Creating and Experiencing Ubimedia

John Barton, Patrick Goddi, Mirjana Spasojevic
Mobile and Media Systems Laboratory
HP Laboratories Palo Alto
HPL-2003-38
February 24th , 2003*

E-mail: [jjbarton, goddip, mirjana]@hpl.hp.com

hypermedia, multimedia, ubiquitous computing, mobility

In this position paper we describe an emerging area of research that we believe will have significant impact in the areas of personal mobility and digital media. Our term for this research area is "**ubimedia**", a concatenation of 'ubiquitous computing', and 'physically-linked hypermedia'. We note that the structure of media is evolving from standalone media objects (photographs, audio tracks, books) to collections of semantically related media objects connected by hyperlinks. These hyperlinks may bridge digital and physical objects as well, thus the term 'physically-linked hypermedia'. Also, we observe that the rapid advance of computing and communication technologies into the realm of everyday life is enabling ubiquitous computing ('ubicomp'), widely thought to be one of the next major waves of computing. Ubimedia research seeks to understand how to design ubicomp systems to support interconnected physical and digital media.

* Internal Accession Date Only
Approved for External Publication

Creating and Experiencing Ubimedia

– Extended Abstract –

John Barton, Patrick Goddi, Mirjana Spasojevic

[jjbarton, goddip, mirjana]@hpl.hp.com

Hewlett-Packard Laboratories, Palo Alto, California

Introduction

In this position paper we describe an emerging area of research that we believe will have significant impact in the areas of personal mobility and digital media, topics of interest to a broad research community and especially to HP. Our term for this research area is "***ubimedia***", a concatenation of 'ubiquitous computing', and 'physically-linked hypermedia'. This concept arises from two observations. First, we note that the structure of media is evolving from standalone media objects (photographs, audio tracks, books) to collections of semantically related media objects connected by hyperlinks. These hyperlinks may bridge digital and physical objects as well, thus the term 'physically-linked hypermedia'. Second, we observe that the rapid advance of computing and communication technologies into the realm of everyday life is enabling ubiquitous computing ('ubicomp'), widely thought to be one of the next major waves of computing. Ubimedia research seeks to understand how to design ubicomp systems to support interconnected physical and digital media.

Our exploration builds on previous work in Cooltown and on Web-Based Nomadic computing [9][10]. These projects explored web-connected appliances and the bridge between the physical world and the virtual world of information and services, inventing the idea that people, places, and things could be "Web Present". We now seek to establish a media model that embeds digital resources into our world, ubiquitously integrating the creation of media with activities in the physical world. In this paper we present some usage scenarios, the key ideas, and the significant challenges for building such systems.

Scenarios

To explain what ubimedia integration might offer, we start with three usage scenarios, for travel, home, and work. These scenarios illustrate three aspects of our approach: 1) integration of media capture, media playback, and media interconnection (linking), 2) co-capture of contextual or coincidental information and 3) horizontal open standard systems that lead to multiple related applications. Each scenario involves a "ubimedia player" – sometimes a camera, a media PC, or a computer embedded in a conference room.

Ubidinner: Out to dinner with co-workers and colleagues, John takes out his "multicorder", a ubimedia player based on a cell-phone and camera with sensors for global position and identification tags. Getting everyone's attention he photographs the diners and then passes the device around for everyone to "sign". As people look at the photo, some of them pass their business cards over the ID sensor. Others use their cell-phones to signal John's phone with their names. When the device returns to John, he presses the "send" button and uploads the data to his web site. His site augments the data with coincidental information, linking in information about the site of the dinner, other pictures John took, and the conference he was attending. The result is an image as shown in Fig. 1 and a set of links, some of them bound to the picture and others bound to the restaurant and the people in the image.

Ubihome: Anna is a teenager who has watched every episode of "American Idol 5." Even though she has every episode recorded on her media PC, she watches the shows live with her best friend Katie. In exchange for watching live and voting each week she receives a credit on her "American Idol" pin, which she wears during the airing of the show. Also her pin receives various credits as she wears it into stores like Tower Records, the Gap, and Burger King. Every piece of Idol Stuff has a unique ID, and that ID equates to points to be collected to enable cool new Idol Experiences. She has earned points by purchasing Idol Stuff (posters, cards, and stickers, etc). Now when she enters Tower Records, or even her own bedroom she may see a special behind the scenes clip from the show that has never been televised, or a song that was

Figure 1. What do you get when you take a ubi-picture?

sung during rehearsals. With her video camera and her Idol doll, Anna created "Anna and the American Idol" to share with friends; each viewing gets her more points. She loves getting "Idolized", the new word for getting Idol media played on nearby appliances like cell phones, picture frames, computers, etc. when she wears her pin.

Ubiroom: Mirjana, John, and Philippe enter a conference room. John has a laptop PC, Philippe has a cell-phone, and Mirjana has a printout and some paper notes. Each one "links" with the room's ubimedia player in different ways. John uses the laptop to read a local infrared signal, getting a URL for the player and as a side-effect becomes linked into it. Philippe uses the cell-phone to "squirt" his URL in to the player. Mirjana sets her badge on the player's RFID reader. Philippe begins to draw their new idea on the room's whiteboard while Mirjana scans her notes into the player. John edits their Microsoft Word document, adding the scanned notes, and, using the player's camera, captures the whiteboard image. The document is reviewed on the player's projector. As they leave, the player emails a URL for the content created in the room to each user.

The Ubimedia Creation Experience

In each of the above scenarios, people use one or more electronic devices to simultaneously experience some digital media and create it. This "creation experience" combines physical media and hypermedia though generalized hyperlinks (Figure 2):

- The digital picture of the diners, combined with identifiers from physical items like business cards and with GPS coordinates, creates a hyperlinked image that can be recalled by any of the diners. They can navigate the links on a PC or they can recall the image when they return to the diner or to the conference next year.
- In the home scenario, physical items like posters and tickets carried ID's that were recognized by the "idol pin" and resulted in points being added. In the case of the pin, possessing it in various environments led to new media experiences. These media experiences were played in the local environment, sometimes on several appliances at one time.
- The ubimedia document created in the conference room combines the Word file, images, and notes from three participants as well as links to the room and the meeting time. When these users return to the room, the document comes up in the player.

In each example media capture, playback, and recording of relationships occur simultaneously. These examples illustrate how we might bind contextual information, such as location, users, time, and contemporaneous or collocated digital data to create a Web of media. By building capture and the

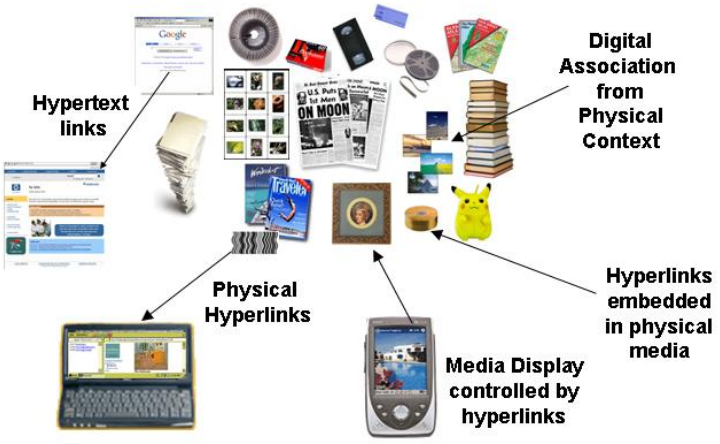

Figure 2. Physical media and hypermedia becomes ubimedia through generalized hyperlinks

construction of links into the ubimedia player we hope to thread authoring into people's natural work and play patterns.

Our approach simplifies the publication of media in the same way that the Web simplified the access to media. Instead of a sophisticated publishing and personalization engine or a dedication to learn arcane syntax or exotic editors, introducing digital media and physical artifacts during media playback creates ubimedia. When users present physical tokens such as concert tickets, photographs, or business cards to the ubiplayer, it records the co-incidental events. Instead of an activity centered on a personal computer, ubimedia happens where ever people use – and consequently create – the media.

Most Significant Research Challenges

While some aspects of our vision may sound exotic, most of the basic elements exist today. Our system is all Web-based, so the underlying protocols are established open standards. For our travel scenario, the "multicorder" ubimedia player amounts to a PDA/phone/camera [6][13] combination with additional sensors [14], which we are prototyping in our lab. The home scenario combines an enhanced home media center with a device like the Forget-Me-Not [12] for recording events. The conference room scenario combines ideas from the Stanford Interactive Room project [4] with the Web Presence Manager [3]. The technology for physical hyperlinks [8] and media exchange with services [1] already exist in our group. Support for security and privacy builds on our work in nomadic systems security [11][16]. The critical new idea of "linking-while-playing" arises naturally from a device designed to sense physical hyperlinks, to capture digital data, and to present multimedia. We need to add a "history" or recording capability for the links and data.

Among the major challenges that lie between a collection of the basic elements and a ubimedia world are:

- *Playing:* Web browsing focuses on a single long page of content on a graphical display; existing work has attempted to extend this model to tiny displays [2][15] or to multimodal outputs [5]. For ubimedia we expect high-end multimodal output of a collection of media and links that might not be in the form of a "page": how can the content be adapted to this environment?
- *Linking*: We are imagining that multiple users combining selected links and captured media can create electronic collections of hyperlinks and media. To make this real requires algorithms for link selection and association, combined with techniques for user control that can work in a wide variety of installations. Search engines or databases, for example, invoked during subsequent playback, might assist link creation: how can this work?
- *User experience*: Can users understand that selecting and viewing media, presentation of physical objects, interaction with the player, and insertion or capture of media into the player will create

new media? Can we develop the ubimedia player to be fun and easy to use and yet powerful in its ability?

- *Security and privacy*: When the interaction between users and devices is spontaneous and implicit how do users authenticate themselves and each other, who "owns" the resulting media, and can the control policies be developed that match user's intuition.

We hope to answer these questions and in doing so create a new media, one that extends the concepts of hyperlinking right into our world. Such new media will influence evolution of appliances such as digital cameras into sensor-enhanced "ubiplayers", will enable projectors to become ubimedia "smart rooms" in a box, and could open new dimensions for home entertainment centers. At the same time, our work on services to support these players contributes to the emerging media systems market.

Acknowledgements

We would like to acknowledge participation of the entire Nomadic Computing Department of HP Labs in developing ideas for this position paper.

References

[1] Barton, J., Kindberg, T., Dai, H., Priyantha, B., Al-bin-ali, F., "Sensor-enhanced Mobile Web Clients: an Xforms Approach", to appear in the Proc. of WWW 2003.

[2] Buyukkokten, O., Garcia Molina, H., Paepcke, A., Winograd, T., "Power Browser: Efficient Web Browsing for PDAs", Proceedings of the Conference on Human Factors in Computing Systems, CHI'00.

[3] Debaty, P., and D. Caswell "Uniform Web Presence Architecture for People, Places, and Things". IEEE Personal Communications, August 2001, pp. 46-51.

[4] Fox, A., Johanson, B., Hanrahan, P., and Winograd, T., "Integrating Information Appliances into an Interactive Workspace", IEEE CG&A, May/June 2000 (also available at http://graphics.stanford.edu/projects/iwork/)

[5] Han, R., Perret, V. and Naghshineh, M., "WebSplitter: A Unified {XML} Framework for Multi-device Collaborative Web Browsing", in Computer Supported Cooperative Work, pp. 21-230, 2000.

[6] HP Cambridge Research Lab's "Project Mercury" http://crl.research.compaq.com/projects/mercury/.

[7] Huang, A., Ling, B.C., Barton, J., and Fox, A., "Running the Web Backwards: Appliance Data Services", Proceedings of the 9th International World Wide Web Conference, May 2000, pp. 619-631 and HP Labs Technical Report HPL-2000-23.

[8] Kindberg, T., "Implementing Physical Hyperlinks Using Ubiquitous Identifier Resolution", Proceeding of 11th International World Wide Web Conference, July 2002.

[9] Kindberg, T. and Barton, J., "A Web-Based Nomadic Computing System", Computer Networks, Elsevier, vol 35, no. 4, March 2001, and HP Labs Technical Report HPL-2000-110.

[10] Kindberg, T., Barton, J., Morgan, J., Becker, G., Bedner, I., Caswell, D., Debaty, P., Gopal, G., Frid, M., Krishnan, V., Morris, H., Pering, C., Schettino, J., Serra, B., and Spasojevic, M., "People, Places, Things: WebPresence for the Real World", MONET Vol. 7, No. 5 (October 2002) and HPL-2000-16.

[11] Kindberg, T., Zhang, K., Shankar, N., "Context authentication using constrained channels", 4th IEEE Workshop on Mobile Computing Systems & Applications (WMCSA), June 2002.

[12] Lamming, M., Flynn, M., "Forget-me-not Intimate Computing in Support of Human Memory". Proc. FRIEND21, '94 International Symposium on Next Generation Human Interface, Meguro Gajoen, Japan, February 1994.

[13] MIT's Project Oxygen "Handy 21 Project" http://oxygen.lcs.mit.edu/11.html.

[14] Pradhan, S., Brignone, C., Cui, J-H., McReynolds, A., and Smith, M., "Websign: Hyperlinks from a Physical Location to the Web" , IEEE Computer special issue on location-based computing, August, 2001 and HP Labs Technical Report HPL-2001-140.

[15] Schilit, B.N., Trevor, J., Hilbert, D.M., Koh, T.K., "Web interaction using very small internet devices" Computer, Volume: 35 Issue: 10 , October 2002. Page(s): 37 -45.

[16] Zhang, K., Tim Kindberg, T., "An authorization infrastructure for nomadic computing", 2002 ACM Symposium on Access Control Models and Technologies (SACMAT), July 2002.