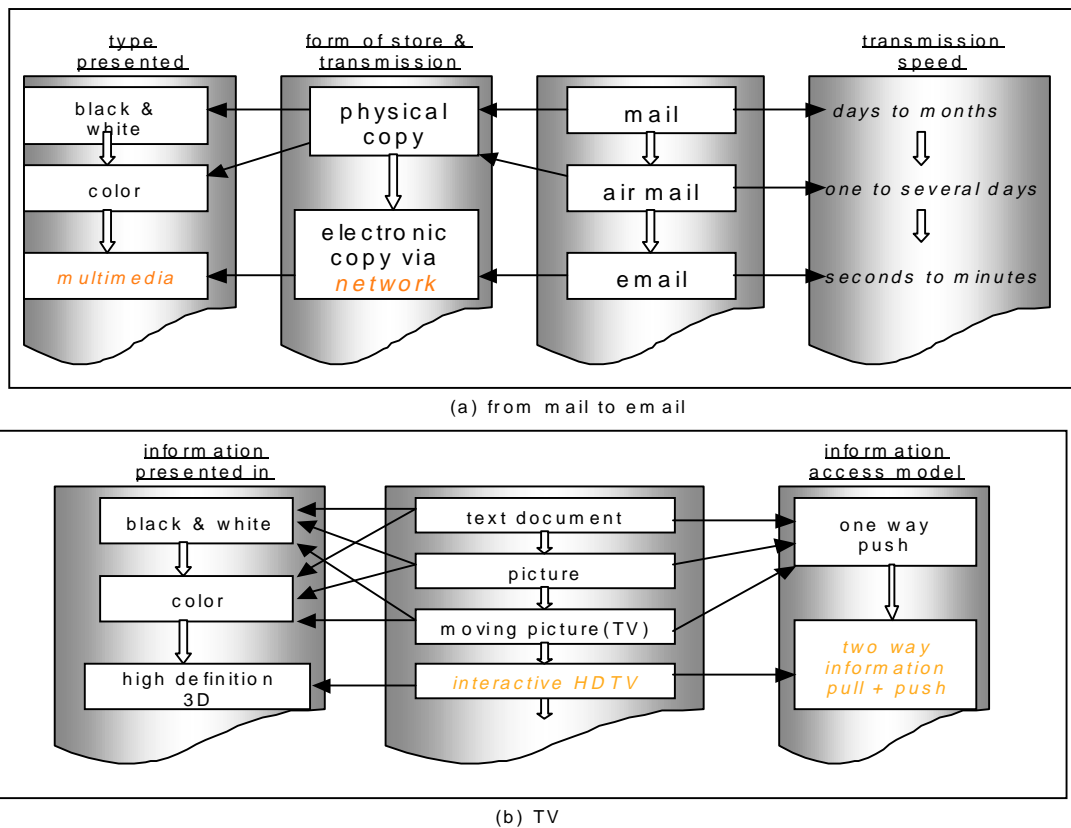# Informing Clientele through Networked Multimedia Information Systems: Introduction to the Special Issues
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Buying a book, a video, even a car, through the Internet; finding a map on the web; watching a live Olympic program streamed over the Internet -- all these sounded like a dream even five years ago. Today they seem natural. The developments of the World Wide Web (WWW) and other Internet technologies are just some of the driving forces that have made

(a) from mail to email

(b) TV

Fig. 1 The history

today's access of information so much easier than before. Figures 1(a) & (b) illustrate the history of 'mail' and 'TV', two classical cases of information distribution/access. These simple examples vividly show the intoxicating ways of information access and the convenience networked multimedia information access has brought to us. Nowadays, information is tailored to
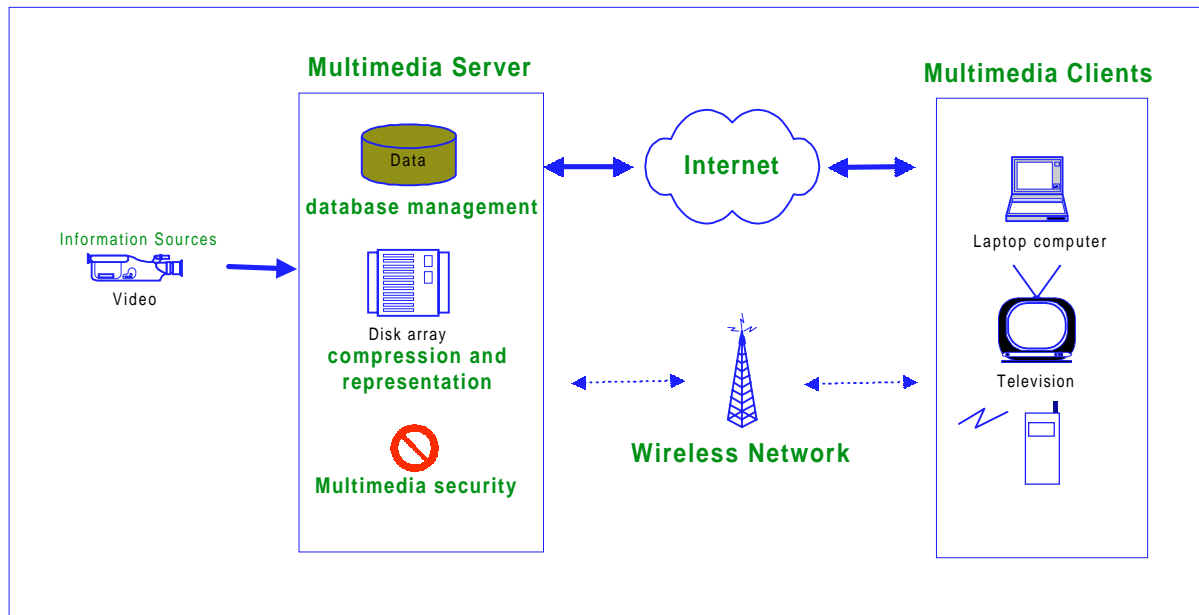
Fig. 2 Multimedia information system components

the interests of individual, where, when, what, and how you want it and is also packaged in a way that is so much fun to access.

Not surprisingly, advances in computing power, communications and networking brought a major change in the nature of computer-based information systems. Increasingly, information is appearing in graphic, image, audio, and full-motion video forms, as opposed to traditional numeric and alphanumeric data. Compared to traditional text-based information database, the multimedia information is far more rich, educational and entertaining. Thanks to the development of the Internet and other networking technologies, today's information subsystems are worldwide connected and are easily accessible. This makes it much easier to gather and convey the multimedia information to interested parties. In fact, many emerging multimedia applications such as on-demand multimedia services, video-conferencing and collaborative work systems require networked multimedia. The emerging digital media revolution and the Internet revolution are poised to change the way we learn, think, work and live. The future is promising. While the challenges to realization of this dream are many, a great deal of research effort has been expended to overcome these challenges. Therefore, the objective of this special issue is to shed light on several aspects of multimedia information access, especially in today's networked environment.

Figure 2 illustrates a typical multimedia information system. A multimedia system consists of several components, including multimedia storage server, media synchronization, multimedia

compression and representation, multimedia database management, networking and communication, content and network security, and methodologies and tools of many multimedia applications. Various technological capabilities must come together to form an acceptable system. In this special issue, we will discuss several vital aspects that enable networked multimedia information system.

Multimedia Management

Not long ago, people were excited about the opportunity provided by the WWW to find useful information quickly. Nowadays, you hear people complaining about too many results that a search engine returns upon a search request. Multimedia data are growing at an exponential rate, which imposes a great challenge on managing the information in a controlled, organized and efficient manner. How to manage non-text data such as images, video and audio is especially challenging, and has attracted a flurry of research activities in recent years. In particular, content management tools have been developed to facilitate effective access, interaction, searching, browsing and visualization of multimedia information. (See Figure 3.) The first article in this special issue-"Multimedia Content Analysis and Indexing for Filtering and Retrieval Applications", contributed by Dimitrova, provides a comprehensive survey of the techniques for the analysis and retrieval of images, video and audio. The article also provides a high level survey of systems and standardization efforts in content description and retrieval. We envision that these techniques and systems will make search retrieval and filtering of digital media manageable.
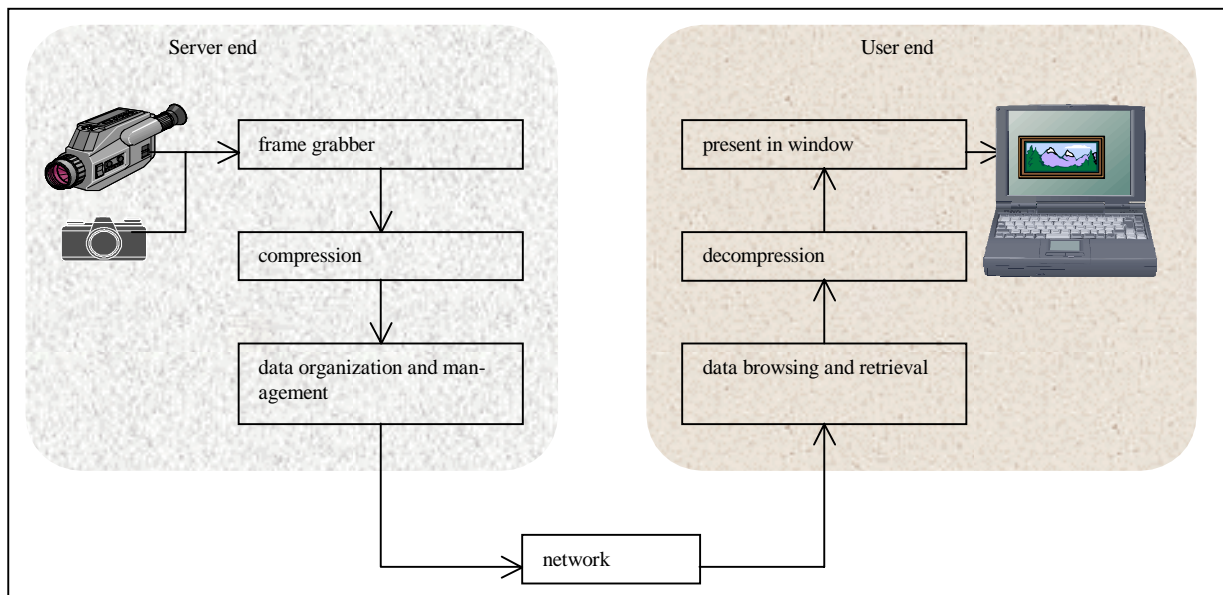
**Fig. 3 Multimedia data management and retrieval**

Multimedia representation

The vast amount of multimedia data imposes a challenging demand for the capacity and speed of the storage device, as well as the bandwidth of the network through which the multimedia data will be transmitted. (See Figure 4.) It is therefore critical to be able to represent those data in a compact way. To ensure the wide distribution of multimedia contents and the interoperability between various consumer devices, multimedia compression and representation standards have been developed in the past decade and are still evolving to accommodate the requirements of new applications. With the advent of some related enabling technologies and the emergence of more and more new applications, recent developments of the multimedia

standards also address, in addition to compression performance, many desirable features that will facilitate the developments of many emerging applications. Examples are the emerging MPEG4 and JPEG2000 standards. Liang discusses the new trends and the potential impact of these new standards on multimedia applications in his article "New Trends in Multimedia Standards: MPEG4 and JPEG2000".

Multimedia content security

An important issue regarding the commercial success of networked multimedia is the protection of the intellectual property rights associated with the media. Content providers will be reluctant to provide their valuable contents if they are not assured that their contents will be securely protected. A good
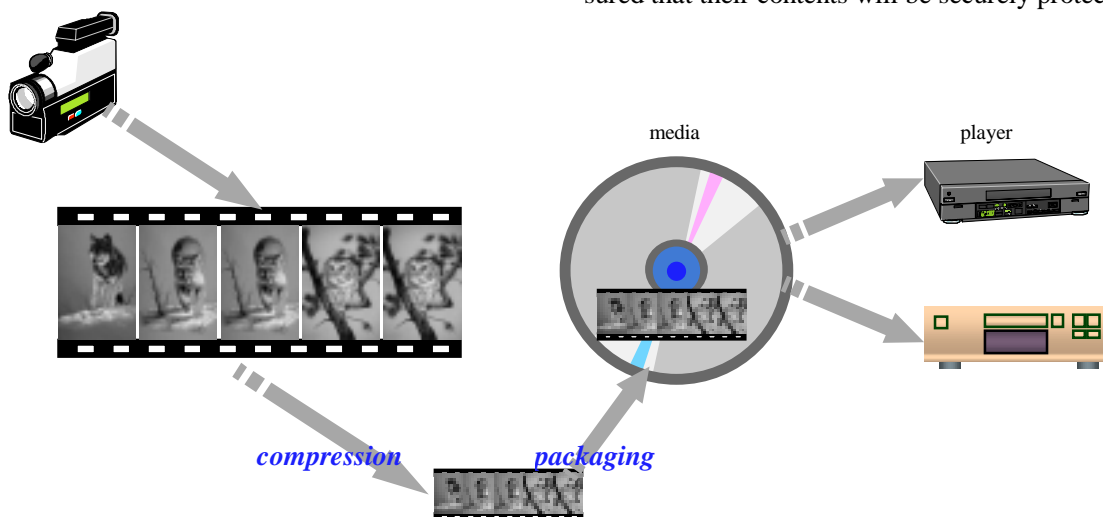
Fig. 4 Multimedia compression and representation

example is the recent development of the digital versatile disk (DVD) market. The DVD digital content can be perfectly copied and easily distributed. Content providers such as the motion picture studios were very concerned about the possible revenue loss due to illegal copying of the DVD contents. As a result, they were reluctant to provide the movie titles in DVD format. The whole DVD market would be in jeopardy if this concern is not properly addressed. Similar situation exists for the on-line music market. Several technologies including encryption, authentication and digital watermarking have been developed to address the content security issue. The one that has relatively longer history is conditional access through encryption. The encryption technology scrambles the digital contents in a way such that, without a decryption key, the user will not be able to retrieve a clear version of the content. This ensures that only authorized people will have access to the digital content. The authentication techniques enable the users to verify the authenticity and integrity of the received content. However, once the content is decrypted, it is no longer protected. People can make illegal copy and distribution of the decrypted contents. To overcome this potential pitfall, digital watermarking technology emerges in recent years. Digital watermarking technology embeds some useful information directly into the digital media to identify the owner, or user of the content, and to control the usage of the content. The article "Digital Watermarking Technologies with Practical Applications", contributed by Morimoto, discusses several different types of digital watermark applications. It elaborates in some details on the particular application for DVD copy control and the on-going worldwide standardization efforts.

As discussed above, conditional access is one way to provide the security of multimedia information. One of the conditional access control methods is biometric access control which automatically verifies or recognizes the identity of a person based on some physiological characteristics, such as fingerprints or facial features, or some aspects of the person's behavior. Since biometric systems identify a person based on the characteristics that are biologically difficult to reproduce, the possibility of access key forgery is greatly reduced. Among various biometric access control methods, face recognition has recently attracted much attention due to its merits of both high accuracy and low intrusiveness. Readers interested in this new trend of security and surveillance approach to the introductory survey article on face recognition technology should read Lin's article, which is found in the next volume of this special issue.

Multimedia applications

From above discussion, we see that several enabling technologies such as multimedia compression and representation, multimedia content management and security, have experienced rapid growth. These advances, coupled with increasingly available communication channels/bandwidth, have made a variety of multimedia services feasible, both technically and economically. These include new learning experience for education, digital libraries, electronic commerce, new channels for entertainment, among others. The next two articles demonstrate some real-world multimedia applications. Ginsberg, Shiau and Sampieri present an Internet-based multimedia distance-learning environment using a virtual room platform. Their work suggests that education and training experience are expected to be changed dramatically due to the combined impact of the Internet and the multimedia technologies. Gagilianello and Rosenberg describe a scalable multipoint video system that is designed for efficient generation and display of high quality, multiple resolution, multiple compressed video streams over the Internet. They present some interesting experiences using the system for several "real-world" applications such as distance learning, virtual theatre, and virtual collaboration over the Internet.

The Future

The delivery of multimedia information demands a large amount of channel bandwidth. This demand becomes one of the major driving forces for the development of new network infrastructure. Broadband delivery of multimedia contents through cable modem, Asymmetric Digital Subscriber Line (ADSL), and satellite transmission, etc., is expected to become a reality soon. It is envisioned that in the near future, anyone can easily communicate with anyone from anywhere, without the constraint of physically wired connection. From wired to wireless, nevertheless, is considered a big challenge for multimedia communication. The hostile environment of wireless communication systems necessitates the incorporation of considerable advanced signal processing intelligence in order to provide reliable multimedia services. The last article "Adaptive Interference Rejection for Wireless Multimedia Communications", contributed by Wang, presents some of the recently developed methodologies for interference rejection that are especially useful for wireless multimedia communications.

As individual technologies advance and mature, it becomes very important to develop practical systems that can efficiently integrate different technologies and provide new convenient multimedia services to the clients. This demands new ways of thinking and calls for tremendous research and development effort. Actually, nowadays a variety of Internet service providers (ISP) and application service providers (ASP) have already emerged. The ISP and ASP markets are projected to grow rapidly. A decade from now, people will again be awed by new technologies for informing clients.

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