Experimentation and Evaluation of a Multimedia Exhibition Information Service Using Visitor-owned Portable Wi-Fi Terminals Suitable for Small-scale Museums

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Abstract Several excellent multimedia museum information services using portable terminals are proposed, but are very difficult to introduce for small-scale museums that have limited human and capital resources.

The experimentation of a simple multimedia exhibition information service using visitor-owned portable Wi-Fi terminals was carried out on a special exhibition of the National Museum of Japanese History in the summer of 2013. It is easy to imitate and will be able to extend more advanced contents.

We have two analyses to evaluate visitors' reaction and acceptance of the service. An analysis of visitor questionnaire survey clarified that there are many users who cannot do a setup of Wi-Fi well beyond our anticipation, and that young women positively accepts the service. An analysis of web access logs revealed that the users tend to select a content not by its meaning but a location of the link to the contents on the screen.

Key words: multimedia exhibition information service, visitor-owned portable Wi-Fi terminal, smartphone, tablet terminal, small-scale museum

1. Introduction

Portable terminals including smartphones and tablet terminals have enough potential to use for multimedia museum information services. Several excellent applications for the museums using portable terminals are proposed, but, at present, most of them are very difficult to introduce for small-scale museums that have limited human and capital resources.

In this paper, a simple solution of multimedia exhibition information service using visitor-owned portable Wi-Fi terminals suitable for small-scale museums is deduced. The service is easy to imitate or refer, and will be able to extend more advanced contents. The experimentation to demonstrate the effectiveness of the service was carried out on a special exhibition of the National Museum of Japanese History, Chiba, JAPAN in the summer of 2013.

We have two analyses to evaluate visitors' reaction and acceptance of the service. One is an analysis of a

visitor questionnaire survey to know visitors' response immediately, and another is an analysis of web access logs to probe unconscious actions of visitors. This paper also shows the result of two analyses.

2. Evolution of museum information service using portable terminals

Providing museum information by using portable terminals is not novel. A rental service of audio guide terminal is popularly prepared in most museums. The National Museum of Japanese History introduced the first version of audio guide service for permanent exhibitions in 1994.

Several excellent multimedia exhibition information services using museum-prepared portable terminals are proposed¹⁾²⁾. "MINPAKU Digital Guide³⁾" which is introduced by the National Museum of Ethnology, Osaka, JAPAN in 1999, is one of pioneer works. This is a portable device that lets you select video and audio explanations of the exhibits you see while visiting the museum. Recently, a multimedia exhibition information service using Nintendo 3DS "The Audioguide Louvre - Nintendo 3DS" was available at the Louvre Museum, Paris, FRANCE in April, 2012⁴⁾. This service is the joint product of the Louvre Museum and Nintendo Co., Ltd and includes several tour programs, location

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estimation technology, high definition photographs and 3D viewing of major pieces, etc.

The use of visitor-owned portable terminals including smartphones and tablet terminals are rapidly spreading. Such terminals have enough ability to play various kinds of multimedia contents. Some museums have already tried to use the terminals as a personal exhibition guide⁵⁾⁶⁾. At the Tokyo National Museum, Tokyo, JAPAN, three kinds of application “e-Museum,” “Tokyo National Museum: 30-minute Tour of the Gallery of Horyuji Treasures,” and “Tohakunavi” are available to download and install⁷⁾. The National Museum of Western Art, Tokyo, JAPAN released an official museum application “Touch the Museum” in 2010⁸⁾. In every case, a certain application software for access to exhibition information is provided. This software uses advanced function of portable terminals such as precise location detection, QR code reading, augmented reality, etc.

3. Practical solution for small-scale museums

In this section, we discuss several requirements of a museum information service using visitor-owned portable terminals for small-scale museums that have limited human and capital resources, and deduce a simple solution to satisfy the requirements. The solution should be easy to imitate or refer by the museums.

In many cases, preparation of an audio guide is limited to the permanent exhibition to which it can count upon prolonged use, or the special exhibition with abundant reserve assets. The expense for maintenances of the hardware is necessary to continue service to rent terminals; disinfecting of used equipments, checking breakdowns, preparation to loss or theft, etc. The expense for developments of the software cannot also be overlooked.

The use of visitor-owned portable terminals for museum information service gives advantage in both the museum and visitors: the museum is released from maintenance of the hardware and can make efforts in the development of the superior software, and visitors can use the favorite portable terminals and is not perplexed with the operation.

Introduction of advanced and attractive work that we mentioned in the last session is desired. But it is very difficult from a viewpoint of small-scale museums. First, almost all museums have no ability of development of application programs on their own. The outsourcing cost for the development comes up, and the

whole of the contents included in the application could not be taken care. In addition, the cost concerning the maintenance management of the developed application is not small. Second, visitors have to download the application for exhibition information services from certified download site and install. Registration of the application to the download site takes the time for several days because the safety and reliability of the application are verified. The schedule for development of application must have enough margin times, and it is very difficult to correct the mistake after the application was distributed.

From the above discussion, requirements of a museum information service using visitor-owned portable terminals are summarized below:

- running costs are small;
- visitors don't need any preparation before coming to the museum;
- museum staffs can perform all the work to do the service by themselves, and outsourcing of whole or partial work is available; and
- change of the provided contents is always possible, and the display of a terminal can be updated as soon as possible.

As a certain solution that satisfies the requirements, the use of a combination of a web browser and a wireless connection network is deduced. Almost all portable terminals have the ability to access a Wi-Fi network and reproduce the web contents. The solution is easy to imitate or refer because most museums have their own museum website, and same skill can be used to edit the HTML contents.

The HTML5⁹⁾ technology will make advanced multimedia information services available in various kinds of terminals. But, at present, it is difficult to develop HTML5 contents which are equally reproduced in every terminal because there are various implementations of the web browser supporting HTML5 tags partially. The use of the HTML5 technology is our next challenge and was excluded from this paper. Announcement of the final recommendation of HTML5 is strongly desired. The solution we deduced is able to extend HTML5 contents easily.

4. Experimentation

4.1 Contents

To demonstrate the suitability of deduced solution practically, an experimentation was carried out in a special exhibition “Musical Instruments Tell Stories¹⁰⁾” in

Fig. 1 Some touchpanel PC terminals in the *gagaku* section.

the National Museum of Japanese History in the summer of 2013. The period of the experimentation was the same as the period of the special exhibition (49 days).

In the exhibition, for more close understanding about Japanese musical instruments, a section for introducing *gagaku* — Japanese ancient court music (and dance) that the instruments were used was arranged in the special exhibition room B. Multimedia contents were developed and provided using 5 touchpanel PC terminal for help of visitor's understanding about *gagaku*. Some PC terminals used in the exhibition can be seen in **Fig. 1**.

Every PC terminal has two headphones, and visitors listen the sound via the headphone to keep the exhibition room quiet. So the number of visitors that can listen the sound simultaneously was restricted. It was one of motive to do the experimentation to enable to listen the sound whenever they desired.

41 audio contents and 3 movie contents are provided via portable terminals. It is the same contents that is provided from PC terminals. Because we were allowed to do the experimentation on condition that every visitor is able to get the same amount of information whether the visitor has a own portable terminal or not. Unfortunately, the functions of free sound mixing providing by some PC terminals were not available on portable terminals, and the quality of audio/video contents was adjusted suitably to control the load of traffic. Audio data have MP3 format (192kbps CBR), and movie data have MP4 format (Apple TV H.264 480p).

To keep quiet, in addition to a portable terminal, a self preparation of a headphone was requested. A few complaints (e.g. a headphone should be sold at a museum shop) are received. (It is a point to be improved in the next trial.)

Details of each content are shown in Appendix A.

4.2 Environment

Fig. 2 shows the arrangement of a web server and Wi-Fi equipments. All of them are not special, not expensive, and easy to purchase. A web server and a Wi-Fi router are located in the accessway between the special exhibition room A and B, and two Wi-Fi repeater are located in each room. As the Wi-Fi router and repeater, three Buffalo WZR-HP-G302H were used. The equipments support the function of WDS (Wireless Distribution System) and cover the whole of the special exhibition as a service area.

Fig. 3 shows the Wi-Fi network diagram. SSID is “gakki”. The Wi-Fi network was not connected to the Internet and was used only as a private network to keep a minimum security. No Wi-Fi encryption was used to escape the input of Wi-Fi encryption key.

IIS6 on Windows XP was used as a web server program. The URL of web server was <http://gakki>. In order to input simply, the URL was shortened as much as possible.

An announcement poster of the experimentation was prepared (**Fig. 4**). Contents of the poster are

- Object of the experimentation,
- What you can do,
- When and Where,
- Equipments to prepare, and
- How to access the contents.

QR code of the URL was presented on the poster.

A visual instruction sheet for connection of the terminal to Wi-Fi network was also prepared (**Fig. 5**). The following two steps are explained with some hardcopies of the screen:

- Choice of the SSID; and
- Access to the top page.

During the exhibition, all equipments work with no trouble.

5. Analysis of visitor questionnaire survey

To know visitors' response immediately, questionnaires are prepared in special exhibition area for investigation of visitors who use our information service using visitor-own portable terminals.

Questions included in the questionnaire are:

- (1) sex (male or female),
- (2) age (until 10, 11-20, 21-30, 31-40, 41-50, 51-60, 61-70, over 71),
- (3) Q. Were you attend this experimentation?

Fig. 2 Arrangement of web server and Wi-Fi equipments.

Fig. 3 Wi-Fi network diagram.

スマートフォンを使った 展示案内の実験を行なっています

実験の目的は何か
近年普及が著しいスマートフォンをうまく使って、来館者のみなさまにさまざまな情報をお伝えするために、どのような問題（技術的・社会的）があり、それをどのように克服していけばよいかについて、博物館として経験を積むために実施します。

どんなことができますか
企画展示「素顔は語る」にて使用している音声・動画コンテンツを、お手持ちのタブレット端末やスマートフォンで再生して視聴することができます。（技術的な問題で提供が難しい一部のコンテンツを除きます。）スマートフォンのみで見られるコンテンツは、今回はありません。あくまで展示場内に設置された端末と同一内容のコンテンツを配信しています。

いつどこでやっていますか
企画展示の開催期間中（2012年7月10日～9月2日）、企画展示室A、B、およびそれをつなぐ通路にて利用することができます。

必要なものは何ですか
・無線LANおよびWebブラウザ（※）の使えるタブレット端末・スマートフォン（iPhone、iPad、Android端末など（※※））
・ヘッドフォン（動画・音声コンテンツの再生時は必ずご使用ください）
※今回は主に動画・音声コンテンツの配信を実施しますので、動画・音声コンテンツの再生機能をもたないもの（ニンテンドーDSシリーズのWebブラウザなど）は利用できません。
※ノートパソコンなど、筐体が大きすぎるものは、他のお客様の迷惑になりますのでご遠慮ください。

コンテンツにアクセスするには
コンテンツにアクセスするには、次の2つの作業を行います。
1. コンテンツ提供用の無線LANにWi-Fi接続を行います。
SSIDは「gakkii」、パスワードは不要です。
2. Webブラウザを起動し、特設コンテンツのページ「http://gakkii/」にアクセスします。
QRコードが読み取れるスマートフォンをお持ちの方は、右の画像をご利用ください。

本実験は、国立歴史民俗博物館共同研究「デジタル化された歴史研究情報の高度利用に関する研究」（平成22年度～24年度）の一環として、デジタル展示研究路が実施しております。責任者は、共同研究代表者の鈴木卓治（本館研究情報資料研究系）です。

Fig. 4 Poster of announcement.

(yes or no),

(4) Q. Could you set up your terminal? (yes or no),

(5) Q. Could you reproduce our contents? (yes or no), and

(6) Q. Did you enjoy our contents? (yes or no).

46 visitors filled out a questionnaire within the period

(a) Choice the SSID
(b) Access the top page

Fig. 5 Instruction of how to connect Wi-Fi and access the contents.

of the special exhibition.

Table 1 shows that the relationship between sex and age. At 50 or less-year-old person occupies approximately 90% of the whole. The number of replies has more females(21) than males(10). The number of most one was 9 for teenage(11-20) females. It is interesting that young women shew stronger concern. It seems that this result is deeply related to how portable terminals are being accepted by society. Major visitors of the museum are older men, and it is one of important problems of the museum to attract more wide range of visitors. The result suggests a possibility of exploitation of new visitors by the use of visitor-owned portable terminals.

Table 2 shows that 4 questions to visitors and answers. Since there were few investigation numbers, it observed only about the relation with sex. Only 5/7 (approx. 71%) people in male and 10/15 (approx. 67%) people in female succeeded to set up his/her portable terminal. It can read in this result that a setup of the portable terminal is not so easy the work for vis-

Table 1 Relationship between age and sex.

age	male	female	(no answer)	total
-10	2	4	3	9
11-20	2	9	4	15
21-30	0	2	2	4
31-40	2	3	1	6
41-50	2	1	3	6
51-60	1	0	2	3
61-70	0	1	0	1
71-	1	0	0	1
(no answer)	0	1	0	1
total	10	21	15	46

Table 2 4 questions to visitors and answers.

	male	female	(no answer)	total
Q. Were you attend this experimentation?				
yes	7	15	11	33
no	3	6	4	13
Q. Could you set up your terminal?				
yes	5	10	10	25
no	2	4	0	6
(no answer)	0	1	1	2
Q. Could you reproduce our contents?				
yes	5	10	9	24
no	0	2	1	3
(no answer)	2	3	1	6
Q. Did you enjoy our contents?				
yes	4	7	6	17
no	0	4	2	6
(no answer)	3	4	3	10

itors even though a visual instruction sheet (Fig. 5) was provided. The result also says that all the people that set up the smart phone reproduced contents and 4/5 (80%) people in male and 7/10 (70%) people in female enjoyed our contents, and convinces us the effectiveness of the service.

6. Analysis of web access logs

To probe unconscious actions of visitors, access logs of IIS6 are analyzed. **Table 3** shows the number of accesses of each part. There are 2,370 accesses during the special exhibition. The number of contents and the number of accesses isn't in proportion.

We want to see a series of access transition of a user. Some users would look at only few contents. On the other hand, other users would look at many contents comprehensively. Unfortunately, the information about the terminal which accessed contents was not recorded

Table 3 The number of contents and accesses of each part.

No.	#contents	A/V	#access
1	6 (13.6%)	A	772 (32.6%)
2	2 (4.5%)	V	206 (8.7%)
3	26 (59.1%)	A	675 (28.5%)
4	1 (2.3%)	V	239 (10.1%)
5	9 (20.5%)	A	478 (20.1%)
total	44		2370

Table 4 The frequency and the cumulative relative frequency of the number of accesses in each chunk.

#access	frequency	c.r.freq.
1	409	56.0%
2	111	71.2%
3	68	80.6%
4	31	84.8%
5	18	87.3%
6	21	90.1%
7-	72	100.0%

Table 5 The number of accesses for every part of type A, type B, and type C users.

No.	1 (type A)	2-6 (type B)	7- (type C)
1	98 (24.0%)	237 (30.8%)	437 (36.6%)
2	58 (14.2%)	80 (10.4%)	68 (5.7%)
3	50 (12.2%)	180 (23.4%)	448 (37.5%)
4	113 (27.6%)	74 (9.6%)	52 (4.3%)
5	90 (22.0%)	199 (25.8%)	190 (15.9%)
total	409	770	1195

on access logs. Then, when the lapsed time from the time of one contents being accessed to access of the following contents was less than the threshold value, the same user regarded it as what was accessed continuously, and made "chunks" of data. In this paper, the threshold value was set to 2 minutes*. 730 chunks of data were made.

Table 4 shows that the frequency and the cumulative relative frequency of the number of accesses in each chunk. The cumulative relative frequency in one access exceeds 50%, and in six accesses or less, exceeds 90%.

Table 5 shows that the number of accesses for every part about each the case of one access (type A users), the case where access is from 2 times to 6 times (type B users), and the case where access is 7 times or more (type C users). A visualization of Table 5 with the relative value of the number of contents of each part is shown in **Fig. 6**. In case of type B and type C users, the tendency for each part's number of relative accesses to approach the number of relative contents, that is, comprehensive accesses was observed.

Table 6, 7, 8, 9 and **10** show that the number of accesses of the contents of Part 1, 2, 3, 4 and 5.

It is observed that type C users accessed every contents comprehensively in every part.

In Part 1, type A and type B users has a tendency to choose a link that is first displayed in several contents which has same category. For example, in the Part 1, pm0.mp3, p3.mp3 and m3.mp3 has same cate-

* Making 5 minutes into a threshold value also tried, and the similar result was obtained.

Fig. 6 Visualization of Table 5 with the relative value of the number of contents of each part.

Table 6 The number of accesses of the contents of Part 1.

Content	all	A	B	C
1/440Hz.mp3	196	33	85	78
1/430Hz.mp3	118	11	37	70
1/mixing.mp3	125	14	42	69
1/pm0.mp3	141	19	39	83
1/p3.mp3	118	13	23	82
1/m3.mp3	74	8	11	55

Table 7 The number of accesses of the contents of Part 2.

Content	all	A	B	C
2/shogaryuteki.mp4	149	41	61	47
2/shogahichiriki.mp4	57	17	19	21

gory (same songs, but each has different pitch) and the link to pm0.mp3 is first displayed (**Fig. 7**).

In Part 2, shogaryuteki.mp4 was first chosen by all type of users, and only few visitor watched both movies. It is suspected that long reproduction time has affected it.

In Part 3, every link to content is assigned to a corresponding image. In **Fig. 8**, the number of accesses of every content is written in the position of the corresponding image. In *icchiku*, the sound of an upper right button was often chosen, and the chord of the upper left button was often chosen in *aitake*. It can be interpreted that an arrangement of button images determined reproductive frequency for a user, since every sound has the the same grade of interest.

In Part 4, it is mentioned especially that 25 percent of type A users (113/409) chose zundoo.mp4. It suggests that many user watch the movie without interruption. The movie has a long playback time (6:00), and the threshold time to determine a chunk is 2 minutes. Therefore watching of the movie without interruption may count as a chunk of type A user.

In Part 5, it is interesting that *biwa* was often chosen. It seems that many user had a interest in the sound of *biwa*.

Table 8 The number of accesses of the contents of Part 3.

Content	all	A	B	C
3/T01.mp3	51	6	14	31
3/T02.mp3	24	0	6	18
3/T03.mp3	19	0	5	14
3/T04.mp3	29	2	1	26
3/T05.mp3	23	3	3	17
3/T06.mp3	22	2	7	13
3/T07.mp3	9	1	0	8
3/T08.mp3	19	2	1	16
3/T10.mp3	11	0	1	10
3/T11.mp3	26	3	1	22
3/T12.mp3	22	0	5	17
3/T13.mp3	10	0	1	9
3/T14.mp3	32	3	10	19
3/T15.mp3	50	7	12	31
3/T17.mp3	54	4	27	23
3/A01.mp3	98	5	41	52
3/A02.mp3	58	3	15	40
3/A03.mp3	19	1	8	10
3/A04.mp3	27	4	7	16
3/A05.mp3	10	1	0	9
3/A06.mp3	12	0	1	11
3/A07.mp3	11	1	2	8
3/A08.mp3	11	0	1	10
3/A09.mp3	8	0	2	6
3/A10.mp3	10	0	3	7
3/A11.mp3	10	2	3	5

Table 9 The number of accesses of the contents of Part 4.

Content	all	A	B	C
4/zundoo.mp4	239	113	74	52

Table 10 The number of accesses of the contents of Part 5.

Content	all	A	B	C
5/etenraku.mp3	161	43	75	43
5/ryuteki.mp3	78	11	38	29
5/hichiriki.mp3	38	5	13	20
5/sho.mp3	42	4	16	22
5/biwa.mp3	60	12	23	25
5/so.mp3	32	7	8	17
5/kakko.mp3	21	3	5	13
5/taiko.mp3	23	2	11	10
5/shoko.mp3	23	3	9	11

7. Discussion

Analysis of visitor questionnaire survey clarified the following three things:

- there are many users who cannot do a setup of Wi-Fi well beyond our anticipation;
- the user who has set up Wi-Fi can access web contents convenient; and
- young women had a strong interest by this experiment.

A problem of the failure of Wi-Fi setup should be solved by a suitable standardization. It is necessary to define the standard procedure for making connection with Wi-Fi more simply, and to make it spread with

Fig. 7 Links to pm0.mp3, p3.mp3 and m3.mp3 in Part 1.

Fig. 8 The number of accesses in the position of the button which reproduces contents in Part 3.

safety secured.

Use of mobile phone network is also effective to avoid the difficulty of Wi-Fi setting. But electric wave of mobile phone cannot be received in many museums. We should maintain environment that the electric wave of mobile phone can be received in the museum as a social infrastructure.

Web access logs tell that most users choose standing out contents overwhelmingly. That is, although the contents that attracts the strong interest of the user are certainly chosen and are reproduced, the design of a user interface influences operation of a user considerably. The analysis of web access logs effectively works on the evaluation of whether the user interface plays a role as we want.

8. Conclusion

A simple solution of multimedia exhibition information services using visitor-owned portable Wi-Fi terminals was deduced. This solution will be easy to imitate or refer from small-scale museums.

An experimentation was carried out to demonstrate the suitability of the solution practically in a special exhibition of the National Museum of Japanese History.

We have two analyses to evaluate visitors' reaction and acceptance of the service. An analysis of visitor

questionnaire survey clarified that there are many users who cannot do a setup of Wi-Fi well beyond our anticipation, and that young women positively accept the service. An analysis of web access logs revealed that the users tend to select a content not by its meaning but a location of the link to the contents on the screen.

In order to promote the spread of the service, the development and offer of a software tool which generate web contents automatically from audio/video data that a museum prepared are effective. This is a future subject.

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Appendix

A. Detail of the contents

A.1 About the special exhibition

The special exhibition “Musical Instruments Tell Stories¹⁰⁾” of the National Museum of Japanese History was held for 49 days (closed days were excluded), from July 10, 2012 to September 2. The number of visitors of the special exhibition was 14,841.

The museum owns one of the best collections of traditional Japanese musical instruments in Japan. They were originally collected by Harutomi Tokugawa (1770-1852), the 10th generation load of the Kisyu-Tokugawa family. One of major purpose of the special exhibition was to introduce the museum’s collection. National Museum of Japanese History had two special exhibitions for this collection in 1992 and 2005.

A.2 Top Page

When the top page contents is accessed, a menu to select one from five parts are reproduced. (See **app.Fig. 1**.) Every part corresponds to 5 PC terminals respectively.

A.3 Part 1: Research of the pitch of the sound of the standard in *gagaku* by Harutomi Tokugawa

The table of the contents provided by Part 1 is shown in **app.Table 1**.

app.Fig. 1 Hardcopy of the top page.

app.Table 1 Contents list of Part 1.

content	A/V	p.type	description
1/440Hz.mp3	A	0:09	pitch standard in Western music
1/430Hz.mp3	A	0:09	pitch standard in <i>gagaku</i>
1/mixing.mp3	A	0:09	comparison of two pitches
1/pm0.mp3	A	0:30	play of <i>etenraku</i> by normal pitch
1/p3.mp3	A	0:30	play by 300 cent high pitch
1/m3.mp3	A	0:30	play by 300 cent low pitch

app.Fig. 2 Hardcopy of the Part 1 page.

Harutomi Tokugawa was researched eagerly about the pitch of the sound of the standard in *gagaku*. In this part, two kinds of contents for understanding the importance of standard pitch are provided. One is contents which hear and compare the difference of two standard tone: 440Hz in Western music and 430Hz in *gagaku*. The other is contents which hear and compare the difference of three playing of a part of *etenraku*, one of famous song in *gagaku*: normal pitch playing, 300 cent high pitch playing, and 300 cent low pitch playing.

A hardcopy of the Part 1 page on a portable terminal is shown in **app.Fig. 2**.

A.4 Part 2: *Shōga* — a ‘singing’ score in *gagaku*

The table of the contents provided by Part 2 is shown in **app.Table 2**.

Shōga is ‘singing’ score in *gagaku* for description of a melody. In this part, two video contents for introducing

app.Table 2 Contents list of Part 2.

content	A/V	p.type	description
2/shogaryuteki.mp4	V	4:26	<i>shōga</i> singing and <i>ryūteki</i> playing
2/shogahichiriki.mp4	V	4:32	<i>shōga</i> singing and <i>hichiriki</i> playing

app.Fig. 3 Hardcopy of a playing of the Part 2 contents.

shōga are provided. One is a *Shōga* of *ryūteki*, and the other is a *Shōga* of *hichiriki*. *ryūteki*, and *hichiriki* are kinds of wind instruments in *gagaku*.

A hardcopy of a playing of a video content in the Part 2 contents on a portable terminal is shown in **app.Fig. 3**.

A.5 Part 3: Let's listen to the tone of *shō*

The table of the contents provided by Part 3 is shown in **app.Table 3**.

shō is a kind of wind instruments in *gagaku*. In this part, 15 kinds of *icchiku* (single tone) and 11 kinds of *aitake*(chord) can be heard.

On the touchpanel PC terminal, free mixing of any *icchiku* tones is available. On the other hand, on a portable terminal, only one *icchiku* tone can be heard simultaneously.

app.Fig. 4 is a hardcopy of Touchpanel PC of the Part 3 contents, and a hardcopy of the Part 3 contents on a portable terminal is shown in **app.Fig. 5**.

A.6 Part 4: A rhythm pattern in *gagaku*

The table of the contents provided by Part 4 is shown in **app.Table 4**.

In this part, a video contents to explain a concept of rhythm pattern in *gagaku* is provided. The movie shows timing of percussion instrument playing of *hayayohyōshi*, the rhythm pattern of *etenraku*. It can be understood that *hayayohyōshi* has the cyclic structure of quadruple times and four measures.

A hardcopy of a playing of a video content in the Part 4 contents on a portable terminal is shown in **app.Fig. 6**.

app.Table 3 Contents list of Part 3.

content	A/V	p.type	description
3/T01.mp3	A	0:14	single tone <i>sen</i>
3/T02.mp3	A	0:15	single tone <i>jū</i>
3/T03.mp3	A	0:12	single tone <i>ge</i>
3/T04.mp3	A	0:12	single tone <i>otsu</i>
3/T05.mp3	A	0:13	single tone <i>ku</i>
3/T06.mp3	A	0:13	single tone <i>bi</i>
3/T07.mp3	A	0:12	single tone <i>ichi</i>
3/T08.mp3	A	0:13	single tone <i>hachi</i>
3/T10.mp3	A	0:15	single tone <i>gon</i>
3/T11.mp3	A	0:16	single tone <i>shichi</i>
3/T12.mp3	A	0:14	single tone <i>gyō</i>
3/T13.mp3	A	0:15	single tone <i>jō</i>
3/T14.mp3	A	0:12	single tone <i>bō</i>
3/T15.mp3	A	0:09	single tone <i>kotsu</i>
3/T17.mp3	A	0:15	single tone <i>hi</i>
3/A01.mp3	A	0:12	chord <i>kotsu</i>
3/A02.mp3	A	0:13	chord <i>ichi</i>
3/A03.mp3	A	0:13	chord <i>ku</i>
3/A04.mp3	A	0:14	chord <i>bō</i>
3/A05.mp3	A	0:12	chord <i>otsu</i>
3/A06.mp3	A	0:12	chord <i>ge</i>
3/A07.mp3	A	0:13	chord <i>jū</i>
3/A08.mp3	A	0:11	chord <i>sōjō no jū</i>
3/A09.mp3	A	0:11	chord <i>bi</i>
3/A10.mp3	A	0:12	chord <i>gyō</i>
3/A11.mp3	A	0:13	chord <i>hi</i>

app.Fig. 4 Hardcopy of Touchpanel PC contents of Part 3 — free mixing of *icchiku* tones. **app.Fig. 5** Hardcopy of the Part 3 page.

A.7 Part 5: A free mixing tool for *etenraku* playings of 8 kinds of music instruments

The table of the contents provided by Part 5 is shown in **app.Table 5**.

In this part, each playing of 8 kinds of musical instruments in *gagaku* — wind: *ryūteki*, *hichiriki*, and *shō*, string: *biwa* and *sō*, and percussion: *kakko*, *taiko*,

and *shōko* — in *etenraku* can be selected and heard.

On the touchpanel PC terminal, free mixing of any playings is available. On the other hand, on a portable terminal, only one playing can be heard simultaneously.

app.Fig. 7 is a hardcopy of Touchpanel PC of the Part 5 contents, and a hardcopy of the Part 5 page on a portable terminal is shown in **app.Fig. 8**.

app.Table 4 Contents list of Part 4.

content	A/V	p.type	description
4/zundoo.mp3	V	6:00	introduction of a rhythm pattern <i>hayayohyōshi</i>

app.Fig. 6 Hardcopy of a playing of the Part 4 contents.

app.Table 5 Contents list of Part 5.

content	A/V	p.type	description
5/etenraku.mp3	A	5:35	ensemble playing
5/ryuteki.mp3	A	5:35	playing of <i>ryūteki</i>
5/hichiriki.mp3	A	5:35	playing of <i>hichiriki</i>
5/sho.mp3	A	5:35	playing of <i>shō</i>
5/biwa.mp3	A	5:35	playing of <i>biwa</i>
5/so.mp3	A	5:35	playing of <i>sō</i>
5/kakko.mp3	A	5:35	playing of <i>kakko</i>
5/taiko.mp3	A	5:35	playing of <i>taiko</i>
5/shoko.mp3	A	5:35	playing of <i>shōko</i>

app.Fig. 7 Hardcopy of Touchpanel PC contents of Part 5 — free mixing of *etenraku* playing.

app.Fig. 8 Hardcopy of the Part 5 page.