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ITB7265

Chapter I

Distributed Multimedia Databases

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Distributed Multimedia Database involves network technology, distributed control, security, and multimedia computing. This chapter discusses fundamental concepts and introduces issues of image database and digital libraries, video-on-demand systems, multimedia synchronization, as well as some case studies of distributed multimedia database systems. Requirements of multimedia database management systems and their functions are also presented.

INTRODUCTION

Internet and Web browser changed the world. In addition to technology evolution, Internet and Web sites brought a new world. It is the virtual cyberspace that stimulates the era of information explosion. From a stand-alone computer to networked workstations, the virtual world links us together and creates a new concept – the ***E-Utopia***. Is it real or virtual? Does it exist? These questions are often asked in international conferences and discussions. The era of E-Utopia is a new concept. The existence of such a world can be as real as it should be, from the perspective of a new sociological justification. On the other hand, E-Utopia is virtual, as no physical material can be used without the support of current social infrastructure. The new concept realizes new activities. E-commerce, E-conferencing, E-entertainment, and E-learning are available based on Internet and Internet2. Due to these activities, distributed multimedia database technique is a requirement. Multimedia presentations and courseware will be stored in an open database architecture and system, which is shared by instructors, students, and administrators of distance learning programs. Similarly, an E-commerce system requires large database entries to store customer information. Behavior of the customers can also be recorded such that recommendation of new products can be delivered. Video-on-Demand is a new entertainment dimension. Unlike traditional video storage, movies and music can be delivered to a customer whenever and wherever necessary.

This chapter appears in the book, Distributed Multimedia Databases: Techniques and Applications by Timothy K. Shih.

The technology involved in distributed system controls and network performance tuning is high but essentially important.

If we look at the evolution of the computer and communication technologies, from a mainframe computer, to computers of a smaller scale (i.e., personal computers), to network linked computers, to the recently developed mobile computers (e.g., personal digital assistants accessible via wireless communication), the focus of technology moves from presentation, to communication, to mobility consideration. On a stand-alone computer, whether a PC or a mainframe machine, computer-based training (CBT), computer-aided instruction (CAI), and multimedia presentation software (i.e., educational CD ROM titles) all have a same focus – the presentation of knowledge. The earlier strategy (i.e., CBT) mostly focuses on drill-based training with limited interaction. With the help of multimedia technologies, presentation quality is improved via the inclusion of pictures, video, and audio. However, from the educational perspective, instruction is one of the most important activities to knowledge transfer. Without proper lectures and class discussions, the effectiveness of learning is limited. Thanks to the Internet technology. Distance learning enables communication between the instructor and students. The interaction, either synchronous or asynchronous, increases the efficiency of knowledge transfer. With the rapid growth of wireless communication technologies, and the 3-G mobile devices (e.g., Do-Co-Mo in Japan), mobility becomes the next consideration. Convenience and flexibility are the main attractions. The end users benefit from the nomadic accessibility of 3-G mobile communication tools, to access information and online discussion. The era of E-Utopia is redefined. A new paradise, the ***M-Utopia*** (or Mobile Utopia), was born. The M-Utopia allows M-commerce, M-conferencing, M-entertainment, and M-learning. Whether we are facing E-Utopia or M-Utopia, distributed multimedia database systems allow the required storage and access mechanism for information exchange. Distributed database technologies will be one of the key issue to facilitate the success of the new paradise.

Distributed multimedia systems and applications involve techniques of computation, communication, and mobility controls. With the maturity of some of these techniques, we are experiencing multimedia communication such as video conferencing, distance education, video-on-demand, and other applications. Yet, there remain some challenges to be solved. For instance, due to the original focus and design of network communication protocol (i.e., TCP/IP), real-time broadband communication is not feasible on the current Internet. To realize useful multimedia communication in real-time, broadband Internet (or so called Internet2) and advanced communication protocol to enable sufficient Quality of Services (QoS) seems to be the trend of new research direction and focus.

In addition to communication, computing techniques, such as memory allocation and buffering methods to realize video-on-demand, as well as high performance media compression technologies are also important. Some of the state-of-the-art solutions solve part of the problems, while the additional requirement of the efficient retrieval of multimedia information remains a challenge. Image and video information retrieval is one of the few interesting research areas. Simply imaging on the search of 1000 pictures, how to select two pictures of similar features effectively is still an unsolved problem. Current technologies rely on the comparison of color, texture, shape, and spatial features of objects in the pictures. However, there exists a gap between human perception and efficient computing. Yet, the automatic segmentation of video clips into shots and scenes in order to realize automatic indexing and searching not only involves image processing techniques, but the computation of temporal properties of video is also essentially important. Also, since video clips require a higher capacity of storage, the efficient allocation of video data on the disk and memory