TVS - A Videoconferencing System

Short Summary of Master's Thesis

Jauvane Cavalcante de Oliveira

Pontifícia Universidade Católica do Rio de Janeiro, Brazil
Computer Science Department - TeleMídia Laboratory

1. Introduction

Meetings generally imply loss of time and money, mainly because the participants must move themselves to a common place. Several research groups have developed a new set of communication services to improve this. These new services are called teleconferencing services.

As a result of years of research, several teleconferencing prototypes were introduced, including videoconferencing prototypes. However, these prototypes have some limitations. Some don't adhere to standards. They are usually limited to the unsynchronized transmission of audio and video streams.

A videoconferencing system (VCS) should present some additional facilities, such as the whole environment configuration, document handling support, cooperative work support, vote support, text message sending between the participants, VCR operation, and security in all functions.

The floor control should be controlled by the system itself, according to the access rights indicated to each one of the participants.

This Master's Dissertation [Oliv 96], whose title is above, describes the implementation of a VCS called TVS (TeleMídia Videoconferencing System), which is the result of the research done in the TeleMídia Laboratory at PUC-Rio, Brazil. The TVS offers most of the above facilities.

The terminology used in this text, adapted from [SzVe 93] and [SoMB 88], is summarized below:

- *Participant*: A user in the conference with right to speech and other facilities, controlled by a chairman.
- *Organizer*: A person that does the appointment of the meeting and the arrangements required. The Organizer can be a participant or not.
- *Chairman*: A special participant with whole control of the conference.
- *Speaker*: A participant that has the speech right at the time.
- *Listener*: A user that is not allowed to get the speech right.
- *Secretary*: A participant or listener that has the multimedia/hypermedia document handling right at the time.
- *User*: Each person in a conference (includes all participants and listeners, as well the chairman, the secretary and the speaker).
- *Seat*: Logical device that can be used by a participant, secretary or listener.
- *Private Base*: Work place of a user with access control restricted to this user.
- *Hyperbase* or *Public Hyperbase*: Storage location of all multimedia/hypermedia documents, whose access control is done by an access control list. All users have access to the documents according to their rights.
- *Shared Base*: Volatile storage location that allows the cooperative work among the users. This device can be seen by all users, however access control is done by TVS. Only the secretary is allowed to do modifications in these documents.

2. General Characteristics

The TVS conforms to several standards, such as multimedia/hypermedia objects exchange and media encoding standards. The main TVS characteristics are listed bellow:

- The basic audio and video codification is done according to the ITU-T recommendation; ITU-T G.711 and ITU-T H.261 recommendations to code the audio and video, respectively.
- The multimedia/hypermedia document handling is done through the Nested Context Model [SoRC 95] and conforms to the MHEG standard proposal.
- Vote and text message sending among users facilities.
- Speaker (and secretary) identification, as requested in ITU-T F.730 recommendation.
- The Floor Control is done by silence detection in the speaker's speech.
- The access control of each participant can be indicated by the organizer before the beginning of the conference and modified by the chairman in real-time during the conference.

3. User Interface

The TVS uses a step before the conference called "pre-conference". In this step, the organizer will indicate the number of seats and its occupation types, that can be: i) *owner seat*, which indicates exactly the person that can use it (somebody@inf.puc-rio.br), ii) *domain seat*, the seat which is available to every user of an indicated domain (*@*.puc-rio.br) or iii) *general seat*, the seat which is available to every person (*@*). The organizer also indicates the access rights for each seat, the environment format, who is the chairman, the maximum time slice of each speaker, etc.

The TVS implements the pre-conference operations through interaction between the UIM – User Interface Module – and a control and connection *daemon*. The daemon maintains a database with the appointment of conferences, the seats and its types, active votes, etc. The daemon controls the access of users to each conferences.

The first task of the UIM is to require the list of appointed conferences from the daemon. At this time, the user can select the chosen conference. After this, the UIM sends a message to the daemon informing that the user would like to join the selected conference. The daemon can accept the connection or deny it.

The TVS UIM environment is composed of two compulsory windows and ten configurable windows. The compulsory windows are the main window and the console. The configurable windows are divided into four main groups: databases, videos, control and vote.

The windows in the databases group are the hyperbase (HB), the private base (PB) and the shared base (SB) windows. The windows in the video group are the speaker video, the local video and the participant video windows. The windows in the control group are the video control, the audio control and the participants list windows. The vote window turns the TVS environment complete.

The speaker video is presented in the CIF format, since he/she is the person that requires the attention from the other users. The local video and participant video are presented in the QCIF format.

The multimedia/hypermedia document storage is mapped in the PB and HB. These windows consist of a *browser* for the Private Base and Hyperbase using [MuSC 95] both conforming to NCM [SoRC 95].

The SB consists of an abstraction created to the cooperative document handling. The same window is presented to each user of the conference. Versions of documents from the HB can be cooperatively handled in this window by the participants. The access rule is simple: the speaker receives the document handling right and speech right at the same time, however, the document handling right can be given to other user of the conference (the secretary). According to the NCM, the shared base is a Private Base whose owner is the TVS itself. So, the document modifying requisitions are done by the secretary to the system. The system (owner of the SB) is allowed to do them as well.

4. Implementation

The TVS presents a GUI through the use of the IUP/LED [Levy 93] package, developed in the Computer Science Dept. of the PUC-Rio. The used version was the IUP-Motif. The source code of the system was written in C++ and the source code of the daemon was written in standard C. Both source codes were compiled by the GNU g++ in SUN-OS and Solaris operating system over SUN machines.

The actual implementation of the system creates an abstraction over the user interface. There is basically one class with its methods for each element of interface (dialog), one class responsible for the control signals transmission and another one for the media transmission. All transmissions are done through UDP sockets.

The daemon has one socket only, on port 5550, to send and receive the control messages. According to the arrived message, the appropriate function is executed. The daemon sends alive bit signal to all UIM periodically. Failures are informed to the appropriated UIM in broadcasting. The daemon uses few CPU resources, since it is blocked in the most part of the time (UNIX select instruction), waiting for messages or the alive bit timeout.

The conference's data are stored in UNIX files. These files are read when the daemon is started. The daemon creates linked lists in memory with the conference's data.

The UIM uses four sockets: port 5551 for sending and receiving of control messages; port 5552 for the media transmissions; and two more whose associated ports are configurable to interact with the HyperProp Machine (NCM documents store manager) and the Browsers (HyperProp Document Structure Browser).

5. Conclusion

The TVS is very flexible and is used to several meeting types, from tele-seminaries to closed meetings. Some facilities, mainly the cooperative document handling according to a Multimedia/Hypermedia Model, are not found in other prototypes and products available at this time, besides the requirements of the ITU-T F.730 recommendation.

The TVS was helpful to validate the Nested Context Model, the HyperProp Architecture and the Browsers mainly in the cooperative work skills.

A first prototype of the TVS system was done in the Motif environment in SUN Microsystems stations, connected by an Ethernet network using the TCP/IP protocols stack. The video codec is done by software. A future version will use hardware to improve the whole performance of the system.

As future work, the VCR operation can be studied and included in the TVS, the security can be provided by the system and a TVS over ATM version can be provided.

6. References

[Levy 93] Levy, C.H. - "IUP/LED: Uma Ferramenta Portátil de Interface com o Usuário" - Dissertação de Mestrado - Departamento de Informática / PUC-Rio, 1993.

[MuSC 95] Muchaluat, D.; Soares, L.F.G; Casanova,M.A. - "Browsing in a Hypermedia System with Nested Composite Nodes" - Monografias em Ciência da Computação MCC23 - DI / PUC-Rio, 1995

[Oliv 96] Oliveira, J. C. - "TVS: Um Sistema de Videoconferencia" - Dissertação de Mestrado, Departamento de Informática, PUC-Rio, agosto de 1996.

[SoRC 95] Soares, L.F.G.; Rodriguez, N.L.R.; Casanova, M.A. - "Nested Composite Nodes and Version Control in an Open Hypermedia System" - Information Systems Vol 20, No. 6, pp. 501-519, 1995.

[SoMB 88] Soares, L.F.G.; Martins, S. de L.; Bastos, T.L.P. - "Lan Based Real Time Audio-Graphics Conferencing System, General Overview" - CCR066 Tech. Report Rio Scientific Center-IBM Brasil, 1988.

[SzVe 93] Szyperski, C. Ventre, G. - "A Characterization of Multi-Party Interactive Multimedia Applications" - International Computer Science Institute TR-93-006, 1993.

7. References resulting from this thesis

Oliveira, J.C.; “TVS - A Videoconferencing System” - Master Dissertation, Computer Science Department, Pontifical Catholic University of Rio de Janeiro, August 1996 (in portuguese).

Oliveira, J.C.; Soares, L.F.G.; “TVS - A Videoconferencing System with Document Handling - Overview” - WoSH'96 - Caesar Park Hotel, Fortaleza, CE, Brazil, May 1996 (in portuguese).

Oliveira, J.C.; Soares, L.F.G.; “TVS - A Videoconferencing System with Shared Documents over HyperProp Architecture” - TeleMidia Technical Report #96-5, Computer Science Department, Pontifical Catholic University of Rio de Janeiro, February 1996 (in portuguese).

Oliveira, J.C. - “Teleconferencing Systems” - Final Design Work Course, Computer Science Department, Pontifical Catholic University of Rio de Janeiro, November 1995 (in portuguese).