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Some consideration on user adaptive interface for universal multimedia access

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Abstract: We have already proposed a new concept of 'universal multimedia access' intended to narrow the digital divide by providing appropriate multimedia expressions according to users' (mental and physical) abilities, computer facilities and network environments. In this paper, we redefine switching functions for our new concept of universal design based multimedia access and discuss its user interface to support the users in accordance with their abilities, computer facilities and network environments.

Keywords: Multimedia system, User interface, Digital divide**.**

I. INTRODUCTION

Recently, immense multimedia information has come to be exchanged on the Internet, where 3DCG, video, image, sound, and text are involved in various circumstances with terminal devices, networks and users different in their competences and performances. This fact may easily lead to 'digital divide' so called unless any special support is given to the weaker.

The universal design concept is proposed to support handicapped people in their social activities [1]. In the computer science field, the universal web [2] has been proposed to evolve this concept. However, this does not support to switch the contents, media and its quality of service (QoS) function to work the devices and network environments in their full performances. On the other hand, many studies about the QoS function proposed to optimize the video quality to give priority on users' requests [3]. These studies focused on performances of devices and network environments but neither users' abilities nor contents. Of course, there were also several studies on 'universal multimedia access (UMA)' but they could not narrow the digital divide because they concerned 'content switching' only [4].

Considering this fact, we have already proposed a new concept of UMA and its switching functions [5] intended to narrow the digital divide by providing appropriate multimedia expressions according to users' (mental and physical) abilities, computer facilities and network environments. In this paper, we redefine these switching functions and propose a concept of user adaptive interface for UMA.

II. UNIVERSAL MULTIMEDIA ACCESS

The digital divide is caused by the differences in users' personal competences, computer facilities and network environments with such detailed items as follows.

(1) Personal competence: sight ability, hearing ability, handling ability, language ability, computer skill and culture,

(2) Computer facility: processing power, resolution, color quality, sound quality and battery life,

(3) Network environment: bandwidth availability, specification and transfer mode.

Therefore, multimedia information is necessarily accompanied by switching user interface, media and QoS parameters reflecting these differences. Here, we present a new approach to UMA for handicapped people to work their devices and network environments in full performances. Our purpose is exclusively to develop a new mechanism for switching appropriately user interfaces, media and QoS parameters based on such a concept as shown in Fig.1.

III. SWITCHING FUNCTIONS

UMA is to selectively provide three kinds of switching function, namely, user interface switching (UIS), media switching (MS) and QoS switching (QS). Fig.2 shows these switching functions working as follows:

(SF1) UIS: switch to user interfaces (UI) appropriate for users' competences and display devices,

(SF2) MS: switch to media appropriate for users' competences, performances of terminal devices and

networks,

(SF3) QS: control media qualities appropriate for users' competences and terminal devices.

These functions are applied in the ascending order (from SF1 to SF3) at beginning to play multimedia information or in the descending order at playing.

1. User Interface Switching

UIS sets up the following items using Table 1 and Table 2.

(U1) Writing style appropriate for language ability,

(U2) UI type and annotation option appropriate for computer skill,

(U3) Media size, font size, number of media and number of characters appropriate for display device size.

Additionally, I/O function is reflected by the users' disability.

2. Media Switching

MS switches to appropriate media according to their priorities after determining usable media types and QoS parameters by logical multiplication of Tab.1 and Tab.2. Numbers and types of media are selected by UIS and such priority as shown in Table.3. Media and its quality are limited by performances both of terminal devices and networks. When MS could not continue to play media by overload of CPU or network, MS is switched to UIS for reducing this load.

3. QoS Switching

QS controls media size and media rate with QoS parameters to measure performances both of terminal devices and networks. The QoS parameter 'Size' means as follows:

(S1) Video – Put priority on the frame size

(S2) Audio – Put priority on the sampling resolution and stereo sound

(S3) Image - Put priority on the size of image

(S4) Text – Enlarge the character

The QoS parameter 'Rate' means as follows:

(R1) Video – Put priority on the frame rate

(R2) Audio – Put priority on the sampling rate

(R3) Image - Put priority on the display timing

(R4) Text – Take priority over any other medias

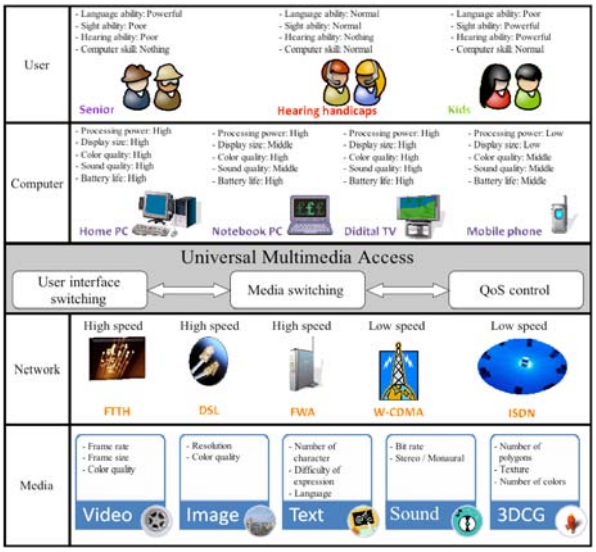

Fig.1. Universal multimedia access

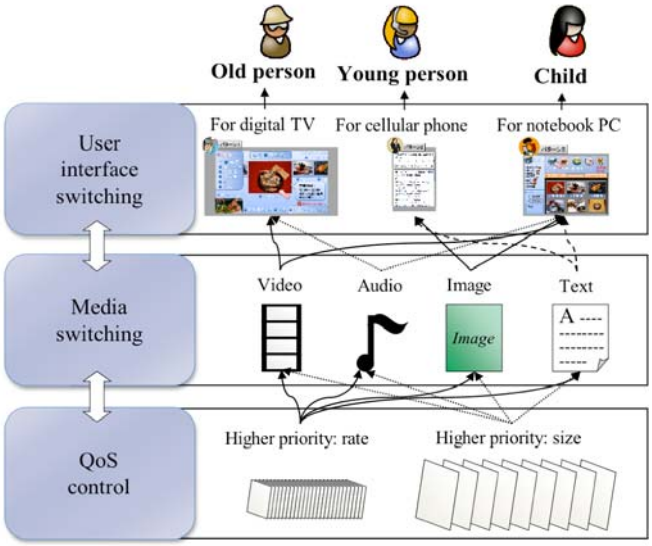

Fig. 2. Switching functions

Table 1. Users' abilities vs. multimedia expressions

	Parameter		Powerful	Normal	Poor	Nothing
Language ability	Expression of media		Advanced text	Simple text	Audiovisual	Nothing
Sight ability	Media	Text	○	○	×	×
		Image	○	○	○	×
		Audio	○	○	○	○
		Video	○	○	○	×
	QoS	Rate	○	○	×	×
		Size	○	○	○	○
Hearing ability	Media	Text	○	○	○	○
		Image	○	○	○	○
		Audio	○	○	×	×
		Video	○	○	○	○
	QoS	Rate	○	○	○	×
		Size	○	○	×	×
Computer skill	Userinterface		Interactive page	Hypertext	On demand	Broadcast
	Annotation		Nothing	Nothing	Abailable	Always

Table 2. Performances of terminal devices vs. multi media expressions

	Parameter		High	Middle	Low	Nothing
Processing power	Media	Text	○	○	○	×
		Image	○	○	○	×
		Audio	○	○	×	×
		Video	○	○	×	×
	QoS	Rate	○	○	○	×
		Size	○	○	○	×
Display size	Media	Text	○	○	○	×
		Image	○	○	×	×
		Audio	○	○	○	○
		Video	○	○	×	×
	QoS	Rate	○	○	○	○
		Size	○	○	○	○
Sound quality	Media	Text	○	○	○	○
		Image	○	○	○	○
		Audio	○	○	×	×
		Video	○	○	○	○
	QoS	Rate	○	○	○	○
		Size	○	○	○	○
Battery life	Media	Text	○	○	○	×
		Image	○	○	○	×
		Audio	○	○	×	×
		Video	○	○	×	×
	QoS	Rate	○	○	×	×
		Size	○	○	×	×

Table 3. Network bandwidth vs. multimedia expression

	Nallowband	Broadband
Text	1	4
Image	2	3
Audio	3	2
Video	Nothing	1

When QS could not keep the quality by overload of CPU or network, QoS control is switched to MS for reducing this load.

IV. USER INTERFACE

UI consists of a template, layout and media expression with such detailed items as follows.

(1) Template includes type of UI and annotation

(2) Layout has media size, number of media, font size, number of characters,

(3) Expression uses writing style.

1. Template for User Interface

Template works to select a primitive UI and annotation option with computer skill. Computer skill is classified by following levels.

Level 1: start up application software,

Level 2: select to play media,

Level 3: display a Web page to input URL,

Level 4: find a desired Web page with search engine.

UI is different at each level because of different computer skill. Examples are shown in Fig.3. Broadcast UI is selected for level 1 not to operate as much as possible and to play media according to time schedule. The user could get information just like TV because it is not necessary to operate application software fundamentally. But the user could only get information according to the time schedule. On-demand UI is selected for level 2 to play selectable media. The user could play media only to click a desired media. But it takes user a much time to select from a lot of media. Hypertext UI is selected for level 3 to get information like a general Web page. The user could get information to input URL or click media with hyper link. But the user needs to understand these operations and gets addresses for desired information previously. Interactive page UI is selected for level 4 to support a search function and customize function. The user could search by keywords and customize both display region and visibility options to use customize functions.

2. Layout of Media

A layout is used to put media on UI and specified display position, display size and number of media for resolution of terminal device and each media. Typical resolution of terminal devices is shown in Fig.4 and available number of media is shown from Tab.4 to Tab.6. Using these relations, a layout is specified to display position after display size and number of media for resolution of terminal device and each media.

Fig. 3. Typical examples of user interface

Table 4. Number of characters for specification of resolution

	Resolution		8pt(11x11)			10.5pt(14x14)			12pt(16x16)			16pt(22x22)			18pt(24x24)		
Standard	Width [pixel]	Height [pixel]	Horizontality [Number of characters]	Verticality [Number of characters]	Total [Number of characters]	Horizontality [Number of characters]	Verticality [Number of characters]	Total [Number of characters]	Horizontality [Number of characters]	Verticality [Number of characters]	Total [Number of characters]	Horizontality [Number of characters]	Verticality [Number of characters]	Total [Number of characters]	Horizontality [Number of characters]	Verticality [Number of characters]	Total [Number of characters]
QVGA	320	240	29	21	609	22	17	374	20	15	300	14	10	140	13	10	130
VGA	640	480	58	43	2494	45	34	1530	40	30	1200	29	21	609	26	20	520
SVGA	800	600	72	54	3888	57	42	2394	50	37	1850	36	27	972	33	25	825
XGA	1024	768	93	69	6417	73	54	3942	64	48	3072	46	34	1564	42	32	1344
SXGA	1280	1024	116	93	10788	91	73	6643	80	64	5120	58	46	2668	53	42	2226
UXGA	1600	1200	145	109	15805	114	85	9690	100	75	7500	72	54	3888	66	50	3300
QXGA	2048	1536	186	139	25854	146	109	15914	128	96	12288	93	69	6417	85	64	5440
WQXGA	2560	1600	232	145	33640	182	114	20748	160	100	16000	116	72	8352	106	66	6996

Table 5. Number of images for specification of resolution

	Resolution		Image for cellular phone (96x120)			Image for cellular phone (320x240)			Image for 80 mega pixel digital still camera (1024x768)			Image for 300 mega pixel digital still camera (2048x1536)			Image for 800 mega pixel digital still camera (3264x2448)		
Standard	Width [pixel]	Height [pixel]	Horizontality [Number of images]	Verticality [Number of images]	Total [Number of images]	Horizontality [Number of images]	Verticality [Number of images]	Total [Number of images]	Horizontality [Number of images]	Verticality [Number of images]	Total [Number of images]	Horizontality [Number of images]	Verticality [Number of images]	Total [Number of images]	Horizontality [Number of images]	Verticality [Number of images]	Total [Number of images]
QVGA	320	240	3	2	6	1	1	1	0	0	0	0	0	0	0	0	0
VGA	640	480	6	4	24	2	2	4	0	0	0	0	0	0	0	0	0
SVGA	800	600	8	5	40	2	2	4	0	0	0	0	0	0	0	0	0
XGA	1024	768	10	6	60	3	3	9	1	1	1	0	0	0	0	0	0
SXGA	1280	1024	13	8	104	4	4	16	1	1	1	0	0	0	0	0	0
UXGA	1600	1200	16	10	160	5	5	25	1	1	1	0	0	0	0	0	0
QXGA	2048	1536	21	12	252	6	6	36	2	2	4	1	1	1	0	0	0
WQXGA	2560	1600	26	13	338	8	6	48	2	2	4	1	1	1	0	0	0

Table 6. Number of videos for specification of resolution

	Resolution		QCIF(176x144)			CIF(352x288)			DV(720x480)			720p(1280x720)			1080i(1920x1080)		
Standard	Width [pixel]	Height [pixel]	Horizontality [Number of videos]	Verticality [Number of video]	Total [Number of video]	Horizontality [Number of videos]	Verticality [Number of video]	Total [Number of video]	Horizontality [Number of videos]	Verticality [Number of video]	Total [Number of video]	Horizontality [Number of videos]	Verticality [Number of video]	Total [Number of video]	Horizontality [Number of videos]	Verticality [Number of video]	Total [Number of video]
QVGA	320	240	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
VGA	640	480	3	3	9	1	1	1	0	1	0	0	0	0	0	0	0
SVGA	800	600	4	4	16	2	2	4	1	1	1	0	0	0	0	0	0
XGA	1024	768	5	5	25	2	2	4	1	1	1	0	1	0	0	0	0
SXGA	1280	1024	7	7	49	3	3	9	1	2	2	1	1	1	0	0	0
UXGA	1600	1200	9	8	72	4	4	16	2	2	4	1	1	1	0	1	0
QXGA	2048	1536	11	10	110	5	5	25	2	3	6	1	2	2	1	1	1
WQXGA	2560	1600	14	11	154	7	5	35	3	3	9	2	2	4	1	1	1

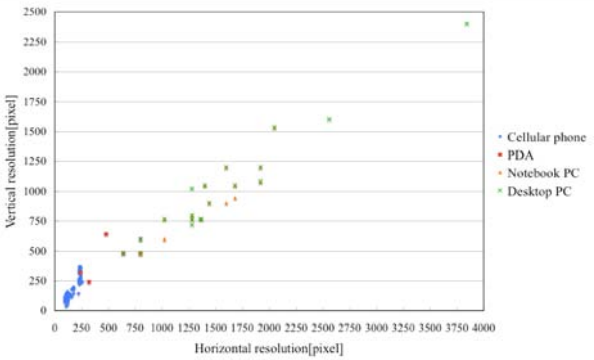

Fig.4. Resolution of terminal device

3. Expression of Media

An expression includes a difficulty of writing style, Kana-Kanji option, alternative media and language. They are determined by language ability and applied to following examples.

(Ex.C1) For children (language ability is low): simple kana text with notes

(Ex.C2) For old person (language ability is high): replacement a loan word with Japanese word

In addition, difficult text is substituted for another media. Also, there are filtered harmful contents from multimedia information.

V. CONCLUSION

In this paper, we redefined switching functions for universal design based multimedia access and discussed its user interface. UMA applies the switching functions to multimedia information according to users' (mental and physical) abilities, computer facilities and network environments. Especially, UIS employs functions to select a template, set up for layout and expressions. Currently, we are implementing a framework for our proposed concept. In the future, we will define rules and transport protocols for each switching function and propose a multimedia markup language for UMA.

REFERENCES

[1] Ronald L. Mace, Graeme J. Hardie, and Jaine P. Place (1996), Accessible Environments: Toward Universal Design. AUED

[2] Kazuhiko Yamazaki (2001), Achievement of universal Web (1) (in Japanese). Design study research 48:330-331

[3] Mohan, R, Smith, J.R and Chung-Sheng Li (1999), Adapting multimedia Internet content universal access, IEEE Multimedia Transcations 1(1):104-114

[4] Fernando Pereira and Ian Burnett (2003), Universal Multimedia Experience for tomorrow, IEEE Signal Proccesing Magazine, IEEE 20(2): 63-73

[5] Y. Maeda, K. Sugita, T. Oka, and M. Yokota (2008), Proposal of a New Concept of Universal Multimedia Access, Proc. 13th International symposium on ARTIFICIAL LIFE AND ROBOTICS (AROB 13th '08), OS7-6.