are familiar with the relevant technology. This means a functional extension of WWW servers for cooperation support - and the BSCW system developed by us is such an extension - would not involve additional problems for the organizations.

2. How the BSCW system supports the cooperation in working groups

The basic idea of the BSCW system is the autonomously managed Shared Workspace which the members of a working group install and use for the organization and coordination of their tasks [7]. The members of the working group can upload documents from their local computer to the workspace as well as access documents in the workspace, e.g. for processing them. Such a workspace can contain different types of (electronic) objects such as folders, documents, tables, graphics or links to WWW pages [4]. In addition to the comfortable document management, there is a notification service providing information about current activities, and a great number of functions and object types for more extensive support of cooperation. The user of the system only requires one of the usual browsers such as Netscape Navigator or Microsoft Internet Explorer.

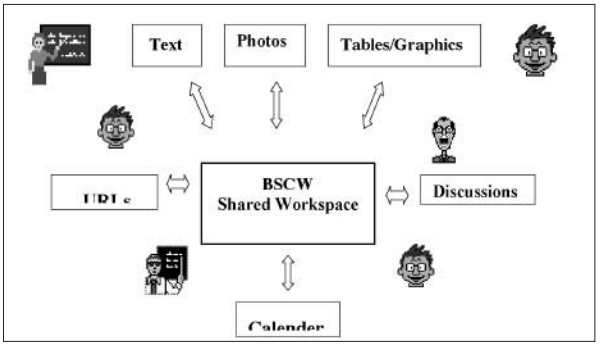

Fig. 1: Use of objects in the shared workspace

In addition to the function of a central information archive, BSCW provides a great variety of further functions which support the cooperation of the members of a working group [2]:

- The system records all "events" occurring in a workspace. An event is triggered by any access to a workspace. This can be, for example, the storing of an article, a contribution to a discussion or the suggestion of a deadline. If a document is read or if its title is modified, this will also trigger an event. If users "enter" a BSCW Shared Workspace, they are informed about the events that happened in the past. In this way, every member of a working group receives information about the activities of the other members (with respect to the objects in the workspace). Though this event-based approach to mutual information about the activities of the members is rather simple, messages such as "Pete stored a new version of the document 'Project state'" or "Dr. Webber read the document 'Weekly work'" often contains sufficient meta information to control the next steps of cooperation in the group.

- Users can also receive the notification about activities in BSCW workspaces via e-mail. If they register for this service, they daily receive an e-mail message about the events in their workspaces. The users can also define the type of events they want to be informed about (e.g. only about the integration of new documents or the modification of documents, but not about read events).

- The members of a working group may have different access rights for the objects in an workspace. The originator of a document can determine, for example, that specific members are entitled to modify a document while other members shall have only read access or no access at all.

- The BSCW system provides functions for the management of the members of a shared workspace, for example, inviting members or canceling invitations which is to be done by members authorized to do so. The access to the workspace is controlled by the system inquiring about user name and password. Furthermore, a user can enter additional information such as e-mail address, telephone numbers or fax numbers.

- Though the BSCW system is intended primarily for asynchronous, i.e. deferred communication, it also contains interfaces to synchronous communication tools such as audio/video conference systems or application sharing, i.e. the shared use of applications. This enables the user to define so-called "meetings" in BSCW workspaces and to activate the corresponding tools comfortably from the workspaces when those meetings take place.

- Furthermore, the system provides a Java applet that enables the users to obtain information about the simultaneous presence of other users in BSCW workspaces and their activities. This component can also be used for synchronous communication such as conferences and/or shared task accomplishment, for example, in the form of a chat session.

3. The system architecture and user interface

The implementation of the system follows the standard client/server model. The BSCW shared workspaces are stored on the BSCW server. The users communicate with the BSCW server via their BSCW clients [5,9].

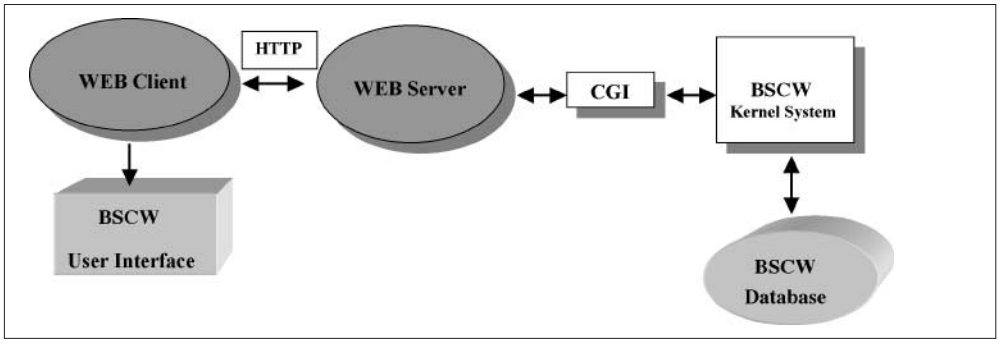

Fig. 2: BSCW client server communication

The BSCW server is an extension of standard WWW servers, that is, the basis is a HTTP demon which is enhanced by additional software implementing the BSCW functionality. Almost every WWW Server can be extended to a BSCW Server. Installations of the system have been done under a great number of Unix versions as well as under Windows NT. The Apache Server and the Microsoft NT Internet Information Server, for example, are being used as Web servers as well.

The implementation of the user interface is almost "language independent": all texts which the system uses for communication with the user are stored separately from the actual code. To create a BSCW interface for a specific language, these texts must only be made available in a corresponding form which requires the translation of a number of HTML pages. Knowledge about the software is not required for this purpose. Currently, German, English, French, Italian, Spanish, Russian and Catalan are available. Further language versions such as a Greek version are in preparation.

BSCW clients are standard WWW browsers. Since the system users usually want to store also objects in the shared workspaces on a BSCW server, the used browser should support the transmission of local files to a WWW server (such as the Netscape and Microsoft servers).

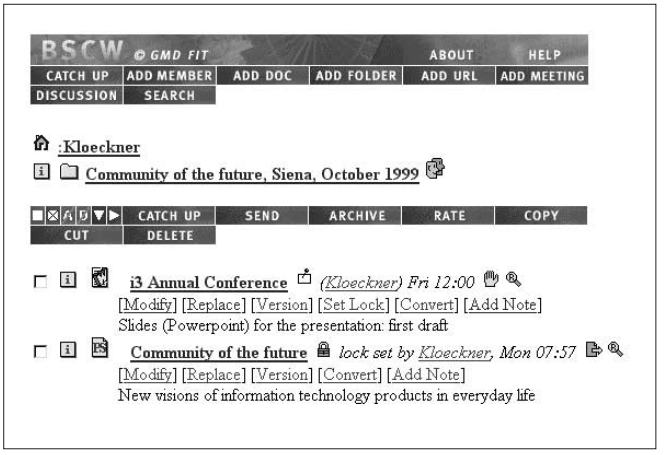

Fig. 3: The user interface to the BSCW system

Further software installation is not required for the user. However, additional software is available facilitating the handling of the BSCW system for the user, e.g. a program for Windows 95 and Windows NT enabling the drag and drop transfer of files from a local computer to the BSCW server.

Version 3.3 of the system (which has just been released) is another step in the direction of open Internet cooperation. This version provides an object browser written in Java which enables simple processing of files and documents in a similar way to the Windows file browser. For the support of information management, documents and World-Wide Web links can now be annotated and rated individually; a median is calculated from the individual ratings and presented to the users.

4. Summary

The BSCW system extends the World Wide Web with shared workspaces. In addition to a tool for information distribution, the user is thus provided with the facility for solving problems cooperatively with other users independently of the hardware and operating system of the used client computers. Consequently, the BSCW system constitutes an adequate system for the shared, decentralized and deferred management of projects. First experiences with the use of BSCW for such projects gained in Germany and other European countries are very positive. However, they also show the requirement for new functionality driven by the users' needs. The BSCW system is currently being evaluated with regard to these requirements and will be extended with the necessary functionality.

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Panels

Learning through playing

Playing through learning

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We in i3 are trying to invent the future. Bold aims such as this depend on enthusiasm, on creativity, on construction. But they also depend on vision. Sometimes — not all the time — we need to stand back from what we are doing and consider what we're thinking, to pause in the process of our practice and consider what we're doing in terms of theory.

Theory sounds dry and unappealing. But there are some meta-level questions that many of us in the ESE projects are trying to grapple with, issues which won't go away just because we have designed, or built, or even tested this or that piece of technology. They are issues about what play is, what learning is, what kinds of experimentation is appropriate in the design of experimental school environments.

We are proposing a panel discussion called Learning through playing: Playing through learning. The pun is intentional: we want to kids to learn through play, but also to play throughout their learning — not just when they are very young. We all know that the best ideas are invented by people who are playing — not 'working' — but play is something that people believe is not 'real work'. By inviting a small group of ESE sister projects to think about meta-level ideas (not just to report on their projects!), we want to contribute to the creation of a synergy in thinking further about the relation of play and work, play and learning — and, we hope, be fun too! We don't want just a talking shop — we'd like discussion to be kick-started by a flavour of the research our projects are doing, and informed by people who are working at the leading edge of designing the learning environments of the next century. We don't want our 'discussion' to just consist of the spoken words either — we have invited participants to illustrate their points provocatively with the use of appropriately varied media.

We start with our common purpose: to design for young children artefacts which allow them to express their creativity, to have fun, to feel a sense of purpose, to handle ideas which are normally thought of as beyond their reach, to play and to learn. A complicated and heady mix of intentions!

We propose in this panel discussion to ask, and perhaps begin to answer, a fundamental question: what are the design principles which best satisfy these varied criteria? If we focus on building artefacts which open new expressive worlds to children, how can we ensure that they are accessible enough for young children to use? Conversely, if we emphasise the sense of fun and immediacy of our new environments, how do we guard against the danger of providing easy-to-use systems which, like those of the 'edutainment' industry, are simply not rich enough to afford learning of anything useful?

The problem of matching play and learning is not one which is specific to digital technologies. When we are playing, immersed in a game, we are attending to the experience of play itself: where to hit the ball, how to move the piece, when to hit the button. We may have, at a more or less conscious level, a rich set of rules about the discourse of the playful situation in which we are immersed. We may be learning more about these rules, and gaining experience of the way they are operationalised. But there can be no guarantee that we will learn just what someone else plans we will learn. To optimise this possibility, it might be that we need to be told: but then we are not playing. If an intelligent agent (including a human one, like a teacher) brings a new idea to the student's attention from outside the activity, then he or she is no longer playing: yet, if it is not imported, he or she might never encounter the idea.

Play confers meaning to an activity but blurs the specificity of the intended meaning — the balance between play and learning is always problematic. We want learners to have sufficient time and space to nudge up against powerful ideas, to play with the objects and relationships of our toys, environments and worlds, and to take on board the tools as personal media of expression. Yet we also want them to reflect on the pieces of knowledge which we may carefully have planted within these worlds.

There are many approaches to resolve this paradox. One is to design black box components which require imagination to assemble, but whose inner workings are closed to the user. What is the right level of opacity here? Another is to attempt what others in the first generation of computers in learning

situations did, and to offer a whole 'language' (Logo, Smalltalk etc) as a medium of expression: but in this scenario, it's easy to end up with nothing but the constituent parts of activities which never coalesce into useful nuggest of knowledge.

We believe that the ESE projects are uniquely placed to resolve some of these issues in that they are challenged simultaneously to construct and evaluate their contributions from an educational point of view. But it is easy, in the work of a project, to overlook that there are broader questions, some of a more theoretical nature, but all with the potential to enhance the outcome of particular artefacts and approaches. Our objective is to create a theoretical synergy of existing projects and associated work, which can simultaneously inform those projects, and push outwards to the wider European community of researchers, educators, technologists and policy-makers.

Supporting, Encouraging, and Augmenting Collaboration in Early Childhood Education

Organisers:
Allison Druin,
Claire O'Malley (KidStory)

Panel Participants:
Paul Brna (Nimis),
Celia Hoyles (Playground),
Claire O'Malley (KidStory),
Marilyn Panayi (Stories),
Mike Scaife (Puppet)

Panel Moderator:
Allison Druin (KidStory)

Panel Format

This panel will be 90 minutes in total length. Each panel participant will give a brief 7-minute opening statement concerning their position on collaboration in educational environments, as it relates to their ESE project. Following this, 5 questions concerning collaboration will then be posed to the panel participants. These video-taped questions will come from children ages 5-7, who are among the research participants/partners in our ESE projects. This discussion of the children's questions will last approximately half an hour and may include such questions as: "Why is collaborating with someone hard?" "How come computers aren't easy to share?" The last 25 minutes of the panel will be devoted to questions from the audience, and a discussion by panel members.

Panel Discussion

Reviews of both psychological and educational investigations of peer collaboration have demonstrated time and again that working in pairs and small groups can have beneficial effects on learning and development, particularly in early years and primary education (Wood & O'Malley, 1996; Rogoff, 1990; Topping, 1992). It has been suggested that learning environments supported by technology offer an opportunity for optimal collaboration (Barfurth, 1995). This may be due to a shared goal where working with others will genuinely lead to an improved solution. However, for the situation to offer optimal collaboration the design of the computer system, computer software, learning activities, and the groups of children must all be considered.

Computer Supported Collaborative Learning (CSCL) will not occur just because two students share the same computer. A number of factors have been reported to have an effect on collaboration experiences at the computer, these include: task, group size, gender, and ability mix (O'Malley, 1992). Different combinations of users (number, ability and gender), computer systems and software designs may support, encourage, or augment collaborative learning in different ways. The proposed panel will attempt to explore these factors in collaborative learning experiences.

Panel participants representing five different ESE projects will address such questions as: How should we design interfaces that support, encourage or even augment collaborative learning? Can we create educationally significant collaborative interactions that go beyond what's currently possible? What technologies, educational strategies, and classroom experiences can we develop that will encourage young children to work and learn together?

The panel discussion will focus not just on design and technology, but also on developmental and educational issues in early childhood education (4-8 years). There are huge changes taking place in young children's cognitive development and social understanding. For the ESE research project teams, these cognitive and social changes have implications for what we are trying to achieve in facilitating collaboration in the classroom. Panel participants will discuss their diverse experiences, research challenges, approaches to learning, and technology development activities in their ESE projects.

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Exhibitions

Fabula

Bilingual Multimedia Storybooks for children

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Introduction

Fabula is a software environment for making and viewing bilingual multimedia storybooks, concentrating on 'lesser-used languages'. The project aims to provide teachers and primary school children in a number of bilingual communities in Europe with high quality, entertaining and easy-to-use teaching and learning tools in order to build language awareness, encourage language learning and the development of literacy skills and provide the less-widely supported languages with the high status attached to computer-based material. In short, Fabula aims to provide children of bilingual communities with a space in which to tell and enjoy their own stories in their own words and their own languages.

Fabula software is being developed by partners at the University of Reading and the University of Brighton, UK and XML Workshop, Eire. The software will initially be used by educational and cultural institutions in the Basque Country, Catalonia, Eire, Friesland and Wales.

The project is funded by the European Union as part of the Educational Multimedia Taskforce, DG XIII Telematics Applications and DG XXII Leonardo da Vinci Programmes.

Technical background

The Fabula project is in the process of producing two separate though inter-related pieces of software: Fabula Maker, with which users will author bilingual multimedia stories (termed 'storybooks'), and Fabula Reader, with which they will be able to access and read them. The software is being implemented using an amended subset of Mozilla (the open source code of the Netscape Communicator suite of products) and the emerging XML (eXtensible mark-up Language) and XUL (eXtensible User-interface Language) standards.

Fabula software can be seen as a layer model. The highest layer is the interface, implemented in XUL. The next layer, the content layer, represents the middleware between the Interface and the functionality, and is implemented in a scripting language called JavaScript. The services layer, which handles the core functionality of the software, for the most part uses existing methods contained in the Mozilla source code, which is written in C++ / C. The storybooks themselves are represented as XML documents, with links to external graphics and sound files. The storybook document is exposed via the content layer or the services layer using the Document Object Model (DOM). Rendering of the story within the software is aided through the use of cascading style sheets (CSS).

Fabula stories are combinations of text, pictures, sounds and text links. The text is displayed in a dual panel layout, one for the major language and one for lesser-used language and accompanied by an image to which a limited range of interactivity (displaying speech bubbles, playing sound files, etc.) can be added. Text links are used to define relationships between the two languages in the two panels in the form of a simple guessing game.

The Design Process

The project has made use of an iterative user-centred design process using children from bilingual communities (principally Welsh- and English- speaking children from schools in Swansea and Neath, South Wales) as informants to determine the range of functionality they would like in the application and to provide valuable feedback on the various design iterations as part of the prototyping-evaluation cycle. This was felt to be an essential element of the design process as children (or at least children working with an adult teacher) will be the principal end-users of the software both as producers and consumers of Fabula storybooks.

The children represented a source of useful information with regard to the usability requirements of the interface, but also quickly highlighted the necessity of using different design approaches to the two modes of the software. The authoring environment (the Maker) in which children and teachers create their stories clearly needs to be as usable as possible in the more traditional sense of being transparent and allowing for 'frictionless' accomplishment of tasks and goals. The viewing mode (the Fabula Reader), however, in which children interact with stories that they (or other children) or their teachers have authored, affords a somewhat different approach. When viewing Fabula stories, for example, the aim of the interaction is on pleasure - enjoying the stories and interactivity -and on learning - discovering similarities and differences between the languages - rather than on completing 'tasks'.

For this reason, during evaluation of the prototype viewing software (simulated in Macromedia Director) it was found that it was more appropriate to provide child-users with a degree of 'friction' and texture in their interaction with certain aspects of the interface. The children still needed to be able to move from page to page easily and seamlessly, but when they were investigating the languages or exploring the pictures a less task-oriented approach was found to be more useful. Rather than simply clicking a button on the toolbar to be 'given' a set of linguistic correspondences between the languages, for example, the children were required to search for, find and guess at the correspondences, as part of a simple interactive game. This was also mirrored with regard to the activation of certain sound and visual events related to pictures. By making the activation of these events dependent upon a search-and-find approach, a certain game-like 'texture' was added to the children's interaction. This both added to their enjoyment and served to involve them more deeply in their experience of the material. As well as being enjoyable and 'game-like', this 'search-and-find approach' was also found to encourage the adoption of problem-solving behaviour and a move from an implicit to a more explicit knowledge and understanding of the two languages and their differences and similarities.

Current progress

Implementation of the Fabula Maker and Reader software is currently in progress. It is expected that initial versions of the software will be available for evaluation and testing with users by early autumn, 1999.

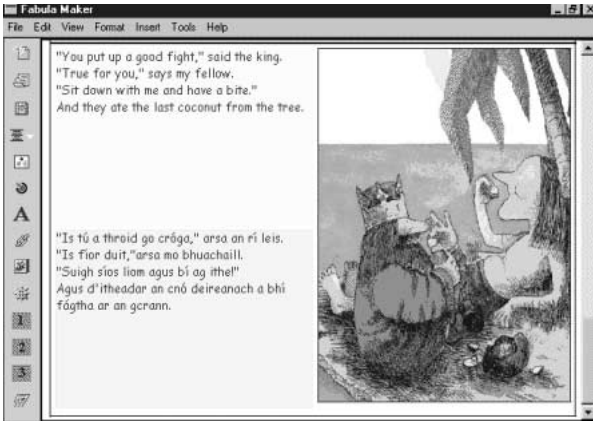

Figure 1: Screenshot of early implementation of the Fabula Maker software displaying texts from a story in English and Irish. Icons on the toolbar are still 'place-holders', to be replaced subject to on-going design work and evaluation with users

Figure 2: Screenshot taken from a prototype version of Fabula Reader implemented in Macromedia Director. This shows the title page of a Fabula storybook written in English and French in collaboration with the two 8-year olds featured in the picture

Plans for the future

Fabula is currently applying for further funding with which to expand the scope of the original project. It is hoped that the project team will be able to use the software developed during this first phase within a broader range of other multimedia language learning activities for children situated in a virtual 'Activity Centre' on the Web aimed at encouraging interaction between children not only within bilingual communities but also between different language communities across Europe.

The aim is not simply to support language learning in the formal sense, but to stimulate children's curiosity about their counterparts in other areas, build awareness of other cultures and provide opportunities for play. This will involve the use of a range of multimedia authoring activities (technically structured templates in XML - including Fabula software) to form the basis of asynchronous interaction between children in different countries; the production of a web site to act as a source for these activities (an Ideas Room); Web-based facilities for teachers to set up collaborations, plan and monitor their children's work on the authoring activities (a Staff Room) and a virtual reality environment supported by machine translation (a Playground) in which children from different language-speaking communities would be able to interact and play synchronously.

CARESS

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The ESE project CARESS looks at the needs of children in mainstream primary and Special Needs education. Bringing 'Sound Therapy' into schools through the innovative use of technology bound to an established research methodology, it enables children to explore their creativity and opens new avenues for aesthetic expression. The iterative design process has led to the development of new 'wearable, shareable' interfaces in the form of Electromyographic (EMG) and Optical Fibre Goniometer (OFG) sensors. Working closely with teachers and children, the implications of this new technology are being addressed through the development of curriculum/teaching materials.

Visitors to the CARESS exhibit will be able to experience the Soundbeam and sensors for themselves. Curriculum materials will be available for inspection and discussion.

The presentation will have two areas:

1. This will centre on a demonstration of the two new sensors being developed as part of the project. These 'wearable, shareable' interfaces can be explored and experienced by conference attendees. The EMG muscle sensor enables muscle activity to be registered and, thus, can convert movement to sound. The new OFG sensor is a wireless sensor enabling greater freedom of movement and increased opportunities for physical expression.

   A video presentation showing on-going work from project schools in Sweden and England from both special needs and mainstream primary classrooms will illustrate the potential for these new sensors. Curriculum materials currently under development will also be available for discussion

2. Members of the public will be able to participate in the CARESS experience. We shall be providing opportunities for at least 4 different learning games to be played on the new equipment. The games are all being developed and trialled in participating schools in the U.K. and Sweden.

Game 1: Throw and Catch.

This game has been designed with the PE curriculum in mind and focuses on the development of motor control skills, co-ordination and team co-operation.

Game 2: Roamer

Programming the 'Roamer', a LOGO type device, children are required to develop skills in IT control and identify and explore sound. They are asked to perform a range of problem solving activities including playing notes at a specified pitch and exploring ways of creating particular sound effects.

Game 3: Stepping Stones

This game has been designed to develop listening skills allied to motor control. Players have to listen keenly and make carefully controlled responses to sound and silence.

Game 4: Navigator

Navigator has been designed to enhance listening skills and physical co-ordination. It has a role in the teaching of music, PE and mathematics. Wearing a blindfold, the player must use sound as a guide to his/her physical position in the space and use their skill to reach a given target.

Other games may well be introduced during the sessions. It is anticipated that this will provide an exciting interactive environment for CARESS to display these potential teaching materials aimed at children from 4-8 years.

Playing with Rules

The Playground Project

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The Playground project is building computer environments for 4-8 year olds to play, design and create games. A playground is a place to play with rules not just play by them. We aim to harness children's playfulness, creative potential and exploratory spirit, allowing them to enter into abstract and formal ways of thinking.

We are building prototypes which allow children to play with new kinds of programming. Rather than using text based languages, the new programming borrows from animation, video games and dynamic graphics. We will also develop and integrate touch, speech, intelligent 'pals' (personal assistants for learning), and gesture in virtual reality.

Playgrounds will be built using two different programming languages, enabling us to compare the benefits of each. The two languages are ToonTalk, an animated programming language and Openlogo a parallel, graphical version of Logo.

Playground design will take place concurrently with studies of children learning across a sample of European schools and clubs. Evaluation of the children's games, game creation and learning outcomes will identify cultural, conceptual and developmental variation.

The social psychologist Lev Vygotsky once said:

"In play it is as though the child were trying to jump above the head of his normal behavior. "

Our project starts from the belief that play is a powerful source of learning. We add to this a further conviction that it is in the construction of personally meaningful projects that learning occurs best. Computer games are an important piece of that culture. They afford opportunities for fantasy, challenge, collaboration and competition, all essential elements of play and learning. Yet their relationship with learning remains tenuous — many computer games achieve very low thresholds of accessibility at the price of considerable restriction in terms of what can be done. Current computer games typically cast children in the role of game-player, playing according to rules programmed by someone else — a situation which, however motivating, sets strong boundaries around what might be learned.

We claim that the fascination of children with computer games is entirely at the level of interface. That is, manipulation of the game objects is fun, expressive and engaging. But for the most part, the interface is all there is: the level below the interface is the preserve of the programmers and designers, not the user. Our aim is to place children in the role of producers as well as consumers of games, and in so doing change their relationship with the rules — rules are necessarily raised to a more overt plane, they become objects of reflection, something else with which to play creatively.

The Playground project has been working since November, 1998, to build playgrounds, computational worlds in which kids can play games, take them apart, reconstruct and share them. We are doing this on two platforms: an animation-based computing formalism called TOONTALK, and a new, concurrent object-oriented version of LOGO.

Our research has progressed simultaneously on three levels: by questionnaire and interview surveying and classification of the games 7-8 year olds like to play on and off computer in our project schools in England, Sweden and Portugal; developing case studies of children as they are introduced to the two platforms and to our protoype games; iteratively designing new game prototypes on the basis of feedback from our case studies, our games analysis and the enhancements made to the platforms to support game (re)construction by the children. These enhancements are of two kinds — kernel and organic. The former so far include two capabilities: force joysticks, and speech (including direct control by speech input). These remain at the prototype stage. The latter include, as an example, easy ways to share or copy playground objects and their behaviours.

Achievements to date.

Our preliminary work has revealed the need for a clearer distinction between children's strategies for building games and for taking apart and reconstructing them. This has led to the development of two types of resource: for the first, playground fragments (play objects such as bouncing balls, noises and pictures) and control objects (such as dice and timers) that can be used to make games; and for the second, a collection of different types of games. A preliminary identification of the most useful categories of games which matched our goals, the tools available and the aspirations of our children has included adventure games, thinking games and flipper games. Protypes of these games have been built. A central part of this development work has been to identify the right grain-size of the objects that children will want to manipulate in their games: the appearance of the play objects, their behaviours and the rules that underpin them.

Our games are taking a number of forms. For example, we have built a simple PONG game in such a way that the eight-year old children we work with have come into contact with deep ideas such as the idea of decomposing motion into components. We have done this by an iterative process of design and testing with children, which has resulted in an emerging aesthetic of building out of small, understandable and malleable pieces.

Gillian and Suleika reconstruct a game using a force joystick

Our exhibition will show the achievements, current work and future plans of our project. As well as displaying our work, it will provide an opportunity for members of the i3 community to experience our concept of a playground. It will include the following:

- Demos of prototype playgrounds on two platforms (ToonTalk and OpenLogo)
- Demos and videos of force joystick and speech control
- Case studies of children interacting with games and how their games evolved.
- Illustrations of the interplay between game platform and design
- Interviews with children talking about playing and building games
- 'Hands-on' tryouts of prototype playgrounds
- Videos of children playing each other's games
- Poster displays
- Leaflets, balloons and T-Shirts for the winners of our 'design-a-game' competition.

NIMIS

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The ESE project "Networked Interactive Media in Schools" (NIMIS) is presenting, after its first project year, part of a Computer Integrated Classroom (CiC). Although the complete installations can only be visited in the local schools, the NIMIS project is seizing the opportunity of the Annual Conference 1999 in Siena to exhibit and demonstrate major parts of a CiC. These parts of a real classroom are exhibited to provide an impression of an integrated software, hardware and furniture ("roomware") architecture. Visible components will be.

The classroom's board: a big interactive computer display

This display replaces the traditional chalkboard in a NIMIS classroom. Children and teachers interact with the surface of the screen with their finger. The screen is height-adjustable in a wide range and equipped with loudspeakers and a networked computer.

The children's workplaces: Interactive LC displays

At the children's desks there are integrated LC displays. Children interact with the surface of these displays with a special pen. While the pen / display combination serves as the basic input device for the younger learners, older children additionally get a keyboard.

Software desktop: Integrated portable software basis

for all necessary classroom procedures

Typical applications of the underlying general features are:

- sending data objects to other children (e-mail functionality),
- storing, visualizing and multiplying personal data items (file-system functionality) ,
- visual companions (login / logout state, visualization of data flow),
- system-wide integration of specialized data parts (e.g. images, drawings, sounds),
- centralized logging of user actions (enables analysis and evaluation)

Specialized applications

On top of the general NIMIS software desktop, the three most prominent applications are:

Learning to read and write: Reading Through Writing

This application is built on a phonics-based approach to literacy, whereby children can select letter sounds and associated letters and pictures from a palette and combine them together to form phonetically spelled words using a drag and drop technique. The program supports them with intelligent text-to-speech pronunciation to ensure that words are spelled in a phonetically correct way. Pupils can select prepared words from a picture database or let the teacher type in the custom word that they want to write. While assembling characters, the children can check their word at any time by letting the computer speak both their word and the prepared word.

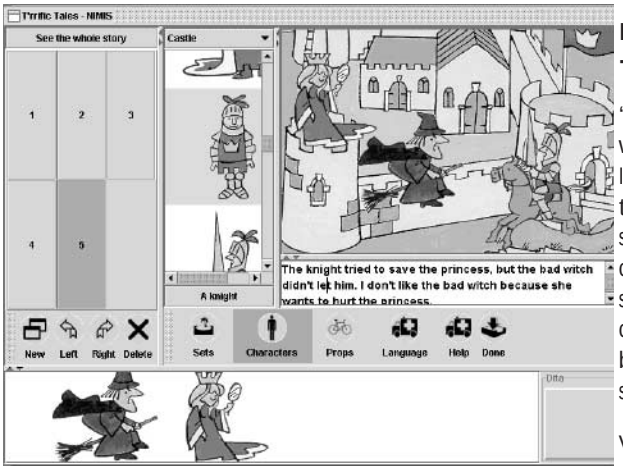
For visitors to our presentation in Siena we support German and Italian versions.

Directing and acting: Story creation with animated agents, TEATRIX

TEATRIX is an application that aims at promoting collaborative story creation and acting among young children. The application provides the children with 3D scenarios, characters, and props for story creation and acting. Children begin by setting the initial situation:

- choosing the elements (characters, scenarios and props) of their story and defining some basic relations among them;
- assigning story roles to the characters; and
- writing a short description of the story's initial situation.

Once the story is settled, each child adopts a character to direct throughout the story and play the story using the chosen elements. The story will evolve from the characters' actions and interactions. In Siena children will have the opportunity to construct the first stories with TEATRIX.



Multiple perspectives: Story telling with cartoons, T'rrific Tales

"T'rrific Tales" is an application, currently under development, which will support collaborative story writing in cartoon format. It has been designed with the help of children and teachers to support five and six year old children in the very earliest stages of writing. Children will be able to select backgrounds, characters and props to create stories. They will be able to add speech bubbles and record sound for their stories as well as create narratives with the aid of intelligent support. They will also be able to exchange ideas, words and pictures as they create stories together.

Visitors in Siena will be able to try out the emerging first prototype of this new application.

AudioLives

Sonic Furniture for Social Interactions in the Workplace.

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AudioLives is sonic furniture designed to trigger social interaction in office environments. While sound installations are usually found in formal gallery settings, with a focus on tightly controlled interaction between users and the installation, sonic furniture is used casually and aims to inspire interaction between the users in everyday life.

The AudioLives have two features that are intended to inspire interaction between people: they are collaborative audio toys that allow users to interact physically with personal sounds, and they are audio containers where people can leave sound "messages" that are played by the next user at a later time.

The intention for this sonic furniture is to create play between colleagues in informal areas of office spaces. As office furniture the AudioLives aim to enhance the playful aspects of belonging to a working community.

Figure 1: AudioLives in an office space.

By activating a microphone, users record their own words or other sound "messages" into each AudioLife. When touched, pressed, shaken or otherwise physically manipulated, the sounds are transformed through a signal processor and play them in a way that reflects the movement of the object.

A scenario of use

As Henry leaves the managing director's office after yet another unsuccessful attempt to get more stock options in the software development company he works for, he strolls by the AudioLives in the lounge at the end of the hall. He whispers, "the boss is thick" into one microphone and walks on with a slight sense of relief and naughtiness.

Later, when two colleagues are taking a coffee break, a third colleague gives the AudioLife a nonchalant slap as he enters the lounge. Suddenly the phrase "the boss is thick" is repeated in a rap-style pattern as the rod vibrates from the slap. This generates considerable amusement among the three colleagues, who decide to leave the phrase in the AudioLife to share the surprise with others.

However, the managing director is also in the habit of touching the sonic furniture on his way through the hallway to get a sense of the mood in the office. As a reaction to the slightly offensive comment stored in the AudioLife, he yells, "I heard that!" into the other AudioLife and leaves hoping the perpetrator will be the next person to use the AudioLives.

The next morning the rumour spreads in the office that a funny conflict is stored in the AudioLives. As theories about the omnipresence of the managing director are being discussed around the AudioLives, Carl records his mobile phone ringing sounds into the first AudioLife with a reference to the director's constantly interrupting phone conversations.

Unexpectedly, playing the combination of the directors' voice and the phone sound doesn't generate much enthusiasm. But it turns out that the sound generated from the ringing signal is quite pleasant in itself when the AudioLife is swung in a quick rhythm. A colleague, Mina, loads another ringing signal into the other rod, and they start playing the two AudioLives together. For five minutes the two co-workers

play a series of sonic variations together, and try a few different ringing sounds to make a sound piece together that they like. Laughing, and relieved of the tension created by the initial "messages" stored in the AudioLives, they return to their computers, but only after Carl has showed Mina the project he's working on that he is really exited about…

Background

In today's knowledge-based businesses, innovation often doesn't happen in formal meetings, but rather informally around the coffee machine, at lunch or in a café after work. In informal settings colleagues are more prone to "play" together and free themselves of the constraints imposed by achieving pragmatic goals together. Around the water tank informal groups are established that mix people across the boundaries of professional fields and team affiliations.

In the knowledge industry the formalities of fixed working hours and hierarchical organisations are being abolished, and the creativity of inspired teamwork is encouraged. Therefore it seems appropriate to explore the potential for office furniture that goes beyond the water tank as a creative social meeting point.

In traditional "productivity tools" products are designed to aid people in achieving certain tasks and goals. To support these goals in a product one can establish a place, whether physical or virtual, an activity, a theme or a task, and define people's roles in the process. In the AudioLives, however, it is central to leave the results open-ended. Therefore this sonic furniture provides a place and an activity to facilitate interaction, while the themes, tasks and roles are left for the most important actors - the users - to define through play.

In organisations that become increasingly project-oriented, where the knowledge and creativity of the workers is a core financial asset and cross-disciplinary co-operation is essential, the Audiolives provide a meeting point where social bonds are allowed to form and grow spontaneously and informally.

AudioLives Description

As the AudioLives are collaborative audio toys, one or more users can engage in physical interaction with them and play them by a variety of means. Each AudioLife consists of a flexible steel rod with a soft silicone pod on top containing a microphone and input sensors and a separate signal-processing unit.

The users store personalised sounds "inside" each AudioLife, and these sounds are dynamically transformed by the handling of the object. In this way the AudioLife turns into an instrument with an endless variety of sonic output. AudioLives always come in pairs, so that several users can use them simultaneously, and play together.

The last-used sound is always stored in each AudioLife, and therefore the next user can expect a surprise when he or she touches the object. In this way the nature of the social interaction comes as a result of the possibilities for leaving "messages" over time in "sound containers".

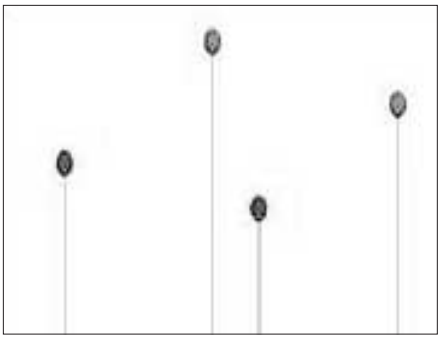

Figure 2: AudioLives

Each AudioLife has a flexible steel rod base that makes it vibrate and swing when set in motion by the user.

Lengths vary, from seat-height to AudioLives that the user has to stand next to manipulate them.

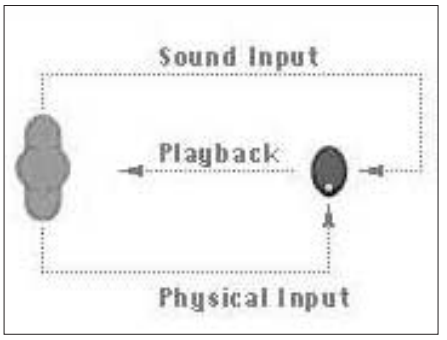

Figure 3: Input-output diagram.

The user can make sounds that are recorded into each individual AudioLife; words, whistles clapping or anything else that comes to mind.

The AudioLife can be touched, stroked, beaten and shaken. Sensors send signals to the signal-processing unit, which translates the motion of the object to commands that control how the sound is played back.

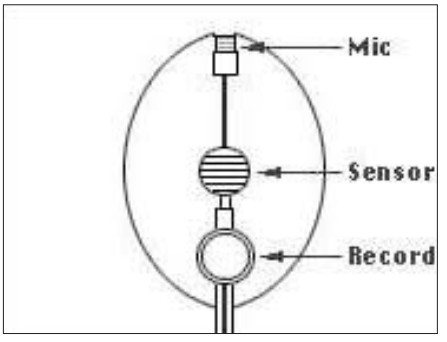

Figure 4: Components.

Inside the pod on top of the AudioLife, there is a microphone where the user directly records sounds.

Pressing the record-button on the surface of the pod starts a two-second recording. Through a touch-sensor and a tilt-sensor, both touches to the silicone pod and vibrations in the steel rod are used to generate patterns from the sound that the user has stored in the AudioLife.

Figure 5: Top pod of an AudioLife.

The components are cast inside translucent silicone rubber for tactile handling and to use the potential of the force-resistor touch sensor.

Prototype/testing

A complete working prototype of two AudioLives was constructed at the Royal College of Art in London during the winter of 1999. It was demonstrated successfully and stimulated immediate enthusiasm and intuitive creative use among passers-by. The AudioLife software is completed and hardware construction issues are resolved.

Technical description

The AudioLives consist of two flexible stainless steel rods of 180 cm and 100 cm height. Each AudioLife is topped by a soft silicone pod 8 cm in diameter, containing a force-resistor touch-sensor, a tilt-sensor, a microphone and a button to record 2 second sounds. When set in motion, the sensors control the playback of the recorded sound.

The signal-processing program is written in Max/MSP. This software records sounds from the microphone embedded in the silicone pod. Signals from the sensors vary according to movement and the force of the

input and control the transformation of the sounds that are played back real-time from the computer. The program is designed to run on a Macintosh G3.

Further work

A further step in the development of the AudioLives would be to integrate them with a virtual environment. Through IP-based appliances, users could play the AudioLives remotely, and join physical and virtual groups of users. Such a step would widen the potential for social interaction triggered by the sonic furniture by making it a focal point for a distributed working community.

HIPS

Hyper Interaction within Physical Space

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HIPS (Hyper Interaction within Physical Space) is a hand-held location-aware tour guide through which the museum visitor can obtain contextually appropriate narratives regarding the physical environment. HIPS detects the position of the tourist in the physical space and provides personalised and contextual information. The presentation of information is dynamically generated, adaptive and integrated with maps and spatial directions. From a hardware point of view HIPS is based on a client-server model where the clients that visitors carry around are pen-driven PDAs with a screen, headphones and no keyboard. Localisation is performed by various means: infrared, radio and GPS. Connectivity to the server is wireless.

The primary objective of HIPS is the investigation and development of new modes of interaction when navigating simultaneously within both a physical space and virtual information space, achieving a seamless boundary between both environments.

1. What's HIPS for?

If we observe people visiting an art setting, such as a museum or a historical city, we can notice a large variety of behaviours. Some visitors just explore the physical spaces letting them to be guided by the environment, others use a guide as a rationale for their paths, others look for specific artworks or places they already heard about. Although the idiosyncrasies determined by personal goals, different knowledge and interests, different time constraint or environmental variables, we can affirm that for all the visitors the engagement with the physical space is the condition for a successful experience.

The main goal of HIPS is to overcome the limits of traditional tourist tools - as books, human guides, labels, audio guides – in supporting the visit of so different needs.

One of the limits of these kind of tools is that they tend to shape the visit of the tourist rather then contextually supporting the personal way of interaction and the exploration of the art setting. For instance, audio and human guides tend to impose a particular path to the user, a book selects the information that is considered relevant, and so on. HIPS would like to be just the opposite: a dynamic and personalised information tool that supports the engagement of different visitors in different ways. In order to support the engagement with the physical environment, the gap between the physical and the information space should be minimised.

Figure 1: Visitors in an art setting

2. Tracing the visitor's path

At the very basic level, minimising the gap between the physical space and the information space means to deliver the information about the artwork the user looks at, without any explicit request or browsing of information. In order to achieve this, HIPS includes a localisation system that traces the visitor's path within the physical space. For the indoor scenario infra-red sensors and wireless technologies are used, while the GPS will be used outdoors. Thanks to the localisation system HIPS can be aware of the movements of the visitors in a considered space and use these data to deliver information according to the users' positions.

3. Delivering fluid and natural information

In traditional hypermedia, where the user is typically expected to browse the information space and read written information (even if enriched with images and sounds), the information retrieval constitutes a completely separated field of actions compared with the exploration of the physical space. The choice of a location-aware electronic tour guide constitutes a first means to overcome this kind of problem. Another step is the choice of an audio modality for the outputs of the system. The visitor is not requested to read the information on a screen, which means temporarily focusing on a different object than the artwork or the art setting. But even if audio output could be a plus, care must be taken not to waste the benefits of this resource. In fact, if message content is not properly adapted to the audio modality there is a risk of of introducing additional disorientation effects or user dissatisfaction. This phenomenon is more evident here than in traditional hypermedia, because the user cannot browse information as easily as in a hypertext (s/he can appreciate a description only when listening to it).

In order to build presentations dynamically from an existing repository, it is necessary for the data to be appropriately structured and annotated. The macronode formalism is a way of annotating existing information with the aim of making explicit the content of each piece of information and the relations that hold among different pieces of information. We intend that the macronode formalism should become general enough to annotate every kind of data (text, audio, video, and images) but at present we are focusing on audio and images only.

The information unit is the macronode. Each macronode corresponds roughly to a paragraph of text. The data structure representing a macronode consists of (i) a message graph — a transition network of message files (audio, text or images). A path through this message graph will produce a contextually appropriate surface realisation of the macronode; (ii) a list of pointers to other relevant macronodes (specifying the particular rhetorical relations among them); (iii) the type of message; and (iv) a pointer to the relevant semantic concepts in the taxonomy. The following figure graphically illustrates the information included in a sample macronode.

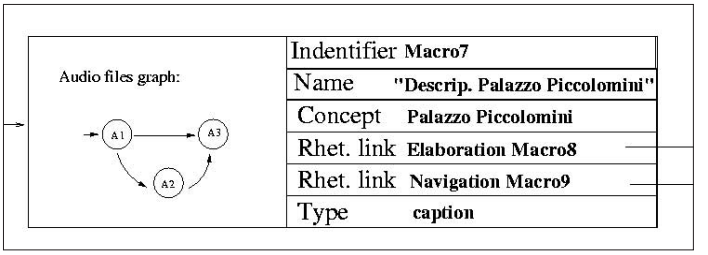

Figure 2: A sample macronode

The macronode formalism has been developed at IRST-ITC. It is inspired by studies of museum literature (macronode types were defined on the basis of studies of museum labels) and work done in natural language generation (work on rhetorical relation supported the definition of links). Macronodes allow existing commentary to be organised in a fine grained way to allow flexible composition of presentations.

This method makes it possible to deliver presentations that are appropriate to the context of the visit, including references to what the user has already seen, deictic references ("You are in front of the Palazzo Pubblico" or "On your left you can admire the Palazzo Pubblico"), and hints for the rest of the visit.

3. Personalising the Presentation

One of the selling points of the HIPS system over existing tourist guides is its ability to adapt presentations to both the context of interaction (what has the user already seen or heard?) and to the preferences of the user (What do they want to hear in this particular moment? How do they want it presented?). These resources allow the system to select content that is of interest to the user, avoid repeating what they have been told before, and present the presentation in the form most suitable to the user.

Towards this end, the HIPS prototype system automatically tracks user-related information, and makes inferences on that information where useful. Three types of information are modelled in this way:

1. Movement Model: the system keeps track of where the user moves throughout an exhibition, in terms of the sequence of locations visited

2. Knowledge Model: the system keeps track of what the user has already been told, and also what the user could be expected to know before the interaction.

3. Interest Model: On the base of an ontology of artworks and artists, and by means of inference rules, the system infers hypotheses about interesting objects and interesting attributes of the objects to select and present interesting information.

4. Visiting Style Model: the system classifies the user into particular visitor types purely on the basis of the way in which they move through the galleries: the kind of path, how long they stay at each exhibit, how systematically they walk through a room, and so on. This classification, based on ethnographic studies in art settings, is used by the system to infer how much information has to be presented to the visitors taking into account contextual strategies of visit.

At this stage of the project only the Visiting Style Module and a Basic User Model Application (not including the interest model) have been integrated.

4. The space as an interface

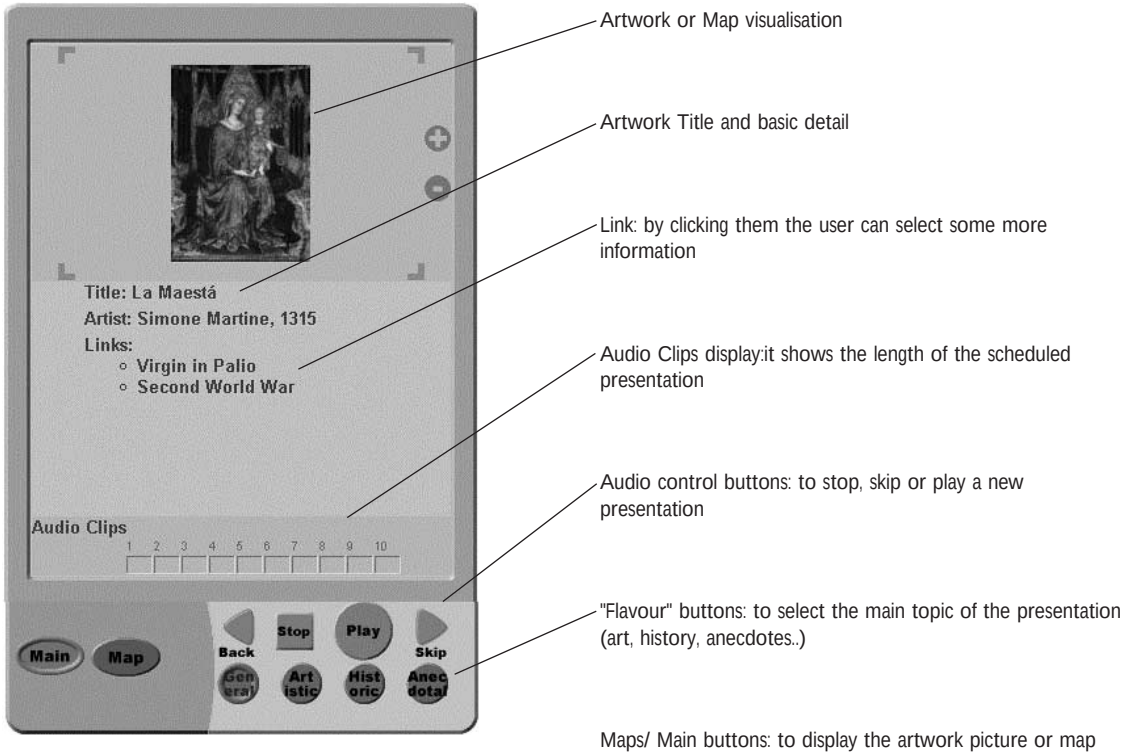

Figure 3: The Hips Interface

A key notion in the HIPS system is the notion of navigating information spaces via movement through the physical space. The system tracks the user's position and orientation and adjusts its notion of relevant information accordingly. Even standing still is seen as a form of navigation, a request for more information on the current artwork.

The user interface allows the user to pursue informational goals unrelated to their physical position, by interface clicks. They can choose follow-ups after a presentation, or view the maps. Audio control buttons make it possible to control the audio presentation.

To provide a better idea of the look and feel of HIPS, we provide a transcript of part of a visit to one room of the Museo Civico in Siena, the "Sala del Mappamondo". The walk-through consists of a series of user-movements in the physical space that trigger the delivery of information. It is structured as follows:

- Column 1: the visitor's action which produced the presentation. The movement is shown on a map of the room (split into areas and relevant object positions). The visitor's position and orientation are shown by a red arrow.
- Column 2: what is displayed on the screen of HIPS in terms of relevant image and relevant follow-ups;
- Column3: the transcription of the audio message that is delivered to the visitor;
- Column 4: commentary showing how HIPS adapts the presentation to the visitor's path.

Move: **m-b-2** **south** 	Title: Sala Mappamondo Author Links 	This is the Sala del Mappamondo, one of the most important halls of the whole Palazzo Pubblico. It gets its name from a map of the world (in Italian: "Mappamondo") which was located here. Here are collected all the main features of the Repubblica Senese's bright political, cultural and artistic past. The wonderful frescoes, even the more religious ones, impose themselves as the very first examples of laic art, involved in history and contemporary political life.	The visitor enters the Mappamondo room facing south. Since this room is freshly entered, a generic presentation describing the room is provided.
Move: **m-b-3 south** 	Title: Bernardinian MonogramŸ Author: Batista di Niccolò Date: 1425 Links: 	From the windows in front of you there is a beautiful view of the Sienes country. On top of the wall in front of you, the Bernardinian Monogram is represented. Batista di Niccolò da Padova painted the fresco in 1425. The portrait of San Bernardino is located behind you.	The visitor moves forward south). The system introduces the windows and the monogram above them. Since there is a related artwork in the room, which the visitor has not seen yet (the S. Bernardino portrait), the system includes a direct reference to this artwork. Note that the reference is given spatially, with respect to the visitor's orientation, using "behind you".

Move: **m-b-3 north**  attention front of	Title: S. Bernardino Author: Sano di Pietro Date: 1460-1461 Links 	On the column in front of you, Sano di Pietro painted San Bernardino in 1460-1461, can be easily identified thanks to the monogram he holds in his hand.	The visitor decides to follow the suggestion and turns to look at the portraits As in the previous step, the system uses a direct reference to the physical space with respect to the visitor's position to direct the visitor's to the exhibit ("In you").
Move: **m-a-5 north** 	Title: S. Caterina of Siena Author: Lorenzo di Pietro (il Vecchietta) Date: 1460 Links: 	This fresco represents Santa Caterina of Siena. It was painted by Lorenzo di Pietro, nicknamed Il Vecchietta. St. Caterina has been remembered and is still venerated by Sienese people because of her life of sacrifices and penitence One of the best-remembered of St. Caterina's penitences was to eat seven bowls of ash. Nowadays this event still has a trace left in a popular saying, when, during grill cooking, something falls into the ashes. To state that food that has fallen down is still edible, Sienese people usually say that eating a little bit of ashes does not cause any problem, since St. Caterina ate seven bowls of it.	Here the system uses a spatial reference to refer to the artwork: "this" is used only when the visitor is in front of the exhibit, close to it and looking at it. In general, depending on the visitor's orientation with respect to the exhibit, different spatial deixis are used: this is, in front of you, etc. The use of spatial deixis is one means through which we reinforce to the visitor the system's awareness of space.

5. A richer audio interface.

The basic concern in designing HIPS is that the fruition of art is not just a matter of getting information about artworks: the emotional component and the level of engagement play a fundamental role in the visit experience. The challenge with HIPS is to design a tool able to mediate the emotional engagement in an art setting: the physical space, the virtual space and the context of interaction are integrated to support a personalised and intense experience of art.

A rich audio environment has being designed in order to better support the experience of visiting and, in particular, the emotional engagement. These include different reading styles, the integration of sounds, music, and audio-icons, different voices, different intonations (local accents, formal, dramatic, rhetorical reading...), use of holographic sounds to communicate information about physical space.

6. State of Project

A first Hips prototype (including localisation system, macronode architecture, visiting style module, basic adaptive features) was demonstrated in March 1999. User testing is currently under-way. During the i3 Annual Conference '99 in Siena a live demonstration of a more stable version of the prototype will be available in the Museo Civico. A ten minute video will be available at the exhibition space. The consortium is currently working to refine the architecture in order to reach a more efficient prototype. New localisation technologies (such as electronic compass and GPS, allowing the portability of the system within an outdoor scenario) and more complex adaptation systems will be integrated soon. In order to improve emotional engagement with the art setting a richer audio environment is under development

7. Press Reviews and Recent Publications

- La Repubblica "Intelligenza Artificiale e PC" by Marta Mandò, 4 March 1999.
- WIRED News "Botticelli on your PalmPilot?" by Cristina Valsecchi. 5 March 1999.
- Prodigio "PalmPilots poderão servir de guias tur'sticos" by Armindo Silva, 5 March 1999.
- Il Tirreno "Siena, La guida turistica? Ci pensa un "palmare" " by Marco Gasperetti, 16 March 1999.
- Il Corriere della Sera "Il minicomputer fa da Cicerone" by Marco Gasperetti, 29 March 1999.
- Le Scienze "Un Cicerone elettronico " by Cristina Valsecchi, n°369, may 1999.
- Libération "Suivez le technoguide" by Annick Rivoire, 20 February 1998.

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Magic Lounge: A Virtual Communication Space with a Structured Memory

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Networked computers, especially the advent of the Internet and the rapidly growing range of mobile communication and computing devices, have made new forms of social interaction possible. Presupposing access to the world's information highways, people from all over the globe can virtually come together somewhere in the so-called Cyberspace. The motivations for entering a virtual space can be as diverse as the interests of the participants. Some may join to chat, make new acquaintances or carry out joint and goal-directed activities. Others may engage in exchanging and sharing ideas, experience and knowledge on matters relating to their professions or hobbies. Yet others may share common cultural or political interests and even use virtual meeting places as arenas of civil discourse. Furthermore, new communities can emerge much more easily because people are no longer required to live in the same geographical neighbourhood.

Virtual meeting spaces represent a major step beyond the classical computer-user relationship. Rather than having a single user interact with the machine, the computer-mediated user-user interaction is becoming a new paradigm. Communicating through computers enables new services which facilitate taking part in cyberspace conversations, as well as assisting the participants in keeping track of the communicative actions performed during conversations. We use the term virtual meeting space in a broad sense and consider that such spaces may simultaneously integrate traditional human-computer interaction processes (for instance, database or Web access) and also be related to what could be called a whole group story made of synchronous and asynchronous interactions.

Our working background is a European project called Magic Lounge in which participatory design studies and sociological studies have been carried out. In Magic Lounge we are especially interested in the way in which ordinary people use current technology, such as chat and audio conferencing, and we try to identify key concepts, services and functions that may drive the development of the next generation of computer-mediated communication systems. Among such concepts and functions are 1) a structured meeting memory, 2) a temporal meeting browser, and 3) the possibility to access the meeting place through heterogeneous communication devices. User needs regarding such services have been studied through questionnaires and tests with prototypical implementations. The following subsections provide an overview of the key concepts that have been identified and will be demonstrated in the exhibition space.

Virtual meeting places that can remember

Study of the current teleconferencing and groupware systems, as well as our own participatory design work with ordinary users, have revealed a strong need for a structured memory. Our hypothesis is that a variety of added-value communication services can emerge from a system's capability to memorise information units that have been obtained from observing how people communicate and interact which each other in a virtual meeting place. Most of today's collaborative systems consist of a set of loosely coupled communication tools (audio/video conferencing tools, textual chat, shared white boards, and shared special-purpose tools, e.g. for voting or collaborative web-browsing). We suggest an architecture centred around the concept of a conversation memory that will keep track of all communication acts regardless of the media-specific tools used for communication, and that can be queried by newcomers or latecomers who want to know what has happened in a meeting so far. The conception of the Magic Lounge memory component foresees the recording of spoken and typed utterances as well as other interaction events, such as the mutual exchange of references to electronic documents, which may be part of the virtual meeting environment. The conception also comprises a set of different user interfaces for accessing the memory content from specific points of view and by means of different communication devices. In particular, a 'temporal meeting browser' allows users to navigate back and forth through recorded meetings, and inspect individual contributions in a non-linear manner. Hence, a Magic Lounge recorded meeting is a structured collection of different types of contribution (such as audio chat, speech turn, textual chat, and log information) which should allow the user to mentally reconstruct the whole meeting, including its meaning, dynamics and progress. A contribution to a meeting can indeed be any action by the users or the system itself.

Beyond the mere exchange of messages and data

An important insight was that a structured communication framework would be needed for the realization of many of the envisaged memory and communication support functions. The consortium adopted a framework that is based on the notion of referable objects (in the sense of objects to which one can refer to), communicative-acts and conversations. Essentially, communicative acts denote activities, such as exchanging audio or chat messages among the communication partners. By treating the communication acts as referable objects, it is possible to reconstruct the flow of activity between all the clients (humans and system components) at a higher level of abstraction, and to reveal the various relations that may exist between the single acts.

Getting the mobile users in

The increasing quest for mobility together with a large variety of new portable computing and communication devices - including PDA's, palmtop, and mobile phones with built-in micro computers - add another level of complexity to systems which are to support tele-communication and collaborative work. This is due to the fact that the devices used by different people may not have the same input and output capabilities. Limited screen real estate, lack of high resolution and colours, no support for audio and video are among the typical restrictions on the output site, whereas restrictions on the input site may be due to miniaturized keyboards and GUI widgets, tiny physical control elements, or sparse capabilities for the capture and recognition of gesture, voice and video input. The new generation of mobiles with built-in Internet connection will create a high demand for a technology that allows users to enter virtual meeting places and to access existing information sources and applications in a user-friendly way. The Magic Lounge platform for hosting virtual meetings allows entering a meeting using heterogeneous communication devices, such as PCs, PDAs, and also mobile phones. Our technology for the automated design of information presentations allows flexible tailoring of both content and layout of WML pages in a way that suits the display restrictions of the target devices.

A user-centred design

Design and development of the Magic Lounge is based on user-centred design methodology. A selected group of users from a number of smaller Danish islands have been involved with the various aspects of the Magic Lounge design and development. The user participation has been through administering questionnaires, conducting workshops, interviews, and the use of the software prototypes. Besides this main Danish user group, other groups have also been utilised for testing specific aspects of the Magic Lounge software, or collecting users' ideas for the design of specific system components, such as the Magic Lounge memory.

An architecture based on standards

Many of the current collaborative systems use proprietary solutions for their architecture which make modifications or extensions difficult. In Magic Lounge, we have decided that, when it was possible and available, our architecture would be based on standards. In this way, the communication infrastructure is based on CORBA (Common Object Request Broker Architecture) from the OMG (Object Management Group). As objects are the basic building blocks of the system, the structured memory uses an object-oriented database which conforms to the standards supported by the ODMG (Object Data Management Group) for API and request language (OQL - Object Query Language).

What will be served at the next i3 Spring Days?

Magic Lounge has been designed to be used by a group of people collaborating on everyday tasks. For example, consider the challenge faced by the organizers of an international conference in selecting the type of cuisine which is going to be offered to the conference participants. Preferably, the chosen menus need to satisfy a wide range of personal tastes but once in a while the choices made by the organizers may not please everyone. For the case of the next i3-Spring Days which will be held in March 2000 somewhere in South Europe, why not collect the suggestions of the participants of the current conference by using the communication facilities of the Magic Lounge demonstrator? That is, throughout the conference period

people will have a chance to use the Magic Lounge to add one of their favourite foods or beverages to the menus to be served during the Spring Days. There will of course be a number of rules which have to be followed to make this selection process more democratic. For instance, everyone will be allowed only one suggestion, and if the suggestion has already been made then a new suggestion has to be made. As there is also a set budget for the conference meals, the overall cost of the items that make up the menus has to be kept within a predefined range. The information and suggestions made by the users will be collected and stored in the Magic Lounge memory. The menus will be created from this collected information, and displayed for reference. The participation of people in this scenario will be facilitated through the use of a number of heterogeneous devices which will be available in the conference exhibition area, especially at the project stand which will be divided into several zones to allow demonstration of different use situations like: being at home, walking on the street, and sitting in the pub.

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Maypole

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How real is visual messaging? After one year of design research into the communicative behaviour of the family, the Maypole team has narrowed its focus to the area of visual communication and the family. Our assumption is that image-based communication might support or enliven interaction among family members.

Wireless prototypes of digital cameras, to send images at the press of a button, were developed for eleven users in four families. We didn't provide further guidance on what to do with the devices. Family members began by sending pictures to one another — mostly inanimate objects just to get the hang of the controls, and gradually started sending messages—faces, visual jokes, and images that expressed emotions and moods. They clearly had fun with the prototype which they used mainly for emotional communications rather than casual exchanges.

To explore this further, we asked a number of sociologists, psychologists and business specialists to give their perspectives. As each discussed the subject in a different context, the resulting stories deepened our understanding of the area of visual communication and the family, offering starting points for design.

Etui

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The partners comprising the eTui organizing team are Pompeu Fabra, Apple Computer and Ultralab. We have focus families and associated schools in Spain, Norway and the UK, where the main research is conducted.

The intention is simple: to work towards the production of a toy that can be observed learning in ways that yield a metalevel understanding of learning for its young users.

Our exhibit presents the components of the eTui project, from our initial concept through to the beginnings of our first eTui prototype. We illustrate the activities we have undertaken with children, orchestrated by our facilitators, teachers and parents in the three focus families and in schools across Europe.

We report what has been learned along the way that has enabled us to design and build the current eTui prototype and to explore metalevel learning awareness in young children of four to eight years. We also suggest directions that we anticipate our current design may take through the next phase of the project timetable as we uncover more about the children's understanding of their own learning. We are currently half-way through development and on schedule.

Although our aim is quite straightforward, the project structure is multifaceted, with inter-dependent strands moving in parallel. Our presentation aims to take the viewer on a journey through the project "world", displayed as a storyboard.

We hope that by following the storyboard from our initial idea stage to our current stage of prototype development, visitors will understand how the various project activities critically depend on each other: they individually inform the prototype design as we build a better understanding of metalevel learning in children.

Although the project work packages and tasks run concurrently with each other, we intend to represent and illustrate some of the activities that combine to tell the eTui 'story'. Simply abstracted, these activities are as follows:

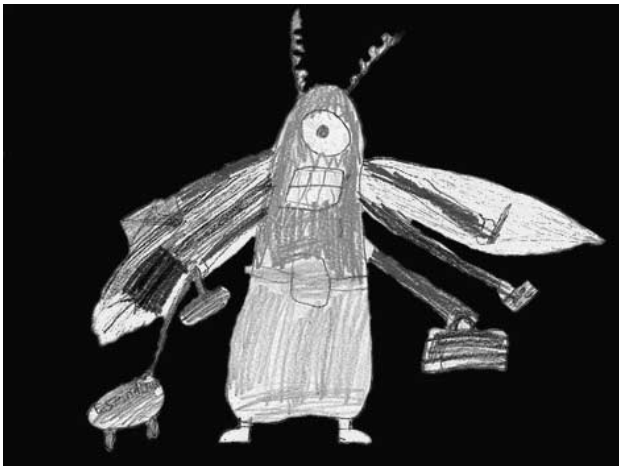
- ONLINE RESEARCH COMMUNITY
- WORKING WITH CHILDREN AT SCHOOL
- WORKING WITH CHILDREN AT HOME
- SOFTWARE DEVELOPMENT
- HARDWARE DEVELOPMENT
- REPORTING ETUI

Since the start of the project in October 1998, we have made inroads into, and gained insights from, each of these strands, having established an active eTui Intranet of schools, families and researchers. This on-line community enabled us to easily co-ordinate activities across the project, discuss ideas and report our findings.

Once the children, teachers and parents were introduced to the project's aims, the children began activities that would lead them into thinking about their favourite toys, and toys they would like if only they existed!

We worked with a range of other children too, and some of that work involved video and transcriptions of their play and opinions. This first stage in thinking about "toys for learning" was carried-out in the three different focus schools; it provided a valuable insight to the cross-cultural differences, and similarities, of children and families.

Our ideas for the initial eTui prototype, in terms of movement, sounds, behaviours and appearance were also informed by Universitat Pompeu Fabra who utilised VRML (Virtual Reality Mark-up Language) simulation worlds, incorporating these attributes; these were trialled with the Catalan children of Daia, Spain to explore their preferences.



Our focus families, and schools have been provided with interactive toys and an internet-connected iMac computer capable of running simulation software, games and eventually, the simulation software being developed to work with the eTui prototype.

The parents have kept diaries over the school holidays about the nature of their children's interactions with the computers and toys. This type of reporting, and the discussions that have followed online, have informed various activities within the project, both in terms of design and in our understanding of learning and ITC.

Attending for eTui @ the i3 exhibition

Professor Stephen Heppell (Ultralab), Richard Millwood (Ultralab), Andrew Simpson (Ultralab), Professor Josep Blat (Universitat Pompeu Fabra) and Dai Griffiths (Pompeu Fabra)

The large surface magnetic force feedback visualisation table

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In the context of eSCAPE WP5.1, a unique new type of generic user interface has been developed by the ZKM called the Large Surface Magnetic Force Feedback Visualisation Table. The technology embodied in this interface is so innovative that a patent has been applied for it. The basic functionality of this interface is such that the user can experience tactile forces over a large surface in relation to computer generated images which are projected onto that surface. These forces are experienced through a special hand piece (Force Feedback Interface) which the user can move freely over the image surface. This device is an exemplary case of artistically driven i3 research and development resulting in a major patentable invention which has significant practical and commercial potentials.

This is an input device that tracks the 2D position of a 2-button hand piece on which a programmable force is applied. The dimension of the table is approximately 1.5x1.0m and the tracking area can be used for back projecting application graphics. The hand piece is removable – the force is coupled magnetically to the mechanical construction below the glass pane that makes up the surface of the table. The force is produced by a controlled offset between the hand piece magnet and the magnet below the pane. The mouse button functionality of the hand piece is provided by the electronics of a wireless mouse with the receiver being built into the table.

Description of the Large Surface Magnetic Force Feedback Visualisation Table

A data input device for a computer that is similar to a digital tablet, by which a manual control device (mouse) can be moved across a demarcated surface area. The position of the manual control device (Force Feedback Interface) is transmitted in an absolute mode to the data processing unit (computer), so that there is a direct connection between the position of the manual control device and the current position of the computer screen (cursor). The Force Feedback Interface is magnetically coupled to a cross slide mechanism that detects the position of the manual control device by means of sensors; when the manual control device is moved the cross slide mechanism, which is driven by a motor, follows the Force Feedback Interface. The magnetic coupling between the manual control device and the cross slide is designed so that when the positions coincide, no force is exerted upon the manual control device; but with an increasing discrepancy between the positions of the manual control device and the cross slide an increasing force is also exerted upon the manual control device. The tracking of the cross slide, which is guided by the sensors, is then combined with computer generated commands that depend on spatial and temporal co-ordinates; these commands cause the position of the manual control device and the cross slide to deviate from each other in a way corresponding to the spatial and temporal dependency relation, and in this way a directional force is transmitted to the manual control device. The effect upon the user is that the manual control device on the computer screen's surface area is either drawn to specific quadrants or in specific directions, or becomes difficult to move to specific quadrants or in specific directions (command fields).

The surface area across which the manual control device is moved is a projected surface area, upon which the current computer screen's contents are displayed. Because the projected surface area is displayed as a background projection, the cross slide is designed so that the projection is obstructed as little as possible. This is done by using thin steel wire or metal bands of the cross slide mechanism, which are connected to a mechanism and also transmit energy and signals to the cross slide. Thus the user moves a manual control device (Force Feedback Interface) directly over a projected surface area; by moving the manual control device in the projection the user also moves cross-hairs (the shadow of the steel wire) and via the manual control device experiences a force that is spatially and temporally dependent.

The system developed for the IO-dencies|Sao Paulo project is a specialized multi-media database in the context of urban development with an emphasis on collaborative work, planning and information retrieval. The system has first been used as a tool for urban planners, architects, artists and philosophers from Sao Paulo for collecting, organizing and maintaining multi-media data about specific urban topics in the city.

Every participant (an editor in the projects terminology) assigns a keyword or short phrase to each piece of data he wants to store in the database and arranges this keyword on a two-dimensional map in a way he thinks it relates to other keywords on the map and in the database. The editors are able to view other editors' keywords and related content, drag them on their own keyword map and organize them spatially in relation to their own keywords. A centralized database system is used to store the participants' data, keywords and keyword maps. A second component, the self-organization, takes these maps and uses them to create a rule set for a self-organization algorithm. The self-organization uses these rules to iteratively calculate the motion of each keyword on a two-dimensional area and stores the motion trail on the database. A second component, the force-field server, takes the actual position of each keyword, assigns a local force field pattern to each keyword and produces a two-dimensional global force field by accumulating the local force fields. This global force field is made available for retrieval over network to the visual client.

The visual client is the user's front-end for information browsing. It retrieves a snapshot of the current global force field and guides the user by a dynamic flow visualization towards clusters of information. Once the user has zoomed in far enough he is able to select the visible keywords to bring up a standard web browser which displays the related information along with the history map, a simple visualization of the motion trail of that keyword over time. By clicking on certain time points on that temporal trail, the user recalls former keyword constellations in relation to the one he has chosen.

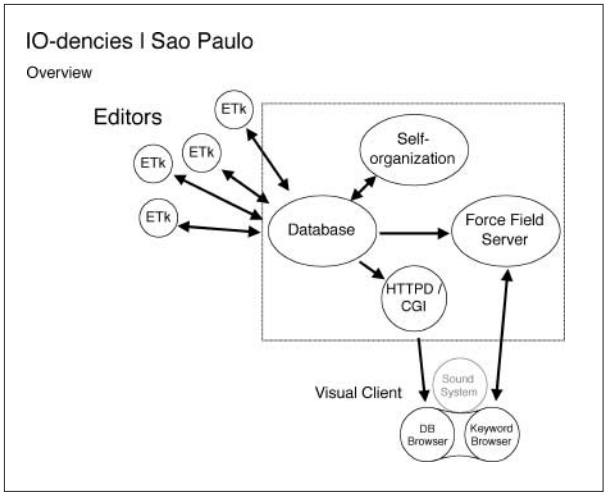

Fig.1 A sketch of the system components. The arrows show the flow of data between components.

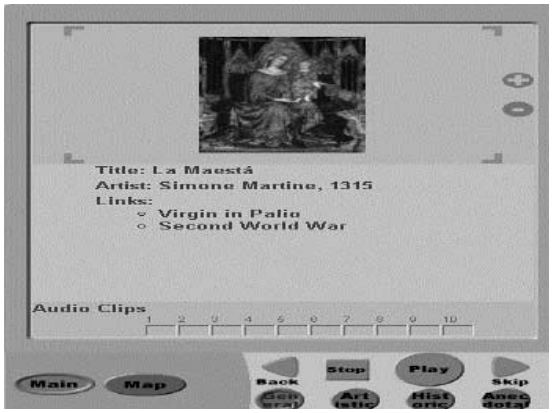

Fig.2 User interacting with the Magnetic Force Feedback Visualisation Table at the Venice Biennale 1999.

Fig.3 Close-up of user interacting with the Magnetic Force Feedback Visualisation Table at the Venice Biennale 1999.

The Community of the Future

eRENA at Siena

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In "The Community of the Future" exhibition the eRENA consortium presents three components of its ongoing work which together provide a strong sense of the group's research concerns and the demonstration projects developed to date:

- the MIRALab booth for the capturing and morphing of avatar faces
- a demonstration of [.tv]world, a 3D virtual world which forms the basis of a new Inhabited Television project; this will run both on a local area network and live across the Web
- a video presentation of Inhabited Television broadcasts and other eRENA projects, including two major new mixed-reality projects

In addition the area will be completed by a new poster presentation of the eRENA project.

eRENA

eRENA is dedicated to exploring electronic arenas which deploy mixed reality technologies to create environments for potentially large-scale real-time participation in media-rich cultural events.

- An electronic arena can combine virtual reality (where participants are embodied within a shared virtual space) with augmented reality (where interactive technologies are embedded within a shared physical space).
- An electronic arena enables the joint participation of multiple individual and groups of varying capabilities and roles on a potentially mass-scale.
- An electronic arena supports real-time participation in events rather than solely the enactment of advance-prepared, fully scripted events.
- An electronic arena inter-relates multiple media sources and distributes them to multiple distributed destinations.
- An electronic arena stages events to enable the remaking of culture and cultural identities through deeper participation in popular media and artistic works.

The MIRALab Booth

This MIRALab project is a sophisticated and efficient system for the automatic creation of numerous differentiated faces for large-scale populations of electronic arenas.

Any visitor to the "Community of the Future" exhibition can be photographed at this booth and his/her 3D facial model will appear on a screen. His/her face will be 3D morphed with the previous visitors heads and the eRENA partners already existing in the virtual database. A new virtual population will be created coming out of the visitors' faces of the community of the future and the eRENA partners. And then a new virtual family will be generated, as a mix-up of all kind of facial features coming from all the visiting i3 people.

Facial animation features will be tracked in real-time using a video camera (no marker is necessary) and to present the cloned virtual visitors. This virtual community of the future will be animated in real-time and show new expressions and emotions.

[.tv]world: "The Ages of Avatar"

[.tv]world, called "The Ages of Avatar", is an electronic arena operating at the conjunction of a 3D social space running on the Web and broadcast television. During the "Community of the Future" conference [.tv]world will be in its final stages of testing, prior to a November 1 launch. This world, created by eRENA partners BT's Advanced Telecommunications Research Group, Illuminations Television, and the University of Nottingham, is being developed alongside the BSkyB television channel [.tv].

The community of [.tv]world will be built through October, and activities within the world will begin at the same time. Recordings of activities in the world will be presented both in the programming of [.tv] and in the interstitial elements of the channel. Live presentations of this form of Inhabited Television are also envisaged.

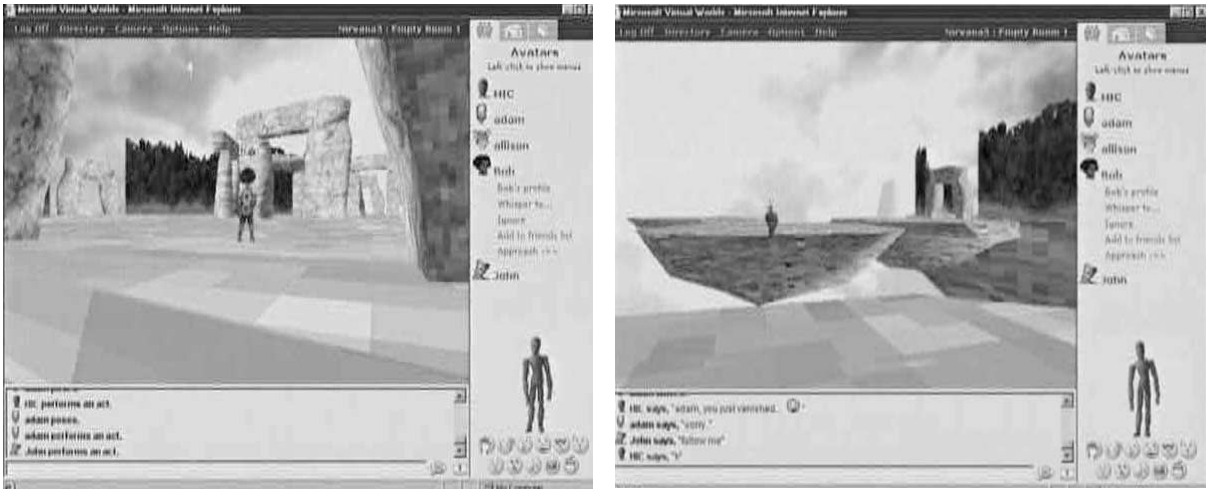
"The Ages of Avatar" is composed of four inter-connected spaces:

- Kindergarten, the first world the user will encounter, is a whimsical and engaging play space. In this brightly-coloured world, users learn the basics of navigation and interaction in a virtual world. Users are encouraged both to move around the three-dimensional space and to interact with other avatars, inhabitants, and worlds objects.

- Behaviour Shift is the world which focuses on the second age of avatar. It is a teenage world of confusion and uncertainty in which the normal rules of space don't apply. In this world you can become famous or infamous, spread gossip and rumours and experience new ways of looking at the world. Inhabitants will be able to eat and drink with their friends, play music, take part in special events and interact with bots to stimulate discussion and help them make friends.

- The third "era" participants experience in the Ages of Avatar, Trade & Power World, is designed to integrate electronic commerce content and commercial sponsorship into a virtual world and to facilitate networking among professionals who share similar interests in communications, new media and business. Through billboards located throughout Trade & Power world, users can access e-commerce sites and online content from [.tv] and its sponsors.

- Nirvana will be the final world and will represent the age of spiritual enlightenment. The user will initially appear in the middle of a Stonehenge construction, with surrounding trees. Surrounding the henge are 4 stone gateways, each with symbols carved into them representing the 4 classical elements of earth, air, fire and water.



Images from two of the worlds in "The Ages of Avatar"

Video Presentation of eRENA Projects

A monitor will present an overview video of the eRENA project, together with edited documentation of a number of recent eRENA projects.

These new projects include two major artist-led mixed-reality projects which will both have been shown for the first time only just before the "Community of the Future" conference. Blast Theory's "Rain Curtain", a project involving the eRENA partners ZKM and Nottingham University, will premiere in Nottingham on October 18. A major installation work by artist Ken Feingold, created with ZKM and MIRALab, will also have been operational at the ZKM for just under one month.

eRENA: The Research Agenda

It is important to stress that eRENA's general notion of an electronic arena is more than just an application of CVE technology as mixed realities. Augmenting physical environments is also emphasised. It is also to be noted that the majority of work that is most well-known in augmented reality research concerns the support of fairly small scale activities with one or a few users. The electronic arena concept emphasises mass-participation.

Our notion of participation is differentiated. That is, we do not see all participants as identical in capability or role in an event. Thus, we do not work with an abstract concept of 'user' for the technologies we develop but prefer to think about the different requirements different kinds of participant may have. In this regard, a contrast can be made with some of the traditional agendas of HCI research which do tend to work with a uniform user-concept.

We emphasise real-time participation. This differentiates our research from those who study non-real-time MUDs and MOOs as well as non-real-time computer graphics and animation techniques. Our emphasis on media-richness also differentiates us from text-based virtual environments and graphics-only applications no matter how experimental. We are more concerned with 'inter-media' (the dynamic relations between media, how they can be juxtaposed, superimposed, translated between) than multi-media (the combination of media conceived in simpler terms, e.g. with instances of different media-types as so many nodes in a hypermedia graph). Finally, we are concerned with cultural events which differentiates our research from much of what is studied in CSCW (computer supported co-operative work) or groupware research.

Tools for (social) navigation

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Within the PERSONA project, four systems have been designed and implemented to deal with the problem of navigation through information space. One is the Agneta & Frida system, two characters that sit below the web browser and comment, ironically, on their contents as the user browses the web. Another is the Social Navigator, a developer's set of tools that allows adding various social navigation possibilities to net-based applications. A third is the on-line store, EFOL, which incorporates social navigation into the domain of shopping for food. Finally, the Navigational Instrument is a computer-based method for evaluating applications early on in the design process.

Introduction

The issue of how users can navigate their way through large information spaces is crucial to the ever expanding and interlinking nature of computer systems. Computer users live in a world of information spaces. One of the most critical activities which users need to undertake is to retrieve information from such spaces and thus the problem of how to help the user to navigate, explore and identify the objects of interest is critical to the success of the system.

We are investigating a new approach to navigation, based on a personalised and social navigational paradigm. Most information retrieval in the 'real' world is accomplished through communication between people. We trust certain individuals to possess the information we are looking for. In addition, we expect them to be able to express the information so that it becomes personalised to our needs, understanding and abilities. Often the information seeking is done through talking to several persons, comparing the advice given, reformulating the original need for information, and only sometimes turning to other information sources such as books or on-line databases.

In the PERSONA project we have produced four different software systems that illustrate different aspects of our view on navigation through information space and social navigation. We want to demo all four at the event in Siena: the Social Navigator, the On-line Store for Food, the Agneta & Frida systems and the Navigational Instrument. Each is described below.

Social navigator

The way we look at our computers is changing from viewing them primarily as tools to viewing them as a medium that we use not only for work, but also for pleasure and as a place where we can meet people. This shift puts new demands on how we (as designers) model the activities users perform with our systems and also how we design for them. One activity that is becoming crucial for users is the ability to navigate the new information spaces we see today (e.g. the WWW). There are several ways to make the information spaces more navigable, and one such way is the introduction of social navigation. In social navigation we use people as a navigational aid for finding the way, either directly by asking them or more indirectly by following someone else's trail.

In the PERSONA project we have developed a framework for social navigation that designers can use to introduce social navigation into their own systems. The Social Navigator is a component that can be incorporated into a system to enhance it socially. It is built around two major concepts: users and their locations, that is, it provides a means to always find out who are in the system and where they are. On top of this the social navigator provides several ways for users to navigate an information space socially, for instance, by chatting with others, seeing user profiles, etc. As an example of how the social navigator might work we can imagine putting it in a web-site to provide information to users on where other users are and also to let them talk to each other.

1. On-line shop

The existing food stores on-line are all 'dead' spaces where users fill in how many milk packages, etc. they want sent to their doorstep. It is clear that the on-line shops are still viewed as tools and not as a places where we do shopping. In the PERSONA food store we use ideas from social navigation to

make the shopping experience richer, both in terms of effectiveness (we buy what we need) and pleasure (shopping should be fun). Customers can either shop by selecting interesting recipes or by wandering around in the store (more or less as we do in the real world). We can think of it as viewing the underlying store in two different ways.

The recipe view of the food store is based on collaborative filtering techniques with visual user groups. What this means is that, based on what recipes a user chooses, the system tries to categorise her into user groups, for instance, as a vegetarian. Recipes are then recommended to a user based on what she and others in that particular user group have chosen in the past. By creating this "open" view of the user groups known to the system we allow a user to both navigate within a group, but also between groups. For example, if I were categorised as a vegetarian it is still possible to get recipes based on the "meat lover" group by temporarily switching to that group.

The other view of the store is a 3D view of an existing supermarket. Here we let customers wander around the store, picking food from the shelves, etc. The rationale is that by replicating a real food store we make a user feel more "at home" with the on-line store.

On top of these two views of the store we put the social navigator. With it customers can see each other and talk to each other. More importantly we use the social navigator to indicate to a user that she is not alone in the space; the idea is that a user will feel more relaxed when she can "feel" the presence of others around her.

2. Agneta and Frida

The AGNETA & FRIDA system seeks to integrate web-browsing and narrative into a joint mode. Below the browser window (on the desktop) are placed two female characters, sitting in their living room chairs, watching the browser during the session (more or less like watching television). Agneta and Frida (mother and daughter) physically react, comment, make ironic remarks about and develop stories around the information presented in the browser (primarily to each other), but are also sensitive to what the navigator is doing and to possible malfunctions of the browser or server. In this way they seek to attach emotional, comical or anecdotal connotations to the information and happenings in the browsing session. Through an activity slider, the navigator can decide on how active she wants the characters to be, depending on the purpose of the browsing session (serious information seeking, wayfinding, exploration or entertainment browsing).

Agneta and Frida are artificial agents not avatars. The communicative and social aspects of these characters are simulated and not real.

3. Navigational Instrument

The navigational instrument is a qualitative method used to evaluate and inform the design of electronic spaces from the perspective of navigation. The method combines a number of areas including traditional human-computer interaction, environmental and cognitive psychology, architecture and the built environment. One of the principal aims is to look at how an environment can support specific tasks as well as exploration by the users.

In order to aid the designer the navigational instrument consists of the units of evaluation as well as supporting documentation. The method covers four areas; conceptual and physical structure, signs within the environment, users within the space and navigational methods and aids.

In addition to being a checklist with supporting documentation a software version ENISpace (Evaluating Navigation in Information Space) has been developed. This aims to make the method itself more usable by providing user and environment profiling, reporting features and collaborative tools.

Learning Components in the ESE projects

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The central aim of the ESE projects is to develop a more critical understanding of the specific learning processes and learning products on which the individual ESE projects are focused. While a number of representatives from different ESE projects have taken advantage of the opportunity to consult us on these matters already, we want to encourage this process further. We have therefore been working on the production of an on-line multi-media database that will provide the projects with a range of research findings and literature reviews on the key terms that we have identified in the projects. The database will also provide a range of challenging questions that have been specifically chosen to stimulate the ongoing dialogue, and provide information about the European Early Childhood Educational (4-8 year-olds) contexts of ICT within which the project applications will ultimately need to be applied. A 'taste' of the work that we have been doing will be provided in our presentation at the Siena exhibition, where we will also provide delegates with free access to the database. Members of the team will be available for discussion/consultation.

Presence

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Presence's key finding: older citizens wish to remain (or become) active participants in society, and more specifically in their local communities.

Throughout the project, older people acted both as design catalysts and as commentators on evolving solutions. As subjects in the innovation process - rather than passive objects - they helped the team focus, and consistently served as "reality checkers".

The Presence team learned that you can both ask and offer, and that you need a good balance between the two. All the partners learned from each other that there are many ways of tackling problems, none of which is objectively "the best".

"Our" older people never ceased to amaze, and it was refreshing and illuminating to work with real people, to see real examples. The test group participants also helped immensely in bridging the natural divide between disciplines within Presence.

Imagination, creativity and new forms of learning

Designing a virtual theatre for young children

1. Children's play in the real and virtual world

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As we watch young children play we are usually struck by the fact that they are immersed in the activity, finding it highly motivating. But consider the differences between the following examples. In the first the child is playing with hand puppets, in the second the child is playing through interacting with a computer-based game such as Super Mario.

Figure 1: Hand Puppet and Computer-Based Game Super Mario.

In both situations the child is likely to be totally engrossed but there are significant differences between the two in terms of learning, social, cognitive and affective experiences. The puppet play occurs in the physical world and involves lots of imagination, where the child improvises by acting out different roles, constructing storylines and setting up dialogues between the puppets. By contrast, the computer game takes place in a virtual world and involves a highly focused, complex problem-solving activity, requiring high levels of sensory-motor skill but may require little imagination from the child. In the vast majority of current software and educational games for young children plotlines, characters, etc., are already provided and there may be little, if any, scope for them to use their imagination, for example, to decide who the characters should be or what they should look like or do. This suggests, therefore, that there is a big difference between how children play in their everyday life and what they are able to do with the kinds of virtual playing currently supported by computer-based technology.

The learning issue

- Young children are highly imaginative but the products of their play, especially the stories, are often loosely-connected segments, with little or no continued narrative skeleton. Can we advance a major goal of elementary drama education which is to bring children into a creative process with a more task-oriented feel, e.g. to construct stories which have a recognisable 'beginning-middle-end' structure - something that can take several grades to normally achieve?

The top-level research question:

- Given the above, how can we harness the power of computers to extend the structure of children's existing repertoire of improvised story-telling through play but still retain an imaginative, improvisational character? How can we encourage this process, using technology in the context of individual child activity, scaffolded by teachers and parents?

2. How will the virtual theatre achieve this?

In physical play, the activities are here and now, and the children cannot step back from them to reflect on what they have done and change it without major effort of memory. A virtual theatre, however, will allow playback, reflection and consequent understanding of the different roles involved in story development. This allows children to fo-cus on the overall structure of a story rather than on small moment-to-moment details - which necessarily happens when they have no external support. This is achievable by having the theatre allow external representations of the story elements with tools for the child to create, edit and produce the story. These are simply not available in everyday play and represent a new form of computer literacy.

Our detailed research aim, therefore, is to determine what kinds of structures and interactivities to provide at the computer interface to encourage children to create richer, more complex and coherent stories and plays. These include the use of avatars, scripting tools, interactive storyboards, cascading menus of options for building up composite characters (e.g. personality traits, emotions) and icons to represent sequences of action.

A virtual theatre is an ideal medium to enable children to exercise both imagination and creativity. Activities such, as scripting, editing and directing, at the interface, allow the planned creation of plots. Other innovative technological features allow the building of characters with personalities, emotions and behaviours. Enabling the children to do this and having these characters interacting with agents, directing avatars and improvising action sequences encourages individual imagination and classroom-relevant genre understanding.

3. Design methodology

To transform our high level requirements into a design specification we adopted an interdisciplinary approach, using a combination of field studies, software prototyping, user testing and conceptual modelling. Our main goal was to design a sufficiently detailed conceptual model that could be implemented as initial prototypes for evaluation. Examples of the kinds of questions that we asked were:

(i) Narrative What kind of prior narrative structure to provide? How much of it should already be apparent and how much freedom should the children be given to develop it, themselves?

(ii) Role switching How many roles should the child be allowed to take on? How do we support the switching between 1st person acting out and 3rd person scripting in terms of making the mode distinction obvious to the child?

(iii) Realism What kinds of realism to provide at the interface? How believable should the characters' appearance and behaviour be? What kinds of representations, in the form of props, animations, etc. should be used?

(iv) Interactivity and externalisation What kinds of interactivities and external representations to include at the interface to support the child in constructing their plays? For example, how much of the behaviour, emotions and other attributes of characters should the user decide and how much should the system determine?

4. User studies

To answer the above questions, it was imperative to begin with a baseline, explicating what children currently do when playing in different settings. To this end, we carried out a series of user studies, investigating the mediating role of different conditions on children's ability to create stories. The studies were videoed and the structure of the stories, use of props, incidents and breakdowns in storylines (e.g. distractions) analysed. The studies were:

Study 1: Investigating existing forms of spontaneous play

Method: Pairs of 4-5 year olds were asked to make a play with a range of props and hand puppets that were provided in either a lab or school setting.

Rationale: To investigate the ability of children to construct and elaborate stories using puppets

Study 2: Investigating the role of mediating artefacts in play

Method: A storyline was given to groups of two or three 4-6 year old children, which was a typical farmyard scenario. They were given different conditions, in which the richness of props and setting was varied. In the 'rich' condition a range of toy animals, fences, gates, model buildings and other props were provided. In the 'minimalist' condition, a background, one cardboard box and a finger puppet were provided.

Rationale: To explore children's narrative when manipulating different configurations of physical toys with a background scene and when given a partial storyline structure and problem to solve.

Study 3: Investigating symbolic story construction

Method: Children were asked to construct a story using picture cards depicting various farmyard characters. The theme was stated as being 'about animals and people on a farm' but no more detail was provided. They could choose cards from a large set on the table before them.

Rationale: To determine whether external representations, in the form of static iconic pictures, would assist children in sustaining their storylines

Study 4. Software prototyping and user testing

Method: Children were brought in to the lab with an accompanying parent and sat next to the computer with the aid of an adult helper. They were invited to explore the interface and then asked to perform a number of tasks. Prototypes involved simple farmyard scenarios, with interactive characters.

Rationale: To explore different kinds of interactivity, including controlling and sequencing the character's actions; creating attributes of characters; understanding simple rule sequences

Figure 2: Children acting out a play: with hand puppets (left); using rich setting (middle) and minimalist setting (right).

5. Conceptual model for the theatre

Based on the findings from the field studies, user testing of the software prototypes and operationalisation of our theoretical framework on external cognition, we devised a preliminary conceptual model for our virtual theatre. A core aspect was that the theatre should comprise a series of modules at different levels of complexity. The modules are intended to satisfy our high level requirements, by supporting different kinds of imaginative and creative activities, involving differing kinds of external support and interactivity. The modules are also intended to be used in conjunction with an adult at successive sessions over a period of weeks, building their knowledge and stories based on previous interactions.

6. Modelling virtual puppets with a mind

Bringing the virtual puppets to life is not just a challenge from the point of view of computer graphics and animation. Since we are envisioning highly interactive and engaging characters, our puppets have to be realized as individual personalities with their own desires, emotions and behaviours. Starting from these considerations, we have developed an architecture which includes the following features:

(1) Combination of planning techniques with computational models of personality and emotions
To control the behaviour of the puppets, we use a combination of deliberative and reactive planning. Personality and emotions serve to prioritize goals during the planning process and are used as filters to constrain the selection and instantiation of agent behaviour. To represent personality and emotions we use a simplification of the 'Five Factor Model of Personality' [McCrae & John 92] and 'The Cognitive Structure of Emotions' Model [Ortony et al. 88]. Based on evidence suggesting that some emotions are universal [Ekman 92], we decided to model: Anger, Fear, Happiness and Sadness. These emotions map directly to distinctive facial expressions, which can be interpreted easily by children of age 4-8 [Reichenbach & Masters 83]. To increase the life-likeness of a character, we also introduce body states (fatigue, boredom, hunger) which act as motivational drives by activating the appropriate behaviour: sleeping, playing, eating and drinking. Emotions are either computed by emotion generating rules or are directly manipulated by the child through the 'mind control interface'.

(2) High-level specification language for defining the puppets' behaviour based on personality traits
Currently, the behaviour specification language is used by the system designer to build up a basic repertoire of Puppet behaviours. To enable the definition of different behavioural styles, behaviour specifications can be tailored to a specific personality. For instance, we might define specific behaviours for extravert characters. To enable children to define their own behaviours, we are planning to design a toolkit based on graphical production rules. The basic idea is to provide pictorial representations for the 'before' and 'after' part of these rules and map combinations selected by the child onto expressions in the planning language.

(3) Smooth integration of narration and interaction
Our approach enables the smooth integration of narration and interaction, which is a known problem inherent in interactive story-making. A story is characterized by a fixed linear structure, whereas interaction provides the option of influencing the course of events at runtime. We handle this conflict by treating the story line as an additional constraint when creating new goals and selecting and instantiating behaviours. That is, certain behaviours will be disabled or enabled in response to a given narrative structure.

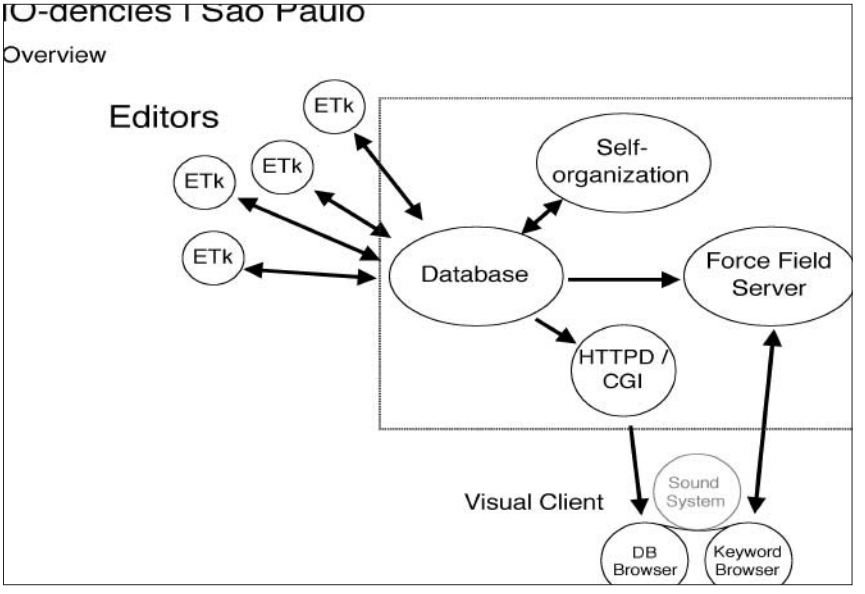

Figure 3: Functional View of the Puppet Agent Architecture.

7. The implementation of the virtual puppet theatre

The virtual puppets, the avatar (representation) of the user, the props etc. need a "stage" to play on, a world to live in, and they need an interface which allows the user to control and/or take part in the play. This first creation of the Virtual Puppet Theatre, VPT-1, presents itself to a single user via 3D Graphics & Sound. The system may be controlled in either of two modes:

- While playing (in "experience mode") the point-and-click actions may control the avatars or affect objects and agents indirectly.
- When off-line, the interactions via a 2D GUI (Graphical User Interface) allow for direct control of agents' intentions, emotions, behaviours, utterances and visual appearance.

Recording of an ongoing play is possible for two different purposes:

- Direct (movie) recording where the "story" played may be repeated to the smallest detail. Only the viewpoint may be repositioned when re-playing such recordings.
- "Re-experience" recording, which allows for re-entering to make alterations. This works like a load-saved-game strategy where alterations can be performed from load point and onwards - with the added possibility of changing avatar (e.g. was farmer, now pig).

The architecture of the VPT platform comprises 7 modules. The central part, the Virtual Environment (VE), handles all activity and communication on the virtual stage. The VE connects to the agents and services their commands (actions). The VE monitors the actions of the agents and generates percepts (audio and visual) for the agents. The agents react to the percepts and may decide to either continue or change action

The agents have been separated into high and low level counterparts. The low level performs motor level control, reports position updates to the VE and plans legal paths from current location to target point. The high level part of an agent (see Section 6) performs reasoning, control of moods, intentions and expressions (audio and visual).

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KidStory

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KidStory is developing collaborative storytelling tools for children aged between four and eight years old. From a technology perspective, KidStory aims to develop tools that are as inherently collaborative as a box of crayons or a pile of blocks. This will involve developing new approaches to the design of shared interfaces. By the end of the project it will also involve replacing conventional computer hardware with tangible, reactive and unencumbered interfaces. From an educational perspective, KidStory aims to develop technologies that encourage children's creative abilities in order to help them develop their collaboration and storytelling skills. From a design process perspective, KidStory is following the approach of co-operative inquiry. This involves considering children to be inventors and design partners.

The exhibition will demonstrate two storytelling technologies called KidPad and The Klump, that have been developed in the first year of KidStory and used in schools in Nottingham and Stockholm. KidPad is a shared drawing tool that allows children to create stories together and then bring them to life using a zooming interface. The Klump is an amorphous 3D object that can be stretched, deformed and textured to create objects and characters and to improvise simple stories. Both KidPad and The Klump incorporate techniques that are intended to support collaboration in young children. The approach of 'single display groupware' allows two or more children to work together shoulder to shoulder at a shared display, but using independent input devices. Both interfaces have been designed to subtly encourage collaboration by enabling children to combine their actions to achieve interesting new effects. The exhibition will also describe the process of co-operative inquiry within our schools, including examples of the children's work from the first year of KidStory.

Experimenting with Community Knowledge in a Campiello

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Introduction

In Venice, a Campiello (or small square) is the meeting point of the local community inhabiting a neighbourhood. In a Campiello people communicate and interact, sharing knowledge about relevant facts, events, places, artefacts and people belonging to the community. In a Campiello, the community living in a particular neighbourhood builds its identity on the knowledge its members share and on the language through which they make reference to it.

Local communities are declining under the pressure of globalization (mass media, delocalization of production, etc.). World-acclaimed art cities are in a particularly difficult situation in this respect since, on the one hand, tourist flows expropriate the inhabitants of their territory, of their place; and, on the other, the industrialization of tourism tends to transform them into a new sort of cultural Disneyland. In an art city like Venice or Chania (Crete, Greece), local communities suffer a progressive lack of identity that seems irreversible.

The main objective of the Campiello project is to use technology to strengthen the community bonds of the local communities living in art cities, creating the conditions for a new type of hospitality towards visitors. In particular, it focuses on and experiments with the use of a knowledge management system in a social setting as a means of helping local communities share and keep alive a collective memory of their common history and experiences. In other words, Campiello is helping the communities to develop a "memory base"—a knowledge base with information on the community and its past. The data in this base are what we call "warm data", as opposed to the "cold" data you typically find in tourist guides: information that is less superficial and truly connected to the community (like the history of traditional phrases, or the tradition behind fiestas, for instance). This information is kept fresh and alive because it is continuously updated on the basis of comments and recommendations by people from the local communities and visitors.

A system supporting the processes around community knowledge needs to be designed in such a way as to make knowledge collection and representation, as well as their dissemination and enrichment (Agostini et al., 1998), as easy and effective as possible. In particular, when moving out from the office setting to the social life of a community, interaction modes are of primary importance and in Campiello they have been designed starting from their invention and not from the functionality of the system (Agostini et al., 1998b).

In focussing on the possible interactions with knowledge in Campiello we envision three main user stereotypes. The first one, denominated 'cultural managers', is composed by the members of active groups in the community who create knowledge while performing their activities: all those people who, for personal interest or for work, usually produce knowledge related to the community. Some examples are cultural associations, city administrations, etc. Within the second group, the 'local community', there are the generic members of the community; compared to the cultural managers they will produce new contents less frequently since it is not part of their everyday activities. Finally, the visitors will mainly comment on and evaluate the knowledge and, therefore, will mostly contribute to the enhancement of it; but the difficulty will be providing fresh information relevant for the community.

Multiple interaction modes through multiple ubiquitous interfaces

In Campiello, we use different kinds of interfaces to access information — from paper to traditional computer-based interfaces to large screens. While for the cultural managers the PC interface seems the most suitable, due to its efficiency, for the second and third group of users different interfaces have been taken into account (see (Grasso et al., 1998)). In particular, interfaces based on paper and large interactive screens are under development. Other interfaces are included in the complete vision of the system, but their development has been postponed.

Experimenting With Community Knowledge

At the Campiello stand, it will be possible to experience the supported interaction via the multiple interfaces of the system (i.e. PC, paper, large screen) to access the 'real' community knowledge available in the system. Apart from supporting traditional pull-oriented mechanisms for 'navigating' the knowledge, Campiello is strongly based on personalised push of the knowledge, based on collaborative filtering and recommendation. Consequently, some predefined stereotyped profiles will be available for the visitors of the stand to play the role, for instance, of Setsuko (a Japanese architect visiting Venice for a week), or Alfredo (a Venetian photographer), or Fotis (a teacher at a Chania school).

In particular, the various chosen profiles will show the different interactions and answers of the system depending on, for instance, the user role with respect to the system (cultural manager, local inhabitant, tourist); the user's interests; the user localisation and context of use (eg reading a Campiello flyer in a pub, chatting with friends in an open space behind the CommunityWall, or preparing the afternoon visit to Chania via the personalised itinerary in a Map).

Scenarios of interaction

The people visiting the Campiello stand could, for example, select from among various scenarios of interaction. The following scenarios are merely examples, the final and definitive versions will be available on the stand.

Setsuko's scenario

Setsuko is an architect student from Kyoto on holiday in Venice. She didn't have any time to collect information from home. She is interested in architectural history in general and, in particular, she loves 13th century painters. As hobbies she likes cooking and reading. She was introduced (and registered) to the Campiello system by chance while visiting those parts of the Biennale exhibition hosted in the Arsenale buildings. After visiting the exhibition she leaves her comments about some of the work via the 'Campiellized' flyer she received at the entrance of the exhibition. Her comments are directly processed via the Multi-Functional Device (MFD- printer and scanner) and displayed on the Campiello large screen (CommunityWall). Both devices are available for the public in the hall of the Arsenale.

Setsuko also decided to ask for personalised recommendations on how to spend the rest of the day, filling in a 'Campiellized' map flyer available in a rack (sticking her PIDpad on the flyer the system recognised Setsuko and her interests). When she nserts the map in the MFD, information about buildings containing frescos near the Arsenale is printed. Moreover, Setsuko is informed that a beautiful and ancient library/publisher (specialising in books regarding Venice) is situated in the area.

Alfredo's scenario

Alfredo is a Venetian photographer. He is a 'cultural manager' of the Campiello system for the area regarding the pop-music events (his main hobby). He has been registered in Campiello for two years and used to interact with the system quite frequently from his home-PC, not only for updating the pop-music area, but also to be updated by the system on news in areas of his interest. Alfredo puts the more interesting information on his 'personal diary' to keep better track of them.

Alfredo and his friends frequent a bar in Via Garibaldi close to the public CommunityWall (the Campiello interactive large screen) and sometimes, in order to organise the evening, they look to the events area displayed on the screen which also contains people's comments and recommendations. Alfredo prints details of some of the displayed news in order to read them peacefully at home.

Alfredo has been contacted by John (a New York photographer). John loves Alfredo's latest photographs of the 'Marie's feast' published in the Campiello area on traditional feasts. John will be visiting Venice next week, and they will meet in order to discuss possible collaboration on publishing a book containing a collection of various international photographers.

Fotis' scenario

Fotis is a teacher of literature in a secondary school of Chania. He registered with the Campiello system when a friend informed him that the list of free courses organised by the Municipality of Chania is published on the system. In fact, he likes to frequent courses on folk dance or gymnastics in water or whatever, 'to do some movement' during the short winter on Crete. He likes fishing and tracking and is used to participating actively in discussions on these topics, which are quite active in Campiello. He is not responsible for any areas in Campiello, but he willingly inserts from his home-PC, reviews of books which he particularly likes or dislikes, as well as comments and ratings of books recommended by other people. In doing so, the system recommends new books. It has also introduced him to Maria who seems to share the same opinions on books, and also likes tracking. They started to exchange e-mail messages quite frequently and decided to exchange books. The place of their first meeting, of course, was near the CommunityWall on the Chania market. Alfredo, waiting for Maria, takes the opportunity to collect some Campiello NewsCards he has never seen before, including one regarding tracking itineraries on the East Mountains. He crosses checkboxes appropriately in order to receive more details on some itineraries which are rated 'Very difficult', and at the same time inserts his rating and comment on one itinerary he doesn't like because the panorama is ruined by many houses.

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COMRIS

An 'en route' snapshot

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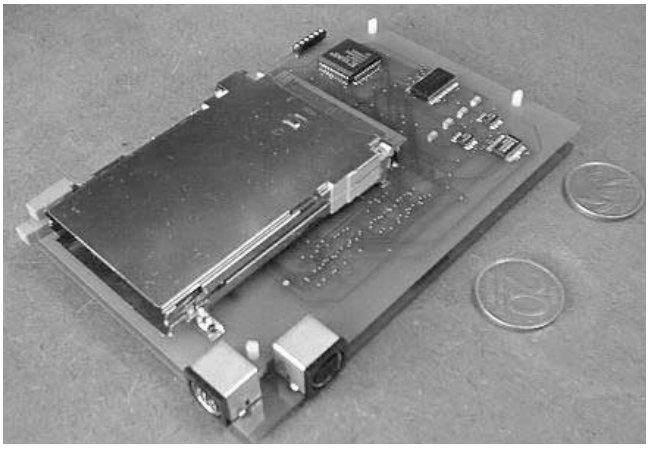
The exhibit illustrates progress of the COMRIS project toward a co-habited mixed reality information space to support social events. It uses an imaginary conference, RAVE'99, as the setting to see the different components of the system in action. The exhibit consists of three parts, highlighting conceptual advances, the internals of the system, and its external realisation. The COMRIS parrot, by now the project's hallmark, will be on display and demonstrated within a limited set up including a wireless network, beacon- and batch systems and intelligent screens. At the exhibit we will also try to perform an experiment where humans formulate advice on behaviour based on a limited context description which is generated by the technology. This will illustrate the essence of the task of in-context advice giving, while the project also hopes to gain some insights in terms of usability of the target system.

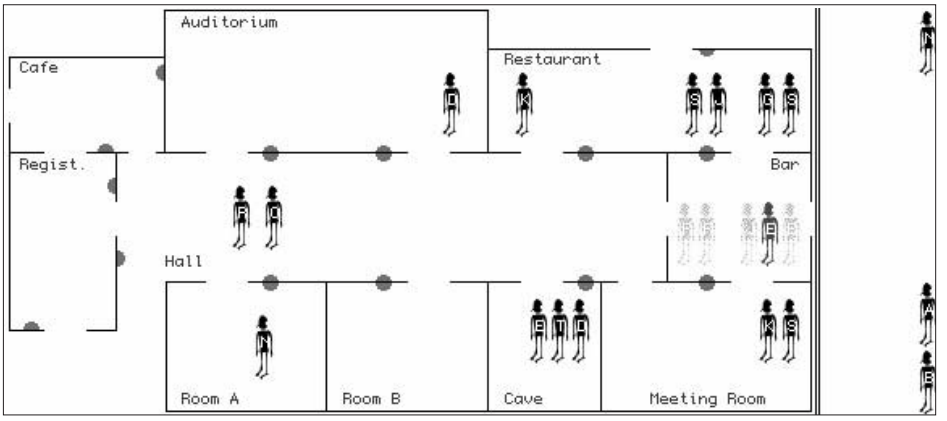
In COMRIS we develop an infrastructure to support social processes in dynamic communities, for instance at large conferences like IST 2000, which we hope to use for a large scale demonstration. To date we have moved the project forward at various levels: conceptually, hardware- and software wise. The core conceptual ideas in COMRIS revolve around the idea of co-habited mixed reality. In essence we use a wearable device as a way of coupling between a real and a virtual society. Both societies can develop their own structures and dynamics. A single parrot, however, provides one world with a limited contextual view of the other, which allows it to evaluate its usefulness to that context. The idea is that the more parrots there are, the more both societies will work in tune.

The COMRIS parrot is of course the most visible part of the project and by now also its hallmark. It is a wearable device that speaks to its 'user' advice and hints as she walks through the fair. Basically, the parrot is helping the user to focus his or her attention on some of those that are competing for it. Competitors for attention come from the real world (in a conference, the speakers, the sessions, the participants, the bar, the lunches, the weather outside, and so on) and, in COMRIS, also from the virtual world (the various agents that believe they have something to say to or do for you). The parrot is valuable to the extent that whatever attention is taken away from the real world is largely compensated for by the value of that advice, i.e., regained in future attention being better spent. To my mind, at least, this was a new and fundamental insight: advice creates an expectation on future behaviour, which is expected to increase effective use of the user's attention. We are now embedding this idea into an approach for the self-evaluation of the parrot and, more generally, a wearable assistant. This is described elsewhere in this conference.



COMRIS hardware

Roughly halfway in to the project the COMRIS parrot has come to life. It is based on a StrongARM processor. In a two-layer sandwich construction we have squeezed two PCMCIA slots and all the rest that is normally found within a powerful state of the art laptop. The wallet sized pack runs LINUX, from which a LAN is wirelessly accessed and interface peripherals are addressed, in particular for speech and simple screen interactions. The 'eyes' for context perception are no more than a bunch of active infrared devices to identify places and to locate other parrots. Apart from this, the parrot is essentially a no-input device. This means that there is no explicit control and command interface.



The RAVE floorplan

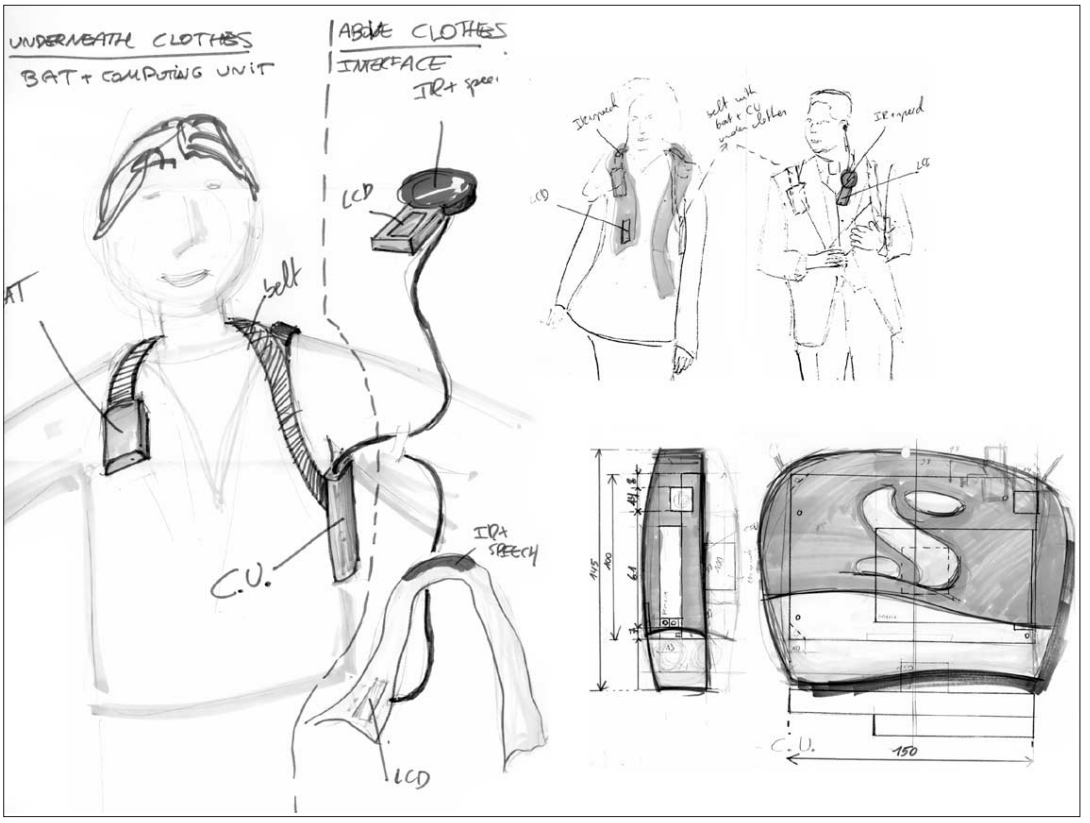
The COMRIS parrot fits into the 'young' tradition of wearable computing. This implies that we want it to be context-sensitive, pro-active with respect to user needs, always 'on', and requiring a minimal shift of attention away from normal activities. For the particular setting that we are aiming at, these requirements add to those of usability and discretion of use. The parrot is now being designed as an information hub with an open set of interface peripherals (wearable or stationary). The core of the parrot (the Feather), is a minimal node for computing, memory and communication but itself has no interfaces. Additional components that a user may be wearing are connected by wire (and in the future wirelessly) to this hub. Whenever some information needs to be relayed to the user, the hub will choose from whatever is available. An add hoc personal network thus links the feather with whatever interface components are available. The 'nomadic personal network' connects to the ubiquitous computing, communication and interfacing environments that, we think, will be more and more available around us. For instance, when the parrot is in the neighbourhood of a screen then this may well be used for communication to the user. And, further down the line but nevertheless a demonstration target for COMRIS, is the use of the parrot wearable in a fully immersive virtual environment like the CAVE.

The hardware development for the parrot is now complemented with a design exercise. We are complementing the feather with peripherals that will satisfy various types of users. We will have a broach-like device, or a wristwatch-kind of device. To push further in the direction of a wearable we are working on a scarf with embedded electronics for context perception and audio output. Remarkably enough, our first user studies have revealed the desire of users to control the parrot behaviour, i.e., to decide for themselves whether they want to hear a message. This goes against the whole philosophy of the project (you can't switch off your dog either), but we'll need to take this into account for the final product design.

But COMRIS is more than its parrot. In the COMRIS virtual world tens of software agents meet one another and engage in interchanges that further their (or their owner's) interests. The infrastructure that we have constructed for this has been tested to be scalable, is essentially decentralized and reasonably robust. We have achieved, around it, the full integration of all components so that we can now run complete interaction scenes in a simulated conference, called RAVE'99. In a simulated day at this conference agents make appointments, listen to talks, and exchange topical information.

At the exhibit we will show the visitor a look at the insides of the COMRIS system. For instance, we show how various interactions occur in the RAVE'99 conference, using a display of a virtual conference centre with agents moving around in time. Interaction protocols unfold, for instance for exchanging information or for making appointments. Another display will show the interaction between the personal representative agents and the 'agent' of a parrot (the personal agent). Here we show how competition for attention (the basic social engine, according to COMRIS) regulates the flow of information toward a user. A third display focuses on the speech generation issues in COMRIS. We want the parrot to speak text that evidences its awareness of the user and its context. To achieve this in near to real time requires a dynamic template based composition mechanism that allows for the necessary variations and dialogical coherence that will make parrot speak interesting and supportable.

Whereas the above focuses on the internals of the COMRIS system, another part of the exhibit focuses on the 'external' view. Here the parrot is a central element, and we will illustrate how it can be used to interact with the personal information through a screen that recognizes its user through the parrot that he or she is wearing. We will also illustrate how a parrot can maintain an awareness of its user's context. We intend to display as many context descriptions as there will be parrots (wait and see), and to show the context descriptions of parrot users as they roam around the conference site. To this end we intend to install a series of infrared beacons, as well as distribute a set of badges to a limited set of participants. As part of a limited usability experiment, we may try a wizard of oz study in which 'human personal agents' provide advice based on the limited context descriptions that comes from the parrot devices. We expect this to be fun, if not instructive.



Sketch for the COMRIS wearable

C3

Children in Choros and Chronos

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The C3 project is planning to give a lively demonstration of the integration of technologies of GPS, wireless communications and specially designed component-based software, within the framework of game-like educational activities that involve reading and constructing maps, navigating, "wayfinding", observing and associating time. Our live demo will consist of running such activities at the conference site.

Specifically, we plan to have a hand-held GPS device of the highest accuracy carried around outdoors in Siena (in the area around the conference site) by people representing the outdoor team of children. The GPS will wirelessly transmit its geographical position (through a GSM network) to a base station (PC) located at the project's "booth'" of some other people representing the indoor/school team of kids. The two teams will communicate using a pair of walkie-talkies.

Notations and routes of the outdoor team will be represented on a specially designed software map component with various manipulation tools. The software will be interactive, i.e. it will be possible to insert or attach objects, agents, labels and possibly sounds to the map to embody children's visual, audio and mental understandings and representations. Besides the map component, the software will comprise time components, steering/orientation components, an icon editor, etc.., which can all be linked to each other and co-operate in a desired configuration.

The prevailing activity scenarios we plan to run for the live demo are similar to the ones that will be implemented in C3 schools, namely:

1. "treasure hunt in Siena": the indoor team will monitor the outdoor team's route as their "trace" will appear (in real time) on the map component, and they will guide them by giving hints, instructions, and so on to help them find the "treasure".

2. "map constuction": we will produce a map of an area in Siena (near the conference site), i.e. have it laid out on the "map component" as the visual representation of the outdoor team's course and observations.

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