Research on Visualization Conference Cooperative Work Platform based on CSCW

Wu Zhenfeng
Nanjing Research Institute of Electronic & Engineering
Nanjing, China
wuzhenf@163.com

Qin Xuan
Nanjing Research Institute of Electronic & Engineering
Nanjing, China
qjohny@163.com

Ding Xiaoli
Nanjing Research Institute of Electronic & Engineering
Nanjing, China
pinkstory@hotmail.com

***Abstract*—Based on the concept and organization mode of CSCW (computer support cooperative work), this paper is to describe the research on establishing an organization structure which has one center and multiple cooperative work nodes. By employing advanced multi-media processing technology and method, it shall constitute a cooperative work platform providing remote video conference capability. Moreover, it also focus on some key points including nodes management, operation information sharing and operation control of remote nodes etc. which shall improve performance of work platform including flexible structure, easy integration and high-efficiency of operation.**

Keywords-CSCW; visualization; cooperative work; conference

I. INTRODUCTION

With the rapid development of network communication and computer technology, information system is widely used in various fields. The operation informationization level is a criterion to judging the maturity level of a field. The demands for communication and coordination are getting more and more since grand collaboration in socialization, wide-area-deployed organizations and rapid-change competitive stance. The traditional centralized conference communication has shortcomings such as low-speed and high-cost which shall not satisfy the developing application requirements. Therefore, a new remote cooperative work mode and application supporting platform is urgently needed in order to greatly improve the informationization level of operation application.

Since 1990s, Computer Support Cooperative Work (CSCW) is widely deemed as the optimal solution. CSCW defines that one group deployed in different area will perform cooperative work, coordination to achieve a mission by employing computer technology and network communication technology [1-2]. CSCW shall provide a networking cooperative work environment for multiple branches deployed in wide area even different organizations. So CSCW provides a platform for multiple agencies to implement a common mission, and also improve the accuracy, efficiency of implementation [3-5]. Video conference is a kind of basic application of CSCW and is already widely used in different fields [6-7]. However, in order to solve more complicated problems, such as co-editing, co-marking, co-analyzing and co-researching etc, a visualization conferencing system for multi-sites is needed to be established. Meanwhile, in order to further spread CSCW application, it is recommended that the visualization conferencing system should be open to a certain operation system. And sometimes they should be integrated by loose-coupling mode if needed, which shall provide fast remote cooperative supporting capability, and also improve capability of operation system.

II. CSCW DEVELOPING AND APPLICATION

In 1984, Irene Grief from MIT and Paul Cashman from DEC Company proposed CSCW concept [8]. The network booming causes the booming of modern world groups coordination which plays a very important role in the field of military, industry, commerce, education, science research and personal information exchange etc. It also facilitates the progress in production efficiency and cooperative innovation ability.

For a long time, North American and European countries have been the leading position of CSCW technology research and application. And gradually, they achieved successfully the transform from the theory research to the enterprise research, development and application. So the CSCW is further developed beyond the pure technology research. The international-famous company like IBM, Microsoft, Oracle, SUN, PTC, BEA offers software/hardware products supporting CSCW. And recently the Boeing 777 is also the new achievement by using CSCW technology [9].

The research of CSCW technology in China was begun from 1998. In this year, a national CSCW academic conference was held in China. In fact, the academism has taken the dominance position which is headed by university and institute. And most research was concentrating on the theories and subjects. Few products applying CSCW is introduced to the market. So far, most typical appliance is in the field of remote research and education training [10]. Such research orientation does not meet with actual application requirement and is harmful for the popularization of CSCW concept and the development of relevant technique.

At home and abroad, current CSCW application adopts tight coupling method. That is to design and exploit a new

business system application capable of remote cooperation according to concrete requirements, or to modify current business system application and expand CSCW application interfaces to provide remote cooperation capability. Remote cooperation capability provided by this tightly coupled CSCW application fits well with specific business system application and can be easily operated, but current business system application needs to be greatly modified and upgraded with many risks such as great R. & D. investment and long period, technical risk and difficult integration; at the meantime, software and hardware productions generated by tightly coupled CSCW application are too special to be popularized. Therefore, it is necessary to deploy a common & basic support platform to provide unified, flexible and easily integrated cooperation work capability support for business system of various businesses so as to popularize CSCW.

III. ORGANIZATION SYSTEM OF VISUALIZATION CONFERENCE COOPERATION WORK PLATFORM

In most business system applications, the basic requirement on cooperation work capability focuses on multi-node cooperation remote visualization conference discussion and cooperation work. For example, cooperative edition of design drawing, cooperative modification of technical proposal, remote conference of business decision making, etc. It is required that universal multi-node cooperation remote visualization conference work platform shall be deployed by expanding business application cooperation capability based on traditional remote video conference. By adopting business layering, the CSCW is placed on the platform support layer, has a transparent application of specific business system and employs maximally existing software and hardware resources of business processing system in various business departments to realize rapid integration and cooperative operation, enhance the universality for different business departments and business operating situations, and ensure the possibility of large scale popularization of the support platform.

The composition, connection and information exchange relationship of Visualization Conference Cooperation Platform is illustrated in Figure 1.

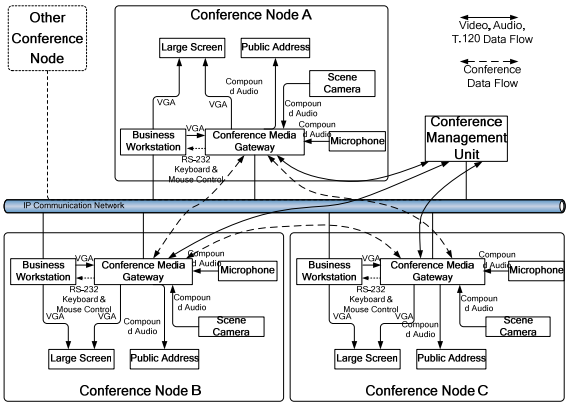

Figure 1. Composition, connection and information exchange relationship of visualization conference cooperation work platform

As shown in Figure 1, based on the IP communication network and the management of visualization management units, Visualization Conference Cooperative Work Platform establishes the conference scenarios among the wide-area multiple work nodes and seamless shared platform of operation information, thus supporting the coordination of the multiple nodes. Similar to the traditional remote video conference, the information exchange of conference scenario only realizes the basic state of coordination, which establishes the remote communication channel for the multiple nodes, listens to the speech at other nodes and airs personal opinions. The exchange and sharing of operation information helps the multiple nodes to real-time acquire the necessary operation information, even directly coordinate and engage in the work processing, and realizes the essence of work coordination.

Because the operation information type and process in various fields are different, it is necessary to share information present applications in order to share operation information, and is necessary to share operation processing system in order to share operation workflow, which is extremely complex. For the operation processing system of informationization, it can realize unified and common work coordination capability if it shares operation information via sharing computer display pictures, and participate in the operation workflow of other nodes via computer remote-control. The conference media gateway is the core equipment to realize this function, which integrates with the operation applications at different nodes, connects the different remote nodes seamlessly via network, processes the conference media stream and operation data stream jointly, and establishes the Visualization Conference Cooperative Work Platform.

IV. WORKFLOW OF VISUALIZATION CONFERENCE COOPERATIVE WORK PLATFORM

A. Node Organizational Management

There are several kinds of data communication in the Visualization Conference Cooperative Work Platform, including signaling interaction information, multimedia information, operation data information etc. When multiple nodes need to coordinate to finish one task, it would be very important to effectively organize and manage the different nodes and dispatch the resources. The platform shall adopt different technical measures such as ID authentication, authority management, speech management, operation authorization etc. to realize the effective origination management and control on the several nodes in the conference, prevent from illegal acquisition of the information from unregistered nodes, and ensure high effectiveness and stability of the visualization conference cooperation. Furthermore, other nodes can apply to join in at any time, i.e. “plug and play”, which ensure the flexibility of the platform.

The node organizational management is illustrated in Figure 2.

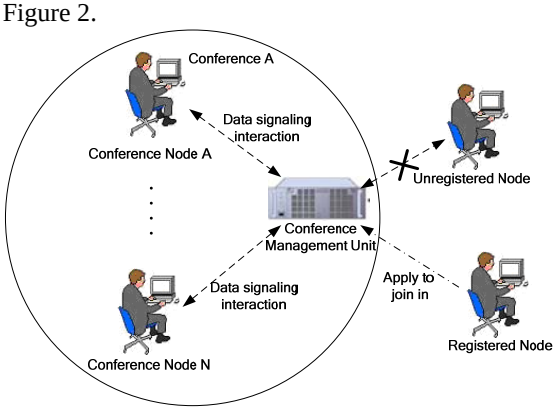

Figure 2. Node organizational management of visualization conference

In Figure 2, the multiple nodes shall comprise one visualization conference centered on the visualization conference management node, and finish the operation mission via remote cooperation. The visualization management unit is the organizational management core of the whole visualization conference work platform, and is responsible for the organizing and holding of the conferences, ID authorization of the conference nodes, authority management, signaling interaction among different nodes, data sharing and interaction etc. During the establishing of the cooperation conference, all the nodes to take part in the conference shall report the registry application to the conference management unit to be authorized. During operation of a conference, new node who wants to take part in shall also report registry application to be confirmed firstly. The node which receives certification can take part in the conference at any time. However, the node without certification can’t take part in the conference, which can guarantee the effective organization and information security of the conference.

B. Operation Information Sharing

Operation information sharing is the primary issue for realizing Visualization Conference Cooperative Work Platform. During operation information sharing, the source node (releasing operation information) and object node (receiving operation information) will be introduced. For an operation information sharing relationship, it can have only one source code, but may have several object nodes. So one-to-one sharing relationship or one-to-several sharing relationship can be established. On the Visualization Conference Cooperative Work Platform, under the control of conference management unit, no matter the one-to-one sharing relationship or on-to-several sharing relationship, the source code just needs to release the shared information as service, while the object node will obtain the information automatically, which can simplify the establishing and maintenance of information sharing relationship. The workflow of operation information sharing is shown as following in Firgure3.

In order to enhance the management and control of the operation information sharing between nodes, information sharing route algorithm will be adopted in conference management unit to build the optimal route of information transmitting, which can increase the cooperation efficiency. The logical structure of the system will be transformed as a binary tree, which has the features of simple structure and easy operation. The nodes of the binary tree will be arranged as a linear sequence, the corresponding position of the node in the linear sequence shall be able to show the logical relationship between notes. A dedicated sequential storage structure will be established for the binary tree. The information of the nodes will be stored in a continuous memory location according to linear sequence relationship.

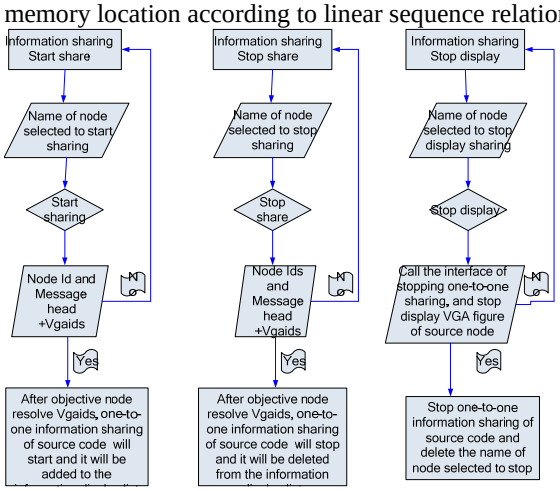

Figure 3. Work flow of operation information sharing

The Huffman tree will be adopted to build the model of the binary tree, which has the shortest weighted path. The weighted path-length (WPL) equals the sum of the weighted value of each leaf node multiply its path-length to root node. If the root node is on level zero, the path-length will be the same as its level number.

$WPL=W_1*L_1+W_2*L_2+W_3*L_3+...+W_n*L_n$

In above formula, W_i（i=1,2,...n） represents the weighted value of each leaf node of the binary tree which has N leaf nodes; L_i（i=1,2,...n）represents the path length of each leaf node. The WPL of the Huffman tree is proved to be the smallest one. So, the Huffman tree algorithm can help to speed up the processing of finding the optimal transmitting and exchanging path of conference cooperation data. The centralized conference management and Huffman tree algorithm will be adopted to ensure effective organization of the cooperation relationship between conference nodes and efficient sharing of the corresponding information.

C. Remote Node Operation and Control

In real multiple-point cooperation visualization conference, application object could be co-processed (analyzing, judging and editing, et.) by several users. After the operation information sharing between remote nodes is established, the visualization conference cooperative environment will be built. However, expanded function like remote control shall be provided to obtain more efficient cooperation support, which will help the authorized remote node to operate and edit the shared local object directly.

The workflow of remote control is shown as following in Figure 4.

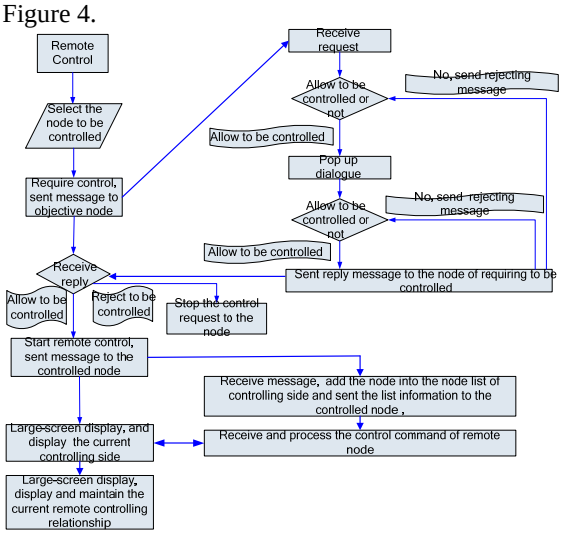

Figure 4. The workflow of remote control

Currently, the network band width and transmission rate is still relatively limited. In order to reduce system response time, the individual network user shall copy the shared object to the local computer. The operation on shared objects will be told to other users in the form of message, who shall implement relevant operation in local computer after receiving the message, so as to keep the coherence of shared object of every user side and realize cooperative sense between the users.

Whereas, due to the concurrency of every user and the influence of network transmission delay, if operation implementation orders of every user side on shared object do not match each other, the shared objects of every user side will not match each other, so the normal cooperative work will be influenced.

Therefore, relevant coherence and concurrency control system shall be introduced. Visualization Conference Cooperation Work Platform adopts shared data lock to solve this problem. In fact, a unique visitor is authorized with modification access right of shared objects in a certain period to make the access to shared objects serialized in order to ensure data coherence. According to this policy, the system accomplishes the lock distribution (for example authorization or reject) through conference management unit. Because the purposes for the access to the shared object may vary, different types of locks are configured. When a certain node requests a certain type of lock for a certain shared object, visualization conference management unit will decide on the authorization of new lock request according to the existing lock on the shared object, the requested lock and the compatibility rules between these locks. Any node can access to relevant object according to requested method only after the authorization of lock request; after the request is finished, relevant lock will be released so that the lock request from other nodes is able to be authorized. The lock will be released automatically by visualization conference management unit after the previous user who requested locks has finished the relevant operation. Lock control system may cause a derivative problem: a small node may occupy a certain object for a long time but in fact carry out no processing on the object. In order to prevent this situation, “Tickle Lock” method shall be introduced: when the user stops working for some time, the lock of relevant object will be released automatically and other requests can be authorized.

V. CONCLUSION

Computer-supported cooperation work is undoubtedly a useful tool for enhancing work efficiency between the organizations and inside the organization under networked and informationization conditions. Relying on the vigorous development of multimedia technology, Visualization Conference Cooperation Work Platform shall form a set of remote cooperation work support platform independent of specific business application for multiples nodes distributed in the wide area, and shall provide the capabilities such as video/audio conference discussion, remote business information sharing & exchange, remote cooperation operation & control, etc. It is a typical CSCW system which can be widely popularized and applied by virtue of its transparency and rapid integration capabilities on specific business application

REFERENCES

[1] L. Hongchen, S. Ruizhi, and S. Meilin, "Workflow-Based CSCW Platform," Mini-Micro Systems, 2004, vol. 25, no. 6, pp. 1057-1063.

[2] K. Schmidt and C. Simonee, "Coordination mechanisms: Towards a conceptual foundation of CSCW systems design," Computer Supported Cooperative Work (CSCW): The journal of collaborative computing, 1996, vol. 5, no. 2-3, pp 155-200.

[3] C. Neuwirth, D. Kaufer, R. Chandhok, and J. Morris, "Issues in the Design of Computer Support for Co-authoring and Commenting," Proc. ACM Conference on Computer-Supported Cooperative Work CSCW '90 (Los Angeles, California), 1990, pp. 183–196.

[4] C. Neuwirth, R. Chandhok, D. Kaufer, P. Erion,J. Morris, and D. Miller, "Flexible Diff-ing in a Collaborative Writing System," Proc. ACM Conference on Computer-Supported Cooperative Work CSCW '92 (Toronto, Canada), 1992, pp. 147–154.

[5] C. Neuwirth, D. Kaufer, R. Chandhok, and J. Morris, "Computer Support for Distributed Collaborative Writing: Defining Parameters of Interaction," Proc. ACM Conference on Computer-Supported Cooperative Work CSCW'94 (Chapel Hill, North Carolina), 1994, pp. 145–152.

[6] W. Zhenfeng, G. Lin, and Q. Xuan, "The research on video transmission and distribution system based on soft switch technology," the 2nd international conference on Power electronics and intelligent transportation system, 2009, vol. 2, pp. 342-345.

[7] L. Suchman, R. H. Trigg, Understanding practice: video as a medium for reflection and design, in: J. Greenbaum, M. Kyng (Eds.), Design at Work: Cooperative Design of Computer Systems, Lawrence Erlbaum, Hillsday, NJ, 1991, pp. 65–89.

[8] W. Xiaoming and Y. Yuqiang, "CSCW - based Compression Algorithm for Still Image Coding," Computer Simulation, 2010, vol. 27, no. 3, pp. 247-249.

[9] X. Yong, and Z. Shaohua, and S. Meilin, "Boosting Creativity of CSCW Research: Survey and Trend Analysis," Journal on Communications, 2006, vol. 27, no. 11, pp. 1-6.

[10] S. Haigang and C. Xueguang, "Research and Analysis of the Development of CSCW," Computer Engineering and Applications, 2004, vol. 40, no. 1, pp. 7-11.