A Time-Constraint Distance Learning System

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ABSTRACT

Distance learning systems have many advantages since they provide distance learning environments where there are no time or space constraints. However, the no time constraint is not only an advantage but also a shortcoming to students in distance learning systems. In general, most students do not prefer to study by themselves or may put off studying particular subjects they dislike. Therefore, students may miss the studying progress of the disliked subjects or give up studying altogether. In this paper, an online face to face and time-constraint distance learning system that overcomes these shortcomings is proposed. A prototype is implemented for Korean students. The Korean in the system is translated to English accordingly.

Keywords: distance learning, online learning systems, web-based system, SMIL, multimedia

1. INTRODUCTION

The advances in technology of computers, networks, and mass media make online learning systems such as cyber and distance learning systems popular these days [1][2][3]. The distance learning system is a learning system that takes place completely online without any constraints of time and space. However, no time constraints can become a disadvantage of distance learning systems since most students tend to put off their studies especially if they dislike a particular subject. Therefore, delaying studies may cause students difficulties in catching up to the progress of lectures or have them give up studying such subjects altogether.

Disabled students who have difficulty going to school should study at a place nearby or at home. Students who study at such places must have the same learning environments as the ones existing formal educational institutes provide. If such students study with common distance learning systems which are not able to control or encourage students, the above problems occur. In this paper, a distance learning system which not only has the functions of existing formal educational institutions but can also be used for a real time learning method with time constraints is proposed. As with common distance learning systems, there is a function that students are able to do reviews. Use of this system may be valuable among those educational institutes who prefer distance learning systems with no spatial constraints but with time constraints for various educational purposes.

2. RELATED WORKS

2.1 Distance Learning

Keegan defines a distance learning system by four different specificities: distance between student and instructor, effectiveness of educational structure, usage of medium, and opportunity of information exchange [4]. Any education method that does not require the student and instructor to be in the same offline classroom can be considered as distance learning. However, transferring media like printed assignments, radios, and televisions are not distance learning because of their lack of ability for exchanging information. The most appropriate and connected medium is the internet based computer. Therefore, online distance learning systems are being commonly developed and used. In conclusion, distance learning is an educational environment where students and instructors can exchange information [5].

2.2 SMIL

SMIL is a Markup language that was proposed for controlling and synchronizing a multimedia playlist [6]. SMIL has the ability of defining the interconnectedness of multimedia objects like texts, images, audios, and videos [7]. It is also simple to produce due to its use of a simple tag structure. The beginning and end of the SMIL document is enclosed by <smil> and </smil>, and the part in between these two tags is divided by <head> which assigns locations of media windows, and <body> which assigns media time to play.

Table 1 is a SMIL document example for the window arrangement of media, and figure 1 is a schematization of the content for table 1. In table 1, the dimension of an image is set to 500 pixels wide and 150 pixels high, and ‘image_region’ and ‘video_region’ are placed in the image.

Table 1 Example of media window allocation

```
<smil> // Region allocation
<head>
   <meta name="title" content="layout example"/>
   <layout>
      <root-layout width="500" height="150"/>
      <region id="img_region" top="0" left="0"
            width="200" height="150"/>
      <region id="video_region" top="0" left="200"
            width="300" height="150"/>
   </layout>
</head>
<body> ... </body>
</smil>
```

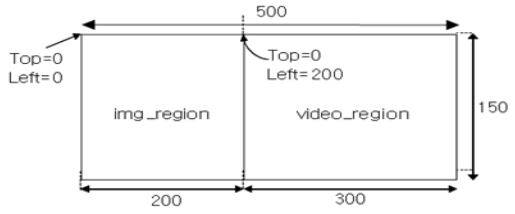

Figure 1 Allocated media window for table 1

There are two methods for time arrangement of media: <seq> which plays media in due order and <par> which plays media by overlapping play times. Table 2 presents an example of <par> in the SMIL document. When this document is played, two media would play with a difference in starting point of 10 seconds, after that, both of them would be playing simultaneously. Figure 2 is a schematization of the content for table 2.

Table 2 Example of media time

```
<smil> // Time assignment
<head> ... </head>
   <body>
   <par>
      <image region="img_region"
            src="/image/hhg.jpg" begin="10s"/>
      <video region="video_region"
            src="http://cser.hufs.ac.kr/ hhg.rm"/>
   </par>
   </body>
</smil>
```

Figure 2 Media play time allocation for table 2

3. SYSTEM DESIGN

3.1 SMIL extension

SMIL is not compatible with functions that distinguish classes and allow interaction between instructors and students. In this paper, SMIL is extended in order to comply with the functions of distinguishing and synchronizing lectures and interacting between students and instructors. The extension involves adding <course>, <chat>, and <teach> tags in SMIL. As a whole property of lecture information, <course> tag includes information such as the start time of a course, play time of a media, and name of media.

The <chat> tag has the information of setting up a chatting window (question-and-answer window) for students and an instructor. Not only is <teach> tag used when the instructor responds to a question, but it is used for pausing and resuming a lecture. Therefore, the chatting window created by <teach> tag appears on the instructor's screen. The <switch> tag is a defined tag in the original SMIL; however in this paper it behaves as the highest tag which has comprehensive information of a lecture by making it include the <course> tag. Table 3 is an example document written in the extended SMIL.

Table 3 Example document written in extended SMIL

```
<smil> //Student screen
:
   <switch>
   <course name="kor" begin="hh:mm:ss">
         <par>
               <text region="..." src="..." />
               <text region="..." src="..." />
               <chat region="..."/>
         </par>
   </course>
   <course name="math" begin="hh:mm:ss">
         <par>
               <video region="..." src="..."/>
               <chat region="..."/>
               <text region="..." src="..."/>
         </par>
   </course>
   </switch>
</smil>
```

```
<smil> //Instructor screen
:
  <switch>
  <course name="kor" begin="hh:mm:ss">
        <par>
              <video region="..." src="..."/>
              <teach region="..."/>
        </par>
  </course>
  </switch>
</smil>
```

3.2 System structure and algorithm

Figure 3 is a structure of the system proposed in this paper. There are two types of classes that students may take: a regular class and a remedial class. In this system, an instructor composes lecture data and saves it in a lecture data database. Lecture data is composed with a document that is written in the extended SMIL and actual lecture elements such as texts, images, and motion pictures. Media that cannot

be stored in the database because of size of data or copyright issue receives a direction of an external memory device or an internet IP address. As figure 3, preparation for a lecture gets done by an instructor executing the lecture manager, and then students log into the system and begin their classes. Students study in a similar teaching pattern to formal educational institutes during regular classes and may review their deficient subjects when they are free.

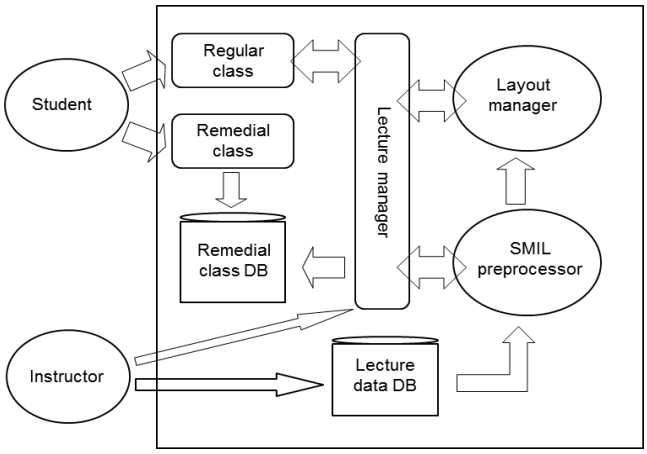

Figure 3 System structures

3.2.1 Lecture manager

Figure 4 is a structure map of the lecture manager and table 4 is a brief algorithm of the lecture manager. As figure 4 and table 4, the lecture manager establishes a distance learning environment by doing the next three steps. First, the lecture manager receives a timetable from the SMIL preprocessor. Second, it sends the time information of media to the layout manager. Finally, it requests allocation of the media window in order to make media be played in a pre-defined window at a scheduled time.

The lecture manager controls the overall flow of a lecture in order to finish a lecture without any problem. It also takes charge of conversations between the students and instructor. When questioning and answering among students and an instructor take longer than the assigned time limit (maximum delay time), it sends a warning signal to the instructor and informs the layout manager of the exceeded time in order to adjust the information of media play time. Maximum delay time can be assigned subjectively by an instructor. For example, length of delay time for subjects such as mathematics which can require longer delay time than expected because of its requirement of exchanging schematic information must be assigned sufficiently.

The lecture manager divides lecture time of a lecture into four identical sections and identifies them as t_1, t_2, t_3, and t_4. Suppose that a quarter of maximum delay time of a lecture is d and actual delay times are rd_1, rd_2, rd_3, and rd_4 in the four sections of a lecture, respectively. The maximum delay time of t_1 is d and the allowed maximum delay time of another section t_i ($1 < i \leq 4$) becomes $\sum_{k=1}^{n-1} (d\text{-}rd_{k-1}) + d$. In other words, the lecture manager gathers the unused delay time for each section of a lecture to allow students and instructors to use sufficient chatting time in a fixed maximum delay time assigned for each lecture.

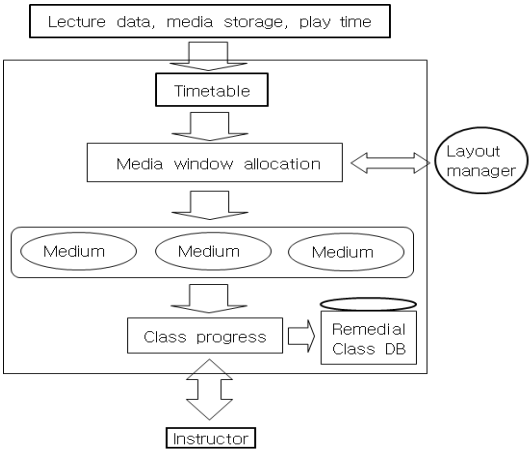

Figure 4 Structure of the lecture manager

Table 4 Algorithm of the lecture manager

```
while Timetable(class, time)
    if (CurrentClass in TimeTable) then
        runClass(layout, class);
    If (Question) then
        suspendClass(MaxDelay); // Pause
            while(!response)
                wait(MaxDelay);
            end while
        resumeClass(MaxDelay); // Resume
    end if
    end if
end while
```

A warning is sent to the instructor by the lecture manager when the delay time approaches its limit. Also, when a lecture is completed, the lecture manager saves the contents of the lecture to the remedial class database to provide an environment for students where they can review lectures by themselves.

3.2.2 SMIL preprocessor

The SMIL preprocessor downloads an extended SMIL document from the lecture data database. It has a lexical analyzer and a syntax analyzer to parse SMIL documents written in extended SMIL. The SMIL preprocessor extracts media information of the play window, storage location, and play time from a SMIL document. Media information of the storage device and play time is extracted when the tag is 'switch', and media information of the play window is extracted when the tag is 'layout'. Based on the extracted media information from a SMIL document, the SMIL preprocessor generates a timetable for all lectures.

3.2.3 Layout manager

Layout manager in figure 5 assigns a window to each media in a lecture screen by using the properties of <head> tags of a SMIL document. It also adjusts the start and finish time of playing media according to the information of media time such as maximum delay time which is received from the lecture manager. The layout manager composes media windows of a subject in a lecture screen based on the information obtained from the SMIL preprocessor. During a lecture, the medium that will be played on the lecture screen can be images, motion pictures, or texts. When allocation of a media window is requested by the lecture manager while a lecture is in progress, the layout manager assigns corresponding media to each window through using the information of the media window.

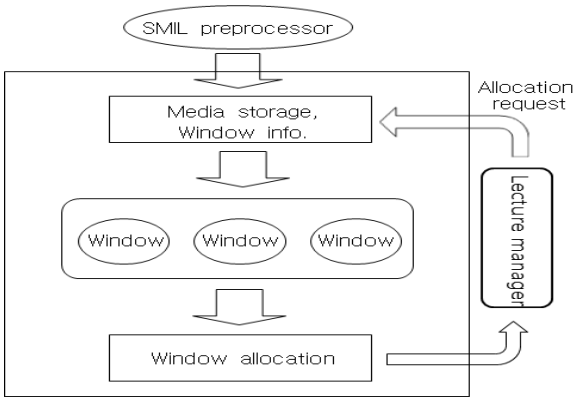

Figure 5 Structure of the layout manager

4. IMPLEMENTATION

In this prototype, Java language was used, and JDK1.6 and JMF2.1.1 were used as development tools [8][9]. A prototype of the system that was proposed and designed in chapter 3 is implemented in Korean. Figure 6 is a student screen of a regular class which is composed with windows for pictures, texts, and question-and-answer. The upper left part of the lecture screen of figure 6 displays 'Hello. Welcome Student' and has a login/logout button. The upper part of the right side of the screen describes the contents of a lecture and the lower part is the question-and-answer window. The Korean sentences in it mean 'Class is in process now. Students can communicate with instructor here. Class may be paused or resumed'.

Figure 7 is an instructor screen when the lecture of figure 6 is paused by the instructor. The left part is the same as figure 6. The Korean sentence in the right part means 'This is a paused instructor screen'. Unlike the student screen, on the instructor screen, there is a button on the bottom right of the question-and-answer window that can pause or resume a lecture.

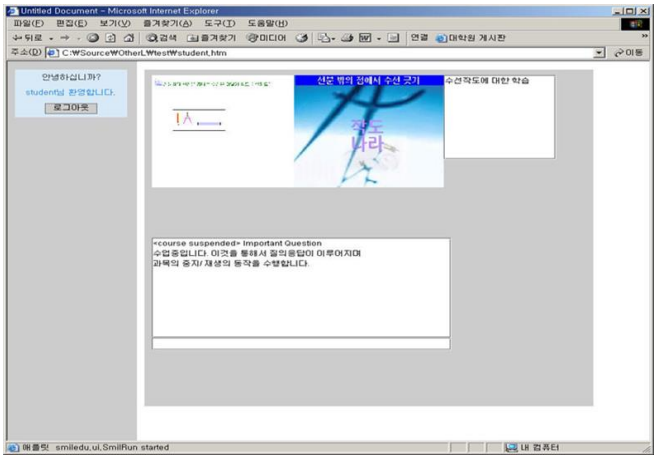

Figure 6 Student screen

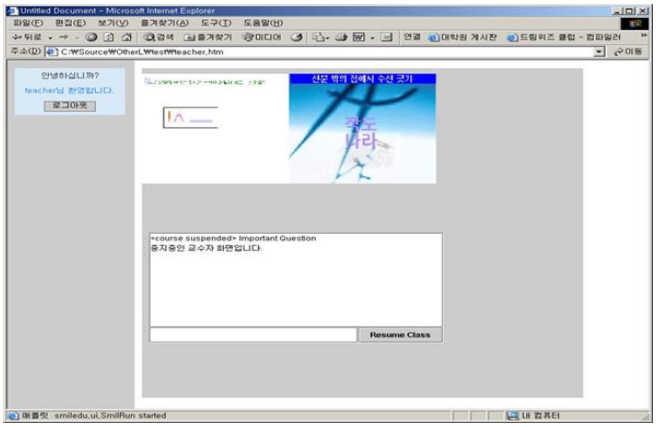

Figure 7 Instructor screen

Figure 8 is a student screen of an ongoing lecture. There is a video window and the texts in the window on its right describe what the video is doing.

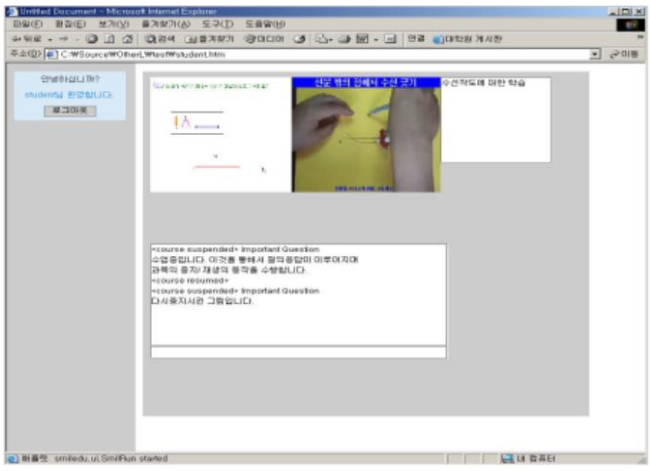

Figure 8 Screen of an ongoing lecture

5. CONCLUSION

In this paper, an efficient time-constraint distance learning system is proposed. SMIL is extended in order to comply with the functions of distinguishing and synchronizing lectures and interacting between students and instructors. An SMIL preprocessor is designed for parsing documents written in the extended SMIL format. A lecture manager which is in charge of most of the lecture processes and a layout manager which is in charge of assigning windows to media are designed also. The proposed system in this paper is believed to be used as an assistant learning system in formal educational institutes, a learning system for handicapped students, and an education system in private corporations. In this paper, students can review lecture data in text since the remedial class is simply designed to show lecture data in text which is in a database. It could be a much better distance learning system if the remedial class were designed in the same style as the existing systems which utilize multimedia data. Moreover, if video messages are exchanged through the question-and-answer window, the proposed distance learning system could provide an educational environment which is very close to the traditional face to face environment. The performance of the proposed distance learning system can be enhanced with high-speed network infrastructure and its corresponding communication protocols such as a multimedia multicast protocol [10] for one instructor to many students communications and a mobility management protocol [11] for students equipped with mobile devices.

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