Web-based Multimedia for Distance Learning

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*Abstrac*t：Education is now engaged in a transitional period with respect to new technologies which is unique in its history. No previous technologies which have been proposed to “revolutionize” education have simultaneously had identical or equivalent revolutionary consequences for this world. Given the technological resources, dealing with the challenges to their effective utilization in education will focus on human-professional. To assist web-based multimedia for distance education, it is important to understand the characteristic and its educational concerns. This study was to identify characteristics of web-based multi-media for distance learning settings.

Keywords: web-based multimedia; distance learning

1 Introduction

Boundless assortments of technological options are available to the distance educator. These options include interactive audio-conferencing, one- and two-way video, computer conferencing, audio graphic systems, as well as printings. To assist distance learning with web-based multimedia, it is important to understand the characteristic and the educational concerns.

2 Problem of this Study

The purposes of this study were to identify characteristics of web-based multimedia for distance learning settings.

There were three major focuses of this study:

1. Needs of using multimedia for distance education.
2. Availability of Current Web-based Multimedia technology.
3. Educational concern of Web-based multimedia.

3 Literature Review

Related literature has been reviewed as foundation of this study. Characteristics of web-based multimedia were identified according to the evidence of literature and results of discussions. For achieving the purpose of this study, following topics were reviewed.

Distance Education
Concerns of Implementing Distance Education
Multimedia
Needs of Multimedia
Web-based Multimedia

4 Distance Education

Distance education can solve many academic problems; it typically creates more than a few in the process. In resolving the problems that are sure to arise, study goal is clear: to capitalize on the strength of instruction while minimizing or eliminating the potential problems arising from its use. This is the challenge of distance education and the focus of this study.

The field of distance education has evolved a long time. As this evolution has unfolded, different phrases have been coined to describe the organizational framework and anticipated instructional outcomes that result. Phrases including "distance education," "distance learning," "distant teaching," "tele-work," "tele-learning," "outreach, and "tele-teaching have been used to describe the same basic process and outcomes. At its most basic Level, distance education takes place when a teacher and student(s) are separated by physical distance, and technology (i.e., voice, video, data, and print) is used to bridge the instructional gap[4] [15].

To be effective, the technology of distance education should remain relatively transparent, allowing the instructor and students to concentrate on the process of teaching and learning.

Unfortunately, due to the charming nature of many distance delivery technologies and techniques, faculty, students, and administrators can easily become troubled by the opportunities and limitations of the delivery system and lose sight of the academic needs to be met. In fact, if faculty, staff, and students are constantly being reminded of the technological delivery system itself, either through technical problems or through impressive but unnecessary technological capabilities, they will be distracted from effective teaching and learning.

For this reason, it is critical for the distant educator choosing appropriate delivery tool to remain firmly focused on instructional goals, content requirements, student needs, and delivery constraints.

Whether they realize it or not, effective classroom teachers rely on visual and informal cues and clues from their students. A quick glance, for example, reveals who is attentively taking notes, pondering a difficult concept, or enthusiastically preparing to make a comment. The student who is frustrated confused, tired, or bored is evident. The alert teacher consciously and subconsciously receives and analyzes these visual cues. As a result, the delivery of information, and often the course content itself, is adapted to meet the unique characteristics and needs of the class during any particular lesson[16] [17].

Again, alert face-to-face teachers factor these unobtrusive cues into their class planning and delivery. A traditional classroom setting offers the teacher and students many opportunities for interaction outside of class. Maybe they talk between classes, meet on a class assignment over lunch, or have mutual interests. Just living in the same community provides a common frame of reference that leads to understanding and familiarity.

Finally, face-to-face interaction takes place without any technological linkage. Communication is free flowing and spontaneous, without the need to manipulate switches, ignore static, or rely on a piece of technical equipment linking teacher and students for purposes of communication and feedback. In contrast, distant teachers have few, if any, visual cues. Even the visual cues that do exist are filtered through technological devices such as video monitors [18].

The effortless flow of a stimulating teacher-class conversation can feel contrived when technical requirements and distance alter spontaneity. Without the use of a real-time visual medium such as television, the teacher receives no visual information from the distant sites. The teacher never really knows if, for example, students are asleep, talking among themselves, or even in the room. Separation by distance also affects the general rapport of the class. Living in different communities, geographic regions, or even states deprives the teacher and students of a common community link.

Until the faculty member becomes familiar with the delivery technologies being used, there is vague discomfort that the instructional message is not coming across as intended, or that the technology is reducing the effectiveness of the course for teacher and students alike.

By any measure, teaching at a distance is challenging. Whether the challenges are worth confronting depends on the instructional mission of the institution, the nature of the content, the faculty's desire and ability to adapt their teaching styles, the characteristics of the students, the time available for planning, the technical systems to be used, and the support service infrastructure.

5 Concerns of Implementing Distance Education

The role and influence of distance education is currently in a period of evolutionary growth Mills[7] & Hovenga [6]. Early efforts in the field focused on print-based correspondence study courses and single-technology approaches to instructional delivery with few opportunities for teacher-student and student-student interaction. In contrast, recent trends seek to innovative integrate the unique characteristics of various voice, video, data, and print delivery systems. Over the past several years, researches exploring effective distance teaching efforts as well as evaluations of student attitude towards the use of distant delivery methods have resulted in some fairly consistent conclusions. These conclusions are worth considering when planning and implementing distance education programs, especially for rural and/or culturally diverse learners.

Research suggests that effective distance learning is more the result of preparation than innovation.

The research suggests, for example, that distance education and traditionally delivered instruction can be equally effective if the distance educator puts adequate preparation into understanding the needs of the student and adapting the instruction accordingly. A teacher's understanding of the target population and their

instructional needs is equally as important as mastery of the content being delivered.

An important part of this preparation is finding content-related examples that are relevant to the distant students. While this can be time consuming, the literature suggests it is critical. An outgrowth of this finding suggests that culturally diverse learners may require more individualized delivery approaches that take into account their cultural backgrounds and past life experiences.

As for delivery systems, the research suggests that there is no significant difference in the effectiveness of the delivery systems used, as long as the characteristics of the delivery system match content requirements. In other words, the content being presented and the capabilities of the delivery system must be complementary.

Hall [3] used levels of interactivity and amount of multimedia as the primary distinguishing factors between different programs and listed three types of programs, Type 1- Text and Graphics Web-based, Type 2- Interactive Web-based, and Type 3-Interactive Multimedia Web-based.

6 Multimedia

Computers, as we understand them today, came into existence about four decades ago. Originally, the computers supported only the computations related to research. As time progressed and with the technological advances, the computers became powerful contrivances and today they are an integral part of our day-to-day life. Perception, memory, thought, and reason, which are considered the basic traits of human beings, are being mimicked today by special systems that are built using powerful computers. These systems are able to 'talk', 'see', 'understand', 'listen', 'think', and 'communicate' although to a much lesser degree of perfection when compared to human beings. Specialized systems are built to perform dedicated tasks such as a class teacher, a librarian, an aircraft pilot, a mining engineer, and numerous other specialized tasks.

All these developments have one thing in common. That is, to automate the following functions: perception, retention, reasoning, and presentation. All four functions directly relate to the sensory, memory, and reactionary modes of behavior of human beings. There are basically two types of systems that are attempted; those which act as replacement for human beings and those which act as facilitating contrivances for human beings. The challenge to the computer technology, science, and engineering is in handling these functions efficiently; and the key to doing so is in understanding the nature of the information that is being perceived, stored, processed, and presented.

Information in the external world can be perceived in five different ways: sound, touch (or feel), scene (or visual), taste, and smell. Literally, multimedia means many media or multiple media. The user of the computing environment today gets input in the form of data, voice, video, image, graphics, or a combination of these. Similarly, the user generates information in one or more of these media. We can visualize the user as the focal point in the computing environment, who constantly accepts input from the external world in multimedia form and interacts with the external world with multimedia information. Pictorially, a modern user deals with a computing environment shown in Figure 1.

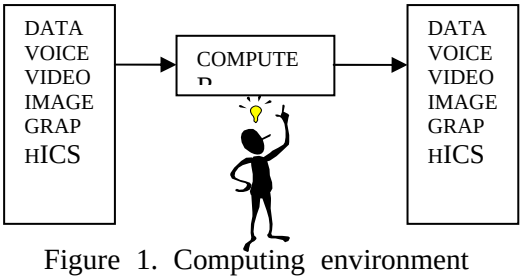


Figure 1. Computing environment of modern users

Currently, multimedia systems related research and development is being pursued by many research groups, often with different perspectives. There is a wide spectrum of work spanning creation, maintenance and retrieval of multimedia databases, synchronization and presentation of multimedia information, conferencing systems using multimedia, protocols for multimedia applications, networks for multimedia applications, performance of multi media systems, and quality of service relating to multimedia systems. In all these studies, researchers and developers have considered two types of applications: those that deal with multimedia information that is stored on a disk and those that deal with multimedia information that is generated live such as a conversation shot through video cameras and speech captured using a microphone during a video conferencing session. The information that is retrieved from storage is also referred to as persistent information. The term persistent refers to the information that is always available and not transient. The information that is generated live from devices such as video cameras or microphones are referred to as non-persistent information. The term non-persistent is used to refer to the information that is transient; there is no way to repeat if lost or corrupted.

A multimedia system is characterized by processing, storage, generation, manipulation, and rendition of multimedia information. The information to be handled may involve time-dependent /continuous (e.g., audio and video) and time-independent/discrete (e.g., text and still images) media. Modern multimedia applications are geographically spread out, and therefore the generation and replay of the multimedia information are often at different physic allocations. In such cases, a computer network is used to interconnect sources to destinations. Supporting multimedia applications over a computer network renders the application distributed. Distributed multimedia applications raise several requirements in communication support and operating system support. Besides, the user interactions may modify the communication requirements of applications.

It may be a good idea to recall the definition of a computer system at this point. A computer system is a machine that can accept data in digital form, process it as per the algorithmic procedure programmed, and give out results in digital form. For the sake of easy interaction, the input and output are mapped onto characters in the form of alphabets, numerals, and special symbols such as +, -, /, ", and so on. Now, let us try to define a multimedia system by comparison! A multimedia system is a computer that can accept information from the external world as data, voice, video, image, or graphics. Of these, only data are mapped to the character set as described earlier. The rest of the information are in their natural form (but recorded digitally) and hence mapping is not required. Also, the devices that are employed for input and output for each media are special and are designed specifically to be able to handle the respective media.

7 Needs of Multimedia

Human beings have the natural ability to understand the information presented in the form of speech, photographs, or video sequences. For example, we cannot only hear the conversation on a telephone, but also identify as to who is talking. A mother can recognize her baby in a crowded railway station platform, simply by the baby's voice or cry. Given a photograph of a baseball team, a baseball fan can recognize each player. If we see a video sequence of a place that we have visited several years ago, we start explaining many things related to the place, by a virtual walk through the memory lane. All these simply underline the fact that there are enough cognitive reasons as to why multimedia is being used increasingly in systems today.

Multimedia is the form in which the information is handled by the computing environment of today. Multimedia is much richer than the informative bits with which it is represented. For example, when we look at an organization's employee database, it is now possible to store the photograph of each employee, details such as age, salary, expertise, etc., and a short presentation by the employee himself. The database of today is very different compared to conventional databases. Also, for a user of this database, it is possible to flip through the photographs of the employees and pick up the details about an individual as opposed to a key-word search. In fact, the user of the multimedia database need not remember any specific detail regarding the employee other than a recollection of the face.

Another use of an employee database in multimedia form can be illustrated using the following scenario: If the presentations recorded by the employees contain the projects or assignments handled by the employee, then the employer can pick a team for a new project by searching through the voice presentation for relevant experience. The process of picking up a team for the new project is equivalent to having a meeting of all employees in which each employee makes a technical presentation highlighting his skills. This is made possible because when we store the information, different media retain their original form. While in the normal form of storage in a database, every piece of information is encoded as a bit or a byte or a group of bytes, with a pre-assigned relationship, thereby losing the original character of the information.

Let us consider yet another example that uses the current information-generation technology. Until now, conferencing using computers only meant that the screen was subdivided into as many units as there were participants in a conversation, each one typing in what they had to express as opinion on the subject matter under discussion. The same conferencing will dramatically change once the input changes from simple keyboard interaction to display of slides, transparencies, computer-generated graphics (possibly with animation), annotation with the voice of the participant or from an expert as an extract from a database, and so on. In fact, the possibilities are limited only by the imagination of the user of this new environment supporting multimedia conferencing.

8 Web-based Multimedia

World Wide Web (popularly known as WWW) is a cooperative project initiated in 1989 at CERN8, Geneva, Switzerland, to design and develop a system for the integration of various types of information sources using hypermedia concepts. The motivation was to support collaborative research among physicists, who produce and exchange large volumes of information and are spread out geographically. It is a successful sharing multimedia information on the Internet. World Wide Web consists of the following:

Technology to establish a WWW server. This includes the protocols to contact other servers and clients.

Technology to establish clients to be parented to any server either statically or dynamically. A user-friendly GUI (Graphical User Interface) to enable interaction with the WWW.

A protocol called http (hyper-text transfer protocol) as a part of the client as well as the server.

A language called html (hyper-text markup language) to enable users to organize the information in the servers.

The interesting aspect of the WWW technology is the transparent access to any web site for information, thereby giving the user the impression of seamless inter-connectivity of information sources (known popularly as web servers) across LANs, WANs, Internet, or a combination of these. Though the technology appears to be uncontrolled and unregulated, there seems to be a voluntary adoption of discipline among the users. The information sources (often referred to as hyperspace, cyberspace, and so on) are linked among themselves, which when drawn on a sheet of paper looks like the web of a spider. For identification purposes, each unit of information that is linked into the cyberspace has an ID called Universal Resource Locator or URL. This idea has enabled a liberalized approach to information sharing anybody can author a document and at the same time optionally refer to anybody else's document - leading to contribution of research results to the cyberspace.

Let us take a few moments to understand the components of WWW.

Uniform Resource Locator: URLs specify how and where to get a document. The host where the document resides is identified by its name and not IP address.

Hyper-Text Markup Language (HTML): HTML provides a format for specifying simple logical structures and hyper-text links. Usual characteristics of documents, viz., headers, paragraphs, character highlighting, bullets, figures, photographs, graphics, special markers called anchor tags, and so on are all possible. HTML also defines how URLs can be inserted. Recent versions of HTML support form filling by users, tables, and mathematical equations.

Hyper-Text Transfer Protocol (HTTP): HTTP is the protocol that supports the transfer of documents attached to WWW hyperlinks. HTTP normally operates on a downloading mode, but it can also operate in real-time transmission mode when large continuous media documents are to be displayed.

9 Discussion and Conclusion

Whenever we consider supporting distance education with web-based multimedia, following questions were raised and should be discussed.

9.1 Characteristics of multi-media used through Networks

9.1.1Desirable Features of a Multimedia System

The features that are expected of a computer system to support the demands of multimedia applications are essentially a phenomenal increase in the conventional capabilities and an additional ability to deal with time-related input and output. Some of the features are highlighted in the sequel.

Multimedia systems that are available today appear to be of different types. But a careful analysis of the systems will show that a typical multimedia system can be thought of as consisting of a multimedia information storage subsystem, multimedia information processing subsystem, and multimedia information display subsystem.

These subsystems could be spread over a network(LANS or WANS) with dedicated communication channels between the three subsystems or can be spread over a wide area network with high-speed switched access. The three representative scenarios are illustrated in Figure.2.

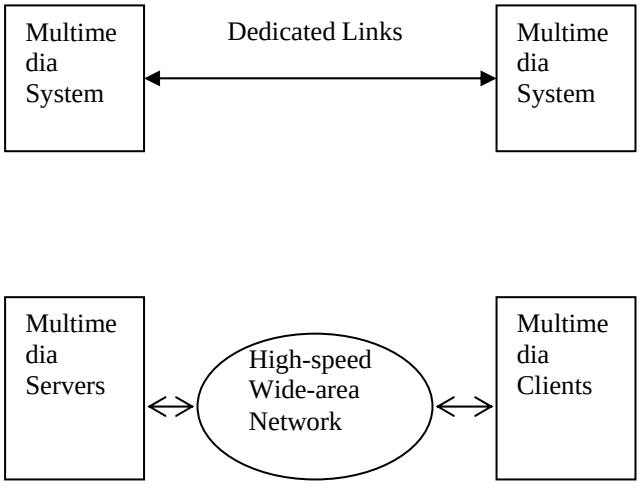


Figure 2. Types of Multimedia System

The first part of Figure 2 represents multimedia systems that have the capability to handle voice and video. Such systems consist of components such as PCs with CD-ROMs, sound blaster card, and video blaster card. These are used commonly in authoring systems and multimedia presentation systems. The second part of the figure represents peer-to-peer communication over a network using a virtual channel setup between the peers. Typical examples are multimedia workstations based conferencing systems that use local or wide area networks. The third part of the figure represents the situation as it exists in a large interconnected network. Internet and corporate networks are examples of this type of system. The servers generally have extraordinarily large storage capabilities, and the clients have the input and output capabilities for handling multimedia.

When the system is used as a standalone system, the entire flow of the multimedia information is within the system. When the system is configured with two workstations interconnected using a dedicated communication link, the NIUs play a role in transporting the multimedia information in either direction as is requested by the application. A dedicated link between the workstations implies that adequate bandwidth is assured.

Network Multimedia systems are used in a variety of situations. By and large they can be classified as network multimedia database systems, network multimedia presentation systems, and network multimedia conferencing systems. These are the generic examples of multimedia systems which can be configured as customized systems tailored to specific applications.

9.1.2 Network Multimedia Database System

Multimedia database systems deal with creation, maintenance, manipulation, and retrieval of multimedia information. In general, the databases can be at several sites (normally referred to as servers) and will be connected to a number of workstations through a communication network. Multiple servers such as video servers, voice servers, and data servers can be realized in a single physical machine as well. The query generated by any of the clients will be internally translated into one or more queries to the different servers. The responses that are received from the individual servers are pieced together into one composite response by the workstation. Such a multimedia database system is shown in Fig. 1.11, where there are three servers, for video, voice, and data, connected to several clients through a communication sub-network. The database may store information as video, voice, data, image, graphics, or a combination of these. Designing a multimedia database system poses a number of challenges. The sheer volume of data to be handled, structuring the data from different sources such as video and audio appropriately, and maintaining the synchronization information are all vital tasks. Once these problems are solved and the database is created, providing a proper query language that can be context sensitive media sensitive, and at the same time lead naturally to efficient searching will be necessary.

9.1.3 Multimedia Presentation System

A multimedia presentation system deals primarily with the problem of retrieving the multimedia information from a database for presentation on a user workstation with the user participation. The database of presentation material is created separately and stored as in the case of multimedia database systems. But the retrieval is under user control. This can also be seen as a special case of a multimedia database system, where the structure of the database and the query are fixed. Because of user participation, the information accessed may vary dynamically within a subset of the database. In addition to the challenges to be faced in the case of multimedia database systems design, handling the user interactions to control the sequence of presentations will be an additional problem to be tackled at design time. The interactions effectively amount to a VCR7-like function on several media simultaneously.

9.1.4 Multimedia Conferencing System

A multimedia conferencing system is an on-line real-time system where the multimedia information is generated, transmitted, and presented in real-time. Optionally, such systems may have a storage facility for later playback. As the number of participants and locations of the conference increase, the resource demands will also increase. Such a system primarily deals with creating digitized video, digitized voice, data, images, and graphics and transmitting such information across a communication network so that it reaches the destination(s) in real-time. The important point to be noted in this context is that the system deals primarily with non-persistent multimedia information. Besides? the design challenges identified earlier, namely, dealing with large quantities of non-persistent information in real-time (using appropriate buffering techniques) is an additional challenge.

9.1.5 Classification of Network Multimedia Applications

Multimedia applications may also be classified as orchestrated and live based on the mode of generation of information. The classification stems from the fact that the multimedia information has a lifetime in the system depending on the way it is generated. For example, for a given application and a system, the multimedia information can be generated either by using multimedia devices such as video cameras and microphones (live) or by accessing stored information in databases (orchestrated or archived). In the live case, the multimedia information is transient (i.e., non-persistent) and in the archived case, it is permanent (i.e., persistent). A multimedia application is referred to as orchestrated if the information handled by that application is persistent. On-demand HDTV server and multimedia database applications fall under the orchestrated category and typically access stored information in large optical disks. On the contrary, a multimedia application is referred to as live if it processes information generated from devices such as a video camera, microphone, or keyboard. Multimedia teleconferencing applications fall under the live category.

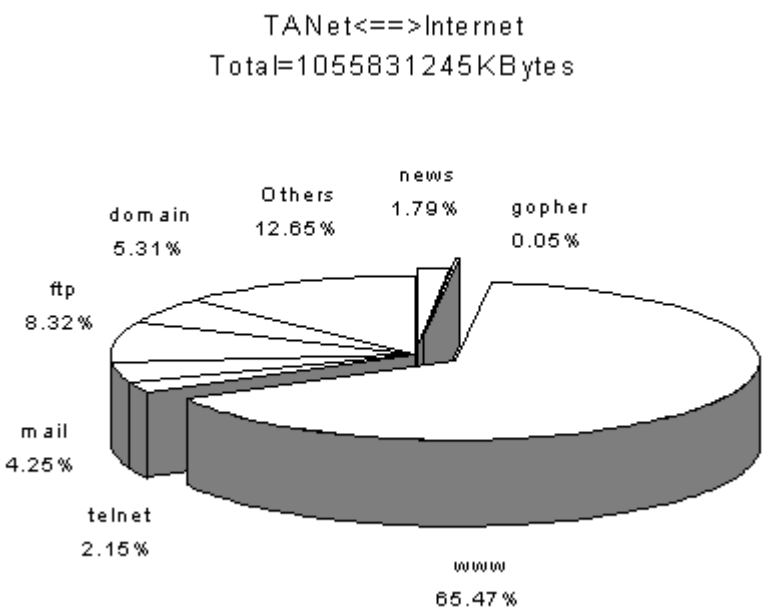
9.1.6Classification of Multimedia Information

Multimedia information can be classified as discrete and continuous based on the relationship of the information with respect to time. Media such as text, graphics, and image have a discrete relation to time with the exception of graphics with animation. On the contrary, media such as audio and video have a continuous relation to time. Multimedia applications, whether orchestrated or live, may deal with both discrete and continuous media. It should be noted that the terms continuous and discrete do not refer to the internal data representation, but to the users' view of the data. Continuous media data (e.g., video) often consists of a sequence of discrete values which replace each other as time progresses. For example, in a video clip the persistence of vision, which is part of human vision, lets us see any image sequence with more than 16 images per second as continuous movement. When such time sequencing is added to discrete media such as graphics, animation will result.

9.1.7 Current Trends

The ubiquitous Internet has two interesting applications that are truly global with a harmonizing touch on the world-wide human population. They are World Wide Web (WWW) and MBone - Multicast Backbone. The WWW technology enables integration of information sources around the world and MBone technology provides the equivalent of conventional radio and television on the Internet. WWW typically uses images along with text. Mbone uses images, voice, video, and text. These two applications together signify a sea-change in the way applications are going to be, in the Internet. Currently, they are the most popular multimedia applications on the Internet.

In Taiwan, TANET, Taiwan Academic Network, is the backbone connected to networks on campus. The traffic of www had grown from showed us that www service traffic grew from 0.8% to 65.47% since July 1994. The current traffic distribution of TANET to Internet was shown in following Figure.



10. Conclusion

10.1 Needs of using multimedia for distance education

According to the traffic loading data of web band width, multimedia of academic usage had shown rapid growing. The essential needs of implementing distance education made this trend possible.

10.2 Multi-media technology used through Internet

Electronics and computer related technologies have been growing at a rapid rate. The increase in the capacity of computer and related equipment have encouraged users to think in terms of new applications.

10.3 Web-based Multimedia technology
Multimedia is one such application. It demands more in terms of processing, storage, and communications from the computer system. In addition to these, there has been a tremendous growth in coding technologies, technologies for application support, and system integration technologies.

10.4 Carrier Technology
fiber, high capacity, high-speeds, high reliability.

10.5 Switching Technology
These technologies relate to high-speed switching of basic units of information called cells or frames. The switches use the carrier technologies as input and output, and therefore operate at speeds of the order of gigabits per second or 2 million cells or frames per second. Some examples are the ATM, D&DB, FDDI, SMDS, frame relays, etc.

10.6 Sensor, Coding and Compression Technology
digital video cam eras, digital microphones, digital scanners, voice code, digital compression techniques for data, voice and video, etc. These technologies help in interfacing the input equipment for video, voice, and image. To conserve bandwidth and to eliminate redundancies, the input devices have the coding mechanisms built in as part of the device itself. The emphasis in designing equipment has been to suit high-fidelity reproduction of the original information.

10.7 Database Technology
large databases, integrated databases, federated databases, active and proactive databases, etc. These technologies address the issue of storing multimedia information of the order of several gigabytes and retrieving them with multimedia keys. For example, from an employee database, one would like to pull out the record of an individual by presenting the photograph of the person as a search criterion. Moreover, when multimedia information is stored as an integral part of each record, the synchronization information should also be stored so that the original nature of the multimedia information is retained on retrieval.

10.8 Software Technology
environments for distributed programming, parallel programming, etc. These technologies become vital in the modern computing environment as the development of multimedia applications require an appropriate development environment. One such environment is the object-oriented software development environment which is becoming popular today. Such an environment includes programming support, runtime library support for multimedia operations, a facility to integrate with protocol stacks 10, debugging with real-time event monitoring, and so on.

10.9 Computation technology
high-performance processors, distributed environments, server-client computing, etc. These technologies are fundamental to multimedia support. In fact, in sophisticated multimedia systems, there can be many processors dedicated to a specific task. The coordination between the processors to conform to the real-time constraints in processing is an interesting area of research in architecture.

10.10 Protocol Technology
new protocol suites, especially at the application level, to support multimedia applications. These technologies relate to providing generic services to the applications such as address location, address resolution, connection setup, multicasting, end-to-end control, quality of service, and so on. High-speed networks demand innovative look ahead schemes from protocol technology.

10.11 Application Technology
Some examples are Head Trackball, Joy-stick. etc. These technologies act as the interface between the protocol technology and the applications themselves. Often these technologies are specific to a class of applications and require to be developed as communication subsystem independent and protocol independent technologies, for deployment in a wide variety of systems.

10.12 System Integration Technology
seamless integration of the technologies mentioned above for domain-specific application development. This is by far the most important requirement in the context of multimedia. Integration involves hardware, software, communication, sensor, coding, and compression technologies to coexist in the modern multimedia system and the whole system should have a simple and easy-to-use user interface.

10.13 Educational Concern of web-based multimedia
If teaching techniques and delivery methods take into account the needs, diversity, and context of distance learners, teaching at a distance can be effective.

Technical innovation continues at a pace that is difficult to measure or monitor.

But, the only educational concern is that Teaching at a Distance Can Be Effective. As a result, distance educators confront increasingly complex and sophisticated technical questions without adequate knowledge to allow systematic decision-making. One of two results is likely: either educators put off technological decisions for fear an updated version will come along, rendering their current technological approach outdated, or they blindly select technology, hoping for the best.

A better and more systematic approach to making technical decisions will result in the merging of less sophisticated but effective technology (audio-tapes, video, and print) with more sophisticated delivery approaches using audio-conferencing, audio graphics, interactive video, multimedia, fax, and electronic mail.

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