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Multimedia Remote Educational Support System Using High Resolution Panorama Video

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Abstract

At present, as increase of the needs of long life learning, remote education systems have important increased as one of the educational techniques. Along with the popularization of the Internet and broadband, many people are exchanging more and more using video among remote sites. Even now communication by High definition video is possible and various remote educational systems are proposed. However, by order to realize a type of sophisticated lesson involving by exercise and practical training distantly, it is necessary to grasp during the lesson. Moreover, in the case where more interactive communication is performed on real time, high speed network is needed. In this paper, multiple video images with various angle are require, during the lesson is grasped using a panorama video. And Real time interactive communication is realized on IP network using by a transcoding function. The prototyped remote educational support system is constructed to evaluate described.

高精細パノラマ映像を用いたマルチメディア遠隔教育支援システムの研究

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近年、生涯教育のニーズの増加に伴い、時間や場所にとらわれない教育手法の一つとして遠隔教育の必要性が高まってきている。インターネットの普及およびブロードバンド化に伴い高精細な映像通信が可能となり、様々な遠隔教育システムが提案されている。しかしながら、実技・演習を伴う実習型授業を遠隔で行うためには、質疑応答に対応し実習全体の状況を常に把握する必要がある。また、双方向通信をリアルタイムで行う場合、広帯域なネットワークが必要となる。本研究ではパノラマ映像を用いて実習全体を把握し、トランスコーディング機能を利用して IP ネットワーク上でのリアルタイム双方向通信を実現する。次世代遠隔教育支援システムを提案し、実装・評価および有効性について述べる。そして、本システムの有効性を確認するためにプロトタイプシステムを構築し、介護実習教育を実施し、その機能評価を行った結果を報告する。

1. Introduction

Currently, as advent of Internet and broadband network technologies, high quality audio and video stream and huge mount of multimedia data by text, image and graphics can be transmitted in real time. A lot of new applications using those communication technologies are being developed. Those applications include a remote education system and collaboration. Tow different types of remote education system; one is asynchronous system which uses on demand video data and text as education material, the other is synchronous system which uses real time audio and video, are used to realize remote lecture and e-learning system. [1] [2]

However most of the e-learning systems are based on self learning oriented using text and video materials as the educational contents. [5] There are few researches which are suitable for the remote lectures and lessons involving physical excise and training. [6] When the physical practice and instruction are carried out remotely, camera work for grasp the lesson is more important [7] [8]. In this research, the image of the whole classroom was acquired using the panorama camera, and grasp was realized for the overall participant situation using the image. Moreover, combining synchronous media, such as video, and asynchronous media like PowerPoint, it was interactive and the real-time distant education support system with presence was proposed. Furthermore, in order to check a participant's detailed information, a domain management system is proposed, expansion and extraction of a panorama image of the appointed domain were realized and it evaluated about the validity.

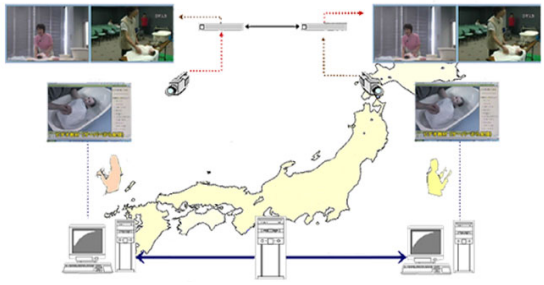

Figure 1：Remote Education Video Model

2. Remote educational support system

Our suggested remote education environment is shown in Fig. 1. The environment of low and high speed IP network is assumed for two classrooms in a remote place. Two educational are prepared in advance. One is the asynchronous teaching materials of video and a text prepared for the server. Another is the synchronous educational video and audio for practical instruction which used all direction videos [4]. The practical exercise which combined these is assumed.

The remote lesson environment in this experiment as shown in Fig. 1 assumes the environment where two classrooms in a remote place are connected with IP network of by the mixed high and low speed network. The practical skill exercise by instruction and questions and answers by the multicast communication using all direction video image and audio and text teaching materials which were prepared for the server etc. in advance are assumed. Since more interaction between lecture and students training is targeted for this system, smaller delay is required as possible.

The delay generated according to the system and network environment makes communication unnatural, leads to the hindrance of training. And in the case of instruction by the teacher if practical skill exercise, the timing which performs the indication and the cautions to the student is delayed, and there is a possibility of reducing a learning effect. Moreover, the flattery nature of the camera according to the minuteness of quality of image or operation must also correspond according to a theme or the contents of lecture.

In the training, since teaching materials by animation are effective in many cases, utilizing effectively the multimedia teaching materials with a combinational, the still picture, the text, and sound leads to improve education effect.

- Education support system configuration

The distant education support system proposed in this paper is constituted using the panorama camera and the mid field system. In the educational support system proposed by this research, in order to be able to acquire by oneself the image which a participant wants to see, two functions were proposed. Blindness in one eye is a function which distributes an image for two images, a panorama image and expanded image a highly minute image, to two or more screens simultaneously.

By using a panorama image, the problem of conventional camera angle, manpower, which was generated with the fixed camera, is solved. The second is the frame extraction and the expansion functions which are included the system. By specification and extraction function in the displayed image domain, proper education corresponding to individual needs is realized. Presentation of the teaching materials by combination of the synchronized video instruction and asynchronous teaching materials effectively is realized.

3. Region Management System

It is combined that Region Management System for educational support and MidField System [3] which realizes interactive communication environment. And synthetic remote education is supported.

Using high resolution video by remote training, an image is required for a high quality. MidField System has a synchronous control function for performing synchronous control between media, and streaming of an image, and has rate control, a packet interval regulating function. In this research, MidField System is used as a means for realizing smooth video delivery through the Internet.

3.1 Region Management System

Remote collaboration using the video and picture of asynchronous education materials and interactive communication is realized. Region Management System that architecture is shown in Fig. 2.

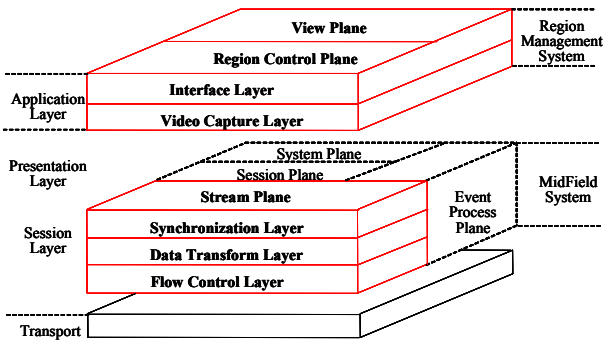

Figure 2：Region Management System architecture

3.2. MidField System

The system architecture that includes required function to realize dynamic interactive communication environment. This System located in under the Region Management System, and it is between the application and transport layer. According to user communication environment and a quality of service (Qos) demand, interactive

communication environment consists of on a computer network dynamically. Moreover, it consists of three-layer a Synchronization layer, a Data Transform layer, and a Flow Control layer, and multimedia communication function is offered to application. By this research, it is RTP Stream by Stream Plane in MidField System. Transmission and reception and transformer coding are performed.

3.3. Transcoding function

Using distributed multimedia system that can integrate various real time and non-real time media data, when the system users communicate with each other by real time audio and video data, the system must guarantee end-to-end Qos (quality of service) according to requirements of the system users and available resource. It is necessary to adjust or control the network bandwidth and media type the remote educational system environment. In order to realize the remote educational system which operates on IP network, the transcoding function of a middle processing base is used, and efficient media conversion is performed. Moreover, media conversion with consideration to the network bandwidth which can be used is realized.

3.4. Function module

The system architecture of our suggested remote educational support system for realizing remote education in interactive communication environment is shown in Fig. 3.

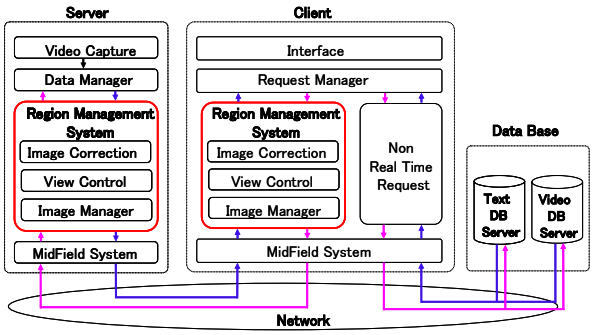

Figure 3 : System architecture

As for remote educational support system which we propose, the system is based on a client and server model. Capturing video and its out put management of output information are performed on both sides. Also, asynchronous media servers, such as media and a text, are managed in integration. The education materials offer according to the advance situation and the understanding situation are changed. The explanation about each function is shown below.

- Server

The processing to the demand from a client uses three functions, Image Correction in Region Management System, View Control, and Image Manager. MedFiled System after performing these processing, it uses, transformer coding is performed and it transmits to the client side. When performing RTP streaming by the server side, the captured data judges whether a calibration is necessity. Then, a display domain is chosen and it rectifies to an image. After this processing of a series of is performed, it is transmitted to the RTP client side by the stream plain in MedField System.

The processing process in image extraction is shown in Fig. 4.

- Client

The image sent to the server side is displayed on the client side.

A request to display teaching materials is managed by Request Manager, and classifies as synchronous media or asynchronous media. In the case of synchronous media request, the extraction, expansion, and the compensation of the image are managed in the Region Management System, and eventually sent to the server, when the specific area in the video output is a elected the image compensation due to distortion in panorama image is process. On the other hand, In the case of asynchronous media request is simply sent to the teaching materials server.

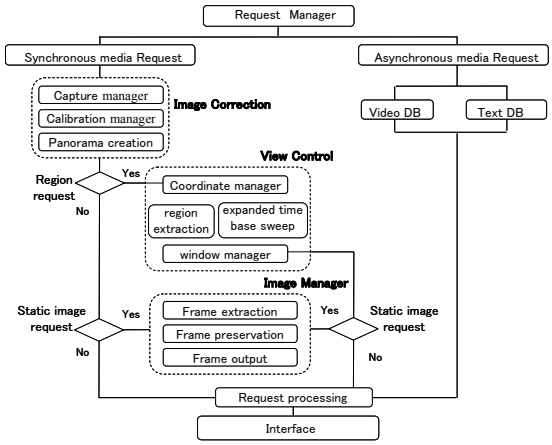

Fig. 4.Image extraction flow on client

- Teaching Materials Database

The lecturer only obtained the video and audio from the students on the screen, they can not perform both observation and instruction.

Moreover, the teaching assistant staff required understanding the contents of training, and a prior arrangement etc. To increase education effect,

introduction of a teaching material database is used in order to solve these problems. Another advantage student can freely determinants, the timing of teaching material display according to the progress of the lean.

In training only with an image and a sound, the timing which performs the change of teaching materials and a lecture image was the photography staff, and the change to the optimal timing was difficult for the student.

It is the contents which the student who is going to learn practical skill after this looks at for the first time, and it is difficult to judge exactly which image is required to which timing. By preparing 2 of a teacher screen and a teaching materials screen screens, it corresponds to the needs of study.

- Sharing Teaching Materials

It is desirable that teaching materials can be shown and shared between remote training simply and effectively like the facing education used by the usual study.

It was carried out by having combined the remote training support system and the teaching materials server whether presentation of teaching materials is simple. From now on, the interface using them needs directions of the layout of a display screen, use of multimedia teaching materials other than an image, and the specific part on teaching materials, fullness of the teaching materials share function of the operatively of the very thing of an educational support system, and to be improved.

4. Prototype System

4.1. Lecture Style

It assumes that having training by connecting two classrooms of a remote place with this experiment. The contents of a lecture were divided roughly into five styles in this research.

- General Lecture Style:

Lecture Style that a lecturer teaches using a white board, OHP, etc. Media data flows from a lecturer to a student.

- Enhancement Work Style:

Lecture Style that students, such as an exercise and a seminar, can take communication to a lecturer and freedom.

- Free Discussion Style:

Lecture Style of performing special communication by a small number of people like the lecture of a graduate school. A participant performs opinion exchange on the basis of the gathered data, respectively.

- Discussion Style:

Lecture Style which the students who are a discussion more formal than a free theory and were nominated by the lecturer advance while following the president's support.

- Self Education Style:

Lecture Style for self-study by VoD or World Wide Website (WWW). Instruction by the lecturer and the assistant, interactive communication between students can also be performed, and spontaneous group study is enabled.

These five lecture Style is combined according to the purpose or the contents, and remote education is performed. Interactive media communication, the various Internet applications, and the education materials prepared for beforehand are used for the education materials to use. And a lecture, discussion, and a practical skill exercise are performed on real time, referring to all direction videos.

The lecture in real time, debate, and a practical skill exercise were performed, having arranged a camera and equipments in the suitable place, and referring to a panorama image. Spontaneous group study between instruction by the lecturer and an assistant or a student was performed.

4.2. Teaching Materials Used

It had training using synchronous teaching materials and asynchronous teaching materials using this system (figure: 5.User Interface).

Figure.5: User Interface

The PAL image and the sound were used as synchronous teaching materials. Moreover, it had from DV by making MPEG4 the fixed camera image by which transformer coding was carried out.It had by making the text distributed before training, and the photograph taken during training

asynchronous teaching materials.

4.3. Apparatus Composition

The experiment environment and apparatus composition which were performed this time are shown in Fig. 6.

- Network environment :
  Iwate IT Open Laboratory local area network
- DV camera : Sony DCR-PC300 NTSC
- Connection form : IEEE1394
- Usage lens : PAL lens
- Machine spec（Dell Dimension 8300）
  * PC : Pentium 4 2.6GHz
  * Memory : 2GB
  * OS : Windows XP
- MPEG4 Image size : 400x300 (pixel)
- PAL DV image size : 840x200 (pixel)
- Reload interval of a screen : 300 millisecond

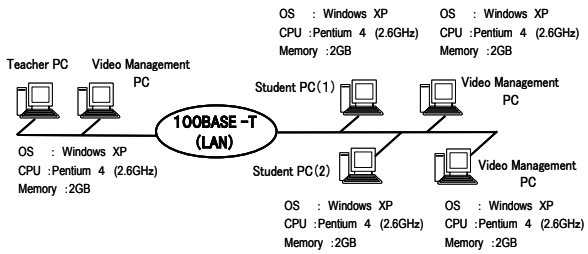

Fig. 6.Prototype System

Moreover, arrangement of both use equipments is shown in Fig. 7.

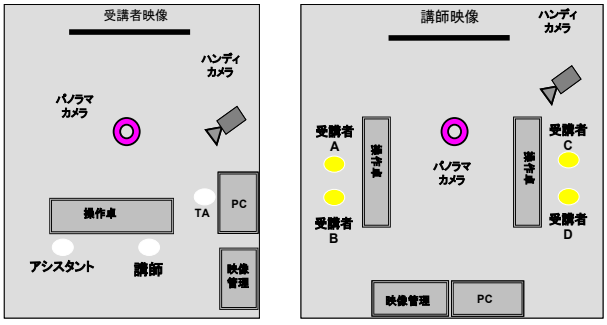

Fig. 7: Equipments arrangement of practical room

5. Experiment

5.1. Participant

In this experiment, two lecturers, two lecturer assistants, four participants, and two photography staff participated. Moreover, apart from training, the eight staff participated as equipments preparation and a situation check staff, and it was carried out by a total of 18 persons. Although two lecturers are performing care instruction from usually and had a career about instruction, the knowledge about a computer did not almost have them. Although the participant had the knowledge about care, it was inexperienced in a remote lecture, video-assisted education, etc.

Moreover, a subject's computer skill was the grade of creation of the Internet or a document which can perform general operation.

5.2. The contents of training

In this training, as for training, the lecturer performed the demonstration first using this system, and the participant had training after that. The wireless microphone was prepared so that instruction and a question could be performed also during training, and in the trainee, care training, such as Foot-bath and Hand-bath, was set to one pair, and it had training by turns. (Figure.7: Training scenery)

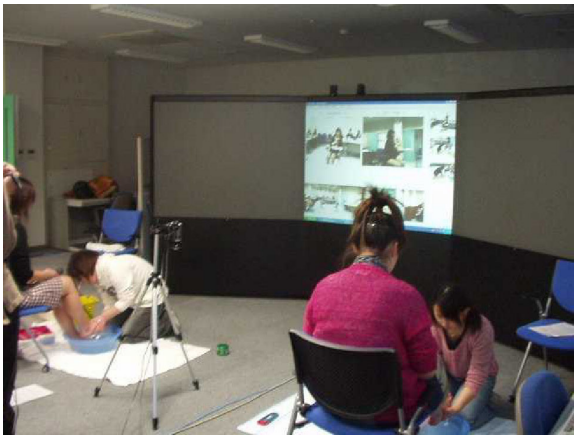

Figure.7: Training scenery (Student side)

Supposing 40 minutes, practice hours performed the rap session and questions and answers using an extraction picture for 10 minutes after training, respectively, and performed training of a total of 1 hour. (Figure.8: Discussion image)

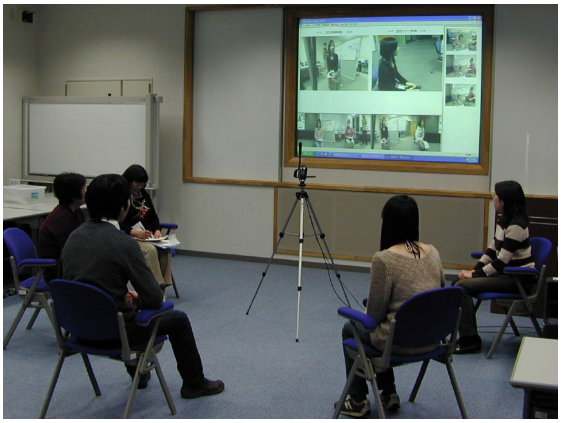

Figure.8: Discussion image (group discussion)

6. Result

The questionnaire by an experiment participant estimated in this experiment. Questionnaires were collected from a lecturer, a participant, and the staff and performed evaluation from a viewpoint of system performance, technology, and education. Quality of image, sound quality, delay, etc. were the most important in the distant education support system using image communication, and it depended for the distant education support system on the contents of a lesson, or a form. The student who used the system during the experiment was only one person, and use frequency was about 1 time in about 5 minutes. The usage was a picture preservation function. The lecturer's use frequency was about 1 time in about 3 minutes the viewpoint change function and the picture preservation function were used equally.

Moreover, the operation mistake of a system was checked by the lecturer and the participant several times. Three participants commented that influence occurred on training by disorder of an image. There was especially no comment about delay of the image from the lecturer side.

In the rap session, the picture preservation function was not used but only the viewpoint change function was used.

7. Conclusion.

The education environment assumed by this experiment is one in the prototype system in remote education, and other environment is considered. Therefore, according to lesson form or an instruction theme, it is necessary to examine the system and necessary condition which constitute remote educational environment. Although mounted this time using Omni directional multi camera, the capability and the characteristic of a camera appeared as a result as it is. Moreover, since the network resource which can be used changes when using on IP network, it is difficult to guarantee stable service offer.

I want to experiment in various lesson styles and to examine the quality and stability of service from now on.

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