STUDY ON ACQUISITION OF LECTURER AND STUDENTS ACTIONS IN THE CLASSROOM

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Abstract: Recently, there are many lecture archiving system that provide lecture video, presentation slide and written text/figure on whiteboard. However, the contents of lecture archiving system are decided by the provider of the service. In this paper, we propose a new lecture archiving method based on students' viewpoint. Our archiving method adopts the viewpoint that the majority of students are watching. We conduct verification of our proposal method, by preliminary experiment. Furthermore, we consider that our acquisition technology of lecturer and student action helps lecturers to recognize students' ROI (Region of Interest) in the classroom.

1 INTRODUCTION

With the development of information technology in recent years, web-based learning system including lecture archiving system has become popular. And the adoption of system to support teaching and learning activities has been rapidly increasing in the higher educational institutions. Recently, many higher educational institutions distributed lecture materials, including presentation slide and lecture video, as a contents of lecture archiving system, OCW (OpenCourseWare) and lecturer's own web site.

Nakamura et al. work on creating lecture contents that catch the attention of students (Naka mura et. al., 2006). The system highlights important term to keep pace with the tempo of lecturer's explanation. Nagai works on lecture recording that uses a HDV (high-definition video) camera and virtual camera work (Nagai, 2008). Le et al. propose an automatic digest generation method from the presentation video recorded by commercial software (Le et. al., 2008). Many software are sold, which can easily convert footage of lecturer and presentation slide into web contents, and deliver lecture contents over Internet.

Many lecture archiving system contains footage of lecturer, presentation slide, written text/figure on whiteboard, and interaction between lecturer and students. The system provides lecture information that combine several materials given above. Existing lecture archiving system 1) provide footage of lecturer depending on lecturer's movement, 2) set the direction of the camera beforehand, 3) edit the video after the lecture. The contents of the system are decided by the provider, lecturer, teaching assistant and system administrator. Existing services don't consider the interaction between lecturer and student that occurs in the classroom.

In higher educational institutions, interaction between lecturer and student is the most basic activity, and the classroom is the primary place for

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such interaction. In this paper, we focus attention on student's face orientation, as one of the non-verbal interaction occur in the classroom. We propose a new method that generates lecture archiving content based on students' attention, that is, using their face orientation. We consider that our acquisition technology helps lecturer to grasp students' condition and ROI (Region of Interest). Lecturers can use students' attention for improving lecture method.

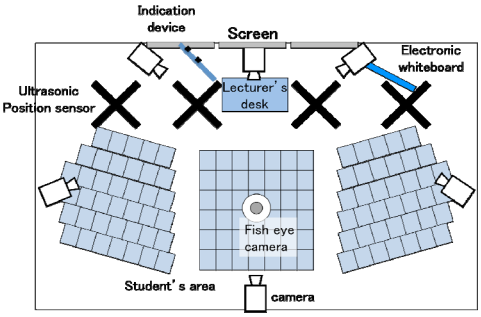

Figure 1: Equipment layout in the classroom.

In Section 2, we describe the overview of our lecture archiving method. Then in Section 3, we describe the acquisition of lecturer and students' actions occur in the classroom, and we propose a new lecture archiving system based on interactions between lecturer and student in Section 4.

2 OVERVIEW OF OUR LECTURE ARCHIVE SYSTEM

In this section, we describe the overview of lecture archiving system. We have been developing automatic lecture archiving system that records various information, such as lecturer and students' voice, video, presentation slide and written text/figure on whiteboard (Marutani et. al., 2006).

Figure 1 shows equipment layout in the classroom. There are three screens at the front of classroom; as a student's view, presentation slide are displayed on the left and center screen, written text/figure on the whiteboard are displayed on the right screen. The cameras located at rear side, right side and left side of the classroom shoot lecturer, and the three cameras located at front side are shooting students. Furthermore, the system acquires lecturer's position and movement by the ultrasonic location sensors, which set on roof, lecturer and indication device.

Our lecture archiving system records and synchronizes audio/video of lecturer and students, presentation slide, written text/figure on the whiteboard, then provide these data as a lecture archiving system.

3 ACQUISITION OF ACTIONS IN CLASSROOM

We have been working for the acquisition of time sequential context occurs in the classroom, such as lecturer's action and movement; utterance, pointing and writing whiteboard, and student's action; face-raising or note-taking (Marutani et. al., 2006), (Hattori et. al., 2008).

3.1 Acquisition of Lecturer's Action

In the classroom, there are three major classes of lecturer's action based on lecturer's location and orientation; descant, explanation of presentation slide and explanation of text/figure on whiteboard. Our system acquires these lecturer's actions using various sensors in the classroom. Ultrasonic location sensors; installed on roof, lecturer and indication device, given location information of lecturer and pointing information. The archiving system records the contents of slide and time to changing slide, furthermore, contents of written text/figure on whiteboard and time when the text/figure are written. Then the system acquires lecturer's actions.

3.2 Acquisition of Students' Action

Three cameras located at the front of classroom shoot students' actions. Left camera is set up at the top of left side screen, right camera is set up at the top of right screen, and all three cameras focus on center zone of students' area. Then we acquire students' face orientation utilizing detecting faces from recorded images.

Now, we categorize student's action in the classroom into four types; hear the lecturer's explanations, view a front screen, view a whiteboard and take lecture notes. We identify these four types based on installation position of equipments and student's face orientation.

3.3 Detecting Student's Face

We experiment to verify the possibility of realize the new archiving method based on student's face orientation. In usual, when lecturer explains using left screen, students view left screen. At that time,

the system detects many faces from the image shooting by left camera, on the other hands, the system detects no faces from image shooting by right camera.

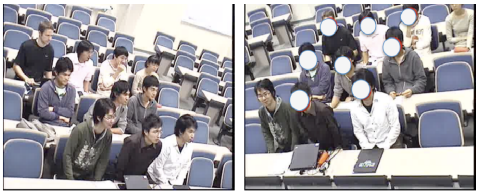

Figure 2: Detection results when lecturer explains using left screen.

Figure 2 shows the result of face detection when lecturer explains displayed on left screen. Left figure shows the detection result of the image shooting by left camera, there are no faces, and then right figure shows the detection results of the image shooting by right camera, there are 8 faces.

3.4 Face Detection Performance

We conduct verification of student's face detection by preliminary experiment. 10 trial subjects take seats in the central area of students' area in the classroom. Three cameras located at the front of classroom shoot students' actions. Lecturer moves freely at the front side of classroom; to descant standing in front of a center screen, to explain presentation slide standing in front of left screen, to write text/figure on whiteboard standing in front of whiteboard. Students turn their face toward lecturer/screen/whiteboard according to lecturer's directions.

Table 1: Face detection performance of sample situation.

	Right camera	Center camera	Left camera
View front screen	5.08	10	4.42
Note taking	0	0	0
Sit chin in hand	0	3.7	0
View left screen	6.11	9.32	0
View whiteboard	0	7.13	7.12

We conduct verification of student's face detection for student's typical condition in lecture room; hear the lecturer's explanations, view a screen, view a whiteboard, take lecture notes, and put their chin in their hands. Table 1 shows the average number of face detected in preliminary experiment. When students view center screen, 5.08 faces were detected by right camera, 10 faces were detected by center camera, and 4.42 faces were detected by left camera. "0" means no faces were detected. We make sure that we can use students' face orientation to grasp their attention.

4 LECTURE ARCHIVING METHOD BASED-ON STUDENTS' VIEWPOINT

Most of lecture archiving systems provide many kind of data, such as footage of lecturer, presentation slide, written text/figure on whiteboard, and so on. However, we consider that it is difficult for audience to pay attention every data. Therefore, we propose new archiving method based on student's viewpoint in real classroom.

In consideration of preliminary experiment described in Section 3, we decide the archiving rule as follow:

- Over two-thirds faces are detected from the image shooting by left camera, the system judges most of students view left screen. Then the system brings the presentation slide displayed on left screen into our archive data.
- Over two-thirds faces are detected from the image shooting by right camera, the system judges most of students view whiteboard. Then the system brings the whiteboard image into archive data.
- Over two-thirds faces are detected from the image shooting by center camera, and no faces are detected form other camera, the system judges most of students view lecturer's explanation. Then the system brings the footages of lecturer into archive data.
- There are no cameras detecting over two-thirds faces, the system judges most of students are taking lecture notes, and then the system brings presentation slides into archive data.

Figure 3 shows the image of proposal lecture archiving method. Horizontal axis is a time scale. Upper 3 lines are data for archive; lecture video, presentation slide and written text/figure on whiteboard. Next 3 lines are data for estimating students' viewpoint; the image shooting by left side camera, center camera and right side camera. And bottom liee is generated archive data. At first, we check leftmost row's three images shooting by left

Figure 3: Image of proposal method.

side camera, center camera and right side camera. If over two-thirds faces are detected from the image shooting by center camera, and no faces are detected from other camera, the system judges most of students view lecturer's explanation. Then the system brings the footages of lecturer into archive data. Then the system checks next image, and the system decides which image are incorporated into archive data. By repeating same procedure, the system generates new archive data. Students can use these generated new archive data during their commuting time by using PDA like iPod touch, and full/traditional archive data are available on PC(web browser).

We consider that good lecture have some relationship between lecturer's action and students' action, interaction between lecturer and student. For providing high quality educational service, lecturers have to grasp students' condition and then lecturers should modify lecture materials or refine teaching method. Our face detection method can help lecturers for grasping students' movement. Therefore, our method can use in FD(faculty development) field.

5 CONCLUSIONS

In this paper, we try to recognize students' face orientation using three types of images shooting by three cameras. And we propose new lecture archiving methods based on students' viewpoint. We consider that our acquisition technology of lecturer and students action can use not only our archiving system, but also grasping students' condition in faculty development. As for future works, we verify the effectiveness of our acquisition technology to apply our technology to real lecture.

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