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A Proposal for Video Application System That Reproduces In-Person Class in Distance Learning Environment

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***Abstract*:** *Due to the spread of COVID-19, many universities have been forced to manage distance learning. Most of the universities are using video calling applications to create an environment similar to in-person classes. However, there is a clear difference from actual in-person classes. Both teachers and students feel the difficulty of providing/taking the course. This can lead to a loss of motivation in the classes. This is specifically due to the fact that distance learning is not able to equip a 'sense of reality' for both teachers and students. Unlike in-person classes, distance learning is not realistic, and the faces of the participants are only displayed on a flat screen on the online screen. Therefore, we considered that the existing video call applications used as environments for distance learning cannot provide classes with realistic experiences. For students, unlike in-person classes, the teacher is not actually standing and teaching on the podium in front of them, in the remote class. The class is free from the style of in-person classes, and students can take classes at home or in any other environment of each their own choice. Since there are no physical existence of teachers or other students around, it is possible for students to take the class while doing something irrelevant to the class. In this study, we propose a video utilization system that can improve this problem and provide a sense of reality similar to that of in-person classes in a distance education environment. The proposed system can work as a realistic tool for both students and teachers in remote classes.*

Keywords: *Distance learning, e-learning, Communication, Interface Design, User Interfaces, User Experience*

1. Current situation of distance learning environment

Due to the worldwide spread of the COVID-19, many universities were forced to start distance learning. For distance learning universities, there was no problem because they had originally established online learning environments. However, the normal university courses had no choice but to conduct distance learning with no prior preparation. This caused some confusion for both teachers and students. Many universities have used existing video calling applications to create distance learning environments, but this also generated a problem. Before the spread of COVID-19, the teachers were able to prepare for the classes and build the normal class environments. However, after the virus went raging, teachers had to manage their classes using video calling applications in addition to their regular class preparations. From students side, it is natural for students of distance learning universities to take online classes. However, students of normal university courses suddenly had to start taking online classes. As a result, there are no longer spatial restrictions for classes, and students can take classes at home or anywhere else they like. This change has brought more convenience for students. However, while the convenience has increased, the sincere learning attitudes of the students and the 'sense of

reality' of the classes have been decreased. In addition, although student had always been able to take the class side-by-side with their friends, now they have to take the remote class by oneself. It is difficult to ask or answer questions, and participate in 'office hours', when taking the class at home. Because teachers have to facilitate them in a different way from 'face-to-face', these activities are quite hard in respect of form. In recent years, some universities have been running complete online classes, while some have established educational environments that combine in-person and online classes. There are also other universities that have returned to in-person classes completely. It is conceivable that the similar spread of such a virus may occur in the future. It is certain that educational institutions will be required to respond to the situation then. For that, there are several problems. It is clear that normal university courses want to establish the remote class environment as effective as face-to-face learning. However, it is difficult for them to build their own environments immediately, and they tend to use existing video application tools. Not all of these video application tools are specialized for the use by educational institutions. These applications may be only handy or suitable for certain environments. There is no general-purpose tool that is appropriate for each educational institution's environment. Therefore, in this research, we propose a system that can provide a remote class similar to an in-person class in distance learning environment. The proposed system reproduces the reality of 'face-to-face' classes in online environment. Specifically, we propose a system to provide the online class environment in which both teachers and students can obtain the realistic educational experience same as that from in-person class.

2. Problems with distance learning using the current video calling applications

In this chapter, we describe a video calling application that was used by many universities after the spread of COVID-19. Then, we mention about some problems from the field of distance learning. Distance learning using video calling applications allows students and a teacher to communicate smoothly in real time even when they are in different locations. On the view, by sharing the slides on the screen, the teacher are able to provide the students with the same class format as the in-person class. While there are a wide variety of video calling applications, those used in educational institutions have been improving their performance and systems in two main directions. One is the system that enhances the functionality of conventional video calling applications to make them more convenient. For example, Google LLC provides a live streaming function using YouTube. It is used for distance learning in universities, but the system has not been specifically dedicated for distance learning. The effort has been made to improve the system so that it is easier for the general public to use or to stream live. Live streaming on YouTube was widely popularized among people even before the spread of COVID-19. This is why the system will be continuously improved to make it more accessible to general users. With hindsight, it was only a good match for educational institutions to live stream online classes. It has not been developed focusing on distance learning. The other is the video calling application that have improved functionality in the way specific to distance education. For example, "Class for Zoom"[1] developed by ClassEDU Inc is an add-on feature of Zoom. After the spread of COVID-19, Zoom was used by people all over the world. Zoom was developed by Video Communications Corporation. In September 2020, ClassEDU Inc. launched "Class for Zoom" as an add-on function. This is the functions dedicated for distance learning in addition to the functions as the conventional video conferencing application. The system can display the teacher or the tutor on the screen in a way that the students can easily recognize him or her, and it can provide the teacher with the feedback regarding the students' engagement, by measuring the length of time the students are speaking, and tracking their attentions. In this way, monitoring student learning is done mechanically and automatically. Although, standard Zoom function only allows text communication through chat. "Class for Zoom" has an additional function that can present large volume of texts and assignments for the class. The system also has a function to project the layout on the screen image as if a student was sitting in a classroom in a virtual space. Therefore, unlike conventional video call applications for live streaming, teachers can automatically monitor student learning. In addition, some of the similar systems have a function to automatically monitor the attendance of the students. However, the authors consider that there is a big problem here. By using such functions, teachers can easily recognize whether students are attending classes properly and how actively they are participating in the

classes. However, for students, taking a class with such a function would not be as comfortable as a normal in-person class. Mechanical judgments influence the students' own attitude toward the class and the recognition of credits. This may make it difficult for students to attend classes with a natural and straight attitude. In other words, the authors assume that although a high performance system specialized for distance learning has been realized, the comfort and convenience for students may be greatly reduced. We consider this kind of direction of the system improvement is not appropriate for the needs of students and the environment in which they would be taking the class. Therefore, in this research, we propose the system that combines the functionality of the existing video calling applications, with the convenience and ease regarding learning environment for teachers and students. In this way, we propose a novel video communication application specialized for distance learning.

3. Previous research

There have been many researches on the construction of practice environment for distance learning.[2][3][4] In a face-to-face environment for programming exercise, students have many questions and ask their teachers and tutors them. When the series of conversations regarding programming questions are conducted online, all of the attendants hear each time, therefore it became difficult for students to ask such questions. On the other hand, when students ask this kind of questions using chat, the questions are listed from the top to the bottom and the respondents are quite busy answering them. Because of these problems, it is difficult to construct a practice environment, although it is possible to conduct a normal class only by video call applications. By many researches, an online practice environment has been established so that the questions and answers from students can be responded smoothly. In addition, a research is being conducted to create an optimized class environment by visualizing the status of assignment submissions and the student's coding for the teacher. Most of the classes in universities are mainly lecture-based, and the environmental optimization by these researches is not versatile enough in this respect. In this research, we would like to construct a general-purpose system that can be used for mainly lecture-based classes in distance learning. More specifically, we will build a system that allows students and teachers to gain a 'sense of reality' without relying on existing application systems.

4. The structure of the system

In this research, we propose a system that enables both students and teachers to have a realistic in-person class experience in the virtual class space. In this system, students log in to the distance learning environment system by entering their ID and password provided in advance. With this setup, the students are required to choose their seat in the virtual space. An overview of the system is shown in Figure 1. We thought that having a seating choice might be important to students of regular college when they attend classes. Therefore, we incorporated such a structure into the system. For example, an enthusiastic student who wishes to actively communicate with the teacher may choose to sit in the front row close to the teacher. On the other hand, students coming to class late would see a limited number of seats left because those who came earlier have already been seated. This is a common sight in face-to-face classes. In an online class, there are no such restraints. While this is an advantage of distance learning, students' seriousness about attendance and self-discipline may be lost because there would be no seating problem if they just log in to the distance learning environment before the class starts. Our system will have the students choose their seats before the class starts to give them a realistic seating experience of in-person class. In addition, visibility of the teacher's chalk/whiteboard presentation and projected slides will vary, depending on the seat location. Teachers, on the other hand, can freely set up the seating chart before the class starts. In face-to-face class, seating arrangement can vary depending on the classroom. According to the seating arrangement, students decide where to sit. In order to have the teachers make use of this situation, several seating arrangement patterns are provided. Teachers can choose the seating arrangement for each class. This provides the teacher with a comfortable environment for teaching. In addition,

the view in the teacher's screen changes depending on where the student is sitting. In the proposed system, the size of the student's window displayed in the teacher's screen changes accordingly. Students who wish to communicate with and promote themselves to the teacher should sit in the front rows. This will maximize the size of the student's window in the screen the teacher sees. In contrast, students seated in the back of the classroom will be shown to the teacher in smaller windows, thus making them less visible.

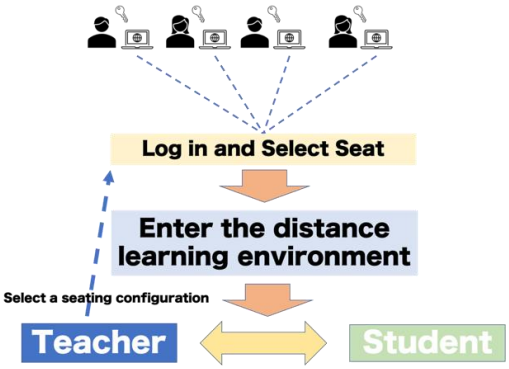

Fig. 1. The proposed system in use

4.1. Seating selection method employed in the proposed system

In this research, we construct a distance learning system that gives a realistic in-person class experience to both teachers and students. We intend to construct an online class environment equivalent to face-to-face class, providing a realistic feeling which is otherwise not available in distance learning classes. Hence, students log into the video call application and select seats on the virtual space. The number and location of seats in the classroom can be set by the teacher in advance. In face-to-face class, seats are arranged differently according to the size or structure of the classroom. However, in distance learning, there is no concept of seating in the first place. Students can use the online video call application from anywhere they like to take courses offered by the faculty. However, the environment and situation make it difficult for the students to attend classes in the same way as they do in face-to-face classes. They remove part of the restrictions and limitations students experience in the classroom. Therefore, we create in the online class the positive stress that face-to-face classes give to students. For this reason, the proposed system incorporates a feature that allows students to choose their own seats. Moreover, the system also lets the seating selected by the students affect the class environment. In this way, students can "take their seats" as they do in face-to-face classes. This is one of the factors that give students a realistic class experience.

4.2. Seating arrangement selection by teacher

In this research, students can freely choose seats arranged according to the seating formation set by the teacher. Different seating configurations cause the students' windows to be displayed in different sizes on the system. We believe this is one of the factors that leads to a realistic teaching experience. Also, at traditional colleges, classes are basically held in fixed classrooms with fixed seating. In offering online classes, it is important to give the students some similar seating constraints. We also thought the system could give students a positive stress when they try to secure a good location in the online class space. The window of the student sitting in the front row is larger than those of the students in other rows. Therefore, as an extreme use of the system, it is possible to set up a special seat that best attracts the teacher's attention, such as one in the front row. It is up to each teacher to decide whether or not to use the setting. As in face-to-face classes, students are given the advantageous seating option, which, in turn, requires them to secure good seats. Therefore, we thought that students would likely log in to the online virtual space before the class starts and try to get a better seat than

other students. This would give both students and teachers a positive stress and realistic experience they might have in face-to-face classes.

4.3. Seating selection by students

Unlike regular distance learning, this research lets students choose their own seats before using the video call application from the seat options made available by the teacher via the system. For example, if the teacher specifies an arrangement with equal number of seats in both vertical and horizontal directions, the seats selected by the students will be colored, and empty seats will be displayed in white. The seat selection process consists of clicking on the desired seat and waiting for the class to start. Originally, students only needed to access the specified link for distance learning to take the class remotely. This method can give the students a realistic experience similar to face-to-face class.

4.4. Viewing Screens of Teacher and Student

In this research, students and teachers are displayed in flat and uniform-sized windows in the screen, just like in general video call applications for distance learning class. However, we propose in this research a display of students and teachers where it changes according to the seating arrangement and the seats selected. We expect the view to be displayed in teacher's screen as shown in Figure 2-1. The size of the student as seen by the teacher changes according to where the student is seated. In in-person class, students sitting close to the teacher can be seen clearly by the teacher, while students sitting far away are difficult to see. In the same way, students sitting in front of the teacher will have a larger window in the teacher's screen while students in the distance will have a smaller window. We think that this interface design can give a sense of realism and tension to both teachers and students more intensely than face-to-face classes do. In addition, we designed a screen structure which allows teachers to click on each student's window to display in this student's screen only the one teacher selected. When the teacher cares about specific students or needs them to answer the teacher's questions, the teacher selects the students by clicking on them using a mouse. The screen is designed to display the selected student in the window within the student's screen. By using the function shown in Figure 2-2, students can answer teacher's questions as in face-to-face classes. In addition, we develop an environment similar to face-to-face classes, giving students positive stress and realistic experience of actual class, which existing video call applications cannot provide. Besides, in this system, depending on the number of students taking the class and the seating arrangement specified by the teacher, the size of the windows displaying students in the front rows differ from those of the students in the back of the classroom. We also thought that it was highly unlikely to be able to display all the students in one flat rectangular screen. Hence, in this system, the displayed images of students are scrolled horizontally for each row of seats so that all the students can be viewed by the teacher as well. With the video call applications currently used in many schools, it is difficult for the teacher to teach while watching all the students due to the system specifications. For example, when teachers teach on Zoom while sharing slides with the students, the thumbnails with students' faces are displayed at the top of the screen or in the sidebar. Teachers need to change the display method to see all the students. In face-to-face classes, teachers can see all the students from the podium. In distance learning, however, it is impossible to see all the students in the classroom with the class being offered online. In order to improve the problem, this system scrolls the screen display of the students so that the teacher can see the entire class. As shown in Figure 2-3, the windows of the students sitting in each row are scrolled horizontally for the teacher to see. Teacher can view the students in real time without pressing any buttons on the screen. It also makes the students aware that they are being monitored by the teacher. The speed of scrolling is mentioned also in the research by Kita et al, which discusses how the speed at which the text is scrolled affects user's reading comprehension [5]. According to the report, visibility of text strings increases when the strings are scrolled at 7 to 9 characters per second. Additionally, the study by Kubota et al. on readability of horizontally-scrolled characters [6] revealed that the smaller the unit scrolled is, the more visible the text becomes. It has been found that the visibility is higher when 4 to 6 characters are scrolled at one pixel per second. Based on these results, the basic scrolling speed is set at 100 pixels per second. In the study by Kubota et al., characters with a width of 13 pixels are used. They state that the optimal range of

movement per second is 4 to 6 characters. On the other hand, the research by Kita et al. reports that the optimal visibility was obtained in a movement range of 7 characters per second for many generations. Based on this fact, we set the movement rate at 90 pixels per second. Next, we will discuss the screen on the student's side. With regular video call applications, the same view is delivered to all the students no matter when or where it is watched. In this system, however, visibility changes depending on where in the classroom the students selected their seats. In face-to-face classes, the teacher has difficulty seeing the students sitting in the back of the classroom. Also, the distance between the teacher and the students makes it difficult for the students to see the board or the projected materials. If the seats are unevenly distributed to the left or right, the students cannot see the slides in the center of the room. This situation is also incorporated in our system. The system we consider is shown in Figure 2-4. By sitting in front as shown in Figure 2-4, students can view the class at an optimal size, as clearly as in face-to-face class. The farther back a student sits, the smaller the screen size becomes. However, if the students can hardly view the class, the characteristics of distance learning cannot be utilized. For this reason, the screen will be reduced to the minimum viewable size range. In addition, the interface design of the proposed system makes the screen to lean slightly when the student sits in the far left or far right of the room. In this way, the seating location causes a change in visibility of the class, which gives some challenges to the students. This would prompt the students to log in to the virtual classroom of distance learning class and take a seat before the session starts so that they could attend the class in a better location. We thought this would motivate students' engagement in the class. We thought that this screen configuration would eliminate the unreal aspect of distance learning the users feel when using common video application tools. Through the use of the system in this research, the students may feel challenged as they are unaware when the teacher is monitoring them, and the teacher can enjoy a realistic teaching experience.

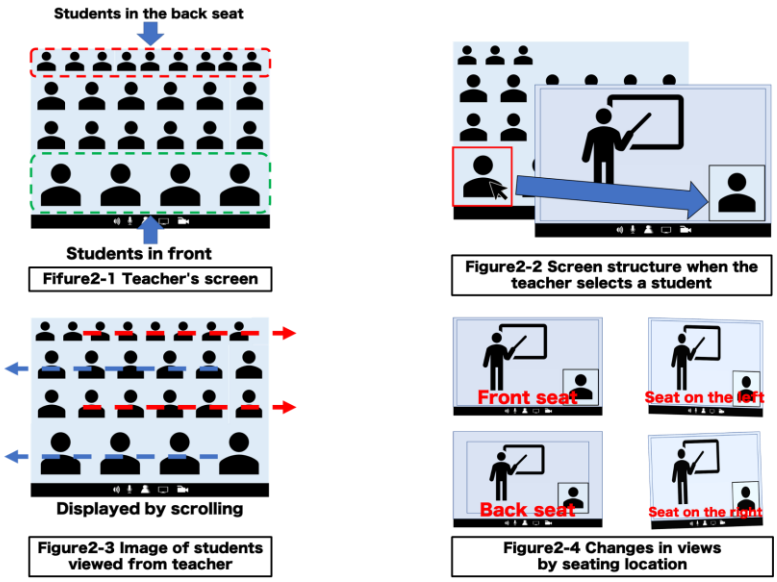

Fig. 2 Image of the viewing screen

5. Conclusion and Future Work

In this research, we were able to construct an environment for distance learning. The global spread of COVID-19 has forced many universities to switch from in-person class to distance learning. It has now become impossible to guarantee that the schools can offer normal class environment. However, the implementation of this system would enable both students and teachers to have classes with the sense of reality as if they were in face-to-face classes. Many existing video call applications have features with improved performance, but do not

provide the ease of use as a distance learning environment for students and teachers. With the system proposed in this research, we were able to construct an environment where students can easily take classes even in a distance learning environment. For teachers, the system made it easier to implement Q&A sessions as in face-to-face classes. Students can reserve their seats before the class starts and enjoy the realistic experience of being asked by the teacher to answer questions just as in in-person class. However, a prototype system should be developed first since the system is still in the proposal stage. Next, the prototype system will be implemented, which is followed by an evaluation experiment of the system for future research and development. As it is still in the proposal stage, we need to evaluate its usability and visibility in actual operation for any improvements. Furthermore, we would like to add more functions to the system in our future research. For example, in the current setting of distance learning class with widely-used video applications, each student watches the teacher's lecture. In in-person classes, however, students may briefly communicate with other students sitting next to them. This is a common sight in face-to-face classes. Therefore, we would like to incorporate an application which allows students to briefly communicate with one another in the distance learning environment. Moreover, unlike face-to-face classes, it is difficult to tell from the screen view whether the students are truly engaged in class. We therefore would like to add a function, after the proposed system is implemented, to allow the teacher to visually recognize if the student is taking the class with other windows open while using the system. For example, when a student opens another browser while using the system, the edge of the student's window changes its color on the teacher's screen. We would like to incorporate a function that allows teachers to intuitively check the students' attitude toward the course. In the future, we would like to construct a system that enables teachers to hold classes in distance learning environment comparable to in-person classes even if another pandemic occurs. We will then construct a distance learning environment system that can be generally used by distance learning universities.

References

[1] Class Technologies Inc. ,https://www.class.com

[2] Shinya Cho, Satoshi Urakami, Kazuhei Nagashima, Susumu Kanemune, Mitaro Namiki, PHP programming practice and environment in a fully online class, Computers and Education,2021-CE-158(10),1-9,2021

[3] Hiroki Manabe, Kazuhei Nagashima, Mitarou Namiki, Shinya Cho, Susumu Kanemune, Report of JavaScript Lessons on 'BitArrow', Online Programming Learning Environment, Computers and Education,2017-CE-138(3),1-8,2017

[4] Y. Matsuzawa, S. Ochiai, A. Saito, and K. Murata,Development of online computing practice support system "CreCoSpeek" and class practice,Computers and Education,2021-CE-159(17),1-11, 2021

[5] Kita Yasunari, Nomoto Kohei, Suzuki Takaya, Nakamura Ryoma, Hirata Takashi, Aihara Yuzi, Nakamura Yoshitomo, Sawada Kumiko, Effects of moving speed of scrolling text on users' understanding, Proceedings of the Fuzzy System Symposium 28(0), 655-658, 2012

[6] KUBOTA Satoru, ITO Mizuho, OKADA Sou, ODA Yasuhisa, Subjective Readability of Horizontally Scrolling Text on a CRT Screen, The Journal of The Institute of Image Information and Television Engineers 57(11), 1595-1597, 2003-11-01

https://doi.org/10.3169/itej.57.1595

[7] Ohtsu Fumiko, Nagamatsu Tadashi, Hasegawa Yoichi, Nadai Masayuki, How to build a distance education system during the COVID-19 epidemic, Japanese Journal of Pharmaceutical Education, Volume 5,2021