Development of Multimedia Database
for Open and Flexible Higher Education in the 21st Century

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1. Introduction

The digital visual materials market is expected to rapidly expand in the near future. A variety of visual materials and other academic and educational learning resources are expected to be utilized effectively in higher education.

However, since it is difficult for individual instructors to secure learning resources to be used in class, it will be necessary to develop a database system that can provide high-quality learning resources which will satisfy advanced academic and educational users in higher education. Visual materials have rarely been published or shared as common properties, resulting in the loss, scattering, hoarding, or deterioration of precious intellectual assets.

The Digital Media Distribution R&D Group in NIME is researching and developing a multimedia database for open and flexible higher education in the 21st century.

2. Demands on Contents Distribution

In 1995, NIME conducted a questionnaire survey on multimedia application in education at 1,200 institutions of higher education (i.e., national/public universities, junior colleges). Based on the survey results, we conducted a "live" survey on a variety of related topics (e.g., curriculum, methods, facilities, staff, administration, benefits, subjects of study, expectations of administration) at 22 universities that offer advanced and specialized education using multimedia technology.

We found that 13 of 19 universities (about 70%) expected NIME to provide information. For instance, 19 of the 60 requests (about 1/3) issued by these 19 universities were requests to be provided with information. These requests can be generally categorized as requests for providing contents (14 requests) and requests for other related information (5 requests). It is obvious that NIME is largely expected to provide contents. The contents required by the universities can roughly be classified as teaching materials and other materials. The following lists a breakdown of what the universities specifically requested:

Providing contents
(1) Providing teaching materials

- Providing contents and software
- Providing lecture videos on primary subjects
- Providing teaching materials and contents
- Providing teaching programs of the University of the Air (via networks)
- Providing multimedia teaching materials offered via the Internet
- Developing and providing all-purpose educational contents
- Establishing databases to provide media teaching materials

(2) Promoting the distribution of teaching materials
- Collecting and distributing multimedia teaching materials
- Playing a central role in the distribution of multimedia teaching materials

(3) Providing other materials
- Providing image materials (e.g., cutting-edge technologies) for classroom use at universities
- Providing resources that may be used without infringing copyrights
- Providing quality materials
- Establishing a system for obtaining quality materials
- Providing panels, graphs, and figures for use as subsidiary teaching materials

Providing related information
- Collecting and publicizing practical examples of remote and media education
- Providing information sources and database service required for education
- Studying media-applied education, developing know-how, and providing information
- Providing information on media teaching materials developed by universities nationwide
- Accumulating and compiling software and various information, and providing these materials via the Internet

3. Electronic Media Development of Academic/Educational Materials and their Effective Use

NIME dared to invite institutes of higher education nationwide to join in the public contribution to promote development of electronic media for academic and educational materials. This chapter outlines the project for academic and educational materials developed during 1994 - 1996 and assesses the effective use.

(1) Outline of the project

The electronic media development project was conducted over the three-year period from 1994 - 1996 for the express purpose of preventing the scattering, loss, or hoarding of academic and educational visual resources while promoting their effective use in cooperation with dedicated

teams annually consisting of about ten members and reaching an overall total of 24 members as follows.

- Paintings in Naga-Toro in Yamagata Prefecture in the early Showa (1926-).
- Quantum-chemistry-related CG
- Aerial photographs taken by the US armed forces in 1945
- Video shots for developing educational materials for "English as a living language"
- Learning resources for English teaching
- Photographs with GPS data on the prefectural scenic spots of Kouchi
- Audio tapes of phonetics in Japanese and other unexplored languages
- Visual resources for chemistry
- Slide films on anatomy
- Photographs of flora and fauna for higher education
- Nagasaki University collection of antique photographs
- Video library of school hours
- Slide films on dissections
- Posi films of the wall paintings of St. Savant Cathedral
- Slide films on bridges
- Slide films on collected folkloristic materials
- Video shots for training teachers of disabled children
- A picture scroll on art design for graduation themes
- Learning resources for regional environmental education
- Slide films of the common boundaries on the outbreak stage of urbanization
- Video materials for university profile videos
- Old brocade pictures

The electronic media were developed for various objective fields in higher education. In the project, researchers and instructors required various original media formats (photographs, slide films, picture scrolls, video, audio, computer programs, etc.) and digital data/media formats (standard still video/graphics, high-resolution still video/graphics, standard animation, high-resolution animation).

(2) Questionnaire on the effective use of the developed electronic media

A questionnaire survey on the effective use of the developed electronic media produced by NIME was conducted in August, 1997 by mail sent to over the 24 project teams (raised by the public subscription in 1994 - 1996) involved in the extended use of the academic/educational materials. 17 teams (71%) replied to the questionnaire. The highlights of the investigated items were the status of utilization of the electronic media developed by NIME, related applications, quality assessment (image resolution, color reproducibility, contrast and usability), publication of

the visual data, and the demands anticipated for the future.

Status of utilization

The percentage of "have put to practical use" was 70 %. The ratio of purposes was, showing 57 % for education, 43 % for academic activities, and 50 % for exhibitions. The utilization covered various fields of applications such as lectures, intensive lectures, training courses, public lessons, graduation researches, special exhibitions, opening ceremonies for new facilities, the internet, video libraries for visitors, and publications through commercial CD-ROMs. Data were sometimes subject to modification by processing and editing due to the image compression which had been used for the purpose of publication using CD-ROMs, media conversion, and software development, although most of them were used as they were originally supplied by NIME.

Quality evaluation

The assessed results were taken as an average of five-grade appraisals on each item, i.e., "fully satisfactory (5)," "fairly satisfactory (4)," "in-between (3)," "rather unsatisfactory (2)," and "totally unsatisfactory (1)." The evaluation of the image resolution was nearly fully satisfactory (4.7) for the educational materials, but was somewhat retrograde for the exhibition (4.1) and research applications (3.8). The color reproducibility and contrast indicated a similar tendency, showing that a higher resolution or a higher image quality was prerequisite for exhibition and researching applications, but somewhat less necessary for educational use.

Future perspective

The results for surveyed items on utilization and demands anticipated for the future were taken as an average of five-grade appraisals on each item, i.e., "will use any chance positively (5)," "willing to use (4)," "in-between (3)," "rather passive in use (2)," and "totally negative (1)." In responses on the future use of the electronic media, "wish to use" was selected in every field of application, but the highest expectations were found in the areas of research and development (4.8). Regarding the tasks to be dealt with from now on, "educational material development (64.7%)" was the first on the list, followed by "electronic media production of video clips (52.9%)," "electronic media production in terms of the high-resolution image (41.2%)," and "publication utilizing the internet (41.2%)."

Since up to 94.1 % of the subscribers acknowledged the "necessity" of technical aids, it can be said without fear of contradiction that support for the promotion of electronic media development is being requested from various quarters. For the publication of the electronic images, only 17.6 %

answered "already made public," and as many as 82.4 % indicated that there was a need continued assistance in publication in the future.

Considering the situation, we can conclude that many are certainly awaiting support for the development of electronic media in the field of academic and educational materials.

4. Study and Development of Server Systems for Distributing Digital Images of the Academic and Educational Materials

As indicated by the above-described research projects, NIME must assume a central role in implementing an academic and educational information infrastructure which is fit for the multimedia age, and in promoting the distribution of learning resources in order to promote the effective use of these resources in higher education.

The Digital Media Distribution R&D Group in NIME is researching and developing a multimedia database for open and flexible higher education in the 21st century. Our study group has completed a database system for audiovisual resources (AMIS). At present, the system holds 100,000 images. AMIS uses existing NTSC video technology. Last year, our study group started to develop a WWW image database system that can distribute digital images via the internet, and to study a VOD system that can support high-speed networks.

The last chapter of this report introduces study and development of server systems for distributing digital images of academic and educational materials for higher education conducted by the Digital Media Distribution R&D Group in NIME.

(1) Database system for audiovisual resources (AMIS)

Our group has developed a database system for audiovisual resources (Fig.1) in order to effectively utilize available resources and promote the use of these resources in higher education. A very useful feature of this system is its ability to handle both images and text-based data. Images, which are central to the database, are comprised of three types of data:
- summary data, including composites of still pictures and sound (digests of TV lecture programs and video course materials)
- still picture images (photographs and slides)
- images of printed materials
Images are stored on optical discs and text-based data are stored on magnetic discs of the mainframe. To provide data services which accommodate the needs of users, the images are distributed to institutes of higher education through ISDN.
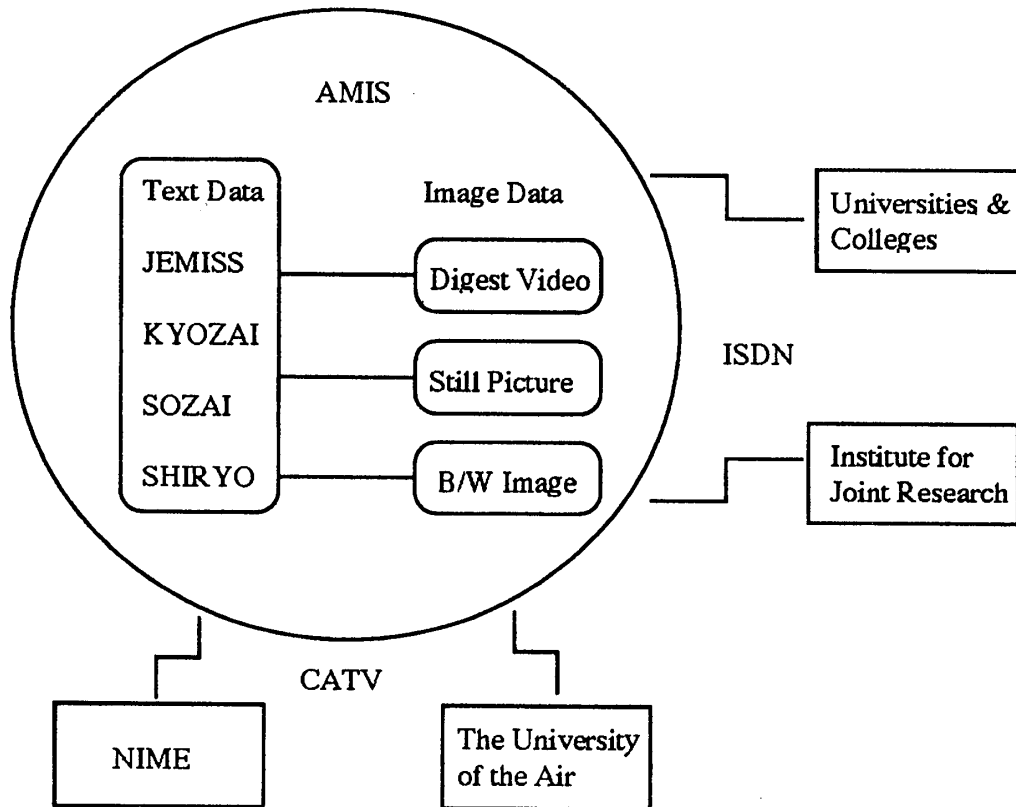
Fig.1 Database for Audiovisual Resources (AMIS)

(2) WWW Image Database System

The WWW image database system can build an image database, register data to the database, store the images, and provide image retrieval and distributing services to clients on the WWW. The system effectively and efficiently provides digital images of academic and educational images (digital image data such as photographs, slides, motion video) to remote users by simple operation.

The digital images handled are academic and educational images for higher education. Although most of these images are still, a few motion images are also included. Basically, the image compression formats are JPEG for still images and MPEG1 for motion images.

The WWW image database system functions are roughly divided into image retrieval and database management. The image retrieval function consists of text-based category retrieval, free word retrieval, image-content-based retrieval functions. The database management function consists of registration, modification, and deletion of the data to/from database. Fig.2 shows an example of the data from this system.
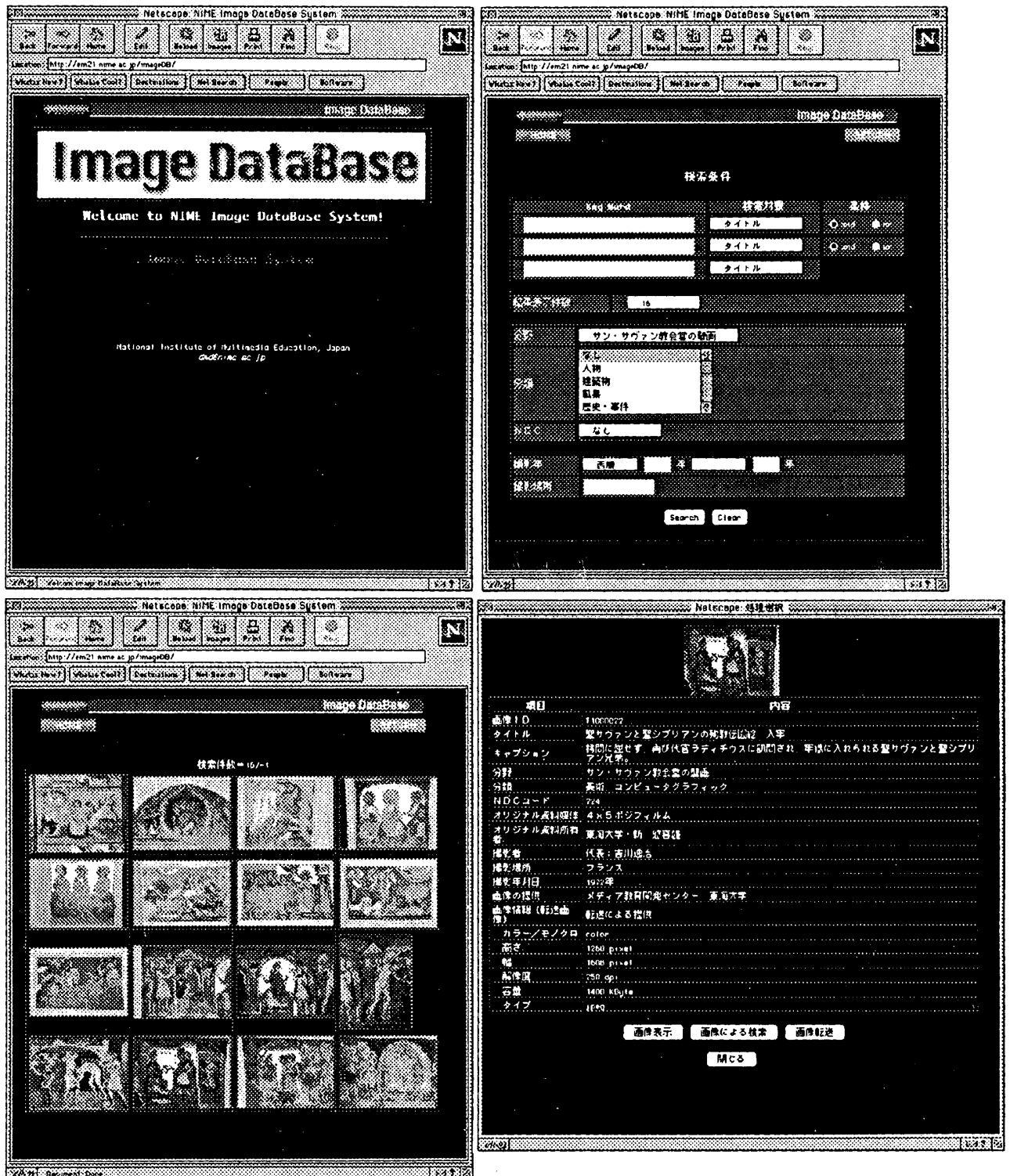
Fig.2 Some Data from the WWW Image Database System

(3) VOD System

To effectively and efficiently use of motion video materials, an on-demand distribution system which can retrieve academic and educational motion video materials from the motion video database and provide the materials via networks is required. We are examining a VOD system using high-speed networks. The VOD system consists of encoders (MPEG1/MPEG2 encoding), data entry terminals, VOD servers, and clients (Fig.3).
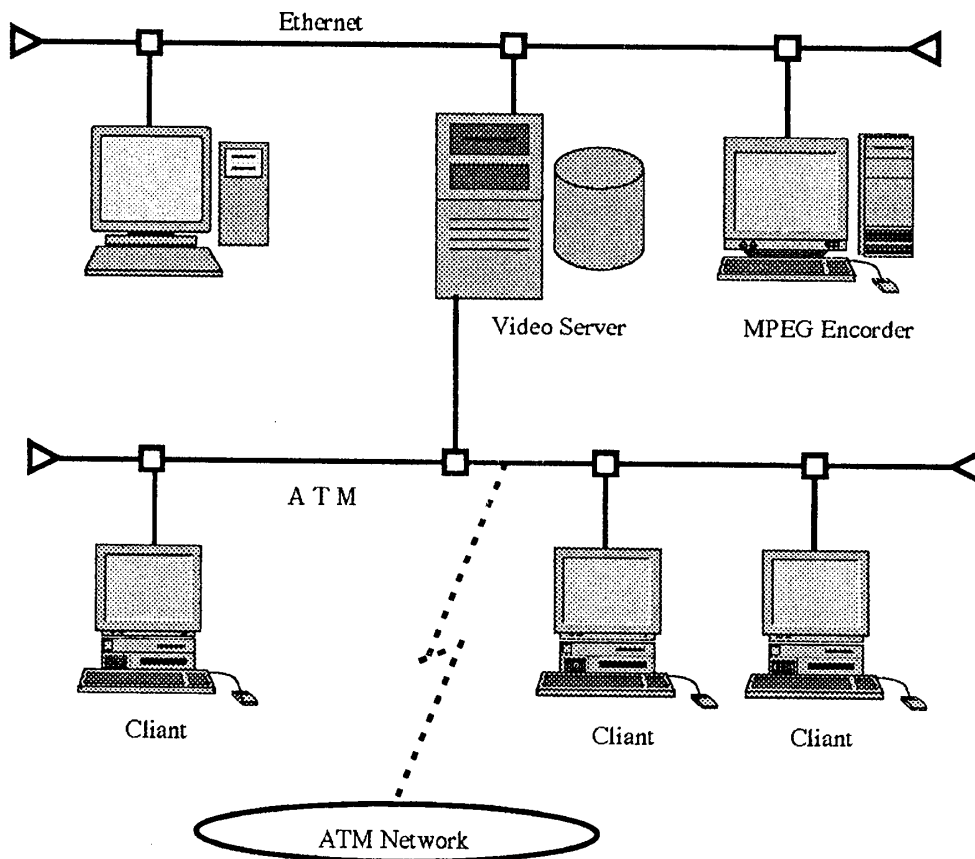

Fig.3 VOD System

5. Summary

In this report, I have introduced several studies and research projects conducted by the Digital Media Distribution R&D Group in NIME. We continue to research and develop multimedia databases for open and flexible higher education in the 21st century.

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