ABSTRACT

It is desirable to build up a lecture video library to enable students to view past lectures at any time and from anywhere on their PCs. For this purpose, we have developed a lecture video player/maker system (Yoshida, 2002, 2003). In developing this system, we considered the usability for students and operability for teachers. The player includes a keyword access function, which enables the student to jump to scenes where one of the registered keywords was spoken. For this purpose, the maker realizes automatic index generation after continuous speech recognition of the whole lecture stream. In this paper, we discuss the structure and functions of an ideal lecture video player and the importance of the index corresponding to the scenes in which the related keywords are spoken. We also will present experimental results regarding keyword extraction from three lecture streams. Evaluations of the lecture videos and the player by students are also discussed.

Keywords: computer-based training; e-learning; indexing; keyword extraction; learning support; lecture video

INTRODUCTION

With recent improvements in networking technologies and highly efficient video coding schemes, Video On Demand (VOD) systems increasingly are being applied in the field of education. A number of such systems, including Classroom 2000 (Abowd, 1999, 2000; Brotherton, 1998) and Intelligent Classroom (Franklin, 1999), have been reported previously. Classroom 2000 focuses on the multimedia lecture style based on PowerPoint presentations. Classroom 2000 uses special equipment, such as a digitized chalkboard, video projector, and fixed video camera. Students learn by
accessing slides and speech mainly via a Web browser. In contrast, Intelligent Classroom consists of computer-aided technology for recording lecture videos. In this system, the teacher can control the changing of slides simply by giving a verbal command. In recording the lecture, the camerawork is controlled automatically, based on the teacher’s actions.

In our department, an electronic library of lecture videos has been developed to allow undergraduate students to study not only in the university but also at home. To encourage students to learn on their PCs, a good human-interface, such as ease of operation and the facility to jump quickly to any particular scene, is required. On the other hand, for teachers, it is preferable to be able to make such video content without special equipment or requirements. For these purposes, we attempted to address the following requirements in the development of an ideal VOD system for use in education.

- **Adaptive to any lecture style.** No special lecture style or equipment should be needed. Only a digital video (DV) camera and operator should be required. The system should be usable with even a traditional lecture style using a blackboard and chalk.
- **Ease of installation and operation.** It should be easy to make the digital video stream with an index of keywords. The teacher should connect an IEEE1394 line between a DV camera and a PC, and the keywords and their time base should be extracted automatically and recorded by a speech recognition engine.
- **Quality of lecture videos.** The word quality has two meanings: picture quality and quality of content. The quality of a lecture video is determined by the clarity of characters and figures on the display and by speech quality from the speakers. The video format and resolution on the screen are standardized. Therefore, skill of the camerawork is very important. The teacher’s speech should be recorded on the DV tape synchronously with low noise, because the quality of speech affects both the ease of listening and the performance of speech recognition.
- **Usability for studying.** A keyword-accessible lecture video player was developed to assist students in studying on their own initiative.

The following sections present an overview of the lecture video files and the system developed in this study. In addition, the results of evaluation by students are also discussed.

**RECORDING LECTURE VIDEO**

In our department, we present an Electrical Circuit class, which consists of 12 lectures for undergraduate students. The details of creating the video files are as follows:

- **AV recording.** We recorded the lectures using a DV camera. To improve the performance of speech recognition in the keyword extraction process, the teacher used a headset with a microphone. To synchronize the audio and video streams, the speech signal was fed to the video camera via a UHF wireless transmitter and recorded onto DV tape in DV format.
- **Video picture framing.** Zooming and framing are done manually to ensure high quality of the contents. The most important factor of the picture is whether char-
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