Collaborative Development and New Devices for Human-Computer Interaction

Hans-Jörg Bullinger and Gunnar Brink

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
Hansastraße 27c,80686 München
hans-joerg.bullinger@zv.fraunhofer.de
www.fraunhofer.de

Abstract. The article pays tribute to the emergence in 1993 of graphical browsers that allow users to address electronic information with a point-and-click interface, and places this development on a par with other important historical events that shaped society and the life of the individuals. It describes the resistance that some voiced at the time to the prompt economical utilization of the Internet's new possibilities. It goes on to describe current technical developments in the human-computer interface environment that could be very, perhaps even comparably, important. It concludes with an appeal for the courage to develop technical innovations, particularly in difficult economic times.

Keywords: Context-aware services, pervasive gaming, collaboration, semantic web, testing methods, interfaces and peripherals, mini-projector, augmented immersive 3D displays, acoustic wave field synthesis.

1 Introduction

There are certain events that most of us remember fairly accurately if we are old enough. You know exactly what you were doing the day the Berlin Wall fell, just as you remember when you found out that the World Trade Center had been destroyed by terrorists with captured airliners, or what you were doing when you learned that Kennedy had been assassinated. Armstrong's steps on the moon: such moments in history are engraved in our memories if we have had the fortune or misfortune to live through them.

There is another event that I can also remember very well: In 1993, a colleague at the Fraunhofer Institute showed me an innovative program: Mosaic 1.0, one of the first browsers with a graphical interface. Of course, we already had an Internet connection at that time, and we used the E-mail function extensively. But compared to today, using the Internet then was a painstaking business. It took at least a handful of UNIX control commands for the simplest matters. Even back then, however, we had more than you might think, for example, e-mail lists, the forerunners of today's Internet forums. In 1993, in an institute (FIT) that today belongs to the Fraunhofer-Gesellschaft, BSCW (Basic Support for Cooperative Work) was developed. In 1995 this was the first fully Web-based groupware system [1] (European Software Innovation Prize 1996).

J.A. Jacko (Ed.): Human-Computer Interaction, Part I, HCII 2009, LNCS 5610, pp. 789–795, 2009.

But Mosaic and all subsequent browsers radically changed the Internet, because they changed the way in which we use the Internet: intuitively, graphically and with a substantially higher quality experience.

"Mosaic" NetScape was already available in 1994, followed by Netscape Navigator. Perhaps some of you still remember how the new Netscape business model unsettled business economists: the product was supplied at no cost. Only later and improved versions required payment of license fees. At that time, this type of market entry seemed revolutionary. Today we use Explorer, Firebird, Safari or Opera as browsers. Each browser is better in some areas than the others.

It is hard to imagine that before 1993, there was not a single browser like these in circulation. What began so quietly in 1993, an Internet that could be used graphically and intuitively started a revolution. JavaScript, frames and tables soon made their appearance. The first Java programs were integrated. The first homepages for private individuals became fashionable around 1996. And from 2000, the Internet became a daily topic of conversation, and so its own safeguard.

2 A Look Back

A number of years ago, Gary Hamel described the impact of the introduction of browsers in the business world in an impressive article in the *Harvard Business Review* [2]. In 1994, at IBM, which at that time was experiencing great economic difficulties, there was an employee named David Grossman, who had also already loaded the abovementioned Mosaic browser on to his UNIX computer in order to familiarize himself with the graphical world of the Internet. Completely without the knowledge of the topmost management level, he formed a small team; the first corporate Intranet was set up, and a team of around 300 activists was put together – a growing movement that developed IBM's first homepage. Only after this homepage was finished was the CEO at that time, Lou Gerstner, included. He was quickly convinced of the new possibilities. It took Gerstner's support to convince the many managers in the hierarchy of the opportunities offered by the Internet. From this event, Grossman developed a few rules, the five most important of which I would like to quote for you here:

1. Start simple; grow fast.
2. Trial by fire.
3. Skip the krill (go to the top of the food chain when you're trying to sell your idea).
4. Take risks, make mistakes quickly, fix them fast.
5. Don't get pinned down (to any one way of thinking).

I could relate any number of similar events at this point.

We were ourselves very active in introducing HTML into the factory workshop, into manufacturing [3], [4], [5]. Today most engineers understand how expedient it is to use Web-based systems for designing and manufacturing. This includes such things as design information integration, remote system control, the use of HTML and Java programming, client-server architectures and, above all, the active inclusion of user interface design and human-machine interaction. In those days, when we talked to the responsible people in companies, most of them saw the Internet as just a game, something for children. Or they were worried by the reports in the media about the unsavory aspects of the Net. Serious applications in the producing trades? Most considered

these to be out of the question. We, or other people, or simply reality convinced them in a process that took many years.

3 What Happens Next

The past is important, because we want to learn from it for the future. Which trends do we see? Where can we see developments in interaction technologies today that are significant in the way that the Internet and browser were in 1993? How can we use them effectively and rapidly?

Today, many people take it for granted that they can be reached anywhere at any time, that they have constant access to e-mail and data at work and at home, that they can listen to music on an MP3 player, skip through their digital photo collections and always find the right route thanks to GPS and satnav. The rapid progress in information and communication technology has made all this possible at the touch of a button. This technology will continue to shape and facilitate our everyday lives. Tiny sensors and wireless communications are the key to this future, imparting new functions to passive objects such as carpets, clothing and windows. As a result, they become active objects which automatically adapt to the user. And they deliver valuable information to communication networks, which for example help drivers to avoid traffic jams or doctors to check the health of patients. How many of the ever-present, invisible helpers are actually used is a matter of personal choice: for instance, in the intelligent house, which autonomously ensures safety, security and optimal energy use, or in consumer electronics systems wirelessly networked throughout the house. People will also be able to deploy their own software agents to handle appointments and find information on the Internet.

The best interaction with services is ultimately the one that the user does not even experiences as an explicit interaction. If services are embedded in the surroundings or if services are context aware, it is possible to reduce the extent of interaction for the user and to increase the accuracy of the support. Context-aware services are an enhancement of user-adaptive services [6]. The Fraunhofer Institute FIT has developed practical solutions in the field of context-aware services, e.g., for guide systems for trade fair and museum visitors [7], for assisting warehouse clerks [8] and for situated learning [9].

We furthermore expect that in the future, too, important impetuses for "serious applications" will come from the computer game segment. Games are an important part of our society. In addition to being plenty of fun, they make it possible to learn new skills and to try these skills out in a safe social environment, and also to explore where our own skills and limits lie. New human-computer interfaces allow users to immerse themselves in highly detailed virtual worlds, play with people from other countries and other cultures and experience the games together [10]. Pervasive gaming removes the limits of conventional games in a real (social and physical) environment and expands (virtual) game worlds for players and spectators. Various electronic media are used here, such as electronic music, video, the Internet, computers, smart phones, etc., in order to blend real game environments and virtual elements as seamlessly as possible; instead of being tied to the PC or game console, players can move about freely in their natural environment, which can itself be an element in the game.

"Epidemic Menace" is such a pervasive gaming approach which is being developed in the integrated EU project IPerG by a consortium of leading European research institutes and companies [11]. Internet players are tied to players in the real world via augmented reality. In addition to the Fraunhofer Institute for Applied Information Technology FIT, some of the other participants are Sony NetServices, Blast Theory, Daydream, the Swedish Institute of Computer Science, Nokia and the Mixed Reality Laboratory at the University of Nottingham. Epidemic Menace includes design and evaluation methods, as well as marketing strategies as the basis for attractive and profitable games, the development of an optimized technical infrastructure, efficient design tools and user interfaces suitable for games.

Speaking very generally, multimodal, immersive worlds are particularly fascinating when various stimuli give rise to an overall impression that is perceived as the integrated user experience. Such approaches, such as linking visual, acoustic and tactile input and output modalities, have meanwhile come to be used in diverse application scenarios. We are also presenting an article on this at this conference [12].

Very generally, many IT applications will be offered and used as services in the future. The boundaries between a company's internal solutions and its external service offers are becoming blurred. New applications and business models networked via the Internet are establishing themselves as attractive alternatives or supplement to existing solutions. At Fraunhofer ISST, at Fraunhofer FOKUS and at Fraunhofer IAO, we are working not only on new technological formats and solutions, but also on utilization strategies, concrete solutions and future business models [13], [14]. Successful Internet information systems must strike a delicate balance between autonomy, flexibility, and governance [15].

Collaboration also calls for semantic integration: documents that know where they belong. This includes Theseus, a research program for developing a new, Internet-based knowledge infrastructure funded by the BMWi (German federal ministry of economics and technology) with a grant of roughly 90 million euros. In addition to the Bertelsmann subsidiary SAP and Siemens, research partners are a total of ten Fraunhofer Gesellschaft institutes receiving grants, as well as other research organizations and universities [16]. The program is expected to produce its results in the form of innovative products, tools, services and business models for the World Wide Web, as well as the service and knowledge society of tomorrow.

The program consists of six so-called Use Cases, each of which is led by a "Use Case Captain" from a company, and of a Core Technology Cluster, led by Fraunhofer, for the basic technologies. Further "transversal activities" are the development of business cases at Fraunhofer IAO and the assessment and evaluation of the technologies by Fraunhofer IDMT [17]. The accompanying research, under the direction of Prof. Weber from ISST, includes the development of new methods for project profiling and service profiling as an innovation management tool.

The acceptance of new interaction technologies hinges on the stability, robustness and performance capability of the systems that build on them. The Fraunhofer Institute FOKUS applies systematic and automated testing methods, which were developed in the European ITEA projects TT-Medal and D-MINT, among others [18], [19]. These are used, for example, for safeguarding Web service-based systems [20], business processes [21] and medical workflows in accordance with IHE [22]. In one current research project at Fraunhofer FOKUS, questions involving the trustworthiness of

network-based offers such as online purchasing or personal networks, which are central for all Internet users, are examined. In order to offer users better assessment and control possibilities for their Internet use, technical and organizational aspects of trustworthiness are analyzed, modeled and evaluated.

4 Interfaces and Peripherals

When there's a discussion of interfaces, it often centers not on interfaces, but on new peripherals.

Portable computer displays are a terrible nuisance. They are scarcely usable on airplanes, because there is not enough room to flip the display back. They are delicate, expensive, heavy and use up the battery. Displays the size of those on portable computers offers reasonable resolution, but they are too large to be used on PDAs and our growing collection of devices in our jacket pockets.

One possible solution can be found in a projector that is barely largely than a sugar cube [23]. Now Fraunhofer researchers have improved their mini-projector to the point that it can project jitter-free pictures when held in the hand. PowerPoint presentations during a business trip can be shown on the spot, and it is no longer a problem for people to find their way in unknown cities when they use a city map projected on the wall of the nearest building. No matter whether the projector is put into our cell phone, PDA or digital camera: soon we will always have a mini-laser projector in our pocket.

The various display techniques developed at different Fraunhofer institutes, e.g. at Fraunhofer HHI, enable any content to be presented in augmented, immersive 3D format [24]. Applications range from the immersive 3D dome cinema, to mixed-reality applications where reality and the virtual world merge, through to presentation on mobile terminal units. An auto stereoscopic display system provides users stereo visualization without the uncomfortable and inconvenient drawbacks of wearing stereo glasses or head-mounted displays. The users perceive a different image with each eye, giving a stereo image. Our solution from Fraunhofer Heinrich Hertz Institute uses an eye tracking system to automatically adjust the two displayed images to follow the viewer's eyes as they move their heads.

This brings us to the subject of acoustics, which is also a part of the human-computer interface of the future.

By means of the Wave Field Synthesis technology, every room can be filled with natural and realistic sound [25]. The optimum sound in a room, e.g., a movie theatre, can usually be experienced by only few people in the audience. Outside of this determined local range, the quality for optimal sound cannot be provided. Other deficiencies of these surround sound systems are the lack of realistic reproduction of natural and virtual sound sources. The Wave Field Synthesis based IOSONO sound system, developed at Fraunhofer IDMT, creates natural sound fields for every room and seat. The basic idea comes from the Huygen's principle of wave propagation. Using this principle in conjunction with audio allows - not only in cinemas - the realistic emulation of virtual sound sources and waves by using of a ring of loudspeakers around the listening space. Every listener is able to enjoy his own sonic sphere where he perceives dialogues and effects from the right acoustic perspective. This reproduction of 3D-wave fields in real time also offers new possibilities for editing and mixing of sound scenes.

5 Outlook

IBM was in an existential crisis in 1994. Today, when everyone is asking:

- "How can we avoid the impact of the incipient economic crisis?
- How can we stabilize already plunging figures and reach our budgeted targets?
- Where can we save additional costs?"

The message of the events from that time, not only at IBM, a company that was really doing poorly, is more important than ever. Success or failure starts in our heads. The brain construes the future. Feed it the right input, so that the right output emerges. We must have a climate free of fear and threats in order to develop new ideas and forge new paths. We must have friendly conditions so that employees can and want to provide their intellectual potential fully and completely to the company. Focus on what can work. Instead of questions directed inwardly, such as those above, which are usually the type asked in the crisis, questions focused on the customers, or an examination of the new technologies and their opportunities, bring us much further. Then the attention is focused outwards, and not inwards.

References

1. De Michelis, G., et al.: Cooperative information systems: A manifesto. Cooperative Information Systems: Trends & Directions, 315–165 (1997)
2. Hamel, G.: Waking up IBM: how a gang of unlikely rebels transformed Big Blue. Harvard Business Review 78(4), 137–146 (2000)
3. Bullinger, H.J., Lentes, H.P., Scholtz, O.H.: Invited paper Challenges and chances for innovative companies in a global information society. International Journal of Production Research 38(7), 1469–1500 (2000)
4. Balve, P., et al.: Prozeßorientierte Fertigungssegmentierung. ua: Montageplanung-effizient und marktgerecht, pp. 75–94. Springer, Heidelberg (2001)
5. Bullinger, H.J., Gudszend, T.: IT-Supported Knowledge Generation and Storage in Competence Networks for Plant Maintenance. In: Proceedings of the The 8th International Conference on Concurrent Enterprising, Rome, Italy, University of Nottingham (2002)
6. Oppermann, R.: From useradaptive to context-adaptive information systems. iCom. Zeitschrift fur interaktive und kooperative Medien 3(2005), 4–14 (2005)
7. Oppermann, R., Specht, M., Stephanidis, C.: Contextualized Information Systems for an Information Society for All. In: Universal Access in HCI: Towards an Information Society for All, vol. 3, pp. 850–853
8. Kaufmann, O., et al.: Implicit interaction for pro-active assistance in a context-adaptive warehouse application. ACM, New York (2007)
9. Oppermann, R.: Situated learning in the work process (2005)
10. Prinz, W., Aschersleben, G., Koch, I.: Cognition and Action. In: Oxford Handbook of Human Action: Mechanisms of Human Action, p. 35 (2008)
11. Lindt, I., et al.: Combining multiple gaming interfaces in epidemic menace. ACM Press, New York (2006)
12. Beinhauer, W., C.H.:, Using Acoustic Landscapes for the Evaluation of Multimodal Mobile Applications HCII 2009 (2009)

13. Renner, T., et al.: Open Source Software: Einsatzpotenziale und Wirtschaftlichkeit. Eine Studie der Fraunhofer-Gesellschaft (2005)
14. Hunt, G.C., et al.: System and method for logical modeling of distributed computer systems, Google Patents (2006)
15. Jarke, M.: On Technology Convergence and Platforms: Requirements Challenges from New Technologies and System Architectures. Springer, Heidelberg (2009)
16. Reuse, B., Vollmar, R., Broy, M.: Informatikforschung in Deutschland. Springer, Heidelberg (2008)
17. Dunker, P., et al.: Content-based Mood Classification for Photos and Music
18. Deiß, T.R.A., Schieferdecker, I., Vassiliou-Gioles, T.: Advanced Test Processes using TTCN-3. ITEA Publications (2006)
19. Din, G., Schieferdecker, I., Petre, R.: Performance Test Design Process and Its Implementation Patterns for Multi-services Systems. In: Suzuki, K., Higashino, T., Ulrich, A., Hasegawa, T. (eds.) TestCom/FATES 2008. LNCS, vol. 5047, pp. 135–152. Springer, Heidelberg (2008)
20. Vouffo-Feudjio, A.a.S.I.: Availability testing for Web services. In: Telektronikk 2009 (to appear, 2009)
21. Din, G., Eckert, K.P., Schieferdecker, I.: A Workload Model for Benchmarking BPEL Engines (2008)
22. Vega, D., Schieferdecker, I., Din, G.: A TTCN-3-based Test Automation Framework for HL7-based Applications and Components. In: 11th Intern. Conf. on Quality Engineering in Software Technology (2008)
23. Scholles, M., et al.: Illumination & Displays Building ultra-compact laser projectors
24. Pastoor, S.: 3D Displays. 3D Video Communication. Wiley, Chichester (2005)
25. Brandenburg, K., Brix, S., Sporer, T.: Wave field synthesis: From research to applications