Whiteboard Extracting and Sharpening for Lecture Archiving System

Hiroaki Kobayashi (1510017)

School of Information Science,
Japan Advanced Institute of Science and Technology

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E-learning is education using computers and networks. It has attracted attention with the spread of the Internet. It can be used at remote locations and can be facilitated by images and videos. It includes WBT (web based training) method especially. Lecture archive is one of e-learning applications.

JAIST introduced a video archive system in the lecture of Information Science in 2006, which allows students to watch lecture videos for self-study. This system records most face-to-face lectures as lecture videos. Students are allowed to watch lecture videos on the Web browser and they can watch from the campus like laboratories or dormitories. They use this system for self-study after attending the lectures.

We have a problem with the system such that some items on whiteboard are sometimes unrecognizable due to a noise or low resolution. “Whiteboard readability” is lower than other questions by the evaluation of the students who used the system.

There are two points to improve whiteboard readability especially. First point is low resolution. The whiteboard area is small in spite of HD videos. Second point is camera position. Image is tilted by fixed ceiling camera.

The purpose of this research is to improve whiteboard readability in lecture archive system to sharpen characters difficult to read in the whiteboard. In JAIST each student comes from a different university, so students in JAIST have different level of knowledge and skills as their

background. The reason is that JAIST is a graduate university. In addition to this, Ministry of education in Japan will improve the education in graduate school. Therefore, reflecting on a lecture is very important.

Current lecture archive system has the following specifications. Lecture videos are full HD resolution, 100 minutes lecture videos and camera not moving. Therefore, this research has three requirements. This method is not using special devices for lecture rooms, needs fast processing for multiple lectures and detects suitable whiteboard for notetaking.

Our method consists of two steps. First step is image extraction. This is preprocessing step before sharpening. This includes extracting whiteboard area from the lecture video, determining extraction timing, removing instructor area, cutting out the whiteboard area and correcting tilt. Second step is sharpening image. We apply the super-resolution processing with multiple frames.

We use multiple frame super-resolution processing for sharpening the whiteboard area. Each frame in a video has slightly different information. Information that does not exist in one frame can be included in another frame. This method restores information lost by sampling from other frames. In the case of Lecture archive videos the frames in lecture videos have some differences in the whiteboard area in spite of no move.

Ni(2016) applied super resolution to whiteboard. The video was recorded by smartphone app. They used OpenCV's super-resolution class. They suggested the effectiveness of the SR class method. However this method cannot be applied to the lecture archive system because some conditions are different. It is important to consider pre-processing best for lecture videos. Although there is a prior study, it does not necessarily correspond to a general lecture room.

Our development system has four steps finally. The steps are input of video, preprocessing (includes determining extraction timing, cutting out the whiteboard area, correcting tilt and Removing instructor area) and applying super-resolution and outputting images.

We did two case studies. The first case study is about extraction processing. We examined whether our system can extract images accurately by applying our extraction process to lecture video. Our system was able to recognize the big change, but we could not recognize the partial change.

The second case study focused on the student's reproduction of the letters on the whiteboard in lecture video. It is whether students can read letters. I prepared images with super resolution and unapplied images, and let

students write letters. The students tended to be able to read the super-resolution more accurately, but in some cases it was not. In addition, the students felt that the images by applied super resolution method was applied was easy to read, and some cases not so. From these study cases, we found that there are effective and not effective situations in our method.

Our system has been shown to be effective for lecture video. However, the system needs more improvement and addition of some functions in our system. In addition, by doing more experiment, we must know the cause of the case where the system is not effective. Application of this method is expected to improve the efficiency of learning of students watching and facilitate note-taking. Development such as conversion to character information is expected in future.