INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Project-Team in-situ

Interaction Située

Futurs

THEME 3A

Activity Report

2003

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1. Team

In Situ is a collaborative project between INRIA (unité Futurs) and the Laboratoire de Recherche en Informatique of the University Paris-Sud within the framework of the PCRI (Pôle Commun de Recherche en Informatique).

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2. Overall Objectives

In Situ is a collaborative project between INRIA (unité Futurs) and the Laboratoire de Recherche en Informatique of the University Paris-Sud within the framework of the PCRI (Pôle Commun de Recherche en Informatique).

The In Situ projet develops novel interaction techniques as well as new tools to develop these techniques, and new methods to control the design process of interactive systems. The goal is to develop situated interfaces, i.e. interfaces that are adapted (or adaptable) to their contexts of use by taking advantage of the complementary aspects of humans and computers. In the long run, the project seeks to create a new generation of interactive environments as an alternative to the current generation of desktop environments.

Our research is organized in three main research topics:

New interaction Paradigms The project addresses novel interaction techniques such as multi-scale (or zoomable) interfaces, interactive information visualization, bimanual interaction, and the use of video and non-speech audio, as well as the integration of these techniques within a consistent environment. The project also addresses augmented reality, i.e. the integration of computation and interaction within physical objects and environments.

Participatory design Participatory design involves users at all stages of the design process. It turns users into innovators and helps understand the situated aspect of the users' activity. The project develops participatory design methods and techniques that make the role of context explicit in the design process.

Engineering of interactive systems Novel interaction techniques and interaction paradigms require the development of specific tools to facilitate their integration and adoption. The project studies component-based architectures where components that implement, e.g. interaction techniques, may be added, removed or substituted dynamically.

3. Scientific Foundations

Researchers have competing views of what constitutes research. Much of computer science relies on formal theory, which, like mathematics, is evaluated with respect to its internal consistency. The social sciences are based more on descriptive theory, attempting to explain observed behavior, without necessarily being able to predict it. The natural sciences seek predictive theory, using quantitative laws and models to not only explain, but also to anticipate and control naturally-occuring phenomena. We are exploring a fourth approach, which we call generative theory, which builds upon existing knowledge in order to create new categories of artifacts and explore their characterstics.

Human Computer Interaction is a multi-disciplinary field that borrows from multiple disciplines, using social science methods to study and understand human behavior with respect to interactive systems, engineering methods to construct the technical foundations and working prototyes, and design methods, to create and explore novel ideas.

Our goal is to produce prototypes, research methods and software tools that facilitate the design, development and evaluation of interactive systems.

4. Application Domains

There are several potential application domains for In Situ. To validate our goals, we have selected domains with the following features:

- multiple validation criteria: increasing productivity, security or comfort;
- diverse users: professionals, specialists or non-professionals;
- diverse environments: classical desktops, non-standard (e.g. airplane cockpits) or mobile.

We have selected the following application domains:

Air traffic control in cooperation with the French Research Center of Air-Traffic Control (CENA) and EuroControl;

Biology and health in cooperation with Institut Pasteur;

Telecommunications and multimedia for families in cooperation with the University of Maryland, USA, the CID-KTH in Sweden (see the Interliving project), the Royal College of Art in London, England and France Telecom R&D, Thomson Multimedia and Philips.

5. Software

5.1. The videoSpace toolkit

Participant: Nicolas Roussel.

Key words: *Video*, *Toolkit*, *C++*.

VideoSpace [48] is a software toolkit designed to facilitate the use of image streams to support such new forms of human-computer interaction and computer-supported collaborative activities. The motivation for this toolkit is the desire to focus on the *uses* of video, rather than the *technologies* it requires. In this perspective, it is not focused on performance or reliability issues, but rather on the ability to support rapid prototyping and incremental development of video applications. This approach contrasts with many of the research themes usually associated to video in the Multimedia or Network communities such as compression, transport or synchronization. VideoSpace is not aimed at these topics. It is rather intended to help HCI and CSCW researchers who want to explore new uses of the images.

VideoSpace is designed after Alan Kay's famous saying: "simple things should be simple, complex things should be possible". It provides users and developers with a set of basic tools and a C++ class library that make it easy to integrate image streams within existing or new documents and applications. The tools, for example, allow users to display image streams in HTML documents in place of ordinary static images (see Fig. 1) or to embed these streams into existing X Window applications. Creating a video link with the library requires only a few lines of code; managing multiple sources and including video processing is not much more complicated. Since the image streams managed by videoSpace often involve live video of people, the toolkit also provides a flexible mechanism that allows users to monitor and control access to their own image.

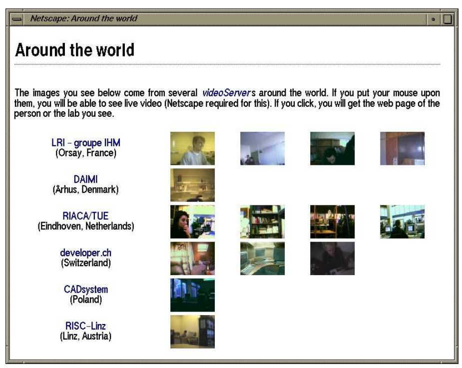

Figure 1. Sample HTML document showing video images captured and transmitted in real-time by a videoSpace application

Source code for videoSpace compiles on Linux and Mac OS X and is freely available under the GNU Lesser General Public License (LGPL). For more information, see http://insitu.lri.fr/~roussel/projects/videoSpace/.

5.2. The Ametista mini-toolkit

Participant: Nicolas Roussel.

Key words: *Window management*, *application redirection*, *OpenGL*, *X Window system*, *VNC*.

Ametista[27] [49] is a mini-toolkit designed to facilitate the exploration of new window management techniques. The current implementation supports three types of windows, that can be freely mixed: *pseudo-windows* that are randomly-colored rectangles; *placeholders* that display a fixed image or a video stream and live windows of X Window applications, through a redirection mechanism. Pseudo-windows can be used for low-fidelity prototyping in the early stages of the exploration of a new window management technique.

Placeholders help getting a better idea of the envisioned technique by displaying snapshots or movies of real applications. Finally, live X windows can be used for high-fidelity prototyping and evaluation of the technique.

Ametista uses OpenGL to display windows. This library offers a rich graphics model well adapted to the exploration of new window management techniques. Alpha blending, for example, makes it easy to create translucent objects and shadows. Scaling, rotation and translation can also be used with a perspective projection to position windows in $2D\frac{1}{2}$ or 3D (see Fig. 2, left and middle). Ametista makes an extensive use of texture mapping. Textures are used to display fixed images and video streams in placeholders as well as the content of X windows. They also make it possible to transform the window shapes in real-time (see Fig. 2, right).

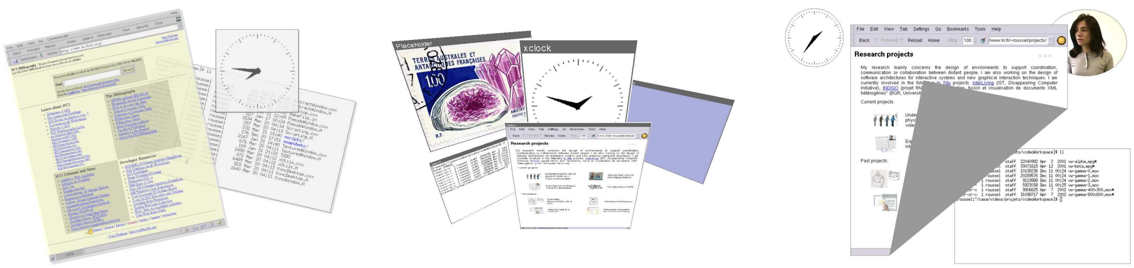

Figure 2. Examples of window image transformations achieved by using Ametista

Source code for Ametista compiles on Linux and Mac OS X and is freely available under the GNU Lesser General Public License (LGPL). For more information, see http://insitu.lri.fr/~roussel/projects/ametista/.

5.3. SVGL: SVG in OpenGL

Participants: Stéphane Conversy [correspondant], Jean-Daniel Fekete.

Key words: *SVG*, *Graphics*.

SVGL is a toolkit designed to display W3C SVG documents using accelerated graphics (see Fig. 3). It relies on the OpenGL API and translates high-level SVG constructs into hardware accelerated OpenGL primitives. Rendering time is improved by factors of 50 or more compared to other SVG implementations such as Batik[1] or the Adobe SVG Plugin[2].

SVGL is used by the renderer of the Indigo project (see section 7.3). It can also be used as a C++ library for interactive graphics for more classical applications. It provides a simpler API than the standard W3C DOM for SVG.

SVGL runs under Linux, MacOS X and Windows and is distributed with an open source license at http://insitu.lri.fr/~conversy/svgl.

5.4. The InfoVis Toolkit

Participant: Jean-Daniel Fekete.

Key words: *Information Visualization*, *Java*, *Toolkit*.

The InfoVis Toolkit is a Interactive Graphics Toolkit written in Java to ease the development of Information Visualization applications and components.

The main characteristics of the InfoVis Toolkit are:

Unified data structure The base data structure is a table of columns. Columns contain objects of homogeneous types, such as integers or strings. Trees and Graphs are derived from Tables.

[1] http://xml.apache.org/batik
[2] http://www.adobe.com/svg

Figure 3. A sample image rendered with SVGL showing a rich graphic and a toolglass to interact with it

Small memory footprint Using homogeneous columns instead of compound types dramatically improves the memory required to store large tables, trees or graphs, and in general the time to manage them.

Unified set of interactive components Interactive filtering (a.k.a. dynamic queries) can be performed with the same control objects and components regardless of the data structure, simplifying the reuse of existing components and the design of generic ones.

Fast the InfoVis Toolkit can use accelerated graphics provided by Agile2D[3], an implementation of Java2D based on the OpenGL API for hardware accelerated graphics [43]. On machine with hardware acceleration, some visualizations redisplay 100 times faster than with the standard Java2D implementation.

Extensible the InfoVis Toolkit is meant to incorporate new information visualization techniques and is distributed with the full source and a very liberal license. It can be used for student projects, research projects or commercial products.

The InfoVis Toolkit, as of version 0.5, implements seven (7) types of visualization (Fig. 4): Time Series and Scatter Plots for tables, Node-Link diagrams, Icicle trees and Treemaps for trees, Adjacency Matrices and Node-Link diagrams for graphs.

The toolkit is used for teaching Information Visualization (DEA I3 and DESS SCHM and II at University of Paris-Sud, Infovis course at Virginia Tech). It is also used in several contracts of the group such as OADymPPaC and Micromegas (see section 7.4).

More information can be found at http://insitu.lri.fr/~fekete/InfovisToolkit or [32][37][38]

5.5. RFID Library

Participant: Loïc Dachary.

The rfid library is a set of C functions to dialog with RFID devices. A RFID transponder is a wireless memory area made of a chip and an antenna. A RFID reader creates a magnetic field that is used as a power source by RFID transponders and as a carrier for communication. A program can use the rfid library to be notified when

[3] http://www.cs.umd.edu/hcil/agile2d

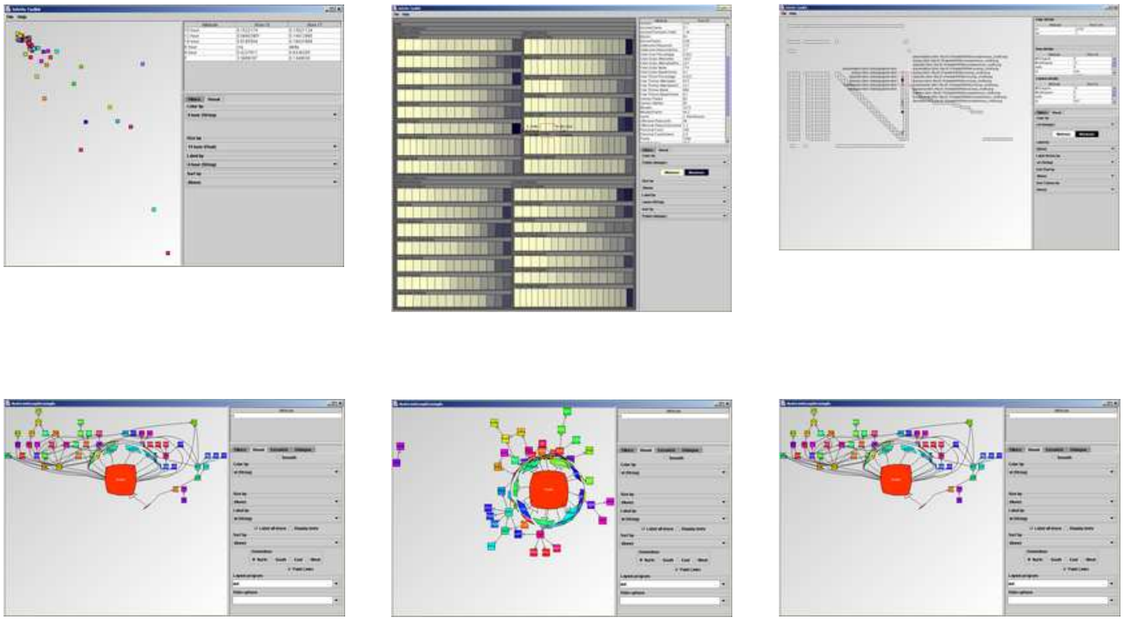

Figure 4. Several visualizations produced using the Infovis Toolkit

a RFID transponder enters or leaves the range of a RFID reader. When a RFID transponder is in range, data can be read from its memory or written into it.

The library supports all ISO-15693-3 conformant RFID transponders, is available under the GPL license at the following location: http://savannah.nongnu.org/projects/rfid/.

6. New Results

6.1. Tools, methods, probes and prototypes to help family members stay in touch

Participants: Wendy Mackay [correspondant], Stéphane Conversy, Helen Evans, Heiko Hansen, Michel Beaudouin-Lafon, Nicolas Roussel.

The interLiving (see section 7.1) project has generated several new design methods [28] including the *Interactive Thread*, [21], a technique for obtaining a large quantity of labor-intensive data and *technology probes*[19] which combine traditional social science goals of recording data about users and the design goal of inspiring ideas for new technology. We ran numerous workshops with family members, including two that combined Swedish and French families, to generate ideas for new technologies. We developed a series of technology probes, including: VideoProbe [13], for sharing candid snapshots, MessageProbe, for sharing hand-written notes, Knocking Probe, for sharing sound patterns and StoryTable, for collaborative video editing. We also developed a more complete prototype, called MirrorSpace [25][26] which lets family members use the proximity of their bodies to a mirror to control the degree of intimacy in a super-imposed live video image of two remotely-located people. We installed and tested the probes in the families' homes over periods of weeks and months.

We call this type of interactive communication system a *communication appliance*, to capture the idea of a single-function, very easy to use method of staying in touch over time and space. Although other researchers have prototyped communication appliances, none have ever left the laboratory. Yet it is clear from our work with families, that such systems are highly desirable.

The key finding of the interLiving project has been the identification of the critical missing element: currently, we do not have an easy way to create and manage the corresponding networks that underlie communication appliances. So we developed FamilyNet[40][24], which has a tangible interface easy enough for a child to use, and enables family members to configure asymmetrical, dynamic, overlapping networks of communication appliances. Such networks are, by definition, very small in scope and require secure data transmission.

We are currently in the process of patenting the hardware interface to FamilyNet (based on cards and RFID tags) and plan to release the software under a free-software license, to maximize potential use. Both Philips and Intel have expressed interest in the concept and we plan to explore further collaborations with industry in 2004.

6.2. Tools for Post-WIMP interaction

Participants: Michel Beaudouin-Lafon [correspondant], Renaud Blanch, Stéphane Conversy, Nicolas Roussel, Jean-Daniel Fekete, Catherine Letondal.

Graphical user interfaces haven't quite changed since the creation of the Desktop metaphor. User interaction hasn't improved as nearly as quickly as the increase in computing power. New interactive applications don't take advantage of new interaction paradigms or interaction techniques, the latter remaining too often at the prototype stage. We are exploring new programming environment and systems able to quickly integrate the new techniques or interaction paradigms as they are discovered.

Our activity focuses on creating a new software architecture that will enable new interactive applications to profit from richer graphics and novel interaction paradigms without changing the non-interactive part of the application. We are coordinating the RNTL Indigo project with ILOG, the W3C and the CENA in Toulouse to create new mechanisms based on technologies standardized by the W3C for the infrastructure and from our experience in toolkits for the separation of application and their interaction and presentation.

6.3. Evaluation and Optimization of Pointing and Interaction Techniques

Participants: Yves Guiard [correspondant], Michel Beaudouin-Lafon, Wendy Mackay, Renaud Blanch, Caroline Appert.

Graphical user interfaces (GUIs) are based on a small set of interaction techniques, which rely heavily on two elementary actions: pointing a target on the screen, e.g. an icon or button, and navigating to a non-visible part of the information space, e.g. by scrolling or zooming.

We are working on improving pointing and navigation performance in GUIs. Indeed, the performance of pointing on a screen is similar to that of pointing in the physical world, and it should be possible to take advantage of the computing power to get a significant advantage when pointing in an information world. The major theoretical tool to study pointing performance is Fitts' law [44], which defines the movement time as an affine function of the index of difficulty (ID), defined as the log of the ratio between target distance and target width. In other words, pointing performance strictly depends on the relative size of the target to the distance to the target.

We have explored a technique called *target expansion*[29][33] which grows the size of the target when the cursor is near it, and showed that the index of the difficulty of the task is that of the expanded target, even when expansion occurs when the cursor has traveled 90% of the distance to the target. However taking advantage of this property proves to be difficult because it requires a proper anticipation by the system of the target to be expanded. Indeed, expanding the wrong target impairs performance and goes against our primary goal.

We have developed two techniques that look for more promising. The first one is *semantic pointing* [31][12]. Semantic pointing uses two independent sizes for each potential target presented to the user: one size in motor space adapted to its importance for the manipulation, and one size in visual space adapted to the amount of information it conveys. This decoupling between visual and motor size is achieved by changing the control-to-display ratio according to cursor distance to nearby targets.

A target with a small visual size and a large motor size will display little information but will be easy to select, which makes it appropriate for, e.g., buttons or links in a Web Page. A target with a large visual size and a small motor size will display more information but will be hard to select, which is appropriate for non-interactive informative labels, for example. A controlled experiment has confirmed that the index of difficulty that best predicts pointing time is the one that uses the motor size rather than the visual size. A prototype application shows how this technique applies to standard GUIs, e.g. scrollbars, dialog boxes, menus and web pages.

The second technique is called *vector pointing*[34]. It can be seen as an extreme version of semantic pointing where the cursor jumps "empty" space and moves from target to target with very little mouse motion. We have shown with a control experiment that Fitts' law does not apply. Indeed, the pointing time of a single target with semantic pointing is constant! In a real application, the performance of vector pointing depends on the accuracy of the prediction of the target being aimed by the user and the influence of distractors. Work is ongoing to develop an application for testing vector pointing in a real setting.

We have also persued our work on multiscale navigation, i.e. navigation of an information world that can be zoomed in or out at any scale (also called Zoomable User Interface or ZUI). Following up on our work that showed that Fitts' law applies to tasks with an extremely high level of difficulty (30 or more, i.e. a ratio of 230 between target size and target distance) we have developed a theoretical model to explain this result[33]. The model shows an effect of view size on multiscale navigation, which we successfully tested in a controlled experiment. We will continue this work in the context of the Micromegas project (see section 7.4) where we will develop ZUIs and study novel navigation techniques.

The complexity of an interaction technique for a given task, *i.e.* a given interaction sequence, measures the cost of the actions relative to the size of the task when using this interaction technique. The work on pointing and navigation studies the limit performance of human subjects in such tasks. However it is often difficult to observe such performance when the technique is used in the context of a real application. In order to better understand how interaction techniques behave in context, we are developing a model and associated tool to describe interaction techniques and predict their comparative performance for multiple tasks representative of different interaction contexts. The model, called CIS[30][35] (Complexity of Interaction Sequences) introduces the notion of complexity for interaction techniques. We have successfully tested the model by evaluating 3 interaction techniques (fixed palettes, bimanual palettes and toolglasses) and shown that the most efficient technique depends on the interaction context, confirming the results of one of our earlier studies [47]. We intend to develop CIS in several directions like improving predictions precision and automating the identification of best and worst contexts for an interaction technique.

6.4. Interactive paper

Participants: Wendy Mackay [correspondant], Jean-Daniel Fekete, Catherine Letondal, Pascal Costa-Cunha.

Most computer software for managing on-line documents assumes that all user interaction takes place via a keyboard, mouse and screen and that documents exist only in their on-line form. Yet users often write by hand and annotate printed documents, forcing them to juggle on-line and off-line versions. We are exploring the concept of "interactive paper"[23], with the goal of better integrating physical and computer documents and allow users to take advantage of the best aspects of each.

We have been working for several years with research biologists at the Pasteur Institute, observing their use of laboratory notebooks[15][20]. For both practical and legal reasons, lab notebooks must exist in a physical format, even though a large percentage of the information they contain may come from a computer. From a user's perspective, some information is best entered by hand as ink on paper, e.g. making annotations or quick sketches, whereas other information is best entered on a computer, e.g. generating a graph of the results of an experiment. We have collaboratively designed several prototypes that help biologists do both, maintaining a physical notebook while simultaneously generating an interactive, on-line version.

This year, we began working with a new technology, the Anoto pen[14][36], which allows us to capture the strokes as the user writes on ordinary paper. This provides an extremely light-weight method of obtaining a copy of the hand-written parts of the notebook, which we can then provide a variety of on-line services. We developed a working prototype in collaboration with several biologists and plan to test it with them in 2004. Of particular interest is investigating how best to let the biologists create their own personal annotation systems, which they can then use to create personalized indexes, facilitate searching, and provide links to both physical and on-line objects.

In the past two months, we began two new projects in a related area, which involves working with historical manuscripts. For historians, the physical characteristics of these manuscripts are often as important as the information they contain. They need to interact with the actual physical object (often without touching it) while simultaneously entering information into a computer, for subsequent analysis. We are interested in exploring new techniques for linking physical and on-line documents, as well as providing novel methods of visualizing their contents. We are also working with archivists, who are interested in identifying and visualizing the evolution of related documents over time. We ran an initial workshop with historians and archivists in November, and will continue collaborating closely with them next year.

6.5. Interactive Information Visualization

Participant: Jean-Daniel Fekete.

Creating new information visualization techniques using traditional GUI toolkits is long and difficult. We have designed a new toolkit that allows us to experiment with new techniques in a much simpler a general way than before: the Infovis Toolkit (see section 5.4).

The InfoVis Toolkit[32] is designed to support the creation, extension and integration of advanced 2D Information Visualization components into interactive Java Swing applications. The InfoVis Toolkit provides specific data structures to achieve a fast action/feedback loop required by dynamic queries. It comes with a large set of components such as range sliders and tailored control panels to control and configure the visualizations. Supported data structures currently include tables, trees and graphs. Supported visualizations include scatter plots, time series, Treemaps, node-link diagrams for trees and graphs and adjacency matrix for graphs. All visualizations can use fisheye lenses and dynamic labeling. The InfoVis Toolkit supports hardware acceleration when used with Agile2D, an OpenGL-based implementation of the Java Graphics API resulting in speedup factors of 10 to 200.

We are currently exploring new techniques for the visualization of large graphs (for constraint-based programs, large social networks, software engineering), time-based data, exploration and management of familiar datasets. We are also exploring new interaction techniques to filter large datasets since existing techniques do not scale well.

See http://insitu.lri.fr/~fekete/InfovisToolkit and [37][39] for more details.

6.6. Interaction and design: using proximity as an interface to video-mediated communication

Participants: Nicolas Roussel, Helen Evans, Heiko Hansen.

One of the advantages of video over audio for mediated communication is the ability to transmit non-verbal information. Physical proximity between people is a language for non-verbal communication that we all employ everyday, although we are barely aware of it. Yet, existing systems for video-mediated communication fail to fully take into account these proxemics aspects of communication.

The MirrorSpace project[25][26] aims at creating an original personal video communication system that takes physical proximity into account. Whereas existing systems aim at creating a single shared space corresponding to a particular interpersonal distance, the goal of MirrorSpace is instead to create a continuum of space that will allow a variety of interpersonal relationships to be expressed. Our work focuses on the understanding of how people's interactions can trigger smooth transitions between situations as extreme as general awareness of remote activity where anonymity is preserved to intimate situations where people can look into the eyes of a remote person.

MirrorSpace units (see Fig. 5) combine a digital camera, a flat screen and a proximity sensor. As we aim to support intimate forms of communication, it felt important to us that people could actually look into each other's eyes and possibly merge their portraits into one, so the camera was placed right in the middle of the screen. This setup allows participants to come very close to the camera while still being able to see the remote people and interact with them.

Figure 5. MirrorSpace installation at Mains d'Oeuvres

The proximity sensor that measures the distance to the closest object or person in front of it. This distance is used by MirrorSpace software to alter the remote images displayed, and possibly the local one. A blur filter is applied on the images to visually express a distance computed from the local and remote sensor values. Blurring distant objects and people in MirrorSpace allows one to perceive their movement or passing with a minimum involvement. It also offers a simple way of initiating or avoiding a change to a more engaged form of communication by simply moving closer or further away.

This work started as part of the interLiving project (see above). MirrorSpace was first exhibited in a public setting in February 2003, at *Jeune Création*, a contemporary art exhibition in Paris. It was then exhibited at *Mains d'Oeuvres* (Saint-Ouen) (May 2003), *Pas vu, pas pris* (July 2003) and at the Interactive Design exhibit in the Pompidou Center (Paris December 2003 - February 2004). See http://insitu.lri.fr/~roussel/projects/mirrorSpace/ for more details.

7. Contracts and Grants with Industry

7.1. European projects IST/FET InterLiving

Participants: Wendy Mackay, Michel Beaudouin-Lafon, Stéphane Conversy, Helen Evans, Heiko Hansen, Nicolas Roussel, Loïc Dachary, Nicolas Gaudron.

The InterLiving project is a multi-disciplinary research project that uses social science, computer science and design methods to develop communication technologies for families. The project has multi-year relationships with six multi-household, multi-generational families in two EU countries who are active partners in testing novel research methods and prototyping ideas. The project investigates the communication patterns and needs of distributed families, especially peripheral communication; produces novel research methods for working with families, with an emphasis on collaborative design; and creates interactive "shared surfaces" to help family members stay in touch and facilitate everyday interaction[22]. The project finished at the end of 2003.

7.2. French RNTL project OADymPPaC

Participant: Jean-Daniel Fekete.

The OADymPPaC project aims at providing tools for the dynamic analysis and debugging of constraint-based programs. It is funded by the RNTL French network. Partners include INRIA (from the Rocquencourt Contraintes project and Futurs IN-SITU project), Ecole des Mines de Nantes, University of Orleans, IRISA in Rennes, the ILOG company and the Cosytec company. The project started in 2000 and will end in 2004

Our role in the project is to provide tools for visualizing dynamically the execution of constraint-based programs. We have designed several tools to read a generic trace produced by constraint-based programs and translate it into generic and specific visualization components. Our current work is focused on visualizing large dynamic graphs that are built and maintained by constraint solvers. Two graphs are important: the constraint/variable graph available on all solvers and the graph of "explanations" produced by recent solvers such as PaLM [45]. We designed the Infovis Toolkit[32] to help building appropriate tools for this project.

Instead of focusing on node-link diagrams for representing graphs, we are exploring the use of adjacency matrices to achieve higher graph density and real-time performances. We are currently investigating three directions: readability of adjacency matrices compared to node-link diagrams, clustering techniques to help aggregating large graphs and interaction techniques to explore the evolution of large graphs[16][17][18].

7.3. French RNTL project INDIGO

Participants: Michel Beaudouin-Lafon, Renaud Blanch, Stéphane Conversy, Jean-Daniel Fekete, Nicolas Roussel.

The goal of the INDIGO project is to design, develop and validate a distributed software architecture for the development of a new generation of interactive systems characterized by the following requirements:

- visualize and interact with more and more complex and dynamic information;
- adapt to a more and more divers set of platforms (mobile phone, PDA, PC, immersive VR, etc.) and input devices;
- support cooperative work, in particular real-time sharing and editing of information across multiple sites.

The INDIGO software architecture is based on a high-level communication protocol between Conceptual Objects (CO) servers and Rendering and Interaction (RI) servers. This architecture is similar to that of the popular X Window System, with the important difference that the RI servers will implement higher-level models for displaying data and interacting with it than the X Server, and CO servers will therefore manage interaction and visualization at a higher level of abstraction than X clients. This has several advantages, including the following: a higher-level protocol requires less bandwidth, novel interaction techniques can be added to the IR servers transparently, CO servers can use multiple RI servers simultaneously to support collaborative work, and CO servers are independent from the end-user platform.

The partners of the project are In Situ (coordinator, RI server, protocol), the French company ILOG (CO server, protocol), the W3C (protocol) and CENA (requirements and sample applications), the French research center for air traffic control. In order to foster the adoption of the INDIGO architecture, the protocol will be publicly available and submitted to the W3C, and reference implementations of the servers will be available under an open source license.

Over the last 12 months, we have designed the first version of the protocol and sample implementations of the CO and RI servers. In particular, rendering is based on an implementation of SVG (Scalable Vector Graphics) with the graphics API OpenGL and interaction is based on the instrumental interaction model[1].

7.4. French ACI Very Large Datasets

Participants: Yves Guiard, Nicolas Roussel, Wendy Mackay, Michel Beaudouin-Lafon, Jean-Daniel Fekete, Emmanuel Nars, Mathieu Langet.

Over the twenty years that elapsed since the Xerox Star, the first personal computer with a graphical user interface ever commercialized, the amount of information stored on our computers has been subject to a thousand-fold increase. The mass of electronic data we have nowadays at our disposal in both our professional and personal lives is such that the risk of being overwhelmed with information – even with the information we have stored ourselves – has become a serious concern.

Micromegas involves four teams that share their experience in the fields of human movement and cognition, human-computer interaction, information visualization, and multi-modal interaction: LMP in Marseille, In Situ and MerLIn at INRIA, and Institut Pasteur in Paris. One essential feature of our approach is an emphasis on multi-scale interaction. Complexity, we believe, cannot be mastered by the human unless it can be tackled hierarchically: the information contained in a huge set of files or an electronic world atlas cannot be retrieved and utilized unless one can easily manipulate the level of granularity at which one wishes to interact with the data, from the most global level (a view of the subsuming folders, a general view of the planet) to the most local (the contents of a file, a detailed city map). The cognitive capabilities of humans, however, are too limited to encompass such a scope, and hence the challenge is to understand how they spontaneously vary the scale factor and, in the context of computerized information, to help them do so.

Micromegas deliberately focuses on the case of *familiar* data – both professional and personal – that have been stored by the users themselves, who not only save their own production but also collect external data. Thus, we are more concerned with personal hard disks than the Web. Still, we are facing huge data bases (on the order of several tens of gigabytes) whose size, which keeps on growing exponentially, makes the multi-scale approach compulsory.

The project is organized in three sub-projects, designed to foster collaboration between the participants and structure the research effort.

Sub-project 1 addresses the fundamental aspects of multiscale navigation. Through an experimental approach, it applies the principles of the ecological approach to visual perception from psychologist J.J. Gibson to design and evaluate novel navigation techniques for multiscale information worlds.

Sub-project 2 addresses visualization techniques. Many visualization techniques have been developed over the years, however few address the actual presentation of large data sets. In many cases, data is aggregated before being presented to the user. Such aggregation essentially supports a hierarchical view of the data, while we are interested in richer representations that support multiscale navigation, transformation between views, and efficient use of the display surface.

Sub-project 3 consists of two case studies. The first one covers management of personal file systems, a task facing almost every computer user and not well supported by current desktop interfaces. The second study covers the management of experimental data by biologists at the Institut Pasteur. Rather than focusing on the data used and produced by an experiment, it addresses the wider picture of sense-making that is part of the scientific process of designing, running and analyzing series of experiments.

The expected results of the project include fundamental results on multiscale visualization and navigation, practical tools to create multiscale interfaces, guidelines and recommendations to design multiscale applications, prototype systems for file management and laboratory notebooks, and, in general, a deeper understanding of how humans can take advantage of and interact with multiscale information worlds.

7.5. French ACI Archiving and Preservation

Participants: Wendy Mackay, Jean-Daniel Fekete, Pascal Costa-Cunha.

Manuscripts are special kinds of documents not well supported in the digital world. When considered as images, they cannot be used for full-text searching or indexing. When transcribed and used as textual documents, they loose all their graphic features. These features can be ever more important than the textual content. For example, laboratory notebooks contain more than text: formulas (mathematical, biological, chemical), references to experimental objects, photographs or results of printouts of various machines. Historical manuscripts can contain ornamented letters, diacritical marks, hard-to-read text portions or schemas. Literary manuscripts can be very complex graphically and convey an intimate relationship with the author lost in the textual form.

We are working on two contracts aimed at digitizing and supporting manuscripts for literary and historical purposes: "Collaborative annotation for online manuscripts" (IDA) and "Publishing ancient Ethiopian manuscripts" (Ethiopia). The IDA project is led by INRIA with two partners: the French National Library (BnF) and the Institute of Modern Textes (ITEM). The Ethiopia project is led by the French National Archives with INRIA , the Ethiopian ministry of culture and the British National Library as partners.

For both projects, we will provide our expertise on augmented documents [46] and manuscripts [41][42]. We will also work on new hypermedia structures and interfaces to better support manuscripts.

8. Other Grants and Activities

8.1. National actions

- Michel Beaudouin-Lafon is co-chair of the CNRS Thematic Network of Human-Computer Interaction (RTP16) representing around 200 researchers
- CNRS STIC: Action Spécifique "Plasticit2 Xes Interfaces": Michel Beaudouin-Lafon

8.2. European actions

- UID-Net: Catherine Letondal
- Convivio: Wendy Mackay
- 6th Framework Multi-modal program reviewer: Wendy Mackay

9. Dissemination

9.1. Academic service

9.1.1. Journal editorial board

- International Journal of Human-Computer Study (formerly International Journal of Man-Machine Study, founded in 1968): Wendy Mackay (co-editor in Chief)
- ACM Transactions on Computer-Human Interaction (TOCHI): Wendy Mackay (associate Chair)
- Revue de l'Interaction Homme-Machine (RIHM): Michel Beaudouin-Lafon, Wendy Mackay

9.1.2. Journal reviewing

- Revue I3: Michel Beaudouin-Lafon (member of the board)
- CSCW Journal: Michel Beaudouin-Lafon (member of the advisory board)
- HCI Journal: Nicolas Roussel
- Software Practice and Experience (SPE): Jean-Daniel Fekete
- IEEE Transactions on Graphics and Visualization: Jean-Daniel Fekete
- Document Numérique, Hermès, France: Jean-Daniel Fekete (member of the board of the special issue on preservation and cultural heritage)
- Pervasive Computing: Wendy Mackay
- ACM/Transactions on Computer-Human Interaction: Wendy Mackay
- IEEE Software: Wendy Mackay

9.1.3. Keynotes and Invited Lectures

- Unversity of British Columbia Distringuished Lecture Series, Canada: Wendy Mackay
- Oregon Research Institute Distringuished Lecture Series, USA: Wendy Mackay
- Philips Human-Computer Interaction Conference, Netherlands: Wendy Mackay
- Interaction Homme-Machine Conference, France: Wendy Mackay
- Seminar on Safety-Critical systems, Denmark: Wendy Mackay

9.1.4. Conference organization

- ACM UIST 2004: Michel Beaudouin-Lafon
- ACM AVI'04: Wendy Mackay (Associate Chair)
- ACM CHI 2003-2004: Michel Beaudouin-Lafon (Associate Chair for 2004)
- IHM 2004: Michel Beaudouin-Lafon (vice-chair), Jean-Daniel Fekete (proceedings chair)
- Graphics Interface 2004: Jean-Daniel Fekete
- ECSCW 2003: Michel Beaudouin-Lafon
- CADUI 2003: Jean-Daniel Fekete
- CIDE 06 (French conference on electronic documents): Jean-Daniel Fekete
- IHM 2003: Jean-Daniel Fekete
- IEEE Symposium on Information Visualization 2003: Jean-Daniel Fekete is co-chair of the Infovis 2003 Contest and will be co-chair of the Infovis 2004 contest. He launched this new submission category in 2003.

9.1.5. Conference reviewing

- ACM CHI 2004: Nicolas Roussel
- ACM IUI 2004: Jean-Daniel Fekete
- ACM DIS'04: Wendy Mackay
- AVI'04: Wendy Mackay
- ACM DUX 2003: Wendy Mackay
- ACM UIST 2003: Michel Beaudouin-Lafon, Wendy Mackay
- UBICOMP 2003: Michel Beaudouin-Lafon
- Tales of the Disappearing Computer 2003: Wendy Mackay
- ACM CHI 2003: Jean-Daniel Fekete, Wendy Mackay, Nicolas Roussel, Michel Beaudouin-Lafon
- IHM 2003: Jean-Daniel Fekete, Wendy Mackay
- Infovis 2003: Wendy Mackay, Jean-Daniel Fekete
- IFIP Interact 2003: Nicolas Roussel
- BR-CHI CLIHC 2003: Nicolas Roussel

9.1.6. Scientific associations

- GDR I3: Jean-Daniel Fekete (Head of WG 2.2)
- AFIHM (French speaking HCI asssociation): Michel Beaudouin-Lafon, Jean-Daniel Fekete, Nicolas Roussel, Executive Committee members
- ACM SIGCHI: Wendy Mackay Vice-Chair for Publications and Chair or SIGCHI Publications Board
- ACM: Michel Beaudouin-Lafon member at large of ACM Council and member of ACM Publications Board

9.1.7. PhD defenses

- Michaël Baron, PhD Thesis "Vers une approche sûre du développement des Interfaces Homme-Machine", Jean-Daniel Fekete jury member
- Judith Aston, Ph.D. Thesis "Interactive Multimedia: an Investigation into its Potential for Communicating Ideas and Arguments", Wendy Mackay, jury member

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