

# Designing a Peer Reviewing Tool on Lecture Video with Handwritten Annotation

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**Abstract.** To improve lessons in accordance with students' comprehension levels, evaluation of teaching performance has been carried out by questionnaire and lesson study. However, lesson study in the context of faculty development is difficult for participants to spend long time for classroom observation and reflective discussion. Even if they have time for discussion, unfocused discussion often causes less fruitful and mutual understanding. We are developing an annotation tool not only to solve the above-mentioned time and space constraint but provide benefits owing to archiving lessons and their reviews. We design a pen-based annotation tool by which reviewers can write comments and draw marks onto on-line and off-line movie of class observation. The details of the annotation tool and user feedback from preliminary experiment in actual classrooms are described in this paper.

**Keywords:** Annotation, lecture video, faculty development, peer reviewing, pen-based interface.

## 1 Introduction

With the spread of digital devices and networks, it has recently become possible to capture lectures and share the lectures. Course material is digitalized, provided to students or open to the public. These trends brought to fruition as the evolution of e-learning or Open Course Ware (OCW). In order to promote these activities, it is often that devices like electric whiteboards, projectors, PC with tangible interfaces and video cameras are equipped for recording lectures. Mechanisms of sharing created contents are also invented and packaged as Content Management Systems (CMS) or Learning Management Systems (LMS).

On the other hand, to improve lesson in primary and secondary education, it is common practice that a few evaluators observe a lecture, and then have their observations discussed in meetings [1]. While we can expect similar practice to improve lectures in higher education, it is difficult to schedule for all participants to come together, due to various reasons, for both lectures and meetings.

In this paper, we propose a peer-reviewing system, which allows the users to add handwritten annotations on video images, both during recording or at a later time. In this way, peer review of lectures can be done flexibly. Evaluation studies, conducted in undergraduate courses, indicated that recorded movies with annotations promoted meaningful discussion and collaboration between teachers and reviewers for faculty development. We are planning to construct rooms that suit to make full use of this annotation tool, which has multiple cameras to shoot both lectures and reactions of students. Facilities required to use the annotation tool are very similar to those required to archive lectures for e-learning education. The architecture of the designed rooms is mentioned at the end of this paper.

## **2 Scenario of Peer Review**

The goal of this research is to provide teachers with tools that are useful for reflecting and improving their lectures. Roughly teaching skills and materials are important elements that determine a lecture is good or not. Materials like handouts, slides and other digital resources are generally organized and easy to be revised. However, a teacher may be unaware of problems in teaching skills including speaking, gesture, usage of the blackboard, interaction with students and so on. Peer review by other teachers is helpful in point of objective analysis. Teachers in the same department or whose specialty is related to faculty development or instructional design are supposed to be reviewers.

We assume the system is used under different situations such as following three cases.

### **2.1 Real-Time Annotation at Class**

Reviewers attend a lecture and review activities in the classroom. In order to grasp the activities during class, video cameras are settled and connected to tablet computers for reviewing in the classroom. They observe the lecture and write comments with the tablet computers. All of the handwritten comments and the movies from the video cameras are stored to the tablet computers with timestamps for synchronizing the comments with the movies.

### **2.2 Annotation to Recorded Class**

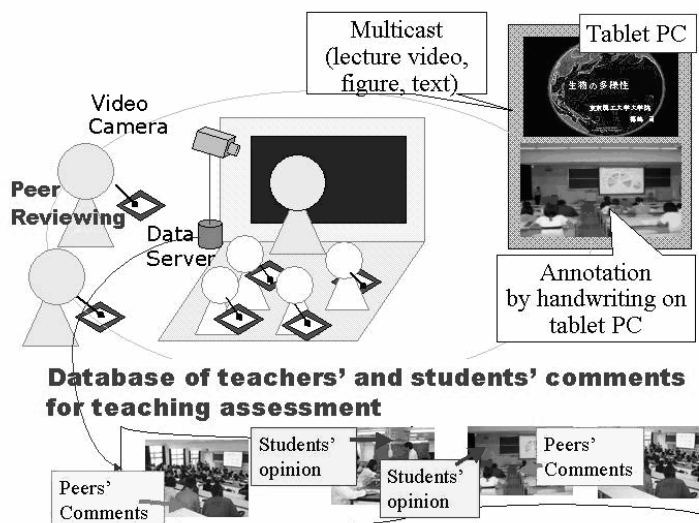
Reviewers observe a lecture with a recorded movie and write comments with the tablet computers the same as shown in 2.1. The movie of the class must be recorded in advance. They do not have to attend the lecture in the classroom, but they may meet difficulty in grasping the atmosphere only with the movie.

### **2.3 Annotation at Review Meeting**

The teacher calls a meeting with reviewers after a lecture. Then they watch the movie of the lecture that is recorded the same as the above two cases. It may be already reviewed by the reviewers as shown in 2.1 or 2.2 and comments are written. During

the discussion at the meeting, reviewers or the teacher can add further comments at any point of the movie.

By using the annotation system in the above asynchronous situations, reviewers are free from time and space constraint. Reviewers annotate comments directly onto movie played on the tablet computers, which allow them to write comments on exact targets in the movie. As a result of these features, discussion will be more focused and condensed referring annotation during the lesson study procedure. Figure 1 shows the outline of the peer-reviewing process proposed in this paper.



**Fig. 1.** The outline of the annotation procedure. The cameras shoot both the lecture of the teacher and the reactions of the students. The movie is sent to the tablet computers and reviewers write comments directly on it with the stylus pen. All of the handwritten comments and the movies from the video cameras are stored.

### 3 Related Work

Movie files became much easier to handle with the progress of computers, cameras, storage devices and their interfaces. It is also easy to release and share those movie files on the networks. Now video sharing websites like Youtube and Yahoo!Video attract many users all over the world. The users post comment or rate each movie through BBS form or chat, and the feedback appears on those websites. Text-based annotation is the major technique to enrich the contents. Other annotation media are also considered like handwritten messages, voice messages, and movie files as a response to original one.

Annotation to the movie files is carried out for various purposes. Tagging metadata for indexing is important to perform useful operations such as content search and content recommendation [2]. TAGGER [3] captures meeting sessions and allows

individuals to manually structure these sessions by tagging with laptop computers. M4Note [4] is a Java based annotation tool with pen-based electronic ink and voice operation. It is possible to play the annotation synchronously with video and, during the playback, to add new annotations or to edit existing ones. It is also extended to the editing of interactive TV multimedia documents by end-users[5]. However, M4Note converts all the annotations into text with handwriting or voice recognition. In addition, the user has to stop the video capture and select a video frame to be annotated. It is not directed to moving pictures themselves.

LEAN [6] is a video editing software that enable casual annotation with the fluid control interfaces. Its primary interface is a digitizer tablet with a pressure-sensitive pen. LEAN allows for the manipulation of a video stream by using a small set of gestures that let users start, stop, and move to any arbitrary point in time in the stream. Annotation can be marked with a size and position directly related to both the number of annotations and the moment a particular annotation was made. Users also have the ability to 'pin' a note into the workspace, making it visible at all times, regardless of the current frame being displayed. Annotation can be written directly over the video frame. This research mainly focuses on the intuitive interfaces and it is free from restriction that aims for a specific purpose. An intuitive interface for video teleconference including annotation that can be written directly over the video frame is also proposed [7].

Several annotation tools that focus on practical use in lectures are designed [8]. Livenotes [9] is intended to be used for cooperative note-taking by students. Slides and blank sheets are prepared as handwriting area. They are also enabled to be written directly over slides, but not over video streams.

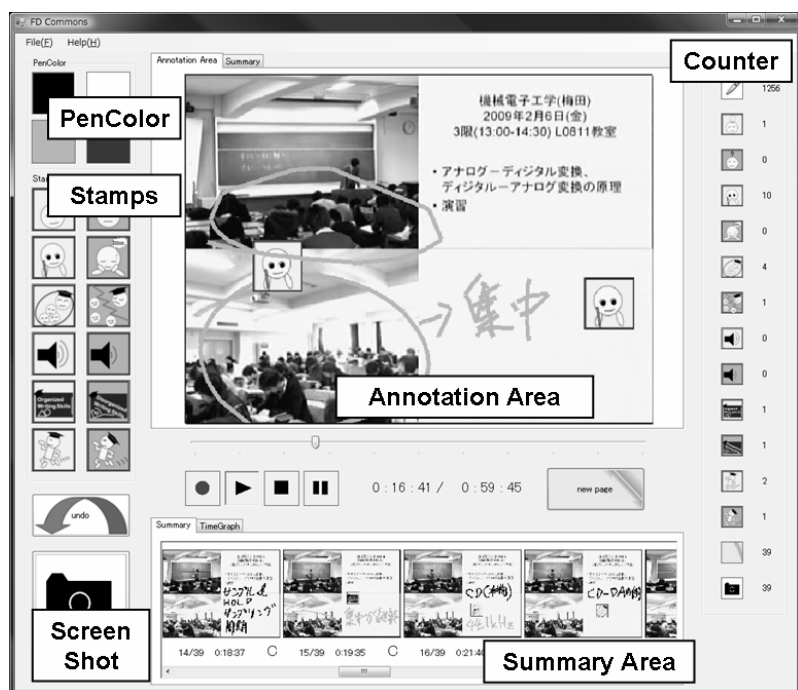
## 4 Design of Annotation Software for Peer Reviewing

The main objectives of our project are to support peer-reviewing process. We come to the conclusion that software specially made for the process is needed. According as the general process of peer-reviewing, prototypes are developed and the functions of the prototypes are revised with the comments from the trial of teachers. The features of developed software are described in this section.

### 4.1 Features of Annotation Software: FD Commons

We named the developed software "FD Commons" that focuses on the peer-reviewing process toward the activities of FD(Faculty Development)[10]. FD Commons is an annotation tool that runs on tablet PC and makes use of the movies of lectures.

By developing handwriting interface with easy operability, it aims to provide teachers outside class with on-line peer reviewing opportunity that is necessary to and relevant to their teaching/learning improvement. Moreover, the database of reviewer annotation has capability of reusing collected comments in order to suggest weak and strong points of class lectures and to design the rubric to evaluate lectures. This system development realizes ubiquitous peer reviewing and reuse of comments of reviewers for assessment of teaching/learning in higher education.



**Fig. 2.** The screen shot of the annotation software “FD Commons”. Mainly it consists of four panes: Toolkits (Left), Annotation Area (Upper middle), Summary Area (Lower middle) and Counter (Right).

Figure 2 shows a screenshot of the annotation tool. Functions of the implemented software are explained as follows. Mainly it consists of four panes. Palettes of pen colors, Stamps stand for typical comments to the lecture, Undo and ScreenShot buttons are settled in the left pane. The lecture being recorded with multiple cameras are shown in the Annotation Area, in the upper middle pane. Screenshots of the Annotation Area are added to the Summary Area in the lower middle pane. The number of each action by reviewers is shown in the right pane.

## 4.2 Annotation Area

The reviewers can mark, point and write comments onto this area using a digital pen. Several stamps are also available for evaluation of the lecture. Movies are shown inside of the area from the cameras connected to the tablet PC as live recording. Instead of recording, pre-recorded movies can be replayed and annotated. The reviewers annotate comments both directly onto the movies and to the blank area next to movies, which allows them to write comments on exact targets in the movies.

## 4.3 Handwriting













Comments and signs that are written by the digital pen are displayed in the Annotation Area with a color selected by reviewers in the palettes. Black, green, red and

white with grey contour (in order to be seen on the blank area) are prepared as pen colors. Undo button is used when the reviewers want to cancel the previous action.

4.4 Stamps

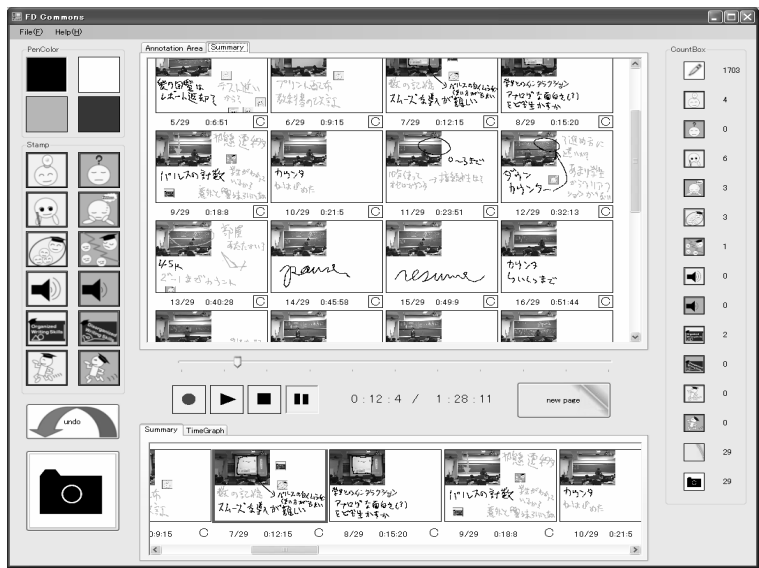
Stamps are prepared as substitutes for frequently used comments so that reviewers do not have to write the same comments repeatedly. The purpose of stamps is not only to save the time for annotation but also to evaluate the lesson quantitatively by counting the number and types of stamps used. The iconized stamps are bitmap files and easy to be exchanged. The meanings of current stamps are shown in Table 1.

**Table 1.** The stamps and their meaning of current version of FD Commons

Stamp Image (Positive / Negative)	Meanings
 / 	well organized for understanding / not organized for understanding
 / 	attractive and motivative for studying / not attractive and motivative for studying
 / 	interactive and aware of students' reaction / not interactive and aware of students' reaction
 / 	volume of voice is appropriate / volume of voice is too loud or low
 / 	blackboard writing is well organized and tidy / blackboard writing is not organized and poor
 / 	lecture speed is appropriate / lecture speed is too slow or fast

4.5 ScreenShot Button and Summary Area

In order to point out a certain comment, the reviewers tap "ScreenShot" button and a snapshot of Annotation Area including handwritings, stamps and movie is taken and added to the right end of Summary Area. When the reviewers tap a certain snapshot while the movie is being played, the movie player jumps to the point that the snapshot is taken. By tapping "New Page" button, all the handwritings and stamps are erased and a snapshot is added to Summary Area the same as by ScreenShot button. After finishing peer-reviewing, all the comments are gathered as a list of snapshots and saved as a bitmap file in order to handle easily. The list of snapshots is shown with tapping the "Summary" tab (Figure 3) and enables users to see the outline of the reviewing.



**Fig. 3.** The screen shot of the list of snapshots (Summary). It appears on the Annotation Area by tapping the "Summary" tab and enables users to see the outline of the reviewing.

## 5 User Feedback and Discussion

In the pilot studies, we investigated the effects and operability of online peer review-ing system on five reviewers those were all faculty members of our university.

One was instructional designer who belonged to center of educational development (faculty developer). The others were academic staffs majoring computer science and mechanical engineering. Totally, nine trials were conducted. All reviewers who used "FD Commons" had no problem with system operability and their views of accessibil-ity. Figure 4 shows the preliminary experiment in a classroom.



**Fig. 4.** The preliminary experiment in a lecture. Cameras are equipped in the front and the rear of the classroom and connected to the tablet computer. The reviewer is sitting in the rear of the classroom and writing comments (Left) of the lecture in the classroom (Right).

The reviewers attend and review the class with writing annotation from the beginning of the class. Reflective session was held immediately after the class. In this evaluation, roughly two feedbacks are investigated. First, by using the annotation tool, the focus of discussion was cleared and retained. Previously discussion had tended to be divergent in reflective session. Secondly, annotation differed depending on the locations of video cameras. The video cameras shooting students provided teacher's viewpoint while others shooting the teacher could provide the students' viewpoint. The amounts of comments were different between these conditions and we observed from the comments that the video camera shooting students was better for evaluation.

From these observations, the annotation tool facilitates the reflective discussion in lesson study, and it requires shorter time for the reflection. Furthermore, we obtained an implication that the use of different views with several video cameras in a classroom could provide better reviewing with rich information of the classroom.

## 6 Conclusion and Future Work

In this paper, we propose a peer-reviewing system, which allows the users to add handwritten annotations on video images, both during recording or at a later time. In this way, peer review of lectures can be done flexibly in order to improve lessons in accordance with students' comprehension levels. Evaluation studies, conducted in undergraduate courses, indicated that recorded movies with annotations promoted meaningful discussion and collaboration between teachers and staffs for faculty development.

In the next step, we will add functions of handwriting recognition and search so that reviewers and teachers can look up specific comments. Also we are planning to construct rooms that suit to make full use of this annotation tool, which has multiple built-in cameras to shoot both lectures and reactions of students.

**Acknowledgements.** This work has been partly supported by Microsoft Research Asia (MSRA) under Mobile Computing in Education Theme "Innovation Based on Recognition Research Platform" and by the grant of CASIO Science Promotion Foundation.

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