

# PLAY research studio, Interactive Institute

## Report to the Academic Board, February 2001

### ***More information and additional materials on the WWW***

The best place to get up-to-date information about PLAY is the main homepage:

<http://www.playresearch.com/>

All the material for the Academic Board (core publications etc.) is available for download from the following address:

<http://www.playresearch.com/ab/>

### ***Introduction***

In December 1998, the PLAY research group (then part of the Viktoria Institute) submitted a proposal to become a studio in the Interactive Institute, entitled *Entertainment and Innovation*. The proposal was accepted, and PLAY became a studio in August, 1999. Although details have changed, what we wrote in the proposal for the most part still holds. In particular, regarding evaluation of the studio, we stated the following:

*If, within the 4-year period initially located for basic funding, the research at the studio has resulted in a number of potentially successful commercial products, several accepted Ph.D. theses and a large body of internationally published academic work, the studio is a success. Otherwise, it is a failure.*

After only 18 months in the Interactive Institute, we are happy to report that the above goal has already been met. One spin-off company based on our research is out the door, and another is on the way. Two Ph.D. theses were presented in 2000, with at least one more coming this year. We have presented a total of 36 papers and posters at international conferences and workshops in 1999 and 2000, and have also taken active part in the scientific community by reviewing papers, hosting workshops, etc. In the following, we will highlight some of PLAY's activities and results since joining the Interactive Institute, but first we will give an account of the group's history.

### ***History***

PLAY was started as a research group at the Viktoria Institute in Gothenburg, Sweden, in January 1998. At that time the Viktoria Institute itself had only existed for approximately six months and had less than 10 employees. The Viktoria Institute was an effort to create a research institute for applied information technology, working in close collaboration with local industry. As such, it has turned out to be very successful, and Viktoria now has about 20 local companies as "members" and about 50 researchers working in a wide variety of projects (see <http://www.viktoria.org/> for more information). We believe that the PLAY group played a significant part in making the Viktoria Institute a success. We continue to have strong ties with Viktoria, and we are still co-located with the Viktoria Institute.

1998 was also the year when the Interactive Institute was formed, and PLAY had some involvement in the process from the start. When the institute was first proposed in the spring

of 1998, we wrote a proposal for a studio, but this was not included among the four original studios when the Foundation for Strategic Research decided to fund the institute in May, 1998. However, soon after the foundation of the Interactive Institute a decision was made to add one more studio, and PLAY submitted a new application in December the same year. This application was accepted and the group finally joined the Interactive Institute in August, 1999.

One reason for applying to the Interactive Institute was to achieve long-term stability for the group's research. The Viktoria Institute does not receive any basic funding from the Swedish state, and is thus totally dependent on project funding. PLAY's funding came mainly from two projects: *Mobile Informatics*, sponsored by the Swedish Institute for Information Technology (SITI), and *Intelligent Environments*, sponsored by the Swedish Board for Industrial Development (NUTEK). With the Interactive Institute, we hoped to move beyond the work-oriented and "productive" focus of these projects to more speculative and future-oriented research, in particular towards our interests in innovative applications for situations outside the working life.

### **Research theme**

We have defined the current research theme of PLAY as follows:

*The PLAY research studio investigates and invents the future of human-computer interaction. As computers become more and more a part of everyday life, the previous view of computers as strictly a work-oriented tool will change.*

*We believe that in the future, computation will become just another material for design, and take a natural place in human existence alongside other basic technologies such as writing and electricity. The research in PLAY will prepare us for that future.*

This theme is somewhat different to, but not incompatible with, the notion of "entertainment and innovation" presented in the original proposal. The reason for this new direction is a realization that the entertainment industry is already successful at solving many of the problems we outlined in the original application (interactive storytelling, virtual actors, AI in entertainment, etc.) and we have neither the skill nor the inclination to improve on this work. Instead, to have the greatest chance of adding something new, we try to look outside the areas that are currently "hot" and receive large amounts of funding, something that has recently become the case with entertainment technology. This has led us to instead look more closely at the design of interactive artifacts, and what it will mean for interaction design when computation becomes a commodity.

But most importantly, the research in the group is always based on the interests and skills of the members, and the last two years work has drifted in some other directions than what we envisioned in the proposal. For this reason, we use "entertainment and innovation" as a general framework within which all PLAY research takes place, and the research theme quoted above as the current best approximation of what the group is about as a whole.

### **Personnel**

PLAY currently consists of the following nine full-time researchers:

- **Lars Erik Holmquist**, studio director, M.Sc. Computer Science, Ph.D. Informatics, Gothenburg University

- **Staffan Björk**, M.Sc. Computer Science, Ph.D. Informatics, Gothenburg University
- **Jennica Falk**, M.Sc. Informatics, Ph.D. student Informatics, Gothenburg University (will spend one year at Media Lab Europe, Dublin, Ireland, starting mid-February 2001)
- **Lars Hallnäs**, M.A. in Music Composition, Royal College of Music, Stockholm, Ph.D. in theoretical philosophy, Stockholm University, Docent in logic at Stockholm University
- **Rebecca Hansson**, M.Sc. Informatics, Ph.D. student Informatics, Gothenburg University
- **Peter Ljungstrand**, M.Sc. Informatics, Ph.D. student Informatics, Gothenburg University
- **Linda Melin**, B.A. Textile Design, M.A. student Textile Design, University College of Borås
- **Johan Redström**, B.A. Cognitive Science, Ph.D. student Informatics, Gothenburg University
- **Tobias Skog**, M.Sc. Computational Linguistics, Ph.D. student Informatics, Gothenburg University

Additionally, we use the system of “amanuenses”, i.e. students that work part-time on practical matters. We currently have two amanuenses, Lisa Ahlberg and Per Jacobsson, who both are fourth-year students in Informatics. We have found this system to be a good way to recruit potential researchers.

### ***Ph.D. studies***

All PLAY researchers either already have a Ph.D. degree or are studying towards a Ph.D., most commonly in Informatics. The close ties with the department of Informatics are partly historical, since the department is closely associated with the Viktoria Institute. But more importantly, Informatics is the only department in the area that offers what could be called a Ph.D. program in “applied information technology”, and has thus become the natural place of study for PLAY employees. The professor at the Informatics department, Bo Dahlbom, is currently the supervisor of all Ph.D. students in the PLAY group, and has been instrumental in making the Ph.D. program a success.

We think it is very important for the research in the group to be tied to a university department and an active Ph.D. education, and Informatics has so far provided be the best way to combine research work with studying towards a degree. A Ph.D. thesis in Informatics typically consists of a set of published papers rather than a monograph, and this is a format that is ideally suited to combining active research of international quality with Ph.D. studies. So far, two Ph.D. theses in Informatics have been presented, and at least one more is planned for 2001, all of which are directly based on the group’s research.

### ***Academic results***

#### **Refereed papers**

PLAY has been very active in presenting papers at international conferences and workshops, ranging in format from student posters to full papers. Our main publishing “homes” have been the various ACM- and IEEE-sponsored conferences on human-computer interaction, computer graphics, information visualization, augmented reality, ubiquitous computing, etc., and Springer’s Journal of Personal Technologies. We produced 17 refereed conference presentations in 1999 plus one journal paper and one book chapter, and a further 19 papers were presented at refereed international conferences and workshops during 2000. A complete list of publications is attached and an updated list (with links to PDF versions of all papers) is available from our homepage.

## Master's and Ph.D. theses

The first two Ph.D. theses in Informatics based on research in the PLAY group were presented in 2000:

- *Breaking the Screen Barrier* by Lars Erik Holmquist
- *Flip Zooming: The Development of an Information Visualization Technique* by Staffan Björk

Both theses are available to download from our homepage.

We have also played an active role in supervising master's theses for students at the Gothenburg University. A total of eight theses were supervised in PLAY projects during 1999 and 2000. As far as possible the work of master's students should be a part of the ongoing research in the group, and several student posters and short papers have been written and published as the result of master's projects that we have supervised. In addition to adding to the research in the group, supervising master's students is also a good way to recruit new researchers, and several of the group's current members got their start by doing their master's project at PLAY.

## Paper reviewing, conference and workshop hosting, etc.

PLAY members have been very active as paper reviewers for a variety of conferences and journals. Conferences where we have taken on a substantial reviewing role include *ACM Computer-Human Interaction (CHI)* in 2000 and 2001, *IEEE Wearable Computing (ISWC)* in 1999, *IHM-HCI* (joint conference of the British and French HCI organizations) in 2000, and *Handheld and Ubiquitous Computing (HUC)* in 1999 and 2000, where Lars Erik Holmquist also served on the program committee for 1999 (and will serve again for 2001). Journals we have reviewed for include the *Journal of Personal Technologies (PeTe)* (Springer), *ACM Transactions on Computer-Human Interaction (ToCHI)* (ACM Press) and the *International Journal of Human-Computer Studies (IJHCS)* (Academic Press).

We have hosted several workshops at international conferences including *The Future of Fun II* at HUC '99 and will host the workshop on *Distributed and Disappearing User Interfaces in Ubiquitous Computing* at CHI 2001 together with researchers from Georgia Tech and University of Karlsruhe. In 2002, we will arrange the fourth international conference on Ubiquitous Computing, *UbiComp 2002* (previously HUC) in Gothenburg, Sweden. (HUC has previously been held in Karlsruhe, Germany and Bristol, UK, and will be held in Atlanta, GA, USA in October 2001.)

## **Spin-off companies**

In 2000, we initiated a relationship with the Chalmers School of Entrepreneurship, a specialized education at the Chalmers University of Technology. In their final year, groups of students work hands-on with developing new companies selected from a number of proposals submitted by local companies and research institutions. We have recently completed a first project, and a second project has just been approved for 2001. The projects are:

- *Hummingbirds*, now basis for the start-up company *Wunderkind*. Based on our research in inter-personal awareness devices, together with the students we worked out a business model for the Hummingbird devices. The business plan won several awards in the business plan competition Venture Cup, and was awarded a stipend of 100.000 SEK by

the Foundation for Technological Development. A patent has been applied for, and the company will soon be looking for its first round of venture funding.

- *PowerCom*. Based on our extensive research in information display strategies for small screens, and the booming market for hand-held computers and mobile phones, the PowerCom project was the natural next candidate for development. This project is currently in the very early stages, but we hope to have another start-up company formed within the year.

Working with the School of Entrepreneurship has proved to be a good way of spinning off companies without losing people from research. The researchers can choose to stay in the group and continue doing what they do best, while the entrepreneur student handles all the practical matters in developing a business plan and running the company.

### **External research funding**

In addition to the basic funding provided through the Interactive Institute by the Foundation for Strategic Research (4,5 million SEK per year), PLAY has a total of about 1,5 million SEK in confirmed external research funding for 2001. The funding is distributed among the following projects:

#### **Smart-Its**

Smart-Its is a project funded by the European Commission's *Disappearing Computer* research initiative. The partners are PLAY, University of Karlsruhe (Germany), VTT Research Center (Finland), and ETH (Switzerland). PLAY receives approximately 1 million SEK per year for 2001 and 2002.

#### **Intelligent Environments**

The Intelligent Environment project was funded by NUTEK, the Board for Technical Research and Development for three years, 1998-2001, in the *PROMODIS (Programming of Distributed Modular Systems)* research initiative. The funding ends in June 2001, and PLAY receives approximately 400.000 SEK for the first half of 2001. We plan to apply for new funding to continue some of the work in this project.

#### **E-People**

This new project is a joint project between PLAY, the Knowledge Management group at the Viktoria Institute, and the Mobile Group at the Interactive Institute in Stockholm. The project is funded by KFB, the Board for Communications Research, in the *Human Interfaces* research initiative. PLAY receives approximately 100.000 SEK per year in 2001 and 2002, mainly to support the collaboration between the groups.

In addition to this, in 2000 we received 170.000 SEK in funding from SITI, the Swedish Institute for Information Technology, to tie up some loose ends in the *Effective Display Strategies for Small Screens* project in the Mobile Informatics initiative.

### **Institute-wide collaboration**

In the fall of 2000, we hosted a "CHI Short Papers Crash Course", a practical guide in how to write and submit academic papers, specifically geared towards submitting short papers and student posters for the ACM Computer-Human Interaction conference. Since PLAY has several years of experience of presenting short papers and student posters at CHI (and many other conferences), we wanted to share this knowledge with the rest of the institute. All

attendants were required to work actively with writing a short paper in the CHI conference format, and we helped out with practical advice both on how to make the papers suitable for CHI and what other conferences might be more appropriate. Additionally, a “peer-review” system was created so that the attendees could support each other in improving their papers, and also get experience in reading and critiquing the work of others. The course was open for everyone at the Interactive Institute, and there were a total of about 10 attendants, coming from the *Emotional* and *Space* studios. Additionally, about 10 persons attended from the Viktoria Institute. Of the 8 student posters that were finally submitted as a direct result of the course, 6 were accepted for presentation. For many of the attendants from the Interactive Institute, this was their first contact with the academic publishing and peer reviewing system, and the general reactions were positive. We hope that the course will lead to more publications from the Interactive Institute in the future, and we might repeat it for next year if there is enough interest from other studios.

### ***International cooperation***

The PLAY group has an extensive informal network of personal contacts in the international research community. This includes contacts with researchers from University of Washington, Xerox PARC, FX Pal, Mitsubishi Electric Research Labs, Georgia Tech, MIT Media Lab, HP Labs Bristol, Imperial College London, Stanford University, MIT AI Lab, Simon Fraser University, Sony CSL, etc.

As for formal collaborations, in the *Smart-Its* research project we collaborate with four European partners including University of Karlsruhe in Germany, VTT in Finland, and two groups at ETH in Switzerland. We are currently working to set up a more formal collaboration in the form of a student exchange program with Media Lab Europe in Dublin, Ireland, and the Computer Related Design course at the Royal College of Art in London, UK.

### ***Cooperation with industry***

In 1999 and 2000 we had industrial collaborations with the following companies:

- Ericsson Radio Systems Usability Lab, in the *PowerView* and *PowerCom* projects
- Telia Research, in the *WEST* project
- Nokia Research Center Tampere in the *Pirates!* project

For 2001 we will continue to collaborate with Ericsson on information visualization for small screens and with Nokia on emergent narratives.

### ***Out-reaching activities***

We have worked actively with alternative ways of presenting our research to the general public and local industry, efforts that have resulted in several radio and TV appearances and newspaper articles. Some of these activities include:

#### **Exhibition at Borås Art Museum**

In May 2000 we arranged a one-night exhibition, *Informative Art and Slow Technology*, at the Art Museum in Borås, Sweden, to expose our work to a new audience. The exhibition was a success with about 250 visitors, and experiences from the exhibition have been used in a variety of publications in the Informative Art and Slow Technology projects. A new public exhibition is planned for 2001 but the venue is not yet decided.

## Gothenburg Science Festival

For three years running we have arranged activities at the Gothenburg Science Festival. In 1998 we hosted guest-lectures by Glorianna Davenport (MIT Media Lab, USA) and Maureen Thomas (then at National Film and Television School, UK) on interactive media, that attracted over 200 visitors. In 1999 and 2000 we presented the work of the PLAY group in an open house format.

## Formation of West Sweden CHI, the first Swedish SIGCHI chapter

Together with the consulting company Carlstedt Research & Technology, we formed the first Swedish local chapter of ACM SIGCHI (currently a prospective SIG) in 1999. Acting as a focal point for the West Sweden region research and development in human-computer interaction, West Sweden CHI has arranged a number of seminars and presentations on HCI topics during 2000. West Sweden CHI has no formal membership registry but the mailing list currently contains almost 200 names.

### ***The future***

According to the Interactive Institute's program plan, a studio should exist for no more than five years. We have decided to take this time-limit seriously. PLAY was formed in January 1998 (before we joined the Interactive Institute) and we feel that five years from that date is a sufficient time for achieving the goals of the group. Thus, PLAY will re-evaluate its existence in 2002, and cease to exist or change into some other form for 2003. This fits well with the institute's program plan, since new studios like PLAY will be evaluated for the first time after three years. The first formal evaluation of PLAY will thus take place around August 2002, and we will use the results from this evaluation when re-assessing the activities of the group.

### ***The PLAY Clocks project***

To externalize the fact that the "clock is ticking", we have designed a number of "five-year clocks" in the form of Java applets at the PLAY homepage. A new clock is presented on the PLAY homepage each month. The intention is to collect a series of examples how one can design for much longer time-spans than the seconds and milliseconds that usually are the focus of human-computer interaction research, thus exploring some more unusual aspects of interaction design.

To see the current "PLAY time", visit the PLAY homepage. A gallery of all previous clocks is available from:

**<http://www.viktoria.informatik.gu.se/play/clocks/>**

(A Java compatible browser is required)

## Projects and results

### **Projects and results 1999-2000**

In 1999 and 2000, PLAY had four project areas: *Awareable Computers*, *Active Narratives*, *Amplified Reality* and *Information Visualization*. Within each area, there were a number of individual projects. However, the borders between the different areas were not very strict, and some projects might fit under more than one area. For 2001, we will focus on five new main projects that have grown from results in the previous project areas.

In the following, we will give a short description of each of the project areas for 1999-2000 and then refer to a number of publications that contain results from individual projects. The *core publications* contain major results from each area. We have made each area's core publications available for download in separate PDF files at the address below. Some *selected additional publications* are also listed to give a further depth to each area, but are not included with the report. All publications can also be downloaded directly from the PLAY publications homepage. A complete list of PLAY publications for 1999 and 2000, including many that are not listed below, is appended to this report.

The following link takes you directly to a page with links to the core publications and other evaluation material in PDF format:

**<http://www.viktoria.informatik.gu.se/play/ab/>**

### Awareable Computers

We coined the term *Awareable Computer* to describe a wearable computer that is aware of its surroundings, or provides support for the user's awareness of others, thus augmenting human communication and information processing. The main project in this area were:

- *The Hummingbird* – an “Inter-Personal Awareness Device” that used short-range radio communication to support informal communication in co-located groups. The Hummingbird was first demonstrated at the ACM conference on Computer-Suported Cooperative Work (CSCW) in 1998, and is currently being turned into a commercial product. A patent has been applied for covering parts of the technology.
- *The BubbleBadge, the WearBoy and ActiveJewel* – three examples of turning the wearable computer “inside out” to create a computer display that is both public and private, thus blurring the line between wearable computing and ubiquitous computing.
- *The Reminder Bracelet* – an attempt to create a subtle but public alternative to the traditional beeps and bells of PDAs and mobile phones.

### *Core publications:*

1. Hansson, R. and Ljungstrand, P. The Reminder Bracelet: Subtle Notification Cues for Mobile Devices. *Extended Abstracts of CHI 2000*. ACM Press, 2000. (poster; a full paper has been submitted for publication)
2. Holmquist, L.E., Falk, J. and Wigström, J. Supporting Group Awareness with Inter-Personal Awareness Devices. *Journal of Personal Technologies*, 3(1-2), Springer Verlag, 1999.

3. Falk, J. and Björk, S. Privacy and Information Integrity in Wearable Computing and Ubiquitous Computing. *Extended Abstracts of Computer-Human Interaction (CHI) 2000*, ACM Press, 2000. (poster; a full paper has been submitted for publication)
4. Weilenmann, A. and Holmquist, L.E. Hummingbirds Go Skiing: Using Wearable Computers to Support Social Interaction. *Proc. IEEE International Symposium on Wearable Computing (ISWC) '99*, IEEE Press, 1999. (poster; an extended version has been accepted for journal publication – see below)

*Selected additional publications:*

1. Falk, J. and Björk, S. The BubbleBadge: A Wearable Public Display. *Extended Abstracts of ACM Computer-Human Interaction (CHI) '99*, ACM Press, 1999. (poster)
2. Ljungstrand, P., Björk S. and Falk, J. The WearBoy: A Platform for Low-cost Public Wearable Devices. *Proc. IEEE International Symposium on Wearable Computing (ISWC) '99*, IEEE Press, 1999. (poster)
3. Weilenman, A. Negotiating Use: Making Sense of Mobile Technology. *Journal of Personal Technologies*, no. 4, 2000, Springer Verlag (to appear; this is an extended version of the poster above)

The work in awareable computers continues in the *Provocative Computing* project.

### Active Narratives

Interactive narrative has been a strong interest of several PLAY researchers. With the term *Active Narratives* we tried to capture the phenomenon of narratives that emerge from the interaction between several users and an interactive application. There have only been a few projects in this area to date, but it will be further developed in a new project in 2001. The main project for 1999-2000 was:

- *Pirates!* – a mobile context-aware game that explored how aspects of face-to-face gaming can be brought into the computer realm. *Pirates!* used hand-held computers, custom-built proximity-sensing hardware and a wireless network and was a joint project with Nokia Research Center Tampere. The game was first publicly demonstrated at the Handheld and Ubiquitous Computing (HUC2K) conference in Bristol in September 2000.

*Core publication:*

1. Björk, S., Falk, J., Hansson, R. and Ljungstrand, P. *Pirates! Using the Physical World as a Game Board*. *Proc. Interact 2001, Eighth IFIP TC.13 Conference on Human-Computer Interaction*, Tokyo, Japan, 2001. (to appear)

*Selected additional publications:*

1. Falk, J., Ljungstrand, P., Björk, S. and Hansson, R. *Pirates: Proximity-Triggered Interaction in a Multi-Player Game*. *Extended Abstracts of Computer-Human Interaction (CHI) 2001*, ACM Press, 2001. (to appear)
2. Holmquist, L.E., Helander, M. and Dixon, S. *Every Object Tells a Story: Physical Interfaces for Digital Storytelling*. *Proceedings of NordiCHI 2000*, Stockholm, Sweden, 2000. (short talk)

The work in active narratives continues in the *Emergent Narratives* project.

## Amplified Reality

The area of *Amplified Reality* is related to augmented reality, but whereas augmented reality is about enhancing *impressions*, enhancing the users senses for instance through specialized goggles or head-phones, amplified reality is about enhancing the *expressions* of things and people in the world. By embedding technology into ordinary real-world objects, we can enrich and enhance the way these things function in our daily life. (The paper from HUC '99, below, gives a more detailed account of this distinction.) The main projects in 1999 and 2000 were:

- *Informative Art* – by using the “language” traditional art, we can construct computer displays that are better integrated with the human environment. the resulting presentation should be able to take the role of a piece of art on display at, for instance, an office or in a home, but reflect some type of dynamic information. A number of pieces of informative art were presented at an exhibition at Borås Art Museum in May, 2000.
- *The ChatterBox* – an automatic text generator that feeds on the electronic “buzz” that is present but invisible at every modern work place. The ChatterBox collects e-mail, web pages, printer documents and other texts, and generates unexpected new texts from this material. The results are then displayed in a public place, to entertain and to inspire new ideas.
- *WebStickers* – a low-cost, distributed system that turns ordinary physical objects into web bookmarks using simple barcode tagging. By doing this we can “inherit” desirable properties of physical objects that traditional web bookmarks do not have. The WebStickers system was a platform that allowed us to explore the consequences of using physical objects as representations for virtual information.
- *Token-Based Access to Digital Information* – in a generalization of the WebStickers project, we looked at how properties of physical objects can be used when representing digital information. The framework of *containers* (generic objects that can “contain” any type of information); *tokens* (objects that physically reflect some aspect of the information they represent); and *tools* (objects that allow the manipulation of information) was put forth to categorize different aspects of information representation.

### Core publications:

1. Falk, J., Redström J., and Björk, S. Amplifying Reality. *Proc. First International Symposium on Handheld and Ubiquitous Computing (HUC) '99*, Springer Verlag, 1999.
2. Holmquist, L.E., Redström J. and Ljungstrand, P. Token-Based Access to Digital Information. *Proc. First International Symposium on Handheld and Ubiquitous Computing (HUC) '99*, Springer Verlag, 1999.
3. Ljungstrand, P., Redström, J. and Holmquist, L. E. Webstickers: Using Physical Tokens to Access, Manage and Share Bookmarks to the Web. *Proc. Designing Augmented Reality Environments (DARE) 2000*, ACM Press, 2000.
4. Redström, J, Skog, T, and Hallnäs, L. Informative Art: Using Amplified Artworks as Information Displays. *Proc. Designing Augmented Reality Environments (DARE) 2000*, ACM Press, 2000.

### Selected additional publications:

1. Fredriksson, C., Liljas, G. and Ljungstrand, P. BreakBits: Using Music to Facilitate Awareness in User Interfaces. *Proceedings of Graphics Interface 2000*, Montréal, Canada. (poster)
2. Ljungstrand, P. and Holmquist, L.E. WebStickers: Using Physical Objects as WWW Bookmarks. *Extended Abstracts of ACM Computer-Human Interaction (CHI) '99*, ACM Press, 1999. (poster)

3. Redström, J. The DishJockey: Integrating Multimedia into Everyday Activities. *Proc. ACM Multimedia 98*, Bristol, UK. (best poster award)
4. Redström, J., Dahlberg, P., Ljungstrand, P. and Holmquist, L.E. Designing for Local Interaction. *Proc. Managing Interactions in Smart Environments (MANSE) '99*, Springer Verlag, 1999.
5. Redström, J., Ljungstrand, P. and Jaksetic, P. (2000). The ChatterBox: Using Text Manipulation in an Entertaining Information Display. *Proceedings of Graphics Interface 2000*, Montréal, Canada.

The work in amplified reality continues in the *Slow Technology* and *Smart-Its* projects.

### Information Visualization

Our research in *Information Visualization* dates back to the early development of the *flip zooming* focus+context visualization technique, first presented at CHI '97. By applying focus+context visualization to hand-held computers and other devices with small screens, we have worked with effectively presenting information on a limited display surface. We have also delved into other areas of information visualization, including visualizing web site activity and the activity at a student workplace. Major projects include:

- *PowerView and PowerCom* – two interfaces that integrate common functions of a PDA using flip zooming and information links. PowerView and PowerCom were both collaborative projects with Ericsson Usability Lab, and PowerCom is currently being turned into a commercial product. A patent will be applied for covering parts of the PowerCom technology.
- *WEST* – a Web Browser for Small Terminals that used a combination of proxy pre-processing, linguistic compression and information visualization techniques to effectively present web pages on a small hand-held computer. WEST was a joint project with Telia Research and the Swedish Institute of Computer Science.
- *Theoretical Frameworks for Focus+Context Visualization* – in an attempt to understand the foundations of focus+context visualization we developed a framework that can be used both descriptively, and as a constructive tool for new visualizations.
- *Hierarchical Flip Zooming* – a generalization of the flip zooming technique that allows for the visualization of nested data structures, such as hierarchically ordered image collections.

### Core publications:

1. Björk, S., Holmquist, L.E., Redström, J., Bretan, I., Danielsson, R., Karlgren, J. and Franzèn, K. WEST: A Web Browser for Small Terminals. *Proc. ACM Conference on User Interface Software and Technology (UIST) '99*, ACM Press, 1999.
2. Björk, S., Redström, J., Ljungstrand, P., and Holmquist, L.E. PowerView: Using information links and information views to navigate and visualize information on small displays. *Proc. Handheld and Ubiquitous Computing 2000 (HUC2k)*, Springer Verlag, 2000.
3. Björk, S., and Redström, J. Redefining the Focus and Context of Focus+Context Visualizations. *Proc. IEEE Symposium on Information Visualization (InfoVis) 2000*, IEEE Press, 2000.
4. Björk, S. Hierarchical Flip Zooming: Enabling Parallel Exploration of Hierarchical Visualizations. *Proceedings of Advanced Visual Interfaces (AVI) 2000*, ACM Press, 2000.

### Selected additional publications:

1. Björk, S. and Redström, J. An Alternative to Scrollbars on Small Screens. *Extended Abstracts of ACM Computer-Human Interaction (CHI) '99*, ACM Press, 1999. (poster)
2. Björk, S., Holmquist, L.E. and Redström, J. A Framework for Focus+Context Visualization. *Proc. IEEE Symposium on Information Visualization (InfoVis) '99*, IEEE Press, 1999.
3. Björk, S., Holmquist, L.E., Ljungstrand, P., and Redström, J. PowerView: Structured Access to Integrated Information on Small Screens. *Extended Abstracts of ACM Computer-Human Interaction (CHI) 2000*, ACM Press, 2000. (short talk)
4. Holmquist, L.E. and Björk, S. A Hierarchical Focus+Context Method for Image Browsing. *Proceedings of SIGGRAPH '98: Sketches and Applications*, ACM Press, 1998.
5. Ljungstrand, P. and Hård af Segerstad, Y. An analysis of WebWho: How does awareness of presence affect written messages? Workshop paper, *Awareness and the World Wide Web workshop*, Computer-Supported Cooperative Work (CSCW) 2000, Philadelphia, PA, USA, 2000. (will be submitted for journal publication)
6. Skog, T. and Holmquist, L.E. WebAware: Continuous Visualization of Web Site Activity in a Public Place. *Extended Abstracts of ACM Computer-Human Interaction 2000*, ACM Press, 2000. (poster)

The work in information visualization continues in the *Beyond Pixels* project.

### **Current projects**

For 2001, we will have five main projects:

- *Beyond Pixels* is an extension of the information visualization research, where we will look at new materials and modalities of displaying dynamic information.
- *Emergent Narratives* will focus on the new narrative structures that will appear when computers make it possible to blur the line between “storyteller” and “audience”.
- *Provocative Computing* will develop concepts and prototypes that are provocative in themselves or that raise issues that can be perceived as provocative.
- *Slow Technology* uses time as a design variable to design technology that encourages moments of reflection and mental rest by being slow, i.e. to provide *food* rather than *fast-food* for thought.
- *Smart-Its* are small, cheap computational devices that can be used for post-hoc computational enhancement of everyday objects. Smart-Its will allow us to explore emergent collective behaviors of large collections of computationally-enhanced objects.

Updated information about project results will be posted at the PLAY homepage as they become available.

## **Bibliography**

### ***Presentations and overviews***

The best place to get up-to-date information about PLAY is always the homepage, located at:

**<http://www.playresearch.com/>**

Here, all forthcoming presentations are listed as well as details of funding, people, projects, publications and an archive of previous events.

The original proposal to the Interactive Institute, *Entertainment and Innovation*, is available for download at:

**<http://www.viktoria.informatik.gu.se/play/publications/entertainment.pdf>**

An organization overview of the PLAY research studio, *The PLAY Research Group: Entertainment and Innovation in Sweden*, was presented at the CHI 2000 conference. The two-page abstract is available for download at:

**<http://www.viktoria.informatik.gu.se/play/publications/2000/overview.pdf>**

The following link takes you directly to a page with links to the above materials, the core publications and other evaluation material in PDF format:

**<http://www.viktoria.informatik.gu.se/play/ab/>**

### ***Refereed academic publications***

We have attached a full list of refereed publications for the years 1999 and 2000. All publications are available for download in PDF format from the PLAY homepage.

## PLAY publications and theses 1999

All publications are available for download from <http://www.playresearch.com>

### **Book chapter:**

- Holmquist, L.E., Björk, S., Falk, J., Jaksetic, P., Ljungstrand, P. and Redström, J. What About Fun and Games? In Ljungberg, F. (ed.) *Informatics in the Next Millennium*, Lund: Studentlitteratur, 1999.

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3. Björk, S., Holmquist, L.E. and Redström, J. A Framework for Focus+Context Visualization. *Proc. IEEE Information Visualization '99*, IEEE Press, 1999.
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All publications are available for download from <http://www.playresearch.com>

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