The Design and Implementation of a Virtual Conference System

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Abstract

With the enormous use of the networks, many real-world activities are realized on the Internet. We proposed a complete virtual conference system (VCS) to handle all activities of real-world conferences. The VCS includes a virtual conference management system and a mobile virtual conference system. Video conferencing is a trend of future communications. With the improvement of broadband network technologies, video conferencing becomes possible in the global society. It is feasible to use video conferencing technologies to organize future international conferences.. This research proposed a total solution toward virtual conferencing. We use a mobile server/storage pre-broadcasting technique, as well as a communication network optimization algorithm, which is based on a graph computation mechanism. With the assistant of a conference management system, the system is able to support virtual conferencing in the future academic society.

Key words: Mobile Computing, Virtual Society, Adaptive Network, Broadband Communication, Virtual Conference Management System.

1. Introduction

With the enormous use of the Internet, there are many real-world activities applied on Internet. We proposed a complete virtual conference system. In virtual conference management system, we introduce the viewpoint of administration on each step of conferences or workshops. This system can provide service for following members:

- **System Administrator**
- **Conference Holder(s)**
- **Referee(s)**
- **Author(s)**
- **General User(s)**

We will apply the flow of real-world conference. Associated with the feature of Internet, we established the flow of virtual conference. That is the schedule of conference. There are many phases or levels on holding a complete conference or workshop. We must take all situations in consideration.

In a real-world conference, the final step is each paper will be present for participators or audiences. We also provide an environment to achieve this purpose. A virtual conference system should support real-world conference activities, such as technical session presentations, discussion, and keynote speeches. With the improvement of broadband network infrastructures over the Internet, in the near future, virtual conferencing is attractive. The purpose of our research is to propose such an environment. This is our mobile virtual conference system.

This paper is organized as follows. Section 2 describes other related researches. And, we address the virtual conference management system in section 3. In subsection 3.1, we discuss the schedule of virtual conference. And we address the architecture of virtual conference management system in subsection 3.2. Section 4 discusses a mobile virtual conference system. We address the system architecture in section subsection 4.1. Subsection 4.2 discusses The Hierarchy of Conference Presentation Database. In subsection 4.3, we will describe the Mobile Conferencing Infrastructure. Subsection 4.4 will describe the implementation of mobile conferencing. Finally, we give a short conclusion and future works in section 5.

2. Related Works

Many researches about holding a conference have done several years ago. But these works are developed on desktop. No research focuses on providing the whole, complete environment for holding a conference. In general, in order to solve the problems of special or particular phase, some works will be done. For example, Electronic Conference Proceeding [11, 12] is a new publishing method for conference. Another example is DeskTop Publishing (DTP) [13], which provide a tool for making the conference program. The previous tools can solve some particular problems, but these are not

enough. They give us good ideas for developing many useful tools on our virtual conference management system. The different environment will be considered.

We found other researches about the virtual conference systems. Some provide a special environment to support their conference. For example, the process of conference is communicated via special, specified medium. Virtual Conference Room [10] is like a discussion room and has achieved features suitable for multi-user conferencing systems, such as visualization of the conference status, unified floor control, and dynamic subgrouping of participants. The idea we proposed in this paper is the whole conference presentation will be communicated through the Internet. That is the difference between our idea and others.

Mobile storage/server is our another important issue. We proposed an electronic notebook [7, 8] according to this idea. We also refer to active directory [9] proposed in windows 2000. By our mobile storage idea, we can reduce the data access time and improve the status of real-time transfer. In order to decrease the data access time, we try to find out the shortest path from the start point to the end over the Internet. Ant Colony Optimization (ACO) [14] algorithm provides good solution for seeking shortcut.

3. The Virtual Conference Management System

If a researcher want to hold a conference or a workshop, he/she is always busy because of the heavy load of academic activities. The traditional method for holding a conference is non-automatic. It costs much human power. In order to solve this problem and conform to the trend of the Internet, we develop this virtual conference management system to assist interests for handling conference organization works.

In real-world conference, there is a schedule for holder. The holder deals with all events according to this schedule. Therefore, the holder of virtual conference also has adaptive schedule in virtual world. The schedule will be discussed in subsection 3.1.

We will develop the related application tool according to schedule. These tools are components of our virtual conference management system. The architecture of these will be discussed in subsection 3.2.

3.1 The Schedule of Virtual Conference Organization

The schedule of virtual conference is as the following:

i. **Hold a conference:**
ii. **Start:**
iii. **Invite PC members:**
iv. **Design CFP and Publish on the Web:**
v. **Collect papers:**
vi. **Organize the received papers:**
vii. **Collect review forms:**
viii. **Notification:**
ix. **Collect Registration Form, Copyright Form, and Camera Ready:**
x. **Design Final Program:**
xi. **Authors submit presentation data to session chairs:**
xii. **Participant can order the session or papers he wants to listen:**

The schedule of virtual conference is unlike the one in the real world. We hope the conference can be held over the Internet. So, we developed many adaptive tools on the Web. The applications we provided are shown in appendix.

3.2 The Architecture of Virtual Conference Management System

In recent years, more human behaviors have changed into electronic ones, such as Distance learning, E-commerce, academic researches, and etc. In traditional, scholars can get new knowledge and exchange their ideas with others by joining a conference. However, this will cause time and cost consuming. Scholars always contribute their papers with the mail, and wait for the response for a long time. Moreover, for the conference holder, it is very hard to maintain a conference scheduling. Consequently, we develop a virtual conference environment system to help the people who want to hold a conference or want to join a conference, to make lower costs, to allow a faster turn-around, and to access easily.

The architecture of Virtual Conference Management System is composed by five parts, including Conference Holder Management System, Author(s) Management System, Referee(s) Management System, General User(s) System, and Administrator Management System.

The Conference Management System is designed for the Conference Holder to process the schedule of conference. There are three subsystems in the Conference Management System, including New Conference System, Conference Management System and querying and maintaining system. (Figure 1)

Holders can invite the program committees and the authors who are interested in the concepts of the conference by auto sending email. And also, conference holders can design the fee charging of

the conference. After collection of paper due to the paper submission deadline, conference holder can assign each paper to the referees who have already registered to this conference. After the referees have finished evaluated the papers, conference holders can decide the acceptance of papers by three mode.

- **Percentage:** Conference holder can give the long paper acceptance percentage, and the short paper acceptance percentage of the conference. Of course, the percentage can be modified if there is not enough paper receiving.
- **Thresholds:** Conference can give the upper bound and lower bound for long paper and short paper acceptance. The two bounds can be modified, too.
- **Program Committees voting:** The program committees will judge all review forms, and decide which papers are long paper, short paper, or rejected. After voting, the conference holder will summarize the conclusion as final result.

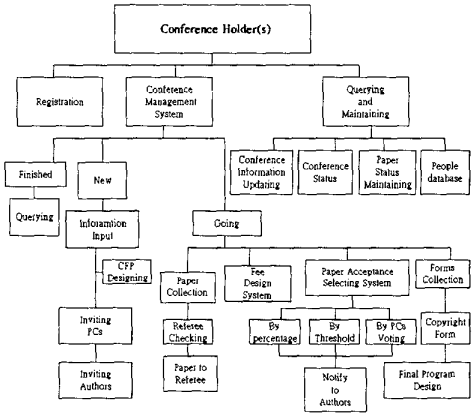

Figure 1: Conference Holders Management System Architecture

In the Author(s) Management System (Figure 2), it offers the online services for the authors. Authors can submit their own paper and new researches to each conference in the system, and also, authors can manage their own papers on line.

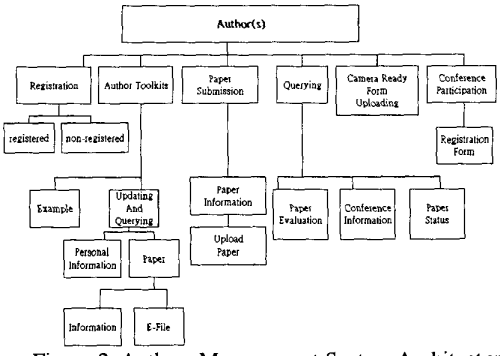

Figure 2: Authors Management System Architecture

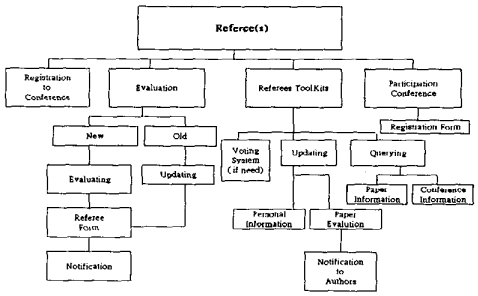

Figure 3: Referees Management System Architecture

In the conference schedule, Referees play the most important roles. Accordingly, the Virtual Conference Management System provides a set of tools for referees to facilitate to finish the evaluation easily. The architecture of Referee(s) Management System is shown in figure 3.

For the general users, Virtual Conference Management System also provides adaptive, friendly, and useful tools. It includes four parts for this General Users Management System as following figure.

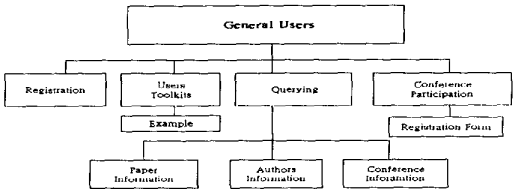

Figure 4: General Users Management System Architecture

Figure 5 shows the architecture of Administration Management System.

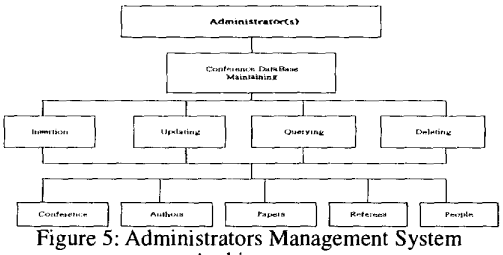

Figure 5: Administrators Management System Architecture

4. A Mobile Virtual Conference System

A virtual conference system should support real-world conference activities, such as technical session presentations, discussion, and keynote speeches. With the improvement of broadband network infrastructures over the Internet, in the near future, virtual conferencing is attractive. The purpose of our research is to propose such an environment, with a sophisticated multicasting control mechanism, to support different virtual

conference activities. The physical Internet infrastructure is fixed. However, the logical connection of such a virtual conference network is dynamic. Network bandwidth and server computing power are shared in a time-slicing manner such that each time slot can hold a number of parallel sessions. The system also requires a number of mobile servers, which can be maintained by session chairs or conference organizers. Our system aims to support the publication of video proceedings. Session presentations and discussions can be recorded in a CD-ROM for future reference. Thus, not only on-line virtual conferencing is possible, the conference can be reviewed off-line. Conclusively, the purposes of our mobile virtual conference system can be summarized as the following:

- mobile virtual conferencing upon demand
- on-line/off-line virtual conferencing
- video presentation and slide synchronization
- video proceedings publication

The design and implementation of our system to realize the above purposes are give in the following sessions.

4.1 The System Architecture

The system architecture illustrated in figure 6 is a global view of our software components. In order to realize such a virtual conferencing system, some automatic tools are required:

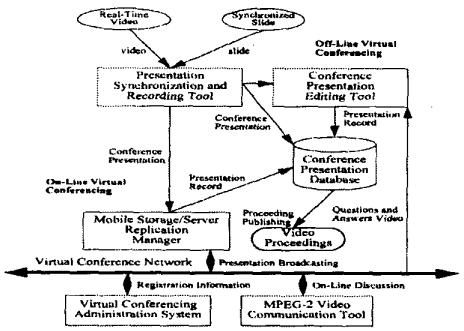

Figure 6: The Software Components in Our Virtual Conference System

- **The Presentation Synchronization and Recording Tool**
- **The Conference Presentation Editing Tool and Database**
- **The Mobile Storage/Server Replication Manager**
- **The Virtual Conferencing Administration System**
- **The MPEG-2 Video Communication Tool**

Note that, the virtual conference system support both on-line virtual conferencing as well as of-line conferencing. On-line conference has session presentations transmitted without editing. But, the transmission records can be stored in the conference presentation database for video proceeding publication. On the other hand, session presentations can be pre-arranged by presenters and conference managers. In this case, presentations can be annotated with simple graphics drawing, as well as video presentation. Whether the presentation is annotated, questions and answers are recorded as video records, which should be included in the video proceedings.

4.2 The Hierarchy of Conference Presentation Database

As discussed in previous sections, the mobile conference system supports both on-line as well as off-line virtual conferencing. Most importantly, the presentation records are collected and a video proceeding can be produced. In order to realize the process, a conference presentation database is required. The design criteria of the database are to support the following considerations:

- Allow off-line presentation editing
- Allow object-based replication
- Allow automatic generation of video proceedings

Off-line presentations are video records which are synchronized with presentation slide update. These presentations can be annotated with drawing and simple text so that the video proceeding can be used as a tutorial. Since the mobile conference system duplicates these presentation records on a session chair's workstation, the base records to replicate includes all presentations of a session. However, invited speeches, panel discussions, and opening remarks can be base records as well. Finally, the database can be used by a tool which generates table of contents automatically and author index in a video proceeding.

Note that, we use several IPs in the mobile communication system. As discussed in next subsection, the mobile conference network infrastructure suggests presentations to be arranged by a number of distributed session chairs. These session chairs have their workstations registered for using mobile video servers. The communication is balanced by a graph algorithm, which is also given in subsection 4.3. The database uses a centralized control policy. However, object records replicated in session chair workstations contains only presentation data and bookkeeping information, which does not contain a hierarchy of the database.

4.3 The Mobile Conferencing Infrastructure

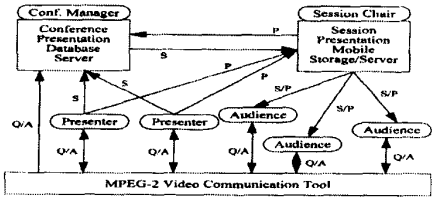

Figure 7: The Dataflow of Virtual Conferencing

Presenters in a conference used to use slides (either demonstrated electronically or via an overhead projector). Some of these slides may contain pictures of a high resolution. Moreover, if the presentation is proceeded using a personal computer, the presenter may use demonstration programs. In a virtual conference environment, slides, pictures, and programs can be pre-loaded in an appropriate network location, instead of being loaded on-the-fly, which is bandwidth-consuming. We suggest to arrange some mobile presentation servers, which can be managed by session chairs of the conference. With these servers, communication load can be shared. In figure 7, ***P*** denotes video presentations, ***S*** represents slides or pictures, ***Q*** is an audience's question in a video record, and ***A*** is an answer video.

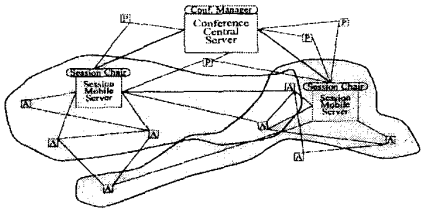

Figure 8: The Virtual Conferencing Mobile Infrastructure

Computing the dynamic multicasting topology is not an easy task. There are some considerations. For instance, the Quality of Services requirement is different from one audience to another since different participator may have different hardware setup. On the other hand, the physical network infrastructure has its limited bandwidth, which may or may not be estimated ahead of time. Since a conference usually has a few sessions that are running at the same time, the number of conference servers should be small. However, the location of the server and the network configuration of those servers should be carefully determined so that the overall performance of a virtual conference can be raised to a reasonable manner. In this section, we propose a mechanism based on graph construction to realize such a mobile virtual conferencing environment.

A Conference Central Server is connected to some Session Mobile Servers (SMSs). Each SMS maintains a subgraph of the mobile network infrastructure. Assuming that, the infrastructure graph, $G = (V, E)$, is connected. Each SMS subgraph, $G_i = (V_i, E_i)$, where $1 \le i \le n$, represents a local area network or a metropolitan area network, which is also connected. Each SMS in its SMS subgraph maintains a multicasting topology from SMS to all nodes in the subgraph. The topology is adaptive to the communication requirement of virtual conferencing. Note that, the union of all SMS subgraphs can be a subset of the infrastructure graph G. That means some audiences are not joining any particular session within a time slot.

In a SMS subgraph, G_i, each node represents an conference audience, A_k. Each audience node A_k has its associated communication bandwidth, CB_x, to a SMS_x, within time slot T_w. Note that, an audience node can be connected to more than one SMS. Also, each A_k has a minimum quality of service requirement, QoS_k.

The physical virtual conference infrastructure is fixed. However, the logical mobile network infrastructure is dynamic from one conference time slot to another. That is, the logical connection of each SMS subgraph and thus the mobile network infrastructure is changeable upon demand. A conference time slot, T_w, can be defined as a duration of session presentation, which can be a technical paper session, a panel discussion, or a keynote address. Note that, within T_w, a number of parallel sessions, $S_{w,j}$, where j is a session number, can be run concurrently. A session presentation has a number of audiences, which are located physically at audience nodes.

The objective of the constraint reasoning algorithm is to find out a mobile network infrastructure with respect to a time slot, with a requirement that, quality of service is guaranteed and the overall infrastructure utilization is a minimum.

4.4 The Implementation of Mobile conferencing

The final program is produced by virtual conference management system. User or participant can choose the interesting session to listen. The participant must fill the IP or Web site in which he/she is. Once a participant register on our VCS and order the sessions he/she wants, our mobile virtual conference system will pre-transfer the data to the server next to the IP according to our algorithm.

Conference manager can check status of sessions and organize the conference central server. The status will be checked are as following:

- Session Title

- Number of papers
- Session server
- Session chair
- Number of slide records
- Number of video records
- Volume of video records

Finally, the participant can join the session according to his/her ordering list from final program. If the session is ongoing, the mode will be set as on-line and others will be off-line. If the chosen sessions are at the same time, participant can save the partial video proceeding of other sessions after clicking the "ok" button in off-line mode. The processes of each session will be recorded as each partial video proceeding. By combining with all partial video proceeding, we can make the complete video proceeding.

We completed the video proceeding and virtual conferencing by using the Advanced Streaming Format (ASF) technique developed by Microsoft. Due to this, we can solve the real-time synchronization problem.

Session chair can check the status of the specified sessions. Some information will be provided in this subsystem. Session chair can contact with authors according to this check form and preview the data transferred from authors. The information is useful for handling the mobile storage/server.

5. Conclusions

In this paper, we provide a virtual conference system for the academic society. This system is divided into two parts. The first is virtual conference management system, and the second part is a mobile virtual conference system. This research proposes a total solution toward virtual conferencing. We use a mobile server/storage pre-broadcasting technique, as well as a communication network optimization algorithm, which is based on a graph computation mechanism. With the assistant of a conference management system, the system is able to support virtual conferencing in the future academic society.

The contributions of this paper are summarized as the following:

- A complete conference system was established according to the conference holding procedure.
- Software architecture and network infrastructure management of virtual conference was proposed.
- The utilization of a mobile storage/server and the media synchronization mechanism were realized.
- A dynamic scheduling algorithm supporting mobile conferencing was developed.

Finally, we put many solid result of our virtual conference system based on previous contributions in the appendix. And, interested readers are welcome to visit our demo Web site at (http://163.13.127.117/VC_new/index.htm).

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