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DEVELOPING AND EXPERIENCING MOBILE VIDEO COMMUNICATION

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Abstract: The paper concerns collaborative research with the twofold task of developing video streaming technology for mobile devices and exploring user experiences in mobile multimedia. The main objective of the technology study was to develop mechanisms that enable the use of multimedia services in wireless terminals. This covered the development of both a software and a technology enabling efficient transfer of digital content over a wireless channel, resulting in the construction of the demonstrator. The primary goal of the user study was to explore how mobile phone users make use of a novel mobile video technology and how they feel about interacting through it in different communication situations. The demonstrator was used as a communication device in the role-play situations of the user study, which allowed the participants to have personal user experiences and to illustrate the potential of the mobile video technology in their own lives.

Keywords: mobile video communication, video stream, PDA, user experience, active role-play method

1 Developing the demonstrator

The research team in the Tampere University of Technology constructed a video streaming demonstrator consisting of two PDAs connected using Wireless Local Area Network (WLAN). One PDA was the server for the video stream and the other was the client. The demonstrator supported audio transmission between two handheld computers. The demonstrator transmitted a one-way video stream and two-way audio. The audio transmission could be used simultaneously with the video streaming. The video streaming software was designed to run on a PDA with a Linux operating system. Compaq iPAQ H3600 and H3800 series were used as an implementation and a testing platform for the software. The iPAQ is based on Intel StrongARM SA-1110 processor that has enough processing power for compressing, decompressing and presenting video streams. The usability issues were not a focus in building the demonstrator because it was intended simply to offer the required processing and video capturing tasks needed by the application

The pre-installed operating system, Windows CE, was replaced with a Linux operating system. The main reason for selecting the Linux was the number of open source code projects in the video streaming area. Another reason for selecting the Linux was its support for IP version 6. The used distribution is called Familiar Linux Distribution which is a part of the handhelds.org project [www.handhelds.org].

The video streaming server was devised so that it does not necessarily require any particular client

software. The client can be any application that can request and receive RTSP messages, and it can receive and present H.263+ compressed video stream, which is streamed using RTP. Both the server and the client supported IPv6 addresses. At an early stage of the implementation the video streaming server yielded only 4 frames per second (fps) but with optimisations it was possible to achieve up to 20 fps.

Figure 1: The video streaming demonstrator.

The audio transmission was implemented using Voice over Internet Protocol (VoIP). The protocol in use was H.323. The VoIP functionality was implemented as a separate software. The video capturing was implemented using a Winnov VideumCam Traveller, which is an all-in-one digital video camera for use with notebook computers. It uses a PCMCIA interface for connecting the computer.

2 Details of the implementation of the demonstrator

The video streaming software was implemented using threads. The video streaming server consisted of eight modules, which were designed to have generic interfaces. They could be optimised or reimplemented with no need to change other modules. The modules were a video capture, a video encoder, a buffer, a video streamer, an RTSP server, a user interface, a still picture and a control module.

Some parts of the software were designed and implemented by reusing and extending libraries and full implementations. One of the reused modules was the encoder module, since a full implementation of an effective and fast video encoder would have taken a long time. We therefore decided to use a fully implemented H.263+ encoder by Telenor Research and Development. Since the idea was to offer a test bench for other video encoders as well, the connections between the video encoder module and the other modules were as simple as possible. Therefore the replacement of the current encoder with a more efficient encoder would be a fairly simple operation.

The other reused module was the RTSP server, which was implemented using LIVE.COM libraries [www.live.com/liveMedia]. These are a set of C++ libraries for multimedia streaming using open standard protocols (RTP/RTCP, RTSP). The implemented client supported the same standard protocols as the server.

3 Procedures of the user study

The user study implemented at the University of Tampere was carried out using the active role-play method as a main research method. The video broadcasting demonstrator was utilised as a communication device in the role-play sessions. Because there were no mobile video devices available to European consumers in the autumn 2002, the demonstrator provided a chance to give people a personal experience of interacting through a mobile video connection. The main focus of the user study was not on interaction between humans and the demonstrator but on the interaction between two participants and their subjective experiences about communicating through handheld computers with one-way video stream.

We had in total ten participants in the user study. They consisted of Finnish students and employees aged from 20 to 33. Half of them were females and half were males. Two participants already known to each other were present in every role-play situation. All of the participants were experienced mobile phone users and they were used to taking pictures with a digital or ordinary camera.

In active role-play there is a script but participants interpret their roles spontaneously on the spot, do things they feel like doing, say the words they feel like saying, and so generate an episode themselves. We had four scripts and the participants chose two of them in each role-play situation. The scripts concerned with different communications situations, such as asking for an opinion when buying a cloth or consulting with one's friend in order to buy a ticket at a ticket

machine. The role-play situations were implemented in urban environment, e.g. in a department store and in the railway station. When acting out the participants were able to talk with each other in real-time through headphones and built-in microphones of PDAs. They were told to act in the way they felt natural in their roles either as receivers or as senders of the video stream.

During the role-play the participants were observed and afterwards they were interviewed by the researchers. In our opinion, role-play should not be used as an exclusive method when studying user experiences. Through the role-play method researchers and designers can get rich data about users' action with a novel product and their interpretation of it's adaptability in different use contexts but in order to explain motives behind the action interviews are needed.

4 Results of the user study

The participants assumed the roles so thoroughly that often they did not notice what was happening around them. The mobile video combined with the audio headset helped them to immerse themselves in the given tasks. The participants, both senders and receivers, stared at the little screens constantly. In the interviews all the participants reported that they did not pay any attention to other people during the role-play. They reported that the performing of the tasks was more captivating than embarrassing or foolish.

Immersing in the tasks may partly relate to the character of handheld computers. According to Strom users of PDAs concentrate on the device and withdraw their attention from the environment while operating the devices. He argues that PDAs (as well as Walkmans) are "cold devices" that facilitate control and withdrawal, while "warm devices" induce expression and sharing of feelings. In any case, warm devices are warm only if people around the user accept the use of the device and people communicating through it already have a close relationship. (Strom, 2002). Although people in our role-play situations concentrated on their devices they also shared feelings through moving image and audio connection. If PDAs are perceived as devices to be used alone for information retrieval or time management, they seem to be fairly cold devices but when they are used for personal communication among users familiar with each other they invite to share emotions like any "warm" device.

To some extent the participants' reactions and comments depended on whether they were sending or receiving the video. The participants felt the two-way audio made the communication situations very natural. Many of them chatted in the test situations as in a real phone-call. They considered the real-time two-way audio connection quite important. They felt the audio connection compensated for the picture quality that was inadequate at some places. It also enabled the receiver to guide the shooting action of the sender. The one-way video connection was not felt awkward in the given tasks while some of the participants considered the headphones disturbing. The participants would have preferred the headset to be wireless, because this would have helped them to concentrate more on operating the device and not the accessories.

Although the appearance of video streaming demonstrator was fairly clumsy and homemade, bystanders did not pay much attention to the participants and their action during the role-play. Using mobile devices in public has become so pervasive in Finland that bystanders do not pay attention to whether a person is speaking, writing text messages or doing something else, like shooting a video, with a mobile device.

The delay in the video frame seemed to bother the senders more than the receivers of the video stream. The delay made it difficult to shoot and focus. Therefore some people wished for a better frame rate. At first glance the participants were satisfied with the picture quality, but especially after using the demonstrator for a while for shooting a video the quality on the whole was considered fairly poor. Many of the participants stated that the video frame was blurred. It was slightly out of focus, the brightness was mainly too dark and the colours were not lifelike. Especially a red colour dominated in interior spaces. On the other hand the receivers were fairly content with the quality of the video in given tasks.

In terms of the social interaction context the participants considered the mobile video useful in situations where people need help or advice. On the other hand they thought that it would be fun to show things to their friends using video streaming mobile devices. The participants mentioned congratulations, holidays, greetings, choosing new products and unexpected encounters as typical contexts when it could be a pleasure to use real-time mobile video. Other uses of mobile video seemed to be difficult to imagine. Probably the unfinished features of the demonstrator induced the participants to regard the given tasks more as make-believe situations than as occasions simulating mobile communication in the real world.

According to our participants communicating through video makes it easier to describe certain items and situations compared to purely verbal descriptions. We reached a similar conclusion in our previous user study (Soronen & Tuomisto, 2002). The fact that the scripts of the role-plays were based on that previous study could also contribute to this result. Although the participants in these two studies were different individuals, it may be that the given communication situations met the participants' expectations too well. Even if the situations described in the scripts were orientated more to getting advice than having fun, the participants interpreted them more in terms of fun and playfulness than that of usefulness. We can agree with Koskinen et al. (2002) who see the playful use of mobile images with friends as one characteristic feature of multimedia messaging.

5 Further development and concluding discussion

The problems that emerged with the functionality of the demonstrator were mainly related to the performance of the video streaming. There were two main reasons for this poor performance. Firstly, the use of the reference codec which was not optimised for the StrongARM processor used and secondly, the used PDA lacked a floating-point unit. Furthermore, the quality of the picture was not satisfactory. It was due to the poor quality of the camera used for video capturing. The further development of the demonstrator concentrates on these problematic areas. In addition, the connection between the client and the server is about to change. One possible solution for connecting handheld computers is GSM/GPRS. A more fault tolerant codec that can be used with the video streaming demonstrator is also being developed.

During the user study we gathered abundant data by observing the participants and their actions with the demonstrator and discussing their experiences afterwards. Both allowing the participants to have their own experiences and reflecting and discussing them together in the interview were important in conceiving of feelings related to a mobile video communication (cf. Fulton Suri, 2002). With the active role-play method we were able both to test some usability factors of the demonstrator and study the participants' first experiences of mobile video communication. The role-play method enabled the participants to feel what it is like to use the real-time mobile video with a familiar person in a particular context. Moreover, the method induced them to further devise and ideate many features of the demonstrator.

A favourable feature of role-play was the way it facilitated concretising of the possibilities of new technology in the participants' own lives. Role-play seems to be a suitable method for developing and evaluating product concepts that relate to social interaction. For further development of the method in prototyping it would be advisable to implement role-play iteratively and revise functional features of the prototype during multiple phases. Furthermore, it would be interesting to study how people's user experiences of mobile video devices will change in the long run and what will be the actual contexts of use when the mobile video technology is not novelty anymore.

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References

Fulton Suri, J. (2002), Designing Experience: Whether to Measure Pleasure or Just Tune In? In W.S. Green & P.W. Jordan (eds.) *Pleasure with Products: Beyond Usability*, Taylor & Francis, pp. 161-174.

Koskinen, I., Kurvinen, E. & Lehtonen T-K. (2002), *Mobile Image*, IT Press. [Originally published in Finnish in 2001]

Soronen, A. & Tuomisto, V. (2002), Mobile Image Messaging - Anticipating the Outlines of the Usage Culture. *Human Computer Interaction with Mobile Devices - Mobile HCI 2002: Proceedings of the 4th International Symposium*, Springer-Verlag, pp. 359-363.

Strom, G. (2002), Mobile Devices as Props in Daily Role Playing. *Personal and Ubiquitous Computing* (2002) 6, Springer-Verlag, pp. 307-310.