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Design Study of Forest Environment Multimedia Contents for Environmental Education with Video Data at the Tokyo University Forests in Chichibu

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1. Introduction

CARSON (1965) mentioned, for the child, it is not half so important to know as to feel. She indicated that "the sense of wonder" for nature is primarily important for children as they grow and that "to feel" can foster children's curiosity for nature, which leads to a desire "to know." The importance of the environmental education has been focused since 1970's as complicated environment problems have increased globally. It is claimed in the Belgrad Charter (UNESCO-UNEP, 1975), which provided the flame work of the international environmental education, that six steps are important such as; i) Awareness, ii) Knowledge, iii) Attitude, iv) Skills, v) Evaluation ability, and vi) Participation. The first step, "awareness" is described as: to help individuals and social groups acquire an awareness of and sensitivity to the total environment and its allied problems. This indication has a same insight as Carson's recommendation that "to feel" the nature in one's childhood is one of the most effective approaches "to know" about the natural environment. Nature-based experiences can be obtained in the field, however, there is little chance for children living in suburbia to experience the real nature. When we focused on the forest, for example, another question how to give chances of awareness more often for these children who can rarely feel natural forest is raised.

Concerning the environmental education in Japan, ICHIKAWA (2002) clarified three stages in its history. Now we are in the third stages since last 1980's, in which the global environment and the domestic pollution problems has been focused. As guidelines of the school education, "Environmental Education Guide of Upper and Lower Secondary Schools" (Ministry of Education, 1991) and "Environmental Education Guide for Primary Schools" (Ministry of Education, 1992) were published in the beginning of this third stage. Ministry of Education (1992) mentioned; "video materials" can attract children's curiosities and interests and thereby it is effective to make comparison between distance places and to understand environmental changes in long terms. The former point matches a commitment of global environmental issues and the latter makes it possible to learn about the forest transition by using daily video recording data of forests.

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Afterward, the environmental education was positioned as part of the integrated course in "New Educational guidelines" (Ministry of Education, 1999a; 1999b; 2000). IWAMOTO *et al*. (2000), analyzing the Environmental Education Guide of Upper and Lower Secondary Schools (Ministry of Education, 1991) with the point of "linkage" and "collaboration", indicated that the environmental education in the integrated course is still in a trial and error process since its contents and objectives are left to schoolteachers' hands. Hence, we regard that a learning kit with observation data from forest science field would be helpful for the environmental education in the integrated course that are lacking class books and proper materials for teaching.

On the other hand, due to the recent development of information technology infrastructure, many kinds of information sources can be digitalized and distributed easily, and as a result, information sharing has flourished. Before the internet generation, "Previous Educational Guideline (Ministry of Education, 1989)" focused on the application of audio-visual contents; now in "New Educational Guideline (Ministry of Education, 1999a)", more active application of audio-visual contents in school education is recommended in order that children can get used to and improve their skills for accessing information networks. Therefore, this study aims to make a prototype of forest environmental multimedia to enable children to enjoy daily forest transitions from video recording data, which is not possible to experience in their ordinary life. Although the targets of the environmental education in schools are from the primary to the upper and the lower secondary school students, our target audience of the multimedia contents in this study is primary school children since it is more important to "feel" the nature during these ages. We intended to make a prototype of the multimedia contents as learning kits that help teachers in the integrated course.

2. Materials and Methods

(1) Materials

Two video recording robot cameras designed for use in forests (hereafter referred to as "robot camera") were set up in the University forest of Tokyo in Chichibu and these cameras, equipped with stereophonic microphones, recorded forest images and acoustic data on a daily basis. The video data included both movies and sound, as it was considered essential to be able to "feel" the forest transitions intuitively with visual and acoustic senses. In this study, we used image recordings from January 6, 2003 to January 5, 2004 from our video data archives to make a prototype of forest environmental multimedia contents. We also used meteorological observation data.

(2) Methods

In this study, we followed the six steps mentioned below:

1) Understanding precisely the characteristics of the video recording data of the forest, 2) Examining the effective relation between the environmental education and the forest video learning materials, 3) Reviewing the concept for making a prototype of multimedia contents, 4) Clarifying the materials for making a prototype of multimedia contents, 5) Making a prototype of

multimedia contents of the forest environment, 6) Clarifying the characteristics of the prototype and examining the application method for the environmental education.

3. Results and Discussions

(1) Characteristics of the video recording data of the forest

The video data recorded by the two robot cameras that were used in this study was of high quality. Movement and sound were recorded at the same time on a daily basis. As this recording data is so accurate, it is scientifically valuable because we can clearly observe the transition of one year's scenery playing one year's video data. Furthermore, we can extract specific images to further our objectives. Although the general video data only included limited sound sources that were recorded by on-microphone, the video data by robot cameras was specific as off-microphone recording because robot cameras record whole sound sources in the forest without any exclusivity of recording. This video data included the songs of birds and insects as well as the sound of winds, leaves, and raindrops that added environmental information to the acoustic sense. It was also found that the acoustic data could be used for analyzing birds' songs and for identifying each avian species. Additionally, as one robot camera captured 40 shots in one day, we combined some shots of a specific tree or trees at different angles, which made it possible to observe the targeted forest in multi-dimensional form.

(2) Examining the environmental education and the forest video learning materials

The integrated courses in primary schools start from the third grade; therefore, the target audiences of the multimedia contents in this study are older than the third grade students. The third and the forth grade students are regarded as the middle grade and the fifth and the sixth grade students as the upper grade.

Ministry of Education (1992) recommended the application of the video with mentioning that video learning materials will help to make comparisons of environmental conditions among different areas and countries. It is said in this guideline; i) the awareness of environmental issues are systematized and the basis of the action for the closer environment is supposed to be constructed, ii) and it makes it easier to understand environmental changes in local areas as well as to attract children's curiosities and interests, by using video materials. At the same time, it is also mentioned the importance of proper use of video materials according to children's knowledge development. The video data used in this study were recorded daily with sounds; therefore, it is possible to show seasonal changes as time goes by, with using a whole one year video data. Especially, for school students, it is required to use appropriate learning materials in accordance with their growing up. For example, the video learning materials of autumn leaves or sprouts of *Fagus crenata* (Beech tree) with detailed explanation about trees phenology are suitable for high school students, which give higher scientific knowledge. On the other hand, the video materials that show the whole year's changes of forest with environmental sounds can be used from primary schools to high schools, because these video data with forest images and natural sounds can give the chance for awareness without any specific knowledge about forest.

(3) Reviewing the concept for making a prototype of multimedia contents

When forest images from video recording data of robot cameras were digitalized for multimedia content, we intended to make a design to stimulate the audience's senses in order that they could feel and recognize unfamiliar forest phenology, seasonal forest landscapes with daily microclimate as well as fauna in the forest. Hence, the concept for our prototype was built up with four points that is described below:

a) We regarded that explanations in writing was not conducive to a learning environment for the audience. A more tactile method of learning facilitated a superior learning environment, which enabled the audience to feel the forest intuitively. Therefore, the forest images were produced as a set of calendar cards so that curiosity and interests of the audience who are not so familiar with the forest are attracted, by recognizing forest phenology on their own time scale.

b) We combined multiple shots in different angles so that children could feel forests in different scales from detailed leaves and branches to a whole forest landscape. Such combinations of different images, which shows the targeted forest in different scales of the same day, attract interests of upper grade students who can logically observe the video images in some extents.

c) Meteorological observation data was added to each card so that children could feel daily climatic changes in forests with views of forest transition as well as that they could compare as enabling a comparison in the temperature in forests with their daily life. To show the meteorological changes not by numeric data but by visual images with graphs can make it possible for middle grade students to recognize seasonal changes.

d) We made avian species composition lists and attached them to forest images so that children could look at the images with information of birds' songs and species. Both middle grade and upper grade students can feel and recognize birds' songs, but especially, it is supposed that upper grade students are interested in the composition of birds and their technical name.

(4) Clarifying the materials for making a prototype of multimedia contents

a) Selection of media

SAITO *et al* (2005) evaluated the characteristics of each media, such as printed text, web contents, and DVDs. According to these results, printed text was effective for observing all contents. On the other hand, web contents value was for interactive access, and DVD viewing produced high quality images. Therefore, in this study, after examining how to effectively combine different media in order to stimulate children's senses and curiosity for the forest environment, we employed the printed calendar for its effectiveness in viewing seasonal changes in a whole year, and additionally we made the DVD for distributing high quality images and sounds to replicate the feeling of forest phenology with visual and acoustic senses. Printed materials are most general media as learning contents and video images of DVDs are useful media to recognize seasonal changes more easily. Web contents regarded as supplementary media were designed for detailed explanation of the calendar and the DVD, and a download site was built to facilitate this.

b) Selection of shots from video data

We selected the effective shots from our data in order to feel the detailed of the forest such as

leaves and branches as well as the whole landscape of the forest. HIGUCHI (1983) described the landscape in short-distance, middle-distance, and long-distance view; we followed this indication. Image shots were used with a combination of short-distance, middle-distance, and long-distance view, i.e., in which each tree and its branches are visible, in which trees become textural units, and not even the variations in texture could be seen (HIGUCHI, 1983). From our video archive, we selected shot number R1S24 (Robot camera number-1, Shot number-24, same as following shot number) as long-distance, R1S33 as middle-distance, and R2S07 as short-distance view (Fig. 1).

c) Selection of the calendar

In order to see and feel the phenology of forests intuitively, the calendar was made based on 24 seasonal periods and 72 climatic seasons (Table 1). Each climatic season is consist of four to six days, hence, the same climatic season expresses the same tree phenology with different weather though. One year is divided into 72 climatic seasons, therefore, it is possible to recognize seasonal changes with shorter terms than a month or a week. Although the 1st climatic season started on the equinox in 72 climatic seasons, the calendar of 2003 produced in this study starts from the 67th climatic season on January 6, 2003 and ends at the 66th climatic season on January 5, 2004. We selected many images of this period from our video archive, and digitalized 1000 data (Table 2).

d) Identification of birds' species from recorded natural sounds

With 10 seconds acoustic data from each *Fagus crenata* (beech tree)'s shoots (R2S7) per day, we identified the songs of various birds. Table 3 includes 20 identified avian species and two cicadas species that were shown with corresponding images (Table 3).

e) Extraction of meteorological data per hour in a year

In order to make a correspondence of temperature data with images, we collected meteorological observation data from the closest point to robot cameras in the University forest and calculated the average temperature each hour. Thereby, we tabled the figures of each day, which are shown on each card. This visual expression helps middle grade students to recognize the meteorological changes intuitively.

Fig. 1. Three selected images
left: R1S24 for long-distance view
center: R1S33 for middle distance view (zoom in shot of the long-distance view)
right: R2S02 for short-distance view (shoots of beech at top crown)

Table 1. 24 Seasonal periods and 72 climatic seasons term and meaning.

24 seasonalperiods	Number of 72 climatic seasons	Month. Day - year	Explanation of 72 climatic seacons
Moderate Cold	67	Jan.06-10,2003	Celeries start to grow richly
	68	Jan.11-15,2003	Springs frozen in the earth begin to move and turn into water
	69	Jan.16-19,2003	Male pheasants enjoy to chatter for the first time of the season
Severe Cold	70	Jan.20-24,2003	Butterbur sprouts begin to put out buds and bloom readily
	71	Jan.25-29,2003	Mountain streams are glittered over with thick ice
	72	Jan.30-Feb.3,2003	Hens are sitting in hencoops being ready to blow eggs
Spring Begins	1	Feb.04-08,2003	Spring breeze begin to take up the thick ices everywhere
	2	Feb.09-13,2003	Bush warblers break into songs in mountain village
	3	Feb.14-18,2003	Fishes are jumping out of cracks of ices and hopping vigorously
Rain Water	4	Feb.19-23,2003	Rain falls give gentle mois-ture into the earth
	5	Feb.24-Mar.1,2003	Misty haze is first flowing for the season
	6	Mar.01-05,2003	All plants and grasses begin to sprout
Insects Awaken	7	Mar.06-10,2003	Insects keeping indoors for the winter start to come out on the ground
	8	Mar.11-15,2003	Peach trees begin to bloom
	9	Mar.16-20,2003	Budworms turn into newly-emerged beautiful butterflies
Spring Equinox	10	Mar.21-25,2003	Sparrows begin to build up nests
	11	Mar.26-30,2003	Cherry flowers are blooming for the first time of the season
	12	Mar.31-Apr.4,2003	Thunders begin to rumble like sounds of distant voices
Pure Brightness	13	Apr.05-09,2003	Swallows are first coming from the south
	14	Apr.10-14,2003	Gaggles of wild geese are going back to the north
	15	Apr.15-19,2003	A rainbow comes up after the rain for the first time of the season
Grain Rain	16	Apr.20-24,2003	Reeds begin to sprout
	17	Apr.25-29,2003	Hoarfrost are melting and rice seedlings begin to grow
	18	Apr.30-May.5,2003	Peonies are blooming gorgeously
Summer Begins	19	May.06-10,2003	Frogs begin to croak for the first time of the season
	20	May.11-15,2003	Earthworms are coming up on the ground
	21	May.16-20,2003	Bamboo shoots sprout out from the ground
Grain Fills	22	May.21-25,2003	Silkworms begin to move and eat first mulberry leaves
	23	May.26-30,2003	Safflowers are bloom gloriously
	24	May31-Jun05,2003	Oats become ripen enough to the time of barley harvests
Awn Appears	25	Jun.06-10,2003	Mantises come into being on the earth
	26	Jun.11-15,2003	Fireflies are born from ripen grasses on the ground
	27	Jun.16-21,2003	Plums turn into mellow yellow
Summer Solstice	28	Jun.22-26,2003	Prunellae spica become dried out
	29	Jun.27-Jul.1,2003	Irises are blooming beautifully
	30	Jul.02-06,2003	Pinellia Tubers start to grow
Moderate Heat	31	Jul.7-11,2003	A warm breeze is coming to first blow
	32	Jul.12-16,2003	Lotus begin to bloom for the first time of the season
	33	Jul.17-22,2003	Baby hawks start to learn how to fly in the sky
Great Heat	34	Jul.23-27,2003	Paulownias begin to bear their berries
	35	Jul.28-Aug.1,2003	Earths become moistened and airs become sticky
	36	Aug.02-07,2003	Heavy rains are coming to fall occasionally
Autumn Begins	37	Aug.08-12,2003	A gentle cool breeze blows for the first time of the season
	38	Aug.13-17,2003	Higurashi cicada begin to drone bitterly
	39	Aug.18-22,2003	A dense fog lay all around in the air
Heat Ends	40	Aug.23-27,2003	Cottonseeds begin to open vigorously
	41	Aug.28-Sep.1,2003	The heat of summer finally calm down
	42	Sep.02-07,2003	Rice become ripen and wait to harvest
White Dew	43	Sep.08-12,2003	Dewdrops on the grass are glistening white
	44	Sep.13-17,2003	Wagtails start to enjoy chattering
	45	Sep.18-22,2003	Swallows are going back to the south
Autumnal Equinox	46	Sep.23-27,2003	Thunders stop to rumble and go away quietly
	47	Sep.28-Oct.2,2003	Insects start to crawl into holes and be ready to keep indoors
	48	Oct.03-08,2003	Streams everywhere begin to freeze little by little
Cold Dew	49	Oct.09-13,2003	Gaggles of wild geese are coming back
	50	Oct.14-18,2003	Buds of chrysanthemums begin to open and bloom
	51	Oct.19-23,2003	Grigs are sitting close by the door and chirping away
Frost Descends	52	Oct.24-28,2003	Hoar frost begin to descend for the first time of the season
	53	Oct.29-Nov.2,2003	Sprinkle of rain drizzle down from time to time
	54	Nov.03-07,2003	Maple leaves and ivies turn red and yellow everywheres
Winter Begins	55	Nov.08-12,2003	Camellia start to bloom gorgeously
	56	Nov.13-17,2003	Mother earth begin to be frosted
	57	Nov.18-22,2003	Daffodils are blooming with sprinkling pleasant fragrances
Light Snow	58	Nov.23-27,2003	A rainbow hides away and hardly appears after the rain
	59	Nov.28-Dec.2,2003	A north wind whips away all the falling leaves
	60	Dec.03-06,2003	Mandarin orange trees start to turn their leaves into yellow
Heavy Snow	61	Dec.07-11,2003	The air and earth become cold and bring the winter finally
	62	Dec.12-16,2003	Bears start to go into their holes for winter sleep
	63	Dec.17-21,2003	A run of salmon is trying hard to go up stream
Winter Solstice	64	Dec.22-26,2003	Prunellae spica begin to sprout everywhere
	65	Dec.27-31,2003	Deer are ready to mew their horns
	66	Jan.01-05,2004	Oats are forming buds under the snow

Table 2. The number of files that were digitalized

View distance class	Number of shots	data existing days	data missing days	sub-total	%
long	R1S24*	335	30	365	92
middle	R1S33	337	28	365	92
short	R2S07	328	37	365	90
total		1000	95	1095	91

*R1S24: Robot camera No.1, Shot No.24

Table 3. List of birds and insects hearing from shot C2S7 sound data.

	Latine Name	English Name
1	*Cuculus saturatus*	Oriental Cuckoo
2	*Cuculus poliocephalus*	Lesser Cuckoo
3	*Dendrocopos kizuki*	Japanese Pygmy Woodpecker
4	*Ixos amaurotis*	Brown-eared Bulbul
5	*Luscinia cyane*	Siberian Blue Robin
6	*Turdus chrysolaus*	Brown-headed Thrush
7	*Dendrocopos leucotos*	White-backed Woodpecker
8	*phylloscopus coronatus*	Crowned Willow Sarbler
9	*Regulus regulus*	Goldcrest
10	*Cettia diphone*	Japanese Bush-Warbler
11	*Aegithalos caudatus*	Long-tailed Tit
12	*Garrulus glandarius*	Eurasian Jay
13	*Parus montanus*	Willow Tit
14	*Parus ater*	Coal Tit
15	*Parus major*	Great Tit
16	*Parus spp.*	Great Tit group
17	*Sitta europaea*	Wood Nuthatch
18	*Zosterops japonica*	Japanese White-eye
19	*Eophona personata*	Japanese Grosbeak
20	*Corvus macrorhynchos*	Large-billed Crow
1	*Tibicen japonicus*	Cicadidae
2	*Terpnosia nigricosta*	Japanese spring cicadas

(5) Making a prototype of multimedia contents of the forest environment

The title of the multimedia contents in this study is “The sense of forest archives 2003.” Also, the title of the printed calendar is “The sense of forest archives 2003 card” and of the DVD is “The sense of forest archives 2003 DVD”.

a) We produced digital engraving for printed calendars as well as a PDF file. One card represents 1 climatic season per year; hence, 72 cards were designed. Every card included a title

from 24 seasonal periods and a name from 72 climatic seasons as well as the serial number of the appropriate climatic season with Japanese traditional expression. We placed three still images of each day with a temperature graph per hour on each card, so that the viewer could easily see and feel the daily transition of sensory temperatures. Fig. 2 shows the example of card design, which represents the 37th climatic season.

Fig. 2. An example of a design for 72 climatic seasonal cards.
The 37th climatic season in 2003 is 5 days period from 8th to 12th August.

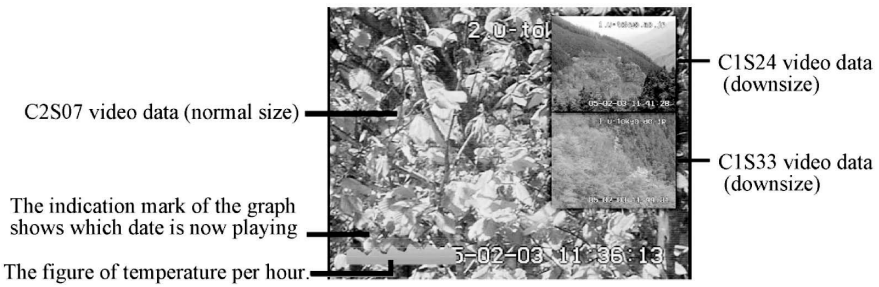

Fig. 3. An example of the DVD screen design
A picture from the 3rd day of the 18th climatic season in 2003.

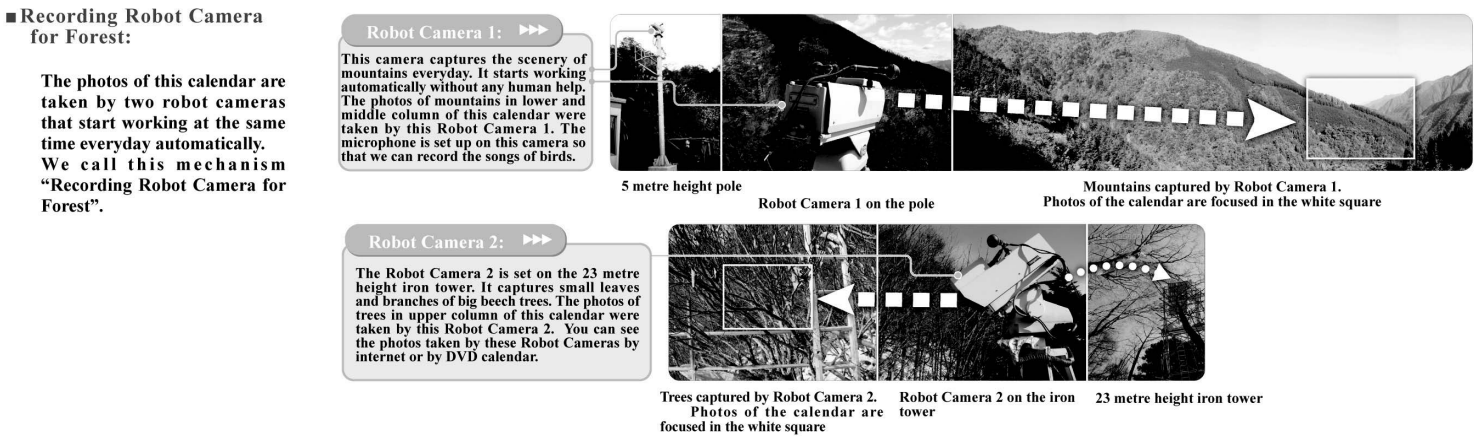

Fig. 4. The explanation figure of robot cameras published on the web
Robot cameras that captured all video data used for the printed calendar card and the DVD are introduced and explained here in simple English.

b) For making the DVD, we first designed movies. In order to compress all the data into DVD movie format NTSC (resolution of 640*480 pixels), we downsized middle-distance and short-distance view movies, and layered them on long-distance ones. Next, we produced a list of avian species identified from acoustic data that corresponded to these movies. The temperature graph used for the calendar was inserted into the movies and the indication mark of the graph showed which date was playing. A screen was designed as Fig. 3; thereby each chapter was produced as a climatic season. As for acoustic sounds, we selected only the sound from short-distance view movies to play and eliminated other sounds.

c) Web-page (URL http://bis.nenv.k.u-tokyo.ac.jp/senseofforest2003/index.html) was designed as an introduction site for the calendar card and the DVD. We illustrated the explanation of robot cameras so that the audiences can easily understand how to collect video data used in the calendar and the DVD. (Fig. 4).

(6) Characteristics of the prototype and examining the application method

a) The sense of forest archives 2003 cards (24 seasonal periods and 72 climatic seasons' card)

72 climatic seasons' cards are easily applied as distributing or rental learning contents since they are printed material. It is easy for the audience to use and observe the images of the cards. When the audience make comparison with daily changes of the forests, the different images

Fig. 5. The 18th climatic season card from "The sense of forest archive 2003" calendar
We can see from the avian species list on the short-distance view in the upper column that *Parus spp*. (Great Tit group), *Corvus macrorhynchos* (Large-billed Crow), and *Parus ater* (Coal Tit) are recorded.

shown in one card as one climatic season are helpful for comparing daily changes. Also it is possible to select and dispose the different cards to see the changes between different climatic seasons. The middle grade students are supposed to be more interested in the DVD contents than the cards, but in this case, the cards can be used as supplementary materials for watching the DVD. The upper grade students can use the card to obtain more information from meteorological graphs, which give them further understanding of characteristics of each climatic season as well as the whole seasonal forest changes in a year.

For example, Fig. 5 shows the card of the 18th climatic season. It represents a 6 day period from April 30 to May 5, 2003. From the middle-distance view images in the middle column, we can see the process of blooming of Hill Cherry. Furthermore, we can feel the weather of that day from the temperature graph, which shows the daily range indicating fine, sunny days during this period. Fig. 6 shows the card of the 21st climatic season. Eleven days have passed from the 18th climatic season card; the cherry flowers are in bloom and starting to wither. Fresh new shoots are starting to appear. We can see from the temperature graph that daily range is low on May 17 because of foggy weather.

Fig. 6. The 21st climatic season card from "The sense of forest archive 2003" calendar
We can see from the avian species list on the short-distance view in the upper column that *Cuculus saturatus* (Oriental Cuckoo), *Parus spp*. (Great Tit group), *Sitta europaea* (Wood Nuthatch) and *Parus ater* (Coal Tit) are recorded.

Thereby, the printed cards help the understanding of the changes from different days, which is difficult to recognize by DVD showing each day separately. It is the effectiveness of printed materials that are handy and comparable.

b) The sense of forest archives 2003 DVD

The DVD already became one of popular media to distribute video images. Since it doesn't need a broad bandwidth internet, the DVD is also useful as distributing or rental learning materials. The edited images in the DVD (Fig. 3) make it possible for the audience to watch the long-distance, middle-distance and short-distance view with temperature data and with natural sounds, furthermore, it is possible to watch the whole year's images with explanation of each climatic season. The operation of the DVD is so flexible and easy that the audience can watch the whole year's changes in a way they want to. In the DVD, we designed one climatic season as one chapter with focusing the flexible use. For example, the audience can easily skip and select a chapter and also can search immediately the images they want to check. This kind of selective observation per chapter would be difficult for the middle grade students, but applicable for the upper grade students. As one chapter represents one climatic season in the same way as a card of the calendar, the audience can refer the card when searching any specific dates of the DVD, or they can use the calendar cards for obtaining additional data from previous and/or next periods, which they may be watching on the DVD. Reversely, it is also possible that the audience refers to the DVD to watch and feel the period they found most interesting when they viewed a card of the calendar.

c) The sense of forest archives 2003 web-page

(URL: http://bis.nenv.k.u-tokyo.ac.jp/senseofforest2003/index.html)

Webpage can be referred by the audience whenever they have any further interests about the robot cameras while they are using the cards or the DVD as learning materials. Not all information related to these learning contents do not have to be in the learners' hands, since it is sufficient to search and obtain additional information by internet. For example, further information about the University Forest of Tokyo in Chichibu where the robot cameras are settled or about climatic data in Chichibu can be significantly obtained according to the audience interests and understanding level.

4. Conclusion

The huge amount of accumulated video data that was captured by robot cameras in the University forest of Tokyo in Chichibu is scientifically worthwhile, but it can also be applied for digital contents that help the public to feel the forest transition intuitively. In this study, we focused on the objective mentioned in the environmental educational guidelines; using video materials to understand environmental changes in long-term more easily. With arranging the digitalized video data as the traditional Japanese season called 24 seasonal periods and 72 climatic seasons, we made a prototype of forest environmental multimedia contents that give awareness of forest seasonal changes to the audiences. It is possible to recognize a tree and a

forests intuitively with the combination of the long-distance, middle-distance and short-distance view. Also, we suggested the forest video use with the additional information like meteorological data per every hour, which is helpful to understand the sensory climate. Likewise, we developed the multimedia prototype, "The sense of forest archives 2003", with combining different types of media such as the printed contents and the DVD.

In school education, because the environmental education is not positioned as general subjects but as a part of the integrated course, there is no specific text book. This is one of the causes that environmental education is still in a trial and error process in each school. The multimedia contents prototype made in this study has reliable scientific roots since they were produced with the data collected by the forest robot cameras that are settled for scientific observation objectives. However, the application of this multimedia learning material should be examined in the real school courses, with collaboration of any schools. Thereby, we can evaluate its application as useful learning contents with schoolteachers. This prototype is the first step to improve the multimedia learning materials that are useful to give chances of awareness for the natural environment like forests.

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Summary

In the university forest of Tokyo in Chichibu, two video recording robot cameras for forests (hereinafter "robot camera") with stereophonic microphones are recording forest images and acoustic data on a daily basis. We believe that these video data, which include movies and sound recordings, can be used for making a new learning environment for children that will help them to feel the forest phenology intuitively. In this study, which targeted an audience at or older than the third grade in primary schools, we aimed to make a prototype multimedia resource for environmental education. We used video data from 6th January 2003 to 5th January 2004 from our video data archives and digitalized them. The media we produced were; i) printed cards, where one card expresses one climatic season, and its associated PDF file, ii) the DVD, which consists of the climatic seasonal chapter and temperature graphs with natural sounds, and iii) the website from which the audience can download the PDF and DVD files and which includes further information about the robot cameras. We introduced the Japanese traditional seasonal expression as a calendar, which contains 24 seasonal periods and 72 climatic seasons. The 24 seasonal periods and 72 climatic seasons are effective when organizing forest transition images; therefore we produced the printed calendar and the DVD following these traditional seasonal units. In the printed calendar, one card represents one climatic season. One chapter on the DVD corresponded to one climatic season and each chapter has daily video images and sounds with temperature graphs associated with this period. Additionally, we built the website as a complement to the calendar and the DVD. Here children can also easily learn about robot cameras as well as downloading all the contents of the calendar in PDF format and the DVD. Consequently, we examined the effective design of these multimedia resources through the process of making a prototype. For example, there are useful techniques such as watching the DVD while using the printed calendar cards as an index of contents or for checking more details about the calendar contents while watching and listening to the DVD. It is necessary for each set of contents to be designed in a complementary way. In the future, it is expected to use this prototype with collaboration of schools so that we can evaluate with school teachers if it is a useful resource for environmental education.

Key words: Multimedia contents, forests, learning contents, video data, archives

東京大学秩父演習林森林映像データを用いた森林環境教育用マルチメディアコンテンツの製作検討

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要　　旨

東京大学秩父演習林では，1995年より2台の森林映像記録ロボットカメラによる森林景観のビデオ記録が続けられている。定点定時の記録動画と音声は，森林の日々の様子を直感的に感ずることのできる環境学習コンテンツになると考えた。本研究では，小学校の総合学習において，環境教育の映像教材を利用する可能性のある3年生以上の小学生を視聴者と想定し，2003年1月6日から2004年1月5日の1年間の森林映像データと気象データをデジタル化し，24節季72候の暦に従って，候単位で映像記録をとりまとめたデジタルコンテンツを試作した。メディアは，1候を1枚のカードにレイアウトデザインした印刷物とPDFファイル，1候を1チャプターとして日々の映像と音声，及び気温の時間変化グラフを視聴できるビデオ再生画面レイアウトをデザインしたDVDを作成した。またPDFファイルとDVDファイルをダウンロードできるWebサイトには，森林映像記録ロボットカメラについて視聴者に理解できるように平易な文章で解説を掲載し，デジタルコンテンツを配信できるようにした。試作を通じて，印刷物とDVDを一緒に視聴することで，印刷物を見ながらDVDで映像を選択して視聴する方法や，逆にDVD映像を見ながらその前後をカードで一覧するなどの使い方があることが分かった。森林の日々の様子を擬似的にでも感じる際に，印刷物とDVDとが相互に補完するメディアとしてデザインすることが必要だと思われる。本研究での試作を通じて明らかになったデザインを踏まえ，さらに洗練したデジタルコンテンツを新たに制作し，森林環境の変化を子供達が感じ取れるデジタルコンテンツの評価実験を小学校の教員との共同で進めたい。

キーワード： マルチメディアコンテンツ・森林・環境教育・ビデオデータ・アーカイブス