International Journal of Information, Control and Computer Sciences
ISSN: 2517-9942
Vol:4, No:8, 2010

# Design and Implementation of Cyber Video Consultation System Using Hybrid P2P

Hyen Ki Kim

***Abstract*—**This paper describes the design and implementation of cyber video consultation systems(CVCS) using hybrid P2P for video consultation between remote sites. The proposed system is based on client-server and P2P(Peer to Peer) architecture, where client-server is used for communication with the MCU(Multipoint Control Unit) and P2P is used for the cyber video consultation. The developed video consultation system decreases server traffic, and cuts down network expenses, as the multimedia data decentralizes to the client by hybrid P2P architecture. Also the developed system is tested by the group-type video consultation system using communication protocol and application software through Ethernet networks.

***Keywords*—**Consultation, Cyber, Hybrid, Peer-to-Peer

## I. Introduction

A cyber-consultation differs from a traditional consultation in that a person who needs help for solving his/her problems uses the Internet and gets help from cyber space. A traditional consultation is completed through a physical meeting of a counselor and a client at a same place. A traditional face to face consultation has characteristics that include the immediate completion of a question and answer, and that a counselor and a client experience an immediate exchange of emotions[1]-[3].

A cyber-consultation has more merits than those of a physical one. That is, if they are able to use Internet, they will be able to solve their problem without meeting a counselor. A client can execute the consultation in his/her own time from having to negotiate a meeting time with a counselor, thus saving time.

Although a cyber-consultation has several merits, it also has some limits. First, since a counselor and a client do not directly face each other during a cyber-consultation, they can not interpret behavior and emotions that would impact the problem solution. Second, it has a limit of continuity to provide proceedings for a client. In particular, message-centered consultations. Which express their consulting contents via messages, are very limited. Third, there is a technical limit. During consultation engagement, access to Internet can be disconnected. Moreover, the person who operates computer is required to install and perform the program of a consultation. To solve these problems, a video consultation on-line is needed.

Hyen Ki Kim is with the Department of Multimedia Engineering Andong National University, Andong Kyungbuk 760-749 Rep. of Korea (corresponding author to provide phone: +82-10-2552-8531; fax: +82-54-820-6257; e-mail: hkkim@andong.ac.kr ).

An on-line video consultation system is a medium with which a client interacts with a counselor in separate places by communicating with each other via the Internet with multimedia.

An on-line video consultation is useful for consulting adolescents, consumers, and hospital patients. In the case of consulting a hospital patient, since a counselor can consult while observing him/her on screen directly, it is easier for a counselor to make a diagnosis. The patient does not need to send messages but communicates through speech and uses gestures to express his/her feelings. Therefore, an on-line video consultation has an advantage for a bed stricken patient with a serious illness[4]-[6].

In this study, an on-line group video consultation is designed and performed for consulting in remote places. The existing on-line video consultation is too expensive, difficult for ordinary people to use, and only supports one-to-one consultations between users. Also, since it is a server-based video consultation, it becomes problematic when a lot of traffic enters the system. But the on-line video consultation suggested in this study makes it possible for several users to consult each other at the same time. It is convenient and has a merit to reduce the converging traffic in server with a P2P Structure. Therefore, this system can minimize time and cost caused by commuting for a consultation or a business trip in a remote area. Also, the disabled can use this system as a medium for an on-line video consultation or a video conference.

## II. Configuration of Cyber Consultation Systems

### A. Type of Cyber Consultation System

The forms of cyber consultation systems using the internet are divided into the unmanned systems and distance systems.

First, the consultations in the unmanned systems are conducted through computerized systems without consultants physically consulting with clients in person. This has an advantage to consult with a lot of clients through the database of the consultation systems. However, this method has a disadvantage for clients to consult only through the limited contents saved in the computer. Therefore, clients who have complex problems cannot be given exact solutions.

Second, distance consultation systems work by consultants using e-mail or web sites' boards in order to communicate with the client. The advantage in using this method is that clients can ask for consultations whenever they want because consultations are conducted through e-mail and web sites'

International Journal of Information, Control and Computer Sciences
ISSN: 2517-9942
Vol:4, No:8, 2010

boards. However, as consultations are conducted in writing, clients have to include all of the information of consultations by writing and can't have a consultation upon request.

Third, real time systems make it possible for consultants and clients to communicate with each other in real time. Even though clients and consultants are in different places, they can communicate and consult with each other in real time. As consultations are conducted through communications, this way makes more profound consultations possible. Cyber video consultations using video and sound belong this kind of system. Cyber video consultations make it possible to consult face to face beyond the existing chatting and writing centered consultations. Therefore, this system has an additional effect of face to face consultations aside from the existing advantage of cyber consultations.

Most existing video consultations - which are primarily server - based only support a person to person video consultation for both users. Though some companies such as MSN(Microsoft Network), AOL(America On Line), and so forth developed video conferencing and applied it to video consultations, there are currently few products to be developed for grouped cyber video consultation systems.

*B. Architecture of Cyber Video Consultation Systems*

The distinction of cyber video consultation systems is that one can consult see each other's face and hearing his voice in person. First of all, microphones and audio equipment are needed to hear sound. Speakers and microphones for web sites are generally used for audio functions of this system. In addition, cameras are needed to see each other's face. Not special cameras but cameras for general website are used here. Even if cameras might not have an equal definition according to their performance, once consecutive images are provided, consultations can proceed in high quality. Users have to be able to chat in the video consultation systems, too. Chatting is used when users send text messages to communicate. Whoever needs consultations has to solve all installation processes easily by one click in the cyber video consultation systems. In addition, once the program is installed, clients have to be able to use it repeatedly for consultations. The disconnection during consultations should not occur because consistent consultations can not be made if consultations stop due to defects of systems or malfunctions of the internet during consultations. Fig. 1 shows client-server architecture of MCU and CVCS clients.

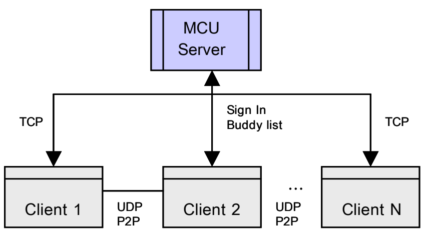



Fig. 1 Client-Server architecture of MCU and CVCS clients

The CVCS clients have a client-server relationship with the central MCU server. The TCP protocol is used for network communications. When a CVCS client starts up, the user must initially log in to the MCU. The user enters his username and password into a dialog box, along with the static IP address of the remote MCU server. The information is posted to the server, which verifies the information against its accounts database, and sends back either a login success or failure notification. The CVCS client also requests the MCU to send a copy of the user's buddy-list down to it.

Since the CVCS client has a local current copy of the IP address and status information for each contact, the peer-to-peer architecture is used for the actual consultation architecture. When a user selects one or more online contacts and starts a new consultation, invitations are sent directly to each remote participant using UDP. The MCU is not involved in this process. Secondary interconnections between all the other consultation members are also automatically established when remote participants accept the consultation invitation. A custom session control protocol is used to handle the consultation invitation, acceptance, refusal, and termination. The MCU server is not involved. Fig. 2 shows the peer-to-peer 4-way architecture of CVCS clients[7]-[9].

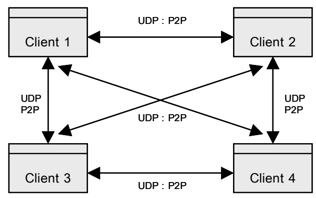



Fig. 2 P2P 4-way architecture of CVCS clients

Both TCP and UDP protocols are used in the CVCS client, over IP and Ethernet. TCP is used for communications with the MCU server, for login/logout, account management, and contact list presence information. UDP is used for the peer-to-peer consultation data transfers, including both the out-of-band session control protocol data and the real-time streaming of video and audio data as well as text messaging data exchanges. This category includes the UDP streaming of audio and video data, captured by the local microphone audio capture device and the local webcam video capture device, as well as the related codecs such as the Audio Codec and the Video Codec . Fig. 3 shows the procedure of cyber video consultation.

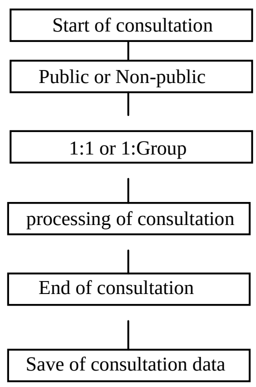



Fig. 3 Procedure of cyber video consultation

International Journal of Information, Control and Computer Sciences
ISSN: 2517-9942
Vol:4, No:8, 2010

## III. DESIGN OF CYBER VIDEO CONSULTATION SYSTEM

Initially an online user will become the consultation host by selecting one or more online buddies in the user list dialog and starting a call. Where, all calls are handled by same subsystem code, whether 1-to-1 or 1-to-many. First, an array of group consultation structures is dynamically allocated, since we don't know ahead of time how many participants any consultation might contain. There is a structure for the host and one for each remote participant. Next, the pointer to the array of group consultation structures is assigned to an element within the group consultation data structure, which also stores a default consultation title string, the username of the consultation host, the number of consultation participants (including the host), and a randomly generated conference id, thus each consultation should have a unique ID. Finally, the group consultation data is assigned to a member element of the group consultation global structure variable. If the initialization of the global group consultation data structures is successful, then video dialog next calls into audio-video manager to send out the conference invitation packets over the network, directly to each remote participant using the peer-to-peer network model. Again, the MCU server is not directly involved in this process.

### *A. Video Consultation Invitation Process*

After video dialog calls into audio-video manager, first a check is made to ensure the maximum number of supported participants has not already been reached. Then, the number of participants is retrieved from the global group consultation data. A network packet is formatted which contains both the standard packet header CMD_HEADER as well as extra data appended containing the group consultation data structures. Fig. 4 shows the network packet structure for initial CMD_MC_INVITE packet.

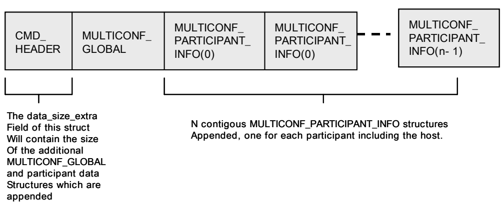



Fig. 4 Network packet structure for initial CMD_MC_INVITE packet

After the CMD_MC_INVITE packet and extra data is constructed, a loop is entered which retrieves the user presence information for each remote participant, obtains the remote network IP address and port and sends the invitation packet, over UDP using the audio-video manager command.

### *B. Audio-Video Manager*

The audio-video manager is the central repository and container class for all activities related to the peer-to-peer consultation support. It contains the implementations of the consultation session control protocol, the network socket thread procedure which receives UDP network requests, the send command methods which provide support for sending the UDP request packets to remote peers. It contains instances of associated classes which provide the audio and video streaming and the codec implementations. It provides the consultation management implementation. Fig. 5 shows the block diagram of audio-video streaming subsystem.

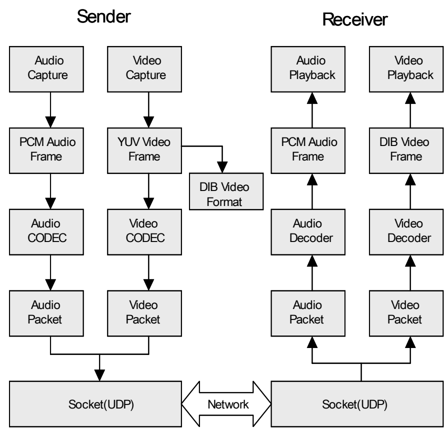



Fig. 5 The block diagram of audio-video streaming subsystem

When a new consultation request is created by the host using the user list dialog, the request to start a new consultation is sent to audio-video manager. When a remote user receives any inbound network packet over UDP, it is received in socket class of to audio-video manager and indicated up to command class of to audio-video manager if it is a session control protocol command packet. When the status of a remote consultation participant changes, such as when they accept, refuse, or hang up a call, the status is updated using update status class of audio-video manager. When the local participant wants to terminate a remote participant's consultation channel structure, or hang up the consultation and disconnect completely, this is done using end talk class of audio-video manager. These are just a few of the primary roles and responsibilities of the audio-video manager component.

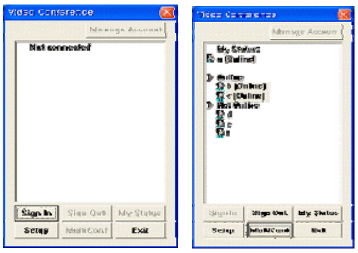
On the conference host system, whenever a remote participant's accept command response is received, the local system will first check that the request is not coming from a participant who already exists in a channel.

## IV. IMPLEMENTATION AND PERFORMANCE EVALUTION

### *A. Implementation*

We implemented the MCU and the CVCS client for the proposed system on Windows XP. The implemented CVCS client consisted of about 30,000 lines of the source list that written in Visual C++.NET. After implementing, we tested the cyber video consultation system using communication protocol and application software through Ethernet networks. In this paper, we implemented the cyber video consultation system based on client-server and peer-to-peer. Fig. 6 shows contact list between CVCS clients for group video consultation system.

Where, (a) shows initial contact list before connection and (b) shows buddy-list of local and remote client after connection.



(a) (b)

Fig. 6 Contact list between DVC client for group video consultation system: (a) initial contact list and (b) buddy list of local and remote client.

In Fig. 6-(b), client a, b and c connected by online each other. Fig. 7 shows sign in dialog box of a client.


Fig. 7 Sign in dialog box of a client

Fig. 8 shows user interface and screen capture for participant display in the client. (a) shows local video of client a and (b) shows remote video of client b in the cyber video consultation system.


(a) (b)

Fig. 8 User interface and screen capture for participant display in the client: (a) local video of client a and (b) remote video of client b.

Fig. 9 shows example of text messaging between client a and client b.

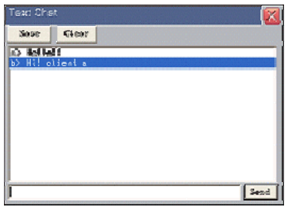


Fig. 9 Example of text messaging between client a and client b.

Fig. 10 shows status information of group video consultation participant

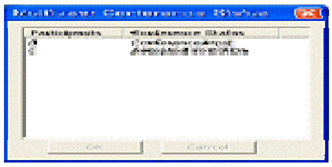


Fig. 10 Status information of group video consultation participant

Fig. 11 shows WMV user interface to control of video quality in the video consultation.

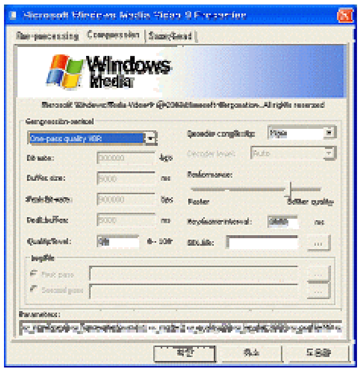



Fig. 11 WMV user interface

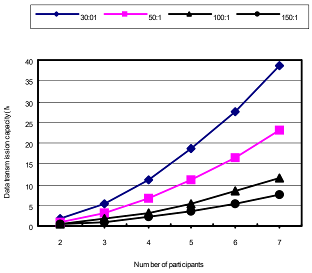
### B. *Performance Evaluation*

This experiment is used H.263 compression and decompression standard for group video consultation, the operating system is used windows XP[10], [11]. The test environment for video consultation is as follows.

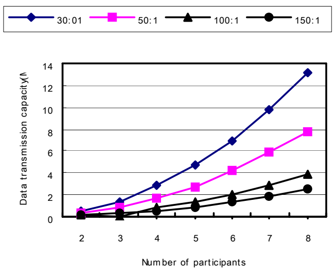
- Number of participant for video consultation : N
- Size of video frame : 320 x 240 x 3Byte(QCIF), 160 x 120 x 3Byte(QCIF)
- Compression ratio of video data : 30:1 (H.263)
- Compression ratio of audio data : 20:1 (G.723.1)
- Number of transmission frame per second : 15 frames/sec
- Sampling rate of audio : 8 KHz PCM, 8 bit Mono
- Transmission speed of network : 100 Mbps (Ethernet)

The Fig. 12 shows data transmission capacity according to video compression ratio and number of participant in case of

CIF and QCIF in video consultation system. In case of CIF for video frame size, the video compression ratio of 30:1 can perform video consultation until 3 participants. But the video compression ratio of 150:1 can perform video consultation until 7 participants. Also, In case of QCIF for video frame size, the video compression ratio of 30:1 can perform video consultation until 7 participants and the video compression ratio of 150:1 can perform video consultation until 15 participants. So, the number of possible participant in video consultation decide according to compression ratio of video data.




(a)




(b)

Fig. 12. The data transmission capacity according to video compression ratio and number of participant: (a) CIF and (b) QCIF

Fig. 13 shows data transmission capacity according to number of participants of video consultation

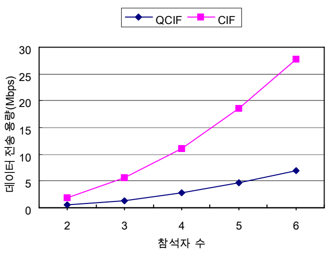



Fig. 13 Data transmission capacity according to number of participants of video consultation

The proposed group cyber video consultation system using hybrid peer-to-peer decreases the traffic of server, and can cuts down the load of a network.

## V.CONCLUSION

As cyber video consultation makes it possible to consult seeing each other's face in person, it can have enhanced effects compared to traditional face to face consultations.

The cyber video consultation system is important and useful in a remote discussion with multiple users. In this paper, we described the design and implementation of cyber video consultation system using hybrid type peer-to-peer architecture based on a client-server and peer-to-peer. Also, we implemented the cyber video consultation system and tested the system over the Ethernet networks through a group video consultation. In case of CIF for video frame size, the video consultation can perform from 3 participants to 7 participants according to the video compression ratio(30:1~150:1). Also, In case of QCIF for video frame size, the video consultation can perform from 7 participants to 15 participants according to the video compression ratio(30:1~150:1). In the future, we plan to apply the embedded devices such as mobile phone or PDA in Windows CE environment.

## REFERENCES

[1] [1] C. Perey and Matthew Feldman, “Videoconferencing over IP Networks,” in Broadband Networking, J. Trulove, ed., pp.193-210, CRC Press, 2000.

[2] A Kantarci and T. Tunali, A Video Streaming Application on the Internet, ADVIS 2000, LNCS 1909, pp.275-284, Springer-Verlag Berlin Hedelberg, 2000.

[3] Jenq-Neng Hwang, "Constrained optimization for audio-to-video conversion", IEEE Transactions on Signal Processing, 52(6):1783-1790, June 2004.

[4] Masayuki Arai etc, “Experiment for High-Assurance Video Conference System over the Internet,” Proc. Of the 7th IEEE International Symposium on HASE’02, 2002.

[5] M. J. van Sinderen and L. Nieuwenhuis, Protocols for Multimedia Systems, Springer-Verlag Berlin Hedelberg 2001.

[6] A Kantarci and T. Tunali, “A Video Streaming Application on the Internet,” ADVIS 2000, LNCS 1909, pp.275-284, Springer-Verlag Berlin Hedelberg, 2000.

[7] Hyen Ki Kim, “A Study on the Multimedia Input/Output Model for Web based Video Conference,” EALPIIT’03, 2003.

[8] S. Itaya, T. Enokido and M. Takizawa, “A High-performance Multimedia Streaming Model on Multi-source Streaming Approach in Peer-to-Peer Networks,” Proc. Of conference on AINA’05, 2005.

[9] Li-wei He and Zhengyou Zhang, "Real-time whiteboard capture and processing using a video camera for teleconferencing", IEEE July 2005.

[10] http://www.javvin.com/protocolH323.html

[11] http://www.vocal.com/data_sheets/g723d1.html