A Ubiquitous Lecture Archive Learning Platform with Note-Centered Approach

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Abstract. The main topic of this paper is to develop a cloud-based ubiquitous video on demand learning (u-VOD learning) platform for the lecture archives. The key ideas of the platform are note-centered and responsive function approaches with universal access. Learning style in only watching the archives tends to be passive. The note-centered approach enables the learners to improve such passive learning by means of note taking corresponding to a timeline of the archives. In addition, there are diverse variables in size, shape, performance, and input function for the ubiquitous/smart devices. The responsive function supports ubiquitous device dependency by HTML 5. The universal access would help operation and text input by application of existing speech recognition technique. Based on a proposed u-VOD learning model, we have developed the prototype platform which follows 3-tier architecture to implement it in a scalable way. We have also conducted a small case study to evaluate effectiveness of the platform. The results did not show significant effect compared with "without-note" condition. But, most of the subjects seemed to accept the proposed functions as the part of the u-VOD learning platform.

Keywords: U-VOD learning · Lecture archive · Note-centered approach · Responsive function · Universal access

1 Introduction

In recent years, advancements of wireless network and appearance of innovative smart devices realize a ubiquitous society where people can communicate with anybody, anytime, and anywhere [3]. On the other hand, diverse educational institutes provide open learning resources as open courseware (OCW) and/or massive open online courses (MOOCs). We are also delivering lecture archives, which record more than 1,000 face-to-face lectures per year in the form of video-on-demand (VOD) from April, 2006 in order to provide a supplemental learning environment in School of Information Science, JAIST [2]. Every learner in the world might be able to access such resources by means of spread of the ubiquitous society. In addition, universal access is required in the field of education to accept international students, disability students, and adult

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students. Under these surroundings, ubiquitous learning (u-learning), which realizes a learning environment suited to each learner's situation at anytime and anywhere, has attracted attention from a number of researchers [6]. However, there are a couple of issues to use traditional e-learning contents, especially lecture archives, in u-learning as follows: (1) learning style in only watching the archives tends to be passive, (2) there are diverse variables such as size, shape, performance, and input function for the ubiquitous devices, and (3) universal access is not always supported.

The challenge of this research is to develop a cloud-based ubiquitous VOD learning (u-VOD learning) platform. The key ideas of the platform are note-centered and responsive function approaches with universal access. (i) The note-centered approach enables the learners to learn more actively by means of a note-taking function in which they not only take a note to the timeline of the archive but also ask a question and discuss with others. (ii) The responsive function approach provides suitable interfaces which respond to diverse constraint of the ubiquitous devices, and combines learning experience caused by the multiple devices. (iii) The universal access function supports operation and text input by application of existing speech recognition technique.

This paper first describes a process model of u-VOD learning for the lecture archives and then proposes a prototype u-VOD learning platform with 3-tier architecture to implement it in a scalable way. We have also conducted a small case study to evaluate effectiveness of the platform, especially for the note-centered approach. Unfortunately, the results did not show significant difference compared with "without-note" condition. But, most of the subjects seemed to accept the proposed functions as the part of the u-VOD learning platform.

2 Learning Process Model in U-VOD Learning

The advantages of u-VOD learning are that the learners would face few restrictions for time and space and learn at their own paces. In addition, Yunus et al. showed VOD has similar educational effect to traditional face-to-face lecture [8]. On the other hand, learning style with VOD is often passive and then difficult to reconstruct learning contents due to absence of interactivity [9]. In recent years, furthermore, the technique of responsive design becomes widely accepted to deal with diverse devices or screen sizes, which optimizes the design and layout of a Web application. But, it does not provide suitable functions for each device, but just controls showing or hiding the functions [1].

In order to resolve these issues for u-VOD learning, we first propose a u-VOD Learning process model which utilizes open lecture archives on the Web as learning materials, and enables the learners to share their learning outcomes with a learning community through the note-taking function as shown in Fig. 1. The model includes the following four phases repeatedly: watching, annotation, reflection, and collaboration.

Watching: The learners would watch an archive in diverse types of the ubiquitous device each of which has constraints such as size, shape, performance, and input function.

Annotation: They could take a note relevant to the contents of the archive as closed memos or opened comments.

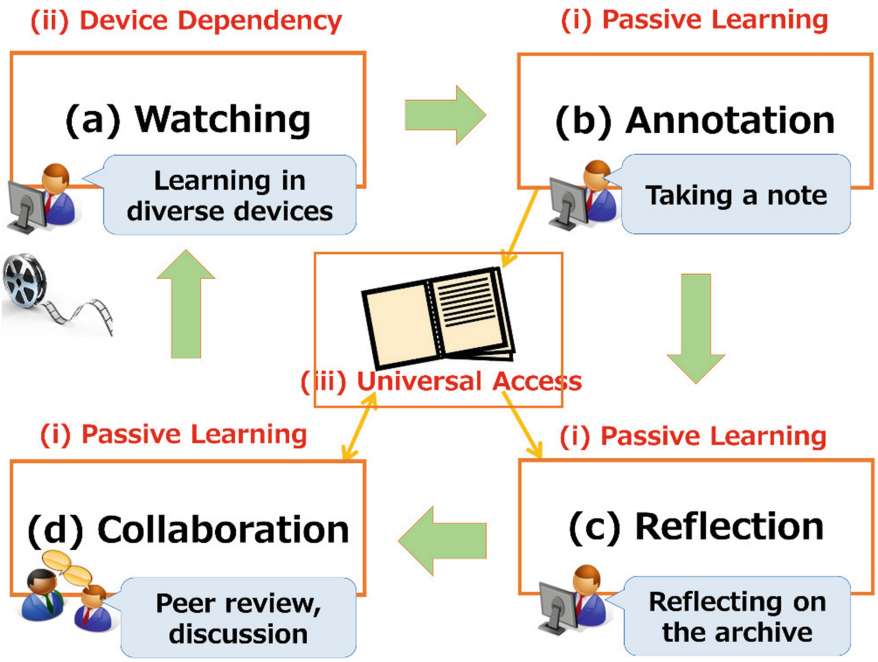

Fig. 1. Learning process model in U-VOD learning

Reflection: They could reflect on their learning process based on the note and the archive in order to memorize the contents.
Collaboration: They might communicate with others to share the knowledge learnt by the previous process. There are diverse effectiveness of collaboration such as learning by teaching, learning by observation, and learning by discussion.

This model regards u-VOD learning as the learning activity that the learners take, refer, and reconstruct the note depending on the learning phases and devices. We call it the note-centered approach. By designing the learning platform based on the model, they can expect to learn actively and self-directly with the interaction among the contents, the learning community, and themselves. It also enables them to centralize all learning experience conducted by different learning phases and devices into the note.

3 Prototype Development

3.1 System Architecture

In developing the prototype platform, we have adopted 3-tier architecture as shown in Fig. 2. A user interface tier provides an interactive web user interface by using the video element of HTML5, JavaScript, and CSS to fit the screen size limitation and input functions of the target device on the client side. A business logic tier offers server side functions such as user management, archive play control, and diverse types of note

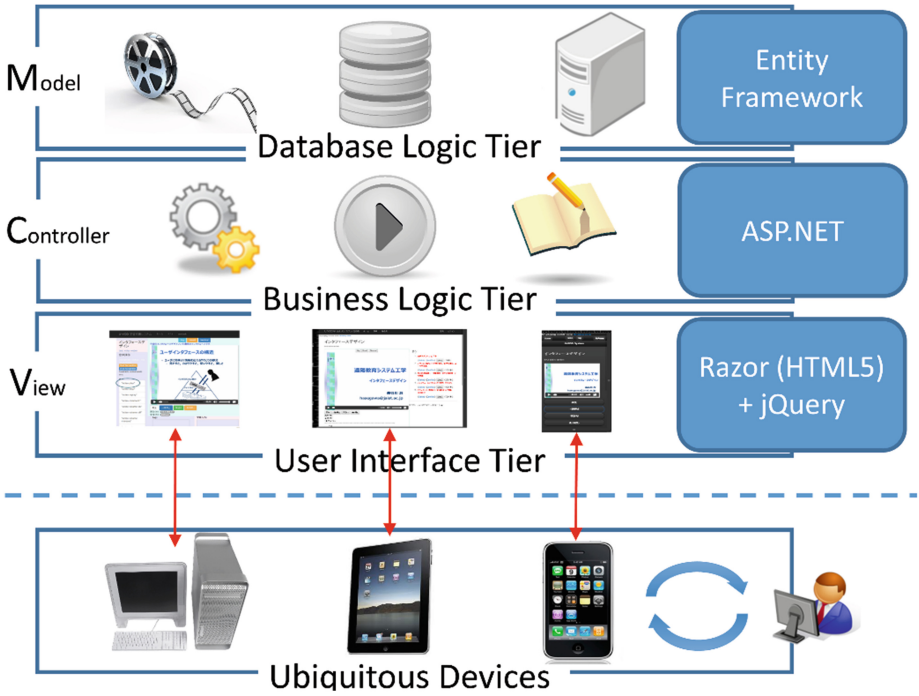

Fig. 2. 3-tier architecture for U-VOD learning platform

representation. A database logic tier uses Microsoft Windows server to host SQL server, the archive files and related tools. It enables us to implement a scalable cloud platform with secure and high performance. As a development environment, we have used ASP.NET MVC 3 which enables us to develop web applications in a similar way to develop Windows applications [4].

3.2 Archive Note Function

In order to improve passive style in u-VOD learning, we have developed a note function called "Archive Note". This function facilitates learning activity in the annotation phase by taking opened comments and closed memos regarding to the timeline of the archive. It then enables the learners to access a specific time of the archive easily in the reflection phase and to add text information to the archive as searchable keywords. If a learning community exists, moreover, they can share the note as a VOD forum like [5]. It is expected to refine their learning outcomes by collaboration. Figure 3 shows an example for usage of the function. If learner A posts a comment on 00:02:30 in an archive, other learners can start discussion by providing hints and making peer review.

3.3 Responsive Function

Another point of the platform is called a responsive function, which supports the ubiquitous device dependency by means of the new standard, HTML 5 with video tag. The learners need not to install additional plug-in for u-VOD learning since some ubiquitous devices impose a limitation on plug-in installation. In addition, the platform provides suitable user interfaces and functions so as to restriction of each device. One of the difference between a desktop PC and a ubiquitous device like a smart phone is operation method, mouse or finger operation. For the ubiquitous device, we have to make clickable buttons larger because it is difficult to tap smaller buttons than the learners' fingertips. In learning on the desktop PC, on the other hand, the platform could provide them with all functions as described above. When they learn on the smartphone, however, the platform would only supply an archive control function since it has a smaller screen size. They can put checkpoints to the archive so that they can

Fig. 3. Interface of archive note

Fig. 4. Interface for iPad and iPhone with responsive function

play back the archive afterward. These learning activities are recorded on the server. Therefore, they can continue their learning from previous point, even with the different device use. The bottom of Fig. 3 is an example interface for the desktop PC and Fig. 4 shows example interfaces for iPad (left side) and iPhone (right side).

3.4 Universal Access Function

In order to provide universal access to the platform, we have also applied existing Web Speech API [7] to support the operation and text input of the application. Once the learners press a "start recognition" button and speak a type of operation, the function operates the system based on the results of the speech recognition. As shown in Fig. 5,

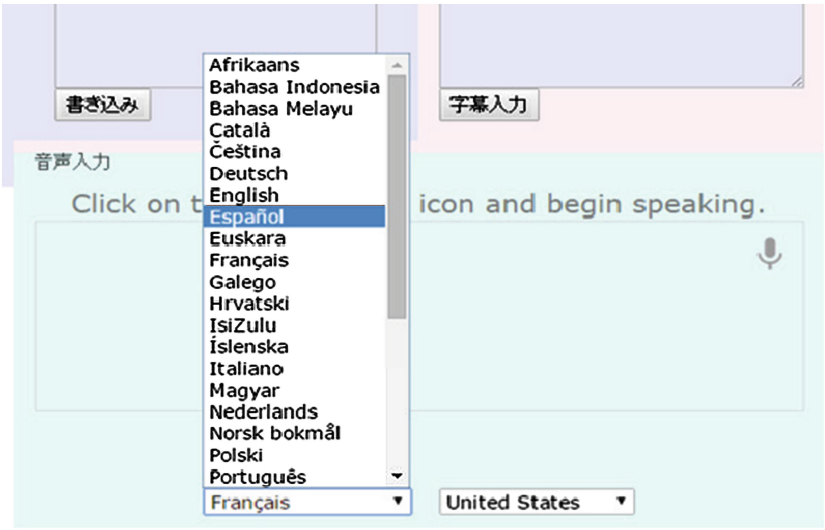

Fig. 5. Interface for universal access function

this function also provides them with the text input because some of the ubiquitous devices are difficult to input text information. This API now supports 36 kinds of language.

4 Case Study

4.1 Purpose and Procedure

The purpose of this case study was to evaluate the effectiveness of the prototype platform, especially for the note-centered approach. The participants were 8 graduate students (4 = female, 4 = male). We had prepared 2 lecture archives in regard to "system evaluation design (duration 00:16:10) and "interface design (duration 00:13:58), which had recorded PowerPoint slides and lecturer's voice. Every participant used similar screen size (11 inch) of laptop PCs. This case study was conducted as within-participants design. In the experimental condition (with-note condition), they were requested to learn the archive using the prototype platform. In the control condition (without-note condition), on the other hand, they used the prototype platform without the note-taking function. The procedure of the case study as follows:

1. Taking a pre-test regarding to the archive topic (5 min).
2. Learning the archive by using prototype platform (20 min).
   - With-note: They could post comments while watching the archive and read others comments with the archive note function.
   - Without-note: They could not use the archive note function.
3. Taking a post-test regarding to the archive topic (5 min).
4. 1st Phase: Taking a rest (15 min) and starting 2nd phase (with considering counterbalance).
   2nd Phase: Answering a questionnaire (5 min).

4.2 Results and Discussions

Table 1 shows the results of pre- and post-test scores (both full marks are 100), and Table 2 shows the results of the questionnaire. Based on the results of the ANOVA analysis, it was found that there were no significant difference between pre- and post-test in "with-note" and "without-note" conditions. In this case study, most of the participants marked high score in "with-note" condition because of ease of the pre- and post-test. Therefore, it was difficult to discuss about effectiveness of the function from Table 1. From the results of the questionnaire, most of the participants answered the questions for the archive note function positively. This indicated the proposed functions were basically accepted as parts of the u-VOD learning platform. In addition, over half of the participants preferred to use smartphones to watch movies. This might be collateral evidence for need of this kind of platform.

Table 1. Results for Pre- and Post-tests

Participants	With-note		Without-note	
	Pre-test	Post-test	Pre-test	Post-test
A	100	80	100	100
B	95	70	80	80
C	100	100	60	80
D	70	100	80	60
E	100	100	80	60
F	85	100	70	20
G	85	100	50	50
H	95	100	70	20
Mean	91.25	93.75	73.75	61.25
SD	112.5	141.1	226.8	869.6
F	0.1489		1.923	
Significance	n.s.		n.s.	

Table 2. Results of questionaire

Q1. Frequency of use for watching movie		
	PC is high: 2	PC is slightly high: 0
	Smartphone is slightly high: 1	Smartphone is high: 5
Q2. Effectiveness of others comments		
	Agree: 2	Slightly agree: 6
	Slightly disagree: 0	Disagree: 0
Q3. Effectiveness of your own comments		
	Agree: 4	Slightly agree: 4
	Slightly disagree: 0	Disagree: 0
Q4. Usefulness of proposed "archive note" function		
	Others comments were useful: 2	Own comments were useful: 2
	Both were useful: 4	Both were not useful: 0
Q5. Usefulness of voice operation		
	Agree: 3	Slightly agree: 5
	Slightly disagree: 0	Disagree: 0

5 Conclusion

This paper has proposed the u-VOD learning platform where the learners are able to not only take a note regarding to the timeline of the lecture archive, but also to use suitable interface demanding on constraint of each ubiquitous device. Moreover, the proposed platform supports universal access with voice operation and input. We believe this research might open the possibility for improving new type of u-VOD learning such as flipped learning.

We have also conducted the small case study to evaluate effectiveness of the platform, especially for the note-centered approach. Unfortunately, the results did not show significant effect compared with "without-note" condition. But, most of the subjects seemed to accept the proposed functions as the u-VOD learning platform.

In the near future, we will first develop a subtitle function as a part of the universal access function by using existing speech recognition technique. In addition, it would be necessary to add some functions such as mathematical and visual expression for note taking. After finishing these developments, a large volume of evaluation will be conducted to make sure firstly whether the learning effectiveness can be improved through learning with note-centered approach, and secondly whether the responsive functions are useful in diverse types of ubiquitous devices.

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