Distributed Digital Lecture Archive System: Model and Implementation

Rei S. Atarashi, Hideki Sunahara
Research Division, Digital Library
Nara Institute of Science and Technology
8916-5 Takayama, Ikoma, Nara, 630-0101, Japan
Tel: +81 743 72 5103 Fax: +81 743 72 5620
ray@dl.aist-nara.ac.jp, suna@wide.ad.jp

Abstract

The growth of digitized technology and computer communication caused new challenge of education systems. We proposed and implemented a digital lecture archive system as one of new education systems. Several lecture courses and special lectures are archiving following actual lectures. Students in a campus or on the Internet can replay these lectures anytime. To implement this system we extend Dublin Core metadata for the lecture archive. We proposed "grow metadata" to manage the lecture data. It makes progress quality of metadata and applications especially in the distributed environment.

We join University of Internet (UoI) project and provide these lectures as contents of this University. This university server and our server are operated different policy but students want to see like one server. The management by grow metadata enable to apply data distribution or unified user interface.

keywords: digital archive, education system, metadata, Dublin Core

1 Introduction

Since April 1999, we started building a digital lecture archive system experimentally in Nara Institute of Science and Technology (NAIST). This archive consists of digital video and synchronized text base materials. It is very useful for NAIST student to help their study. A part of this archive is provided through the Internet for all people in the Internet. Additionally, NAIST joins University on the Internet (UoI) Project [1] since fall 1997. The project proposed new model of University on the Internet and implemented a core set called "School of Internet(SOI)"[2]. The growth of the project caused the problems: scalability, administration and expansion. In NAIST, we propose a distributed server model and implement core set of this model. These distributed servers work as one server for students(users). They are expected to browse or search data same as one server environment. To realize this concept, metadata description is required, we use Dublin Core extensions.

In this paper, we introduce our digital lecture archive system, and propose a concept "grow metadata".

2 Distributed Digital Lecture Archive System

In this section, we describe Distributed Digital Lecture Archive System model. The implementation in NAIST is discussed in following section.

2.1 Motivation

Since 1996, NAIST has started operation of the Digital Library System[3]. The system stores digitized paper and video that can be browsed through the Campus Network.

Currently we are planning and design a next generation system. The goals of the system are shown below.

1. Variation of contents type: not only paper and video
2. Cooperation with other digital libraries and information servers
3. Advanced user interface
4. Powerful search function

Digitized lecture is important archive for education in the university libraries. It is required to Exchanging lecture archive among some universities and to publishing university lectures for lifelong education. Advanced user interface and

powerful search functions are most important tool for education systems. At technical point of view, lecture are complex data which requires a new data management model.

2.2 System concept

The important technology of the system is lecture data management. The features of these data are (1)complex data consist with video, text, many informations and tools and (2)having two type of data: unchangeable data such as video contents and changeable data such as lecture informations, links.

We propose to manage of these data by "grow metadata". Grow metadata is changeable metadata by teachers/lecturers and students. The teacher can qualify these metadata. The interface is provided for teachers and students to add metadata such as keywords and descriptions. The access log is also able to make important metadata such as reference counts. These data became the base of quality of the data and is able to apply data distribution to other server for decreasing load average of the server and increasing to access speed.

The metadata of the system is based on Dublin Core (ver.1). We design and implement the interface for making and changing metadata.

2.3 Target lecture

Nara Institute of Science and Technology (NAIST) is graduate school of Information Science, Biological Science and Material Science in Japan. The lecture courses open for master degree students. Often the special lecture is held by special speaker from outside of university.

We started project with three lecture courses from Information Science and special lecture. The teachers and teachers of course lecture are cooperated us by using digitized presentation materials.

3 System Design

In this section, system design and components of this system are described. Implemented system is core set of this model to provide several lectures in NAIST.

3.1 Design concept

Generally, the lecture consist of (1) teacher's and teacher's video(voice and figure), (2)text-based material such as blackboard, slides, OHP and recently digitized presentation material such as magicpoint and Microsoft PowerPoint data. We

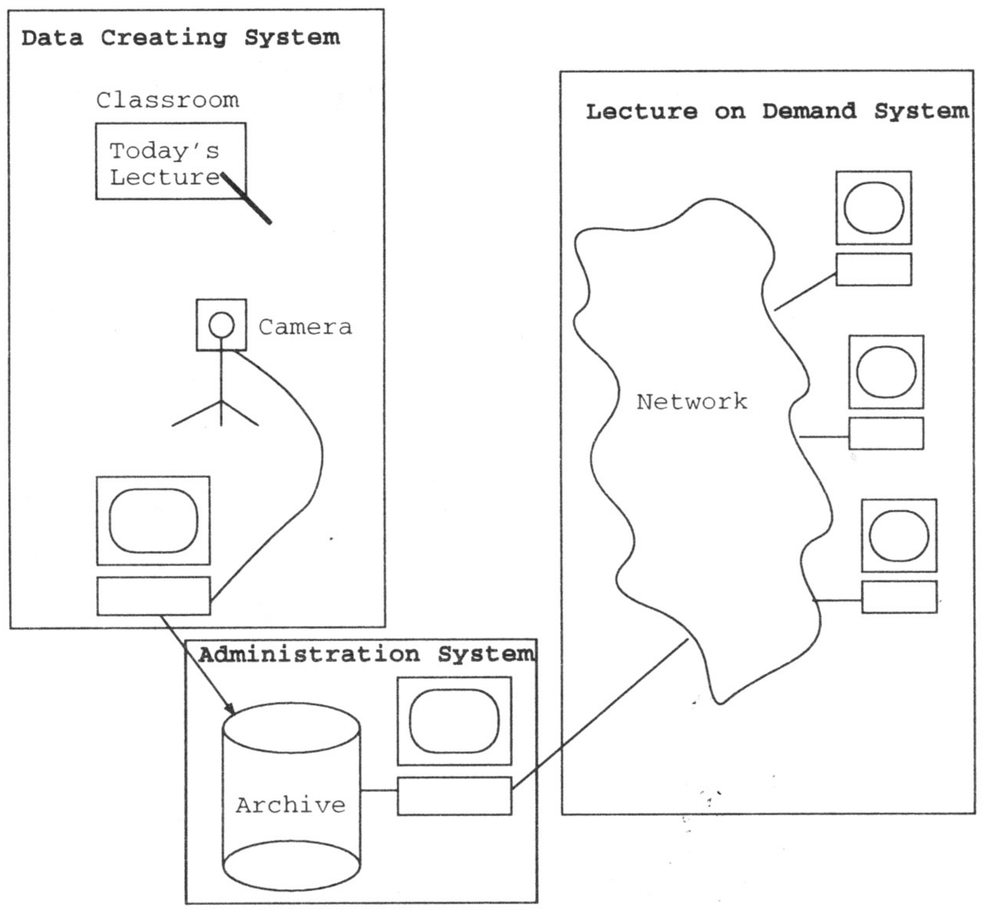

Figure 1: System Architecture

build the system using existed device technology such as video camera, capture card, encoding system and digital presentation materials.

3.2 System Components

We designed and implemented following components to provide service by the concept. Figure. 1 shows overview of the system architecture.

1. Lecture on Demand System: providing recorded lecture.
2. Data Creating System: taking video, encoding and editing.
3. Administration System: data archiving, data management, administrating lectures database, students database.

3.2.1 Lecture on Demand System

A Lecture on Demand System consists of class information and contents. The Contents have teacher's and lecturer's voice and figure and synchronized material. The teacher's voice and figure recorded video camera is encoded RealMedia format and MPEG2 format. In the campus area network, MPEG2 video server and high-speed network are provided. Students can access and replay MPEG2 data on their personal Workstation in the university. RealMedia server also provided to be able to service all people on the Internet.

Presentation materials are converted to text-base HTML format and synchronized to teacher's voice using SMIL[6] and tools we developed. When students starts playing lecture, the material is loaded automatically following teacher's

voice. The lecture and synchronized materials provided through WWW sever. Figure. 2 shows example scene of the lecture.

3.2.2 Data Creating System

A Data Creating System consists of video camera, encoder, editing tools and material synchronized tools. We need lecture video and magicpoint or Microsoft PowerPoint data provided from teacher and slide change timing to make one lecture content. The procedure of making content is below.

1. Recording teacher's voice and figure by video camera.
2. Encoding MPEG2 and/or RealMedia.
3. Editing video.
4. Converting PowerPoint file to text-based HTML files.
5. Making SMIL file for synchronizing video and materials.
6. Creating metadata
7. Putting Lecture on Demand Server.

The recorded data is encoded MPEG2 by hardware MEPG2 encoder. Encoding RealMedia is executed by software RealMedia encoder. RealMedia file is created in the lecture simultaneously, MPEG2 file is encoded after the lecture. PowerPoint file is converted HTML by Microsoft Office tool. We implemented Making SMIL files and creating metadata tool.

3.2.3 Administration System

The Administration System is consist of large storage and processing computer. The functions is classified to next four management.

1. Contents Management
2. Students Data Management
3. Metadata Management
4. Distribution Management

Contents Management manages Lecture Data Archiving (lecture series and special lecture) consisted of video, text and many informations. It has interface to access log and searching. Access control mechanism is also provided because it is decided by each teacher whether the contents is open through the Internet or only inside university. Figure. 3 shows sample of class information.

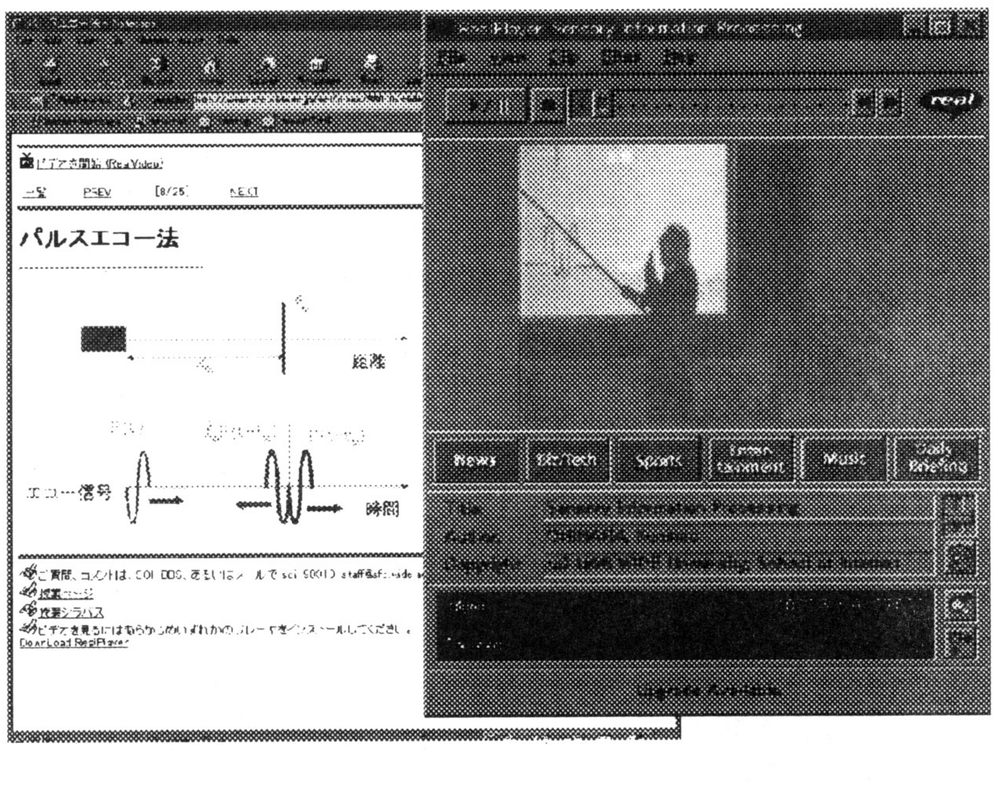

Figure 2: Example: A Scene of Lecture

Students Data Management deals with data what class he/she takes, his/her grade and reports. This system required security and right management.

Metadata Management has interface for adding metadata and tool for analyzing log file. The "grow metadata" make grow this system by feedback from students.

Distribution Management has important function to cooperated other server. Currently, it manages mirroring SOI server archive.

4 Discussion

We designed and built this Lecture Archive System. Two lecture courses are archived this system. Many special lecture data are also archived.

In this section, we discuss this system at two point of view: system architecture and metadata.

4.1 System Architecture

This system can handle the flow of digitizing, archiving, servicing and managing lecture in a lump. It makes acceleration to increase new type of multimedia contents in the Digital Library System. The system dose not required special technology, only two operators control video camera and execute some command after the lecture.

Students can attend these lecture anytime, anyplace through the Internet. They can replay lecture whenever they want to hear again. Additionally, these lecture contents are referenced other people in the Internet. It shows that university lectures are very useful for lifelong education.

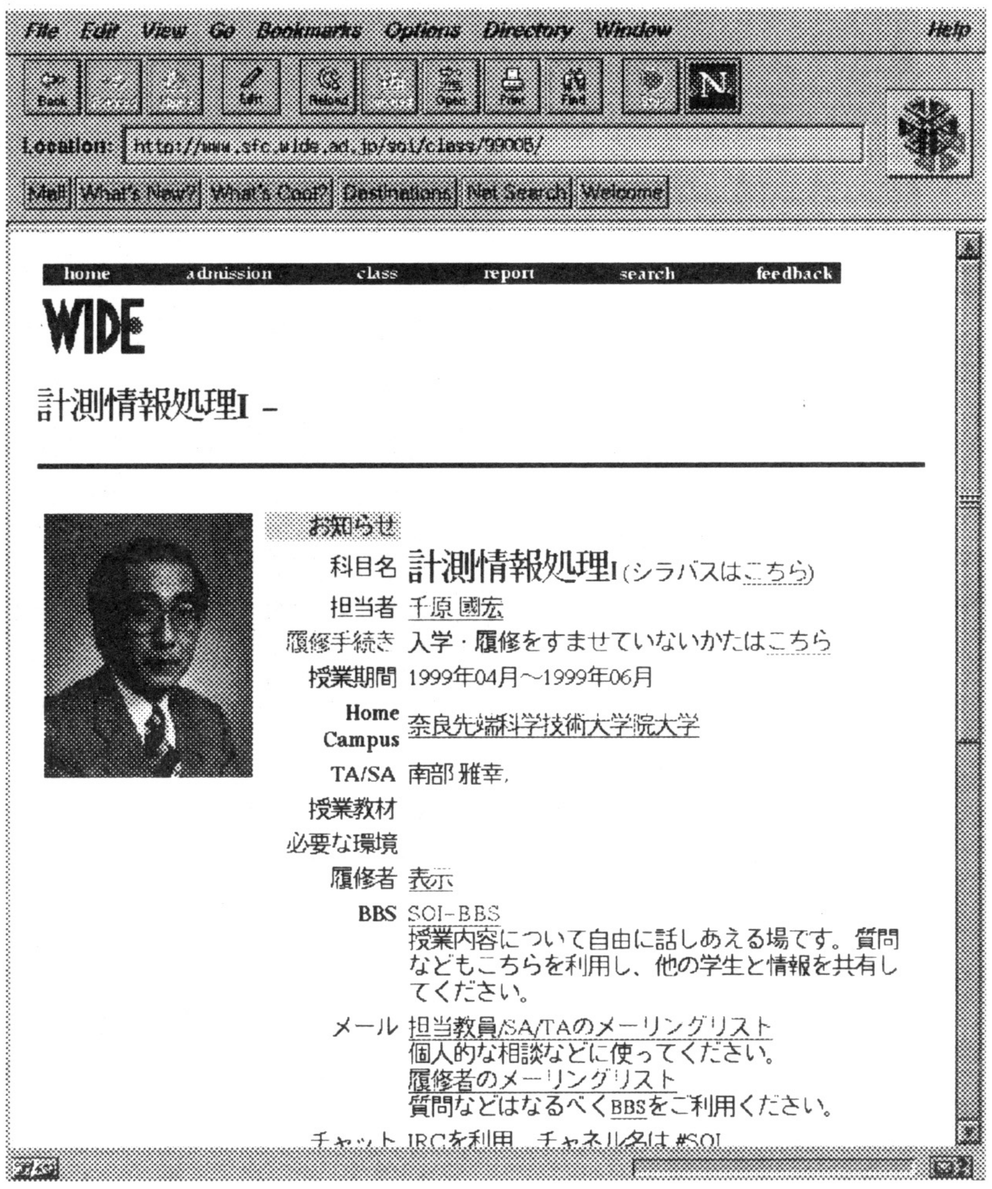

Figure 3: Example: Class page

4.2 Metadata and Applications

The purposes of adaptation metadata are that simplify the management and discovery these lecture data in this system. The metadata based Dublin Core is simple and fit to use lecture data and database. The elements about video such as indexing, time code are not exist, we supplement this function using SMIL. That combination is very useful.

"Grow metadata", we proposed, is one of way to qualify the lecture metadata. Since someone who operates this system is not specialist about the lectured field, they may not create perfect metadata, especially about contents. When the teacher or other specialist reply the lecture data, that interface is useful to make correction these mistake. The qualifier is the teacher.

4.3 Future Work

This Lecture Archiving System is not completed. Powerful search system based on metadata will provide as system components. The teacher has rights on his/her lecture. It should be controllable whether this data can be published Internet of only campus area network or only people who register this course. Combination some technologies is needed to realize this requirement.

Technology of converting and distributing video data is important for providing all people on the Internet. We plan to solve by intelligent server that can convert and distribute suitable data.

5 Conclusion

We have proposed Digital Lecture Archive System model. In Nara Institute of Science and Technology(NAIST) environment, we implemented (1) Lecture on Demand System, (2) Data Creating System, (3) Administration System. To design this system, we extended Dublin Core metadata element set for lecture archive. We also proposed "grow metadata" to manage the lecture data. It makes progress quality of metadata and application especially distributed environment.

Acknowledgment

We would like to thank teachers who agree their lecture to publish through this system, member of Research Division, Digital Library, NAIST, especially Mr.Hisakazu Hada and WIDE Project School of Internet group members.

References

[1] Keiko Okawa, Jun Murai: "School of the Internet: A University on the Internet", In Proceedings Internet Global Summit, INET98, 1988.
[2] http://www.wide.ad.jp/soi/
[3] Rei Suzuki, Hideki Sunahara, Masakazu Imai, Kunihiro Chihara: "Building Digital Library System - NAIST Challenge", International Symposium on Research, Development and Practice in Digital Libraries 1997, ISDL'97, 1997
[4] "Description of Dublin Core Elements", http://purl.org/metadata/
[5] "W3C RDF Activity", http://www.w3c.org/RDF/
[6] "Synchronized Multimedia Integration Language (SMIL) 1.0 Specification", W3C Recommendation, http://www.w3.org/TR/REC-smil/
[7] WIDE project home page, http://www.wide.ad.jp/
[8] Lagoze, C., C.A. Lynch and R. Daniel: "The Warwick Framework: A Container Architecture for Aggregating Sets of Metadata", 1996