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# Applying Evolutionary Prototyping Model in Developing Stream-based Lecturing Systems

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# *Applying Evolutionary Prototyping Model in Developing Stream-based Lecturing Systems*

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## ***Abstract***

Web-based learning courses lack the explanation and interpretation of teaching materials coming from the teacher. According to Theory of Transactional Distance, web-based learning cannot reduce transactional distance if we ignore teacher's explanation and interpretation to teaching materials and just create "dialog" by using communication mechanism like on-line forum, BBS and e-mail. Therefore it's very important to have teachers' lectures available online for web-based courses. To solve this problem, we implement a stream-based lecturing system that can fully integrate with web-based teaching materials and recur traditional lecturing situation in limited network bandwidth. We propose three versions of stream-based lecturing system by using evolutionary prototyping development model. Version one is *synchronization mode*. The drawbacks of this mode are the need of special players for viewing, based-on IE browser, the mismatch of font size, the error of URL path and so forth. To improve these problems, we developed a version two named *browser capture mode*. It solves most of the problems that version one has, but one main issue remains and that is browser capture mode is still based-on IE browser. Therefore, we are proposing the version three named *full screen capture mode*. Version three will capture video, audio and annotation into a single streaming video file. Finally, we recommend that version three full screen capture mode is the best solution for delivering teacher's online lectures. Besides, this paper also indicates that we will be able to achieve the ideal of " Mobile classroom" by making good use of the stream-based lecturing system.

## ***Keywords***

Stream-based lecturing system, Web-based learning, Mobile classroom, e-learning

## ***1. Introduction***

In traditional teaching, most of the teachers focus their efforts to lecture and answering questions. Teachers spend most of their time doing one-way lecturing like instructing students, explaining materials and clarifying students' concepts, and they spend the rest of the time doing two-way interactions with students like solving students' problems about courses. With the improvement of information technologies, the teacher's instructions will not have any restrictions as in the traditional classroom because teachers could take advantages of the time and space convenience of the Internet to make their teaching activities online for students. Web-based learning becomes one oncoming trend. The difference between the web-based learning

and the traditional learning is that in the web-based learning, teachers and students won't have any contact with each other face-to-face, and therefore they will discuss or interact with each other through the Internet. Owing to this reason students' learning activities and teachers' teaching activities aren't limited to time and space, and they could economize on time and money without going to school to and from [3][4][8].

For meeting the development of the web-based learning and the social demand, many colleges and universities are beginning to put the distance education into practice through Internet, hoping to enhance the learning efficiency by conducting new educational methodologies from Internet media. The establishment of Web-based universities creates a whole set of Web-based instructional and learning systems that simulate the real teaching-learning environment in the classroom via the computer software and WWW based tools [5][6]. Students can study teachers' teaching materials from Internet according to their personal interest and need or teachers' instructional schedule. By using Internet to learn, therefore, is very flexible and autonomic for students who can select the learning sequence that suits themselves and being able to study repeatedly [7].

Nowadays, in the web-based universities, teachers deliver most of the course materials online to the web-based universities after making them into electronic files. However, some teachers make their course materials just by putting the contents of textbooks into web pages, and some adopt the multi-media technology to make their materials vivid, but generally speaking, these course materials all lack the explanation and interpretation from teachers that are commonly happened in the traditional classroom. It would seem that learning just change from books to web pages [7].

Since the teacher's lecture is the major teaching activity in the traditional classroom, we shouldn't ignore it in the web-based learning. Therefore we have to realize the situation of teachers' instruction, explanation and interpretation of the materials. To solve this problem, one well-functioned web-based university must have one mechanism to support teachers to do their instruction, explanation and interpretation of the materials for the web-based courses, so this research developed a stream-based lecturing system to assist teachers and facilitate them to deliver their whole lectures of the web-based courses online in the web-based university quickly. It not only can make students who study on the Internet experience the situation of the teachers' lecture in the traditional classroom but it also can enhance students' interest and comprehension about the teaching materials.

## ***2. Streaming Technology***

We made a short description about the basic concept of the stream-based lecturing system before stating introduction of three different implementation modes. On the Internet, most of the information was presented in static text or pictures in the early days, and users had to download the complete video or audio file to his or her own computer before displaying it with the playing software in their computers. With the development of the Internet and the increase of network bandwidth, however, there are more and more information presented in dynamic and multimedia technology. If we still use the traditional delivering technology to transmit this information at this time, users will spend much time waiting for the file being downloaded. Moreover, these files will be saved in users' hard disk in their computers, and the files that users accumulate to download from Internet will occupy much space for a period of time. The streaming technology is developed just for solving the foregoing problem.

Recently the streaming technology is a promising transmission method for delivering multimedia files on the Internet. When one user requests a video or audio file, the server will decompose this file into packets, and then transmit them to the client. After receiving these

packets, the client will reassemble them and display the file. The client will first download some seconds of information of the file from the server and then display them, and at the same time the client will continue requesting the rest of information from the server. Repeating the same action, the client displays the file while receiving the other packets from the server, and these actions will bring continuous streams. It's just why this transmission method is called streaming [1][2].

There are two advantages to use this transmission method. First, users are able to display the video or audio file without having to download the complete file again. It reduces the users' waiting time and doesn't waste users' time and money to download the information of no use. Second, because the streaming technology only transmit information, the copy of the file will not be kept, and therefore in fact, users don't save the file in their local hard disk. For this reason, the file providers don't have to take the risk that their files will be delivered everywhere, and the copyright will also be protected [2].

The stream-based lecturing system of this research is based on the streaming technology mentioned above to assist teachers in recording his or her video and annotations synchronously when lecturing. By doing so, when going to the web-based learning environment, students are able to see teachers' lectures online right away without having to download the complete lectures.

### ***3. The Development Model of The Stream-based Lecturing System***

Because we don't have the users' needs described completely and clearly before developing this system, we intend to use the prototype model to be the method of developing the stream-based lecturing system. The prototype model is one developmental method that is used to deal with the development of this kind of system for users who can't express their needs completely and clearly or the developers and designers can't find the designing methods or information technologies to solve the problems. It's very helpful to use the prototype model to understand and solve the problems. The prototype model not only can increase communication between users and the system developers but also allow the developers to find out more about the users' needs in advance and acquire users' feedback quickly [9].

There are two applications of the prototype model. One is the rapid throwaway prototype model and the other is the evolutionary prototype model. Here this research adopts the latter to be the developmental model of this system. First we focus on the clearest aspect of users' needs, and after analyzing and designing we complete the first version of the prototype of the stream-based lecturing system. We implement this prototype and modify and expand its functions by users' operations and feedback based on this prototype. We took these suggestions for the evolutionary basis of the next prototype to meet users' needs. The system development procedure of the evolutionary prototype model that this research adopts is like Figure 1 [9].

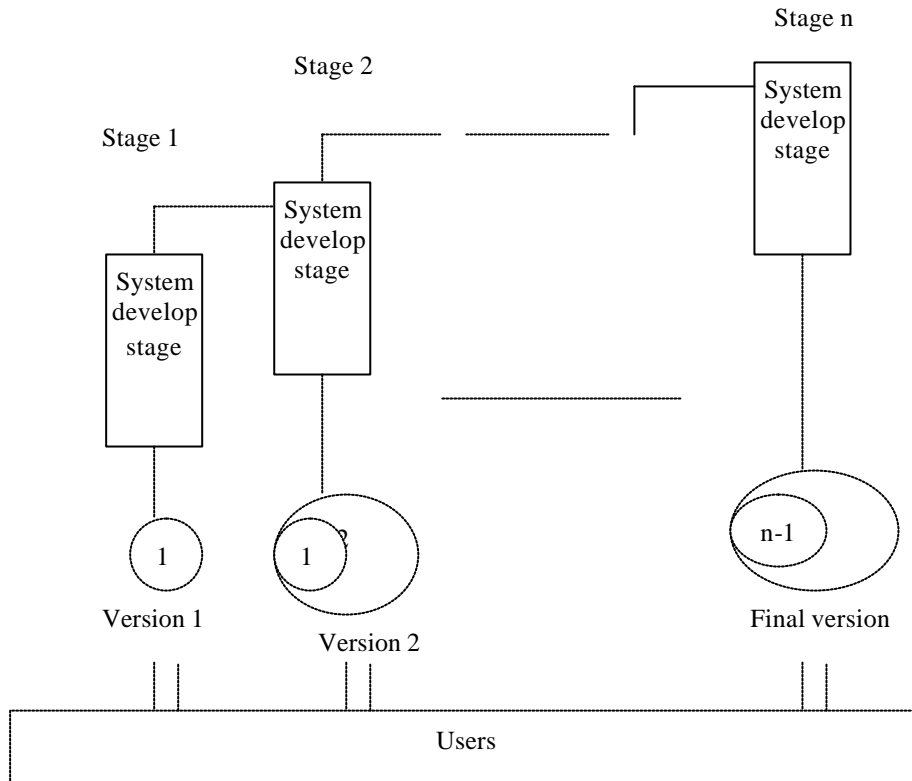


Figure 1: The system development procedure of the evolutionary prototyping model  
 Note. From Systems Analysis & Design—Theory & Application (p.41), by J.H. Wu & H.H. Lin  
 , 2000, Taipei: BestWise Co., Ltd. Copyright 2000 by J.H. Wu & H.H. Lin

#### ***4. Three Stages of The Stream-based Lecturing System Development***

This research is based on the system development procedure of the evolutionary prototype model and users' feedback to develop the stream-based lecturing system that is fit for the web-based learning environment. We pass through three stages of the evolutionary model during the period of developing the stream-based lecturing system and developed one version of the stream-based lecturing system in each stage to provide users to operate practically. We continue modifying and expanding this system via users' feedback after they operate the prototype. For example, after developing the first version and implementing it, this research took users' feedback and drawbacks that users found out to revise the first version, and therefore proposing the second one. Similarly, we have tried our best to solve the drawbacks that the second version has and to improve the second one on the basis of users' needs and feedback. Finally we develop a stream-based lecturing system that is suitable for the web-based learning environment. Three stages of the stream-based lecturing system that we developed are as follows.

##### **4.1 Version one: Synchronization mode**

The first version, which we call *synchronization mode*, is composed of Browser, Stream-based lecturing recorder and Stream-based lecturing player. The system can recur traditional lecturing situation in the limited network bandwidth. There are three major functions as follows:

(1) Web browsing function

This function is just similar to the popular Web browser IE and Netscape.

(2) Stream-based lecturing recorder

Teachers could select the teaching materials that are from his or her computer or Internet and use graphical tools supported by the recording tool of this mode called Media Master Recorder to mark the focal points or add some text annotations where students have to pay attention. Then the stream-based lecturing system could record video streams, audio streams, teacher's motions and annotations synchronously (Figure 2).

(3) Stream-based lecturing player

Students don't have to download anything and can just browse the streams online with web-based teaching materials, video, audio and annotations created by Media Master Recorder. The playing tool of this mode called Media Master Player will display the web-based teaching materials, video streams, audio streams and annotations synchronously so that students could view the whole of teachers' explanation, instruction and interpretation of the web-based course materials clearly (Figure 3).



Figure 2: The recording function of Synchronization mode

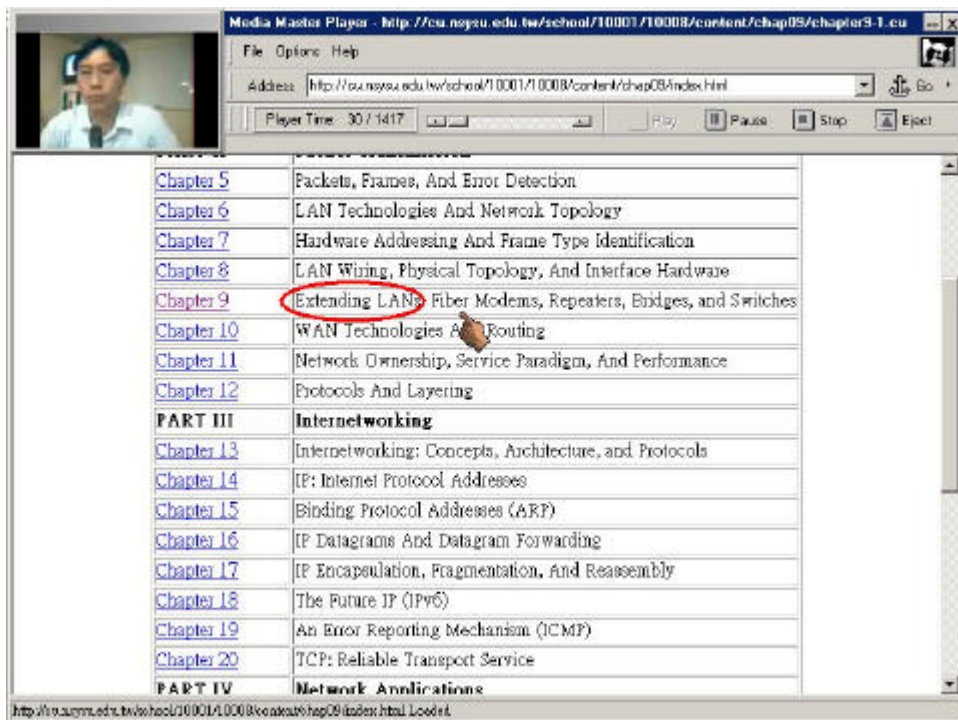


Figure 3: The playing function of Synchronization mode

After developing and implementing Synchronization mode, we get some drawbacks about it. These drawbacks are as follows:

(1) Font size mismatch problem

When teachers instruct teaching materials, they mark the annotations including text and lines on his or her computer. Namely the locations of these annotations are on the browser of teacher's own. However, because the teaching materials that teachers instruct, explain and interpret are all HTML format, the font size of material pages will change according to users' setting of the browser. When the font size changes, the locations of annotations that teachers marks on the materials will also change. Just because of this, students can't clearly grasp where the key points are in the teaching materials.

(2) Recorded data are saved into separated files

After teachers finish his or her lecture, the recording tool of this mode will record video streams, audio streams and teachers' annotations into three separated files. Adding the web-based pages that teachers instruct, teachers will have four different files.

(3) Need one special player for viewing

Because this mode will save teachers' lecture into separated files after teachers record his or her lecture, therefore, users need to download one special playing tool to display teacher's video, audio, annotations and materials synchronously. They can't see the teachers' lectures without installing the special player.

(4) Incorrect URL path problem

The web pages that teachers instruct and interpret already exist before teachers start to record his or her lecture, and furthermore the web pages and video, audio as well as annotations are saved into separated files and might be located in different folders after teachers finish recording. When one teacher delivers these files from his or her own computer to the web-based learning environment, the situation in which

students can't display teacher's lecture will happen if the locations of the web pages on the web are different from those in teacher's computer.

(5) User's cookie disappears

Generally speaking, the web-based learning environment employs cookie to record students' ID and password. Nevertheless, when students want to see teachers' lectures by using the player of this mode, this mode will open another window to display teacher's lecture, and the cookie in this window does not record students' ID and password, so the player will not be able to display the lecture in this window due to the disappearance of cookie.

(6) The teaching materials have to be HTML format

In the synchronization mode, the teaching materials that teachers want to instruct, explain and interpret must be able to be presented on the browser. Only the teaching materials on the browser can teacher instruct and record them. For this reason, teachers have to design and save their course materials that they intend to instruct in HTML format before recording their lectures.

#### 4.2 Version two: Browser capture mode

After using Synchronization mode, we found out the problems mentioned above, and hence we modify the first mode to propose the second one named Browser capture mode. Browser capture mode makes use of the idea of capturing the whole image of the browser. The difference from Synchronization mode is that after one teacher finishes recording his or her lecture, the recording tool of this mode will capture video streams, audio streams, teacher's teaching materials and annotations into a single streaming video file. Then the teacher just uses the recording tool to compress this video file into WMV format, and delivering it to the web-based learning environment. Figure 4 shows the case of using the recording tool to record the lecture. The teacher even can select whether to show her image or not, or select to put her image on which position and the size of her image.

Because this mode saves the teacher's lecture including video, audio, teaching materials and annotations into a single video file, students could view teachers' lectures without installing one special player. Students just use general playing software like Windows Media Player to display, like Figure 5. It's also due to the reason of capturing the lecture into a single video file that Browser capture mode solves the most of problems that version one has like the font size mismatch problem, the incorrect URL path problem, the disappearance of cookie and so on.

Although Browser capture mode solves many drawbacks, one major issue still remains that is similar to that of the Synchronization mode. Browser capture mode doesn't overcome the difficulty that the teaching materials must be presented in HTML format. It is also still based-on browser. Because this mode catch the whole image of the browser into a single file, if the teaching materials that teachers want to instruct are not presented on the browser, teachers can't use the recording tool to record the lectures. Namely teachers still have to teach with the course materials that are presented in HTML format. However, sometimes teachers instruct and explain the concepts of static text and pictures, but sometimes they have to instruct students how to operate an application software on the computer. At this moment if the teachers only use the materials that are presented in HTML format to explain, their teaching and students' learning effects will be reduced.





Figure 4: The recording situation of Browser capture mode

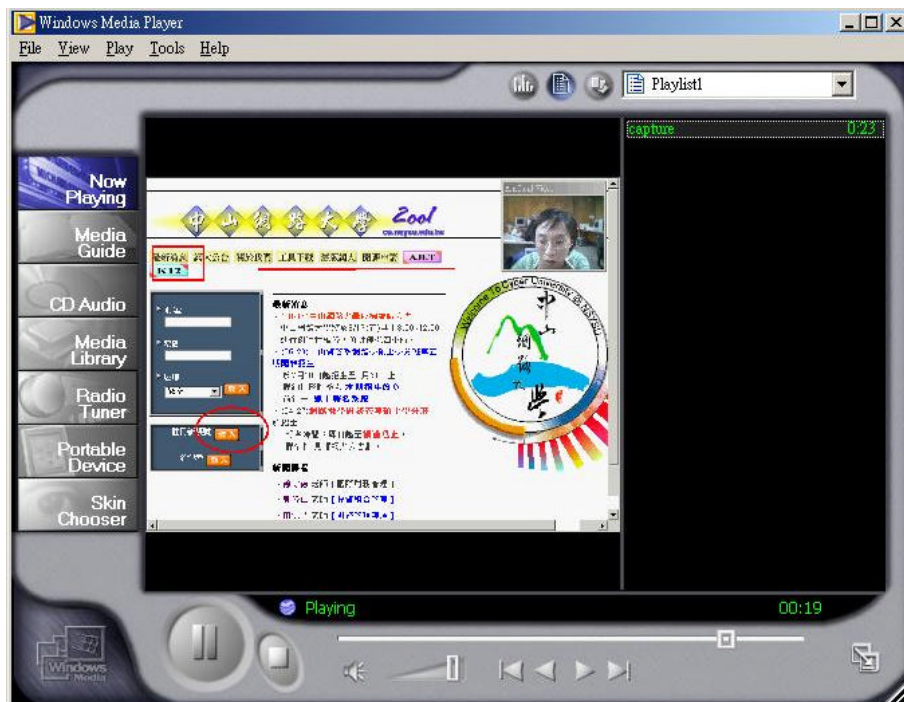


Figure 5: Using Windows Media Player to display

### 4.3 Version three: Full screen capture mode

In view of the drawback that Browser capture mode can't record teachers' lectures about operating any application software on the computer, we develop the third one called Full screen capture mode. Teachers can select the fittest mode according to the property of teaching

materials to record lectures or operating processes (Figure 6).



Figure 6: Window to select modes in version three

The teaching materials of Full screen capture mode of this version can be any documents, applications or software on the computer. Full screen capture mode is not limited on the browser any more, because it captures the whole screen of the computer that teachers use, and hence teachers can instruct, explain and interpret whatever on the computer screen, and record the whole lecturing and operating process into a single file, just like Figure 7. Furthermore, students don't need to install one special player to view; they just take general playing tool to display teachers' lectures and the whole processes of operating software or applications (Figure 8).



Figure 7: Recording how to operate an application software



Figure 8: Displaying the operating process of an application software

As for the recording function of this version, in addition to providing teachers the graphical tools to mark the focal points or add some text annotations where students have to pay attention, teachers can even select whether or not to show his or her image but also the size of his or her image. Teachers are able to use hot keys to move the image, and put the image in different

positions on the materials at his or her own will. Moreover, as previously mentioned in version two, compressing the video file into WMV format with the recording tool will reduce the size of the video file so that teachers can deliver it online conveniently and quickly. In Full screen capture mode, teachers can even decide to record how many frames in one second (frames/per second) by him or herself. We didn't find any drawbacks about version three until now after putting it into practice; therefore, we believe that version three Full screen capture mode is the best one out of the stream-based lecturing systems.

After making a description of three stages of the stream-based lecturing system that we develop, we sum up the above-mentioned drawbacks of three stages in Figure 9 to illustrate the evolution of development of the stream-based lecturing system.

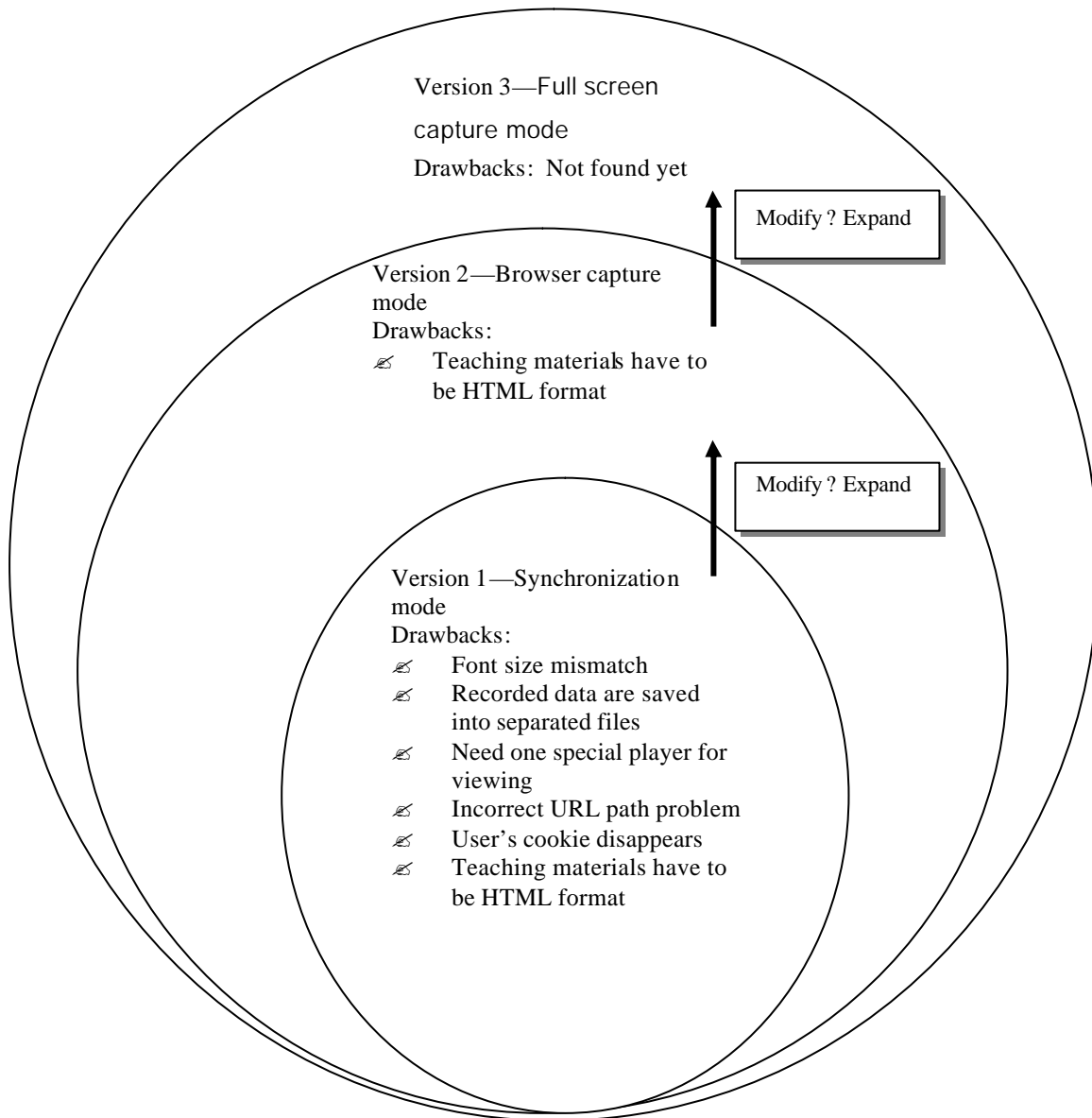


Figure 9: Three evolutionary stages of developing stream-based lecturing system

## 5. Mobile Classroom

In the web-based learning environment, teachers are able to do their lectures anytime and anywhere if they make good use of the stream-based lecturing system, and they are not limited to time and space anymore. It's the concept of Mobile classroom and will be also a direction of developing web-based instruction in the future.

In addition to the stream-based lecturing recorder, Mobile classroom still has two other components including one notebook computer and one CCD camera. Because a notebook computer has smaller size and lighter weight than the desktop computer, a teacher can take one notebook computer with him or her, and then the teacher doesn't have to worry that he or she won't have one computer to record his lecture anywhere. As for the CCD camera, as implied by the name, it is used to capture the teacher's image, so students can see the teacher's image and expressions when going to the web-based learning environment to view teachers' lectures. Figure 10 is the framework of Mobile classroom that this research proposes.

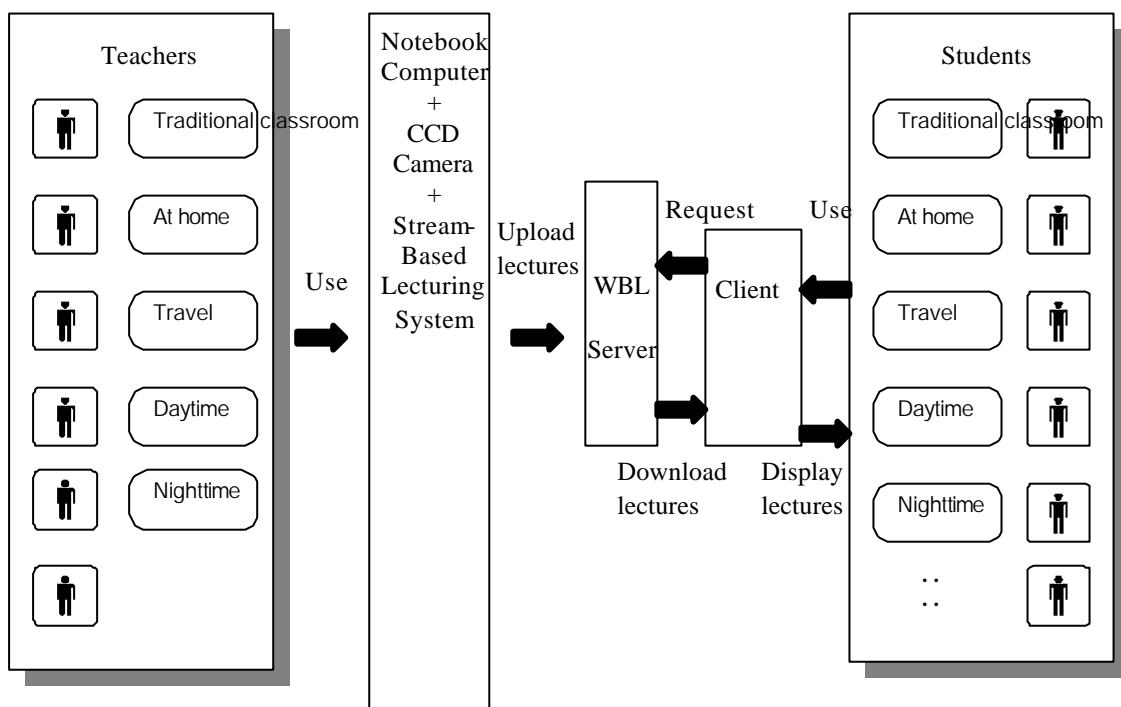


Figure 10: The framework of Mobile classroom

Although teachers who just have the three components of Mobile classroom are able to record lecturing processes anytime and anywhere, however, some teachers are not used to lecturing when facing the computer, and some don't have any idea how to instruct and interpret without students in front of them. The suggestion that we gave to these teachers is that they can take Mobile classroom to the traditional classroom. By doing this, they can lecture in front of students in the traditional classroom, and on the other hand they are able to use Mobile classroom to record the whole lecturing process and then deliver it online. As follows are two scenarios using Mobile classroom. Teachers who need it can take the one that suits them.

- Taking Mobile classroom to the traditional classroom

As mentioned above, some teachers cannot get used to facing the computer to lecture, especially when they see their images on the computer, they will not be able to lecture with ease, because it's just like that talking to themselves. And some teachers have no desire to instruct when there are no students sitting in front of them. In such situations,

teachers can take Mobile classroom to the traditional classroom. For one thing teachers will lecture vividly and vigorously because of the familiar place and scenario to them, and for the other thing, they don't have to spare time to record the instruction, explanation and interpretation of materials as a result of the whole lecturing process that is already recorded in the traditional classroom.

- Using Mobile classroom in anywhere

The original ideal of Mobile classroom is to offer teachers one teaching environment that is not limited to time and space completely. No matter where to go, even not in the school or going abroad, teachers will not have to worry about the problem that students can't keep up with the scheduled progress anymore. Mobile classroom, in such circumstance, is like its name with high portability; however, the only one drawback of this scenario is the lack of students.

## **6. Conclusion**

In the web-based learning environment, teachers' instruction, explanation and interpretation are very important for students undertaking the web-based courses. Students are able to comprehend better the key concepts embedded in the materials by viewing teachers' lectures for the materials. Furthermore, it also can raise students' interest about the web-based learning and make them view the teachers' lecture with more concentration. So for facilitating teachers to record the whole lecturing process easily and deliver the lecture online, this research, according to the evolutionary prototype development model, proposes three versions of the stream-based lecturing system to assist teachers. The third one Full screen capture mode is the ultimate solution for developing the stream-based lecturing system.

As to the other concept that we mentioned above, Mobile classroom, is very convenient and flexible for teachers to record their lectures anytime and anywhere. They will not be restricted to lecture in the traditional classroom anymore. Teachers just have one CCD camera and one notebook computer in which the stream-based lecturing recorder is installed with them; then they will be capable of lecturing anytime and anywhere and having the ideal teaching environment to meet the developmental trend of the web-based learning in the future. In the end, this research recommends that if we make good use of the stream-based lecturing system, we will be able to achieve the ideal of Mobile classroom.

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