At the intersection of broadband and broadcasting: How ITV technologies can support Human Connectedness

Stefan Agamanolis
Media Lab Europe
stefan@media.mit.edu

Abstract
Broadcasting is all about creating shared experiences. How can new technologies broaden the effects of broadcasting – enabling new modes of communication, providing an enhanced sense of community, offering opportunities to meet new people, and allowing us to build relationships in new ways? This paper surveys several research projects undertaken in the Human Connectedness group at Media Lab Europe that address these themes.

Introduction

Researchers and ITV advocates often talk about the social and commercial benefits of the transition to a digital television infrastructure: Advertisers will be able to target messages to specific households and individuals with pinpoint accuracy. Governments will be able to offer a range of services directly in our living rooms. Businesses will be able to sell us products at the touch of a button on our remote controls.

These kinds of applications are all interesting and useful, but some believe the greatest potential for new ITV technologies lies in the communicative domain. The digital television platforms being introduced, together with the broadband "back-channels" they will be connected to, enable new modes of awareness and communication among different groups of people that were not possible before. These new capabilities and ways of "staying in touch" could serve a significant role in the swift acceptance and deployment of ITV technologies throughout Europe and the world.

The Human Connectedness research group at Media Lab Europe explored the theme of human relationships and how they are mediated by technology, with the mission of developing new technologies and experiences that allow people to build and maintain relationships in new ways. Several of the group's projects addressed the areas of radio, television, and broadcasting either directly or indirectly. This paper gives an overview of relevant projects, with the hope that they can inspire further research in this area. Links to longer publications with additional information are included, which in turn reference related efforts in other research centers.

The Human Connectedness group operated for 3 ½ years before closing in January 2005 due to an inability of the Irish government to come to agreement with MIT on how Media Lab Europe would be funded and managed going forward. Despite this unfortunate development, most researchers rapidly found new homes and many of the projects and themes described below are still in active development. Some of this activity will be concentrated in the Distance Lab, a new research institute in the highlands and islands of Scotland that aims to invent new technologies that reduce or address the effects of distance.

Viper

Traditional television is one-size-fits-all. Editing is fixed, and although viewers see the same thing, they often don't experience the same thing. **Viper** is a tool that allows video producers to create responsive programs whose editing can change during viewing in response to preference or profile information, presentation equipment or conditions, or real-time sensor feedback. (Agamanolis, 2003)

Unlike traditional editing systems in which producers build a single linear video program, those using Viper create a database of annotated video and audio clips and other media objects along with a set of editing guidelines that describe which bits of this source material should be included and how they should be layered and assembled into complete high-quality programs for different viewing situations.

Viper consists of a graphical interface (Figure 1) for creating annotated media databases, and a framework of primitives, based in the Isis programming language, for expressing the editing guidelines. Unlike other systems that simply splice clips end to end, Viper's framework enables the use of complex editing constructs, such as inserts, AB rolls, graphics, and transitions of various sorts.

Figure 1: Viper interface for creating and annotating databases of media clips.

Viper aims to enable a new genre of video programming, distinct from traditional television, that offers new narrative possibilities and allows directors and producers to gain more control over how their programs are edited and exhibited in different viewing situations. Viper's playback engine supports client-side personalization, in which the final edit is performed on the viewer's receiving device, eliminating the need to transmit personal information to a distant and perhaps untrusted server.

When Viper was conceived in the Object-Based Media group at the MIT Media Lab, we were initially interested in the area of personalized advertising, in which a marketing message could be customized to aspects of a viewer's profile. As a somewhat sarcastic demonstration, we created a responsive political campaign ad that tailors its presentation to portray the candidate in the most persuasive way for each individual viewer. The mock candidate in our example is running for "student council" at the Media Lab, and the advertisement responds to factors like the viewer's job title (affects the way the candidate addresses the viewer), information about the viewer's concerns (affects the visual imagery and content of the candidate's message), and the viewer's favorite music genre (affects the background music). It is also possible to vary the pacing of the ad based on information about the viewer's attention span.

As the Viper project continued at the Human Connectedness group, we explored another important potential application area: equalization of experience. Normally personalized television implies a lack of shared experience, which is arguably the real power of broadcasting. However, the same is true of traditional broadcasting – many viewers *see* the same thing but they may not *experience* the same thing because of varying educational backgrounds, skill levels, mental states, and so on. Tools like Viper could be used to create adaptive programs, such as educational documentaries or news shows, that aim to equalize experience across a population of viewers.

Reflexion

Anyone who uses video conferencing technologies on a regular basis is probably acutely aware of their limitations. Many multi-party systems display participants in separate windows, in scenes that often look like the 3x3 grid title sequence from the American TV show "The Brady Bunch". Some systems use audio-based camera switching algorithms, limiting awareness of the inactive participants. We feel the visual or temporal separation characteristics of these designs gives rise to a negative confrontational dynamic even before a conference begins.

Figure 2: Screen shots of a 3-person Reflexion session.

Reflexion is an interpersonal video communication system that operates like a "magic mirror" in which you see a reflection of yourself together with the reflections of other people in remote locations. All participants are layered together and can "touch" and interact with each other directly in the virtual video scene (Figure 2). This potentially creates a space with a unique and intimate social dynamic, one that may be more appropriate for many kinds of applications. (Cullinan et al, 2002)

A Reflexion station consists of a camera and video display connected to a computer (Figure 3). Each participant, of which there can be several, uses a separate Reflexion station. The computer extracts an image of the participant from his background and transmits a mirror image of it over the network to the other stations. The computer also receives extracted participant images from the other stations and combines them all together into a single video scene.

The system automatically monitors auditory cues and uses them to compose the scene in a way that enhances the interaction. For example, the system listens to who is speaking in order to judge who is the "center of attention". Active participants are rendered opaque and in the foreground to accentuate their visual presence, while other less-active participants appear slightly faded in the background in a manner that maintains awareness of their state without drawing undue attention. The system smoothly transitions the layering and appearance of the participants as their interactions progress. Every participant sees exactly the same composition, enhancing the sense of occupying a "shared space".

In our experiments with Reflexion, we found that one of the most satisfying ways to use it is to watch TV programs or movies together. This could potentially be done between friends or family members who might be anywhere in the world. In this mode, each participant is miniaturized along the bottom of the screen so the video image is more visible while everyone can still see everyone else's facial expressions and gestures. The video playback or live television feed is synchronized at all locations so the viewers can discuss or laugh about the program together while it is showing.

Reflexion uses a peer-to-peer networking strategy for audio and video transmission to achieve low latency. Multicasting is used if available to reduce the need for duplicate packet transmissions during multi-point conferences (we have tested up to four stations running simultaneously – limited by the amount of hardware we had available). A central

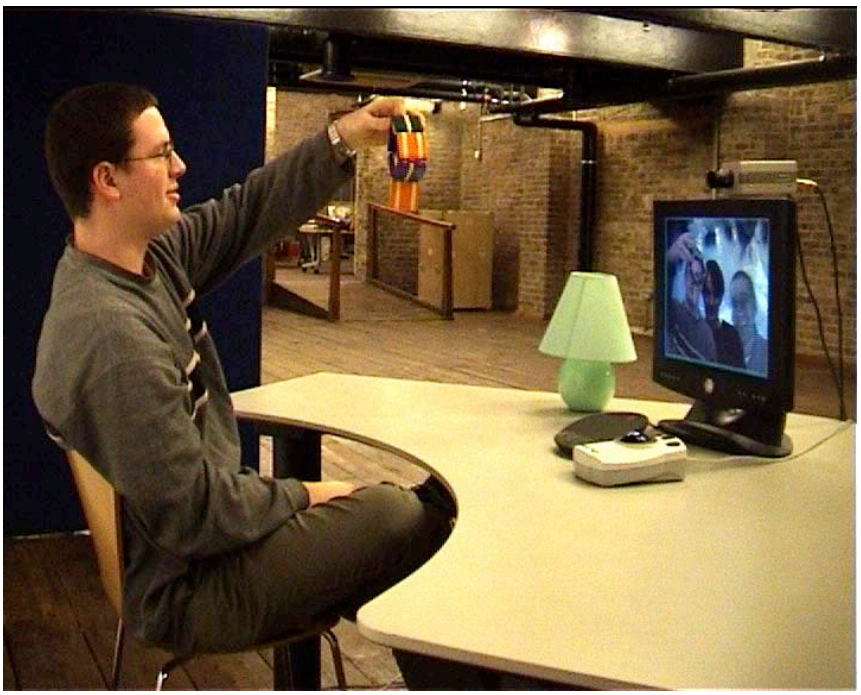

Figure 3: A Reflexion station in use at Media Lab Europe.

server handles control messages that synchronize the screen compositions or movies at each station.

iCom

TV is normally a foreground experience – it demands the attention of those nearby. But the same technology, coupled with a broadband back-channel, could be used in a more "ambient" mode in a variety of ways, for example to create a sense of community between remote households or work spaces. As we worked on this theme in our group, we aimed to break out of the physical constraints of normal television screens and embed these kinds of experiences in the surrounding physical environment.

We created a system called **iCom** that connected several laboratory areas at Media Lab Europe and the MIT Media Lab 24 hours a day in order to support background awareness, chance encounters, and ad-hoc audiovisual meetings between remote research colleagues—things we felt were important to build a sense of family and togetherness between the two labs and at the same time were not well supported by other communication media like telephones and email. (Agamanolis, 2003b)

At each iCom location there was a large-screen projection and seating area integrated within a larger work space. (Figure 4) These screens displayed several live streams of video captured from at least two cameras in each location. The characteristics of each connected space were similar and the researchers located in these spaces generally knew each other. A sofa and coffee table in front of the screen emphasized use of the locations as informal socializing areas.

A trackball enabled users to rearrange the windows or turn on microphones for meetings or casual interaction with the remote sites. The design addressed some potential privacy issues by synchronizing the screen projections at each site: what you saw on the screen is what the other sites saw on their screens, and nothing was recorded or available to view in other places. The system conserved bandwidth by reducing frame rates where no activity was detected and by adjusting transmitted resolution to reflect the size of each video window. The use of connectionless networking protocols enabled the system to operate effectively on a commercial (and often problematic) transatlantic Internet connection.

The iCom operated more or less continuously for about 4 years and served as a lightweight communication tool for holding project meetings for cross-lab collaborations as well as for informal socializing between remote friends, including occasional flirting. An important goal of the iCom, like some media space efforts predating it, was not to be "yet another video conferencing system", but rather to use audiovisual media to in an architectural mode – to make it feel like the connected locations were *physically adjacent*, just like an conventional window provides a view between adjacent spaces. This desired architectural effect was often difficult to explain to visitors who spent only a few minutes in our space. Feedback

from those working near the iCom for longer periods suggested that after an initial "novelty" period, those who frequented the iCom spaces began to think about the installations more in this spirit. Some reported feelings of isolation when their site was occasionally out of order due to a projector malfunction or network outage.

Figure 4: iCom stations at Media Lab Europe (top) and the MIT Media Lab (bottom).

Our group worked on other prototypes involving background awareness and ambient media. One project, the **Open Window**, involved creating an ambient audiovisual portal between hospital rooms and locations considered to be strengthening to a patient (Cullinan et al, 2004). **Habitat** explored using ordinary pieces of furniture as interfaces to convey information about the rhythms of connected households that could perhaps be used among members of a family living in different places (Patel et al, 2003). It is easy to imagine variations on these themes that would involve traditional television hardware, or applications that overlay traditional TV programs.

tunA

Personal music players like the Walkman and the iPod allow users to insulate themselves from the outside world, which is often a positive thing given the level of stress and annoyance in modern city life. At the same time, sometimes people are curious about other people or may be interested in making new acquaintances, and this often proves difficult in an often alienating urban environment. The **tunA** project addresses these desires, using the medium of music as a catalyst for interaction.

Developed on iPaqs and connected via 802.11b in ad-hoc mode, tunA is a mobile wireless application that allows users to share their music locally through handheld devices. Users can listen to their own music just like a normal music player, or they can "tune in" and listen to what other people in physical proximity are listening to (Figure 5). When tuning in, tunA synchronizes any receiving devices and the source device so that a group of users can gesture or dance together in synchrony, just as if they were listening to the same conventional radio station (Figure 6).

Figure 5: Screen shots of the tunA prototype, which ran on iPaq handheld computers.

By default, every tunA user is their own mini radio broadcaster, potentially creating a new kind of music sharing experience that adds a social dimension to an activity that previously was usually done in individual isolation (Figure 5). tunA lets you see the playlists of other users in range and bookmark songs that others own so that you could buy them yourself later if you want. tunA lets you bookmark other users as well, so that you can be notified in the future if they come into range again.

Figure 6: Depiction of the desired effect of tunA.

Perhaps most importantly, tunA allows users to exchange short text messages, similar to SMS messages, without necessarily knowing anything about each other except what they are listening to. In initial user studies, this messaging feature was felt to be an essential ingredient to support the desired ice-breaking effect of the application. (Bassoli et al, 2006)

Breakout for Two

Remote controls don't have to be the only way to interact with digital television applications, especially those that involve human communication and connectedness. In fact, one of the best activities that people can engage in to build a new relationship is sports. Traditional sports foster bonding and team spirit through the sharing of a physically taxing competitive activity.

Breakout for Two is a prototype "sports over a distance" installation that aims to build the same sense of community over a distance, not with email and instant messengers, but with real balls, sweat, and exertion. The system employs what we call an *exertion interface* – an interface that deliberately requires intense physical effort and can be expected to be physically exhausting when used for an extended period of time. In short, it gets your adrenaline moving and makes you sweat, just like any physical exercise or sport.

The Breakout for Two game is a combination of soccer, tennis, and the vintage video game *Breakout*. Players in remote locations must throw or kick a real soccer ball at a local physical wall to break through a projection of virtual "bricks" that overlay a live video image of the opposite player. The installation creates the effect of a "virtual game court" in which the competitors are separated by a transparent barrier through which they can speak to each other and interact (Figure 7).

The bricks on each player's screen are synchronized – when one player breaks through a block, the same block disappears from the other player's screen. Players win the game by destroying the most bricks in a given time period. Games typically last several minutes and can incorporate varying levels of difficulty or two-on-two play (Figure 8).

Our theory is that augmenting an online sport

Figure 7: A Breakout for Two court installed at Media Lab Europe.

environment with exertion will greatly enhance the potential for social bonding, just as playing an exhausting game of squash or tennis with a new acquaintance or co-worker helps to "break the ice" and build friendships. The heightened state of arousal induced by the exertion also potentially makes the interaction more memorable.

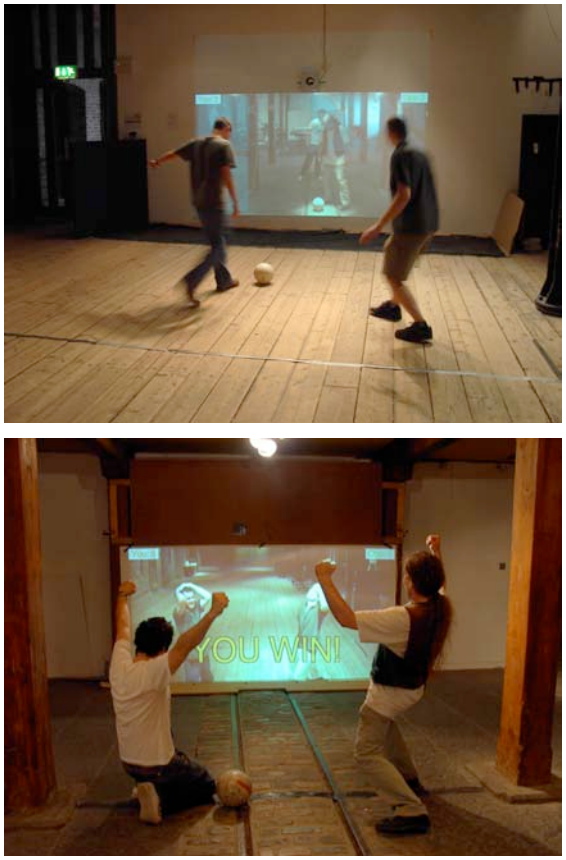

Figure 8: Scenes from a match of Breakout for Two involving two players in each court.

We undertook an initial experiment to test these hypotheses and evaluate the effects of exertion interfaces, with encouraging results. Players of Breakout for Two said they got to know each other better, became better friends, felt the other player was more talkative, and were happier with the transmitted audio and video quality in comparison to a control group playing an analogous game using a traditional non-exertion keyboard interface. (Mueller et al, 2003)

Summary

The intention of this paper was to introduce the reader to a few projects from the Human Connectedness group that may provide insight into potential research areas and future applications at the intersection of the realms of digital television and broadband networks. At the root of all of these projects is an aim related to human communication or connectedness, which we believed was the most promising area in which to work in order to stimulate interest in and acceptance of the changes in progress in television systems. Not all of the prototypes discussed relate directly to television or broadcasting, but hopefully the ideas underlying them are relevant and can inform and inspire potential future research and development efforts.

Acknowledgements

I would like to thank all of the members of the Human Connectedness group for their great ideas and contributions to these projects. This research was supported by sponsors of Media Lab Europe.

References

Agamanolis, S. & Bove, V.M., Jr. (2003a). Viper: A Framework for Responsive Television. *IEEE MultiMedia*, 10(1), 88-98.

Agamanolis, S. (2003b). Designing Displays for Human Connectedness. In O'Hara, K., Perry, M., Churchill, E., & Russell, D. (Eds.), *Public and Situated Displays: Social and interactional aspects of shared display technologies*, Kluwer, 309-334.

Bassoli, A., Moore, J., & Agamanolis, S. (2006). tunA: Socialising Music Sharing on the Move. In O'Hara, K. & Brown, B. (Eds.), *Consuming Music Together: Social and Collaborative Aspects of Music Consumption Technologies*, Springer.

Cullinan, C. & Agamanolis, S. (2002). Reflexion: a responsive virtual mirror. *Conference Companion, UIST 2002 Symposium on User Interface Software and Technology*.

Cullinan, C., Agamanolis, S., Roche, D., & Hegarty, F. (2004). Open Window: Reducing Isolation for Patients. *Adjunct Proceedings, UbiComp 2004*.

Mueller, F., Agamanolis, S., & Picard, R. (2003) Exertion Interfaces: Sports over a Distance for Social Bonding and Fun. *Proceedings of CHI 2003*, ACM Press.

Patel, D. & Agamanolis, S. (2003). Habitat: awareness of life rhythms over a distance using networked furniture. *Adjunct Proceedings, UbiComp 2003*.

Human Connectedness group web site: http://www.medialabeurope.org/hc